# Malheur National Wildlife Refuge
## Comprehensive Conservation Plan

**Prepared by:**
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May 2013

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## Comprehensive Conservation Plan

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Pacific Northwest Planning Team
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January 2013

Approved: Robyn Thorson ______ Jan. 24, 2013 ______
Regional Director, Pacific Region — Date
Portland, Oregon

# U.S. Fish and Wildlife Service
# Malheur National Wildlife Refuge
# Comprehensive Conservation Plan
# Approval Submission

In accordance with the National Wildlife Refuge System Administration Act, as amended, the U.S. Fish and Wildlife Service completed a Comprehensive Conservation Plan (CCP) for Malheur National Wildlife Refuge (Refuge). The purpose of this CCP is to specify a management direction for the Refuge for the next 15 years. The goals, objectives, and strategies for improving Refuge conditions—including the types of habitat we will provide, partnership opportunities, and management actions needed to achieve desired future conditions—are described in the CCP. The Service's preferred alternative for managing the Refuge is described in this CCP and the effects on the human environment were described in the Draft CCP and Environmental Impact Statement.

This CCP is submitted for the Regional Director's approval by:

_______________________________ 1/24/13
Tim Bodeen, Project Leader
Malheur National Wildlife Refuge
Date

Concur: _______________________________ 1/24/13
Refuge Supervisor
Date

Concur: _______________________________ 1/24/13
Regional Chief
Acting National Wildlife Refuge System
Date

# Malheur National Wildlife Refuge Comprehensive Conservation Plan Foreword

Not many years ago it was hard to imagine that the process of developing a long-term management plan for Malheur National Wildlife Refuge (Refuge) would result in a broad spectrum of interests, including the local community, conservation organizations, and other government agencies, all working collaboratively together to craft the future direction of the Refuge. Today, after a three-year collaborative effort by dozens of stakeholders working closely with each other and with Refuge staff and experts, there is broad agreement on a comprehensive planning process that will restore the Refuge's aquatic health, enhance wildlife habitat, and revitalize relationships with stakeholders and the community. This process is laid out in the Comprehensive Conservation Plan (CCP) and the upcoming Inventory and Monitoring Plan, which describe priorities for the Refuge and how decisions will be made over the next 15 years.

The Refuge is a cherished place, widely embraced by all kinds of people for its ability to provide for wildlife, recreation, and support of local communities. However, it has also been a flashpoint for conflict and controversy over the past few decades. This controversy has created deep divisions and distrust between the Refuge and stakeholders as well as between the stakeholders themselves. In the meantime, the ecological health of the Refuge's waterways and wetlands—long recognized as some of North America's most important habitat for migratory birds—was in steep decline as common carp came to dominate most wet areas while other invasive non-native species spread throughout the Refuge.

This non-traditional and innovative collaborative planning process has helped rebuild the relationships and communication necessary to produce a remarkable consensus around the core principles embedded in the Refuge's 15-year CCP:

- Ongoing collaborative approach to implementation, built around partnerships and a shared commitment to the long-term sustainability of the Refuge and the larger Harney Basin's wildlife, habitats, and human communities;
- Commitment to science-based, active adaptive management, driven by monitoring and evaluation of results, with Refuge decision making that is transparent and informed by stakeholder involvement;
- Focus on aquatic ecosystem health and the subsequent benefits to waterways, wetlands, and upland habitats.

At many different levels the challenges moving forward will be great, although the stakeholder consensus achieved in developing this plan represents a significant achievement. We hope you will join us, the Malheur Refuge staff and the many participating stakeholders, to turn this vision into reality.

*Colby Marshall, Bruce Taylor, and Matt Little*
On behalf of the Collaborative Group

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# Executive Summary

The Malheur National Wildlife Refuge (Refuge) is located in southeastern Oregon's high desert, at the northern end of the Great Basin. It is adjacent to the Steens Mountain, from which the Wild and Scenic Donner and Blitzen River flows into the Refuge's southern boundary. The Refuge is famous for its spectacular concentrations of wildlife which are attracted to the Refuge's habitats and abundant water resources in an otherwise arid landscape. With more than 320 bird species, and 58 mammal species, Malheur is a mecca for birdwatchers and wildlife enthusiasts.

The Refuge was established in 1908 to protect migratory waterfowl, with an emphasis on colonial nesting species. We, the U.S. Fish and Wildlife Service (Service), manage the Refuge as part of the National Wildlife Refuge System (Refuge System). We are required by the National Wildlife Refuge System Administration Act of 1966 as amended, to manage each unit of the Refuge System in accordance with a comprehensive conservation plan that is developed in a public process with public input considered at key points in the process. This is a summary of the Malheur National Wildlife Refuge Final Comprehensive Conservation Plan (CCP); more background information is provided in Chapter 1.

We evaluated and compared three alternatives for conserving the Refuge's fish, wildlife, and plant resources through population monitoring, habitat management and restoration, and invasive species control, in Chapter 2 of the Final CCP/EIS. Providing the Refuge System's priority public uses—wildlife observation and photography, hunting, fishing, environmental education, and interpretation, in a manner that is compatible with the Refuge's conservation purpose, were also evaluated. The alternatives were the result of a collaborative public planning process initiated in 2008. Hundreds of individuals, nonprofit organizations, State and local agencies, and tribal governments shared ideas, concerns, and information during our process. Alternative 1, the no action alternative, described our current Refuge management activities. In Alternatives 2 and 3 we described management actions that would further improve Refuge conditions. We identified Alternative 2 as our management direction.

The Refuge's physical, biological, and human environments are described in detail in Chapters 3, 4, and 5. A collection of maps follows Chapter 5, and a number of appendices follow the maps, including appropriateness findings and compatibility determinations for public uses in Appendices A and B.

After the Final CCP/EIS was available to the public for 30 days, a Record of Decision was signed by the Service's Regional Director in Portland, Oregon, selecting a management direction for implementation on the Refuge. The CCP will guide management of Malheur Refuge for 15 years.

### Refuge Information and Background

In the late 1880s, plume hunters were decimating North American bird populations in pursuit of breeding bird feathers highly valued by the hat industry. Hunters targeted colonial nesting birds and shorebirds, killing birds indiscriminately and orphaning chicks. When plume hunters discovered the large flocks of colonial nesting birds on Malheur Lake in 1898, the area's white heron (egret) population was nearly wiped out. Ten years later, wildlife photographers William L. Finley and Herman T. Bohlman toured Malheur Lake and determined that nearly all of the egrets had been killed and the egret population had not recovered.

With backing from the Oregon Audubon Society, Finley and Bohlman proposed establishment of a bird reservation to protect birds using Malheur, Mud, and Harney lakes. Government lands identified as the Lake Malheur Reservation were set aside on August 18, 1908, by President Theodore Roosevelt, through Executive Order No. 929 "*as a preserve and breeding ground for native birds*." A letter from the Secretary of the Interior dated August 12, 1908, to the President stated that the purpose and intent was "to preserve the habitat values of the three lakes (Malheur, Mud and Harney Lakes) for migratory waterfowl, and especially, the colonial nesting species."

The Refuge now encompasses 187,757 acres that are a small part of the northern Great Basin. The Refuge is disproportionately important as a stop along the Pacific Flyway, and as a resting, breeding and nesting area for hundreds of thousands of migratory birds and other wildlife. Many of the species migrating through or breeding here are highlighted as priority species in national bird conservation plans. Historical bird counts show that Malheur Refuge and the adjoining Silvies River floodplain to the north may support between 50 percent and 66 percent of the Pacific Flyway's migrating bird populations for various priority waterfowl.

The Refuge's breeding habitat is also significant for waterbirds; it currently supports more than 20 percent of Oregon's population of breeding greater sandhill cranes. Most colonial waterbird numbers have easily exceeded 10 percent of the regional population at its peak, and numbers for certain species have reached up to 77 percent of the populations located within the Great Basin. Numbers of migrating shorebirds have been documented at levels high enough to qualify the Refuge as a Regional Western Hemispheric Shorebird Reserve. The Refuge also supports high densities of certain nesting riparian passerines and the largest local population of bobolinks in the western U.S.

The Refuge is well-loved by its visitors, many return year after year, compelled by the excellent birding, opportunities for solitude, intriguing historic remnants and geologic sites, and its proximity to Steens Mountain, an Oregon landmark. The Refuge has strong historic ties to local residents as an important contributor to local economies. Far-flung birding communities also feel a strong connection to the Refuge and the Audubon Society's role in its initial establishment. Both local and distant communities will continue to play a large role in the Refuge's future.

**Refuge Purposes, Vision, and Management Goals**

The primary purposes for Malheur Refuge follow.

- "a refuge and breeding ground for migratory birds and other wild life…" Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated Sept. 24, 1957
- "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. § 715d (Migratory Bird Conservation Act)
- "for the development, advancement, management, conservation, and protection of fish and wildlife resources…" 16 U.S.C. § 742f(a)(4)
- "for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude…" 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)
- "conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans…" 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge System Administration Act)

The Service's vision for Malheur Refuge is stated as follows in the CCP.

> *Together with our surrounding community, partners, friends, staff, and all those who cherish this unique place where desert and water meet…*
>
> *Malheur National Wildlife Refuge commits to care for, conserve, and enhance the health of the Malheur Lake, Blitzen Valley, and Double-O units, including the playas, dunes, marshes, rivers, meadows, and ponds that are all part of this landscape.*
>
> *We will observe nature and manage in harmony with ecological forces, while recognizing and maintaining the Refuge as a key anchor for migratory and breeding waterfowl, waterbirds, shorebirds, songbirds, and raptors.*
>
> *We will work diligently to improve the health of the land and water, reducing the destructive impact of carp and other invasive species, addressing imbalances in floodplain function, and restoring the original abundance of fish and wildlife for which Malheur is famous.*
>
> *We will celebrate and welcome our visitors, noting and protecting the features that draw people again and again—the expansive landscape, the plenitude and diversity of wildlife, and the signs of a timeless history.*
>
> *We will allow and enhance opportunities to experience abundance, solitude, and renewal, for people birding, fishing, hunting, and learning on the Refuge. In respect to our ancestors and their fortitude, we will carefully preserve the legacies they left behind on this land.*
>
> *Collaboration with our neighbors, partners, and friends will be a critical cornerstone in our day to day work; we recognize that nature crosses our boundaries and we can be successful only in partnership. We recognize that our activities are inextricably linked to the health of the local economy. We commit to environmental stewardship and sustainable management. We commit to learn from our efforts, successes, and failures; to be humble about what we know; and to continuously strive for greater understanding in our stewardship of this remarkable place*

The vision for the Refuge would be achieved by managing the Refuge to accomplish the following goals, as stated in the CCP.

Goal 1. Enhance aquatic health and habitat conditions essential to the conservation of the flora and fauna that depend on Malheur Lake and associated water bodies.

Goal 2. Protect, maintain, and rehabilitate riverine and riparian habitats to conditions essential for the conservation of native fish and wildlife species.

Goal 3. Protect, maintain, and rehabilitate riparian habitats to conditions essential for the conservation of wildlife species.

Goal 4. Enhance, protect, and/or maintain primary habitats essential to the conservation of a diversity of aquatic and terrestrial wildlife species.

Goal 5. Enhance and maintain rare and unique habitats.

Goal 6. Visitors will be welcomed and can safely experience the Refuge’s outstanding features – diversity of wildlife, signs of earlier inhabitants, scenic landscapes, and solitude. As a result, visitors will leave the Refuge with a memorable experience that fosters a connection between themselves and nature, and an appreciation of Malheur’s unique resources.

Goal 7. Connect the hearts and minds of visitors with places and resources the Refuge protects, and enlighten visitors’ experiences with an understanding, appreciation, and knowledge about the historic and natural resources, and the importance of conservation and stewardship.

Goal 8. Provide reasonable challenges and opportunities, and provide uncrowded conditions for the hunting and fishing public.

Goal 9. Initiate and nurture relationships to build support of the Refuge, and fortify Refuge programs and activities to achieve the Refuge's purpose and goals.

Goal 10. Manage prehistoric and historic cultural resources for their educational, scientific, and cultural values for the benefit of present and future generations of Refuge users and for the communities that are connected to these resources.

Goal 11. Identify and protect prehistoric and historic resources on the Refuge that are eligible for or listed on the National Register of Historic Places.

Goal 12. Manage the Refuge’s paleontological resources for their educational and scientific values for the benefit of present and future generations of Refuge users.

Goal 13. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

Goal 14. Integrating our conservation-based mission with the best available science, the Refuge will become a leader in advancing best design and management practices for innovative, sustainable Refuge and community development opportunities.

**Management Issues**

Through the collaborative development of the CCP we addressed several important Refuge management issues with input from State and tribal governments, other Federal agencies, and the public. The following major issues are analyzed and addressed in the CCP.

- The importance of the Refuge and Silvies River floodplain for migratory and breeding birds.
- Invasive species, including common carp and perennial pepperweed.
- Habitat and vegetation management.
- Riverine conditions: geomorphology, hydrology, fisheries, and riparian habitat.
- Water system infrastructure and water delivery.
- Preserving the legacy of human and paleontological history at Malheur.
- Visitor access, facilities, and information.
- Providing quality wildlife observation, photography, interpretation, and environmental education.
- Providing quality fishing and hunting opportunities.

- Wilderness preservation.
- Collaboration with all stakeholders.

**Management Direction**

The management direction described in this CCP will restore the Refuge's degraded aquatic habitats that are being adversely impacted by invasive common carp and the spread of invasive nonnative weeds, and improve services, infrastructure, and access for visitors. It will best implement Service policies by removing invasive common carp from the Refuge; managing self-sustaining high-quality sport fishing opportunities; and designating roads and motorized vehicle routes for wildlife-dependent recreation that minimize adverse impacts to Refuge resources.

The Refuge is legally mandated to conserve and protect migratory birds to achieve its establishing purposes. Addressing aquatic health is key to meeting this obligation, and full attention will be given to its improvement under the management direction. The greatest obstacle to this effort is common carp, an introduced fish that negatively impacts water quality, and in turn impacts native fish, wildlife, and plants that depend on the Refuge's aquatic resources. Primary management emphasis will be placed on improving aquatic health, with staff time and budget largely directed to carp control. Partnerships and staff resources will also address visitor services and habitat management programs. We will develop a comprehensive riverine/wetland rehabilitation plan that will progress as staffing, funding, partnerships, and other resources become available.

*Lake and Wetland Habitats.* The management emphasis is to improve the aquatic health of the Refuge's lake and wetland habitats, to enhance the feeding, resting and nesting components necessary for a variety of shore/wading birds, waterfowl, and other wildlife species. This will be achieved largely through carp population control. As turbidity decreases and submergent vegetation and invertebrate species become more abundant, the productivity of Malheur Lake and other water bodies within the Refuge (e.g., Boca Lake and Warbler Pond) will improve.

Because of the sheer size and complexity of the Refuge's aquatic health problem, a variety of assessment and control tools will be implemented to effectively address it. Existing partners, such as the Aquatic Health Coalition (comprised of federal, state, NGO, and Tribal participants) will assist in identifying strategies and implementing effective methods of control, inventory, funding, and monitoring. We will customize and incorporate methods successfully implemented worldwide, to suit the Refuge.

Strategic assessments of aquatic habitats and carp population dynamics will guide control activities and provide enhanced understanding of the system's innate ability to recover from carp impacts. Control strategies will include, but not be limited to, the application of piscicide, chemo-attractants, chemo-repellants, barriers, commercial harvest, angling, and water manipulation. The need for continued amendments to and construction of additional strategically placed instream structures (i.e., traps, screens, and fish wheels) that allow native fish passage and impede/prohibit carp movement through the system, will also be considered.

*Riverine Habitat.* The Blitzen River and its tributaries provide habitat that fish and wildlife depend upon. Because a vast majority of Refuge-managed habitats are reliant on irrigation via a network of dams, canals, and ditches associated with the river, the connectivity between Malheur, Mud, and Harney Lakes, systems, and associated wetlands adds a level of complexity to carp control. Under the CCP, we will develop a comprehensive riverine/wetland rehabilitation plan to improve lake and wetland aquatic health through carp control. We may also pursue water management efforts to reduce the river's water temperatures in the summer, by increasing the cold water barrier that keeps carp out of wetlands in the upper Blitzen Valley.

Refuge management under the CCP will emphasize carp control primarily, and strategic riverine assessment and rehabilitation. The management direction allows for flexibility in our progress, which depends on available resources, partnerships, and carp control success on the Refuge. We will gain a greater understanding of the impacts on adjacent floodplain habitats over a longer study period, which will enable us to gain site-specific knowledge of how riverine, wet meadow, and marsh communities respond to hydrologic system changes. We will also use a science-based process to determine existing biological conditions, site capability, and management decisions. We will work with the Ecology Work Group and other stakeholders to prioritize and refine objectives for creating a comprehensive riverine strategy. Our priority inventory and monitoring efforts will focus on building baseline data that could be used as part of our riverine rehabilitation activities and improve our understanding of adjacent habitats.

*Wetlands and Terrestrial Habitats.* We will continue to manage wetland and terrestrial habitats for the life history needs of focal resources (see Appendix E), with greater flexibility in identifying strategies to meet establishing objectives. Flexibility is critical for maintaining a variety of plant communities within emergent marsh, wet meadow, and dry meadow habitats, to meet foraging, breeding, brood rearing, and other life cycle needs of migratory birds and other native wildlife. For example, bobolinks and sandhill cranes both depend on wet meadows during the breeding season; however, their use of it and the conditions they require differ. To address the wide assortment of needs found within each habitat type, vegetation management tools to address litter accumulation and plant community succession will include traditional late summer haying and autumn/winter rake-bunch grazing to meet the foraging needs of early-arriving wildlife species, and highly prescriptive warm-season grazing, mowing, farming, burning, and extended dewatering, to reclaim acres lost to invasive plants such as common cattail and reed canarygrass, or to rehabilitate communities that have transitioned beyond desired conditions.

*Wildlife Viewing, Photography, and Interpretation*. The cornerstone of our public use program will be quality wildlife observation and photography opportunities. Management under the CCP will focus on expanding facilities and programs for visitors and birders. Both spur and loop trails a mile or longer will be added to allow visitors to explore and learn about the wildlife and Refuge, and several trails will be upgraded or developed to meet accessibility compliance standards. Viewing overlooks and elevated viewing platforms will be upgraded and/or developed. The historic Audubon photography blind will be restored at the Refuge Headquarters Display Pond, two permanent screened photography blinds will be built to comply with accessibility standards, and an elevated viewing platform will be developed at Malheur Lake. For advanced birders, the Refuge will maintain and replant cottonwood and other non-endemic trees and shrubs at six historic landscapes to continue to provide habitat for rare and incidental passerines.

Docent-led tours will be conducted seasonally at various Refuge locations, and will include opportunities for guided kayak and canoe tours on Malheur Lake. Expanded vehicle access will be available, with year-round vehicle access to Krumbo Reservoir, access provided along the Boat Landing Road near Refuge Headquarters, and from the southern portion of the East Canal Road north to the confluence of Bridge Creek. In addition, boating that is not directly supporting the fishing program will be available at Krumbo Reservoir to enhance wildlife viewing.

Interpretive features and programs are another high priority and key interpretive themes will include the significance of the Refuge to breeding and migratory birds, pre- and post-contact historic events, wilderness, geology, aquatic health, water importance, resource challenges, and the National Wildlife Refuge System. A stronger emphasis will be placed on developing and utilizing modern media. The George Benson Memorial Museum at Refuge Headquarters will be enhanced with interpretive panels, to connect visitors with the places and resources that the Refuge protects. Additional outdoor interpretive panels will be placed at key field sites and will focus on improving aquatic health and associated management activities, and the connection between historic events and the ecology of the Refuge. Special events and public presentations by Refuge staff and volunteers will be expanded and promoted to enlighten visitors' experiences.

*Welcome and Orientation*. Welcome and orientation features will improve under the management direction, with an emphasis on the use of modern and traditional media to reach and orient visitors. Up to eight outdoor panels will be located near Refuge entrances, and at other congregation areas to direct and guide visitors during their visit. To welcome visitors, developed sites with visitor amenities, such as picnic tables, shelters, and vault toilets will be upgraded, and at least five new sites will be developed. An enlarged visitor contact station and gift shop at Refuge Headquarters and a seasonal contact station at P Ranch will be built to provide visitors contact with Refuge staff and volunteers.

*Environmental Education.* We will provide environmental education (EE) using Refuge staff time and resources strategically, by coordinating efforts with other EE initiatives. Existing modules from national and regional programs, such as the Junior Duck Stamp competition and International Migratory Bird Day, will be utilized as Refuge staff and volunteers become available. We will develop an outdoor shelter and learning area at Refuge Headquarters to support EE programs.

*Hunting.* Opportunities for upland game hunting will be enhanced, by improving the Saddle Butte access on Malheur Lake's north side, and opening the program three weeks early, from the fourth Saturday of October to the end of the State's pheasant season in the Buena Vista Hunt Unit. The north part of Malheur Lake and the Boundary Hunt Unit will remain open under existing regulations.

Waterfowl hunting will be enhanced, by promoting a youth hunt and improving the Saddle Butte access. In addition, new waterfowl hunt areas will be provided, doubling the existing waterfowl hunt area by opening a portion of the south-central area of Malheur Lake, and allowing waterfowl hunting within the existing Buena Vista Hunt Unit. The season will be open from the fourth Saturday of October to the end of the State waterfowl season. One new access point with an expanded parking area and an enhanced boat launch will be provided at the airboat launch site near Refuge Headquarters, to access the new Malheur Lake hunt unit. In partnership with potential users, the Refuge will support adding barrier-free facilities for waterfowl hunters with mobility impairments in the Buena Vista Hunt Unit.

An exchange of portions of Refuge lands west of State Highway 205 and southeast of Krumbo Reservoir (the Boundary Hunt Unit) to the Bureau of Land Management (BLM) in exchange for other lands will be explored, and the hunt will likely be managed under existing regulations. The exchange will facilitate the Refuge's focus on key aquatic areas and reduce the administrative problem of managing lands with an unmarked boundary.

*Fishing.* Fishing opportunities along the upper Blitzen River, the southern portion of East Canal, and Mud and Bridge Creeks, will continue. Vehicle access will be allowed on the East Canal Road to the confluence of Bridge Creek, which will enable access to BLM's Granddad Reservoir. In addition, a new pedestrian crossing at Bridge Creek will enhance fishing access to seven miles of Bridge Creek located between the East Canal and Blitzen River. We will open a new bank fishing season from August 1 to September 15 on the Blitzen River, with a parking area on Boat Landing Road, from Sodhouse Lane to the bridge. Orientation panels with maps, brochures, and regulations, will be added to fishing areas, to provide information to visitors about fishing opportunities.

At Krumbo Reservoir, year-round access will be provided for wildlife viewing, boating, and fishing, in coordination with State seasons, which will increase public fishing opportunities. The triploid rainbow trout stocking program will continue in coordination with the Oregon Department of Fish and Wildlife (ODFW), and a redband trout genetic introgression study will be conducted.

*Volunteer Program.* To help enhance the Refuge's volunteer, public use, and other programs, a full-time volunteer coordinator will be added to the staff to increase recruitment, retention, and the return rate of volunteers, to better utilize Refuge facilities and staff, and to assist with building partnerships and increasing public outreach.

*Cultural Resource and Paleontological Protection.* We will strengthen protection of the Refuge's cultural and paleontological resources by developing step-down management plans with partners for administrative sites where historic, prehistoric, archaeological, and paleontological resources occur. Interpretation of historic sites will be expanded through the development and implementation of site specific interpretive plans. Opportunities for Native Americans to collect plant materials for traditional uses will be expanded. Monitoring and inventory of archaeological resources will increase as part of step-down management plan implementation.

*Energy Independent.* Refuge staff will pursue energy independence and carbon negative Refuge operations, and will continue to emphasize partnerships to maximize adaptive management.

*Inventory and Monitoring.* The Refuge will develop inventory and monitoring plans to guide annual management actions. The plans will emphasize focal species and national monitoring efforts, and a geodatabase will be created to record and track the data collected under these plans.

*Adaptive Management.* The Refuge will use adaptive management (AM) to implement strategies identified in the CCP. Adaptive management is a science-based public participation process for evaluating and adjusting a conservation effort relative to goal achievement as experience and knowledge are gained through implementation, study, and discussion. The Refuge and its collaborative partners support flexible decision making as outcomes from management actions and other events become better understood. As the CCP is implemented, the Refuge will achieve diverse goals through AM while enhancing wildlife benefits, advancing scientific knowledge, and improving working relationships among stakeholders.

*Implementation Subject to Funding Availability.* Actions will be implemented over a period of 15 years as funding becomes available. Project priorities are described in Appendix E. The Refuge will continue to work with partners to implement the CCP by sharing science, providing updates on successes and challenges, initiating discussions, encouraging participation, and hosting working groups.

*Tribal Coordination.* Regular communication and coordination with the Burns Paiute Tribe will continue regarding issues of shared interest. Currently, we coordinate with the Tribe on Native American Graves Protection and Repatriation Act and National Historic Preservation Act issues.

*Harney County Court Coordination.* We will continue to maintain regular discussions with the Harney County Court as CCP actions are implemented over 15 years.

*State Coordination.* The Service will continue to maintain regular discussions with the Oregon Department of Fish and Wildlife. Key topics for discussion will include wildlife monitoring, fisheries management, including fish passage and barriers, hunting and fishing seasons and regulations, and the management of species of concern (i.e. sage grouse).

*Infrastructure Maintenance to Support Management of Wetlands and Meadows.* Efforts to enhance the water management system will be made throughout the life of the CCP, to reflect aquatic health (e.g. carp control) and other habitat management needs and constraints. Actions will be directed by existing water rights, funding opportunities, and Refuge maintenance priorities.

*Refuge Fire Management.* Fire Management Plans, and accompanying NEPA documents and Endangered Species Act consultations were finalized for the Refuge in 2010. Fire management actions will continue to be guided by the direction set forth in these plans. Prescribed fire will be used in areas where it is the most appropriate tool to achieve habitat goals (e.g. emergent wetlands). Prescribed burns will generally be conducted in late winter to meet litter management objectives, but may be done at other times depending on desired outcomes.

*Climate Change.* The Refuge staff will participate in and contribute to climate change assessment efforts, including those underway at a landscape scale, such as the Great Basin Landscape Conservation Cooperative (LCC). As needed, objectives and strategies will be adjusted to enhance Refuge resources' resiliency to climate change.

*Partnerships.* Partnerships will be maintained and/or developed, to enhance collaboration in support of fish and wildlife resources, recreational opportunities, cultural and paleontological resources, and educational programs; and to explore funding opportunities and grants for projects of mutual interest. We will also accomplish common goals through partnerships, promote eco-tourism opportunities, and encourage environmentally friendly development. Workshops and training sessions with professional colleagues and the general public will be conducted to obtain ideas, techniques, and support for Refuge management decisions.

*Volunteer Opportunities.* Volunteers are key components of the successful management of public lands, and are vital to implementation of Refuge programs, plans, and projects. Volunteer opportunities will be maintained and expanded to best utilize facilities and Refuge staff, and to assist with building partnerships and conducting public outreach. A volunteer management plan will be developed, to address volunteer/staff roles, recruitment and retention of volunteers, volunteer orientation and training, and administration of the Friends of Malheur National Wildlife Refuge.

*Transportation Coordination.* Roads, bridges and trail systems play a vital role in providing public access to compatible wildlife dependent recreation opportunities. Under the management direction, the Service will look for opportunities to partner with the Oregon Department of Transportation, BLM's Burns District, and Harney County, to maintain and improve safe and appropriate transportation access in and around the Refuge.

*Refuge Revenue Sharing Payments.* Annual payments to Harney County under the Refuge Revenue Sharing Program will continue according to the established formula and subject to payments authorized by Congress. Total payments made to the County in recent years are listed in Chapter 5.

*Sustainable Practices for Maintaining and Updating Existing Infrastructure.* Periodic maintenance and updating of Refuge buildings and facilities will be necessary. Infrastructure maintenance is necessary for safety and accessibility, and to support staff and management needs, and is incorporated in the Service Asset Maintenance Management System and Environmental Management System. The Refuge will implement green technology and sustainable practices to progress toward energy independent and carbon negative operations.

*Endangered Species Act Section 7 Consultations.* All projects will be compliant with the Endangered Species Act. Section 7 consultation was not completed programmatically on the CCP. The need for Section 7 consultations for special projects or actions not described in this plan (e.g. management actions related to aquatic health) will be conducted on a case-by-case basis.

*Section 106 Compliance.* Any new ground-disturbing projects or modifications (e.g. removal of historic water control structures or dams) will undergo a review under Section 106 of the National Historic Preservation Act.

*Integrated Pest Management (IPM).* In accordance with Department of the Interior and Service policies, an integrated pest management (IPM) approach will be implemented where practicable, to eradicate, control, or contain pests and invasive species (herein collectively referred to as pests) on Refuge lands. Pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. We will select IPM methods based on effectiveness, cost, and minimal ecological disruption, including minimum potential effects to nontarget species and the Refuge environment. If we need to use a pesticide on the Refuge, we will identify the most specific (selective) chemical available for the target species, unless persistence or other environmental and/or biotic hazards preclude it. In accordance with 517 DM 1, pesticide use is restricted to pesticides registered with the U.S. Environmental Protection Agency (EPA), that are in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act, and regulations, orders, or permits issued by EPA.

Environmental harm by pest species is identified as a biologically substantial decrease in environmental quality, indicated by a variety of potential factors including declines in native species populations or communities, degraded habitat quality or long-term habitat loss, and/or altered ecological processes. Environmental harm may result from the direct effects of pests on native species, including preying and feeding on them, causing or vectoring diseases, preventing them from reproducing, killing their young, and out-competing them for food, nutrients, light, nest sites or other vital resources; or hybridizing with them so frequently that within a few generations few if any truly native individuals remain. Environmental harm may also result from an indirect effect of pest species. For example, decreased waterfowl use may result from invasive plant infestations that reduce the availability of native wetland plants used by waterfowl as forage during the winter.

Environmental harm may involve detrimental changes in ecological processes. For example, cheat grass infestations in shrub steppe habitat can greatly alter fire return intervals, which can displace native species and communities of bunch grasses, forbs, and shrubs. Environmental harm may also cause or be associated with economic losses and damage to human, plant, and animal health. For example, invasions of fire-promoting grasses that alter plant and animal communities and eliminate or sharply reduce native plant and animal populations can also greatly increase fire-fighting costs.

See Appendix G for the Refuge's IPM program for managing pests. Appendix G also describes the selective use of pesticides for pest management on Refuge lands where necessary. Throughout the life of the CCP, most proposed pesticide uses on Refuge lands will be evaluated for potential effects to biological resources and environmental quality. These potential effects will be documented in Chemical Profiles. Pesticide uses with appropriate and practical best management practices (BMPs) for habitat management as well as cropland/facilities maintenance will be approved for use on Refuge lands where there will likely be only minor, temporary, and localized effects to species and environmental quality, based on non-exceedance of threshold values in Chemical Profiles. However, pesticides may be used on Refuge lands where substantial effects to species and the environment are possible (exceed threshold values) in order to protect human health and safety (e.g., mosquito-borne disease).

*Hazard Analysis and Critical Control Point Plan.* A Hazard Analysis and Critical Control Points Plan (HACCP) is a tool for natural resource managers to use when identifying critical control points in their activities to decrease the spread of invasive species. The HACCP Wizard Version 2.04 will be used to develop plans for staff, contractors, volunteers and other users of the Refuge to evaluate and conduct their activities in a manner that limits the chance of spreading invasive species.

*Water Rights.* The right to use water on the Refuge is managed through Oregon's Water Resources Department. Almost all water use on the Refuge has a State-certified water right. The exception is spring water in the Refuge's Double-O Unit which is threatened by groundwater withdrawals in the area. To protect the habitats and values associated with springs, the Service will take steps to file a groundwater right.

*Water Quality.* Water quality is addressed through the Oregon Department of Environmental Quality. Refuge-specific water quality guidelines have not yet been established through a formal Total Maximum Daily Load study conducted by the State. Although water quality impairments exist in the Blitzen River before it reaches the Refuge boundary, various studies have indicated a continued increase in temperature and turbidity and a decrease in dissolved oxygen levels within some Refuge water bodies (see Chapter 3) during specific times of the year. Refuge staff will continue to identify and implement best management practices to address water quality.

*Blitzen River Water Management.* The Refuge will continue to maintain a minimum flow of 25 cubic feet per second (cfs) in the Blitzen River as a minimum flow to benefit aquatic resources.

*Research, Monitoring, and Inventory.* Refuge staff will continue to work with others to share information and expertise on habitat management, terrestrial and aquatic health, and restoration/rehabilitation techniques. Partnerships with local universities, NGOs, Tribes, State and local agencies, and others will be expanded to conduct research that will advance sound science associated with decision-making on the Refuge.

*Malheur NWR State-and-Transition Model.* The Refuge will continue to partner with ecologists, wildlife biologists, and scientists from various State and federal agencies and nongovernment organizations to develop the Malheur NWR State-and-Transition Model (STM) to increase our understanding of the Refuge's wetlands. Through the STM we will describe various habitat types along a hydrological gradient and identify the conditions that likely cause transitions between associated plant assemblages. The STM will serve as a roadmap for managing wetlands and uplands toward target habitat conditions and will increase our understanding of the short-term and long-term effects of management treatments on Refuge habitats.

*Nonpriority Uses.* Nonpriority wildlife-dependent recreational uses will be allowed at the Refuge if found appropriate and compatible. These uses will be allowed under the stipulations identified in Appendix B. Incidental uses such as horseback riding will be permitted only on the Center Patrol Road. Bicycling and cross country skiing will be permitted on all public roads, and pets will be permitted in designated areas.
Prohibited activities will include fires, swimming, recreational ATV use, camping, and collecting natural objects (such as plants, animals, minerals, antlers, etc.), and objects of antiquity. See Appropriate Use Determinations in Appendix A, and Compatibility Determinations in Appendix B, for more information. Such recreational activities not specifically addressed in this document may be allowed on Refuge lands, if the Refuge Manager determines that they are appropriate and compatible.

*Predator Control.* Although predator control could be justifiable, specific attainable objectives must be determined before conducting predator control. It has been noted, for example, that removing coyotes often leads to an increase in other predator populations such as foxes, raccoons, and mink, which can be even more detrimental to wildlife production. If predator control is deemed necessary during the life of the CCP, the proper public process will be followed. Productivity of select key avian species will be monitored under the guidance of the Inventory and Monitoring Plan to assess whether the Refuge is serving as a source or sink for local avian populations, and if the Refuge is not serving as a source, management options including manipulation of habitat conditions and predator control will be considered.

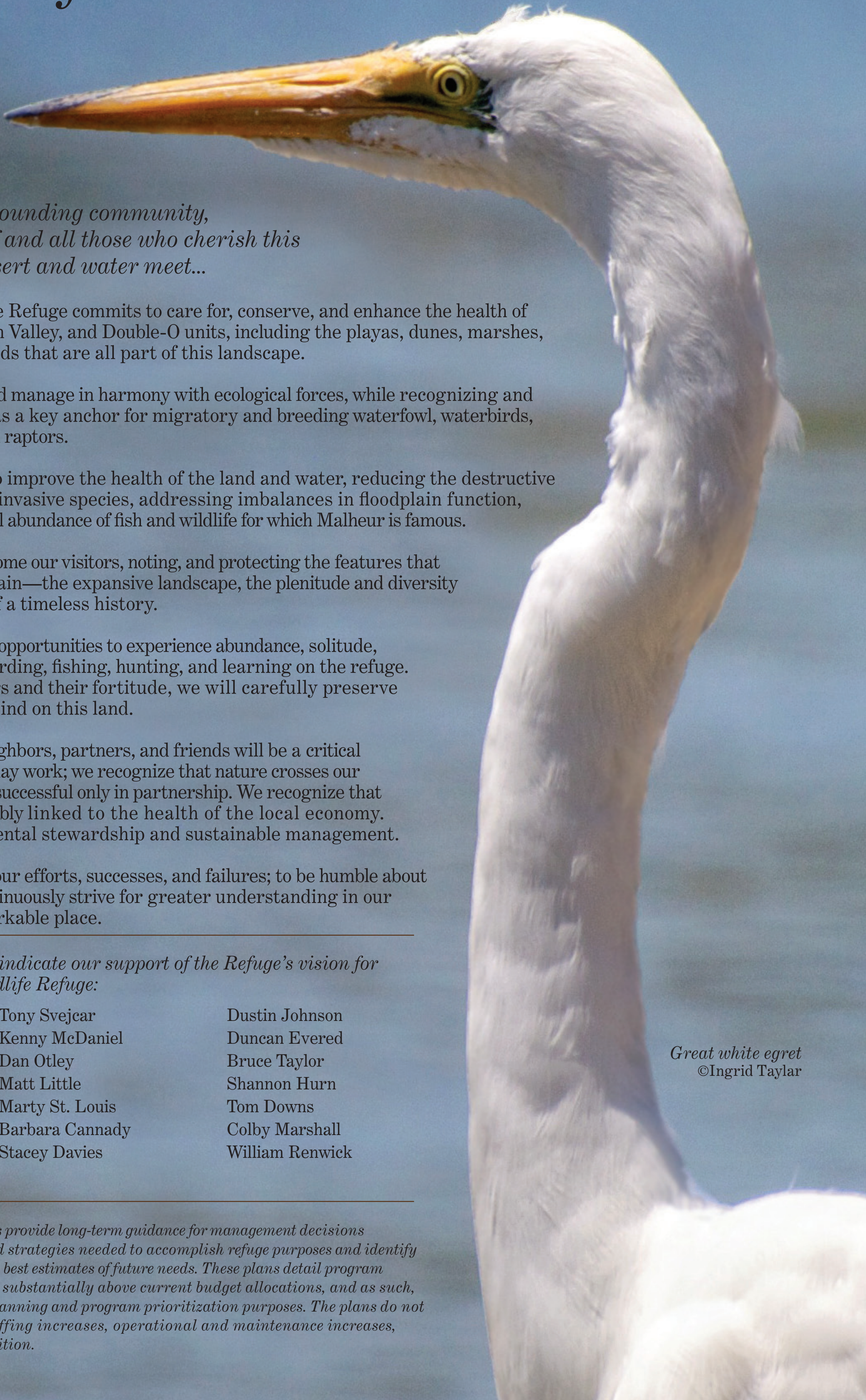
**Environmental Consequences**

Implementation of the management direction presented in the CCP will be expected to cause both beneficial and adverse impacts to Refuge resources, recreation opportunities, and local communities and their economies. The CCP addresses these impacts, with the majority of discussion and detail focused on impacts that are potentially significant.

We anticipate the management direction will have long-term beneficial impacts on the Refuge’s fish, wildlife, plants, habitats, recreation opportunities, and cultural resources, primarily as a result of more intensive and aggressive management actions to improve ecological integrity throughout the Refuge. We also anticipate that the same management actions will have a number of short-term, less intensive, adverse impacts. Beneficial impacts will result from:

- Improving the aquatic health of the Refuge’s lakes and wetlands, primarily by control of common carp.
- Managing wet meadows and wetland habitats for specified attributes, and initiating comprehensive riverine/wetland strategic planning for watersheds within the Refuge.
- Providing a more developed and structured visitor experience, with additional birding, fishing, and hunting opportunities.
- Protecting and developing historic, cultural, and paleontological resource plans.

# *A Vision of Conservation*



*Together with our surrounding community, partners, friends, staff and all those who cherish this unique place where desert and water meet...*

Malheur National Wildlife Refuge commits to care for, conserve, and enhance the health of the Malheur Lake, Blitzen Valley, and Double-O units, including the playas, dunes, marshes, rivers, meadows, and ponds that are all part of this landscape.

We will observe nature and manage in harmony with ecological forces, while recognizing and maintaining the Refuge as a key anchor for migratory and breeding waterfowl, waterbirds, shorebirds, songbirds, and raptors.

We will work diligently to improve the health of the land and water, reducing the destructive impact of carp and other invasive species, addressing imbalances in floodplain function, and restoring the original abundance of fish and wildlife for which Malheur is famous.

We will celebrate and welcome our visitors, noting, and protecting the features that draw people again and again—the expansive landscape, the plenitude and diversity of wildlife, and the signs of a timeless history.

We will allow and enhance opportunities to experience abundance, solitude, and renewal, for people birding, fishing, hunting, and learning on the refuge. In respect to our ancestors and their fortitude, we will carefully preserve the legacies they left behind on this land.

Collaboration with our neighbors, partners, and friends will be a critical cornerstone in our day to day work; we recognize that nature crosses our boundaries and we can be successful only in partnership. We recognize that our activities are inextricably linked to the health of the local economy. We commit to environmental stewardship and sustainable management.

We commit to learn from our efforts, successes, and failures; to be humble about what we know; and to continuously strive for greater understanding in our stewardship of this remarkable place.

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*We the undersigned hereby indicate our support of the Refuge's vision for The Malheur National Wildlife Refuge:*

Gary Marshall
Karen Moon
Dan Nichols
Jay Kerby
Brad Bales
Erica Maltz
Jaime Damon
Amanda Benton

Tony Svejcar
Kenny McDaniel
Dan Otley
Matt Little
Marty St. Louis
Barbara Cannady
Stacey Davies

Dustin Johnson
Duncan Evered
Bruce Taylor
Shannon Hurn
Tom Downs
Colby Marshall
William Renwick

*Great white egret*
©Ingrid Taylar

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*Comprehensive Conservation Plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the U.S. Fish and Wildlife Service's best estimates of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations, and as such, are primarilyused for strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.*

**U.S Department of the Interior, Fish and Wildlife Service**

# Record of Decision
# for the
# Malheur National Wildlife Refuge
# Final Comprehensive Conservation Plan and Environmental Impact Statement
Harney County, Oregon

Through this Record of Decision (ROD), the U.S. Fish and Wildlife Service (Service) selects the Comprehensive Conservation Plan (CCP) for the Malheur National Wildlife Refuge (Refuge). This ROD includes brief summaries of the alternatives we considered in the Final CCP and environmental impact statement (EIS), the public involvement process, and our rationale for selecting Alternative 2 for management of the Refuge. The CCP will provide guidance for managing and conserving the Refuge's natural resources and public use activities during the next 15 years.

## Public Involvement

We initiated the CCP process in February 2008 by announcing our intention to complete a CCP/EIS. Recognizing the complexity of challenges on the Refuge, we worked with the High Desert Partnership (HDP), and Oregon Consensus (OC), to engage diverse stakeholders in a transparent, collaborative, and constructive planning process. The HDP is a nonprofit organization focused on creating collaborative forums to enable people to discuss complex and controversial issues and arrive at points of agreement. The OC is a State agency affiliated with Portland State University; it provides conflict assessment and neutral facilitation services.

Public engagement through the collaborative process was structured on three tenets, commitment, honesty, and communication. By working with the HDP and OC, collaboration efforts were enhanced between the Refuge, local and conservation communities, scientists, elected officials, the Burns Paiute Tribe and many other stakeholders throughout the planning process. The number of interactions was extensive and included:

- 12 collaborator group meetings.
- 45 Conservation and Community Organization meetings.
- 21 meetings with County, State and Federal elected officials.
- 4 Tribal meetings.
- 48 agency and academia meetings.
- 6 open houses.
- 18 listening posts.
- 5 workshops/field reviews.
- Hundreds of discussions with individual stakeholders.
- 4 planning updates.
- 3 Federal Register notices.
- Multiple local and regional media releases (press and radio).
- A 60-day public comment period for the Draft CCP/EIS.

The public comment process for the Draft CCP/EIS provided an opportunity for further collaborative refinement of the document. The Final CCP includes changes in the inventory and monitoring process, and identifies implementation of wet meadows studies as a "very high" priority.

Pretreatment wildlife inventories will be completed, before any warm/growing season habitat treatments occur. We will document and develop a comprehensive account of all habitat treatments throughout the life of the CCP. The effectiveness of the habitat treatments will be monitored in coordination with the Ecology Work Group and collaborators, and development of a comprehensive inventory and monitoring plan is now a top priority. The habitat management language regarding the 60 percent to 40 percent ratio of treated to untreated habit (60% treated to 40% untreated), was clarified as only a starting point that will be adjusted through time based on site specific science. Alternative 2 now reflects our commitment to establishing a set of priority questions and objectives which will create the scientific foundation for developing an integrated riverine and wetland strategy.

The majority of comments we received during the comment period for the Draft CCP/EIS were in support of the collaborative process. The collaborative process encouraged participating stakeholders to take ownership in the creation of the CCP, and fostered a desire to continue working together during CCP implementation. The Final CCP now reflects continuation of the collaborative process through the life of the CCP, as we work together to achieve the vision for the Refuge.

## Alternatives Considered

In the Draft CCP/EIS three alternatives were evaluated for the Refuge, including a no-action alternative (Alternative 1) as required under the Council on Environmental Quality's regulations (40 Code of Federal Regulations [CFR] 1500-1508). Summaries of the alternatives follow.

*Alternative 1.* Under Alternative 1, the no-action alternative, we would assume no change from current management. This alternative is considered the base from which to compare other alternatives. Under Alternative 1, management of invasive carp and the water quality in Malheur, Harney, and Mud Lakes would remain limited. Fish screens and ladders, water diversion dams, and carp barriers would remain, and riparian rehabilitation would continue. Habitat management in meadows, marshes, streams, and uplands would continue for waterbirds, shorebirds, and waterfowl. Flood irrigation would occur on meadows. Prescribed burning, haying, and rake-bunch grazing would reduce plant litter, and some meadows would be hayed or grazed annually. Wildlife observation, photography, interpretation, environmental education, hunting, and fishing would continue using existing facilities. Cultural resources would be preserved, restored, and interpreted.

*Alternative 2.* Under Alternative 2, our preferred alternative, fish and wildlife, habitat, and public use management will advance through key actions. Improving the aquatic health of Refuge lakes and wetlands will be the highest ecological priority, including reducing invasive carp in Malheur, Harney, and Mud Lakes. An integrated riverine/wetland rehabilitation plan will be developed. Prescriptive grazing, haying, rest, and farming will be used to manage terrestrial habitat for focal species. Terrestrial habitat responses to treatments will be monitored through a collaborative adaptive management structure. Visitor facilities and wildlife-dependent recreation will be upgraded or developed. Interpretation activities will be enhanced at physical sites and through social media. Accessibility for visitors with mobility-impairments will improve. Vehicle access will increase on the Boat Landing and East Canal Roads. Visitors will also be able to drive to Krumbo Reservoir year-round. Current hunt areas will remain open, the upland game hunt will open earlier, and additional areas at Malheur Lake and the Buena Vista Unit will open to waterfowl hunting. A new boat launch on Malheur Lake will be developed with seasonal access. Fishing opportunities at Krumbo Reservoir, Blitzen River, East Canal, Mud Creek, and Bridge Creek will continue with improved access. A new seasonal bank fishing opportunity will open near Refuge Headquarters.

The Oregon Department of Fish and Wildlife's triploid rainbow trout stocking program will continue at Krumbo Reservoir. A cultural resources management plan, and inventory and monitoring plans for focal species will be developed. Implementation of these actions will occur through an ongoing collaborative approach.

*Alternative 3.* Under Alternative 3, habitat management would be similar to Alternative 2 (Alt. 2); except that our emphasis on aquatic health improvement (carp management focus) and riverine/wetland rehabilitation would be equal. Other wetlands and habitat management would be the same as Alt. 2. Wildlife viewing, photography, education and interpretation would be similar to Alt. 2, with fewer facilities and more self-guided and off-trail experiences. The Blitzen Valley auto tour route would be closed to vehicles seasonally, and redesigned into shorter year-round routes. Free-roam, walk-in access along Center Patrol Road would be allowed seasonally, as would vehicle and walk-in access to Krumbo Reservoir. Vehicle access via Boat Landing Road to the Malheur Lake viewing platform would be open year-round. Temporary photography blinds would be permitted in free-roam areas. Waterfowl and game hunts would be similar to Alt. 2, except the Buena Vista waterfowl hunt would not occur. We would consider opening a youth hunt on the Double-O Unit. Fishing would be similar to Alt. 2, with less vehicle access. Other visitor and cultural resources management would be the same as Alt. 2. Implementation of these actions would occur through an ongoing collaborative approach.

## Environmentally Preferable Alternative

The definition of "environmentally preferable alternative" (40 CFR 1505.2(b)) is different from that of the preferred alternative. The environmentally preferred alternative generally causes the least damage to the environment and best protects natural and cultural resources. For this CCP/EIS, Alternative 2, our preferred alternative, is also the environmentally preferable alternative. Under Alternative 2, wildlife and habitat management actions will be conducted as follows.

- Aquatic health will be a priority, and we will focus our efforts on actions having the greatest ecological benefit.
- Scientific studies will be advanced to obtain necessary life history information for common carp in and around the Refuge.
- Based on life history and other sources of information, sustainable strategies will be implemented to control carp populations at a level that allows ecological processes to function properly.
- An integrated riverine/wetland plan will be developed through assessments of the hydrologic, geomorphic, and biologic features associated with target riverine systems and wetlands.
- Based on an integrated riverine/wetland plan and successful carp management, we will conduct riverine pilot projects, to evaluate biological and physical responses to management actions.
- Beginning with wet meadows and submergent aquatics, a State and Transition Model (STM) will be developed for all habitat types based on data collected on the Refuge.
- Scientific experts in plant community modeling and associated ecological processes will form the Ecology Work Group with a focus on STM development. The Group will provide recommendations to the Refuge and collaborators for annual adjustments to the STM and associated habitat management strategies based on continuous inventory and monitoring. The Refuge will implement the CCP with engaged collaborators. New information, successes, and failures will be shared, to create solutions to complex challenges.

- Wildlife inventory and monitoring objectives, protocols, and data will be managed and stored using advanced electronic formats.

## Decision

The Service has selected Alternative 2, as it is described in the Final CCP/EIS, for implementation on the Refuge. Alternative 2 is the most effective alternative for addressing the key issues identified during the planning process; it will best achieve the purposes and goals of the Refuge, and the goals of the National Wildlife Refuge System (Refuge System). Implementation of the CCP will occur over the next 15 years. Interested and affected parties are being notified of our decision.

## Factors Considered in Making the Decision

In reaching our decision to implement Alternative 2, we identified and analyzed its impacts to the Refuge environment in Chapter 6 of the Draft and Final CCP/EIS. Issues, concerns, and opportunities presented by collaborators, organizations, agencies, individuals, and all other stakeholders throughout the planning process were also considered. Other relevant factors include achieving the purposes for which the Refuge was established, and complying with statutory and regulatory guidance.

**Alternative 2** was selected for implementation for the following reasons.

- Alternative 2 will best achieve the Refuge's purposes and fulfill the Service's mission; the alternative is consistent with the principles of sound wildlife management and will facilitate priority public uses that are compatible with the purposes of the Refuge.
- The single most important issue to address is improving the Refuge's aquatic ecosystems that are impacted by common carp. Through management of carp populations, the ecological function of Malheur Lake and other Refuge lakes and wetlands can be enhanced. Improving the aquatic systems will provide benefits to migratory birds at the Refuge and flyway scales.
- Under Alternative 2 the Refuge will manage terrestrial habitats to support the various life stages of focal species. A comprehensive inventory and monitoring program carried out in collaboration with the Ecology Work Group will focus on maintaining desirable habitats and rehabilitating/restoring degraded habitats. A broad range of management tools will be available, including prescribed fire, haying, grazing, idling, and water management. Habitat responses to management tools will be evaluated annually, through a collaborative adaptive management approach, to ensure that the Refuge's vision, purposes, and goals are achieved.
- We will conduct a strategic riverine assessment; it will provide a greater understanding of the impacts on adjacent floodplain habitats and enable us to develop site specific knowledge of how riverine, wet meadow, and marsh communities would respond to hydrologic system changes. We will also utilize a science-based process to determine existing biological conditions and site capability, and to inform our river management decisions.
- Implementing this alternative will provide for a more developed and structured visitor experience, with additional opportunities for our six priority public uses—hunting, fishing, wildlife observation, photography, environmental education, and interpretation. These programs will provide quality experiences for our visitors while providing sufficient protection for wildlife and their habitats.
- This management approach will prove to be effective for inventorying, protecting, and enhancing (where appropriate) the Refuge's cultural and historic resources.

**Alternative 1** was not selected as the preferred alternative for the following reasons:

- Under Alternative 1, we would continue to manage carp using existing strategies, which have not controlled the carp population to a level that would enable us to restore and sustain the proper ecological functions of Refuge lakes and wetlands.
- Under Alternative 1, habitat management would continue with limited assistance from collaborating ecologists. Habitat management strategies would not be based on a Refuge inventory and monitoring system that feeds a collaborative adaptive management decision making process. Due to the lack of information, there would be limited opportunity to restore plant communities that have crossed ecological thresholds.
- Efforts to address river functionality would be limited to existing strategies, without a comprehensive approach to incorporate biological conditions and site capability.
- The public use focus of Alternative 1 is on maintaining existing opportunities, interpretation, and educational materials. Historical and cultural resources would continue to be protected and maintained through partnerships.

**Alternative 3** was not selected as the preferred alternative because managing aquatic health/carp, and implementing a comprehensive river/wetland strategic plan, would be equal in priority. Full research, planning and implementation of a river/wetland plan would significantly detract from available resources, and decrease the potential success of aquatic health/carp management actions. The visitor experience would also be less structured and developed.

## Measures to Minimize Environmental Harm

All practicable measures to avoid or minimize environmental harm that could result from implementing Alternative 2 have been identified and incorporated into the Final CCP/EIS at Chapter 2 (Alternatives, Goals, Objectives, and Strategies), Chapter 6 (Environmental Effects), and Appendix B (Compatibility Determinations). The stipulations identified in the compatibility determinations ensure that public uses and other uses are compatible with the Refuge System mission and the Refuge's purposes. The stipulations and other mitigation measures identified in Alternative 2 and Appendix B, are adopted by the Service in this ROD, and will be implemented by Refuge staff members, collaborators, volunteers, and other stakeholders.

## Findings Required by Other Laws and Executive Orders

The proposed action complies with all federal laws and executive orders related to the CCP planning process. A compliance statement has been completed, which explains how the selected alternative complies with the requirements of the National Wildlife Refuge System Administration Act, as amended, (16 U.S. Code [U.S.C.] 688dd-688ee); the National Environmental Policy Act (42 U.S.C. 4321 et seq.); the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884); the National Historic Preservation Act (16 U.S.C. 470-470b, 470c-470n); the Wilderness Act (16 U.S.C. 1131-1136); the Architectural Barriers Act, as amended, (42 U.S.C. 4151 et seq.); Executive Order 11988, Floodplain Management; Executive Order 11990, Protection of Wetlands; Executive Order 12372, Intergovernmental Review; Executive Order 13186, Protection of Migratory Birds; Executive Order 12898, Environmental Justice; and Executive Order 13175, Consultation and Coordination with Indian Tribal Governments.

## For Further Information

Questions about the CCP and ROD may be directed to Tim Bodeen, Project Leader, Malheur National Wildlife Refuge, 36391 Sodhouse Lane, Princeton, Oregon 97721, phone number (541) 493-2612, fax number (541) 493-2405, and e-mail Tim_Bodeen@fws.gov.

Robyn Thorson
Regional Director, Pacific Region
Portland, Oregon

Jan. 24, 2013
Date

## Supporting References

U.S. Fish and Wildlife Service. 2012. *Malheur National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Impact Statement.* U.S. Fish and Wildlife Service, Malheur National Wildlife Refuge, Princeton, OR.

U.S. Fish and Wildlife Service. 2012. *Malheur National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Impact Statement.* U.S. Fish and Wildlife Service, Malheur National Wildlife Refuge, Princeton, OR.

Note: This ROD and supporting references are available for public review at the Malheur National Wildlife Refuge, 36391 Sodhouse Lane, Princeton, Oregon 97721, and the U.S. Fish and Wildlife Service, Division of Planning, Visitor Services, and Transportation, 911 NE 11th Avenue, Portland, Oregon 97232. These documents can be found on the internet at http://www.fws.gov/malheur/.

*Yellow-headed blackbird*
©Barbara Wheeler

# Chapter 1 Introduction and Background

# 1.1 Introduction

> *The sedges were full of birds, the waters were full of birds: avocets, stilts, willets, killdeers, coots, phalaropes, rails, tule wrens, yellow-headed black birds, black terns, Forster's terns, Caspian terns, pintail, mallard, cinnamon teal, canvas-back, redhead and ruddy ducks, Canada geese, night herons, great blue herons, Farallon cormorants, great white pelicans, great glossy ibises, California gulls, eared grebes, Western grebes—clouds of them, acres of them, square miles—one hundred and forty-three square miles of them!*
>
> *—Dallas Lore Sharp [1914] remarking on Lake Malheur Bird Reservation*

In the late 1880s, plume hunters decimated North American bird populations in pursuit of breeding feathers for the hat industry. Hunters targeted large flocks of colonial nesting birds and shorebirds, killing birds indiscriminately and orphaning chicks. Eventually, the large numbers of colonial nesting birds on Malheur Lake were discovered by plume hunters. In 1908, wildlife photographers William L. Finley and Herman T. Bohlman discovered that most of the white herons (egrets) on Malheur Lake had been killed in 1898 by plume hunters. After 10 years the white heron population still had not recovered. With backing from the Oregon Audubon Society, Finley and Bohlman proposed establishment of a bird reservation to protect birds using Malheur, Mud, and Harney lakes.

Government lands identified as the Lake Malheur Reservation were set aside on August 18, 1908, by President Theodore Roosevelt using Executive Order No. 929 "as a preserve and breeding ground for native birds." An August 12, 1908 letter to the President from the Secretary of the Interior stated that the purpose and intent was "to preserve the habitat values of the three lakes (Malheur, Mud and Harney Lakes) for migratory waterfowl, and especially, the colonial nesting species."

Decisions made today for refuge management will have far-reaching consequences for the hundreds of species dependent on refuge habitats, as well as for current and future Harney County residents and refuge visitors. This document is a plan for the next 15 years. Planning is a means to an end, and that end is good decisions. We have attempted to think through the critical resources and public use issues carefully, to design a plan that will meet the conservation and recreation challenges of the coming years.

# 1.2 The Significance of Malheur National Wildlife Refuge

Malheur National Wildlife Refuge (Malheur Refuge, or the Refuge) is situated within the Harney Basin in southeastern Oregon (Map 1). Located in the Northern Great Basin, this portion of the State is lightly populated, generally arid with cold winters, and characterized by wide open spaces.

The Refuge, measuring 187,757 acres, constitutes a small percentage of the Northern Great Basin's total acreage but is a tremendously important source of wildlife habitat relative to other portions of the Northern Great Basin. The Refuge represents a crucial stop along the Pacific Flyway and offers resting, breeding, and nesting habitat for hundreds of migratory birds and other wildlife. Many of the species migrating through or breeding here are highlighted as priority species in national bird conservation plans.

Historical bird counts show that the Refuge and the Silvies River floodplain just north of the Refuge may support anywhere between 5 and 66 percent of the Pacific Flyway's migrating populations for various priority waterfowl. On the Refuge, breeding habitat is significant for waterbirds, with the Refuge currently supporting over 20 percent of the Oregon population of breeding greater sandhill cranes (*Grus canadensis tabida*). Most colonial waterbird numbers have easily exceeded 10 percent of the regional population at peak, even reaching up to 77 percent of the Great Basin population for certain species. Numbers of migrating shorebirds have been documented at levels high enough to qualify the Refuge as a Regional Western Hemispheric Shorebird Reserve. The Refuge also supports very high densities of certain nesting riparian passerines and the largest local population of bobolinks (*Dolichonyx oryzivorus*) in the western U.S.

In addition to these biological values, the Refuge is well-loved by its visitors, many of whom return year after year. The Refuge is cherished for its excellent birding, the opportunity to find solitude in a remote, open landscape, its many historic remnants and geologic sites of interest, and its proximity to an Oregon landmark, Steens Mountain. The Refuge has strong historic ties to local residents as an important contributor to local economies. Far-flung communities of birders also feel a strong connection to the Refuge, with awareness that the Audubon Society played a pivotal role in its initial establishment. Both local and distant communities will continue to play a large role in the Refuge's future.

Challenges for maintaining and enhancing these biological and social values are explored below. Further information regarding the area's physical environment, biological resources, and public use patterns are found in Chapters 3, 4, and 5 of this document.

## 1.3 Action

The U.S. Fish and Wildlife Service (USFWS or the Service) is adopting and implementing a comprehensive conservation plan for Malheur National Wildlife Refuge, located in the Northern Great Basin of southeast Oregon in Harney County. This document is a comprehensive conservation plan (CCP) for the Refuge. The CCP sets forth management guidance for the Refuge over the next 15 years, as required by the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee as amended by the National Wildlife Refuge System Improvement Act of 1997). The Improvement Act (P.L. 105-57) mandated that CCPs be developed for all refuges in the National Wildlife Refuge System.

The management direction described in Chapter 2 will best achieve the purpose and need for the CCP while maintaining a balance among the varied management needs and programs. It addresses the issues and relevant mandates and is consistent with principles of sound fish and wildlife management.

The management direction was modified between the draft and final documents based on comments received from the public or other agencies and organizations. The Regional Director for the Service's Pacific Region decided which alternative will be adopted for implementation. For details on the management direction, see Chapter 2.

## 1.4 Purpose and Need for Action

The purpose of the CCP is to provide consistent, reasonable, scientifically grounded guidance. This guidance will ensure that, over the next 15 years, the Refuge will:

- protect, maintain, and enhance lake, in-stream, riparian, marsh, meadow, and upland (sagebrush steppe, basin big sagebrush islands, salt desert scrub) habitats, for the benefit of migratory and breeding birds and a diverse assemblage of other native species;
- protect and maintain rare, unique, and special habitats at Malheur Refuge, including cliffs, rimrock, lava flows, cold and hot springs, dunes, and playas for the benefit of migratory and breeding birds and a diverse assemblage of other native species;
- contribute to the conservation, protection, and recovery of rare species, including any federally listed or candidate species, State sensitive species, and other priority species (Appendix E);
- provide compatible wildlife-dependent recreation opportunities for visitors, fostering an appreciation and understanding of the Refuge's fish, wildlife, plants, and their habitats;
- adequately inventory, protect, restore, and interpret the Refuge's unique cultural, historical, and paleontological resources;
- gather scientific information to contribute to better decision making and monitor environmental change; and
- actively engage in off-refuge collaborative conservation efforts.

The CCP is needed for a variety of reasons. These reasons consist of the need to:

- review the contribution of the Refuge to Flyway and landscape goals for migratory and breeding birds and other priority species, to assess current management strategies in light of these goals, and to recommend appropriate actions to ensure that the Refuge will provide the quantity and quality of habitats necessary for meeting these goals;
- review the Refuge's water system operations and infrastructure in relation to all habitats and identify needs related to providing water for priority species;
- maintain a consistent management plan and direction regardless of refuge staff changes;
- effectively address the problem of the spread and expansion of invasive species, such as carp and perennial pepperweed, across a wide range of habitats;
- improve degraded habitat conditions;
- properly prescribe the use of tools such as haying, grazing, crop cultivation, and burning in the creation and maintenance of desired habitat conditions;
- ensure that neither refuge management activities, including habitat management and administrative activities, nor public uses result in damage or loss of irretrievable cultural and paleontological resources;
- assist in cultivating strong relationships with partners such as the Burns Paiute Tribe, other governments, refuge neighbors, and various nongovernmental organizations;
- determine what improvements or alterations should be made in the "Big Six" Refuge System wildlife-dependent uses (wildlife observation, wildlife/nature photography, environmental education, interpretation, hunting, and fishing) or other programs and services offered to refuge visitors; and
- increase the energy efficiency and sustainability of refuge operations.

# 1.5 Legal and Policy Guidance

The Refuge is managed as part of the National Wildlife Refuge System and must adhere to various legal and policy guidelines. In developing a CCP, the planning team considers the various laws, regulations, agency missions and policies, and ecosystem goals, together with the Refuge's purpose and refuge-specific issues and goals. The broader mandates that apply to each refuge are explained and described in this section.

## 1.5.1 The U.S. Fish and Wildlife Service

All refuges are managed by the U.S. Fish and Wildlife Service, an agency within the Department of Interior. The Service is the principal Federal agency responsible for conserving, protecting, and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people.

***U.S. Fish and Wildlife Service Mission:*** The mission of the U.S. Fish and Wildlife Service is "working with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people." National natural resources entrusted to the Service for conservation and protection include migratory birds, endangered and threatened species, interjurisdictional fish, wetlands, and certain marine mammals. The Service also manages national fish hatcheries, enforces Federal wildlife laws and international treaties on importing and exporting wildlife, assists with state fish and wildlife programs, and helps other countries develop wildlife conservation programs.

## 1.5.2 National Wildlife Refuge System

The 150-million-acre National Wildlife Refuge System (Refuge System, NWRS) encompasses 551 National Wildlife Refuges, thousands of small wetlands and other special management areas. The Refuge System is the world's largest network of public lands and waters set aside specifically for conserving wildlife and protecting ecosystems. From its inception in 1903, the Refuge System has grown to encompass refuges in all 50 states and waterfowl production areas in 10 states. More than 36 million visitors annually fish, hunt, observe and photograph wildlife, or participate in environmental education and interpretive activities on National Wildlife Refuges.

The needs of wildlife and their habitats come first on refuges, in contrast to other public lands that are managed for multiple uses. Refuges are guided by various Federal laws and executive orders, Service policies, and international treaties. Fundamental are the mission and goals of the Refuge System and the designated purposes of the refuge unit as described in establishing legislation, executive orders, or other documents establishing, authorizing, or expanding a refuge.

***National Wildlife Refuge System Mission and Goals:*** The mission of the Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (16 U.S.C. 668dd-668ee, as amended).

The goals of the National Wildlife Refuge System, as articulated in the Mission, Goals, and Purposes Policy (601 FW 1) are to

- conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered;
- develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life-history needs of these species across their ranges;
- conserve those ecosystems, plant communities, wetlands of national or international significance and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts;
- provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); and
- foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

***National Wildlife Refuge System Administration Act:*** Key concepts and guidance of the Refuge System derive from the National Wildlife Refuge System Administration Act of 1966 as amended (16 U.S.C. 668dd-668ee). Of all the laws governing activities on National Wildlife Refuges, the Refuge Administration Act undoubtedly exerts the greatest influence. The National Wildlife Refuge System Improvement Act (Improvement Act; P.L. 105-57) amended the Refuge System Administration Act in 1997 by including a unifying mission for all National Wildlife Refuges as a system, a new process for determining compatible uses on refuges, and a requirement that each refuge will be managed under a CCP, to be developed in an open public process.

The Refuge Administration Act states that the Secretary of the Interior shall provide for the conservation of fish, wildlife and plants, and their habitats within the System as well as ensure that the biological integrity, diversity, and environmental health of the System are maintained. House Report 105-106 accompanying the Improvement Act states that “the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first.” Biological integrity, diversity, and environmental health are critical components of wildlife conservation. As later made clear in the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3), “the highest measure of biological integrity, diversity, and environmental health is viewed as those intact and self-sustaining habitats and wildlife populations that existed during historic conditions.”

Under the Refuge Administration Act, each refuge must be managed to fulfill the Refuge System mission as well as the specific purposes for which it was established. The Refuge Administration Act requires the Service to monitor the status and trends of fish, wildlife, and plants in each refuge.

Additionally, the Refuge Administration Act identifies six wildlife-dependent recreational uses for the Refuge System. These uses are hunting, fishing, wildlife observation and photography, environmental education and interpretation. Under the Refuge Administration Act, the Service is to grant these six wildlife-dependent public uses special consideration in the planning for, management of, and establishment and expansion of units of the National Wildlife Refuge System. When determined compatible on a refuge-specific basis, these six uses assume priority status among all uses of the refuge in question. The Service is to make extra efforts to facilitate priority wildlife-dependent public use opportunities.

When preparing a CCP, refuge managers must re-evaluate all general public, recreational, and economic uses (even those occurring to further refuge habitat management goals) proposed or occurring on a refuge for appropriateness and compatibility. No refuge use may be allowed or continued unless it is determined to be appropriate and compatible. Generally, an appropriate use is one that contributes to fulfilling the refuge purposes, the Refuge System mission, or goals or objectives described in a refuge management plan. A compatible use is a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge. Updated appropriate use and compatibility determinations for existing and proposed uses for Malheur National Wildlife Refuge are in Appendices A and B of this CCPS.

The Refuge Administration Act also requires that, in addition to formally established guidance, the CCP must be developed with the participation of the public. Issues and concerns articulated by the public play a role in guiding alternatives considered during the development of the CCP and together with other formal guidance, can play a role in selection of the management direction. It is Service policy that CCPs are developed in an open public process and that the agency is committed to securing public input throughout the process. Appendix J of the CCP details public involvement that has been undertaken during the CCP process.

## 1.5.3 Other Laws and Mandates

Many other laws govern the U.S. Fish and Wildlife Service and Refuge System lands. Examples include the Migratory Bird Treaty Act of 1918, Refuge Recreation Act of 1962, National Historic Preservation Act of 1966, and the Endangered Species Act of 1973. For additional information, a list and brief description of laws of interest can be found at http://www.fws.gov/laws/Lawsdigest.html.

All laws that pertain to the National Wildlife Refuge System are implemented through regulations covering the National Wildlife Refuge System, published in Title 50, subchapter C of the Code of Federal Regulations (50 C.F.R. 401-453). These regulations govern general administration of units of the Refuge System.

The Refuge System also maintains and updates a Refuge System manual, which elaborates upon these laws and regulations and provides further policy and guidance for the Refuge System. Over the last few years, the Service has developed or revised numerous policies and Director's Orders to reflect the mandates and intent of the Improvement Act. Some of these key policies include the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3); the Compatibility Policy (603 FW 2); the Comprehensive Conservation Planning Policy (602 FW 3); Mission, Goals, and Purposes (601 FW 1); Appropriate Refuge Uses (603 FW 1); Wildlife-dependent Public Uses (605 FW 1); Wilderness-related Policies (610 FW 1-5); and Coordination and Cooperative Work with State Fish and Wildlife Agencies (601 FW 7). These policies and others in draft or under development can be found at http://refuges.fws.gov/policymakers/nwrpolicies.html.

## 1.5.4 Summary Hierarchy of Guidance

In developing a CCP, a refuge must consider the various broader laws, regulations, missions, goals, and policies. The CCP must be consistent with these and also with the refuge's purpose, when addressing refuge-specific issues and goals. Figure 1-1 illustrates the hierarchy of planning guidance for refuges.

Applicable Federal Laws and Executive Orders/Regulations
⇩
U.S. Fish and Wildlife Service Mission
⇩
Refuge Purposes
⇩
National Wildlife Refuge System Mission*/Goals/Policies
⇩
Ecosystem Vision/Goals/Objectives
⇩
Refuge Vision
⇩
Refuge Goals
⇩
Refuge Objectives
⇩
Refuge Strategies
⇩
Projects

*Developed or revised as part of the CCP process* (Refuge Vision, Refuge Goals, Refuge Objectives, Refuge Strategies)

*Developed as part of the CCP or with step-down management plans* (Projects)

* established by law

**Figure 1-1. Hierarchy of guidance within the National Wildlife Refuge System.**

# 1.6 Refuge Establishment and Purposes

## 1.6.1 Legal Significance of the Refuge Purpose

The purpose for which a refuge was established or acquired is of key importance in refuge planning. Purposes must form the foundation for management decisions. The refuge purposes are a driving force in the development of the refuge vision statements and goals in a CCP and are critical to determining the compatibility of existing and proposed refuge uses.

The purposes of a refuge are specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit.

Unless the establishing law, order, or other document indicates otherwise, purposes dealing with the conservation, management, and restoration of fish, wildlife, and plants, and the habitats on which they depend take precedence over other purposes in the management and administration of any unit.

Where a refuge has multiple purposes related to fish, wildlife, and plant conservation, the more specific purpose will take precedence in instances of conflict.

Refuges often consist of units that were acquired at different times and under different authorities. The original establishing purpose applies to each and every unit of a refuge, regardless of when it was acquired. When an additional unit is acquired under an authority different from the authority used to establish the original unit, the addition takes on the purpose of the original unit, but the original unit does not take on the purpose of the addition.

By law, refuges are to be managed to achieve their purposes. When a conflict exists between the Refuge System mission and the purpose of an individual refuge, the refuge purpose may supersede the Refuge System mission.

## 1.6.2 Purpose and History of Refuge Establishment

Malheur Refuge encompasses three main units that were established at different times. The following discussion is organized by these units. The purposes are also summarized at the end of the discussion.

### Malheur, Mud, and Harney Lakes

When the Refuge was established in 1908, Euro-Americans had been living on homesteads and ranches in the area for nearly 40 years. As is common elsewhere in the arid west, access to water was the determining factor for settlement. However, the shifting shorelines of Malheur, Mud, and Harney lakes, combined with an absence of legal surveys, created a situation where ownership boundaries and governmental authorities were ambiguous. Homesteaders and ranchers competed for control over riparian areas and water, essential to livelihood in these arid regions. Ownership rights were legally murky because Oregon had not codified its water law and because the boundary between “land” and “riparian areas” is fluid (Langston 2003). As a result, the early years of settlement (prior to and after refuge establishment) were marked by prolonged legal wrangling among the Federal and State governments and private landowners over authorities and ownership lines. The following discussion includes some of the legal history that occurred as these issues were resolved.

In 1895, no wildlife refuges existed anywhere in the nation. During this year, in response to several court cases disputing land title and the legal doctrines governing water and riparian use, the U.S. government initiated survey of a meander line around Malheur, Mud, and Harney lakes. Known as the Neal Survey, it established a legal boundary between lands held in private ownership and those lands and waters held by the government as public domain lands. The meander line helped to distinguish land acquired under a homestead claim from surrounding lands held in ownership by the Federal government. A 1901 U.S. Supreme Court ruling, *Marshall v. French*, determined that Marshall’s homestead claim on Malheur Lake, which straddled the meander line, had been made on lands within the public domain rather than lands claimed by the French-Glenn Livestock Company, thus settling a dispute between the two landowners. This decision by the Supreme Court provided a legal basis for the President to declare unclaimed lands around the lakes as Federal property when the Refuge was established.

As described in Section 1.1, plume hunters wreaked havoc on Malheur Lake, decimating its waterbird colonies by 1898. Wildlife photographers William L. Finley and Herman T. Bohlman documented the destruction and observed only limited recovery on the lake even after 10 years.

They, in concert with the Oregon Audubon Society, petitioned the Federal government for establishment of a bird reservation on the lakes.

Government lands within the Neal Survey line were set aside on August 18, 1908, by President Theodore Roosevelt using Executive Order No. 929 “as a preserve and breeding ground for native birds.” A letter dated August 12, 1908, to the President from the Secretary of the Interior stated that the purpose and intent was “to preserve the habitat values of the three lakes for migratory waterfowl, and especially, the colonial nesting species.” The new Lake Malheur Reservation[1] purportedly encompassed 81,786 acres around the lakes but was unsurveyed at the time of establishment and the exact acreage for the new reservation was not known.

In 1916, the State of Oregon filed a claim for title to Malheur Lake as part of an effort to reclaim wetlands for agricultural purposes. The State argued that it had legal jurisdiction over lands within the meander line of all navigable bodies of water within the state, including Malheur Lake. In 1935, the Supreme Court, using the decision in *Marshall v. French*, upheld a lower court ruling that the State did not have title under its navigability claim and that the United States had not abandoned any lands by issuing patents. However, the Court also ruled that homestead claims on Malheur, Mud, and Harney lakes still needed to be reviewed and settled before the Federal government could take possession. The Federal government made offers to buy out the homesteads, but a “fair” price for inholdings could not be agreed upon.

In the interim, President Herbert Hoover issued Executive Order No. 5891 on July 16, 1932, which temporarily withdrew all public lands around Malheur and Harney lakes for classification as to their suitability for migratory bird refuge purposes. Plot locations but not exact acreages were identified. On June 1, 1933, President Franklin D. Roosevelt issued Executive Order No. 6152, which withdrew additional public lands west of Harney Lake and in the Silver Lake area for a similar suitability study.

In June 1934, Executive Order No. 6724, Declaration of Taking, provided funds under the “Emergency Conservation Fund (transfer from War to Agriculture—Act of March 31, 1933-March 31, 1935)” known as the $10,000,000 fund for the purchase of 3,845.84 acres below the Neal meander line from willing sellers on Malheur, Mud, and Harney lakes.

During the Great Depression years, drought hit the area and lake levels receded with decreased precipitation, As a result, adjacent landowners increased their agricultural practices on the newly exposed land. In December 1936, the U.S. filed suit against landowners claiming ownership of lands inside the meander line. The Ninth Circuit Court of Appeals ruled in favor of the private landowners but did not attempt to apportion the lands among the individuals involved, so the Federal government continued to administer the lake area (including the exposed areas now farmed by settlers) as a waterfowl refuge.

In 1937, the U.S. government asked that Malheur Lake be placed in receivership (i.e., administered by an uninterested third party) until all land within the meander line was purchased or condemned. The courts complied and a receiver appointed by the court regulated, by permit, the use of lakebed lands by adjacent landowners. Funds received from economic permits on the Refuge were held by a

[1] The original name “The Lake Malheur Reservation” was changed to Malheur Migratory Bird Refuge on July 19, 1935. On July 25, 1940, Presidential Proclamation No. 2416 officially changed the name from Malheur Migratory Bird Refuge to Malheur National Wildlife Refuge.

court-appointed receiver until 1940, when the receivership was dissolved after another court ruling upheld the ruling of private ownership.

In an attempt to hasten some sort of court action that would define ownership boundaries within the meander line of Malheur Lake, a presidential proclamation was sought to close the lake to economic use. Proclamation No. 2516, dated October 1, 1941, "closed all lands within the Meander Line of Malheur and Harney Lakes and the streams and waters connecting said lakes to the taking, capturing or killing, or attempting to take, capture, or kill migratory birds." A modification of the hunting closure on Malheur Lake came via Presidential Proclamation No. 2818 (in 1948). This proclamation made it possible to open portions of the lake to hunting (approximately 4,241 acres). Proclamation No. 2859 (in 1949) redefined those areas closed to hunting and again expanded the portion of the lake open to hunting. The hunting area was increased a third time by order of the Secretary of Interior on October 21, 1953. The remainder of the original refuge area established in 1908 remained closed to hunting until November 19, 1982. On that date, the proclamation closures were eliminated and now no longer serve as a legal constraint to waterfowl hunting (USFWS 1985).

In April 1944, the Oregon U.S. District Court ruled in the case of the *United States v. Malheur Lake Property Owners*. The ruling found that 1) the original Neal Survey meander line was a valid survey of the lake boundary; 2) Executive Order No. 929 establishing Malheur Lake Reservation was valid; and 3) the patentees of lands through which the Neal Survey line passed or bounded did have property rights that extended to the center of Malheur Lake. The court also defined the exact location of the centerline of the lake, which generally ran east-west through the lakebed. The boundaries of the tracts claimed by the defendants were specifically laid out and designated as legally owned private tracts. The court decreed that 23,947.10 acres were held in private ownership, and 23,913.30 acres were in government ownership. It also ruled the government should compensate those landowners for use and occupation of the defendants' land since January 1937. No specific amount was set for compensation.

In September 1944, the Migratory Bird Conservation Commission approved the acquisition of all of the privately owned lands within the meander line of Malheur Lake. Negotiations were undertaken in the hopes of reaching price agreement with the owners of this property, but this effort failed. Negotiations continued and agreements were finally reached for the purchase of 13,003.84 acres. In January 1945, the Secretary of the Interior requested that condemnation proceedings be filed for the remaining 10,943.26 acres of privately owned property within the lakebed of Malheur Lake.

In 1947, Federal condemnation hearings were held in Burns for the remaining tracts on Malheur Lake. The Federal government had offered $10 per acre for similar tracts on the lake and the defendants, using testimony from similar hearings in the Klamath Falls area, felt that the value should be $100 per acre. The court accepted the value of $100 per acre, and the government dropped their condemnation proceedings. The Refuge negotiated with the remaining landowners over the next nine years and through purchase or exchange managed to acquire the remaining lakebed lands within the Neal Survey meander line of Malheur Lake.

Public Land Order (PLO) No. 1511 on September 24, 1957 revoked Executive Orders 929, 5891, and 6152 and amended Executive Order 7106:

> Executive Order No. 7106 of July 19, 1935, establishing the Malheur Migratory Bird Refuge which was redesignated the Malheur National Wildlife Refuge by Proclamation No. 2416 of July 25, 1940, is hereby amended by eliminating from the first paragraph thereof the words

> “and in order to effectuate further the purposes of the Migratory Bird Conservation Act (45 Stat. 1222)” … Subject to valid existing rights, the following-described public lands in Harney County, Oregon, are hereby withdrawn from all forms of appropriation under the public-land laws, including the mining but not the mineral leasing laws, and reserved under the jurisdiction of the Bureau of Sport Fisheries and Wildlife of the Department of the Interior as an addition to the Malheur National Wildlife Refuge.

The legal description of an additional 18,017.54 acres was included in this PLO and added to the 22,016.54 acres of public land that was originally withdrawn by Executive Orders No. 5891 and No. 6152.

The PLO withdrew lands of the public domain from all forms of appropriation under public land laws, including homesteading, desert land, and small mining, but not the mineral leasing laws, and reserved those lands solely under the jurisdiction of the Bureau of Sport Fisheries and Wildlife (now known as the U.S. Fish and Wildlife Service). In total, 40,034.08 acres around Malheur and Harney lakes were withdrawn from the public domain under this PLO.

Between 1978 and 1983, three additional tracts were added to the Refuge. The 1,518-acre Hill Tract just west of Refuge Headquarters was the last large portion of lakebed to be acquired and was purchased in 1978. A 1981 exchange involved acquisition of 480 acres on Harney Lake for 950.36 acres in the Kern Reservoir area above Krumbo Reservoir. In 1983, 80 acres of lakebed within the meander line on the north side of Malheur Lake was exchanged for 120 acres above the meander line. PLO No. 6470 was issued by the Secretary of the Interior on September 26, 1983. The order transferred 199.9 acres on the east side of Malheur Lake from the jurisdiction of the Bureau of Land Management (BLM) to the Service.

A 2,462-acre inholding on Mud Lake was acquired in 1984 in exchange for 1,042 acres of refuge land in the Diamond Swamp area. Acquisition of the Mud Lake property would allow the Refuge to better manage the flow of water and lands of the Dunn Ranch (Mud Lake area) to benefit migratory birds, which are the primary management concern for the Refuge.

In exchange for 277 acres of refuge land in the Diamond Swamp area deemed to have low wildlife value, 360 acres of private land in the center of Mud Lake were acquired in 1999. The final acquisition in the 1990s was the divestment, in 1999, of 28 acres north of Frenchglen to the State of Oregon for part of a 904-acre parcel on Mud Lake; the remainder of the acreage was acquired through purchase. The last two acquisitions would protect wetland habitat and help to maintain or improve water quality in Mud, Harney, and Malheur lakes, while consolidating an irregular boundary.

A 240-acre parcel on the southeast side of Mud Lake was donated to the Refuge in 1994 by the Hunt family. In 1998, the 362-acre Opie parcel on the north side of Malheur Lake in the vicinity of Lawen was purchased using Migratory Bird Conservation Commission funds to support wildlife-dependent uses and to protect wetland habitat and Malheur Lake water quality.

Land acquisitions between 2000 and 2003 focused on property on the south side of Malheur Lake. Migratory Bird Conservation Commission funds were used to purchase 280 acres on the southwest side of the lake to protect wetland habitat and Malheur Lake water quality. Migratory Bird Conservation Commission funds were again used to purchase 702.78 acres on the south side of Malheur Lake in 2001. A 2003 exchange and purchase of 267 acres on the south side of Malheur

Lake for 193 acres in the Diamond Swamp vicinity was the most recent land acquisition. The last two acquisitions were made to protect wetland habitat; help to maintain or improve water quality in Mud, Harney, and Malheur lakes; and consolidate an irregular boundary.

## The Blitzen Valley

The cyclical trends of drought and flood in the Great Basin were made dramatically apparent when Malheur Lake dried up in the early 1930s. Recognizing that the lake could not be viewed in isolation from its primary sources (the Donner und Blitzen River and the Silvies River), William L. Finley again played an integral role in the Refuge's history by championing purchase of the Blitzen Valley as an addition to the Refuge. Control of the valley meant control of the Blitzen River and control of the river allowed the reservation to restore water to the lakes (which were dry as a result of the drought) by releasing water held behind ranch dams. The addition of the Blitzen Valley was aimed at acquiring the water rights held in private ownership for waters flowing from Steens Mountain and ultimately ending in Malheur Lake.

The 64,717-acre Blitzen Valley portion of the Refuge was acquired from the Eastern Oregon Land and Livestock Company for $675,000 on February 21, 1935 using funds made available pursuant to the provisions of the *Act for the Relief of Unemployment through the Performance of Useful Public Work* (48 Stat. 22) and the National Industrial Act (48 Stat. 195). The Blitzen Valley addition was formally added to the Lake Malheur Reservation under Executive Order No. 7106 signed by President Franklin D. Roosevelt on July 19, 1935. The order specified that the land was for use "as a refuge and breeding ground for migratory birds and other wildlife." At the same time, the name of the reserve was changed to Malheur Migratory Bird Refuge.

An additional 1,125.20 acres of Blitzen Valley land held in private ownership was purchased in 1936 with funds made available by the N.I.R., Agriculture, Wildlife Refuges Fund, known as the $6,000,000 fund. This fund conferred migratory bird purposes for lands (Castineira 2010).

PLO No. 4661 was issued by the Secretary of the Interior on April 16, 1969. In this PLO, 4,021.14 acres of small tracts of scattered uplands above the Blitzen Valley, acquired as part of the Eastern Oregon Land and Livestock Company Blitzen Valley acquisition, were deemed to have limited wildlife value and were relinquished to BLM jurisdiction.

Other additions to the Refuge were made in the 1990s. In 1997, a 225-acre parcel at the south end of the Blitzen Valley was purchased with funds reprogrammed from the land acquisition fund for San Francisco Bay National Wildlife Refuge. This parcel was acquired for use as an administrative area for operations at the south end of the Blitzen Valley; moving operations at the P Ranch to a less public location. A 320-acre tract inholding in the Dunn Dam vicinity of the Blitzen Valley was acquired in 1998 under the authority of the Migratory Bird Conservation Commission Act of 1929 (as amended).

## Double-O

The Double-O Unit was added to the Refuge in 1941. The deepening nationwide Depression and the ongoing drought forced reductions in the number of cattle the land could support. The Hanley family sold 14,517.89 acres at the Double-O to the U.S. government for addition to the Refuge under authority of the Migratory Bird Conservation Commission Act of 1929 (as amended) for $116,143 as "a reservation for migratory birds."

### Summary of Refuge Purposes

- "a refuge and breeding ground for migratory birds and other wildlife" Executive Order No. 7106, dated July 19, 1935, as modified by PLO No. 1511, dated September 24, 1957.
- "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds" 16 U.S.C. 715d (Migratory Bird Conservation Act).
- "for the development, advancement, management, conservation, and protection of fish and wildlife resources" 16 U.S.C. 742f(a)(4).
- "for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude" 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956).
- "conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans" 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act).

## 1.6.3 Land Status and Ownership

**Table 1-1. Malheur Refuge Acreage by Type of Acquisition**

| Type of Acquisition | Acres |
|---|---|
| Acquired by purchase, willing seller | 43,665.57 |
| Acquired by purchase, condemnation (E.O. No. 6724) | 5,070.39 |
| Acquired by purchase (Blitzen Valley Project) | 64,713.54 |
| Acquired by exchange | 12,287.73 |
| Withdrawn from public domain | 73,222.07 |
| Acquired by donation | 240 |
| *Out of fee title by exchange/sale/transfer* | *-11,442.76* |
| **Total** | **187,756.54** |

Source: USFWS 2011.

# 1.7 Relationship to Other Plans and Assessments

## 1.7.1 Previous and Future Refuge Plans

***Previous Refuge Plans:*** Several previous comprehensive planning efforts have guided decisions and operations at Malheur Refuge. In the early 1980s, under the leadership of Joe Mazzoni and George Constantino, the Master Plan was developed (USFWS 1985), which outlined major "outputs" of the Refuge (both wildlife and public use), and outlined wildlife, public use, and land/water management strategies by refuge unit. It replaced the former Master Plan Technical Report, prepared in March 1965.

Unit-specific five-year plans were prepared subsequent to the completion of the Master Plan. The Blitzen Valley Management Plan (USFWS 1990) was signed by then-Refuge Manager Forrest Cameron. The focus of this document was to improve the Blitzen Valley's ability to meet migratory bird production objectives as outlined in the 1985 Master Plan. With the selection of seven focal species, this plan, and focused primarily on water management, carp, predator, and vegetation management issues. Prescriptions in the plan were documented for six units delineated within the Blitzen Valley.

Similarly, the Double-O Habitat Management Plan (David and Ivey 1995) was a step-down management plan. While less detailed than the Blitzen Valley Management Plan, it outlined major actions to be pursued within the unit.

***Future Refuge Planning:*** The CCP will be revised every 15 years or earlier if monitoring and evaluation determine that changes are needed to achieve refuge purposes, vision, goals, or objectives. The CCP provides guidance in the form of goals, objectives, and strategies for refuge program areas but may lack some of the specifics needed for implementation. Step-down management plans will therefore be developed for individual program areas, as needed, following completion of the CCP. Step-down plans require appropriate NEPA compliance.

## 1.7.2 Ecosystem Plans and Assessments

When developing a CCP, the Service considers the goals and objectives of existing national, regional, state, and ecosystem plans and/or assessments. The CCP is expected to be consistent, as much as possible, with existing plans and assist in meeting their conservation goals and objectives (602 FW 3). This section summarizes some of the key plans reviewed by members of the core team (Appendix I) while developing the CCP.

### Migratory Birds

***Birds of Conservation Concern:*** The 1988 amendment to the Fish and Wildlife Conservation Act mandates the USFWS to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973." Based on the efforts and assessment scores of three major bird conservation efforts (Partners in Flight, the U.S. Shorebird Conservation Plan, and the North American Waterbird Conservation Plan), this report (USFWS 2008) identifies, by Bird Conservation Region (BCR), the bird species most in need of conservation attention. Waterfowl game species covered by the North American Waterfowl Management Plan are excluded from the list. Malheur Refuge is located within BCR Region 9, for which 28 species are listed. The list includes two waterbirds, three shorebirds, and several raptors. The rest are upland or riparian associated species.

***Partners in Flight (PIF):*** The primary goal of the Conservation Strategy for Landbirds in the Columbia Plateau of Eastern Oregon and Washington (Altman and Holmes 2000) is to ensure long-term maintenance of healthy populations of native landbirds. Focal species and habitat objectives for habitat types present at the Refuge, including riparian shrub, cliffs and rimrock, steppe-shrubland, sagebrush, shrublands, and juniper-steppe. Malheur Refuge is targeted in this plan as important for two focal species: yellow-billed cuckoo and bobolink.

***North American Waterfowl Management Plan:*** This plan, first formulated in 1986, provides a strategy to protect North America's remaining wetlands and to conserve waterfowl populations through habitat protection, restoration, and enhancement. The plan was updated in 2004 with an emphasis on strengthening the biological foundation, using a landscape approach, and expanding partnerships. The 2004 update contains species-specific population objectives and evaluations of whether the continental population is currently short or over the target. There are also flyway goals for production by species, but the plan did not target population objectives for wintering or migratory waterfowl by area (North American Waterfowl Management Plan 2004). Implementation of this plan is accomplished at the regional level by partnership, within 11 Joint Venture areas. Malheur Refuge is located within the area of the Intermountain West Joint Venture.

***Pacific Flyway Plans:*** Flyway management plans are the products of Flyway Councils, developed to help State and Federal agencies cooperatively manage migratory game birds. Several flyway management plans pertain to Malheur Refuge, but specific management objectives are not identified for the Refuge in these plans. Species that occur on the Refuge and are identified in these plans as important are:

- Pacific population of western Canada geese (Subcommittee on Pacific Population of Western Canada Geese 2000)
- Wrangel Island population of lesser snow geese (Pacific Flyway Council 2006)
- Rocky Mountain population of trumpeter swans (Pacific Flyway Study Committee)

***Intermountain West Regional Shorebird Management Plan:*** This plan (Oring et al. 2000) notes that perhaps a million shorebirds breed in the Intermountain West and that millions more migrate through the area each year. The plan recognizes that finding ample high-quality fresh water will be the greatest challenge faced by shorebirds in the Intermountain West. The regional plan articulates seven goals and associated objectives and strategies related to habitat management, monitoring and assessment, research, outreach and planning. The Harney Basin is recognized as a Key Shorebird Area. High priority species found in eastern Oregon include 10 of the 13 species in the Intermountain West with scores of 4 or 5 in the plan’s species scoring process. These high priority species include snowy plover, black-necked stilt, American avocet, willet, long-billed curlew, marbled godwit, western sandpiper, least sandpiper, long-billed dowitcher, Wilson’s phalarope and red-necked phalarope.

***Intermountain West Joint Venture Coordinated Implementation Plan for Bird Conservation in Eastern Oregon:*** This plan (Oregon Habitat Joint Venture 2005) identified important habitat types for bird conservation, including flood-irrigated pastures and hay meadows, alkaline wetlands, emergent marsh, wet meadows, and riparian shrub are identified to provide a strategic framework for site-specific habitat protection and restoration projects within the priority areas in eastern Oregon. The plan recommends specific acreage figures in the Harney Basin for the following habitat types:

- Grassland: 3,000
- Sagebrush steppe: 5,000
- Playa vernal pool: 20,000
- Pasture-hay: 70,000
- Alkaline wetlands: 20,000
- Emergent marsh: 40,000
- Wet meadow: 30,000
- Riparian shrub: 2,000

***Oregon Closed Basin: Wetlands Implementation Plan (Ivey 2000):*** This plan recommends objectives and strategies related to conservation of wetlands for the Oregon Closed Basin, the Oregon portion of the Northern Great Bain. This plan has several key recommendations:

- Improve water delivery system to enhance efficiency and flexibility of irrigation and wetland management strategies.
- Protect at least an additional 10,000 acres through acquisition of lands from willing sellers.
- Improve passage and screening facilities to enhance the Blitzen River and tributaries for Great Basin redband trout and other native fishes.
- Use fishways, traps, and screens to limit common carp migration into the Blitzen River and Double-O Unit to enhance productivity of wetlands and other aquatic habitats.
- Enhance 30 miles of in-stream riparian habitat in the Blitzen River and tributaries for redband trout and other native fish and wildlife. Improve 40 miles of Blitzen River and Bridge Creek channels to restore more natural hydrology and improve water quality.
- Improve water management capabilities in 1,100 wetland acres of the Double-O Unit to allow better wetland management and carp control.
- Enhance wetlands by improving brood ponds to reduce predation on breeding waterfowl and waterbirds.
- Control invasive exotic plants on 30,000-40,000 acres and develop strategies to prevent future introductions.

## State Plans

***Oregon Conservation Strategy (OCS):*** This document, authored by the Oregon Department of Fish and Wildlife (ODFW 2006) is an overarching strategy for conserving fish and wildlife within Oregon. The Strategy identifies specific Conservation Opportunity Areas (COAs) where high-priority species and habitat conservation may be most efficiently addressed. The Harney-Malheur area is identified as COA No. NBR-08. Key habitats identified in the OCS for this COA include riparian and wetlands. The plan references conservation actions for these and other habitats included in other planning documents. Some of the plan’s conservation actions relate directly to the Refuge:

- Initiate actions to maintain alkaline wetland habitats in conservation status at the following locations: 20,000 acres (Harney Basin).
- Initiate actions to maintain emergent wetland habitats in conservation status at the following locations: 40,000 acres (Harney Basin).
- Initiate actions to maintain wet meadow habitats in conservation status at the following locations: 50,000 acres (Harney Basin); 10,000 acres (Silvies/Bear Valley); 20,000 acres (Malheur Refuge Headquarters).
- Initiate actions to maintain riparian shrub habitats in conservation status at the following locations: 2,000 acres (Harney Basin); 300 acres (Aldrich Mountains); 200 acres (Malheur Refuge Headquarters).
- Restore drainage; improve water management facilities; use fishways, traps, and screens to limit carp migration to enhance productivity of wetlands and other aquatic habitats: Malheur Lake, Harney Basin.
- Improve fish passage; for example, modify barriers or use spans where appropriate.

Nine mammals, 15 plants, three herptiles, eight invertebrates, 16 fish species, populations or segments, and 15 birds are listed as strategic (high priority) species in the OCS. Many of these species are found on Malheur Refuge.

***State Comprehensive Outdoor Recreation Plan:*** A detailed summary is provided in Chapter 5, Section 5.7.2

# 1.8 Special Designation Lands

## 1.8.1 Important Bird Areas

Malheur Refuge has been designated by the Audubon Society as an Important Bird Area (IBA). This program recognizes that habitat loss and fragmentation are the most serious threats facing populations of birds across America and around the world. An IBA is a site that provides essential habitat for one or more species of birds and that is recognized as being important on a global, continental, or state level. IBAs often support a significant proportion of the total population of one or more species. In the United States, the IBA program has become a key component of many bird conservation efforts, including Partners in Flight, North American Waterbird Conservation Plan, and the U.S. Shorebird Conservation Plan (Audubon 2011).

Malheur Refuge was selected and approved as an IBA for the following reasons (Audubon IBA 2008):

- It hosts 20 percent of the of the world's population of white-faced ibis.
- It has high densities of willow flycatchers.
- It has one of the highest Breeding Bird Survey counts for the watch-listed Brewer's sparrow.
- It supports breeding populations of watch-listed western snowy plover (400 individuals), long-billed curlew, Franklin's gull, short-eared owl, bobolink, and trumpeter swan.
- Significant populations of American white pelican, cinnamon teal, and redhead use the Refuge for breeding.
- It supports 20 percent of Oregon's breeding population of greater sandhill cranes.
- The Refuge supports breeding populations of Franklin's gulls, Forster's terns, Caspian terns, and black terns.
- Great blue herons and great egrets nest on the Refuge in scattered colonies.
- Post-breeding concentrations of ring-billed gulls sometimes reach 25,000 in August.
- Up to half of the world populations of Ross's geese pass through the area.
- A significant proportion of the total populations of green-winged teal, American wigeon, northern shoveler, northern pintail, canvasback, and ruddy duck pass through the Refuge.
- Hundreds of thousands of waterfowl (including up to 100,000 snow geese, 15,000 green-winged teal, 15,000 mallards, 250,000 northern pintail, 250,000 northern shovelers, 4,000 canvasbacks, 2,000 ring-necked ducks, 5,000 lesser scaup, and 50,000 ruddy ducks) pass through the Refuge during migration.
- Concentrations have been recorded of up to 25,000 western sandpipers, 350 pectoral sandpipers, 35,000 long-billed dowitchers, 15,000 Wilson's phalaropes, 15,000 American avocets, and 200 black-necked stilts.

## 1.8.2 Wilderness Status

There is no designated wilderness within Malheur Refuge. However, a wilderness review was conducted in conjunction with the CCP process as outlined in 602 FW 1 and 602 FW 3. The purpose of a wilderness review is to identify and, if appropriate, recommend for congressional designation National Wildlife Refuge System lands and waters that merit inclusion in the National Wilderness Preservation System.

The wilderness review process consists of three phases: wilderness inventory, wilderness study, and wilderness recommendation. Lands and waters that meet the minimum criteria for wilderness are identified in the inventory phase. These areas are called wilderness study areas (WSAs). WSAs are evaluated through the CCP process to determine their suitability for wilderness designation. In the study phase, a range of management alternatives are evaluated to determine if a WSA is suitable for wilderness designation or management under an alternate set of goals and objectives that do not involve wilderness designation. The recommendation phase consists of forwarding or reporting recommendations for wilderness designation from the Director through the Secretary of the Interior and the President to Congress in a wilderness study report.

Through this process, 10 units were defined for evaluation (see Appendix D) on the Refuge. The majority of Malheur Refuge is a highly altered wetland and upland system. The lands and waters have been significantly altered prior to and during Service ownership. The Refuge has actively managed these lands to meet the needs of wildlife species at both refuge and Pacific Flyway levels to enable the Refuge to meet its establishing purposes. The effects of management have included changes to the soils, flora, and fauna. Human-made developments abound in the form of an extensive road system; hundreds of miles of primary dikes, ditches, and fences; altered creeks and river; and thousands of water management structures.

Three units of the Refuge (Malheur Lake, Upper Bridge Creek/Knox Springs, and Barnes Springs) may potentially exhibit wilderness characteristics that are currently not present. Each of these areas is experiencing significant invasive species (plant and or animal) impacts that compromise the achievement of refuge purposes, the NWRS mission, and biological integrity, diversity, and environmental health.

In this inventory (Phase I), the Harney Lake Unit was found to meet the minimum wilderness criteria for size, naturalness, and outstanding opportunities for solitude and primitive/unconfined recreation. A total of 31,157 acres were found to have wilderness characteristics, which is 1,157 acres greater than an existing WSA proposed in 1969 that was never finalized (see Appendix D, Section D.1.4). Based on the findings in this inventory Harney Lake will be further evaluated in the wilderness study phase as a step-down process to the CCP.

## 1.8.3 Research Natural Areas

The Refuge manages two Research Natural Areas (RNAs): the Harney Lake RNA and the Stinking Lake RNA. RNAs are part of a Federal system of tracts protected for research and educational purposes. Each constitutes a site where natural features are preserved for scientific purposes and natural processes are allowed to dominate. The main purposes are to provide

1. baseline areas against which effects of human activities can be measured;
2. sites for study of natural processes in undisturbed ecosystems; and
3. gene pool preserves for all types of organisms, especially rare and endangered species.

According to the Standards and Policy Guidelines issued for RNAs (Dec. 1976 revision), an RNA is a unit in which natural conditions are maintained except when deliberate manipulation maintains the unique features of the site.

Refuge policy on RNAs (8 RM 10) addresses RNA management and stresses that RNAs must be reasonably protected from any influence that could alter or disrupt the characteristic phenomena for which the area was established. RNA policy encourages discontinuing recreational uses if these uses threaten serious impairment of research or education values. Vegetation management is permitted only where necessary to preserve vegetation, and must be documented in a plan approved by the Regional Director. Natural processes are stressed for wildlife population management.

The guiding principle in management of RNAs is to prevent unnatural encroachments (activities which directly or indirectly modify ecological processes on the tracts). Uncontrolled grazing is not allowed, nor is public use that threatens significant impairment of scientific or educational values. Management practices necessary for maintenance of the ecosystem may be allowed.

***Harney Lake Research Natural Area:*** The Harney Lake RNA was established in 1975 to "exemplify southeast Oregon alkaline lakes (playas) and associated vegetation and wildlife" (Copeland 1979). The RNA encompasses 30,000 acres and consists of the 28,000-acre lake itself and a 2,000-acre strip of land surrounding the lake (see Map 11). The lake is a vast body of very shallow water during wet periods and a vast alkali flat in dry periods. At the lowest elevation in the Harney Basin, the lake exceed 10 feet in depth during the flood of the mid-1980s.

The RNA includes habitat for snowy plovers, avocets, American white pelicans, terns, and migrating ducks and geese. Raptors, including golden and bald eagles, use the area at least seasonally. Among the animal species known or expected to use the RNA are 33 bird and 13 mammal species which were identified as species of concern in Oregon at the time the RNA was established. These include nesting golden eagles, prairie falcons, and snowy plovers. Mammals of special concern include the Malheur shrew, Merriam's shrew, and the northern grasshopper mouse.

Significant changes in substrate, alkalinity, and moisture occur over short distances on Harney Lake. These changes produce a complex, intergrading mosaic of plant communities, which can be broadly described as saltbush-greasewood, sagebrush steppe, and tule marshes. The lakebed is mostly devoid of vegetation; however, bulrush communities surround small springs on the southern and eastern portions of the lake.

***Stinking Lake Research Natural Area:*** The Stinking Lake RNA was established in 1975 to "preserve and example of a small, spring-fed alkaline lake in southeast Oregon and the associated high desert vegetation and wildlife" (Copeland and Greene 1982). Important natural features include a variety of salt desert plant communities, a permanent cold spring and associated wetlands, and a large number of birds and small mammals. The RNA encompasses 1,555 acres in the Double-O Unit of the Refuge (see Map 11). The cold spring on the west side of the lake and precipitation are the only sources of water. The lakebed encompasses 752 acres, but the actual lake surface varies with rainfall and flow volume from the spring. The lake is rimmed on three sides by rimrock and low dunes on the fourth side.

The Stinking Lake RNA is best known for large number of migratory shorebirds using the lake and shoreline. Thousands of American avocets, Wilson's phalaropes, willets, and western sandpipers rest and feed on flies on the saline flats. Certain birds (black-bellied plover, pectoral sandpiper, and dunlin) are rare elsewhere on the Refuge but can often be found at Stinking Lake. Among the animal species known or expected to use the RNA are 19 bird and 14 mammal species which were identified as species of concern in Oregon at the time the RNA was established. Two inhabitants of the spring waters, the speckled dace and a small crayfish, are worth mentioning. The dace appear to differ from other speckled dace in the area. The crayfish is a rare subspecies encountered occasionally in the Harney Basin and some parts of the Snake River drainage (Copeland and Greene 1982).

Vegetation in the RNA consists of salt desert plant communities (saltbush-greasewood, and sagebrush steppe) with small amounts of wetland vegetation (tule marshes) adjacent to the spring and big sagebrush on the rimrock. Along portions of the lakeshore and in highly alkaline areas the vegetation is dominated by alkali saltgrass or Nevada bulrush (Copeland and Greene 1982).

# 1.9 Planning Process and Issue Identification

## 1.9.1 Planning Process

A core planning team, consisting of the refuge project leader, deputy project leader, wildlife biologist, ecologist, public use planner, archaeologist, and a regional planner, began developing the CCP in 2009. The core planning team is identified in Appendix I.

***Collaborative Process:*** This CCP was also developed through a collaborative process in order to solicit and incorporate public input throughout all stages of plan development, as well as build support for its content and implementation.

An extended team (see Appendix I), comprising technical specialists versed in resource issues and key intergovernmental partners, assisted in CCP development and was invited to several workshops or consulted via e-mail and conference calls. These groups were particularly important in assisting with focal species selection, defining the ecological considerations and transitions (see Appendix L, Ecology Work Group) and in assisting in developing recommendations for carp assessment and treatment (the Aquatic Health Coalition). Members of the extended team also provided comments at key points in development of the CCP.

A variety of other organizations and individuals contributed to this CCP (see Appendix I). A series of interactive meetings to review key topics addressed in the CCP, review drafts of the CCP, and otherwise facilitate discussion between the Service and stakeholders, was chaired by the Oregon Consensus Program and the High Desert Partnership. Each collaborative meeting was attended by 30-40 participants, including technical experts, scientists, government agencies, conservation organizations, local and statewide residents, recreation groups, Tribal representatives, refuge visitors, and elected officials.

Technical working groups were created by the Service to serve as forums for specific complex resource issues. To address concerns about carp, the Aquatic Health Coalition was created to involve partners in strategizing effective methods for dealing with the carp issue, to leverage partner involvement and to secure funding. Three aquatic health working groups have been formed within the Coalition to develop strategies for carp population assessment, carp control on- and off-refuge, and partnership enhancement and funding opportunities. Participants include fish and wildlife biologists, researchers, subject matter experts and ecologists from various Federal and State agencies, nongovernmental organizations, and institutions.

To address issues of concern about invasive species and transitions of habitat types, the Refuge established the Ecology Work Group (Appendix L). Consisting of ecologists and wildlife biologists representing a broad assortment of organizations, this group is focusing on the development of habitat models that describe successional conditions and provide guidance in achieving specific plant-community objectives.

Early in the planning process, a review of numerous plans and assessments was completed (see Section 1.7). A comprehensive list of resources of concern was compiled based upon review of the plans referenced above, many of which highlight priority species or habitats for conservation. A workshop was held with the extended team to assist in further defining the list to focus on priority species, species groups, and communities of concern for the Refuge. The final Priority Resources of Concern list is located in Appendix E. Much of the biological emphasis of the CCP is focused on maintaining and restoring these priority resources.

Public use planning centered on developing goals, objectives, and strategies around the Big Six uses. Other non-wildlife-dependent uses that currently occur were also addressed.

Public scoping began in August 2009. Scoping meetings were held in several locations around the region and state. Public comments were also solicited through distribution of a planning update to the Refuge’s mailing list, refuge visitors, and other interested parties. A complete summary of public involvement is in Appendix J.

An internal draft was distributed to Service Region 1 reviewers and members of the extended team, collaborative group, and technical working groups including states and the Burns Paiute Tribe, in April 2011. All changes requested by those who reviewed the internal draft and the actual changes made were documented.

## 1.9.2 Key Issues Addressed in the CCP

An issue is defined as *a concern or problem; a matter that is in dispute; or a vital or unsettled matter* (Merriam-Webster 2011). The primary intent of a planning process is to make sound decisions and to better address problems and concerns. Thus a key component of the planning process is a structured definition of the issues (problems, concerns, opportunities) that lay before us in the current and future management of Malheur Refuge. Each of the issue statements that follow presents background information and is followed by key questions that we hope to resolve in the CCP.

This issue summary is a description of the main management issues facing Malheur Refuge. Issues were derived from discussions with staff, partners, other agencies, longtime refuge observers, and the public. Each of the issues is within the scope of the CCP and they are considered by the Service to be the major issues to address in the planning process:

- The importance of Malheur Refuge and the Silvies floodplain to migratory and breeding birds
- Invasive species, including common carp and perennial pepperweed
- Habitat and vegetation management

- Riverine conditions: geomorphology, hydrology, fisheries, and riparian habitat
- Water system infrastructure and water delivery
- Preserving the legacy of human and paleontological history at Malheur Refuge
- Visitor access, facilities, and information
- Providing quality wildlife observation, photography, interpretation, and environmental education
- Providing quality fishing and hunting opportunities
- Wilderness
- Collaboration

## The Importance of Malheur Refuge and the Silvies Floodplain to Migratory and Breeding Birds

***Waterfowl:*** Malheur Refuge and the Silvies floodplain support several priority waterfowl species as defined by the North American Waterfowl Management Plan, including tule and Pacific greater white-fronted goose, northern pintail, mallard, lesser scaup, snow goose, wood duck, redhead, canvasback, ring-necked duck, and American wigeon. The Refuge also supports breeding population of the Rocky Mountain Population trumpeter swans—a priority in the Pacific Flyway.

Historical data show that substantial numbers of these species may occur on the Refuge, varying with habitat conditions. For example, comparing peak refuge counts conducted in the 1980s and 1990s during spring and fall migration with annual Pacific Flyway midwinter population indices, the Refuge has supported up to

- 66 percent of the white goose population (spring 1996);
- 63 percent of the American wigeon population (fall 1993);
- 48 percent of the tundra swan population (in fall 1980 after carp control on Malheur Lake);
- 40 percent of the American green-winged teal population (fall 1993);
- 24 percent of the ruddy duck population (spring 1995);
- 22 percent of the northern shoveler population (fall 1993);
- 10 percent of the northern pintail population (spring 1996); and
- 5 percent of the mallard population (fall 1996).

Additionally, redhead and canvasback duck counts on the Refuge have exceeded the Pacific Flyway midwinter indices (328 percent for redheads in fall 1992 and 148 percent for canvasbacks in fall 1995). This is because the midwinter counts do not include Mexico, where substantial numbers of redheads and canvasbacks winter.

During spring migration, the Silvies River floodplain, which lies just north of the Refuge, supports high numbers of migrant waterfowl. A study conducted by the Service in the late 1970s and early 1980s found that 56 percent of the waterfowl use in the Harney Basin occurred on the private lands of the floodplain during the spring. Scientists from the U.S. Geological Survey (USGS) have documented the importance of such flood irrigated areas in southeastern Oregon and northeastern California; these areas support about 80 percent of the Pacific Flyway pintails during spring migration (Miller et al. 2010). Therefore, it is important for the Refuge to work with private partners on the floodplain with a goal of maintaining these flood irrigation values.

***Waterbirds:*** Malheur Refuge supports the highest number of breeding greater sandhill cranes of any refuge in the western United States. This species is a priority species in the Pacific Flyway and the Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006), and it is listed as a "sensitive" species in Oregon. A statewide crane pair survey in 2000 found 245 pairs on the Refuge, 21 percent of the Oregon population. An additional 78 pairs were recorded on the Silvies Floodplain (Ivey and Herziger 2001).

High numbers of colonial-nesting waterbirds have also been counted on the Refuge. The Refuge supports several colonial waterbird species identified as priority species in the Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006), including western and Clark's grebes, American white pelicans, California gulls, and Forester's terns. Comparing peak refuge counts of nesting waterbirds with population estimates for the Great Basin Bird Conservation Region, most colonial waterbird peak counts exceeded 10 percent of the regional population. Malheur Refuge supported 20,500 breeding white-faced ibises (35 percent of regional population in 1998); 7,782 breeding western and Clark's grebes (50 percent of the regional population in 1983); 4090 breeding American white pelicans (15 percent of the regional population in 1988); and 1,730 breeding great egrets (77 percent of the regional population in 1983).

***Shorebirds:*** Malheur Refuge supports several breeding and migrating shorebird species that are designated as high priority species in the Intermountain West Shorebird Plan. Priority breeding species include the snowy plover, long-billed curlew, American avocet, and black-necked stilt. Priority migrant species that are common at Malheur Refuge include the long-billed dowitcher, western and least sandpiper, and red-necked phalarope. Numbers of migrant shorebirds using the Refuge were estimated during the Malheur-Harney Basin Study from 1975-1984 (USFWS 1975-1984). Total shorebird numbers exceeded 20,000 during fall migration during most years, with a peak of over 41,000 in August 1975. Western sandpipers, long-billed dowitcher and Wilson's phalaropes tend to be the most abundant migrant species using the Refuge, each with peaks exceeding 15,000 birds. The numbers of migrant shorebirds at the Refuge qualifies the area as a Regional Western Hemispheric Shorebird Reserve, although the Refuge has not been designated as such.

***Landbirds:*** Oregon and Washington Partners in Flight identified priority landbird species in various habitats in the 2000 Columbia Plateau Bird Conservation Plan. Many of these priority species are found at Malheur Refuge. Malheur Refuge is known to support very high densities of nesting willow flycatchers and yellow warblers; both are priority riparian habitat associates. Other refuge priority riparian birds include Bullock's orioles and yellow-breasted chats. The Refuge also supports the largest local population of bobolinks in the western U.S. (a wet meadow–dependent species). Other priority species found in the uplands on the Refuge include loggerhead shrike, sage sparrow, sage thrasher, black-throated sparrow, lark sparrow, and Brewer's sparrow (all shrub-steppe dependent). The Refuge supports also burrowing owls, Swainson's hawks, and ferruginous hawks (upland associates).

## Key Questions for the CCP

- What are the trends in migratory and breeding bird populations over the last 20 years?
- What are the key factors affecting trends?
- What is the role that Malheur Refuge should assume in the larger region with respect to supporting migratory and breeding bird populations?

## Invasive Species, Including Common Carp and Perennial Pepperweed

***Common Carp:*** Common carp were apparent in refuge waters by the early 1950s. By the mid-1950s, carp were established in large numbers throughout the Refuge. Currently carp are found in Malheur, Mud, and Harney lakes; in refuge wetlands; and throughout large areas of the Silvies and Blitzen River systems. Carp compete directly with waterbirds for aquatic food. In addition, carp feed by disrupting the benthic environment, which causes water turbidity issues that further decrease the productivity of the aquatic environment. Decreases in habitat quality and productivity within lakes, ponds, and marshes have been observed since the introduction of carp into the system, where there has been an absence of effective population control.

Carp control methods have included drawdowns, rotenone, electroshocking, physical barriers, fish screens, traps, poison bait stations, and blasting. Rotenone can be very effective but has proven to be less than 100 percent effective. Any benefit is short-lived because all fish are not killed, the remaining fish have a high fecundity, and the interconnectedness of the waters in the Silvies River, Blitzen, and the Refuge's lakes provide a continual source of carp. Rotenone negatively affects native fishes, spotted frogs, and other wildlife.

Electroshocking has been very useful in controlling carp in dewatered ponds and canals, but like other methods of control, is not 100 percent effective. This treatment works well for small, specific areas.

The construction and/or repair of physical barriers have proven to be very effective in reducing carp impacts in wetlands. At Malheur Lake it will be necessary to consider barriers that do not degrade water quality and reduce connectivity (i.e., impede passage of native aquatic species).

***Noxious/Invasive Plants:*** The Refuge has been involved in weed control efforts for decades. Field management strategies incorporated the repression of Canada thistle through cultural practices such as haying as early as the 1950s. By the 1970s, the use of chemicals was commonplace for Canada thistle, perennial pepperweed, poison hemlock, and Russian knapweed. Biological control was used for the first time in 1982 in an attempt to control thistle.

Since that time, the list of noxious weeds that require attention within the Refuge has continued to grow. Those species that are listed as noxious by Harney County and are chemically treated on an annual basis include diffuse and Russian knapweeds, perennial pepperweed, puncture vine, Scotch thistle, medusahead rye, and white top. Individual salt cedar are occasionally discovered within the Refuge adjacent to Malheur and Harney Lakes and are eradicated immediately. Other nuisance species that are subject to control measures include Russian olive, reed canarygrass, common and hybrid cattail, and common reed.

Weeds and invasive species in upland habitats include medusahead, which has invaded shrublands on the southernmost portion of the Refuge (approximately 30 acres). Perennial pepperweed, Russian knapweed, and other invasive species occupy a large percentage of lowland shrub communities. In addition to these, common reed, reed canarygrass, and other undesirable weeds are expanding in marshes.

Effective control of invasive species is an important issue to many in the public, judging from the number of comments received on this topic during scoping.

## Key Questions for the CCP

- How could current management strategies be improved upon? Especially, what possible strategies could control carp in the lakes and rivers associated with the Refuge?
- What would the effects of any large-scale efforts be on habitats, wildlife, and other aquatic species?
- How does this issue interact with those pertaining to fish passage, wetland management, and the water delivery system?
- How can the management of water and emergent marsh and meadow habitats be modified to balance wildlife production goals while discouraging the encroachment of emergents and invasives such as reed canarygrass?
- Are more plant management options (such as prescribed grazing during the growing season) desirable as strategies for meeting desired structure and condition?

## Habitat and Vegetation Management

***Lacustrine (lakes) and Playa:*** Malheur Lake was once capable of annually producing over 100,000 ducks (Cornely 1982) and ranked as one of the most productive waterfowl areas in North America. The lake also once played a much more significant role in the Pacific Flyway for migratory birds. Fluctuating water supplies over time stimulated marsh productivity and provided a variety of habitats.

The negative impacts of common carp became noticeable in the early 1950s and the productivity of this system has been far from optimal since that time. As carp populations increase, submergent vegetation, aquatic invertebrates, and other food staples for waterfowl and other waterbirds began to decrease. (See previous issue discussion of invasive carp.)

The 30,000-acre Harney Lake RNA and the 1,555-acre Stinking Lake RNA were established in 1975. The Harney Lake RNA protects the alkali lakes and associated and unique vegetation and wildlife species; this RNA is mostly undisturbed, particularly in dune and hot springs areas. Important natural features of the Stinking Lake RNA include a variety of salt desert plain communities, a permanent cold spring, and an alkaline lake. Public entry into Malheur Refuge’s RNAs is by Special Use Permit only and must be for scientific research purposes.

Compared to other Refuge habitats, the lakes are not heavily manipulated, except by upstream diversion in the major watersheds. Malheur Lake has remnants of a dike system built primarily to protect farmed areas from high water on the north- central portion of the lake and to hold more water in the center of the lake where the best marsh habitat was (Cole Island).

***Palustrine Emergent (seasonally flooded wet meadows) and Dry Meadow:*** Seasonally wet meadows provide foraging, resting, and nesting habitat for a variety of waterbirds and waterfowl, such as the sandhill crane, white-faced ibis, cinnamon teal, mallard, and gadwall; shorebirds, such as the American avocet and black-necked stilt; and neotropical migrants, such as the bobolink. Meadows are optimally characterized by native grasses (e.g., spike bentgrass, American sloughgrass, Nevada bluegrass, creeping wildrye), sedges, rushes, and native forbs.

Meadows undergo a number of manipulations to ensure desired vegetation structure, including flood irrigation, prescribed fire, haying, and grazing. Generally, meadows are provided flood irrigation (inundations of 0 to 3 inches deep) annually, beginning in March and extending until July or August.

Other meadow treatments vary from year to year. The Refuge removes residual vegetation in treated meadows with prescribed fire, rake-bunch grazing, haying, and mowing to stimulate early season growth of meadow plant species and manage desirable levels of litter accumulation. Short, early growing vegetation provides high protein foods to support feeding, breeding, and brood-rearing ducks, cranes, geese, and shorebirds. Periodic removal of decadent litter has been demonstrated to enhance nesting conditions. Most meadow treatments require a period of drying, which can interfere with brood rearing for some species. Untreated (idle) meadows are allowed to rest with residual vegetation from the previous growing season left on-site. The residual vegetation provides escape and nesting cover for cranes, waterfowl, and waterbirds.

Managing plant species composition in meadows is difficult. Weeds, especially perennial pepperweed, are a serious problem, and are currently managed primarily with herbicides. Since some practices (haying and rake-bunch grazing) are currently implemented only after the growing season ends, they do not exert negative pressure on invasive species or encroaching native species. Some in the public continue to believe that grazing poses unacceptable threats to resources on National Wildlife Refuges, as evidenced by comments received during scoping. Some members of the public dislike the use of fences, believe that they cause harm to wildlife, and feel that they are not well maintained. Preliminary data from a pilot study involving selective, intensive grazing of perennial pepperweed by sheep on the Refuge have suggested that this could be an effective treatment option.

Some observers believe that refuge meadow habitats are experiencing serious encroachment from emergents such as cattail. Some units have been managed as idle with fairly constant hydrology due to a lack of interior fences or inability to fine-tune water placement. In some areas the plant community has shifted from grasses toward emergents, thus reducing habitat diversity. Reversing this trend has proven difficult.

***Palustrine Emergent (seasonally flooded marsh associated with wet meadows):*** Marshes ideally provide emergent nesting cover and limited open-water feeding areas for waterfowl and marsh birds. This habitat is generally located adjacent to ponds and experiences shallower flooding depths. Water depths range from 6 inches to 3 feet and flooding typically occurs from late winter/early spring through July. Marshes are used by overwater nesters, such as sandhill crane, rails, and redheads; provide escape cover for waterfowl broods, particularly late-season nesters, such as gadwall, redhead, and grebes; and provide habitat for other species, such as amphibians. Water depths may range to 4 feet.

Open water areas should make up 20-40 percent of this habitat and host a diversity of submergent plant species such as sago pondweed. This is difficult to maintain. Cattail, an emergent, has a high tolerance of water level fluctuations and higher pH soils and forms large acreages in some places. Common strategies used on the Refuge to set back succession include flooding, drawdown, and mowing. Disking, herbicides, and prescribed fire also assist in achieving the desired ratio and in managing litter.

Emergent marsh management is closely linked with the management of adjacent meadows. It is often necessary to fully irrigate meadows in order to maintain desired pond levels, resulting in emergent encroachment into adjoining meadow systems.

***Palustrine Open Water/Emergent (semipermanently flooded wetland impoundments):*** Ponds and associated vegetation are semipermanently flooded and provide food resources for brooding diving and dabbling ducks and support sandhill crane roosting and nesting. Emergent plants provide nesting and escape cover for broods and molting adults.

Fire and herbicides are used to manage for the targeted emergent-to-open-water ratio of 50:50. Drawdowns and disking provide opportunities for growth of smartweed, other moist soil plant species, and submergents. Infrastructure improvements have assisted in carp control and water management. Carp removal is also critical, to enable submergent plants to grow in undisturbed substrates and nonturbid water. To eliminate carp, we often dry up ponds, but this is not a completely effective management tool, as carp have shown a tenacious resistance to eradication in these habitats. Infrastructure improvements have assisted in carp control and water management.

Maintaining pond water levels through summer can be difficult, particularly in the Blitzen River units because of insufficient water supply. Even where late summer diversions are feasible, they can result in reductions in flow that are unacceptable for native aquatic species. Dikes surrounding ponds support predators, such as raccoon and mink, which prey on young waterfowl, cranes, and other waterbirds. Larger impoundments tend to promote higher brood survival.

***Uplands (salt desert scrub, sagebrush lowland, sagebrush steppe, and dunes):*** Upland habitats include sagebrush steppe, salt desert scrub, dune, and sagebrush lowland. They provide habitat for ground nesting migratory birds, landbirds, and a diverse variety of mammals. Observers have noted a decrease in native forbs and grasses throughout these habitat types, as well as western juniper encroachment in shrublands on the southwest side of the Blitzen Valley. However, juniper cutting is not supported by many in the public, as evidenced by comments received during scoping. Crested wheatgrass was seeded on the Refuge following wildfires in the 1970s and 1980s. While successful in preventing establishment of cheatgrass, crested wheatgrass has hindered the re-establishment of native shrub, grass, and forb species in most areas.

***Cropland:*** The Refuge annually plants 70-100 acres of winter wheat, rye, oats, and spring barley, to support greater sandhill cranes during fall staging. Past Flyway plans stressed retaining cranes on the Refuge as late as possible to reduce mortality in California’s Central Valley after migration. Planted grains complement wetland foods, especially after the ground freezes. Deer, pheasants, geese, and dabbling ducks also use croplands.

The dryland farming program encounters various operational issues such as controlling weeds, ensuring successful seed establishment, preventing soil compaction from equipment, and managing yield variability.

## Key Questions for the CCP

- How much area should be maintained in each habitat type and what are the desired structures and plant compositions to best support the diversity of species using these habitats? What should the interspersion of these habitats be and at what scale should we achieve target conditions?
- Should the Refuge prioritize maintenance or restoration of some habitats over others? How would such prioritization play out, including consideration of broader issues such as invasive species, fisheries, water quality, climate change, and visitor experiences?
- What kinds of management tools should be used, and when, and where, considering effectiveness, efficiency, compatibility with refuge purposes, and minimizing negative consequences? What modifications should be made to current management tools?

- Is the Refuge currently meeting crane, duck, and waterbird production goals? What is our past record? What limiting factors may be preventing achievement of these goals?
- Considering the needs of priority wildlife species and groups, how should we balance habitat management practices (flood irrigation, haying and grazing, burning, herbicide application, predation management, etc.)? What kinds of timing considerations are necessary to prevent nesting season or migration conflicts, to work effectively with plant growing seasons, and to fit in with water rights, variable water supply, and other issues?
- To what extent can manipulated habitats in the Blitzen Valley and Double-O Unit be shifted to Malheur Lake? How would this change the habitat mix and management opportunities in these areas?
- What research opportunities should be pursued?

## Riverine Condition: Hydrology, Geomorphology, Riparian Habitat, and Fisheries

The value of the Refuge’s migratory bird habitat is currently dependent on the availability and management of water resources. Management of the Blitzen Valley and the Double-O units is critical for meeting the Refuge’s purposes because of their high values to migratory birds. In these areas, there is sufficient water and infrastructure to provide the necessary habitats.

***Hydrology:*** The Blitzen River begins on Steens Mountain and flows north through the Blitzen Valley into Malheur Lake, joined by other tributaries originating on Steens Mountain as it flows northward. A system of dikes, canals, drains, and water control structures was developed beginning in the late 1880s to facilitate grazing and farming. Between 1907 and 1913, 17.5 miles of the river were channelized and straightened. The Blitzen River was also diked and deepened and more than 50 miles of secondary river channels were excluded from riverine hydrology. Portions of this water distribution system still exist and are used to manage water in the Blitzen Valley. Additional dikes, canals, drains and water control structures were added between 1935 and 1942 by the Civilian Conservation Corps (CCC). The area represents the most intensively managed and most productive habitat on the entire Refuge. On the Double-O Unit, water comes from large springs along the southwest margin of the basin and from Silver Creek to the northwest. The Double-O springs have water control infrastructure adequate to provide approximately 6,000 acres of wetland and marsh habitat. Silver Creek provides irrigation to the remaining 3,000 acres of wet meadow habitat but is only available in years of above-normal water conditions.

***Geomorphology:*** The Blitzen River has a variety of physical conditions including a deep, wide channel; limited willows; steep, bare banks; few deep holes; and minimal habitat complexity. Connectivity between the river and its floodplain is limited in many areas. This could be a function of anthropogenic factors, such as water withdrawals, channelization, substrate trapped behind upstream dams, flood management, and historic grazing practices. For many reaches of the Blitzen River and its tributaries, the predevelopment hydrology is not fully understood.

***Riparian Habitat:*** The Refuge contains riparian habitat along the Blitzen River, its tributaries, ditches and canals, and remnant traces of previously active sloughs in the Blitzen Valley, as well as a few patches in the Double-O Unit. The south Blitzen Valley also supports extensive stands of willow associated with irrigated meadows, and these stands are very important for riparian landbirds. Smaller stands of willow are associated with wet meadows and seasonal wetlands in the north Blitzen Valley and the Double-O. Since major reductions in livestock grazing occurred during the 1970s, riparian habitats have increased and expanded, especially in the south Blitzen Valley. Although riparian development is hampered in many areas due to the floodplain isolation related to geomorphologic factors described above, the condition of the Refuge's riparian habitat is generally good. There is much diversity in the plant communities along the Blitzen River, its tributaries, and the East Canal. In other portions of the Refuge, diverting water for irrigation or incision of stream banks has lowered the water table; this has prevented riparian species from re-establishing.

Various efforts, including fence exclosures, vegetation management, plantings, and in-stream weir placement, have been undertaken in the last decade on the Blitzen River and its tributaries. On Bridge and Mud creeks these efforts have markedly improved riparian and riparian habitats. The Blitzen River, however, is deeply incised and channelized in many areas and vegetative restoration has proved difficult. Weirs placed in the Blitzen River were intended to improve riparian habitats, but their overall effectiveness needs to be thoroughly evaluated.

***Fisheries Habitat/In-stream Flows:*** The Refuge has an interim agreement with ODFW to maintain minimum in-stream flows for native fish and other aquatic species. The Refuge currently tries to maintain a minimum flow of approximately 25 cubic feet per second (cfs) in the Blitzen River.

The Refuge has a permit for a winter water right (October 1 through March 1), which designates bypass flows ranging from 43 cfs to 54 cfs depending upon the time of year. The Refuge and ODFW are nearing completion of a 1D Phabsim model that will provide an objective basis for year-round in-stream flow targets. The Refuge has pending transfers before the Oregon Water Resources Department to change the existing irrigation water rights to a different purpose—wildlife refuge management. This will provide significant flexibility in how, where, and when the Refuge could apply its water so that it is most beneficial for wildlife and habitat management.

In the Double-O Unit, the Refuge has senior irrigation water rights that are seldom served because of water availability and infrastructure issues. The large spring water resources of the Double-O Unit are effectively used for irrigation and pond management.

Denil-style fish ladders were installed on three dams on the Blitzen River in the late 1990s and at two in-line structures on canals. Studies by Anderson (2009) revealed substantial delays at the old ladders and denils. New fish passage and screening at the dams began to be addressed in 2010 through projects funded by the American Recovery and Reinvestment Act. Upgraded or new screening of diversions for fish began to take place in the late 1990s and continues as funding becomes available.

***Water Quality:*** Refuge practices to manage water and migratory bird habitat have the potential to adversely impact water quality. Irrigation and water management on the Refuge may decrease in-stream flows, exacerbate high water temperatures, reduce dissolved oxygen concentration, increase turbidity, increase nutrient loading, and degrade fish habitat. Nutrients, fecal coliforms, and other pathogens may enter the Blitzen River via irrigation return flows, drawdowns, and overland flow, decreasing water quality.

The Blitzen River, Krumbo Creek, Bridge Creek and Canal, and Mud Creek currently are 303(d) listed with impaired water quality. Temperature is an impaired parameter for all of these segments and most others do not meet the regulatory standards for flow modification, sedimentation, pH, DO, and phosphate-phosphorus. Some of these water quality issues can only be addressed at a larger watershed scale, such as the Blitzen River, which is already impeded prior to flowing onto the Refuge by elevated water temperatures and low DO in the upper Blitzen River. At this point there is no total maximum daily load (TMDL) for the Blitzen system. In 2006, the Oregon Department of

Environmental Quality (ODEQ) specified a target date of 2010 for starting this TMDL. However, the current ODEQ website indicates that this has not occurred.

Best management practices (BMPs) currently underway to improve water quality include riparian plantings, fence exclosures for cattle, carp control in wetlands, and management of surface return flows when meadow and wetland habitats are being drained. Slower drawdowns in wetlands may reduce turbidity or surface return flows to the river; however, these increase salinity levels and temperature that can affect the biotic composition of meadows, marshes, and wetlands.

## Key Questions for the CCP

- How should the Refuge work with cooperating agencies, neighbors, and regulators to implement the BMPs that will further address water quality issues?
- Is river and riparian management sufficient for sustaining or enhancing populations of priority fish species? How could the Refuge enhance its management of aquatic resources including native fishes?
- How should we approach riparian restoration on the Refuge? What are feasible strategies that complement site potential?
- How should the Refuge balance in-stream restoration of the upper Blitzen River with water management in Blitzen Valley?
- What role will climate change play in the future condition and management of these habitats? What parameters should be monitored and assessed?
- What role do the Refuge's water rights play in the management of these habitats?
- How much, if at all, has prior/current management altered this system (e.g., soil characteristics, gravel, sediment distribution, channel form, erosion rates, connectivity, riparian vegetation)? What assessments and tools are necessary to evaluate trade-offs among management strategies so that sustainable approaches for both aquatic and terrestrial habitats can be developed?
- Are life histories of priority aquatic species sufficiently understood to inform management decisions?
- What are the objectives for establishing in-stream flow targets, and what actions can be taken to determine whether attaining targets are having desired effects?

## Water System Infrastructure and Delivery

The water delivery system operates by stacking water behind six dams on the Blitzen River. The water is diverted (mainly during spring and early summer) via canals, ditches, and feeder ditches to flood-irrigate a number of meadows and wetlands before returning to the Blitzen River as irrigation return flows, surface sheet flow, or subsurface percolation.

The existing flow-through delivery system is thought to mimic the natural flooding regime during peak flow events associated with spring runoff (mid-April through late May), but relies on an enormous system of ditches, water control structures, culverts, dikes, spreaders, and other structures the remainder of the year. Costs associated with maintaining this system are high.

Generally speaking, the system lacks the capacity to independently flood or draw down individual wetlands, marshes, or meadows. The irrigation system is only capable of managing fields at a gross scale (typically 1,000+ acres). The system's inefficiency and sheer size makes it difficult to maintain desirable meadow and wetland water levels at key points in time for breeding waterfowl and sandhill cranes. For instance, keeping brood water in meadows until August for cranes requires the Refuge to divert a large volume of water during a low-flow period to keep ditches charged. Water infrastructure also limits site-specific habitat management efforts such as disking, mowing, haying, and invasive species control.

Ditches require clear passage to move water efficiently; however, riparian plants and beavers regularly create clogs in the system. Past ditch cleaning with an excavator has exacerbated the system's inefficiency by deepening delivery ditches. Chemical control of vegetation is expensive and raises concerns about effects on habitats.

### Key Questions for the CCP

- What opportunities and constraints does the existing water delivery system provide for wildlife and habitat management? How can we improve its efficiency and increase our effectiveness in meeting desired habitat and population outcomes?
- Are more efficient or "river-friendly" water management practices complementary or in conflict with wildlife management objectives for marshes, ponds, and meadows? If there is tension between the two, how could this be resolved?
- What are the best methods for cleaning ditches from the standpoint of effectiveness, cost, and environmental health?
- What changes could be made to the water delivery system to improve water quality?
- Should the practice of removing woody vegetation along key water ways (dikes and canals) continue to maximize efficiency for water delivery?
- Would a water budget assist in guiding operation of the water delivery system and assist in evaluating management options?
- What tools exist (or are needed) to evaluate options to benefit both river and wildlife management objectives?

### Preserving the Legacy of Human and Paleontological History at Malheur Refuge

Archaeological data indicate that humans have lived in and around Malheur Refuge for over 9,800 years. Although less than 30 percent of the Refuge has been formally surveyed, over 300 sites have been recorded on the Refuge and are widely distributed across the landscape. These sites include lithic scatters, summer villages, burials, rock shelters, winter villages, rock art, traditional cultural properties, hunting blinds, and vision quest sites. Two precontact sites have been listed on the National Register of Historic Places (NRHP) for their scientific value.

The modern descendants of the early inhabitants of the Refuge are members of the Burns Paiute Tribe. The precontact sites, as well as traditionally collected plants and animals, at Malheur Refuge continue to be important to the Tribe.

Three historic ranches (P Ranch, Sod House Ranch, and the Double-O Ranch), dating from the early Euro-American ranching and homesteading period, are also present on the Refuge and are listed on the NRHP. Historic sites that date back to the 1870s are generally located near reliable water sources or are associated with livestock grazing. A number of buildings and features constructed between 1935 and 1942 by the CCC are located on the Refuge and are eligible for listing on the NRHP. Four CCC-constructed lookout towers have been listed on the National Historic Lookout Register.

The paleontological resources at Malheur Refuge have not been investigated in detail. Camel vertebrae fossils have been found on the Refuge in Pleistocene (2.6 million to 11,700 years ago) volcanic ash deposits. Beyond this very little is known about the significance or educational potential of the site or others that the Refuge may contain. The Paleontological Resources Preservation Act (PRPA; P.L. 111-011) directs the Secretary of the Interior to manage and protect paleontological resources on Federal lands, including inventory, monitoring, and scientific and educational use of paleontological resources.

Because they are not renewable and are often subtle, fragile, and easily damaged, cultural and paleontological resources are quite vulnerable to weathering, destruction, degradation, or looting. The Refuge System's vision document, *Fulfilling the Promise*, illustrates that cultural resources are more than merely a legal responsibility. They represent a trust resource, a recreational destination, and perhaps most importantly, a tool for education and a mechanism for inspiring support for the Refuge System. A cross-section of the American experience is available at Malheur Refuge, from the first peoples subsisting on the same marsh and riverine resources of concern today, to the earliest pioneers, settling in a harsh and uncertain landscape. The legacy of the pioneering conservationists and the epic experiment in mass employment that was the CCC are also contained at the Refuge. These stories of the past enrich the visitor experience and support community pride. There is an opportunity to better understand and interpret lithic scatters, the role of rock art, the use of chert quarries, activities at winter villages, the evolution of hunting technology, and the overall use of the landscape around the Refuge.

Ground disturbance creates potential for impacts to cultural and paleontological resources. Habitat management tools, including flood irrigation, ditch maintenance, disking, prescribed fire, herbicide use, grazing, planting, and riverine restoration, can involve ground disturbance from access and movement of equipment in addition to the actual activity. Any of these activities has the potential to adversely impact such resources. When these resources have not been completely inventoried (as is the case at the Refuge), understanding adverse impacts is more difficult; knowing what is present is the first step in knowing what could be affected.

Recreational use of the Refuge can inadvertently hasten the demise of cultural or paleontological resources. Recreational use also creates opportunities for looters, especially in more remote areas.

A number of information or research needs related to cultural resource and paleontological management have been identified, including a field inventory in places sustaining or proposed for high public use; an inventory and assessment of stabilization and restoration needs for historic sites; a model identifying the sensitivity of various habitat types for the presence of cultural resources; a museum plan; and a paleontology inventory.

### Key Questions for the CCP

- What sort of educational and interpretive messages and experiences should be provided, on-site or off-refuge, to provide residents and visitors the unique perspective of archaeology and history at Malheur Refuge?
- In the absence of a 100 percent inventory, which areas are likely to be most sensitive or contain the most significant precontact sites? Should recreational use in these areas be restricted? If not, which strategies would be most effective in preventing looting and destruction of cultural resources?

- What criteria should we establish to help us determine if a site is significant, and how should management activities adjust?
- How should we balance the continued administrative use of historic sites, including headquarters, dikes, roads, maintenance, and upgrades, with the historic features of the site?

## Visitor Access, Facilities, and Information

Malheur Refuge receives visitors from across North America and the world. Nearly half of refuge visitors come from out of state. Nearly all visitors stay more than one day. Various independent groups organize regular trips to Malheur Refuge, especially during the spring. The Refuge is also a partner for the John Scharff Migratory Bird Festival each spring and is a stop for organized tours and independent visitors during the festival weekend. Malheur Refuge is a destination refuge, with attendant concerns, opportunities, and responsibilities.

A visitor center, staffed by trained volunteers, is located at Refuge Headquarters, and is open weekdays, as well as on the weekends during the spring, summer, and fall. Other visitor information is provided through the refuge website, local tourism information outlets and lodgings, directional and entry signs, and orientation maps and brochures at selected locations on the Refuge.

Currently access is mostly provided and promoted in the Blitzen Valley Unit. Public access to the Double-O Unit has not been encouraged or emphasized, although a gravel county road runs through the unit and the area is identified on refuge maps.

Up until the late 1980s, dike tops, management roads, and some other areas were open to public access outside of the breeding and nesting season. The Refuge’s adoption of the concept of minimal disturbance in the 1990s resulted in restrictions in such access. Currently the public can use public roads, trails, and viewing facilities at any time of year, or areas specifically designated for fishing or hunting during those seasons. Occasionally, access into closed areas is made available to tour groups (such as during the John Scharff Migratory Bird Festival) with advance permission and Special Use Permits. Some members of the public have expressed the desire to have access more widely available on the Refuge, to provide a greater diversity of viewing experiences. There is concern from others that additional access may disturb wildlife or jeopardize the preservation of cultural resources.

## Key Questions for the CCP

- Are marketing efforts and communications reaching current and potential visitors?
- Are brochures, signs, and maps clear and easily located throughout the Refuge’s units? Do visitors understand when they are on Malheur Refuge?
- Should additional visitor access be provided in areas currently closed, for example, allowing access for wildlife observation and photography on or adjacent to Malheur Lake?
- Which aspects of previous facilities planning should be revived, implemented, and funded?
- What is the best way to regulate and manage the occasional use of the Refuge by commercial groups?
- Where and how should the Refuge provide additional access opportunities for people with disabilities?

### Providing Quality Wildlife Observation, Photography, Interpretation and Environmental Education

***Wildlife Observation and Photography:*** The most popular activity on the Refuge is wildlife observation and photography, especially in the spring and fall. Key sites are located in the Blitzen Valley, along the 42-mile auto tour route reaching from Refuge Headquarters, with its views of Malheur Lake, down to Page Springs and Frenchglen at the foot of Steens Mountain.

Birders are often quite interested in unusual or rare birds, especially passerines (perching birds or songbirds), which tend to congregate in areas with large trees and shrubby undergrowth. Malheur Refuge Headquarters and Benson Pond are favorite spots for such sightings and the appropriate vegetation management needed to draw in such species is of acute interest to many birders. Many scoping comments were received on this topic. Since some of the favored trees and shrubs used by these passerines are non-native or invasive, a decision should be made about where and how much of this kind of vegetation to maintain or promote.

In addition to the sites mentioned above, eight foot-trails are available on the Refuge, including a cross-state trail known as the Desert Trail. This trail is not maintained, and route layout and connections are poorly understood. Very few people use this trail for long-distance backpacking.

A Basin and Range “Birding Trail” has been proposed, to link the Refuge and other Great Basin birding sites. In concept, this type of trail will be supported by a map and make use of existing roads and facilities.

***Environmental Education:*** The environmental education program at Malheur Refuge is a small staff- and volunteer-led program. At this time, no indoor facilities at Refuge Headquarters are available for this program. Limited transportation funds and staff time constrain program offerings. Environmental education activities are often focused on visitors and families participating in events such as the John Scharff Migratory Bird Festival, Free Fishing Day, and others.

***Interpretation:*** Most of the Refuge’s interpretive stops are located along the Center Patrol Road, or Highway 205 (a State-designated Scenic Byway). Interpretative materials are also associated with historic sites and found at Refuge Headquarters. Interpretation emphasis has been on signs, brochures, and web information. On-refuge and off-refuge presentations for Malheur Refuge are limited.

A number of previous planning efforts (some interagency) identified interpretative needs and proposed various facilities on and around the Refuge. Lack of funding has limited implementation of these plans. It is important to review the good ideas and the barriers to implementing these interpretive ideas, as well as considering new venues that incorporate technology into the interpretive experience.

## Key Questions for the CCP

- Do current facilities, programs, and habitat management practices adequately support quality experiences in wildlife observation, photography, interpretation, and environmental education, and are they compatible with refuge purposes? In what ways can these programs be more effective?

- Are current trail offerings sufficient? Is maintaining the Desert Trail in alignment with other refuge objectives?
- What audiences should program offerings and facilities efforts be focused on? Novices? Advanced birders? Local students? Age groups? What balance of on- and off-site programming is desirable?
- How should the Refuge use partnerships to leverage and extend limited resources in these programs?
- What opportunities are available to directly connect children with nature?
- What additional visitor facilities should be developed, if any?
- In what ways can the Refuge improve its communication and coordination with visiting wildlife viewing groups at Malheur Refuge and with other partners?
- Are key messages supported by interpretive offerings and educational curricula? What are the perceptions and take home messages absorbed by new visitors, repeat visitors, and tour participants?

## Providing Quality Fishing and Hunting Opportunities

***Hunting:*** An estimated 1,400 hunters recreate on the Refuge each year. Hunting is the only “dispersed” recreational use on the Refuge, where hunters are permitted to wander cross-country within designated hunting units. The main issues identified with the hunting program include lack of opportunity, road access, and regulatory consistency.

Waterfowl hunting is provided on the north side of Malheur Lake, but hunting success and participation have declined sharply since carp became established in the lake. Access to this unit varies significantly from year to year due to fluctuating water levels.

Pheasant hunting occurs in the Buena Vista Unit and is a popular opportunity, partly due to the fact that off-refuge pheasant hunting opportunities are limited in the surrounding area. Special regulations are in effect in the unit to reduce conflicts with greater sandhill cranes during fall staging.

Hunters may take a wide variety of game in the Boundary Hunt Unit, including waterfowl, upland game, big game, coyotes, etc. The hunt unit covers the narrow western border of the Refuge west of Highway 205 and south of Foster Flat Road, and includes some land southeast of Krumbo Reservoir. The refuge boundary is not well marked along its shared boundary with BLM and follows rimrock in many areas; hence, this hunt unit is managed consistent with regulations used on BLM lands. The hunt is primitive with no designated facilities. Above Krumbo Reservoir, access is gained from Diamond Lane at Moon Hill Road and the condition of the road is poor.

***Fishing:*** Two separate fishing areas are open for fishing opportunities on the Refuge: Krumbo Reservoir and the south fishing loop, which encompasses a portion of the Blitzen River, the East Canal, and Bridge and Mud creeks.

Krumbo Reservoir was originally developed as a water storage area. Warm water fish, including crappie and large-mouthed bass were introduced several decades ago; large-mouthed bass remain, but are not actively managed for. Non-native rainbow trout have been stocked for many decades. ODFW stocks the reservoir annually with sterile rainbow trout. This program is technically out of compliance with Service policy, which prohibits stocking of non-native species. A small population of non-sterile rainbow trout that remains from historic plantings spawns in Krumbo Creek.

The reservoir provides a reliable fishing opportunity in Harney County and is very popular with local residents. Bank and boat fishing (with nonmotorized boats or electric motors) are allowed. The reservoir and adjacent lands are closed to all public access outside of the designated fishing season to minimize wildlife conflicts.

The south fishing loop is open year-round for a native redband trout fishery. Special regulations are in effect in this area. This area is a popular fly fishing area with local residents and out-of-area anglers.

East Canal, part of the south loop, is a popular fishing area. East Canal was formerly open for vehicular access. It was changed to hike-in only access in the late 1990s, which some members of the public believe unnecessarily restricts access.

Carp have successfully established in the river and canal system and have severely reduced and impacted the aquatic habitat. The redband trout fishery may directly benefit from Refuge efforts to control carp populations.

### Key Questions for the CCP

- Does the current array of hunting and fishing opportunities meet demand from a diverse set of consumptive recreationists and provide high-quality experiences, compatible with Refuge purposes?
- Is there a need for additional waterfowl, big game, upland game, or non-game (i.e., coyote) hunting areas?
- Are restrictions to avoid conflicts with natural and cultural resources adequate?
- How can access concerns and problems be best dealt with?
- Is transitioning from a stocked non-native rainbow fishery to a stocked redband fishery in Krumbo Reservoir a reasonable alternative to consider in the CCP?
- What modifications to the program might improve fishery or game populations and improve the experience for visitors?
- Is the use of live bait a concern?
- Should a recreational carp fishery be provided? Are there opportunities for recreational carp fishing outside the south fishing loop?
- Are native redband trout present in Krumbo Creek? If so, could the population establish a fishery in the reservoir?
- Is there evidence that fertile non-native rainbow trout in Krumbo Reservoir are affecting redband trout in the Blitzen River basin?

### Wilderness

Harney Lake was previously recommended for wilderness designation, but the recommendation was neither completed nor terminated. All refuges undertake new wilderness reviews as a part of the CCP process.

### Key Questions for the CCP

- Which areas qualify as wilderness study areas? How would management and use of any potentially eligible refuge areas be affected by wilderness designation?

### Collaboration

Involving the public in major refuge decisions and working successfully with partners to increase effectiveness have been recent emphases for the Refuge. Several resource issues, such as effective control of invasive or habitat restoration, cannot be effectively addressed without awareness of and attention to landscape level conditions. Refuge actions in the areas of habitat management and water rights are other areas where larger communities are affected. The need for collaboration and outreach has been a message the Refuge has consistently received from diverse interests both prior to and during scoping. The Refuge has a need to ensure that key stakeholders understand, support, and are involved in a meaningful and productive manner throughout the planning process.

Effective collaboration creates an opportunity for the Refuge to engage the diverse public in constructive dialogue that seeks agreement on key issues. This process will enhance relationships between the Refuge and stakeholders and among the stakeholders themselves. These relationships will enable the Refuge to address challenges in a more efficient and comprehensive manner.

## 1.9.3 Issues outside the Scope of the CCP

The following issues were raised by the public and not addressed in the CCP:

- The need for pullouts for bird watchers along State and County roads.
- Issues related to the placement of transmission lines over or adjacent to the Refuge in conjunction with the development of alternative power projects on Steens Mountain (seehttp://www.blm.gov/or/districts/burns/plans/steen_trans/index.php).
- Use of the Silvies River floodplain for agricultural purposes and without an emphasis on wildlife uses.

# 1.10 Refuge Vision and Goals

## 1.10.1 Refuge Vision

*Together with our surrounding community, partners, friends, staff, and all those who cherish this unique place where desert and water meet:*

Malheur National Wildlife Refuge commits to care for, conserve, and enhance the health of the Malheur Lake, Blitzen Valley, and Double-O units, including the playas, dunes, marshes, rivers, meadows, and ponds that are all part of this landscape.

We will observe nature and manage in harmony with ecological forces, while recognizing and maintaining the Refuge as a key anchor for migratory and breeding waterfowl, waterbirds, shorebirds, songbirds, and raptors.

We will work diligently to improve the health of the land and water, reducing the destructive impact of carp and other invasive species, addressing imbalances in floodplain function, and restoring the original abundance of fish and wildlife for which Malheur Refuge is famous.

We will celebrate and welcome our visitors, noting and protecting the features that draw people again and again—the expansive landscape, the plenitude and diversity of wildlife, and the signs of a timeless history.

We will allow and enhance opportunities to experience abundance, solitude, and renewal, for people birding, fishing, hunting, and learning on the Refuge. In respect to our ancestors and their fortitude, we will carefully preserve the legacies they left behind on this land.

Collaboration with our neighbors, partners, and friends will be a critical cornerstone in our day-to-day work; we recognize that nature crosses boundaries and we can be successful only in partnership. We recognize that our activities are inextricably linked to the health of the local economy. We commit to environmental stewardship and sustainable management. We commit to learn from our efforts, successes, and failures; to be humble about what we know; and to continuously strive for greater understanding in our stewardship of this remarkable place.

## 1.10.2 Refuge Goals

The Service defines a goal as a "descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose, but does not define measurable units" (602 FW 1). Refuge goals are a means to achieving refuge purposes. Goals translate into one or more objectives that define these conditions in measurable terms. A well-written goal directs work toward achieving a refuge's vision and ultimately, the purposes of a refuge. Collectively, a set of goals is a framework within which to make decisions. This CCP defines 14 goals for the Malheur Refuge.

GOAL 1. Enhance aquatic health and habitat conditions essential to the conservation of the flora and fauna that depend on Malheur Lake and associated water bodies.

GOAL 2. Protect, maintain, and rehabilitate riverine and riparian habitats to conditions essential for the conservation of native fish and wildlife species.

GOAL 3. Protect, maintain, and rehabilitate riparian habitats to conditions essential for the conservation of wildlife species.

GOAL 4. Enhance, protect, and/or maintain primary habitats essential to the conservation of a diversity of aquatic and terrestrial wildlife species.

GOAL 5. Enhance and maintain rare and unique habitats.

GOAL 6. Welcome visitors and offer them a safe experience of the Refuge's outstanding features: diversity of wildlife, signs of earlier inhabitants, scenic landscapes, and solitude. As a result, visitors will leave the Refuge with a memorable experience that fosters a connection between themselves and nature and with an appreciation of Malheur Refuge's unique resources.

GOAL 7. Connect the hearts and minds of visitors with the places and resources the Refuge protects, and enlighten visitors' experiences with an understanding of, appreciation for, and knowledge about historic and natural resources, and the importance of conservation and stewardship.

GOAL 8. Provide reasonable challenges and opportunities, and provide uncrowded conditions for the hunting and fishing public.

GOAL 9. Initiate and nurture relationships to build support for the Refuge, and fortify refuge programs and activities to achieve the Refuge's purpose and goals.

GOAL 10. Manage prehistoric and historic cultural resources for their educational, scientific, and cultural values for the benefit of present and future generations of refuge users and for the communities that are connected to these resources.

GOAL 11. Identify and protect prehistoric and historic resources on the Refuge that are eligible for or listed on the National Register of Historic Places.

GOAL 12. Manage the Refuge's paleontological resources for their educational and scientific values for the benefit of present and future generations of refuge users.

GOAL 13. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

GOAL 14. Integrate our conservation-based mission with the best available science and become a leader in advancing best practices for the design and management of innovative, sustainable refuge and community development opportunities.

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*American avocet and chick*
USFWS

# Chapter 2 Management Direction

## 2.1 Overview

The established refuge purposes serve as the foundation on which this plan is constructed (see Chapter 1). Formulating management direction that corresponds with refuge establishment purposes is mandated for National Wildlife Refuges by the NWRS Administration Act of 1966 (as amended 16 U.S.C. 668dd-668ee). Malheur Refuge's purposes and natural resource considerations are therefore foundational in formulating the management direction of this CCP. House Report 105-106 accompanying the National Wildlife Refuge System Improvement Act of 1997 states, "the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first."

This CCP was also developed through a collaborative process in order to solicit and incorporate public input throughout all stages of plan development, as well as build support for its content and implementation. A variety of organizations and individuals contributed to this CCP (see Appendices I and J). Together with vested collaborators and stakeholders, we created, reviewed, and refined the content of the management direction for the Wildlife and Habitat, Visitor Services, Cultural Resource, and Paleontology programs through a series of interactive meetings.

Each collaborative meeting was attended by 30 to 40 participants, including technical experts, scientists, government agencies, conservation organizations, local and statewide residents, recreation groups, Tribal representatives, refuge visitors, and elected officials. Technical working groups were created by the Service to serve as forums for specific complex resource issues.

Of the resource concerns discussed by participants these significant issues were identified as priorities: improvement of aquatic health through carp population control; enhancement of the inventory and monitoring program (including climate change); habitat management (including implementation and adaptive management); active engagement with partners to implement and evaluate management and restoration activities within and beyond our refuge boundaries; and strategic assessment and planning for the restoration of refuge watersheds, primarily the Blitzen River and its tributaries.

The poor aquatic health of the Refuge's lakes and wetlands is the biggest and most immediate issue facing the Refuge over the next 15 years. Common carp are the largest contributor to degradation of aquatic habitats. With carp as the top priority, staff time and funding will be predominantly directed at reducing the carp population to a threshold goal of 100 pounds of carp per acre in refuge lakes (see Appendix R). Studies (Bajer et al. 2009) have shown that at this level, carp impacts to the food web are reduced and other organisms can flourish despite the presence of carp. Carp control strategies must also address minimizing carp numbers in wetland and riverine habitats throughout the Harney Basin. To reach this goal the Refuge will need active partners to assist with assessment and control projects. The Aquatic Health Coalition has been created to leverage partners and secure funding. Three aquatic health working groups have been formed within the coalition to develop strategies for carp population assessment, carp control on- and off-refuge, and partnership enhancement and funding opportunities. Participants consist of fish and wildlife biologists, researchers, subject matter experts, and ecologists from various Federal and State agencies, nongovernmental organizations, and institutions. The desired condition for refuge aquatic habitats would be represented by teeming masses of phytoplankton and zooplankton, reduced suspended silts, and a flourishing diversity of macroinvertebrates, vegetation, and fish—all for the benefit of migratory birds and resident wildlife.

A comprehensive inventory and monitoring (I&M) program is critical to the mission of the Refuge, and the development of an effective I&M program has been identified as an integral part the CCP. This program will allow the Refuge to gather the necessary data to evaluate the impacts of various management strategies, climate change, and other major influences as they relate to CCP goals and objectives. To carry out the I&M program the Refuge will not only need its staff, but others, such as citizen scientists, partners, and other interested parties, to assist with data collection, input, and analysis. We aim to create an I&M program that is transparent, uses best available science, is collaborative, and links to adaptive management strategies.

The Refuge has a diversity of habitats spread across a large landscape interwoven with waterways, both natural and artificial. This complex and interconnected systems of land and water require intensive management. The upland landscape is also overwhelmed with invasive plants (pepperweed (*Lepidium latifolium*) and large monotypic stands of reed canarygrass (*Phalaris arundinacea L.*)) covering thousands of acres. To address this habitat management priority the Refuge established the Ecology Work Group (Appendix L). Consisting of ecologists and wildlife biologists representing a broad assortment of organizations, this group is focusing on the development of habitat models describing successional conditions that will provide guidance in achieving specific plant community objectives. Partners and working groups will continue to work together with the Refuge in the pursuit of the best available science to further our understanding of the effects of implementing management activities, evaluating methods and techniques, and initiating adaptive management to address needed changes. The desired outcome is to work collaboratively with others to address habitat management needs using best available science, innovative methods and techniques, and transparency. The Refuge is committed to keeping our partners, neighbors, and others engaged in our progress and will host an annual educational science day to highlight the methods, techniques, and strategies being used for refuge management.

The restoration of ecosystem function both on- and off-refuge is of great interest to our collaborators. Several watersheds terminate on the Refuge and influence its ecological health. To address these larger landscape issues the Refuge will actively engage with partners to develop and implement solutions. The Blitzen River, for example, was once a free-flowing river that was harnessed while in private ownership to irrigate meadows for livestock. After acquisition of the valley by the Service, water continued to be diverted to meadows and wetlands to provide habitat for migratory birds. Water is fed by gravity from the river into the water delivery system, which consists of approximately 2,000 miles of ditches and canals, and through about 1,000 water control structures. To date millions of dollars have been spent to improve passage and screening at existing facilities and structures for redband trout (*Oncorhynchus mykiss gairdnerii*). The best quality wetland habitat for migratory birds on the Refuge is found within the human-made wetlands and ponds of the Blitzen Valley because the aquatic health of the Refuge’s lakes have been so detrimentally impact by invasive carp. Although the Refuge’s highest priority is to reach a desired carp control threshold goal of 100 pounds per acre across the entire aquatic landscape, efforts will be made to continue making progress on improving passage and screening to enhance conditions for native fish and to facilitate trapping carp and restricting their movements; on improving water quality and where possible, lowering summer stream temperatures to make riverine conditions more attractive to redband trout and less favorable to carp; and on reducing negative impacts of flood events to nesting birds. The Refuge may pursue small-scale projects that enhance habitat for redband trout and lower water temperatures in the upper Blitzen Valley, which will contribute to the aquatic health objective of a reduced carp population. Watershed restoration is a very complex, multilayered project that will require extensive cultural resource clearances and surveys, water rights evaluation, infrastructure changes, and discussion about desired outcomes. The end result should be substantial improvements for the Blitzen River and neighboring watersheds, as represented by healthy populations of native fish and mussels, a flourishing diversity of macroinvertebrates and plants, improved passage and screening for redband trout and other native fish, carp passage deterrents, lower water temperature, and reduced turbidity for the benefit of migratory birds and resident wildlife.

## 2.2 List of Goals

GOAL 1. Enhance aquatic health and habitat conditions essential to the conservation of the flora and fauna that depend on Malheur Lake and associated water bodies.

GOAL 2. Monitor, protect, maintain, and/or rehabilitate riverine and riparian habitats to conditions essential for the conservation of native fish and wildlife species.

GOAL 3. Protect, maintain, and rehabilitate riparian habitats to conditions essential for the conservation of wildlife species.

GOAL 4. Enhance, protect, and/or maintain primary habitats essential to the conservation of a diversity of aquatic and terrestrial wildlife species.

GOAL 5. Enhance and maintain rare and unique habitats.

GOAL 6. Welcome visitors and offer them a safe experience of the Refuge's outstanding features: diversity of wildlife, signs of earlier inhabitants, scenic landscapes, and solitude. As a result, visitors will leave the Refuge with a memorable experience that fosters a connection between themselves and nature, and with an appreciation of its unique natural resources.

GOAL 7. Connect the hearts and minds of visitors with the places and resources the Refuge protects, and enlighten visitors' experiences with an understanding of, appreciation for, and knowledge about the historic and natural resources, and the importance of conservation and stewardship.

GOAL 8. Provide reasonable challenges and opportunities, and provide uncrowded conditions for the hunting and fishing public.

GOAL 9. Initiate and nurture relationships to build support for the Refuge, and fortify refuge programs and activities to achieve the Refuge's mission and goals.

GOAL 10. Manage prehistoric and historic cultural resources for their educational, scientific, and cultural values for the benefit of present and future generations of refuge users and for the communities that are connected to these resources.

GOAL 11. Identify and protect prehistoric and historic resources on the Refuge that are eligible for or listed on the National Register of Historic Places.

GOAL 12. Manage the Refuge's paleontological resources for their educational and scientific values for the benefit of present and future generations of refuge users.

GOAL 13. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

GOAL 14. Integrate our conservation-based mission with the best available science and become a leader in advancing best practices for the design and management of innovative, sustainable refuge and community development opportunities.

## 2.3 Summary of Management Direction

The management direction described in this CCP can be summarized as follows:

- The primary focus and top priority will be to improve the aquatic health of lakes and wetlands, primarily via aggressive control of common carp.
- Habitat management for specified habitat attributes with wetland habitats[1] will follow. A comprehensive riverine/wetland strategic plan for watersheds within the Refuge will be initiated.
- A more developed and structured visitor experience will be available with additional birding, fishing, and hunting opportunities.
- Historic, cultural, and paleontological resource plans will be developed and protected.

The management direction recognizes that the Refuge is legally mandated to conserve and protect migratory birds to achieve its establishing purposes. Addressing aquatic health is key to meeting this obligation and full attention will be given to its improvement. The greatest obstacle to this effort is common carp, an introduced fish that negatively impacts water quality and in turn impacts native fish, wildlife, and plants that depend on the Refuge's aquatic resources. Primary management emphasis will be placed on improving aquatic health, with staff time and budget largely directed to carp control. Partnerships and staff resources will also address the needs of the visitor services and habitat management programs. Development of a comprehensive riverine/wetland strategic plan will be initiated with the rate of progress determined by staff and resource availability, as well as interest and resource contributions from partners.

***Lake and Wetland Habitats:*** The emphasis of the management direction is to improve the aquatic health of the Refuge's lake and wetland habitats, and to enhance the feeding, resting, and nesting components necessary for a variety of shore/wading birds, waterfowl, and other wildlife species. This will be achieved largely through carp population control. As turbidity decreases and submergent vegetation and associated invertebrate species become more abundant, the productivity of Malheur Lake and of other water bodies within the Refuge (e.g., Boca Lake and Warbler Pond) will increase.

Because of the sheer size and complexity of the aquatic health problem, primarily due to carp, a variety of assessment and control tools will be needed to effectively address it. Existing partnerships such as the Aquatic Health Coalition (made up of Federal, State, nongovernmental organization, and Tribal participants) will assist in strategizing and implementing the most effective suite of control, inventory, funding, and monitoring methods.

Although the overall carp assessment and control strategy for the Harney Basin is currently being considered, it would incorporate methods successfully implemented worldwide and customized, as needed, to suit the Refuge. Strategic assessments of lake, river, and wetland habitats and carp population dynamics would guide control activities and provide enhanced understanding of the system's innate ability to recover from carp impacts. Control strategies would include, but not be

[1] Wetland habitats include wet meadows that depend on flood irrigation during the growing season.

limited to, the application of piscicide, chemo-attractants, chemo-repellants, barriers, commercial harvest, angling, and water manipulation. The need for continued amendments to and the construction of additional strategically placed in-stream structures (i.e., traps, screens, and fish wheels) that allow native fish passage and impede/prohibit carp movement through the system would also be considered.

***Riverine Habitat:*** The Blitzen River and its tributaries currently provide the foundation and lifeblood on which fish and wildlife depend. Because a vast majority of refuge-managed habitats are reliant on irrigation via a complex network of dams, canals, and ditches associated with the river, it is important to understand the connectivity between the Malheur/Mud and Harney Lake systems and associated wetlands in light of carp control. The management direction allows for initiating the development of a comprehensive riverine/wetland strategic plan, which will depend on staff and funding availability. The primary focus of refuge staff is the improvement of lake and wetland aquatic health through carp control. However, we may make efforts to reduce summer river temperatures through changes in water management to increase the cold water barrier, which keeps carp out of wetlands in the upper Blitzen Valley.

The mechanisms for addressing river-related issues will be placed in motion strategically under the management direction by completing necessary assessments and pilot projects as funding, staff time, and resources provided through partnerships allow. The Refuge recognizes that achieving a greater understanding of riverine habitat parameters and opportunities for improvement is very important. If, during the life of this CCP, the minimum carp threshold (e.g., 100 pounds per acre) is met and maintained, more staff time and resources would be directed to addressing whether river rehabilitation efforts are needed and, if so, how such efforts should be identified, prioritized, and achieved.

I&M efforts will place a high priority on information that assists the Refuge in building a baseline data layer that could be used in pursuing riverine activities while furthering our understanding of adjacent habitats. More in-depth, site-specific assessments will be done if opportunities arise (e.g., funding availability and additional refuge staff).

***Wetlands and terrestrial habitats*** will continue to be managed to promote the life-history needs of focal resources (see Appendix E). The overarching theme for the management of wetland and terrestrial habitats will be greater flexibility in identified strategies to adequately meet establishing objectives. Flexibility is critical for maintaining a variety of plant communities within habitats, such as emergent marsh, wet meadow, and dry meadow, to meet foraging, breeding, brood rearing, and other life-cycle needs of migratory birds and other native wildlife. For example, bobolinks and sandhill cranes both depend on wet meadows during the breeding season. They do, however, differ greatly in their use of and the conditions needed within these meadows. To address the wide assortment of needs found within each habitat type, vegetation management tools will address the accumulation of litter and plant community succession. Tools will include, but will not be limited to, traditional late summer haying and autumn/winter rake-bunch grazing (to meet the foraging needs of wildlife species that arrive early) and highly prescriptive warm-season (growing season) grazing, mowing, farming, extended dewatering, etc. (to reclaim acres lost to invasive plants, such as common cattail and reed canarygrass) or to rehabilitate communities that have transitioned beyond desired conditions.

***Wildlife viewing, photography, and interpretation,*** the cornerstones of the public use program, will provide quality opportunities for observing nature. Management under this CCP will be focused on expanding developed facilities and programs for casual visitors and birders (of all abilities). Both spur and loop trails (at least 1 mile) will be added to allow visitors to explore and learn about wildlife and the Refuge, and several trails will be upgraded or built to Americans with Disabilities Act (ADA) standards for accessibility compliance. A number of specific viewing facilities to enhance visitors experiences, such as viewing overlooks and elevated viewing platforms, will also be upgraded and developed. These projects will include restoring the historic Audubon photography blind at the Refuge Headquarters Display Pond; building two ADA-compliant, first-come, first-served permanent screened photography blinds; and building an elevated viewing platform at Malheur Lake. For advanced birders, the Refuge will maintain and replant cottonwood trees and other non-endemic trees and shrubs at six historic landscapes to continue to provide habitat used by rare and incidental passerines (perching birds or songbirds).

Connecting the hearts and minds of visitors with the Refuge will be accomplished with docent-led tours conducted on a seasonal basis at different locations on the Refuge, and will include opportunities for guided kayak and canoe tours on Malheur Lake. Expanded vehicle access will be available, with year-round vehicle access to Krumbo Reservoir, along the Boat Landing Road near Refuge Headquarters, and the southern portion of the East Canal Road to the confluence of Bridge Creek. In addition, boating that is not directly supporting the fishing program will be available at Krumbo Reservoir to enhance wildlife viewing.

Interpretive features and programs are another high priority, and key interpretive themes will include the significance of the Refuge to breeding and migratory birds, precontact and post-contact historic events, wilderness, geology, aquatic health, water importance, resource challenges, and the National Wildlife Refuge System. A stronger emphasis will be placed on developing and using modern media. The George Benson Memorial Museum at Refuge Headquarters will be enhanced, with interpretive panels added to connect visitors with places and the resources that the Refuge protects. Additional outdoor interpretive panels will be placed at key field sites and will focus on improving aquatic health and associated management activities, and weaving historical events with the ecology of the Refuge. Special events and public presentations by refuge staff and volunteers will be expanded and promoted to enlighten visitors' experiences.

***Welcome and Orientation:*** Refuge staff will emphasize improvements in welcome and orientation features, with an emphasis on the use of modern and traditional media to reach and orient visitors. Up to eight outdoor welcome and orientation panels will be located near Refuge entrances and at other congregation areas to direct and guide visitors during their visit. To welcome visitors, developed sites with visitor amenities, such as picnic tables, shelters, and vault toilets, will be upgraded and at least five new developed sites features will be built. An enlarged visitor contact station and gift shop at Refuge Headquarters and a seasonal contact station at P Ranch will be built to provide personal contact between visitors and Refuge staff and volunteers.

***Environmental education*** will be provided, but with more strategic use of Refuge staff time and resources. Strategies will include coordinating efforts with other environmental education initiatives. Existing modules from national and regional programs, such as the Junior Duck Stamp Program and International Migratory Bird Day, will be used as refuge staff and volunteers become available. An outdoor environmental education shelter and learning area at Refuge Headquarters will be built to augment the existing environmental education program and other environmental education initiatives.

***Hunting opportunities*** for upland game will be enhanced by improving the Saddle Butte access on the north side of Malheur Lake and extending the season opener to the fourth Saturday of October (approximately three weeks earlier than current program) to the end of the State pheasant season in the Buena Vista Hunt Unit. The northern part of Malheur Lake and the Boundary Hunt Unit will remain open under slightly modified regulations.

The waterfowl hunt will also be enhanced by promoting a youth hunt and with improvements to the Saddle Butte access. In addition, new waterfowl hunt areas will be provided (approximately doubling or tripling the existing hunt area) by opening a portion of the south-central area of Malheur Lake and within the existing Buena Vista Hunt Unit. The season opener for the new waterfowl hunt units will be on the fourth Saturday of October to the end of the State waterfowl season. One new access point with an expanded parking area and an enhanced boat launch will be provided on the Boat Landing Road near Refuge Headquarters to access the new hunt unit of Malheur Lake. In partnership with potential users, the Refuge will also support adding accessible facilities in the Buena Vista Hunt Unit for waterfowl hunters with disabilities.

***Fishing opportunities*** along the upper Blitzen River, the southern portion of East Canal, and Mud and Bridge creeks will continue. Vehicle access will be allowed on the East Canal Road north to the confluence of Bridge Creek to make this opportunity more accessible for visitors and will enable access to Granddad Reservoir located on BLM land. In addition, a new pedestrian crossing at Bridge Creek will enhance fishing access to the 7 miles of Bridge Creek located west of the East Canal to its confluence with the Blitzen River. Opening a new bank fishing opportunity with a parking area at Sodhouse Lane to the bridge on the Boat Landing Road, part of the Headquarters Loop Trail, will open a new area to fishing on the Blitzen River. The season for this fishing unit will be from August 1 to September 15. Orientation panels with maps, brochures, regulations, and additional information will be added to fishing areas to provide information to visitors about fishing opportunities.

At Krumbo Reservoir, year-round access will be provided for wildlife viewing, boating, and fishing in coordination with State seasons and will increase public fishing opportunities. The stocking program of triploid rainbow trout will continue in coordination with ODFW, and steps will be undertaken to conduct a genetic introgression study on redband trout.

***Volunteer Program:*** To help enhance the public use program and other refuge programs, a full-time volunteer coordinator will be added to the staff. The volunteer coordinator will increase recruitment, retention, and the return rate of volunteers. The position will also expand the program to better use facilities and refuge staff, assist with building partnerships, and increase public outreach.

***Protection of cultural and paleontological resources*** will be strengthened by the development, in cooperation with partners, of step-down management plans for administrative sites where historic or prehistoric resources are present, and for archaeological and paleontological resources. Interpretation of historic sites will be expanded through the development and implementation of site-specific interpretive plans. Opportunities for Native Americans to collect plant materials for traditional uses will be expanded. I&M of archaeological resources will increase as part of step-down management plan implementation.

***Boundary Unit Lands:*** Some Refuge lands located within the Boundary Hunt Unit (Refuge lands west of State Highway 205 and isolated parcels in the Krumbo watershed) are managed by the BLM under cooperative land management agreements with the USFWS. Under these agreements, typical BLM land management practices and uses are allowed to occur. Upon final signature of this CCP, these cooperative land management agreements will be allowed to expire, except for those pertaining to the use of Diamond and Nine Mile corrals. Refuge lands will be managed by the USFWS to further Refuge purposes, until a land interchange or new cooperative land management agreement is negotiated with BLM.

***Energy Independence:*** The refuge staff will seek to become energy independent and carbon negative, and will continue to emphasize partnerships to maximize adaptive management.

***Inventory and monitoring*** for all programs will be strengthened. Program-wide I&M plans will be developed to guide annual management actions. The fish, wildlife, and vegetation plans will emphasize focal species and national monitoring efforts. A geodatabase will be created to track data collected under these plans.

***Adaptive Management:*** The Refuge will be using an adaptive management (AM) decision-making process to implement management strategies authorized in the CCP. AM is a science-based public participation process for evaluating and adjusting a conservation effort relative to goal achievement as experience and knowledge are gained through implementation, study, and discussion. The Refuge and its collaborative partners support the fact that AM promotes flexible decision making, which can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. As the CCP is implemented, AM will help the Refuge achieve diverse goals while enhancing wildlife benefits, advancing scientific knowledge, and improving working relationships among stakeholders.

The principle of AM recognizes that ecosystem function is inherently complex and often results in knowledge gaps. AM implementation means a firm commitment to the development of measurable outcomes and the application of rigorous evaluation and monitoring methods to determine whether management goals are being met. Careful monitoring of these actions advances scientific understanding and helps adjust policies or operations as part of an ongoing learning process. This is not a trial-and-error process but rather emphasizes learning while doing, which recognizes the importance of incorporating new information as it becomes available. AM requires flexibility and an ability to acknowledge risks and failures and use new knowledge in a constructive manner to make adjustments while building a foundation for ongoing learning/adjustment. This may include changing which Resources of Concern are used for habitat management as a result of new data acquired during the Inventory and monitoring process.

The Refuge is committed to a rigorous and inclusive AM approach to enhance public confidence in the Refuge's ability to transfer the theory into practice. The Refuge recognizes that there is a critical need for transparency as CCP implementation moves forward. This transparency as it pertains to AM needs to include both the learning and decision-making processes. The following discussion describes how the Refuge will move forward through AM.

- ***Information Sharing/Learning:*** The Refuge is committed to an AM process that will bring diverse interests together through various forums to share information and site-specific results so that all those engaged, including the Refuge, can learn together (Figure 2-1). These forums will evolve over time but will include collaborative mechanisms with others such as (and potentially evolving from) the collaborative groups that have been active during the CCP process, including the Aquatic Health Coalition, the Ecology Work Group, and an evolution of the Collaborative Planning Group. The timing and frequency of information sharing and learning will be determined by how rapidly new information is being acquired, level of partners' interest and engagement, ecological cycles, and the forum being used. The Refuge will also share the results of its I&M work on an ongoing basis and strive to be responsive to partners' requests for open discussion and collaboration in assessing the need for adaptive changes in management to achieve the goals and objectives of the CCP.

- ***Decision Making:*** As the Refuge and our partners learn through the AM process, new information may show the need for adjustments (e.g., selecting new habitat focal species or evaluation metrics), confirm existing strategies, or identify additional information (Figure 2-1). Based on the best information available at the time, the Refuge will make decisions for future management actions. As with the sharing and learning aspects of AM, the Refuge recognizes the importance of transparency for decisions made during the AM process. The Refuge is committed to bringing together interested parties to assist with the evaluation of available information, as well as consultation about management options and their implications prior to making course-changing decisions. This process does not diminish the Refuge's legal authority to make decisions but rather serves to enhance the decision making process by enabling the Refuge to approach issues from multiple perspectives thereby finding creative solutions to complex challenges.

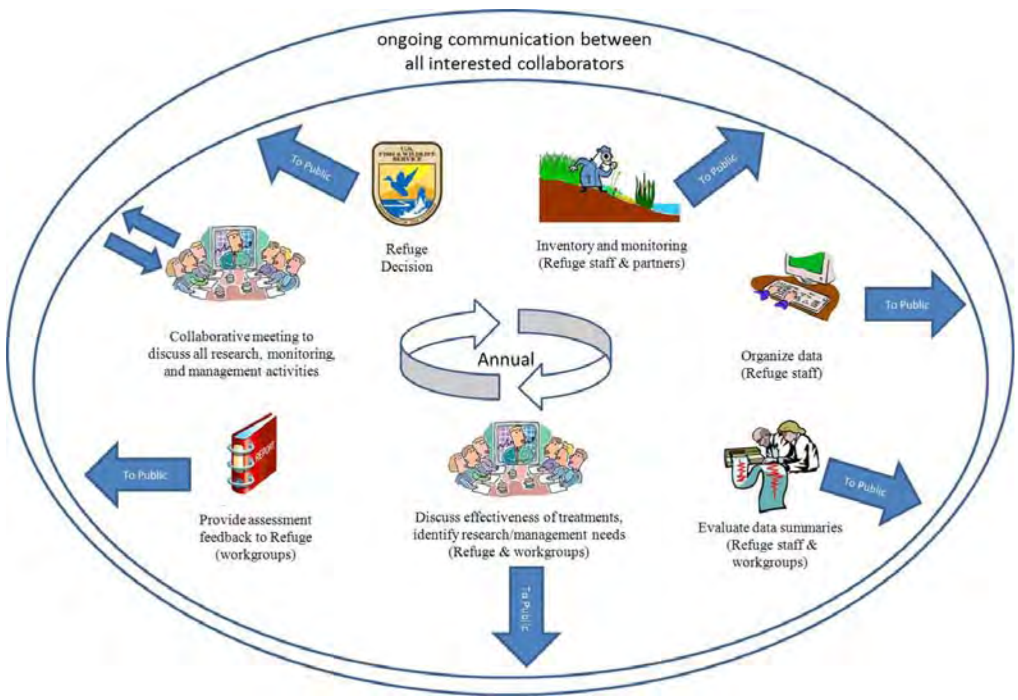


**Figure 2-1. Adaptive Management Model**

***Implementation Subject to Funding Availability:*** Actions will be implemented over a period of 15 years as funding becomes available. Project priorities are described in Appendix C. The Refuge will continue to work with partners to implement the CCP by sharing results, providing updates on successes and challenges, initiating discussions, encouraging participation, and hosting working groups.

***Tribal Coordination:*** There will be regular communication with the Burns Paiute Tribe. This tribe is the major local tribal entity the Refuge will coordinate and consult with regarding issues of shared interest. Currently, the Service coordinates with the Tribe on issues related to the Native American Graves Protection and Repatriation Act (NAGPRA; P.L. 101-601) and National Historic Preservation Act (NHPA; 16 U.S.C. 470 et seq.).

***State Coordination:*** The Service will continue to maintain regular discussions with ODFW. Key topics for discussion will be wildlife monitoring, fisheries management (including fish passage and barriers), hunting and fishing seasons and regulations, and the management of species of concern (i.e., sage-grouse).

***Harney County Court Coordination:*** The Service will continue to maintain regular discussions with the Harney County Court as actions under this plan are implemented over the next 15 years.

***Maintenance of Infrastructure to Support Management of Wetlands and Meadows:*** Efforts to enhance the water management system will be made throughout the life of the CCP, to reflect aquatic health (e.g., carp control) and other habitat management needs and constraints. Actions will be directed by existing water rights, funding opportunities, and refuge maintenance priorities.

***Refuge Fire Management:*** The current Refuge Fire Management Plan (FMP) based on the 1985 Refuge master plan and step-down plans was updated in 2010. Under this FMP the Refuge is designated as a single Fire Management Unit (FMU). The FMP will be revised and approved at the Regional level and will act as a step-down plan to the CCP. An approved FMP allows a manager to consider a wide range of management responses to wildfires and to conduct prescribed fires. The FMP contains strategic and operational elements that describe how to manage applicable fire program components such as: response to unplanned ignitions, hazardous fuels and vegetation management, burned area emergency stabilization and rehabilitation**,** prevention, community interactions and collaborative partnerships roles, and monitoring and evaluation programs.

Prescribed fire will be used in areas where it is the most appropriate tool to achieve habitat and hazardous fuels reduction goals. Prescribed burns will generally be conducted in the late winter to meet litter management objectives, but may be done at other times depending on desired outcomes.

***Climate Change:*** The refuge staff will participate in and contribute to climate change assessment efforts, including those underway at a landscape scale, such as the Great Basin Landscape Conservation Cooperative (LCC). LCCs are formal science-management partnerships consisting of the Service, other Federal agencies, states, Tribes, nongovernmental organizations, universities, and other entities. LCCs provide science support, biological planning, conservation design, research, and design of inventory and monitoring programs to address climate change and other environmental stressors in an integrated fashion. As needed, objectives and strategies will be adjusted to assist in enhancing refuge resources' resiliency in the face of climate change. The refuge staff will also continue to pursue and engage in mechanisms to conserve energy in refuge operations, including the use of fuel-efficient vehicles.

***Partnerships:*** Partnerships will be maintained and developed to enhance collaboration in support of fish and wildlife resources, recreational opportunities, cultural resources, paleontological resources, educational programs, and to explore ways to share funding and seek grants on projects of mutual interest. Partnerships will also be used to work with others to accomplish common goals, promote mutual understanding, encourage environmentally friendly development, and promote ecotourism opportunities. Workshops and training sessions with professional colleagues and the general public will be developed to obtain ideas, techniques, and support for management decisions to address natural process management, agency mission, and refuge objectives.

***Volunteer Opportunities:*** Volunteers are recognized by the Refuge as key components of the successful management of public lands, and they are vital to implementation of refuge programs, plans, and projects, especially in times of declining budgets. Volunteer opportunities will be maintained and expanded to best use facilities and refuge staff, and to assist with building partnerships and public outreach. A volunteer management plan will be developed and will address the following for all refuge programs: job descriptions, volunteer/staff roles, recruitment and retention of high-quality volunteers, orientation/training, housing, performance evaluations, recognition, administration of the Malheur Wildlife Associates, promotion of the role of the Malheur Wildlife Associates, and Malheur Wildlife Associates program evaluation.

***Transportation Coordination:*** Roads, bridges, and trail systems play a vital role in providing access to the public for compatible wildlife-dependent recreation opportunities. The Service will look for opportunities to partner with the Oregon Department of Transportation (ODOT), Burns District of the BLM, and Harney County to maintain and improve safe and appropriate transportation access in and around the Refuge.

***Refuge Revenue Sharing Payment:*** Annual payments to Harney County under the Refuge Revenue Sharing Program will continue according to the established formula and subject to payments authorized by Congress. Total payments made to the County in recent years are listed in Section 5.8.5.

***Sustainable Practices for Maintenance and Updating of Existing Infrastructure:*** Periodic maintenance and updating of refuge buildings and facilities will be necessary. Periodic updating of infrastructure is necessary for safety and accessibility and to support staff and management needs and is incorporated in the Federal Business Management System and Environmental Management Plan. The Refuge will seek to become energy independent and carbon negative by implementing green technology and sustainable practices.

***Endangered Species Act Section 7 Consultations:*** All projects will be compliant with the Endangered Species Act (ESA, 16 U.S.C. 1531-1544 et seq.). Section 7 consultation was not completed programmatically for the CCP. The need for Section 7 consultations for special projects or actions not described in this plan (e.g., management actions related to aquatic health) will be conducted on a case-by-case basis.

***Section 106 Compliance:*** Any new ground-disturbing projects or modifications (e.g., removal of historic water control structures or dams) will undergo a review under Section 106 of the NHPA (16 U.S.C. 470 et seq.).

***Integrated Pest Management (IPM):*** In accordance with 517 DM 1 and 569 FW 1, an integrated pest management (IPM) approach will be used, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on refuge lands. IPM will involve using methods based upon effectiveness, cost, and minimal ecological disruption, which considers minimum potential effects to non-target species and the refuge environment. Pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. If a pesticide is needed on refuge lands, the most specific (selective) chemical available for the target species will be used unless considerations of persistence or other environmental and/or biotic hazards preclude it. In accordance with 517 DM 1, pesticide usage will be further restricted because only pesticides registered with the U.S. Environmental Protection Agency (USEPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA; 7 U.S.C. prec. 121) and as provided in regulations, orders, or permits issued by USEPA may be applied on lands and waters under refuge jurisdiction.

Environmental harm by pest species refers to a biologically substantial decrease in environmental quality as indicated by a variety of potential factors including declines in native species populations or communities, degraded habitat quality or long-term habitat loss, and/or altered ecological processes. Environmental harm may be a result of direct effects of pests on native species including preying and feeding on them; causing or vectoring diseases; preventing them from reproducing or killing their young; out-competing them for food, nutrients, light, nest sites or other vital resources; or hybridizing with them so frequently that within a few generations, few if any truly native individuals remain. Environmental harm also can be the result of an indirect effect of pest species. For example, decreased waterfowl use may result from invasive plant infestations reducing the availability and/or abundance of native wetland plants that provide forage during the winter.

Environmental harm may involve detrimental changes in ecological processes. For example, cheatgrass infestations in shrub-steppe greatly can alter fire-return intervals, displacing native species and communities of bunchgrasses, forbs, and shrubs. Environmental harm may also cause or be associated with economic losses and damage to human, plant, and animal health. For example, invasions by fire-promoting grasses that alter entire plant and animal communities eliminating or sharply reducing populations of many native plant and animal species can also greatly increase fire-fighting costs.

See Appendix G for the Refuge's IPM program documentation to manage pests. Along with a more detailed discussion of IPM techniques, this documentation describes the selective use of pesticides for pest management on refuge lands, where necessary. Throughout the life of the CCP, most proposed pesticide uses on refuge lands will be evaluated for potential effects to refuge biological resources and environmental quality. These potential effects will be documented in "Chemical Profiles" (see Appendix G). Pesticide uses with appropriate and practical BMPs for habitat management as well as cropland/facilities maintenance will be approved for use on refuge lands where there likely will be only minor, temporary, and localized effects to species and environmental quality based upon non-exceedance of threshold values in Chemical Profiles.

***Hazard Analysis and Critical Control Point Plan:*** Hazard analysis and critical control points planning (HACCP) is a tool to help natural resource managers identify critical control points in their activities to decrease the spread of invasive species. The HACCP Wizard Version 2.04 (http://www.haccp-nrm.org/Wizard/default.asp) will be used to construct plans for staff, contractors, volunteers, and other users of the refuge to evaluate their activities and address ways to conduct their activities to limit the chance of spreading invasive species.

***Water Rights:*** The right to use water on the Refuge is managed through the State of Oregon's Water Resources Department. Water rights in Oregon are managed by two basic principles: beneficial use and first in time/first in right. Almost all water use on the Refuge has some form of a State-certified water right. The exception is springwater in the Double-O Unit of the Refuge, which is threatened by groundwater withdrawals in the area. To protect the habitats and values associated with springs, the Service will take steps to file a groundwater right.

***Water Quality:*** Water quality is addressed through the ODEQ. Refuge-specific water quality guidelines have not yet been established through a formal TMDL study conducted by the State. Although water quality impairments exist in the Blitzen River before it reaches the refuge boundary, various refuge-led studies have indicated a continued increase in temperature and turbidity and a decrease in dissolved oxygen levels within some refuge water bodies (see Chapter 3) during specific times of the year. Refuge staff will continue to identify and implement best management practices to address water quality.

***Blitzen River Water Management:*** The Refuge will continue to maintain a minimum flow of 25 cfs in the Blitzen River to benefit aquatic resources.

***Research, Monitoring, and Inventory:*** Refuge staff will continue to work with others to share information and expertise on habitat management, terrestrial and aquatic health, and restoration/rehabilitation techniques. Partnerships with local universities, nongovernmental organizations, Tribes, State and local agencies, and others will be expanded to conduct research that will advance sound science associated with decision making on the Refuge.

***Malheur Refuge State and Transition Model:*** The Refuge is partnering with ecologists, wildlife biologists, and scientists from various State and Federal agencies and nongovernmental organizations to develop the "Malheur Refuge State-and-Transition Model" (STM) to increase understanding of the wetlands managed by the Refuge. It describes various habitat types along a hydrological gradient and discusses the conditions that likely cause transitions between associated plant assemblages. The STM will serve as a "road map" for managing wetlands and uplands toward target habitat conditions and will provide increased understanding of the short- and long-term effects of management treatments on refuge habitats.

***Non-priority Uses:*** Non-priority wildlife-dependent recreational uses will be allowed at the Refuge if found appropriate and compatible. Certain uses will be allowed under the stipulations identified in Appendix B. Incidental uses such as horseback riding will be permitted only on the Center Patrol Road. Bicycling and cross-country skiing will be permitted on all public roads; pets will be permitted in designated areas. All-terrain vehicle (ATV) use is permitted in conjunction with the grazing and haying program. Recreational use of ATVs, snowmobiles, or dirt bikes will not be permitted anywhere on the Refuge. Special stipulations apply for ATV use on the Refuge as outlined in Appendix B.

Prohibited activities include fires, swimming, camping, and collecting natural objects (such as plants, animals, minerals, antlers, etc.), and objects of antiquity. See Appropriate Use Determinations (Appendix A) and Compatibility Determinations (Appendix B) for more information. Such recreational activities not specifically addressed in this document may be allowed on refuge lands, if the Refuge Manager determines that they are appropriate and compatible.

***Predator Control:*** Although such an action is often justifiable, specific attainable objectives must be determined before conducting predator control. It has been noted, for example, that removal of coyotes (*Canis latrans*) often leads to an increase in other predator populations that can be even more detrimental to wildlife production (raccoons (*Procyon lotor*), mink (*Neovison vison*), etc.). If predator control is deemed necessary during the life of the CCP, the proper public process will be followed. Productivity of select key avian species will be monitored under the guidance of the I&M plan to assess whether the Refuge is serving as a source or sink for local avian populations, and if the

Refuge is not serving as a source, management options including manipulation of habitat conditions and predator control will be considered.

## 2.4 Summary of Future Management

Table 2-1 represents a conceptual future of the Refuge using best science to determine likely outcomes. A reliance on adaptive management is key to successfully incorporating the broad array of factors that will influence implementation of the plan. Numbers denoted in the table represent a range of possible futures and are not attached to specific ground locations unless indicated otherwise.

**Table 2-1. Summary of Future Management**

| Management Theme | Management Direction |
| --- | --- |
| **Top priority will be to improve the aquatic health of lakes and wetlands.**<br><br>**Create a more developed and structured visitor experience with additional birding, fishing, and hunting opportunities.**<br><br>**Initiate the development of a comprehensive riverine/wetland rehabilitation plan.** | |
| **Habitat Management** | |
| **Lacustrine (lakes)** | Major emphasis on carp population control for restoring aquatic health (see Invasive Species Control). |
| **Riverine** | Strategic approach beginning with most critical, foundational assessments and pilot studies and moving toward the creation of an integrated wetland/riverine rehabilitation plan sometime in the near future, most likely beyond the life of this CCP. Once carp control objectives are reached and successfully maintained (e.g., 100 pounds per acre in Malheur Lake), resource emphasis may expedite the development and implementation of the above-mentioned plan. Aquatic health inventory, monitoring and carp control will occur. |
| **Woody Riparian** | Maintain and enhance 1,000-1,500 acres. |
| **Palustrine Emergent (seasonallyflooded wet meadow)** | • Enhance and maintain 20,000-25,000 acres<br>• An increase in overall meadow acreage (±2,000 acres) and enhanced diversity of meadow/marsh complexes<br>• Increase management flexibility by utilizing State-and-Transition Model to address management issues with best available science (e.g., summer grazing) |
| **Palustrine Emergent (seasonally flooded marsh associated with wet meadow)** | Increased management flexibility to enhance and maintain 15,000-16,000 acres.<br>Increased blocking of carp movement and redband trout intrapment by installing fish screens. Increased inventory and monitoring of aquatic health. |
| **Palustrine Open Water/Emergent (semipermanently flooded Wetland Impoundment)** | Enhance and maintain 2,200-2,800 acres of wetland impoundments.<br>Increased blocking of carp movement and redband trout intrapment by installing fish screens. Increased inventory, monitoring research and assessment of aquatic health. |
| **Dry Meadow** | Enhance and maintain 4,500-5,500 acres:<br>• Idle strategy dominates<br>• Treatment frequency determined by monitoring of structure and vigor |

| Management Theme | Management Direction |
|---|---|
| **Salt Desert Scrub** | Maintain 40,000 acres. |
| **Sagebrush Lowland** | Maintain 4,300-4,500 acres. |
| **Sagebrush Steppe** | Maintain 14,000-15,000 acres:<br>• Continue to eradicate invasive western juniper<br>• Investigate the diversification of crested wheatgrass seedings.<br>• Implement projects to add native plant diversity in crested wheatgrass seedings<br>• Conduct experimental burns and other treatments (shrub control, etc.) to increase desirable understory cover in pertinent plant communities |
| **Dune** | Protect and maintain 6,300 acres with minimal management. |
| **Playa** | Protect and maintain 29,000 acres with minimal management. |
| **Cropland** | Increase row crop up to 1,000 acres. |
| **Cold and Hot Springs** | Maintain and enhance 236 acres. Increased inventory, monitoring research and assessment of aquatic health. |
| **Cliffs, Rimrocks, and Outcropping** | Maintain current acres. |
| **Special Protection Areas** | |
| **RNA and WSA Management** | Continue to manage as closed areas except for research and/or maintenance activities and docent- or staff-led tours. |
| **Wilderness Study Area** | Adjust Harney Lake WSA proposal to reflect 2010 wilderness inventory of 31,157 acres. |
| **Refuge Boundary and Management Area** | |
| **Lands West of State Highway 205 and East of Krumbo Reservoir** | With BLM, explore opportunities to coordinate land management and enhance conservation in the Refuge's Boundary Unit adjacent to BLM land, considering mechanisms such as cooperative management agreements and/or interchange of lands. Because the identified land area is a thin sliver of uneven ground between road and rimrock, and is unmarked and unfenced in most areas, it is difficult to manage under Refuge regulations. No difference in public use opportunity is envisioned. |
| **Invasive Species Control** | |
| **Carp Control** | Following assessments (see Goal 13), use appropriate techniques to aggressively control carp that can be applied to the diversity of aquatic habitats throughout the watershed. IPM strategies to control carp will include, but not be limited to, the application of piscicide, chemo-attractants, chemo-repellants, barriers, commercial harvest, angling, and water manipulation. In-stream structures (i.e., traps, screens, and fish wheels) that address native fish passage issues and the prohibition of carp movement through the system will also be considered. |
| **Invasive Species Control** | Increase monitoring and control for undesirable species, determine efficacy of treatments, and map areas at risk of exceeding threshold levels (see Goals 1-4 for thresholds). |
| **Wildland Fire and Hazardous Fuels Management** | |
| **Biological Fuels Treatment** | • Use wildfire, prescribed fire, and mechanical treatment to manage biological fuels.<br>• Continue to coordinate with the Burns Interagency Fire Zone.<br>• Use chemical treatment to manage biological fuels. |

| Management Theme | Management Direction |
|---|---|
| **Wildland Fire Prevention and Response** | • Continue to coordinate with the Burns Interagency Fire Zone.<br>• Where required, suppress wildfires, but consider objective opportunities for resource benefits and ability to safely manage fires. |
| **Hazardous Fuels** | • Use wildfire, prescribed fire, and mechanical treatment to manage hazardous fuels<br>• Continue to coordinate with Burns Interagency Fire Zone<br>• Use chemical treatment to manage hazardous fuels. |
| **Water Resources** | |
| **Watersheds** | • Continue to improve aquatic health in Silvies, Double-O, and Blitzen River watersheds by working with public and private partners<br>• Work with public and private partners to protect spring migratory habitat (e.g., snow goose) in the Harney Basin via available land protection and stewardship programs |
| **Water Rights** | • Prove up on new winter water rights for the Blitzen River and tributaries<br>• Finalize transfer of existing Blitzen River water rights to wildlife refuge management<br>• Establish a groundwater right for the springs in the Double-O Unit. |
| **Water Delivery System Assessment and Feasibility** | Complete a full assessment of water control structures of water delivery system for water management efficacy. |
| **Inventory, Monitoring, Scientific Assessments, and Research** | |
| **Inventory and Monitoring** | • Inventory, monitor, and assess fish, wildlife, and vegetation to guide annual management actions<br>• Re-establish a program-wide I&M plan around focal species and national monitoring efforts<br>• Design a geodatabase for inventory and monitoring surveys conducted |
| **Research** | Focus on aquatic health and wetland/terrestrial habitat management. Initiate development of the river/wetland rehabilitation plan. Systematically conduct research to further aquatic health and carp control on the refuge. |
| **Assessment** | • Conduct aquatic health assessments on focal areas of the refuge<br>• Assess carp population dynamics and migratory patterns.<br>• Conduct wetland and terrestrial habitat assessments.<br>• Assess habitat response to management actions primarily from carp control and water connectivity through the watershed<br>• Assess water delivery system to determine water control structures that deter carp passage<br>• Commence assessment of riverine habitat characteristics that will influence future restoration efforts |
| **Welcome and Orientation** | |
| **Welcome and Orientation Panels** | Maintain and update 4 existing outdoor welcome and orientation panels at:<br>• Narrows Pull-out<br>• Refuge Headquarters<br>• Buena Vista<br>• Frenchglen |

| Management Theme | Management Direction |
|---|---|
| | • Krumbo Reservoir<br>• P Ranch<br>• Harney Lake<br>• Double-O |
| **Developed Sites with Visitor Amenities (i.e., picnic tables, shelters, vault toilets)** | Maintain five developed sites at:<br>• Refuge Headquarters<br>• Buena Vista<br>• Krumbo Reservoir<br>• P Ranch<br>Provide all or some described developed sites as shown:<br>**Complete Developed Sites**<br>• Double-O<br><br>**Vault Toilets Only**<br>• Sod House Ranch<br><br>**Picnic Tables and Shelters Only**<br>• Refuge Headquarters (ADA-compliant)<br>• Buena Vista Overlook<br>• P Ranch |
| **Visitor Contact** | • Maintain year-round visitor contact station/gift shop at Refuge Headquarters<br>• Build an enlarged visitor contact station and gift shop at Refuge Headquarters<br>• Enhance George Benson Memorial Museum to meet ADA standards and to meet preservation standards to protect specimens.<br>• Establish a seasonal contact station at P Ranch, and provide staffing as available with volunteers during spring, summer, and fall<br>• Continue to consider/participate in discussions for an interagency visitor facility off-refuge |
| **Wildlife Observation and Wildlife/Nature Photography** | |
| **Docent-led Tours** | Provide docent-led tours in conjunction with the annual John Scharff Migratory Bird Festival.<br>Provide advertised docent-led tours, approximately monthly, to a variety of audiences at different locations on the Refuge, including kayaking and canoeing tours on Malheur Lake. |
| **Auto Tour Route and Vehicular Access** | Maintain refuge public roads on:<br>• 42-mile Blitzen Valley auto tour route (Center Patrol Road) year-round<br>• Seasonal access to Krumbo Reservoir from fourth Saturday of April through October 31<br>Provide year-round vehicle access and vehicle pull-offs when road conditions are not hazardous at:<br>• Boat Landing Road<br>• Krumbo Reservoir<br>• East Canal Road to the confluence of Bridge Creek |

| Management Theme | Management Direction |
|---|---|
| | Participate in Basin and Range Birding Trail on-refuge with Harney County Chamber of Commerce and other partners. |
| **Trails (foot, bicycle)**<br><br>**Trails (foot, bicycle)** | Maintain 10 trails at:<br>• Headquarters Overlook<br>• Buena Vista Overlook<br>• Crane Pond Overlook<br>• Krumbo Reservoir<br>• Benson Pond Trail<br>• Bridge Creek Trail<br>• River Trail<br>• East Canal Trail<br>• Barnyard Springs Footpath<br>• Desert Trail<br>Additional trails at:<br>**Spur Trail**<br>• Frenchglen to Barnyard Springs Footpath<br><br>**Loop Trails (≥ 1 mile)**<br>• Refuge Headquarters along the Blitzen River and Display Pond (Headquarters Loop Trail)<br>• Connect Bridge Creek Trail, River Trail, and East Canal Trail with pedestrian crossings and boardwalks.<br><br>**ADA-compliant Trails**<br>• Sections of Headquarters Loop Trail<br>• Sod House Ranch (upgrade to ADA standards)<br>• Benson Pond<br>• P Ranch<br><br>Enhance the Desert Trail by:<br>• Proposing alternative route<br>• Posting appropriate Desert Trail signs |
| **Viewing Overlooks** | Maintain and enhance two viewing overlooks at:<br>• Refuge Headquarters<br>• Buena Vista (upgrade to ADA standards)<br>Develop an ADA-compliant viewing overlook at Krumbo Reservoir. |
| **Elevated Viewing Platforms** | Develop elevated viewing platforms at:<br>• Historic CCC lookout tower at Refuge Headquarters<br>• Malheur Lake at airboat launch site<br>• Harney Lake<br>• Double-O |
| **Photography Blinds** | • Restore historic Audubon photography blind at Refuge Headquarters Display Pond<br>• Build two ADA-compliant, first-come/first-served permanent photography blinds at appropriate sites to view wildlife |

| Management Theme | Management Direction |
|---|---|
| **Site Management for Rare and Incidental Passerines and Historic Landscapes** | Prepare and implement site plans, to manage vegetation and maintain trees and shrubs at:<br>• Refuge Headquarters<br>• Sod House Ranch<br>• Benson Pond<br>• Witzel Field<br>• Barnyard Springs<br>• P Ranch |
| **Interpretation** | |
| **Primary Interpretive Themes** | Maintain existing interpretive programs to include natural and historic resources themes. Include:<br>• Historical and current significance of the Refuge to breeding and migratory birds<br>• Precontact and post-contact history<br>• CCC work in the area<br>• Wilderness<br>• Geology<br>• Aquatic health<br>• Water's importance, hydrology, and movement through the landscape<br>• Refuge's primary management objectives, and management challenges, and methods for wildlife, habitat, and other resources<br>• Role and importance of the National Wildlife Refuge System<br>• An understanding of visitors' relationships to, and impacts on, natural and historic resources to become stewards of the land |
| **Modern and Traditional Media** | Maintain and update existing modern and traditional media as shown:<br>• Website and brochures<br>Make greater use of modern media (CDs, podcasts, social media, etc.). |
| **Panel Locations** | Maintain five sites with outdoor interpretive panels at:<br>• Narrows Pull-out<br>• Refuge Headquarters<br>• Sod House Ranch<br>• Buena Vista Overlook<br>• P Ranch<br>Provide indoor interpretive panels in the George Benson Memorial Museum to connect visitors with places and the resources the Refuge protects<br>Provide additional outdoor interpretive panels at key field sites to appropriately implement key interpretive themes focusing on improving aquatic health and associated management activities, and weaving historic events with ecology of the Refuge |
| **Special Events** | Participate in four local events, on- and off-refuge:<br>• John Scharff Migratory Bird Festival (April)<br>• Free Fishing Day (June)<br>• Invasive Carp Awareness (August)<br>• Harney County Fair (September)<br>Provide three additional local events, on- and off-refuge, with docent-led |

<table>
<tr><th>Management Theme</th><th>Management Direction</th></tr>
<tr><td></td><td>activities, booths, educational materials, etc. for:<ul><li>International Migratory Bird Day (May)</li><li>Ranching Heritage Day combined with Invasive Carp Awareness (August)</li><li>National Wildlife Refuge Week (October)</li></ul></td></tr>
<tr><td>Presentations</td><td>Provide public presentations by refuge staff and volunteers to a variety of visiting groups upon request.<br>Advertise through modern and traditional media that public presentations by refuge staff and volunteers are available, approximately monthly, for visiting groups<br>Coordinate additional public presentations with other environmental education partners</td></tr>
<tr><td colspan="2">Environmental Education</td></tr>
<tr><td>Environmental Education Program</td><td>Reach approximately 500 students, on- and off-refuge, using refuge staff and volunteers with:<ul><li>Local first and third graders</li><li>John Scharff Migratory Bird Festival Fun Fair and “Conservation through the Arts”</li><li>Free Fishing Day</li><li>Other environmental education programs upon request</li></ul>When refuge staff and volunteers are available, use and implement existing curricula, and national and regional environmental education modules, such as the Junior Duck Stamp Program, International Migratory Bird Day, etc., on- and off-refuge<br>Coordinate and assist with local environmental education initiatives upon request</td></tr>
<tr><td>Great Basin Society/Malheur Field Station</td><td>Review and revise as needed the cooperative Agreement between the Great Basin Society/Malheur Field Station and the Refuge.</td></tr>
<tr><td>Environmental Education Facilities</td><td><ul><li>Build an outdoor shelter at Refuge Headquarters where environmental education activities can be conducted during inclement weather</li><li>Provide an outdoor learning area at Refuge Headquarters for existing environmental education programs, and efforts with other environmental education initiatives</li></ul></td></tr>
<tr><td colspan="2">Hunting</td></tr>
<tr><td>Upland Game</td><td>Maintain upland game hunting at:<br>Malheur Lake Hunt Unit<ul><li>26,200 acres on north side of Malheur Lake; Open pheasant season same as State</li><li>Enhance by improving Saddle Butte access on the north side of Malheur Lake</li></ul>Buena Vista Hunt Unit<ul><li>36,000 acres</li><li>Extend season opener from the fourth Saturday of October to the end of State pheasant season</li></ul>Boundary Hunt Unit<ul><li>2,600 acres west of State Highway 205 and in Krumbo Creek area;</li></ul></td></tr>
</table>

| Management Theme | Management Direction |
|---|---|
| | Open to deer and pronghorn west of State Highway 205 and south of Foster Flat Road; Open to upland gamebirds, rabbit, and coyote in all Unit areas, according to State regulations.<br>• Include Krumbo Creek area for pronghorn and deer. |
| **Waterfowl** | **Malheur Lake Hunt Unit**<br>• 26,200 acres on north side of Malheur Lake; Open waterfowl season same as State; Nonmotorized or electric boats permitted<br>• Promote a youth hunt opportunity on State-designated weekend in the northern Malheur Lake Hunt Unit<br>• Enhance by improving Saddle Butte access on the north side of Malheur Lake<br>• Expand allowable boundary to include south-central area of Malheur Lake with special date regulations of fourth Saturday of October through end of State waterfowl season<br>• Open new boat access for nonmotorized or electric boats on Malheur Lake at the airboat launch site near Refuge Headquarters with expanded parking area and an ADA-compliant boat launch with special date regulations of fourth Saturday of October through end of State waterfowl season<br>• At low water (<10,000 acres), close Malheur Lake to waterfowl hunting<br><br>**Buena Vista Hunt Unit**<br>• Open hunt unit to waterfowl hunting with special date regulations of fourth Saturday of October through end of State pheasant season; boats will not be permitted<br>• Support reasonable waterfowl hunting opportunities that comply with the ADA in partnerships with potential users<br><br>**Boundary Hunt Unit**<br>• 2,600 acres west of State Highway 205 and in Krumbo Creek area; Open waterfowl season same as State |
| **Fishing** | |
| **Stream Fisheries** | • Maintain fisheries at:<br>**South Fishing Loop**<br>Upper Blitzen River, southern portion of East Canal, and tributaries open year-round to walk-in access; redband trout with special regulations<br>• Allow drive-in access on East Canal Road to the confluence of Bridge Creek with access to Granddad Reservoir (BLM), except when road conditions are hazardous<br>• Build a new pedestrian crossing at Bridge Creek to access a portion of the fishable area west of East Canal to its confluence with the Blitzen River<br>• Open new seasonal bank fishing opportunity from Sodhouse Lane to the bridge on the Boat Landing Road, part of the Headquarters Loop Trail, from August 1 through September 15<br>• Develop five panels with maps, brochures, regulations, and additional information at main entrance points |
| **Reservoir Fishery** | • Maintain fisheries at: |

| Management Theme | Management Direction |
|---|---|
| | **Krumbo Reservoir**<br>Open fourth Saturday of April through October 31 to drive-in access and to nonmotorized or electric boats; stocked with triploid rainbow trout.<br>• Allow year-round, drive-in access, except when road conditions are hazardous.<br>• Allow year-round boating access (nonmotorized and electric boats), except when reservoir begins to ice over.<br>• Conduct genetic introgression study on redband trout in coordination with ODFW.<br>• Develop one panel with maps, brochures, regulations, and additional information at main parking area. |
| **Volunteer Program and Partnerships** | |
| **Volunteer Program** | Maintain volunteer program:<br>• Runs eight months of the year (March-October)<br>• Over 5,000 hours are generated, with at least a 50% return rate<br>Hire a full-time volunteer coordinator position to:<br>• Increase recruitment, retention, and return rate of volunteers<br>• Expand the program to best use facilities and refuge staff<br>• Assist with building partnerships and increase public outreach |
| **Law Enforcement** | |
| **Regulations** | Continue to post regulations at key welcome and orientation sites, as well as locations where fishing and hunting uses predominate (Krumbo Reservoir, Malheur Lake, Buena Vista Unit, etc.).<br>Improve all posting of regulations at key welcome and orientation sites, as well as locations where fishing and hunting uses predominate. |
| **Staffing/Field Presence** | Maintain current law enforcement staffing. Continue to emphasize information, education, and friendly presence in the field during key seasons. |
| **Cooperative Assistance** | Continue cooperative relationships and agreements with Oregon State Police and Harney County Sheriff's office. |
| **Trespass Cattle** | Continue to fence in certain refuge boundary areas to minimize trespass cattle.<br>Improve all fencing in certain refuge boundary areas to minimize trespass cattle. |
| **Transportation** | |
| **Public Roads** | Maintain current refuge public roads at:<br>• 42-mile Blitzen Valley auto tour route (Center Patrol Road)<br>• Krumbo Reservoir<br>• P Lane<br>Enhance:<br>• 42-mile Blitzen Valley auto tour route (Center Patrol Road)<br>• P Lane<br>• Boat Landing Road<br>• East Canal Road to the confluence of Bridge Creek<br>• Double-O Road<br>• Saddle Butte hunt access |

| Management Theme | Management Direction |
|---|---|
| **Pull-offs** | Develop additional vehicle pull-offs (1-2 vehicle lengths) at:<br>• Boat Landing Road<br>• 42-mile Blitzen Valley auto tour route (Center Patrol Road)<br>• Krumbo Lane<br>• East Canal Road to the confluence of Bridge Creek |
| **Parking Areas** | Develop additional parking areas at:<br>• Bridge on Boat Landing Road<br>• Airboat launch site (to ADA standards)<br>• East Canal at the confluence of Bridge Creek |
| **Cultural Resources** | |
| **Cultural Resource Management and Protection** | • Prohibit access to sensitive areas. Continue law enforcement patrols to monitor and protect cultural resources. Continue cultural resource surveys in advance of program projects where soil disturbance may occur. Coordinate with the Burns Paiute Tribe on cultural resource issues. No cultural resources management plans.<br>• Develop and implement step down cultural resource management plans for historic sites and archaeological areas<br>• Increase monitoring, inventory, and protection of cultural resources |
| **Opportunities for Native American Uses** | Expand opportunities for Native American uses by increasing the type and quantity of species of native plants used for traditional uses |
| **Cultural Resource Interpretation and Education** | • Expand interpretation to improve awareness and appreciation of refuge cultural resources<br>• Develop and implement site specific interpretive plans for Sod House Ranch, P Ranch, Benson Pond and the Double-O Ranch |
| **Paleontological Resources** | |
| **Paleontological Resource Management and Protection** | Prohibit access to sensitive areas. Continue law enforcement patrols to monitor and protect paleontological resources. No paleontological resources management plan.<br>Develop and implement a paleontological resources management plan. |
| **Paleontological Resource Interpretation and Education** | Provide interpretation to instill appreciation for the Refuge's paleontological resources and the valuable information they can yield about past environments. |

## 2.5 Goals, Objectives, and Strategies

Goals and objectives are the unifying elements of successful refuge management. They identify and focus management priorities, resolve issues, and link to refuge purposes, Service policy, and the Refuge System mission.

A CCP describes management actions that help bring a refuge closer to its vision. A vision broadly reflects the refuge purposes, the Refuge System mission and goals, other statutory requirements, and larger-scale plans as appropriate. Goals then define general targets in support of the vision, followed by objectives that direct effort into incremental and measurable steps toward achieving those goals. Finally, strategies identify specific tools and actions to accomplish objectives (USFWS 2002).

In the development of this CCP, the Service also prepared an EIS. The EIS evaluates alternative sets of management actions derived from a variety of management goals, objectives, and implementation strategies.

The goals for Malheur Refuge over the next 15 years under the CCP are presented on the following pages. Each goal is followed by the objectives that pertain to that goal.

The goal order does not imply any priority in this CCP. Priorities are described in the narrative above and further developed in Appendix C.

***Readers, please note the following:***

- Below each objective statement are the management strategies that could be employed in order to accomplish it.
- Ranges in habitat acres capture the geographical extent of habitat types and not the quality of habitats, which is influenced by varying climatic conditions (e.g., low to high water years). Such variations do not typically cause dramatic shifts between habitats but do affect the plant communities found within the habitat types. Malheur Lake is an exception because widely fluctuating water levels do cause dramatic shifts in habitat types (i.e., salt desert scrub to lacustrine).

## GOAL 1. Enhance aquatic health and habitat conditions essential to the conservation of the flora and fauna that depend on Malheur Lake and associated water bodies.

| **Objective 1a. Lacustrine (Malheur and Mud lakes)** |
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| Throughout the life of the CCP, enhance and maintain 500 to 110,000 acres for the health of the lake basin and associated terrestrial successional cycles of the lake systems on Malheur Refuge. American white pelican (*Pelecanus erythrorhynchos*), northern shoveler (*Anas clypeata*), canvasback (*Aythya valisineria*), and tui chub (*Gila bicolor*) will be used to evaluate habitat conditions that indicate ecosystem health for this unique marsh system. Desirable characteristics of Malheur and Mud lakes include: |

- Emergent vegetation is mainly hardstem bulrush (*Scirpus acuta*), bur-reed (*Sparganium eurycarpum*), cattail (*Typha* spp.), and Baltic rush (*Juncus balticus*) and will vary in abundance depending on lake level, topography, water chemistry, wind/wave action, etc. The western portion of Malheur Lake (west of Graves Point) has the greatest opportunity to achieve hemi-marsh conditions (approximately half marsh and half open water).
- >40% cover of submergents (e.g., sago pondweed (*Stuckenia pectinata*)), associated with low turbid water conditions and maximum depth distribution in areas protected from extensive wave action.
- Russian olive (*Elaeagnus angustifolia L.*) and salt cedar (*Tamarix ramosissima*) will be absent around lakeshore or in adjacent habitats.

- Less than 100 pounds of carp per acre. This overall threshold is influenced by a multitude of factors (water quality, response of aquatic life, water depth, etc.) and may be adjusted as monitoring and inventory activities continue over time (Bajer et al. 2009).
- Provide habitat conducive to supporting viable populations of fishes such as redband trout, bridgelip suckers (*Catostomus columbianus*), and tui chubs.
- Diverse invertebrate community, including crustaceans, midges, aquatic worms, dragonflies, snails, mussels and water beetles.
- <10% cover of established noxious weed species (e.g., perennial pepperweed) per designated management area.

| **Strategies Applied to Achieve Objective** |
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| Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. |
| Continue to use opportunistic approaches (i.e., the use of piscicide rotenone at low lake levels) to rapidly lower carp populations. |
| Conduct research to understand carp population dynamics and seasonal movements. |
| Conduct research to understand relationships among water chemistry, lake levels, and habitat/migratory bird responses in lakes. |
| Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the lakes. |
| Investigate and implement aggressive control strategies appropriate to the Refuge, based on assessment and research findings. Control strategies could include, but not be limited to, the application of piscicide, chemo-attractants, chemo-repellants, barriers, commercial harvest, angling, and water manipulation. |
| Consider the need for continued amendments to and the construction of additional strategically placed in-stream structures (i.e., traps, screens, and fish wheels) that address native fish passage issues and the prohibition of carp movement through the system. |
| Develop partnerships to address water quality, vegetation, and carp control issues within the Harney Basin. |
| Enhance emergent vegetation within the lake system via carp exclosures, wind breaks, etc. |
| Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. |

**Rationale:**

Common carp were introduced into the Silvies River watershed in the early 1920s. The Silvies River has intermittent connectivity with Malheur Lake. During times of connectivity, carp and other fish species have free passage to the lake. Prior to carp infestation, a diversity of submerged and emergent vegetation was abundant. By 1952, carp activity had created such turbidity that desirable submerged aquatic plants were nearly eliminated. In 1955 the carp population was controlled with rotenone, a fish toxicant or piscicide. It is estimated that 1.5 million carp, averaging 20 to 25 inches in length, were killed. The beneficial effect was demonstrated the next year, when sago pondweed showed an immediate response to improved growing conditions and covered 15,000 acres. Intensive efforts to control carp using rotenone continued in subsequent decades and realized similarly positive, yet fleeting, responses.

Over time, however, responses to carp control became less dramatic as the lake experienced a significant reduction in emergent vegetation and a dramatic overall decrease in bird use. A combination of prolonged negative carp impacts, high water depths, and associated ice shearing during the 1980s, followed by severe drought cycles, and possible changes in water chemistry are believed to have led to the lake's dramatically declining habitat conditions. Although emergent wetlands have persisted on the southern side and isolated patches remain primarily on the western half of the lake (Bat House Island, etc.), many large areas show little to no evidence of recovery.

Bajer et al. (2009) examined changing carp densities in a recently restored 300-hectare (ha) Midwestern lake, and found that although a carp biomass of 30 kg/ha (approximately 30 lb/acre) had no discernible effects on vegetative cover (which exceeded 90%) or waterfowl (which exceeded 150,000 individuals during fall censuses), the increase in carp biomass to 100 kg/ha (100 lb/acre) was associated with a 50% decrease in both vegetative cover and waterfowl. A further increase in carp biomass to over 250 kg/ha (250 lb/acre) coincided with a decrease in the vegetative cover to 17% of the lake's surface and a decline in waterfowl use to 10% of its value when carp were absent. Overall, the increase in carp biomass could explain 93% of the variation in waterfowl abundance decline during the 4 years studied. Although the lake studied is significantly smaller than Malheur Lake, the threshold value is the only known threshold from a field study correlating carp biomass, vegetative response, and waterfowl use.

The selection of White pelican, Northern shoveler, Canvasback, and Tui chub as focal species for this goal define the mix of open water, island, hemi-marsh, and submergent plant habitat conditions essential to restoring the diversity and abundance of wildlife that historically used this area. Pelicans used open water segments for foraging and low-lying islands for breeding. Open water areas are also used by canvasbacks for loafing during migration and submergent beds such as sago pondweed for foraging. Northern shoveler depicts the interspersion of open shallow water with stands of submernent and emergent vegetation for foraging as well as associated grasslands and rangelands for nesting needed by a variety of wildlife species. This same general habitat type is used by Tui chub for spawning and foraging with a heavier vegetation component. The chub is an essential foodbase for waterbirds, one of the primary guilds of birds intended to be preserved in the lake's acquisition.

It is not known at this time if historic levels of hemi-marsh and submergent plant communities can be attained if carp control thresholds are successfully reached and maintained. Through the life of this CCP, a comprehensive, science-based approach to carp control will be initiated to reduce the carp population to the targeted threshold of 100 pounds of carp per acre. Lake rehabilitation efforts will involve the assessment of current water quality and habitat conditions, site potential, and vegetative trends, and these efforts will seek to increase our understanding of common carp's biotic potential, carrying capacity, density-dependent factors, distribution, and susceptibilities within the lake and connected aquatic systems. The understanding gained through these efforts will assist refuge staff and partners in increasing the productivity of Malheur Lake, once a significant resource in the Pacific Flyway. Increased partnerships with subject-matter experts and funding agencies will be the key to this effort's success.

## GOAL 2. Monitor, protect, maintain, and/or rehabilitate riverine habitats to conditions essential for the conservation of native fish and wildlife species.

**Objective 2a. Riverine (rivers and associated tributaries terminating on the Refuge): Develop an Integrated Wetland/River Rehabilitation Plan and Associated NEPA Document with Partners**

Throughout the life of the CCP, necessary information will be gathered to develop a comprehensive rehabilitation plan for targeted river systems[2] and floodplain habitats. Information concerning biological, physical, and management attributes of these habitats will be gathered through specific assessments, pilot projects, and modeling (see Objectives 13b and 13c). This information will contribute to developing a decision support system that will allow comparisons among various alternatives in achieving management objectives and establish tools necessary to support development of a comprehensive riverine/wetland rehabilitation plan.

Pending the above approach for gaining understanding of pertinent riverine systems, desirable characteristics of riverine habitats for redband trout, other fish species, and native wildlife within the Refuge include:

- Water quality (e.g., maximum water temperature of <20°C, dissolved oxygen, turbidity, etc. within Oregon standards or exhibit no additional degradation attributable to refuge management actions)
- Native fish habitat (i.e., redband trout): stream shading (>80%); bank cover (no bare soil); bank stability (<5% eroding); channel stability (<1% channel movement); fine sediment <2 mm (<10%); cover (>50% of channel [Zoellick and Cade 2006]); percent late summer pools (25%-75%); and mean annual base flow (>45% of annual flow) (Raleigh et al. 1984)
- Connectivity among habitats (i.e., unimpeded passage within channels, floodplain regularly flooded, continuous site-appropriate vegetation along riparian zones)
- Channel form and substrate composition consistent with geomorphic and hydrologic setting

**Strategies Applied to Achieve Objective**

Initiate process necessary to complete wetland/riverine strategic plan and associated NEPA documentation.

**Rationale:**

Using information and research gleaned from assessments and pilot projects (see Objectives 13b and 13c), an integrated wetland/riverine strategic plan will be pursued to consider if rehabilitation is needed and various alternatives for river restoration; weigh the biological, cultural, economic, and social benefits and costs; and determine a future course of action supporting desired ecological outcomes. A three-tiered process will be required to develop the management plan: (1) identification of management objectives and assessment of hydrologic, geomorphic, and biologic features associated with target riverine systems (e.g., Blitzen River) and associated wetlands; (2) implementation of riverine pilot projects to evaluate biological and physical responses to management action and assess management objectives; and (3) development of a decision support system to support an integrated wetland/river rehabilitation plan and associated NEPA process (and resulting documentation) with partners.

[2] Refuge riverine systems include the Blitzen, Silver Creek, and Silvies watersheds.

Redband trout is designated as the focal species for riverine habitat. Redband need a stable free-flowing stream with a mix of channels, riffles, and pools as well as shading along various river reaches to support the year-round requirements of this species as well as a variety of other native fish and wildlife. This will provide the cornerstone for the three-tiered assessment process used in development of a wetland/river rehabilitation plan.

The management direction was formulated to emphasize carp control while moving forward strategically with the riverine strategy. It follows a three-tiered process leading toward a strategic plan but allows for flexibility in the amount of progress that is made depending on the availability of resources and success related to carp control on the Refuge. It offers the advantage of using other available resources if they become available through agency funding, and partnerships. Another advantage of the management direction is that a greater understanding of the impacts on adjacent floodplain habitats will be gained over a longer study period, enabling the development of site-specific knowledge of how riverine, wet meadow, and marsh communities would respond to hydrologic system changes. The management direction will use a science-based process to inform decisions regarding the river to determine existing biological conditions and site capability. The Refuge will work with the Ecology Work Group and other stakeholders within the first 5 years of the CCP to prioritize and refine a set of priority questions/objectives (see Objectives 13b and 13c), creating a foundation to construct a comprehensive riverine strategy. Based on these questions/objectives the Refuge will take advantage of new resource opportunities to implement appropriate science-based steps to continue the advancement of a comprehensive river strategy.

**Objective 2b. Riverine**

Throughout the life of the CCP, enhance and maintain the aquatic health of the riverine systems of Malheur Refuge for the benefit of redband trout and other priority resource species by doing inventory and monitoring of biotic and abiotic factors and conducting research pertaining to carp control.

Desired characteristics of Riverine include:

- Native and localized fish populations thriving and invasive carp population controlled
- Screened diversions and effluents pertaining to the river water delivery system
- Diverse invertebrate community, including crustaceans, midges, aquatic worms, dragonflies, snails, mussels and water beetles.

| Strategies Applied to Achieve Objective |
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| Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. |
| Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. |
| Conduct research to understand carp population dynamics and seasonal movements. |
| Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. |

**Rationale:**

Yellow warblers, willow flycatchers, and associated benefitting species require dense thickets of deciduous riparian shrubs dominated by various willow species and occasionally interspersed with other shrubs and hardwood trees for feeding, reproduction, and migration. With these species almost entirely restricted to river corridors in this arid region the condition of this habitat is vitally important.

The riverine system of the Malheur Refuge is an integral part of the success or failure of many habitat types. For the life of this CCP, the focus will be on collecting data of biotic and abiotic parameters and finding ways to control carp. The recent addition of fish passage ladders, traps, and screens on the

Blitzen River have decreased thousand of acres that were available for spawning and juvenile rearing of common carp. In addition, this has decreased the number of redband trout and other species from entrainment in the irrigation system. The Silvies and Silver River health will be pursued by collaborating with landowners and other partners to focus on carp control.

## GOAL 3. Protect, maintain, and rehabilitate riparian habitats to conditions essential for the conservation of wildlife species.

### Objective 3a. Woody Riparian

Throughout the life of the CCP, enhance and maintain 1,000 to 1,500 acres of riparian shrub habitat on Malheur Refuge for the benefit of migratory land birds (e.g., yellow warbler (*Dendroica petechia*), willow flycatcher (*Empidonax traillii*)) and other wildlife. Desired characteristics of riparian shrub include:

- 40%-80% canopy cover of native shrub species (e.g., coyote willow (*Salix exigua Nutt*.), hawthorn (*Crataegus L*.), redosier dogwood (*Cornus sericea L*.), goose berry (*Ribes hirtellum*), Wood's rose (*Rosa woodsii*)) that are >3 feet tall in areas associated with flood irrigation or shallow water table
- >10% cover of understory native herbaceous species (e.g., sedges, rushes, spike bentgrass (*Agrostis exarata*), cinquefoil (*Potentilla L*.), false lupine (*Thermopsis villosa*))<5% cover of reed canarygrass and noxious species

**Strategies Applied to Achieve Objective**

Improve native plant cover and distribution by active planting or seeding appropriate native species.

Exclude livestock from riparian habitats adjacent to meadow areas receiving grazing treatments (e.g., temporary or permanent fencing).

Promote riparian shrub health (e.g., prescribed fire and mechanical removals to stimulate new growth and suckering), especially in decadent stands.

Permanently exclude grazing from streamside corridors (Appendix K).

Manipulate soil moisture in riparian areas outside of the naturally occurring floodplain (e.g., flood irrigation associated with meadow management).

Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G).

**Rationale:**

Yellow warblers, willow flycatchers, and associated benefitting species require dense thickets of deciduous riparian shrubs for feeding and/or reproduction. This objective and associated strategies seek to maximize shrub density while managing for periodic disturbance to reinvigorate woody riparian stands. The greatest negative impact to riparian shrub habitat over the last century has been past grazing practices and the purposeful eradication of riparian habitats throughout the Blitzen Valley. In recent years, livestock grazing and other impacts to woody riparian communities have been significantly reduced. The result has been an increase in both the quantity and quality of this habitat type on the Refuge. In order to continue this upward trend, it will be necessary to protect these and additional potential woody riparian areas from unnecessary impacts. In target areas that are either disconnected from the floodplain, or lie outside of floodplain areas, supplemental soil moisture via flood irrigation will be used to sustain existing acres of this habitat and promote its expansion. Strategic planting will be used to increase shrub species diversity, particularly along waterways, and may include native shrubs such as various willows (e.g., beak, Drummond's, Geyer, Lemmon's Pacific, and yellow), black hawthorn, chokecherry, golden currant, Lewis' mock orange, redosier dogwood, Saskatoon serviceberry, silver buffaloberry, and water birch. Prescribed fire and mowing treatments will be infrequent and balanced by the need for older stands of dense, undisturbed willow/shrub areas according to focal species needs and designated acreages.

The vast majority of this habitat is located in the southern Blitzen Valley and extends northward along the Blitzen River and associated waterways and adjacent to impoundments. This habitat is not prolific in the Double-O Unit due to prevailing soil conditions (i.e., alkalinity) and only occurs there in isolated areas.

## GOAL 4. Enhance, protect, and/or maintain primary habitats essential to the conservation of a diversity of aquatic and terrestrial wildlife species.

**Objective 4a. Palustrine Emergent (seasonally flooded wet meadow)**

Throughout the life of the CCP, enhance and maintain 22,000 to 27,000 acres of moist/wet meadow habitat on Malheur Refuge for the benefit of migratory birds (e.g., bobolink (*Dolichonyx oryzivorus*), sandhill crane, cinnamon teal (*Anas cyanoptera*)), and a diverse assemblage of other wildlife (e.g., Columbia spotted frog (*Rana luteiventris*)). Desired characteristics of moist/wet meadow habitat include:

- Irrigation depths ranging from 0 inches (subirrigation) to 5 inches of standing water
- >75% cover of perennial grasses, rushes, and sedges
- 15%-20% cover of forbs such as lupine, clover, and cinquefoils
- <20% cover of reed canarygrass
- <5% cover of noxious weeds (e.g., perennial pepperweed and Canada thistle)
- Grass height of treated acres <6 inches by October 1
- Maintain site vigor (i.e., prevent excessive litter accumulation from hindering diversity and expression of plant species)
- >50% of stems in a vertical or semivertical position for nesting waterfowl and other wildlife
- No willows
- Intake and effluent water screened or manipulated to stop influx of carp during spawning and juvenile rearing

| **Strategies Applied to Achieve Objective** |
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| Maintain/enhance management units within this habitat type through the use of prescribed fire, haying, rake-bunch grazing, and rest from defoliation. |
| Maintain/enhance management units within this habitat type through the use of active successional vegetation management (e.g., seeding, disking, grazing, grain farming, etc.). |
| Use tolerance thresholds specific to each plant community as determined through the Malheur Refuge State-and-Transition Model (Appendix L) to influence management prescriptions to meet annual and long-term wet meadow habitat objectives. |
| Use both winter and summer water rights in flood irrigation. Commencement and duration will depend |

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| on site-specific objectives. |
| Modify dikes, ditches, and other infrastructure as needed to reclaim acres lost to cattail encroachment (e.g., Northwest Big Sagebrush field). |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. |
| Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. |
| Conduct research to understand carp population dynamics and seasonal movements. |
| Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. |
| Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type. |
| Enhance water control structures to stop the influx of spawning carp and juvenile rearing. |
| **Rationale:**<br>Cinnamon teal, greater sandhill crane, and bobolink have been designated as focal species for palustrine emergent seasonally flooded wet meadows. Cinnamon teal nest near water in rushes, sedges, and grasses or occasionally over water in dense bulrush and cattails and move to nearby large wetlands for molting and brood development. The sandhill crane nests in isolated emergent vegetation within expanses of wet marshy meadows and forage in these same locations. The bobolink uses irrigated lowland wet meadows within the refuge landscape. They prefer transitional areas between wetter and drier sites dominated by dense stands of vegetation with a high percentage grass and moderate percentage of forbs and good litter density.<br>The Refuge provides much needed wetland habitat within the Pacific Flyway. Refuge wetlands have long been managed under prescriptions necessary to meet the needs of migrating and reproducing waterbirds and waterfowl. Unfortunately, these same prescriptions can cause undesirable plant community transitions. This dilemma creates a need for a creative and flexible new management paradigm. For example, warm-season cattail treatments may need to take place in areas experiencing encroachment of meadows by cattail (e.g., the lower Buena Vista Unit). Although extended irrigation schedules encourage this problem in some areas, they also play a significant role in meeting critical needs during various stages of wildlife reproduction and development. Therefore, the cessation of such a practice may not be desirable.<br>The CCP will begin with a 60:40 ratio of treated to untreated meadow, which was arrived at by examining past and current management practices (Blitzen Valley and Double-O Management Plans), consulting with former refuge biologists and flyway experts, and carefully examining life stage requirements for various wildlife species that use this habitat throughout the year (see Appendix K). It represents a starting point to test the efficacy of the haying and grazing program to achieve wet meadow objectives. This ratio is relevant only when considering all wet meadows within the Refuge and differs across fields and area-specific management units. The needs of focal species, the suite of wildlife they represent, and the nature of habitats they depend on determines the use and extent of these tools in realizing or maintaining attributes identified under this objective. This ratio provides an understanding of the overall use of haying and grazing but does not address the specific needs of wildlife in specific areas. These tools will be carefully evaluated on an annual basis by the science advisory team and adjusted relative to their efficacy in terms of achieving refuge objectives. The 60:40 ratio is meant to be illustrative, not definitive. Key to this approach is a recognition that haying and grazing is a tool to achieve desired habitat conditions as opposed to an objective unto itself. To ensure long-term habitat integrity of at-risk wet meadows, a combination of irrigation schedule adjustments, |

the designation of alternative suitable acres to meet irrigation prescriptions, or warm-season treatments may be used. Associated changes in water management that make these areas less susceptible to cattail expansion will be sought if alternative suitable acres are available to meet irrigation prescriptions. Treatments may include the use of livestock on reed canarygrass monocultures or the use of a marsh master (i.e., mowing), aerial application of appropriate pesticide, among other methods to set back cattail stands.

Mesic wet meadow areas may be placed on a rest-rotation schedule and forego defoliating treatment for periods suitable to site-specific conditions and associated wildlife habitat objectives (>50% vertical stems, etc.). Although most dense vegetative nesting is encouraged in marsh or dry meadow/sagebrush lowland/salt desert scrub sites, wet meadow areas less prone to flooding after the initiation of nesting activities can provide valuable breeding habitat for a variety of avian species.

In many refuge management units, topographic heterogeneity plays a significant role in providing for the habitat needs of a diversity of wildlife species. Variations in depth to water table allow for a variety of plant assemblages to be expressed across the landscape. Extra care is needed in areas where gradients in elevation occur with less frequency. In the former situation, prolonged irrigation may meet nesting and foraging needs of waterfowl and cranes without crossing thresholds that lead to significant decreases in forb and grass species and susceptibility to cattail and reed canarygrass invasion. In the latter situation, irrigation can strongly influence the long-term viability of the site for wildlife use.

In many areas, topographic diversity has been greatly reduced by past farming practices involving disking, plowing, and other ground-leveling disturbances. This is why it is important to remain cognizant of hydrological gradients that can drive plant community expression and subsequent habitat quality and availability for a number of target wildlife species. Sandhill cranes and bobolinks were both selected as focal species for this habitat type because they tend to prefer conditions on opposite ends of the moist-to-wet meadow gradient that exists for this habitat type. It is important to establish irrigation prescriptions that accommodate the habitat needs of both species. By carefully identifying priority areas for both focal species and regarding the larger plant successional characteristics that are involved in meadow management to meet prescriptions long-term, dynamic management will seek to maintain or enhance the integrity of this habitat type in areas where dynamic, yet subtle shifts in topography have been compromised or an unacceptable percentage of plant assemblages is shifting toward undesirable species such as reed canarygrass or hybrid/common cattail.

Treatments may be applied during the growing or dormant season, depending on a science-based rationale. Due consideration will be given for late nesting requirements. Grazing may take the form of rake-bunching for litter management and to provide for migrants and early arriving wildlife. The use of livestock may be prescribed during the growing season in designated areas to influence plant community succession (see Appendix K).

Grain farming may be used as a tool to facilitate a significant successional shift toward more desirable plant communities. This approach is appropriate when conditions merit the manipulation of the existing soil propagule bank (e.g., seeds, tubers, rhizomes). The intensive annual management needed for grain production can drive undesirable plant species from the treatment area and allow a transition to more favorable species. Under this type of strategy, the cessation of farming will coincide with assisted/controlled colonization of desirable species.

Enhancement of water control structures on the intake and outflow of this habitat is an integral way to control spawning and rearing of juvenile common carp. By installing/maintaining fish screens or modifying the current water control structures the acres inhabitated by carp will sharply decrease and the food source for birds will increase.

**Objective 4b. Palustrine Emergent (seasonally flooded marsh associated with wet meadow)**

Throughout the life of the CCP, enhance and/or maintain 15,000 to 16,000 acres of emergent marsh on Malheur Refuge (excluding marshes associated with Malheur Lake) for the benefit of migratory birds (e.g., yellow-headed blackbird, sandhill crane, redhead, bittern, mallard) and a diverse assemblage of other wetland-dependent wildlife (beaver, muskrat, native amphibians, and reptiles). Emergent marsh generally occurs within a mosaic of moist/wet meadows. Desired characteristics of emergent marsh within this habitat complex include:

- Dominated by emergents (favoring hardstem bulrush and burreed while de-emphasizing cattails)
- Water depths ranging from 6 inches to 3 feet
- Irrigated in concert with associated wet meadows. Typically flooded by mid-March for breeding/nesting migratory birds and inundated until at least July 1
- 20%-40% open water for foraging wetland birds in areas of continuous marsh >10 acres in size
- Open water areas host submergents (e.g., sago pondweed)
- No carp or Eurasian water milfoil (Myriophyllum spicatum L.)
- Intake and effluent water screened or manipulated to stop influx of carp during spawning and juvenile rearing
- <20% cover invasive plants (e.g., reed canarygrass, common reed (*phragmites* spp., hybrid cattail)
- Diverse invertebrate community, including crustaceans, midges, aquatic worms, dragonflies, snails, mussels, and water beetles.

| **Strategies Applied to Achieve Objective** |
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| Reduce extensive emergent cover using prescribed fire, disking, herbicides, and mowing. |
| Facilitate treatment of extensive emergents and/or carp control using periodic drawdowns. |
| Ensure water delivery and management through maintenance or enhancement of infrastructure (e.g., delivery ditches, water control structure). |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. |
| Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. |
| Conduct research to understand carp population dynamics and seasonal movements. |
| Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. |
| Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type. |
| Enhance water control structures to stop the influx of spawning carp and juvenile rearing. |

**Rationale:**

Palustrine emergent seasonally flooded marsh associated with wet meadow is usually found immediately adjacent to our irrigated meadow system. Sandhill crane and yellow-headed blackbird, focal species for this habitat, require nesting sites over or near water in dense emergent stands of cattail, bulrush, or reeds, which predominate on these sites. They forage on the abundance of insects, macro-invertebrates, and other small wildlife species found in this environment during brood rearing. The adjacent meadows are used later in the year for summer foraging and staging for the fall migration. This blend of habits is central to the success of these birds and other associated wildlife species. Managing toward 20%-40% open water in emergent stands associated with wet meadows provides optimum conditions for the greatest diversity of dependent species. Diverging from this range in either direction decreases overall wildlife diversity and abundance; however, it may not be practical to meet this prescription for every acre across this habitat type due to its quantity and the limited availability of resources. Priority will be given to areas directly adjacent to the most productive wet meadows. Seasonal marshes should be irrigated simultaneously with wet meadows since the two are generally connected hydrologically, as well as biologically in terms of wildlife use.

The above-mentioned strategies (mowing, grazing, burning, deep flooding, prescribed drought, plowing, herbicides, etc.) can generally reduce the density of emergent vegetation in direct relation to the intensity of the treatment. The plant species composition of specific target areas will determine appropriate management actions because some species are preferred over others (e.g., bulrush at the expense of cattail), and species such as burreed are more sensitive to disturbance than others.

The reduction of approximately 2,000 acres in this habitat type coincides with an equivalent increase in semiflooded seasonal wet meadows. This projected shift will not lead to a decrease in quality marsh habitat because the specified acreages address areas of meadow that have been invaded by cattail species.

Enhancement of water control structures on the intake and outflow of this habitat is an integral way to control spawning and rearing of juvenile common carp. By installing/maintaining fish screens or modifying the current water control structures the acres inhabited by carp will sharply decrease and the food source for birds will increase.

**Objective 4c. Palustrine Open Water/Emergent (semipermanently flooded wetland impoundment)**

Throughout the life of the CCP, protect and maintain 2,200 to 2,800 acres of semipermanently flooded wetland impoundments on Malheur Refuge for the benefit of migratory birds (e.g., trumpeter swans, sandhill crane, redheads, mallards, soras, Virginia rails, colonial waterbirds) and other wetland-dependent species (beaver, muskrat, native amphibians and reptiles). The desired characteristics sought for this habitat type include:

- Between 40:60 and 60:40 ratio of open water to emergent plant cover in individual units (with the exception of Boca Lake, which will be managed for <20% emergent marsh cover, and West Knox Pond, which will be managed primarily as a moist soil unit)
- Emergent species include bulrush (predominantly hardstem), burreed, and cattail (predominantly common)
- Water depths ranging from 6 inches to 3 feet
- Permanently flooded with drawdowns every three to seven years (with the exception of West Knox Pond, which will be managed primarily as a seasonal wetland [i.e., moist soil unit] and Boca Lake, where water levels will fluctuate more frequently to meet annual seed production goals and carp control)
- >40% cover of submergents (e.g., sago pondweed) within open water
- No carp or Eurasian water milfoil (Myriophyllum spicatum L.)
- <10% cover invasive plants (e.g., reed canarygrass, phragmites, hybrid cattail)
- Diverse invertebrate community, including crustaceans, midges, aquatic worms, dragonflies, snails, mussels and water beetles.

**Strategies Applied to Achieve Objective**

Deliver and manage water through maintenance or enhancement of infrastructure (e.g., delivery ditches, water control structure). Address needs associated with spotted frog refugia in identified areas (e.g., East Canal, Five Mile Spring within West Canal, etc.).

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| Use prescribed fire to remove extensive emergent cover. |
| Use disking to remove extensive emergent cover. |
| Use mowing to remove extensive emergent cover. |
| Apply herbicide(s) to control emergents. |
| Experiment with grazing as a tool in monotypic stands of emergent cover to set back succession. |
| Manage water levels by flooding up and drawing down for habitat and carp management. |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. |
| Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. |
| Conduct research to understand carp population dynamics and seasonal movements. |
| Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. |
| Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type. |
| Enhance water control structures to stop the influx of spawning carp and juvenile rearing. |
| **Rationale:**<br>Palustrine open water/emergent (semi-permanently flooded wetland impoundments) are vital to migratory waterfowl and other water birds. The focal species eared grebe, redhead, and ruddy duck express the range of habitat requirements used by the wide diversity of wildlife species benefiting from this habitat. All three prefer large permanently or semi-permanently wetlands or impoundments where open water areas are interspersed with emergent and submergent vegetation tracts. Water depth is the critical factor separating how our focal species and other associated wildlife species use the habitat. The eared grebe favor abundant submergent aquatic beds linked to open water areas up to 10 feet deep to nest and forage in. The ruddy duck prefers interspersed open water and vegetation areas from 1 to 3 feet deep while redheads can be found in the same environments with water depths from a few inches to 3 feet. It should be remembered that these wetlands are critical brooding and rearing areas for the very large portion of the diversity of birds using the refuge.<br>This wetland habitat will be managed for moist soil vegetation or to provide optimum food production in the form of submergent aquatic plants and aquatic invertebrates. For shorebirds, shallow water drawdowns will provide important feeding opportunities. Emergent vegetation in marshes provides nesting cover for overwater nesters (e.g., sandhill crane, trumpeter swan, rail, redhead, bittern, canvasback, mallard, and diving ducks) and escape cover for broods of numerous species, particularly late-season nesters such as gadwall, redhead, and grebes.<br>Periodic drawdowns and deep flooding are important tools in management of pond vegetation. A gradation of water depths from mud flats to deep water pools will encourage use by a wide variety of wildlife.<br>Enhancement of water control structures on the intake and outflow of this habitat is an integral way to control spawning and rearing of juvenile common carp. By installing/maintaining fish screens or modifying the current water control structures the acres inhabitated by carp will sharply decrease and the food source for birds will increase. |

| **Objective 4d. Dry Meadow** |
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| Throughout the life of the CCP, enhance or maintain 4,500 to 5,000 acres of dry meadows on Malheur Refuge for the benefit of nesting migratory birds (e.g., cinnamon teal, northern pintail, savannah sparrow) and a diverse assemblage of other species (e.g., small mammals). The desired characteristics of dry meadow habitat include: <br>• 50%-70% cover of live native grasses (e.g., creeping wildrye)<br>• At least 20% cover of plant litter (residual)<br>• <10% cover of invasive plants (e.g., Russian knapweed (*Acroptilon repens*), pepperweed, whitetop (*Cardaria* spp.))<br>• Disturbance regime on five- to 10-year intervals to rejuvenate nesting cover (see Appendix B, Grazing and Haying Compatibility Determination, for potential uses) |
| **Strategies Applied to Achieve Objective** |
| Use agricultural practices (e.g., haying, grazing) to maintain/enhance fields to meet the habitat objective. Treatments may be applied during the growing season or dormancy, depending on a science-based rationale. |
| Use burning regimes where feasible. |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| **Rationale:**<br>Western meadowlark is the focal species for this habitat and its habitat requirements provide many of the key needs for the diversity of other wildlife using this environment. Meadowlark favor open country meadows, fields, or desert grasslands with good grass and litter cover with little or no woody layer.<br>Manipulation of vegetation via mowing, burning, or grazing will be used to stimulate vertical nesting structure (Cornely et al. 1983) and deter successional shifts away from desirable conditions (i.e., shrub encroachment could be controlled through the use of prescribed fire). Prescribed fire is the preferred tool for stimulating this habitat type because it is also the most effective tool for controlling sagebrush encroachment from adjacent upland habitats and has the highest potential for stimulating a favorable forb response. If perennial pepperweed and/or other noxious species pose a threat to areas needing treatment, then mowing will be the preferred tool. Mechanical treatments can be advantageous on weed-prone sites because the amount of resources (e.g., nutrients) released by this management action is less than that released by prescribed fire. If mowing is not feasible due to the presence of rocks, shrub stumps, or other obstacles, then late-season grazing may be implemented.<br>Warm-season grazing or other manipulations as directed by the Malheur Refuge State-and-Transition Model (see Appendix L) and associated collaborative process may be merited in specific situations where target plant community characteristics are at risk or are no longer present (e.g., increasing dominance of Russian knapweed).<br>When desirable characteristics for this habitat type are achieved, site productivity and plant species composition will determine the frequency and specific type of disturbance on a field-by-field basis. Treatments should be infrequent because many avian species prefer to nest in dry meadows consisting of dense residual vegetation. |

| Objective 4e. Salt Desert Scrub |
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| Throughout the life of the CCP, protect and maintain 40,000 acres of salt desert scrub for the benefit of breeding migratory birds (e.g., sage thrasher, sage sparrow) and other native wildlife species (e.g., kangaroo rats (*Sorex preblei*), grasshopper mouse (*Onychomys leucogaster*)) on Malheur Refuge. The desired characteristics of desert salt scrub and greasewood habitat include: <br>• <15% cover of scattered patches of shrubs (e.g., greasewood)<br>• <20% cover of native herbaceous species<br>• >20% cover bare ground<br>• Microbiotic crust present<br>• <10% cover of invasive plants<br>• Minimal human disturbance |
| **Strategies Applied to Achieve Objective** |
| Protect existing sensitive sites with microbiotic crusts. |
| Use prescribed fire depending on site-specific factors. |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| **Rationale:**<br>Aside from periodic weed control and prescribed fire, this habitat type does not receive a significant amount of active management.<br>The habitat preferences of loggerhead shrike of open terrain with low density of shrubs mixed with low or sparse grasses characterize the needs of other wildlife species typically found in the settings. |

| Objective 4f. Sagebrush Lowland |
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| Throughout the life of the CCP, protect and maintain 4,300 to 4,500 acres of lowland big sagebrush habitats (e.g., basin big sagebrush, Wyoming big sagebrush, basin wildrye, Indian ricegrass, Sandberg's bluegrass, bottlebrush squirreltail, etc.) for the benefit of ground nesting migratory birds (e.g., gadwall, short-eared owl, meadowlark) and a diverse assemblage of native species (e.g., small mammals). At any time, 40% of the sagebrush lowland habitat on the Refuge is characterized by the following attributes: <br>• 0%-12% canopy cover of dominant and subdominant brush species (e.g., basin big sagebrush, Wyoming big sagebrush, greasewood, rabbit brush, horse brush)<br>• 10%-25% cover of native bunchgrasses (e.g., great basin wildrye, Sandberg's bluegrass, etc.) and forbs<br>• >5% cover of residual bunchgrasses<br>• <10% cover invasive plants (e.g., pepperweed, knapweeds) |
| **Strategies Applied to Achieve Objective** |
| Use prescribed fire. |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to |

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| control/eradicate invasive plants (see Appendix G). |
| **Rationale:**<br>Mallard and gadwall are focal species for sagebrush lowland and in this region prefer islands of brushy shrubland mixed with clumps of native bunchgrasses in the vicinity of water.<br>Aside from periodic weed control and prescribed fire, this habitat type does not require a significant amount of active management. |

**Objective 4g. Sagebrush Steppe**

Throughout the life of the CCP, protect and maintain 15,500 acres of sagebrush steppe upland habitat on Malheur Refuge for the benefit of migratory landbirds (e.g., sage sparrow, brewer sparrow, sage thrasher) and a diverse assemblage of other sagebrush-obligate species (e.g., jackrabbit, mule deer). Desired characteristics of sagebrush steppe habitat to achieve include:

- 0%-20% canopy cover of sagebrush species (e.g., Wyoming sagebrush, rabbit brush, bitterbrush)
- >5% cover of bunchgrasses (e.g., Idaho, fescue, Sandberg's bluegrass, bluebunch wheatgrass)
- 3%-5% cover of native forbs (e.g., western yarrow, arrowleaf balsam root, lupine)
- No medusahead or young juniper present
- 5% cover of cheatgrass
- <5% cover of other invasive plants

| **Strategies Applied to Achieve Objective** |
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| Add diversity to crested wheatgrass monocultures using best science practices (i.e., Krumbo research project). |
| Mimic natural disturbance process in sagebrush communities using mechanical and chemical methods to promote bunchgrasses and forbs. |
| Seed desirable grasses and forbs. |
| Use prescribed fire, where appropriate, and based upon site-specific conditions. |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| **Rationale:**<br>Wildlife use in this sagebrush landscape is dominated by rangeland passerine birds with the sage thrasher designated as the focal species. The thrasher favors large contiguous tracts of open terrain covered with high density of shrubs with a scattered herbaceous layer. These habitat elements also support a number of mammals such as the pronghorn antelope as well as other wildlife species.<br>Aside from periodic weed control and limited prescribed disturbance, this habitat type does not require a significant amount of active management. Research is currently being conducted on the Refuge to address the lack of species diversity in areas that were historically seeded into crested wheatgrass following wildfire. Depending on research results, some successional management may occur on these sites, but wetland habitat management will continue to receive highest management priority. |

| Objective 4h. Dune |
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| Throughout the life of the CCP, protect and maintain 6,300 acres of dune habitat on Malheur Refuge. Desired characteristics of dune habitats include:<br>• Open sand dunes hosting widely spaced shrubs (e.g., shortspine horsebrush, fourwing saltbush, bud sagebrush, green and gray rabbitbrush, greasewood, and Basin big sagebrush), grasses (e.g., Indian ricegrass, needle-and-thread, bottlebrush squirreltail, alkali sacaton), and forbs (e.g., tufted evening primrose, Paiute suncup, Geyer's milkvetch, sharpleaf penstemon, various lupines)<br>• Soil formation by lacustrine sands is neutral to moderately alkaline (8.2); moist in the winter and spring and usually dry June through October<br>• Host rare and unique invertebrates  |
| **Strategies Applied to Achieve Objective** |
| Protect dune areas from disturbance (e.g., well-maintained boundary fences). |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| **Rationale:**<br>The sage sparrow has been defined as the focal species for this environment. The habitat needs of this bird as well as associated wildlife species readily describe the landscape. It prefers tracts of widely spaced shrubs surrounded with open patches of bare soil or sand and lightly scattered grasses and forbs. Aside from periodic weed control, this habitat type does not require a significant amount of active management. |

| Objective 4i. Playa |
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| Throughout the life of the CCP, protect and maintain 29,000 acres of playa on Malheur Refuge for the benefit of migratory birds (e.g., snowy plover) and associated guilds. The desired characteristics of playa habitats include:<br>• Retention of hypersaline conditions where appropriate (avoid dilution caused by freshwater irrigation)<br>• Water depth ranges from hydrated soils to 3-4 feet<br>• Bare ground with little vegetation (e.g., saltgrass, shrub, herbaceous cover)<br>• Recharge through springs or natural overland flow<br>• High populations of brine flies and brine shrimp<br>• Retention of fringe habitats consisting of dunes, salt desert scrub, and mudflat habitats<br>• No salt cedar present  |
| **Strategies Applied to Achieve Objective** |
| Prevent freshwater irrigation from negatively impacting water chemistry. |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| **Rationale:**<br>This unique environment is well defined by the habitat needs of its focal species, the snowy plover. |

This bird favors barren, sparsely vegetated alkaline flats usually with an adjacent very shallow gloss of water within a mile.
Aside from periodic weed control around perimeters, this habitat type does not require a significant amount of active management.

**Objective 4j. Provide Agricultural Crops for Migratory Waterfowl and Sandhill Cranes**

Throughout the life of the CCP, annually provide approximately 80 to 1,000 acres of small grains (e.g., wheat, barley) as forage for migrating aquatic birds (e.g., waterfowl, sandhill crane) and other resident wildlife. The desired characteristics of agricultural lands cropped in small grains include:

- Fall harvesting completed by October
- ≤1,000 acres as short-stature small grains available during mid-fall to mid-winter
- Limited presence of invasive plants

**Strategies Applied to Achieve Objective**

Use traditional agricultural practices (cultivating, seeding, fertilizing) to produce grain crops.

Conduct cropland management through cooperative farming agreement and/or refuge staff.

Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G).

**Rationale:**

Grain farming in the Blitzen Valley is essential to meeting Refuge objectives for fall maintenance of greater sandhill cranes. Grain crops on the Refuge and adjacent private lands provide for a large population of staging and migrating cranes in fall, and are recommended under the Greater Sandhill Crane (Central Valley Population) Pacific Flyway Plan (Pacific Flyway Council 1997). Analysis has determined that 190 tons of grain is required to meet 225,000 crane use-days (Rule et al. 1990). This is the target number of crane use-days, based on historical crane use on the Refuge. The average yield per acre in the Blitzen Valley is 1 ton per acre. Currently the acres farmed on the Refuge have the potential to meet about half this target, but the force-account (Refuge staff conducts farming) method of grain production results in the grain availability being less consistent. In addition, there is no guarantee that the adjacent private lands will continue to be farmed in the future.

Under the CCP, the Service attempts to resolve these issues by doubling the target level of grain produced on Refuge lands, and by modifying the program to a cooperative farming model. Under this model, Refuge lands are used for growing crops but the labor is provided by a private farmer. The farmer will be compensated for his/her efforts by being permitted to take an 80% share of the crop. The remaining 20% will be left in the field for wildlife. Although such a model will provide more consistency in the grain production for the benefit of cranes, it also requires a larger land base for crop production. Under this scenario, approximately 950 acres of grain farming will be needed.

## GOAL 5. Enhance and maintain rare and unique habitats.

**Objective 5a. Cold and Hot Springs**

Throughout the life of the CCP, protect and maintain 230 to 250 acres of cold and hot springs, associated pools, and vegetative habitats on Malheur Refuge for the benefit of a diverse assemblage of native plants, fish, and wildlife species (e.g., Columbia spotted frog, endemic invertebrates).

The desired characteristics of cold and hot springs include:

- Water table and springhead integrity maintained
- Diversity of native macroinvertebrates
- Breeding, feeding, and winter refugia for native amphibians
- Dominant substrate vegetation, with boulders, fines, cobble, or gravel
- Vegetation varies depending upon soil type
- No turbidity
- No carp or bullfrogs present

| Strategies Applied to Achieve Objective |
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| Secure/adjudicate groundwater rights to protect cold and hot springs. |
| Protect spring habitat to provide a stable permanent water source for Columbian spotted frogs. |
| Protect spring habitat areas from undesirable, preventable disturbance (i.e., livestock grazing, traffic, etc.). |
| Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G). |
| Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. |
| Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. |
| Conduct research to understand carp population dynamics and seasonal movements. |
| Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. |
| Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type. |

**Rationale:**

Springs provide a stable, permanent source of water for spotted frog breeding, feeding, and winter refugia. Current refuge distribution of the spotted frog is believed to be associated with spring-fed water bodies. Invasive species in these habitats may compete for habitat and food, carry diseases, or be predators upon these amphibians.

**Objective 5b. Cliffs, Rimrock, and Lava Flows**

Throughout the life of the CCP, protect and annually maintain cliff, rimrock, and lava flow habitats for the benefit of migratory birds (e.g., golden eagle, prairie falcon) and a diverse assemblage of native, cliff/canyon-dependent wildlife (e.g., bat species, marmot) on Malheur Refuge. The desired characteristics of cliffs, rimrock, and lava flow habitats include:

- Well-sheltered crevices, cavities, bluffs, high walls, or rocky ledges overlooking valleys within range of open grasslands, wet meadows, and shrub-steppe deserts
- Largely unvegetated
- Minimal human disturbance, especially in proximity to nesting birds

| **Strategies Applied to Achieve Objective** |
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| Prohibit mining and rock removal, except by the Refuge and according to valid permits for use of existing gravel/rock pits. |
| Prohibit rock climbing. |
| **Rationale:**<br>This habitat type is not actively managed. These areas will be protected from disturbance (rock mining, climbing, etc.) due to their high value for nesting birds as well as reptiles, mammals, and other wildlife. |

## Public Use Goals

The following goals and objectives cover facilities and programs associated with wildlife-dependent recreational uses (the "Big Six"): wildlife observation, wildlife/nature photography, interpretation, environmental education, hunting, and fishing. Objectives for related activities, including welcome and orientation, volunteers, partnerships, law enforcement, and transportation, are also included.

Although all of the wildlife-dependent recreational uses will be provided on the Refuge, the cornerstone of the program will be providing quality wildlife observation and wildlife/nature photography opportunities. Interpretation and welcome and orientation features are also high priorities. These programs will be focused on enhancing visitor experiences and promoting the key values and features unique to the Refuge: a renowned diversity of wildlife, signs of earlier inhabitants, remoteness, and solitude. Environmental education, hunting, and fishing will also be provided, but with less commitment of refuge staff time than the other programs. However, additional areas will be opened to enhance opportunities for hunting and fishing. Each of these programs will be supported with the help of volunteers and partnerships.

Quality will be emphasized for each use and program. The definition of "quality" for wildlife-dependent recreational uses is defined in refuge policy by several elements (605 FW 1):

- Promotes safety of participants, other visitors, and facilities;
- Promotes responsible behaviors and compliance with applicable laws and regulations;
- Minimizes or eliminates conflicts with fish and wildlife population or habitat goals or objectives;
- Minimizes or eliminates conflict with other compatible wildlife-dependent recreation;
- Minimizes conflicts with neighboring landowners;
- Promotes accessibility and availability to a broad spectrum of the public;
- Promotes resources stewardship and conservation;
- Promotes public understanding and increases public appreciation of natural resources and the Refuge's and National Wildlife Refuge System's roles in managing and protecting these resources;
- Provides reliable, reasonable opportunities to experience wildlife;
- Uses facilities that are accessible and blend into the natural setting; and
- Uses visitor satisfaction to help define and evaluate programs.

## GOAL 6. Welcome visitors and offer them a safe experience of the Refuge's outstanding features: diversity of wildlife, signs of earlier inhabitants, scenic landscapes, and solitude. As a result, visitors will leave the Refuge with a memorable experience that fosters a connection between themselves and nature, and with an appreciation of Malheur Refuge's unique resources.

### Objective 6a. Provide Welcome and Orientation to Visitors

Provide an integrated set of welcome and orientation features for visitors to:

- Feel welcomed
- Easily find accurate, timely, and appropriate orientation materials and information
- Be aware of their options (available activities and experiences, where and when to go, how to get there, etc.)
- Safely pursue self-guided activities.

Welcome and orientation features shall be characterized as follows:

- Both modern and traditional media will be used to reach and orient visitors to the Refuge
- Entrance signage welcoming visitors to Malheur Refuge will be located at all seven refuge entrances and road junctions at Refuge Headquarters, Malheur Field Station, both access points at Buena Vista, Krumbo Lane, P Lane, and Double-O
- Directional signs that alert visitors to the presence of nearby attractions (such as "Krumbo Reservoir – Fishing", "Visitor Center" or "Contact Station") will be posted on State Highway 205 and along the auto tour route (Center Patrol Road) in appropriate locations
- Outdoor welcome and orientation panels will be provided at four to eight locations to direct and guide visitors
- Maps, brochures, regulations, and additional information on the outdoor welcome and orientation panels will be positively worded and available at attractive and visible structures, such as masonry work, near main refuge entrances and at areas where visitors tend to congregate, especially at the Narrows Pull-out, Buena Vista, Krumbo Reservoir, P Ranch, and Frenchglen
- Five to 10 clean, well maintained, and accessible developed sites with visitor amenities, such as picnic tables, shelters, and vault toilets will be provided in logical and appropriate locations in the Blitzen Valley and at Double-O
- Structures and developed sites will be built to blend in with the surrounding features and habitat
- Daily opportunities for personal contact with refuge staff and volunteers at Refuge Headquarters and P Ranch contact station will be provided

#### Strategies Applied to Achieve Objective

Continue to maintain and update existing modern and traditional media (website, brochures, Flickr account, etc.) to reach and orient visitors. Use other modern media as appropriate.

Develop step-down plans for outdoor panels, facilities, and signs.

Continue to maintain and update four existing outdoor panels to welcome and orient visitors at:

- Narrows Pull-Out
- Refuge Headquarters
- Buena Vista

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| • Frenchglen<br>Develop additional outdoor welcome and orientation panels at:<br>• Krumbo Reservoir<br>• P Ranch<br>• Harney Lake<br>• Double-O |
| Maintain existing developed sites with visitor amenities such as picnic tables, shelters, and vault toilets at:<br>• Refuge Headquarters<br>• Buena Vista<br>• Krumbo Reservoir<br>• P Ranch<br>Provide additional developed sites:<br>**Complete Developed Sites**<br>• Double-O<br>**Vault Toilet Only**<br>• Sod House Ranch<br>**Picnic Tables and Shelters Only**<br>• Refuge Headquarters (ADA-compliant)<br>• Buena Vista Overlook<br>• P Ranch |
| Build an enlarged visitor contact station and gift shop at Refuge Headquarters. |
| Enhance George Benson Memorial Museum to meet ADA standards and meet preservation standards to protect specimens. |
| Establish a seasonal contact station at P Ranch, and provide staffing as available with volunteers during spring, summer, and fall. |
| Continue to consider/participate in discussions for an interagency visitor facility off-refuge. |
| **Rationale:**<br>A high number of visitors to the Refuge are new to the area and benefit from direction and guidance especially at refuge entrances and road junctions. The strategies focus on providing quality customer service and improving information and orientation availability. Utilizing modern and traditional media, and providing outdoor welcome and orientation panels and developed sites that are clean, well maintained, and accessible, while also not detracting from the surroundings, will be emphasized. This objective and its strategies are aimed at ensuring that information provided to visitors is clear so visitors can easily determine where they can go, what they can do, and how to safely and ethically engage in wildlife-dependent recreational uses. |

| **Objective 6b. Address Transportation Issues and Concerns** |
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| Develop a transportation plan for existing and needed roads, bridges, pull-outs, access points, parking areas, trails, and other elements of transportation infrastructure that support public uses and refuge management needs as identified within other CCP objectives. The transportation plan will:<br>• Develop strategies for maintaining three to six public roads, parking areas and several vehicle |

pull-offs, to minimum public safety standards

- Consider provisions, according to management and public use needs, for vehicles, farming equipment, bicycles, school buses or other larger vehicles, and pedestrians
- Include ancillary facilities, such as interpretive signage, environmental education shelters, restrooms, parking areas, boat launches, etc.
- Address potential impacts to wildlife and associated habitats
- Include a safety audit of all transportation facilities identified above
- Include a prioritized list of construction and improvement items
- Implement as funds become available to bring all facilities up to approved Service standards

**Strategies Applied to Achieve Objective**

Continue to maintain existing refuge public roads:

- 42-mile Blitzen Valley auto tour route (Center Patrol Road)
- Krumbo Reservoir
- P Lane

Enhance the following refuge public roads:

- Boating Landing Road
- East Canal Road to the confluence of Bridge Creek
- Double-O
- Saddle Butte hunt access

Continue to maintain a variety of vehicle pull-offs (one or two vehicle lengths) on the 42-mile Blitzen Valley auto tour route (Center Patrol Road) and develop the following additional vehicle pull-offs to assist with wildlife observation and wildlife/nature photography, hunting, and fishing programs:

- Boating Landing Road
- East Canal Road to the confluence of Bridge Creek

Maintain existing parking areas and develop the following parking areas to assist with wildlife observation and wildlife/nature photography, hunting, and fishing programs:

- Bridge on Boat Landing Road
- Airboat launch site (to ADA standards)
- East Canal at the confluence of Bridge Creek

Work with local and State governments to identify alternative funding sources and cost-sharing opportunities for maintenance of and improvements to the transportation system to and through the Refuge.

Partner with the Federal Highway Administration, ODOT, local county road departments, and others to develop the transportation plan and safety audit.

**Rationale:**

A comprehensive transportation plan and safety audit is needed to ensure the safest and most efficient access for visitors, cooperative ranchers, and others who need to access the Refuge. A transportation plan will also assist the Refuge in obtaining funds available under Federal and State transportation authorities for project implementation.

## GOAL 7. Connect the hearts and minds of visitors with the places and resources the Refuge protects, and enlighten visitors' experiences with an understanding of, appreciation for, and knowledge about historic and natural resources, and the importance of conservation and stewardship.

### Objective 7a. Provide Wildlife Observation and Wildlife/Nature Photography Opportunities to the Casual Visitor and Beginning to Moderate Birders


Provide casual visitors and beginning to moderate birders with a variety of structured opportunities to view wildlife, observe nature, and photograph wildlife and the surrounding landscape. The program shall:

- Provide docent-led tours, approximately monthly, at different locations on the Refuge, including into areas that are normally closed to the public
- Provide occasional opportunities to experience Malheur Lake with docent-led kayaking and canoeing tours
- Integrate the interpretive program with observation and photography opportunities so that visitors can make their own discoveries (see Objective 7c)
- Provide a variety of vehicle pull-offs on the 42-mile Blitzen Valley auto tour route (Center Patrol Road) at key locations to enhance the birding experience
- Provide an opportunity for exercise and enhanced opportunities for solitude as part of the recreational experience by providing two to four loop trails ($\geq$1 mile)
- Provide at least five or six spur trails to good birding sites, with some trails meeting ADA standards
- Include trail signs (e.g., trail access information (TAI) signs) posted at all trailheads (see photo).
- Provide access to five to seven developed viewing facilities, such as overlooks and platforms at key locations for viewing wildlife and landscapes
- Provide opportunities for quality photography in three first-come/first-served permanent, ADA-compliant photography blinds or temporary, day-to-day basis photography blinds

**Strategies Applied to Achieve Objective**

**Docent-led Tours**

Continue to provide docent-led tours in conjunction with the annual John Scharff Migratory Bird Festival.

Advertise and provide docent-led tours, approximately monthly, to a variety of audiences for the purposes of viewing wildlife and habitats at different locations on the Refuge. Tours may include kayaking or canoeing on Malheur Lake. Encourage advanced birders to volunteer to lead docent-led tours for the general public and groups.

**Auto Tour Route and Vehicular Access**

Continue to maintain existing refuge public roads on the 42-mile auto tour route (Center Patrol Road), Krumbo Reservoir, and P Lane. Provide additional vehicle access year-round, except when road conditions are hazardous, at Boat Landing Road, Krumbo Reservoir, and East Canal Road to confluence of Bridge Creek.

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| Participate in Basin and Range Birding Trail on-refuge with Harney County Chamber of Commerce and other partners. |
| **Trails** |
| Provide trails listed below. Mark all existing and new trailheads with trail signs (e.g., TAI).<br>**Spur Trail**<br>• Frenchglen to Barnes Springs Footpath<br>**Loop Trails (≥1 mile)**<br>• Refuge Headquarters along the Blitzen River and Display Pond (Headquarters Loop Trail)<br>• Connect Bridge Creek Trail, River Trail, and East Canal Trail with pedestrian crossings and boardwalks<br>**ADA-compliant Trails**<br>• Sections of Headquarters Loop Trail<br>• Sod House Ranch (upgrade to ADA standards)<br>• Benson Pond<br>• P Ranch |
| Propose alternative route to enhance the Desert Trail and post appropriate Desert Trail signs at logical locations. |
| **Observation and Photography Features** |
| Provide viewing features listed below and develop step-down plans for viewing overlooks and platforms.<br>**Viewing Overlooks**<br>• Krumbo Reservoir (ADA-compliant)<br>**Elevated Viewing Platforms**<br>• Historic CCC lookout tower at Refuge Headquarters<br>• Malheur Lake at airboat launch site<br>• Harney Lake<br>• Double-O |
| Restore historic Audubon photography blind at Refuge Headquarters Display Pond. |
| Provide two ADA-compliant, first-come/first-served permanent photography blinds for high-quality wildlife photography at appropriate locations. |
| Allow boating use (nonmotorized or electric boats, kayaks, canoes, etc.) that is not directly supporting fishing at Krumbo Reservoir year-round, except when reservoir begins to ice over. |
| Require a yearly special use permit for for-profit commercial wildlife guiding and commercial photography uses on the Refuge. |
| **Rationale:**<br>During scoping, casual visitors and beginning to moderate birders expressed a need for increased access, vehicle pull-offs near a variety of trails, viewing and photography facilities, and other opportunities for this user group. Wildlife observation is the primary visitor activity that occurs on the Refuge, but visitors also come to enjoy the area’s wide open spaces, geology, and historic resources. The Refuge provides docent-led tours during the John Scharff Migratory Bird festival to closed areas of |

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| the Refuge; visitors respond enthusiastically to these tours. An expanded use of docent-led tours will promote relationship-building between the Refuge and visitors, create greater awareness of the values of Malheur Refuge, and allow occasional access to areas that are normally closed to refuge visitors, in a manner that minimizes conflicts with fish and wildlife population or habitat goals.<br>Connecting people to nature is a national initiative that the Refuge will contribute to via the strategies described above. Providing docent-led tours on Malheur Lake by kayak and canoe will enhance the opportunity for freedom and experience of one of the Refuge's most well-known landmarks, and provide an opportunity to educate visitors about the management challenges posed by invasive common carp and the degradation of important habitat on the lake.<br>Continuing to provide an auto tour route, while enhancing the experience by providing additional areas for vehicle access and pull-offs, providing longer trails, and providing additional viewing and photography facilities, will also help to meet a visitor need to connect with the larger landscape and resources. |

| **Objective 7b. Provide Opportunities to View Rare and Incidental Species to Advanced Birders** |
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| Provide advanced birders with continued opportunities to enjoy sightings of rare and incidental birds, particularly passerines. The Refuge will:<br>• Maintain four to six sites (approximately 300 acres) of habitats characterized by cottonwood trees, other non-endemic trees, and shrubs associated with historic landscapes |
| **Strategies Applied to Achieve Objective** |
| Participate in and promote real-time rare bird alerts utilizing modern media. |
| Prepare and implement a site plan for Refuge Headquarters that incorporates birders' concerns, such as maintaining cottonwood trees, other non-endemic trees, and shrubs. |
| Prepare and implement site plans to maintain cottonwood trees, other non-endemic trees, and shrubs at Sod House Ranch, Benson Pond, Witzel Field, Barnes Springs, and P Ranch. |
| Conduct vegetation management of invasive species in ways that do not interfere with the ability of the identified sites to host rare and incidental species. |
| Integrate vegetation management and access at the identified sites with appropriate cultural resource protection and interpretation (see Goal 10). |
| Continue to maintain seasonal closure at Sod House Ranch to protect heron rookery. |
| **Rationale:**<br>Advanced birders are a small but important component of the visitor base at the Refuge. Some of the trees that host the rare and vagrant species are not native to the area but were brought in deliberately by early settlers for shade. Because these special birding sites are located at sites of historic significance, maintaining a component of tall shade trees meets both the objective of providing habitat for rare and incidental species, and the purpose of providing a continued "look and feel" characteristic to these historic landscapes. In addition to these reasons, these sites occupy a small percentage of the overall refuge landscape and also provide values to native wildlife, including a heron rookery at Sod House Ranch; therefore, we consider it acceptable to maintain and promote this non-native vegetative component. |

| **Objective 7c. Provide Interpretive Opportunities of Key Resources and Issues** |
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| Provide a variety of interpretive opportunities to connect refuge visitors and the local community with historic and natural resources. Interpretive features shall be characterized as follows:<br>• Enhance uses of modern media to convey information to visitors and enhance opportunities for |

self-guided or multisensory experiences

- Provide a range of traditional interpretive materials and programs, including indoor and outdoor interpretive panels, approximately monthly presentations, and four to seven local events
- Provide well-marked outdoor interpretive panels that include “attractants” to slow and encourage visitation, such as masonry work

Using various methods, advance visitor understanding of the following key themes:

- Historical and current significance of the Refuge to breeding and migratory birds
- Precontact and post-contact history (see Goal 10)
- CCC work in the area (see Goal 10)
- Wilderness
- Geology and paleontology
- Aquatic health
- Water’s importance, hydrology, and movement across the landscape
- Primary refuge wildlife, habitat, and resources management objectives and management challenges, and methods
- Role and importance of the National Wildlife Refuge System
- An understanding of visitors’ relationships to, and impacts on, natural and cultural resources to encourage and inspire them to become stewards of the lands

**Strategies Applied to Achieve Objective**

Regularly maintain and update information on key interpretive themes via a variety of media such as websites and brochures. Make greater use of modern media such as CDs, podcasts, social media, etc.

Provide new interior panels in the George Benson Memorial Museum to connect visitors with places and the resources the Refuge protects.

Continue to maintain five existing outdoor interpretive panels at Narrows Pull-out, Refuge Headquarters, Sod House Ranch, Buena Vista Overlook, and P Ranch. Provide additional outdoor interpretive panels at key field sites to appropriately implement key interpretive themes, and focus on aquatic health and associated management activities and weaving historic events and ecology of the Refuge.

Participate in local events, on- and off-refuge, providing docent-led activities and visits to specified sites with booths and educational materials as appropriate:

- John Scharff Migratory Bird Festival (April)
- Free Fishing Day (June)
- Invasive Carp Awareness (August)
- Harney County Fair (September)
- International Migratory Bird Day (May)
- Ranching Heritage Day combined with Invasive Carp Awareness (August)
- National Wildlife Refuge Week (October)

Continue to provide public presentations by refuge staff and volunteers at least monthly. Advertise and share presentations by utilizing modern media.

**Rationale:**

Interpretive features and programs emphasizing key interpretive themes relevant to the Refuge can greatly assist visitors in discovering the resources and understanding the role and relevance of the

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| Refuge. The visiting public has expressed a need for a stronger emphasis on connecting visitors with places and resources the Refuge protects, and enlightening visitors' experiences through interpretive panels, docent-led tours, special events, and group presentations. Investing in such programs and facilities is consistent with the Refuge System mission and will expand refuge support and relationships. |

| **Objective 7d. Support and Provide Environmental Education Programs** |
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| In partnership, implement environmental education programs that:<br>• Emphasize enjoyable, hands-on, outdoor learning<br>• Integrate key interpretive themes (see Objective 7c)<br>• Promote discovery and wildlife awareness<br>• Build understanding and appreciation of the Refuge's historic and natural resources<br>• Promote conservation and stewardship<br><br>The program shall be characterized as follows:<br>• Facilitate on- and off-refuge education for all ages for ≥500 students annually, with a target audience of local first and third graders<br>• Partner with other environmental education initiatives to promote assistance with programs, activities, and exhibits<br>• Support local, state, and national education standards and other curricula<br>• Serve formal educators (i.e., teachers) and informal educators (i.e., Scouting group leaders)<br>• Use various refuge resources to assist with environmental education activities, and use refuge facilities, including wildlife observation structures, interpretive panels, trails, etc.<br>• Coordinate and assist with other environmental education initiatives |
| **Strategies Applied to Achieve Objective** |
| Continue to conduct existing environmental education program and ongoing collaboration with environmental education initiatives. |
| When refuge staff and volunteers are available, use and implement existing curricula, and national and regional environmental education modules, such as Junior Duck Stamp Program, International Migratory Bird Day, etc., on- and off-refuge. |
| Coordinate and assist with local environmental education initiatives upon request. |
| Review and revise as needed the Cooperative Agreement between the Great Basin Society/Malheur Field Station and the Refuge. |
| Build an outdoor shelter at Refuge Headquarters where environmental education activities can be conducted during periods of inclement weather. |
| Provide an outdoor learning area at Refuge Headquarters to assist with existing environmental education program and efforts with other environmental education initiatives. |
| Require a yearly special use permit for non-profit groups and educational institutions engaging in EE programs on the Refuge. |
| **Rationale:**<br>The Refuge has an opportunity to support and provide environmental education programs for local schools, universities, and other educational or community groups, in partnership with other local environmental education initiatives. Using and enhancing partnerships with established programs like these, and using ready-made national curricula will provide greater efficiency for the Refuge and build community relationships. The existing environmental education program will remain, and when staff |

and volunteers are available existing curricula and national and regional environmental education modules will be used and implemented. Provision of specified outdoor learning facilities will promote enjoyable and hands-on learning and an integrated curriculum at key target sites, while mitigating demands on the Refuge's indoor spaces.

## GOAL 8. Provide reasonable challenges and opportunities, and provide uncrowded conditions for the hunting and fishing public.

### Objective 8a. Provide Hunting Opportunities for Upland Game

Provide high-quality hunting opportunities for upland game hunting in the Malheur Lake, Buena Vista, and Boundary hunt units, for the species, seasons, and other details described in the Hunt Plan (Appendix P).

The program shall be managed such that:

- Youth are provided added emphasis
- Conditions are uncrowded, with abundant opportunities for solitude over 58,000 allowable hunting acres
- The hunt is safe and managed to minimize conflicts with wildlife and other priority wildlife-dependent recreational uses
- Access is provided on suitable all-weather access roads
- Game are wild or naturalized (not stocked)
- Most hunters reach their quota each day
- Refuge staff engages in close cooperation and coordination with State fish and wildlife management agencies for management of hunting opportunities on the Refuge and in setting population management goals and objectives
- Hunt is consistent with State fish and wildlife laws, regulations, and management plans

**Strategies Applied to Achieve Objective**

Update existing hunting brochure and website to explain upland game hunting opportunities and regulations; update Code of Federal Regulations [CFRs] per revised Hunt Plan (Appendix P).

**Malheur Lake Hunt Unit**

Maintain hunt program under current regulations, except drop rabbit from the list of allowable species. Improve Saddle Butte access on north side of Malheur Lake Hunt Unit (see Appendix P).

**Buena Vista Hunt Unit**

Maintain hunt program under current regulations, except drop rabbit from the list of allowable species and extend season opener from the fourth Saturday of October to the end of the State pheasant season (see Appendix P).

**Boundary Hunt Unit**

Manage hunt program as described in Hunt Plan (Appendix P).

**Rationale:**

The most substantial modification suggested for the upland game hunt on the Refuge under the management direction is the season extension for the Buena Vista Unit; this will provide greater hunting opportunity. The hunt openers have been designed to minimize disturbance to staging sandhill cranes, which do not use the northern part of the Malheur Lake Hunt Unit; hence, this unit will remain open at the same time as the regular State season, thus spreading out the openers across two weekends and reducing crowding.

Greater vehicular access for the Buena Vista Unit was considered but rejected because many believe the free-roaming, off-road nature of the hunt is one of its key assets. The P Ranch Unit was also considered but was rejected due to conflicts with wintering waterfowl, which use the P Ranch Unit more heavily than other units because of the access to open water, which is limited during winter on the Refuge.

Rabbit will be dropped from the Malheur Lake and Buena Vista hunt units because this species may be taken at any time of day or night, and this presents a conflict with the hunts as designed for these units.

**Objective 8b. Provide Hunting Opportunities for Waterfowl**

Provide high-quality opportunities for waterfowl hunting in the Malheur Lake, Buena Vista, and Boundary hunt units, for the species, seasons, and other details described in the Hunt Plan (Appendix P).

The program shall be managed in such that:

- Youth are provided added emphasis
- Conditions are uncrowded with abundant opportunities for solitude over 63,000 allowable hunting acres
- The hunt is safe and managed to minimize conflicts with wildlife and other priority wildlife-dependent recreational uses
- Access is provided on suitable all-weather roads
- Hunters can enjoy a range of waterfowl hunting experiences, ranging from traditional setup with decoys and dogs to jump-shooting
- Parking areas are adequate, with parking at three existing locations and one new parking area and boat launch at the airboat launch site to access a new hunt opportunity on the southern side of Malheur Lake
- Most hunters reach their quota each day
- Refuge staff engages in close cooperation and coordination with State fish and wildlife management agencies for management of hunting opportunities on the Refuge and in setting population management goals and objectives
- Hunt is consistent with State fish and wildlife laws, regulations, and management plans

**Strategies Applied to Achieve Objective**

Update existing hunting brochure, website, and CFRs to explain waterfowl hunting opportunities and regulations.

**Malheur Lake Hunt Unit**

Manage the waterfowl/migratory bird hunt on Malheur Lake Unit as described in Appendix P.

Promote waterfowl youth hunt opportunity on State-designated weekend in the northern Malheur Lake Hunt Unit.

Improve Saddle Butte access on north side of Malheur Lake Hunt Unit.

Expand allowable boundary to include south-central area of Malheur Lake with special date regulations of the fourth Saturday of October to the end of the State waterfowl season.

Open new boat access for nonmotorized or electric boats on Malheur Lake at the airboat launch site near Refuge Headquarters with expanded parking and a boat launch (ADA standards). Opening date for the access will be the on the fourth Saturday of October to the end of the State waterfowl season.

At low water (<10,000 acres), close Malheur Lake to waterfowl hunting.

The new Caspian tern island in the South Malheur Lake Unit will be permanently closed to hunting.

**Buena Vista Hunt Unit**

Open Buena Vista Hunt Unit to waterfowl hunting with special date regulations, from the fourth Saturday of October to the end of the State pheasant season. Boats will not be permitted. See Appendix P for details.

Support reasonable waterfowl hunting opportunities that comply with the ADA in partnerships with potential users.

**Boundary Hunt Unit**

Continue to allow waterfowl/migratory bird hunting within the Boundary Hunt Unit under existing regulations (see Appendix P).

**Rationale:**

Although historically Malheur Lake was renowned for its waterfowl hunting opportunities, currently the waterfowl hunt is perceived as poor quality. The key issue preventing greater success is seen as the plenitude of invasive common carp in the lake. Access is also poor from the existing access points; lake fluctuations often preclude opportunities to provide easy drive-in access to reliable boat launches on most parts of the lake. Hence, at the present time, few hunters hunt the lake and those who do rarely use boats to access the lake. Providing a fourth access point at the more reliable airboat launch site on the Blitzen River delta near Refuge Headquarters will allow hunters to access a larger portion of the lake by boat and provide additional opportunities for hunting. As aquatic health improves (see Objective 1a), waterfowl hunting opportunities on the lake should improve.

Opening the Buena Vista Hunt Unit will provide a quality experience in a large additional area with good access. This unit has some wetlands and the mainstem of the Blitzen River. Hunters may walk in and set up decoys on some of the wetlands or jump-shoot as opportunities present themselves. Although the small size of ponds and wetlands could pose competition and disturbance issues, the limited number of hunters past opening weekend will likely mitigate against these concerns. Safety issues along the auto tour route (Center Patrol Road) will also be mitigated as visitor use is expected to be light during the hunting season.

Other areas considered for waterfowl hunting included the P Ranch and Double-O units. With the change in water rights, there could be a potential opportunity to flood up additional areas for hunting in the Blitzen Valley. However, most of the additional water will arrive early in the spring, so it will not be available during prime waterfowl hunting time. In addition, the P Ranch Unit was also rejected as a hunt unit due to conflicts with wintering waterfowl, which use the P Ranch Unit more heavily than other units because open water is more concentrated in the P Ranch Unit during winter. The Double-O Unit is considered more sensitive to biological and cultural resource disturbances, but a weekend youth hunt may be possible while limiting the amount of disturbance.

**Objective 8c. Provide Stream Fisheries Aimed at Experienced Fly-fishers and Other Anglers**

Provide a high-quality, challenging, semiprimitive fishing opportunity aimed at experienced fly-fishers and non-bait anglers along the upper Blitzen River, a portion of the East Canal, and tributaries (collectively known as the South Fishing Loop), and along a new fishing opportunity near Refuge Headquarters. The program shall be managed such that:

- Drive-in access is available in close proximity on approximately 3 miles of the stream opportunity, with pedestrian crossings for walk-in access to 7 miles of fishable area west of the East Canal to the confluence of Bridge Creek at the Blitzen River
- Conditions are uncrowded, with abundant opportunities for solitude over 11 miles of river

- Minimal facilities are present for a more undeveloped experience
- Maps, brochures, regulations, and additional information are positively worded on panels and available at attractive and visible structures, such as wooden kiosks, at all five fishing entrances;
- Redband trout and other native fish are present
- Conflicts with wildlife and other priority wildlife-dependent recreational uses are minimized;
- Refuge staff engages in close cooperation and coordination with State fish and wildlife management agencies for fisheries management
- Fishing is consistent with State fish and wildlife laws, regulations, and management plans

| **Strategies Applied to Achieve Objective** |
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| Continue to allow fishing opportunities in the areas identified in this objective's other strategies and under regulations currently in place and specified. |
| Allow drive-in access on East Canal Road to the confluence of Bridge Creek with access to Granddad Reservoir (BLM), except when road conditions are hazardous. |
| Build a new pedestrian crossing and boardwalks at Bridge Creek to access a portion of the fishable area west of East Canal to its confluence of Bridge Creek with the Blitzen River. |
| Open new seasonal bank fishing opportunity from Sodhouse Lane to the bridge on the Boat Landing Road, part of the Headquarters Loop Trail. Dates for fishing access will be August 1 to September 15. |
| Develop five outdoor panels with maps, brochures, regulations, and additional information at main entrance points, such as the East Canal, P Ranch, Bridge Creek, Sodhouse Lane, and the bridge on the Boat Landing Road, and provide additional signing. |

**Rationale:**

The fishery as currently managed offers a semideveloped experience with greater challenge than the Krumbo Reservoir fishery. Re-opening the East Canal Road to Bridge Creek to vehicles under The management direction will provide greater access, including access to Granddad Reservoir (BLM). Currently, members of the fishing public either cannot or do not wish to walk long distances. Opening a new seasonal bank fishing opportunity from Sodhouse Lane to the bridge on the Boat Landing Road near Refuge Headquarters will also provide additional fishing opportunity.

**Objective 8d. Provide a Reservoir Fishery Aimed at Successful Take for Casual Anglers**

Provide a quality year-round fishing opportunity at Krumbo Reservoir aimed at providing successful trout and bass fishing for beginning, casual, and local anglers. The program shall be managed such that:

- Visitors can drive in and walk short distances
- Anglers may fish from the shoreline, on the accessible fishing dock, or by boat
- Access for visitors with disabilities is available
- Clean and maintained facilities, including vault toilets, picnic tables, and shelters, are available
- Maps, brochures, regulations, and additional information will be positively worded and available at one attractive and visible structure, such as a wooden kiosk at the main parking area
- Numerous catchable fish are present
- Managed to minimize conflicts with wildlife and other priority wildlife-dependent recreational uses
- Refuge staff engages in close cooperation and coordination with State Fish and Wildlife management agencies for stocking of fish and fisheries management
- Fishing is consistent with State fish and wildlife laws, regulations, and management plans

| Strategies Applied to Achieve Objective |
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| Develop fishing brochure to explain fishing opportunities and regulations, and update existing website. |
| Continue coordination with ODFW and stocking of Krumbo Reservoir with triploid rainbow trout with steps to undertake genetic introgression study on redband trout (See Objective 13d). |
| Open Krumbo Reservoir to fishing year- round with drive-in access, except when road conditions are hazardous. For safety reasons, ice fishing or nonmotorized or electric boats will not be permitted when the reservoir begins to ice over. |
| Develop one panel with maps, brochures, regulations, and additional information at the main parking area. |
| **Rationale:**<br>Providing access for fishing (and other uses) year-round is a way to provide greater opportunity for this use and to avoid the opening day rush and overcrowding that currently occurs in the spring. As noted in a strategy under Objective 7a, it will also allow use of the area during fall, winter, and spring for wildlife observation and hikers. Some wintering use by diving ducks, swans, and other wintering waterfowl occurs on the reservoir, but since wintertime visitor use is expected to be light, any disturbance that may occur is not expected to significantly impact these species. Wildlife surveys will be underway in the winter of 2010-2011 to evaluate the extent of wildlife use and to estimate future wildlife disturbance. Camping was requested by several members of the public during scoping and was considered for Krumbo Reservoir to support the fishing experience; it was determined that it is unnecessary to provide camping in the area because of the availability of nearby camping opportunities on BLM and at the Narrows, and because of the demands camping would place upon refuge staff and law enforcement.<br>The CCP team recommends continuing the current practice of stocking the reservoir with triploid rainbow trout, a non-native fish. Transitioning the fishery to a native redband trout fishery was considered but a variety of steps would need to be undertaken (public review, genetic introgression study, and regulation change). If the fishery was transitioned to a native fishery, it would likely require a regulation change to catch-and-release or two-fish limit. Although the stocking of non-native species is discouraged under refuge policy (601 FW 3), in this case it is justified because of the importance of this recreational opportunity to local and nonlocal visitors. There are only a few other such opportunities for year-round fishing in southeast Oregon. |

## GOAL 9. Enhance Refuge Programs, Partnerships and Public Outreach

| Objective 9a. Enhance Refuge Programs, Partnerships and Public Outreach with Volunteer Opportunities |
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| Build a volunteer program and partnerships to help the Refuge achieve its mission and goals. The programs shall:<br>• Identify ways the Malheur Wildlife Associates can best support the Refuge<br>• Provide volunteer opportunities that allow the public to maximize their interaction with refuge facilities and staff<br>• Focus on priority projects that will enhance the wildlife and habitat on the Refuge, and support a variety of projects and programs<br>• Focus on building partnerships and public outreach<br>• Increase recruitment, retention, and a volunteer return rate of ≥50% |

| **Strategies Applied to Achieve Objective** |
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| Continue to conduct existing volunteer program and ongoing collaboration with Malheur Wildlife Associates, including assisting with building their capacity. |
| Establish a full-time volunteer coordinator position that will focus specifically on improving the volunteer program, such as by increasing recruitment, retention, and return rate of volunteers and expanding the program for efficient use of facilities and Refuge staff. The position will also focus on building partnerships and increasing public outreach. |
| **Rationale:**<br>Although the Refuge is remote, current capacity for supporting volunteers is relatively high. The Refuge has six RV pads with full hookups; in addition, two bunkhouses with 11 bedrooms provide the potential to support up to 15 volunteers at any one time. Typically 50 volunteers are on-site between March and October, each serving approximately two months. Over 5,000 hours are contributed annually with a return rate of at least 50%. However, to increase the volunteer program without additional assistance will be difficult. Establishing a full-time volunteer coordinator position will enable desired improvements to the program, efficient use of facilities, and more use of volunteers by Refuge staff. |

| **Objective 9b. Maintain an Effective Law Enforcement Presence** |
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| Establish and maintain an effective, professional, and courteous law enforcement presence to discourage unauthorized uses and maintain reported incidents at a flat or declining trend over a 15- year period. |
| **Strategies Applied to Achieve Objective** |
| In connection with Objective 6a, improve posting of regulations at key welcome and orientation sites, as well as locations where fishing and hunting uses predominate (Krumbo Reservoir, Malheur Lake, Buena Vista Unit, etc.). |
| Maintain current law enforcement staffing (one dedicated law enforcement officer). |
| Continue cooperative relationships and agreements with Oregon State Police and Harney County Sheriff's office. |
| Continue to emphasize information, education, and a friendly presence in the field during key seasons. |
| Improve fencing in certain refuge boundary areas to minimize trespass cattle. |
| **Rationale:**<br>Enforcement of Federal wildlife laws, regulations specific to the Refuge System, and State laws is an essential component of refuge operations; enforcement ensures that natural and cultural resources are protected and that visitors have a safe environment. Fortunately, law enforcement incidents at the Refuge are relatively few compared to other refuges. The predominant law enforcement concerns center on cultural resource protection, trespass cattle, and fishing and hunting compliance. Cooperative relationships with other law enforcement organizations improve effectiveness. |

| **Objective 9c. Engage Partners and Stakeholders in Adaptive Management** |
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| Continue to work with partners and stakeholders in the pursuit of the best available science to further our understanding of the effects of implementing management activities, evaluating methods and techniques, and initiating adaptive management to address needed changes. |

| Strategies Applied to Achieve Objective |
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| Via the Ecology Work Group, develop the Malheur Refuge State-and-Transition Model (STM) (see Appendix L). |
| Implement use of the Malheur Refuge STM. |
| Use the Malheur Refuge STM as a framework for presenting results of management activities to partners and stakeholders. |
| Via the Aquatic Health Coalition's workgroups (control, assessment, and partnership and funding) develop grant proposals and conduct research to adaptively manage aquatic health. Communicate via the Aquatic Health Coalition list serve. |
| **Rationale:**<br>The benefits of the STM concept for Malheur Refuge are greater than the ecological understanding of refuge habitat it promotes. The STM is a living model that is continually transformed as new information is gleaned over time and because of this, it introduces an amplified dependence on actualized adaptive management. It also provides a framework for organizing results and reporting them to the interested public. The STM and the Aquatic Health Coalition provide transparency, heightened and continued interaction with partnering agencies/organizations, and accountability for continued monitoring of management actions. The desired outcome is to work collaboratively with others to address habitat management and aquatic health needs using the best available science, innovative methods and techniques, and transparency. The Refuge is committed to keeping our partners engaged as we move forward with adaptive management activities. |

## GOAL 10. Manage prehistoric and historic cultural resources for their educational, scientific, and cultural values for the benefit of present and future generations of refuge users and for the communities that are connected to these resources.

| Objective 10a. Identify and Protect Prehistoric and Historic Archaeological Resources |
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| Increase monitoring and protection of all cultural resources, prehistoric and historic, on the Refuge while increasing public and staff support and appreciation. |
| **Strategies Applied to Achieve Objective** |
| Continue to identify archaeological sites and historic structures that coincide with existing and planned roads, facilities, public use areas, habitat restoration, and research projects. Prepare and implement activities to mitigate impacts to sites as necessary. |
| Implement a program to evaluate eligibility for listing on the NRHP for those archaeological sites and historic structures that may be impacted by Service undertakings, management activities, erosion, or neglect. |
| Develop a historical buildings management plan with list of maintenance and restoration needs by structure. Prioritize the list by structure and include estimated repair costs. Actively seek funding and develop partnerships to maintain and protect structures. |
| Coordinate with the Tribe on cultural resources inventory, evaluation, and project monitoring, consistent with the regulations of the NHPA. Protect all identifiable archaeological sites by avoiding disturbance within the area. |
| Develop and strengthen partnerships with educational and historic institutions for the interpretation and |

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| protection of cultural resources at the Refuge. |
| Facilitate partnerships with other appropriate Federal and State agencies, professional archaeologists, descendants of early settlers, and the general public to aid in the management of cultural resources. |
| **Rationale:** Various Federal historic preservation laws and regulations require the Service to implement the kind of program described under this objective. Providing adequate attention and resources to these responsibilities will identify areas to be avoided by disturbances associated with projects being implemented by Refuge staff as they focus on other land, habitat, and wildlife management efforts. |

| **Objective 10b. Provide Interpretation of Cultural Resources** |
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| Increase awareness of and appreciation for the Refuge's cultural resources among refuge users, the community, and staff. |
| **Strategies Applied to Achieve Objective** |
| Prepare interpretive media (e.g., pamphlets, signs, exhibits) that communicate cultural resources information and Native American perspectives to visitors. |
| Develop interpretive media (e.g., pamphlets, signs, exhibits) that describes the history of Euro-American settlement and use of the Refuge. |
| Prepare environmental/cultural education materials for use by local schools concerning cultural resources, the discipline of archaeology, the perspectives of Native Americans, the history of the area, and conservation of natural and cultural resources. These materials could include an artifact replica kit with hands-on activities and curriculum prepared in consultation with the local school district, the historical society, and the Tribe. |
| Consult with the Tribe and other preservation partners to identify the type of cultural resources information appropriate for public interpretation. |
| Develop an outreach program and materials so that the cultural resource messages become part of cultural events in the area, including the State's Archaeology Month, National Wildlife Refuge Week, and local festivals (see Objective 7c). |
| Develop museum property inventory for the George Benson Memorial Museum. Create storage and use plans for museum property as part of the outreach program. |
| Promote reuse of existing historic structures (e.g., for environmental education, interpretive programs, storage). |
| Develop and implement interpretive plans for the Headquarters CCC site, Sod House Ranch, Benson Pond CCC site, P Ranch, and Double-O Ranch. |
| Continue working with the Tribe on the collection of native plant materials where compatible. |
| **Rationale:** Cultural resources are not renewable. Interpretation of cultural resources can raise public interest and appreciation for the peoples who lived in earlier times. Ultimately, such appreciation can result in public support for conservation, maintenance, and protection of archaeological and historic sites. |

| **Objective 10c. Consultation on Cultural Resources** |
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| Increase coordination and consultation with the Burns Paiute Tribe for prehistoric resources and important native plants and wildlife on the Refuge. |

**Strategies Applied to Achieve Objective**

Continue consulting and coordinating with the Tribe on refuge projects that may affect prehistoric sites, native plants, or wildlife important to the Tribe. Meet with the Tribal Council at least three times a year to review upcoming refuge projects.

Continue working with the Burns Paiute Tribe on the collection of native plant materials where compatible and the inclusion of important traditional plants in riparian or other habitat restoration projects.

**Rationale:**

Federal historic preservation laws and regulations require the Service to consult with Native American Tribes concerning projects which may affect archaeological sites. Collaborating with the Tribe on the inclusion of important traditional plants in refuge restoration projects ensures greater communication with the Tribe.

### Objective 10d. Establish Site Significance Factors

Identify criteria that allow us to determine what cultural resource sites, site types, and data from sites are important and need preservation or analysis to address specific research questions.

**Strategies Applied to Achieve Objective**

Develop a model identifying the sensitivity of various habitat types for the presence of cultural resources. Link these to specific layers in a GIS database.

Perform an archaeological analysis of the Refuge and the surrounding area to formulate a short list of information and research needs for cultural resources and their management.

**Rationale:**

Implementation of this objective will streamline the process used to identify cultural resources that may be impacted by refuge projects or public uses.

## GOAL 11. Identify and protect prehistoric and historic resources on the Refuge that are eligible for or listed on the National Register of Historic Places.

### Objective 11a. Increase Management Efforts for Historic Sites Listed on or Eligible for Listing on the NRHP

Identify, stabilize, and restore eligible historic resources from the homestead, ranching, and CCC eras.

**Strategies Applied to Achieve Objective**

Perform an inventory and assessment of historic sites to determine NRHP eligibility. As part of this inventory, identify specific stabilization and restoration costs. This should include prioritization of the most critical needs for each site and structure.

Develop partnerships (University of Oregon, National Park Service, etc.) to assist in the stabilization and restoration of historic sites and structures.

**Rationale:**

Federal historic preservation laws and regulations require a determination of eligibility for the NRHP for sites 50 years or older, and preservation of historic resources determined to be eligible for listing.

| Objective 11b. Increase Management Efforts for Prehistoric Sites Listed on or Eligible for Listing on the NRHP |
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| Identify and protect prehistoric archaeological sites listed on or eligible for listing on the NRHP. |
| **Strategies Applied to Achieve Objective** |
| Identify archaeological sites that coincide with existing and planned roads, facilities, public use areas, and habitat projects. Evaluate threatened and impacted sites for eligibility to the NRHP. Prepare and implement activities to mitigate impacts to sites as necessary. |
| Implement a program to evaluate eligibility to the NRHP for those archaeological sites that may be impacted by Service undertakings, management activities, erosion, or neglect. |
| Develop a GIS layer for cultural resources that can be used with other GIS layers for the Refuge yet contains appropriate locks to protect sensitive information. |
| **Rationale:**<br>Federal historic preservation laws and regulations require a determination of eligibility for the NRHP for archaeological sites 50 years or older. |

## GOAL 12. Manage the Refuge's paleontological resources for their educational and scientific values for the benefit of present and future generations of refuge users.

| Objective 12a. Protect Paleontological Resources |
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| Increase monitoring and protection of paleontological resources on the Refuge. |
| **Strategies Applied to Achieve Objective** |
| Continue to identify paleontological sites that coincide with existing and planned roads, facilities, public use areas, habitat restoration, and research projects. Prepare and implement activities to mitigate impacts to sites as necessary. |
| **Rationale:**<br>Paleontological resources are not renewable. Federal laws and regulations mandate protection of this resource on Federal lands. |

| Objective 12b. Provide Interpretation of Paleontological Resources |
|---|
| Provide interpretation to instill appreciation for the Refuge's paleontological resources and the valuable information they can yield about past environments. |
| **Strategies Applied to Achieve Objective** |
| Provide interpretation of paleontological resources at Refuge Headquarters using static displays, brochures, etc. |
| Partner with National Park Service staff from the John Day Fossil Beds National Monument on the development of interpretive and educational materials about the Refuge's paleontological resources. |
| **Rationale:**<br>Interpretation of paleontological resources can raise public interest and appreciation of the scientific information that can be gained from studies of fossil fauna and flora and how this information relates to |

past environments in the Great Basin. Ultimately, such appreciation can result in public support for conservation, maintenance, and protection of paleontological resources.

## GOAL 13. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

### Objective 13a. Inventory and Monitoring (Surveys)

Throughout the life of the CCP, conduct high-priority inventory and monitoring (survey) activities that evaluate resource management and public use activities to facilitate adaptive management. Surveys should contribute to the enhancement, protection, use, preservation, and management of wildlife populations and their habitats on and off refuge lands. Additionally, surveys can be used to evaluate achievement of resource management objectives identified in the CCP. These surveys have the following attributes:

- Data collection techniques should result in minimal animal mortality or disturbance, and minimal habitat destruction
- The minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) to meet statistical analysis requirements will be collected for identification and/or experimentation in order to minimize long-term or cumulative impacts
- All common carp will be lethally sampled unless the survey pertains to telemetry or mark and recapture.
- Proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary, will minimize the potential spread or introduction of invasive species
- Projects will adhere to scientifically defensible protocols for data collection, where available and applicable

**Strategies Applied to Achieve Objective**

**The following is a list of survey activities to support resource management decisions on the Refuge.**

Aquatic inventory and monitoring associated with highest priority habitat objectives.

Terrestrial inventory and monitoring associated with highest priority habitat objectives.

Wildlife inventory and monitoring associated with highest priority habitat objectives.

Habitat inventory and monitoring associated with highest priority habitat objectives.

**Rationale:**

National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C. 668dd-ee) requires the Service to "monitor the status and trends of fish, wildlife, and plants in each refuge." Surveys will be used primarily to evaluate resource response to assess progress toward achieving refuge management objectives (under Goals 1-4 in this CCP) derived from the NWRS mission, refuge purpose(s), and maintenance of biological integrity, diversity, and environmental health (601 FW 3). Determining resource status and evaluating progress toward achieving objectives is essential to implementing adaptive management on Department of Interior lands as required by policy (522 DM 1). Specifically, results of the surveys will be used to refine management strategies, where necessary, over time in order to achieve resource objectives. Surveys will provide the best available scientific information to promote transparent decision-making processes for resource management over time on refuge lands.

| **Objective 13b. Assessment of Hydrological Features Associated with Riverine Systems and Associated Wetlands (i.e., Blitzen River)** |
|---|
| Conduct geomorphological, hydrological, and biological assessments that will provide current baseline information about the ecological status of riverine systems (i.e., Blitzen River and tributaries) and associated wetlands. |
| **Strategies Applied to Achieve Objective** |
| Historic channel/floodplain geometry (e.g., historic aerial photo analysis, transport measurements). |
| Sediment flux (sediment/hydraulic modeling). |
| Water allocation (water budget, habitat use, and availability surveys). |
| Life history/habitat needs of aquatic species (population modeling, literature review, aerial photos). |
| Bank erosion and incision rates (e.g., erosion pins, channel surveys). |
| Channel morphology surveys (e.g., sediment budget). |
| Sediment transport measurements (e.g., channel change). |
| Continued gauging of flows (water supply, potential climate change, channel and floodplain change). |
| Ongoing aerial photo collection and analysis (bank erosion rates, extent of floodplain inundation). |
| Riparian plant surveys (composition/distribution of riparian vegetation). |
| Habitat availability surveys for focal species (condition of in-stream habitat). |
| Habitat use surveys for focal/invasive species (physical factors affecting aquatic species). |
| Investigate bed erosion associated with in-stream structures. |
| **Rationale:**<br>See Objective 2a. |

| **Objective 13c. Implement Riverine Pilot Projects to Assess River and Wetland Response to Rehabilitation Efforts** |
|---|
| Utilizing information gleaned from assessment results, identify and implement two to five pilot projects to gain greater understanding of plant community and physical responses to rehabilitation efforts of the Blitzen River and associated tributaries, wetlands, and meadows. |
| **Strategies Applied to Achieve Objective** |
| Study response of wetland habitats to the cessation of flood irrigation. |
| Initiate small in-stream rehabilitation pilot projects in tributaries or reaches of the Blitzen River in response to assessment results. |
| **Rationale:**<br>See Objective 2a. The necessity of this objective is dependant upon the outcomes of Objectives 13a and b. |

| **Objective 13d. Research** |
|---|
| Throughout the life of the CCP, conduct high-priority research projects that provide the best science for habitat and wildlife management on and off the Refuge. Scientific findings gained through these projects will expand knowledge regarding life-history needs of species and species groups as well as |

identify or refine habitat and wildlife management actions. Research also will reduce uncertainty regarding wildlife and habitat responses to refuge management actions in order to achieve desired outcomes reflected in resource management objectives and to facilitate adaptive management. These research projects should exhibit the following attributes:

- Projects will adhere to scientifically defensible protocols for data collection, where available and applicable, in order to develop the best science for resource management
- Data collection techniques should cause minimal animal mortality (except for invasive species) or disturbance and temporary habitat damage
- Investigators should collect the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) to meet statistical analysis requirements for identification and/or experimentation in order to minimize long-term or cumulative impacts
- All common carp will be lethally sampled unless the research pertains to telemetry or mark and recapture
- Investigator equipment and clothing will be properly cleaned or quarantined, where necessary, to minimize the potential spread or introduction of invasive species
- Permitted research should result in peer-reviewed articles in scientific journals and publications and/or symposiums

| **The following is a prioritized list of research projects to support resource management decisions on the Refuge.** |
|---|
| Conduct research to gather scientific data to further carp control efforts. |
| Determine management action responses by native fish and wildlife resources. |
| Identify methods for restoration of crested wheatgrass plantings and cheatgrass-dominated areas to native sagebrush steppe communities. |
| Monitor the effect of seasonal water table depths on plant communities along hydrological gradients in emergent marsh and wet and dry meadow habitats in select areas. |
| Identify strategies for diversifying plant communities (e.g., reed canarygrass and other introduced grass monocultures) where appropriate. |

**Rationale:**

Research projects on refuge lands would address a wide range of natural and cultural resource as well as public-use management issues. Examples of research projects include habitat use and life-history requirements for specific species/species groups, practical methods for habitat management and restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, identification and analyses of paleontological specimens, wilderness character, modeling of wildlife populations, and assessment of responses of habitat/wildlife to disturbance from public uses. Projects may be species-specific or refuge-specific, or they may evaluate the relative contribution of the Refuge to issues and trends at larger landscape level (e.g., ecoregion, region, and flyway, national, international). Like monitoring, results of research projects would expand the best available scientific information and potentially reduce uncertainties to promote transparent decision-making processes for resource management over time on refuge lands. In combination with results of surveys, research would promote adaptive management on refuge lands. Scientific publications resulting from research on refuge lands will help increase the visibility of the NWRS as a leader in the development of the best science for resource conservation and management.

**Objective 13e. Scientific Assessments**

Throughout the life of the CCP, conduct scientific assessments to provide baseline information to

| |
|---|
| expand knowledge regarding the status of refuge resources to make better resource management decisions. These scientific assessments will contribute to the development of refuge resource objectives and they will also be used to facilitate habitat restoration through selection of appropriate habitat management strategies based upon site-specific conditions. These scientific assessments should exhibit the following attributes:<br>• Use of accepted standards, where available, for completion of assessments<br>• Scale and accuracy of assessments where appropriate for development and implementation of refuge habitat and wildlife management actions |
| **The following is a prioritized list of scientific assessments to support resource management decisions on the Refuge.** |
| Conduct aquatic health assessment of Malheur Lake pertaining to fish, macroinvertebrates, water, and plants. |
| Assess avian predation on carp. |
| Assess carp control study areas before and after treatment. |
| **Rationale:**<br>In accordance with policy for implementing adaptive management on refuge lands (522 DM 1), appropriate and applicable environmental assessments are necessary to determine resource status, promote learning, and evaluate progress toward achieving objectives whenever using adaptive management. These assessments will provide fundamental information about biotic (e.g., vegetation data layer) as well as abiotic processes and conditions (e.g., soils, topography) that are necessary to ensure that implementation of on-the-ground resource management achieve resource management objectives identified under Goals 1-4. |

**Objective 13f. Monitor Public Use Programs**

Monitor public use programs to meet the needs and desires of refuge visitors, and to ensure visitor satisfaction with wildlife-dependent recreational opportunities. The program will use visitor satisfaction surveys or other instruments to help define and evaluate wildlife-dependent recreational opportunities.

| Program | Indicator | Method | Frequency | Locations | Partners |
|---|---|---|---|---|---|
| Overall use | Visitation numbers | Traffic counters | Checked monthly | Entrances at Headquarters parking area and P Lane | Volunteers |
| Site visits | Number of visitors at key sites | Door counter, head count and self-registration | Checked monthly | Visitor Center, trail heads, and fishing areas | Volunteers |
| Facility conditions | Conditions | Visual/site condition form | Checked quarterly | Signs, trails, interpretive panels, etc. | Volunteers |
| Welcome and orientation | Number of users and user satisfaction | Comment cards | Checked monthly | Visitor Center and key sites | Volunteers |
| Wildlife observation | Number of users and user | Self-registration | Checked monthly | Visitor Center and key sites | Volunteers |

| | | | | | |
|---|---|---|---|---|---|
| | satisfaction | | | | |
| Wildlife/ nature photography | Number of users and user satisfaction | Self-registration | Checked monthly | Visitor Center and key sites | Volunteers |
| Interpretation | Number of users and user satisfaction | Self-registration | Checked monthly | Visitor Center and key sites | Volunteers |
| Environmental education | Number of users and user satisfaction | Feedback forms | Per scheduled programs | All scheduled programs | |
| Hunting | Number of users and user satisfaction | Verbal communication | During hunting seasons | All hunt units | |
| Fishing | Number of users and user satisfaction | Self-registration | Checked monthly | Entrances to fishing areas | Volunteers |
| Volunteers and partnerships | Number of users and user satisfaction | Feedback forms and verbal communication | End of volunteer tour of duty or opportunity | All volunteers; partners at bi-annual intervals | |

**Rationale:**

Monitoring public use, including the level of visitation, facility condition, and visitor experience, assists in maintaining a quality public use program. Monitoring will provide a tool to evaluate the public use program and assist the Refuge with making needed improvements.

## GOAL 14. Integrate our conservation-based mission with the best available science and become a leader in advancing best practices for the design and management of innovative, sustainable refuge and community development opportunities.

### Objective 14a. By 2020, Achieve Carbon Neutrality (striving for carbon negative), Meeting and Exceeding All Energy and Material Efficiency and Effectiveness as Defined by 565 FW 1 and Executive Order 13514 for All Facets of Refuge Management and Operations

| Strategies Applied to Achieve Objective |
|---|
| Establish performance benchmarks within Environmental Management System (515 DM 4) as the critical first step, then create metrics and benchmarks for all other sustainability-based practices (environmental, social, economic, and community). |
| Complete audits for energy and material use, carbon footprint, and biomass-based carbon sequestration. |
| Integrate sustainability-based approaches into partnerships, contracts, and other external stakeholder efforts. |
| Provide staff and external stakeholder training for sustainability-based principles and practices, social justice/equity, community development, and partnership performance standards. |

| |
|---|
| Develop projects to refit and right-size facilities, infrastructure, and vehicle fleet to maximize energy efficiency and production. Seek funding through Refuge Operations Needs and Deferred Maintenance databases, and other opportunistic and entrepreneurial funding sources. |

**Rationale:**

The word "sustainability" came into common use only in the past 25 years, most formally in 1987 when the Brundtland Commission defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

This widely published definition says much about the ethics and responsibility of one generation to the next. Sustainability is how we commonly think in terms of leaving the nation and world a better place for our children and grandchildren, whether in regards to family, land, and finances, or in terms of public land and resources. As such, it is a reinforcement of traditional American values: protection of our natural and cultural resources, self-sufficiency, self-determination, ingenuity, and responsibility. Sustainability-based planning, design, and management practices are essential to the conservation of biodiversity as well as, if not synonymous with, the longevity and resilience of surrounding local communities and landowners, who are possible partners in Refuge sustainability initiatives.

There are numerous policy statements and initiatives that call for integrating sustainability-based principles and practices within the CCP.

- USFWS Strategic Plan for Climate Change, which calls for the Service to become carbon neutral by 2020
- 515 DM 4, Environmental Management System (EMS), which gives facilities a systematic way to identify environmental impacts from operational activities and to set facility-specific goals and targets for sustainability; Malheur Refuge is one of 17 USFWS facilities chosen to implement EMS
- Executive Order 13514, Federal Leadership in Environment, Energy, and Economic Performance
- Executive Order 13423, Federal Environmental, Energy, and Transportation Management (codified by Section 748 of the Omnibus Appropriations Act of 2009 (P.L. 111-8)), and Instructions for Implementing the Order)
- Secretary of Interior Salazar's speech at the UN Conference on Climate Change in Copenhagen, entitled "New Energy Future: The Role of Public Lands in Clean Energy Production and Carbon Capture"

As such, in the interest of contributing to national security and economic competitiveness through our mission, the Refuge must do its part in producing more energy than it consumes, storing more carbon than it produces, proactively adapting to climate change, and maximizing the delivery of all other ecological services, especially biodiversity and clean water.

The Refuge is taking the approach of the old adage that if we are not part of the solution, then we are part of the problem. If we are part of the problem, then we risk being irrelevant, if not disposable, in the eyes of the general public. Our intent is to lead.

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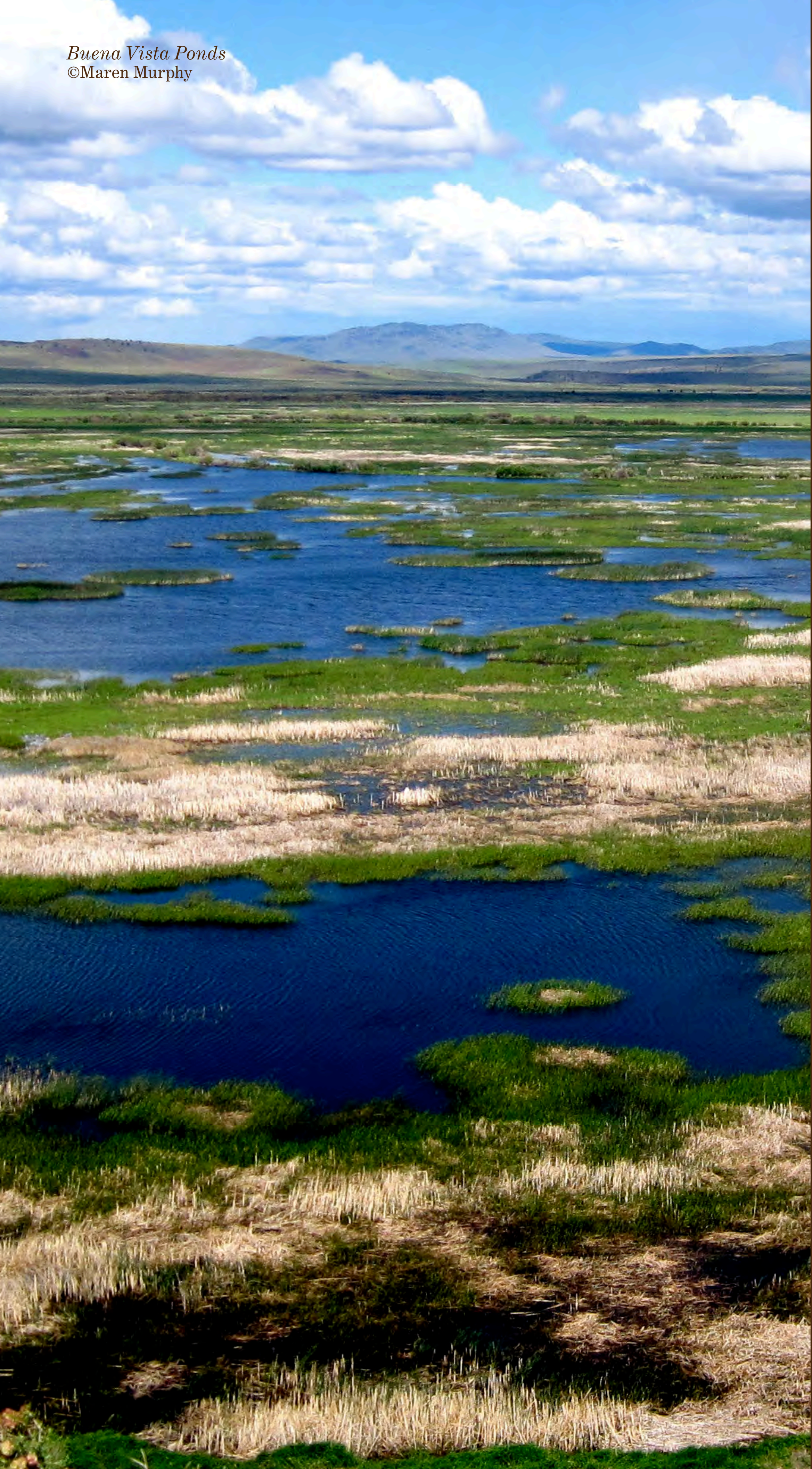

*Buena Vista Ponds*
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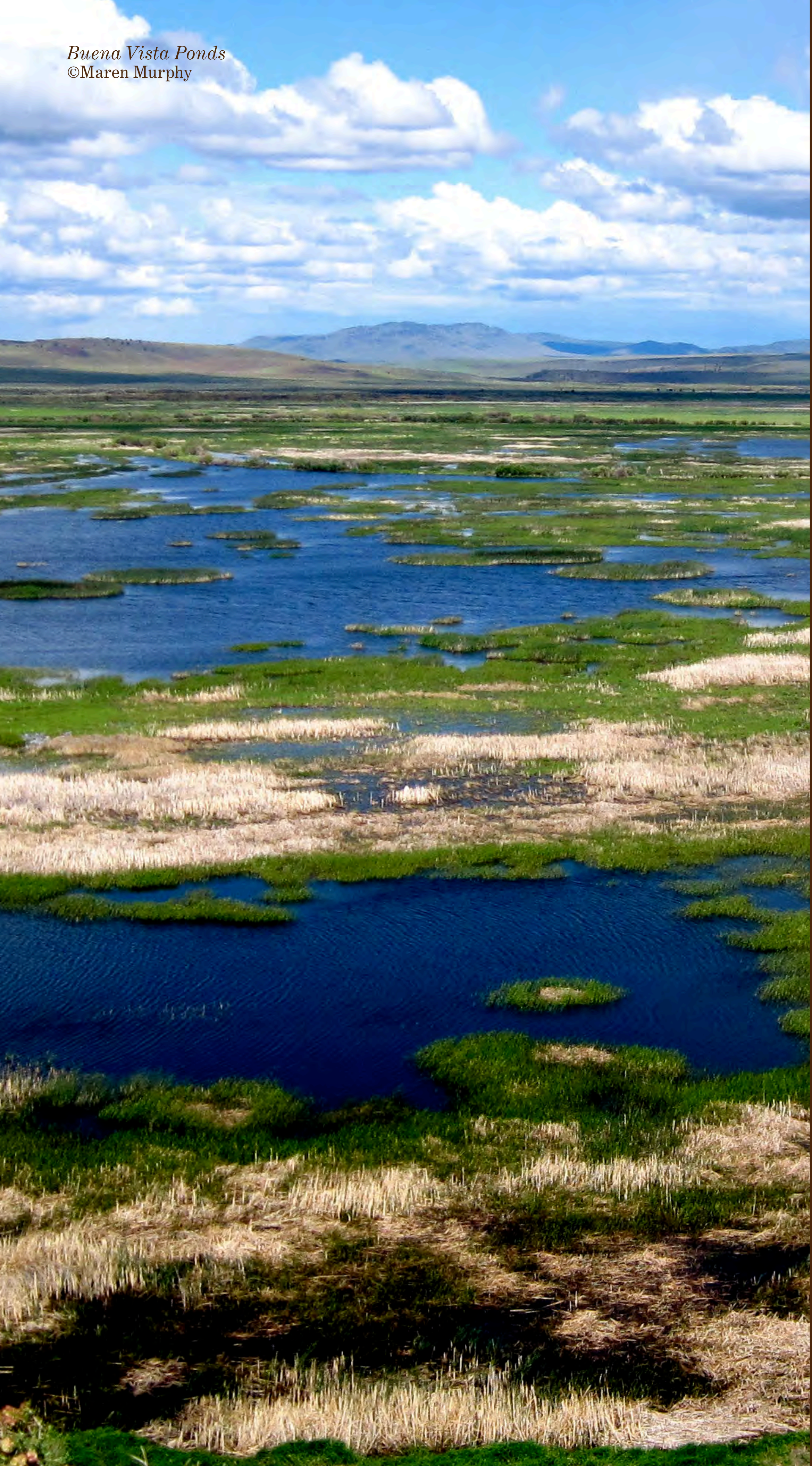
# Chapter 3 Physical Environment



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# Chapter 3 Physical Environment

# 3.1 Major Landforms

Situated in the wide open spaces of the Harney Basin physiographic area, on the northern edge of the Great Basin, the Refuge centers on three shallow playa lakes, Malheur, Mud, and Harney. These lakes are located in the lowest portion of the Harney Basin and receive life-producing water from the surrounding hills and mountains. Most of the water reaching the lakes arrives in the spring as snow melts and flows southward down the Silvies River, northward in the Donner und Blitzen River (Blitzen River), and through the Silver Creek drainage from the northwest. With an average annual rain/snow fall of only 9 inches, a drought year can result in extremely dry conditions; the lakes can be reduced to a mere fraction of their former size or become alkali-covered playas. The area surrounding the lakes is relatively flat, so a 1-inch rise in the water level will put almost 3 square miles of adjacent land underwater. A year of extremely abundant rain and snow can force water to rise beyond the boundaries of the Refuge to cover surrounding lands, doubling or tripling the size of the marsh. In the mid-1980s three years of above-normal snow forced Malheur Lake beyond the refuge boundary; the lake grew from 67 square miles to more than 160 square miles. The reverse is also possible: in 1992 Malheur Lake was reduced to 500 acres with a depth of 2 inches (USFWS 1992).

Malheur Refuge lies in the Harney Basin in southeastern Oregon. The basin is in a hydrographically closed watershed on the northern reaches of the Great Basin. It lies mainly within the High Lava Plains physiographic province and is characterized as alluvial lowlands and surrounding volcanic rock uplands.

# 3.2 Climate

## 3.2.1 Current Climate

### Climate Patterns

In winter, air masses moving inland from the Pacific Ocean to the North American continent pick up unlimited moisture from the ocean. The Cascade Range, some 100 miles west of the Refuge, forces this moisture-laden marine air from the Pacific Ocean to rise as it moves eastward. The resultant cooling and condensation produces heavy winter moisture on the western side of the Cascades and a rain shadow effect that extends across eastern Oregon. This produces a semiarid steppe climate for the Harney Basin, with relatively low rainfall in the lowland areas. Higher elevation areas in the basin, including Steens Mountain, are cooler and much wetter than the valley floors. The distribution of vegetation communities, which is strongly controlled by temperature and precipitation gradients, reflects this difference. Vegetation in these higher elevation areas includes western juniper and quaking aspen as well as mountain sagebrush, grasses, and other low-growing shrubs. These areas are very important to refuge water resources because the river systems that supply the Refuge are mainly sourced from higher-elevation areas. In particular, the Blitzen River, which flows through the Blitzen Valley before emptying into Malheur Lake, originates on the western side of Steens Mountain. Because of the importance of the Blitzen River to refuge water resources, the following climate discussion includes the Blitzen watershed, upstream of the Refuge, as well as the valley floor and the Refuge.

## Local Temperature and Rainfall Sources 1975-2009

There are several sources of historic climate data for the Refuge. The main data source used here is the Parameter-elevation Regressions on Independent Slopes Model (PRISM) (Daly 2002; Daly et al. 2008). PRISM provides a complete record (i.e., no missing data) of temperature and precipitation data at 4-km resolution for the United States. Monthly minimum and maximum temperature and monthly precipitation PRISM data from 1950 to 2009 was used. A Geographic Information System was used to delineate two areas, the area encompassed by the refuge boundary and the Blitzen watershed upstream of the Refuge and Page Springs. This was then used to intersect the 4-km gridded PRISM data and queried temperature and precipitation for all grid points within the boundaries of these two areas at each monthly time step, so that an average monthly temperature and total monthly precipitation could be calculated for both the Refuge and the Blitzen watershed for every month from 1950 to 2009.

A second source of daily and monthly climate data is the individual weather stations in the area. These include Burns Municipal Airport, four National Weather Service/National Oceanic and Atmospheric Administration (NWS/NOAA) government weather stations on the Refuge (Buena Vista Station, P Ranch Substation, Double-O Station and Refuge Headquarters), and the United States Historical Climatology Network (USHCN) Malheur Refuge Headquarters station (Station No. 355162). Data from the USHCN station data was the main source of data because this station provides a complete record of high-quality climate data (Menne et al. 2009). The PRISM method described above likely used data from all these local stations, as well as snowpack telemetry (SNOTEL) station data described below, to develop the interpolated dataset for the area.

A third source of climate data is two Natural Resources Conservation Service (NRCS) SNOTEL sites, Silvies SNOTEL (Site No. 759) and the Fish Creek SNOTEL (Site No. 477), located on Steens Mountain within the Blitzen watershed (NRCS 2011). The Silvies site is slightly lower (6,990 feet) than the Fish Creek site (7,660 feet) but both sites are at high elevations for SNOTEL sites in Oregon. These sites have April 1 snow water equivalent measurements (SWE) from 1939 to the present, with daily SWE, precipitation, and air temperature measurements beginning in 1984.

Average temperature, precipitation, and April 1 SWE were calculated from the PRISM data or the SNOTEL data using the period 1975 to 2009. Summary statistics (average, maximum, and minimum) for the shorter, more recent period will be more representative of average climate in the area today. Data from the longer period (from 1950 to 2009) were used to evaluate long-term trends in the monthly temperature and precipitation PRISM data and the April 1 SWE data. Temperature or precipitation trends observed in the PRISM dataset were compared to data from the USHCN station. A Mann Kendall test, a nonparametric trend test that is less sensitive to outliers than linear regression, was used for trend testing. Because the trend is less sensitive to outliers, the test results can be thought of as more conservative—meaning it will be more difficult to detect statistically significant trends in the data.

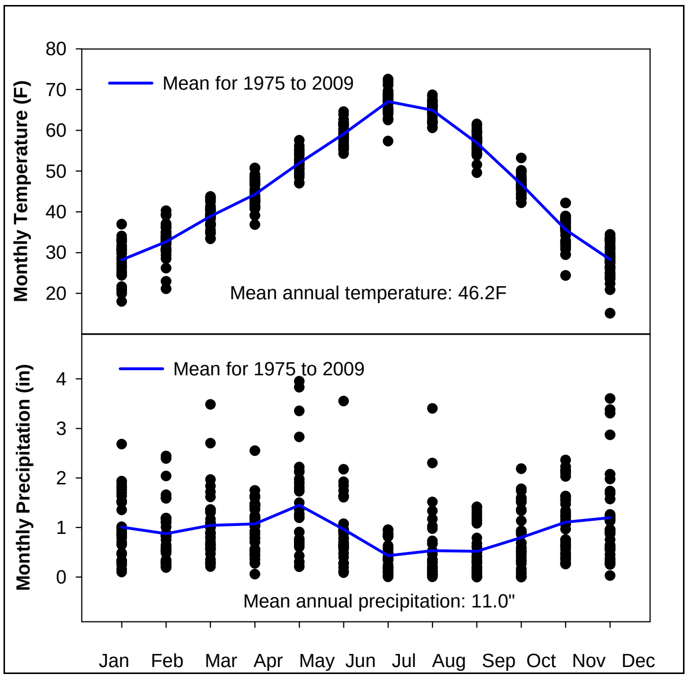
## Refuge Temperature and Precipitation Averages 1975-2009

***Temperature:*** The mean annual temperature for the Refuge is 46.3°F for the period 1975 to 2009 (Figure 3-1). July is the warmest month, with an average monthly maximum temperature of 84.9°F. January is the coldest month, with an average monthly minimum temperature

**All references to elevations in this document are at the National Geodetic Vertical Datum of 1929 (NGVD29), to the best of our knowledge.**

of 18.4°F. Average monthly minimum temperatures are below 32°F from November through April. The USHCN station (elevation 4,118 feet) at Malheur Refuge Headquarters has recorded an average of 18 days a year with temperatures of 90°F or greater, and an average of 182 days a year with temperatures of 32°F or less.

***Precipitation:*** Average annual precipitation for the Refuge is 11.0 inches for the water year (October-September), with most of that total (9.5 inches) falling from October to June (Figure 3-1). The summer months, July through September, are typically very dry, although August has been wet in some years because of thunderstorm activity. Thunderstorms accompanied by lightning are common during the late summer and influence the frequency of wildland fires on and around the Refuge.




Source: PRISM 4-km gridded data.

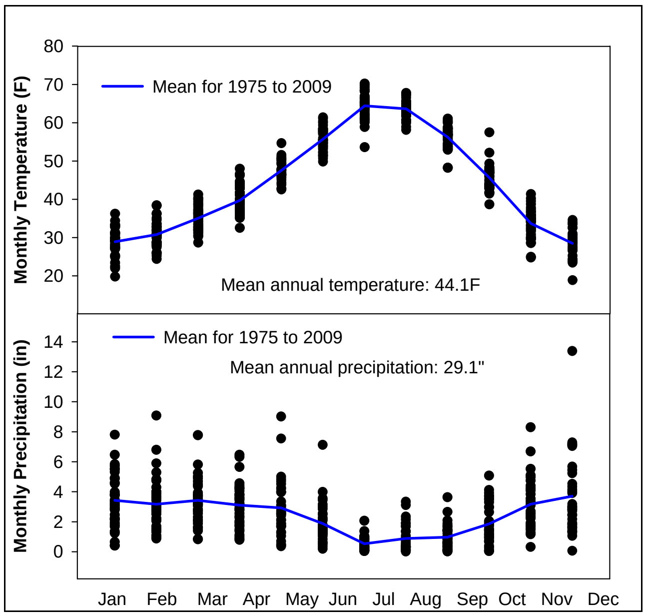
**Figure 3-1. Mean and distribution of monthly temperature and precipitation for the area encompassed by Malheur Refuge for the period 1975 to 2009.**

***Wind:*** Winds are common in the area with an annual average speed of 6.7 miles per hour (MPH) and gusts over 25 MPH. In general, winds are westerly but switch to the north and east during the winter. Severe wind conditions are usually associated with the onset of late summer thunderstorm activity.

## Blitzen Watershed Temperature and Precipitation (Off-refuge)

The Blitzen watershed upstream of the Refuge and Page Springs is higher in elevation than the Refuge (average elevation is 6,200 feet compared with the valley floor elevation of 4,150 feet). Average temperatures are not very different from the valley floor of the Refuge, but precipitation is much greater on the mountain. Over the period from 1975 to 2009, the mean annual temperature for the Blitzen watershed measured 44.1°F (Figure 3-2), with an average monthly maximum temperature of 78.2°F in July and an average monthly minimum temperature of 20.1°F in December, the coldest month.

Average annual precipitation in the watershed is 29.1 inches, almost three times the amount on the Refuge, with most of that (26.7 inches) occurring October through June (Figure 3-2). Much of the winter precipitation in the area falls as snow. April 1 SWE at the two Steens Mountain SNOTEL sites averages 17.6 inches (range 0 to 40.8 inches) at Silvies and 29.0 inches (range 9 to 49.8 inches) at Fish Creek for the period 1975 to 2009. The Fish Creek site receives more snow because of its higher elevation. As in many areas of the West, the spring snowpack represents an accumulated reservoir of water that is released slowly from April through June and sustains streams through the typically dry summers of the region.



Source: PRISM 4-km gridded data.

**Figure 3-2. Mean and distribution of monthly temperature and precipitation in the Blitzen River watershed above Page Springs for the period 1975 to 2009.**

## Climate Variability

Pacific Northwest climate variability is strongly shaped by two large-scale patterns: the El Niño/Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). Each ENSO phase (El Nino or La Nina) typically lasts six to 18 months, while, during most of the 20th century, each PDO phase has typically lasted for 20 to 30 years. These climate drivers can act separately or in concert in creating patterns of warm/dry or cool/wet winters. Via their influence over both winter temperature and winter precipitation, these natural climate patterns exert significant influence on snowpack and hydrology.

Although both ENSO and the PDO have been shown to affect climate in the Pacific Northwest (Cayan et al. 1999; Mantua and Hare 2002; McCabe and Dettinger 2002), neither is significantly correlated with precipitation or temperature at the Refuge or in the Blitzen watershed. The lack of any relationship may be due to the fact that the Refuge is located at the intersection of two geographic regions, the Pacific Northwest and the Great Basin, with contrasting responses to ENSO and the PDO.

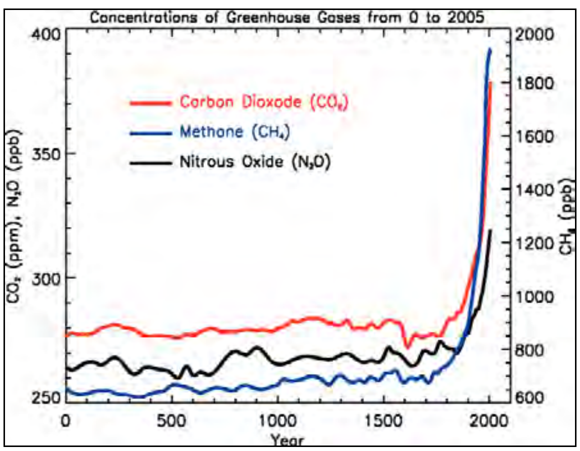
## 3.2.2 Climate Change

As required by DOI Secretarial Order 3226, issued in 2001, the Service requires consideration and analysis of climate change in long-range planning. Detailed information about climate change is contained in Appendix M. Relevant data that apply to the Refuge have been taken from this appendix and are presented below.

### Global Greenhouse Gases

The greenhouse effect is a natural phenomenon that assists in regulating and warming the temperature of our planet. Just as a glass ceiling traps heat inside a greenhouse, certain gases in the atmosphere, called greenhouse gases, absorb heat from sunlight, trapping heat in the atmosphere and warming the planet. The primary greenhouse gases occurring in the atmosphere include carbon dioxide ($CO_2$), water vapor, methane, and nitrous oxide. $CO_2$ is produced in the largest quantities, accounting for more than half of the current impact on the earth's climate.

A growing body of scientific evidence from basic theory, climate model simulations, and observations has emerged to support the idea that humans are changing the earth's climate (IPCC 2007; NAS 2008; USGCRP 2009). The concentrations of heat-trapping greenhouse gases have increased significantly over the last several hundred years due to human activities such as deforestation and the burning of fossil fuels (Figure 3-3).

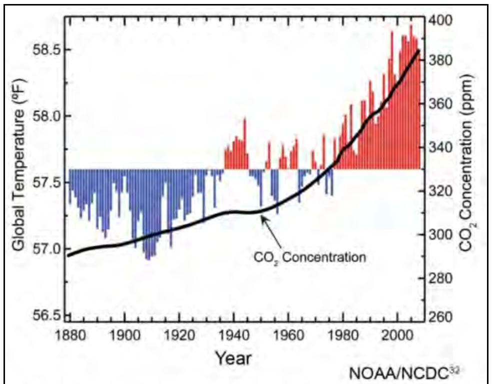



Source: IPCC 2007.

**Figure 3-3. Concentrations of important heat-trapping greenhouse gases over the last 2,000 years.**

### Global Temperature in Relationship to Greenhouse Gases

There is a direct correlation between greenhouse gas concentrations and the temperature of the earth's surface. Global surface temperatures have increased about 1.3°F since the late 19th century (USGCRP 2009), and the rate of temperature increase has risen in more recent years (Figure 3-4). The Intergovernmental Panel on Climate Change (IPCC), a large group of scientists created by the United Nations to evaluate the risk of climate change caused by human activities, reported in 2007 that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level" (IPCC 2007).




Global annual average temperature (as measured over both land and oceans). Red bars indicate temperatures above and blue bars indicate temperatures below the average temperature for the period 1901-2000. The black line shows atmospheric carbon dioxide ($CO_2$) concentration in parts per million (ppm). While there is a clear long-term global warming trend, each individual year does not show a temperature increase relative to the previous year, and some years show greater changes than others.[33] These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niños, La Niñas, and the eruption of large volcanoes.

Source: USGCRP 2009.

**Figure 3-4. Global average temperature and $CO_2$ concentrations from 1880 to 2008.**

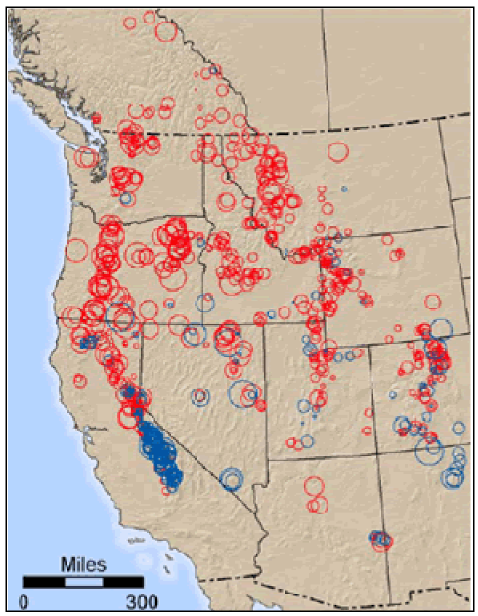
In the northern hemisphere, recent decades appear to be the warmest since about A.D. 1000, and warming since the late 19th century is unprecedented over the last 1,000 years. Globally, 2010 and 2005 tie as the warmest years in the instrumental record (1880 to the present), while 2009 was only a fraction of a degree cooler, matching 1998, 2002, 2003, 2006, and 2007 for the second warmest on record, according to independent analyses by NOAA and the National Aeronautics and Space Administration (NASA). The new 2010 record is particularly noteworthy because it occurred in the presence of a La Niña and a period of low solar activity, two factors that have a cooling influence on the planet. However, in general, decadal trends are far more important than any particular year's ranking.

## Pacific Northwest Climate Indicators and Trends

From a climate change perspective, the Refuge is more closely aligned with changes that have occurred in the Pacific Northwest than those in the desert regions of the Southwest. In the Pacific Northwest, regionally averaged temperature rose 1.5°F between 1920 and 2000, slightly more than the global average. Warming was largest for the winter months of January through March. Minimum daily temperatures have increased faster than maximum daily temperatures. Longer-term precipitation trends in the Pacific Northwest are more variable and vary with the period of record analyzed (Mote et al. 2005). Looking at the period 1920 to 2000, precipitation has increased almost everywhere in the region. Most of that increase occurred during the first part of the record.

In the Pacific Northwest, increased greenhouse gases and warmer temperatures have resulted in a number of physical and chemical impacts to the region. These include changes in snowpack, streamflow timing and volume, flooding and landslides, sea levels, ocean temperatures and acidity, and disturbance regimes like wildfires and outbreaks of insects and diseases (USGCRP 2009).

***Snowpack Changes:*** One of the most important responses to warmer winter temperatures in the Pacific Northwest has been the loss of spring snowpack (Mote et al. 2005). As temperatures rise, the likelihood of winter precipitation falling as rain rather than snow increases. This is especially true in the Pacific Northwest where mountainous areas of snow accumulation are at relatively low elevations and winter temperatures are near freezing. Small increases in average winter temperatures can lead to increased rains, reduced snowpack, and earlier snowmelt. The loss of spring snowpack in the Pacific Northwest has been significant, with most of the stations showing, on average, a decrease (Figure 3-5). Data recorded each April 1 show that snowpacks have declined 25 percent over the past 40 to 70 years (Mote et al. 2005). The fact that the declines are greatest at low-elevation sites and that the trend has occurred in the absence of significant decreases in winter precipitation implicates temperatures rather than precipitation as the cause of the trend.



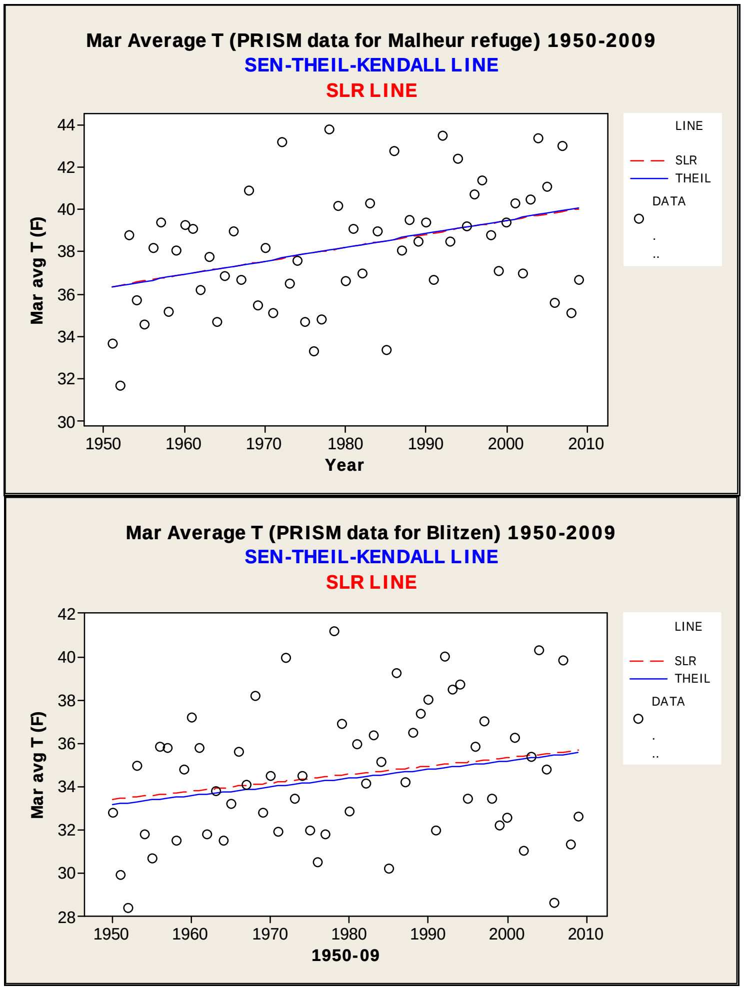

Source: Mote et al. 2005.
Red (blue) circles indicate decreasing (increasing) snow water equivalent (SWE), with the size of the symbol indicating the magnitude of the trend

**Figure 3-5. Trends in April 1 snow water equivalent in the western United States from 1950 to 1997.**

***Streamflow changes:*** The decrease in spring snowpack and earlier snowmelt has led to a change in streamflow in many systems, including earlier spring runoff peaks, increased winter streamflow, and reduced summer and fall streamflows. Stewart et al. (2005) examined 302 streamflow gages in the western United States and reported that the timing of winter runoff and annual streamflow had advanced by one to four weeks from 1948 to 2002. The degree of change depends on the location and elevation of the specific river basin. Basins located significantly above freezing levels have been much less affected by warmer temperatures than those located at lower elevations. River basins whose average daily winter temperatures are close to freezing are the most sensitive to climate change, as is apparent from the dramatic shifts in streamflow timing that have resulted from relatively small increases in wintertime temperatures.

## Climate Change Indicators and Historical Trends at Malheur Refuge

An analysis of historic PRISM data between 1950 and 2009 for both the refuge area and the Blitzen watershed revealed a statistically significant trend in March monthly temperatures, showing a 3.5°F increase over the period measured (0.6°F per decade; see Figure 3-6). The USHCN data from the Malheur Refuge Headquarters station validate this (data not shown). The USHCN station data also show statistically significant increases in several other months.




Source: PRISM data.

**Figure 3-6. Trend in March monthly temperature for the Refuge and the Blitzen from 1950 to 2009.**

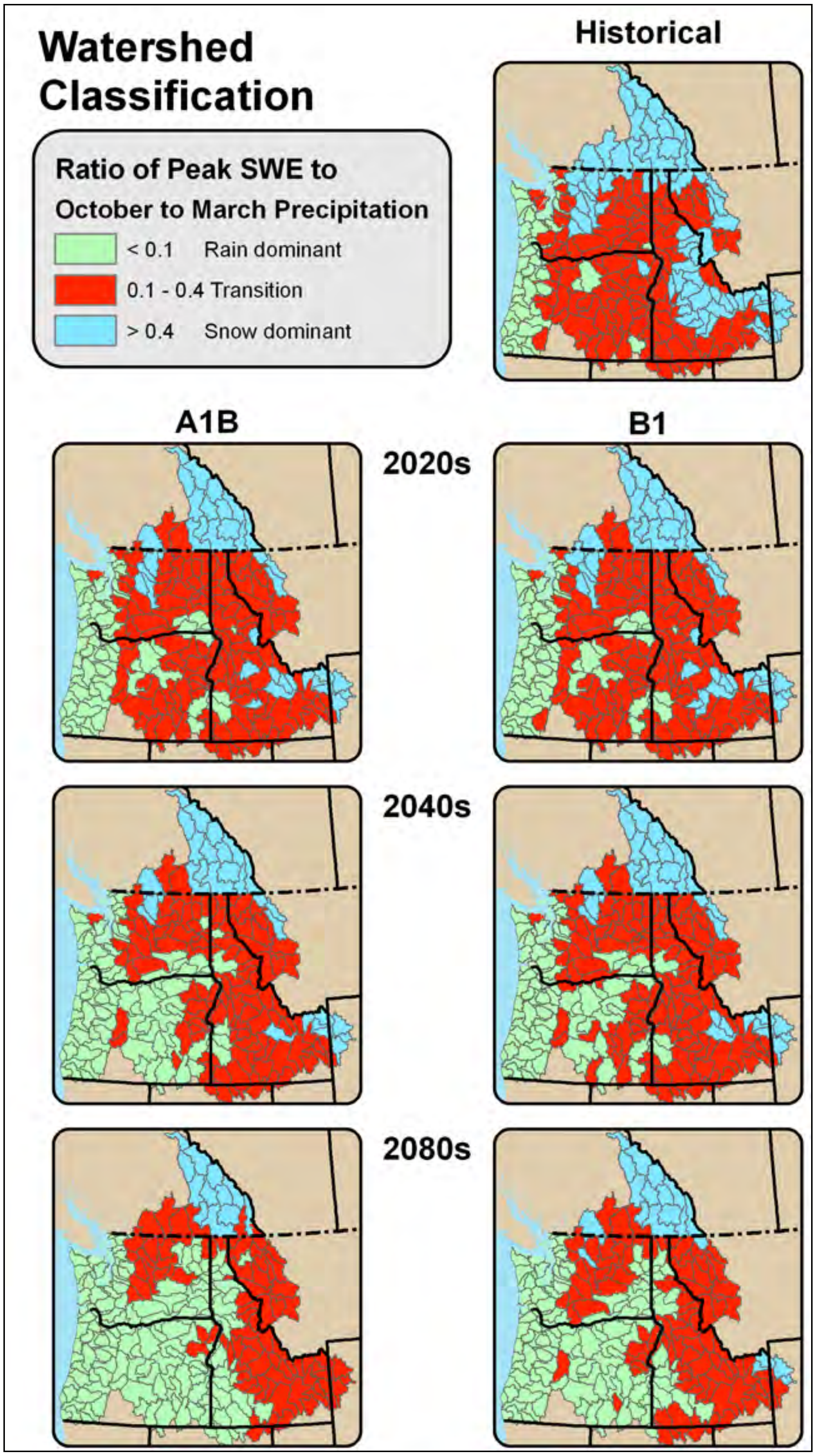
Precipitation data from PRISM and USHCN show opposite trends (one increasing and one decreasing) from 1950 to 2009 but neither trend is statistically significant. As discussed above, winter temperatures, particularly in January and March, have been shown by other studies to be increasing in the West (Hamlet and Lettenmaier 2007; Knowles et al. 2006). The increases can cause more precipitation to fall as rain versus snow, resulting in reduced April 1 SWE, earlier snowmelt, and changes in streamflow.

The SNOTEL data from Steens Mountain suggest that warmer March temperatures may have impacted snowpack at least at lower elevations in the Blitzen watershed. There is a statistically significant decreasing trend (-5 percent per decade or -34 percent) from 1950 to 2009 in the April 1 SWE at the Silvies SNOTEL, the lower-elevation site. April 1 SWE at Fish Creek, the higher-elevation site, shows a very slight decrease from 1950 to 2009, but the trend is not statistically significant. Note that the Blitzen PRISM dataset shows an increase in precipitation over the same period. The fact that precipitation in the Blitzen watershed has increased or at least not changed while SWE at the lower-elevation site has decreased significantly indicates that the decreasing trend at the Silvies SNOTEL site is most likely related to warmer temperatures. Because of the relatively high elevation and cold climate of the Blitzen watershed and the Steens Mountain area, snowpack has not been affected by warming temperatures to the degree it has in other lower-elevation areas around the Pacific Northwest. However, as temperatures continue to warm, snowpack will likely continue to decline.

One of the expected impacts of declining snowpacks and earlier snowmelt is a change in streamflow timing and volume, specifically higher winter flows, an earlier snowmelt runoff peak, and reduced late season baseflows. Because the USGS Blitzen River stream gage has a long period of record (continuous measurements from 1939 on) and is upstream of any significant diversions or regulation, it provides an excellent record of the river’s response to climate. To date, few climate change impacts can be observed in the Blitzen River streamflow record, in contrast to other stream systems in the Pacific Northwest. There is no trend in the annual streamflow centroid (the date on which approximately half of the annual volume of streamflow occurs for the water year) or the annual minimum seven-day average flow. There has been no change in the percentage of monthly flows to total annual flow for March through September over the same period (data not shown). There has been a slight decrease in the ratio of June-to-May flows, as might be expected with earlier runoff, and an increase in the annual maximum daily flow, as might be expected with more winter/spring rains, but the statistical significance of both of these trends is weak ($p=0.14$).

In addition to changes in the amount of precipitation, a major concern in the Pacific Northwest is the change in the form of winter precipitation expected due to warmer temperatures. The Climate Information Group at the University of Washington (CIG) has modeled changes in the current and future peak SWE versus October-March precipitation (O-M pcp) for fourth-level hydrologic unit code (HUC) watersheds in the Columbia Basin area, including the Blitzen watershed. CIG has classified watersheds into three categories to reflect projections of the dominant precipitation regime: snow (peak SWE/O-M pcp > 0.4), transition (peak SWE/O-M pcp = 0.1 to 0.4), and rain (peak SWE/O-M pcp < 0.1). Generally, there is a large shift in the Pacific Northwest from snow and transition basins to rain basins. In basins where these changes occur, there will likely be a tendency for higher winter flows and possibly an increased risk of flooding, earlier snowmelt and runoff peaks, and lower summer streamflows (Figure 3-7).

The Blitzen watershed is currently classified as a transition basin and is projected to remain that way until the 2080s under the A1B scenario and through the 2080s under the B1 scenario (see Appendix M), when it will become a rain basin. This shift to a rain basin occurs more slowly than in many of the surrounding basins in the Pacific Northwest and the Blitzen watershed appears to be more resilient to climate change, probably because of the higher elevation and cooler climate in the Steens Mountain area.




Source: CIG 2010. The Blitzen watershed is not identified in this figure; however, it is the small, isolated basin in southeastern Oregon shown in red in the lowest right figure

**Figure 3-7. Ratio of April 1 SWE to total October-March precipitation for the historical period (1916-2006), for the A1B scenario (left panel), and for the B1 scenario (right panel) at three future time periods (2020s, 2040s, 2080s).**

## Observed and Predicted Ecological Response to Climate Change in the Region

An emerging body of literature indicates that over the past three decades, the changes in the climate system, including the human-caused component of warming, have resulted in physical and biological changes in a variety of ecosystems (IPCC 2007; Parmesan 2006; Root et al. 2003) that are discernable at the global scale. Climate change has and will continue to combine with other nonclimate stressors to impact ecosystems and threaten biodiversity. In the Great Basin, climate change, invasive species, habitat fragmentation, and rangeland and riparian degradation have placed numerous species at risk, including sage-grouse and redband trout (Chambers and Pellant 2008).

Disturbances, both natural and human-induced, shape ecosystems by influencing their composition, structure, and function. One observed response to climate change in the Pacific Northwest is the change in disturbance regimes like fire and outbreaks of insects and diseases. Increased spring and summer temperatures, earlier snowmelt, and prolonged drought have contributed to longer fire seasons and an increase in wildfire activity in the Pacific Northwest. Westerling et al. (2006) evaluated the effects of both land-use histories and climate on wildfire and concluded that the increase in fire frequency in the past two to three decades has been driven primarily by recent changes in climate. Areas in southern Oregon, northern California, and the northern Rockies have been especially vulnerable to these changes.

Interactions between climate change and non-native invasive species may combine to increase invasion risk to ecosystems. Bradley (2009) showed that the potential area for cheatgrass invasion, which is sensitive to precipitation and temperature, increased up to 45 percent in the western U.S. with decreasing summer precipitation and warmer winter temperatures. Cheatgrass invasion also interacts with climate change to alter fire regimes. Frequent fires promote invasive grasses like cheatgrass, and large grassland fires are more likely in a warmer, drier climate with exotic grasses present. The cheatgrass-fire cycle has been a major factor in the decline of sagebrush-steppe ecosystems, and climate change is likely to exacerbate this decline (Chambers and Pellant 2008).

Climate change is also expected to cause major changes in grassland and sagebrush distribution across the landscape (Bachelet et al. 2001). Range expansions of woody species are predicted to continue, particularly the expansion of pinyon-juniper into sagebrush steppe and grasslands (Rowland et al. 2008), resulting in a decrease in sagebrush and an increase in woodlands across the West. More frequent wildfires may favor non-native invasive species and exacerbate the loss of big sagebrush, a keystone species that is not very fire tolerant. In the Great Basin, current sagebrush habitat is predicted to decrease 12 percent for each 1.8°F (1°C) increase in temperature, partly because of these factors (Chambers and Pellant 2008). However, more frequent fires might also limit juniper expansion.

Climate change has a large potential to impact aquatic ecosystems in the Pacific Northwest. Although there have been few climate change impacts on Blitzen streamflow to date, aquatic habitats at the Refuge, including rivers, streams, springs, wetlands, and wet meadows, face future threats from climate change. River and stream temperatures may increase with warmer air temperatures and longer growing seasons, threatening redband trout. Water temperatures in the Blitzen River are already quite warm; seven-day average maximum temperatures are frequently near 77°F (25°C) in the summer (Mayer et al. 2007). Even at the upstream end, where the river enters the Refuge from the canyon, water temperatures exceeded the State standard of 68°F (20°C) for an average of 64 days during the summers of 2003 and 2005 (Mayer et al. 2007).

Evaporative and seepage losses in wetlands and wet meadows may increase due to warmer temperatures, longer growing seasons, drier soils, and lower water tables, potentially limiting the available habitat that can be sustained for migratory waterfowl. Changes in transpiration are uncertain. There may be less transpiration because of greater photosynthetic efficiency from higher $CO_2$ concentrations in the atmosphere, but higher $CO_2$ concentrations could also mean more plant growth, plant leaf area, and increased transpiration. Earlier runoff and higher evaporation losses could cause a decrease in wetland acreage that can be maintained on the Refuge given the refuge water supply.

## Climate Change Adaptation Strategies

The slower response and apparent resilience of the Blitzen watershed to climate change may provide the Refuge with an opportunity to develop and implement climate change adaptation strategies (or adjustments in management). The goal of adaptation is to reduce the risk of adverse environmental outcomes through activities that increase the resilience of ecosystems to climate change and other stressors (USCCSP 2008). *Resilience* is defined as the amount of change or disturbance a system can absorb without undergoing a fundamental shift to a different set of processes and/or structures. One of the most effective means of increasing resilience is to reduce or eliminate nonclimate stressors.

Climate change will combine with other nonclimate stressors to exacerbate existing problems with water supply, aquatic resources, invasive weeds, and ecosystem function on the Refuge. Even now, there are difficulties balancing the needs of water management for wetlands with the needs of in-stream flows for fish. Wetland irrigation and water management on the Refuge decrease river flows, exacerbate high water temperatures, and reduce dissolved oxygen concentrations in the river (Mayer et al. 2007). River temperatures are already at or near the limit of tolerance for redband trout on most of the Refuge. The river was channelized in the 1910s to facilitate drainage and water delivery. Riparian vegetation is limited and the river habitat is degraded, with little complexity. Wetland and wet meadow habitats on the Refuge are threatened by several non-native invasive plant species including perennial pepperweed, Russian olive, and reed canarygrass. Aquatic and riverine habitats are threatened by non-native invasive carp.

Reducing nonclimate stressors means controlling invasive species and could include restoring the river, rehabilitating riparian vegetation, re-establishing where possible the natural sinuosity of the channel, and reconnecting where viable valley wetlands and floodplains with the river channel. Reducing the impacts of current stressors is a “no regrets” adaptation strategy that could be used to enhance ecosystem resilience to climate change. These activities would require time. Fortunately, the fact that climate change impacts are slower to manifest themselves here compared with other areas would allow more time to implement these restoration activities.

Key to the successful implementation of these adaptation and restoration strategies will be the monitoring of results. The NWS weather stations, the USGS Blitzen river gage, and the two NRCS SNOTEL sites on Steens Mountain will continue to provide very valuable climate and streamflow information on the local impacts of climate change. It is in the Refuge’s best interest to see that these sites are maintained and monitored in the future. The Water Resources Branch of the Service monitors streamflows and diversions at several sites on the Refuge; this should be continued as well. The branch also monitored water temperatures in the river during the summers of 2002, 2003, and 2005. This seasonal water temperature monitoring should be continued in the future. Finally, ongoing efforts to monitor and contain invasive species will be important for providing information on the status of nonclimate stressors.

Monitoring may provide information that will require modification of adaptation strategies or point to new restoration needs. One method for integrating new information into resource management decisions given uncertainty is adaptive management. Adaptive management is a process that promotes flexible decision making so that adjustments are made in decisions as outcomes from management actions and other events are better understood. This method supports managers in taking action today using the best available information while also providing the possibility of ongoing future refinements through an iterative learning process.

# 3.3 Hydrology

This section first describes the hydrologic units within which the Refuge is located. The rivers, streams, and lakes of the Refuge are then explored in detail. Finally, groundwater sources are discussed, followed by water rights.

## 3.3.1 Hydrologic Units

The USGS maps the river basins and nested sub-basins, watersheds, of the United States using a system of nested hydrologic units. Each region is divided and subdivided into successively smaller hydrologic units. Hydrologic units are identified by a unique code (i.e., an HUC) consisting of two to eight digits. The number of digits indicates the scale: the grossest level of classification receives two digits while the finest based on the four levels of classification in the hydrologic unit system.

The Refuge, together with much of the surrounding area, is contained within USGS Accounting Unit 171200—Oregon closed basins. The area of this accounting unit is 17,300 square miles. Within this area are nine smaller hydrologic units (known as cataloguing units or watersheds). The Refuge includes portions of three of these hydrologic units:

- Unit 17120001—Harney-Malheur Lakes (area=1,420 square miles)
- Unit 17120003—Donner und Blitzen (area=765 square miles)
- Unit 17120004—Silver (area=1,670 square miles)

Although not identified as a USGS-delineated hydrologic unit, many people refer to the Harney Basin as a hydrologic entity. The Harney Basin is a hydrographically closed basin located largely in northern Harney County, bounded on the north by the southern end of the Blue Mountains. The ridge of Steens Mountain separates the basin from the watershed of the Alvord Desert to the southeast. No streams cross the volcanic plains that separate the basin from the watershed of the Klamath River to the southwest. The basin encompasses an area of 5,300 square miles in the watershed of Malheur Lake and Harney Lake. (Wikipedia 2011)

The basin coincides with a large down-warped and faulted structural basin that formed during the late Tertiary (65 to 2.6 million years ago) and Quaternary (2.5 million to 500,000 years ago) periods (McDowell 1992). The shallow playa lakes of the Refuge (Malheur, Mud, and Harney lakes) are located in the center of the basin.

### Malheur-Harney Lakes Sub-basin

An assessment of the Harney-Malheur Lakes Sub-basin was prepared in 2001 by the Harney County Watershed Council (HCWC 2001) for future watershed management plans.

The Harney-Malheur Lakes Sub-basin is over 894,000 acres in size; 11.4 percent (101,555 acres) of this sub-basin is managed by Malheur Refuge. The groundwater system encompassed by the sub-basin receives discharge from the adjacent uplands and from stream seepage adjacent to the uplands. Although Silver Creek, the Silvies River, and the Blitzen River do not originate within the sub-basin, all eventually discharge into Malheur Lake or Harney Lake (HCWC 2001).

During the Pleistocene (2.6 million to 11,700 years ago) epoch, the levels of Malheur, Mud, and Harney lakes fluctuated widely with climatic conditions. When levels were high enough, water exited the basin through Virginia Valley via the Malheur River. A Pleistocene basalt flow in the vicinity of Princeton at Malheur Gap, which occurred around 32,000 years ago, prevents outflow from the basin except during very high water events. Lake levels must exceed 4,114 feet in elevation before water can flow over the lava flow at Malheur Gap.

Lake level fluctuations are characteristic of closed basins, and even today the level of Malheur Lake can fluctuate dramatically from year to year. Recent lake level fluctuations attest to the dynamic nature of Malheur Lake levels. Beginning in 1982 Malheur Lake began to rise as greater than normal precipitation occurred in the Harney Basin. By 1985, the lake level exceeded 4,102 feet, a rise of over 7.5 feet in just three years, and Malheur Lake reached 124,440 surface acres. At that time, the combined surface areas of Malheur, Mud, and Harney lakes exceeded 172,000 surface acres, or 279 square miles. The reverse is also common for the lakes: in 1992 Malheur Lake was reduced to 500 surface acres with a depth of 2 inches (USFWS 1992).

### Donner und Blitzen Sub-basin

An assessment was prepared for the Donner und Blitzen Sub-Basin in 2003 (HCWC 2003). The Donner und Blitzen Sub-basin originates on the north slope of Steens Mountain and extends northward to the boundary of the Harney-Malheur Lakes Sub-basin. The sub-basin consists of over 505,100 acres, with just 64,652 acres, or 12.8 percent of the land, under refuge management. The Blitzen River is located within this sub-basin and, except during very high precipitation years when flows from the Silvies River reach Malheur Lake, provides the only water supporting Malheur Lake.

### Silver Creek Sub-basin

An assessment of the Silver Creek Sub-basin was completed in 2000 (HCWC 2000). The Silver Creek Sub-basin is located in the northwest corner of Harney County with a very small portion extending into Lake County. It is contained in the Malheur Lake Basin. The sub-basin consists of over 1,075,748 acres, with just 20,574 acres, or 1.9 percent of the land, under refuge management in the Double-O Unit. The Silver Creek area in the northwestern part of the Malheur Lake basin comprises all drainage into Harney Lake west of the Narrows, an area of land separating Harney and Malheur lakes.

## 3.3.2 Rivers and Streams

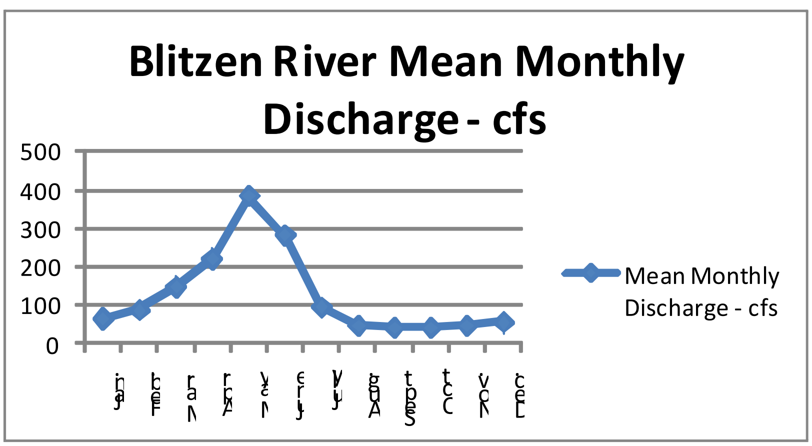
Three major streams (the Silvies River, the Blitzen River, and Silver Creek) flow from the north, south, and west, respectively, and enter the Harney-Malheur Lakes Sub-basin and ultimately the Refuge. Water originates primarily from snowmelt and runoff from higher elevations; however, springs, especially in the Double-O Unit, also contribute to flows. As these watercourses enter the Harney-Malheur Lakes Sub-basin, flows decrease with irrigation withdrawals before reaching the lakes. Two of the three waterways (Blitzen River and its tributary Bridge Creek) have USGS gage stations located just upstream of their entrances into the alluvial valley.

### The Blitzen River

The largest watercourse influencing refuge lands is the Blitzen River. The Blitzen River drains the southern portion of the Donner und Blitzen Sub-basin and receives most of its volume from Steens Mountain as snowmelt. By the time the river enters Malheur Lake it has drained an area of 760 square miles (Hubbard 1975). It is joined by a number of tributaries, (Mud, Bridge, Krumbo, and McCoy creeks) as it continues downstream. The discharge of the Blitzen is reduced as it enters the valley because of irrigation withdrawals at four dams.

The maximum annual runoff, recorded at the USGS gaging station upstream of the Refuge from 1939 to 2004, was 198,000 acre-feet in 1984 and the minimum was 36,000 acre-feet in 1992. The mean annual discharge carried by the waterway is 91,000 acre-feet, and Mann-Kendall trend analysis showed no significant change to the mean annual discharge over the 67 year period (Mayer et al. 2007). However, by the time the river reaches the lake the mean annual flow is 60,000 acre-feet. This decrease in flow is the result of a system of dams and irrigation canals that divert water to meadows, marshes, and pools throughout the Blitzen Valley. Figure 3-8 shows the monthly mean discharge for the Blitzen River.

Streamflow on the Blitzen River is driven by snowmelt which contributes increased discharges to the Refuge beginning in early March and reaches a peak in May. The average May volume is 369 cfs, or 22,700 acre-feet for the month, representing 25 percent of the total annual runoff. Flows tend to decline in June with minimum levels attained in August or September averaging a discharge of 42 cfs, or 2,490 acre-feet for the month.




Source: USFWS, Region 1 Water Resources Division.

**Figure 3-8. Monthly mean discharge for the Blitzen River.**

***Water Control and Distribution:*** A system of dikes, canals, drains, and water control structures were developed along the Blitzen River system beginning in the late 1800s, to facilitate the movement or diversion of portions of the river's discharge for the benefit of grazing and farming (Burnside 2008). Between 1907 and 1913, 17.5 miles of stream were channelized and straightened. Additional dikes, canals, and water control structures were added between 1935 and 1942 by the Civilian Conservation

Corps. More than 900 water control structures occur in the Blitzen Valley as part of the intensive water management system used by the Refuge to manage ponds, wetlands, and meadows. River water is pooled behind four dams before being diverted via canals and ditches to meadows, ponds, and wetlands. Flows return to the river by surface sheet flow, flow through ditches or pipes, and subsurface seepage (Mayer et al. 2007). Portions of the early water distribution system still exist but have been substantially modified as the Refuge has made changes to manage water in the Blitzen Valley.

Diversion of the Blitzen starts at the Page Springs Dam at the southern end of the Blitzen Valley and continues to be diverted at Grain Camp Dam, Busse Dam, and Sodhouse Dam. The diversion sites from upstream to downstream are as follows: Page Springs Dam, Old Buckaroo Dam, Grain Camp Dam, Busse Dam, Dunn Dam, and Sodhouse Dam. The Refuge maintains a minimum flow of 25 cfs in the river to benefit aquatic resources. Table 3-1 shows the diversion capacity in cfs for canals associated with the main structures used to divert water from the Blitzen River.

**Table 3-1. Barrier Diversion Capacity for Structures on the Blitzen River**

| Structures | Number of Diversion Canals | Cubic Feet per Second |
|---|---|---|
| Page Springs | 2 | 200 |
| Old Buckaroo | 1 | 10 |
| Grain Camp | 2 | 303 |
| Busse | 2 | 166 |
| Dunn | 2 | 84 |
| Sodhouse | 1 | 37 |

The water delivery system of the Refuge is complex and a summary of how this system works is difficult to describe.

## Tributaries of the Blitzen River

Five major tributaries contribute water to the Blitzen River after it enters the Refuge (other upstream tributaries on Steens Mountain provide significant flows to the river before it enters the Refuge and are not discussed here). The tributaries are Mud Creek, Bridge Creek, Krumbo Creek, McCoy Creek, and the Diamond Drain, which incorporates water from Cucamunga and Kiger creeks. Mud Creek water flows directly into the East Canal. A portion of Bridge Creek contributes to flows in the East Canal, but most of the water meanders westward until it flows into the Blitzen River. Krumbo Creek flows into Krumbo Reservoir and then enters a series of ditches in the Krumbo Valley before reaching the Blitzen River. McCoy Creek skirts the southern edge of the Diamond Swamp where it becomes channelized in the Diamond Canal before entering the river north of Diamond Lane. The Diamond Drain moves water to the north along the edge of the valley before draining into the river via the Skunk Farm Canal.

### The Silvies River

The other main water source for Malheur Lake is the Silvies River, which drains the north side of the Harney Basin. The river receives most of its volume from the Strawberry Mountains and the Aldrich Mountains as snowmelt. It flows through the Bear and Silvies valleys before entering the Harney Basin near the community of Burns. The watercourse drains a larger area than the Blitzen River but provides less inflow to the lake because of upstream diversions and withdrawals. The Silvies River enters the Refuge at two locations on the north side of Malheur Lake when sufficient flows are present. Currently, the Silvies River contributes water to Malheur Lake only when flows exceed upstream water right allocations, usually two to three times per decade.

### Silver Creek

The northwestern portion of the Harney Basin and the Refuge is drained by Silver Creek, which flows southward before entering Harney Lake. This waterway drains an area of 544 square miles with most of the volume coming from the Snow Mountain area. The creek travels through the Warm Springs and Silver Creek valleys before entering Moon Reservoir. Shortly below Moon Reservoir, the creek channel turns into a complex series of irrigation ditches on private lands. The creek continues to flow through these ditches until it enters Refuge lands and flows into Harney Lake across a marsh delta and the channel transitions into a playa. Silver Creek contributes standing water over the surface of Harney Lake only during very high water years.

## 3.3.3 Malheur, Harney, and Mud Lakes

### Malheur Lake

Malheur Lake is the highest and freshest of the three lakes. Because the lake depression is broad and shallow, a slight rise in water level results in a large expansion of lake or marsh surface area. Inundated areas typically range from 25,000 to 45,000 acres. During historic times, Malheur Lake surface acres have ranged from completely dry (1934) to 124,000 acres (1986). Water depth ranges from 1 to 6 feet with an extreme depth of 14 feet in 1986. Water quality is variable across the lake, with the freshest water found where the rivers empty into the lake.

Malheur Lake consists of three units that are ecologically and hydrologically distinct (Duebbert 1969). The western unit extends from the Narrows east to Graves Point, a discontinuous ridge, which runs north-south. The central unit extends from Graves Point to the remnants of Cole Island Dike, the dike is created from a discontinuous series of dune islands which trend north-south across the lake. The eastern unit extends from Cole Island Dike to the eastern edge of the lake east of the Pelican Islands. Under normal water levels, Malheur Lake consists of shallow marsh in the western third of the lake, shallow open water in the middle third of the lake, and shallow *Juncus* marsh or mud flats on the eastern third of the lake.

Discharge from the Blitzen and Silvies rivers enters the central portion of the lake, which contains the freshest water on the lake. The central unit also has the lowest point on the lake at 4,088 to 4089 feet above mean sea level (msl). When water entering the central unit reaches an elevation of 4,091 feet msl, the water spills into the eastern portion of the lake, which contains the most alkaline water in the entire lake. The east side of the lake functions as an overflow reservoir that receives water during wetter periods. The western side of the lake is better connected to the central basin but is hydrographically complex with a series of ponds separated by islands and peninsulas, with a number of connections that are overtopped at different lake levels. Water starts to flood into the west side when lake elevations reach 4,092 feet msl, and when water elevations drop below 4,093.5 feet msl the surface area of this unit at the Narrows begins to decline (Hamilton et al. 1986).

Malheur Lake last went completely dry in 1934, and it reached its next lowest level in 1961, when the lake was reduced to 500 acres. The highest lake level was recorded in 1986 when the lake reached an elevation of 4,102.6 feet msl and an area of 124,000 surface acres.

## Harney Lake

At the lowest elevations in the Harney Basin, Mud and Harney lakes act as a sump for the entire watershed. Harney Lake is a playa and receives water from Silver Creek and the Warm Springs Canal. Usually these flows do not sheet across the lake surface but are lost through infiltration into the permeable layer of the alluvial valley or by evapotranspiration as the water enters the west central portion of the lake. There are a few springs located along the south-central and east-central portions of the playa, but these do not contribute surface water to other portions of the lake.

Harney Lake is described as the most variable and unstable of the three lakes in the Harney Basin watershed and has varied during the historical period from completely dry to nearly 49,000 acres. Harney Lake itself is dry at about 4,079.7 feet msl, but after the dunes on the east side are breached, water quickly sheets over the surface area of the playa from 4,080 to 4,085 feet msl. The lake shoreline becomes relatively steep-sided from elevations of 4,085 to 4,100 feet msl, and under these conditions, the water overtops its defined margin and spreads over the lake plain on its western and northern sides (McDowell 1992). Only during the flood of the mid-1980s did it reach this height. Harney Lake dries up completely during dry periods, with the lake becoming salty as water levels decline and salts accumulate on the playa. When wet, the lake is primarily open water with little aquatic vegetation.

## Mud Lake

Mud Lake is broad and shallow like Malheur Lake, and its surface area expands as water levels rise. Malheur Lake must reach a level of 4,093 feet msl before flows enter Mud Lake at the Narrows. Separated by a lunette dune, Harney and Mud lakes first begin to combine as water levels in Mud Lake rise and water begins to seep under the dune ridge between alternating silt and sand layers. A series of shallow ponds develop on Harney Lake parallel to the dune as water seeps under the dune ridge from Mud Lake.

At elevations above 4,097.3 feet msl, the lunette dune separating Mud and Harney lakes may be breached at the Sand Gap, and the three lakes may become connected (Hamilton et al. 1986). This connection is subject to modification by natural and human processes, so the elevation at which water spills from Mud Lake into Harney Lake has varied. For example, in 1972-1973 the water level of Malheur Lake varied between 4,090.8 and 4,094.6 feet msl. During this time period the gap was dammed by private landowners to store water for irrigation before it flowed into Harney Lake and became salty (Hubbard 1975).

## 3.3.4 Groundwater

### Springs

In addition to the streams, a number of springs are located in the lowlands around the margins of Malheur and Harney lakes or make significant contributions to streamflows. Springs with less significant flows or which have outputs farther away generally support a marsh or pond that eventually drains into a channel or vanishes due to evapotranspiration losses.

Springs contributing flows to Malheur Lake from the Blitzen River are Knox (1.3 cfs), Hog Wallow (3.0 cfs), Page (11 cfs), Warm (2.5 cfs), Five Mile (0.5 cfs) and Sodhouse (8.6 cfs) springs. These freshwater springs are used by a variety of wildlife and support a diversity of aquatic species. The other significant springs contributing flow to Harney Lake include the Double-O Spring (14.7 cfs, composed of Ross and Hibbard springs) that joins the Silver Creek channel and empties into Harney Lake, as well as Hughett (12.5 cfs), Barnyard (6.0 cfs), Basque (2.5 cfs), Johnson (2.0 cfs), and Cold springs (0.8 cfs), all of which flow southeasterly before emptying into Harney Lake. Most of the springs in this stream are alkaline (Scharff and Davis 1962).

### Aquifers

The groundwater system underlying the basin occurs at two distinct levels. There is a shallow unconfined aquifer that occurs in the upper alluvial fill, commonly within 20 feet of the surface. This is fed by infiltration of precipitation and streamflow on the valley floor. The water table fluctuates seasonally from 3 to 4 feet below the surface in the spring and 8 to 10 feet below the surface in the fall.

The second and deeper aquifer is confined and occurs in the lower part of the Quaternary fill and the underlying Tertiary rocks. Groundwater occurs in porous layers, such as gravel, sand, or porous rock, and is confined by impermeable clay in the upper part of the Quaternary fill. The confined aquifer is fed by infiltration of precipitation, streamflow in the uplands, and infiltration of streamflow where the waterways enter the alluvial basin floor. This is generally within 50 feet or less of the surface. Pressure in the deeper confined aquifer causes water to leak upward to the shallow aquifer. Groundwater withdrawal from wells throughout the basin appears to be lowering the water table in some locations within the Harney Basin (Leonard 1970).

The surfaces of both the confined and unconfined layers slope toward the center of the alluvial basin; interdicting groundwater is discharged through the surface at lower elevations. The piezometric layers under Malheur Lake slope away on the northern, southern, and western margins, indicating that infiltration from the lake is contributing to the groundwater. The relationship between the aquifer layers and Mud and Harney lakes is not documented.

## 3.3.5 Water Rights and Use

The right to use water on the Refuge is managed through the State of Oregon’s Water Resources Department (OWRD). Water rights in Oregon are managed by two basic principles: beneficial use and first in time/first in right. All water use on the Refuge has some form of a State water right. The current exception is springwater in the Double-O Unit of the Refuge. Because these waters originate and terminate on the Refuge, they are exempt from a State-controlled surface water right.

The Service has adjudicated water rights on the Blitzen River and Silver Creek. In addition, the Refuge has 30 wells that have been permitted by the State for domestic, livestock, or irrigation uses. The Refuge has no water rights on the Silvies River and has not applied for any.

### Pond/Storage Water Rights

The Refuge has 71 sites where water is stored to meet a variety of wildlife objectives. The majority of these sites are small, holding less than 100 acre-feet, but a limited number do store thousands of acre-feet, such as Derrick Lake and Krumbo Reservoir. Most of the storage sites are seasonally managed.

### Blitzen River and Associated Tributaries Water Rights

The adjudicated water right for the Blitzen River and tributaries allows diversion of water between March 15 and October 1 for domestic, livestock, and irrigation purposes. The Service has an application before the State of Oregon to transfer the existing water right from the current use to a Wildlife Refuge Management use. The transfer will also allow the movement of water within the refuge boundaries of the Blitzen valley to meet wildlife management needs. The status of the transfer application is pending based on the outcome of affidavits of cancellation.

The Service has also received a permit for a Wildlife Refuge Management water right for the Blitzen River and tributaries that will allow for water diversion from March 1 through September 30. The ability to use water during this time period enables the Refuge to use runoff events to stimulate plant activity in wetland and meadow habitats. The current permit, which allows the Refuge to use water during this time frame, is conditioned with four primary conditions that the Refuge must address before OWRD will grant an actual water right. These conditions are 1) install water measurements devices with an appropriate reporting plan, 2) complete a water quality plan, 3) complete a bypass flow study, and 4) meet ODFW fish passage and screening requirements. The first two requirements are complete and the second two are near completion.

Through the combination of both existing and permitted water rights, the Refuge is limited to diverting no more than 145,000 acre-feet on an annual basis and no more than 820 ccfs at any one point in time.

### Silver Creek and Spring Water Rights

The water right to Silver Creek (23,287 acre-feet) is from March 1 to October 1 and is for domestic, livestock, and irrigation use on the Double-O portion of the Refuge. A second important water source for this area is a series of springs that originate and remain on refuge lands. Water from these springs is used in the management of wetland/pond and meadow habitats. Even though these waters are exempt from any type of mandatory water right, the Refuge plans to file for a groundwater right for the springs in the Double-O Unit. Currently the groundwater sources providing water to these springs are potentially threatened by groundwater withdrawals outside of the Refuge. To protect the groundwater that creates unique habitats both within the springs and in associated habitats, a State groundwater right needs to be obtained.

## 3.4 Topography and Bathymetry

As described above, the Refuge occupies the central and lowest portion of the Harney Basin and contains portions of three delineated sub-basins. Bathymetry is described above in detail in Section 3.3.3. The lowest point of the Refuge is contained in Harney Lake (somewhere below 4,079 feet msl). The Refuge is generally flat with outcroppings of rock that reach 4,800 feet msl.

## 3.5 Geologic History and Features

The climatic and geologic conditions in this portion of Oregon have changed significantly over time. Nearly 10 million years ago, tectonic faults and regional uplifting began the formation of Steens Mountain on the south side of the Harney Basin. Eventually rising 9,700 feet above the surrounding valleys, Steens Mountain developed a vast ice field covering the upper reaches of the mountain around one million years ago. More recent glaciers carved the spectacular U-shaped gorges on the flanks of the mountain. As the glaciers slowly moved downhill, their weight and movement ground the rock below into a fine powder, or loess. This loess was captured in the numerous streams flowing from beneath the glaciers and carried down the Blitzen River and other creeks on the western flank of the mountain to be deposited on the floodplain of the Blitzen Valley. Turbulent downslope winds pushed these deposits of loess around the valley floor, eventually forming a series of low, vegetation-covered dunes at the south end of the river valley (Burnside 2008).

Corresponding with the cooler and moister conditions of the late Pleistocene epoch, 1.8 million to 11,550 years ago, vast amounts of water flowed into the lowest elevations of the basin; from there it drained down the Malheur River and then to the ocean. This connection to the ocean gave salmon and other fish species access to the basin. However, this continuous access to the ocean ended around 32,000 years ago, when basalt flows erupted in the southeast corner of the basin, blocking the outlet from the lake into the river. As climatic conditions varied over the centuries with shifts in seasonal rain fall and temperature, the right combination of conditions created an enormous lake covering the floor of the basin. At several different times, conditions were wet enough and water levels rose until the lake was over 25 feet deep; when this happened, the water was high enough to spill over the top of the blocked outlet and reconnect the basin to the ocean. Salmon bones discovered in spawning gravels near the connection between Malheur and Mud lakes attest to one of these overflow events around 22,000 years ago (Burnside 2008).

With the end of the cold conditions of the Pleistocene, subtle warming conditions combined with abundant rain fall transformed the lower elevations of the Harney Basin into an expansive pluvial lake. With no outlet to the ocean until the level of the lake crested at over 30 feet, a major portion of the Harney Basin was covered with water by 9,300 years ago. This rise in lake levels would combine Malheur, Mud, and Harney lakes into a deep lake at least four times over the next 9,000 years. A lush, narrow band of wetland vegetation bordered the edges of this lake. As the water expanded southward into the Blitzen Valley, shallower areas developed in to extensive cattail and tule marshes. Remnant shore lines of these pluvial lake occurrences are still evident along the south side of Harney and Mud lakes (see Map 9). Large gravel bars, formed under these large lakes, can be seen at various locations along the south side of the lakes and at the mouth of the Blitzen Valley (Burnside 2008).

These same climatic changes also had a profound influence on the Blitzen Valley. In times of plentiful snow on the upper elevations of Steens Mountain, the Blitzen River burst out of the narrow canyon at the south end of the valley, depositing nutrient-loaded sand and silt on the floodplain.

Water overflowing the banks of the river settled into old channels of the river, creating small, linear ponds and providing water for nearby native grass meadows. Creeks entering the valley from the east side funneled water across these grassy meadows, creating numerous stringers of lush riparian vegetation. As water decreased in the river in the late spring or during periods of lower snowfall, these creeks became increasingly important habitat for wildlife using the area (Burnside 2008).

The geological information presented here is excerpted from McDowell's geomorphic description of the Harney Basin (McDowell 1992). The geology of Harney Basin is characterized by an essentially continuous depositional sequence composed of volcanic and volcanic-derived sedimentary rock. The sequence includes a large number of different lithologies and ages. Faulting, uplifting, and tilting of fault blocks occurred during the Pliocene epoch (5.3 to 2.5 million years ago), creating a closed basin. Today these constructional volcanic features can be seen as faulted and weathered masses within fault-blocked uplands and include Steens Mountain, Wagontire Mountain, and Burns Butte.

The specific origins of the Harney Basin are not known, but the basin may have been partially defined by calderas that formed during the eruption of ash-flow tuffs. Three distinctive and very widespread ash-flow tuffs erupted from the calderas in Harney Basin. They are the Devine Canyon ash-flow tuff, covering three-quarters of the basin up to a maximum depth of 98 feet (30 meters); the Prater Creek ash-flow tuff, covering about a third of the basin to a similar depth; and the Rattlesnake ash-flow tuff, centered over western Harney Basin and covering 19,305 square miles (50,000 square kilometers) up to a maximum depth of 198 feet (60 meters). The fine-grained sedimentary rocks in the Harney Basin suggest a low-relief landscape with closed drainage basins.

A layer of volcanic and sedimentary rock flow was deposited over these ash-flows along the western and northwestern portions of the Harney Basin. This caused the formation of Wright's Point, which is sheltered by a resistant cap of basalt which covered weaker sedimentary rock. As subsequent erosion removed sedimentary rock from the surrounding area, Wright's Point remained. After this eruption, the central basin continued to be deeply eroded but was filled again during the Pleistocene epoch (2.5 million to 12,000 years ago).

Leonard (1970) reported that the Pleistocene fill in the Harney Basin is more than 300 feet thick near Lawen and the east-central portion of the basin. To accomplish this amount of erosion, the basin must have been connected to the Snake River System and externally drained. The external drainage to the basin was probably to the east, into Malheur River and the Snake River system. This is evidenced by the thickest fill occurring in the eastern part of the basin, near the former outlet. Much of the erosion and creation of the incised valleys of the Silvies and Blitzen rivers along with Silver Creek occurred during this period.

External drainage from the basin is controlled by geologic structures in the uplands east of the Harney Basin. The main structural features are north-trending faults. The outlet for Harney Basin and the headwaters for the Malheur River cut through this area at right angles to the fault features. After the early Pleistocene erosion, the basin filled with fluvial sand and gravel along its margins (from streams entering the basin) and lacustrine silt, clay, peat, and ash deposits in the central portion. Minor amounts of eolian deposits also occurred with sand dunes and lunettes on the basin floor and loess in the uplands.

Volcanic activity continued as basalt flows sealed the outlet to Malheur Lake at Malheur Gap, re-establishing a closed basin. Diamond Craters, the youngest geological feature in the Harney Basin, began to develop during this time along the eastern edge of the Blitzen Valley. Following the initial extrusions of lava, a series of magma intrusions caused doming and cracking of the surface. Explosive eruptions formed craters and distributed tephra and bombs on the surface of the surrounding area, and minor basalt extrusions occurred.

## 3.6 Soils

The soils of Malheur Refuge have been defined and influenced by the geological actions outlined above. Other influences responsible for soil formation are climate, living organisms, time, and weathering.

Soils on the Refuge include the following orders:

- **Aridisols** are dry desert soils. The lack of moisture greatly restricts the intensity of the weathering process and limits most soil development processes to the upper part of the soil column. Aridisols often accumulate gypsum, salt, calcium carbonate, and other materials. These are commonly located in the sagebrush-steppe habitats on the Refuge.
- **Inceptisols** are soils of semiarid to humid environments which exhibit moderate degrees of soil weathering and development. These are located in the salt desert scrub in the lower Blitzen Valley and Double-O areas.
- **Entisols** are soils that show little or no evidence of pedogenic horizon development. These are areas of recently deposited parent material or areas where erosion or deposition rates are faster than the rate of soil development, such as dunes, steep slopes, and floodplains. An example of these would be the dunes between Harney and Mud lakes.
- **Mollisols** are relatively high in organic content and have a dark-colored surface horizon. These soils are quite rich and are characteristically formed under grass in climates that have moderate to pronounced seasonal moisture deficit.

The NRCS carried out a soil survey for Harney County (Keller and Horn 1997). The following information was compiled using data from that report.

The soils on the Harney, Mud, and Malheur lake beds and the terraces adjacent to them are classified as Lolak, Ausmus, Crowcamp, Poujade, and Lawen series. The very deep, clayey Lolak soils are in the lowest positions on the lake plains (Malheur Lake) and are poorly drained. They formed in lacustrine deposits from volcanic rock. Vegetation is sparse to fairly dense and consists mainly of black greasewood (*Sarcobatus* spp.), seepweed (*Sueda depressa*), saltgrass (*Distichlis spicata*), and rush (*Juncus* spp.). The Ausmus (Harney and Mud lakes area and lower Blitzen Valley) and Crowcamp (Double-O) soils are very deep and on slightly higher positions on the lake plains. They are somewhat poorly drained soils formed in alluvium and lacustrine deposits. Vegetation found in the Ausmus series is mainly of basin wildrye (*Leymus cinereus*), black greasewood, and saltgrass. On the Crowcamp series, native plants are mainly silver sagebrush (*Artemisia cana*), creeping wildrye (*Leymus triticoides*), Nevada bluegrass (*Poa nevadensis*), and mat muhly (*Muhlenbergia richardsonis*). The very deep Poujade soils (Double-O) are on low-lying lake terraces that have a thin mantle of recent alluvium over lacustrine volcanic sediment. They are moderately well drained with vegetation of basin big sagebrush (*Artemisia tridentata*), black greasewood, and basin wildrye. The Lawen (Malheur Lake) soils are slightly higher lake terraces, and are formed in loamy alluvium. They are very deep, well-drained soils formed in wind- and water-deposited sediments. Vegetation is generally basin big sagebrush, western needlegrass (*Achnatherum occidentale* ssp.), Indian ricegrass (*Achnatherum hymenoides*), and basin wildrye.

Near the margins of the basin, perennial streams deposit alluvium over the lacustrine sediment. The sediment eroding from the hills and plateaus is low in alkalinity. The Fury and Widowspring series of soils are very deep and formed in this alluvium. These soils have very dark surface layers, evident by the high content of organic matter and high productivity. The moderately well-drained Widowspring (upper Blitzen Valley) series soils are in areas farther from streams. Vegetation found on Widowspring soils are basin big sagebrush and basin wildrye. The poorly drained Fury soils (dominant throughout the entire Blitzen River Valley) are adjacent to streams. Fury soils are typified by a wide variety of plants including sedges, tufted hairgrass (*Deschampsia caespitosa*), rushes, quackgrass (*Agropyron repens*), alkali bluegrass (*Poa juncifolia*), Sandberg's bluegrass (*Poa secunda*), saltgrass, yarrow (*Achillea millefolium*), lupine (*Lupinus* spp.), three-tip sagebrush (*Artemisia tripartita*), silver sagebrush, willow, shrubby cinquefoil (*Dasiphora fruticosa*), wildrye, and wild rose (*Rosa woodsii*).

Soils on the lake plains that are subject to a fluctuating water table have a high level of salinity and alkalinity. Evaporative recharge is a process that is common to the formation of these soils. During evaportative recharge, water moves upward to the soil surface and carries dissolved salts that concentrate as surface water evaporates and that appear as a white crust. A limited number of plant species are adapted to these saline and sodic conditions. Soils that fit this category are Alvodest, Thenarrows, and Skidoosprings series. The Alvodest series soils (Harney Lake) are very deep, poorly to moderately drained soils formed in lacustrine sediments on basin floors. Vegetation found on these soils is represented by black greasewood, basin wildrye, and saltgrass. The Narrows series (dominant in Mud Lake and Malheur Lake areas) is found on lake terraces. These are very deep, poorly drained soils formed on lacustrine sediments. Alkali bluegrass, saltgrass, and alkali sacaton (*Sporobolus airoides*) symbolize this soil series. Skidoosprings soils (Double-O and the upper Blitzen Valley) consist of a deep, moderately well drained duripan that are formed in lacustine deposits derived from volcanic rock. These soils are generally found on high lake terraces as remnant mounds in stream dissected areas. Plants associated with these soils are basin wildrye, black greasewood, and inland saltgrass.

The next soils by landscape feature are the series found on plateaus and hills surrounding the basin where a duripan has developed and are represented by the Raz soil series (Double-O and lower Blitzen Valley). These soils are found on lava plateaus and consist of well-drained duripan formed in the alluvium, colluviums, and residuum derived from basalt and tuff. Plants found in association with these soils are Wyoming big sagebrush, bluebunch wheatgrass (*Pseudoroegneria spicata*), Thurber's needlegrass (*Achnatherum thurberianum*), bottlebrush squirreltail (*Elymus elymoides*), and Indian ricegrass.

Soils within refuge boundaries on the steep slopes of the valley basin are Felcher (south and west aspects) and Westbutte (north and east aspects) series. The Felcher series soils (lower Blitzen Valley) dry out in early summer and have lower plant productivity. These are deep, well-drained soils formed in colluvium from volcanic rock. Plants associated with this soil are bluebunch wheatgrass, Wyoming big sagebrush, and Thurber's needlegrass. The Westbutte series stays moist longer in the summer; it has higher organic content and higher plant productivity. This series is a moderately deep, well-drained soil formed in colluvium composed of weathered basalt, tuff, and andesite. Plants found in this series are Sandberg's bluegrass, antelope bitterbrush (*Purshia tridentata*), mountain big sagebrush (*A. tridentata* ssp. *vaseyana*), and scattered western juniper (*Juniperus occidentalis*).

# 3.7 Fire

Fire has been used as a tool on the Refuge to remove decadent vegetation and improve wildlife habitat for decades and perhaps for as long as a century. There is some documented use of fire prior to 1985; however, most information about the use of fire before this date is based on anecdotal accounts from former refuge biological staff. Fire was used primarily in the winter months to burn cattail stands and overgrown fields to improve wildlife habitat, open up choked marshes, or open a large area to see the condition of water control structures. The majority of prescribed burns from 1985 to the present were implemented during the winter into early spring.

Between 1985 and 1991, the Refuge did not have an established prescribed fire program, and the fire program consisted of a crew leader and three firefighters dedicated to wildland firefighting during the summer. During this period and likely prior to this, biological staff determined where fire was to be used and implementation was performed by refuge staff. From 1985 to 1991, refuge reports show that the primary use of fire was for habitat maintenance and debris removal and that use of fire resulted in the treatment of 17,865 acres, with an average of 2,552 acres per year.

A permanent and professional fire program was established at the Refuge in 1992 with the appointment of a full-time fire management officer and increased staffing. At this time the Refuge began to increasingly use fire as a tool and incorporated the use of mechanical equipment into the program’s treatment strategy. From 1992 to 2002, the fire program used prescribed fire and mechanical treatments for habitat maintenance, debris removal, exotic species control, fuel breaks, and hazardous fuels reduction, with the majority of the use for habitat maintenance. Over this period, 32,190 acres were treated with an average of 3,261 acres per year. The refuge fire program was also responsible for fuels management for the southeast Idaho refuges and the northwest Oregon refuges.

Beginning in 2002, the fuels management program reduced the number of annual treatments and acres treated because of staffing shortages, the reoccurrence of perennial pepperweed in areas treated with fire, and a lack of funding for follow-up chemical treatment. The majority of the treatments were for hazardous fuels reduction, but two treatments during this time were for exotic species control. Total acres treated from 2002 to 2006 were 5,098, averaging 1,274 per year, and no treatments were completed in 2006.

In 2007, the Refuge’s fuels program was increased with the addition of a new fire management officer, and the Refuge also became a signatory partner in the Burns Interagency Fire Zone, which meant that prescribed fire resources were readily available to implement fuels treatment projects at the Refuge. Between 2007 and 2010, the majority of prescribed fires were conducted for habitat maintenance by burning fields that were out of the haying/grazing rotation and were scheduled to be sprayed in the summer post-treatment, or fire was used to remove decadent vegetation in marsh areas where invasive weeds would not be an issue. There was also an increase in the use of mechanized treatments during this period. During this time a single fall burn was performed with moderate success. From 2007 to 2010, 29,037 acres were treated for an average of 5,807 acres per year.

## 3.7.1 Objectives of Prescribed Fire in Emergent Marsh

Prescribed fire is used in wetlands at the Refuge to maintain ecological processes, specifically: thinning and opening up emergent vegetation, removing decadent material, stimulating herbaceous production, maintaining herbaceous species diversity, and improving wildlife habitat and foraging. It is also used to reduce the accumulations of hazardous fuels. Prescribed fires are usually conducted in the winter when marsh vegetation is dormant, migratory nesting birds are not present, and reptiles and amphibians are hibernating. At the Refuge it would be ideal to apply prescribed fire to 25 percent of the marshlands annually. However, budget constraints drive the actual amount that can be accomplished.

1. Remove 50 percent or more of the decadent vegetation
2. Maintain 20 to 40 percent open water among emergent vegetation
3. Release tied-up nutrients
4. Reduce or maintain invasive plant density and cover
5. Maintain habitat for focal plants and animals
6. Provide underwater waterfowl food (both plants and invertebrates)
7. Provide safe nesting and brood-rearing habitat
8. Reduce hazardous fuels
9. Reduce the likelihood of catastrophic wildfire

## Complications associated with Prescribed Fire in Wetlands

***Noxious weeds:*** Introduced noxious weeds are a major concern with fire and wetlands. Fire can stimulate the growth of noxious weeds in wet meadows and nearby uplands. Fire equipment can facilitate spreading of seeds. Disturbances such as fire lines often facilitate establishment of noxious weeds.

***Access:*** Access for fire equipment in wetlands is often limited. Operations usually must take place when the ground is frozen. Specialized amphibious equipment like a Marshmaster is usually required on fire lines. Aerial ignition is often required for the main portion of the burn unit to reach areas beyond the range of wheeled or tracked vehicles; however, it is costly.

***Adjacent uplands:*** The uplands surrounding marshes are usually excluded from prescribed burns. Fire in uplands removes woody shrubs and leaves the area vulnerable for colonization of invasive species like cheatgrass and noxious weeds. Intensive follow-up seeding is usually required. The amount of fire line, labor, and equipment needed to keep fire out of uplands can often be insurmountable.

## Management Implications for Prescribed Fire in Emergent Marsh and Wet Meadow

- Prescribed fire treatment areas should be rotated to maintain wetlands in various stages of density and recovery. Suitable no-action areas should be allowed for escape cover and alternate habitat. This will provide a wide range of habitat, nesting, and foraging opportunities for wildlife.
- Prescribed burns should be conducted in the late fall and winter when vegetation is dormant and amphibians, reptiles, and invertebrates are hibernating.
- Head fires should be used to minimize fire-residence time. Backing fires and peat fires should only be allowed when addressing specific goals like reducing organic layers or eradicating seed banks.
- Prescribed burn plans should include both pre-burn work and follow-up actions to address invasive species and noxious weeds.

With careful planning and a science- and biological-based understanding, prescribed fire can be a valuable tool in maintaining the productivity and species diversity in wetlands.

## 3.8 Environmental Contaminants (Point Source)

***On-refuge Contaminant Sites***: There are no known point sources of environmental contaminants within the approved refuge boundaries.

***Off-refuge Contaminant Sites:*** Three sites have been identified in the Harney Basin as known sources of contaminants. The Burns Air Force Radar Station, located 35 miles northwest of the Refuge, is designated by the Environmental Protection Agency as a Superfund project for the removal of friable asbestos and soils contaminated with polychlorinated biphenyls (PCBs). There is no known pathway for movement of contaminants from the site to refuge lands. The other two locations, in Frenchglen, have been designated by ODEQ as leaking underground storage tank sites. It is unknown whether or not there is a potential conduit to move contaminants from these sites to refuge lands. Additional information on these sites can be obtained at the EPA and ODEQ websites found in the reference section of this chapter (EPA 2011; ODEQ 2011). Municipal wastewater is not an issue in this area, as the only treatment facilities are located in the Burns/Hines communities. These facilities have no outlet to any watercourse that feeds into Malheur, Mud, or Harney lakes. With a rural landscape dominated by ranching and agriculture interests, there is some potential for contamination from fertilizers and other agrochemicals topically applied to flood-irrigated meadows in the Diamond Valley and adjacent to Malheur Lake.

## 3.9 Air Quality

The action area is not located in a Class I airshed, nonattainment area, or maintenance area (EPA 2009). Air pollution sources include local agricultural activities, wildfires, vehicle traffic on Oregon State Highway 205, and local and refuge traffic.

## 3.10 Water Quality

States are required to identify waters that do not meet their water quality standards under Section 303(d) of the Clean Water Act (CWA). Such waters are classified as impaired and termed water quality limited. The Blitzen River and its tributaries (Mud, Bridge, and McCoy Creeks) as well as the Silvies River and Silver Creek are 303(d) listed streams for water temperature (http://www.deq.state.or.us/wq/assessment/rpt2010/search.asp). In addition, Silvies River is listed for dissolved oxygen and Bridge Creek is listed for iron, beryllium, and manganese. Under the CWA, when a state lists a water body on the 303(d) list as impaired, it must develop a total maximum daily load (TMDL) for the impaired water body to address the sources of the limitation to bring the water body into compliance. Currently, the TMDL for the Blitzen River has not been developed by the ODEQ or approved by the EPA.

A reconnaissance investigation addressing water quality, wetland hydrology, and surface water drainage through the irrigation systems both on and off the Refuge was carried out in 1988-1989 (Rinella and Schuler 1992) following the mid-1980s floods. The study found elevated concentrations of arsenic, boron, mercury, and selenium in some Harney and Malheur lake water and/or biological tissue samples exceeding recommended criteria or guidelines for the protection of the health of humans, fish, or wildlife, or adversely affecting other identified beneficial uses. In addition, small but detectable concentrations of dichlorodiphenyltrichloroethane (DDT) and its metabolites, and endrin, were reported in lake bottom sediment, while most biota (aquatic plants, invertebrates, fish, bird eggs, and bird tissue) contained small or undetectable levels of organochlorine pesticides and polychlorinated biphenyls (PCBs) were contained in most biota. Although elevated concentrations of some constituents were found in some of the samples, bio-accumulation did not appear to be an issue. None of the elevated concentrations were thought to be associated with agricultural drainage or irrigation systems, but were attributed to water evaporation increasing and accumulating concentrates of harmful ions during periods of drought, and dissolution of these deposits during periods of high water raising the overall loading of these elements. It was concluded that irrigation drainage and agricultural runoff was not causing significant harmful effects to human or resource health.

A later study carried out in 2002-2003 (Mayer et al. 2007) on this same system investigated a variety of standard water-quality measures but did not look at pesticide residues. Mayer et al. (2007) reported the main water-quality parameters of concern in the Blitzen River were conductivity, dissolved oxygen, turbidity, and suspended sediment, total phosphorus, and total nitrogen. With distance downstream, dissolved oxygen decreased, and conductivity, turbidity, suspended sediment, total Phosphorus, and total Nitrogen increased. Low dissolved oxygen concentrations, in particular, were a concern downstream during the summer base flow period. Concentrations were below State standards at downstream sites. Irrigation and wetland return flows contribute to low dissolved oxygen and higher biological oxygen demand in the Blitzen River and may be responsible for some of the low concentrations farther downstream. However, warmer temperatures downstream also contribute to low dissolved oxygen rates.

Late-season increases in river turbidity and total suspended sediments are suspected to be related to dam operations. These two parameters increased at about the time that the dams were opened up in late July and early August.

The timing of conductivity increase downstream on the river seems to implicate return flows as sources of higher conductivity. The return flows were generally much higher than the river conductivities. The increases downstream in the river were observed to occur through the irrigation season and reach maximums in late July, coinciding with the end of the irrigation season on the Refuge.

Return flows were also implicated as a potential source of nutrients to the river. Concentrations of both macronutrients were higher in return flows, and they increased downstream in the river. The wetlands, particularly the wet meadows, appeared to be a source of phosphorus and possibly nitrogen, based on the nutrient budget for the west side of P Ranch area. Despite the fact that nutrient concentrations increase downstream, there did not seem to be a problem with eutrophication and planktonic algae in the river. Concentrations of chlorophyll were very low throughout the river. This may be because of limited phosphorus availability, based on phosphorus concentrations and nitrogen-to-phosphorus ratios in the river.

## 3.11 Visual Quality

The Refuge and the surrounding area are natural in appearance and undeveloped in nature. Where human signs exist, the feeling is rural, with high integration into the natural world. As a result, the Refuge and the surrounding area are considered to have very high visual quality. Due to the low level of development, very little light is radiated into the night sky, resulting in excellent star-viewing opportunities.

## 3.12 Surrounding Land Use

Much of the land surrounding the Refuge or within Harney Basin is in public ownership, and is administered by the BLM, the U.S. Forest Service (USFS), or Oregon Department of State Lands. These public-trust lands are open to public access under the authority of those agencies. Most lands in private ownership are found along the north and east boundary of Malheur Lake, and land use is dominated by rangeland, with some agricultural production (alfalfa).

Harney County has an overall population of 7,700, with small communities in a rural setting. Industrial and commercial development is light, with enterprise based on livestock and agricultural production or recreational and service oriented. The community of Frenchglen is the only consolidated residential area adjacent to the Refuge, and most development near the Refuge consists of individual residences.

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*Western meadowlark*
©Dan Dzurisin

# Chapter 4 Biological Environment

This chapter addresses the biological resources and habitats found on the Refuge. However, it is not an exhaustive overview of all species and habitats. The chapter begins with a discussion of biological integrity (historic conditions and ecosystem function), as required under the Improvement Act. The bulk of the chapter is then focused on the presentation of pertinent background information for habitats used by each of the priority resources of concern (ROCs) and other benefitting species designated under the CCP. That background information includes descriptions, conditions, and trends of habitats and threats (stresses and sources of stress) to the habitats and/or associated ROCs. This information was used to develop goals and objectives for the CCP.

# 4.1 Biological Integrity, Diversity, and Environmental Health

The National Wildlife Refuge System Administration Act (as amended) requires the maintenance of the biological integrity, diversity, and environmental health (BIDEH) of the System. The BIDEH policy (601 FW 3) defines *biological integrity* as "the biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities." *Biological diversity* is defined as "the variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur." Simply stated, BIDEH is represented by native fish, wildlife, plants, and their habitats as well as those environmental conditions and processes that support them. The Administration Act states that each refuge will be managed to fulfill refuge purpose(s) as well as to help fulfill the System mission. We strive to accomplish these purposes and our mission by ensuring that the biological integrity, diversity, and environmental health of Malheur Refuge is maintained and enhanced.

The Refuge System policy on BIDEH (601 FW 3) also provides guidance on consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on the refuges and in associated ecosystems, that represents BIDEH on each refuge.

## 4.1.1 Overview

Throughout this document, the concept of a healthy system (either aquatic or terrestrial) is the goal or direction the Refuge wishes to take in habitat management. The Refuge defines a healthy system as a landscape, land unit, or habitat in which natural ecological processes function in concert to permit an area to be productive and have a fundamentally dynamic nature. These interacting processes result in a mosaic of communities that are resilient to disturbances but that change over time along the ecological continuum defined by the Ecology Work Group (Appendix L). This result ensures balance, appropriate niches, or natural variation necessary for the wide array of potential wildlife species that could use the area. The refuge goal of restoring or maintaining the resiliency of this system and understanding the importance of all the components or needs of wildlife (migration, production, and maintenance habitat) ensures the richness necessary to maintain a healthy system, provide for the wide diversity of wildlife that use the area, and allow the area to buffer or absorb impacts from major disturbances.

Malheur National Wildlife Refuge is composed of three very distinct environments, each including a diversity of native habitats and landscapes. The core of the Refuge is dominated by a shallow lake basin and encompasses Harney, Mud, and Malheur lakes. This 103,799-acre area covers 56 percent of refuge lands. The Blitzen Valley, a broad corridor (64,215 acres) to the south of the lake basin, is divided along its entire length by the Blitzen River and associated riparian habitat. The valley covers

34 percent of the Refuge and provides most of the water feeding the central lake basin. The Double-O is a broad valley basin which covers 10 percent (19,198 acres) of refuge lands. Intermittent water from the Silver Creek watershed flows through this management area and drains into Harney Lake (see Chapter 3). Together, these three environments result in a diversity of habitats, which support more than 415 species of birds, mammals, fish, reptiles, and amphibians.

## 4.1.2 Wildlife and Habitat Conditions and Changes Since 1800

The Harney Basin ecosystem, of which the Refuge is a part, has undergone dramatic alteration over the past 200 years. Three of the most discernible changes are

- changes in Harney Basin lake and river hydrology due to diversion dam and irrigation operations;
- changes to species composition (decline and loss of native species and influx of non-native and invasive species) into the system; and
- conversion of basin habitats to agricultural and ranching lands (including diking and irrigation).

Many of the habitat changes and the spread of non-native and invasive species were underway long before the Refuge was established. This section discusses the connection between these landscape-level changes and the current vegetation and wildlife on the land and waters managed by the Refuge. This summary is not a complete analysis of all factors related to changes in native vegetation, fish, and wildlife. Much of the information presented here is based on staff knowledge of the area.

### Historic Description of Habitat and Wildlife

Historically the Blitzen and Double-O valleys, along with the lake basin located within the refuge boundary, had a much different appearance than they do today. Wigand's work (Wigand 1987) on the vegetation and water table history of Diamond Pond, located in the Diamond Craters, illustrates the constant flux and change in water levels which prevailed in the area prehistorically. Between 1400 and 900 B.P., increased grass pollen signified greater effective moisture resulting in deeper water with abundant pondweed (*Potamogeton* sp.). Increased greasewood and saltbush pollen around 500 B.P. provide evidence of drought conditions. Widgeongrass (*Ruppia* sp.) seeds and pollen and the presence of bivalve mollusk (*Musculium* sp.) shells indicate shallow brackish water. Abundant juniper and grass pollen samples indicate moister conditions from 300 to 150 B.P. Numerous hornwort fruits (*Ceratophyllum* sp.) indicate deeper, freshened water during this period. The last cycle, sampled from the mid-1880s, showed another climate change with sagebrush re-expansion and increased sedge (*Scirpus* sp.) macrofossils indicating shallower water.

Fur trapper Peter Skene Ogden's journal of 1826 describes the lakes portion of the Harney Basin as swampy country with flat terrain and rivers flowing into two lakes with no outlet (see Section 5.1.2). Eli Cooley's diary of 1845 (Cooley and Cooley 2004) describes the vegetation along the lower Silvies River as plenty of grass and willow. As their wagon train moved west along the north side of Malheur Lake, cutting across the end of Wright's Point and camping by Harney Lake, the habitat was described as plenty of grass, no wood, and some sage. As they moved upstream along Silver Creek before crossing it and turning west, the area was again defined as having plenty of grass and willow.

The 1853 journal of wagon train emigrant Benjamin Owen labeled the lower Blitzen River as a deep miry stream. They had trouble finding a suitable ford and had to travel over 5 miles (in the vicinity of

Rattlesnake Butte) upstream to secure a safe crossing for their wagons and livestock (Beckham 1995).

The Wallen party of 1859 moved through the basin on the north side of Malheur Lake and described the area as follows: “the country is a beautiful level valley, covered with luxuriant growth of bunch grass, wild pea vines, and red clover, interspersed with fields of camas on a rich soil abundantly watered by numerous mountain streams …. This wide savannah or grassy meadow section is abundant; pronghorm, deer, elk, and several species of grouse, prairie chickens, ducks and geese, etc.” (Beckham 1995).

Langston provides a historical perspective of habitat conditions before substantial alterations by settlers in her book entitled *Where Land & Water Meet: a Western Landscape Transformed* (Langston 2003). She states that when Peter French first arrived in the Blitzen Valley in the early 1870s, he found “a water world: a maze of streams, channels, wetlands, bogs, alkaline lakes, and lush riparian meadows—all fed by waters from the Blitzen River.” She also documents that in a 1935 radio talk show, William L. Finley stated, “Peter French … wandered into what is now known as the Blitzen Valley, a wide flat plain watered by a fine stream, green with wide meadows of luxuriant grasses, interspersed with thickets of willow, and with great areas of swampy ground and shallow ponds.” Moreover, tule marshes characterized extremely wet areas surrounding the P Ranch at the southern end of the Blitzen Valley. In fact, French noted that his livestock took cover in tules during extreme winter weather (Langston 2003).

Documentation of vegetation prior to Euro-American settlement is sketchy, existing only in the form of broad-sweeping descriptions caught in diaries and correspondence. Nevertheless, combining these references with soils information and comparisons with similar systems within the Northern Great Basin suggests that the area hosted a complex, heterogeneous mixture of plant species ranging from cattails and bulrushes in permanent marshes to dryland grasses, forbs, and shrubs in highland areas with rushes, sedges, and wetland grasses appearing along moisture gradients.

## Changes to Harney Basin Hydrology, Wildlife, and Habitats Since 1850

Although people were present in Harney Basin prior to the 1850s, human influences were probably limited to minimal impacts by Northern Paiutes, fur-trapping expeditions, and settlers moving by wagon train through the area. Beckham’s (1995) document on the historical appearance and uses of the Donner und Blitzen River from its headwaters to the confluence with Malheur Lake shows the trend of changes that have occurred throughout the basin over time.

In the 1870s stockmen poured into the rangelands of the Harney Basin claiming all the primary water sources and thus dominating the surrounding lands. Meanwhile, the State of Oregon was accepting applications to purchase tracts of swamplands and in the 1880’s began issuing deeds. Peter French and other cattlemen acquired control of these deeds throughout the basin. This initiated an ambitious period of irrigations projects, first in the Blitzen River Valley but soon expanding to other waterways in the basin. Water was diverted into canals and ditches, flooding out sagebrush and inducing the growth of meadow grasses. This heavy irrigation had dramatic effect on basin landscapes, affecting not only uplands, but wetlands and the lakes. Giles French wrote of Peter French’s irrigation projects: “His irrigation projects of themselves held water of Malheur Lake at a lower level, causing more dry land between the water and the meander line” (French 1964).

The Blitzen River has undergone significant alterations since the late 1800s. The construction of an intensive irrigation system, including seven diversion dams and a vast network of ditches, dikes, and ponds, was initiated under the management of Peter French and reached its peak during the CCC era following the Great Depression. The channelization of approximately 17.5 miles of the Blitzen River between Bridge Creek and Busse Dam also took place prior to Federal acquisition in 1935. Human activity in its various forms has disrupted the natural hydrology of historic river meanders and smaller braided tributaries; however, the ability to move irrigation water around the Blitzen Valley via canals and ditches has expanded wetland habitats that would not otherwise exist.

***Changes to Species Composition:*** Irrigation and livestock grazing have had a profound impact on basin habitats and wildlife. Native grasses and forbs are not adapted to heavy grazing pressure or extended irrigation and have become susceptible to the spread of exotic plant species in many areas. Non-native pasture and forage grasses were also introduced. These grasses had a competitive advantage over native species under heavy grazing or irrigation pressure and thus altered many plant communities. Increased and improved irrigation around riparian areas permitted reed canarygrass to invade and largely replace the native understory plant community. Today, areas within irrigated meadows are dominated by creeping wildrye, orchardgrass, timothy, smooth brome, Nebraska sedge, meadow foxtail, and reed canarygrass. Creeping wildrye and Nebraska sedge are native species, but the remainder have been introduced to the area and did not occur before European settlement. These two factors were the beginning of the decline of wildlife species tied to upland or riparian habitats such as the yellow-breasted chat, willow flycatcher, meadowlark, and bobolink. On the other hand, grazing may have benefited other wildlife species such as greater sandhill cranes, horned larks, and snow geese. The positioning of wetlands, pasture, and croplands may have actually helped sustain populations of waterfowl and other birds that prefer short, nutritious grass.

Interruption of ecological function on the Blitzen River, Silvies River, and Silver Creek also had a profound impact on fish species. Channelization destroyed habitat complexity on large reaches of these waterways and is believed to have reduced the abundance of fish species. Barriers prevented or delayed migratory fish patterns and isolated portions of some populations. Altered water parameters such as water quality have pushed some species such as mountain whitefish to the least disturbed stretches of these streams. The increase in human disturbance has also naturally led to the introduction of exotic species such as sunfish, bluegills, large-mouth bass, and bullheads.

***Conversion of Basin Habitats to Agricultural and Ranching Lands:*** At the close of the 1800s and the beginning of the new century, homesteaders moved onto lands below the Malheur Lake meander line, leading to conflict between ranchers and these new immigrants. During this time, heavy use was made of the lake bottom by large and small ranching operations for grazing, haying, and crops. During the same time frame, women’s millinery fashions created a major market for plume hunters, who decimated populations of herons and egrets on Malheur Lake.

It was in this altered environment that Malheur National Wildlife Refuge was established in 1908. As a result of the outrage over the decimation of colonial nesting birds on Malheur Lake, President Theodore Roosevelt set aside unclaimed government lands encompassed by Malheur, Mud, and Harney lakes.

## 4.1.3 History of Refuge Management

As discussed in Chapter 1, the purposes of the Refuge primarily pertain to the perpetuation of breeding birds, migratory birds, and other wildlife.

Malheur Refuge lies in the shrub-steppe association of the Basin and Range Province of Oregon (Bailey et al. 1994) and hosts a significant portion of riparian and floodplain habitats (wet meadows and marshes) that are under-represented and degraded throughout this ecoregion. It is one of the oldest and most important migratory bird refuges in the Refuge System. It has long been recognized for its contribution to the Pacific Flyway as a major and essential feeding and resting location for Pacific Flyway birds migrating between the northern breeding grounds and wintering areas to the south. It is also an important breeding ground for wetland-dependent migratory birds.

The maintenance and enhancement of wetland systems occurring within the Refuge contributes not only to management for refuge purposes but also to biological integrity at multiple landscape levels. On the larger landscape scale, it is important to migratory birds on the Pacific Flyway. At the local scale, the area is significant because of native wetland and riparian plant communities and their value to resident wildlife. At the same time, the Service recognizes that wetland management should be balanced with the habitat requirements of native fishes (redband trout) and the need to improve water quality.

After the Refuge was established the Refuge remained unstaffed until 1911, when State game wardens were assigned to enforce State hunting and trapping laws. It was not until 1915 that data were finally compiled about lake levels and bird populations. Considerable time was spent banding waterfowl after 1920, and these records were used to determine bird population trends on the lakes.

In the 1930s, drought had a profound effect on the basin; with decreased flows from rivers and streams, lake levels shrank. Without a fence around the Refuge, the sole refuge employee spent considerable time keeping adjacent landowners from using refuge lands for agricultural purposes. Resolution to this issue came in 1935 when the Blitzen Valley was added to the Refuge. Acquisition of water rights for the Blitzen River allowed the release of water to the lakes that had previously been kept behind ranch dams.

William Finley described the Blitzen Valley and lake condition at that time as

> a wide flat plain watered by a fine stream, green with wide meadows of luxuriant grasses, interspersed with thickets of willow, and with great areas of swampy ground and shallow ponds. … Within the boundaries of this refuge such favorite waterfowl as Canada geese, Mallards, Pintails, Gadwall, Redheads, Ruddy Ducks and Cinnamon Teal nest and rear their young by the thousands, while during the fall and spring migrations myriads of northern-bred ducks and geese find a haven of refuge on Malheur Lake and in the swamps of the Blitzen Valley where natural food is abundant. Not only are ducks and geese found here but the great American egret, the White-faced Glossy Ibis, and the Black-necked Stilt…. Herons, bitterns, coots, grebes, and great colonies of California and Ring-billed gulls, Forester Terns, Black Terns and other marsh-loving birds held interest of the visitor. … Of upland game and song birds there is an unusual population. Sage hens stalk about the sagebrush covered slopes, and the California or Valley Quail scurry under the tickets. The introduced Hungarian Partridge and the Ring-necked Pheasant find the climatic conditions here to their liking. … Although birds, both in number of species and the number of individuals, form the greatest of the wildlife population, the visitor can find a large number of beaver along the Blitzen River.

Nationwide waterfowl numbers had declined so rapidly because of widespread drought that Federal funds were allotted to restore breeding and feeding areas. Malheur Lake was given high priority, and thus began the era of the Civilian Conservation Corps and major refuge restoration projects. Projects included the construction of Refuge Headquarters, boundary fences, dikes (to better conserve water for both the lakes and valley), canals (to carry water to favored feeding grounds), and roads (to better patrol the area). The water delivery system within the Blitzen River Valley was developed or enhanced to provide water for new wetlands (Boca, Benson, Knox, Wright, and Buena Vista ponds).

Although most of the projects were considered very beneficial to restoring water to the lakes and wetlands, some of the projects continued the disruption of the natural hydrological processes in the basin, such as replacement of five wooden diversion dams with concrete diversion dams, which included fish ladders. In addition, when some projects were combined with other human impacts, such as grazing and irrigations practices, whole plant communities were altered. The Refuge developed a cropland management program to provide carbohydrate-rich crops for fall migrants, particularly waterfowl and cranes.

The 1940s and 1950s saw the next major change to Harney Basin ecology and impacts to the Refuge, with the introduction of common carp to the Silvies River. Carp spread throughout the system in a very short period of time and altered wetland systems by uprooting submergent and emergent vegetation, increasing turbidity, and exposing wetlands to wind and wave erosion. This had a tremendous impact on the number of birds using Malheur Lake, particularly waterfowl and other wetland nesting and feeding species. Intermittent attempts to eradicate carp were carried out in 1955, 1961, 1968, and periodically since then. Control efforts showed positive results for one to two years after treatment until population dynamics re-established carp in treated areas.

Other management activities during this period saw the third major addition to the Refuge with the purchase of the Double-O Unit to provide habitat for shorebirds, waterbirds, and waterfowl. Grazing was used as a management tool to maintain short-grass habitat for waterfowl, cranes, and other grasslands nesting species. Rainbow trout were introduced into Krumbo Reservoir (constructed in the mid-1950s), and trumpeter swans were reintroduced to the Refuge.

In the 1970s, the Refuge shifted its management direction to bring activities in line with new Service directives by developing a refuge land use plan for habitat management. This called for a shift in management actions by reducing the amount of cattle grazing on the Refuge and providing other tools to maintain short grass or meadow habitat. Management actions to control exotic and invasive species were initiated. Formal survey procedure and protocols were developed to monitor habitat and wildlife. All these changes were part of a move to support greater conservation of resources under new national policies.

Higher-than-normal precipitation levels in the 1980s resulted in extensive flooding throughout the basin and the subsequent destruction of infrastructure and habitat. With the high water and the deleterious effects of carp on Malheur Lake, conditions were in place to accelerate destruction of Malheur Lake ecology. Wind, waves, and ice scoured the lake substrate, creating a shallow uniform lake bottom in which sediments never settled and emergent and submergent vegetation became mostly absent from the central portion of Malheur Lake. With the loss of emergent vegetation, the muskrat population on the lake was drastically reduced and to date has not recovered. Refuge staff was also charged with developing a master plan for the Refuge.

As quickly as the water rose in the 1980s, the lake rapidly diminished in the early 1990s, with watering covering just a few thousand acres in the center of the lake. This shift sharply curtailed wildlife use of the lake. From the 1990s onward, the Refuge continued to repair the damage to habitats and infrastructure and provide for wildlife needs in the Blitzen Valley while waiting for increased precipitation events to restore water to Malheur Lake.

Fish passage, screening, and fish traps became an important issue trying to ensure passage of Great Basin redband trout over the dams on the river while preventing movement of carp through the system. The concrete fish ladders in operation since the dams were constructed were retrofitted with new denil-style fish passage structures. Screens were placed on a number of diversion canals and ditches to prevent entrainment of native fishes and decrease spawning areas for invasive carp in fields, ponds, and ditches. Fish traps were manufactured and fitted at the top of the fish ladders to sort carp from the native fish moving upstream on migration. Fish screens were installed on the diversion of the East Canal. A fish screen and passage structure was installed on the Blitzen River at the West Canal diversion to prevent entrainment of fish into the irrigation ditch and permit passage of fish up and down the mainstem of the Blitzen River. Research conducted by Matt Anderson concluded that fish passage and screening on the Blitzen River was not optimal for the native redband trout (Anderson 2009). Therefore, ODFW recommended that new fish ladders be installed. In 2009, construction of three new fish ladders and screens was started to improve fish passage and screening and was complete in 2012.

The Refuge put a greater emphasis on controlling exotic and invasive species as infestations increased in size. Fire became a more active management tool for enhancing wetland, meadows, and grassland habitats through the removal of decadent growth, reduction in fuel loads, and setting back undesired vegetation. With degradation of the lake ecosystem, an emphasis was placed on maintaining water on wetlands units and meadows for as long as possible to maximize production for all species of waterfowl, cranes, and other birds that use these habitats. This had the desired outcome, and production has been sustained at very high levels. However, maintaining water on these habitats has also provided ideal conditions for water-tolerant plant species and a competitive advantage to the exclusion of other species, resulting in dense monotypic stands of emergent vegetation and encroachments into meadow habitats.

Restoration efforts focused on riparian and riverine habitats. Canals and ditches were fenced to reduce erosion from cattle and to provide an opportunity for re-establishment of riparian plants. The upper Blitzen River was the site of a restoration project in which inverted rock weirs were staggered over a 5- mile length of river between the P Ranch and the confluence of the river with Bridge Creek. The restoration project was intended to create in-stream and riparian habitats, reconnect the river to the floodplain, and raise the level of the deeply incised river. Assessments of the effect and success of this project are still being conducted.

## 4.1.4 Changes in Species Composition of Wildlife Populations after Refuge Establishment

### Hydrologic Changes that Led to Altered Habitats

It can be hypothesized that the greatest difference between plant community conditions prior to Euro-American settlement and current conditions can be directly correlated with the extent and availability of water. Prior to hydrological modifications (ditches, dams, and the channelization of 17.5 miles of the Blitzen River, as well as the rerouting and damming of Silver Creek in the Double-O Unit), concentrations of plants would have been dependent on the level of flooding that occurred in conjunction with topographic features. Beckham (1995) believes that the Blitzen Valley once hosted a much higher percentage of upland and meadow plant communities, such as basin big sagebrush, bluebunch wheatgrass, and basin wildrye, than exist today.

After settlement, some uplands and meadows were leveled to maximize efficiency of flood irrigation, which was provided by a complex system of diversion dams and ditches, and to facilitate the production of grain and grasses. Under current refuge management an emphasis on extended irrigation in these areas provides ideal conditions for water-tolerant plant species, and some sites have become dominated by such species as cattails, phragmites, and reed canarygrass. However, extended irrigation has also encouraged the re-establishment of woody riparian species, such as willow, to some of its historic range.

Although historic numbers for waterfowl in the Blitzen Valley and Double-O are not available, it is likely that construction of the water-delivery systems and the managed impoundments and wet meadows in these irrigated units led to increased numbers of breeding waterfowl, cranes, and shorebirds. However, this benefit to waterfowl could not compensate for the loss of quality waterfowl habitat in Malheur and Mud lakes because of invasive carp.

When refuge grain fields were abundant, use of the valley by migrant geese and ducks was very high with peaks in the hundred-thousands. However, as the grain fields were converted back to irrigated meadows, high use by migrants diminished.

Gabrielson and Jewett (1940) stated that the greater sandhill crane was rapidly disappearing from Oregon in the late 1930s and estimated that the remaining flock numbered only about 100 pairs in the Blitzen Valley and east of Steens Mountain. The Blitzen Valley was a stronghold for crane survival during the era of unregulated market hunting. By the late 1990s, the refuge crane population had increased to 245 pairs (Ivey and Herziger 2000). Migrant crane use of refuge grain fields increased over time as populations recovered from unregulated hunting and peaked in the early 1980s at approximately 3,500. However, during the flood years of the mid-1980s and the subsequent droughts in 1988 and 1992, refuge grain crops were poor, and fall crane use declined to less than 10 percent of the peak and has remained low.

While nesting colonial waterbirds were historically abundant in Malheur Lake, there is no evidence that colonial waterbirds were nesting in the Blitzen Valley or Double-O units before refuge acquisition and subsequent development of large impoundments. Today, managed impoundments support substantial numbers (numbering in the thousands in good years) of nesting white-faced ibis, Franklin’s gulls, and eared grebes.

It is likely that changes to the Blitzen River hydrology have caused significant declines in the carrying capacity of the river for native fishes, mollusks, and other aquatic species. Development of the irrigation system contributed to lower water quality (primarily water temperature) and eliminated connectivity between many braided channels in the valley, significantly reducing aquatic and riverine habitat diversity and availability for aquatic fauna. This loss of extensive riverine habitat may also have had a major impact on local beaver populations.

## Influx of Exotic and Invasive Species

Exotic plants and animal invasions are a serious threat to the biological integrity of the Refuge. Invasive plant species displace native vegetation, alter the composition and structure of vegetation communities, affect food webs, and modify ecosystem processes (Olson 1999). Ultimately, invasive plant and animal species can result in considerable impacts to native wildlife. Common carp are believed to have had the largest impact to habitat and wildlife, causing reduced migratory bird use of the Refuge.

***Exotic Plants in Riparian and Wetland Systems:*** Exotic invasive plants that have proliferated in riparian and wetland areas include perennial pepperweed, reed canarygrass, Canada thistle, and Russian olive. Common reed is also present on a much smaller scale in some wetland units. All of these species displace native plant communities and reduce the habitat values for many wildlife species. For example, reed canarygrass forms tall, dense, almost impenetrable stands, which have almost no value for nesting birds and other wildlife.

***Exotic Species in Aquatic Systems:*** The Harney Basin supports fish mirroring the native fishes of the Columbia River with a few species absent or undetected, before they disappeared. (As noted in Chapter 3, the basin was connected thousands of years ago to the Columbia River drainage.) Since Euro-American settlement, a variety of warm-water fish species have been introduced to the basin to increase the diversity and quality of recreational angling. Many of these introduced fish prey on native species and/or compete with them for food resources. Common carp were introduced into the Silvies River in the 1920s and invaded Malheur Lake in the late 1940s, becoming a noticeable problem in the early 1950s. Their presence has resulted in devastation of aquatic plant and invertebrate communities, reduced water quality, and increased turbidity, and they have caused a large reduction in waterfowl use and production on the lake (Ivey et al. 1998). Carp have also spread or have the potential to spread to most of the aquatic systems of the Blitzen Valley and the Silver Creek drainages. A small established population of bullfrogs located at the south end of the Blitzen Valley could threaten the Refuge's population of Columbia spotted frog by predation, loss of habitat, and food resources.

A number of non-native fish have been recorded in various surveys on the Refuge. These fish include common carp, rainbow trout (*Oncorhynchus mykiss*), mosquito fish (*Gambusia affinis*), yellow bullhead (*Ictalurus natalis*), brown bullhead (*Ictalurus nebulosus*), black bullhead (*Ameiurus melas*), largemouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), white crappie (*Pomoxis annularis*), and yellow perch (*Perca flavescens*).

***Exotic Plants in Upland Systems:*** Major invasive weeds that have invaded refuge upland habitats include perennial pepperweed, Russian knapweed, and whitetop. These species occupy a large percentage of lowland shrub communities and have replaced native grasslands and forbs, which are important to native animals, such as small mammals. More recently, medusahead has invaded shrub lands on the southernmost portion of the Refuge (approximately 30 acres).

***Control Efforts:*** An IPM approach is used, which includes a variety of tools such as mechanical/physical control methods, cultural control methods, biological control, pesticides, habitat restoration, and protocols preventing new introductions (see Appendix G, Integrated Pest Management Plan). Control efforts are planned annually, and Pesticide Use Proposals (PUPs) are submitted to regional and/or national IPM coordinators for approval.

Mechanical, physical, biological, and chemical methods have been used to combat invasive plants in a variety of habitats. Biological methods have included prescribed use of cattle and sheep grazing and prescribed burning. Insects introduced for biological control include thistle stem gall flies, thistle beetles, and thistle weevils for Canada thistle. Considerable progress has been made with infestations of Russian olive around Malheur Lake, using burning, grazing, and chemical control.

Much effort has focused on controlling carp. Annual wetland management plans prescribe drawdowns of impoundments to kill carp; traps have been placed in major dams to prevent their migration upstream; various types of netting techniques have been used for removal and population assessments and electroshocking has been used to remove them from some areas. Rotenone, a piscicide, has been used to supplement other measures of carp control. Several large-scale rotenone projects were conducted on the Refuge during years when lake levels were low and such treatments were deemed cost-effective. These treatments resulted in temporary increases in waterfowl use before the carp population rebounded.

## 4.2 Priority Resources of Concern

A key step in biological planning involves selection of priority ROCs (sometimes called conservation targets in other planning methodologies). These priority ROCs framed the development of the CCP's goals and objectives for wildlife and habitat.

### 4.2.1 Selection Process

Resources of concern, as recommended under the Service's Habitat Management Planning policy (620 FW 1), include:

> all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, State, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect "migrating waterfowl and shorebirds." Federal or State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts (620 FW 1.4G).

Negative features of the landscape, such as invasive plants, may demand a large part of the refuge management effort but are not designated as resources of concern.

To identify these resources, the team reviewed numerous plans and assessments that have been completed (see Section 1.7). A large list of species, species groups, and habitats were identified (see Appendix E, Biological Resources of Concern list). The list was then narrowed to a shorter list of priority ROCs.

The main criteria for selection of the priority ROCs included the following requirements drawn from the document *Identifying Refuge Resources of Concern and Management Priorities: A Handbook* (USFWS 2008a):

- Reflective of the Refuge's establishing purposes and the Refuge System mission

- Species that may be used as an indicator of the health of one the main natural habitat types found at the Refuge
- Recommended as a conservation priority in the Wildlife and Habitat Management Review (USFWS 2008a)
- Federally or State listed, candidate for listing, or species of concern

Other criteria that were used in section of the resources of concern included the following:

- Species groups and/or refuge features of special management concern
- Species contributing to the biological diversity, integrity and environmental health of the ecosystem
- Species where it is feasible to estimate population size (needed for future monitoring and adaptive management)

Early in the planning process, the planning team invited extended team members to assist in identifying priority species for the Refuge (see Appendix I for names of team members). A number of different species were recommended by the participants in this collaborative workshop. The list was refined to 21 priority species for the Refuge and consists of canvasback, sago pondweed, northern shoveler, tui chub, white pelican, eared grebe, redhead, ruddy duck, yellow-headed blackbird, greater sandhill crane, bobolink, cinnamon teal, willow flycatcher, yellow warbler, redband trout, snowy plover, gadwall, mallard, sage thrasher, loggerhead shrike, and sage sparrow. Each species in discussed in more detail by habitat below.

## 4.2.2 Relationship of Priority Resources of Concern to Habitat Goals and Objectives

Wildlife habitat goals and objectives were designed directly around the habitat requirements of the priority ROCs. Goals were written for priority ROC habitats. Objectives were developed from the habitat requirements of priority ROC species.

To develop objectives, the team followed the process outlined in the document *Identifying Resources of Concern and Management Priorities for a Refuge: A Handbook* (USFWS 2008a). For each priority ROC, the team identified the ecological attributes of habitats that are necessary to meet the ROC's life history requirements, and are therefore, critical to sustain the long-term viability of the ROC and other benefitting species. Ecological attributes of habitats include parameters such as vegetation structure, species composition, age class or seral stage, patch size and/or contiguity with other habitats, hydrologic regime, absence of human disturbance, and natural disturbance events (e.g., flooding, fire). These attributes, when described in measurable terms, provide specific habitat targets that strongly correlate with the ability of a habitat to support priority species, and by extension, other benefitting species. For most attributes, the team developed "desired" conditions that were based partly on scientific literature review and partly on the team's professional judgment. These desired conditions for specific attributes were used to help design measurable habitat-based objectives, as presented in Chapter 2.

Limiting factors were also considered in developing objectives. A limiting factor is a threat to, or an impairment or degradation of, the natural processes responsible for creating and maintaining plant and animal communities. In developing objectives and strategies, the team gave priority to mitigating or abating limiting factors that presented high risk to ROCs. In many cases, limiting factors occur on a regional or landscape scale and are beyond the control of the individual refuge. Therefore, objectives and strategies may seek to mimic, rather that restore, natural processes. For example, mowing and/or grazing may be used to maintain a desirable vegetation structure, when restoring native grassland communities may be impractical.

# 4.3 Major Habitat Types on Malheur Refuge

## 4.3.1 Lacustrine (lakes)

### Overview

***Malheur Lake:*** One of the largest inland marshes in the United States, Malheur Lake may vary dramatically in size (from 500 to 110,000 acres) but generally fluctuates about 2 feet during the calendar year and upon average covers approximately 37,500 acres, or 20 percent of the total refuge acreage. On the basis of water depth, water chemistry, and vegetation, it is classified as an Inland Deep Fresh Marsh (Shaw and Fredine 1956). The lake is described in great detail in Duebbert (1969). It receives water from the Blitzen and Silvies rivers, fills from the center, then flows east and finally to the west, and then connects with Mud Lake. Water supply is predominantly influenced by snowpack on Steens Mountain to the south and the Blue Mountains to the north.

The western section of Malheur Lake is a series of natural ponds separated by a network of low dune islands and peninsulas. The center section, the deepest area of the lake, is predominantly open water with some hardstem bulrush stands near the mouth of tributaries. The eastern section tends to be more alkaline and lacks tall emergent vegetation.

Common emergent species in Malheur Lake include hardstem bulrush, cattail, burreed, Baltic rush, and various sedges. The largest stands of hardstem bulrush are at the mouths of both rivers and typically support mixed colonies of ibises, egrets, Franklin’s gulls, and western grebes. The lake contains extensive areas of open, aquatic bed habitat supporting submergent plants such as sago pondweed, water milfoil, horned pondweed, coontail, small and leafy pondweed, white water buttercup, bladderwort, and widgeon grass.

***Harney and Mud Lakes:*** Harney Lake has a bottom elevation about 8 feet lower than Malheur Lake and is deeper than Malheur Lake when it is full. However, Harney Lake dries up completely during dry periods, shifting from a hypersaline lake to a dry salt flat (Dugas 1996). Water often enters Harney Lake through Silver Creek. Harney Lake is too saline to support emergent vegetation.

### Regional Distribution, Condition, and Trends of this Habitat Type

These types of aquatic systems are thinly scattered throughout the Great Basin.

The large invasive carp population in Malheur and Mud lakes and in the Blitzen and Silvies rivers has severely compromised submerged aquatic vegetation (e.g., sago pondweed); therefore, the lakes do not adequately support refuge purposes. Historically, Malheur Lake was a key staging area for canvasbacks and tundra swans in the Pacific Flyway. As a consequence of declining habitat quality, these and other waterfowl no longer stage in significant numbers on the lake except during years following major carp control efforts. Waterfowl production is less than 10 percent of its potential on the lake because of carp. There were high numbers of canvasbacks using Malheur Lake during the falls of 1993 and 1994, after drought conditions and a carp control project in 1992; duck production was estimated to be over 100,000 produced per year on Malheur Lake before the carp invasion (Cornely 1982). During the 1980s, high water levels eliminated most emergent vegetation in Malheur Lake, causing a significant number of colonial birds to abandon nesting on Malheur Lake and shift to flooded private lands to the north. The large stands of hardstem bulrush that were present before the 1980s flood have not recovered. Historically, Mud Lake had an extensive bulrush community used by nesting canvasbacks; however, with low water levels there are minimal bulrush stands present on the lake.

Malheur Lake also supports a diverse community of other exotic fish species, and they likely have an adverse effect on the native species in the system. Other invasive aquatic species, such as quagga and zebra mussels, are not present but could arrive in the lake system in the future, with huge potential for negative effects on the natural biological integrity of the lakes and adjacent wetlands.

When Harney Lake is full and less saline, it supports extensive stands of wigeongrass and high numbers of waterfowl. At higher salinities, it supports an abundance of brine shrimp and brine flies, important food sources for many birds.

### Key Species Supported

The primary wildlife value of the refuge lakes includes their importance as foraging sites for migrating waterfowl, waterbirds, and shorebirds and as nesting habitat for colonial nesting waterbirds and diving ducks. Canvasbacks and tundra swans are particularly abundant when sago pondweed is abundant in the lakes, and many other dabbling and diving ducks are also supported in large numbers. Very high numbers of nesting colonial birds use the lake when habitat conditions are favorable, including white-faced ibis; American white pelican; great and snowy egrets; herons; Franklin’s, California, and ring-billed gulls; Caspian and Forster’s terns; and western, Clark’s, and eared grebes. Total colonial waterbird nests have at times exceeded 10,000 when the lakes reach optimal conditions. Migrant shorebirds use the lakes extensively, when natural fluctuating water cycles expose mudflats. The lakes are also very important to molting geese and ducks as the expansive open water provides them security from predators. Malheur Lake supports over 10,000 molting ducks in good years, and some of the mallards molting there have been documented as birds that nested in California. Occasionally, when Harney Lake is full, it supports well over 300,000 migrating ducks foraging on extensive beds of wigeongrass.

The emergent vegetation in the lakes also once supported most of the Refuge’s population of muskrats and also supported many beaver and mink.

The lakes are very important in preserving the life-history diversity of redband trout in the Harney Basin. A portion of the population migrates to the lower Blitzen River and also Malheur Lake during high water years. Migrations expand resources available to redband trout and allow expression of diverse life histories (Anderson 2009). Native tui chubs are also abundant in the lakes when water conditions are favorable, and they too are likely limited by other exotic fishes in the system. Historically, large numbers of native suckers were reported spawning in Sodhouse Spring (Bendire 1875-1876) and they were likely once abundant in the lakes. Priority ROCs for this habitat type are presented in Table 4-1 and include canvasback, northern shoveler, tui chub, and American white pelicans.

**Table 4-1. Selected Priority Resources of Concern Lacustrine Habitats**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Canvasback | Concentrate in large numbers in lakes and open marshes heavily vegetated with beds of sago pondweed (Mowbray 2002). Nesting requirements similar to redheads. | Migration and breeding | Tundra swan, geese, ducks, coots, grebes, fish, muskrat |
| Northern shoveler | Prefer margins of open shallow wetlands usually with submergent vegetation and associated nearby grasslands, sagebrush, or rangelands for nesting. Prefer grass cover for nesting from 0 to 2 feet (0.6 m) in height, 295 feet (>90 m) from water (Dubowy 1996). | Breeding and foraging | Teal, shorebirds, herons, egrets, other wading birds, blackbirds |
| Tui chub | Inhabit small streams to lakes, prefers areas of shallow water with heavy vegetation for spawning, 3 feet (1 m). Diet of invertebrates, plant material, algae, plankton (Bird 1975; Knopf and Kennedy 1981). | Spawning and foraging | Redband trout, cormorant, marsh and wading birds, mergansers, other native fish species |
| White pelican | Inhabit marshes and open water areas such as lakes and nesting on isolated, flat, low-lying islands with sparse interspersed vegetation adjacent to bare soil (Evans and Knopf 1993). Foraging in shallow water ≤37 feet (11.4 m) and prey dominated by small to medium sizes 1-27 inches (2.5-68.6 cm) (Finholt and Anderson 1995; McMahon and Evans 1991). | Breeding and foraging | Geese, ducks, herons, egrets, rails, white-faced ibis, coot, shorebirds, yellow-headed and other blackbirds, marsh wren, common yellowthroat, black tern, muskrat, mink |

## Refuge Management Activities

There is little direct management of the lakes. The primary management activity on Malheur Lake has been periodic carp control using rotenone when lake levels were low. A riprap barrier with screened culverts has been installed at the Narrows Bridge on Highway 205 to slow carp movements between Malheur and Mud lakes. In the 1950s dikes were constructed between dunes in the Cole Island Dike area to span the lake north to south, while other smaller dikes were constructed to keep water out of private lands north of the lake, but these dikes were destroyed during the flood of the 1980s and are no longer functional.

## 4.3.2 Riverine

### Overview

The major areas of riverine habitat on the Refuge are the Blitzen River and its tributaries. Ideal riverine conditions exist when hydrologic floodplains are intact and when waterways support riparian communities that provide shade to maintain cooler water temperatures and are appropriate to stream channel type. A fully functional river or stream exhibits balanced pool-riffle-glide ratios depending on slope and substrate due to the lack of fine sediments covering large section of river reaches. In such a waterway, water turbidity is typically low with an appropriate level of sediment storage, which buffers against the sediment loading of critical rearing pools and spawning gravels for native fishes. Boulders, undercut banks, logs, and vegetation provide ample hiding cover for native fishes and other aquatic species. Eddies and other slow-current areas contain abundant populations of various aquatic invertebrates. Low turbidity also allows a variety of native aquatic vegetation to establish and propagate in suitable microniches.

On the Refuge, the highest quality riverine habitat occurs at the south end of the Refuge in the unchannelized reaches of the Blitzen River and in the major tributary streams (Mud, Bridge, and Krumbo creeks). Although artificial, the East Canal from Page Dam to Bridge Creek provides attributes of riverine habitat and is in better condition than much of the Blitzen system. Below the confluence of Bridge Creek, the river channel is deeply incised and does not support floodplain hydrology or riparian vegetation and is poor quality habitat for native fish. The river suffers from poor water quality with high sediment and nutrient loading and, in summer, warm temperatures (see Chapter 3).

Silver Creek in the Double-O Unit is disconnected above the Refuge by Moon Reservoir dam and no longer has a natural channel until it reaches the boundary between the East Freeman and Martha Lake fields where the channel is re-established. Riverine habitat conditions are very poor, as flows are intermittent and the lower channel is artificially maintained by the diversion of spring water.

### Regional Distribution, Condition, and Trends

A portion of lower Bridge Creek and 17.5 miles of the Blitzen River were channelized early in the 20th century prior to refuge acquisition, resulting in degraded riverine conditions through much of this portion of the Blitzen Valley. In some reaches, channel incision has lowered water tables enough to allow sagebrush to grow along the river. Development of the irrigation system, including six active irrigation dams, further modified riverine hydrology and caused significant reduction of riverine habitats as floodplain connectivity was disrupted and natural riverine function was reduced.

Much of the degradation of refuge water quality may be the result of historic overgrazing by livestock and the condition of upstream rangelands. It appears these factors still contribute to silt loading and high stream temperatures due to the slow recovery of riparian habitat in affected areas. Since restrictions on livestock grazing were implemented in the 1970s, riparian habitat associated with the riverine system has recovered in the south Blitzen Valley, but remains poor elsewhere.

Channelization and overgrazing have increased incision of the Blitzen River, compromised in-stream habitat diversity, and diminished the system’s ability to disperse energy during high flow events. Channelization has also led to the loss of the functionality of most floodplains on the Refuge, and the associated channel incisions have reduced adjacent water tables and limited recovery of riparian vegetation. The presence of invasive carp likely has a significant impact in reducing the carrying capacity of the riverine system for native species. Altered hydrology and passage impediments have also influenced water and habitat conditions and access by redband trout.

### Key Species Supported

Riverine habitats are prime habitat for redband trout, other native fishes, and native mollusks. This habitat is also important to Oregon spotted frogs, mergansers, belted kingfishers, river otters, and mink. Redband trout is the sole priority ROC species under this habitat type, and more information about this species is listed below in Table 4-2.

**Table 4-2. Riverine Habitat Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Redband trout | Native fish habitat for redband trout: stream shading (>80%), bank cover (no bare soil), bank stability (<5% eroding), channel stability (<1% channel movement), fine sediment <2 mm (<10%), cover (>50% of channel (Zoellick and Cade 2006); percent late summer pools (25%-75%), mean annual base flow (>45% of annual flow) (Raleigh et al. 1984). | Year-round | Native suckers, sculpins, dace, whitefish, mollusks, river otter, beaver |

### Refuge Management Activities

Within the past two decades, the refuge staff has focused on improving fish passage through refuge dams and screening irrigation diversions to minimize loss of fish via irrigation diversion. Considerable effort has been applied to enhance stream-side riparian habitat in Bridge and Mud creeks and along the southern reach of the Blitzen River through plantings. Inverted weirs were installed in this reach of the river to raise the water table and increase habitat diversity in the natural channel. These projects are still being monitored to assess their effectiveness.

## 4.3.3 Woody Riparian

### Overview

The Refuge hosts a variety of riparian habitat along the Blitzen River and its tributaries, along ditches and canals, along remnant traces of previously active sloughs in the Blitzen Valley, and in a few patches in the Double-O Unit. Riparian habitat encompasses 800 to 1,000 acres. Although many plant associations are found within this habitat type, the principal woody species include willows, cottonwoods, alder, redosier dogwood, Wood’s rose, golden currant, common snowberry, Lewis’ mock orange, water birch, and alder. Herbaceous groundcover is characterized by Nebraska sedge, yellow monkey-flower, Northwest cinquefoil, American speedwell, wooly sedge, slender-beaked sedge, meadow barley, tufted hairgrass, western yarrow, and Baltic rush. The south Blitzen Valley also supports extensive stands of willow associated with irrigated meadows, and these stands are very important for riparian landbirds. Smaller stands of willow are associated with wet meadows and seasonal wetlands in the north Blitzen Valley and the Double-O.

## Regional Distribution, Condition, and Trends

Since major reductions in livestock grazing occurred during the 1970s, riparian habitats have increased and expanded, especially in the south Blitzen Valley. The condition of riparian habitat is generally good. There is much diversity in the plant communities along the Blitzen River, its tributaries, and the East Canal. In other portions of the Refuge, diverting water for irrigation or incision of stream banks has lowered the water table, and this has prevented riparian species from re-establishing.

Threats to riparian habitat on the Refuge include invasion by non-native plants, such as reed canarygrass, water hemlock, Russian olive, and perennial pepperweed; river channelization; lowered groundwater table; and water quality impairments. Grazing by trespassing livestock occasionally occurs and can be damaging to the structure of riparian habitat.

## Key Species Supported

There are 97 native landbird species considered by the Partners in Flight plan to be associated with riparian habitat in the Columbia Plateau (Altman & Holmes 2000). This plan lists several species as "dependent," including western wood peewee, Bullock's oriole, willow flycatcher, yellow-breasted chat, yellow-billed cuckoo, and yellow warbler. The same species, including lazuli bunting and excluding western wood peewee, are considered focal species under the plan.

Common refuge breeding bird species using this habitat include song sparrow, willow flycatcher yellow warbler, American robin, eastern kingbird, and black-billed magpie. Also present, but less common, are long-eared owl, black-headed grosbeak, yellow-breasted chat, cedar waxwing, and lazuli bunting. Many other warblers, vireos, and sparrows use this habitat type during migration. Riparian areas are very important to beaver, porcupine, and mule deer (especially in winter) and are used as cover by raccoons, striped skunks, and weasels. Montane voles and jumping mice are also closely associated with this habitat. The priority ROC species under this habitat type include willow flycatcher and yellow warbler and more information about these species is listed below in Table 4-3.

**Table 4-3. Woody Riparian Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Willow flycatcher | Inhabit thickets of willow, cottonwood, dogwood, and other shrubs along river corridors or waterways through the broad valley. Shrub layer cover >40%-80% of native shrubs more than 3 feet (1 m) tall; canopy tree | Breeding and foraging | Yellow-billed cuckoo, black-headed grosbeak, long-eared owl, yellow-breasted chat, song sparrow, eastern kingbird, skunk, weasel |

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| | cover <30% (Altman and Holmes 2000; Sedgwick 2000). | | |
| Yellow warbler | Found in riparian and wet deciduous thickets dominated by willow, alder, dogwood, and other early successional species. Mean territory 0.14-0.29 ha, nest height of 1.6-6.5 feet (0.5-2.0 m) located in dense stands (Knopf and Sedgwick 1992; Lowther et al. 1999). | Breeding and foraging | Yellow-billed cuckoo, black-headed grosbeak, long-eared owl, yellow-breasted chat, song sparrow, eastern kingbird, skunk, weasel |

### Refuge Management Activities

Historically, willows, other shrubs, and trees were mechanically and chemically removed to maximize wet meadow forage for livestock. This practice ended in 1972, and grazing and haying activities were also excluded from stream banks to protect riparian habitat. A 400-foot ungrazed corridor along the Blitzen River and a 200-foot corridor for other streams were established as a standard in the Blitzen Valley Management Plan (USFWS 1990). Selective burning, grazing, haying, or mechanical disturbance may be used to reinvigorate decadent riparian stands. Many riparian areas have been excluded from livestock grazing by implementing hay-only management practices or through the use of protective fencing.

Refuge riparian habitat has been managed for structure, patch size, and patch distribution or spacing of woody clumps within a specified area to meet life-history needs of migratory landbirds, including willow flycatchers and yellow warblers (USFWS 1990).

## 4.3.4 Palustrine Emergent (Seasonally flooded wet meadows)

### Overview

Meadows are influenced by water depths and the timing of irrigation. On the Refuge, they are seasonally flooded and managed artificially by irrigation. The largest areas of meadow habitats are located in the southern Blitzen Valley, where much of the valley is flat and water supplies are more dependable. Meadows in the northern half of the Blitzen Valley and in the Double-O Unit tend to be drier and less extensive; however, they are widely dispersed throughout these managed units of the Refuge. The Blitzen Valley and Double-O currently supports approximately 20,000 to 25,000 acres of meadow habitats. Water conditions in meadows range from subirrigated up to 1 foot in depth. Drier sites are typically dominated by creeping wildrye or saltgrass, while wetter areas tend to be dominated by sedges such as woolly sedge, Nebraska sedge, and slender-beaked sedge. Other native species include Baltic rush, arrow-grass, Nevada bluegrass, western yarrow, slender cinquefoil, large-leafed avens, and fringed willow-herb.

### Regional Distribution, Condition, and Trends

Beginning in the 1870s, uplands, marshes, and irrigated meadows in the Blitzen Valley and Double-O were converted to wet meadows to provide forage for livestock. Further development of the irrigation system in the Blitzen Valley by the CCC led to further habitat conversions in the 1940s. Acreage numbers for meadow habitats have remained relatively stable since these earlier conversions.

The largest threats to the biological integrity of meadows are invasive plant species. Reed canarygrass poses the greatest threat and has already degraded extensive areas of meadow habitat in the Blitzen Valley. Reed canarygrass stands are very poor wildlife habitat. Limited water supplies are another threat to maintenance of meadows. If water supplies are reduced by global warming in the future, the Refuge will need to be strategic about how it uses and delivers water to important meadow habitat.

### Key Species Supported

The primary importance of meadows is to provide nesting cover for ground-nesting birds. Cover provided by drier meadow sites serves nesting cinnamon teal, northern shovelers and northern pintail. Short vegetation in meadows provides habitat for nesting bobolinks and shorebirds, such as Wilson's snipe, Wilson's phalarope, American avocets, and black-necked stilts. Other nesting species are numerous (e.g., mallard, gadwall, short-eared owl, western meadowlark, long-billed curlew). Meadows also serve as foraging sites for territorial greater sandhill cranes, Canada geese, waterfowl, white-faced ibises, and other waterbirds. Meadows support large numbers of montane voles and other small mammals, which are important prey for raptors and mammalian predators (e.g., weasels and coyotes). Deer, pronghorn, and occasionally elk graze in refuge meadow habitats. Priority ROC species for this habitat type are listed below in Table 4-4.

**Table 4-4. Palustrine Emergent (seasonally flooded wet meadow) Priority Resources of Concern Species**

| Focal Species | Habitat Type | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|---|
| Cinnamon teal | Palustrine emergent (seasonally flooded wet meadow) | Use seasonal and semipermanent freshwater marsh nesting near water in low dense perennial vegetation composed of rushes, grasses, and various forbs interspersed with willows, rabbitbrush, and greasewood. Emergent layer cover with a height of 11-35 inches (28-90 cm); grass layer cover with a height of <4 inches (10 cm); water depth 5.5-58.5 cm) | Breeding and foraging | Mallard, northern harrier, northern shoveler, northern pintail, short-eared owl |

| Focal Species | Habitat Type | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|---|
| | | (Thorne and Zwauk 1993). | | |
| Greater sandhill crane | Palustrine emergent, (seasonally flooded marsh associated with wet meadow) | Found in isolated, open, wet marshy meadows dominated by grasses, sedges, and rushes surrounded by shrubs. Shrub/emergent cover <30%; grass cover layer 40%-50%; forb cover layer 10%-20% (Mullins and Bizeau 1978; Stone 2009). | Breeding and foraging | Shrike, teals, gadwall, meadowlark, common yellowthroat, Savannah sparrow, blackbirds, voles, mice, nesting shorebirds |
| Bobolink | Palustrine emergent, (seasonally flooded marsh associated with wet meadow) | Breed in subirrigated meadow composed of grasses and large forbs. Dependent on annual growth of grass cover layer 50%-70%, up to 3 feet (1 m) tall; 10%-20% forbs; bare ground <20% (Dechant et al. 1999; Moskwik and O'Connell 2006; Wittenberger 1978). | Breeding and foraging | Shrike, teals, gadwall, meadowlark, common yellowthroat, Savannah sparrow, blackbirds, voles, mice, nesting shorebirds |

## Refuge Management Activities

During spring irrigation, wet meadows are sheet flooded (subirrigated to 5 inches of standing water). To provide habitat for breeding greater sandhill cranes, Canada geese, and early nesting mallards, irrigation will commence by March 15 for a majority of wet meadow habitat. Fall irrigation of some meadow areas may be desirable to achieve other habitat goals. Irrigation water is maintained in meadows through early August for crane broods, except when drawdowns are necessary to repair facilities or accomplish other habitat management projects (e.g., mowing).

Meadows are managed to provide two habitat structure objectives: to provide dense nesting cover for ground-nesting birds, and to provide short stubble for early green-up as forage for early nesting birds such as waterfowl and cranes and as short-cover nesting sites for shorebirds. To achieve the second objective, meadows are treated by mowing the vegetation in late summer and removing it as hay or through rake-bunch grazing.

## 4.3.5 Palustrine Emergent (seasonally flooded marsh associated with wet meadows)

### Overview

This habitat type, measuring approximately 17,000 to 18,000 acres, exists within a mosaic of wet meadow and open water areas. Emergent marshes are found throughout the southern Blitzen Valley, become less extensive north of Buena Vista, and occur in the southern half of the Double-O Unit. Common emergent plant species include burreed, bulrushes, cattails, sedges, rushes, and spike rushes. Refuge emergent marshes are dominated by hardstem bulrush, cattails, or broad-fruited burreed. These emergents typically tolerate fluctuations in water availability ranging from 3 feet (1 m) above to 4-5 inches (10-12 cm) below the soil surface. Submergent plants such as pondweeds, bladderworts, waterweeds, and duckweeds occur in adjacent deeper open water (aquatic beds) areas. Willow species can occur along elevated ecotones along marsh perimeters.

### Regional Distribution, Condition, and Trends

The greatest challenge associated with this habitat is maintaining an adequate prescribed fire cycle to remove excess litter, create open water areas, and generally make it more conducive to use by wildlife (e.g., nesting cranes and mallards). The two prevalent invasive species within emergent marshes are common reed and hybrid cattail. Some emergent stands in the Blitzen Valley (i.e., common cattail) have expanded and encroached into adjacent wet meadow and open water areas in the past decade, reducing habitat values for some nesting birds.

Common reed and hybrid cattails have the potential to displace significant areas of marsh plant community types that are more valuable for nesting birds.

### Key Species Supported

Wildlife species associated with these marsh habitats include sandhill cranes, trumpeter swans, overwater nesting ducks (diving ducks and mallards), rails, bitterns, black and Forster’s terns, coots, marsh wrens, common yellowthroats, and yellow-headed and red-winged blackbirds. Marshes provide foraging, resting, pairing, and nesting habitat for these species. Emergent vegetation in marshes provides escape cover for broods of numerous species, particularly late-season nesters such as gadwall, redhead, and grebes. The priority ROC species under this habitat type are listed below in Table 4-5 and include yellow-headed blackbirds and greater sandhill cranes.

**Table 4-5. Palustrine Emergent (seasonally flooded marsh associated with wet meadow) Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Yellow-headed blackbird | Found in a variety of wetland areas but in this region prefers seasonal wetland with dense emergent vegetation over standing water. Favor vegetation around 23 inches (60 cm) in height, a mean stem density of 80-104/yd², over 11-22 | Breeding and foraging | Bitterns, mallards, other waterfowl, sora, other rails and marsh birds, other blackbirds, willets, snipe, other shorebirds, swallows |

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| | inches (28-57 cm) of water (Twedt and Crawford 1995). | | |
| Greater sandhill crane | Prefer coarse, emergent vegetation predominately hardstem bulrush, cattail, and burreed with an average water depth of 7 inches (18.0 cm) (Littlefield 1995; Tacha et al. 1992) for nesting. | Nesting | Bitterns, mallards, other waterfowl, sora, other rails and marsh birds, other blackbirds, willets, snipe, other shorebirds, swallows |

### Refuge Management Activities

The maintenance of existing emergent communities is artificial, requiring extensive infrastructure and active water diversion. Tools such as burning, mowing, disking, and using herbicides have been used to enhance this habitat type. Herbicides are occasionally used to control invasive species within this community.

## 4.3.6 Palustrine Open Water/Emergent (semipermanently flooded wetland impoundments)

### Overview

This habitat type, measuring between 2,200 and 2,800 acres, is primarily provided in wetland impoundments in the Blitzen Valley and Double-O units. Palustrine open water habitats are semi permanently flooded at depths that preclude the development of extensive stands of emergent vegetation. Extensive areas of emergents occur in larger impoundments. The aquatic beds of these impoundments support submerged and floating plants including common and greater duckweed; Canadian waterweed; coontail; water milfoil; common bladderwort; white water crowfoot; and sago, longleaf, and small pondweeds. Emergent plants occupy shallow areas within and alongside of open water communities and include bulrushes, cattails, sedges, rushes, and spike rushes.

### Regional Distribution, Condition, and Trends

Most refuge impoundments are in good condition and meet the goal of providing hemi-marsh conditions (approximately half marsh and half open water); however, a few are overgrown with emergent vegetation and lack diversity and extent of open water. These are typically sites that have poor water control or that have undergone changes in hydrology.

Palustrine systems are threatened by a number of factors. Invasive species such as carp and reed canarygrass reduce their wildlife values. Aging infrastructure and management of vegetation within the water delivery system poses challenges in ensuring reliable and consistent water supplies.

### Key Species Supported

These impoundments are the primary habitat for breeding and foraging of the Refuge’s population of trumpeter swans. The impoundments provide brood water for late-nesting ducks, such as redheads and gadwalls, and provide overwater nesting substrate for a large variety of wetland birds, including Canada geese, diving ducks, mallards, American coots, rails, grebes, and colonial species such as white-faced ibises and Franklin's gulls. They also provide foraging habitat for migrating waterfowl and serve as night roosts for staging sandhill cranes and Canada geese. They serve migrant shorebirds when they are being flooded or drawn down and provide very shallow or moist mudflats.

Muskrats use the emergent marsh component of this habitat for their lodges. Their lodges are also used by mink, which hunt muskrats and wetland birds in the marshes. Raccoons also forage in these areas.

The priority ROC species for this habitat type are listed in Table 4-6 and consist of eared grebes, redhead ducks, and ruddy ducks.

**Table 4-6. Palustrine Open Water/Emergent (semipermanently flooded wetland impoundments) Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Eared grebe | Inhabit large fresh open water marshes and prefer to nest in waters with abundant and diverse submergent aquatic beds and periphery emergent vegetation and 10 feet (3 m) deep. 60:40 to 70:30 ratio of open water to emergent vegetation with a stem density 8-144 stems/yd², open water areas with submergent vegetation covering 40%-70% of area dominated by sago pondweed (Cullen et al. 1999; Dechant et al. 2002). | Breeding and foraging | Swans, geese, ducks, herons, egrets, rails, ibis, coot, yellow-headed and other blackbirds, swamp sparrow, marsh wren, common yellowthroat, black tern, muskrat, mink |
| Redhead | Inhabit permanently or semipermanent palustrine wetlands, water depth 8-39 inches (20-100 cm) (interspersed open water pockets 1.7-2.5/yd²; emergent stem density bulrush 350-450 stems/yd² or cattails 32-52 stems/yd² (Custer 1993; Low 1945; Woodin and Michot 2002). | Brooding | White pelican, egrets, herons, mergansers, grebes, cormorants, rails, ducks, coot, marsh wren, black tern, red-winged and yellow-headed blackbirds, muskrat |
| Ruddy duck | Inhabit large open water areas with submergent vegetation during foraging but use dense emergent vegetation >35 inches (91 cm) in height for breeding. Prefer stems density 88-200/yd² with a water depth of 16-24 inches (42-61 cm) (Bura 2002). | Breeding and foraging | Swans, geese, ducks, herons, egrets, rails, ibis, coot, yellow-headed and other blackbirds, swamp sparrow, marsh wren, common yellowthroat, black tern, muskrat, mink |

### Refuge Management Activities

With the exception of small natural depressions next to springs (e.g., Double-O Spring), the palustrine community has been maintained through active and intensive management. Emergents within impoundments are managed to maintain a hemi-marsh condition. Tools such as burning, mowing, disking, and using herbicides have been used to reduce extensive stands of emergents. Occasional drawdowns oxidize nutrients and consolidate substrates to facilitate the germination of submergent vegetation, such as sago pondweed. When pond bottoms are exposed production of smartweed and other desirable native colonizers is higher after reflooding, especially in mudflats in shallow benches. Periodic drawdowns are occasionally used to remove carp from impoundments. When impoundments cannot be totally dried up, rotenone, netting, and electroshocking have been used to remove invasive carp.

## 4.3.7 Dry Meadow

### Overview

Dry meadows are influenced by water depths and the timing of irrigation through the availability of subirrigation. Standing water is typically not found within these plant communities. The largest areas of dry meadow habitats are located in the northern Double-O and scattered throughout the Blitzen Valley where gradual shifts in elevation facilitate the presence of this habitat type, which lies between wet meadows and sagebrush lowland/salt desert scrub. The Blitzen Valley and Double-O currently supports approximately 4,500 to 5,500 acres of dry meadow habitats. Dry meadow habitats are typically subirrigated but may be temporarily inundated during flood events. Shallow depth to water table makes these areas largely uninhabitable by woody upland vegetation such as basin big sagebrush and greasewood. Sites are typically dominated by creeping wildrye, Nevada bluegrass, bluejoint, or saltgrass. Other native species include western yarrow, slender cinquefoil, and lanceleaf goldenweed.

### Regional Distribution, Condition, and Trends

Depth to water table is a driving factor influencing the presence of dry meadow communities. Water management within wet meadows and emergent marshes impact outlying water tables, and these impacts cause this habitat type to either expand or contract. In areas near prevailing ecotones between dry meadows and sagebrush lowland/salt desert scrub habitats, upland shrub invasion has occurred. This habitat is highly susceptible to invasion by perennial pepperweed.

The largest threat to the biological integrity of dry meadows is invasive plants (either upland shrubs or noxious weeds). Fire suppression over the last century has favored the expansion of shrub communities into this habitat, and the prolific availability of weed seed throughout the Refuge proves difficult to manage.

### Key Species Supported

The primary importance of dry meadows is to provide nesting cover for ground nesting birds such as cinnamon teal, bobolink, gadwall, and mallard. These communities are also significant for the western meadowlark, a species that uses this habitat type for breeding and foraging. The latter species is the priority ROC species for this habitat type and more information about it is listed in Table 4-7.

**Table 4-7. Dry Meadow Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Western meadowlark | Prefer open country with meadows and fields with good grass and litter cover and little or no woody layer. Grass layer 20%-80%, forb layer 1%-17%, mean thatch layer of 16%, bare ground ≤10% (Dechant et al. 2002; Greer 2009; Lanyon 1994) | Breeding and foraging | Savannah sparrow, vesper sparrow, horned lark, blackbirds, sandhill crane, northern harrier, curlew |

### Refuge Management Activities

Active management within dry meadows consists mainly of weed control and the stimulation of nesting cover via occasional disturbance (prescribed fire, haying, rake-bunch grazing). Water management of adjacent habitats does influence these plant communities by raising or lowering the prevailing water table.

## 4.3.8 Salt Desert Scrub

### Overview

Salt desert scrub occurs in barren alkali flats or alkaline valley bottomlands, and occupies 40,000 acres of the Refuge. This community is most abundant in alkaline areas around the Double-O Unit, Harney Lake, and Mud Lake but also occurs in portions of the Blitzen Valley and along the east end of Malheur Lake where soil alkalinity is high. Infrequent inundation of outer playa areas or wind erosion from these playas distributes salts to nearby low-lying areas, causing elevations in alkalinity and pH, which favor this community association. The plant community for this habitat type consists of widely spaced shrubs with dense patches of rhizomatous grasses, as well as low densities of other annual and perennial grasses and succulent forbs. Dominant species are black greasewood and inland saltgrass, but shortspine horsebrush, fourwing saltbush, bud sage, green and gray rabbitbrush, alkali sacaton, alkali cordgrass, and alkali bluegrass are often present. Mat muhly and Sandberg’s bluegrass may be present in mosaics which exhibit more moderate conditions (lower pH.).

### Regional Distribution, Condition, and Trends

These upland sites also experience moderate to heavy grazing by livestock during the winter, and this probably reduced the resiliency of this community to resist invasive plants. Perennial pepperweed has significantly encroached in these areas at lower elevations and has replaced vast areas of native vegetation. Rabbitbrush tends to be invasive in some sites after burning.

Livestock grazing may compromise plant species diversity within this community type. There is no wildlife benefit to grazing in these uplands. Perennial pepperweed has invaded vast areas of this habitat in the Blitzen Valley and to a lesser degree in the Double-O Unit.

### Key Species Supported

This community is preferred for nesting by loggerhead shrikes, which use the thorny shrubs to impale their prey. Similar to the sagebrush lowland community this habitat is important as nesting cover for ground-nesting birds, such as mallards, gadwalls, and short-eared owls when in proximity to water. Nesting birds primarily rely on tall grass and forb components. A variety of landbirds also breed here, including sage thrashers, Brewer’s sparrows, black-throated sparrows, sage sparrows, Brewer’s blackbirds, and western meadowlarks. Many mammalian species use these communities including American badgers, weasels, black-tailed jackrabbits, cottontails, Townsend’s and northern pocket gophers, and deer mouse. They are typical denning sites for coyotes and are also frequented by bobcats. They also get used regularly by mule deer and pronghorn. The priority ROC species under this habitat type is loggerhead shrike, and more information about this species is listed below in Table 4-8.

**Table 4-8. Salt Desert Shrub Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Loggerhead shrike | Found in open gentle terrain with low density of shrubs (particularly sagebrush) mixed with low and sparse grasses such as saltgrass. Shrub layer cover 5%-15%, grass layer cover 50%-70% <10 inches (25 cm) tall (Pampush and Anthony 1993; Paton and Dalton 1994). | Breeding and foraging | Sage sparrow, sage thrasher, vesper sparrow, snakes, shrews, lizards |

### Refuge Management Activities

Although this habitat type was historically intensively grazed, in more recent years cattle have been excluded from grazing in this habitat type on the Refuge. Prescribed burning is periodically used in these sites to set back succession and composition over the short term, but these communities often do not contain enough continuous fuels to accomplish a complete burn, so the result is a mosaic burning pattern.

## 4.3.9 Sagebrush Lowland

### Overview

These upland habitats occur in elevated basin bottomlands with deep silty or sandy soils along stream channels in valley bottoms and flats. Lowland sagebrush habitat is found on 4,300 to 4,500 acres of the Refuge. Structurally, these habitats are composed of widely spaced medium-tall to tall shrubs (1.5-6 feet) with an understory of perennial bunchgrasses. Basin big sagebrush, Wyoming big sagebrush, rabbitbrush, and basin wildrye are dominant features in this habitat type. These habitats occur in upland areas on the valley floors of the Blitzen Valley and Double-O units. The fire frequency in these habitats ranges from 10 to 25 years (ODFW 2006).

## Regional Distribution, Condition, and Trends

Historically, this habitat was probably more abundant in the Blitzen Valley. As the development of the irrigation system changed the water regime, it likely also changed the composition of plant communities on lower-elevation upland sites. However, most of the loss of upland habitat due to development of irrigation more likely occurred in the meadow areas dominated by creeping wildrye/Nevada bluegrass communities throughout the Blitzen River Valley. These communities have developed along the incised river and stream channels and along the edges of some refuge canals and dikes.

Before the reduction of grazing in the 1970s, these upland sites were moderately to heavily grazed by cattle during the winter, with cattle use extending into early spring, for over 30 years. This use degraded these sites and likely changed a number of plant community characteristics.

Invasive plants, such as cheatgrass, have degraded this community and have altered the natural fire regime by allowing more frequent fire-return intervals. Perennial pepperweed has significantly encroached in these areas at lower elevations and has replaced vast areas of native vegetation. Rabbitbrush tends to proliferate in some sites after burning.

Weed invasions are the biggest threats to this habitat type. There is no wildlife benefit to grazing in these uplands. Grazing by trespassing livestock can be an issue.

## Key Species Supported

A primary value of this upland community is as dense nesting cover for ground-nesting birds, such as mallards, gadwalls, and short-eared owls. These birds primarily rely on tall grass and forb components. A variety of landbirds also breed here, including California quail (*Callipepla californica*), sage thrashers, Brewer's sparrows, Brewer's blackbirds, and western meadowlarks. Many mammalian species also use these communities, including American badgers, weasels, black-tailed jackrabbits, cottontails, potentially pygmy rabbits, Townsend's and northern pocket gophers, least chipmunk, bushy-tailed and desert woodrats, northern grasshopper mouse, deer mouse, and sagebrush vole. These habitats are typical denning sites for coyotes and are also frequented by bobcats. They also get used by mule deer, pronghorn, and elk and provide good hiding cover for these species. The priority ROC species under this habitat type consist of gadwall and mallard. More information about these species is listed below in Table 4-9.

**Table 4-9. Sagebrush Lowland Priority Resources of Concern Species**

| Focal Species | Habitat Type | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|---|
| Gadwall | Sagebrush lowland | Prefer islands of brushy habitat with Great Basin wildrye, or tall grass or forb component in proximity to open water. Shrub layer cover <10%; herbaceous veg. cover 10%-20%, 9-13 inches (25-35 cm) tall, within 147 feet (45 m) of | Nesting | Short-eared owl, mallard, western meadowlark, sage thrasher |

| Focal Species | Habitat Type | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|---|
| | | open water (Leschack et al. 1997; Sousa 1985). | | |
| Mallard | Sagebrush lowland | Nesting in dense cover scattered shrub lands surrounded by water for brooding (Drilling et al. 2002). Nests are generally equal to or less than 164 yards (150 m) from water (Dzus and Clark 1997). | Early season nesting and brood water | Short-eared owl, gadwall, song sparrows |

### Refuge Management Activities

The primary management activities in these upland communities are weed control and prescribed burning to reinvigorate basin wildrye for dense nesting cover for ducks.

## 4.3.10 Sagebrush Steppe

### Overview

This community includes 14,000 to 15,000 acres on the Refuge and is dominated by shrubs with an understory of various bunchgrass and forb species found within interspaces. It can be found above greasewood/lowland sagebrush communities on various aspects, slopes, and soil types. It occurs around the fringe of the Blitzen Valley at higher elevations, at several locations in the Double-O Unit, and along the south side of Harney Lake. Plant species include Wyoming and low sagebrush, bluebunch wheatgrass, Sandberg's bluegrass, bottlebrush squirreltail, Idaho fescue, needle-and-thread, Thurber's needlegrass, western yarrow, arrowleaf balsamroot, and various locoweed and phlox species. A gradient in soil depth determines whether Wyoming big sagebrush or low sagebrush dominates a site. Low sagebrush sites typically host higher densities of forbs due to higher concentrations of available soil moisture due to shallow, rocky conditions. These communities depend on natural fire cycles or equivalent disturbance to maintain a balance between shrub, grass, and forb components. A lack of disturbance lends itself to high shrub densities with sparse vegetation in the interspaces.

### Regional Distribution, Condition, and Trends

Originally, upland habitats were composed of native shrubs, bunchgrasses, and forbs. Most of the former native vegetation has been severely altered by historical land use, including intensive livestock grazing, reduced burning frequency, and cultivation. Large areas of shrub-steppe have been seeded to crested wheatgrass or as part of former "fire restoration" activities.

Invasive plants, such as medusahead and cheatgrass, are major threats to the remaining shrub-steppe areas of the Refuge. Medusahead is capable of outcompeting native grasses and forbs in the understory. An altered fire regime resulting in more frequent fire return intervals due to the volatility of cheatgrass can limit recovery of sagebrush species in these communities, and wildfire can exacerbate these invasions.

## Key Species Supported

Examples of obligate shrub-steppe species include sage-grouse, Brewer's sparrow, sage sparrow, and sage thrasher. Likely because of the elevation, condition and fragmentation of refuge shrub-steppe, only very limited use by sage-grouse has been observed. Historically the area also supported sharp-tailed grouse (*Tympanuchus phasianellus*), which were last documented in southeastern Oregon in 1940. Many other birds occur in shrub-steppe but are not as dependent on sagebrush. Examples of these include burrowing owl (*Athene cunicularia*), lark sparrow (*Chondestes grammacus*), vesper sparrow, horned lark, loggerhead shrike, long-billed curlew, and western meadowlark.

Mule deer, pronghorn, and occasionally elk use these areas, which are within their winter range. Coyotes, bobcats, and badgers are common in these areas, and mountain lions are rarer, but present. The black-tailed jackrabbit, Nuttall's cottontail, least chipmunk, Townsend's and golden-mantled ground squirrels, and northern and Townsend's pocket gophers are locally abundant in shrub step.

A variety of reptiles use shrub-steppe habitat, including sagebrush, fence and side-blotched lizards; western rattlesnakes; racers; gopher snakes; and common garter snakes. Amphibians are represented by spade-foot toads.

The priority ROC species for this habitat type is the sage thrasher, and more information about this species is listed below in Table 4-10.

**Table 4-10. Sagebrush Steppe Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Sage thrasher | Found in open terrain with a high density of sagebrush and large contiguous tracts. Shrub layer cover 5%-25%, 31 inches (>80 cm) in height; other shrub cover <10%; herbaceous cover 5%-20%; tract size >39 acres (16 ha) (Altman and Holmes 2000; Reynolds et al. 1999). | Breeding and foraging | Sage sparrow, sage-grouse, long-billed curlew, ground squirrel, mule deer, pronghorn |

## Refuge Management Activities

To provide green winter browse for wintering Canada geese, crested wheatgrass seedings have been treated with livestock grazing to provide short stubble. Otherwise, cattle have been excluded from most of these sites on the Refuge. Research on restoring crested wheatgrass areas to more native shrub-steppe communities is being conducted in conjunction with the Eastern Oregon Agricultural Research Center (USDA Agricultural Research Service).

## 4.3.11 Dune

### Overview

Dune habitat on the Refuge is located adjacent to playa basins and is characterized by open sand ridges with widely spaced shrubs, grasses, and forbs. Created by wind erosion off nearby dry playa bottoms (i.e., Stinking and Harney lakes), dune shrub communities are made up of shortspine horsebrush, fourwing saltbush, bud sage, green and gray rabbitbrush, and black greasewood. Grasses include Indian ricegrass, needle-and-thread, bottlebrush squirreltail, and alkali sacaton. Forbs include tufted evening primrose, Paiute suncup, Geyer's milkvetch, sharpleaf penstemon, and various lupines. Dunes cover about 6,300 acres on the Refuge and are primarily located on the east side of Harney Lake and as islands on Malheur Lake.

### Regional Distribution, Condition, and Trends

Possibly because of harsh conditions, constantly shifting sand and specific adaptations of the plants that inhabit these sites, this habitat has fewer invasive weed issues than other upland types on the Refuge. Some invasive weeds, such as Russian thistle, are present, but their extent is very limited. The dunes are unstable and slowly shift over time. We have no trend data for the dunes but consider them basically pristine and unique habitat on the Refuge.

Dunes are susceptible to invasion by exotic weeds such as *Halogeton*, povertyweed, and Russian thistle. These plants could change the dynamics of sand movement in the dunes and lead to increased stability, which would change the natural vegetation patterns on the dunes and compromise their integrity. Grazing by trespassing livestock occasionally occurs as well as use by trespassing all-terrain vehicle riders. Both of these are a significant threat to the stability of the dunes.

### Key Species Supported

Vertebrate wildlife associated with dunes are dependent on the associated vegetation and include many small mammals, including black-tailed jackrabbits, western cottontails, kangaroo rats, dusky-footed woodrats, and deer mice. Occasionally mule deer use the dunes to forage and seek cover. Shrub-steppe nesting birds such as sage thrashers, sage sparrows, and black-throated sparrows nest in the associated brush. Reptiles such as western fence lizards, side-blotched lizards, short horned lizards, and Pacific rattlesnakes frequent the dunes and some likely lay their eggs there. During high water periods, the sandy shorelines are used by foraging shorebirds. The priority ROC species under this habitat type is the sage sparrow, and more information about this species is listed below in Table 4-11.

**Table 4-11. Dune Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Sage sparrow | Prefer large patches of contiguous sagebrush; semi-open, evenly spaced shrub habitat with big sagebrush and rabbitbrush as part of the community component. Shrub layer cover 10%-25% with a height of >19 inches (50 cm); herbaceous layer | Breeding and foraging | Sage thrasher, sage-grouse, loggerhead shrike, badger |

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| | cover >10%; open ground >10% (Altman and Holmes 2000; Martin and Carlson 1998). | | |

### Refuge Management Activities

Dune habitats have received no direct management as these area lie within the RNA and proposed wilderness boundary for Harney Lake. Natural ecological factors continue to shape the dune terrain, without any significant human influences. The primary management objective is protection from trespassing livestock and people.

## 4.3.12 Playa

### Overview

Refuge playa habitats are located primarily in Harney Lake (a 40,000-acre playa when dry) and the Double-O. Stinking Lake is the second-largest refuge playa and is spring-fed and isolated from other surface hydrology. Total average refuge acres of playa habitats are approximately 29,000. During low-water periods, there are large playa areas in Mud Lake and a few along the east side of Malheur Lake. The flat playa surfaces that appear during drier periods are periodically flooded but generally too alkaline to support vegetation. They are bare or scattered with dead vegetation killed by floodwaters of the 1980s (Dugas 1996), and these unique habitats are often intermixed with saltgrass or desert salt-scrub communities. Evaporation of closed basin water during dry periods results in high levels of alkalinity and associated pH. During high-water events, the alkaline water is diluted, stimulating the temporary production of aquatic species. Playa soils are typically very deep and poorly drained. Virtually no vascular plants reside within Harney and Stinking lakes, with the exception of spring areas where steady freshwater inflows modify water chemistry.

### Regional Distribution, Condition, and Trends

Generally, refuge playa habitats are in pristine condition with these communities least impacted by human actions or changed by environmental conditions. A few playas in the Double-O have been bisected by roads. Harney Lake is a designated Research Natural Area and wilderness study area, and has been protected for those values. Stinking Lake is designated as a Research Natural Area.

When dry, playas are popular for off-road all-terrain vehicle use, which can cause soil compaction and erosion, reducing their resiliency and allowing soils to blow away. With access on the Refuge restricted, this is mostly a limited trespassing issue. Disruption of natural water supplies from local runoff by road construction or drainage systems could reduce the flood frequency and the wildlife value of playa habitats.

### Key Species Supported

Playas systems are rich in invertebrates, such as brine flies and brine shrimp. They support breeding snowy plovers and occasionally American avocets and black-necked stilts. Harney Lake is the most important breeding site for snowy plovers in the Harney Basin and has supported over 400 breeders. When these habitats develop standing water, large numbers of waterfowl have been observed using the sites. Because they are rich in invertebrates, playas attract high numbers of migrant shorebirds when they are wet. When brine shrimp are abundant, the Refuge's playas receive high use by Wilson's and northern phalaropes, northern shovelers, ruddy ducks, gulls, and eared grebes. Peaks of over 15,000 phalaropes have been counted at Stinking Lake. The priority ROC species under this habitat type is the snowy plover, and more information about this species is listed below in Table 4-12.

**Table 4-12. Playa Priority Resources of Concern Species**

| Focal Species | Habitat Structure and Attributes | Life History Requirements | Other Benefiting Species |
|---|---|---|---|
| Snowy Plover | Found in barren or sparsely vegetated alkaline or saline lakes, playas, and flats. Bare ground with little vegetation of any kind; nests are usually <0.8 mile from water; water levels for foraging are from 0-1 inch (0-2 cm) deep (Page et al. 1985; Page et al. 1995). | Breeding and foraging | Phalaropes, eared grebe, northern shoveler, ruddy duck, shorebirds |

### Refuge Management Activities

These systems generally do not require any management other than protecting them from trespassing and off-road vehicle use.

## 4.3.13 Cropland

### Overview

Croplands are maintained on the Refuge to provide forage for fall-staging sandhill cranes and waterfowl. Grain fields are present at scattered locations in the Blitzen Valley. In the past two decades, refuge maintenance staff have planted and irrigated these fields. Winter wheat and spring barley are the primary crops planted, which are rotated among about 300 acres of grain fields. These fields are left unharvested for wildlife use.

Grain crops are occasionally planted in bottoms of refuge impoundments as part of the drawdown cycle to reinvigorate wetland nutrients.

### Regional Distribution, Condition, and Trends

Historically, a much higher percentage of the Blitzen Valley was managed as grain fields. Grain crops were extensive in the late 1930s through the 1950s to support fall migrants. Many fields that are now managed as wet meadows were leveled and ditched to allow farming. Approximately 1,300 acres of grain fields were managed in the 1990s (USFWS 1990). Today about 80 acres of grain fields are managed on the Refuge.

Invasive weeds can be a threat to these lands if farming operations are terminated, with soils freshly tilled, and if the field is left idle and not restored.

### Key Species Supported

Grain field farming has primarily been conducted to support fall-staging sandhill cranes. They are heavily used by cranes, Canada geese, mallards, northern pintails, and occasionally American wigeon. They are also used by mule deer, pronghorn, and upland game birds, including pheasants and California quail. Red-winged, yellow-headed, and Brewer's blackbirds, as well as a variety of sparrows, also use them.

### Refuge Management Activities

Crops are maintained on an annual basis. These areas are periodically treated for invasive weeds.

## 4.3.14 Cold and Hot Springs

### Overview

Springs occur throughout the Refuge, ranging from the southern end of the Blitzen Valley to the Double-O Unit. They provide stable, permanent sources of water for flood irrigation, pond filling, and/or maintenance, and wildlife.

### Regional Distribution, Condition, and Trends

The ability of many springs to provide high quality aquatic habitat for fish and wildlife has been compromised due to the prevalence of common carp throughout the Refuge's water system. Those areas that have remained carp-free provide abundant submergent vegetation and associated invertebrates.

### Key Species Supported

Springs provide habitat for a diverse assemblage of macroinvertebrates, native plants, fish, other aquatic species, and wildlife. These areas provide essential habitat for spotted frog (breeding, feeding, and winter refugia) and trumpeter swan (warm-water springs are often the only open water available during the winter).

### Refuge Management Activities

Areas adjacent to cold and hot springs are treated as needed for invasive weeds.

## 4.3.15 Cliffs, Rimrock, and Outcroppings

### Overview

Areas of steep basalt cliffs and outcroppings can be found along the sides of the Blitzen Valley and the south end of Mud and Harney lakes and in the Double-O Unit. This habitat type occurs within the refuge perimeters of the Blitzen and Double-O valleys.

### Regional Distribution, Condition, and Trends

Frequent wildfires have reduced the quality of vegetation occurring on and near cliff areas. The trend for the condition of these habitats is generally stable. Some sites have been modified in the past for use as sources of gravel and rock.

Invasive weeds are a threat to the integrity of habitat surrounding cliffs and talus areas as they reduce the value of the sites for foraging wildlife. Disturbance of nesting raptors is an issue and human trespass needs to be minimized during the nesting period.

### Key Species Supported

These areas provide nesting habitat for cliff dwelling birds, as well as various reptiles and are particularly important for nesting raptors, including golden eagles; prairie falcons; red-tailed hawks; and great-horned, screech, barn, and long-eared owls. Historically, they supported nesting peregrine falcons and they will likely soon reoccupy such refuge sites based on upward population trends and available habitat. These areas are used by mule deer, bighorn sheep, black-tailed jackrabbit, Nuttall’s cottontail, yellow-bellied marmots, golden-mantled ground squirrels, and bushy-tailed and desert woodrats. Many lizard and snake species are associated with this habitat type and some of the sites support rattlesnake hibernacula, especially in the Double-O Unit.

### Refuge Management Activities

These systems generally do not require any management other than protecting them from trespassing.

# 4.4 Major Species Groups

## 4.4.1 Migratory and Resident Birds

### Waterfowl

The Refuge supports several priority waterfowl species that are highlighted in the North American Waterfowl Management Plan (North American Waterfowl Management Plan Committee 1998). Species present that are identified as “high” priority in the plan and which use the Refuge are tule greater white-fronted goose, northern pintail, mallard, and lesser scaup. Most of the refuge use for these high-priority species is provided during migration periods. However, substantial numbers of mallards nest on the Refuge with some nesting by pintail and lesser scaup. Additionally, “other” priority waterfowl species identified in the plan use the Refuge or the area surrounding the Refuge, including Pacific greater white-fronted goose, Wrangel Island snow goose, wood duck, redhead, canvasback, ring-necked duck, and American wigeon. Most refuge use is migratory, but breeding pairs of wigeon, canvasback, ring-necked, and redhead ducks are observed each year. The Refuge also supports a breeding Rocky Mountain population of trumpeter swans, which are a priority for the Pacific Flyway.

Use of the Refuge is substantial for many of these waterfowl species and varies with habitat conditions. A comparison of peak refuge counts, conducted in the 1980s and 1990s during spring and fall migration, with annual the Pacific Flyway midwinter population indices shows that the Refuge supported up to the following percentages for each species:

- 66 percent of the white goose (snow and Ross's) population (spring 1996)
- 63 percent of the American wigeon population (fall 1993)
- 48 percent of the tundra swan population (in fall 1980 after carp control on Malheur Lake)
- 40 percent of the American green-winged teal population (fall 1993)
- 24 percent of the ruddy duck population (spring 1995)
- 22 percent of the northern shoveler population (fall 1993)
- 10 percent of the northern pintail population (spring 1996)
- 5 percent of the mallard population (fall 1996)

Additionally, refuge counts for both redheads and canvasbacks exceeded the Pacific Flyway midwinter indices (328 percent for redheads in fall 1992 and 148 percent for canvasbacks in fall 1995). However, it should be noted that the midwinter counts do not include Mexico, where substantial numbers of redheads and canvasbacks winter.

Tule and Pacific greater white-fronted geese, snow geese, and Ross's geese use the Refuge, primarily during migration. Tule geese primarily use the marshy areas on the north side of Malheur Lake in the fall, while white geese and Pacific white-front geese use the area more extensively in the spring. They use the lakes for night roosting and forage in irrigated meadows on the Refuge in the north Blitzen Valley and Double-O. However, it should be noted that the majority of these birds forage off-refuge on the Silvies River floodplain. Large numbers of western Canada geese winter here.

Breeding waterfowl most commonly found on the Refuge include western Canada geese, cinnamon teal, mallard, gadwall, redhead, northern shoveler, northern pintail, American wigeon, canvasback, and ruddy duck. Several other species breed here but in much lower densities. A small flock of resident trumpeter swans use the Refuge year-round and nest in the Blitzen Valley.

Waterfowl annual production has declined from production numbers of over 100,000 birds to between 50,000 and 60,000 annually by the 1980s (Cornely, 1982). A precipitous decline occurred in the early 1950s which was strongly suspected to be correlated with expanding carp populations and degradation of Malheur Lake aquatic habitats. Waterfowl production has rebounded from the lows of the 1960s but still remains less than half of historic production levels (Cornely, 1982). Information on production in the last decade is incomplete.

## Waterbirds

Thirty different species of waterbirds occur on the Refuge. The Refuge supports several colonial waterbird species identified as priority species in the Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006), including greater sandhill cranes, western and Clark's grebes, American white pelicans, California gulls, and Forster's terns.

Greater sandhill cranes are also listed as a sensitive species in Oregon. Malheur supports the highest number of breeding greater sandhill cranes of any refuge in the western United States. A statewide pair survey in 2000 found 245 pairs on the Refuge, 21 percent of the Oregon population (Ivey and Herziger 2000).

Comparing peak refuge counts of nesting waterbirds with population estimates for the Great Basin bird conservation region, most colonial waterbird numbers peak counts exceeded 10 percent of regional populations. The Refuge supported

- 20,500 breeding white-faced ibises (35 percent of regional population in 1998);
- 7,782 breeding western and Clark's grebes (50 percent of the regional population in 1983);
- 4,090 breeding American white pelicans (15 percent of the regional population in 1988); and
- 1,730 breeding great egrets (77 percent of the regional population in 1983).

The Refuge also supports high numbers of breeding Franklin's gulls in good water years. The Refuge also supports very high numbers of sora, Virginia rails, American coots, and American bitterns.

Nesting populations fluctuate annually and quite dramatically depending on water levels and habitat conditions. Populations have disappeared during drought conditions and then rebounded with rising water levels. Populations such as white pelican (nesting on Malheur and Harney Lakes and in the Blitzen Valley) have moved as habitat conditions changed.

## Shorebirds

The Refuge provides vital habitat for a wide variety of shorebirds. Twenty-seven shorebird species are found on the Refuge during different seasons of the year. The most common migrant species are the western sandpiper, long-billed dowitcher, Wilson phalarope, American avocet, and common snipe. From 1990 to 1995, the Refuge participated in the Pacific Flyway Project (Ivey et al. 1995), a study coordinated by Point Reyes Bird Observatory. Shorebird numbers were counted each spring and fall when the migrating shorebirds were using the Refuge as a stopover site (Figure 4-1). Total peak numbers exceeded 20,000 individuals during migration. Using peak numbers of shorebirds counted along the Pacific coast as estimates of Pacific Flyway populations (Page et al. 1999), refuge uses were as follows: the western sandpiper peak was <0.5 percent of the Pacific Flyway population, the long-billed dowitcher peak was 4.4 percent, and the American avocet peak was 10.8 percent.

Malheur, Mud, Harney, and Stinking lakes provide most of the shorebird habitat on the Refuge and within the Harney Basin. Other important shorebird habitat on the Refuge can be found in the Double-O and Blitzen Valley units. Stinking Lake is an especially important shorebird use area. For example, Littlefield and Paullin (1976) documented 8,300 Wilson's phalaropes and 10,000 American avocets there on August 21, 1975. These birds were likely attracted to crustaceans and brine flies, which are abundant when saline playa lakes are at low levels and salts are concentrated. Breeding snowy plovers use Harney Lake and other refuge playas, and the Refuge supports over 400 breeding adults in good years.

## Raptors

Twenty-three species of raptors have been recorded on the Refuge. The recorded species consist of osprey, bald eagle, northern harrier, sharp-shinned hawk, cooper's hawk, northern goshawk, red-shouldered hawk, Swainson's hawk, red-tailed hawk, rough-legged hawk, golden eagle, American kestrel, merlin, peregrine falcon, prairie falcon, barn owl, flammulated owl, western screech-owl, great horned owl, burrowing owl, long-eared owl, short-eared owl, and northern saw-whet owl.

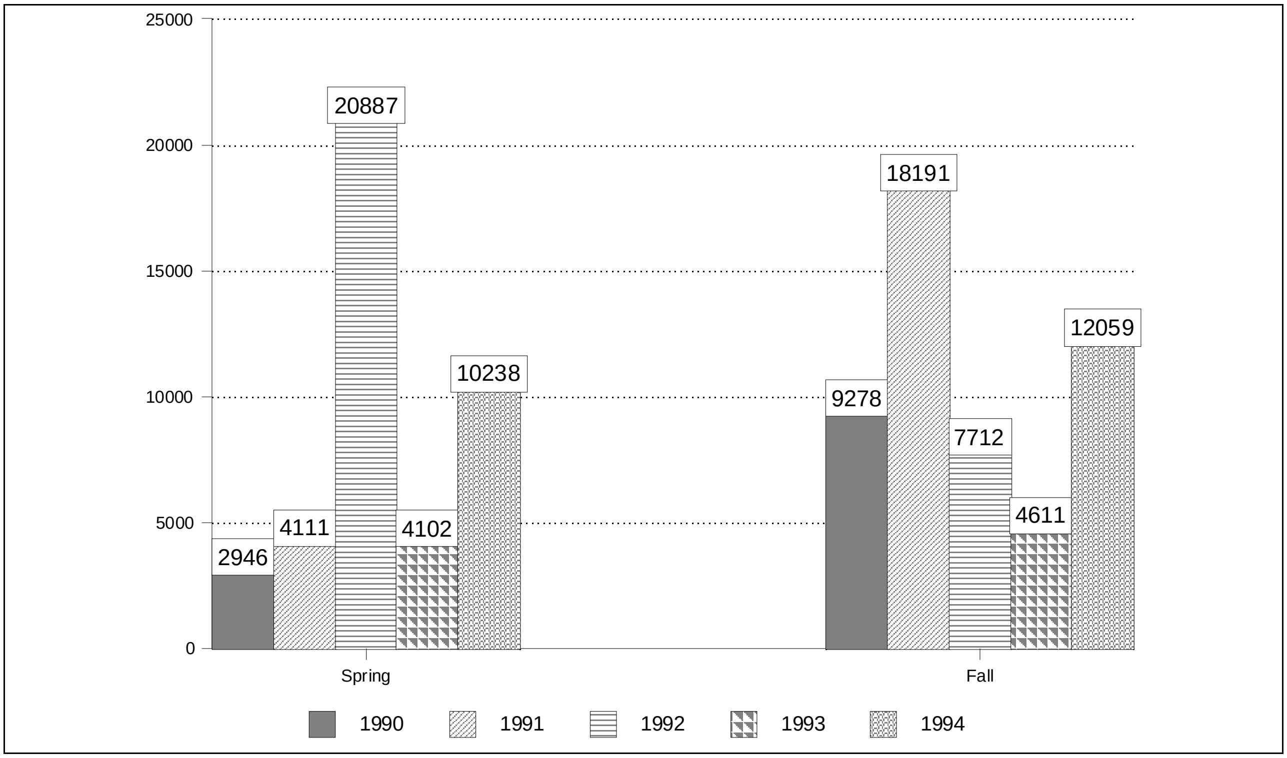


**Figure 4-1. Total shorebird numbers from counts conducted at Malheur National Wildlife Refuge during the Pacific Flyway Project, 1990-1994.**

### Passerines

The Refuge supports at least 130 species of passerines, many of them identified as priority species by the Oregon and Washington Partners in Flight (Altman and Homes 2000). Riparian-dependent priority species include willow flycatchers, yellow warblers, Bullock's orioles, and yellow-breasted chats. The Refuge also supports the largest local population of bobolinks in the western U.S. Passerine species found in the uplands include loggerhead shrike, sage sparrow, sage thrasher, black-throated sparrow, lark sparrow, and Brewer's sparrow.

### Other Birds

Thirty-four species of non-passerine birds are found on the Refuge, including five species of gulls, three species of hummingbird, and seven species of woodpecker.

## 4.4.2 Fisheries

### Native Fishes

The Harney Basin, because of historic connections with the Columbia River drainage, supports a fish fauna mirroring the native fishes of the Columbia, with a few species absent or undetected, before they disappeared. A diverse assemblage of native fishes inhabit the Refuge, including the Great Basin redband trout, bridge lip sucker, coarse scale sucker, chisel mouth, northern pikeminnow, red-sided shiner, mountain whitefish, longnose and speckled dace, and Malheur mottled sculpin. Of these species, redband trout and Malheur mottled sculpin are listed as Oregon State-sensitive species.

### Non-native Fish Species

A number of non-native fish are present in the Refuge's permanent wetlands, rivers, impoundments, and lakes. Introduced fish include common carp, green sunfish, largemouth bass, rainbow trout, bluegill, yellow bullhead, brown bullhead, black bullhead, mosquito fish, yellow perch, pumpkinseed, and white crappie. Many of the introduced species were stocked by the State of Oregon for recreational fisheries. Other species invaded the Refuge during flood events.

## 4.4.3 Other Wildlife and Plants

***Land Mammals:*** Fifty-eight species of mammals have been observed on the Refuge. The muskrat is the most conspicuous mammal in Malheur Lake and has an important influence on the marsh ecology. Like waterbird populations, numbers of muskrats fluctuate primarily in response to habitat conditions and, to a lesser extent, disease. The benefit of muskrats to a marsh results from their feeding and lodge-building activities. By cutting emergent vegetation for food, muskrats create an interspersed habitat more desirable for waterfowl than pure stands. Muskrat lodges provide attractive and productive nest sites for Canada geese and trumpeter swans.

Deer mice, montane voles, Great Basin pocket mice, and least chipmunks made up 91 percent of the small mammals captured between 1973 and 1975 (Feldhamer 1979). Other mammals include pronghorn, mule deer, beaver, raccoon, coyote, bobcat, mink, long-tailed weasel, bats, and black-tailed jackrabbit.

***Reptiles and Amphibians:*** The following amphibians occur on the Refuge: long-toed salamander; great basin spadefoot, pacific tree frog, western toad, Columbia spotted frog, and bullfrog.

The following reptiles occur on the Refuge: western fence lizard, sagebrush lizard, side blotched lizard, short-horned lizard, western skink, rubber boa, racer, striped whipsnake, gopher snake, common garter snake, western terrestrial garter snake, night snake, and western rattlesnake.

The following species occur near the Refuge, but no known specimens have been collected on the Refuge: collared lizard, leopard lizard, desert horned lizard, western whiptail, and western ground snake.

***Invertebrates:*** At least 54 species of butterflies and dragonflies occur on the Refuge. There is a great diversity of aquatic macroinvertebrates due to the diversity of aquatic habitats. No comprehensive list of these organisms exists for the Refuge.

# 4.5 Threatened, Endangered, and Sensitive Species

## 4.5.1 State or Federally Listed Species Known to Occur on the Refuge

One goal of the Refuge System is "To conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered." In the policy clarifying the mission of the Refuge System, it is stated, "We protect and manage candidate and proposed species to enhance their status and help preclude the need for listing" (16 U.S.C. 1531-1543; 87 Stat. 884).

In accordance with the above, the planning team considered all species with Federal or State status in the planning process. Table 4-13 lists species that are federally endangered, threatened, or candidate species and are known to occur on or near Malheur Refuge. A discussion of the federally listed candidate species follows the table in Section 4.5.2.

A total of 19 Federal species of concern (declining or in need of conservation) are known to occur or are likely to occur on the Refuge: least bittern, white-faced ibis, black tern, ferruginous hawk, burrowing owl, yellow-breasted chat, willow flycatcher, sage-grouse, mountain quail, Lewis' woodpecker, redband trout, fringed myotis, long-legged myotis, silver-haired bat, small-footed myotis, spotted bat, Townsend's big-eared bat, Yuma myotis, and Preble's shrew. Among this group the willow flycatcher and redband trout were selected as focal species whose requirements indicating the habitat parameters that would also support a large group of other species using these areas.

**Table 4-13. Federally Listed Species Known to Occur on or Adjacent to Malheur Refuge**

| Common Name | Scientific Name | Federal Status* | Current Occurrence on Refuge |
|---|---|---|---|
| Malheur wire-lettuce | *Stephanomeria malheurensis* | Endangered | Adjacent to Refuge |
| Great Basin Columbia spotted frog | *Rana luteiventris* | Candidate species | Page Springs, Mud Creek, Double-O Springs |
| Yellow-billed cuckoo | *Coccyzus americanus* | Candidate species | Occasional migrant according to historic records |
| Greater sage-grouse | *Centrocercus urophasianus* | Candidate species | Incidental and adjacent to Refuge |

## 4.5.2 Habitat Needs, Conditions, and Trends of Federally Listed, Proposed, or Candidate Species

***Malheur Wire-lettuce:*** This annual plant is not present on the Refuge but is located on public lands adjacent to the Refuge. It is found on top of a dry, broad hill on volcanic soil intermixed with layers of limestone. Dominant plants at the site are big sagebrush, gray rabbitbrush, green rabbitbrush, and cheatgrass. Malheur wire-lettuce may be one of the few species able to survive on and around the otherwise barren harvester ant hills at the site (USFWS 1991).

This plant is in great danger due to its small population size. Natural fluctuations in population numbers occur in response to variations in annual rainfall and spring frosts and are particularly problematic for small populations. Immediate threats include competition from cheatgrass and predation by native herbivores, such as black-tailed jackrabbits. Currently, there are no plans to introduce this species in appropriate refuge habitats. The Refuge is working closely with USFWS Ecological Services and other State and Federal agencies on the status of this plant.

***Great Basin Columbia Spotted Frog:*** The Columbian spotted frog consists of two distinct populations: the Northern and Great Basin populations. The Refuge is believed to have a population of the Great Basin distinct population segment (DPS) of the Columbia spotted frog. The Great Basin Columbia spotted frog is designated as a Federal candidate species for listing under the Endangered

Species Act. However, the geographic distribution of the Northern and Great Basin DPS Columbia spotted frogs overlap in eastern Oregon, quite possibly on the Refuge, given the available data. The Northern Columbia spotted frog is not designated as a Federal candidate species. Sporadic monitoring of spotted frogs has occurred for over two decades on the Refuge; however, refuge-wide species distribution and genetic analyses have yet to be completed. Known populations within the northwest portion of the Refuge appear to be geographically isolated from populations approximately 25 miles south within the Blitzen River watershed.

There are numerous threats to Columbia spotted frogs (e.g., habitat destruction, fragmentation and/or degradation of wetlands, non-native predatory species, fire and fire suppression, contaminants). The habitat present on the Refuge needs to be assessed to determine water for breeding, summer habitat, and winter refugia to aid in the conservation of the species. In addition, results from the assessment will assist Refuge management and biologists to understand the distribution of Columbia spotted frogs on the Refuge, help facilitate the development of an annual egg mass monitoring protocol, and identify the role the Refuge plays in Columbia spotted frog conservation.

***Yellow-billed Cuckoo:*** The yellow-billed cuckoo has been documented on the Refuge; however, no breeding has been recorded and cuckoo observations are considered accidental. Refuge sightings account for most of the recent sightings of the yellow-billed cuckoo in Oregon (USFWS 2008b).

The primary reason for the decline of the yellow-billed cuckoo west of the Rocky Mountains is loss of tall streamside habitat. They tend to prefer trees with extensive canopies, such as cottonwood, which are not abundant on Malheur Refuge.

***Greater Sage-grouse:*** This species is a rare user of the Refuge, but it uses public lands adjacent to the Refuge. Occasional sighting have been documented of sage-grouse watering on the East Canal during drought years. They have also occasionally been observed foraging in meadows at the northern end of the Double-O in late summer. Other uses have not been documented.

## 4.6 Invasive and Nuisance Species

### 4.6.1 Exotic and Invasive Plant Species

Invasive plant species infect and degrade many of the aquatic and terrestrial habitats on the Refuge. Some highly invasive species (e.g., pepperweed and reed canarygrass) can produce monotypic stands that completely displace native and desirable plant communities. These native communities are essential habitat that supports high-priority species and species groups on the Refuge (e.g., migratory birds). The Refuge’s overall strategy to manage invasive plants is to use an IPM approach. For IPM, mechanical, physical, biological, and chemical methods are used to control invasive plants as a basis for achieving desirable habitat conditions. Many factors affect efficacy of control efforts for invasive plants. Aerial spraying is limited because treated ditches typically cannot be charged soon after applications based upon pesticide label restrictions. For species with extensive infestations throughout the Refuge (e.g., pepperweed), the Refuge’s strategy involves containment to prevent spread to uninfested areas.

There are nine species of plants found adjacent to or on the Refuge (Table 4-14) which are classified by the Oregon Department of Agriculture as noxious weeds.

**Table 4-14. Oregon Department of Agriculture Noxious Weeds Found on or Adjacent to Malheur Refuge**

| Common Name | Scientific Name |
|---|---|
| Canada thistle | *Cirsium arvense* |
| Diffuse knapweed | *Centaurea diffusa* |
| Medusahead rye | *Taeniatherum caput-medusa* |
| Perennial pepperweed | *Lepidium latifolium* |
| Puncture vine | *Tribulus terestris* |
| Russian knapweed | *Acroptilon repens* |
| Salt cedar | *Tamarix ramosissima* |
| Scotch thistle | *Onopordum acanthium* |
| Whitetop | *Cardaria draba* |

The plants listed below are of the highest priority for the Refuge and are part of invasive species management.

***Perennial Pepperweed:*** Flooding during the mid-1980s initially spread pepperweed throughout the Refuge and adjacent private lands; subsequent drought (1988-1992) exacerbated this invasive plant problem. There are approximately 30,000 acres of perennial pepperweed infestation on the Refuge, likely because the water delivery system has spread seeds throughout the system. Pepperweed represents a significant threat to the Refuge's capability to meet refuge purposes and habitat management objectives, especially those related to migratory birds. Pepperweed infests and forms monotypic stands and displaces grass/shrub uplands, wet meadows, and riparian habitat that are used by breeding waterfowl, cranes, and landbirds. Because it infests meadows, it can jeopardize the Refuge's haying program, which provides short-grass habitat used by breeding aquatic migratory birds. Pepperweed also infests and compromises fire breaks. Moreover, areas disturbed during riparian restoration may become infested with pepperweed.

***Phragmites, Reed Canarygrass, and Other Undesirable Plant Species:*** Plants such as these are also displacing native/desirable species in marsh/meadow complexes. Based on habitat surveys, approximately 80 percent of the 60,000 wetland and meadow acres on the Refuge are infested to some degree with invasive plants. As a result, habitat quality for breeding migratory birds is declining relative to the degree of infestations.

***Russian Olive:*** This species spread across refuge lands around Malheur and Mud lakes during the floods of the 1980s.

## 4.6.2 Exotic Wildlife Species

Common carp are the most invasive and detrimental wildlife species that inhabits the Refuge. Carp first invaded the Refuge in the late 1930s or early 1940s. The Silvies River provided access to Malheur Lake, and carp migrated up the Blitzen River and invaded the wetlands of the Blitzen Valley. Carp invaded the Double-O Unit during the early 1950s when the natural sand dune barrier separating Malheur and Mud lakes was breached and allowed water and carp from Malheur and Mud lakes to enter Harney Lake. By the early 1960s carp had successfully invaded virtually all aquatic systems within the Refuge and surrounding private lands. Before carp invaded the Refuge, duck production averaged over 111,000 ducks annually in the 1940s and peaked at 147,000 ducks in 1948. After the carp population became established, duck production has averaged less than 30,000 annually (Ivey et al. 1998). Carp compete directly with waterfowl and waterbirds for aquatic invertebrates and vegetation, and their benthic foraging causes a detrimental decrease in water quality.

A small population of bullfrogs has established at the south end of the Blitzen Valley. This invasive species could be a threat to the Oregon spotted frog population because of predation or habitat competition.

# 4.7 Wildlife and Habitat Research, Inventory, and Monitoring

The Refuge has a long history of strong biological monitoring and research. Many projects are collaborative efforts between the Refuge and other Service programs, agencies, nongovernmental organizations, and universities.

## 4.7.1 Monitoring

Table 4-15 summarizes surveys conducted by refuge biological staff in the late 1990s. Due to changes in staff and budget cuts, many of these surveys were discontinued in the last decade.

**Table 4-15. Biological Surveys Conducted at Malheur Refuge during the Peak of Biological Monitoring in the Late 1990s**

| Survey Type | Survey Type |
|---|---|
| Mid-winter waterfowl survey (flight) | Migration waterfowl surveys (5 flights) |
| Muskrat house surveys | Raptor survey routes (4) |
| Read goose neck collars | Bald eagle roost counts |
| Use telemetry to scan for radio-marked waterfowl | Golden eagle nest survey |
| Crane pair survey | Water temperature monitoring (Hobotemps) |
| Goose pair survey | Monitor goose, duck and crane nest success |
| Predator survey | Neotropical migrant monitoring station (mist net; spring, fall) |
| Common raven roost surveys | Colonial waterbird surveys |
| North American migration count | Duck and waterbird pair survey |
| Dove coo count (2 routes) | Spotted frog surveys |
| Trumpeter swan production survey | Duck brood survey |
| Bobolink survey | Snowy plover survey |
| Upland habitat monitoring | Breeding bird survey routes (7) |

| Survey Type | Survey Type |
|---|---|
| Botulism monitoring | Aquatic plant surveys |
| Tule goose surveys | Fall crane use surveys |
| Fall crane survey for Pacific Flyway | 2 Christmas bird counts (Sodhouse, P Ranch) |

## 4.7.2 Refuge Research

Many research studies have been conducted at Malheur National Wildlife Refuge since the Refuge was established. Projects are listed below in chronological order and a complete copy is on file at Malheur Refuge library, summarized in the narratives or available as literature cited:

- Breeding Habits of the Canvasback, *Nyroca valisineria* (Wilson), on the Malheur National Wildlife Refuge (Erickson 1942).
- Relationship between Land-use Patterns and Waterfowl Production at Malheur National Wildlife Refuge, 1964 (Jarvis 1965).
- Breeding Biology of Greater Sandhill Cranes on Malheur National Wildlife Refuge, Oregon (Littlefield 1968; Littlefield and Ryder 1968).
- Color Marking of Greater Sandhill Cranes on Malheur Refuge, Oregon. The study is ongoing and was initiated by Carroll Littlefield in the late 1960s. The objective of this study is to color mark greater sandhill cranes and monitor their movements and life history. Marking these birds helps document effects of land use practices on cranes breeding at Malheur Refuge and assess their migration and wintering movements, annual productivity, and behavior.
- Land-use Patterns and Duck Production at Malheur National Wildlife Refuge (Jarvis and Harris 1971).
- Distribution and Survival of Mallards Banded at Malheur National Wildlife Refuge (Jarvis and Furniss 1978).
- Productivity of Greater Sandhill Cranes on Malheur National Wildlife Refuge, Oregon (Littlefield 1976).
- An Ecological Study of the Common Raven (*Corvus corax*) at Malheur NWR and its Effects on the Nesting Success of Selected Waterfowl (Stiehl 1976, 1985; Stiehl and Trautwein 1991).
- Factors Affecting the Ecology of Small Mammals on Malheur National Wildlife Refuge (Feldhamer 1977).
- Effects of Experimental Management Schemes on Production and Nesting Ecology of Ducks at Malheur National Wildlife Refuge (Clark 1977). This is a duck nesting ecology study.
- The Breeding Biology of an Isolated Bobolink Population in Oregon (Wittenberger 1978).
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- Future Management of Malheur Lake Marsh: Recommendations of the Technical Advisory Committee (Summerfelt et al. 1980).
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- Habitat Definition of Nesting Birds in the Double-O Unit, Malheur National Wildlife Refuge (Foster 1985).
- Fire Ecology and Management in Plant Communities of Malheur National Wildlife Refuge Southeastern Oregon (Young 1986).
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- A Summary of Trumpeter Swan Production on Malheur National Wildlife Refuge, Oregon (Cornely et al. 1985).
- Autumn Sandhill Crane Habitat Use in Southeast Oregon (Littlefield 1986).
- The Re-establishment of American White Pelican Nesting in the Malheur-Harney Lakes Basin, Oregon (Paullin et al. 1988).
- Effects of Land Management on Nesting Success of Sandhill Cranes in Oregon (Littlefield and Paullin 1990).
- Rough-legged Hawk Habitat Selection in Relation to Livestock Grazing on Malheur National Wildlife Refuge, Oregon (Littlefield et al. 1992).
- Nests and Eggs of Colonial Birds Nesting in Malheur Lake, Oregon, with Notes on DDE (Cornely et al. 1993).
- Population Trends of Small Mammals on Malheur Refuge, Oregon. This study was initiated in 1986 by Dr. David Kerley of Eastern Oregon State College at La Grande. The purpose is to monitor long-term trends in small mammal populations in Great Basin sagebrush and greasewood shrub communities. Field work only. No report.
- Environmental Contaminants and Reproductive Success of Waterfowl, Stilts, and Coots at Malheur Refuge. This study was initiated by Dr. Charles Henny, of Patuxent Wildlife Research Center, Pacific Northwest Field Station, to investigate levels of contaminants in eggs of selected wetland species and to determine if contaminants were impacting production in these species. Field work only. No report.
- Willow Flycatcher Reproductive Success, Population Dynamics, and Habitat Relationships. Jim Sedgwick of the National Ecology Research Center initiated this study in 1988. The study is designed to examine the extent and causes of variation in reproductive success and the survival, productivity, and habitat relationships of willow flycatchers at Malheur Refuge. Site tenacity, as related to reproductive success and habitat quality, predation, parasitism by brown-headed cowbirds, and environmental (habitat) correlates of reproductive success receive special attention. Field work only. No report.
- Recovery of Vegetation at Malheur Lake Following Extensive Flooding (Spencer 1994).
- Overview of Shorebird Abundance and Distribution in Wetlands of the Pacific Coast of the Contiguous United States. From 1990 to 1995, refuge staff participated in the Pacific Flyway project, a study coordinated by Point Reyes Bird Observatory (see Page et al. 1999). One count of Malheur, Mud, and Harney lakes was conducted each spring and fall using airboats.
- Archaeological and Geomorphic Investigations of Prehistoric Sites on Malheur Lake. This study, conducted by Intermountain Research of Silver City, Nevada, examines the

relationship of archaeological sites and the geomorphic processes that have shaped the landforms on Malheur, Mud, and Harney lakes. (Raven and Elston 1992)

- A Radio-telemetry Study to Identify Sandhill Crane Colt Mortality Factors. In 1991, a radio-telemetry study was initiated by Gary Ivey to determine causes of crane colt mortality. This study continued through 1998 to provide data for better management of sandhill cranes on the Refuge. Field work only. No report.
- Breeding Biology of Eared Grebes at Malheur National Wildlife Refuge. This study was conducted by Dr. Wendy Hill of Lafayette College in Pennsylvania. She studied two eared grebe colonies, one at Boca Lake and the other near the mouth of the Blitzen River in Malheur Lake. (Hill et al. 1997).
- Use of Integrated Pest Management to Restore Meadows Infested with Perennial Pepperweed at Malheur National Wildlife Refuge (Kilbride et al. 1997).
- Roaring Springs Ranch Riparian Bird Monitoring. A study to determine occurrence and abundance of riparian-dependent songbirds was initiated by refuge biologists on Roaring Springs Ranch. The Ranch signed a cooperative agreement with the Refuge and BLM regarding grazing practices along streams on their property and adjacent Federal land. This study was designed to monitor bird species during the breeding season to note changes in bird populations as the riparian zone along these creeks recovers.
- Eastern Kingbird Study. From 2001 to 2010, Malheur Refuge has been the site of eastern kingbird studies that have shown a decline in the Malheur Refuge's kingbird population along with an increase in the population of American crows. Field work only. No report.
- Establishing Native Plants in Crested Wheatgrass Stands Using Successional Management (Fansler and Mangold 2007). Field work only. No report.
- Factors Influencing Nest Success of Greater Sandhill Cranes at Malheur National Wildlife Refuge, Oregon (Ivey and Dugger 2008)
- Geomorphic History and Current Channel Condition of the Donner und Blitzen River, Malheur National Wildlife Refuge, Oregon (Salant et al. 2010).
- Migratory Behavior and Passage of Redband Trout (*Oncorhynchus mykiss*) in the Donner und Blitzen River, Oregon (Anderson 2009).

## 4.8 Paleontological Resources

Paleontological resources, also known as fossils, are the remains or traces of prehistoric plant and animal life that are found in the geologic formations in which they were originally buried. At Malheur Refuge fossils are found within volcanic ash deposits on the Refuge dating from the Pleistocene epoch (2.6 million to 11,700 years ago). Fossilized remains (vertebrae) of a camel-like species have been recovered from the site. The site may also contain additional fauna and flora, but other than a cursory examination by a paleontologist from the John Fossil Beds National Monument, there has not been any scientific investigation of the site. The site has regional importance as it encompasses a period of geologic time that has not been found elsewhere in eastern Oregon. Paleontological resources are considered to be nonrenewable, sensitive, scientific, and educational resources and are protected by the Paleontological Resource Preservation Act (P.L. 111-011 2009).

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*Visitors birding*
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# Chapter 5 Human Environment


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Maps
Appendices

This chapter covers topics and the current status (as of 2011) of programs associated with the human environment. This includes cultural resources and history; infrastructure and administrative facilities; and programs associated with wildlife-dependent recreational uses (the "Big Six"): wildlife observation, wildlife/nature photography, interpretation, environmental education, hunting, and fishing. Other related activities, such as non-priority uses, illegal uses, and area outdoor recreational opportunities and trends are also included. Some of the facilities and wildlife-dependent recreational uses are shown on Map 3a. Finally, the chapter also includes socioeconomic data for local, regional, and State areas.

Note that some program offerings, areas open, and facilities available will change under the management direction described in Chapter 2. This chapter is a complete description of the current management situation as it stands in 2011.

# 5.1 Cultural Resources

Archaeological and other cultural resources are important components of our nation's heritage. The Service is committed to protecting valuable evidence of plant, animal, and human interactions with each other and the landscape over time. This may include previously recorded or undocumented historic, cultural, archaeological, and paleontological resources as well as traditional cultural properties and the historic built environment. Protection of cultural resources is legally mandated under numerous Federal laws and regulations. Foremost among these are the National Historic Preservation Act (NHPA) as amended, the Antiquities Act, the Historic Sites Act, the Archaeological Resources Protection Act (ARPA) as amended, and the Native American Graves Protection and Repatriation Act (NAGPRA). The Service's Native American Policy (1994) articulates the general principles guiding the Service's relationships with tribal governments in the conservation of fish and wildlife resources. Additionally, refuges seek to maintain a working relationship and consult on a regular basis with the tribes that are or were traditionally tied to lands and waters within refuges.

This cultural history provides an overview of the known archaeological, ethnographic, and historical uses of Malheur National Wildlife Refuge.

## 5.1.1 Native American Overview

### General Prehistory of the Harney Basin

The profusion of wildlife and plants found in the Harney Basin provided Native Americans with an abundance of food and resources for over 11,000 years. Use of the area was greatly influenced by climatic changes, some lasting one or two centuries. In turn, these changes altered the range of plants across the basin, influencing both wildlife and human use. In particular, the archaeological record documents how cyclical fluctuations of water levels have dictated the types of resources available in the wetlands and have affected human settlement and resource-gathering patterns.

Archaeological research shows that people were using the area now managed by the Refuge by 9,800 years ago. At that time, the Harney Basin contained a huge lake that covered 255,000 acres. These early inhabitants used plants and animals found along the edge of this vast lake and in the surrounding uplands. Hunters used spears to hunt large game animals. Ground stone tools used to process plants, such as grass seeds and roots, have been found from this period, but are not abundant and suggest that plant foods were not as highly processed as in later periods. Abundant plant resources also meant that materials used to fashion baskets were readily available. It is around this time that twined bags, mats, burden baskets, and trays begin to appear in the archaeological record of the Northern Great Basin (Adovasio 1986).

The climate then became progressively drier, lowering lake levels (Wigand 1987). The shallower lake meant that the marsh covering Malheur Lake actually increased in size and supported more plants and wildlife. Eventually the dry climate caused the marsh to shrink and then disappear, limiting the resources available to both people and wildlife. Evidence of Native American use of the immediate area decreases as the climate became drier, and the inhabitants of the area focused their activities around higher elevation springs (Fagan 1973). Stone tools show that animals continue to be hunted in the area, and there is a gradual change from the use of spears to the atlatl and dart. The atlatl consists of a piece of wood shaped with a handle on one end and a hook on the other end. It is used to hurl a light spear (dart) through the air with more accuracy than that of a hand-thrown spear.

Use of the Refuge increases around 6,000 years ago, when climatic conditions became wetter and marsh resources increased. The first documented use of the spring at Refuge Headquarters begins at this time and continues into the historic period (Aikens and Greenspan 1988; Raven and Elston 1992). Inhabitants of the Headquarters site were fishing for tui chub, suckers, and squawfish, and were hunting ducks, antelope, mountain sheep, coyote, muskrat, and bison. It is during this time period that the historical pattern of seasonal movements to resource areas becomes more apparent in the prehistoric record.

Small villages appear along the edge of the lakes, the Blitzen Valley marshes, and the Donner und Blitzen River around 3,500 years ago. These sites include either stone ring structures or house pits. Three sites excavated in the Blitzen Valley show increased use of marsh and river resources, and a stable way of life. At one of these early villages, rabbit, fish, and large game animals were being eaten; grass and juniper seeds were being harvested; and conifer and sagebrush were being used to fuel fires (Musil 1990, 1991). Unfortunately, the inhabitants of this village were forced to abandon their homes when volcanic cinders from an eruption at Diamond Craters blanketed the landscape.

Projectile point styles indicate that the bow and arrow was being used by 2,500 years ago. This new technology greatly increased a hunter’s accuracy. Modifications to arrows included blunting the end so waterfowl could be hunted with the bow and arrow. Before the introduction of the bow and arrow, waterfowl hunting was limited to capturing ducks and coots in long twined nets strung across narrow areas of the marsh. Large numbers of birds could be herded into the nets in the late summer when they molted their flight feathers.

Around 1,400 years ago, the lakes and marshes shrank again as a drought hit the area (Wigand 1987). Smaller wetlands meant fewer resources for people, so they used the area less. The subsequent return of moist conditions brought an abundance of lake, marsh, and upland resources—and people. As resources increased, so did the number of sites around the lakes, in the Double-O area and in the Blitzen Valley. This may be the period of most intensive use of resources in the basin.

Geomorphic data from the Headquarters site suggests that the lake rose significantly 1,050 years ago and again flowed into the Malheur River for a short time before it shrank to its current size (Dugas 1996). This rise in lake levels forced the inhabitants of the area to move to higher ground around the lakes including shorelines created during older high lake stands. As the lake grew deeper the size of the marsh decreased when the water became too deep to support marsh plants. Conversely, as water levels decreased, a greater abundance of marsh resources again became available for humans and wildlife.

But the cycle of wet and dry was to continue. A drought around 700 years ago and then another around 500 years ago again briefly limited the resources available to inhabitants of the basin. As conditions improved**,** people increased their use of the area, living in stone ring villages in the valley or house pits on the lakes. At the Headquarters site, a cache pit filled with seeds from wapato (Indian potato), bulrush, and goosefoot attests to the harvest of important plant foods around 400 years ago (Raven and Elston 1992). The presence of the cached seeds suggests that the site was occupied continuously for several years. Fish bones were found in two fire hearths from this time period, as well as charred sagebrush and willow.

Mat-covered shelters, known as wickiups, have been documented during this late period. In historic times these structures were used from late spring through early fall as the Northern Paiute Indians moved to different resource areas to harvest plants and animals. Of particular interest during this late occupation of the basin is the harvest of tui chub at Harney Lake, where roasting pits and garbage piles filled with thousands of fish bones have been excavated. All of similar size, the tui chub were caught in gill nets and then roasted, which preserved them for long-term storage (Raymond 1994).

Burns Paiute elders recall the continuation of a seasonal round into historic times. They talk about gathering plants, hunting, and fishing as foods became abundant in the rivers, lakes, marshlands, and uplands of the Harney Basin. Spring was a time for gathering roots and fish, which they dried and stored away. Tui chub were harvested in Harney and Malheur lakes, and salmon were procured from the Malheur River (Burns Paiute Tribe; Couture 1978; Soucie n.d.).

In the summer they traveled around their territory, gathering seeds and berries and hunting game. In the autumn, they harvested the tiny black seeds of wada (*Sueda depressa*), a plant that grows along the shores of Harney Basin lakes. (The term Wada'Tika [the Paiute name for the Burns Paiute Tribe] refers to the Paiutes living in the Harney Basin and literally means "wada eaters.") Fall was also a time for hunting waterfowl, jackrabbit, bighorn sheep, and antelope. Families came together in the fall for communal antelope and rabbit drives. Fall was also an important time for collection of plant materials to be used for manufacture of sandals, baskets, and clothing during the winter (Burns Paiute Tribe; Couture 1978; Soucie n.d.).

During the winter they retrieved their supplies of dried food and erected houses of tule (bulrush) mats near springs in the wetlands around Malheur, Mud, and Harney lakes. While the rest of their territory lay frozen, the wetlands offered fresh plants, waterfowl, and mammals to supplement their stored food (Burns Paiute Tribe; Couture 1978; Soucie n.d.).

Many of these important resources are still harvested today by the Burns Paiute Tribe at a variety of locations in the basin. Members of the Tribe continue to harvest important plants on the Refuge as they seek to sustain and share their cultural traditions of basket weaving, and tule mat and duck decoy construction with tribal youth.

## 5.1.2 Euro-American Overview

### Fur Trapping Expedition

In 1826 French-Canadian fur trapper Peter Skene Ogden led a large expedition of trappers from the Hudson's Bay Company into the Harney Basin. The fur trappers were looking for beaver, river otter, and other fur-bearing animals. On November 1, 1826, as Ogden reached the north side of Malheur Lake, he described the lake portion of the Refuge, including the separation of Harney and Mud lakes by the large lunette dune and the salty nature of the water in both lakes. He also described in very brief detail the shrub component surrounding the lakes and mentioned the presence of bison skulls on the surface (Elliott 1909).

Ogden and his company of trappers remained on the north side of the lakes. However, had they gone to the south side of Malheur Lake, they would have found fresh water at the spring near today's Refuge Headquarters and the abundant plant and animal resources of the Blitzen Valley.

During their late fall arrival, they encountered Northern Paiute Indians camped along the shore of the lakes. The Hudson's Bay Company frequently expected local tribes to supply food for their large expedition groups. Unfortunately, the Paiutes were entering the winter season after a very unproductive summer and were unable to help the explorers with food.

On November 3, Ogden documents his company's hardships and provides a description of the Paiutes and their small villages (Elliott 1909). He also describes the hardships the Indians were enduring because of a lack of food:

> *From 4 a.m. snow has fallen. This will make it difficult for my 2 express men from Ft. Vancouver to find our tracks though every precaution was taken making marks at different camps; if only the Indians do not destroy these marks. It is incredible the number of Indians in this quarter. We cannot go 10 yds. without finding them. Huts generally of grass of a size to hold 6 or 8 persons. No Indian nation so numerous as these in all North America. I include both Upper and Lower Snakes … They lead a most wandering life. An old woman camped with us the other night; and her information I have found most correct. From the severe weather last year, her people were reduced for want of food … Unfortunate creatures what privations you are doomed to endure; what an example for us at present reduced to one meal a day, how loudly and grievously we complain; when I consider the Snake sufferings compared to our own! Many a day they pass without food and without a murmur. Had they arms and ammunition they might resort to buffalo; but without this region the war tribes would soon destroy them. This country is bare of beaver to enable them to procure arms. Indian traders cannot afford to supply them free. Before this happens a wonderful change must happen. One of Mr. McKay's party was sent back to request us to raise camp and follow his tracks. A chain of lakes [most likely the springs in the Double-O area] was all they had seen, no game. Truly, gloomy are our prospects* (Laut 1905).

The lack of available food and a scarcity of fur-bearing animals around the lakes led Ogden to write the name "Malheur," the French word for misfortune, on his maps of the area. From that time on, the area would be identified as Malheur Lake. Ogden mistakenly believed the lake was connected with the Malheur River, thus providing the river with its name. It would be nearly 20 years before the next significant presence of Euro-Americans in the Basin.

## Wagon Trains

The 1845 Meeks Wagon Train represented the next major entry of non-natives into the area. Convinced by Stephen Meek, who claimed that he knew a shorter route to the Willamette Valley, nearly 800 pioneers followed Meek across Oregon's high desert. As the wagon train entered the Harney Basin, their primary concerns were finding water and feed for their livestock. Water and grass had not been particularly abundant since the wagon train turned off the established Oregon Trail, and livestock were beginning to suffer. Under the direction of Meek, they arrived in the northern portion of the Harney Basin and then, in search of water, detoured south to the lakes. They camped along Malheur and Harney lakes but found that the water, because of its alkaline nature, was not fit for humans or animals. The ill-fated wagon train eventually made their way to The Dalles, but not before suffering from the deprivations of the high desert. In his diary, Eli Casey Cooley (Cooley and Cooley 2004) talks about the wagon train's entrance into the Harney Basin and their travels along the north side of the lakes to Silver Creek, where they encountered the first potable water after leaving the Silvies River.

In September 1853, the "Lost Wagon Train" led by Elijah Elliot, seeking a shorter route to the Willamette Valley, followed the route of the Meeks Wagon Train into the Harney Basin. Upon entering the Basin, Elliot decided to detour around the south side of Malheur Lake, where the group encountered marshy areas that were difficult to traverse. The wagon train forded the Blitzen River and, in doing so, left behind one of the most reliable sources of fresh water in the area. The wagon train continued around Mud and Harney lakes until they reached the springs in the Double-O area. Many members of the wagon train believed they were hopelessly lost, but riders from Central Oregon eventually located the wagon train many miles west of the Double-O area and led them to safety (Bassett et al. 1998; Gibson n.d.).

## Military Expeditions

Various military expeditions ventured into the area in the late 1850s, and several military camps were established in the Harney Basin in the 1860s, including a camp near the tip of Wrights Point and another at Fort Harney. Many local landmarks received their names during these expeditions. Harney Lake received its name in 1859 in honor of General William S. Harney after he ordered an expedition through the basin in search of a reliable route to the Snake River. Steens Mountain is named after Major Enoch Steen, who led an expedition to survey a military road through the area in 1860.

Many early bird observations were recorded in military journals from these expeditions. The first published descriptions of waterfowl and wildlife in the area occurred in 1874, when Captain Charles Bendire wrote about the birds found in the vicinity of Malheur Lake (Bendire 1875-1976). Bendire made additional observations about pelican nests on islands in Malheur Lake, as well as a large cormorant colony and Western gull and Forster's tern colonies. This information would later attract feather hunters to the area and eventually bring about the establishment of the Refuge.

## Ranching in the Blitzen Valley

It took 10 years after passage of the 1862 Homestead Act for settlers to arrive in the Blitzen Valley. Dr. Hugh Glenn of California took advantage of the Act to begin building a vast cattle empire in southeastern Oregon. In 1872 he sent Peter French with 1,200 head of cattle, six vaqueros, and a cook to Oregon. French used the Act to claim 160 acres at the south end of the Blitzen Valley for his boss. Using this as headquarters for the ranch he managed for Glenn, French continued to acquire land over the next 25 years using not only the Homestead Act, but also the Swamp Land and Desert Acts. French eventually managed a ranch that encompassed more than 140,000 acres including the Blitzen, Diamond, and Catlow valleys.

Under each of the Acts, applicants were required to make “improvements” to the land for agricultural purposes; this could include improvements for livestock grazing. As a result of these stipulations, the Blitzen Valley and surrounding areas underwent a transformation from the more natural conditions attributed to pre-European contact to the highly altered landscape of today. Roads were constructed; water was directed into ditches to drain or irrigate areas; streams were impounded to control the direction and velocity of flow; meadows were hayed; and uplands were grazed.

After French’s death in 1897, the ranch was managed as the French-Glenn Livestock Company until debts forced the sale of land in 1907 to Henry L. Corbett and C.E.S. Wood of Portland. They formed the Blitzen Valley Land Company under the management of area rancher William Hanley. The goal of the company was to restore the property to a successful working ranch. To accomplish this, the company needed to improve water distribution in the valley. Between 1907 and 1913, the company channelized 17½ miles of the Donner und Blitzen River to improve drainage of adjacent wetlands. They also authorized the construction of 8 miles of the Busse Ditch and 4 miles of the Stubblefield Ditch to improve distribution of water in the north end of the valley.

In 1916, the company was reorganized as the Eastern Oregon Livestock Company (EOLC). Louis Swift of the Swift Packing Company of Chicago purchased 46 percent of the company under this reorganization. The construction of a Union Pacific rail line from Ontario to Crane in 1916 made shipping livestock to market easier. Swift was interested in the thousands of feral pigs in the Blitzen Valley, as well as the cattle raised on the ranch. Under his direction the pigs were rounded up and herded to Crane, where they were loaded on stock cars and transported to his Chicago meatpacking plant.

In 1920, the company established the Blitzen River Reclamation District. Tracts of 160 acres were laid out and leased in a sharecropping arrangement. Several dairies were established on these tracts, and the EOLC used the railroad at Crane as a venue for shipping dairy products out of the county. The EOLC also established a hotel and store at Frenchglen in the mid-1920s. In 1918, an irrigation ditch was constructed from Page Springs along the west side of the valley to what is now known as Krumbo Lane. In 1928, Swift bought out Corbett’s controlling shares in the company and owned the ranch until 1935 when he sold it to the U.S. Government.

### Settling the South Side of Malheur Lake

Sometime after Bendire’s 1874 spring ornithology visit to the south side of Malheur Lake, Peter Stenger began using the area for summer livestock grazing. He constructed a small sod structure for shelter at the location of today’s Refuge Headquarters. This “sod house” provided intermittent shelter over the years and was used to describe the area from that time onward.

Eventually Peter French expanded the French-Glenn Livestock Company holdings to the south side of Malheur Lake. He established a sub-headquarters at Sod House Ranch to maintain control of land at the north end of the ranch. Continued expansion of the ranch eventually created conflicts between homesteaders on Malheur Lake and the ranch. As the ranch expanded northward in the 1880s, more and more water was diverted from the Donner und Blitzen River via in-stream impoundments to irrigate hay meadows, and water was also being diverted along the Silvies River. This resulted in diminishing quantities of water reaching Malheur Lake and a corresponding change in the high meander line of the lake. The ranch claimed ownership of all land up to the high meander line, but with diminished lake levels the area between the former high meander line and the actual lake was undefined. Settlers claimed it was new public domain land available for settlement, but the ranch claimed it was just an extension of their original riparian claim. The State of Oregon claimed that the land belonged to them under the provisions of the Swamp Land Act.

By the late 1880s settlers were building shacks on any available high spot on this newly exposed land. They farmed and grazed the adjacent ground until water levels became too high, but eventually water levels would decrease and they were in business again. Eventually French was pressured into filing lawsuits against “squatters” on the south side of the lake by Glenn’s heirs. While the lawsuits worked their way through the court system, the settlers became increasingly hostile toward French and the ranch holdings. Fences were cut and stores of winter hay were burned by angry settlers. Eventually these hostilities culminated in the death of Peter French. On December 26, 1897, French was shot by Ed Oliver, one of the homesteaders, while he was moving cattle near Sod House Ranch. Oliver was eventually acquitted of murder.

French’s demise did not end the conflict. Settler Sarah Marshall won her case against the French-Glenn Livestock Company, when appeals in the case reached the U.S. Supreme Court. The Court ruled in 1901 that the lands were not part of the Company’s original claim based on their riparian rights, and awarded the property to Marshall as a claim on the public domain. This decision by the Court also gave the President a legal basis for declaring unclaimed land around the lakes federal property, thus providing an opportunity for establishment of the Refuge 7 years later.

## A Ranch on the West Side of Harney Lake

In 1875, the partnership of Amos W. Riley, Colonel James A. Hardin, and John Taylor established a ranch on the west side of Harney Lake. Already owners of extensive holdings in Nevada, they claimed the springs at today’s Double-O Ranch, as well as the area around the outlet of Silver Creek at Harney Lake and land bordering Silver Creek, as part of their Oregon ranch. Centered on the productive springs of the Warm Springs Valley, cattle from the ranch had access to plentiful native grasses and reliable water.

The Double-O Ranch was seriously impacted in 1878 during a raid led by Bannock Indians. The ranch had been abandoned as the crew fled to Fort Harney for protection. All of the buildings at the ranch were destroyed and most of the ranch’s cattle and horses were herded west to the Wagontire area where they were slaughtered. Reconstruction began immediately, and the ranch recovered to become the third largest ranch in Harney County.

In 1890, Taylor dropped out as a partner and Hardin sold his half interest in 1892 to Riley. Beginning with a mere 1,200 acres, the ranch grew to over 8,600 acres before being sold to William Hanley in 1903. Hanley combined the Double-O property with his larger Bell-A Ranch holdings, creating the second largest cattle operation in Harney County.

In 1909, irrigation ditches were constructed from the springs to various areas of the ranch. With the addition of irrigation water, the ranch grew ample amounts of winter feed for ranch livestock and for sale to neighboring ranches. Many of these irrigation ditches are still used today to move spring water and Silver Creek water around the Double-O Unit.

When Hanley died in 1933, his wife, Clara, continued operation of the ranch. The deepening nationwide depression and the ongoing drought forced reductions in the number of cattle the land could support. Mrs. Hanley sold 14,751 acres of the Double-O area to the U.S. Government in 1941 for $116,143, and the land was added to the Refuge.

## Plume Hunters

In the late 1880s, plume hunters were decimating North American bird populations in the name of fashion. The hunters were collecting breeding feathers for the hat industry, where the latest fad included wearing part or all of a bird on ladies hats. Shorebirds and colonial nesting birds suffered the most as hunters targeted large flocks, injuring birds indiscriminately and orphaning chicks. In an era when an ounce of breeding feathers was worth more than an ounce of gold, it’s not surprising that plume hunters sought to make a fortune by hunting birds on Malheur Lake.

On a trip to Harney County in 1908 to photograph nesting white herons (later renamed great egrets) on Malheur Lake, wildlife photographers William L. Finley and Herman T. Bohlman learned that most of the white herons had been killed in 1898 by plume hunters (Finley 1910). After 10 years the white heron population had still not recovered.

Outraged by their observations, they presented the situation to fellow members of the Oregon Audubon Society. Facing similar circumstances at Klamath Marsh, the Society pushed for designation of both areas as wildlife refuges. As President of the Society, Finley approached President Theodore Roosevelt with the proposal. Already familiar with Finley and Bohlman because of their involvement in the establishment of Three Arch Rocks Refuge in 1907 on the Oregon Coast, Roosevelt was amenable to Finley’s proposal.

The Lake Malheur Reservation was established on August 18, 1908, by executive order of President Theodore Roosevelt. Roosevelt set aside unclaimed government lands encompassed by Malheur, Mud, and Harney lakes “as a preserve and breeding ground for native birds.” The newly established “Lake Malheur Reservation” was the nineteenth of 51 wildlife refuges created by Roosevelt during his tenure as president. At the time, Malheur was the third refuge in Oregon and one of only six refuges west of the Mississippi.

## Managing the New Bird Reservation

Management of the new Lake Malheur Reservation was given to the Department of Agriculture’s Bureau of Biological Survey. Oversight was provided by the Washington D.C. Office, but the Reservation remained unstaffed until 1911. In 1910, the Oregon Fish and Game Commission was created to oversee hunting and trapping in the state. In 1911 William L. Finley, one of the main proponents for establishing the Refuge, was appointed State Game Warden. Concerned about the continuing illegal activities on the new bird reservations, Finley appointed state game wardens to enforce the no-hunting ban and to monitor trapping activities at the Malheur and Klamath Marsh Reservations. The new game wardens were paid by the Bureau of Biological Survey, but were selected by the State Game Commission and enforced state game laws.

The drought years of the 1930s would also have a profound effect on the bird reservation. Lake levels shrank with the decrease in flows from the rivers and creeks that fed the lakes. Without a permanent fence around the bird reservation, the Refuge game warden, George Benson, was tasked with keeping adjacent land owners from using lands within the reservation for agricultural purposes. His log books and letters to his supervisors document his frustrations with the new task facing him. Resolution did not come until the Blitzen Valley was added to the bird reservation.

William L. Finley again played an integral part in the purchase of the Blitzen Valley as an addition to the reservation. Finley worked closely with J.N. "Ding" Darling, Chief of the Bureau of Biological Survey at the time, and later with Ira Gabrielson, first Director of the U.S. Fish and Wildlife Service (USFWS), to purchase the Valley. The purchase would include acquiring the water rights held by the ranch for waters flowing from Steens Mountain. Control of the river would allow the reservation to restore water to the lakes by releasing water held behind ranch dams.

The 64,717-acre Blitzen Valley portion of the Refuge was acquired from the Eastern Oregon Land and Livestock Company for $675,000 in 1935 using funds designated for national unemployment relief (e.g., the Civilian Conservation Corps [CCC]) and added to the Lake Malheur Reservation under an executive order signed by President Franklin D. Roosevelt. The order specified that the land was for use "as a refuge and breeding ground for migratory birds and other wildlife." At the same time, the name of the reserve was changed to Malheur Migratory Bird Refuge. With the addition of the Blitzen Valley, the Refuge grew to encompass 146,503 acres of habitat for native birds and other wildlife.

The Bureau of Biological Survey continued managing the Refuge, and George Benson remained the Refuge Protector. However, Refuge Superintendent Stanley Jewett was appointed to oversee all aspects of Refuge development. Jewett's first priority was to establish CCC camps on the Refuge to begin working on Refuge projects, including construction of a boundary fence around the Refuge.

In 1940, the Migratory Bird Refuge was renamed Malheur National Wildlife Refuge after the Bureau of Biological Survey was combined with the Bureau of Fisheries in 1939 to become the U.S. Fish and Wildlife Service.

## Civilian Conservation Corps

The Great Depression severely impacted the country, with economic turmoil and rampant unemployment throughout the nation. In an effort to revive America, President Franklin Delano Roosevelt in 1933 created the CCC. This action would ultimately have a profound effect on Malheur Refuge.

Roosevelt's plan was to recruit thousands of unemployed young men, enroll them in a peacetime army, and send them to do battle (or to wage war) against destruction and erosion of our natural resources. This young, inexperienced, $30-a-month labor force met and exceeded all expectations. Enrollee families received $25.00 of the enrollee's monthly wage. The economic boost provided by this money was felt in cities and towns all across the nation. Between 1933 and 1942 three million young men worked on CCC projects across the United States; more than 1,000 young men would complete projects during this time at Malheur Refuge.

With the purchase of the Blitzen Valley portion of the Eastern Oregon Land and Livestock Company holdings, the Refuge became an ideal location for CCC projects (CCC 1935-1942), hosting three

CCC camps. A seasonal camp was built near today's Refuge Headquarters during the spring and summer of 1935. The first permanent camp was established at Buena Vista Station in October 1935. Large camps were located at Refuge Headquarters, Buena Vista Station, and Five Mile Lane, north of Frenchglen. A small side camp was set up at Ewing Springs on Malheur National Forest to cut timber for work projects on the Refuge. The last camp was closed in 1942 with the start of World War II. Little evidence remains of the camps, as the wood buildings associated with the camps were dismantled by the army and moved to Alaska to serve as barracks during construction of the Alaskan Highway.

In communities close to the camps, local purchases averaging about $5,000 monthly staved off the failure of many small businesses. Each of the three camps sent trucks to Burns for food and other provisions at least weekly, if not daily. This, in addition to local hires, contributed about $15,000 per month to the Harney County economy. Skilled local men were hired by the CCC and the Refuge to teach enrollees a variety of tasks including carpentry, heavy equipment operation, surveying, and concrete construction techniques. In addition to classes offered at the camps, the enrollees learned many life skills from these men in the course of their interactions and many used them to develop careers later in life. The Biological Survey, which later became the U.S. Fish and Wildlife Service, selected work projects, while the Army ran the day-to-day operations of the camps.

Construction materials could not always be purchased from local businesses, so these items were often manufactured by CCC enrollees on-site or at other locations. The stone blocks used to construct the buildings at Headquarters were quarried near Buena Vista Station, while the basalt used for the house at Buena Vista Station was transported from the Diamond Craters area. Willow stays, used for fence construction, were cut from the banks of creeks in the Blitzen Valley. Procuring these materials often meant moving equipment and enrollees closer to the needed resources.

The three CCC camps on Malheur Refuge left behind an incredible legacy of infrastructure that remains today. Initial projects undertaken by the camps included fencing over 200 miles of the Refuge boundary; some of this fence is still in use today. Cattle guards were installed at all access points to the Refuge to prevent trespass by adjacent cattle. At Refuge Headquarters, work began on construction of four stone buildings (two residences, an office, and a barn) to better manage the Refuge. The CCC also extended the telephone lines from the Narrows to Refuge Headquarters, and then on to the communities of Diamond and Frenchglen.

The telephone lines followed improved or new roads. Major portions of Highway 205 south of the Narrows were surveyed and constructed by enrollees from all three camps. This not only improved access to the camps and made transportation of materials more efficient, but also enhanced the transportation network used by Refuge neighbors. The enrollees also improved access to the community of Diamond as bridges were constructed across the Donner und Blitzen River. Along portions of the river channelized by the Eastern Oregon Land and Livestock Company in the early part of the century, enrollees used dozers to sculpt the dredge piles into a network of roads that would traverse the center of the valley. Over 35 miles of road would provide access to the center of the Refuge for better management of the newly acquired lands. Seven bridges were constructed by the CCC along this newly created Center Patrol Road.

As work progressed over the next 7 years, the CCC enrollees constructed five concrete diversion dams on the Donner und Blitzen River. Several of these dams replaced existing smaller wood structures left over from the ranching days. All five dams improved diversion of irrigation water along hundreds of miles of new or revamped irrigation ditches. Major diversion ditches, including the Buena Vista Canal, the East and West Canals, Ram Ditch, and the Stubblefield Canal, increased the amount of water that could be diverted over a greater distance in the Blitzen Valley. Much of this water was directed to new ponds (the Buena Vista Ponds, Wrights Pond, the Knox Ponds, and Boca Lake) that were crafted from the valley floor.

As transportation improved across the Refuge, the CCC also made significant improvements elsewhere on the Refuge. Two large shop buildings and a residence were constructed at Buena Vista Station to facilitate management of the north end of the valley. At the south end of the valley, major renovations were made to Peter French's White House to improve living conditions for new Refuge employees. Existing ranch buildings at the P Ranch were modified for new Refuge uses. An addition was also added to the back of the Frenchglen Hotel, which became part of the Refuge with the purchase of the Blitzen Valley.

The improved access throughout the valley and better distribution of irrigation water led to increased public use. Four lookout towers were constructed in the last years of the CCC improvements. Two metal towers and two wood towers were placed at strategic locations across the valley for fire and wildlife observation. The most famous of these towers is the metal tower at P Ranch, which is a favorite roost for scores of turkey vultures. The CCC was also responsible for early development of camping facilities at Page Springs Campground.

As the involvement of the United States in World War II loomed, the CCC camps began closing on the Refuge. Young men who served with the CCC at Malheur enlisted in the armed forces and served across the world as the war escalated. Many of the very skilled men from the camps became civilian employees of the military and worked under contract throughout the South Pacific.

## 5.1.3 Current Knowledge of Local Cultural Resources

Malheur Refuge contains over 300 recorded prehistoric sites and 21 historic sites in a wide variety of habitats. Two prehistoric sites (35HA403 and 35HA1038) and three historic sites (Sod House Ranch, Double-O Ranch, and P Ranch) are listed in the National Register of Historic Places (NRHP). Generally, CCC sites and structures meet the eligibility requirements for inclusion in the NRHP, and three CCC-constructed dams (Sodhouse, Busse, and Page Springs) have been determined eligible for inclusion in the NRHP by the State Historic Preservation Office, though they have not been formally nominated. Prehistoric sites on Malheur, Mud, and Harney lakes in combination are eligible for listing as an Archaeological District in the NRHP. This is also true of prehistoric sites in the Double-O Unit and the Blitzen Valley; however, additional research and investigations would be needed to determine the full extent of their importance before nomination to the NRHP.

Cultural resource inventories began on Malheur Refuge in the early 1970s and have continued into the present. While the protocols used to conduct prehistoric site inventories have varied over the decades, even the earliest work provides important information on the types of prehistoric and historic resources that are, and may be, located on the Refuge. Prehistoric sites vary in age from 9,800 years old to just 120 years old. A variety of site types occur and range from winter villages, summer villages, rock art sites, burial sites, and quarries to small campsites and food processing locales. The locations of these sites indicate that a wide variety of resources in a broad range of habitats were being used for thousands of years by Native Americans before Euro-Americans entered the Harney Basin.

Three historic ranch sites, P Ranch, Sod House Ranch, and Double-O Ranch, provide excellent examples of early ranching (1870-1900) in the Harney Basin. The P Ranch and Sod House Ranch were part of the large French-Glenn Livestock Company holdings and are associated with ranch manager Peter French. The Double-O Ranch was owned and operated by William Hanley, and while only two buildings remain from the ranch era, many of the early ditches used to divert water for livestock grazing and hay operations are still in use today and are moving water to ponds and meadows for wildlife uses. The foundations of six homesteads can be found at various locations on the Refuge. Information is sparse about this period of history on the Refuge. The first recorded homestead claim occurred in the 1860s near Refuge Headquarters, and other claims were deeded to various landowners until the early 1900s.

The Refuge hosted three CCC camps and numerous buildings and infrastructure were constructed by enrollees between 1937 and 1942. The CCC camp sites, buildings, and selected infrastructure (bridges, rubble structures, towers, dams, etc.) are now eligible for listing in the NRHP. Benson Pond has a variety of infrastructure (bridge, rubble structure, ditches, and stone well house) that are excellent examples of CCC work, and mature trees planted by CCC, which, when combined, make the area eligible for listing in the NRHP. The exteriors of the CCC-constructed buildings at Refuge Headquarters and at Buena Vista Station are also eligible for listing. The four CCC-constructed lookout towers have been listed in the National Historic Lookout Register and are also eligible for listing in the NRHP.

## 5.1.4 Investigations

### Archaeological Investigations

Portland State University (PSU) conducted a 3-year project involving survey and limited excavations on the Refuge between 1972 and 1974. Over the course of three summers, Refuge staff identified areas with known but unrecorded archaeological resources, and then PSU conducted surveys of these areas. Over 200 sites were recorded across the Refuge during this phase of investigation.

***Headquarters Area:*** Prehistoric site 35HA403, the Headquarters Site, was listed in the NRHP in 1979 after initial test excavations (Benson n.d.; Thomas 1979,). Since listing, six archaeological investigations have been conducted at the site (Aikens 1983; Aikens and Greenspan 1986; Campbell n.d.; Dugas and Bullock 1994; Minor and Greenspan 1985; Minor and Toepel 1988) as mitigation for a variety of sewer, water, sprinkler, and building relocation projects. Two investigations, Thomas (1979) and Benson (n.d.), were conducted specifically for installation of the existing water system. In 1985, Aikens and Greenspan (1986) examined a series of trench profiles excavated in conjunction with the placement of a new sewer system at Refuge Headquarters, in the vicinity of the maintenance shop. They found that artifact densities increased westward from this area (Aikens and Greenspan 1986:44-45). Test excavations conducted by Intermountain Research in 1993 (Dugas and Bullock 1994) also indicate that artifact densities are higher in the central and western portions (both areas are at higher elevations) of the site. Several features were identified by Intermountain Research during their investigations in the western portion of the site. Radiocarbon dates (Dugas and Bullock 1994) from excavations at the Headquarters site show an early occupation at 4,760 years ago, another period of occupation between 1,040 and 960 years ago, and a more recent occupation around 400 years ago. The presence of storage pits and a wide range of artifacts and other cultural materials indicates intensive occupation of the site during these three time periods. Dugas and Bullock (1994:25) also documented the presence of a wave-cut scarp and beach deposits at an elevation of 4,113.77 feet, indicating a high lake level around 1,000 years ago.

***Buena Vista Area:*** The Buena Vista Site (35HA988), a large habitation site with associated petroglyphs (35HA987), is north of the substation buildings. Ground leveling activities conducted by the CCC during construction of the station may have impacted portions of 35HA988. Auger tests performed in 1979 (Kent 1979) in advance of the installation of a new residential water cistern did not encounter subsurface cultural resources in the project area; however, sparsely distributed surface artifacts were noted at that time at the base of the hill below the residential water cistern. An Earthwatch Field School was conducted by the Service in 1997 to record the extensive petroglyph panels at 35HA987 and to map and excavate stone ring features at 35HA988.

***Krumbo Area:*** As mandated by Section 106 of the NHPA, archaeological investigations must be conducted in advance of realty actions when lands will be transferred out of federal ownership. In 1981, an intensive survey of 1,320 acres (Buck 1981) was conducted for the proposed Krumbo Land Exchange. Sixteen prehistoric sites were identified during this survey. They consisted of low-density lithic scatters representing either hunting camps or stone tool manufacturing sites in advance of hunting expeditions; extensive lithic scatters representing multiple occupations for the purposes of large game hunting and stone tool manufacturing; and small and large sites with ground stone implements. The smaller sites represent seasonally occupied sites used for the exploitation and processing of locally available plants, while the larger sites appear to be multi-purpose areas, occupied seasonally over many years for the collection and processing of plant resources, as well as hunting. This pattern corresponds with the ethnographic pattern of seasonal exploitation of resources at various places in the Harney Basin by the Wada'tika Paiute.

***Diamond Swamp Area***: Surveys conducted for the 1,220-acre Proposed Dunn Land Exchange (Musil 1990, 1991; Toepel and Minor 1983) in the Diamond Swamp area identified six archaeological sites and two historic sites. Both historic sites consist of house foundations, likely dating from 1892 and 1910, and represent either homesteads or small ranches. Two sites, 35HA1261 (the Dunn Site) and 35HA1263 (the McCoy Creek Site), underwent archaeological excavations to determine NRHP eligibility and were subsequently placed in the NRHP.

The Dunn Site contains three occupation levels. The earliest may date from 7,000 to 10,000 years ago and represents a sparse deposit of artifacts. The next occupation consists of a semi-subterranean house pit dating to 3,255 years ago. The house pit included a central hearth, storage pits, and postholes along the edge of the structure. Cinders from an adjacent eruption at Diamond Craters buried the site around 3,200 years ago. The site was reoccupied between 3,000 and 500 years ago. The Dunn Site house pit is the earliest occurrence of a semi-sedentary occupation site in the Harney Basin and suggests intensification in the exploitation of resources in nearby Diamond Swamp during a period of greater effective moisture in the region.

Three cultural components were identified during excavations at the McCoy Creek Site (35HA1263) (Musil 1991). Component I at the site represents a tool manufacturing site and dates to the early Holocene. Component II is a dense artifact assemblage associated with a series of house floors. This component dates between 1,900 and 900 years ago. The presence of ground stone in this component of the site again reflects an intensification of plant resources usage from the adjacent Diamond Swamp. Bone and shell artifacts include both utilitarian and ornamental items. Aquatic and terrestrial fauna are broadly represented. This component represents a semi-sedentary, if not sedentary, village at the site. Component III, the most recent occupation at the site, consists of the floor of a wickiup structure (a conical shelter constructed from willow poles and covered with brush) dated to 480 years ago and associated artifacts. Wickiups are described in the ethnographic record for the Great Basin and at this site suggest a more mobile occupation with limited use of the site.

***Eagles Nest Burn Area:*** Rehabilitation of lands impacted by a wild land fire in 1983 led to an intensive survey of 775 acres by Heritage Research Associates within the Eagles Nest Burn area. Fourteen sites were identified during the survey and projectile points found within the burn area indicate occupation of the area beginning as early as 7,000 years ago, with an intensification of use around 4,000 years ago.

***Lakes Area:*** Extensive flooding of Malheur, Mud, and Harney lakes began in 1985 and continued into the early 1990s. This precipitated a series of surveys and data recovery projects on the lakes as illegal artifact collection and looting began to occur on sites. Heritage Research Associates conducted archaeological surveys in 1988 and 1989 as islands began to emerge from inundation. Twenty-eight archaeological sites were located and recorded on the Refuge during the surveys. Extensive mapping and artifact collections were conducted at each of the sites, and fourteen sites were revisited for additional artifact collections. Possible house floors and depressions were found at two sites, and a hearth with an associated activity surface was found in a cutbank at a third site. The density and variety of cultural materials at the newly exposed sites was impressive. A total of 1,940 artifacts were collected, including 593 classifiable points and 43 large obsidian biface blades. Partially exposed human burials were located and documented. The distribution of projectile points suggests that widespread occupation of the lakes may not have begun until after 4,000 years ago, and then intensified around 2,000 years ago as semi-sedentary groups focused on resources associated with the lakes and associated marsh.

Excavation and collection of the exposed human remains began in 1989 as illegal looting activities increased on the lakes. Heritage Research Associates was contracted to remove and perform analysis of the remains. All analysis was coordinated with the Burns Paiute Tribe, and only limited invasive analysis was permitted.

Intermountain Research was contracted by the Service in 1991 to undertake geomorphological and archaeological investigations at selected locations on Malheur Lake. The work was intended to establish a conceptual framework for understanding the history of human occupation in the region and to develop baseline data to determine how human use was influenced by the geomorphic and hydrologic history of Harney Basin. Backhoe trenches were excavated at the Harney Lake Dune and at two archaeological sites on Malheur Lake to recover data about the paleoenvironmental history of the area. The stratigraphic profiles of the trenches show a complex history of interbedded layers of lacustrine deposition, soil formation, and eolian deposition, often with substantial gaps between depositional episodes. While showing very ancient lacustrine deposits (120,000-130,000 years old), the trenches also revealed an intermittent record of post-Pleistocene lake stands, and at one site the occurrence of a previously unrecognized deep water stand between 7,400 and 8,400 years ago. This site also contained cultural material that accumulated around the time of this deep water episode.

In 1992, Intermountain Research returned to focus on the excavation of four sites on Malheur Lake. Their investigations showed that sites on eastern islands are younger than sites on northern islands. Differences in faunal assemblages among the four sites also seem best explained by geographical position. Rabbits were more abundant on the site located closest to the lake shore, while muskrats, coots, and fish were more abundant at sites in the lake interior.

In 1994, an Earthwatch Field School was conducted by the Service (Raymond 1994) at sites on the dunes bordering Harney Lake. The field school focused on surveying the entire face of the dune, mapping cultural resources, systematic surface collections, and later limited excavations of tui chub roasting pit features. The excavations and subsequent radiocarbon dates showed that the sites containing roasting pits were in use around the time of contact with Euro-Americans.

Intermountain Research conducted excavations at the Stubblefield Lookout Tower Site (35HA53) in 1994 to assess the potential of the site to address research issues of cultural sequence, subsistence, seasonality, lithic technology, raw material use, and the record of geomorphic processes and environmental change. The investigations identified a geomorphic and stratigraphic sequence that began with a large paleolake phase and the deposition of beach sediments, followed by a series of soil forming intervals interspersed with lacustrine beach depositions and the accretion of dune sediments. The earliest human occupation of the site occurs around 8,000 years ago during the early Holocene in dune sediments. Two episodes of intense use of the site occurred around 4,500 years ago and again between 600-1,500 years ago when inhabitants of the site were hunting and processing plants at the site.

## 5.1.5 Looting of Archaeological Resources

The first documented looting of archaeological resources on the Refuge occurred in 1979, soon after the passage of the Archaeological Resources Protection Act (ARPA) of 1979, although anecdotal evidence suggests that it occurred for many years prior to passage of the Act. Refuge law enforcement records indicate an ongoing problem that escalated in the mid-1980s as water levels rose on Malheur Lake and inundated islands and uplands around the lake and expanded into Mud and Harney lakes. Vast expanses of vegetation were removed or eroded from archaeological sites, exposing artifacts, features, and human burials. The Service contracted archaeological survey and scientific collection efforts to salvage scientific data from the sites before they were illegally removed. In 1992, the Refuge hired its first full-time law enforcement officer to address this problem. This full-time presence has resulted in the conviction of a number of individuals under ARPA, but the problem continues and escalates when lake levels fluctuate and inundate archaeological sites.

## 5.1.6 Historic Resources

Historic sites and features on Malheur Refuge include buildings, corrals, fences, and other features at the NRHP-listed Sod House Ranch, Double-O Ranch, and P Ranch; homestead sites at Brenton Cabin, Wrights Pond, two locations on South Malheur Lake, Rock Island, and Oliver Springs; a line shack at the South Center field; four CCC-constructed lookout towers; CCC buildings at Buena Vista Station and Refuge Headquarters; three CCC camp locations (Headquarters, Buena Vista, and Five Mile); intact CCC-constructed fences; CCC infrastructure: four dams, rubble structures on Stubblefield Canal, East Canal, along the Blitzen River, a CCC-constructed bridge and stone well house at Benson Pond; and historic stands of mature trees at Benson Pond, Refuge Headquarters, Sod House Ranch and P Ranch.

### Stabilization and Restoration Needs

Stabilization and restoration plans have been developed and implemented for the P Ranch Long Barn and the Sod House Ranch Long Barn. Deteriorated support posts and beams were repaired or replaced at each barn to stabilize the structures. Repairs were made to doors and gates. A cable system was installed in each barn to prevent further structural movements associated with moist soil conditions, snow loads, and prevailing winds. While the two barns are now structurally sound, minor repairs will continue to be needed and both barns will require new roofs within the next decade to protect the structures from further decay.

The Buckaroo Bunkhouse at Sod House Ranch has also undergone stabilization and restoration work, and with only minor ongoing repairs will remain in good condition. Similar work is needed at other buildings at Sod House Ranch and at the Double-O Ranch site. The beef wheel and hay derrick at P Ranch also require stabilization and limited restoration work to preserve their integrity. Stabilization and Restoration Plans will be required prior to the initiation of repairs to these buildings.

Minimal repairs and restoration have occurred to the exteriors of the CCC-era buildings at Refuge Headquarters and Buena Vista Station. Lead paint was removed from the exteriors of the buildings at Headquarters in 2003 because of health and safety concerns. Minor structural repairs were made to exterior wood elements at the time of lead removal. Missing terra-cotta roof tiles were also replaced at this time. New casement windows, which match the look of the original CCC windows, were installed on the sunroom at the Buena Vista residence as part of these repairs. The interior wood work, walls, and ceilings at Buena Vista were also stripped of lead paint and returned to their original appearance as part of this project. Kitchen cabinets and light fixtures matching the original plans for the structure were installed to bring the structure back to its original appearance in coordination with the State Historic Preservation Office.

Aluminum and vinyl windows in the CCC-era buildings at Headquarters and Buena Vista were replaced with wood casement windows in 2010 as part of an energy efficiency project. Original CCC-constructed windows on the horse barn and old warehouse were not replaced as part of this project. Exterior doors matching originally constructed doors replaced warped wood CCC doors on several buildings. The restoration activities that have occurred on the exteriors of these CCC buildings have returned them to a condition that makes them eligible for inclusion in the NRHP.

All CCC-era buildings will require periodic maintenance and repair to maintain their historic and structural integrity. CCC-era buildings located at Refuge Headquarters include the main office building; the fire office; the old warehouse building, which houses the Law Enforcement, Archaeology, and Fisheries programs; the conference room building; and the horse barn. At Buena Vista Station, the shop building and house are of the CCC-era, as is the stone well house at Benson Pond. All buildings will require exterior painting and, in some cases, minimal structural stabilization to maintain the integrity of these historic buildings. The stone well house at Benson Pond will require a new wood shake roof and repairs to the window and door.

Historic CCC-constructed Refuge infrastructure remains at several locations on the Refuge. This includes the bridge and rubble structure at Benson Pond, several rubble structures along the East Canal and one along the channelized portion of the Blitzen River, three of the four CCC-constructed diversion dams (Sodhouse, Busse, and Page Springs dams), and the four lookout towers. Care should be taken to preserve these excellent examples of CCC construction techniques and periodic maintenance, and limited restoration and stabilization will be necessary to maintain the integrity of these structures. Mature stands of trees originally planted by the CCC at Benson Pond and Refuge Headquarters are also of importance from a historical perspective and should be preserved through careful trimming to maintain the vigor of the trees.

### 5.1.7 Museum Property

Archaeological investigations have generated important collections. Over 7,000 artifacts and scientific samples have been accessioned and are curated at the Museum of Natural and Cultural History at the University of Oregon in Eugene. These artifacts and samples were collected between 1970 and 1990 as the result of archaeological investigations carried out on the Refuge. An additional 4,000 artifacts are internally curated at the Refuge and are from archaeological investigations conducted after the 1980s floods and from other small projects conducted by Refuge staff.

Several items related to Peter French's management of the Blitzen Valley portion of the Refuge came into Refuge ownership when the Valley was added to the Refuge. In 1981, these items were loaned to the Harney County Historical Society (HCHS) Museum for display. They include a large safe, hall tree, five framed photos of wildlife, and possibly some other pieces of furniture. They remain in the possession of the HCHS today.

The Benson Memorial Museum at Refuge Headquarters contains an important collection of 100 taxidermy bird mounts and an egg collection that predates the use of DDT in the United States.

## 5.2 Refuge Facilities

### 5.2.1 Boundary Fences and Markers

Barbed wire fencing delineates and protects most of the Refuge's 187,756-acre boundary. Where possible, the Refuge has posted boundary signs. Portions of the Refuge where it is transected by public roads (State Highway 205, State Highway 78, Sodhouse Lane, Diamond Lane, P Lane, and Double-O Ranch Road) are fenced, with boundary signs at main entrances or on barbed wire fences delineating the Refuge boundary. The Boundary Hunt Unit is adjacent to Bureau of Land Management (BLM) land, and, because of the rugged landscape and presence of rimrock, marking the Refuge boundary is difficult or impossible, making this area difficult to manage.

### 5.2.2 Entrances and Access Points

There are nine year-round entrances located on the Refuge: four in the Buena Vista Unit, three in the P Ranch Unit, and two in the Double-O Unit. Five of the year-round entrances in the Buena Vista and P Ranch units are marked with large entrance signs. The eastern entrance to the Double-O unit is marked with an entrance sign.

In the three hunt units (Malheur Lake, Buena Vista, and Boundary hunt units), seasonal entrances or access points are provided. The Malheur Lake Hunt Unit has three entrances: 1) on State Highway 205 near the Narrows pull-out; 2) off State Highway 78 at Lawen, and 3) on the Saddle Butte access. The Boundary Hunt Unit is accessible from numerous points along State Highway 205; however, hunters must access the portion of the Boundary Hunt Unit located southeast of Krumbo Reservoir via the BLM's Moon Hill Road. The Buena Vista Hunt Unit can be accessed from the Center Patrol Road, Sodhouse Lane, Diamond Lane, and State Highway 205.

Fishing access points are provided in the P Ranch Unit from the Center Patrol Road and from the P Ranch along the river dike. The Bridge Creek portion of the fishing area is accessible by pedestrians on the East Canal Road and from the Center Patrol Road at Bridge Creek.

Gates are located at five entrance areas along the Center Patrol Road, three in the Buena Vista Unit and two in the P Ranch Unit. Gates have been installed to minimize impact and disturbance when road conditions are poor, yet allow Refuge staff access for maintenance purposes or wildfire suppression. A gate has also been installed at the Krumbo Reservoir entrance to allow seasonal use for anglers and visitors, and to reduce wildlife disturbance. The gate is open from the fourth Saturday of April until October 31.

## 5.2.3 Roads and Parking Areas

State Highway 205 bisects the Refuge at the Narrows, continues south through the Blitzen Valley, and crosses through portions of the Refuge's western boundary. Two paved county roads (Diamond Lane and Sodhouse Lane) transect east-west through the Refuge. The Refuge is also crossed by two gravel roads (the Double-O and P Lane roads); the first is maintained by the county and the second by the Refuge. All remaining roads are gravel, Service owned, and maintained by the Refuge. These include the Center Patrol Road, Buena Vista Lane, P Lane, the East Canal Road, the Headquarters road complex, and Malheur Lake access roads. All other motorways are dike tops and unimproved two tracks.

Power line corridors are generally along road rights-of-way or adjacent to them. A major 115 kV transmission line owned by Harney Electric Cooperative bisects Refuge lands at the Narrows and continues to cross portions of the western boundary of the Refuge the length of the Blitzen Valley. State and county roads crossing the Refuge have smaller capacity power lines feeding homes, ranches, irrigation wells, and Refuge facilities.

Approximately 60 miles of unpaved roads are maintained for public access on the Refuge. Most of the unpaved roads are gravel, but small sections are natural dirt surfaces. Mileages are based on the Refuge Road Inventory, and this does not include maintenance roads or dikes that are not open to public access.

There are a variety of parking areas on the Refuge. Five parking areas are routinely maintained and are located at Refuge Headquarters, Sod House Ranch, Buena Vista Overlook, Krumbo Reservoir, and P Ranch. A small parking area for four vehicles at Refuge Headquarters and the Krumbo Reservoir main parking area are paved. Both parking areas are compliant with the Americans with Disabilities Act (ADA). Most parking areas (2-3 vehicle lengths) that are not routinely maintained are associated with wildlife observation and wildlife/nature photography, hunting, and fishing programs. They are located on Center Patrol Road and P Lane, in the Malheur Lake hunt unit (three), and in the Boundary hunt unit southeast of Krumbo Reservoir (one). One vehicle pull-off that can be occupied by at least five vehicles is located on State Highway 205 at the Narrows pull-out.

## 5.2.4 Trails

There are 10 designated hiking trails throughout the Refuge, which provide over 20 miles for visitors to explore and learn about wildlife and the Refuge, including the nationally recognized Desert Trail.

The Refuge has a Memorandum of Understanding with the Desert Trail Association for the establishment of and maintenance of a hiking trail corridor across the Refuge. This segment of the National Desert Trail runs through the western desert areas of the United States from Canada to Mexico and connects with adjacent segments on BLM-administered areas.

Most of the trails are undeveloped spur trails (≤ 1 mile), and are signed and mapped. Refuge staff, Youth Conservation Corps (YCC), and volunteers maintain three of the 10 hiking trails. Other hiking trails at Benson Pond, Bridge Creek, P Ranch/River Trail, and East Canal are located on maintenance roads and are mowed seasonally. Others, which are not routinely maintained, include the Krumbo Reservoir fishing trail and the National Desert Trail segment.

### 5.2.5 Administrative Facilities

Administrative facilities located at Refuge Headquarters on the south side of Malheur Lake, 32 miles south of Burns, consist of offices, a small visitor center and gift shop, the George Benson Memorial Museum, a conference room/library, a maintenance shop, and storage areas for maintenance and fire equipment. Five of the buildings at Refuge Headquarters and two buildings at the Buena Vista substation were built by the CCC.

Other buildings located at Refuge Headquarters include public restrooms, hazardous materials storage space, fuel tanks space, and residential housing. Residential housing includes a two-bedroom house for seasonal staff, a fire bunkhouse, a three-bedroom volunteer bunkhouse, a volunteer/RV Park common room, and a laundry and shower/restroom facility.

Government-owned living quarters for Refuge staff are located at the three substations (Buena Vista, P Ranch, and Double-O units). In addition to residences, a maintenance shop, storage areas for equipment, and fuel tanks can be found at the main substation areas. Government-owned housing for the P Ranch substation is located at the South Place maintenance area. A three-bedroom volunteer bunkhouse, equipment storage areas, and fuel tanks are located at the P Ranch proper.

### 5.2.6 Easements and Rights-of-Way

The Refuge is either adjacent to or bisected by public roads and state highways. Existing and relocated rights-of-way for electric transmission and phone lines, gas lines, and access roads are located throughout the Refuge.

The Saddle Butte access on the north side of Malheur Lake provides access to the Malheur Lake hunt unit. This access is an easement across private property, and public access is only permitted during the state waterfowl season. The condition of the access route significantly changes from year to year due to fluctuating lake levels, making the route tenuous and maintenance of the road difficult.

### 5.2.7 Dikes, Irrigation, and Water Control Structures

There are hundreds of miles of earthen dikes throughout the Refuge, including water control structures that control water levels for habitat management. Wildlife observation, wildlife/nature photography, interpretation, and environmental education are secondary benefits on some of the dikes accessible to the public (East Canal Road, Bridge Creek fishing access, Brenton Cabin Road, and the River Dike Road).

# 5.3 Public Use Overview

## 5.3.1 Open and Closed Areas

The Refuge is open to the public year-round from sunrise to sunset on designated roads and trails. The Center Patrol Road, the Refuge's 42-mile auto tour route, provides the main access to the Blitzen Valley, the most frequently visited portion of the Refuge. Access to the Center Patrol Road is provided at Refuge Headquarters, at the Malheur Field Station, at Buena Vista Station and Diamond Lane, via Krumbo Lane, and at the P Ranch. The Double-O portion of the Refuge is accessed from the North Harney Lake Road and the Double-O Road from State Highway 20.

Most dikes/maintenance roads on the Refuge are closed to public access to reduce wildlife disturbance; however, the public are allowed to use the East Canal Road, the Bridge Creek fishing access, the Brenton Cabin Road, and the River Dike Road for pedestrian access for fishing.

Seasonal wildlife-dependent recreational uses are associated with the historic Sod House Ranch, and the hunting and fishing programs. Sod House Ranch is seasonally open from August 15 to October 15 for historic interpretive and wildlife-viewing purposes. It is closed the remainder of the year to meet wildlife objectives associated with the heron and cormorant rookery nesting in the cottonwood trees.

Hunting and fishing programs are open in designated areas and seasons. Malheur Lake and the Boundary hunt units follow Oregon State seasons, and the Buena Vista hunt unit opens on the third Saturday of November until the end of Oregon State pheasant season. Fishing opportunities at the south loop of the upper Blitzen River, the southern portion of East Canal, and Mud and Bridge creeks are available year-round with special regulations. Krumbo Reservoir is seasonally open to anglers and visitors from the fourth Saturday of April to October 31. Krumbo Reservoir is closed outside of the fishing season to reduce wildlife disturbance.

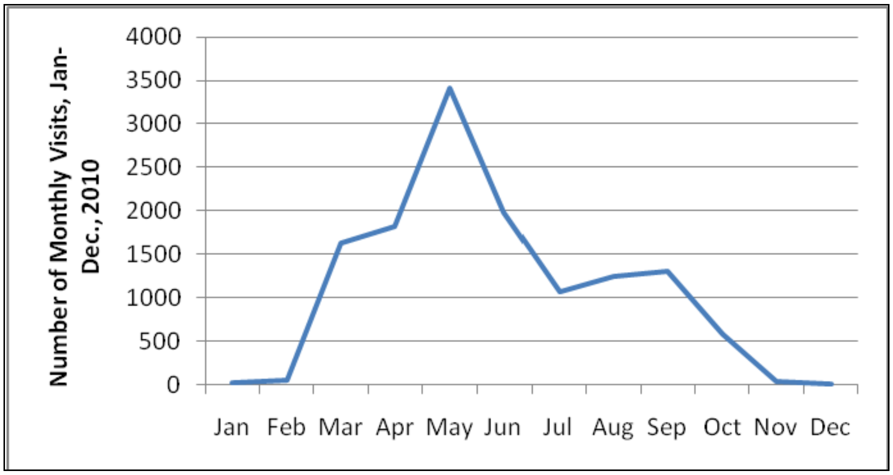
## 5.3.2 Annual Recreation Visits

During the 12-month period starting December 1, 2009, and ending November 30, 2010, an estimated 65,600 total daily visits were made to the Refuge. This is not a sum of visits by visit category; this is an estimate of total visits to the Refuge based on door and vehicle counts at the Refuge headquarters, adjusted using mean group size and mean length of visit. Since the average visitor spends almost three days at the Refuge (see discussion below), this would translate into roughly 22,600 visitors at the Refuge per year.

### Data Sources Used in Calculating Refuge Visits

During 2010-2011, the Refuge engaged in a set of integrated efforts to better estimate Refuge visitation. These included a door counter, automated vehicle counter, and vehicle counts at hunt sites. Visitor characteristics were deduced from a survey conducted by U.S. Geological Survey (USGS). Each of these sources is described below.

***Door Counter at Visitor Center*:** The Refuge maintained a door counter on one visitor center door at the Refuge headquarters for a full year (January-December 2010). Door counts during this period are shown in Figure 5-1. Door counts were not used directly because of the possibility that counts were under-estimated or over-estimated (one count could let in multiple visitors, visitors could use different doors, etc.). However, the pattern of door count fluctuation over the year was instructive and was used in conjunction with the vehicle count sample to estimate vehicle counts by month.




Source: Refuge Headquarters door counter records.

**Figure 5-1. Monthly visits recorded in Refuge Headquarters visitor center with door counter, January to December 2010.**

***Headquarters Road Car Counter:*** A car counter was placed underneath the entrance road to Refuge headquarters. Although the car counter was only operational for about two months, it provided valuable baseline data on total vehicle traffic that could be correlated with the visitor center door counts. Car counts were halved (so that entries and exits were not double counted), and adjusted to subtract staff, volunteer, and contractor entries and exits. Vehicle counts were estimated for the months in which they were not measured, by applying the pattern of Refuge door counts to the adjusted vehicle count data.

***Vehicle Counts at Hunt Sites:*** During the 2010-2011 upland game hunt season, vehicles parked at hunting sites were counted on the opening weekend of the upland game hunt season at the Buena Vista Unit, as well as on nine other days of the hunt season. Opening weekend counts were adjusted based on the judgment of the law enforcement officer that vehicle counts were about half the "normal" activity for opening weekend.

Observation efforts at Malheur Lake Unit and Boundary Hunt Unit were insufficient to use in calculations of upland game hunt visits. Staff was consulted about the approximate number or percent of hunters thought to use these hunt areas, and these were added to the Buena Vista total for the upland game hunt visit estimate.

Waterfowl hunt visits were similarly estimated based on staff consultation rather than vehicle counts.

***Visitor Characteristics:*** At least two studies have been made of Refuge visitors over the years. A study of the economic impact of ecotourism and the demographics of ecotourists was conducted on the Refuge from June 1993 to May 1994 (Kerlinger 1994). A total of 481 questionnaires were completed by visitors. Kerlinger examined visitor demographics (gender, age, income) and activities preferred, as well as the amount of money spent on a visit.

A similar study was completed in 2010-2011 (Sexton et al. 2011) as described above. The USGS partnered with the Refuge System in 2010-2011 to conduct a standardized national survey of visitors at 50 refuges across the country, including Malheur Refuge (Sexton et al. 2011). The goal of the survey was to provide refuge managers, planners, and visitor services specialists with reliable baseline data about refuge visitors and their experiences. Visitor opinions about their visit and various topics of interest were also gathered and analyzed. Some findings from the study are presented in Table 5-1. The full study report can be found in Appendix Q of this CCP.

At Malheur, 273 visitors completed the survey for an 88 percent response rate and ±6 percent margin of error. Two different sampling periods were used; the first extended from August 28, 2010, till September 11, 2010. The second extended from May 21, 2011, until June 4, 2011. Survey data yielded valuable information on parameters of visitation, including percent of local and non-local visitors, average group size, the percent of visitors who reported having visited the visitor center, activities visitors engaged in during the previous year while visiting the Refuge, etc. These are summarized in Table 5-1.

Because the survey did not occur during hunting season, it is considered to provide limited information about hunting visitors. In addition, the spring sampling season occurred during a period of time when portions of the Refuge were inundated with unusually high water. This likely drove the percent of visitors using the Auto Tour Route down to below-normal levels.

In addition to the activities reported by Refuge visitors in the USGS survey, a study conducted in 1994 on the Refuge (Kerlinger 1994) found that the “typical” Refuge visitor is also interested in scenery; geology; hiking; and botany. As reflected in Figure 5-1, visitors engage in these activities primarily in the spring, summer, and fall; May is the busiest month of the year.

**Table 5-1. 2010-2011 Survey Data: Key Parameters Used in Calculating Refuge Visits**

| Parameter | Result |
|---|---|
| Percent non-local visitors | 96% |
| Percent local visitors | 4% |
| Percent of visitors with a group | 73% |
| Percent alone | 15% |
| Mean group size (for those in a group) | 5 |
| Mean group size (overall) | 3.9 |
| Percent of visitors using visitor center | 92% |
| Mean days per visit | 2.9 |
| **Visitor Self-Reports: Activities Engaged in at Refuge During Previous 12 Months** | |
| Bird watching | 93% |
| Wildlife observation | 87% |
| Auto tour/driving | 62% |
| Photography | 60% |
| Interpretation | 47% |

| Parameter | Result |
|---|---|
| Hiking | 45% |
| Environmental education | 8% |
| Fishing | 6% |
| Bicycling | 4% |
| Non-motorized boating | 3% |
| Migratory bird/waterfowl hunting | 1% |
| Special event | 1% |

Source: Sexton et al. 2011.

## Integration of Data in Calculating Current Refuge Visits

The above data sources were used in conjunction to calculate overall visits to the Refuge, per year as well as visits by activity. To calculate Refuge visits per year, the following formula was used.

$$\textbf{Total Refuge visits per year} = \text{Monthly visitor vehicle counts at headquarters (empirical or estimated from door count pattern)} * \text{Mean group size (overall)} * \text{Mean days per visit} \,/\, \text{Percent of visitors who visit the visitor center}$$

To calculate Refuge visit by activity, the percent of visitors reporting that they had engaged in that use was used as the primary parameter. This percent was multiplied by the total Refuge visits per year to estimate visits per year, by activity.

Upland game hunt visits were calculated by estimating visits for opening weekend and adding these to estimated mean visitor activity on weekdays and weekends, over the total season. Waterfowl hunt visits are currently estimated as 10 percent of upland game hunt visits. Table 5-2 shows the 2011 number of Refuge visits by key activity.

**Table 5-2. Current Number of Refuge Visits Per Year, by Key Activity***

| Activity | Current Refuge Visits (2011) |
|---|---|
| **Consumptive Use** | |
| Hunting visits: waterfowl | 85 |
| Hunting visits: upland game birds | 850 |
| Hunting visits: big game | 40 |
| Fishing visits | 1,300 |
| **Non-Consumptive Use** | |
| Pedestrian visits; hiking and walking | 28,000 |

| Activity | Current Refuge Visits (2011) |
| --- | --- |
| Auto tour visits | 61,000 |
| Boat trail/launch visits | 400 |
| Bicycle visits | 2,600 |
| Photography visits | 52,000 |
| Environmental education visits (non-local visitors) | 6,700 |
| Environmental education visits (local) | 700 |
| Interpretation visits | 52,000 |
| Wildlife observation visits | 61,000 |
| Commercial activities | 1,000 |

*Visits are counted per separate visit. Each day of an extended visit is counted as a separate visit.

### 5.3.3 Accessibility of Recreation Sites and Programs for People with Disabilities

The Refuge provides some accessible facilities for persons with disabilities participating in programs associated with wildlife observation, wildlife/nature photography, interpretation, environmental education, and fishing. Related activities, such as welcome and orientation and the volunteer program also have limited ADA-accessible facilities.

ADA parking is provided at Refuge Headquarters and provides access to the Visitor Center and gift shop, the George Benson Memorial Museum, and public restrooms. Accessible public restroom facilities are also available at Buena Vista, Krumbo Reservoir, and the P Ranch. Other accessible opportunities include an accessible interpretive trail at the Sod House Ranch, an accessible viewing overlook at Buena Vista, and an accessible fishing pier and boat dock at Krumbo Reservoir.

At Refuge Headquarters the volunteer program provides ADA-accessible facilities at the three-bedroom volunteer bunkhouse, the volunteer RV Park common room, and the RV Park laundry and shower/restroom facilities. The fire bunkhouse is also ADA-accessible and serves as overflow housing for temporary staff and volunteers as needed.

### 5.3.4 Law Enforcement

One full-time law enforcement officer provides law enforcement coverage for the Refuge. Law enforcement officers from other refuges and agencies assist with patrols during periods of high visitation including the opening weekend of pheasant hunting, the opening weekend of fishing at Krumbo Reservoir, and on holiday weekends.

## 5.4 Wildlife-Dependent Public Uses

The National Wildlife Refuge System Improvement Act passed by Congress in 1997 identified six wildlife-dependent uses (wildlife observation and photography, interpretation and environmental education, and hunting and fishing) as priority public uses for the National Wildlife Refuge System. These uses are explored below.

## 5.4.1 Wildlife Observation and Wildlife/Nature Photography

### Program Offerings

The cornerstone of the public use program and one of the most popular activities on the Refuge is the wildlife observation and wildlife/nature photography program. Beginning to advanced bird watching is the most common activity under this program because of the diversity and abundance of birds (320 species) and wildlife (58 mammal species) on the Refuge. Rare and incidental bird species are common during the spring migrations and are the main focus for advanced birders. Areas preferred for viewing rare and incidental bird species include Refuge Headquarters and other historic landscapes where cottonwood trees and other non-endemic trees and shrubbery are present, such as Sod House Ranch, Benson Pond, Witzel Homestead, Barnyard Springs, and P Ranch.

Docent-led tours for wildlife observation and wildlife/nature photography occur in conjunction with the annual John Scharff Migratory Bird Festival held in April. Four to six tours are provided by the Refuge's friends group, the Malheur Wildlife Associates, or by volunteers. These tours provide 20-35 festival participants with an opportunity to learn about and experience the Refuge in greater detail. Most of the tours access areas normally closed to the public. The Refuge is also a stop for other tours led during the festival weekend by the Malheur Field Station, the Burns Llama Trailblazers, and other tour operators.

Independent visitors and groups from Audubon chapters and other organizations, such as the Malheur Field Station (see Environmental Education), also organize visits for wildlife observation and wildlife/nature photography on the Refuge, especially during the spring and fall. These informal wildlife observation and wildlife/nature photography opportunities are available on designated roads and hiking trails (see Trails) on the Refuge.

### Facilities

Several facilities to assist the wildlife observation and wildlife/nature photography programs are available throughout the Refuge. Located at Refuge Headquarters, an exterior deck, an indoor telescope, and an overlook are available for visitors to view wildlife and the landscape. Another viewing overlook at Buena Vista also provides enhanced views of the surrounding landscape and improves visitor experiences. The Refuge does not have elevated viewing platforms or photography blinds.

The Refuge's 42-mile Blitzen Valley auto tour route (Center Patrol Road) has six designated sites for viewing wildlife: Refuge Headquarters, Buena Vista Ponds and Overlook, Krumbo Reservoir, Benson Pond, Knox Pond, and P Ranch. A number of vehicle pull-offs for viewing wildlife are also available at small ponds, marshes, and impoundments along the Blitzen Valley auto tour route.

## 5.4.2 Interpretation

### Program Offerings

Interpretive features and programs are another popular activity on the Refuge. Visitors have expressed an interest in learning more about the Refuge. Key interpretive themes relevant to the Refuge include the significance of the Refuge for breeding and migratory birds; pre- and post-contact historic events; wilderness; geology; aquatic health; the importance of water; resource challenges faced by management; and the role of the National Wildlife Refuge System. Many of these themes have been emphasized as part of the Refuge's interpretive features and programs. With the use of traditional and modern media, special events, public presentations, and outdoor interpretive panels, visitors are enlightened and connected with the places and resources the Refuge protects.

A variety of interpretive brochures (e.g., the Blitzen Valley Auto Tour Route Self-Guided Interpretive Brochure) are available at the Refuge Headquarters Visitor Center and at five brochure boxes at the Buena Vista and P Ranch unit entrances.

The Refuge also maintains a website (www.fws.gov/malheur) where information about the Refuge can be obtained, including information associated with key interpretive themes, recreational opportunities, and management issues. The most visited web pages on the site are associated with wildlife viewing, recreational opportunities, hunting, and planning a visit to the Refuge, followed by links providing information about where to stay near the Refuge. The Refuge's website statistics are displayed in Figure 5-2 and Table 5-3.

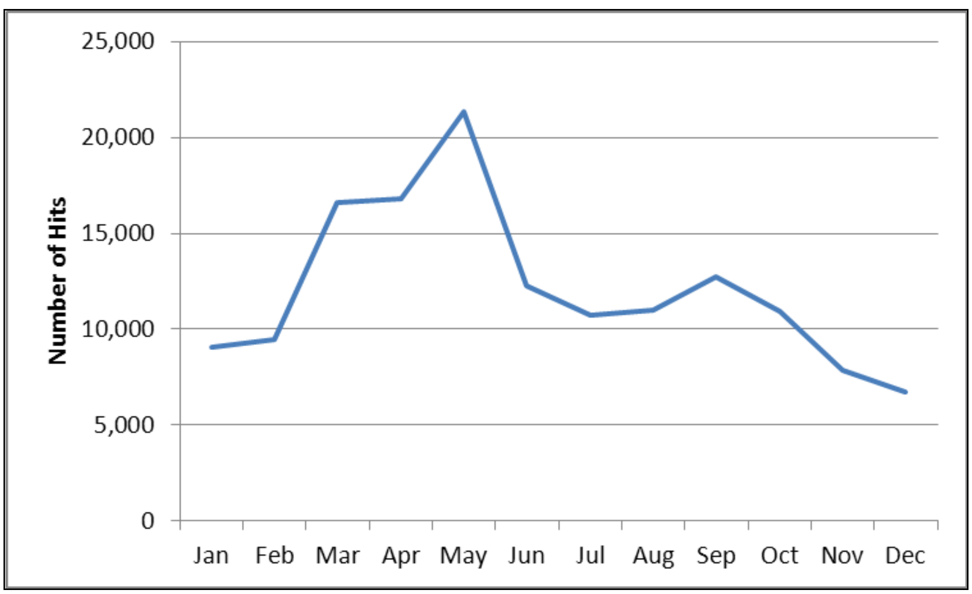



**Figure 5-2. Website statistics for monthly visits to the Refuge's website, January to December 2010.**

**Table 5-3. Website Statistics for Most Popular Pages Viewed by Visitors, January to December 2010**

| | Top Page | Second Page | Third Page | Fourth Page |
|---|---|---|---|---|
| **Jan** | Wildlife | Plan Your Visit | Recreation – Main Page | Bird List |
| **Feb** | Wildlife | Recreation – Main Page | Plan Your Visit | Where to Stay |
| **Mar** | Recreation – Main Page | Plan Your Visit | Wildlife | Bird List |
| **Apr** | Plan Your Visit | Wildlife | Recreation – Main Page | Where to Stay |
| **May** | Wildlife | Plan Your Visit | Recreation – Main Page | Where to Stay |
| **Jun** | Wildlife | Recreation – Main Page | Plan Your Visit | Where to Stay |
| **Jul** | Recreation – Main Page | Wildlife | Plan Your Visit | Where to Stay |
| **Aug** | Wildlife | Plan Your Visit | Recreation – Main Page | Where to Stay |
| **Sept** | Plan Your Visit | Wildlife | Recreation – Main Page | Where to Stay |
| **Oct** | Wildlife | Recreation – Main Page | Plan Your Visit | Hunting |
| **Nov** | Hunting | Wildlife | Recreation – Main Page | Plan Your Visit |
| **Dec** | Hunting | Recreation – Main Page | Wildlife | Plan Your Visit |

The Refuge is involved with and participates in four local special events on and off-Refuge: the John Scharff Migratory Bird Festival (April), Free Fishing Day (June), Invasive Carp Awareness Day and Ranching Heritage Day (August), and the Harney County Fair (September). During these events, docent-led tours (see Wildlife Observation and Wildlife/Nature Photography), booths, and educational materials that connect visitors with places and resources on the Refuge are available.

Public presentations are also given by Refuge staff and volunteers to a variety of visiting groups. Public presentations are scheduled upon request by visiting groups, and are primarily requested between April and October. Four to five staff presentations are requested each year for high school and university classes, and reach about 200 visitors.

## Facilities

Refuge Headquarters is the top “wildlife experience point,” as nearly all visitors use the facilities and spend time experiencing wildlife present at the site. The small Visitor Center and gift shop is staffed by Refuge staff and volunteers and provides interpretive brochures and other information. The George Benson Memorial Museum, also located at Refuge Headquarters, aids visitors in the identification of wildlife found on the Refuge using 200 mounted bird specimens.

To enhance visitors' experiences and address key interpretive themes relevant to the Refuge, outdoor interpretive panels are provided at Refuge Headquarters and throughout the Refuge. Other outdoor interpretive panels are located at the Narrows pull-out, Sod House Ranch, the Buena Vista Overlook, the River Trail, and the P Ranch.

## 5.4.3 Environmental Education

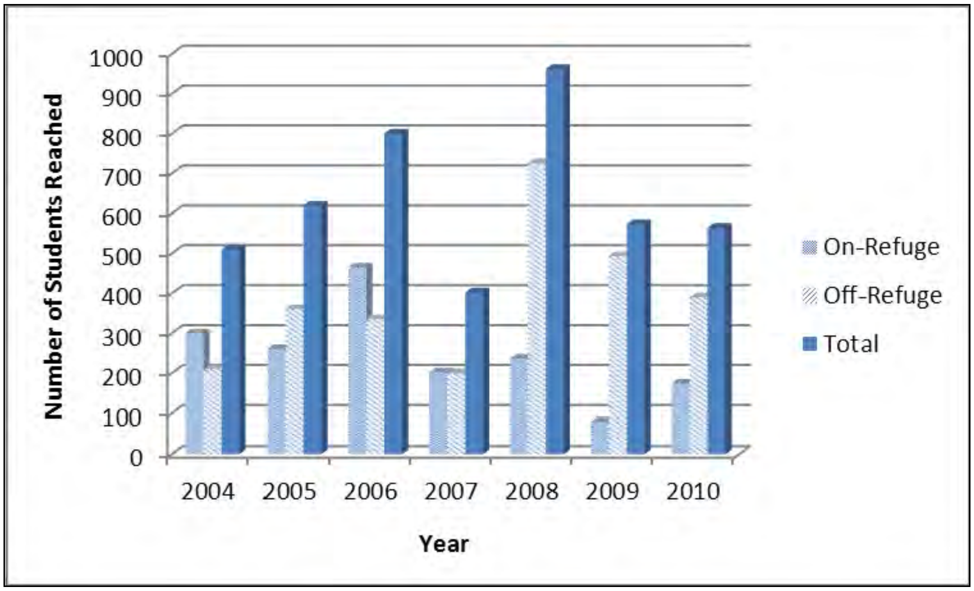
### Program Offerings

The environmental education program is based on strategic use of Refuge staff and volunteer time, and Refuge resources. The small environmental education program is conducted on- and off-Refuge to promote an understanding of wildlife, habitat, and resource management objectives and issues. The environmental education program makes every effort to correlate activities with the State Educational Standards and local district curricula for elementary levels as illustrated in Table 5-4.

**Table 5-4. Typical Lesson for Students in Grade 1**

| Subject | Goal | Content | Statement | Performance |
|---|---|---|---|---|
| • Life Science: Understand structure, functions, and interactions of living organisms and the environment | • Begin to identify what habitats and ecosystems are | • Describe the characteristics, structure, and function of organisms<br>• Explain and analyze the interdependence of organisms in their natural environment | • Recognize similarities and differences between organisms<br>• Describe the basic needs of living things<br>• Describe a habitat and the organisms that live there | • Identify living and non-living things (Grade K-1)<br>• Identify what living organisms need to survive (Grade K-3)<br>• Recognize that the population of a given organism affects its habitats (Grade 1) |

The environmental education program also uses existing curricula, such as that provided for International Migratory Bird Day and the Connecting Children with Nature initiative, by using hands-on learning (e.g., photography, painting/drawing). Special events, such as the annual John Scharff Migratory Bird Festival Nature and Heritage Fun Fair, "Conservation through the Arts," and Free Fishing Day, reach over 500 students. Class sizes and activities are dependent on Refuge staff, volunteer, and educator time, and transportation funding. The number of student visits on- and off-Refuge is shown in Figure 5-3.




Source: Refuge records. In 2008, the Refuge celebrated its centennial with an emphasis on reaching out to more students.

**Figure 5-3. Number of student visits for environmental education, on- and off-Refuge, 2004 to 2010.**

The majority of classes reached by the Refuge are local elementary classes with an emphasis on first and third grades. Visits to the Refuge and special events are primarily conducted between April and June, although the Refuge has at least one class visit at other times of the year from non-local educational organizations. In addition to the Refuge's environmental education program, the Refuge coordinates and assists with local environmental education initiatives as requested.

Malheur Field Station, operated by the non-profit Great Basin Society, has offered educational opportunities and adventures since 1971 and operates an educational and research facility on Refuge lands under a Cooperative Agreement. The facilities of the Malheur Field Station are owned and managed by the Great Basin Society. Malheur Field Station is dedicated to learning in and about the northern Great Basin and offers a variety of educational programs to individuals, families, informal groups, K-12 school groups, colleges, and universities.

### Facilities

The Refuge has limited environmental education facilities. Most environmental education activities occur outdoors on the exterior deck and lawn at Refuge Headquarters. The environmental education program also uses the conference room, which can accommodate 20 students, and the George Benson Memorial Museum. Malheur Field Station accommodations include a variety of lodging options, a natural history museum, and classrooms.

## 5.4.4 Upland Game Hunting

Areas currently open to upland game hunting are described below.

### Malheur Lake Hunt Unit

This area consists of 18,000 acres on the north side of Malheur Lake. It is open during the Oregon State pheasant season and according to limits set by the state.

### Buena Vista Hunt Unit

This area consists of 22,000 acres in the Buena Vista Unit. It is open from the third Saturday of November to the end of the Oregon State pheasant season and according to limits set by the state. The opening date has been designed to minimize conflicts with fall-staging sandhill cranes.

Upland game in the Buena Vista hunt unit is one of the Refuge's most popular hunts. Ring-necked pheasants, an introduced species, provide quality hunting opportunities on the Refuge; opportunities off-Refuge in the surrounding area are limited. The Refuge has no maintenance or production objectives for exotic species, and pheasants are not stocked.

### Boundary Hunt Unit

This area includes Refuge lands located on the west side of State Highway 205 and several small tracts of Refuge lands southeast of Krumbo Reservoir in the vicinity of Krumbo Creek. This area is open during the Oregon State pheasant season and according to limits and regulations set by the State.

### Facilities

No facilities are maintained or managed expressly for this program. The Saddle Butte access road, four parking areas, and various vehicle pull-offs (see Infrastructure and Administrative Facilities) are used during the hunting season on the Refuge.

## 5.4.5 Waterfowl Hunting

Areas currently open to waterfowl hunting are described below.

### Malheur Lake Hunt Unit

Eighteen thousand acres on the north side of Malheur Lake are open during the Oregon State waterfowl season and according to limits set by the State. Seasonal closures can occur to protect waterfowl populations when water levels drop and the lake acreage falls below 10,000 acres. Non-motorized or electric boats are permitted during the hunt season.

Invasive carp have become successfully established in Malheur Lake and in the Blitzen and Silvies river systems. Their feeding behavior has eliminated or severely reduced an important waterfowl food source (sago pondweed), and as a result waterfowl use on Malheur Lake has been reduced. The Refuge's waterfowl hunt is perceived as being of poor quality.

### Boundary Hunt Unit

The area west of Highway 205 and the Krumbo Creek area are open during Oregon State waterfowl season, according to the limits and regulations set by the State.

### Facilities

No facilities are maintained or managed expressly for this program. Saddle Butte access road, four parking areas, and various vehicle pull-offs (see Infrastructure and Administrative Facilities) are used during the hunting season on the Refuge. Temporary hunting blinds may be constructed, but must be removed daily.

## 5.4.6 Other Hunting

In addition to upland game and waterfowl hunts, the Boundary Hunt Unit is open to deer, pronghorn, coyote, and rabbit hunting. This unit, west of Highway 205 and the Krumbo Creek area, is open during the Oregon State seasons and according to limits set by the State. The Boundary Hunt Unit is adjacent to BLM land, and, because of the rugged landscape and presence of rimrock, marking the Refuge boundary is difficult or impossible, making this area difficult to manage. Hunters may take all State-allowed species.

### Facilities

No facilities are maintained or managed expressly for this program. Hunters access this area via State Highway 205 or via BLM-administered roads.

## 5.4.7 Fishing Program

Areas currently open to fishing are described below.

### South Fishing Loop

Located in the south part of the Blitzen Valley, this area includes the Blitzen River from below the Page Springs Dam to the confluence of Bridge Creek with the River, the southern portion of East Canal to Bridge Creek, and Mud and Bridge creeks. The loop is open year-round to pedestrian access. This fishery has special trout regulations per the State of Oregon.

The south fishing loop is a popular fly-fishing area for native redband and naturalized rainbow trout, and fishing is typically desirable when sediment in the water coming from Steens Mountain settles and the water column becomes clear.

### Krumbo Reservoir

The Krumbo Reservoir is open from the fourth Saturday of April until October 31 for drive-in access. Non-motorized or electric boats are permitted during the fishing season. Closure for the remainder of the year eliminates conflicts with management objectives by limiting wildlife disturbances.

The Krumbo Reservoir fishery was established in 1959 as a two-story fishery consisting of largemouth bass and rainbow trout. Triploid rainbow trout are stocked twice a year by the Oregon Department of Fish and Wildlife (ODFW). The Reservoir provides a reliable fishing opportunity in Harney County and is perceived as a quality fishing opportunity by the local community and out-of-area anglers. On average, 12- to 24-inch rainbow trout are caught, and anglers are known to be successful. As is typical of desert lakes, fishing is best in spring and fall when the weather and water are cool.

### Facilities

***South fishing loop:*** No facilities are maintained or managed expressly for this program. A public restroom and parking are available at P Ranch. Walk-in access is via East Canal Road to the convergence of Bridge Creek with the East Canal, and along the River and Bridge Creek trails.

***Krumbo Reservoir:*** One ADA-accessible fishing pier, a concrete boat ramp, two vault toilets, a floating boat dock, one paved and one gravel parking lot, and two covered picnic tables are located at the Reservoir. The launch and parking area has capacity for 24 boat trailer parking spaces, one ADA-accessible boat trailer parking space, nine single parking spaces, and one single ADA-accessible parking space.

# 5.5 Other Refuge Uses

## 5.5.1 Hiking, Horseback Riding, Bicycling, and Cross-Country Skiing

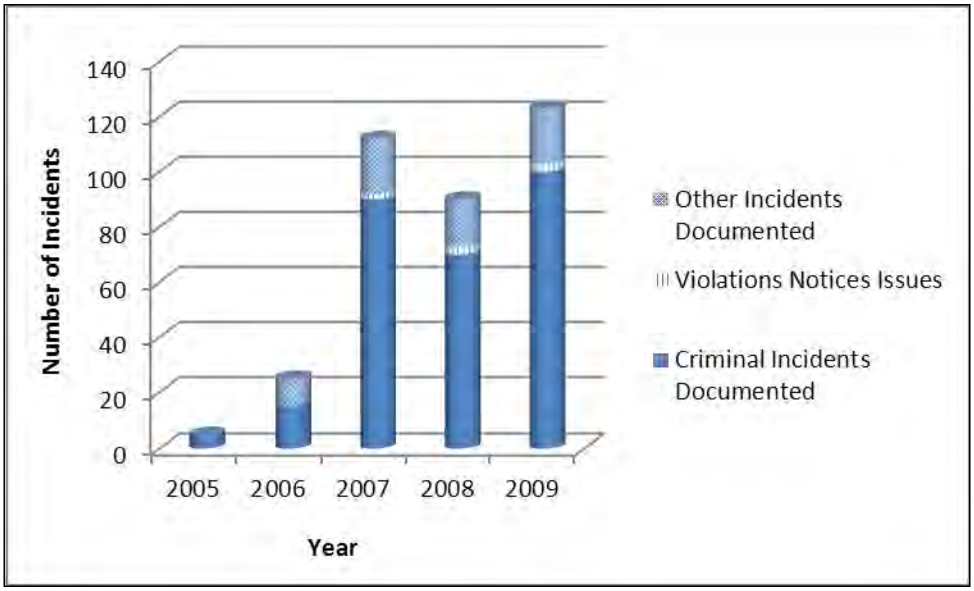
Hiking occurs regularly on the Refuge trails identified in Section 5.2.4. Horseback riding, bicycling, and cross-country skiing occur infrequently. These activities are currently allowed only on Refuge roads open to vehicular traffic.

## 5.5.2 Commercial Public Use

Commercial public uses include those activities where monetary gain is realized through recreational activities. These uses occur occasionally on the Refuge and include commercial photography and commercial guided tours and trail ride operations. These activities are generally limited to portions of the Refuge already open to the public, such as designated roads, trails, and hunting and fishing areas. The scale of commercial activities conducted each year on the Refuge is currently unknown. Commercial outfitters are required to obtain a special use permit, but the Refuge has been unable to enforce this provision because of the large size of the Refuge and multiple access points.

# 5.6 Illegal Uses

The Refuge has been affected by wildlife poaching, off-road vehicle use, trespassing cattle, looting of archaeological sites, and fishing and hunting violations. Target shooting and vandalism of entrance, boundary, and directional signs is also a problem. Over 1,300 law enforcement field hours were documented in the 2009 RAPP Station Report. Cooperative relationships with other law enforcement organizations have improved the effectiveness of law enforcement on the Refuge. Violations, criminal incidents, and other incidents are shown in Figure 5-4.




Source: Refuge records.

**Figure 5-4. Violation and incidents documented, 2005 to 2009 RAPP Station Report.**

# 5.7 Area Outdoor Recreational Opportunities and Trends

## 5.7.1 Nearby Recreational Opportunities

The BLM manages about 60 percent of the lands within the county, and the USFS manages an additional 20 percent. Forests in the northern part of the county, the Refuge in the middle of the county, Steens Mountain and the associated Steens Mountain Wilderness Area (SMWA) to the south, Diamond Craters Outstanding Natural Area, several wild and scenic river (WSR) segments (e.g., the Donner und Blitzen WSR), and several scenic byway tour routes provide a wide variety of recreational opportunities for the county's residents and visiting recreationists.

Recreational opportunities and activities include hunting, fishing, camping, picnicking, wildlife/landscape viewing, geological sightseeing, horseback riding, biking, cross-country skiing, snowmobiling, high-altitude running, historic buildings, and hot springs. Over 300 species of birds migrate through the county each spring and their importance is acknowledged with the annual John Scharff Migratory Bird Festival, held in April. In addition, Harney County is known for having some of the lowest levels of ambient light in the nation, which provides excellent star-gazing opportunities (Harney County Chamber of Commerce [HCCC] 2010).

The Steens Mountain Cooperative Management and Protection Area, managed by BLM, draws an estimated 44,000 visitors to the area each year. Popular activities include camping, picnicking, sightseeing, and exploring the open country on foot and horseback. Bicycling, fishing, and hunting are also popular. Cross-country skiing, snowshoeing, and limited snowmobiling are winter favorites. Some activities within the Cooperative Management and Protection Area, such as motorized access for winter recreation and organized group functions, may require a special use permit from BLM.

BLM provides a popular campground at Page Springs along the boundary of the southern part of the Refuge, as well as dry camping on lands adjacent to the Refuge. Several local businesses provide camping and lodging near the Refuge.

In addition to the recreational activities mentioned above, a private hunt club is located adjacent to the Refuge, and private outfitters/guides offer opportunities for personalized tours or other activities. ODFW also manages a hunter access program on private lands adjacent to the Refuge that is open according to state regulations for hunting and fishing.

## 5.7.2 Regional and State Recreation Factors and Trends

Oregon Parks and Recreation Department (OPRD) began an Oregon Statewide Comprehensive Outdoor Recreation Plan (SCORP) planning process in September 2005 (OPRD 2008). OPRD has taken a more proactive approach in addressing a limited number of previously identified and defined issues. Key findings from the 2003-2007 SCORP and the 2005-2014 statewide trails planning efforts identified a number of important demographic and social changes facing outdoor recreation providers in the coming years, including:

- Rapidly aging Oregon population
- Fewer Oregon youth learning outdoor skills
- Increasingly diverse Oregon population
- Oregon’s physical activity crisis

Following completion of the research studies, key recommendations were divided into two categories: statewide recommendations and local recommendations. Statewide recommendations are relevant for all recreation providers across the State of Oregon as described in Table 5-5. Local recommendations apply to those high-priorities counties and/or cities identified in SCORP research projects.

**Table 5-5. 2008-2012 Oregon SCORP Statewide Recommendations**

| Rapidly Aging Oregon Population | Fewer Oregon Youth Learning Outdoor Skills | Increasingly Diverse Oregon Population | Oregon’s Physical Activity Crisis |
|---|---|---|---|
| • Develop a trails website to facilitate recreational trail use<br>• Develop a marketing plan to encourage outdoor recreation participation of baby boomers<br>• Create an interagency | • Develop a youth outdoor programming framework and funding source to focus youth programming efforts toward set key objectives<br>• Develop a menu of after-school programs that are linked to current education standards and key | • Encourage organizational cultural change within public recreation agencies and organizations to effectively address the diversity issue<br>• Create a pilot project to identify how to increase under-represented population access | • Develop a marketing plan to encourage Oregonians to become physically active by using park and recreation facilities and services<br>• Develop and institutionalize the statewide trails website and add information about physical activity–related recreation programs and facilities following completion of the recreational trails work<br>• Work with medical community to get outdoor recreation |

| Rapidly Aging Oregon Population | Fewer Oregon Youth Learning Outdoor Skills | Increasingly Diverse Oregon Population | Oregon's Physical Activity Crisis |
|---|---|---|---|
| volunteer information website or other communications medium to match boomer volunteers with recreation or natural resource projects<br>• Facilitate the development of local senior walking clubs<br>• Identify ways to fund accessible trails in remote settings | objectives in the youth outdoor programming framework<br>• Develop a "Let's Go Camping" marketing campaign targeting adults with children to get parents outdoors with their children<br>• Create a new Outdoor Recreation Section within the Oregon Recreation and Park Association | to outdoor sports fields<br>• Develop recommendations for addressing language barriers to encourage under-represented populations' use of outdoor recreation facilities and programs<br>• Create a customer service training module related to serving the outdoor recreation needs of an increasingly diverse population | participation information into medical offices and physician referrals<br>• Identify ways to fund recreation maintenance and facility development on school grounds<br>• Develop a strategy to strengthen the role of parks and recreation agencies in the state's Safe Routes to Schools grant program<br>• Create a pilot program to identify how to increase under-represented populations' access to outdoor sports fields<br>• Identify ways to fund and maintain bicycle trails on Oregon Department of Transportation rights-of-way |

## 5.8 Social/Economic Environment

Much of the socioeconomic data presented in this chapter is derived from data compiled for the 2010 North Steens 230-kV Transmission Line Project Draft Environmental Impact Statement (TLDEIS) prepared by the Burns District BLM (BLM 2010). A portion of that project includes Malheur Refuge, making information contained in the TLDEIS relevant to this CCP.

### 5.8.1 Environmental Justice

In February 1994, President Clinton issued Executive Order 12898, requiring that all Federal agencies seek to achieve environmental justice by "identifying and addressing … disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations." Environmental justice is defined as the "fair treatment for people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies."

Additional guidance from the President's Council on Environmental Quality (CEQ) clarifies that environmental justice concerns may arise from effects on the natural and physical environment that produce human health or ecological outcomes, or from adverse social or economic changes.

The evaluation of environmental justice issues is mandated and regulated at the Federal level, and compliance with the National Environmental Policy Act (NEPA) requires analysis of environmental justice effects. As such, environmental justice is considered part of the NEPA process.

The key social and economic parameters addressed here are race/ethnicity and measures of social and economic well-being, including per capita income, poverty rates, and unemployment rates. Each of these is addressed in the sections below.

## 5.8.2 Regional Economic Setting

Malheur Refuge is located in southeastern corner of Oregon in Harney County. Towns located near the Refuge include the agricultural communities of Diamond (15 miles distant), Frenchglen (immediately adjacent), and Crane (40 miles distant), and Burns/Hines (35 miles distant).

The economics of the area are evenly divided between private industry (livestock production, tourism, retail, transportation, etc.) and government (federal, state, and local) employment.

## 5.8.3 Population and Income

### Population

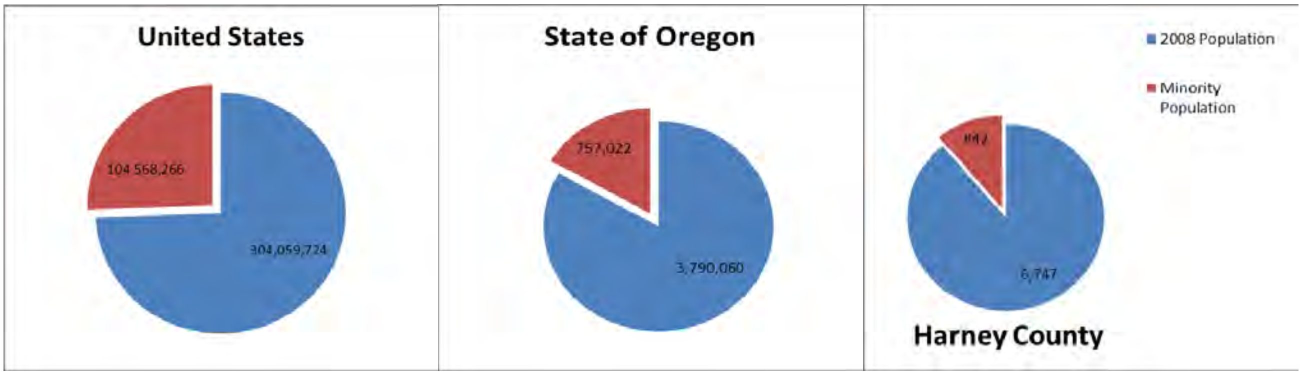
Table 5-6 shows the population estimates and past trends for Harney County, as well as the Burns and Hines communities. As shown in Table 5-6, the 2010 population of Harney County accounts for only a fraction of a percent of the population of Oregon. The two cities of Burns and Hines house the majority of the county’s population.

**Table 5-6. Local and Regional Population Estimates and Characteristics**

| | Residents | Persons per Square Mile | Population Percent Change 2000-2010 |
|---|---|---|---|
| State of Oregon | 3,831,074 | 40 | 12% |
| Harney County | 7,422 | >1 | −2.5% |
| Principal towns near Refuge | | | |
| Burns | 2,806 | N/A | |
| Hines | 1,563 | N/A | |

Source: U.S. Census Bureau 2011.

***Minority Populations:*** Figure 5-5 presents relative population and minority percentages for the county, state, and nation based on 2008 population estimates by the U.S. Census Bureau. In 2008, Harney County’s minority population was 842 residents and represented 12 percent of the total population. The Harney County minority population continued to reflect relatively fewer minority residents compared to Oregon, which was comprised of 20 percent minorities in 2008, and the United States, comprised of 34 percent minorities in 2008.




Source: U.S. Census Bureau 2008.
Notes: Minority is defined as Black and African American, American Indian and Alaskan Native, Asian, Native Hawaiian and Other Pacific Islander, Hispanic/Latino, or any person of two or more races.

**Figure 5-5. Regional minority composition.**

## Personal Income

***Median Family Income:*** The U.S. Department of Housing and Urban Development defines low income as less than 80 percent of the median family income for the area, subject to adjustment for areas with unusually high or low incomes or housing costs.

The median household income documented in 2007 for Oregon was $35,143, whereas the median household income for Harney County was $28,238, which is approximately 80 percent of the statewide level.

***Per Capita Income:*** As presented in Table 5-7, per capita income in Harney County is about $7,000 less than that in Oregon and $10,000 less than that in the United States. This low per capita income indicates the presence of low-paying employment opportunities in the county.

The annualized rate at which per capita income grew between 2001 and 2007 within the county (5%) is greater than the state or national rate of 3.9 percent and 4.4 percent, respectively (U.S. Bureau of Economic Analysis 2009). A low per capita income in a community indicates the presence of low-paying employment opportunities.

**Table 5-7. Per Capita Personal Income**

| | 2001 | 2007 | Annualized Rate of Change (%) |
|---|---|---|---|
| Harney County | 21,706 | 28,238 | 5.0% |
| Oregon | 28,530 | 35,143 | 3.9% |
| United States | 30,582 | 38,615 | 4.4% |

Source: U.S. Bureau of Economic Analysis 2009.

***Poverty Rates:*** Poverty rates represent the percentage of an area's total population living at or below the poverty threshold established by the U.S. Census Bureau. Based on 2000 Census data, the poverty rate was 11.8 percent in Harney County and 11.6 percent in the State of Oregon (13.4

percent based on 2008 estimates). According to the 2000 Census, the poverty rate for children aged 17 years or less in Harney County was 12.9 percent (Table 5-8).

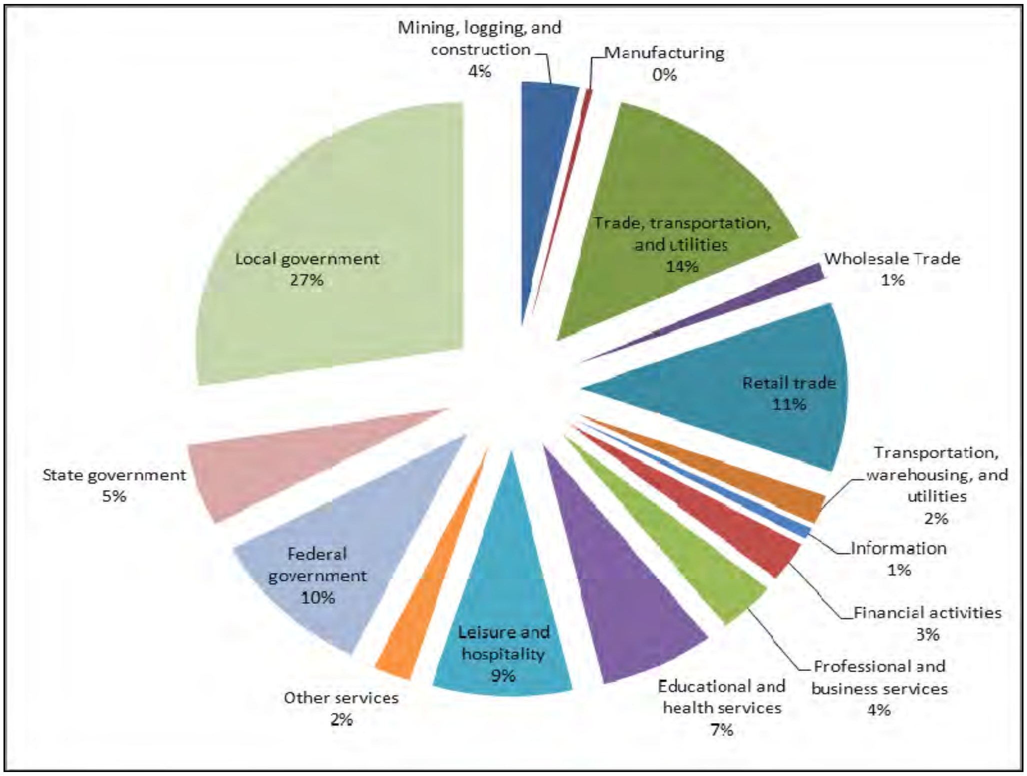
**Table 5-8. Poverty Rates at Local, County, and State Scales**

| Area | Per Capita Income | Median Household Income | Poverty Rate | Child Poverty Rate | % Difference in Poverty Rate Compared to Harney County | % Difference in Child Poverty Rate Compared to Harney County |
|---|---|---|---|---|---|---|
| Burns City | $20,756 | $34,105 | 12.3% | 8.7% | 4.2% | −32.5% |
| Hines City | $20,192 | $52,347 | 9.9% | 10.7% | −16.0% | −16.9% |
| Harney County | $20,673<br>($21,706 in 2001)<br>($28,238 in 2007) | $39,605 | 11.8% | 12.9% | 0.0% | 0.0% |
| State of Oregon | $26,789<br>($28,530 in 2001)<br>($35,143 in 2007) | $52,346<br>($49,863 in 2008) | 11.6%<br>(13.4% in 2008) | 14.7% | −1.4% | 14.0% |

Sources: Unless otherwise stated, the source of data presented in this table is the 2000 Population and Housing Census (U.S. Census Bureau 2000a, 2000b, 2000c). For the sake of consistency, all dollar values in this table are converted to 2009 dollars, such as the values for per capita income and median household income.
Other sources: U.S. Bureau of Economic Analysis 2009; U.S. Census Bureau 2009.

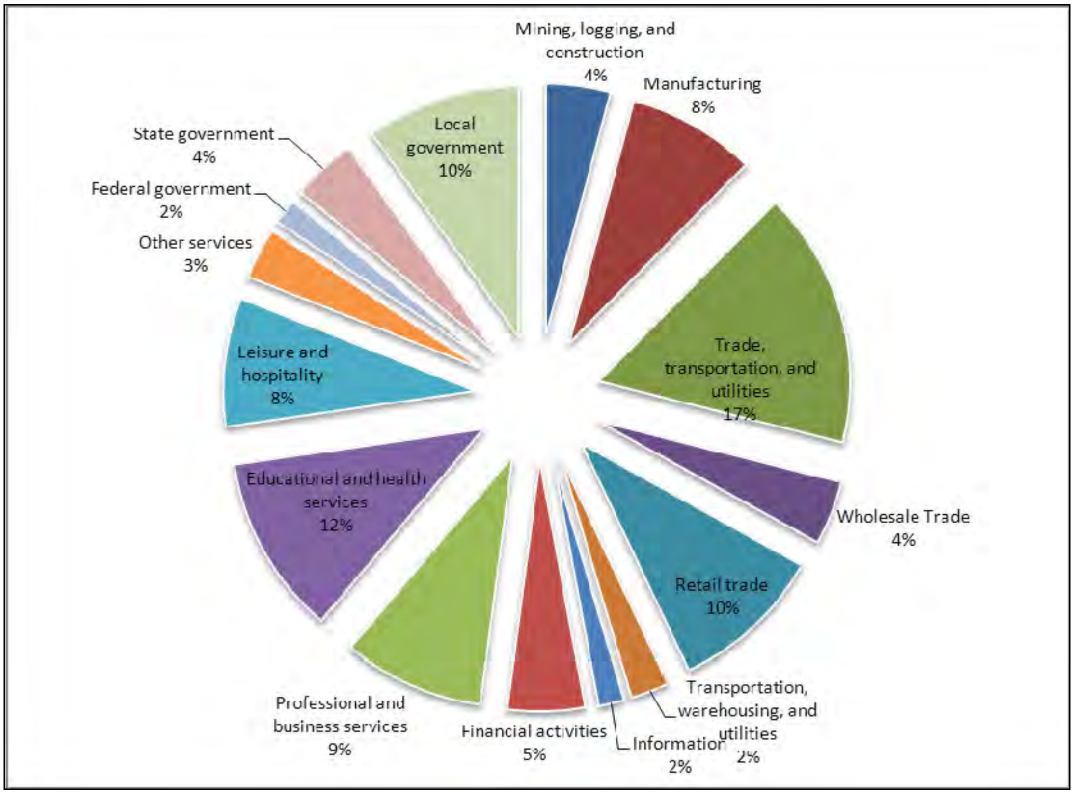
## 5.8.4 Employment and Business

***Jobs by Industry and Sector:*** Industry-specific employment information provides an important insight into the makeup of a regional economy. Total nonfarm employment in Harney County was 2,220 jobs in November 2009 (Oregon Employment Department 2009). Nonfarm employment in the county is evenly divided between private employment (50 percent) and government employment (50 percent). Comparatively, private employment constitutes 81 percent of Oregon’s nonfarm employment, with government accounting for only 19 percent of Oregon’s nonfarm employment. The industrial category employing the most people in Harney County is local government with 32 percent of the workforce, compared with only 12 percent statewide. The trade, transportation, and utilities industry is the largest private employer in Harney County with 370 employees constituting 17 percent of the employment countywide. Figures 5-6 and 5-7 show the relative contributions of each industry to total employment for Harney County and the State of Oregon, respectively.




Source: Oregon Employment Department 2009.

**Figure 5-6. State of Oregon non-farm employment.**




Source: Oregon Employment Department 2009.

**Figure 5-7. State of Oregon nonfarm employment.**

***Job Trends:*** Statewide, a 25 percent decrease occurred in the manufacturing industry, though at a significantly lower rate than in Harney County (96 percent) (Oregon Employment Department website). Other industries experiencing significant losses or gains are presented in Table 5-9 below.

**Table 5-9. Nonfarm Employment Trends by Industry, 2001 to November 2009**

| | Harney County | | | Oregon | | |
|---|---|---|---|---|---|---|
| | **2001** | **Nov 2009** | **% Change** | **2001** | **Nov 2009** | **% Change** |
| **Total nonfarm employment** | 2,580 | 2,220 | −14% | 1,605,500 | 1,626,800 | 1% |
| **Total private** | 1,380 | 1,110 | −20% | 1,323,700 | 1,321,500 | 0% |
| Mining, logging, and construction | 90 | 90 | 0% | 89,800 | 83,300 | −7% |
| Manufacturing | 240 | 10 | −96% | 215,700 | 162,800 | −25% |
| Trade, transportation, and utilities | 430 | 370 | −14% | 320,800 | 320,100 | 0% |
| Wholesale trade | 30 | 30 | 0% | 74,800 | 75,300 | 1% |
| Retail trade | 340 | 290 | −15% | 189,200 | 190,900 | 1% |
| Transportation, warehousing, | 50 | 50 | 0% | 56,800 | 53,900 | −5% |

| | Harney County | | | Oregon | | |
|---|---|---|---|---|---|---|
| | 2001 | Nov 2009 | % Change | 2001 | Nov 2009 | % Change |
| and utilities | | | | | | |
| Information | 40 | 20 | −50% | 39,900 | 34,700 | −13% |
| Financial activities | 70 | 70 | 0% | 95,200 | 93,200 | −2% |
| Professional and business services | 70 | 90 | 29% | 177,100 | 180,600 | 2% |
| Educational and health services | 160 | 180 | 13% | 178,800 | 229,200 | 28% |
| Leisure and hospitality | 230 | 220 | −4% | 149,600 | 160,300 | 7% |
| Other services | 50 | 60 | 20% | 56,700 | 57,300 | 1% |
| **Government** | 1,200 | 1,110 | −8% | 281,800 | 305,300 | 8% |
| Federal government | 260 | 260 | 0% | 30,000 | 29,000 | −3% |
| State government | 160 | 140 | −13% | 72,500 | 79,900 | 10% |
| Local government | 770 | 710 | −8% | 179,400 | 196,400 | 9% |

Source: Oregon Employment Department 2009.

In addition to a changing industry profile, Harney County has faced a reduction in jobs. Between 2001 and November 2009, 360 jobs were lost in Harney County, a decrease of 14 percent. In comparison, the number of state jobs increased by 1 percent, or 21,300 employees, over the same time period (Oregon Employment Department 2009).

Although not classified as a separate industry, there are numerous businesses in the retail and services sectors in Harney County that serve the tourism and recreation economy. In particular, the accommodation and food services, and the arts, entertainment, and recreation sectors are supported by the spending of recreation visitors. As indicated in Table 5-10, the Oregon Employment Department does not report the individual total employment in these industries, instead presenting the combined data for these two industries. In November 2009, an estimated 220 employees were employed in the Harney County leisure and hospitality sectors. Employment in these sectors has remained fairly constant in the county, fluctuating between 220 and 260 employees since 2001. Tourism is also important to the Harney County economy.

***Earnings by Industry:*** Federal non-military government employment accounts for the highest per employee earnings of any industry in Harney County with an average earning of $85,141 per industry employee (earnings include wage and salary disbursements, supplements to wages and salaries, and proprietors' income) (U.S. Bureau of Economic Analysis 2009). This figure trails State and national per employee earnings for the industry by $8,423 and $13,703, respectively. With the average State/local government employee earning $43,552 in the county, the industry is the second highest earning industry per employee. The county employee earnings in state and local government also trail the state and national earnings. Detailed information on employee earnings by industry is presented in Table 5-10.

Employees residing in Harney County earn less than similar employees in every industry elsewhere in the state or nation. The differences can be substantial, ranging up to $55,771 for finance workers. State and local government is the greatest employer in the county and accounts for the greatest total employee earnings of any industrial category in the county. Due to undisclosed data at the county level, it is impossible to compare employee earnings by industry across the county, state, and national levels in all industries in 2007. At the state and national level, the highest employee earnings are in the utilities industry, with average earnings of $141,268 per employee and $157,166 per employee, respectively. Employment and earnings in the utilities industry are not disclosed at the county level (U.S. Bureau of Economic Analysis 2009).

**Table 5-10. Employment and Earnings by Industry for Harney County and Oregon**

| | Harney County | | | Oregon | | |
|---|---|---|---|---|---|---|
| **Industry** | **Earnings ($1,000s)** | **Employees** | **Per Employee Earnings** | **Earnings ($1,000s)** | **Employees** | **Per Employee Earnings** |
| Farm earnings | $9,738 | 877 | $11,104 | $1,192,358 | 67,660 | $17,623 |
| All nonfarm earnings | $113,161 | 3,574 | $31,662 | $97,541,631 | 2,252,383 | $43,306 |
| Forestry, fishing, related activities, and other | $2,814 | 177 | $15,898 | $1,448,996 | 35,770 | $40,509 |
| Mining | | <10 | | $226,283 | 3,681 | $61,473 |
| Utilities | (D) | (D) | | $701,752 | 4,964 | $141,368 |
| Construction | (D) | (D) | | $6,745,644 | 150,561 | $44,803 |
| Manufacturing | (D) | (D) | | $14,437,333 | 217,114 | $66,497 |
| Wholesale trade | $1,343 | 54 | $24,870 | $6,378,920 | 89,537 | $71,243 |
| Retail trade | $9,050 | 493 | $18,357 | $6,885,871 | 255,349 | $26,967 |
| Transportation and warehousing | (D) | (D) | | $3,392,809 | 68,813 | $49,305 |
| Information | $1,333 | 39 | $34,179 | $2,816,534 | 42,724 | $65,924 |
| Finance and insurance | $1,774 | 67 | $26,478 | $4,930,999 | 85,602 | $57,604 |
| Real estate and rental and leasing | $1,707 | 87 | $19,621 | $1,915,803 | 89,921 | $21,305 |
| Professional, scientific, and technical services | $2,571 | 103 | $24,961 | $6,942,550 | 128,427 | $54,058 |
| Management of companies and | $0 | 0 | | $2,755,874 | 31,849 | $86,529 |

| | Harney County | | | Oregon | | |
|---|---|---|---|---|---|---|
| **Industry** | **Earnings ($1,000s)** | **Employees** | **Per Employee Earnings** | **Earnings ($1,000s)** | **Employees** | **Per Employee Earnings** |
| enterprises | | | | | | |
| Administrative and waste services | $873 | 98 | $8,908 | $3,388,650 | 125,923 | $26,910 |
| Educational services | (D) | (D) | | $1,011,154 | 50,770 | $19,916 |
| Health care and social assistance | (D) | (D) | | $10,645,180 | 242,233 | $43,946 |
| Arts, entertainment, and recreation | (D) | (D) | | $773,380 | 51,204 | $15,104 |
| Accommodation and food services | (D) | (D) | | $3,021,903 | 161,529 | $18,708 |
| Other services excluding public administration | $3,194 | 205 | $15,580 | $3,080,219 | 125,347 | $24,574 |
| Federal, non-military government | $20,519 | 241 | $85,141 | $2,725,141 | 29,126 | $93,564 |
| Health care and social assistance | (D) | (D) | | $10,645,180 | 242,233 | $43,946 |
| Military government | $732 | 19 | $38,526 | $548,005 | 12,378 | $44,272 |
| State and local government | $34,537 | 793 | $43,552 | $12,768,631 | 249,561 | $51,164 |

Source: U.S. Bureau of Economic Analysis 2009.

## 5.8.5 Local Tax Revenues

The principal sources of tax revenue in Harney County are income taxes and property taxes. Oregon does not collect sales taxes. The total employment income for Harney County in 2006 was $91,948,000, generating $4,741,000 in state income taxes. Over $90 billion in total income in Oregon in 2006 generated over $5 billion in tax revenues for the state (State of Oregon 2010). Income and income tax statistics for Harney County and Oregon are presented in Table 5-11.

Property assessed value and tax revenues are presented in Table 5-11. The property tax rate in Harney County is over 1 percent lower than the Oregon average rate. Harney County generated over $5.5 million in property tax revenue from total assessed property value of $382 million in the county (State of Oregon website 2009).

**Table 5-11. Regional Income and Income Tax Statistics**

| | Harney County | Oregon |
|---|---|---|
| Total income | $91,948,000 | $90,213,382,000 |
| Total income taxes | $4,741,000 | $5,150,942,000 |
| Overall income tax rate | 5.2% | 5.7% |
| Net assessed value of properties | $382,191,276 | $271,355,283,098 |
| Total property taxes | $5,547,000 | $4,279,042,000 |
| Property tax rate | 14.51% | 15.77% |

Source: Oregon Department of Revenue.

### Refuge Revenue Sharing Act

Counties receive payments in lieu of taxes from the USFWS under the Refuge Revenue Sharing Act. Payments are determined based on two criteria:

1. On acquired land, the greatest amount calculated on the basis of 75 cents per acre, three-fourths of 1 percent of the appraised value, or 25 percent of the net receipts produced from the land, and

2. On land withdrawn from the public domain, 25 percent of net receipts and basic payments under Public Law 94-565, payment in lieu of taxes on public lands.

Table 5-12 shows the in lieu of taxes payments to Harney County between 2002 and 2010.

**Table 5-12. In Lieu of Taxes Payments to Harney County, 2002 to 2010**

| Payment Year | Tax Year | Paid to Harney County |
|---|---|---|
| 2002 | 2001 | $93,449 |
| 2003 | 2002 | $46,106 |
| 2004 | 2003 | $79,443 |
| 2005 | 2004 | $89,719 |
| 2006 | 2005 | $83,038 |
| 2007 | 2006 | $80,295 |
| 2008 | 2007 | $75,842 |
| 2009 | 2008 | $75,842 |
| 2010 | 2009 | $75,842 |

## 5.8.6 Lifestyle and Social Values

Harney County was incorporated in 1889 and is very rural. The county was first explored by fur trappers and traders, and was then settled by cattle ranchers who were attracted to the abundance of bunchgrass for grazing. Many of the area ranches are still owned by members or descendants of the original homestead families, and cattle ranching, raising sheep, and hay production remain important parts of the economy in the county. An important part of the rural lifestyle and community identity is derived from the undeveloped and open landscape of much of the county.

### 5.8.7 Refuge Impact on the Local Economy

Visitors to Malheur Refuge spend money on food, lodging, equipment, transportation, and other expenses, which creates jobs within the local economy.

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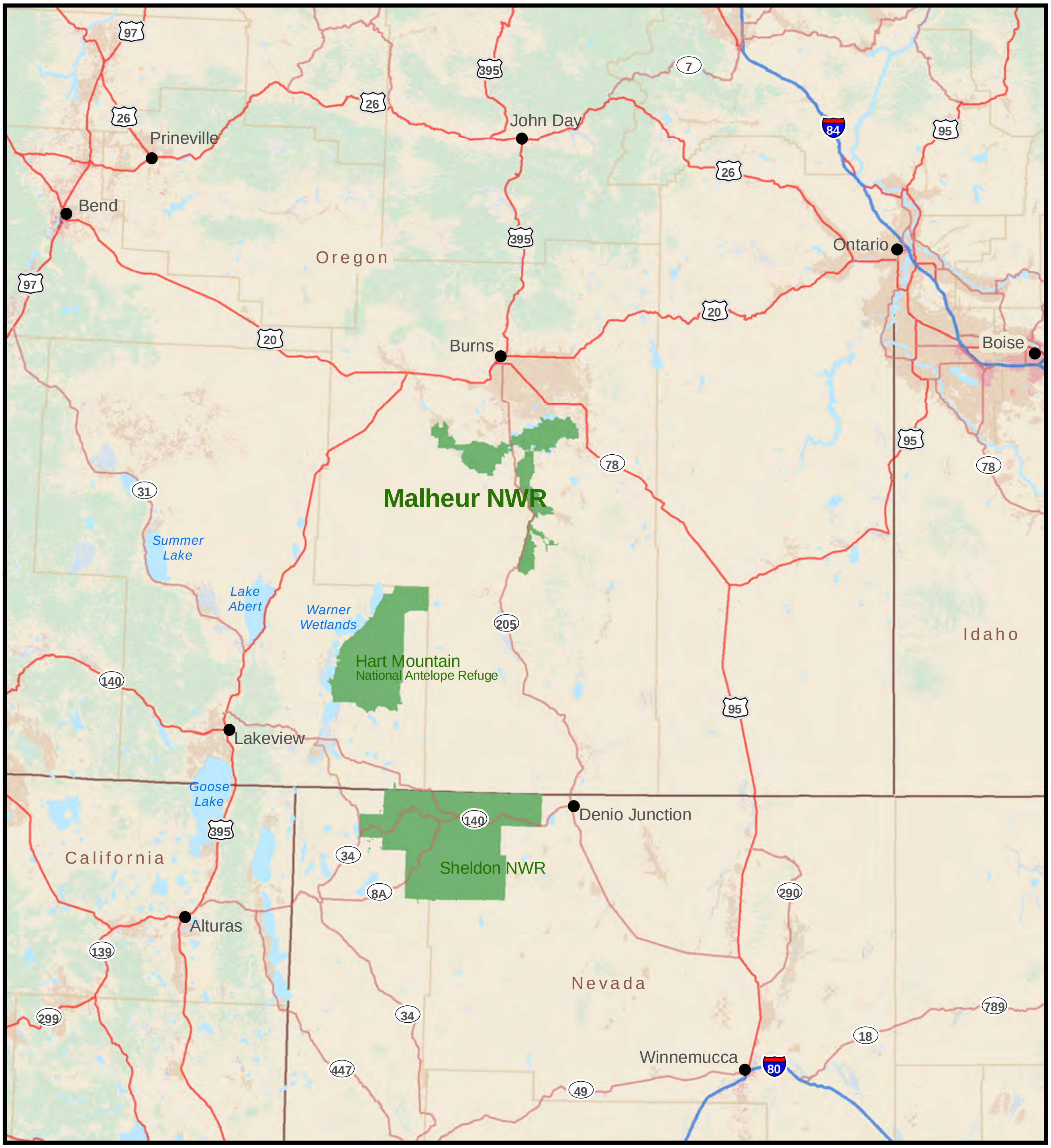
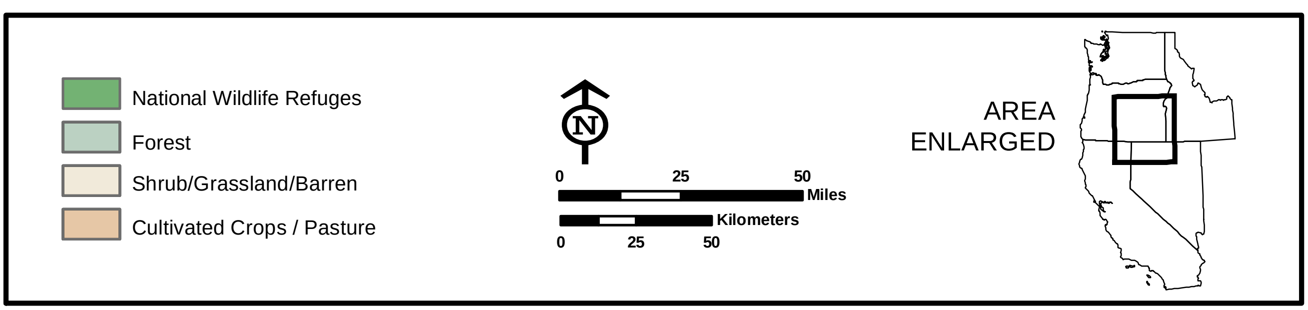
# Maps

**Map 1** ***Location of Refuge and Regional Land Cover***

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Data Source: ESRI StreetMap North America, USGS National Land Cover Dataset 2001

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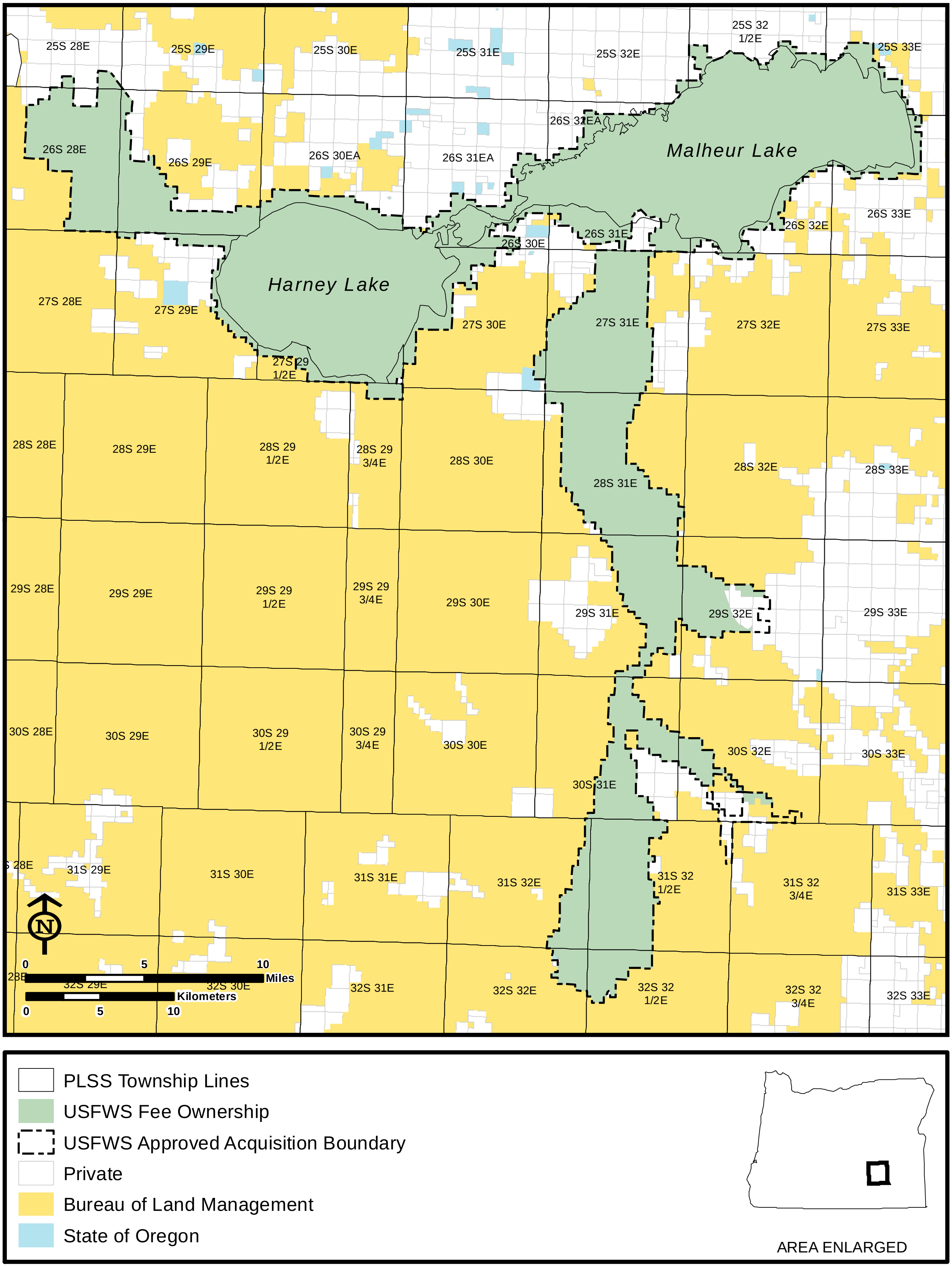
## Map 2 *Land Status*

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Data Source: Bureau of Land Management Ownership, PLSS

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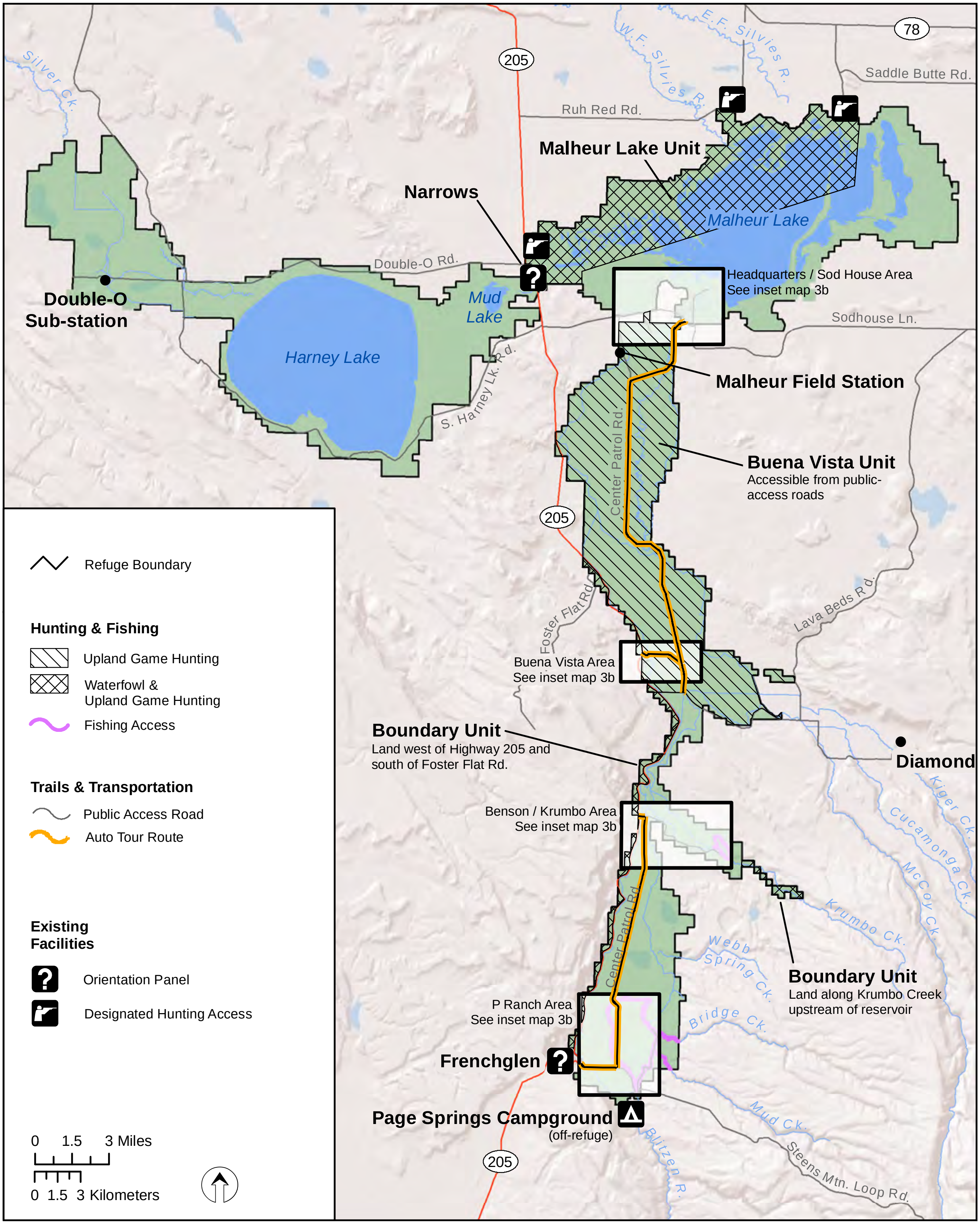
Map 3a Public Use Facilities Under Current Managment

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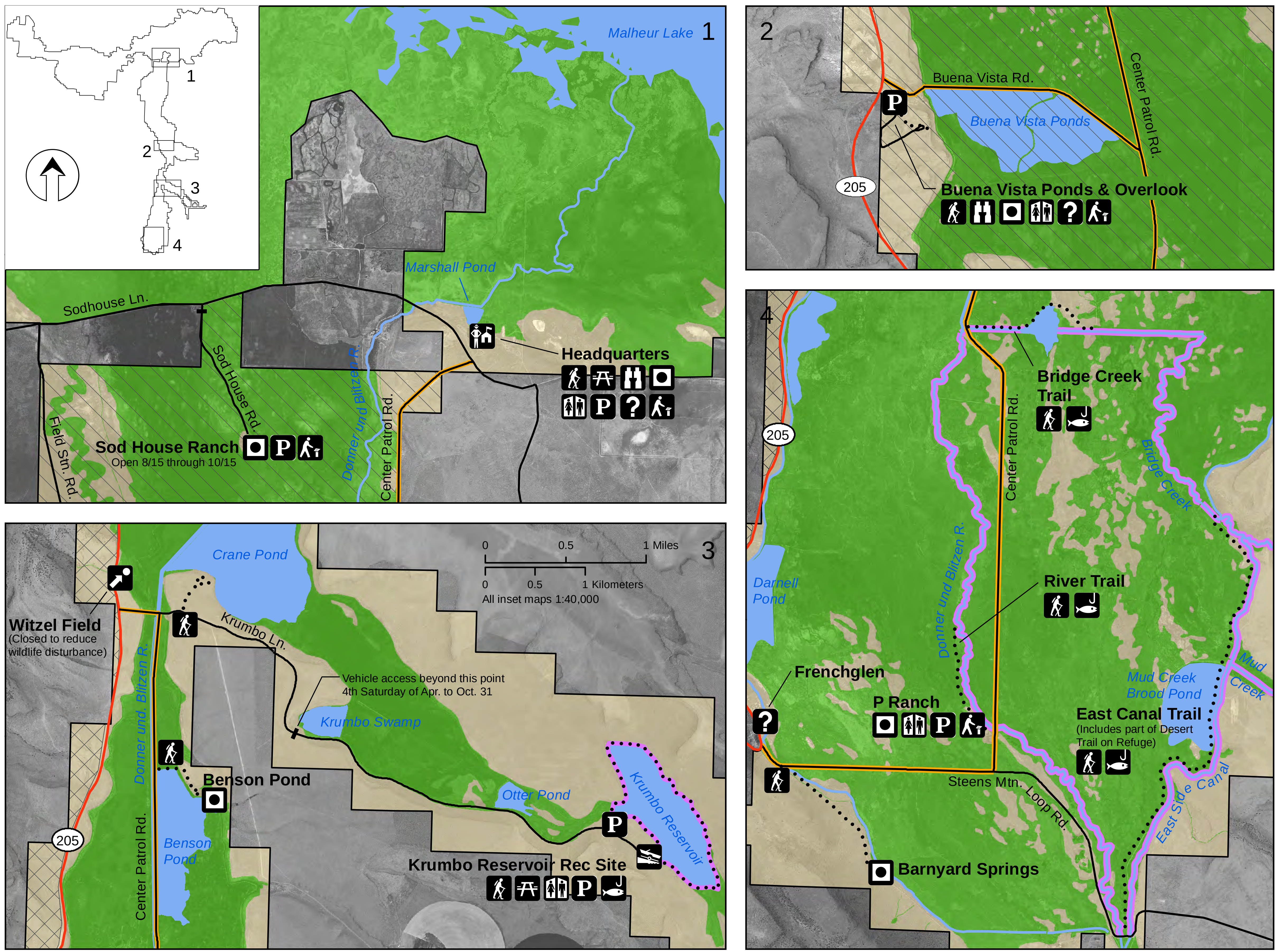
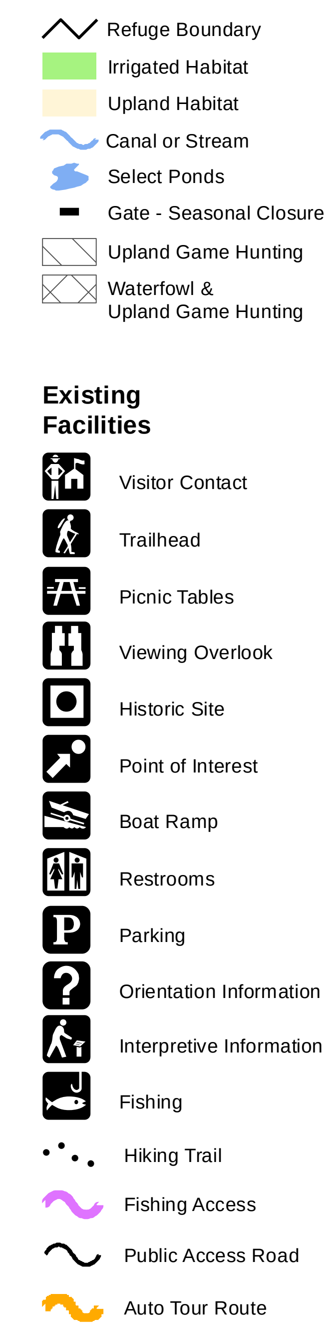
## Map 3b
## Public Use Facilities (Insets)
## Current Management

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Data Source: USDA National Agriculture Imagery Program 2009

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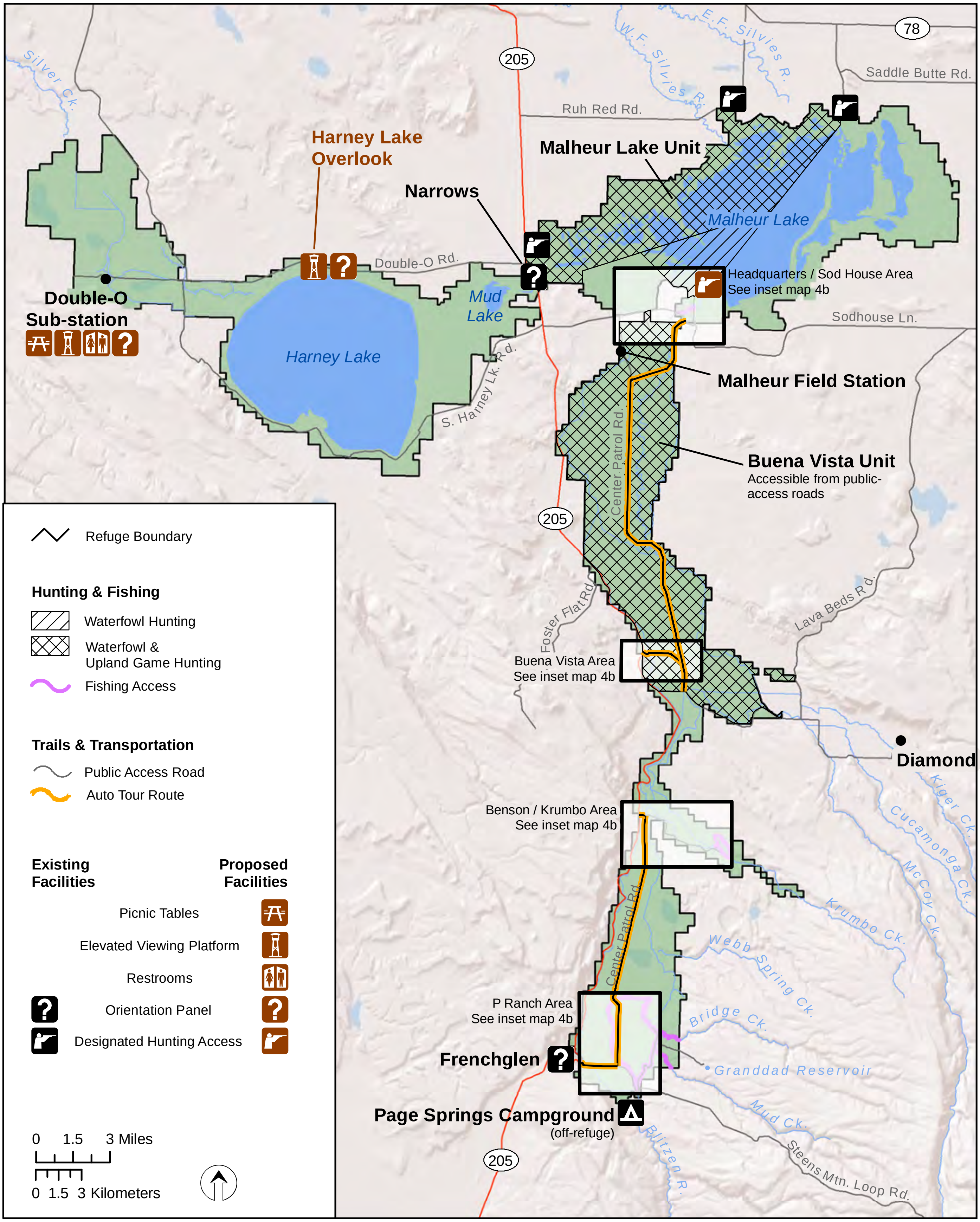
## Map 4a Public Use Facilities Under Management Direction

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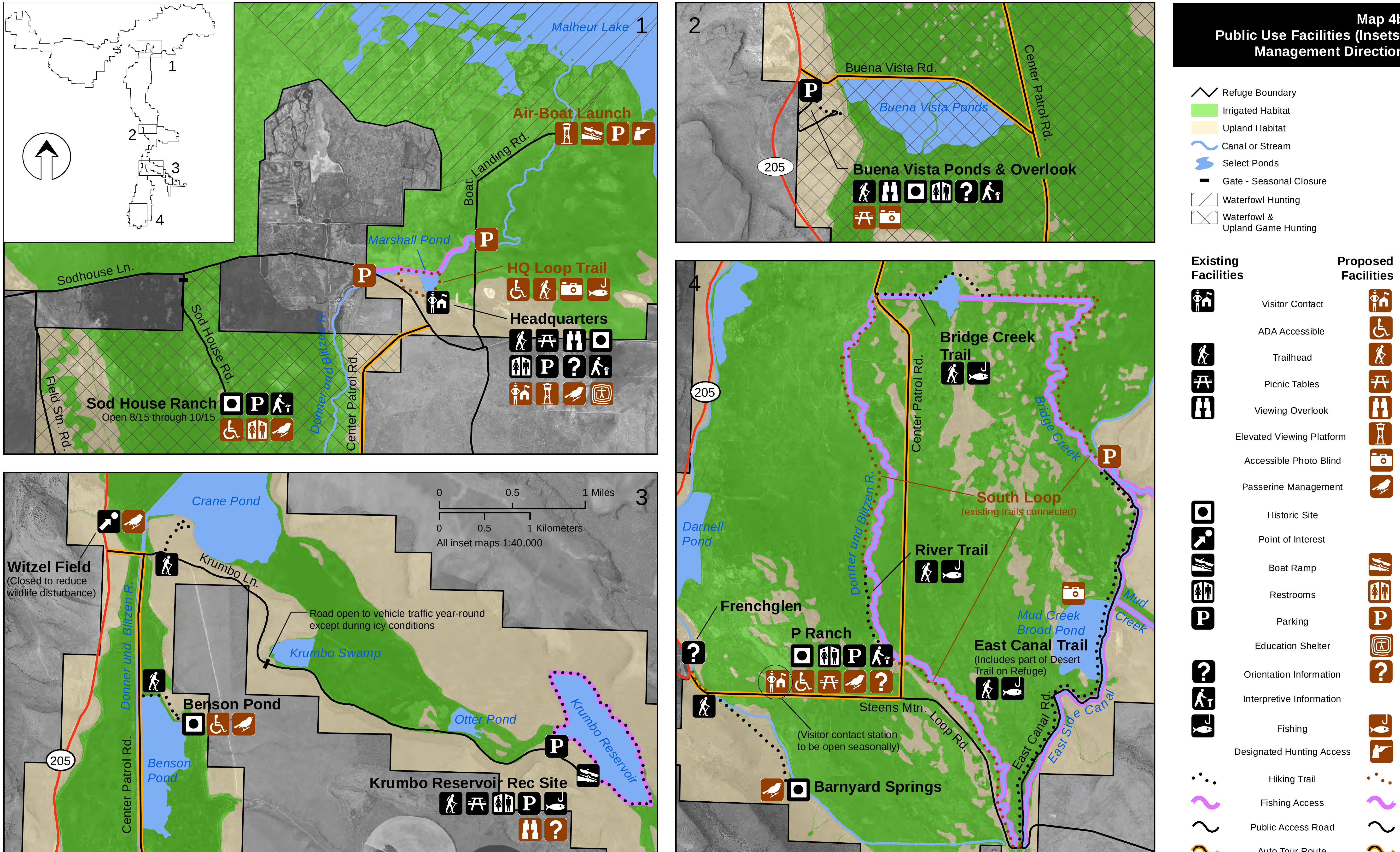
## Map 4b
## Public Use Facilities (Insets)
## Management Direction



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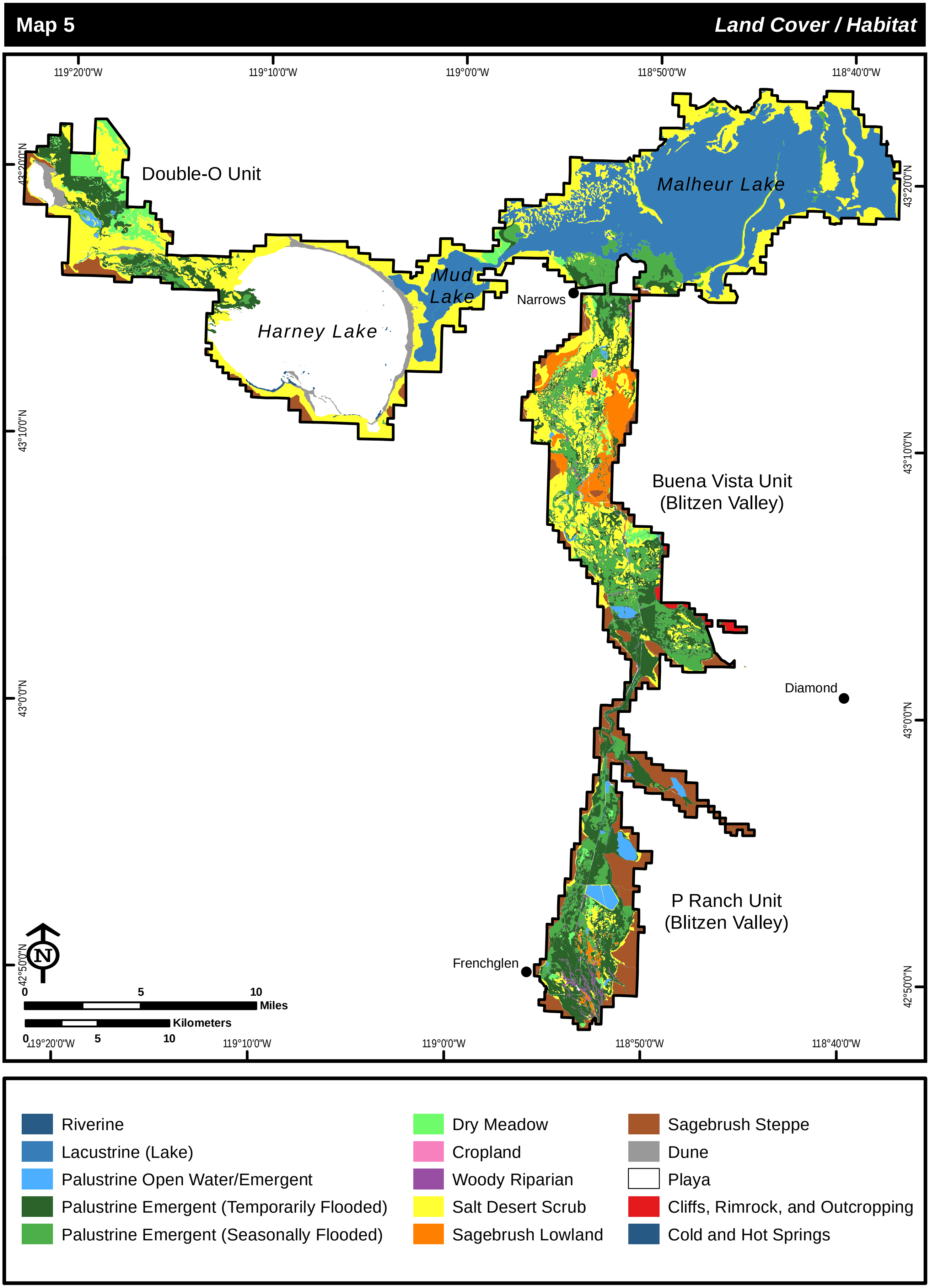


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Data Source: USDA National Agriculture Imagery Program 2011

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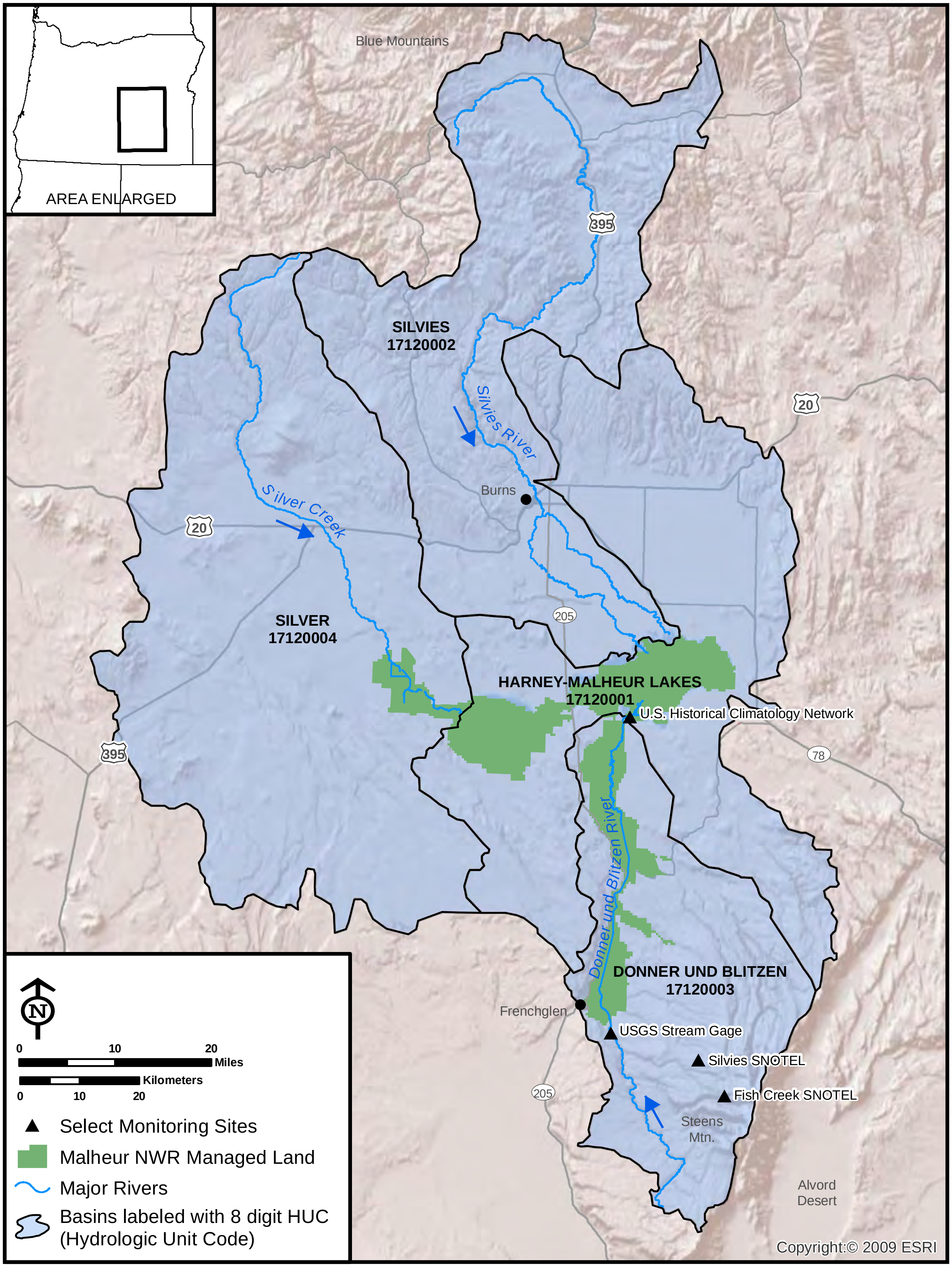
**Map 6** ***Watersheds***

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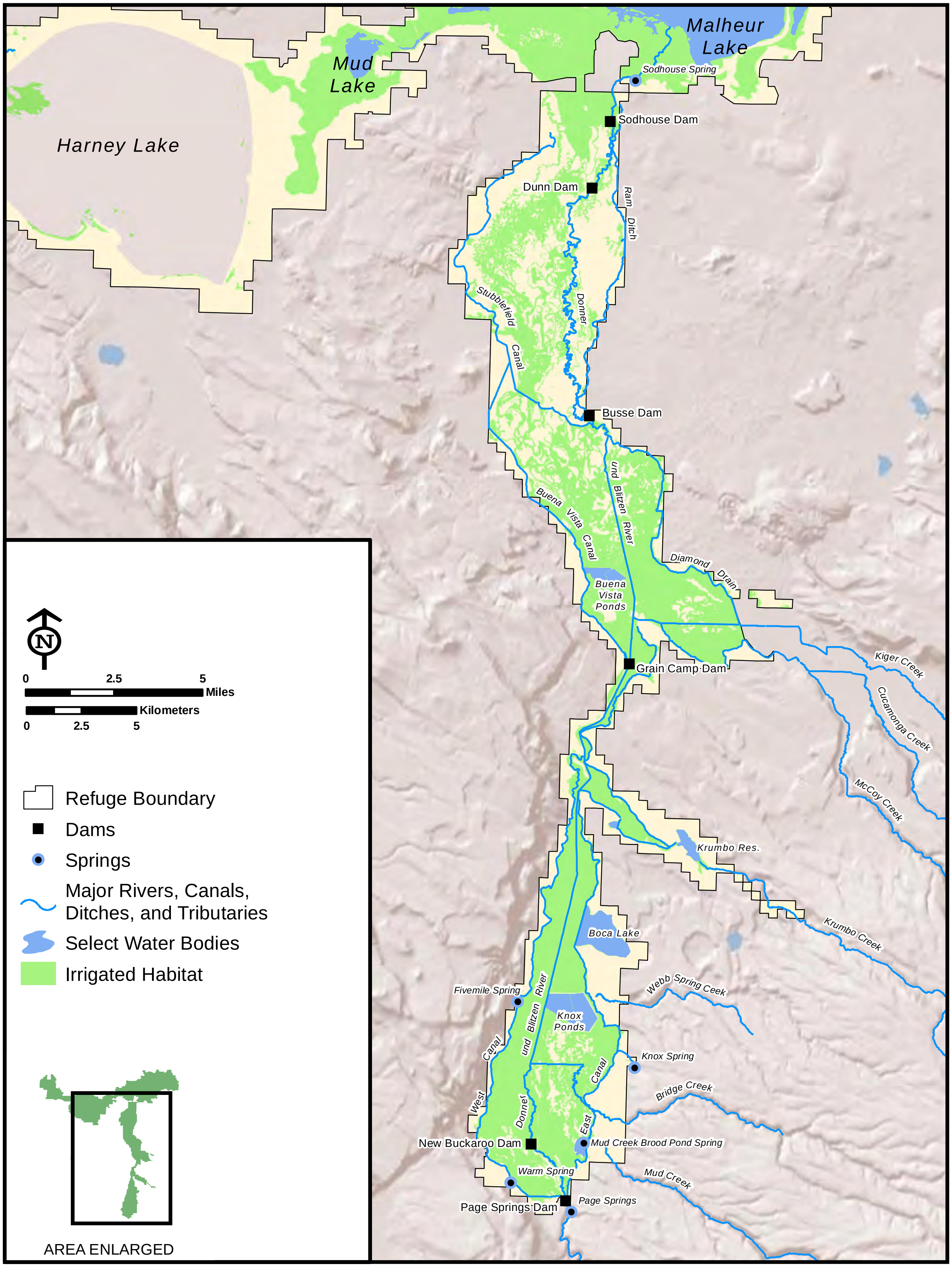
## Map 7 — *Blitzen Valley Hydrologic System*




Map Date: 9/6/2012 File: 11-053-8.mxd
Data Source: USGS NHD, ESRI_ShadedRelief_World_2D

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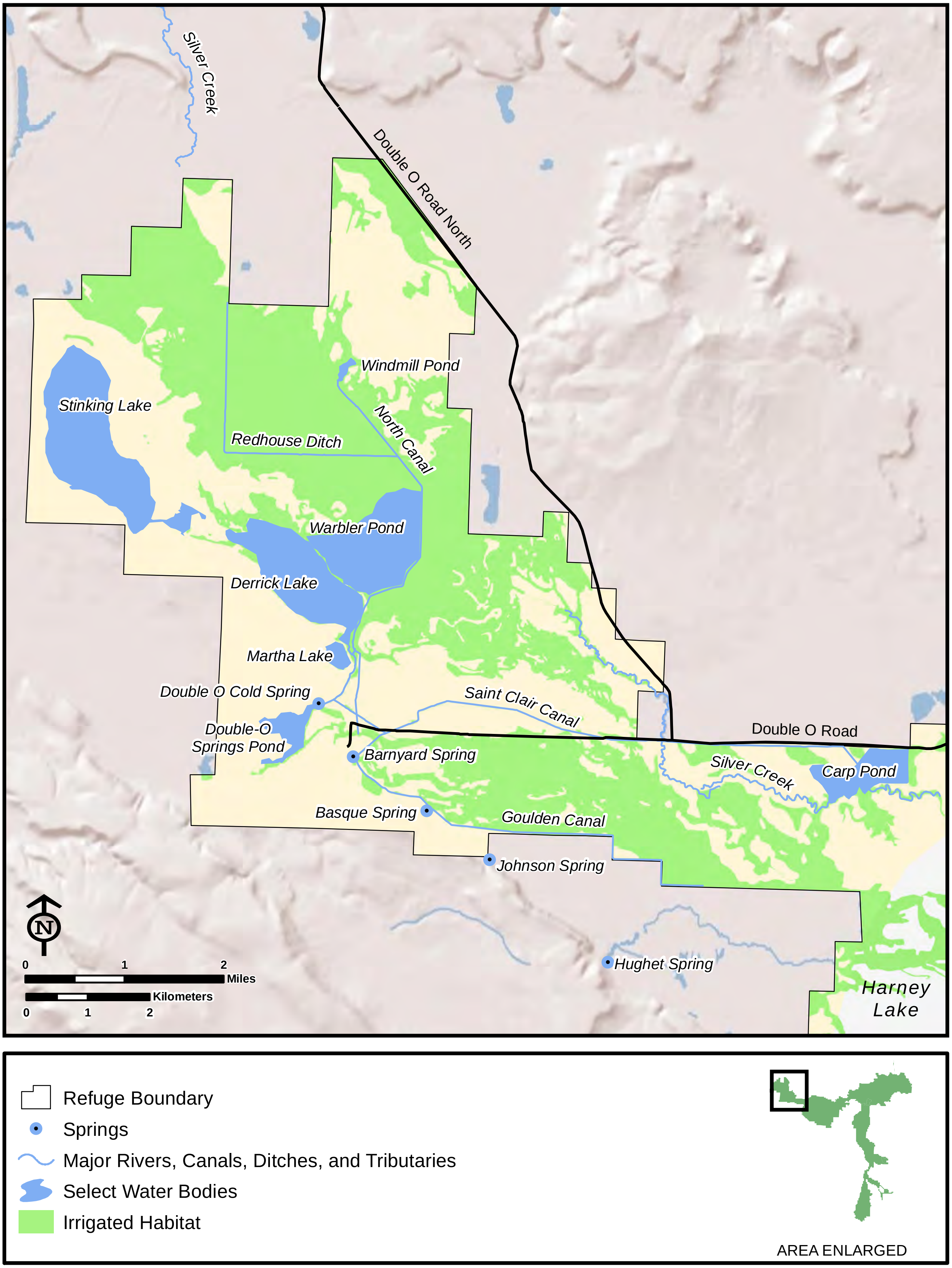
## Map 8 — *Double-O Unit Hydrologic System*




Map Date: 9/6/2012 File: 11-053-9.mxd

Data Source: USGS NHD, ESRI_ShadedRelief_World_2D, USDA National Agriculture Imagery Program 2011

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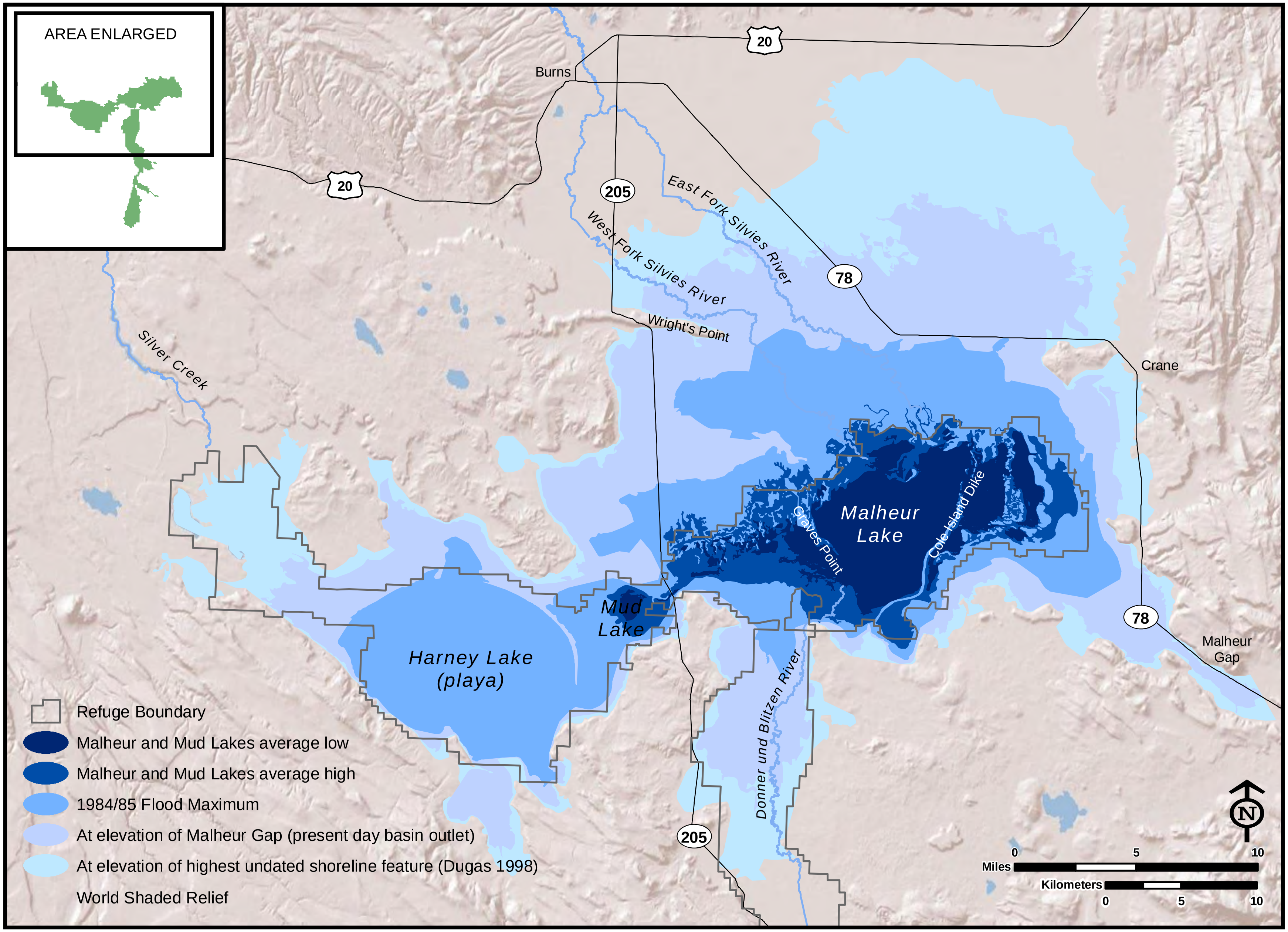
**Map 9** | ***Malheur, Mud, and Harney Lakes***




Map Date: 9/7/2012 File: 11-053-10.mxd
Data Source: ESRI_ShadedRelief_World_2D

Average low and high Malheur Lake elevations based on staff gage records 1938-2008, Malheur NWR. Contours (NGVD29 feet) derived from USGS National Elevation Dataset 30M DEM.
Source: Dugas, D.P. 1998. Late Quaternary Variations in the Level of Paleo-Lake Malheur, Eastern Oregon. Quaternary Research. 50, 276-282.

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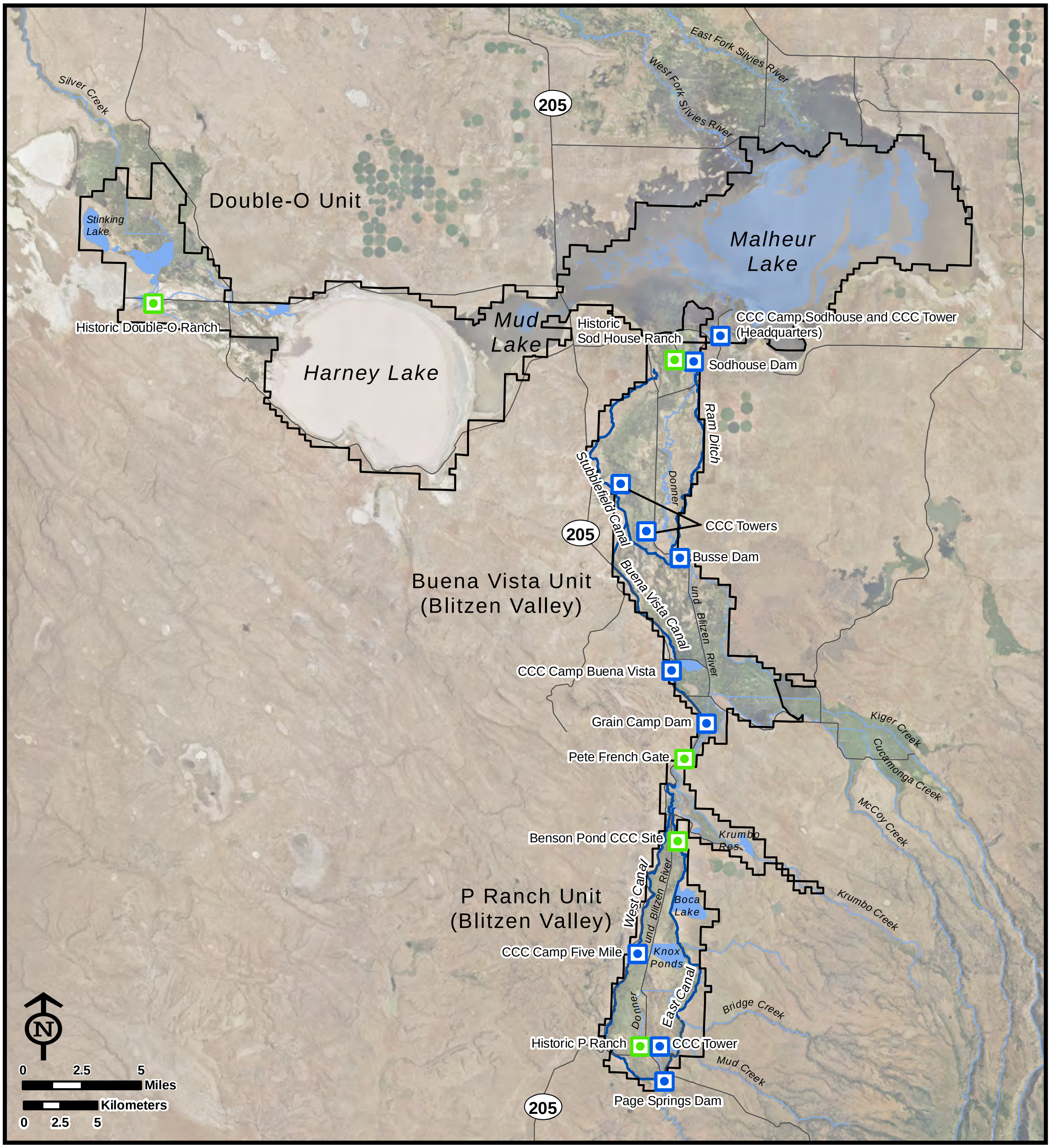
**Map 10** ***Historic Sites***




- Ranch-era Sites
- Civilian Conservation Corps (CCC) Sites
- CCC Constructed Canals and Ditches
- Refuge Boundary
- Select Hydrography
- Select Water Bodies

Map Date: 9/6/2012 File: 11-053-11.mxd

Data Source: USGS NHD, USDA National Agriculture Imagery Program 2011

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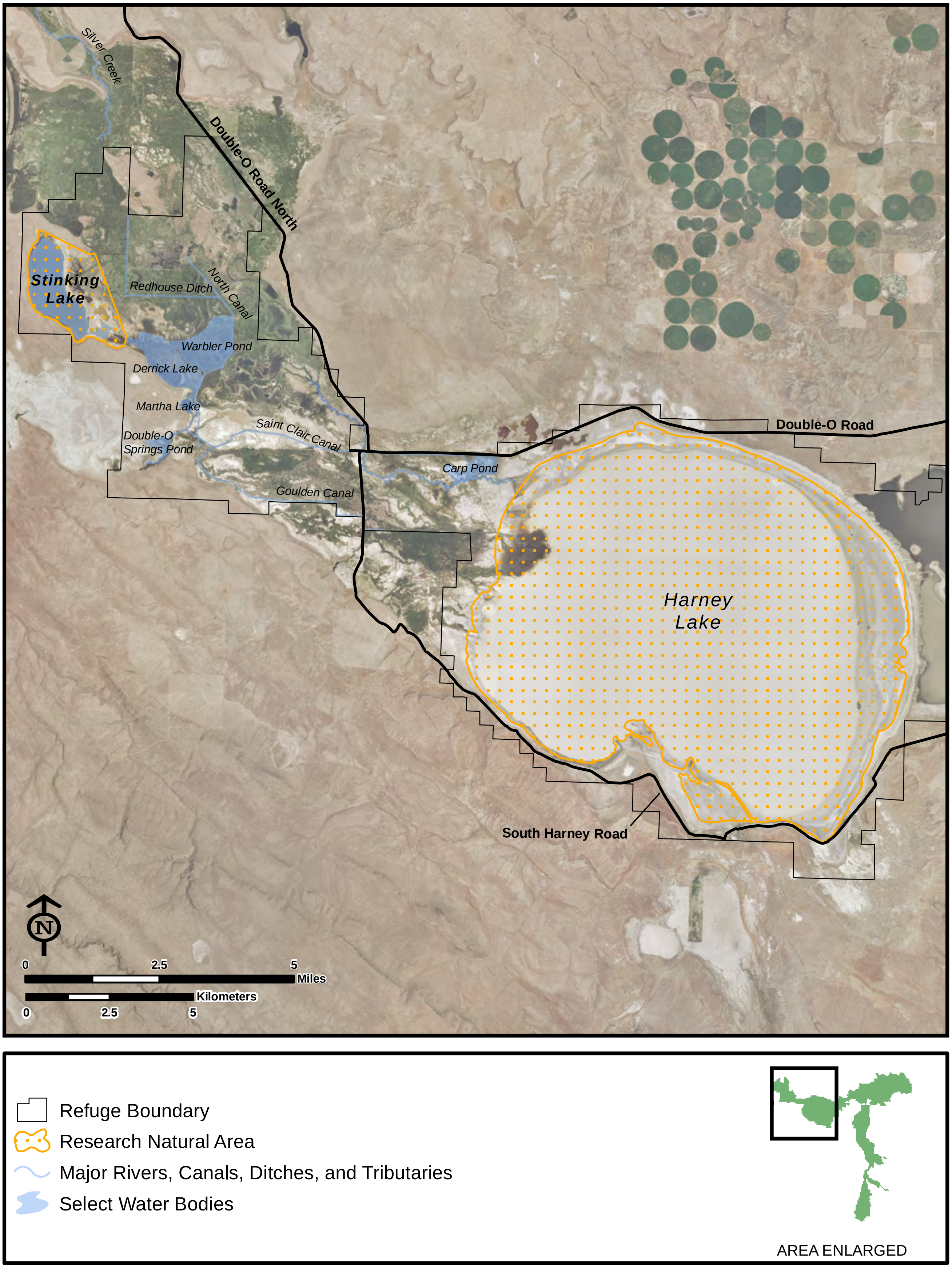
**Map 11** ***Research Natural Area Boundaries***




Map Date: 9/6/2012 File: 11-053-12.mxd
Data Source: USGS NHD, USDA National Agriculture Imagery Program 2011

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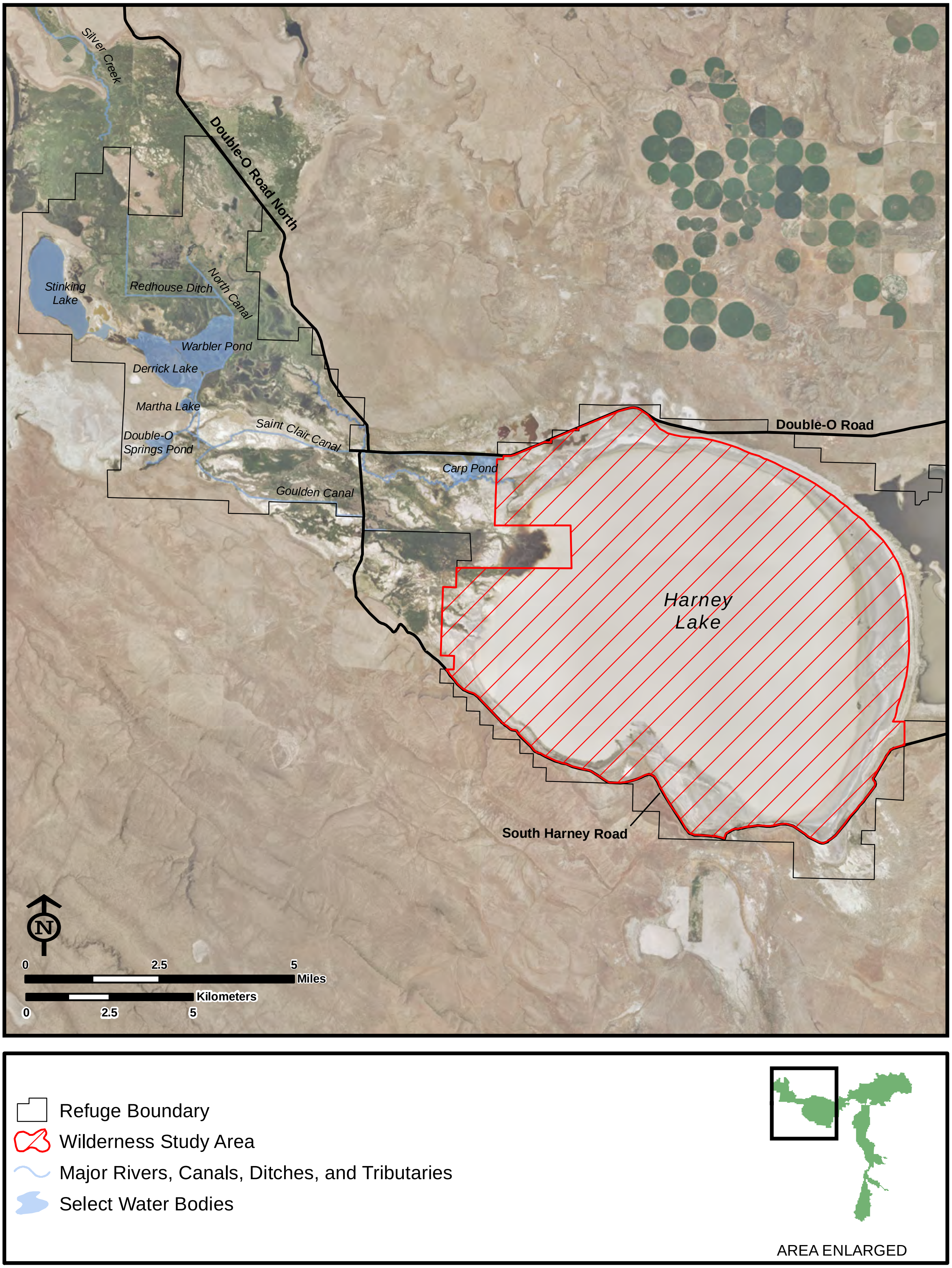
**Map 12** ***Wilderness Study Area Boundary***




Map Date: 11/5/2012 File: 11-053-13.mxd
Data Source: USGS NHD, USDA National Agriculture Imagery Program 2011

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*Greater sandhill crane*
©Brendan Lally

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*Refuge staff conducting research*
©Barbara Wheeler

# Appendix A
## Appropriate Use Findings


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Response to Comments

The Appropriate Refuge Uses Policy (603 FW 1), finalized in 2006, outlines the process that the Service uses to determine when general public uses on refuges may be considered. Uses proposed for a National Wildlife Refuge must first be found appropriate and compatible. The appropriate use review occurs prior to applying the compatibility screening. Compatibility determinations are found in Appendix B.

Public uses previously defined as wildlife-dependent uses under the National Wildlife Refuge System Improvement Act of 1997 (hunting, fishing, wildlife observation and photography and environmental education and interpretation) are generally exempt from appropriate use review. Other exempt uses include refuge management activities and situations where the Service does not have adequate jurisdiction to control the activity. State fish and wildlife agency activities are not subject to this policy when they:

1. Directly contribute to the achievement of refuge purpose(s), refuge goals, and the Refuge System mission, as determined by the refuge manager in writing,
2. Are addressed in a document such as a Regional or California/Nevada Operations Office (CNO) memorandum of understanding or a comprehensive conservation plan (CCP), or
3. Are approved under national policy.

Other existing, proposed, or requested public uses are required to undergo the appropriateness screen. Appropriate use policy provides refuge managers with a consistent procedure to screen and document decisions concerning public uses, with the use of the following questions:

(a) Do we have jurisdiction over the use?
(b) Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?
(c) Is the use consistent with applicable executive orders and department and Service policies?
(d) Is the use consistent with public safety?
(e) Is the use consistent with goals and objectives in an approved management plan or other document?
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
(g) Is the use manageable within the available budget and staff?
(h) Will this be manageable in the future within existing resources?
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality, compatible, wildlife-dependent recreation into the future?

Uses marked "no" for questions (a) or (b) are not evaluated further. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate.

When a use is determined to be appropriate, a refuge manager must then decide if the use is compatible before allowing it on a refuge.

The following forms show which uses have been determined appropriate and which have been determined not appropriate. Narrative answers for findings follow each form. Interpretation of two of the questions on the form, (e) and (f), are explained below:

- Question (e) on the appropriate uses form (Is the use consistent with goals and objectives in an approved management plan or other document?) is interpreted as follows: The approved management plan in question is interpreted as the CCP.
- Question (f) (Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?) was checked yes if this is the first time the use has been formally considered in a planning process. Question (f) was also checked yes if there is no documentation of the use being denied in an earlier planning process.

**FINDING OF APPROPRIATENESS OF A REFUGE USE**

Refuge Name: Malheur National Wildlife Refuge

Use: Commercial Tours and Photography

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

| Decision Criteria: | YES | NO |
|---|---|---|
| (a) Do we have jurisdiction over the use? | ✓ | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)? | ✓ | |
| (c) Is the use consistent with applicable Executive orders and Department and Service policies? | ✓ | |
| (d) Is the use consistent with public safety? | ✓ | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | ✓ | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | | ✓ |
| (g) Is the use manageable within available budget and staff? | ✓ | |
| (h) Will this be manageable in the future within existing resources? | ✓ | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | ✓ | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | ✓ | |

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ___ **Appropriate** ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: ______ Date: 1-24-13

**A compatibility determination is required before the use may be allowed.**

FWS Form 3-2319
02/06

## Appropriate Uses Justification, Attachment 1

**Date:** November 2, 2011

**Refuge:** Malheur National Wildlife Refuge (Refuge)

**Use:** Commercial Tours and Photography

**Summary:** Commercial tours and photography uses on the Refuge cover a broad range of resource-based activities, including birding, geology, plant identification, art and visual interpretation, music, sound recording, and other similar non-consumptive activities. These uses usually occur in areas open to the public, using the same facilities associated with non-commercial recreational uses.

For findings listed on FWS Form 3-2319, and if deemed necessary, a justification has been provided below.

**a. Do we have jurisdiction over the use?**

All of the proposed activities would take place within Refuge boundaries. The Refuge has jurisdiction over collections within Refuge boundaries.

**b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?**

Any proposed activities would comply with all applicable laws and regulations and any restrictions or qualifications that are required to comply with law and regulations would be specified in the special use permit (SUP).

**c. Is the use consistent with applicable executive orders and department and Service policies?**

Under U.S. Fish and Wildlife Service (USFWS) Policy (50 CFR 29.1), a commercial recreational use is a use that generates revenue or that results in a commodity that is or can be sold for income or revenue.

The Appropriate Use Policy (603 FW 1) specifically references commercial uses of this kind. The policy states that "Commercial uses of a refuge may be considered appropriate if they are a refuge management economic activity (see 50 CFR 25.12), if they directly support a priority general public use, or if they are specifically authorized by statute … An example of a commercial use that may be appropriate is a concession-operated boat tour that facilitates wildlife observation and interpretation."

**d. Is the use consistent with public safety?**

Through SUP review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project's SUP.

**e. Is the use consistent with goals and objectives in an approved management plan or other document?**

The use is consistent with Goal 7 in the CCP. Requests would be approved in instances where they can provide meaningful biological and cultural significance and public appreciation of natural resources.

**f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?**

This use had a determination completed in 1994. Use was determined to be compatible.

**g. Is the use manageable within available budget and staff?**

The use is manageable with available budget and staff.

**h. Will this be manageable in the future within existing resources?**

The proposed activity at current levels would be manageable in the future with existing resources (see above).

**i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?**

The proposed use would contribute to the public's understanding and appreciation of natural and/or cultural resources.

**j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?**

The Refuge will ensure that the activities will not impair existing or future wildlife-dependent recreational use of the Refuge during individual project review, prior to issuing SUPs.

**FINDING OF APPROPRIATENESS OF A REFUGE USE**

Refuge Name: Malheur National Wildlife Refuge

Use: Grazing and Haying

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

| Decision Criteria: | YES | NO |
|---|---|---|
| (a) Do we have jurisdiction over the use? | ✓ | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)? | ✓ | |
| (c) Is the use consistent with applicable Executive orders and Department and Service policies? | ✓ | |
| (d) Is the use consistent with public safety? | ✓ | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | ✓ | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | | ✓ |
| (g) Is the use manageable within available budget and staff? | ✓ | |
| (h) Will this be manageable in the future within existing resources? | ✓ | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | ✓ | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | ✓ | |

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ___ **Appropriate** ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: ________ Date: 1-24-13

**A compatibility determination is required before the use may be allowed.**

FWS Form 3-2319
02/06

## Appropriate Uses Finding, Attachment 1

**Date:** November 2, 2011

**Refuge:** Malheur National Wildlife Refuge

**Project:** Grazing and Haying.

**Summary:** Livestock grazing and haying have occurred in the past at Malheur Refuge and are proposed to be used in the future as tools to provide optimum conditions for wildlife (specifically, foraging areas for waterfowl, waterbirds, and shorebirds; pairing habitat for waterfowl; nesting habitat for shorebirds; and nesting habitat for certain passerines) and, where possible, to improve biological integrity (native plant diversity; hereafter, restoration) in Refuge plant communities. These actions would be undertaken by private parties under cooperative agreement.

For each of the findings listed on FWS Form 3-2319, a brief narrative response has been provided below.

**a. Do we have jurisdiction over the use?**

All proposed activities would take place within Refuge boundaries and under the supervision of Refuge staff.

**b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?**

The proposed activities would comply with all applicable laws and regulations and would be spelled out in each Cooperative Land Management Agreement (CLMA).

**c. Is the use consistent with applicable executive orders and department and Service policies?**

Under USFWS Policy (50 CFR 29.1), grazing and haying under the circumstances applicable at the Refuge are considered refuge management economic activities. “Refuge management economic activity” refers to a refuge management activity on a National Wildlife Refuge, which results in generation of a commodity that is or can be sold for income or revenue or traded for goods or services. Examples include farming, grazing, haying, timber harvesting, and trapping.

The Appropriate Use Policy (603 FW 1) specifically states that “Commercial uses of a refuge may be considered appropriate if they are a refuge management economic activity ….”

The proposed use would provide high-quality forage for migrating waterfowl and cranes within close proximity to high-quality roosting habitat. The use of a private cooperator to graze Refuge meadows helps provide high-quality forage and removes thatch that would be left behind if mowing were used as the only management technique. Other methods such as prescribed fire may remove thatch and mimic natural processes. Given the difficulty in using prescribed fire for meadow management, grazing is consistent with the Service’s Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3).

**d. Is the use consistent with public safety?**

The proposed use is consistent with public safety and generally occurs in areas not accessible to the public. Some waterfowl/upland bird hunting does take place in areas where livestock are being used, but hunters are advised to avoid these highly visible treatment areas.

**e. Is the use consistent with goals and objectives in an approved management plan or other document?**

The proposed use is consistent with Goal 4 of the CCP; recommendations in the 2009 Wildlife and Habitat Management Review (USFWS 2010); and the 1990 Blitzen Valley Management Plan (Rule 1990).

**f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?**

This use had a determination completed in 1994. Use was determined to be compatible.

**g. Is the use manageable within available budget and staff?**

The proposed use is manageable with available budget and staff. The use of cooperators may save staff time and resources. Force account management of this nature would prove to be highly cost-prohibitive to the Service.

**h. Will this be manageable in the future within existing resources?**

The proposed use would be manageable in the future with existing resources and may save staff time and resources (see above).

**i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?**

The proposed use is beneficial to the Refuge's natural resources because haying and grazing would help achieve Refuge purposes by providing many waterfowl, waterbird, shorebird, and landbird with high-quality food sources as well as nesting and fledging habitat.

**j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?**

Haying and grazing operations may occasionally conflict with the experiences of some Refuge visitors. However, such impacts would be expected to be minor to moderate at the Refuge due to the seasonal differences in uses. Refuge visitation peaks during spring, when little grazing or haying will likely occur. Growing-season mowing and grazing will not occur at a scale that would disrupt or significantly impact wildlife viewing opportunities enjoyed by Refuge visitors. During the fall when haying and rake-bunch grazing operations are active, wildlife observation and photography visitation drops. Hunting use increases during this season but is concentrated in the Buena Vista Unit and around Malheur Lake, where little or no haying or grazing occurs.

## References

Rule, M., G. Ivey, and D. Paullin. 1990. Blitzen Valley Management Plan. Malheur National Wildlife Refuge. Princeton, OR. 169 pp.

USFWS (U.S. Fish and Wildlife Service). 2010. Malheur National Wildlife Refuge, Wildlife and Habitat Management Review. June 1-5, 2009. Unpublished report. Available at Refuge Headquarters. 52 pp.

**FINDING OF APPROPRIATENESS OF A REFUGE USE**

Refuge Name: Malheur National Wildlife Refuge

Use: Plant Gathering of Culturally Important Plants

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

| Decision Criteria: | YES | NO |
|---|---|---|
| (a) Do we have jurisdiction over the use? | ✓ | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)? | ✓ | |
| (c) Is the use consistent with applicable Executive orders and Department and Service policies? | ✓ | |
| (d) Is the use consistent with public safety? | ✓ | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | ✓ | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | | ✓ |
| (g) Is the use manageable within available budget and staff? | ✓ | |
| (h) Will this be manageable in the future within existing resources? | ✓ | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | ✓ | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | ✓ | |

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___ Appropriate ✓

Acting Refuge Manager: Chad Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: [signature] Date: 1-24-13

**A compatibility determination is required before the use may be allowed.**

FWS Form 3-2319
02/06

## Appropriate Uses Finding, Attachment 1

**Date:** November 2, 2011

**Refuge:** Malheur National Wildlife Refuge

**Use:** Plant Gathering of Culturally Important Plants

**Summary:** Culturally important plants that grow in the wetlands, marshes, and riparian areas have been collected by members of the Burns Paiute Tribe for generations. Culturally important plant collection involves taking hand cuttings from live plants (e.g., willow whips) or plants that have reached senescence (cattails and bulrush). Plant materials are collected in small amounts and plant mortality does not occur as a result of these activities.

For findings listed on FWS Form 3-2319, and if deemed necessary, a brief narrative response has been provided below.

**a. Do we have jurisdiction over the use?**

All of the proposed activities would take place within Refuge boundaries. The Refuge has jurisdiction over collections within Refuge boundaries.

**b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?**

Any proposed collection activities would comply with all applicable laws and regulations and any restrictions or qualifications required to comply with law and regulations would be specified in an SUP.

**c. Is the use consistent with applicable executive orders and department and Service policies?**

The Appropriate Use Policy (603 FW 1) specifically references Native American ceremonial, religious, medicinal, and traditional gathering of plants. The policy states that the Service "will review specific requests and provide reasonable access to Native Americans to refuge lands and waters for gathering plants for ceremonial, religious, medicinal, and traditional purposes when the activity is appropriate and compatible or when existing treaties allow or require such access."

**d. Is the use consistent with public safety?**

Through individual project review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project's SUP.

**e. Is the use consistent with goals and objectives in an approved management plan or other document?**

Plant gathering by tribal members is consistent with Goal 10 in the CCP.

**f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?**

This use had a determination completed in 1994. Use was determined to be compatible because of the infrequent use.

**g. Is the use manageable within available budget and staff?**

Currently, the Refuge receives fewer than six requests per year for this activity, and it is manageable with available budget and staff.

**h. Will this be manageable in the future within existing resources?**

If use remains at current levels, the use would be manageable in the future with existing resources (see above).

**i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?**

Collection activities would be approved in instances where they can provide meaningful cultural significance and public appreciation of natural resources.

**j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?**

Persons collecting plants may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or environmental education groups, but this conflict would be expected to be minimal. The Refuge will ensure that collection activities would not significantly impair existing or future wildlife-dependent recreational use of the Refuge during individual project review, prior to issuing each SUP.

**FINDING OF APPROPRIATENESS OF A REFUGE USE**

Refuge Name: Malheur National Wildlife Refuge

Use: Research, Scientific Collecting, and Surveys

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

| Decision Criteria: | YES | NO |
|---|---|---|
| (a) Do we have jurisdiction over the use? | ✓ | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)? | ✓ | |
| (c) Is the use consistent with applicable Executive orders and Department and Service policies? | ✓ | |
| (d) Is the use consistent with public safety? | ✓ | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | ✓ | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | | ✓ |
| (g) Is the use manageable within available budget and staff? | ✓ | |
| (h) Will this be manageable in the future within existing resources? | ✓ | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | ✓ | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | ✓ | |

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate**____ **Appropriate** ✓

Acting Refuge Manager: Chd Karges Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: ____________ Date: 1-24-13

**A compatibility determination is required before the use may be allowed.**

**FWS Form 3-2319**
**02/06**

## Appropriate Uses Finding, Attachment 1

**Date:** November 2, 2011

**Refuge:** Malheur National Wildlife Refuge

**Project:** Research, scientific collecting, and surveys

**Summary:** The Refuge receives or initiates requests for scientific research on Refuge lands and waters. Research topics cover a variety of biological, physical, archeological, and social issues and concerns to address Refuge management information needs or other issues not related to refuge management. This compatibility determination refers to research, collecting, or surveys conducted by non-USFWS entities. This may include other Federal, state, tribal, and private entities, or their contractors. Research proposals must be accompanied by a detailed study plan. Proposals will be reviewed and granted special use permits on a case-by-case basis.

For each of the findings listed on FWS Form 3-2319, a brief narrative response has been provided below.

**a. Do we have jurisdiction over the use?**

The Refuge has jurisdiction over those research projects that are sited within Refuge boundaries.

**b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?**

Any proposed research activity would comply with all applicable laws and regulations and any restrictions or qualifications that are required to comply with laws and regulations would be specified in the SUP.

**c. Is the use consistent with applicable executive orders and department and Service policies?**

The Appropriate Use Policy (603 FW 1) specifically references research. Under this policy, the Service actively encourages cooperative natural and cultural research activities that address Service management needs, and encourages research related to the management of priority general public uses. According to the policy, research that directly benefits refuge management has priority over other research.

Through the review of individual projects, the Refuge would ensure that project proposals are consistent with other applicable policies.

**d. Is the use consistent with public safety?**

Through individual project review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project plan.

**e. Is the use consistent with goals and objectives in an approved management plan or other document?**

The proposed use is consistent with Goal 13 of the CCP. Research activities would be approved in instances where they can provide meaningful data that may contribute to Refuge management and public appreciation of natural resources.

**f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?**

This use had a determination completed in 1994. The use was determined to be compatible.

**g. Is the use manageable within available budget and staff?**

Currently, the Refuge typically receives fewer than six requests per year for this activity, and it is manageable with available budget and staff.

**h. Will this be manageable in the future within existing resources?**

Research activity is expected to increase over the next 15 years. Projected levels of research activity would be manageable in the future with existing resources.

**i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?**

Completed research projects would provide information useful for the management of the Refuge's natural or cultural resources.

**j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?**

Researchers may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or environmental education groups, but this conflict would be expected to be minimal.

The Refuge will ensure that research activities would not significantly impair existing or future wildlife-dependent recreational use of the Refuge through SUP stipulations, as needed for each project.

**FINDING OF APPROPRIATENESS OF A REFUGE USE**

Refuge Name: Malheur National Wildlife Refuge

Use: Farming

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

| Decision Criteria: | YES | NO |
|---|---|---|
| (a) Do we have jurisdiction over the use? | ✓ | |
| (b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)? | ✓ | |
| (c) Is the use consistent with applicable Executive orders and Department and Service policies? | ✓ | |
| (d) Is the use consistent with public safety? | ✓ | |
| (e) Is the use consistent with goals and objectives in an approved management plan or other document? | ✓ | |
| (f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed? | | ✓ |
| (g) Is the use manageable within available budget and staff? | ✓ | |
| (h) Will this be manageable in the future within existing resources? | ✓ | |
| (i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources? | ✓ | |
| (j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future? | ✓ | |

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

**Not Appropriate** ___ **Appropriate** ✓

Acting Refuge Manager: [signature] Date: 1/24/13

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: [signature] Date: 1-24-13

**A compatibility determination is required before the use may be allowed.**

FWS Form 3-2319
02/06

## Appropriate Uses Finding, Attachment 1

**Date:** November 2, 2011

**Refuge:** Malheur National Wildlife Refuge (Refuge)

**Project:** Farming

**Summary:** The cooperative program would include between 80 to 1,000 acres to support objectives described in the CCP using appropriate farming practices. Crops would include wheat, barley, rye, oats, or similar crops known to have wildlife forage value.

Cropland management would be carried out by cooperative farmers under agreement with the Refuge. The resulting crop would be shared by the cooperator and the government. To benefit wildlife, the Refuge share would be left in the field where it would be available to wildlife.

Since cereal grains are favored by cranes and some waterfowl as a high-carbohydrate food, the 2009 Wildlife and Habitat Management Review (USFWS 2010) recommended continuing crop production to benefit cranes.

For each of the findings listed on FWS Form 3-2319, a brief narrative response has been provided below.

**a. Do we have jurisdiction over the use?**

All proposed activities would take place within Refuge boundaries and under the supervision of Refuge staff.

**b. Does the use comply with applicable laws and regulations (Federal, state, tribal, and local)?**

The proposed activities would comply with all applicable laws and regulations and would be spelled out in the Cooperative Farming Agreement (CFA).

**c. Is the use consistent with applicable executive orders and department and Service policies?**

Under USFWS Policy (50 CFR 29.1), farming under the circumstances applicable at the Refuge are considered refuge management economic activities. “Refuge management economic activity” refers to a refuge management activity on a national wildlife refuge that results in generation of a commodity that is or can be sold for income or revenue or traded for goods or services. Examples include farming, grazing, haying, timber harvesting, and trapping.

The Appropriate Use Policy (603 FW 1) specifically states that “Commercial uses of a refuge may be considered appropriate if they are a refuge management economic activity ….”

The proposed use would provide high-energy and readily available foods for migrating waterfowl and cranes within close proximity to other natural food sources and high-quality roosting habitat. Crops provide wildlife with easily accessible high-energy foods, are more digestible than many native plants, and can reduce foraging time required to meet caloric demands (Alisauskas and Ankney 1992; Baldassare and Bolen 2006). Because these conditions cannot be met by singularly managing natural foods, the production of non-genetically modified crops is consistent with the

Service's Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3) and will help achieve Refuge purposes.

**d. Is the use consistent with public safety?**

The proposed use is consistent with public safety and would be sited in areas closed to the general public.

**e. Is the use consistent with goals and objectives in an approved management plan or other document?**

The proposed use is consistent with Goal 3 in the CCP and with recommendations in the 2009 Wildlife and Habitat Management Review conducted by the Service (USFWS 2010) and the 1990 Blitzen Valley Management Plan (Rule 1990).

**f. Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?**

The use has been ongoing for many years.

**g. Is the use manageable within available budget and staff?**

The proposed use is manageable with available budget and staff. The use of cooperators may save staff time and resources and increase the reliability of successful crop production.

**h. Will this be manageable in the future within existing resources?**

The proposed use would be manageable in the future with existing resources and may save staff time and resources (see above).

**i. Do the uses contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?**

The proposed use is beneficial to the Refuge's natural resources because crop production would help achieve Refuge purposes by providing migrating waterfowl and cranes with a high-energy, easily accessible food source in close proximity to natural foods and roosting sites.

**j. Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see Section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?**

The proposed use will not impair existing or future wildlife-dependent recreational use of the Refuge. A maximum of 1,000 acres (approximately 0.5percent of the Refuge area) would be used for crop production.

## References

Alisauskas, R.T. and C.D. Ankney. 1992. The cost of egg laying and its relationship to nutritional reserves in waterfowl. Pages 30-61 in: B.D.J. Batt, A.D. Afton, M.G. Anderson, C.D. Ankney, D.H. Johnson, J.A. Kadlec, and G.L. Krapu, eds. Ecology and management of breeding waterfowl. Minneapolis: University of Minnesota Press.

Baldassare, G.A and E.G. Bolen. 2006. Waterfowl ecology and management. Hoboken, NJ: John Wiley and Sons, Inc.

Rule, M., G. Ivey, and D. Paullin. 1990. Blitzen Valley Management Plan. Malheur National Wildlife Refuge. Princeton, OR. 169 pp.

USFWS. 2010. Malheur National Wildlife Refuge, Wildlife and Habitat Management Review. June 1-5, 2009. Unpublished report. Available at Refuge Headquarters. 52 pp.

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*Anglers on Blitzen River*
©Barbara Wheeler

# *Appendix B*
## *Compatibility Determinations*


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Appropriate Use Findings

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Compatibility Determinations

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# Introduction

The compatibility determinations (CDs) developed during the comprehensive conservation plan (CCP) planning process evaluate uses as projected to occur under the management direction described in the CCP. The evaluation of funds needed for management and implementation of each use also assumes implementation as described under the management direction.

## Uses Evaluated at This Time

The following section includes full CDs for all refuge uses that are required to be evaluated at this time. According to Service policy, CDs will be completed for all uses proposed under a CCP that have been determined to be appropriate. Existing wildlife-dependent recreational uses must also be reevaluated and new CDs prepared during development of a CCP. According to the Service's compatibility policy, uses other than wildlife-dependent recreational uses are not explicitly required to be reevaluated in concert with the preparation of a CCP, unless the conditions of the use have changed or unless significant new information related to the use and its effects has become available, or the existing CDs are more than 10 years old. However, the Service planning policy recommends preparing CDs for all individual uses, specific use programs, or groups of related uses associated with the management direction. Accordingly, the following CDs are included in this document for public review.

**Table B-1. Summary of Compatible Use Determinations**

| # | Refuge Use | Page | Appropriate? | Compatible? | Year Due for Reevaluation |
|---|---|---|---|---|---|
| B.1 | Wildlife Observation, Photography, and Interpretation | B-4 | N/A | Yes | 2027 |
| B.2 | Environmental Education | B-20 | N/A | Yes | 2027 |
| B.3 | Waterfowl Hunting | B-29 | N/A | Yes | 2027 |
| B.4 | Upland Game Hunting | B-44 | N/A | Yes | 2027 |
| B.5 | Fishing | B-61 | N/A | Yes | 2027 |
| B.6 | Commercial Tours and Photography | B-72 | Yes | Yes | 2022 |
| B.7 | Grazing and Haying | B-80 | Yes | Yes | 2022 |
| B.8 | Plant Gathering of Culturally Important Plants | B-109 | Yes | Yes | 2022 |
| B.9 | Research, Scientific Collecting, and Surveys | B-114 | Yes | Yes | 2022 |
| B.10 | Farming | B-121 | Yes | Yes | 2022 |

## Compatibility: Legal and Historical Context

Compatibility is a tool refuge managers use to ensure that recreational and other uses do not interfere with wildlife conservation, the primary focus of refuges. Compatibility is not new to the Refuge

System and dates back to 1918 as a concept. As policy, it has been used since 1962. The Refuge Recreation Act of 1962 directed the Secretary of the Interior to allow only those public uses of refuge lands that were “compatible with the primary purposes for which the area was established.”

Legally, refuges are closed to all public uses until officially opened through various administrative actions, including CDs. Regulations require that adequate funds be available for administration and protection of refuges before opening them to any public uses. However, wildlife-dependent recreational uses (hunting, fishing, wildlife observation, photography, interpretation, and environmental education) are to receive enhanced consideration and cannot be rejected simply for lack of funding, unless the refuge has made a concerted effort to seek out funds from all potential partners. Once found compatible, wildlife-dependent recreational uses are deemed the priority public uses at a refuge. If a proposed use is found not compatible, the refuge manager is legally precluded from approving it. However, a use found not compatible may be modified such that it can be found compatible. Economic uses that are conducted or authorized by the refuge also require CDs.

Under compatibility policy, uses are defined as recreational, economic/commercial, or management-related uses of a refuge by the public or a non–Refuge System entity. Uses generally providing an economic return (even if conducted for the purposes of habitat management) are also subject to CDs. The Service does not prepare CDs for uses where the Service does not have jurisdiction. For example, the Service may have limited jurisdiction over refuge areas where property rights are vested by others; where legally binding agreements exist; or where there are treaty rights held by tribes. In addition, aircraft overflights, emergency actions, some activities on navigable waters, and activities by other Federal agencies on “overlay Refuges” are exempt from the compatibility review process.

New compatibility regulations, required by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), were adopted by the Service in October 2000 (U.S. Fish and Wildlife Service [USFWS] 2000). The regulations require that a use must be compatible with both the mission of the System and the purposes of the individual refuge. This standard helps to ensure consistency in application across the Refuge System. The Act also requires that CDs be in writing and that the public have an opportunity to comment on most use evaluations.

The Refuge System mission emphasizes that the needs of fish, wildlife, and plants must be of primary consideration. The Improvement Act defined a compatible use as one that “ … in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the Refuge.” Sound professional judgment is defined under the Improvement Act as “ … a finding, determination, or decision, that is consistent with principles of sound fish and wildlife management and administration, available science and resources ….” Compatibility for priority wildlife-dependent uses may depend on the level or extent of a use.

Court interpretations of the compatibility standard have found that compatibility is a biological standard and cannot be used to balance or weigh economic, political, or recreational interests against the primary purpose of the Refuge (Defenders of Wildlife v. Andrus [Ruby Lake Refuge]).

The Service recognizes that CDs are complex. For this reason, refuge managers are required to consider “principles of sound fish and wildlife management” and “best available science” in making these determinations (House of Representatives 1997). Evaluations of the existing uses on Malheur National Wildlife Refuge are based on the professional judgment of Refuge and planning personnel including observations of Refuge uses and reviews of appropriate scientific literature.

In July 2006, the Service published its Appropriate Refuge Uses Policy (603 FW 1). Under this policy, most proposed uses must also undergo a review prior to compatibility. Uses excepted from the policy include the Big Six uses and uses under reserved rights—see the policy for more detail. Appropriate uses reviews are included in Appendix A.

## References

Defenders of Wildlife v. Andrus (Ruby Lake Refuge I). Case 2098 (D.D.C. 1978). Environmental Reporter 11:873.

House of Representatives. 1997. Report 105-106 on National Wildlife Refuge System Improvement Act. Available at: http://www.fws.gov/Refuges/policiesandbudget/HR1420_part1.html.

USFWS (U.S. Fish and Wildlife Service). 2000. Compatibility regulations. Available at: http://www.fws.gov/Refuges/policymakers/nwrpolicies.html. Accessed June 23, 2011.

# B.1 Wildlife Observation, Photography, and Interpretation Compatibility Determination

**RMIS Database Uses:** Wildlife Observation; Photography (wildlife); Interpretation

**Refuge Name:** Malheur National Wildlife Refuge

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

**Description of Use**

This CD examines wildlife observation, wildlife photography, and interpretation as described under the management direction of the Malheur Refuge CCP. There is substantial overlap between activities associated with wildlife observation, wildlife photography, and interpretation on the Refuge, and as such these uses are evaluated together in this CD. Associated uses include hiking, motorized boating (electric), and non-motorized boating. Horseback riding, cross-country skiing, and bicycling also may occur incidental to these uses, but at very low levels (<5 visits per year per activity); they are analyzed as part of this CD.

***Program Offerings:*** Under the management direction, the uses will continue to occur primarily informally as self-guided activities. However, in addition, monthly, docent-led tours will be established to diversify the visitor experience and opportunities for these uses, including kayaking or canoeing tours on Malheur Lake by Refuge staff and/or qualified volunteers.

***Location of Use:*** Visitors typically engage in wildlife observation, wildlife photography, and interpretation uses at the Refuge Headquarters, along Center Patrol Road on the Auto Tour Route, and at a number of historic and interpretive sites, including Benson Pond, the historic Sodhouse Ranch, Buena Vista Overlook, Krumbo Reservoir, and the historic P Ranch. The historic Sodhouse Ranch is a significant resource for colonial nesting great blue herons and cormorants and winter roosting for bald eagles; the site will continue to be closed for the majority of the year to prevent disturbance, but it is open to the public from August 15 through October 15, after peak wildlife activity has subsided and before bald eagles roost in the winter. Krumbo Reservoir provides habitat for migrating loons in early spring and fall, and eared grebes during winter nesting season. Under the management direction, Krumbo Reservoir will be opened to year-round wildlife observation, photography, and interpretation. Non-motorized boats or boats with electric motors will be allowed on Krumbo Reservoir to support these uses. Other areas on the Refuge will be occasionally visited during docent-led tours.

***Associated Facilities:*** A network of pull-offs, viewpoints, kiosks, overlooks, and hiking trails that vary in length from less than 1 mile to 11 miles will support these uses. The management direction provides more opportunities for developed wildlife observation, photography, and interpretation programs and structured visitor experiences with enhanced facilities and improved access. An enlarged visitor contact station/gift shop and office will be developed at Refuge Headquarters, as well as a seasonal contact station at the P Ranch. Additional developed visitor amenities (including restrooms, vault toilets, picnic tables, and shelters), new interpretive panels, vehicle pull-outs, viewing overlooks and elevated viewing platforms, and permanent photography blinds will be constructed throughout the Refuge at specific strategic public use locations.

***Access:*** As is the case currently, use will be permitted for vehicles on public roads; on foot along roads open to motorized vehicles and designated hiking trails; and, occasionally, for boats. Except for docent-led tours (which will occur monthly and during special events), which may venture farther afield, public access will remain confined to roads and trails. Road access will be expanded by opening the Boat Landing Road to the Malheur Lake airboat launch site near Refuge Headquarters and the East Canal Road to the confluence of Bridge Creek with the East Canal. Additional loop, spur, and Americans with Disabilities Act (ADA) trails will be created, resulting in a total of 44 miles of roads and 17 miles of trails open to public access under the CCP. In contrast to current management, occasional canoe/kayak access via docent-led tours will be encouraged on Malheur Lake.

***Number of Visitors and Seasonal Patterns:*** Wildlife observation, photography, and interpretation are expected to remain the most popular activities on Malheur Refuge over the life of the CCP. An estimated 93 percent of Refuge visitors engage in bird-watching and other forms of wildlife observation. Current annual visits associated with wildlife observation are estimated at 61,000. Annual visits associated with interpretation are estimated at 52,000, and annual visits associated with wildlife photography are also estimated at 52,000 (visits are tabulated separately). Wildlife observation, photography, and interpretation occur year-round on the Refuge, but peak during spring migration (March to May) and fall migration (September). The remainder of the year, the Refuge may see less than 100 visitors per month. As a result of the emphasis on enhanced facilities, expanded access, and more special events and programs under the CCP, these uses will be expected to grow over 15 years to 82,000 visits per year for wildlife observation, 71,000 visits per year for photography, and 71,000 visits per year for interpretation (visits are tabulated separately).

### Availability of Resources

Availability of resources for administering and managing wildlife observation, photography, and interpretation under the CCP are detailed in Table B-2.

**Table B-2. Costs to Implement the Use**

| Category | One-time Expenses ($) | Recurring Expenses ($/year) |
|---|---|---|
| **Welcome and Orientation (W&O)** | | |
| Update existing W&O panels and develop new panels at four locations | $120,000 | $500 |
| Maintain existing and develop two new vault toilets | $50,000 | $5,000 |
| Maintain existing and develop new visitor amenities, including accessible picnic tables, trash cans, and shelters | $7,500 | $5,000 |
| Construct enlarged visitor contact station and gift shop | $250,000 | $10,000 |
| Rehabilitate George Benson Memorial Museum facility | $50,000 | |
| Establish seasonal contact station at P Ranch | $45,000 | $3,000 |
| Develop modern media W&O materials, maintain website, etc. | | $1,000 |
| **Wildlife Observation, Photography, Interpretation** | | |
| Conduct docent-led canoe/kayak tours on Malheur Lake | $100,000 | $15,000 |
| Advertise, train volunteers, and conduct other monthly land-based docent tours monthly, plus special events | $50,000 | $5,000 |
| Provide new non-ADA trails and develop new trail signage | $72,000 | $2,000 |
| Provide new ADA trails at Sodhouse Ranch, Benson Pond, P Ranch | $225,000 | $2,000 |
| Construct wildlife-viewing overlook at Krumbo Reservoir | $40,000 | $1,000 |
| Construct four elevated viewing platforms | $220,000 | $4,000 |
| Provide three photography blinds | $30,000 | $1,000 |
| Maintain historical landscapes for birding | | $1,000 |
| Develop new interpretive panels | $45,000 | $1,000 |
| Administer and manage programs | | $55,000 |
| **Transportation** | | |
| Raise and surface Center Patrol Road | $1,200,000 | $100,000 |
| Develop additional vehicle pull-offs | $52,500 | |
| Improve vehicle access along East Canal Road | $90,000 | |
| Improve vehicle access at Boat Landing Road, including pull-offs | $45,000 | |
| Maintain Krumbo Lane | | $10,000 |
| Develop parking areas to assist with public use programs | $150,000 | |

| Category | One-time Expenses ($) | Recurring Expenses ($/year) |
|---|---|---|
| Overall road maintenance (public roads, pull-offs, parking areas) | | $20,000 |
| **Total** | $2,792,000 | $241,500 |

Wildlife observation, photography, and interpretation are the biggest programs on the Refuge and attract the most visitors and visits. The Refuge has one full-time equivalent (FTE) position dedicated to the visitor services program as a Visitor Services Manager, with a majority of time spent on administering and managing the wildlife observation, photography, and interpretation program. There are two additional FTE positions supporting cultural resources programs and law enforcement needs. Other Refuge staff assist in trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects. The Refuge has a strong volunteer base, and the visitor center and tours are generally staffed by volunteers during the high visitation months from May to September.

Some capital projects may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of uses associated with wildlife observation, photography, and interpretation. Exact costs will be developed during design and implementation.

Welcome and orientation facilities, signage, access trails, and other transportation resources are used for multiple purposes across programs, including environmental education, hunting, and fishing. Program-specific facilities and resources are included in the appropriate CDs.

**Anticipated Impacts of the Uses**

General Impacts Expected from the Scientific Literature

A general assessment of impacts resulting from wildlife observation, photography, and interpretation uses has been compiled from the literature and is briefly summarized below.

***Disturbance Intensity (Frequency, Distance, etc.):*** Human activities on recreational lands, trails, and other access points can result in direct effects on wildlife. Disturbance responses can depend upon the activity type, recreationists' behavior, and the distance, duration, frequency, predictability, timing, and visibility of the use (Knight and Cole 1995). Disturbance to migrant shorebirds on eastern coastal bays was found to increase as the total number of disturbances and recreationists increased and the distance from the disturbance decreased (Burger 1986). Flushing, especially repetitive flushing, can strongly impact patterns of many bird species. Migratory birds have been observed to be more sensitive than resident species to disturbance (Klein 1989), and in the case of the eastern coastal migrant shorebirds, the percentage of observed shorebirds that were flushed and did not return increased by 53 percent from 1982-2002, suggesting that the birds were not adapting to the presence of people by habituation and were being affected in the long-term (Burger et al. 2004).

Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1976), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people, where disturbance flushes birds away from their nests and creates vulnerabilities during nesting seasons. Frequency is a major factor, and songbirds have been found to alter behavior after repeated human disturbance, particularly red-winged blackbirds, goldfinches, and American robins, which became much more aggressive toward humans who repeatedly visited their nests (Knight and Temple 1986a, 1986b, 1986c).

Set-back distances for public use facilities have been found to be important in limiting human disturbance to wildlife. In Florida, 15 species of colonial waterbirds nesting at 17 colonies were exposed to three different human disturbance mechanisms in order to determine recommended set-back distances for protecting mixed-species nesting assemblages (Rodgers and Smith 1995). In general, a recommended set-back distance of about 100 meters (328 feet) for wading bird colonies and 180 meters (590 feet) for mixed tern/skimmer colonies was found to be adequate to effectively buffer sites from human disturbance caused by approach of pedestrians and motor boats (Rodgers and Smith 1995). In Nebraska, roosting sandhill cranes avoided sites near human disturbance features at 500 meters (m [1,640 feet]) from nearest paved road, 400 m from nearest gravel road, and 400 m from a single dwelling structure (Norling et al. 1992). Conversely, wildlife tends to habituate best to disturbance that is predictable, as indicated by sandhill cranes in Florida and in Nebraska that nested within 400 m of highways, railroads, mines, and power lines, which provided predictable background disturbance (Dwyer and Tanner 1992; Norling et al. 1992).

***Group Size:*** Disturbance impacts to wildlife related to visitor group size is not a well-documented research area; however, a few studies have analyzed these impacts. Most animals flee from humans, and large groups of people may represent greater perceived risk of predation (Geist et al. 2005). Remacha et al. (2011) analyzed visitor group size influences on the number and variety of birds observed during guided educational tours in a forested area in central Spain, with group sizes ranging from 7 to 20 people. The study showed that increasing visitors’ group size has an impact on wildlife, as large groups were associated with decreased bird numbers; additionally, the study found that birds may demonstrate reduced tolerance not only by reducing their frequency of occurrence but also by reducing the number of individuals when faced with large groups of visitors. The study concluded that reducing the size of visitors’ groups helps to minimize the negative impacts on wildlife and also allows visitors to watch more wildlife (Remacha et al. 2011).

Another study by Beale and Monaghan (2004) on human disturbance effects to seabird colonies at St. Abbs Head National Nature Reserve in Scotland examined the variation in nesting success for two birds, kittiwakes (*Rissa tridactyla*) and guillemots (*Uria aalge*), as a function of different disturbance regimes, including varying the average number of people per hour and people load, which takes into consideration the number of visitors and their distance from the nest. Human disturbance was found to have a significant negative effect on the nesting success in both species of birds. Increasing visitor numbers by 8.5 percent resulted in a 22 percent increase in the failure rate of kittiwakes, and a 13 percent increase in the failure rate for guillemots. Beale and Monaghan concluded that perhaps the most likely explanation is that nesting birds perceive people to be a potential predator and show appropriate anti-predator physiological responses, which interfere with energy resources available for nesting. The results showed that safe distances, or buffer zones, depend on the numbers of people visiting an area, and that both numbers and distance matter in determining disturbance effects.

In addition to group size, loudness has also been found to be an important variable in determining whether birds altered their behavior. A study was conducted at the Arthur B. Marshall Loxahatchee National Wildlife Refuge in Florida between 1992 and 1994 to observe how people affect foraging birds at the Refuge (Burger and Gochfeld 1991). Variation in feeding behavior was largely explained by whether people were present, the number of people present, and the amount of noise made by the people (Burger and Gochfeld 1991). For all species, time devoted to feeding and number of strikes or pecks decreased while people were present and as the noise made by people increased; interestingly, loudness was found to be more important than the number of people present (Burger and Gochfeld 1991). Noise level is not necessarily correlated with number of people present, but larger groups might be more prone to producing noise than small groups or individuals.

Conversely, a study analyzing the impacts of groups of cross-country skiers to elk in Yellowstone National Park found that the number of skiers did not impact the elk once they were already disturbed by the first skier, and instead the amount of winter range used by skiers and the number of days involved seemed to be more important than skier numbers (Cassierer et al. 1992). Literature suggests that organizing visitors in small numbers is recommended for groups, but also spreading out visits and locations of visits is recommended to mitigate disturbance across the landscape.

***Impacts of Pedestrian (Hiking) vs. Vehicular Access:*** It is widely accepted that wildlife is frequently more sensitive to disturbance from people on foot than in vehicles (Skagen 1980; Grubb and King 1991; MacArthur et al. 1982; Pease et al. 2005). Numerous studies have confirmed that people on foot can cause a variety of disturbance reactions in wildlife, including flushing or displacement (Erwin 1989; Fraser et al. 1985; Freddy 1986; Pease et al. 2005), heart rate increases (MacArthur et al. 1982), altered foraging patterns (Burger and Gochfeld 1991), and even, in some cases, diminished reproductive success (Boyle and Samson 1985).

A study on seven species of dabbling ducks at the Back Bay National Wildlife Refuge found a significant difference between vehicular (diesel truck and electric passenger tram) and non-vehicular (pedestrian and bicyclist) treatments in the number of ducks that were flushed. In this study, 90 percent of the birds showed an observable response to non-vehicular treatments, of which 43 percent flew; the proportion of ducks that flew was greatest when they were located less than 100 m from the disturbance (Pease et al. 2005). In a review of several studies of the reaction of waterfowl and other wetland birds to people on foot, it was found that distances greater than 100 m in general did not result in a behavioral response (DeLong 2002). Mule deer in sagebrush-grassland habitat in Utah showed a 96 percent probability of flushing at 100 m from the line of movement of off-trail recreationists, with the percentage not dropping to 70 percent until the perpendicular distance increased to 390 m (Taylor and Knight 2003).

Wildlife photography in particular can be a more disturbing activity because photographers are more likely to leave vehicles and wander off-trail, approach wildlife, and remain close for an extended period of time to capture a detailed photograph, as observed at Ding Darling National Wildlife Refuge and other places (Klein 1993; Morton 1995; Dobb 1998). This may also apply to the experience of the user, as avid wildlife viewers tend to intentionally seek out rare or spectacular species and/or are more eager to use the most viewing opportunities in the limited amount of time (e.g., bird listing) and thus potentially pose a larger negative impact to wildlife (Knight and Cole 1995). People engaged in wildlife observation and photography react to the presence of birds and thus are generally more unpredictable on foot depending on excitement level, curiosity, and desire to observe closely.

***Impacts of Cross-country Skiing:*** In two different studies of winter recreation impacts to wildlife in Yellowstone National Park, Aune (1981) and Cassirer (1990) found that, except for coyotes, all wildlife species observed (mostly big game) reacted more quickly to an approaching skier than to a snowmobile, and the flight distance was generally greater from skiers. Bison were found to respond dramatically to skiers who were off established trails. In another study, elk began to move when skiers approached to within 15 m in an area heavily used by humans year-round, and within 400 m in an area where human activity is much lower (Cassirer et al. 1992).

***Boating Impacts:*** Recreational boating can alter bird distribution, reduce the use of particular habitats or entire areas by waterfowl and other waterbirds, alter feeding behavior and nutritional status, and cause premature departure from areas due to the noise and speed of boats (Knight and Cole 1995; Knapton et al. 2000). Canoes and kayaks can cause significant disturbance effects based on their ability to penetrate into shallower marsh areas (Speight 1973; Knight and Cole 1995). In the Ozark National Scenic Riverway, green-backed heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow-moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985). Huffman (1999) found that non-motorized boats within 30 m (98 feet) of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964; Huffman 1999; DeLong 2002).

The total number of boats and people can be an inappropriate measure of recreational intensity because the presence of a single boat might be just as disturbing as that of many (Tuite et al. 1983; Knight and Knight 1984). Even a low level of boating activity affects the duration and pattern of use by wildlife (Bratton 1990).

***Bicycling Impacts:*** In a Canyonlands National Park study comparing the effects of trail bikes, hikers, and vehicles to bighorn sheep behavioral responses, distances moved, and duration of responses, Papouchis et al. (2001) found that hikers caused the most severe responses in desert bighorn sheep (animals fled in 61 percent of encounters), followed by vehicles (17 percent fled) and mountain bikers (6 percent fled), apparently because hikers were more likely to be in unpredictable locations and often directly approached sheep. However, Taylor and Knight (2003), who found no difference in effects between hikers and bikers (see below), noted that Papouchis et al. compared the responses of sheep approached directly and off-trail by hikers with those of sheep approached tangentially on a road or trail by mountain bikers and vehicles. Generally, wildlife exhibit a stronger response to humans that approach them directly and to humans located off designated trails.

In a Utah study comparing mountain biking and hiking disturbance to mule deer, antelope, and bison, both on- and off-trail, Taylor and Knight (2003) found little difference between the responses to hiking or biking. However, their results did show differences in species and based on whether the activity takes place on or off the trail. They did suggest that, because bikers travel faster than hikers, they may cover more ground in a given time period than hikers, thus having the opportunity to disturb more wildlife per unit of time.

***Horseback Riding Impacts:*** Impacts related to horseback riding include exotic plant seed dispersal in horse coats, forage, and manure (Beck 1993; Hammitt and Cole 1987); soil compaction and erosion (Bainbridge 1974; Hendee et al. 1990; Hammitt and Cole 1987); stream sedimentation (Wilson and Seney 1994); trail widening (Whittaker 1978); vegetation trampling (Nagy and Scotter 1974; Weaver and Dale 1978; Whittaker 1978); and direct wildlife disturbance (Owen 1973).

Vegetation and soil compaction and erosion impacts can be much more pronounced from horses than hikers (Bainbridge 1974; Hendee et al. 1990; Hammitt and Cole 1987), with soil compaction as much as 1,500 psi (pounds per square inch) exerted on the soil surface with each step (Hendee et al. 1990). Hikers tend to flatten vegetation while horses tend to chum up soil, thus cutting plants off at the rootstalk (Whittaker 1978). Hoof action tends to dig up and puncture the soil surface (McQuaid-Cook 1978), which could cause greater sediment loss than any other form of recreational trail use and increase the potential for disturbance-tolerant vegetation establishment. Trail widening is also a consideration as horses tend to walk on the down slope sides of trails (Whitson 1974), creating a much wider area of disturbance and increasing trail maintenance problems. This can increase the spread of previously established exotics by providing loose, disturbed soil for germination and spreading reproductive plant structures.

Wildlife disturbance relative to horseback riding has been poorly studied, with most references using other activities such as hiking and cross-country skiing to infer horseback riding impacts. Only one study identified disturbance tolerance of waterfowl to horseback riders and found that horseback riders could approach geese up to a distance of 150 feet. This is compared to suggested hiking trail distances of 250 feet (Miller et al. 1998) and boat buffers ranging from 250 to 900 feet (depending on type of boat, whether motorized, and species impacted; Burger et al. 1999). The 150-foot approach distance offered by Owen (1973) is consistent with observations suggesting that horseback wildlife observers can approach wildlife at closer distances than through other form of travel. Many wildlife species appear to be habituated to livestock and thus are less likely to flee when approached through this method. However, any form of approach is expected to cause some disturbance, which will vary according to the species affected and the type, level, frequency, and duration of disturbance, as well as the time of day or year that it occurs.

***Disturbance from Dogs:*** Dogs elicit a greater response from wildlife than people on foot alone (MacArthur et al. 1982; Hoopes 1993). In the case of birds, the presence of dogs may flush incubating birds from nests (Yalden and Yalden 1990), disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). For mule deer in Colorado, the presence of a dog resulted in a greater area of influence, alert and flush distance, and distance moved than when a pedestrian was alone (Miller et al. 2001). Many of these authors indicated that dogs with people, dogs on leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals. Indirectly, domestic dogs can potentially introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

Refuge-specific Impacts

This section evaluates the likely impact at the Refuge, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge.

Over 130 species of birds nest in the Refuge, and unusual or rare birds, particularly passerines, can often be seen during the spring migrations. Malheur Refuge provides some of the most significant habitat and resources for migratory birds on the Pacific Flyway. If not adequately protected, especially during the migration and nesting seasons, bird populations could be impacted by regular disturbance and flushing from feeding, resting, or nesting areas.

***Loss of Habitat from Facility Construction:*** Under the management direction of this CCP, new facilities constructed for wildlife observation, photography, and interpretation, as well as facilities supporting welcome and orientation, will result in 10 acres of habitat loss, which is a fraction of a percentage of the Refuge. A large number of facilities will be associated with already developed sites, but as a result of enhanced opportunities in the P Ranch Unit, in particular, a majority of the habitat loss (approximately 6.5 acres) will be associated with wet meadow habitat. Overall, habitat loss from new facilities is considered negligible across the landscape.

***Vegetation, Soil, and Water Impacts:*** Pedestrian access to the Refuge creates the highest potential for direct disturbance or damage to vegetation and soil, as foot travel associated with these uses could potentially result in temporary or minor vegetation trampling and soil compaction. People can also be vectors for invasive plants by moving seeds from one area to another. The threat of invasive plant establishment will always be an issue requiring regular monitoring and treatment. However, under the management direction of the CCP, self-guided visitor access for wildlife observation, photography, and interpretation will be limited to roads, 18 miles of trails, and developed sites. No impacts from these uses are expected to water resources. Habitat and soil impacts related to horseback riding will be minor, as the use is mostly incidental and occurs at very small numbers (<5 visits a year). Horseback riding is limited to Center Patrol Road.

In addition to the self-guided opportunities along trails, roads, and developed sites, the Refuge will offer up to 20 docent-led tours a year to areas that may be away from established public roads or trails, including tours for special events. Docent-led tours may create potential for additional impacts to vegetation and soil, but limitations on group size, the likelihood that tours will visit a variety of different locations over time, and the relatively infrequent offerings of these types of visits mean that the likely impacts to soils and vegetation will be minor within the context of the Refuge as a whole.

***Disturbance-related Impacts:*** Many of the studies noted above analyze disturbance impacts to wildlife from human presence. However, at Malheur Refuge, visitors most often access and explore the Refuge by vehicle, thus minimizing pedestrian disturbance to resources, which as noted above, can be larger than disturbance from vehicles. Vehicles act as a blind, shielding wildlife from humans, and the Refuge encourages this practice in their visitor brochure and in visitor interactions with volunteers and staff. Center Patrol Road allows visitors to see a diversity of habitats and wildlife while largely concentrating the impacts of visitors to a single road through the Refuge. Given previously cited studies, wildlife tends to be most disturbed by human presence at distances less than 100 m (328 feet). Assuming a wildlife distance buffer zone of 200 m on all Refuge roads open to public use, the total impact of disturbance from visitors on open Refuge roads and trails is approximately 9,800 acres, or 5 percent of the Refuge. Disturbance to habitat will vary depending on the location of the road or trail, and, based on calculations, the majority of habitats that will be disturbed from Refuge roads and trails will be wet meadow at 28 percent, which includes a number of public use sites (salt desert scrub at 25 percent and sagebrush-steppe at 11 percent of total acreage disturbed). In the long-term, even if visitor numbers increase more than expected due to program and facility development, disturbance impacts from wildlife observation, photography, and interpretation will pose minimal impact to Refuge wildlife, because users will be concentrated on the designated roads, trails, and public facilities described above, leaving wildlife thousands of acres of undisturbed sanctuary.

***Impacts at Specific Sites:*** Docent-led tours will also include opportunities for group kayaking or canoeing on Malheur Lake, which has the potential to cause disturbance to wildlife using this resource and habitat, including sandhill cranes using the lake as a staging area in the fall migration season. Careful scheduling of the tours around sensitive wildlife seasons and resource areas, limiting the group size to a manageable and sustainable size, and providing public education to inform visitors of ethical and least intrusive methods to wildlife viewing and photography will reduce impacts.

Under the management direction of the CCP, opportunities will also be expanded at Krumbo Reservoir for wildlife observation, including electric and non-motorized boating, outside of the fishing season, except when the water ices over. Increasing access to the Reservoir could have potential impacts to birds during the winter nesting season at Krumbo Reservoir as well as Krumbo Swamp and Otter Pond along the Krumbo Access Road. The number of birds using the Reservoir during the winter is less than 400 birds on any given day and less than 100 birds during the coldest part of the season; most birds have migrated farther south during the winter. The Reservoir is 184 acres, which is less than 20 percent of the total 1,004 acres of available open water wintering habitat in this part of the Refuge, leaving at least 820 acres of open water for wintering bird use including Boca Lake, Benson Pond, and East or West Knox Pond. Additionally, the number of visitors to the Reservoir during the winter months will be significantly lower than in the spring, summer, or fall months. With the low number of birds present, low visitor use levels, and availability of additional wintering habitat and sanctuary, it is expected that year-round access at Krumbo Reservoir will have minor impacts. Wildlife surveys and monitoring will be conducted to ensure disturbance stays at a minimum.

***Pet Impacts:*** Pet impacts are expected to be minor in relation to wildlife observation, photography, and interpretation use, since all pets must be kept leashed and stay on designated public use roads and trails while on the Refuge. Horses must also stay on public use roads.

***Impacts to Listed Species:*** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; Oregon Department of Fish and Wildlife [ODFW] 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from wildlife observation, photography, and interpretation uses and facilities will be negligible. These uses will continue to occur at public sites and on designated roads and trails, away from sensitive habitat and resources and outside of breeding areas and seasons. The greater sage-grouse is not known to breed on the Refuge. Incidental use of the east side of the south Blitzen Valley by sage-grouse has been reported during the late summer when visitor numbers and activities are lower. Wildlife observation, photography, and interpretation uses will be minimal in the areas of Mud and Bridge Creek, where frog populations are known to occur and thus will not impact the spotted frog populations. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Other Priority Public Uses:*** Wildlife observation, photography, and interpretation generally result in little disturbance to other visitors. Conflicts between hunters and these activities will be minimal due to the seasonal differences in uses. Hunting on the Refuge occurs at a time of year when visitors engaged in wildlife observation, photography, and interpretation are fewer in number. Under the management direction of this CCP, hunting will be open on the southern portion of Malheur Lake at Boat Landing Road where docent-led kayaking or canoeing tours will also occur. To minimize safety conflicts between hunters and non-hunters, docent-led tours on the southern portion of Malheur Lake will occur prior to the hunting season so there is no overlap between uses. Other hunting areas are not open to self-guided wildlife observation, photography, or interpretation and thus this use should not conflict with hunting. There is no conflict expected between anglers or environmental education participants and wildlife observers or photographers.

***Infrastructure:*** No significant effects to roads, trails, or other infrastructure from the wildlife observation, photography, and interpretation programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

**Public Review and Comment**

Extensive opportunities were provided for stakeholder engagement through the collaborative CCP planning process. Appendix J details the collaborative involvement undertaken during the development of the CCP.

**Determination**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

- Visitors will be restricted to designated trails, sites, or facilities as determined by Refuge staff. Use is open daily from dawn to dusk. Camping, overnight use, swimming, and fires will be prohibited.
- Motorized vehicles, bicycles, horseback riding, and cross-country skiing will be authorized on Center Patrol Road and Krumbo Lane, and vehicles must observe posted speed limits.
- Pets must be kept leashed while on the Refuge, and will be only permitted on open Refuge roads. Pet owners will be expected to clean up after their pets and properly dispose of any waste.
- The Refuge will require advance reservations for groups in need of staff and volunteer participation to avoid conflicts with other groups and management activities.
- Docent-led tours will be limited to 20 tours a year and 15 participants maximum per group. All tours will be led by Refuge staff or qualified volunteers. Tour-goers will be instructed to stay on-trail, in designated program boundaries, and observe extra precautions if visiting closed areas.
- Improved trail signage will be developed to inform and guide visitors on name, length, difficulty, and destination.
- Seasonal closure at Sodhouse Ranch will be maintained.
- Elevated observation platforms, overlooks, trails, and blinds may be constructed to help reduce negative visitor impacts to wildlife, soils, vegetation, and hydrology.
- Collection of natural objects, such as plants, animals, minerals, antlers, and cultural resources are prohibited.
- If disturbance to wildlife or damage to habitat reaches unacceptable levels, the Refuge will limit uses in areas where unacceptable impacts occur. Monitoring will be conducted to ensure that high-quality habitat for wildlife feeding, resting, and breeding is maintained.

**Justification**

Wildlife observation, photography, and interpretation receive enhanced consideration in the CCP planning process, and are considered priority public uses when determined compatible. Although these activities can result in disturbance to wildlife, they will occur on a small percentage of Refuge acres. There is a sufficient amount of undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline. The physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing wildlife observation, photography, and interpretation to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge Mission. Wildlife observation, photography, and interpretation programs complement the Refuge Purpose, vision, and goals, and help fulfill the mission of the National Wildlife Refuge System.

**Mandatory Reevaluation Date**

__09/2027__ Mandatory 15-year Reevaluation Date (for priority public uses)

**NEPA Compliance for Refuge Use Decision**

____X____ Environmental Impact Statement and Record of Decision

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**Signatures:**

| | | |
|---|---|---|
| Prepared by: | (Signature) | 1/24/13 (Date) |
| Acting Refuge Manager/ Project Leader Approval: | (Signature) | 1/24/13 (Date) |

**Concurrence:**

| | | |
|---|---|---|
| Refuge Supervisor: | (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | (Signature) | 1-24-13 (Date) |

## B.2 Environmental Education Compatibility Determination

**RMIS Database Uses:** Environmental education (not conducted by Refuge System staff or authorized agents); Environmental Education (teaching teachers or group leaders); Environmental Education (teaching students)

**Refuge Name:** Malheur National Wildlife Refuge

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

**Description of Use**

This CD examines environmental education (EE) on the Refuge as described in the management direction in this CCP. This CD addresses on-site EE programs and educational programs associated with non-profits and educational institutions.

***Program Offerings:*** EE at the Refuge is currently conducted on- and off-site and is led by Refuge staff and qualified volunteers. The on-site EE program has been formally correlated with Oregon State Educational Standards and with local school district curricula for elementary levels kindergarten through fifth grade, as well as secondary and university levels. Under the management direction of the CCP, the program will continue with ongoing collaborative efforts with local and regional EE initiatives to facilitate on- and off- Refuge EE for over 500 students annually, with the focal audience of local first and third grade students.

In addition to supporting local schools, the Refuge will continue to support environmental education and natural resource–based programs on the Refuge led by a variety of non-profits and educational institutions. Currently, these groups include: Audubon Society chapters; high schools; public and private universities; and community colleges. The same or similar organizations will be expected to continue to participate in EE on the Refuge. Under the management direction in the CCP, non-profit groups and educational institutions will be required to apply for a special use permit before engaging in EE on the Refuge.

The off-site EE program will be associated with established events and special programs, and the Refuge will continue to participate in and support local, regional, and national events and education modules.

***Location of Use and Associated Facilities:*** The on-site program for local schools occurs outdoors at the Refuge Headquarters and inside the George Benson Memorial Museum. Under the management direction of the CCP, an outdoor learning area and outdoor learning shelter at the Refuge Headquarters will be constructed to assist with existing EE program efforts, to provide the opportunity for more experiential learning, and to support EE programs during periods of inclement weather.

EE programs associated with non-profits and educational institutions occur on foot or in vehicles in areas open to the public, and use the same facilities as wildlife observation, photography, and interpretation programs. Due to the large size of the Refuge, these programs are mainly conducted in vehicles, with occasional stops at public sites to allow groups to observe and learn about wildlife outside the vehicle.

***Number of Visits and Seasonal Patterns*****:** An estimated 700 visits per year are made to the Refuge currently by local students for EE programs. EE for local students is currently facilitated by Refuge staff. EE activity conducted for non-local visitors (mostly adult visitors) is estimated to total approximately 6,700 visits per year. Most of the non-local EE is thought to be facilitated through universities, Malheur Field Station, or other non-profit groups. Based on past history, the majority of classes will be expected to visit the Refuge between April and June (spring migration season) under the CCP, although the classes may visit at any time of year. Groups may include up to 100 students. Class visits will be rotated to spread out the visits across different days and throughout the season to reduce the number of students on the Refuge at one time.

Non-profit groups and educational institutions will continue to conduct programs during the spring and fall migrations to make the most of the opportunity to observe and experience the wide variety of wildlife on the Refuge. Educational institutions occasionally bring groups during the summer for special programs, like geology and field biology classes. Due to the long distances travelled by many of these groups to get to the Refuge, the programs associated with these groups are generally multi-day and occur over the weekend, with groups staying overnight off-Refuge.

As a result of continued emphasis on EE under the management direction of the CCP, this use is be expected to grow over 15 years to 800 visits by local students and 9,000 visits by non-local persons per year.

**Availability of Resources**

Availability of resources for administering and managing EE under the CCP are detailed in Table B-3.

**Table B-3. Costs to Implement the Use**

| Category | One-time Expense ($) | Annual Expense ($/year) |
|---|---|---|
| Construct outdoor EE shelter at Refuge Headquarters | $80,000 | $1,000 |
| Provide outdoor learning area at Refuge Headquarters | $25,000 | $1,000 |
| Administration and management of program (curriculum development, initiatives, special events, coordination) | | $14,000 |
| Equipment and materials | | $2,000 |
| **Total** | **$105,000** | **$18,000** |

The EE program works closely with area schools and regional and statewide partners to teach and engage students of all ages on Refuge resources, both on-site and off-site. The Refuge has one FTE position dedicated to the EE program as a Visitor Services Manager. Additional Refuge staff supports topic-specific programs like carp awareness and cultural resources. Other Refuge staff assists in maintenance of EE facilities; the EE program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011).

Some EE projects may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of the EE program. Exact costs will be developed during design and implementation.

**Anticipated Impacts of the Use**

<u>General Impacts Expected from the Scientific Literature</u>

A general assessment of impacts resulting from EE uses has been compiled from the literature and is briefly summarized below.

***Disturbance Impacts:*** In general, impacts that could occur from EE programs will be similar to those expected from wildlife observation, photography, or interpretation activities, especially those expected from larger groups using the site (USFWS 2011). Such impacts would be expected to include temporary damage to vegetation resulting from trampling, disturbance to nesting birds, and disturbance to feeding or resting birds or other wildlife in the proximity. EE programs generally accommodate groups of participants, and studies have shown that increasing group size has an impact on wildlife (Beale and Monaghan 2004; Remacha et al. 2011). In addition to group size, loudness has also been found to be an important variable to disturbance of wildlife, and loudness of people present can be more important than the number of people present (Burger and Gochfeld 1991. Studies showed that reducing group size, allowing safe distances, and reducing noise levels help minimize negative impacts on wildlife (Burger and Gochfeld 1991; Beale and Monaghan 2004; Remacha et al. 2011).

An unpublished study examined the effect of EE site activities at Blackhorse Lake on the Turnbull National Wildlife Refuge (Jose 1997). The study was designed to compare waterfowl presence and behavior patterns between the times EE activities were occurring and the times when EE classes were not on-site. The study results indicated that fewer waterfowl were present in the study area when EE classes were on-site as compared to the control times. The study also found more shore flights undertaken by birds when EE classes were on-site. Redheads displayed the highest number of flight responses, followed by mallards. Ruddy ducks almost never flew but had the highest increase in directional swimming away from the EE classes. The study recommended that sites heavily used by smaller-bodied birds, such as ruddy ducks, buffleheads, and teals, not be used as EE sites.

***Conservation Benefits:*** EE provides indirect beneficial impacts for visitors engaged in EE programs and activities. One study found that animal-oriented activities have an impact on the knowledge and attitudes of students involved in EE. Direct instruction methods in which children examined the anatomical and behavioral characteristics of live spiders and snakes promoted a positive attitude toward these animals (Kress 1975; Kellert and Westervelt 1983). Eighth graders engaged in wildlife-oriented activities were found to be more likely to recognize the importance of lower forms of animal life and preserving endangered species, and to have greater tolerance for predators (LaHart 1978). Another study concluded, “If one were to try to change attitudes, education without an experiential component might not be very effective” (Baird and Tolamn 1982, p. 12).

Refuge-Specific Impacts

This section evaluates the likely impact at the Refuge itself, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge.

***Loss of Habitat from Facility Construction:*** Under the CCP, new facilities constructed for EE will result in 0.25 acre of habitat loss, which is a fraction of a percentage of the Refuge; thus, habitat loss from new facilities is considered negligible.

***Vegetation, Soil, and Water Impacts:*** Collection of resource samples for study (i.e., mud, water, plants) will be primarily focused at the Refuge Headquarters, and samples will be used on-site. Collection will be of materials needed to enhance hands-on learning and investigation and will be designed as part of structured activities and lessons guided by teachers and Refuge staff and volunteers. These activities will be an integral part of the EE philosophy, and their impacts will be minimal. Some additional trampling will also occur from larger group sizes, but impacts will be concentrated at public sites. To minimize trampling along the east side of the Display Pond, a hardened site may be developed. Impacts to water resources are expected to be negligible.

***Disturbance Impacts:*** Under the management direction of the CCP, the construction of an outdoor learning area and shelter at the Refuge Headquarters will have short-term disturbance impacts. Maintenance of facilities and equipment related to EE could also result in very local disturbance depending on time and place of need.

Disturbance to wildlife could occur from EE programs, as with any group, if birds near EE activities will be disturbed by human presence. The EE program will continue to be small, and will generally support groups of 10 to 30 participants at any one time, although occasionally multiple groups visit the Refuge at the same time. A special use permit (SUP) will be required for EE programs on the Refuge to ensure groups understand Refuge regulations, the purpose and mission of the Refuge and Refuge System, and to help the Refuge gather use information. For special permission into closed habitat/wildlife areas, an SUP will be required, and will be approved on a case-by-case basis. All participants involved in EE will be instructed in ethical wildlife observation etiquette to view wildlife with minimal disturbance.

Table B-4 details the SUP requirements under the CCP for environmental education.

**Table B-4. Special Use Requirements for Environmental Education**

| Access to Open Areas | Access to Closed Areas | Access to Hunting Areas | Access to Fishing Areas |
|---|---|---|---|
| • Special use permit<br>• No fee | • Special use permit<br>• No fee | • No entry during hunting season | • Special use permit<br>• No fee |
| • Special use permit<br>• No fee | • Special use permit<br>• No fee | • No entry during hunting season | • Special use permit<br>• No fee |

Participation in EE programs is growing throughout Oregon, with the Service's *Connecting People with Nature* initiative, and nationally with the *America's Great Outdoors* initiative. With this growing emphasis, future program participation and associated effects will be expected to be higher than present. The EE program could have increased impacts on Refuge habitats and wildlife, but a majority of EE activities will be conducted at the Headquarters or along roads and trails open to the public.

It is not expected that EE will cause any additional short-term, long-term and/or cumulative and indirect/secondary impacts other than those detailed above.

***Impacts to Listed Species:*** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from EE uses and facilities will be negligible. These uses will continue to occur at public sites and on designated roads and trails, away from sensitive habitat and resources and outside of breeding areas and seasons. The greater sage-grouse is not known to breed on the Refuge. Incidental use of the east side of the south Blitzen Valley by sage-grouse has been reported during the late summer when visitor numbers and activities are lower. EE uses do not generally occur at Mud Creek and Bridge Creek outside of the fishing season and thus will not impact the spotted frog populations. Groups participating in EE on the Refuge will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. EE will also assist in raising awareness and preventing undue impacts to these species. If the use results in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Other Priority Public Uses:*** EE generally results in little disturbance to other visitors. Some additional crowding at the Refuge Headquarters or along public roads and trails may occur with EE groups, but the EE programs will consist of structured activities and will be carefully scheduled to ensure groups are spread out and not impacting other programs or events.

***Infrastructure:*** No significant effects to roads, trails, or other infrastructure from EE programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade is addressed in the Availability of Resources section.

**Public Review and Comment**

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination**

| | |
|---|---|
| ______ | Use is Not Compatible |
| X | Use is Compatible with the Following Stipulations |

**Stipulations Necessary to Ensure Compatibility**

***Special Use Permit***

- An SUP will be required for groups engaging in EE on the Refuge. No fee will be charged for EE groups.
- A standard permit form stipulating dates, times, and locations of use will be made available prior to the visit on the Refuge's website or by mail.
- SUPs for areas open to the public grant permissions to open areas for up to 1 year under the same use stipulations before renewal.
- Special permission requests to closed habitat/wildlife areas or other special considerations (e.g., access to Refuge after normal public visitation hours, setting up temporary equipment, requiring additional resources or staff) will be granted on a case-by-case basis with no renewal.
- The SUP is required to be readily available while conducting the permitted use on the Refuge.
- Requests must demonstrate intent to enhance education, appreciation, and/or understanding of the Refuge and the National Wildlife Refuge System. Failure to abide by any part of the SUP or regulations will be considered grounds for immediate revocation of the permit and could result in denial of future permit requests.

***General Stipulations***

- On-site EE programs will be conducted at Refuge Headquarters or along roads and trails open to the public.
- Class size will be limited to 30 participants at a time.
- Refuge staff will instruct all groups in behavior etiquette and ways to reduce wildlife and habitat disturbance during a "welcome" session.
- Collection of resource samples for study (i.e., mud, water, plants) will be restricted to the Refuge Headquarters, and samples will be used on-site. Collection will be of materials needed to enhance hands-on learning and investigation and will be designed as part of structured activities and lessons.

- Periodic monitoring and evaluation of Refuge Headquarters and EE programs will be conducted to assess if objectives are being met and the resource is not being unacceptably degraded.

**Justification**

EE receives enhanced consideration in the CCP process, and is considered a priority public use when determined compatible. By limiting the size of groups, providing structured activities, and providing closed areas for wildlife away from human disturbance, this program will limit disturbances to wildlife. There is sufficient undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. The use of SUPs allows the Refuge Manager to continually adjust the activity to any significant new or changing conditions on the Refuge as needed, and to facilitate outreach and coordination of activities with EE groups. Thus, allowing EE to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System mission.

EE contributes to the mission of the Refuge System by providing wildlife-oriented educational benefits to visitors. EE programs on Refuge lands are inherently valuable to the USFWS because they will enhance the public's knowledge of the Refuge and its resources, and expand the number of visitors who engage in the Refuge's conservation mission. EE on-site and off-site is an important part of the Refuge's vision and goals.

**Mandatory Reevaluation Date**

09/2027 Mandatory 15-year Reevaluation Date (for priority public uses)

**NEPA Compliance for Refuge Use Decision**

X Environmental Impact Statement and Record of Decision

**References**

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USFWS. 2011. Compatibility determination for wildlife observation, photography, and interpretation. Malheur National Wildlife Refuge. Princeton, OR.

**Signatures:**

| | | |
|---|---|---|
| Prepared by: | (Signature) | 1/24/13 (Date) |
| Acting Refuge Manager/ Project Leader Approval: | (Signature) | 1/24/13 (Date) |
| **Concurrence:** | | |
| Refuge Supervisor: | (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | (Signature) | 1-24-13 (Date) |

# B.3 Waterfowl Hunting Compatibility Determination

**RMIS Database Use:** Hunting (waterfowl)

**Refuge Name:** Malheur National Wildlife Refuge

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

**Description of Use**

***Program Offerings:*** This CD examines waterfowl hunting on designated units of the Refuge as described in the management direction of the CCP. Under the CCP, the Refuge would offer waterfowl hunting in two units: the Malheur Lake Unit and the Buena Vista Unit. The total waterfowl hunt area under the CCP will measure approximately 63,100 acres or 33 percent of the Refuge. Staggered hunt openings will provide the equivalent of two "opening weekends" at the Refuge.

A youth waterfowl hunt will be promoted, and the Refuge will support reasonable waterfowl hunting opportunities in the Buena Vista Unit for disabled hunters. Species available for take include ducks, geese, and coots. To increase hunter success during the hunting season, the use of well-trained hunting dogs will be encouraged by the Refuge for prey retrieval.

***Location of Use, Associated Facilities, and Access:***

*Malheur Lake Unit:* Malheur Lake Unit is currently located on the north side of Malheur Lake, east of Highway 205 and west of Cole Island Dike (approximately 26,000 acres or 14 percent of the Refuge).

Under the management direction of the CCP, the allowable hunt area on the lake will be expanded to include an area on the south side of Malheur Lake east of the Sodhouse Farms (a private inholding) eastern dike and west of Cole Island Dike (approximately 4,600 acres), creating two hunt units on the lake: the North Malheur Lake Unit and the South Malheur Lake Unit. The opening on the North Malheur Lake Unit will remain the same as the state waterfowl season, which is generally from the end of September to mid-October. Access will be improved to the North Malheur Lake Hunt Unit by refurbishing the Saddle Butte lake access with an all-weather road. Existing walk-in access from Highway 205 and the Lawen access will remain. The north hunt boundary will be redefined to reflect the actual huntable acreage west of Cole Island Dike, and to protect significant resources on Malheur Lake.

The South Malheur Lake Unit will have special date regulations from the fourth Saturday of October to the end of the regular state waterfowl season and will include a fourth access point at the airboat launch site near Refuge Headquarters with expanded parking and a refurbished boat launch. A no-hunt buffer zone around the airboat launch site and proposed observation tower will be enforced. This will bring the North and South Malheur Lake Units to a total of 27,100 acres under the CCP. See Map 3b.

*Buena Vista Unit:* The Buena Vista Hunt Unit, currently open only for upland game hunting, will also be opened to waterfowl hunting under the CCP, adding 36,000 acres of waterfowl hunt area to the waterfowl hunt program. A special date regulation will apply from the fourth Saturday of October to the end of the regular state pheasant season. Boats will not be permitted in this hunt unit; however, the hunt unit will provide a walk-in hunting experience where hunters could set up temporary decoys or jump-shoot if opportunities present themselves.

Like other Refuge users, hunters rely on roads, parking lots, pull-offs, trails, and dikes while using the Refuge.

***Number of Visits and Seasonal Patterns:*** In 2010-2011, an estimated 85 visits were made to the Refuge to engage in waterfowl hunting activities. Waterfowl hunting is the smallest use of all the priority public uses on the Refuge. With improvements made to habitat management, access, and enhanced hunting opportunities, the number of waterfowl hunting visits is expected to grow over 15 years to 180 visits per year.

**Availability of Resources**

Availability of resources for administering and managing the waterfowl hunting program under the CCP are detailed in Table B-5.

**Table B-5. Costs to Implement the Use**

| Category | One-time Expense ($) | Annual Expense ($/year) |
|---|---|---|
| Improve Saddle Butte access road | $130,000 | |
| Open new ADA-accessible boat launch and parking area on Malheur Lake at the end of Boat Landing Road | $150,000 | |
| Develop new publications and signage for hunt program | $2,000 | $1,000 |

**Table B-5. Costs to Implement the Use**

| Category | One-time Expense ($) | Annual Expense ($/year) |
|---|---|---|
| Staff administration and management (programmatic, law enforcement, regulations, and information) | | $5,000 |
| Facility maintenance | | $2,000 |
| **Total** | **$282,000** | **$8,000** |

Administering the waterfowl hunt program does not require significant staff time, equipment, or funding. Still, to maintain a quality hunting experience, access trails, parking lots, signs, and other facilities are maintained annually. The Refuge has one FTE Visitor Services Manager and one FTE position for law enforcement that patrols the Refuge during hunting season to ensure compliance with Federal, state, and Refuge conditions. The majority of the staff time spent administering this program will fall mostly on the law enforcement position. Other Refuge staff assists in maintenance of hunting facilities like access roads and parking lots; in general, the waterfowl hunt program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011). Additional costs and staff time will include updating and printing hunting brochures and developing new publications for the hunt program.

Some hunt program enhancements may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of waterfowl hunting. Exact costs will be developed during design and implementation.

**Anticipated Impacts of the Use**

<u>General Impacts Expected from the Scientific Literature</u>

A general assessment of impacts resulting from waterfowl hunting uses has been compiled from the literature and is briefly summarized below.

***Direct Impacts to Hunted Wildlife:*** Sport hunting involves the direct take of wildlife designated as huntable game species by regulation. In addition to loss of target individuals, additional birds are sometimes crippled or killed and not retrieved.

Hunting causes disturbance to feeding and resting waterfowl as well as non-target species due to noise (shotgun), movement, vehicular traffic, and use of dogs for hunting activities. It can also alter behavior, population, structure, and distribution patterns of wildlife (Owens 1977; Raveling 1979; White-Robinson 1982; Thomas 1983; Bartlet 1987; Madsen 1985; Cole and Knight 1990; Dooley et al. 2010). Disturbance levels from hunting activity outside Chincoteague NWR were found to be high enough to force wintering black ducks into a pattern of nocturnal feeding within surrounding salt marsh and diurnal resting within Refuge impoundments (Morton et al. 1989a, 1989b). Unhunted populations have been documented to behave differently from hunted ones (Wood 1993). Although disturbance from hunting is noted to have effects directly on wildlife, the U.S. Department of the

Interior (U.S. DOI) concluded that hunting disturbance has less of an impact compared to the direct mortality caused by hunting (2009).

There appears to be an inverse relationship between the number of birds using an area and hunting intensity (DeLong 2002). In California, the number of northern pintails on Sacramento NWR non-hunt areas increased after the first week of hunting and remained high until the hunt season was over in early January (Heitmeyer and Raveling 1988). Following the close of hunting season, ducks generally increased their use of the hunt area; however, use was lower than before the beginning of the hunting season. Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1995; Paulus 1984).

Sanctuaries or non-hunt areas have been identified as the most common solution to disturbance problems caused by hunting (Havera et al. 1992). In Denmark, hunting disturbance effects were experimentally tested by establishing two sanctuaries, and over a 5-year period, these sanctuaries became two of the most important staging areas for coastal waterfowl; numbers of dabbling ducks and geese increased 4- to 20-fold within the sanctuary (Madsen 1995).

***Disturbance from Dogs:*** Dogs elicit a greater response from wildlife than people on foot alone (MacArthur et al. 1982; Hoopes 1993). The presence of dogs may disrupt foraging activity in shorebirds (Hoopes 1993) and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that dogs with people, dogs on leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals. In effect, off-leash dogs increase the radius of human recreational influence or disturbance beyond what it would be in the absence of a dog. Indirectly, domestic dogs can also potentially introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

Refuge-specific Impacts

This section evaluates the likely impact on Refuge resources specifically, considering the scientific studies discussed above and considering the use within the context of Malheur Refuge. It also considers the cumulative effect of Refuge hunts on regional and flyway populations of target species.

NEPA considerations by the Service for hunted migratory game bird species have been addressed nationally. In August 2009, a *Draft Supplemental Environmental Impact Statement: Issuance of Annual Regulations Permitting the Hunting of Migratory Birds* (hereafter abbreviated as SEIS 2009) was released (U.S. DOI 2009). Annual NEPA considerations for waterfowl hunting frameworks are covered under a separate Environmental Assessment and Finding of No Significant Impact.

***Harvest Management—Regulatory Procedures:*** The hunting of waterfowl in the United States is based upon a thorough regulatory setting process that involves numerous sources of waterfowl population and harvest monitoring data. Waterfowl populations throughout the United States are managed through an administrative process known as flyways, of which there are four (Pacific, Central, Mississippi, and Atlantic). Oregon is included in the Pacific Flyway. A review of the policies, processes, and procedures for waterfowl hunting is covered in a number of documents.

Because the Migratory Bird Treaty Act stipulates that all hunting seasons for migratory game birds be closed unless specifically opened by the Secretary of the Interior, the Service annually promulgates regulations (50 Code of Federal Regulations [CFR] 20) establishing the Migratory Bird Hunting Frameworks. The frameworks are essentially permissive, in that hunting of migratory birds would not be permitted without them. Thus, in effect, annual Federal regulations both allow and limit the hunting of migratory birds.

The Migratory Bird Hunting Frameworks provide season dates, bag limits, and other options for states to select from, which should result in the level of harvest determined to be appropriate based upon Service-prepared annual biological assessments detailing the status of migratory game bird populations. In North America, the process for establishing waterfowl hunting regulations is conducted annually. In the United States, the process involves a number of scheduled meetings (Flyway Study Committees, Flyway Councils, Service Regulations Committee, etc.) in which information regarding the status of waterfowl populations and their habitats is presented to individuals within the agencies responsible for setting hunting regulations. In addition, public hearings are held and the proposed regulations are published in the Federal Register to allow public comment.

For waterfowl, annual assessments used in establishing the Frameworks include the Breeding Population and Habitat Survey, which is conducted throughout portions of the United States and Canada. This survey is used to establish an annual Waterfowl Population Status Report. In addition, the number of waterfowl hunters and resulting harvest are closely monitored through both the Harvest Information Program (HIP) and the Parts Survey (Wing Bee). Since 1995, such information has been used to support the adaptive harvest management (AHM) process for setting duck-hunting regulations. Under AHM, a number of decision-making protocols determine the choice (package) of pre-determined regulations (appropriate levels of harvest) that comprise the framework offered to states that year. Each state’s wildlife commission then selects season dates, bag limits, shooting hours, and other options from the Pacific Flyway package. Their selections can be more restrictive, but cannot be more liberal than AHM allows. Thus, the level of hunting opportunity afforded each state increases or decreases each year in accordance with the annual status of waterfowl populations.

Season dates and bag limits for National Wildlife Refuges open to hunting are never longer or larger than the state regulations. In fact, based upon the findings of an environmental assessment developed when a Refuge opens a new hunting activity, season dates and bag limits may be more restrictive than the state allows. Each National Wildlife Refuge considers the cumulative impacts to hunted migratory species through the Migratory Bird Frameworks published annually in the Service’s regulations on Migratory Bird Hunting.

***Population and Harvest Data:*** The following analysis of hunting effects on the Refuge uses data on harvest and population, comparing the number of birds taken at various scales with the estimated population size. Since hunting occurs in the fall and winter, the mid-winter population index is used to compare take to population. The index is provided by the 2010 Pacific Flyway Data Book, which tracks waterfowl harvests and status, and hunter participation and success in the Pacific Flyway and United States (Collins and Trost 2010). The Pacific Flyway is one of the major north-south routes of travel for migratory birds in the Americas along the West Coast, and the Refuge is part of the flyway route. The data is provided at a variety of scales: Pacific Flyway, State of Oregon, and Survey Unit 69-3 S, which includes Klamath, Lake, and Harney counties, providing a good view of regional populations (Collins and Trost 2010). Although the Refuge receives the majority of its birds during the spring and fall migration months, the mid-winter index provides an example of bird populations that may be present regionally during the Refuge hunting season.

***Wintering Populations:*** Recent mid-winter waterfowl survey counts for ducks and geese in the Pacific Flyway, the State of Oregon, and regional Survey Unit 69-3 S are presented in Table B-6.

These numbers only represent an index, not an absolute population number. Oregon hosts only a small percentage of wintering waterfowl; within the Pacific Flyway, the majority of waterfowl winter in California. At Malheur, the main wintering species include: Canada geese, mallards, common goldeneye, bufflehead, and common and hooded merganser; coots are smaller in number. Most waterfowl species migrate away from the Refuge by mid-November with peaks during October. The Refuge has a low number of wintering birds, usually less than 3,000 birds reported during counts. The mid-winter population index from the Pacific Flyway Council is not reported for Malheur Refuge.

***Fall Populations:*** Counts were conducted on the Refuge during the 1970s to 1990s to gather information on fall use days of ducks and geese. Between 1975 and 1981, the counts captured ducks and geese on Malheur Lake only; counts were Refuge-wide between 1982 and 1990, which assumed 90 percent of fall use still on Malheur Lake. From 1991 to 1997, counts did not specify location of populations, so it is hard to determine if they represent Malheur Lake, Harney Lake, or Refuge-wide counts, and thus do not provide a reliable source. The fall population counts from the 1970s to 1990s represent population numbers from mid-September through mid-December on the Refuge. Although dated, the counts provide the best available data for fall bird populations over time on the Refuge. (Paullin et al. 1977; Horton et al. 1983; Littlefield 1983)

Area harvest information is not available at the regional or Refuge level, as it is not consistently tracked by the Pacific Flyway Council, ODFW, or the Refuge. The Pacific Flyway provides harvest data at the flyway, state, and regional levels. The Refuge harvest numbers are estimated by Refuge staff, but are only an estimate.

***Estimated Harvest Mortality:*** Hunting results in mortality to waterfowl, and these numbers are tracked at different scales. See Table B-6 for harvest estimates at different scales in 2009. The estimated future harvest of ducks and geese on the Refuge due to hunting under current management and future CCP management is also captured.

**Table B-6. Harvest and Population at Flyway, State, and Survey Unit Scales: Ducks, Geese[1], and Coots**

| Area | Area Harvest 2009 | Breeding Population 2010 | Mid-winter Population Index 2010 | Average Fall Count 1982-1990[2] | Estimated Harvest[3] | |
|---|---|---|---|---|---|---|
| **Ducks** | | | | | **Current Management** | **Future Management** |
| Pacific Flyway | 3,225,718 | 980,298 | 4,620,523 | | No change | |
| State of Oregon | 422,001 | 219,876 | 349,654 | | No change | |
| Survey Unit 69-3 S[4] | Not available | | 14,173 | | No change | |
| Malheur NWR | Est. <100 | | | 25,593 | <100 | <250 |
| **Geese** | | | | | **Current Management** | **Future Management** |
| Pacific Flyway | 425,739 | | 1,522,908 | | No change | |
| State of Oregon (total season) | 60,901 | | 125,447 | | No change | |
| Survey Unit 69-3 S[3] | Not available | | 13,024 | | No change | |
| Malheur NWR | Est. <150 | | | 6,253 | <150 | <200 |
| **Coots** | | | | | **Current Management** | **Future Management** |
| Pacific Flyway | 35,564 | | 606,642 | | No change | |
| State of Oregon (total season) | 2,124 | | 13,585 | | No change | |
| Survey Unit 69-3 S[3] | Not available | | 100 | | No change | |
| Malheur NWR | Est. <50 | | | Not available | <50 | <100 |

[1] Source: Collins and Trost 2010.
[2] From Refuge-wide population counts, averaged from available data from Harney Basin Study Reports.
[3] Klus 2001; Megan and Bodeen 2011.
[4] Survey Unit 69-3 S is a unit that the Pacific Flyway Council uses for mid-winter surveys that includes Klamath, Lake, and Harney counties, which includes Malheur Refuge.

Although in Table B-6, harvest in 2009 appears to represent more than the actual mid-winter survey for ducks at the state level, it is important to remember that to make any kind of comparison between the seasonal harvest and some population level, an estimate of the number of birds available for harvest in Oregon would be needed. The mid-winter count represents simply a snapshot at one point during mid-winter, and thus can underestimate total wintering populations. The duck harvest in Oregon accounted for approximately 13 percent of the Pacific Flyway duck harvest in 2009. Similarly, the goose harvest in Oregon accounted for approximately 14 percent of the Pacific Flyway goose harvest in 2009.

***Direct Mortality Stemming from Refuge Hunts:*** Refuge-specific harvest data is not available at this time, but per communication with Refuge staff and ODFW, hunter numbers and harvest numbers are generally very low and do not exceed more than 250 waterfowl harvested annually. With expanded access to the South Malheur Lake Unit and the opening of the Buena Vista Hunt Unit for waterfowl hunting under the CCP, the number of harvests will be expected to increase to 550 waterfowl annually. These estimated harvests represent a tiny fraction of a percent of the total mid-winter population of wintering waterfowl in the Survey Unit and State of Oregon, and an even smaller fraction of the Pacific Flyway population. Under the CCP harvest estimation, the waterfowl harvested will be less than 2 percent of the mid-winter survey population in the Survey Unit 69-3 S (Klamath, Lake, and Harney counties). From available data provided in the Harney Basin Study Reports, the duck and goose harvested will be between 1 percent and 4 percent of fall counts at average 1982-1990 levels. Coot populations have been increasing over the last 50 years, from 600,000 birds in 1955 to 1.6 million birds in 2005. American coot harvest in Oregon during 2005 was 1,500 birds taken by 200 hunters. As the flyway coot population continues to remain high, these birds are underutilized and, with liberal bag limits, can provide increased hunting opportunity. The overall impacts from the harvest estimates will be minor to negligible.

Historical data demonstrates that Malheur Lake was once an extremely productive area for waterfowl, with annual waterfowl production estimates from 1942 to 1980 averaging over 51,000 birds, of which ducks constituted over 95 percent, or over 48,000 ducks produced annually. In 1948 alone, 146,950 ducks were produced (Cornely 1982), suggesting that these high levels of production resulted in high-quality waterfowl hunting. After 1980, population data is not readily available; however, Refuge staff believe production has been decreasing over the years due to lake level fluctuations and invasive carp. As management activities work to control carp in Malheur Lake over the next 15 years, it is expected that the number of nesting birds in this area will increase and consequently the number of hunters and harvests will also increase. There are many unknowns in carp control, and an accurate estimate of waterfowl to be harvested under this scenario cannot be predicted at this time.

The Buena Vista Hunt Unit will considerably increase the acreage open to waterfowl hunting to 63,000 acres; however, the expected number of waterfowl hunters after opening weekend will be small, thus mitigating against hunter competition and disturbance issues. Additionally, spreading out opening weekend for waterfowl hunting between the hunt units over two weekends will help reduce conflicts between hunters and allows additional protection for staging sandhill cranes.

Given the small amount of the estimated take and the distribution of the hunt units, the hunt program as designed is not expected to adversely affect the Refuge's ability to sustain optimum population levels for maintaining populations of migratory waterfowl. As the health of Malheur Lake improves and the hunt program grows over the 15-year time frame of the CCP, the hunt program will be revisited with ODFW guidance to determine what the appropriate level of harvest would be with growing population projections.

***Disturbance to Target Wildlife*****:** Hunting could result in redistribution of waterfowl and waterbirds at the Refuge. Disturbance effects associated with hunting were examined in the SEIS 2009 for waterfowl and some other migratory bird species. On the basis of a review by Dahlgren and Korschgen (1992), the SEIS 2009 noted that disturbance has its most pronounced detrimental effect during the nesting period. Hence the SEIS 2009 noted that hunting-related disturbance does not have any pronounced population level effects (U.S. DOI 2009).

***Impacts to Non-Target Wildlife:*** Non-hunted wildlife would include any non-target waterfowl and other birds; small- and medium-sized mammals; reptiles; amphibians; and invertebrates. Occasionally, non-target species are illegally killed by hunters by accident or intentionally, or are disturbed by hunter presence or noise. The free-roam hunting opportunity and use of temporary blinds at the Buena Vista Unit could increase habitat disturbance in areas not currently accessed.

The cumulative effects of disturbance to non-hunted birds under the CCP management direction are expected to be moderate to minor for the following reasons. Hunter education courses are required for youths. Hunting seasons do not coincide with nesting seasons; thus, reproduction will not be reduced by hunting. Disturbance to the foraging or resting activities of migrating or resident birds might occur, and will increase with the new access for boats at the South Malheur Lake Unit and the opening of the Buena Vista Hunt Unit to waterfowl hunters. However, even with these changes, hunting is still expected to involve a small numbers of participants. On North Malheur Lake Unit, due to the long walk-in distances and difficulties and inconsistencies of getting boats out on the lake, many hunters hunt the shoreline rather than using boats on Malheur Lake, thus limiting the area disturbed on that side. The Buena Vista Unit will remain a walk-in hunt, but prohibiting overnight camping will decrease the likelihood of hunters roaming long distances in the Buena Vista Unit and other hunt units.

Waterfowl can be an important food resource for bald eagles in winter. On the Refuge, bald eagle presence is low during the winter, and the majority of the population is found during the spring. During waterfowl hunting season, there will be adequate food resources available on Malheur Lake and the wetlands for any bald eagles on the Refuge at this time. Furthermore, hunting pressure is generally low overall, and there will be no expected competition between hunters and bald eagles for waterfowl.

Disturbance to other taxa will be unlikely or negligible for the following reasons. Encounters with reptiles and amphibians, invertebrates, and small mammals in the early fall will be few and should not have cumulative negative effects on Refuge populations. Refuge regulations further mitigate possible disturbance by hunters to non-hunted wildlife. Vehicles will be restricted to public roads and the harassment or taking of any wildlife other than the game species legal for the season will not be permitted.

Dogs will increase the level of disturbance to target and non-target species, but this impact is expected to be minor, especially to migratory wildlife, and is encouraged to support the use. Dogs will be required to be under the close control of their owners while on the Refuge.

Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. Under the CCP, a late season opener for the southern portion of Malheur Lake and the

Buena Vista Unit will allow sufficient protection of the sandhill cranes until they migrate south, thus mitigating any hunting-related impacts to sandhill cranes. Other birds using the area may be disturbed by noise and human presence; however, since most birds will have already migrated through the area by the time hunting begins, disturbance levels will be expected to be minor overall. Outreach with hunting brochures and timely information on the website will help educate hunters on hunting opportunities, regulations, and ethical hunter behavior.

***Loss of Habitat from Facility Construction:*** Saddle Butte access road will be upgraded but will follow the same route. Construction of the boat launch at Boat Landing Road will result in 0.5 acre of habitat loss, which is a fraction of a percentage of the Refuge. Thus, habitat loss from new facilities is considered negligible. No additional new facilities will be added to support this use separate from general visitor use facilities described in the CD for wildlife observation, photography, and interpretation.

***Vegetation, Soil, and Water Impact:*** Since access to waterfowl hunting areas is walk-in, associated foot travel from accessing Malheur Lake and the Buena Vista Unit for hunting could potentially result in temporary and minor vegetation trampling.

***Impacts to Listed Species:*** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from waterfowl hunting uses and facilities will be negligible. The greater sage-grouse is not a hunted species on the Refuge. Hunting is not allowed south of the Buena Vista Unit where sage-grouse have been observed, and there have been no occurrences of spotted frogs in the area encompassed by the Buena Vista or Malheur Lake Hunt areas. Public education will assist in raising awareness and preventing undue impacts to these species. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Other Priority Public Uses:*** Hunting has the potential to disturb Refuge visitors engaged in other priority public uses; however, given the season during which hunting occurs, the likelihood of conflicts is low. The Malheur Lake airboat launch site near the Refuge will be opened to other uses during hunting season; however, the number of visitors to the Refuge during this season is drastically lower than in other seasons and hunting regulations will be established to provide a no-hunt buffer zone around the airboat launch site and observation tower. Although Center Patrol Road is the most popular attraction during the migration seasons, use is also very light during hunting season, and state regulations also prohibit shooting from, on, and across roads. Fishing along the Blitzen River from Sodhouse Lane to Boat Landing Road will conclude prior to the hunting season opening. Generally, winter use on the Refuge is only a fraction of the use during the spring and fall seasons.

***Infrastructure****:* No significant effects to roads, trails, or other infrastructure from the hunting program are foreseen. Normal road, trail, and facility maintenance will continue to be necessary.

Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

***Other Effects:*** There could be some indirect beneficial impacts of Refuge hunting. Refuge hunting can contribute to wildlife and habitat conservation and provide educational and sociological benefits. The hunting community in general remains the largest support base for funding land acquisitions in the Refuge System through the purchase of Duck Stamps. Waterfowl hunting at the Refuge is a "Big Six" use and helps meet the Refuge's goals of wildlife-dependent recreation for all visitors. Additionally, providing youth hunting opportunities is an important initiative in the Fish and Wildlife Service, and enhancing this opportunity on the Refuge helps address a public desire to see more hunting opportunities for youth.

**Public Review and Comment**

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles will be allowed only on maintained public roadways. Parking will be allowed only within one vehicle length of the roadway. Hunters will be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires will not be permitted on the Refuge.
- Access will be walk-in only. Electric motorized boating or non-motorized boating will be permitted on Malheur Lake during the waterfowl hunt season.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Seasonal hunting closures may occur to protect waterfowl populations when the Malheur Lake water level drops below 10,000 acres.
- Hunting closures will be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. Shooting from or across public roads or road right-of-ways is prohibited.
- Law enforcement patrols will ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information will be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

**Justification**

Under the National Wildlife Refuge System Administration Act, as amended, waterfowl hunting is a wildlife-dependent recreational activity, which receives enhanced consideration in the CCP planning process and is to be encouraged on National Wildlife Refuges if compatible with refuge purposes.

Despite the direct and indirect impacts associated with sport hunting of waterfowl, waterfowl populations are unlikely to be affected significantly by the hunting program on the Refuge. Waterfowl population objectives and allowable harvests are determined on a flyway basis using an established annual regulatory process. Limited hunt seasons at the Refuge in significant wildlife areas, and no hunt zones, ensure that wintering and migrating waterfowl, as well as non-target species, will find adequate food and rest areas on the Refuge even in the midst of the hunting season. Thus, allowing waterfowl hunting to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System's mission.

**Mandatory Reevaluation Date**

__09/2027__ Mandatory 15-year Reevaluation Date (for priority public uses)

**NEPA Compliance for Refuge Use Decision**

____X____ Environmental Impact Statement and Record of Decision

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**Signatures:**

| | | |
|---|---|---|
| Prepared by: | Carey G[illegible] (Signature) | 1/24/13 (Date) |
| Refuge Manager/ Project Leader Acting Approval: | Chad Karges (Signature) | 1/24/13 (Date) |

**Concurrence:**

| | | |
|---|---|---|
| Refuge Supervisor: | [illegible] (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | Robt L. West (Signature) | 1-24-13 (Date) |

## B.4 Upland Game Hunting Compatibility Determination

**RMIS Database Use:** Hunting (upland game)

**Refuge Name:** Malheur National Wildlife Refuge

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

**Description of Use**

***Program Offerings*:** This CD examines sport hunting for upland game on designated units of the Refuge as described in the management direction of the CCP (for more detail, see Hunt Plan, Appendix P). Under the CCP, the Refuge will offer upland game hunting in three units: the Malheur Lake Unit, the Buena Vista Unit, and the Boundary Hunt Unit.

The total acreage open to upland game hunting under the management direction will be 49,000 acres, or 27 percent of the Refuge; however, regulations will vary by unit, as described below.

***Location of Use, Associated Facilities, and Access:***

*Malheur Lake Unit:* Upland game hunting is currently open on the North Malheur Lake Unit, east of Highway 205 and west of Cole Island Dike. It currently measures 14,000 acres based on the average low water line of the lake. Current federal regulations (50 CFR 32.56) indicate that the Refuge allows hunting of pheasant, quail, partridge, chukar, and rabbit in accordance with State regulations, concurrent with the State pheasant season. Access is walk-in only from Lawen and Saddle Butte roads on the north side of the lake, and there is one access point on Highway 205 at the Narrows. Upland game hunting occurs on the edge of the lake and not on the actual lake itself.

Under the CCP, rabbit will be dropped from the species allowable; all other allowable species will remain the same. In addition, the boundary of the Malheur Lake Unit will be redefined to reflect the actual huntable acreage and to protect significant resources on the lake, reducing the unit to an average of 13,000 acres based on the typical low water line. Additionally, access will be improved by refurbishing the Saddle Butte lake access with an all-weather road. A youth upland game youth hunt will be promoted on the Malheur Lake Unit, on the State-designated weekend, generally in September each year. All other aspects of the hunt, including harvest season and other regulations, will remain the same.

*Buena Vista Unit:* The Buena Vista Hunt Unit, which totals 36,000 acres, is one of the most popular hunting areas in Harney County for ring-necked pheasants. Federal regulations (50 CFR 32.56) indicate that the Refuge allows hunting of pheasant, quail, partridge, chukar, and rabbit within this Unit. The State season opens in mid-October, but the Buena Vista Hunt Unit currently has a later season opening to reduce conflicts with fall staging sandhill cranes.

Under the CCP, rabbit will be dropped from the species allowable; all other allowable species will remain the same. In addition, the opening date will change from the current third Saturday of November to the fourth Saturday of October to provide more quality opportunities for upland game hunting earlier in the season while still ensuring a buffer for migrating sandhill cranes (sandhill cranes have usually migrated farther south by the middle of October). All other aspects of the upland game hunts will remain the same as they currently are.

*Boundary Hunt Unit:* The Boundary Hunt Unit includes the strip of land west of State Highway 205 and south of Foster Flat Road (2,122 acres), and an area bordering Krumbo Creek upstream of Krumbo Reservoir (504 acres). Both pieces of this unit border Bureau of Land Management (BLM) land. An uneven and generally unmarked boundary has contributed to difficulties in distinguishing the boundary between Refuge lands and BLM lands, so these areas have traditionally been managed to align with BLM hunt regulations (which conform to State regulations)[1]. Federal regulations (50 CFR 32.56) indicate that the Refuge allows hunting of “all upland game species” in the Boundary Unit section *west of Highway 205* during authorized State seasons; however, only deer and pronghorn are specifically mentioned in the regulations as allowable for this area, and the area identified for pronghorn and deer harvest includes only the western portion of the Boundary Unit (i.e., the Krumbo Creek area is excluded). Pheasant, quail, partridge, chukar, coyote, and rabbit are mentioned elsewhere in the regulations as upland game species available “in designated areas” but these areas are not described in the CFR. The Refuge has managed the hunt to include all of these species within the Boundary Unit.

State regulations define coyote and rabbit as predatory animals; coyotes are also defined as unprotected mammals. However, some rabbits are protected by the State and are not allowable for hunting.

Under the CCP, the Boundary Hunt Unit species allowable and areas will remain the same, with the following exceptions:

- Rabbit species allowable for take within this unit will be defined specifically as black-tailed jackrabbit (*Lepus californicus*) and Nuttall’s cottontail (*Sylvilagus nuttallii*).

[1] State regulations do treat Federal refuges differently from other federal lands in at least one way. State rules (OR 635-050-0210) specifically bar hunting or trapping of fur-bearing mammals or unprotected mammals (both are defined in OR 635-050-0050) on “Federal refuges.”

- The Krumbo Creek area will be included as an area where deer and pronghorn may be hunted.

***Number of Visitors and Seasonal Patterns:*** In 2010-2011, an estimated 850 visits were made to the Refuge to engage in upland game hunting activities in all three units, which accounts for over 90 percent of Refuge hunting visits. With improvements made to habitat management and access, and enhanced hunting opportunities, the number of upland game hunting visits is expected to grow over 15 years to 1,000 visits per year.

***Harvest Management:*** Harvest and season regulations for upland game will be fully consistent with the State's regulations, via ODFW's *2010-2015 Upland Game Bird Hunting Season Framework* (ODFW 2010c). Hunting seasons and daily bag/possession limits have been established to maximize hunting opportunities over the next 5 years. The Refuge may manage under stricter, but not under more liberal, regulations. Note that trapping (an allowable method under State rules to take coyote and rabbit) will not be permitted under this CD.

**Availability of Resources**

Availability of resources for administering and managing the upland game hunting program under the CCP are detailed in Table B-7.

**Table B-7. Costs to Implement the Use**

| Category | One-time Expense ($) | Annual Expense ($/year) |
|---|---|---|
| Administration and management (programmatic, law enforcement, information) | | $2,000 |
| **Total** | **$0** | **$2,000** |

Administering the upland game hunt program does not require significant staff time, equipment, or funding. The Refuge has one FTE Visitor Services Manager and one FTE position for law enforcement that patrols the Refuge during hunting season to ensure compliance with state and Federal regulations and Refuge conditions. The majority of the staff time spent administering this program will fall mostly on the law enforcement position. Other Refuge staff assists in maintenance of general hunting facilities like access roads and parking lots that are included under the waterfowl hunt program (USFWS 2011a); in general, the upland hunt program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011b). Additional costs and staff time will include updating and printing hunting brochures and developing new publications for the hunt program.

Some hunt program enhancements may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels for upland game hunting. Exact costs will be developed during design and implementation.

**Anticipated Impacts of the Use**

General Impacts Expected from the Scientific Literature

A general assessment of impacts resulting from upland game hunting uses has been compiled from the literature and is briefly summarized below.

***Direct Impacts to Hunted Wildlife*****:** Sport hunting involves the direct take of wildlife that are designated as huntable game species by regulation. In addition to loss of individual target species, additional birds are sometimes crippled or killed and not retrieved.

Hunting causes disturbance to feeding and resting waterfowl as well as non-target species due to noise (shotgun), movement, vehicular activity, and use of dogs for hunting activities. It can also alter behavior, population, structure, and distribution patterns of wildlife (Owens 1977; Raveling 1979; White-Robinson 1982; Thomas 1983; Bartlet 1987; Madsen 1985; Cole and Knight 1990; Dooley et al. 2010).

***Disturbance from Dogs*****:** Dogs elicit a greater response from wildlife than people on foot alone (MacArthur et al. 1982; Hoopes 1993). The presence of dogs may disrupt foraging activity in shorebirds (Hoopes 1993) and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that dogs with people, dogs on leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals. In effect, off-leash dogs increase the radius of human recreational influence or disturbance beyond what it would be in the absence of a dog. Indirectly, domestic dogs can also potentially introduce various diseases and transport parasites into wildlife habitats (Sime 1999).

***Species-specific Impacts: Upland Birds***

This section evaluates the likely impact on Malheur Refuge resources specifically, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge. It also considers the effect of Refuge hunts on target species.

***Population and Harvest Data:*** Population data of upland game birds is provided by ODFW through surveys of upland game bird production inventories. These inventories are typically conducted during the last half of July or the first half of August on established routes throughout Oregon. ODFW biologists record the species observed, the gender of birds observed (if possible), number of chicks observed, and number of chicks in complete broods, which produces a production index (number of chicks/adult). As they formulate an index and are not a full population sample, these survey techniques detect an unknown proportion of the population; consequently, the numbers cannot be used to provide an estimate of the total population. However, the data collected can be used to generate population trends, and the greater the increase in birds for a given year, the more likely ODFW biologists will be to count more birds (ODFW 2010a).

Harvest data of upland game birds is reported by hunters to ODFW annually, although harvest data at the Refuge level is not available. ODFW conducts annual harvest surveys to determine statewide hunter effort and take for upland birds. These surveys randomly select hunters for surveying and generally occur via telephone during hunting seasons. The hunters report by harvest unit, and Harney and Malheur counties are combined into one harvest unit, Area 7 (ODFW 2010b).

***Estimated Harvest Mortality:*** The following analysis of upland bird game hunting uses data on population indices and harvests at a variety of scales. Species analyzed include ring-necked pheasants, California quail, and chukar partridge. Table B-8 captures ODFW's upland game bird production inventories for 2004-2008 and 2009, and the 2009-2010 season upland game harvest data from the random telephone survey. The estimated harvest of upland game birds on the Refuge due to hunting under current management and future (CCP) management is also captured.

Upland game bird populations can vary greatly from year to year, and the production indices only represent a proportion of known upland game birds. In 2009, the production indices for ring-necked pheasant, California quail, and chukar partridge were all near or above the previous 5-year average from 2004-2008, particularly pheasants and California quails (ODFW 2010a). This suggests that upland game bird populations are relatively stable.

Based on harvest data collected from ODFW's annual telephone survey from the 2009-2010 season, upland game bird harvest in Harney and Malheur counties included 39 percent of pheasant hunted statewide, 42 percent of California quail hunted statewide, and 59 percent of chukar partridges hunted statewide. As the surveys are recorded by harvest unit, it is impossible to disaggregate the harvest information to determine the number of harvests in Malheur County or Harney County alone, or even at the Refuge level (Budeau 2011, personal communication). Based on the availability of habitat to support upland game birds in Malheur County, particularly pheasants, it is highly likely that a majority of upland game birds harvested in this unit are actually in Malheur County rather than Harney County, which the Refuge is located in (Budeau 2011, personal communication). Still, pheasants harvested in Harney County are most likely harvested on the Refuge because of the high quality of hunt available on the Refuge and the limited suitable habitat off-Refuge (Budeau 2011, personal communication). This pattern is likely true for other upland game birds too. Based on this information, the number of harvests at the Refuge-scale is expected to be considerably less than harvests reported at the harvest unit scale.

**Table B-8. Upland Game Bird Population Index and Estimated Harvest**

| Area | Production Index (chicks/adult) 2004-2008[1] | Production Index (chicks/adult) 2009[1] | Number of Harvests 2009-2010[2,5] | Estimated Refuge Harvest[3] | |
|---|---|---|---|---|---|
| **Ring-necked Pheasant** | | | | **Current Management** | **Future Management** |
| Oregon State | 3.6 | 3.6 | 33,720 | No change | |
| High Desert[6] | 3.3 | 3.8 | | No change | |
| Harney County | 1.5[4] | 0[4] | 12,989 | No change | |
| Malheur NWR | Not available | Not available | | <250 | <300 |
| **California Quail** | | | | **Current Management** | **Future Management** |
| Oregon State | 2.2 | 2.1 | 38,684 | No change | |
| High Desert[6] | 1.9 | 1.8 | | No change | |
| Harney County | 2.5[4] | 4.2[4] | 16,165 | No change | |
| Malheur NWR | Not available | Not available | | <150 | <200 |

| Area | Production Index (chicks/adult) 2004-2008[1] | Production Index (chicks/adult) 2009[1] | Number of Harvests 2009-2010[2,5] | Estimated Refuge Harvest[3] | |
|---|---|---|---|---|---|
| **Chukar Partridge** | | | | **Current Management** | **Future Management** |
| Oregon State | 2.4 | 2.7 | 57,628 | No change | |
| High Desert[6] | 2.0 | 2.1 | | No change | |
| Harney County | 1.7[4] | 1.7[4] | 33,744 | No change | |
| Malheur NWR | Not available | Not available | | <75 | <10[7] |

[1] ODFW 2010a
[2] ODFW 2010b
[3] Klus 2011; Megan and Bodeen 2011
[4] Production index is for Harney County only.
[5] Number of harvests was reported for ODFW's Harvest Unit 7, which includes both Harney and Malheur counties combined.
[6] High Desert refers to the combined ODFW district/field offices for Mid-Columbia, Deschutes, Ochoco, Klamath, Lake, Harney, and Malheur.
[7] Chukar partridge hunt will essentially be eliminated on the Refuge due to the transfer of the Boundary Hunt Unit to Bureau of Land Management.

Under the CCP, estimated harvest for upland game birds will not likely increase from current levels because the program will not markedly increase. An earlier season opening (extended hunt season overall) will provide additional hunting opportunities during the season and may increase hunters' harvest rates, but the harvest is small overall. The estimated Refuge harvest of <510 upland game birds will constitute about 1 percent of the entire harvest in Harney and Malheur counties based on 2009-2010 season. Given the wide range of upland game birds and 49,000 acres available to hunt on the North Malheur Lake Unit and Buena Vista Unit, it is expected that the overall upland game bird hunting pressure under the CCP will be low; about 100 hunters come out for opening weekend and that number continues to drop throughout the season. Additionally, given the small number of the estimated take and the distribution of the hunt units, the hunt program as designed is not expected to adversely affect the Refuge's ability to sustain optimum population levels for maintaining populations of upland game birds.

Population-specific Impacts: Coyotes

Refuge-specific data on past coyote harvest are not available. According to a recent ODFW report (Hiller 2011), coyote populations have increased substantially in both abundance and distribution during the past several decades. Hiller further reports that southeastern Oregon leads harvest by both trappers and hunters, with Harney County having 486 coyotes taken by hunters and 276 coyotes taken by trappers in 2010 (Table B-9). However, by Oregon Revised Statute (ORS 610.002), coyotes are classified as predatory animals (which may be taken without permit, limits, or reporting on private lands); therefore, the report likely underestimates coyotes hunted or trapped for control purposes on private lands. In eastern Oregon, coyotes are the second-most common animal trapped, second only to muskrat (Hiller 2011).

**Table B-9. Reported 2010 Coyote Harvest on the Refuge, County, Region, and State**

| Area | Trapping | | Hunting | |
|---|---|---|---|---|
| | **Number Reported as Taken** | **Percent of State Reported Harvest** | **Number Reported as Taken** | **Percent of State Reported Harvest** |
| Refuge | Not allowable | 0 | Unknown[1] | Unknown |
| Harney County | 276 | 9% | 486 | 21% |
| Eastern Oregon | 2,498 | 78% | 1,997 | 83% |
| State of Oregon | 3,220 | 100 | 2,277 | 100% |

Source: Hiller 2011.

[1]Although the take rate is unknown, the Refuge law enforcement officer estimates that 10-12 hunters per year pursue coyote or rabbit within the Boundary Unit.

Gese (2005) examined a variety of coyote population parameter responses under exploitation and compared these with responses under no exploitation, as part of a 7-year study. In the experimental area, coyote removal rate was estimated at 44 percent to 61 percent and 51 percent to 75 percent, in each of 2 years of removal. The study found that home range sizes remained the same in both the experimental and control areas. Litter sizes increased significantly in the removal area 2 years after the beginning of the removal. However, litter sizes were confounded by changes in the prey base. Litter size was significantly related to rabbit abundance, while rodent abundance was less of a factor. Accounting for changes in both prey abundance and coyote density, litter size was significantly related to total prey abundance per coyote.

Given the data above and the study by Gese, it is unlikely that coyote harvest on Malheur Refuge is negatively impacting coyote populations.

<u>Population-specific Impacts: Pronghorn</u>

The Boundary Unit is located at the eastern edge of the State of Oregon Juniper Hunt Unit 71. Population data were not reported for 2009 or 2010, but in 2008, ODFW (2010d) reported that aerial counts averaged 2.1 pronghorn per mile for this unit. This compares with a statewide average of 2.8 pronghorn per mile for 2008.

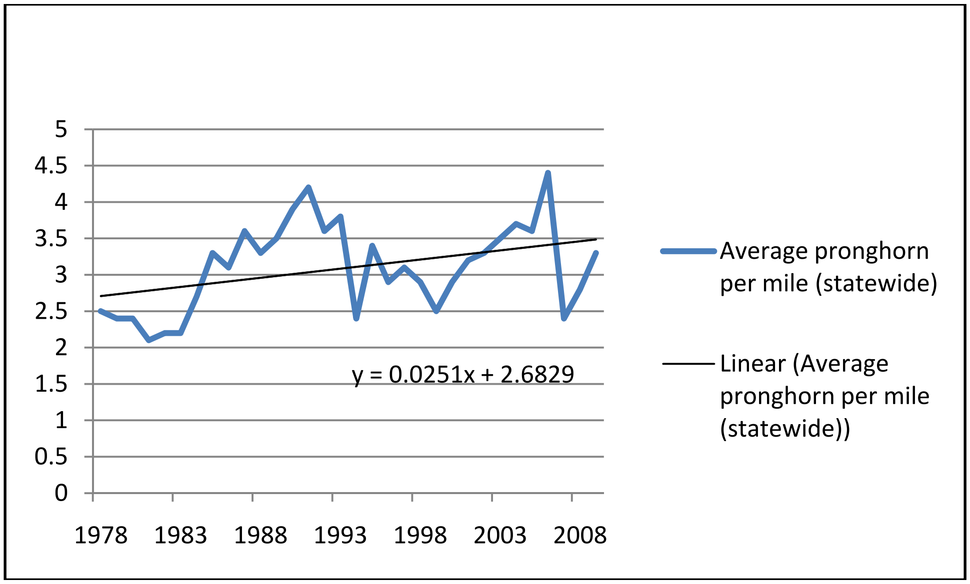
Hunt data are available for 2009 for both statewide harvest and local unit harvest and are presented in Table B-10.

**Table B-10. Reported 2009 Pronghorn Harvest on the Refuge, State Hunting Unit, and State Scales**

| | Number Reported as Taken | Percent of State Reported Harvest |
|---|---|---|
| Refuge | Unknown[1] | Unknown |
| Juniper Unit | 70[2] | 5% |
| State of Oregon | 1,424[3] | 100% |

[1] Although the Refuge harvest number is unknown, the Refuge law enforcement officer estimates that approximately half of the hunters with tags for the late-season muzzleloader hunt concentrate along the Boundary Unit.
[2] Pronghorn data from 2009 (ODFW 2010d).
[3] Pronghorn data from 2009 (ODFW 2010d). (Also available at: http://www.dfw.state.or.us/resources/hunting/big_game/controlled_hunts/docs/hunt_statistics/11/PRONGHORN_HARV_Trend_1950-2010.pdf.)

Data are not available at the Refuge or unit level to estimate population impact or trends from hunting. In addition, since population data are gathered and presented as a linear estimate (animals/mile), it is not possible to directly calculate the density of animals per unit area or the total number of animals within a unit. However, linear survey data for pronghorn presented back to 1945 (ODFW 2010d) allow trend analysis (at least at the State level), which permits some conclusion about whether populations may be increasing or decreasing. Since 1978, pronghorn at the State level have increased at an average rate of approximately 2 percent per year, as illustrated in Figure B-1.




Source: ODFW 2010d

**Figure B-1. Pronghorn population trends for the State of Oregon, 1978-2009.**

Given overall population trends as well as the percentage of pronghorn taken in the local State hunting unit, it is unlikely that Refuge harvest, if projected at current levels for the next 15 years, will negatively impact pronghorn populations.

Population-specific Impacts: Deer

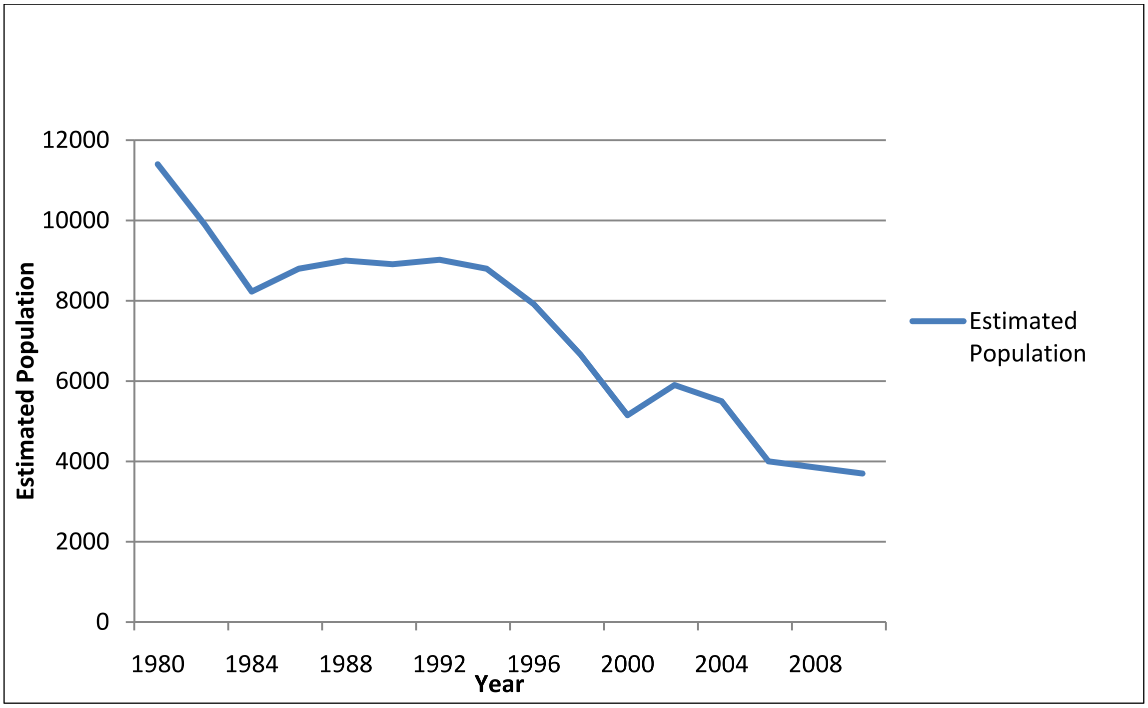
The Boundary Unit is located within the State of Oregon Juniper Unit. Although overall harvest of deer within the Boundary Unit area during the several open seasons is unknown, it is estimated that during one of the open hunts (the late-season muzzleloader hunt), approximately half of the 10 tag-holders use the Boundary Hunt Unit (Megan 2011) (Table B-11).

**Table B-11. Reported 2009 Deer Harvest on the Refuge, State Hunting Unit, and State Scales**

| | Number Reported as Taken | Percent of State Reported Harvest |
|---|---|---|
| Refuge | Unknown[1] | Unknown |
| Juniper Unit | 102[2] | 0.5% |
| Eastern Oregon total | 20,980[2] | 100% |

[1] Although the Refuge harvest number is unknown, the Refuge law enforcement officer estimates that approximately half of the hunters with tags for the late-season muzzleloader hunt concentrate along the Boundary Unit.
[2] Pronghorn data from 2009 (ODFW 2010d).

Mule deer across the West and in Oregon are declining in population, and are below current management objectives in Oregon. Populations have dropped by about a third statewide since 1980 (Whittaker 2011) after having reached a peak in the 1950s and 1960s (ODFW 2011b). Deer populations in the State unit encompassing the Refuge (Steens Mountain Unit) have dropped by approximately two-thirds in the last 30 years. Data for populations in the Steens Mountain Unit (which encompasses the Refuge and is just east of the Juniper Unit) are shown in Figure B-2. ODFW (2011b) attributes the primary causes of the observed decline to the combined effects of drought and severe winters, coinciding with an increased number of predators.




Source: ODFW 2011b.

**Figure B-2. Mule deer population trend, Steens Mountain Unit, 1980-2009.**

Continuing to allow mule deer harvest on the Boundary Hunt Unit will continue an incremental level of pressure on a declining population. However, given that the Boundary Unit constitutes a small fraction of the area of the Juniper Unit, and harvest within the Juniper Unit is less than 1 percent of the eastern Oregon harvest, the additional local and regional population pressure stemming from hunting on the Boundary Unit is expected to be negligible to minor. The State of Oregon (ODFW 2011b) has identified a number of strategies to boost mule deer populations, none of which include reduced hunting in the Juniper Hunt Unit.

<u>Population-specific Impacts: Nuttall's Cottontail and Jack-tailed Jackrabbit</u>

An estimated 10 to 12 hunters use the Boundary Hunt Unit to pursue rabbit and/or coyote each year (Megan 2011). Statewide statistics on rabbits harvested are not available; however, ODFW (date unknown) states that rabbit hunting is the third most popular type of hunting activity in the United States, behind wild turkey and deer hunting.

Population estimates for local rabbit populations are unavailable; however, a study done in Central Oregon in 1972-1973 that used monthly censuses in a shrub-juniper scabland habitat (McKay and Verts 1978) reported that Nuttall's cottontail population densities ranging from 6.6 to 254.4 animals per 100 ha (2.6 to 103 animals/100 acres), with marked seasonal fluctuations.

Lagomorphs are capable of extremely high productivity; a doe jackrabbit produces 2 to 6 young every 6 weeks during the breeding season, from February to June. The young born in February become sexually mature by early summer. As a result, lagomorphs are very important prey for a number of predators. Black-tailed jackrabbits naturally undergo 10- to 11-year population cycles.

Without better local data on harvest and population, only general conclusions are possible, based on reasonable assumptions and life history information. Currently, a small number of hunters is thought to hunt rabbits within the Boundary Hunt Unit, and hunting levels in the unit are expected to change little over the next 15 years. If habitat conditions remain stable (jackrabbits are sensitive to reduction in population with wildfire [Kochert et al. 1999]), hunting of jackrabbits and rabbits is likely to have a negligible effect on local or regional rabbit populations.

Other Refuge-specific Impacts

***Impacts to Non-Target Wildlife:*** Non-hunted wildlife would include any non-target birds; small- and medium-sized mammals; reptiles; amphibians; and invertebrates. Occasionally, non-target species are illegally killed by hunters by accident or intentionally, or are disturbed by hunter presence or noise.

The cumulative effects of disturbance to non-hunted birds under the management direction are expected to be minor for the following reasons: hunter education courses are required for youths; hunting seasons do not coincide with the nesting season, so reproduction will not be reduced by hunting; and disturbance to the foraging or resting activities of migrating or resident birds might occur, but hunting is still expected to involve a small numbers of participants. The North Malheur Lake Unit and Buena Vista Unit will have walk-in access.

Disturbance to other taxa will be unlikely or negligible for the following reasons: encounters with reptiles and amphibians, invertebrates, and small mammals in the early fall will be few and should not have cumulative negative effects on Refuge populations; Refuge regulations further mitigate possible disturbance by hunters to non-hunted wildlife; and vehicles will be restricted to public roads and the harassment or taking of any wildlife other than the game species legal for the season will not be permitted.

Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. Under the CCP, a late season opening for the Buena Vista Unit will allow sufficient protection of the sandhill cranes until they migrate farther south, and thus mitigate any hunting-related impacts to sandhill cranes. Other birds using the area may be disturbed by noise and human presence; however, since most birds have already migrated during the fall, disturbance levels will be minor overall. Outreach with hunting brochures and timely information on the website will help educate hunters on hunting opportunities, regulations, and ethical hunter behavior.

Waterfowl can die from toxic lead shot if they eat even very small amounts of spent lead shots; shot pellets deposited during fall hunting seasons can later be ingested by waterfowl and other wildlife feeding in wetland areas where hunting occurs. On Malheur Refuge, only federally approved nontoxic shot is allowed for upland game hunting to eliminate this hazard for waterfowl. Nontoxic shot is defined by USFWS as any shot type that does not cause sickness and death when ingested by migratory birds, and includes shots made of steel, bismuth, tungsten-iron, or tungsten-polymer.

Dogs will increase the level of disturbance to target and non-target species, but this impact is expected to be minor, especially to migratory wildlife, and necessary to support the use and ensure successful harvests. Dogs will be required to be under the close control of their owners while on the Refuge.

***Loss of Habitat from Facility Construction:*** No additional new facilities will be added to support this use in addition to the general visitor use facilities described in the CD for wildlife observation, photography, and interpretation.

***Vegetation, Soil, and Water Impacts:*** Foot travel associated with accessing the hunt units could potentially result in temporary and minor vegetation trampling. Based on past Refuge history and trends, hunting usually involves very small numbers of hunters; thus, the effect to vegetation will likely be negligible. No impact is expected to soil or water resources as a result of this use.

***Impacts to Listed Species:*** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). However, it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from upland game hunting uses and facilities will be minor to negligible. The greater sage-grouse is not a hunted species on the Refuge, although disturbance may result from noise related to hunting activities during the hunting season, which overlaps with the most recent seasonal observations of sage-grouse on the Refuge. Hunting is not allowed south of the Buena Vista Unit, and there have been no occurrences of spotted frogs in the Blitzen River Valley north of Knox Ponds. Additionally, frogs will most likely be hibernating during the winter, and hunting season ends prior to breeding season. Public education will assist in raising awareness and preventing undue impacts to these species. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Other Priority Public Uses:*** The phased opening weekends between the north Malheur Lake Hunt Unit and the Buena Vista Hunt Unit will help reduce hunter competition and conflicts. Additionally, hunting numbers generally decrease over the hunting season after opening weekends, further reducing impacts of the hunting season.

Hunting has the potential to disturb Refuge visitors engaged in other priority public uses; however, given the season during which hunting occurs, the likelihood of conflicts is low. Although Center Patrol Road is the area most used by other visitors during the migration seasons, use is very light during hunting season. State regulations also prohibit shooting from on and across roads. This is expected to mitigate any overlap conflicts between hunting and other uses in the Buena Vista Unit.

***Infrastructure:*** No significant effects to roads, trails, or other infrastructure from the hunting program are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

***Other Effects:*** There could be some indirect beneficial impacts of Refuge hunting. Refuge hunting can contribute to wildlife and habitat conservation and provide educational and sociological benefits. The hunting community in general remains the largest support base for funding land acquisitions in the Refuge System through purchase of Duck Stamps. Upland game hunting at the Refuge provides a priority public use and helps meet the Refuge's goals of wildlife-dependent recreation for all visitors. Additionally, providing youth hunting opportunities is an important initiative in the USFWS, and enhancing this opportunity on the Refuge helps address a public desire to see more hunting opportunities for youth.

**Public Review and Comment**

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination:**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles will be allowed only on maintained public roadways. Parking is allowed only within one vehicle length of the roadway. Hunters will be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires will not be permitted on the Refuge.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Hunting closures will be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. Shooting from or across public roads or road right-of-ways will be prohibited.
- Law enforcement patrols will ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information will be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

**Justification**

Under the National Wildlife Refuge System Administration Act, as amended, upland game hunting is a wildlife-dependent recreational activity that receives enhanced consideration in the CCP planning process and is to be encouraged on National Wildlife Refuges if compatible with refuge purposes. Despite the direct and indirect impacts associated with sport upland game hunting, upland game populations are unlikely to be affected significantly by the hunting program on the Refuge. Upland game population objectives and allowable harvests are determined by the State of Oregon. Limited hunt seasons, two weekend openings, and no-hunt zones ensure that upland game, as well as non-target species, will find adequate food and rest areas on the Refuge even in the midst of the hunting season. Thus, allowing upland game hunting to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge's mission.

### Mandatory Reevaluation Date

__09/2027__ Mandatory 15-year Reevaluation Date (for priority public uses)

### NEPA Compliance for Refuge Use Decision

___X___ Environmental Impact Statement and Record of Decision

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**Signatures:**

| | | |
|---|---|---|
| Prepared by: | (Signature) | 1/24/13 (Date) |
| Acting Refuge Manager/ Project Leader Approval: | (Signature) | 1/24/13 (Date) |

**Concurrence:**

| | | |
|---|---|---|
| Refuge Supervisor: | (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | (Signature) | 1-24-13 (Date) |

# B.5 Fishing Compatibility Determination

**RMIS Database Use:** Fishing (general)

**Refuge Name:** Malheur National Wildlife Refuge

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

**Description of Use**

This CD examines recreational fishing in designated areas of the Refuge as described in the management direction of the CCP. A commercial carp fishery was found compatible on the Refuge in 2009 and is not examined in this CD (USFWS 2009).

***Program Offerings:*** Fishing currently occurs at Krumbo Reservoir and the South Loop along the Blitzen River and its tributaries. Species allowable for take are redband trout, rainbow trout, largemouth bass, and carp. Rainbow trout and largemouth bass occur in Krumbo Reservoir, and redband trout, other native fish, and carp occur in the Blitzen River. All fishing is permitted by angling only. Table B-12 shows the following regulations for sport fishing as related to the Refuge under the 2011 ODFW Sport Fishing Regulations.

**Table B-12. ODFW Regulations for Sport Fishing for 2011[1]**

| Species | Regulations |
|---|---|
| **Krumbo Reservoir[2]** | |
| Trout (rainbow) | • Open fourth Saturday of April to October 31<br>• Catch: 5 per day, 2 daily limits in possession<br>• Length: 8-inch minimum length<br>• Bait: Artificial only |
| Largemouth bass | • Open fourth Saturday of April to October 31<br>• Catch: 5 per day, 2 daily limits in possession<br>• Length: No more than 3 over 15 inches in length<br>• Bait: Artificial only |
| **Blitzen River Mainstem, East Canal, and Tributaries Upstream and Including Bridge Creek (South Fishing Loop)** | |
| Trout (redband) | • Open May 28-Oct. 31, 2 per day<br>• Open Jan. 1-May 27 and Nov. 1-Dec. 31, catch and release for trout |

[1] Source: ODFW 2010.
[2] Krumbo Reservoir falls under the same ODFW regulations as lakes, except for its special fishing dates.

Location of Use, Associated Facilities, and Access

***Krumbo Reservoir:*** Krumbo Reservoir is 184 acres in size. It is not a natural water body and has historically been managed for irrigation and fishing activities. ODFW annually stocks Krumbo Reservoir with sterilized rainbow trout; in 2010, ODFW stocked 13,100 rainbow trout in Krumbo Reservoir. The area is equipped with a number of public use facilities, including picnic tables for lunch-time activities, parking, and restrooms, making the Reservoir a big attraction for families with children. Access to the site is via vehicle by Krumbo Lane. Once at the Reservoir, anglers may fish from any shoreline area and an informal trail circles the reservoir for this purpose. In addition, a boat launch permits boating access on the Reservoir itself. Boats with electric motors and non-motorized boats will continue to be authorized for use on Krumbo Reservoir, except when the water begins to ice over.

***South Fishing Loop:*** The South Fishing Loop near P Ranch includes the Blitzen River mainstem, East Canal, and tributaries upstream, including Bridge Creek. This unit is open year-round, although different regulations apply in different seasons, as indicated in Table B-12. This is a popular fly fishing area for locals and out-of-area users. Under the CCP, drive-in access along the East Canal Road to the confluence of the East Canal with Bridge Creek will be opened in order to improve fishing opportunities and to accommodate vehicle access to Granddad Reservoir on Bureau of Land Management lands. People may continue to use this road as a hiking trail if they wish. In addition, the River Trail, a pedestrian trail, is available to access this area. A new pedestrian crossing at Bridge Creek will be constructed to improve fishing access west of East Canal.

***Headquarters Fishing Unit:*** Additionally, under the CCP, the Refuge will provide a new seasonal stream fishing opportunity at the Headquarters Fishing Unit along the Blitzen River from Sodhouse Lane north to the Boat Landing Road bridge near Refuge Headquarters, accessible by a fishing trail along the dike. At the new Headquarters Fishing Unit, use of bait will be allowed and regulations for catch limits will be defined by ODFW based on state regulations. At the Headquarters Unit, fishing will only be available August 1 to September 15 to mitigate conflicts with migrating birds.

***Other Facilities:*** The Refuge will also provide informational kiosks at strategic entrance points and additional signage to enhance visitors' knowledge of fishing regulations and provide directional and program information.

***Number of Visitors and Seasonal Patterns*****:** At Malheur National Wildlife Refuge, an estimated 1,300 visits in 2011 were for fishing activities. With increased fishing access and additional fishing opportunities, the number of fishing visits is expected to grow over 15 years to 1,750 visits per year.

Under the CCP, the Reservoir and Krumbo Lane will be opened year-round to access for fishing, wildlife observation, boating, and hiking, which represents a big increase from the current open season of April to October. However, the majority of the use will likely continue to occur during spring and fall when the weather and water are cool, and year-round fishing will eliminate any pressures and crowding associated with fishing season opening day. Fishing use on the South Loop of the Blitzen River typically peaks in late spring when the water runoff from Steens Mountain settles and the water clears. The South Loop Fishing Unit and the new Headquarters Fishing Unit will be seasonal fishing opportunities as outlined above.

### Availability of Resources

Availability of resources for administering and managing the fishing program under the CCP are detailed in Table B-13.

**Table B-13. Costs to Implement the Use**

| Category | One-time Expense ($) | Annual Expense ($/year) |
|---|---:|---:|
| Develop fishing brochure | $1,500 | $2,000 |
| Develop outdoor fishing information kiosks | $60,000 | |
| Build 2-3 new pedestrian crossings and complete development of loop trail at South Fishing Loop | $275,000 | |
| Open new seasonal bank fishing opportunity along the Lower Blitzen River with fishing trail, two bridges, parking, and portions that meet ADA standards | $275,000 | |
| Replace Krumbo Reservoir floating platform and maintain facilities | $35,000 | $2,000 |
| Fishing program administration and management (programmatic, law enforcement, information) | | $6,000 |
| **Total** | **$646,500** | **$10,000** |

Administering the fishing program does not require significant staff time, equipment, or funding. The Refuge has one FTE Visitor Services Manager, and one FTE position for law enforcement that patrols the Refuge during fishing season to ensure compliance with state and Federal regulations and

Refuge conditions. The majority of the staff time spent administering this program will fall mostly on the law enforcement position. Other Refuge staff assists in maintenance of fishing facilities like access roads, trails, kiosks, and platforms; in general, the fishing program uses many of the same facilities and resources as the wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011b). Additional costs and staff time will include developing and printing fishing brochures and constructing new kiosks for the fishing program.

Some fishing program enhancements may currently lack funding, but the Refuge will develop partnerships and seek additional funding resources over the next 15 years as necessary to complete projects. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels for fishing. Exact costs will be developed during design and implementation.

**Anticipated Impacts of the Use**

General Impacts Expected from the Scientific Literature

A general assessment of impacts resulting from fishing uses has been compiled from the literature and is briefly summarized below.

***Disturbance to Wildlife:*** Fishing as a solitary and stationary activity tends to be less disturbing to wildlife than hunting or motorized boating (Tuite et al. 1983). Fishing has the potential to cause disturbance to birds and other wildlife using open waters and tributaries where fishing occurs. Fishing activities may influence the composition of bird communities, as well as the distribution, abundance, and productivity of waterbirds (Tydeman 1977; Bouffard 1982; Bell and Austin 1985; Bordignon 1985; Edwards and Bell 1985; Cooke 1987; Bouffard and Hanson 1997). Anglers often fish in shallow, sheltered bays and creeks that birds prefer, which can negatively impact distribution and abundance of waterfowl, grebes, and coots (Cooke 1987). Increases in anglers and associated shoreline activity have been found to discourage waterfowl from using otherwise suitable habitat (Jahn and Hunt 1964). When compared to non-fishing days and/or non-fishing rivers, anglers influenced the numbers, behavior, and diurnal distribution of avian scavengers present at sites along the Skagit and Toutle rivers in Washington, disrupted feeding, and increased energy expenditure through avoidance flights (Knight and Knight 1984; Knight et al. 1991).

***Stream Fishing Impacts:*** Shoreline activities related to stream fishing, such as human noise, will cause some birds to flush and go elsewhere. Waterbirds and waterfowl in particular use shorelines seasonally for resting, feeding, and nesting. Anglers often use vehicles to gain access to angling sites and remain there for long periods of time. Furthermore, anglers frequently show long periods of inactivity interspersed with short periods of rapid movements, which has the potential to disturb nearby wildlife (Bell and Austin 1985).

***Boating Impacts:*** Boating associated with fishing can alter bird distribution, reduce the use of particular habitats or entire areas by waterfowl and other waterbirds, alter feeding behavior and nutritional status, and cause premature departure from areas due to the noise and speed of boats (Bouffard 1982; Kaiser and Fritzell 1984; Korschgen et al. 1985; Havera et al. 1992; Ward and Andrews 1993; Knight and Cole 1995; Knapton et al. 2000). On the Missouri’s Ozark Scenic Riverways, herons often left the river for areas of dense habitat or less productive tributaries when the number of recreationists increased (Kaiser and Fritzell 1984). The level of disturbance to waterfowl has been found to vary considerably based on watercraft type. A study by Havera et al. (1992) showed waterfowl took flight and flushed farther in response to hunting and fishing craft, while few flushed because of barges. On the Upper Mississippi River, which includes the Upper Mississippi River National Wildlife and Fish Refuge, birds were found to be more sensitive to boats with outboard motors (Korschgen et al. 1985). In addition, trampling of vegetation and deposition of sewage or other chemicals from recreation has been found to impact freshwater plants and wildlife (Liddle and Scorgie 1980).

***Off-Road Vehicle Impacts**:* Wildlife can be impacted when they are disturbed and flushed from feeding, resting, or nesting areas vulnerable to loud noise and activity from off-road vehicles. In addition, temporary disturbance to habitat could impact nesting and foraging resources available for wildlife. In general, disturbance impacts of off-road vehicles are related to the intensity of use or use characteristics, in combination with the level of fragility of the affected environment. A majority of the off-road vehicle uses are in coordination with the grazing and haying program, and use for fishing is only a minor subset (USFWS 2011a).

Refuge-specific Impacts

This section evaluates the likely impact at the Refuge itself, considering the scientific studies discussed above and considering the uses within the context of Malheur Refuge.

***Disturbance-related Impacts from Reservoir Fishing:*** Krumbo Reservoir is one of the most heavily used areas on the Refuge. During the spring and fall, disturbance, especially near the parking lot and boat launch, undoubtedly prevents use by a variety of waterfowl and waterbirds. However, the Refuge maintains numerous other ponds and flooded areas in the spring and into summer and therefore spring/summer disturbance is of negligible concern, given the Refuge context.

Previous research has shown that the level of disturbance to waterfowl varies considerably based on watercraft type. To limit disturbance impacts to wildlife, only non-motorized boating and electric motorized boating will be allowed on Krumbo Reservoir. The use of non-motorized and electric motorized boating minimizes noise associated with boating and prevents the spread of oil and gas residue associated with diesel- and gas-powered motorized boats. It also reduces the speed with which anglers can travel on the Reservoir.

Under the CCP, Krumbo Reservoir and Krumbo Lane will be opened year-round to access, except when the water ices over. A concern raised by some is that increasing wintertime access to the Reservoir could have potential impacts to wintering waterfowl that use Krumbo Reservoir and Krumbo Swamp and Otter Reservoir along Krumbo Lane. There are limited open-water resources available on the Refuge during winter as most areas are dry or have frozen. The number of birds using the Reservoir during the winter is typically less than 400 birds on any given day, and there are less than 100 birds during the coldest part of the season (J. Dastyck, personal communication); most birds have migrated farther south during the winter. The Reservoir comprises around 20 percent of the total 1,004 acres of available open water wintering habitat on the Refuge, leaving 820 acres (more than 80 percent) of open water wintering habitat including Boca Lake, Benson Reservoir, and East Knox Reservoir. Given this and the likelihood that the number of visitors to the Reservoir during the winter months will be significantly less than in the spring, summer, or fall months, the disturbance impact to wintering birds is expected to be minor.

ODFW annually stocks Krumbo Reservoir with triploid rainbow trout, meaning they are sterilized and never develop normal eggs or sperm and are unable to reproduce. This will continue under the CCP. Sterilization negates the risk of any genetic reproduction and modification with native redband trout, thus creating a negligible impact on the native fishery. Additionally, Krumbo Reservoir is dammed, which prevents rainbow trout from migrating into the Blitzen River. Largemouth bass are also present in Krumbo Reservoir from historical stocking, but are not currently stocked and are a self-sustaining population; native redband trout are not found in the Reservoir, as Krumbo Creek water levels are not high enough to maintain a sustainable native population for spawning. Genetic studies have occurred in the Blitzen River for any evidence of introgression of redband trout with hatchery rainbow trout and there has been no strong evidence indicating this in the Blitzen population of redband, specifically in Bridge and Mud creeks (ODFW 2005).

With the low number of birds present, low visitor use levels, and availability of additional wintering habitat and sanctuary, it is expected that year-round access at Krumbo Reservoir will have negligible impacts. Wildlife surveys and monitoring will be conducted to ensure disturbance stays at a minimum.

***Disturbance-related Impacts from Stream Fishing*:** Stream fishing allows anglers direct access to a portion of the Blitzen River, East Canal, and Mud and Bridge Creeks. Under the CCP, the South Loop along the East Canal will change from walk-in only access to include drive-in access up to the confluence of the East Canal with Bridge Creek. This has the potential to increase disturbance to wildlife to moderate levels, as it is expected this change will attract more anglers to the fishing area and disperse users across a wider stretch of the river (compared to present). The River Trail on the west bank of the Blitzen River will remain walk-in access.

Under the CCP, a new seasonal stream fishing opportunity at the Headquarters Fishing Unit from Sodhouse Lane to the Boat Landing Road bridge near Headquarters will be opened. This will increase the amount of stream fishing along the Blitzen River by nearly 1 mile for a total of 14 miles on the Refuge. This could increase the potential for disturbance to resting and feeding waterbirds and waterfowl, as well as impacts to shoreline habitat and vegetation. However, the new fishing area will only be open seasonally from August 1 to September 15 after birds have fledged and moved on. Given this, and because generally, the fishing pressure along the Blitzen River is low, it is anticipated that with the limitations included in the CCP, disturbance to wildlife will be minor.

A new pedestrian crossing at Bridge Creek will be constructed under the CCP to enhance access to fishing west of East Canal along Bridge Creek. The bridge will increase the number of anglers in an area that was previously hard to access. Construction of the trail enhancements will be done in a way to reduce impacts to wildlife and resources.

***Direct Mortality to Target Species (Take):*** Fishing will result in direct take of target fish. Harvest is coordinated with ODFW to avoid excess pressure on populations. Fishing will be permitted by angling only and will be restricted to artificial flies and lures in streams, except in the Headquarters Fishing Unit where use of bait will be allowed.

Barbed hooks will be permitted to increase the success of take. Some impacts may come from barbed hooks to native redband trout populations, but this is expected to be minor as redband trout do not occur in Krumbo Reservoir and fishing pressure on the Blitzen River is generally low. Outreach with fishing brochures, informational panels, and public education on best fishing practices will help educate anglers on fishing regulations and ethical behavior.

***Loss of Habitat from Facility Construction:*** Under the CCP, new panels constructed for fishing will result in 0.5 acre of habitat loss, which is a fraction of a percentage of the Refuge; thus, habitat loss from new facilities is considered negligible. No additional new facilities will be added to support this use separate from general visitor use facilities (USFWS 2011b).

***Vegetation, Soil, and Water Impacts*:** Some vegetation, soil, and water impacts will be anticipated from bank fishing and access to water along the Krumbo Reservoir and Blitzen River shorelines where anglers access the areas by foot. Impacts will also be anticipated as a result of allowing vehicle access on East Canal. However, trail enhancements along the South Loop may also benefit the surrounding habitat by concentrating users on a formal trail instead of social trails that are not regulated.

The developed parking and concrete boat ramp at Krumbo Reservoir potentially carries stormwater runoff and toxins from vehicles into the Reservoir, although these facilities also contribute positively to habitat conservation by concentrating visitors on hardened surfaces and decreasing impacts to vegetation and soil adjacent to the fishing area. An undeveloped pedestrian fishing trail circles the perimeter of the Reservoir, potentially causing impact to shoreline habitat (USFWS 2011b). Additional impacts related to public use at the Reservoir include a certain amount of litter and general garbage left at shoreline fishing sites.

***Impacts to Listed Species:*** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). It is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Impacts to Columbia spotted frogs will be expected to increase under the CCP with expanded stream fishing access for anglers along the South Fishing Loop of the Blitzen River and its tributaries, and the construction of a new pedestrian crossing at Bridge Creek to access a portion of fishable area west of East Canal. Public tramping along the shoreline during the April to May frog breeding season has the potential to disturb/dislodge egg masses. It is anticipated that disturbance from anglers accessing the shoreline will be sporadic, and impacts will be minor due to generally low levels of fishing activity and the patchy occurrences of Columbia spotted frogs on the Refuge. Public education or use of interpretation will assist in raising awareness and preventing undue impacts to this species. Informational panels and additional signage will also be posted at the South Fishing Loop to inform anglers of proper fishing practices. If stream fishing results in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions on stream fishing to mitigate disturbance.

***Impacts to Other Priority Public Uses:*** Fishing generally results in little disturbance to other visitors. Both fishing and hunting will use Boat Landing Road to access the Blitzen River; however, the uses occur at different seasons, with fishing from August 1 to September 15 and hunting opening on the fourth Saturday of October.

***Infrastructure:*** No significant effects to roads, trails, or other infrastructure from fishing are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

**Public Review and Comment**

Various opportunities were provided for the public to engage with the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination:**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

***General Stipulations***

- Use is open daily from dawn to dusk. Camping, overnight use, swimming, and fires are prohibited.
- All fishing on the Refuge will require an appropriate state license and tag, and all fishing will be consistent with applicable state and Refuge regulations.
- Fishing on the Refuge will be permitted by angling only and will be restricted to artificial flies and lures in streams, except in the Headquarters Fishing Unit where use of bait will be allowed. Only catch-and-release fishing is allowed in the South Fishing Loop from January 1 to May 27 and November 1 to December 31. No discharge of weapons will be allowed on the Refuge, and the use of bows and arrows, crossbows, and spear guns will be prohibited.
- The Refuge will provide information on fishing and access at appropriate sites and through printed brochures. Information will also include current migratory bird and Refuge regulations, as well as maps of closed areas.
- The Service shall maintain public use facilities to minimize waste problems on shorelines.
- ODFW will continue to monitor harvest by anglers and routinely adjust regulations to ensure that overall populations of game species remain healthy into the future.
- Law enforcement patrols will be conducted to ensure compliance with fishing regulations.

**Justification**

Fishing receives enhanced consideration in the CCP planning process and is considered a priority public use when determined compatible. Providing a quality fishing program contributes to achieving the Refuge’s goals. The fishing opportunities and anticipated level of use, as described, were determined to not materially detract from the ability of the Refuge to meet its purposes, despite the potential impacts that fishing and supporting activities (boating) can have on wildlife and habitats. Only electric boating or non-motorized boating will be allowed for Reservoir fishing, thus lessening the disturbances to waterfowl and other wildlife. The combination of closed areas, seasonal use areas, minimally used areas, and seasonal high-use areas allows sport fishing and high-quality fish and wildlife habitat to co-exist on the Refuge by dispersing uses throughout different areas and different seasons.

It is anticipated that wildlife, primarily waterbirds, will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened; fishing pressure will not cause fish stocks to decline; fish stocking with sterilized triploid rainbow trout will not cause genetic modification to the native redband trout fishery; the physiological condition and production of waterfowl and other waterbirds will not be impaired; behavior and normal activity patterns will not be altered dramatically; and overall wildlife welfare will not be negatively impacted.

**Mandatory Reevaluation Date**

09/2027 Mandatory 15-year Reevaluation Date (for priority public uses)

**NEPA Compliance for Refuge Use Decision:**

X Environmental Impact Statement and Record of Decision

**References**

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**Signatures:**

| | | |
|---|---|---|
| Prepared by: | (Signature) | 1/24/13 (Date) |
| Acting Refuge Manager/ Project Leader Approval: | (Signature) | 1/24/13 (Date) |

**Concurrence:**

| | | |
|---|---|---|
| Refuge Supervisor: | (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | (Signature) | 1-24-13 (Date) |

# B.6 Commercial Tours and Photography Compatibility Determination

**RMIS Database Uses:** Photo/Video/Film or Audio Recording (commercial); Wildlife Observation Guiding/Outfitting

**Refuge Name:** Malheur National Wildlife Refuge

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

**Description of Use**

This CD addresses non-consumptive commercial uses related to photography and wildlife/nature observation. This determination does not address consumptive uses such as commercial guiding for hunting and fishing, nor activities *not* related to natural, historical, or cultural subjects. Additionally, a variety of non-profits and educational institutions engage in natural resource– and EE-based activities on the Refuge. Although this use is similar in nature to the commercial recreational use, non-profit and EE-based activities are covered under the CD for EE (USFWS 2011a).

By regulation, the Service may only authorize public or private economic use of the natural resources of any National Wildlife Refuge where it is determined that the use contributes to the achievement of the National Wildlife Refuge's purposes or the National Wildlife Refuge System's mission (50 CFR 29.1). Refuge System policy on management of specialized uses (5 RM 17) states that when monetary gain (profit) is the objective of a refuge recreational use, the use is to be managed as an economic use.

Commercial photography is a visual recording (motion or still) by firms or individuals (other than news media representatives) who intend to distribute their photographic content for money or other consideration, including the creation of educational, entertainment, or commercial enterprises as well as advertising audio-visuals for the purpose of paid product or services, publicity, and commercially oriented photo contests (Service Manual 605 FW 5). This typically involves taking still photographs or recording wildlife sounds and images related to a Refuge's wildlife and resources. Commercial tours and guiding are activities conducted by private organizations or businesses using National Wildlife Refuges. These uses are considered beneficial when they support and extend public appreciation and understanding of wildlife, natural habitats, and the mission of a Refuge and the National Wildlife Refuge System.

Commercial photography and observation uses on Malheur National Wildlife Refuge cover a broad range of resource-based activities and tours, including birding, geology, plant identification, art and visual interpretation, music, sound recording, and other similar non-consumptive activities. These uses will usually occur in areas open to the public, using the same facilities associated with non-commercial recreational uses (USFWS 2011b). Users typically engage in guiding and commercial photography at Refuge Headquarters, along Center Patrol Road and at a number of historical and interpretive sites, including Benson Pond, the historic Sodhouse Ranch (when opened), Buena Vista Overlook, Krumbo Reservoir, and the historic P Ranch.

Commercial photography on the Refuge is most often conducted by individuals, while commercial tours are generally conducted in groups; both uses will be expected to occur at smaller levels than non-commercial photography and wildlife observation. These uses may occur year-round on the Refuge, although the best time of year for wildlife photography and observation is during the spring and fall migrations (March to May and September). Activities related to other natural resources (e.g., geology) may occur at other times of the year depending on the program. These uses may be conducted in vehicles on public roads and on foot on designated hiking trails and roads. Due to the large size of the Refuge, uses are mainly conducted in vehicles with occasional stops at public sites to allow users to photograph or view outside the vehicle.

Under the CCP, an SUP will be required for all commercial uses on the Refuge as described under the Stipulations Necessary to Ensure Compatibility section in this document.

**Availability of Resources**

Under the CCP, user fees will be collected for issuing SUPs to commercial photographers and commercial tours requesting permission to go into a closed habitat/wildlife sanctuary. If any special resources (such as transportation, access to restricted areas, or guide service) are provided by the Refuge staff, these costs will be added to the standard fee for issuing an SUP. Availability of resources for administering and managing commercial recreational uses under the CCP are detailed in Table B-14.

**Table B-14. Costs to Implement the Use**

| Category | One-time Expense ($) | Annual Expense ($/year) |
|---|---|---|
| Administration and management of SUPs | | $5,000 |
| Offsetting revenues ($100 for SUP into closed areas) | | ($2,400) |
| **Total** | | **$2,600** |

Commercial photography and wildlife guiding use the same facilities and resources as the non-commercial wildlife observation, photography, and interpretation program, including trail and parking area maintenance, facility and road maintenance, sign posting, and construction projects (USFWS 2011b). The Refuge has one FTE position dedicated to administering the commercial recreational uses program as a Visitor Services Manager, in addition to the Refuge Manager who has to approve the SUPs. There is an additional FTE position for any law enforcement needs. Other Refuge staff assists maintenance and construction. The majority of the costs associated with the commercial recreational uses program will be administrative time and costs for SUPs; SUPs are also included under EE but total cost for permits is reflected here. Based on the availability of resources, the Refuge will have sufficient funds for managing current and expected levels of these uses associated with wildlife observation, photography, and interpretation. Exact costs will be developed during design and implementation.

## Anticipated Impacts of the Use

General Impacts

In general, impacts that will occur from commercial recreational uses will be similar to those expected from non-commercial uses; however, commercial recreational uses could be more disturbing than non-commercial uses because commercial uses tend to occur in groups of people. This effect is explored in this CD.

Impacts that could occur from commercial recreational uses will be similar to those expected from non-commercial wildlife observation and photography activities, especially those expected from larger groups (USFWS 2011b). Such impacts will be expected to include temporary damage to vegetation resulting from trampling, disturbance to nesting birds, and disturbance to feeding or resting birds or other wildlife in the proximity. Commercial recreational uses generally accommodate groups of participants, and studies have shown that increasing group size has an impact on wildlife (Beale and Monaghan 2004; Remacha et al. 2011). In addition to group size, loudness has also been found as an important variable to disturbance of wildlife, and the loudness of people present can be more important than the number of people present (Burger and Gochfeld 1991). Studies showed that reducing group size, allowing safe distances, and reducing noise levels helps minimize negative impacts on wildlife (Burger and Gochfeld 1991; Beale and Monaghan 2004; Remacha et al. 2011).

Refuge-specific Impacts

Commercial recreational uses at the Refuge occur in areas open to the public and, for the most part, are expected to use the same facilities and resources as non-commercial uses (USFWS 2011b). The administration of this use will allow occasional access into closed areas, subject to review and approval of an SUP.

As the literature demonstrates, the number of people visiting a site can influence disturbance to wildlife. Larger group sizes customary of tours will likely increase some disturbance to wildlife on the Refuge during sensitive times of the day or seasons, particularly during the spring and fall migrations when the Refuge supports substantially more wildlife. There could be additional crowding along Center Patrol Road or at public use sites, which will increase vegetation trampling and localized impacts to habitats. Groups requesting special permission to access a habitat/wildlife sanctuary area not normally visited by the public could further increase impacts to sensitive wildlife. Individual commercial photographers will be expected to have the same minor impacts as non-commercial photographers, although filming or recording that involves additional equipment and set-up could have additional impacts on habitats and wildlife due to heavy equipment and/or increased sound levels. Overall the impacts are expected to be minor due to the large size of the Refuge, the availability of sanctuary closed to the public, and the small number of commercial groups and commercial photographers that visit the Refuge throughout the year.

To ensure commercial recreational uses are conducted in a manner compatible with the Refuge's purposes and the National Wildlife Refuge System's mission, an SUP will be required for all for-profit commercial uses occurring on the Refuge. This is expected to benefit both the users and the Refuge as it will aid users in understanding Refuge regulations and the purpose and mission of the Refuge and Refuge System. At the same time, it will provide the Refuge a tool for managing uses; protecting natural and cultural resources; reducing user conflicts; and gathering use information. The SUP will also create an opportunity for communication and outreach between the Refuge staff and commercial photographers or tour groups to increase knowledge and awareness of the Refuge's habitat and wildlife, and disseminate information to users on ethical photography and wildlife observation behavior. Table B-15 details the special use permit requirements under the CCP.

**Table B-15. Special Use Requirements for Commercial Recreational Uses**

| Who | Access to Open Areas | Access to Closed Areas | Access to Hunting Areas | Access to Fishing Areas |
|---|---|---|---|---|
| Commercial Photographers | • SUP<br>• No fee | • SUP<br>• *Fee required* | • No entry during hunting season | • SUP<br>• No fee |
| Commercial Tour Groups | • SUP<br>• No fee | • SUP<br>• *Fee required* | • No entry during hunting season | • SUP<br>• No fee |

It is not expected that commercial photography and wildlife observation will cause any additional short-term, long-term and/or cumulative and indirect/secondary impacts other than those detailed above.

***Impacts to Listed Species*:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from commercial recreational uses will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. Uses will continue to occur primarily at public sites and on designated roads and trails away from sensitive habitat and resources, and outside of breeding areas and seasons. Users will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. Public education or use of interpretation will assist in raising awareness and preventing undue impacts to these species. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Other Priority Public Uses*****:** Commercial recreational uses generally result in little disturbance to other visitors. However, larger groups may cause crowding on roads and at public sites, which could impact the experiences of individuals and non-commercial users. Some tours may inadvertently flush game being pursued by bird hunters, but this conflict will be expected to be minimal as hunting areas will not be open to non-hunters during hunting seasons. There will be no conflict expected between anglers, non-commercial wildlife observers, or photographers. Careful scheduling with EE groups will be done to reduce any conflicts between groups and uses.

***Impacts to Infrastructure:*** No significant effects to roads, trails, or other infrastructure from commercial photography and wildlife observation programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. Additional facility construction or upgrade, if needed, is addressed in the Availability of Resources section.

**Public Review and Comment**

Various opportunities were provided for the public to engage with the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

***General Stipulations***

- Visitors are restricted to designated trails, sites, or facilities as determined by Refuge staff. Use is open daily from dawn to dusk. Camping, overnight use, swimming, and fires are prohibited.
- Motorized vehicles will be limited to designated public roads and parking lots and must observe posted speed limits.
- Commercial photographers should ensure proper credit is given to the Refuge and the Service.
- Collection of natural objects such as plants, animals, minerals, antlers, and cultural resources are prohibited.
- If disturbance to wildlife or damage to habitat reaches unacceptable levels, the Refuge will limit uses in areas where unacceptable impacts occur. Monitoring will be conducted to ensure that high-quality habitat for wildlife feeding, resting, and breeding is maintained.

***Special Use Permit***

- An SUP will be required for all commercial photography and wildlife/nature tours and guiding on the Refuge. Guiding for hunting and fishing is not allowed on the Refuge.
- A standard permit form stipulating dates, times, and locations of use will be made available prior to the visit on the Refuge's website or by mail.
- SUPs for areas open to the public grant permissions to open areas for up to 1 year under the same use stipulations before renewal, and no fee is charged for the permit.
- Special permission requests to closed habitat/wildlife sanctuary areas or other special considerations (e.g., access to the Refuge after normal public visitation hours, setting up temporary equipment, requiring additional resources or staff) will require an SUP and permit fee, and will be granted on a case-by-case basis with no renewal.
- The SUP will be required to be readily available while conducting the permitted use on the Refuge.
- Requests must demonstrate a means to enhance education, appreciation, and/or understanding of the Refuge and the National Wildlife Refuge System. Failure to abide by any part of the SUP or regulations will be considered grounds for immediate revocation of the permit and could result in denial of future permit requests.

**Justification**

By allowing commercial guiding and photography uses to occur under the stipulations described above, it is anticipated that wildlife species that could be disturbed during the use will find sufficient resources and resting places such that their abundance and use of the Refuge will not be measurably lessened. Additionally, it is anticipated that use of SUPs will provide the Refuge a tool for managing uses, protecting natural and cultural resources, reducing user conflicts, and mitigating disturbance impacts. The SUP will also create an opportunity for communication and outreach between the Refuge staff and commercial photographers or tour groups to increase knowledge and awareness of Refuge regulations and ethical photography and wildlife observation behavior. Thus, the use will not materially interfere with or detract from the Refuge System's mission or the purposes for which the Refuge was established.

This activity contributes to the mission of the USFWS. Commercial guiding provides visitors an organized and educational opportunity to view wildlife safely under the use stipulations. Additionally, commercial photography, through educational wildlife media, creates end products that may provide an educational opportunity to a much broader distribution of people who may not have the opportunity to visit and personally view the Refuge's wildlife and resources. The media products produced by these commercial operations will also be beneficial in promoting the mission of the National Wildlife Refuge System.

It is determined that commercial photography and wildlife observation within the Refuge as described herein, will not materially interfere with or detract from the purposes of the Refuge or the mission of the National Wildlife Refuge System. The stipulations outlined above will minimize potential impacts relative to wildlife/human interactions. The commercial recreational uses program is intended to foster a better understanding of Refuge wildlife and resources, and in turn build a public that is more knowledgeable about, and involved in, resource stewardship.

**Mandatory Reevaluation Date**

09/2022 Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

**NEPA Compliance for Refuge Use Decision**

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**References**

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ODFW (Oregon Department of Fish and Wildlife). 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

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Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

USFWS (U.S. Fish and Wildlife Service). 2011a. Compatibility determination for environmental education. Malheur National Wildlife Refuge. Princeton, OR.

USFWS. 2011b. Compatibility determination for wildlife observation, photography, and interpretation. Malheur National Wildlife Refuge. Princeton, OR.

**Signatures:**

| | | |
|---|---|---|
| Prepared by: | (Signature) | 1/24/13 (Date) |
| Acting Refuge Manager/ Project Leader Approval: | (Signature) | 1/24/13 (Date) |

**Concurrence:**

| | | |
|---|---|---|
| Refuge Supervisor: | (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | (Signature) | 1-24-13 (Date) |

# B.7 Grazing and Haying Compatibility Determination

**RMIS Database Uses:** Grazing; Haying or Ensilage

**Refuge Name:** Malheur National Wildlife Refuge

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

**Description of the Use**

<u>Purpose and Intent of Haying and Grazing as a Management Tool at Malheur Refuge</u>

This CD examines haying and grazing as described in the management direction of the CCP. Livestock grazing and haying have been used in the past at Malheur Refuge and will be used in the future as tools to provide optimum conditions for wildlife (specifically, foraging areas for waterfowl, waterbirds, and shorebirds; pairing habitat for waterfowl; nesting habitat for shorebirds; and nesting habitat for certain passerines) and, where possible, to improve biological integrity (native plant diversity; hereafter, restoration) in Refuge plant communities. A complete description of how grazing and/or haying is likely to result in these outcomes is contained in the section of this CD titled Anticipated Impacts of the Use.

<u>Policies Pertaining to Use of Haying and Grazing on National Wildlife Refuges</u>

***Administration Act:*** Almost one hundred years after its establishment, the U.S. Fish and Wildlife Service's National Wildlife Refuge System received organic (i.e., foundational) legislation that provided policy direction and management standards applicable to all refuges. This statute, the National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57) amended the National

Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee). In sharp contrast to the organic legislation of other Federal land management systems (e.g., National Forests administered by the U.S. Forest Service and Public Lands administered by the U.S. Bureau of Land Management), legislation pertaining to the NWR System states that it is not a multiple-use management system and is not managed for commodity production or on the basis of sustained-yield economic principles. Refuges are managed first and foremost for fish, wildlife, plants, and their habitats (Section 5, House Report 105-106). This is often referred to as the “Wildlife First” management mandate.

The Improvement Act also established a three-tiered hierarchy for management activities that occur on Refuge System lands. The first tier involves management actions that specifically assist the Refuge in fulfilling the purpose for which it was established (e.g., for migratory birds and other wildlife) and the Refuge System mission, including the conservation, management, and restoration of fish, wildlife, plants, and their habitats. The second and third tiers involve wildlife-dependent public uses (i.e., hunting, fishing, wildlife observation and photography, and environmental education and interpretation) and general public uses.

Management tools (such as grazing, haying, pest management, or burning) that help refuges achieve established refuge purposes become first-tier management priorities, when properly authorized through signed management plans and CDs. When management tools such as grazing and haying are not specifically used on a refuge to help achieve established refuge purposes, then these activities fall into the third, lowest priority tier.

***Compatibility:*** All uses on National Wildlife Refuges must be deemed “compatible.” A compatible use is one that in the “ … sound professional judgment [of the Refuge Manager], will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the Refuge” (603 FW 2.6 B). Among other things, a CD involves evaluation of a proposed use’s effects upon refuge fish, wildlife, plants, and their habitats; potential conflicts with other refuge uses, especially wildlife-dependent public uses; indirect, future, and cumulative effects; precedent-setting implications; maintenance and monitoring costs; and off-refuge opportunities to exercise the use in question.

***Regulations:*** There are specific USFWS regulations that address economic uses of refuges. In 50 CFR 29.1, it is stated, in part, that “ … we may only authorize public or private economic use of the natural resources of any national wildlife refuge, in accordance with 16 U.S.C. 715s, where we determine that the use contributes to the achievement of the national wildlife refuge purposes or the National Wildlife Refuge System mission.” This regulatory standard is in addition to the compatibility requirement. Grazing livestock and harvesting hay are listed in the regulations as example uses to which this provision applies.

Use Details

***Habitats Subject to These Tools:*** The primary habitat types where grazing and haying will be used are wet meadows (meadow habitats with standing surface water during the growing season), and reed canarygrass areas (an undesirable exotic wet meadow grass that has spread to dominate some Refuge fields). Livestock grazing may also be used when necessary to maintain or restore[2] other habitat

[2] The term “restoration” is used generally in this document to specify an alteration of plant community dynamics such as plant species diversity, composition, etc., in order to meet wildlife habitat needs. It does not necessarily mean a return to conditions that may have existed at a certain time in history. Because many communities are novel

types (e.g., to transition undesirable plant communities to more native species and improve future habitat conditions).[3]

***Area Treated Annually:*** As a starting point of implementing the CCP, approximately 12,000 to 15,000 acres across the Refuge's 20,000 to 25,000 acres of wet meadow habitat type (see Appendix K) will be treated in initial calendar years. Actual treatment levels will vary on a field-to-field basis depending on area-specific objectives of focal species. For example, higher levels of treatment will typically occur to provide conditions most favorable for sandhill crane foraging and bobolink nesting (e.g., southern Blitzen Valley) and idle conditions will dominate where use of grass meadows for waterfowl nesting is emphasized (e.g., north of Warbler Pond in the Double-O Unit). Application of these treatments may be adjusted as more information is gleaned through inventory and monitoring activities and analyzed by Refuge staff, the Ecology Work Group, and other collaborators (Appendix I).

***Habitats that will not be Subject to Grazing/Haying and/or Will be Protected from Grazing/Haying:*** Objectives developed for cold and hot spring, dune, playa, riparian shrub, riverine and associated riparian zone, sagebrush lowland, sagebrush-steppe, and salt desert scrub habitat types do not include strategies recommending the use of haying and/or grazing as a part of land management within the CCP. The exception to this could be when a shift in community attributes is desired within a specific area of a particular habitat to meet overall wildlife objectives. One example may be the use of early growing season livestock grazing as a tool to reduce reproduction and influence the soil seed bank of cheatgrass before conducting a seeding effort to enhance native plant diversity on-site.[4]

Overview of the Four Treatment Types

Four treatment types will take place on the Refuge (i.e., rake-bunch grazing (RBG), grazing, haying, and mowing) during two pronounced periods (dormant versus growing season). Mowing is a pre-treatment that occurs prior to both RBG and haying.

*a) Dormant Season Haying and Rake-bunch Grazing*

***Desired Vegetation Condition:*** Dormant season hay only (HO) grazing and RBG will be used to meet desired characteristics of wet meadows across the Refuge as specified in Objective 4a (see Chapter 2), with grass/sedge/rush stubble heights of less than 6 inches by October 1. Haying and RBG treatments during this time also play a vital role in maintaining site vigor by preventing excessive litter accumulation from hindering plant species diversity and expression (Foster and Gross 1998; Xiong et al. 2003). Plant species composition and the response of those species to site-specific conditions that may change annually due to climate or refuge management have a significant influence on biomass production and subsequent litter production. Spatial RBG and HO treatments will be adjusted on an annual basis to account for these dynamics according to information gleaned from inventory and monitoring efforts.

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(i.e., made up of either native and non-native species or native species outside historical spatial distributions), a return to such a state may not be preferable to the Service or the Pacific Flyway because such a shift may compromise the regional availability of suitable wetlands for waterfowl, waterbirds, etc.

[3] See Appendix K for further discussion on the decision-making process for habitat manipulation within the CCP.

[4] Interested public are encouraged to provide input and participate in discussions with the Ecology Work Group. Semi-annual meetings discussing habitat management and associated inventory, monitoring, and research are open to the public (Appendix K).

***Timing of Treatment:*** The majority of wet meadow habitats under the "dormant season" program will be mowed beginning August 10 when most meadow plant species are mature (quiescent) and preparing to enter into senescence (when aboveground biomass dies). From a wildlife standpoint, postponing mowing until this time reduces mortality rates of crane colts and other late-maturing species; mowing before this date is discouraged under the Greater Sandhill Crane Management Plan (Central Valley Population) (Pacific Flyway Council 1997).

Mowing will be followed either by RBG or HO treatment. RBG is a form of treatment where meadow hay is mowed and raked into windrows, but left in place to be consumed by livestock during the late fall and winter. RBG will take place beginning September 1 and may continue through January 31. Refuge staff will annually direct permittees in the amount of rake-bunch feed to prepare and its location before or during the August haying season. No windrows remain under HO, as all mowed vegetation is baled and removed from the Refuge.

***Ancillary Equipment and Infrastructure Necessary for the Use****:* HO and RBG treatments require the use of equipment normally used for general haying activities (e.g., tractor, swather or rotary mower, rake) with the addition of balers for HO and specialized rakes for bunching windrows for RBG. All-terrain vehicles (ATVs) and horses are necessary for moving cattle efficiently across designated fields. RBG and experimental grazing treatments also require necessary infrastructure for livestock management, including permanent wells and associated stock tanks and permanent/temporary fences. Additional fencing requirements are expected to be minimal. Power lines are currently specifically associated with two wells in the northern Double-O Unit and two wells in Diamond Swamp. All other wells are serviced via generators or power lines serving outlying residences (e.g., Diamond, Frenchglen).

*b) Short-duration, High-intensity Experimental Dormant Season Grazing*

This treatment may take place in fields that would otherwise be rake-bunch grazed or mowed. In recent discussions with past refuge biologists[5] it was expressed that this may be useful in providing litter management necessary for species such as the bobolink while retaining some vertical structure. Timing and equipment used will be similar to RBG (except that no mowing equipment will be used). Any haying or grazing prior to these dates will be pursued under the growing season program.

*c) Growing Season Hay Only and Growing Season Grazing Treatments*

***Desired Vegetative Condition:*** Growing season HO and the use of livestock in treating uncut vegetation (grazing) will be used to meet desired characteristics of wet meadows across the Refuge as specified in Objective 4a (see Chapter 2) by encouraging successional shifts in plant community composition where designated attributes (i.e., >75% cover of perennial grasses, rushes, and sedges; 15-20% cover of forbs such as lupine, clover, and cinquefoils; <20% cover of reed canarygrass; <5% cover of noxious weeds) are not being met and maintaining desired habitat heterogeneity at larger spatial scales (e.g., conditioning reed canarygrass monocultures for fall migrating waterfowl or encouraging a compositional shift from a reed canarygrass association to that of aquatic sedge). Growing season HO will be used as needed in an effort to control/eradicate noxious weed populations in meadows that have exceeded designated site-specific thresholds based on plant community attributes and associated abiotic resources (e.g., soil type). HO will be effective in

[5] This conversation took place during an organized Refuge management review involving current Refuge staff and the following former biologists: John Cornely, Gary Ivey, David Johnson, David Paullin, and Michael Rule.

preventing the maturation of viable weed seed (e.g., mid-June), thus reducing further enhancement of the soil seed bank in this instance. An example of this is the mowing of pepperweed in mid-June, prior to the production of viable seed.

***Timing of Treatment:*** "Growing season" treatments will typically occur April through August, but may extend past the period of senescence depending on site-specific objectives. Manipulation of vegetation during the growing season can have negative effects on wildlife due to disturbance/displacement. Littlefield (1989) documented sandhill crane nest desertion and trampling with spring and summer grazing. Therefore, growing season treatments will be pursued when the need for a shift in vegetative community attributes or structural heterogeneity is necessary within a particular unit to meet overall long-term meadow habitat objectives.

***Ancillary Equipment and Infrastructure Necessary for the Use*:** Growing season grazing may use existing dormant season infrastructure, but will most commonly use electric fencing and/or other temporary fencing to control livestock movement. Temporary water will be provided as needed.

Livestock Trailing

When the movement of livestock is necessary, routes will be carefully selected to prevent damage to cultural resources, sensitive soils, wildlife habitat availability and integrity, and plant community health. A description of prescribed livestock movement will be included within individual cooperative land management agreements (CLMAs) (see below).

Corrals

Corrals facilitating livestock movement on- and off-Refuge (Diamond and Nine Mile) by Refuge permittees are also used by BLM permittees using neighboring BLM allotments. The existing cooperative agreement placing responsibility of all maintenance of related infrastructure on the BLM will be extended.

### Administration of the Use

***Cooperative Land Management Agreements****:* The two programs using haying and grazing (dormant season and growing season) will be treated separately and will differ in the types of agreements that are used. Both programs will use CLMAs as authorized under 50 CFR 29.2. These agreements will allow Refuge staff and permittees to effectively work together to meet habitat objectives (e.g., feeder ditch maintenance, noxious weed management).

***Dormant Season CLMAs:*** The CLMAs for dormant season treatments (i.e., haying and RBG) will be 5 years in duration,[6] will designate acreages of use, and will allow payment in the form of services (permittee labor and equipment or cost of contractor) or the financing of field management activities such as noxious weed control. The labor involved in installing and maintaining field fences (permanent or electric) is a condition of the permit and will not be deducted from the bill, although materials will be provided by the Refuge. A percentage of each invoice will go toward funding (1) noxious weed management and (2) a third-party entity that will be active in Refuge land management research, inventory, and monitoring. Designated acres will involve target habitats within field

[6] The duration of dormant season CLMAs may be adjusted in subsequent agreement cycles on a case-by-case basis if it is demonstrated that the 5-year timeframe does not prove adequate (either too short or too long) in understanding plant community trends and the Refuge's ability to respond appropriately to community dynamics.

management units (e.g., Oliver Springs Field) and CLMAs will designate necessary rotations if a complex of fields is included in the agreement.

Existing permittees[7] will be provided an identified acreage in which vegetation management activities will take place. If objectives pertaining to individual units within this acreage are not being achieved as determined through the state-and-transition model (STM) process, adjustments will be made within the areas included in the agreements.

The overall treatment of each CLMA land base will be analyzed annually by the Ecology Work Group, and appropriate changes to the CLMA agreement will be made at the end of the contract period. This provides opportunities each year to make changes based on habitat trends within the conditions expressed in the CLMA. If inventory, monitoring, and analysis reveal that the conditions of individual agreements are not sufficient for meeting or maintaining habitat objectives at the conclusion of the 5-year CLMA time frame, then the nature of the specific CLMAs may either be altered (e.g., replacing RBG with HO) upon renewal or the Refuge may choose not to renew them. This 5-year timeline recognizes the need to observe plant community trends in order to gain deeper understanding of treatment effects. Considerations involving operational changes within CLMAs may necessitate an alteration of this time frame. An example of operational considerations includes whether the physical management of individual CLMAs is consistent with habitat objectives (e.g., are non-target habitats being impacted?). Changes based on physical management can take place at any time during the life of the CLMA if problems are not able to be readily addressed within the conditions expressed in individual CLMAs. Permittees and interested public will have the opportunity to participate in semiannual Ecology Group reviews of the Inventory and Monitoring Program, thus enabling all interested parties to fully engage.

***Growing Season CLMAs:*** Growing season treatments (e.g., successional plant community management, creation of shifting mosaic of successional stages) will use annual CLMAs to maximize flexibility in response to changing needs as driven by research or specific management goals addressing particular management issues (e.g., encouraging one suite of plant species at the expense of another). Annual CLMAs will be applied in designated areas, will specify the objective vegetation condition, and will be subject to monitoring to evaluate the treatment prior to renewal. Exchange of services and other aspects of annual CLMAs are the same as those of 5-year CLMAs. Cooperators who are able to demonstrate flexibility in providing livestock and associated labor (intensive herding, etc.) to allow site-specific treatments on an annual basis will be sought for annual CLMAs. If unforeseen circumstances take place (e.g., weather-related phenomena), mid-year modifications to CLMAs may take place if the rationale is documented through the Ecology Work Group process. Further information regarding oversight of habitat responses related to CLMAs through the state-and-transition model and the Ecology Work Group is found in Appendix L. The costs of administering and managing the haying and grazing program under the CCP are detailed in Table B-16.

[7] Permittees currently possessing annual haying and grazing Special Use Permits (SUPs) will be issued 5-year CLMAs upon implementation of the CCP.

**Table B-16. Costs to Implement the Use**

| Category and Itemization | One-time Expenses($) | Recurring Expenses ($/yr) |
|---|---|---|
| Administrative support | $0 | $35,000 |
| Materials and equipment | $0 | $0 |
| Offsetting revenues/services | $0 | $170,000 |
| **Total expenses for the complex** | $0 | −($135,000) |

***Ecology Work Group Role:*** As discussed in Chapter 2 of the Refuge's CCP, regular assessment and modification will be made possible through the Malheur STM framework. This involves the development of site-specific management strategies (using a combination of tools) to meet vegetative objectives (such as desired structural and successional characteristics) as laid out in the STM. The Ecology Work Group, consisting of ecologists and wildlife biologists representing agencies, academia, and other ecologists, will assist the Service in the development of the model and will provide recommendations for annual modifications to the model and associated habitat management strategies based on continuous inventory and monitoring. The structure of this information gathering and land management decision process is designed to provide transparency in the Refuge's decision-making process.

**Anticipated Impacts of the Uses**

<u>Grazing/Haying Effects to Wildlife</u>

Table B-17 lists the wildlife species that depend on treated meadows for particular life history stages. Wet meadows can provide both nesting and foraging sites for avian species. Both are discussed below.

***Spring Foraging Habitat During Migration:*** The primary reason for treating wet meadows is to improve foraging conditions, especially during the pairing season. Wet meadows receive high use by foraging birds in the spring when they are treated with grazing, haying, or burning. These treatments provide short-stubble habitat, which allows early warming of soil and water and early availability of new green sprouts and invertebrates for birds to eat in the spring. This short structure proves valuable as a foraging area for waterfowl, waterbirds, and shorebirds. Important species such as sandhill cranes, white-faced ibises, and many waterfowl focus their foraging on these areas.

While much of the migrant waterfowl use occurs on the Refuge lakes, many migrant birds are attracted to the hayed and grazed meadows after they are flooded in the spring. Treated meadow vegetation (mowed, grazed, burned) provides high-protein browse and invertebrate foods for a large variety of birds and other wildlife during the early spring period, when high-protein foods are needed for egg-laying. Theoretically, treated meadow sites receive more solar radiation, resulting in early warming of soils and earlier availability of important invertebrates for food (Rule et al. 1990). These treated meadow sites on Malheur Refuge generally support high waterfowl and crane use during the early spring period. In particular, the Double-O Unit receives very high use in March and April by migrating snow geese, Ross' geese, ducks, and sandhill cranes, and is very important to these species during dry years, because little feeding habitat is available elsewhere in the basin (David and Ivey 1995). Therefore, Malheur Refuge plays a critical role in providing energy for migrating birds within the Pacific Flyway, and management of wet meadows by haying and grazing is a means of providing much needed energy for these birds to continue migration and replenish their nutritional reserves. Successful reproduction upon arriving at breeding grounds depends on the quality and quantity of food acquired at such stopovers (Davidson and Evans 1988; Ricklefs 1974).

***Nesting Habitat for Waterfowl and Waterbirds: Pairing and Pre-Nesting:*** A study of Malheur Refuge land use in relation to spring waterfowl pair use was initiated by Gary Ivey in 1988. Paired plots of different land use were established, and waterfowl were counted weekly during April and May using a four-wheeled motorcycle, which flushed nearly all birds within each transect; therefore, detectability was considered close to 100 percent for all land use types. One set of plots comparing RBG and idle management was established in 1990. A preliminary analysis of data from these two paired, 800-heactare plots showed duck numbers to be, on average, six times higher in April and two times higher in May on the grazed plot in comparison to the idle plot. Also, Canada goose counts were 17 times higher on the grazed plot versus the idle plot (Ivey, unpublished data). Duck pairs used wetlands that had been treated (burned, grazed, or mowed) earlier in the season than wetlands with idle vegetation, which showed increased pair use later in the season. Theoretically, treated areas receive more solar radiation, and therefore, frozen soils thaw much earlier than non-treated areas, resulting in earlier plant growth and earlier availability of invertebrate foods (Rule et al. 1990). The new plant growth and invertebrates are sources of protein, which is very important to breeding waterfowl and other birds for egg-laying, as described by Eldridge and Krapu (1988).

The past Refuge strategy has been to treat most of the wet meadow habitat with haying and/or winter livestock grazing to reduce the attractiveness of these habitats for nesting ducks, because early nesting species like mallards often nest in wet meadows before irrigation water is present and many of their nests get flooded during irrigation and with flood events—as such, nests generally don’t float like they do in marsh vegetation. Often, mallards will select alternate overwater nesting sites and build floating nests in marsh vegetation. Most ducks, geese, and cranes select marsh sites for nesting within large, wet meadow areas of the Refuge (e.g., Units 11 and 12). Refuge studies of duck nest success have documented much higher success for ducks nesting over water in marsh plant communities than for ducks nesting in meadows or uplands (Malheur Refuge, unpublished data). Although some species focus primarily on nesting in meadow habitats (e.g., cinnamon teal, northern pintail, short-eared owl), treating the wet meadow sites encourages these species to nest in dry meadow (which are sub-irrigated), upland (e.g., sagebrush lowlands, salt desert scrub), or marsh habitats by managing wet meadows for low structure in early spring.

***Shorebird Nesting and Migratory Habitat:*** Shorebirds and other migratory species that depend on wetland stopovers in North America are being challenged by a rapidly changing landscape. For example, in the Great Plains of North America, 90 percent of the wetlands in some areas have been lost to agricultural development since the early 1900s (Ducks Unlimited 1994; U.S. Department of the Interior 1994). Furthermore, wetlands may be altered in the future by global warming (Houghton et al. 1990; Poiani and Johnson 1991). Such large-scale habitat changes raise concerns about maintaining an adequate network of stopover habitats in the future (Farmer and Parent 1996).

Nine species of shorebirds regularly breed at Malheur Refuge, including snowy plovers, long-billed curlews, Wilson’s phalaropes, American avocets, and black-necked stilts, which are all priority species in the Intermountain West Regional Shorebird Plan (Oring et al. 2000). Estimates of breeding populations of common species in the Harney Basin from 1975 to 1978 are provided by Horton et al. (1983).

The short structure of treated meadows is attractive to nesting shorebirds such as Wilson's snipe, Wilson's phalarope, American avocet, and black-necked stilts, as well as some ground-nesting passerine birds such as bobolink and savannah sparrow.

Most shorebird species select very short cover or barren sites for nesting (Eldridge 1992). Little information has been published on management of breeding shorebirds in the Intermountain West. However, a Malheur Refuge study of ground-nesting birds in the Double-O Unit found that in all cases, shorebirds used shorter and sparser vegetation than ducks, primarily nesting in bluegrass/creeping wildrye associations (Foster 1985). In these habitats, Foster found high densities of nesting shorebirds when they were livestock-grazed and high densities of nesting ducks when they were untreated; he recommended using livestock grazing or mowing to enhance attractiveness of that vegetation type to nesting shorebirds. Other authors have also identified that essential habitat for breeding shorebirds can be provided through grazing, mowing, or prescribed burning (Eldridge 1992; Helmers 1992). Therefore, to provide short cover needs in areas of the Refuge important for shorebird nesting (e.g., the north end of the Double-O Unit), wet meadow vegetation should be treated with livestock grazing, mowing, or burning after the breeding season (Ivey et al. in prep.).

***Greater Sandhill Cranes:*** Greater sandhill cranes are considered a "Sensitive Species" in Oregon and are also a "Strategy" species in the Oregon Conservation Strategy (ODFW 2006). These birds are members of the Central Valley Population and their management needs are addressed in a Pacific Flyway plan (Pacific Flyway Council 1997). They are also identified as a priority species in the Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006). Malheur Refuge supports a significant portion of Oregon's population of breeding greater sandhill cranes, with over 20 percent of the state's pairs found there during surveys in 1999 (Ivey and Herziger 2000).

Three essential ingredients for a crane nesting territory were outlined by Littlefield and Ryder (1968); a feeding meadow, nesting cover, and water. Territories averaged 43 acres at Malheur Refuge and contained irrigated meadow for feeding and flooded marsh cover for nesting. An ideal territory contains a shallow marsh with residual emergents in close proximity to foraging meadows (Littlefield and Ryder 1968). Feeding cranes have a preference for mowed meadow habitats when compared with unmowed (Littlefield 1975).

Only 8 percent of the crane nests documented on the Refuge have been in meadow vegetation (Rule et al. 1990). The primary importance of meadows to cranes is for feeding and brooding young. Radio telemetry studies conducted on the Refuge showed that the wet meadow zone adjacent to uplands is a preferred area for crane chick brooding (Littlefield 1985). This preference is assumed to be associated with invertebrate abundance and availability. Generally, cranes are attracted to intensely treated meadows (mowed, burned, or rake-bunched grazed) for feeding during early spring. These intensive treatments remove ground cover, allowing solar radiation to warm the soil, causing earlier green-up of vegetation and earlier invertebrate availability (Epperson et al. 1999; Rule et al. 1990).

Cranes initiate nesting when their territories are adequately flooded and the females have consumed enough protein to begin egg-laying. Cranes nest early in fields that are irrigated early and later in fields that are flooded late. Nest initiation is also affected by land use treatments because treatments that remove ground cover (burning, grazing, haying) result in earlier soil warm-up and availability of protein-rich invertebrate foods. Cranes nest earliest in burned areas, followed by mowed and grazed areas, and they nest latest in idle areas (Littlefield 2010, personal communication). A study was conducted at Ash Creek Wildlife Area in California, where habitat is similar to the Blitzen Valley's (Epperson et al. 1999). That study compared bird use on hayed (previous summer) versus idle plots and documented significantly higher numbers of individuals and species of birds as well as significantly higher numbers of sandhill cranes on hayed plots during June and July. The study also reported that cranes in hayed plots spent significantly more time foraging and less time in vigilant behaviors as haying likely increased their ability to see approaching predators. They reported that because vegetation was less dense in the hayed plots, travel, foraging, and vigilance by cranes would be more efficient and the reduced litter and vegetation cover enhanced the ability of cranes to find and capture prey, supporting the idea that providing short-stubble habitat benefits cranes and other wildlife foraging.

An evaluation of Refuge crane nest success from 1990 to 1998 revealed that success was lower the season following a burn, declined with nest initiation date, and was higher in deeper water sites. It also revealed that haying, livestock grazing, or predator control did not influence success during those years (Ivey and Dugger 2008). The study found no evidence for haying, grazing, or idle treatment effects on crane nest success, which is similar to the findings of a study at Grays Lake National Wildlife Refuge in Idaho (Austin et al. 2002). The significance of higher nest success for early nests suggests that providing early water and ideal foraging habitats (treated meadows) can encourage early nesting, leading to increased success. Also, haying and grazing of wet meadows can encourage cranes to nest in the deeper marsh sites, where success is higher.

***Bobolink Habitat:*** Bobolinks are identified as a focal species in the Partners in Flight conservation plan for eastern Oregon and Washington (Altman and Holmes 2000), and Malheur Refuge supports the largest local breeding population of bobolinks in the western United States. Bobolinks are a wet meadow–dependent landbird species and tend to nest in shorter vegetation types.

Malheur Refuge bobolink populations were monitored annually from 1984 to 1998 (Malheur Refuge, unpublished data). A preliminary review of the data indicates that bobolinks select treated wet meadows in suitable areas of the Refuge with a high composition of forbs such as cinquefoils and clovers. Such fields that were placed in idle status were abandoned by bobolinks, and the data suggest that they respond positively to haying, grazing (dormant season), and burning treatments. Other studies support their preference for grazed or hayed areas. Johnson (1997) reported that if habitat is not maintained, use by bobolinks significantly declines, and that bobolink use peaked 1 to 3 years after burns and began to decline about 5 years post-burn. Several authors report that bobolinks respond positively to burning or mowing treatments (Bollinger and Gavin 1992; Dechant et al. 2003; Herkert 1991, 1994; Johnson 1997; Madden 1996; Madden et al. 1999; Renfrew and Ribic 2001). A Saskatchewan study reported that bobolink abundance was higher in mowed tame hayland than in idle native grassland (Dale et al. 1997). Recommendations for bobolinks in the Great Plains provided by Dechant et al. (1999) include providing hayland areas and delaying mowing as much as possible. Therefore, managing Refuge wet meadow sites where habitat is suitable for bobolinks (based on past surveys) using haying, RBG, and burning is appropriate to provide breeding habitat for this species.

**Table B-17. Wildlife Species that Depend on Treated Meadows for Particular Life History Stages**

| Wildlife Species | Use of Treated Wet Meadow |
| --- | --- |
| American avocet | Nesting/foraging |
| Black-necked stilt | Nesting/foraging |
| Bobolink | Nesting/foraging |

| Wildlife Species | Use of Treated Wet Meadow |
|---|---|
| Canada goose | Foraging |
| Mallard | Foraging |
| Sandhill crane | Foraging |
| Savannah sparrow | Nesting |
| White-faced ibis | Foraging |
| Wilson's phalarope | Nesting/foraging |
| Wilson's snipe | Nesting/foraging |

***Effects of Treatment Timing to Breeding Birds:*** Early mowing of vegetation has conflicted with production and maintenance objectives by destroying nests, killing incubating hens, killing young before fledging, and exposing nests and young to predators. Mowing could potentially impact any bird that nests or rears young in wet meadow habitats. Young cranes have the habit of lying still in meadow vegetation rather than moving away at the approach of a swather. Delaying Refuge haying dates until August 10 (as is practiced currently) will minimize mowing conflicts.

Grazing livestock, haying, and mowing during the growing season may disturb/displace nesting activity for that year from a particular field unit, but at any one time will only impact a small percentage of the available wet meadow habitats available within the Refuge.[8]

***Reed Canarygrass:*** Although this species actually occurs in plant communities within the wet meadow habitat type, it is significant enough to merit attention in this discussion. Large areas of robust reed canarygrass stands are essentially biological deserts in terms of wildlife use, as they quickly become too tall and rank and exclude most species. Currently about 6,000 acres[9] of the Refuge wet meadow communities are dominated by such stands. Intensive treatments such as haying and grazing to keep the stubble height as short as possible will greatly improve wildlife use of these areas, and they should be treated annually until they are restored to more desirable and diverse communities.

***Effects from Fences and Infrastructure:*** Electrical lines are a direct mortality source for cranes and other wildlife. Power line strikes are a major mortality factor for larger birds such as cranes and trumpeter swans as well as many other birds.

The Refuge has removed a vast majority of lines not associated with rural power distribution. Orange plastic spheres and reflective tags placed on some existing power lines where mortalities have occurred in the past have reduced collisions significantly. The stipulation below to bury the electric lines should mitigate somewhat against these hazards.

Fencing can interfere with the movement of wildlife or create entanglements, leading to mortality or altered movements for birds and mammals (Christianson 2009). In a 1-year study in Colorado and Utah surveying 1,046 kilometers (km) of fences, Harrington and Conover (2010) measured ungulate

[8] If a 500-acre wet meadow is used for habitat treatment within the growing season, this only accounts for 2 percent of this meadow habitat type being impacted.
[9] Locations of reed canarygrass monocultures is being mapped during the 2011 field season as specific wet meadow plant communities are identified spatially.

mortality rates at 0.25 mortalities/km for the wire fences studied, with 0.08 mule deer mortalities/km, 0.11 pronghorn mortalities/km, and 0.06 elk mortalities/km. Mortalities were highest in August, when fawns were weaned, and juveniles were eight times as likely as adults to suffer mortality.

In past years, biologists have found several chicks killed from fence entanglement, as well as many deer and antelope, at Malheur Refuge (Ivey 2011). Avian fence collisions are most common in areas where fences cross marshes. However, the Refuge now uses smooth wire as the bottom wire on all fences, and this is placed at a standard height to minimize impacts to pronghorn antelope. Observations at the Refuge have confirmed that with these adaptations most pronghorn cross under the fences rather than through them. In addition, bird flight patterns have been considered when building fences, and many fence lines have been moved or removed to minimize the number of bird strikes. Therefore, though some fence impacts should be expected, overall, infrastructure effects from grazing will be relatively minor.

***Effects to Other Wildlife (small mammals, large mammals, fish, herps, inverts):*** There will be negative impacts to some small mammals, reptiles, and amphibians. Not only are these species subject to mortality from machinery, but the conversion of tall pasture grasses to mowed grasses results in habitat loss. However, at any one time, approximately 40 percent of the wet meadow habitat will be in an idle (untreated) condition, which allows for habitat use by species dependent on this condition.

***Disturbance Effects:*** The use of noise-producing equipment such as ATVs, tractors, swather or rotary mowers, rakes, and other potential equipment may cause localized disturbance to wildlife during the period of the equipment use. Oregon law restricts noise emissions from ATVs to 99 dB (OPRD 2011). In general, use of equipment will occur in the fall and thus occurs outside of the sensitive breeding period. In addition, most of the areas that will be accessed with equipment will be dry at this time of year, with reduced wildlife densities.

***Potential for Injury:*** Based on Malheur data, 75 percent of sandhill crane chicks are fledged by August 10. The remaining 25 percent unfledged chicks (typically five chicks per year) are vulnerable to haying mortality. Haying attracts coyotes and other predators, and unfledged chicks around hayed fields tend to be taken by predators (Ivey 2011). The stipulations outlined below should help reduce risk of mortality for the remaining chicks.

<u>Effects to Vegetation: Short-term and Long-term</u>

***Wet Meadow Plant Community Composition:*** Wet meadows are ideally dominated by native grasses (e.g., American sloughgrass, spike bentgrass), sedges, rushes, and native forbs and are commonly found interspersed within marsh and upland complexes. On the Refuge, wet meadows are currently dominated by introduced pasture species such as smooth brome, meadow foxtail, orchardgrass, reed canarygrass, and various clovers. Because meadows hosting a larger percentage of grasses provide more tonnage and higher nutrition for livestock, forage species such as timothy and smooth brome were introduced (decades ago). Other species were either introduced to the area in contaminated hay grown in other areas (e.g., meadow foxtail) or were purposefully planted because native meadow plants were generally believed to be less resilient, productive, and responsive to intensive land management. As a result, the diversity of native plants in some of these areas has decreased substantially, and restoration is emphasized in land management objectives 4A, 4B, and 4D, which strive to improve the biological integrity of plant communities.[10]

***Differentiating between Riparian and Wet Meadow Habitats:*** The CCP distinguishes between riparian and wetland habitat management. As laid out in Goal 3 of Chapter 2, livestock grazing will not generally occur in areas designated “riparian” (e.g., streamside riparian zones and riparian woodlands). For this reason, issues such as stream bank integrity, willow propagation and enhancement, cattle distribution concerns relating to the inclusion of riparian areas in upland paddocks, and so on, are not addressed in this analysis.

Wet meadows and woody riparian areas are managed for different wildlife objectives. The former provides habitat for pairing/nesting/foraging waterfowl, waterbirds, shorebirds, and so on, while the latter is managed for willow-dependent landbirds. The different habitat requirements of yellow warblers and bobolinks illustrate this point well. Yellow warblers require large, dense willow stands while bobolinks seek out large, open, treated meadows for nesting. Wet meadow and riparian habitat types do have much in common, however, and these commonalities (e.g., plant community composition, plant species response to defoliation) will be addressed below.

How a plant community responds to defoliation is greatly affected by the compounding influences of its environment (e.g., climate) as well as the physiology of individual plant species and the influence this has on fitness at the individual plant and community levels. Unfortunately, as discussed earlier, many individual species have not been studied to an extent that would be helpful in truly comprehending how individuals and composite communities will respond to various management scenarios.

It is also important to note that studies pertaining to rangelands, mixed-grass and tall-grass prairies, woodlands, and narrow riparian meadows may or may not be relevant to the habitats being considered at Malheur Refuge. Basic principles can and do apply to all the above-mentioned systems, but one must be careful how conclusions are drawn when premises are built on habitat types that are different than the Refuge’s wet meadows. A vast majority of the research that is cited below has taken place in riparian areas adjacent to streams or in small riparian meadows west of the Rocky Mountains or within laboratory environments.

***The Dominant Role of Hydrology in the Expression of Plant Communities:*** A driving factor that separates wet meadows from other habitat types often discussed in grazing-related literature is hydrology. An overview of existing literature indicates that water table characteristics (i.e., soil moisture availability) are the most important factors influencing the composition and distribution of plant species in mesic and wet meadows (e.g., Allen-Diaz 1991; Dwire et al. 2006; Henszey et al 1991; Martin and Chambers 2001, 2002; Perata and Alpi 1993; Rumburg and Sawyer 1965; Stringham et al. 2001). Thus it is critical to consider the underlying influence of hydrology whenever plant community responses to livestock grazing are being considered. Ultimately, the net effect of any disturbance (e.g., flood irrigation, grazing) is often a function of its interaction with other disturbances.

Considering the influence of anaerobic conditions on plant communities, Dwire et al. (2006) found that small changes in water-table depth could result in either a short-term shift in species dominance or the ultimate replacement or loss of certain species. Water sedge (*Carex aquatilis*) can readily

[10] The reader is referred to Chapter 2 of the Refuge CCP for further elaboration of these objectives.

transport oxygen through aerenchyma (Perata and Alpi 1993) and can persist in anaerobic conditions that would exclude other sedge species over time (Gomm 1979). Baltic rush (*Juncus balticus*) has a greater range of drought tolerance than many other rushes, and may not be as negatively impacted by long-term drying trends that would exclude other rush species.

Unfortunately, with a few noted exceptions such as those found above, there is a considerable knowledge gap regarding a majority of individual species' tolerance to water-table depth and associated anaerobic conditions. It is also difficult to categorize level of water tolerance by genus or other human-made classifications because of significant differences between species (e.g., aquatic versus Nebraska sedges). Many species have broad ecological amplitudes and do quite well in typical wetland settings as well as more "terrestrial" habitats (Tiner 1991).

There is, however, enough existing data to begin addressing Refuge management strategies from a scientific basis. It has been observed that timing and duration of soil saturation during the growing season can determine the distribution and abundance of Nebraska sedge (*Carex nebraskensis*) and Kentucky bluegrass (*Poa pratensis*) in riparian meadows (Kluse and Allen-Diaz 2005; Martin and Chambers 2001). There is also a positive correlation between soil aeration and species abundance, and anaerobic conditions can negatively influence total plant cover and species diversity (Dwire et al. 2006). Stem density of some wetland obligates may decrease without adequate soil aeration during the growing season (e.g., beaked sedge in Mornsjo 1969). Flooding depth and duration may negatively impact sedges and grasses, while allowing rush populations to expand (Gomm 1979; Rumburg and Sawyer 1965). Henszey et al. (1991) found that 7 to 10 cm (2-4 inches) of standing water during spring flooding, with a maximum water-table depth of −30 to −90 cm (−11 to −35 inches), was enough to create a shift to a wetter meadow plant community and a decrease in the presence of tufted hairgrass (*Deschampsia caespitosa*).

Water-table–driven thresholds are particularly difficult to determine, partially due to a general lack of species-specific data and the large degree of overlap that can occur among species (Dwire et al. 2006). Summarizing existing data and knowledge about the physiology and response of specific plant species (i.e., presence or absence of aerenchyma) may assist in the creation of general water management guidelines. This could serve as a foundation for managing water-table depths at the peak of growing season according to requirements of dominant species within particular guilds.

Because water table and topography play such a decisive role in determining the composition and dynamics of meadow and wetland habitats on the Refuge, the Ecology Work Group has already begun constructing the STM using hydrology as its foundation. Depending on the availability of water, one soil type may host either a hemi-marsh or a mesic meadow. The key to understanding the roles and impacts of haying and grazing during the life of the CCP is remaining mindful that these treatments interact strongly with site-specific hydrological regimes.

***How the Use of Grazing During the Growing Season can be Valuable in Meeting or Maintaining Wildlife Habitat Objectives:*** The concept of scale is critical in discussing the role livestock play in managing biodiversity within the Refuge's wet meadow habitats. Taken as a whole, these meadows encompass a diverse assemblage of plant community types consisting primarily of novel communities.[11] Within specific areas, however, a lack of species diversity is often problematic,

[11] Novel plant communities consist of species assemblages that did not naturally occur prior to the introduction of desirable and undesirable exotics. Many novel communities are able to function in a similar manner to native communities (e.g., promotion of soil stability, watershed function, distribution of nutrients and energy) and provide

especially for wildlife such as the bobolink, which depends on a wide assortment of plant species to carry out their annual reproductive cycles (Wittenberger 1978, 1980). As discussed earlier, topography plays a significant role in determining depth to water table and provides a foundational template in guiding the potential expression of multiple grass, sedge, rush, and forb species. Within the wet meadow complex we discover the highest potential for diversity within mesic areas that are subirrigated for a majority of the growing season. Lower-lying areas are negatively predisposed to diversity due to extended anaerobic conditions and the limited number of species that are able to cope with an oxygen-limited environment. The following discussion is primarily mindful of mesic sites within this habitat type, although some points are relevant to sedge- and rush-dominated communities where introduced forage species such as reed canarygrass overtake desirable natives.

When let loose to graze on actively growing vegetation, livestock are capable of inducing a series of biological and physiological modifications that can drive changes in function at the individual plant scale. Grazing can also alter the expression of plant populations, leading either to an increase or decrease of biomass production at the community or ecosystem scale (Dyer et al. 1993) or in the number of plant species that are expressed (Leege et al. 1981). Cattle effects on vegetation should always be examined at various scales, including (1) the effect upon continuous changes in resource allocation and the phenological/morphological/physiological[12] responses and adaptations of individual plants; and (2) the effect upon plant community attributes such as plant species abundance, distribution, diversity, and overall habitat structure. These considerations should take place in a context that recognizes the influence of local hydrological dynamics and prevailing soil properties (e.g., depth to restrictive layer, pH, texture). Such an approach will allow Refuge staff and partners such as the Ecology Work Group to establish management strategies that are likely to succeed in attaining or maintaining desired conditions.

It is important to remain mindful that overarching conclusions are difficult to apply across the landscape because herbivory affects the same species differently across various sites and any generalizations would require an attempt to replicate responses in different areas (Belsky 1992). Kauffman et al. (1983) stressed the importance of recognizing and differentiating between plant community types: “Because of the great community diversity and differing ecological tolerances of riparian plant communities, a management practice that may be beneficial for one community may not be beneficial to another community in the same area.”

***Physiological Responses of Vegetation to Grazing During the Growing Season:*** Research conducted on numerous forage grasses has demonstrated that herbivory has an immediate effect on the functionality of individual plants during the growing season. A temporary cessation of root elongation (Crider 1955) and decreases in root respiration and nutrient acquisition (Davidson and Milthorpe 1966) can occur within 24 hours. Crider (1955) noted that there was a relationship between the percentage of foliage removed and the percentage of roots that ceased growing for a time. Richards (1984) concluded that a “reduction of root growth following defoliation appears to be an effective mechanism to aid reestablishment of the photosynthetic canopy and the root:shoot balance.” Briske and Richards (1995) believed that such alterations and reductions are an important adaptation to chronic defoliation and associated reduced entire-plant photosynthetic rates. The findings of Kauffman et al. (2004) illustrate this overall concept well. They examined the overall

satisfactory habitat for wildlife. Others become monotypic over time and become less diverse than site potential would otherwise merit.

[12] Physiology refers to how a plant functions at various levels (e.g., growth rate, hormone production). Phenology examines the relationship between a plant’s growth and reproductive cycle in response to environmental conditions. Morphology considers the various forms and structural components of plants.

impact of belowground root biomass in response to herbivory and found that although there was no difference between plots in the distribution of root biomass by depth, root biomass was consistently higher in volume in non-grazed sites. Similar research conducted on aquatic sedge in a tundra setting yielded different results, finding that two or more defoliation events were required before root growth was reduced. Respiration and nutrient absorption rates were either maintained or increased for this species in relatively infertile conditions (Chapin and Slack 1979).

The complex relationship between physiological responses to defoliation and the overlying influence of temporal and spatial scales give testimony to the nonlinear nature of these interactions. In addressing the nonlinearity of these responses, Dyer et al. (1993) noted that metabolic activity and growth and development rates initially increase directly following a defoliation event until a maximum level of all three characteristics is attained. Once this level is reached, production potential decreases with sustained or increased levels of grazing (see also De Angelis 1992; Dyer et al. 1986; Dyer et al. 1991). Competitive interactions between species could be influenced by the level at which individual species would plateau in this way. These findings suggest that the desirable timing, duration, and location of prescribed grazing will differ dramatically based on the treatment's effect on the competitive abilities of desirable and undesirable plant species.

***Considering Plant Morphology:*** Belsky (1992) confirmed the importance of plant morphological expression in determining the influence of grazing upon plant competition in a diversity of Tanzania grasslands. She noted that tall perennial species increased and short perennial species decreased when grazing was removed from her plots. Across all plots, cessation of grazing led to an increase in species dominance and a decrease in species diversity. She concluded that short, sexually reproducing species were overtopped and crowded out by tall, vegetatively reproducing species. When grazing effects were examined, she found that the reverse was true.

This research is consistent with the general understanding that has been developed regarding plant morphological relationships with defoliation as related to tillering rates, shoot length (and associated meristematic tissues),[13] and the presence or absence of asexual reproduction (rhizomes and stolons). Considering such holistic relationships, Belsky concluded that herbivory response is different when one plant is affected versus multiple plants and that intraspecific and interspecific competition are critical components of the outcome of these interactions.

***Responses of Plant Communities to Grazing:*** Research has demonstrated that grazing may encourage competition by reducing enough biomass (cover and density of prevailing vegetation) to release available resources (Briske 1991; Damhoureyeh and Hartnett 1997; Kluse and Allen-Diaz 2005) or may be able to maintain current levels of competition by favoring the growth of disturbance-adapted species (Chesson and Huntly 1997). Shifting the intensity and duration of grazing has also been demonstrated to alter species composition, distribution, and productivity (Crawley 1987).

Plants compete for resources both spatially and temporally. The phenology of some species, such as Nevada bluegrass, will allow them to compete more readily early in the growing season while other species have not yet emerged from dormancy. Others, such as smooth brome, have the ability to readily respond to autumn moisture when neighboring species have already entered quiescence. In this same manner, plant species have been observed to respond differently physiologically to

[13] Meristematic tissue simply refers to groups of cells that are densely packed and able to divide, thus providing the growth and elongation of plant parts (e.g., leaves).

herbivory. Those species that are able to reallocate resources quickly, have developed mechanisms to protect meristematic tissue, or have reduced the overall likelihood of being defoliated will have a competitive advantage over their neighbors. Differences in the response to herbivory not only occur among various plant species, but among various genotypes of the same species as well.

In addition, cattle and other livestock are not indiscriminate in their grazing behaviors. Therefore their presence can influence plant community composition by providing a competitive edge to untargeted plants. The individual plants cattle will likely prefer include those lowest in structural carbohydrates and providing the highest, most available amount of nutrients such as nitrogen for the production of protein via rumen microorganisms.

Leege et al. (1981) addressed the impact of grazing versus rest on mountain meadow sites that had either experienced or were protected from heavy grazing for over 10 years. They observed that redtop, rushes, timothy, dandelion, and clover increased and sedges and aster decreased in grazed moist meadow communities. In wet meadows they discovered that redtop, tufted hairgrass, bulrush, timothy, and clover increased while sedges were more common in protected areas. Jackson and Allen-Diaz (2006) conducted a study on spring-fed wetlands in northern California (which more closely resemble conditions found on Refuge meadows), and found that herbaceous cover and diversity were maintained under light to moderate grazing regimes. Kauffman et al. (1983) discovered that lineleaf Indian lettuce (*Montia linearis*), various willowweeds (*Epilobium* spp.), and sedges were favored while meadow timothy, leafy-bract aster (*Aster foliacens*), and northwest cinquefoil decreased with a 3-year rest from grazing in eastern Oregon. These studies do not necessarily conflict with one another, but point out that species' responses to grazing not only differ between type of use (heavy versus moderate being an extremely coarse description of use) and composition of plant species, but also across individual populations within a species.

Prescriptions are easiest to meet when target vegetation is also the most preferred by livestock (e.g., reed canarygrass during spring green-up). Flexibility and continuous monitoring is required, however, to ensure that non-target vegetation is not impacted enough to compromise specific grazing objectives. This is important because the vegetation most preferred by livestock would likely shift during designated treatment windows.

When considering the use of grazing in a specific area, first-hand knowledge of local cattle behavior and an awareness of studies conducted on comparable sites are very helpful. Most grazing research does not provide enough information to fully understand the overall role that livestock played in study results and how their impact may be replicated or avoided in other situations.

The studies discussed above are helpful in understanding how grazing behavior and competitive interspecific relationships within different plant communities have influenced plant community characteristics over time. They also provide things to look out for or to be particularly cognizant of when creating treatment strategies in similar communities. They do not, however, provide a reliable mechanism for predicting vegetation response across the landscape. Use of the best science available, continuous inventory and monitoring associated with adaptive management, and management flexibility will provide the best results over time as methods and approaches are refined through site-specific experience.

***Responses of Plant Communities to Dormant Season HO/RBG:*** Haying may be used in the pursuit of directional change (replacement of one community by another) when conducted within the growing season (e.g., cattail abatement in encroached wet meadows), but such a use is more appropriately placed alongside growing season treatments as discussed above. The overall concept of haying and RBG treatment is to provide non-directional management[14] on wet meadow habitat. The purpose of this section is to evaluate the scientific literature to determine what impacts haying and RBG may have on plant communities as structural objectives (e.g., for migratory and shorebird habitat) are met.

Traditionally, the haying of native meadows within the Harney Basin begins in early July when plants have reached maturity and before a decline in forage quality takes place. Over the last 20 years, the Refuge adjusted its haying practices by delaying cutting until August 10 because collected data revealed that a much higher mortality rate of nesting and fledged birds takes place before then (Rule et al. 1990). Although a later haying date does decrease the value of forage harvested by cooperating permittees, this practice is consistent with meeting wildlife production objectives across the Refuge's wet meadow areas. Because wildlife depend on specific habitat attributes in order to successfully propagate, it is important to consider vegetative impacts alongside reproductive chronologies.

A review of available research generally supports the practice of delayed mowing as valuable in maintaining meadow diversity.[15] Martin and Chambers (2001, 2002) concluded that biomass was not affected by clippings conducted in late July and that late season herbage removal had few effects on the vegetation because it had already begun to senesce. This is consistent with other studies such as Critchley et al. (2009), who noted that late cutting (associated with senescence) was most likely to aid in the reestablishment of target species–rich communities.

***Discussion of HO versus RBG:*** Both RBG and HO treatments can provide benefits to wildlife. HO can provide a higher level of control by working with permittees to treat only target areas, thus ensuring that non-target plant communities remain unimpacted. RBG targets mowed vegetation that offers nearly twice the level of crude protein for livestock than that which is left standing (Turner 1987),[16] thus ensuring that livestock will focus on treated acres as well. However, it is possible for fall rains to provide green-up that may attract livestock to non-mowed areas within the overall treatment boundary, thus causing unintentional grazing outside of the designated treatment area. Shifts in management from RBG to HO have already taken place across the Refuge in areas where this has commonly occurred to prevent the future occurrence of this.

Even though RBG and HO are both used to meet the same meadow prescriptions, there are several reasons why the Refuge anticipates continuing to use RBG as a habitat management tool. First, the presence of noxious weeds on Refuge meadows is a considerable problem. HO involves the transport of hay and associated weed seeds from the Refuge to private lands. The more HO is used, the greater the spread of weeds such as perennial pepperweed will be across the county and beyond. Because all Refuge meadows host pepperweed and other problem plants at various levels of infestation, current weed control efforts primarily target existing HO fields in order to retard the spread of invasive plants onto other lands. (Priorities are necessary as it will cost over $1.5 million for initial treatment

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[14] Non-directional management strives to maintain the long-term equilibrium of a site where changes in plant composition is temporary and reversible.

[15] Cited research does not, however, directly address the Refuge's practice of coinciding prolonged irrigation with delayed mowing.

[16] Turner (1987) found that the average crude protein content of rake-bunch versus standing crop was 7.5 percent and 4.3 percent, respectively, over a 3-year period within the Harney Basin. Because pregnant, mature cows require approximately 8 percent crude protein to maintain condition, they will seek available forage that is highest in nutritional value.

of all impacted areas on the Refuge). Herbicides in current use are restricted from use along waterways, which prevents full resolution of the problem. In addition, the soil seed bank will likely require this level of treatment to continue indefinitely. The spread of weeds to private lands is less of a concern when livestock are grazed directly on the Refuge using RBG, because livestock can be quarantined when leaving the Refuge, thus preventing additional expansion of noxious weeds across land management boundaries.

Second, many fields require the mowing of vegetation such as cattail and common reed to prevent or halt the encroachment of emergent marsh vegetation into the wet meadows. Emergent vegetation is generally not palatable to livestock. Nonetheless, HO permittees are required to pay for the tonnage that is hauled off the Refuge, and they are required to bale what is cut in order to achieve litter management objectives for wildlife species the following season. When mowing is conducted in association with RBG, piles are spread out by livestock as they seek nutritious, digestible feed. Any remaining emergent plant litter then becomes disseminated by cattle, which assists in its breakdown prior to the following spring growing season, ultimately promoting the vigor of desirable meadow species.[17]

If piled RBG-treated vegetation remains on the field at the start of the next growing season, it is possible for sandhill cranes and other birds to contract a potentially lethal fungal infection called Aspergillosis. This can occur either under natural conditions or when piled vegetation becomes wet and moldy. Adequate use of vegetation by livestock in RBG-treated meadows has been successful at preventing avian mortality.

Effects to Soils

Soils play a critical role in the management of wildlife habitat because they provide the substrate by which plant communities express themselves. Consideration of soil resources is not only important for the production of vegetation, but also to meet water quality and geomorphic objectives as well. Concerns related to soil resources relative to the use of grazing and haying include the potential for increased erosion, compaction, and/or changes in fertility.

Within the Refuge’s wet meadows, two soils dominate the areas targeted for haying or RBG. The Skidoosprings series consists of sandy loam within 11 inches of the soil surface, while the Fury series consists of silty-clay loam within the top 10 inches. More attention is merited for the Fury series because of its finer texture class. Typical of mollisols, however, this soil type is high in organic matter content and also hosts plant species that are high in root length density (RLD) (see discussion below) and biomass. Finer textured soils such as this across the Refuge where haying or grazing treatments are occurring will be prioritized in annual monitoring efforts.

***Erosion:*** The Refuge’s wet meadows are located on relatively flat topography within the Blitzen and Double-O valleys and are able to rapidly dissipate the energy of potentially destructive flood waters. Because they do not host stream channels and are not found on slopes, erosion caused by water is not a large concern. Impacts caused by wind erosion are also negated by the extensive fibrous root systems of vegetation found just below the surface of the soil within this habitat type. The potential for soil erosion is greatest along dikes, but most of these areas fall outside designated rake-bunch

[17] A third reason that may be argued is the impact repeated use of HO may have on meadow systems via nutrient mining. How long can a site remain productive if nutrients aren’t returned to the system from which they came? There is no research to back up this hypothesis, however, although soil testing may be conducted comparing HO and RBG fields to determine if this concern is merited.

areas and the exclusion of cattle from all canal systems is expected to be completed in the next few years.

Livestock management and associated inventory and monitoring activities will seek to prevent the creation of bare soil in wet meadows by not impacting isolated areas to the point where vegetation is removed and large areas of bare soil are exposed (e.g., regular movement of mineral tubs, adequate graveling of the immediate area of stock tanks, routing tank overflows to nearby emergent stands).

***Compaction:*** The dominant concern regarding the relationship between soils and haying/grazing treatments is compaction. The way soils respond to the presence of machinery or livestock depends on the following prevailing factors: soil texture, on-site soil conditions (wet versus dry, frozen versus thawed), and plant community type (e.g., sedges versus bunchgrasses).

***Influence of Soil Texture**:* Fine-textured soils (clay, clay-loam, etc.) have high plasticity and cohesion properties. When they are disturbed under moist conditions, their aggregates are easily broken down. When this occurs, macropores within the soil profile can be greatly diminished. If the impact (i.e., compaction) is extensive enough the soil can become puddled.[18] Because of this, issues regarding compaction and infiltration cannot be separated. Fortunately, there are mitigating factors that influence whether and to what extent such “restructuring” takes place under moist conditions. Soils high in organic matter in the O and A horizons are much more stable than those that are not.

Soil organic matter can consist either of detritus/humus or living vegetative root masses. In riparian studies, RLD has been found to greatly influence site stability. RLDs were found to be especially high in communities dominated by Nebraska sedge, Douglas sedge, and Baltic rush (Manning et al. 1989). Although Manning et al. (1989) associated RLD with the control of erosion in riparian systems, a link can be made between community type and likely compaction issues within wet meadows. Warren et al. (1986) observed that degree of compaction was at least partially influenced by relative sparseness of vegetation in upland sites.

Research conducted on moderately fine soils (silt loam/loam) subjected to season-long and deferred (rotating early/late summer use) grazing treatments found that bulk density (a measure of compaction) was significantly lower and infiltration rates were consistently higher in exclosed plots within both dry and wet meadow sites (Kauffman et al. 2004). Results from a Kentucky bluegrass community study stated that the amount of compaction varied according to soil texture and only impacted the upper 4 inches of the profile. Sites highest in silt and clay had significantly reduced pore space and higher bulk density on grazed areas (treated annually June 1 through October 31) than within exclosures. Where soil texture was more coarse (slightly less clay and more sand), only the first 2 inches displayed these properties (Orr 1960).

Comparable observations were made by other studies examining the relationship of treatment duration/timing and various soils along a texture gradient. The conclusion of a study conducted on fine-textured soil hosting newly seeded alfalfa (*Medicago sativa*) and bromegrass (*Bromus biebersteinii*) revealed that increases in cattle stocking rates during the winter significantly increased soil bulk density (Stephensen and Veigel 1987). Plots within a blue grama (*Bouteloua gracilis*) and buffalograss (*Buchloe dactyloides*) site consisting of rough-textured soil revealed no significant differences between treatments,[19] while bulk density significantly increased in fine-textured soils

[18] Puddling is a term used to express a state of relative impermeability of the soil to air and water.
[19] The grazing treatment took place from May 1 to October 31 for a period of 30 years.

(Van Haveren 1983). No compaction was found to occur on gravelly/sandy loam soils in a riparian area in northeastern Oregon (Bohn and Buckhouse 1985).

Of particular interest is a study conducted by Wheeler et al. (2002) in a plant community that consisted primarily of Kentucky bluegrass, water sedge, beaked sedge, tufted hairgrass, and dandelion, similar in nature to the hydrologically driven plant community gradient found within the Refuge's wet meadows. The study found that although bulk density increased at a depth of 5 to 15 cm (2-6 inches) in grazed treatments occurring in early spring and late summer, the highly organic surface area (0-5 cm [0-2 inches]) did not experience compaction. Of additional interest in this study was the discovery that the bulk density and infiltration rate impacts observed at lower soil depth recovered within 1 year after grazing ceased, which was mainly attributed to frequent freeze–thaw events and high soil organic matter. Similarly, Stephensen and Veigel (1987) observed that recovery of impacted soils on their plots was nearing completion after two growing seasons following their full range of stocking intensities.

Effects to Surface and Groundwater Resources

Under the CCP, cattle grazing will not be permitted in riparian or riverine habitats without site-specific management prescriptions created with input provided by the Ecology Work Group. Such prescriptions will clearly state the rationale for livestock use as well as timing, stocking rate, and other thresholds used in meeting specific plant community attributes. A minimum buffer of 20 meters (65 feet) will protect river and creek channels from haying and grazing treatments. Water delivery canals will not fall under this buffer requirement with the exception of East Canal, which is managed as a fishery for redband trout.

***Surface Water:*** A study assessing the water quality impacts associated with Refuge water and habitat management (irrigation of hay and rake-bunch meadows, grazing, surface and subsurface return from wetlands and agricultural fields) was conducted in the mid-2000s (Mayer et al. 2007). The study investigated a variety of water quality parameters, including water temperature, conductivity, pH, dissolved oxygen, turbidity, nutrients, E. coli, and total coliform between April and September. Grazing has the potential to influence bacteria and nutrients in surface water.

***Bacteria:*** *E. coli* and total coliform samples were collected at numerous stations from Page Springs (southern boundary of the Refuge) to below Sodhouse Dam (near Malheur Lake). The state standard for *E. coli* is that the geometric mean of five samples collected over a 1-month period cannot exceed 126 organisms per 100 mL and no single sample can exceed 406 organisms per 100 mL.

Samples from Station 1 (Blitzen River below Page Springs Dam) were very low (geometric mean of 1 organism/100 mL). Numbers increased slightly downstream at Station 10 (Blitzen River near Grain Camp Dam) and Station 12 (Blitzen River below Sodhouse Dam), but they were still quite low (geometric means of 10 organisms/100 mL or less). The highest numbers of *E. coli* were found at the confluence of McCoy Creek and the Blitzen River, but the numbers were still well below the standard (<50 organisms/100 mL).

***Nutrients:*** The study also examined nutrient loading for irrigated wet meadow areas. Based on the Westside P Ranch area examined in the study, the authors concluded that return flows from seasonally flooded wet meadow habitat contribute to phosphorus concentrations in the river, and possibly to nitrogen. However, the study authors did not identify cattle to be the source of this nutrient loading. It could be the wetting/drying cycle and/or the prevalence of thousands of defecating waterbirds and waterfowl associated with these wetlands.

***Groundwater:*** Stock tanks are used to supply livestock with water sufficient to meet their needs while on the Refuge. Water for the stock tanks comes from wells. Because stock tanks use a minimal amount of water drawn from wells with 2 hp pumps, groundwater levels will not be likely to be significantly impacted.

Other Effects

***Loss of Habitat from Facility Construction:*** Under the CCP, no new facilities will be constructed for haying and grazing activities.

***Impacts to Priority Public Uses:*** Haying and grazing operations may occasionally conflict with the experiences of some Refuge visitors. However, such impact will be expected to be moderate to minor at the Refuge due to the seasonal differences in uses. Refuge visitation peaks during spring, when little grazing or haying will likely occur. Growing season mowing and grazing will not occur at a scale that will disrupt or significantly impact wildlife viewing opportunities enjoyed by Refuge visitors. During the fall when haying and RBG operations are active, wildlife observation and photography visitation falls off. Hunting use increases during this season but is concentrated in the Buena Vista Unit and around Malheur Lake, where little or no haying or grazing occurs.

***Impacts from Horses and ATVs:*** Livestock trailing will continue to occur on the Refuge. ATVs and horses are permissible for use in trailing activities and ATVs may be used in providing supplement tubs in RBG areas. The impacts of horses are considered in the Wildlife Observation, Photography, and Interpretation Compatibility Determination.

Negative impacts will be avoided or minimized by considering specific routes, timing, and other factors on a case-by-case basis.

***Infrastructure:*** Regular, semiannual road maintenance activities cover the minimal disturbance that livestock trailing and equipment/hay hauling activities may cause. Livestock activities have not harmed, nor are they predicted to harm, public use trails on the Refuge.

Use of Diamond and Nine Mile corrals impacts less than 2 acres of Refuge land. Therefore, impacts from this use are negligible.

**Public Review and Comment**

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

***General***

- Use shall be administered as described in the Description of Use above.
- Neighboring habitat boundaries and large mosaics of upland areas (e.g., dry meadow, sagebrush lowland) found within wet meadow treatments will either be excluded by means of fencing or monitored annually to ensure that these areas are not negatively impacted by grazing treatments. Parameters for monitoring will include desirable attributes associated with pertinent habitat types.
- Class 1 ATVs with Oregon permits will be allowed at Malheur Refuge in association with grazing and haying. Class 1 includes ATVs and three-wheelers, are vehicles 50 inches wide or less, have a dry weight of 800 pounds or less, have a saddle or seat, and travel on three or four tires (OPRD 2011). ATVs may only be used in trailing livestock along designated routes to prescribed treatment areas and when necessary to maintain herd health (e.g., feed supplementation) and maintain fence lines (e.g., stringing wire). ATV use is restricted to the fields subject to the use or the designated routes for trailing. ATVs must be weed-free upon entering the Refuge.
- A pre-treatment inventory of local wildlife populations within the propsed warm season treatment area(s) will take place prior to the initiation of treatments.

***Grazing***

- Permittee has the responsibility to ensure that all fences are intact and gates closed before turning out livestock.

***Haying***

- All haying operations must be conducted from dawn to dusk only.
- Hay cannot be fed out on the Refuge unless authorized by the Refuge Manager for the purpose of weed prevention. Quarantines will last no longer than 5 days.

**Justification**

The haying and grazing cooperative land management program contributes to achieving Refuge purposes and goals as identified in the CCP and the Refuge System mission by providing valuable foraging, resting, pairing, nesting, and brood-rearing areas and conditions for the sandhill crane, bobolink, cinnamon teal, and other meadow-dependent species. It also contributes by economically providing weed control and other habitat maintenance functions that are not feasible for limited Refuge staff to accomplish. Grazing and haying are desirable means of maintaining this type of habitat because its area is too large for annual prescribed burning and repeated mowing of the meadows is beyond the capability of the Refuge staff. Haying and Grazing could have adverse impacts including potential disturbance to wildlife, trampling of nests, water quality impacts and introduction of invasive species. In addition auxiliary components of the grazing program such as introduction of fence lines and use of ATVs can also have adverse impacts on wildlife. Although allowing haying and cattle grazing on the Refuge can result in the above described disturbances to wildlife, disturbance will be intermittent and short term, particularly since wildlife disturbance concerns are primarily associated with warm season treatments, which are experimental in nature when initiated. The efficacy of this strategy will be rigorously reviewed on an annual basis by the ecology working group to ensure that in fact ecological targets are being achieved, adverse impacts are being minimized, and that the most effective overall strategies are being employed. Because a majority of haying and grazing treatments that will take place occur late in the season when most birds are capable of avoiding disturbance (i.e., dormant season), the relatively limited number of individuals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. The goal of both dormant and growing season treatments is to improve habitat for wildlife and rigorous annual review and revision by the ecology working group will help ensure that short-term tradeoffs are good investments for the birds. Thus Malheur National Wildlife Refuge CCP Appendix B Compatibility Determinations B-103 allowing haying and cattle grazing on the Refuge in conjunction with rigorous annual review and revision (as necessary) is found to be in support of and compatible with the purposes for establishment of the Refuge and the mission of the Refuge System.

**Mandatory Reevaluation Date**

09/2022 Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

**NEPA Compliance for Refuge Use Decision**

X Environmental Impact Statement and Record of Decision

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**Signatures:**

| | | |
|---|---|---|
| Prepared by: | (Signature) | 1/24/13 (Date) |
| Acting Refuge Manager/ Project Leader Approval: | Chad Karges (Signature) | 1/24/13 (Date) |

**Concurrence:**

| | | |
|---|---|---|
| Refuge Supervisor: | (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | (Signature) | 1-24-13 (Date) |

# B.8 Plant Gathering of Culturally Important Plants Compatibility Determination

**RMIS Database Use:** Plant Gathering

**Refuge Name:** Malheur National Wildlife Refuge

**City/County and State:** Princeton, Harney County, Oregon

**Establishing and Acquisition Authorities and Refuge Purposes:**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the [National Wildlife Refuge] System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

**Description of Use**

Malheur Refuge is the ancestral home of the Burns Paiute Tribe. Culturally important plants that grow in the wetlands, marshes, and riparian areas have been collected by members of the Tribe for generations. Culturally important plant collection involves taking hand cuttings from live plants (e.g., willow whips) or plants that have reached senescence (cattails and bulrush). Plant materials are collected in small amounts and plant mortality does not occur as a result of these activities. Collection typically occurs in areas closed to all public access.

Culturally important plants collected on the Refuge are used by Tribal members in a non-commercial way to obtain materials used to perpetuate traditional weaving techniques, and as an educational opportunity used to introduce Tribal youth to an important aspect of their heritage. Tribal elders have been involved in the development of a native plant list that is consulted by Refuge staff when habitat restoration projects are being planned on the Refuge.

The occurrence of this activity is infrequent and is not expected to grow significantly in the near future. Tribal members prefer to collect plant materials on the Refuge because of their abundance, ease of access, and the absence of herbicide use. Selection of collection areas occurs in coordination with Refuge staff and typically occurs where access for elders is easy, where plants are abundant, where collection has occurred in the past and plants have responded positively (e.g., willow growth is enhanced by cutting), and where conflicts with wildlife will be minimal or absent. Collection typically occurs from late summer through the winter when plants are dormant and when fields and ponds are dry.

The opportunity for Tribal members to collect culturally important plants on the Refuge has resulted in the development of a positive and collaborative relationship between the Burns Paiute Tribe and Malheur Refuge. Continuation of this culturally important opportunity will ensure that the relationship continues and matures in the future.

*Plant Materials:* Plants typically collected include cattails (*Typha* spp.), bulrush (*Scirpus* spp.), sedges (*Carex* spp.), redosier dogwood (*Cornus sericea*), various willows (*Salix* spp.), milkweed (*Asclepias* spp.), and seepweed (*Suaeda* spp.).

**Availability of Resources**

Adequate Refuge personnel and base operational funds are available to manage this activity at existing and projected levels. Staff time (less than 1 day per year) primarily involves phone conversations, email correspondence, and preparation of SUPs.

**Anticipated Impacts of the Use**

Non-commercial collection of culturally important plants at current levels is not expected to incur more than negligible short-term or long-term impacts to natural resources. These will involve localized and temporary vegetation trampling and localized and temporary wildlife disturbance. Sites will be monitored by Refuge staff to ensure that plant gathering does not result in depletion of the harvested resource. Under these conditions, no long-term impacts will be expected.

***Impacts to Listed Species*:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from plant collecting will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. Persons engaging in plant collecting will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Other Priority Public Uses*:** Persons collecting plants may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or EE groups, but this conflict will be expected to be minimal.

**Public Review and Comment**

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

- An SUP will be issued for the collection of culturally important plants by Burns Paiute Tribe members. The SUP will indicate the plant collection locations, dates of access, and quantity of materials that may be harvested.
- Collection sites shall be monitored by Refuge staff to ensure that plant gathering does not result in depletion of the harvested resource.

**Justification**

Although collection of plants can result in vegetation modification and disturbance to wildlife, this activity will occur on a small percentage of Refuge acres. There is sufficient undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing this use to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System’s mission.

Issuance of an SUP eliminates the potential for overcollection of culturally important plants, guarantees that collectors have authorization to be in areas closed to public access, and ensures that Refuge staff are aware of collection activities.

**Mandatory Reevaluation Date**

__09/2022__ Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

**NEPA Compliance for Refuge Use Decision**

____X____ Environmental Impact Statement and Record of Decision

## References

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Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

**Signatures:**

Prepared by: ______________________ (Signature) 1/24/13 (Date)

Acting Refuge Manager/ Project Leader Approval: ______________________ (Signature) 1/24/13 (Date)

**Concurrence:**

Refuge Supervisor: ______________________ (Signature) 1-24-13 (Date)

Regional Chief, National Wildlife Refuge System: ______________________ (Signature) 1-24-13 (Date)

# B.9 Research, Scientific Collecting, and Surveys Compatibility Determination

**RMIS Database Use:** Research; Scientific Collecting; Surveys

**Refuge Name:** Malheur National Wildlife Refuge

**City/County and State:** Princeton/Harney, Oregon

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the Unites States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 USC 668dd-668ee]).

**Description of Use**

***Program:*** The Refuge allows research on a variety of biological, physical, archeological, and social issues and concerns to address Refuge management information needs or other issues not related to Refuge management. This CD refers to research, collecting, or surveys conducted by non-USFWS entities. This may include other Federal, state, tribal, and private entities, or their contractors.

***Location of Use:*** Research, scientific collecting, and surveys may occur at any location on the Refuge. Location will depend on the research objectives.

The Refuge has numerous archaeological and paleontological sites. All research conducted on the Refuge must take this into consideration. All laws and Refuge policy associated with artifacts must be followed when gaining access to closed sites on the Refuge for research.

***Associated Facilities and Access***: Although no facilities at the Refuge will be maintained expressly for this use, the use may involve temporary use of some facilities. Research study sites, sampling locations, and transects shall be temporarily marked by highly visible wooden or metal posts, and/or flagging that must be removed when research ceases.

Access to study sites shall be by foot, truck, all-terrain vehicle, boat, airboat, canoe, other approved watercraft, and aircraft. Vehicle use is allowed on Refuge roads normally open to the public. Researchers may not enter closed areas, unless specifically authorized access in the SUP.

***Administration of the Use:*** The use will be conducted on an as-needed basis, subject to SUP approval. Prior to initiating the project, research applicants must submit a proposal outlining: 1) objectives of the study; 2) justification for the study; 3) detailed methodology and schedule; 4) potential impacts on Refuge wildlife and/or habitat, including disturbance (short and long term), injury, or mortality; 5) potential impacts to wilderness natural areas; 6) personnel required; 7) costs to Refuge, if any; and 8) end products (i.e., reports, publications).

Proposals will be reviewed by Refuge staff, the Regional Office Branch of Refuge Biology, and others as appropriate. Evaluation criteria will include, but not be limited to, the following: 1) research that will contribute to management will have higher priority than other requests; 2) research that will conflict with higher priority research, monitoring, or management programs may not be granted; 3) research projects that can be reasonably conducted off-Refuge are less likely to be approved; 4) research that causes undue disturbance or is intrusive will likely not be granted. Level and type of disturbance will be carefully weighed when evaluating a request. All requests will be carefully considered because some species are very sensitive to disturbance; 5) research evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.; 6) if staffing or logistics make it impossible for the Refuge to monitor researcher activity in a sensitive area, this may be reason to deny the request; 7) the length of the project will be considered and agreed upon before approval. Projects will not be open-ended and will be reviewed annually at a minimum.

If no conflicts to the Refuge’s mission are determined and an SUP is written, then the study will be conducted. At any time if the research is in violation of the terms and agreement of the SUP, the Refuge can terminate access.

***Number of Projects and Seasonal Patterns:*** The number of projects is expected to vary but based upon current experience, may range from 2 to 12 projects per year. Chapter 4 in the CCP describes the kinds of research projects that have occurred in the past.

The season of use may be at any time of the year. This use will only be permitted when conflicts did not occur with natural resources. This will be detailed in the permit’s Special Conditions section. For example, Malheur Lake access with an airboat will not be granted to researchers if a disruption of breeding and nesting birds occurs.

**Availability of Resources**

***Resources Involved in the Administration and Management of Use:*** Time will be required by office staff to prepare and issue SUPs. Designated research areas will need to be monitored by staff within the Biology, Visitor Services, or Archaeological programs and Refuge law enforcement to ensure permit conditions are met.

***Special Equipment, Facilities, or Improvements Necessary to Support the Use****:* The demand for Refuge equipment and facilities will be considered on a case-by-case basis depending on research study objectives. Arrangements will have to be made between the Refuge and researchers to determine if support is needed. If so, the researcher will have to provide grant money to cover costs or the Refuge will donate in-kind to the project.

***Maintenance Costs:*** Maintenance costs will be considered on a case-by-case basis depending on the research study objectives. The specific use will have to provide grant money to cover costs or the Refuge will donate in-kind to the project.

***Monitoring Costs****:* No monitoring costs will occur. The researchers will be responsible for monitoring.

***Offsetting Revenues:*** Because this usage aids the Refuge in understanding specific objectives and projects in addition to staff activities, research results provide the potential for overall cost savings for Refuge management activities. Since research represents a cost saving to the Refuge, there will be no fee for the issuance of permits.

**Anticipated Impact of the Use(s)**

Given the stipulations listed below, some short-term impacts can be expected, but no long-term or cumulative effects are anticipated because of the specifications in the SUP.

***Short-term Impacts:*** Research activities may disturb fish and wildlife and their aquatic and terrestrial habitats in the short term. For example, the presence of researchers can cause waterfowl to flush from resting and feeding areas, or cause disruption of birds in nests or breeding territories. Efforts to capture animals can cause disturbance or injury. To wildlife, the energy cost of disturbance may be appreciable in terms of disruption of feeding, displacement from preferred habitat, and the added energy expended to avoid disturbance.

Sampling activities can cause compaction of soils and the trampling of vegetation, the establishment of temporary foot trails and boat trails through vegetation beds, disruption of aquatic sediments, and minor tree damage when tree climbers access bird nests. This may lead to avenues of predation and predator habituation. The removal of vegetation or sediments by core sampling methods can cause increased localized turbidity and disrupt non-target plants and animals. Installation of posts, equipment platforms, collection devices and other research equipment in open water may present a hazard to boaters if said items are not adequately marked and/or removed at appropriate times or upon completion of the project. Research efforts may also discover methods that result in a reduction in impacts described above.

Adverse impacts of research will be minimized through stipulations described below. Vehicular access will be allowed only on roads and mowed dike tops, thus resulting in no net increase in vehicular impact. Access into any closed areas will only be permitted under terms specifically described in the SUP, thus avoiding and minimizing human disturbance to feeding and resting waterfowl. Researchers will also be required to observe public use regulations to avoid disturbance of fish and wildlife and provide areas of quiet and solitude sought by many users of the Refuge. Any research equipment that remains in the field for the duration of the project will be clearly marked to avoid potential hazards presented to other Refuge users.

***Long-term Impacts:*** The long-term impacts of research may include injury or death to groups of wildlife or to individuals during efforts to capture samples. Continual disruption could cause expenditure of energy, decreased immunity to pathogens, nest abandonment, displacement in less than optimal habitat, and nest swamping from wave action. However, given the stipulations listed below, no or very minimal impacts will be expected in the long term. Research efforts may also discover methods that result in a reduction in impacts described above.

***Cumulative and Indirect/Secondary Impacts****:* Because continuous, long-term research will rarely be allowed at one site, long-term cumulative impacts such as poor water quality, benthic disturbances, wildlife disturbance, and/or vegetation trampling will be negligible. SUP conditions will include special conditions to ensure that impacts to wildlife and habitats are kept to a minimum and are short term.

***Impacts to Listed Species*****:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from research will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. Persons engaging in research will be required to apply for an SUP, and stipulations for reducing impacts to candidate species will be further covered by the permit. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Priority Public Uses*****:** Researchers may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or EE groups, but this conflict will be expected to be minimal.

## Public Review and Comment

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

## Determination

| | |
|---|---|
| __________ | Use is Not Compatible |
| ____X____ | Use is Compatible with the Following Stipulations |

**Stipulations Necessary to Ensure Compatibility**

This activity will only be allowed in designated areas and specific terms will be established in associated SUPs regarding designated research areas, permissible dates, conditions of research, off-road use of vehicles, and acceptable research procedures. Permit conditions are likely to change from project to project depending on study objectives. These conditions may include, but are not limited to, the following:

- If the proposed research methods will impact or potentially impact Refuge resources (habitat or wildlife), it must be demonstrated that the research is essential (i.e., critical to survival of a species; critical habitat for a species; or assessment and/or restoration after cataclysmic events) and the researcher must identify the issues in advance of the impact. Highly intrusive or manipulative research is generally not permitted in order to protect our natural resource.
- Prior to conducting investigations, researchers will submit a written study proposal with their request to obtain an SUP from the Refuge that makes specific stipulations related to when, where, and how the research will be conducted (see Description Of Use section). Managers retain the option to prohibit research on the Refuge that does not contribute to the purposes of the Refuge or the mission of the Refuge System, or that causes undue resource disturbance or harm.
- Approved research projects will be conducted under a Refuge-issued SUP, which will have additional project-specific stipulations.
- Researchers must possess all applicable state and Federal permits for the capture and possession of protected species for conducting regulated activities in wetlands and for other regulated activities.
- Research must adhere to current species protocols for data collection.
- Researchers must clearly mark posts, equipment platforms, fencing material, and other equipment left unattended in open water so as to not pose a navigation hazard to boaters. Such items shall be removed from the river as soon as practicable upon completion of the research.
- SUPs will be valid for 1 year only. Renewals will be subject to the Refuge Manager’s review of research data, status reports, compliance with the CD and permit stipulations, and permits.
- Off-road access is only allowed when soils are frozen or dry in areas where native vegetation will not be impacted, within specific boundaries.
- Research must be during hours when appropriate staff are available to monitor conduct and permit compliance.
- Inspection and washing of research equipment to decrease the spread of invasive species is required.
- Activities are allowed only where minimal impacts to wildlife may occur.
- Periodic evaluation of research projects will be held to assess if objectives are being met and ensure that resources are not being degraded.
- Regulations to ensure the safety of all participants must be followed.
- Law enforcement patrols are conducted to ensure compliance with state and Refuge regulations.
- The Refuge Manager can suspend/modify conditions/terminate on-Refuge research that is already permitted and in progress, should unacceptable impacts or issues arise or be noted.

## Justification

Research by third parties plays an integral role in Refuge management by providing information needed to manage the Refuge on a sound scientific basis. Investigations into the biological, physical, archeological, and social components of the Refuge provide a means to analyze management actions, impacts from internal and outside forces, and ongoing natural processes on the Refuge environment. Research provides scientific evidence as to whether the Refuge is functioning as intended when established by Congress.

Although these activities can result in disturbance to wildlife, these activities will occur on a small percentage of Refuge acres. There is sufficient undisturbed habitat available to Refuge wildlife for escape and cover, and wildlife populations will find sufficient food resources and resting places. The relatively limited number of individual plants and animals expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of Refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing research, scientific collecting, and survey activities to occur under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the Refuge System's mission.

## Mandatory Reevaluation Date

__09/2022__ Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

## NEPA Compliance for Refuge Use Decision

____X____ Environmental Impact Statement and Record of Decision

## References

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

ODFW. 2011. Greater sage-grouse backgrounder. Available at: http://www.dfw.state.or.us/wildlife/sagegrouse/docs/Greater_Sage_Grouse_Candiadate_species_Backgrounder.pdf [sic].

Pearl, C.A., S.K. Galvan, M.J. Adams, and B. McCreary. 2010. Columbia spotted frog (*Rana luteiventris*) in southeastern Oregon: A survey of historical localities, 2009. U.S. Geological Survey Open File Report 2010-1235. 96 pp.

Rombough, C. and J. Engler. 2010. Surveys for Columbia spotted frog (*Rana luteiventris*) at ARRA project sites, Malheur NWR. Report to USFWS from Rombough Biological. Princeton, OR. 13 pp.

**Signatures:**

Prepared by: ______________________ 1/24/13
(Signature) (Date)

Acting Refuge Manager/
Project Leader
Approval: ______________________ 1/24/13
(Signature) (Date)

**Concurrence:**

Refuge Supervisor: ______________________ 1-24-13
(Signature) (Date)

Regional Chief,
National Wildlife
Refuge System: ______________________ 1-24-13
(Signature) (Date)

# B.10 Farming Compatibility Determination

**RMIS Database Use:** Farming

**Refuge Name:** Malheur National Wildlife Refuge

**City/County and State:** Princeton/Harney, Oregon

**Establishing and Acquisition Authorities and Refuge Purposes**

- " … a Refuge and breeding ground for migratory birds and other wild life … " Executive Order 7106, dated July 19, 1935, as modified by Public Land Order 1511, dated September 24, 1957
- " … for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 U.S.C. 715d (Migratory Bird Conservation Act)
- " … for the development, advancement, management, conservation, and protection of fish and wildlife resources … " 16 U.S.C. 742f(a)(4)
- " … for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude … " 16 U.S.C. 742f(b)(1) (Fish and Wildlife Act of 1956)
- " … conservation, management, and … restoration of the fish, wildlife, and plant resources and their habitats … for the benefit of present and future generations of Americans … " 16 U.S.C. 668dd(a)(2) (National Wildlife Refuge System Administration Act)

**National Wildlife Refuge System Mission**

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the Unites States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 USC 668dd-668ee]).

**Description of Use(s)**

***Acres and Crops Grown:*** The cooperative program will include between 80 to 1,000 acres to support objectives described in the CCP using appropriate farming practices. Crops will include wheat, barley, rye, oats, or similar crops known to have wildlife forage value. Crops will generally be grown under non-irrigated or sub-irrigated conditions; however, in some years spring runoff and rainfall during the growing season are insufficient to produce a successful crop.

***Location of Use:*** The use will take place in areas deemed advantageous to target wildlife species per the goals and objectives listed in various Refuge plans. Initially, the farming program will focus on areas in the vicinity of Center Patrol Road near Refuge Headquarters north of Rattlesnake Butte.

***Timing of Use:*** Depending on the target crop, seed bed preparation and seeding will take place in late winter/early spring with associated soil amendments and herbicide being applied in spring and summer, respectively. Mowing will occur in the summer or early fall, depending on the crop. Harvesting of the crop will occur as soon as the crop has matured and ripened and before the fall hunting season.

***Equipment, Facilities and Improvements:*** To support this use, standard crop farming equipment will be used such as tractors, plows, disks, seeders, trucks, wagons, spray rigs, and combines. The cooperator will not use any on-Refuge facilities for seed or harvested grain storage. Minimal access road improvements and maintenance will be needed for farming equipment ingress/egress.

***Administration of the Use:*** Cropland management will be carried out by private parties on Refuge lands under the terms of cooperative agreement. The agreement could take the form of either a Cooperative Farming Agreement (CFA) or a Cooperative Land Management Agreement (CLMA). Under either scenario, the farmer will receive an 80 percent share of the crop and the remaining 20 percent is left in the field for wildlife. Under this scenario, approximately 950 acres of grain will be needed. The two types of cooperative agreements are described below:

- **CFA:** Within such agreements, the cooperator will provide labor, equipment, and materials and the government will provide the land base unless other arrangements are made between the Refuge Manager and cooperator(s). The resulting crop will be shared by the cooperator and the government.

- **CLMA:** The CLMA is an in-kind program, which means that both parties receive benefits from the land. In this case, the cooperator and Refuge both receive a portion of the crop, and the Service receives management actions that enhance habitat condition through activities such as weed control and prevention strategies incorporated into the program.

  The CLMA will be an annual agreement composed of: 1) objectives of the program; 2) commitment and responsibilities of each partner under the contract; 3) description and map of the area affected by the agreement; 4) details on the techniques, schedules, strategies, and methods to be used in the cooperative agreement; 5) crop or other products produced under the agreement; and 6) delineation of shares. The CLMA will be reviewed and updated annually. The CLMA will not express or describe any permanent or long-term agreement between the cooperator and the Refuge.

The cooperator (farmer) will be selected based on his or her ability to: 1) adapt and meet the changing conditions of the program; 2) apply best land management practices to selected land tracts; 3) use best management practices of an integrated pest management (IPM) plan; 4) meet the special conditions outline in the CLMA; 5) sustain an operation under potential impacts of wildlife depredation and changing habitat conditions; and 6) be economically capable of operating under the conditions of the program.

***Rationale for the Use:*** The purpose of developing a cooperative farming program is to manage high-carbohydrate autumn foraging habitat for sandhill cranes, waterfowl, and other migratory and resident wildlife species. The Refuge (together with cereal grains then grown on the Refuge) was identified as one of four autumn staging and migration stopover sites in the Greater Sandhill Crane (Central Valley Population) Pacific Flyway Plan (Pacific Flyway Council 1997). The plan noted that the Malheur fields had been used for several decades. Grain farming will support greater sandhill crane use during the fall staging period, when a large percentage of the Central Valley population uses the Refuge. The Pacific Flyway Management Plan (Pacific Flyway Council 1997) recommended up to 400 acres of cereal grain production at Malheur Refuge to provide for staging cranes. The plan also noted that autumn roosting habitat (large isolated wetlands, secure from human disturbance) should be maintained at Malheur Refuge.

This level was established with the assumption that grain farming will continue on the Refuge. Canada geese, dabbling ducks, and migratory grassland birds also benefit from grain farming since they use grain to build their fat reserves. Grain production also increases the Refuge's carrying capacity for wintering Canada geese.

An additional purpose of the program is to limit the presence of invasive species by providing a mechanical tool to set back infestations and develop a stage for the restoration of native plant communities. Farming cultivation practices such as mowing, haying, and chemical application have been recognized as viable means to control invasive plant species and discourage the proliferation of non-beneficial plants.

Over the next several years the cropland farming program will be the main instrument for implementing Objective 4j in the CCP for Malheur Refuge. This action will support the goals and objectives outlined in the CCP for Malheur Refuge and the Pacific Flyway Council Management Plan for Sandhill Cranes (Pacific Flyway Council 1997).

### Availability of Resources

Special equipment, facilities, or improvements necessary to support the use and maintenance costs are the responsibility of the cooperator with no associated expenses to the Refuge.

***Offsetting Revenues:*** Because this use aids the Refuge in specific wildlife and habitat objectives and frees up maintenance staff equipment, materials, and personnel for other projects, there is the potential for overall cost savings for Refuge management activities. Since cooperative farming could represent a cost saving to the Refuge, there will be no fee associated with the agreement. The costs of administering and managing this use under the CCP are detailed in Table B-18.

**Table B-18. Cost to Implement the Use**

| Category and Itemization | One-time Cost | Annual ($/yr) |
|---|---:|---:|
| Administration and management | $2,000 | $2,000 |
| Maintenance | $0 | $0 |
| Monitoring | $1,000 | $1,000 |
| Special equipment, facilities, or improvements | $0 | $0 |
| Offsetting revenues | $0 | $0 |

### Anticipated Impact of the Use

***Short-term Impacts:*** Farming activities in proposed areas are currently taking place by force account (conducted by Refuge staff), so the nature of the disturbance will not be significantly different. The activity may cause some degree of disturbance to wildlife, including negative impacts on fauna that are not able to emigrate off-site during soil-disturbing activities. Any hydrologic impacts will be minimal (water needs of the actual crops will be served primarily through sub-irrigation). Wind erosion will be marginalized by instituting best management practices such as crop residue management, eliminating or reducing fall cultivation practices. The sites already host significant invasive plant species and are currently being treated in cooperation with force account farming activities; thus, cultivation practices will have minimal impacts to native plant communities. With the size of the fields 50 acres or less, farming activities will have negligible effects to invertebrate, reptile, and amphibian populations and their movements. Disturbance to ground nesting birds should be minimal by delaying any mowing operations to after the nesting season.

Sandhill cranes, Canada geese, dabbling ducks, and grassland passerines benefit from grain farming since they use grain to build their fat reserves. Grain production also increases the Refuge's carrying capacity for wintering Canada geese. This activity provides for the early detection and treatment of invasive species, thereby creating a healthier environment for native plant communities. This is particularly important in areas targeted for native plant restoration.

***Long-term Impacts****:* Farming activities may deplete the soil seed bank of native species over time, but due to the fact that these areas currently contain high percentages of noxious weeds in existing seed banks, the negative impact is offset by an increased level of control of non-desirable vegetation over time.

Cultivating annual crops may alter soil structure and wind erosion may occur. Whenever possible, cooperators will seek strategies to minimize this occurrence, such as timing and manner of tilling. The acreage being converted to farming is currently being farmed by force account and consists of 0.01 percent of Refuge lands. Therefore, the impacts noted above are expected to be negligible. Because farming is already taking place on these acres, this practice will likely have a neutral impact within the structure of the program.

Positive long-term benefits result in providing food/habitat for birds during critical migration period and minimizing crop depredation on neighboring lands.

***Cumulative Impacts:*** Farming will only be practiced on lands that have been previously farmed. The management direction is not expected to incrementally add to any other actions that are planned or currently occurring in the area. The proposal benefits numerous wildlife species. This activity will not significantly impact other Refuge activities or actions and will not affect Refuge-wide or nationwide wildlife populations.

***Impacts to Listed Species*****:** There are no listed or endangered species on the Refuge. Greater sage-grouse (*Centrocercus urophasianus*) and the Great Basin Columbia spotted frog (*Rana luteiventris*) are designated as Federal candidate species for listing under the Endangered Species Act. Incidental post-breeding observations of sage-grouse have been made in recent years in the southeast portion of the Blitzen Valley. Spotted frogs have been documented in limited areas on the Refuge (Engle 2001; Pearl et al. 2010; Rombough and Engler 2010; ODFW 2011). But it is unclear at this time if the Refuge population is part of the Great Basin distinct population, which is the Federal candidate species, or if they belong to the Oregon population.

Although the Refuge has occurrences of these candidate species, it is anticipated that impacts from farming will be negligible and will not be expected to increase disturbance to candidate species any more than non-commercial uses. If uses result in unacceptable adverse effects to candidate species or habitats, the Refuge will impose restrictions to mitigate disturbance.

***Impacts to Priority Public Uses*****:** During operations, farming cooperators may occasionally flush wildlife from areas used by hunters, wildlife observers, photographers, anglers, or EE groups, but this conflict will be expected to be minimal. The presence of the crops, which may attract a variety of species, may support hunting, wildlife observation, wildlife photography, environmental education, and interpretation

**Public Review and Comment**

Various opportunities were provided for the public to engage in the CCP planning process. Appendix J details public involvement undertaken during the development of the CCP.

**Determination**

__________ Use is Not Compatible
____X____ Use is Compatible with the Following Stipulations

**Stipulations Necessary to Ensure Compatibility**

- This activity will be conducted under an annual CLMA or CFA specifying roles and responsibilities of the Service and each cooperator.
- Cooperators will only apply herbicides and fertilizers with prior Refuge approval.
- All weed control strategies and associated herbicides must be approved by the FWS and Pesticide Use Proposal procedures.
- Seeds must be certified weed free.
- Equipment must be thoroughly cleansed before entering the Refuge to prevent the introduction of new weed species or populations to the Refuge.

**Justification**

Crop production has been shown to provide a cost-effective means of providing high-quality food source for target wildlife species at the Refuge. Specifically, crop production provides high-energy grain and forage crops, as well as green forage crops that are highly digestible and easily accessible. Wintering and migrating waterfowl and cranes readily use agricultural crop fields to help meet their energy needs. The use of a cooperator to produce grain crops may facilitate the management of croplands by increasing the reliability of a successful crop.

In addition, the food support crop production provides for target wildlife species and indirectly supports several wildlife-dependent recreational activities such as wildlife observation and photography.

By conducting the crop production program under the practices and stipulations described above, it is anticipated that wildlife species that could be adversely affected will find sufficient food resources and resting places so their abundance and use will not be measurably lessened on the Refuge. Additionally, it is anticipated that monitoring, as needed, will prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats.

The cooperative farming program will contribute to achieving Refuge purposes and goals as identified in the 1990 Blitzen Valley Management Plan (Rule et al. 1990) and the Refuge System mission by providing valuable foraging areas and conditions for sandhill cranes, waterfowl, and other wildlife. It also benefits other Refuge management actions by providing weed control and other habitat-maintenance functions.

The combination of management practices and stipulations identified above will ensure that crop production contributes to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the Refuge. As a result, crop production contributes to achieving Refuge purposes; contributes to the mission of the National Wildlife Refuge System; and helps maintain the biological integrity, diversity, and environmental health of the Refuge.

**Mandatory Reevaluation Date**

09/2022 Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

**NEPA Compliance for Refuge Use Decision**

X Environmental Impact Statement and Record of Decision

**References**

Engle, J.C. 2001. Population biology and natural history of Columbia spotted frogs (*Rana luteiventris*) in the Owyhee Uplands of southwest Idaho: implications for monitoring and management. M.S. thesis. Boise State University, Boise, ID. 66 pages. Available at: http://www.fws.gov/oregonfwo/Species/Data/ColumbiaSpottedFrog/.

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**Signatures:**

| | | |
|---|---|---|
| Prepared by: | (Signature) | 1/24/13 (Date) |
| Acting Refuge Manager/ Project Leader Approval: | (Signature) | 1/24/13 (Date) |

**Concurrence:**

| | | |
|---|---|---|
| Refuge Supervisor: | (Signature) | 1-24-13 (Date) |
| Regional Chief, National Wildlife Refuge System: | (Signature) | 1-24-13 (Date) |

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Full moon over East Canal
©Barbara Wheeler

# Appendix C
## Implementation


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Appropriate Use Findings

Appendix B
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Appendix C
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# C.1 Overview

Implementation of the management direction of the Comprehensive Conservation Plan (CCP) will require increased staffing and funding levels to successfully accomplish the planned actions, which will depend upon additional Congressional allocations, partnerships, and grants. There are no guarantees that additional federal funds will be made available to implement any of these projects. We will seek to develop innovative and committed partnerships with a variety of public and private entities. The identified activities and projects will be implemented as funds become available.

This Refuge has one of the largest infrastructures in the National Wildlife Refuge System, with approximately 200 miles of public roads; 2,000 miles of waterways/dikes; 5 dams; 1,000 water control structures; 6 automated fish screens; 27 administrative, 7 quarters, and 25 visitor services facilities; 4 historic building sites; and a large fleet of heavy/light vehicles and equipment. This extensive infrastructure requires a high degree of routine maintenance/repair to efficiently and effectively support the various Refuge programs and maintain tens of thousands of acres of wetlands, 30 miles of rivers/creeks, and 16,000 acres of irrigated meadow. At the current staffing level, a vast majority of routine maintenance/repair needs are addressed reactively. Additional staff and/or funding are needed to proactively address the maintenance/repair backlog and move this Refuge forward to its full ecological potential and ensure biological integrity.

The CCP describes activities and projects to be implemented over the next 15 years. Many of these projects are included in the Refuge Operational Needs System (RONS-new staff), or Service Asset Maintenance and Management System (SAMMS-deferred maintenance projects), which are used to request funding from Congress. Currently, a very large backlog of maintenance needs exists for the Refuge. In 2011, the deferred maintenance backlog for the Refuge was approximately $48 million, with more projects needing to be added annually. An attempt to reduce this backlog needs to be addressed and is included here in the analysis of staffing and funding needs. Prioritized staffing needs identified in the RONS will be necessary to implement the CCP to meet Refuge goals, objectives, and legal mandates.

Annual revenue-sharing payments, associated with the Refuge in Harney County, may continue. Total payments made in 2011 were $75,842.00 to Harney County.

Inventory and monitoring activities will be conducted on new and existing projects and activities to document changes across time, habitat conditions, and responses to management practices. The adaptive management process will be employed to address new information that may show the need for management adjustments, confirm existing strategies, or identify additional information needs. Based on the best information available at the time, the Refuge with feedback from partners and interested parties will make decisions for future management actions.

As with the sharing/learning aspects of adaptive management, the Refuge recognizes the importance for transparency of decision making. The Refuge is committed to bringing together interested parties to assist with evaluation of available information and consultation about management options and their implications prior to course-changing decisions being made. This process does not diminish the Refuge’s legal authority to make decisions but, rather, serves to enhance the decision-making process by enabling the Refuge to approach issues from multiple perspectives, thereby finding creative solutions to complex challenges.

# C.2 Costs to Implement the CCP

The following sections detail both one-time and recurring costs for needed projects. One-time costs reflect the initial costs associated with a project, whether it is purchase of equipment, contracting services, construction, a research project, etc. Recurring costs reflect the future operational and maintenance costs associated with the project. The following tables primarily document projects with a physically visible, track-able, “on-the-ground” component, such as structures, habitat restoration, research, and monitoring and surveys. The scope and costs for “administrative” activities such as memoranda of understanding (MOUs), reporting, and establishment of partnerships are difficult to estimate in advance and thus are not accounted for in the tables below.

## C.2.1 One-time Costs

One-time costs are project costs that have a start-up cost associated with them, such as purchasing a new vehicle for wildlife and habitat monitoring, or designing and installing an interpretive sign. Some are full project costs for projects that can be completed in 3 years or less. One-time costs can include the cost of temporary or term salary associated with a short-term project. Salary for existing and new positions, and operational costs, are reflected in operational (or recurring) costs.

Funds for one-time costs will be sought through increases in Refuge base funding, special project funds, and grants. Projects listed in Table C-2 show one-time costs, such as those associated with building and facility needs including offices, public use facilities, road improvements, and new signs. One-time costs are also associated with projects such as habitat restoration, invasive plant and animal control, and research. New research projects, because of their short-term nature, are considered one-time projects and include costs of contracting services or hiring temporary staff for the short-term project. Some project costs are taken from RONS or SAMMS proposals; others are not yet in any project database and their costs have been estimated, particularly if the scope of the project is unknown at this time due to lack of baseline data.

## C.2.2 Annual Operational (Recurring) Costs

Operational costs reflect Refuge spending of base funds allocated each year. These are also known as recurring costs and are usually associated with day-to-day operations and projects that last longer than 3 years. Operational costs use base funding in Service fund code 1260.

Table C-1 highlights the current and future staff needed to accomplish the activities forecast in the CCP.

Table C-2 highlights projected one-time and recurring costs for new or expanded visitor service opportunities and facilities, aquatic and terrestrial habitat restoration, conservation activities, and inventory and monitoring needs. This table includes such things as implementation and operational expenditures such as supplies, materials, utilities, and maintenance costs.

***Maintenance Costs:*** The maintenance need over the next 15 years is defined as funds needed to repair or replace buildings, equipment, and facilities. Maintenance includes preventative maintenance; cyclic maintenance; repairs; replacement of parts, components, or items of equipment; adjustments, lubrication, and cleaning (non-janitorial) of equipment; painting; resurfacing; rehabilitation; special safety inspections; and other actions that ensure continuing service and prevent breakdown. Maintenance costs include the maintenance "backlog"—maintenance needs that have come due but are as yet unfunded, as well as the increased maintenance need associated with new facilities, infrastructure needing updating or rehabilitation, moving to a carbon negative status, and employing facility greening measures.

The facilities associated with the Refuge that require maintenance include trails, interpretive panels, regulatory signs, roads, water delivery system, and structures. Major equipment includes airboats, vehicles, heavy equipment, firefighting equipment, all-terrain vehicles (ATVs), and utility terrain vehicle UTVs.

***Staffing:*** Table C-1 illustrates the staffing costs. One column shows the current estimated expenditure on the Refuge, in FY 2011 dollars. The next column reflects costs associated with increased staffing needs under the CCP.

### Table C-1. Current and Future Staffing

| Current Staff Positions | Series and Grade[1] | Annual Salary Cost | Expenditure Under Current Management | Expenditure Under Future Management |
|---|---|---|---|---|
| Wildlife Refuge Manager | GS-0485-14 | 138,330 | 138,330 | 138,330 |
| Wildlife Refuge Manager | GS-0485-13 | 132,270 | 132,270 | 132,270 |
| Wildlife Biologist | GS-0486-12 | 97,660 | 97,660 | 97,660 |
| Fish Biologist | GS-0482-11 | 93,000 | 93,000 | 93,000 |
| Archaeologist | GS-0193-11 | 96,410 | 96,410 | 96,410 |
| Ecologist | GS-0408-11 | 87,240 | 87,240 | 87,240 |
| Park Ranger | GS-0025-11 | 93,150 | 93,150 | 93,150 |
| Fire Management Officer | GS-0401-11 | 94,290 | 94,290 | 94,290 |
| Park Ranger (LEO) | GL-0025-9 | 88,660 | 88,660 | 88,660 |
| Prescribed Fire Specialist | GS-0455-9 | 40,000 | 40,000 | 40,000 |
| Administrative Officer | GS-0341-9 | 71,680 | 71,680 | 71,680 |
| Supervisory Range Technician | GS-0462-8 | 71,740 | 71,740 | 71,740 |
| Office Assistant | GS-0303-6 | 49,340 | 49,340 | 49,340 |
| Forestry Technician | GS-0462-5 | 50,270 | 50,270 | 50,270 |
| Range Technician | GS-0455-5 | 14,930 | 14,930 | 14,930 |
| Biological Technician (fisheries) | GS-0404-4 | 27,000 | 27,000 | 27,000 |
| Forestry Aide Fire | GS-0462-3 | 13,910 | 13,910 | 13,910 |
| Range Technician | GS-0455-3 | 15,410 | 15,410 | 15,410 |
| Supervisory Engineering Equipment Operator | WS-5716-9 | 97,480 | 97,480 | 97,480 |
| Engineering Equipment Operator | WG-5716-10 | 77,860 | 77,860 | 77,860 |
| Engineering Equipment Operator | WG-5716-10 | 78,640 | 78,640 | 78,640 |
| Engineering Equipment Operator | WG-5716-10 | 78,680 | 78,680 | 78,680 |
| Maintenance Mechanic | WG-4749-9 | 70,600 | 70,600 | 70,600 |
| Engineering Equipment Operator | WG-5716-8 | 61,910 | 61,910 | 61,910 |
| **Total Annual Cost for Current Staff** | | **1,740,460** | **1,740,460** | **1,740,460** |

| Future Staff Positions in the Refuge Operational Needs System (RONS) + Project # and 2008 Ultimate Organizational Chart | Series and Grade | Annual Salary Cost | Current Management | Future Management |
|---|---|---|---|---|
| Geographic Information System Specialist, FY08-5019 | GS-0150-11 | 104,480 | | 104,480 |
| Natural Resource Specialist, FY08-5005 | GS-0401-11 | 104,480 | | 104,480 |
| Private Lands Biologist, FY08-5016 | GS-0401-11 | 104,480 | | 104,480 |
| Refuge Operations Specialist, FY08-5013 | GS-0485-9 | 86,360 | | 86,360 |
| Park Ranger (Volunteer Coordinator), FY08-5008 | GS-0025-9 | 86,360 | | 86,360 |
| Park Ranger (Interpretive), FY10-1303 | GS-0025-7 | 70,600 | | 70,600 |
| Range Technician, FY08-5004 | GS-0455-7 | 70,600 | | 70,600 |
| Hydrological Technician, FY08-5007 | GS-1317-7 | 70,600 | | 70,600 |
| Biological Technician (Habitat), FY08-5018 | GS-0404-6 | 63,530 | | 63,530 |
| Biological Technician (Facilities), FY08-5015 | GS-0404-6 | 63,530 | | 63,530 |
| Maintenance Mechanic, FY08-5009 | WS-4749-10 | 121,970 | | 121,970 |
| Engineering Equipment Operator, FY08-5017 | WG-5716-8 | 82,190 | | 82,190 |
| Engineering Equipment Operator, FY08-5003 | WG-5716-8 | 82,190 | | 82,190 |
| Maintenance Mechanic, FY08-5006 | WG-4749-8 | 82,190 | | 82,190 |
| Maintenance Worker, FY08-5011 | WG-4749-6 | 70,490 | | 70,490 |
| Park Ranger (Law Enforcement), FY10-2173 | GL-0025-11 | 80,370 | | 80,370 |
| Park Ranger (Law Enforcement), FY10-2174 | GL-0025-9 | 68,640 | | |
| **Total Annual Cost for Future Staff** | | | | **1,344,420** |
| **Grand Totals** | | | | **3,084,880** |

[1]GS/GL: General Schedule, Federal Employee, WG/WS: Wage Grade Scale, Federal Employee

Costs are based on FY 2011 Full-Time Equivalent (FTE) utilization plan for the Refuge and the Office of Personnel Management (OPM) General Schedule FY 2011 plus 40 percent benefits. For the proposed positions, the cost is the grade level at step one plus 40 percent for benefits.

Table C-1 illustrates an increase of 16.0 FTE staff positions over the current staffing level for the management direction. At the current staffing level, action items that need immediate attention can be addressed, but the Refuge does not have the capacity to be proactive in addressing items before they reach the critical threshold. To have the Refuge reach its full potential, it needs additional staff to move its operational level from reactive to proactive.

The **Geographic Information System (GIS) Specialist** position is needed to improve and build the capacity of the aquatic health and habitat management programs by coordinating the development of needed resource geospatial databases, including design, data collection, data storage, and resource data implementation. The GIS information will enable the Refuge to effectively track climate change, improve inventory and monitoring data, communicate geospatial information, and enhance decision making. Geospatial information is critical to effectively implementing the actions outlined in this plan. RONS Project No. FY08-5019

The **Natural Resources Specialist** position is needed to develop and implement CCP step-down management plans, compatibility determinations, habitat management plans, environmental assessments, environmental management system protocols, and other strategic habitat conservation plans. RONS Project No. FY08-5005

The **Private Lands Biologist** position is needed to develop the necessary private landowner relationships to address the variety of natural resources issues impacting Harney County, such as watershed connectivity, aquatic health, fish passage/screening, and migratory bird habitat conservation. RONS Project No. FY08-5016

The **Refuge Operations Specialist** is needed to conduct environmental compliance, safety programs, permitting, infrastructure “greening” activities, sustainable practices, RONS input, SAMMS input, database management, and facility maintenance/repair planning activities. RONS Project No. FY08-5013

**Park Rangers (4)** are needed for the following:

1. The **Park Ranger** will serve as the much-needed volunteer coordinator. He/she will recruit, coordinate, orient, train, and support volunteers for a variety of Refuge programs such as visitor services, maintenance, administration, and fish/wildlife management. This position is critical for the Refuge to continue moving forward with citizen science opportunities for inventory/monitoring, visitor contact/bookstore operations, special events assistance, and visitor services programming. RONS Project No. FY08-5008

2. The **Park Ranger** will assist the visitor services manager in providing high-quality wildlife-dependent recreational programming for the visiting public, schools, special events, and organized groups. The position will also assist with visitor services program assessment, social media development, docent training, and event planning. RONS Project No. FY10-1303

3. The **Park Ranger, Law Enforcement Officer** will assist in protecting wildlife, lands, facilities, employees, and the general public. This position will serve as the liaison for canoe/kayak tours of Malheur Lake. RONS Project No. FY10-2173

4. The **Park Ranger, Law Enforcement Officer** will assist in protecting wildlife, lands, facilities, employees, and the general public. RONS Project No. FY10-2174

The **Range Technician** will assist with livestock-related issues, field and geospatial data collection, plant community monitoring and enhancement, the development of cooperative land management agreements, invasive species control, boundary fence inspection and repair, and coordinating with the haying/grazing program permittees. RONS Project No. FY08-5004

**Biological Technicians (2)** are needed for the following:

1. The **Biological Technician** will be responsible for mowing the hundreds of miles of dike tops and road ways and removing beaver/muskrat debris from water control structures and dams. RONS Project No. FY08-5015

2. The **Biological Technician** will assist with aquatic health and fisheries programs, biological inventory and monitoring programs, and other habitat-management activities. RONS Project No. FY08-5018

The **Hydrological Technician** will collect the necessary water flow data to protect Refuge water rights, enabling the Refuge to accurately meet legal requirements critical to protecting water rights. RONS Project No. FY08-5007

**Engineering Equipment Operators (2)** will be responsible for:

1. The **Engineering Equipment Operator** will meet the needs of an increased maintenance program by assisting with the maintenance/repair of the water delivery system, roads, dikes, and habitat enhancement projects. RONS Project No. FY08-5017

2. The **Engineering Equipment Operator** will meet the needs of an increased maintenance program by assisting with the maintenance/repair of the water delivery system, roads, dikes, and habitat enhancement projects. RONS Project No. FY08-5003

**Maintenance Mechanics (2)** will be responsible for:

1. The **Maintenance Mechanic, Work Leader** will supervise facility maintenance to ensure the necessary level of coordination, administration, and workforce planning is in place for an efficient and effective maintenance program. RONS Project No. FY08-5009

2. The **Maintenance Mechanic** will maintain/repair facilities' infrastructure. RONS Project No. FY08-5004

The **Maintenance Worker** will assist with the maintenance of facilities and infrastructure, health and safety program, grounds keeping, and trail and sign maintenance. RONS Project No. FY08-5011

## C.2.3 Partnership Opportunities

Partnerships are critically important to the implementation of this plan, which is reflected in Chapter 2's goals, objectives, and strategies. The Refuge's ecological significance, reputation for being a leader in field research, and location facilitate many opportunities for partnerships. Current and past partners include federal and state agencies, tribes, non-governmental organizations, volunteers, and individuals.

Coordinated partnership efforts will focus on habitat restoration, land protection, environmental education, fish and wildlife monitoring, outreach, and quality wildlife-dependent recreation. Refuge staff will work to strengthen existing partnerships and will actively look for new partnerships to assist in achieving the goals, objectives, and strategies in this CCP/WSP.

This is a general list of partners we have established working relationships with through past efforts or in the formulation of this collaborative CCP. These partners support this plan's vision and have committed to working with the Refuge to implement the plan's prescribed actions and activities to ensure programmatic integrity for biological, visitor services, sustainable practices, and cultural resource programs. For a complete list of CCP collaborators and partners, see Appendix I.

- Burns Paiute Tribe
- Audubon Society of Portland and other Audubon chapters
- Malheur Wildlife Associates
- Bureau of Land Management

- Ducks Unlimited
- Eastern Oregon Agriculture Research Station
- Harney County Chamber of Commerce
- Harney County Historical Society
- Harney County Soil and Water Conservation District
- Harney County Watershed Council
- High Desert Partnership
- Intermountain Joint Venture
- The Nature Conservancy
- Natural Resources Conservation Service
- Oregon Defenders of Wildlife
- Oregon Department of Fish and Wildlife
- Oregon Joint Venture
- Oregon Natural Desert Association
- Private landowners
- U.S. Geological Survey
- U.S. Forest Service
- U.S. Army Corps of Engineers
- Universities (University of Wisconsin-River Falls, University of Minnesota, Oregon State University, and Iowa State University)
- Wetlands Conservancy
- Private citizens

**Table C-2. Budget Summary for Implementation and Inventory and Monitoring (I&M) Activities (Wildlife and Habitat, Sustainable Practices Programs)**

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| **Goal 1. Lacustrine** | | | | | | | | | |
| 1a | Aquatic: I&M | Conduct baseline inventories of aquatic vertebrates/invertebrates to guide future management actions | Fish assemblage and Tui Chub production (includes riverine) (each 3 years) | 3 | 3,000 | | VH | 500 | x |
| | | | Macroinvertebrate assemblage | | | 16,000 | VH | 200 | x |
| | | | Native mussel distribution | 1 | 500 | | M | 300 | x |
| | | | Immigration, emigration, mortality, spawning, and juvenile rearing (see RONS) | 3 | | 500,000 | VH | 500 | x |
| | Aquatic: Research | Surveys, inventories, and assessments pre- and post-carp control aquatic habitats | Water quality monitoring (turbidity, etc.) | 1 | 3,000 | 1,000 | VH | 1,500 | x |
| | | | Carp population dynamics (age and growth) | | | 125,000 | VH | 10,000 | x |
| | | Research carp population dynamics and movements | Carp mark and recapture | | | 50,000 | VH | | x |
| | | | Carp telemetry | Initial 5 | 48,000 | 54,000 | VH | 24,000 | 78,000 |
| | Aquatic: Management Action | Conduct research to investigate and implement aggressive control strategies | Statistical analysis and model construction | | | 206,000 | VH | - | x |
| | | | Rotenone | | | 200,000 | M | | |
| | | | Attractants, repellents | | | 47,000 | H | 12,000 | 35,000 |
| | | | Barriers, traps, and screens | | | 300,000 | VH | - | x |
| | | | Harvesting | | | 900,000 | H | - | x |
| | Aquatic: Habit | Enhance emergent | Wind breaks and carp exclosures | 1 | 21,400 | 5,000 | VH | - | x |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| | Management | vegetation within the lake system | to promote colonization/expansion of emergent/submergent vegetation | | | | | | |
| | | Understand relationships among water chemistry, lake levels, and habitat/migratory bird responses in lakes | Development of lacustrine section of State-and-Transition Model | 1 | 3,200 | | VH | - | x |
| | | Develop a model to predict habitat response to carp control | Establishment of an Aquatic Health Assessment and Implementation Plan for the Malheur Wetlands; collaboration with Oregon State University (OSU), Harney County Soil and Water Conservation District (HCSWCD), Ducks Unlimited (DU) | | | 422,000 | VH | - | x |
| | Habitat: I&M | Lacustrine emergent trend (cost covered in telemetry) | | 1 | - | - | H | - | x |
| | | Lacustrine submergent trend | | 1 | 800 | | H | - | x |
| | Habitat: Management | Use Integrated Pest Management (IPM) strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | 1 | 25,000 | | M | - | x |
| | Wildlife: I&M | Conduct baseline/ongoing inventories of wildlife to guide future management actions | Waterfowl production survey (also includes 4a, 4b, 4c, and 4d) | 1 | 900 | 3,000 | H | x | x |
| | | | Colonial waterbird production survey | 1 | 300 | 600 | H | x | x |
| | | | Muskrat lodge count | 1 | 1,000 | | L | | x |
| **Goal 2. Riverine** | | | | | | | | | |
| 2a | Aquatic: | Screens, barriers, fish wheel, weirs, passage, and traps | | each | 10,000 | 800,000 | VH | - | x |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| | Management | Initiate small in-stream strategic pilot projects in tributaries or reaches of the Blitzen River in response to assessment results | | each | | 500,000 | L in 2, H in 3 | | x |
| | | Dikes, water control structures, and roads | | 1 | 500,000 | 500,000 | VH | x | x |
| | Habitat: I&M | Wetland/riverine strategic plan and associated studies and National Environmental Policy Act (NEPA) | Assorted studies, inventories, pilot projects, and studies identified by Utah State Report | | | 3,000,000 | L in 2, H in 3 | | x |
| | | | Floodplain topography (Lidar, other methods) | | | 1,000,000 | L in 2, H in 3 | - | x |
| | | | Cultural resources inventory and mitigation | | | 2,000,000 | L in 2, H in 3 | | x |
| | Administration | Adjudicate riverine water rights, continued gauging of flows (water supply, potential climate change, channel and floodplain change) | | 1 | | 5,000 | VH | x | x |
| 2b | Aquatic: I&M | Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. | | 5 | 30,000 | | VH | x | x |
| | | Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. | | each study | 30,000 | | VH | x | x |
| | Aquatic: Research | Conduct research to understand carp population dynamics and seasonal movements. | | 1 | | 30,000 | VH | x | x |
| | | Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. | | 2 | 800 | 1,000 | VH | x | x |
| **Goal 3. Woody Riparian** | | | | | | | | | |
| | Habitat: I&M | Woody riparian trend (validation monitoring of objective) | | 5 | 500 | | M | | x |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Manage ment | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| 3a | Habitat: Management | Active planting or seeding appropriate native species | Propagating and planting shrub species | each | 2,000 | 30,000 | M | | x |
| | | Exclude livestock from riparian habitats | Construct/ maintain 4-strand fence | 1 | 5,000 | 40,000 | VH | x | x |
| | | Promote riparian shrub health | Use of disturbance (fire) (~5% of habitat total) | | | 22,000 | H | | x |
| | | Permanently exclude grazing from streamside corridors | Construct fence | 1 | 1,500 | 60,000 | VH | x | x |
| | | Manipulate soil moisture in riparian areas outside of the naturally occurring floodplain | Maintain irrigation infrastructure (folded into costs in 4a) | | | | H | | |
| | | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) (200 acre/year @ $80.00/acre) | | 1 | 16,000 | | H | x | x |
| | Wildlife: I&M | Woodland bird survey (equipment costs covered in other survey costs) | | 1 | 400 | | M | | x |
| **Goal 4. Wet Meadow** | | | | | | | | | |
| 4a | Aquatic: I&M | Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. | | 5 | 30,000 | | VH | x | x |
| | | Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. | | each study | 30,000 | | VH | x | x |
| | Aquatic: Research | Conduct research to understand carp population dynamics and seasonal movements. | | 1 | | 30,000 | VH | x | x |
| | | Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses | | 2 | 800 | 1,000 | VH | x | x |

| Objective | Program | Strategy / Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|
| | | in this habitat type. | | | | | | |
| | Aquatic Habitat: Management | Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type. | 1 | | 50,000 | VH | x | x |
| | Habitat: I&M | Wet meadow trend (validation monitoring of objective) | 1 | 36,000 | | H | | x |
| | Habitat: Research | Plant community–specific research and associated wildlife response | 1 | 36,000 | | H | | x |
| | Habitat: Management | Water delivery and management through maintenance or enhancement of infrastructure (e.g., delivery ditches, water control structures) | 1 | 350,000 | | H | x | x |
| | | Modify dikes, ditches, and other infrastructure as needed to reclaim acres lost to cattail encroachment (e.g., Northwest big sagebrush field). | | 250,000 | M | | x | x |
| | | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants | 1 | 350,000 | | H | x | x |
| | | Prescribed fire, discing, herbicides, and mowing to reduce extensive emergent cover | 1 | 10,000 | | H | | x |
| | Wildlife: I&M | Migratory bird survey (includes 4b–j as well) | 1 | 10,000 | | H | x | x |
| | | Passerine bird survey (includes 4b, 4d–i as well) | 1 | 10,000 | | H | x | x |
| | | Waterfowl/waterbird production survey (includes 4b–c as well) | 1 | 10,000 | | H | x | x |
| **Goal 4. Emergent Marsh** | | | | | | | | |
| 4b | Aquatic: I&M | Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. | 5 | 30,000 | | VH | x | x |
| | | Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. | each study | 30,000 | | VH | x | x |

| Objective | Program | Strategy / Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|
| | Aquatic: Research | Conduct research to understand carp population dynamics and seasonal movements. | 1 | | 30,000 | VH | x | x |
| | | Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. | 2 | 800 | 1,000 | VH | x | x |
| | Aquatic Habitat: Management | Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type. | 1 | | 50,000 | VH | x | x |
| | Habitat: I&M | Emergent marsh trend | 1 | 2,000 | | H | | x |
| | Habitat: Research | Experiment with grazing as a tool in monotypic stands of emergent cover to set back succession | | Covered in 4a research | | H | | x |
| | Habitat: Management | Prescribed fire to remove extensive emergent cover | 2 | 192,000 | | M | x | x |
| | | Discing to remove extensive emergent cover | 1 | 400 | | M | | x |
| | | Mowing to remove extensive emergent cover | 1 | 400 | | M | | x |
| | | Herbicide applications to control emergent plants | 5 | 45,000 | | M | x | x |
| | | Flood up and drawdowns (water level management) | | Covered in 4a Management | | H | | |
| | | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | 4 | 20,000 | | M | x | x |
| **Goal 4. Palustrine Open Water/Emergent** | | | | | | | | |
| 4c | Aquatic: I&M | Conduct baseline inventories of fish, wildlife, and vegetation to guide future management actions. | 5 | 30,000 | | VH | x | x |
| | | Conduct surveys, inventories, and assessments of pre- and post-carp control effects on aquatic habitats. | each study | 30,000 | | VH | x | x |
| | Aquatic: | Conduct research to understand carp population dynamics | 1 | | 30,000 | VH | x | x |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| | Research | and seasonal movements. | | | | | | | |
| | | Conduct research to understand relationships among water chemistry, water levels, and habitat/migratory bird responses in this habitat type. | | 2 | 800 | 1,000 | VH | x | x |
| | Aquatic Habitat: Management | Develop a model to predict habitat response based upon changes in biotic and abiotic factors in the habitat type. | | 1 | | 50,000 | VH | x | x |
| | Habitat: I&M | Palustrine Open Water/Emergent Trend | | 1 | 400 | | H | | x |
| | Habitat: Management | Water delivery and management through maintenance or enhancement of infrastructure (e.g., delivery ditches, water control structures). Needs associated with spotted frog refugia will be addressed in identified areas (e.g., East Canal, Five Mile Spring within West Canal, etc.) | | | Covered in 4a Management | | H | x | x |
| | | Prescribed fire to remove extensive emergent cover | | 5 | 3,600 | | M | x | x |
| | | Discing to remove extensive emergent cover | | 1 | 400 | | M | x | x |
| | | Mowing to remove extensive emergent cover | | 1 | 400 | | M | x | x |
| | | Flood up and drawdowns (water level management) | | | Covered in 4a Management | | H | | |
| | | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | | Covered in 4a Management | | M | | |
| **Goal 4. Dry Meadow** | | | | | | | | | |
| 4d | Habitat: I&M | Dry meadow trend | | 1 | 400 | | M | x | x |
| | Habitat: Management | Use agricultural practices (e.g., haying, grazing, etc.) to maintain/enhance fields | | | Covered in 4a Management | | M | | |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| | | Use burning regimes where feasible | | 3 | 12,000 | | M | x | x |
| | | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | | Covered in 4a Management | | M | | |
| | Wildlife: I&M | Grassland breeding bird survey | | 1 | 600 | | H | | x |
| **Goal 4. Salt Desert Scrub** | | | | | | | | | |
| 4e | Habitat: I&M | Salt desert scrub trend | | 1 | 400 | | L | | x |
| | Habitat: Management | Protect existing sensitive sites with microbiotic crusts | | 1 | 10,000 | | M | x | x |
| | | Use of prescribed fire depending on site-specific factors | | 5 | 20,000 | | L | | x |
| | | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | | Covered in 4a Management | | L | | |
| | Wildlife: I&M | Passerine breeding bird survey (includes 4f–h) | | 1 | 700 | | M | | x |
| **Goal 4. Sagebrush Lowlands** | | | | | | | | | |
| 4f | Habitat: I&M | Sagebrush lowland trend | | 1 | 400 | | M | | x |
| | Habitat: Management | Prescribed fire | | | | 15,000 | M | | x |
| | | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | | Covered in 4a Management | | M | | |
| **Goal 4. Sagebrush Steppe** | | | | | | | | | |
| 4g | Habitat: I&M | Sagebrush steppe trend | | 1 | 400 | | M | | x |
| | Habitat: Management | Add diversity to crested wheatgrass monocultures using best science practices (i.e., Krumbo Unit research from Eastern Oregon Agricultural Research Station) | | ? | ? | ? | M | x | x |
| | | Use IPM strategies including chemical, mechanical, | | | Covered in | | L | | |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Manage ment | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| | | horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | | 4a Management | | | | |
| **Goal 4. Dune** | | | | | | | | | |
| 4h | Habitat: I&M | Dune trend | | 1 | 400 | | L | | x |
| | Habitat: Management | Protect dune areas from disturbance | | | Covered in 4e Management | | M | | |
| | | Use IPM strategies (chemical, mechanical, horticultural, and/or biological control) for invasive plants (Appendix G) | | | Covered in 4a Management | | L | | |
| **Goal 4. Playa** | | | | | | | | | |
| 4i | Habitat: I&M | Playa trend | | 1 | 200 | | L | | x |
| | Habitat: Management | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | | Covered in 4a Management | | L | | |
| | Wildlife: I&M | Shorebird breeding survey | | 1 | 400 | | H | x | x |
| **Goal 4. Crop Land** | | | | | | | | | |
| 4j | Habitat: I&M | Crop land trend | | 1 | 200 | | L | | x |
| | Habitat: Management | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive plants (see Appendix G) | | | Covered in 4a Management | | L | | |
| **Goal 5. Cold and Hot Springs** | | | | | | | | | |
| 5a | Aquatic: I&M | Spotted frog population | | | Covered in 1a | | VH | x | x |
| | Aquatic: Research | Carp control | | | Covered in Goals 1 and | | VH | | x |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2 | | | | |
| | Aquatic: Management | Aquatic assemblages | | 5 | 30,000 | | H | | x |
| | Habitat: I&M | Cold and hot spring trends | | 1 | 400 | | M | | x |
| | Habitat: Management | Use IPM strategies including chemical, mechanical, horticultural, and biological control agents to control/eradicate invasive species (see Appendix G) | | 1 | 1,000 | | VH | x | x |
| | Administration | Adjudicate ground water rights | | 1 | | 5,000 | VH | | x |
| **Goal 5. Cliff, Rimrock, and Lava Flows** | | | | | | | | | |
| 5b | Habitat: Management | Continued use of existing Refuge gravel/rock pits. Upon closure of gravel rock pits remediation will occur | | | | | L | x | x |
| | Administration | Continue to restrict access to rimrock areas for the benefit of wildlife | | 1 | 100 | | L | x | x |
| | Wildlife: I&M | Raptor wintering and nesting surveys | | 1 | 400 | | M | x | x |
| **Goal 13. Assessments of Hydrological Features** | | | | | | | | | |
| 13 b | | Water allocation (water budget, habitat use, and availability surveys) | | 1 | 5,000 | 130,000 | VH | | x |
| **Goal 13. Scientific Assessments** | | | | | | | | | |
| 13 e | | Assess avian predation on carp | | | | 200,000 | VH | | x |
| | | Assess carp control study areas pre- and post-treatment | | each study | | 30,000 | VH | x | x |
| **Goal 14. Sustainability** | | | | | | | | | |
| 14 a | | Establish Refuge program benchmarks for sustainability-based practices | | | | 25,000 | H | | x |
| | | Provide staff training for the implementation of | | 1 | 1,000 | | H | | x |

| Objective | Program | Strategy | Project/Methodology | Recurrence interval | Recurring Cost | One-time Cost | Priority[1] | Current Management | Future Management |
|---|---|---|---|---|---|---|---|---|---|
| | | sustainability-based principles and practices | | | | | | | |
| | | Complete energy audits, carbon footprint audits, and biomass-based carbon sequestration assessments | | 5 | 25,000 | 250,000 | H | | x |
| | | Use GIS technologies for benchmarking and tracking Environmental Management Plan parameters and climate change across program areas | | 1 | 5,000 | 50,000 | H | | x |
| | | Integrate sustainability-based initiatives into all partnerships and other external stakeholder activities | | 1 | 1,000 | | H | | x |
| | | Integrate training for social justice/equity, community development, and cultural resource and partnership performance standards with all sustainability-based initiatives | | 1 | 1,000 | | H | | x |
| | | Refit and right-size facilities and infrastructure for energy efficiency and production | | 1 | 35,000 | 2,000,000 | H | | x |

[1]**Priority Rankings:**
**Very High (VH):** these actions are very critical and must be completed in the first 5 years of the plan in order to move other elements of the plan forward. Funding will be directed to complete VH priority actions first and foremost.
**High (H):** these actions are critical and must be completed in the first 5 years of the plan in order to move other elements of the plan forward. Funding will be directed to complete H priority actions as funding levels allow.
**Medium (M):** these actions will be accomplished as time and funds allow.
**Low (L):** these actions will be accomplished as time and funds allow.
**Columns:**
x = project is included in the management direction or current management. -- = project is not included in the management direction or current management (thus, cost = 0).
**Note:** An empty space in the recurring cost column means that there will be no recurring costs. A number in this column means that the cost will recur at the amount specified at the interval identified. An empty space in the one-time cost column means that there will be no one-time costs. A number in this column means that a one-time cost at the amount specified will need to occur at some point over the lifetime of the CCP (15 years). If there is numeric information in the column for current management and only an x in the future management column, the number in the column for current management refers to the one-time cost that has already been spent. The one-time cost will be 0 for future management, but the recurring costs and recurrence interval will be the same. If there is numeric information in each column, this is the one-time cost that will vary (again, some money has already been spent). The recurring costs and intervals will be the same for current management and future management.

**Table C-3. Budget Summary for Implementation and Inventory and Monitoring Activities (Visitor Services and Cultural Resources Programs)**

| Activity or Project | Cost/Unit | # of Units (Current Management) | # of Units (Future Management) | One-time Expense (Current Management) ($) | One-time Expense (Future Management) ($) | Recurring Expense (Current Management) ($/year) | Recurring Expense (Future Management) ($/year) |
|---|---|---|---|---|---|---|---|
| **Goal 6. Welcome and Orient Visitors** | | | | | | | |
| **Objective 6a. Provide welcome and orientation to visitors** | | | | | | | |
| Update existing panels and develop new panels at new locations | $15,000 | 4 | 8 | $60,000 | $120,000 | $500 | $500 |
| Maintain existing and develop new vault toilets | $25,000 | 0 | 1 | $0 | $25,000 | $3,500 | $5,000 |
| Maintain existing and develop accessible picnic tables, trash cans, and shelters | ADA – $4,500, non-ADA – $1,500 | 0 | 1 ADA, 2 non | $0 | $7,500 | $5,000 | $5,000 |
| Build enlarged visitor contact station and gift shop | $250,000 | -- | 1 | $0 | $250,000 | $0 | $10,000 |
| Rehabilitate museum facility (temperature and humidity control, accessibility) (see interpretation for interpretive panels) | $25,000-$75,000 | -- | 1 | $0 | $50,000 | $0 | $0 |
| Establish seasonal contact station at P Ranch | $10,000-$100,000 | 0 | 1 | $0 | $45,000 | $0 | $3,000 |
| Develop modern media welcome and outreach materials, maintain website, etc. | $10,000 | | | $0 | $0 | $1,000 | $1,000 |
| **Objective 6b. Address transportation issues** | | | | | | | |
| Raise and surface Center Patrol Road (CPR) | $1,200,000 | 1 | 1 | 0 | $1,500,000 | | $100,000 |
| Develop additional vehicle pull-offs | $10,000-$25,000 | 0 | 3 | $0 | $52,500 | $0 | $0 |

| Activity or Project | Cost/Unit | # of Units (Current Management) | # of Units (Future Management) | One-time Expense (Current Management) ($) | One-time Expense (Future Management) ($) | Recurring Expense (Current Management) ($/year) | Recurring Expense (Future Management) ($/year) |
|---|---|---|---|---|---|---|---|
| Improve East Canal for vehicle access | $30,000 | 0 | 3 | $0 | $90,000 | $0 | $0 |
| Improve public vehicle access at Boat Landing Road, including vehicle pull-offs | $30,000 | 0 | 1.5 | $0 | $45,000 | $0 | $0 |
| Maintain Krumbo Lane | | | | | | | $10,000 |
| Develop parking areas to assist with public use programs | $50,000 | | 3 | $0 | $150,000 | $0 | $0 |
| Overall road maintenance (public roads, vehicle pull-offs, parking areas) | | | | | | $0 | $20,000 |
| **Goal 7. Wildlife Observation, Photography, Interpretations** | | | | | | | |
| **Objective 7a. Provide wildlife observation and photography opportunities** | | | | | | | |
| Docent tours on lake | $100,000 | $0 | 1 | $0 | $100,000 | $0 | $15,000 |
| Other land-based docent-led tours monthly plus special events (advertise, train, provide) | $50,000 | 0 | 1 | $0 | $50,000 | $0 | $5,000 |
| Provide new non-ADA trails (also see fishing compatibility determination [CD] for fishing trails - not included here), and develop new trail signage (spur trail) | $6,000 | 9 | 12 | 0 | $72,000 | $0 | $2,000 |
| Provide new ADA trails at Sodhouse, Benson Pond, P Ranch, (also see fishing CD - not included here) | $75,000 | 0 | 3 | $0 | $225,000 | $0 | $2,000 |
| Construct viewing overlook at Krumbo Reservoir | $40,000 | 0 | 1 | $0 | $40,000 | $0 | $1,000 |
| Construct elevated viewing platforms | $55,000 | 0 | 4 | $0 | $220,000 | $0 | $4,000 |
| Provide photography blinds | $10,000 | 0 | 3 | $0 | $30,000 | $0 | $1,000 |
| Administration and management | | | | $0 | $0 | $20,000 | $20,000 |
| **Objective 7b. Provide birding opportunities** | | | | | | | |
| Maintenance (habitats) | | 0 | 6 | | | $1,000 | $1,000 |

| Activity or Project | Cost/Unit | # of Units (Current Management) | # of Units (Future Management) | One-time Expense (Current Management) ($) | One-time Expense (Future Management) ($) | Recurring Expense (Current Management) ($/year) | Recurring Expense (Future Management) ($/year) |
|---|---|---|---|---|---|---|---|
| **Objective 7c. Provide interpretive opportunities** | | | | | | | |
| Develop new interpretive panels | $10,000 | 0 | 3--6 | $0 | $45,000 | $1,000 | $1,000 |
| Administration and management (local events, public presentations, media) | | | | $0 | $0 | $35,000 | $35,000 |
| **Objective 7d. Provide environmental education programs** | | | | | | | |
| Build outdoor shelter at Refuge headquarters (HQ) (sun and wind protection) | $80,000 | | 1 | $0 | $80,000 | $1,000 | $1,000 |
| Provide outdoor learning area at Refuge HQ | $25,000 | | 1 | $0 | $25,000 | $1,000 | $1,000 |
| Administration and management (curriculum development, initiatives, special events, coordination) | $5,000 | | | $0 | $0 | $7,000 | $14,000 |
| Equipment and materials | $10,000 | | | $0 | $0 | $1,500 | $2,000 |
| **Goal 8. Provide Hunting and Fishing Opportunities** | | | | | | | |
| **Objective 8a. Provide upland game hunting opportunities** | | | | | | | |
| Administration and management (programmatic, law enforcement, information) | | | | $0 | $0 | $2,000 | $2,000 |
| Maintenance (covered under waterfowl hunting CD) | | | | $0 | $0 | $0 | $0 |
| **Objective 8b. Provide waterfowl hunting opportunities** | | | | | | | |
| Improve Saddle Butte access road (covers upland game use too) | $130,000 | 0 | 1 | $0 | $130,000 | $0 | $0 |
| Open new ADA boat launch and parking area on Malheur Lake (end of Boat Landing Road) | $150,000 | 0 | 1 | $0 | $150,000 | $0 | $0 |

| Activity or Project | Cost/Unit | # of Units (Current Management) | # of Units (Future Management) | One-time Expense (Current Management) ($) | One-time Expense (Future Management) ($) | Recurring Expense (Current Management) ($/year) | Recurring Expense (Future Management) ($/year) |
|---|---|---|---|---|---|---|---|
| Develop new publications and signage for hunt program | $2,000 | 0 | 1 | $0 | $2,000 | $1,000 | $1,000 |
| Staff administration and management (programmatic, law enforcement, information) | | | | $0 | $0 | $5,000 | $5,000 |
| Facility maintenance | | | | $0 | $0 | $2,000 | $2,000 |
| **Objective 8c. Provide stream fishing opportunities** | | | | | | | |
| Develop fishing brochure | $5,000 | | | $1,500 | $1,500 | $2,000 | $2,000 |
| South Fishing Loop: Build 2-3 new pedestrian crossings and complete development of loop trail | $275,000 | 0 | 1 | $0 | $275,000 | $0 | $0 |
| Lower Blitzen: Open new seasonal bank fishing (trail with 2 bridges and parking) (portion will be ADA-accessible) | $275,000 | 0 | 1 | $0 | $275,000 | $0 | $0 |
| Develop outdoor fishing information kiosks | $10,000 | 0 | 6 | $0 | $60,000 | $0 | $0 |
| Replace Krumbo floating platform/other maintenance of Krumbo facilities | $35,000 | 1 | 1 | 0 | $35,000 | $2,000 | $2,000 |
| Fishing program administration and management (programmatic, law enforcement, information) | | | | | | $6,000 | $6,000 |
| **Goal 11. Identify and Protect Prehistoric and Historic Resources that are Eligible or Listed on the National Register of Historic Places** | | | | | | | |
| **Objective 11a. Increase management efforts for eligible historic sites** | | | | | | | |
| Stabilization and restoration of historic structures at Sodhouse Ranch | | 8 | 8 | $300,000 | $300,000 | $5,000 | $5,000 |
| Stabilization and restoration of the historic structures at P Ranch | | 3 | 3 | $0 | $150,000 | $2,000 | $2,000 |

| Activity or Project | Cost/Unit | # of Units (Current Management) | # of Units (Future Management) | One-time Expense (Current Management) ($) | One-time Expense (Future Management) ($) | Recurring Expense (Current Management) ($/year) | Recurring Expense (Future Management) ($/year) |
|---|---|---|---|---|---|---|---|
| Stabilization and restoration of the sod structure at Barnes Springs | | 1 | 1 | $0 | $35,000 | $500 | $500 |
| Stabilization and restoration of the historic structures at Double-O Ranch | | 3 | 3 | $0 | $100,000 | $2,000 | $2,000 |
| Maintain Civilian Conservation Corps buildings at Refuge HQ and Buena Vista Station and Benson Pond | | 8 | 8 | $0 | $60,000 | $5,000 | $5,000 |
| **Goal 12. Manage the Refuge's Paleontological Resources for their Educational and Scientific Values** | | | | | | | |
| **Objective 12b. Provide interpretation of paleontological resources** | | | | | | | |
| Develop interpretive and educational materials for paleontological resources | $15,000 | 2 | 2 | $30,000 | $30,000 | $0 | $0 |
| | | | | $675,000 | $675,000 | $14,500 | $14,500 |

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*Landscape from north of CPR*
©Barbara Wheeler

# *Appendix D*
## *Wilderness Review Inventory Phase*


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# D.1 Introduction

## D.1.1 Refuge Overview

The 187,757 acre Malheur National Wildlife Refuge (NWR) is situated within the Harney Basin in southeastern Oregon. Located in the Northern Great Basin, this portion of the state is lightly populated, generally arid with cold winters, and characterized by wide open spaces. Although the Refuge constitutes a small percentage of the Northern Great Basin it is disproportionately important as a stop along the Pacific Flyway and as a resting, breeding, and nesting area for migratory birds and other wildlife. Many species migrating through or breeding here are highlighted as priority species in national bird conservation plans.

Malheur NWR is composed of three very distinct environments, each including a diversity of native habitats and landscapes. The core of the Refuge is dominated by a shallow lake basin and encompasses the Harney, Mud, and Malheur Lakes. This 103,799-acre area covers 56 percent of Refuge lands with the majority of acres being highly impacted by invasive common carp. The Blitzen Valley, a broad corridor (64,215 acres) to the south of the lake basin, is divided down its entire length by the Blitzen River and its associated linear riparian habitat. The Blitzen Valley covers 34 percent of the Refuge and provides most of the water flowing to the lake basins. The Double-O is a broad valley basin that covers 10 percent of Refuge lands. Intermittent water from the Silver Creek watershed flows through this management area and drains into Harney Lake. Together, these three environments result in a diversity of habitats and support more than 415 species of birds, mammals, fish, reptiles, and amphibians.

Historical bird counts show that the Refuge and the Silvies River floodplain just north of the Refuge may support anywhere between 5 to 66 percent of the Pacific Flyway migrating populations for various priority waterfowl. On the Refuge, breeding habitat is significant for waterbirds, with the Refuge currently supporting over 20 percent of the Oregon population of breeding greater sandhill cranes. Most colonial waterbird numbers have easily exceeded 10 percent of the regional population at peak, even reaching up to 77 percent of the Great Basin population for certain species. Numbers of migrating shorebirds have been documented at levels high enough to qualify the Refuge as a Regional Western Hemispheric Shorebird Reserve. The Refuge also supports high densities of certain nesting riparian passerines and meadow-dependent species such as the largest nesting population of bobolinks in the western United States.

Currently the majority of productive habitat is within the Blitzen Valley and the Double-O Units. Both of these units are comprised of highly altered habitats consisting of open water ponds, marshes, meadows, uplands, and riparian areas. Pond, marsh, and meadow habitats are intensively managed through an extensive series of roads, dikes, canals, water control structures, and other man-made features.

The lake units of the Refuge (Malheur, Mud, and Harney) have experienced a lesser degree of active management than the other units. However, during the first half of the twentieth century, invasive common carp were introduced into the Harney Basin. Introduction of carp has caused the ecological collapse of one of the largest natural freshwater marshes (Malheur Lake) in the lower 48 states.

This has resulted in a change from the 1970s when the lake’s bulrush/cattail marsh spanned tens of thousands of acres, supporting hundreds of thousands of waterfowl, shorebirds, and waterbirds.

Today the lake is a large body of muddy water absent of aquatic vegetation, with very limited bird use. The carp-induced conditions in Malheur Lake are compromising the biological integrity, diversity, and environmental health of the lake. These factors are ultimately preventing Malheur Lake from fulfilling the refuge purpose that President Theodore Roosevelt established by Executive Order No. 929, “as a preserve and breeding ground for native birds.”

## D.1.2 The Wilderness Review Process

U.S. Fish and Wildlife Service (USFWS) policy (602 FW 3.4 C.(1) (c)) requires that wilderness reviews be completed as part of the Comprehensive Conservation Planning process.

The National Wildlife Refuge Service’s (NWRS’s) Policy on Wilderness Stewardship includes guidance for conducting wilderness reviews (610 FW 4).

A wilderness review is the process of determining whether the FWS should recommend NWRS lands and waters to Congress for wilderness designation. The wilderness review process consists of three phases: wilderness inventory, wilderness study, and wilderness recommendation.

### Wilderness Inventory (Phase I)

The wilderness inventory is a broad look at a refuge to identify lands and waters that meet the minimum criteria for wilderness: size, naturalness, and outstanding opportunities for solitude or primitive and unconfined type of recreation. All areas meeting the criteria are classified as preliminary Wilderness Study Areas (WSAs). If preliminary WSAs are identified, those areas then proceed to the study phase.

**This Wilderness Review only includes the inventory phase (phase 1 of the whole wilderness review process). A subsequent study phase would occur following the publication of the CCP/EIS.**

### Wilderness Study (Phase II)

During the study phase, WSAs are further analyzed:

- for all values of ecological, recreational, cultural, economic, symbolic importance.
- for all resources, including wildlife, vegetation, water, minerals, soils.
- for existing and proposed public uses.
- for existing and proposed refuge management activities within the area.
- to assess the refuge’s ability to manage and maintain the wilderness character in perpetuity, given the current and proposed management activities. Factors for evaluation may include, but are not limited to, staffing and funding capabilities, increasing development and urbanization, public uses, and safety.

### Wilderness Recommendation (Phase III)

If the wilderness study demonstrates that a WSA meets the requirements for inclusion in the National Wilderness Preservation System, a wilderness study report would be written that presents the results of the wilderness review, accompanied by a Legislative Environmental Impact Statement (LEIS). The wilderness study report and LEIS that support wilderness designation are then transmitted from the Director of the USFWS through the Secretary of Interior to the President of the United States, and ultimately to the United States Congress for action. Refuge lands recommended for wilderness consideration by the wilderness study report will retain their WSA status and be managed as wilderness and in accordance with the management direction established in the refuge's CCP until Congress makes a decision on the area. According to FWS (610 FW 3.13), when a WSA is revised or eliminated, or when there is a revision in "wilderness stewardship direction, we include appropriate interagency and tribal coordination, public involvement, and documentation of compliance with NEPA."

## D.1.3 Criteria for Evaluating Lands for Possible Inclusion in the National Wilderness Preservation System

The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136) provides the following description of wilderness:

> *A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act as an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions ….*

The following criteria for identifying areas as wilderness are outlined in Section 2(c) of the Act and are further expanded upon in NWRS policy (610 FW 4). The first three criteria are evaluated during the inventory phase; the fourth criterion is listed during the inventory but is then evaluated during the study phase.

- generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
- has outstanding opportunities for solitude or a primitive and unconfined type of recreation;
- has at least 5,000 acres of land or is of a sufficient size as to make practicable its preservation and use in an unimpaired condition; and
- may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value.

## D.1.4 Relationship to Previous Wilderness Reviews

The Wilderness Act of 1964 (Public Law 88-577) provided the authority for evaluating existing NWRs, or parts thereof, for inclusion into the National Wilderness Preservation System. This Law directed the review of every roadless area of 5,000 contiguous acres or more, and every roadless island within the NWRS.

A wilderness review and subsequent WSA document was prepared in March 1967 (U.S. Department of the Interior [USDI] 1967); this document identified Malheur Lake (48,317 acres) and Harney Lake (30,000 acres) as potential wilderness areas. As a part of this procedure, the Secretary of the Interior directed the USGS to conduct mineral surveys on these sites. The USGS completed the mineral appraisal in March 1967.

A public Wilderness Hearing was conducted in Burns, Oregon, on May 2, 1967, to gather public input, and written comments continued to be accepted through August 1967. In a letter dated September 5, 1967, the USDI Bureau of Outdoor Recreation indicated that the Malheur Lake unit would be reduced to 20,600 acres; this decision was based on public comments. The Harney Lake unit remained at 30,000 acres.

The revised proposal, totaling 50,600 acres in the Malheur Lake and Harney Lake units, was first introduced in a Wilderness Omnibus Bill (S.3014) in October 1969. The Senate Committee on Interior and Insular Affairs held hearings on November 6, 1969. Due to opposition from Congress regarding the Malheur Lake unit, the Malheur proposal was deleted from the bill (S.3014) and sent back for revision.

According to a FWS Wilderness Fact Sheet, in 1973 the FWS once again reviewed the proposal as directed by Congress and revised the proposal to encompass only the 30,000-acre Harney Lake area. Memos also indicate that this revision was forwarded as a recommendation to the Secretary of the Interior. This recommendation was formally adopted, according to Refuge memos, by the Secretary on May 16, 1973. The 1979 Wilderness Fact Sheet and memos from the associate director of the Bureau of Sport Fisheries and Wildlife (BSF&W) to the Legislative Council (dated July 31, 1973, and signed August 4, 1973) and from the Secretary of the Interior to the Chairman of the House Committee on Interior and Insular Affairs outlines the issues and revised recommendation. A draft Environmental Statement (as they were known at that time) was prepared later in 1973 (USDI 1973), but was never finalized. This draft Environmental Statement included only the 30,000-acre Harney Lake unit.

In 1975, H.R. 5893 (dated April 10, 1975) and H.R. 3507 (dated February 20, 1975) were introduced during the 1st session of the 94th Congress. Both of these bills included the original 50,600 acres from the original 1967 proposal. The inclusion of Malheur Lake in these bills appears to be a mistaken carryover from the original 1969 bill, as none of the requested revisions (from the 1969 hearings) were forwarded to Congress, and there is no indication in the records that Congress discussed the Malheur proposal. No action was taken regarding the Malheur proposal during the 1976 Omnibus Wilderness Hearings.

Between 1976 and 1987, there are no Malheur NWR wilderness-related correspondences in the files. From 1988 to the present, all correspondences indicate that only the 30,000-acre Harney Lake unit was still being considered for wilderness designation. The Harney Lake unit has continued to be managed as a Wilderness Study Area since the original 1969 proposal was introduced.

## D.2 Inventory Phase of Wilderness Review

The following constitutes the inventory (Phase I) of the wilderness review for Malheur NWR. Based on inventory outcomes, the next phase (wilderness study) will be conducted as a step-down process to the CCP.

### D.2.1 Lands and Waters Considered Under This Wilderness Review

All FWS-owned lands and waters (in fee title) within the Malheur NWR–acquired boundary were considered during this wilderness review. This review includes the re-evaluation of Refuge lands first evaluated during the 1960s and 1970s as described above.

## D.2.2 Inventory Units

The first step of a wilderness assessment is to divide the refuge or other management entity into preliminary wilderness evaluation units. The boundaries of these artificial units can follow the refuge boundary, but may not cross permanent roadways, private or other non-Federal lands, or non-Service owned waterways. These roads, non-Federal lands, or waterways can form the boundary for an individual evaluation unit. Other obvious incompatible wilderness uses or structures (such as refuge headquarters, residential areas, rights-of-way, and non-jurisdictional waters) may also be eliminated from any evaluation units at this time. Once boundaries have been established for each individual evaluation unit, the criteria in Sections D.2.3 and D.2.4 are applied to determine each unit's suitability as potential wilderness and the need for further evaluation under the Wilderness Study.

In determining units to be evaluated for wilderness character per this inventory, the Refuge was mapped using geographic information system (GIS) software. Using the major constraints set by the Wilderness Act, specifically land ownership/refuge boundary and permanent road systems, initial large evaluation units were developed by including all contiguous lands within those intractable confines. Through this process, ten units were defined for evaluation and are described below.

## D.2.3 Evaluation of Unit Size

### Criteria for Evaluation

Roadless areas are defined in Section 3(c) of the Wilderness Act as: 1) a roadless area of 5,000 contiguous acres or more, or 2) a roadless island. "Roadless" is defined as the absence of improved roads suitable and maintained for public travel by means of 4-wheeled, motorized vehicles that are intended for highway use.

According to Service policy (610 FW 4), roadless areas meet the size criteria if any one of the following standards applies:

- The area is over 5,000 contiguous acres solely in FWS ownership.
- It is a roadless island of any size. A roadless island is defined as "an area surrounded by permanent waters or an area that is markedly distinguished from the surrounding lands by topographical or ecological features."
- It is an area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- It is an area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management (BLM).

### Results of Evaluation

The 59,664-acre **Malheur Lake Unit** meets the minimum size requirements for a wilderness area. This acreage encompasses the lake bed and associated wetland habitats. Because of the continuity of this area, it was not deemed reasonable to split the lake bed into smaller parcels.

The 31,157-acre **Harney Lake Unit** meets the minimum size requirements for a wilderness area. This is 1,157 acres more than in the 1969 Harney Lake Wilderness Proposal.

The 5,818-acre **Double-O–Stinking Lake Unit** meets the minimum size requirement for a wilderness area. This area includes the northwestern section of the Double-O Unit, including the Stinking Lake Research Natural Area (RNA).

The 5,660-acre **Double-O–Chappo Unit** meets the minimum size requirement; this unit is comprised of the northeastern section of the Double-O Unit.

The 7,973-acre **Sodhouse-West Unit** meets the minimum size requirement. It includes lands west of the Center Patrol Road.

The 6,497-acre **Sodhouse-East Unit** meets the minimum size requirement. It includes lands east of the Center Patrol Road, including the waters of the Blitzen River.

The 1,206-acre **Upper Bridge Creek–Knox Springs Unit** does not meet the minimum size requirement, but is located adjacent to a BLM Wilderness Study Area and therefore will be further evaluated.

The 426-acre **Barnes Springs Unit** does not meet the minimum size requirement, but is located adjacent to a BLM Wilderness Study Area and therefore will be further evaluated.

The 4,520-acre **Buena Vista–Unit 8 Unit** does not meet the minimum size requirement, but is sufficiently close to minimum size to continue evaluation.

The 3,336-acre **P Ranch–East Block Unit** includes lands east of the Center Patrol Road to the Refuge boundary. This unit does not meet the minimum size requirement and will not be evaluated further.

Six of the ten units identified for wilderness evaluation are of sufficient size to evaluate further in the inventory process. Two additional units do not meet the size requirement, but are adjacent to existing BLM wilderness study areas, and therefore will be considered further for inventory evaluation. One unit is only slightly less than the minimum size requirement, so it will be evaluated further. The remaining unit is sufficiently below the minimum size requirement and therefore will not be further evaluated.

## D.2.4 Naturalness Evaluation

### Criteria for Evaluation

Section 2(c) defines wilderness as an area that "… generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable."

According to Service Policy (610 FW 4), an area meets the naturalness criterion under the following considerations:

- We make a distinction between an area's "apparent naturalness" and "historic conditions" in the context of biological integrity, diversity, and environmental health. The term "historic conditions" refers to the condition of the landscape in a particular area before the onset of significant, human-caused change. The term "apparent naturalness" refers to whether or not an area looks natural to the average visitor who is not familiar with historic conditions versus human-affected ecosystems in a given area. We address the question of the presence or absence of apparent naturalness (i.e., are the works of humans substantially unnoticeable to the average visitor?) in the inventory phase of the wilderness review. In the study phase of the wilderness review, we make an assessment of an area's existing levels of biological integrity, diversity, and environmental health.

- We avoid an approach to assessing naturalness that limits wilderness designation only to those areas judged pristine. Land that was once logged, used for agriculture, or otherwise significantly altered by humans may be eligible for wilderness designation if it has been restored or is in the process of being restored to a substantially natural appearance.
- We use caution in assessing the effects on naturalness that relatively minor human impacts create. An area being evaluated may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Examples of manmade features that would not disqualify an area for consideration as a WSA include: trails, trail signs, bridges, fire towers, fire breaks, fire presuppression facilities, pit toilets, fisheries enhancement facilities (such as fish traps and stream barriers), fire rings, hitching posts, snow gauges, water quantity and quality measuring devices, research monitoring markers and devices, wildlife enhancement facilities, radio repeater sites, air quality monitoring devices, fencing, spring developments, and small reservoirs. Even with these features, an area may express wilderness character and values.
- We may disqualify portions of an area from consideration where significant human-caused hazards make that area unsafe for public use, such as contaminated sites or the existence of unexploded ordnance from military activity. Once these conditions are corrected, we may then consider that portion of the area.
- We do not disqualify areas from further wilderness study solely on the basis of the "sights and sounds" of civilization located outside the areas. Where human impacts are outside the area being inventoried, we do not normally consider them in assessing naturalness. However, if an outside impact of major significance exists, we should note it and evaluate it in the inventory conclusions. Human impacts outside the area should not automatically lead us to conclude that an area lacks wilderness characteristics.
- We do not disqualify areas from further wilderness study solely on the basis of established or proposed refuge management activities or refuge uses that require the use of temporary roads, motor vehicles, motorized equipment, motorboats, mechanical transport, landing of aircraft, structures, and installations generally prohibited in designated wilderness (see definition of "generally prohibited use" in 610 FW 1.5). The physical impacts of these practices should be the focus of the naturalness evaluation. We evaluate existing and proposed refuge management activities and refuge uses in the study phase of the wilderness review.

Today few areas exist that do not exhibit some impact from anthropogenic influences, be it noise, light, or air pollution; water quality or hydrological manipulations; past and current land management practices; roads; suppression of wildfires; invasions by non-native species of plants and animals; or public uses. While allowing for the near-complete pervasiveness of modern society on the landscape, the spirit of the Wilderness Act is to protect lands that still retain the wilderness qualities of being: 1) natural, 2) untrammeled, and 3) undeveloped. These three qualities are the cornerstones of wilderness character. For areas proposed or designated as wilderness, wilderness character must be monitored to determine baseline conditions and thereafter be periodically monitored to assess the condition of these wilderness qualities. Proposed and designated wilderness areas by law and policy are required to maintain wilderness character through management and/or restoration in perpetuity.

Defining the first two qualities (natural and untrammeled) requires a knowledge and understanding of the ecological systems that are being evaluated as potential wilderness. Ecological systems are comprised of three primary attributes: composition, structure, and function. Composition refers to the components that make up an ecosystem, such as the habitat types, native species of plants and animals, and abiotic (physical and chemical) features. These contribute to the diversity of the area. Structure is the spatial arrangement of the components that contribute to the complexity of the area. Composition and structure are evaluated to determine the naturalness of the area. Function refers to the processes that result from the interaction of the various components, both temporally and spatially, and the disturbance processes that shape the landscape. These processes include, but are not limited to, predator–prey relationships, insect and disease outbreaks, nutrient and water cycles, decomposition, fire, windstorms, flooding, and both general and cyclic weather patterns. Ecological functions are evaluated to determine the wildness or untrammeled quality of the area.

The third quality assessment is whether an area is undeveloped. Undeveloped refers to the absence of permanent structures such as roads, buildings, dams, fences, and other man-made alterations to the landscape. Exceptions can be made for historical structures or structures required for safety or health considerations, provided they are made of natural materials and relatively unobtrusive on the landscape.

### Results of Naturalness Assessment

***Malheur Lake Unit:*** The Malheur Lake Unit contains approximately 8 miles of levee system, 1.6 miles of access roads, and 68 miles of boundary fence. Roads access hunt areas and a boat launch. An artificial osprey nesting platform also exists within the lake bed. In the 1970s, Malheur Lake was an extensive bulrush/cattail/sago pondweed marsh that supported hundreds of thousands of migrating and nesting birds. The lake today is a body of muddy water devoid of most bird use. Although Malheur Lake has retained most hydrological inputs, the lake basin itself has lost much of its natural function due to the introduction of invasive species. Invasive species, aquatic and terrestrial, have altered this ecological system in a manner that has changed all natural attributes except hydrology. The hydrology of the lake is still driven by annual climate conditions that cause the lake to fluctuate from an average low of 24,000 acres to an average high of 47,000 acres. Lake surface acres have ranged from a low of 400 in 1992 to a high of 170,000 in 1984 (well outside of the Refuge boundary).

Due to the impacts of invasive common carp, Malheur Lake is now devoid of nearly all aquatic vegetation. Upland areas that are not submerged contain significant amounts of invasive species such as perennial pepperweed and Russian olive. Aquatic and terrestrial invasives are also present in all tributaries. This has created a situation where issues on the Refuge impact the watershed and the watershed impacts the Refuge. Although Malheur Lake is nearly devoid of aquatic vegetation, and it has lost much of its natural biological function, the works of man are substantially unnoticeable to the casual visitor. Malheur Lake would appear natural to the average visitor who is not familiar with historical conditions versus the human-affected ecosystem. Even though Malheur Lake is a highly altered ecological system that no longer functions properly, it does meet the wilderness criteria of "apparent naturalness." Naturalness in combination with properly functioning ecosystems is a valued attribute.

Although Malheur Lake meets the "apparent naturalness" criteria, current ecological conditions do not meet the requirements of the NWR System mission, nor does the Lake possess biological integrity, diversity, or good environmental health. In addition to these criteria, Malheur Lake's suitability for management and preservation as wilderness is evaluated based on the area's primary purpose. The purpose for Malheur Lake is "… a refuge and breeding ground for migratory birds and other wild life …" as defined by Executive Order 7106, dated July 19, 1935.

Through the Comprehensive Conservation Planning process, the Refuge is developing strategies to restore the ecological function of Malheur Lake, thereby enabling the fulfillment of Refuge purpose and other mandates. As strategies are developed, they will be based on the best available science, including site-specific science that is being currently being compiled through extensive research, inventory, and monitoring. The Refuge's goal is to develop and implement a comprehensive restoration strategy for Malheur Lake while striving to retain the area's natural appearance.

Malheur Lake does meet "apparent naturalness" from a wilderness standard; however, the purpose and other required mandates for Malheur Lake are not being fulfilled under current deteriorated biological conditions. For this reason USFWS will delay further wilderness evaluation until ecological integrity is restored.

***Harney Lake Unit:*** The Harney Lake Unit is primarily an alkali playa with a desert scrub vegetation component around the periphery. Minimal water flows reach the Harney Lake basin and originate primarily from spring systems and Silver Creek. Silver Creek inflows rarely reach the basin due to upstream diversions on the adjacent Double-O unit and private lands. Independent of these diversions and impoundments, water flows from springs and Silver Creek are insufficient to fill the basin annually, and the basin fills completely only during extreme flood events. This alkali playa creates a unique and somewhat harsh environment suited for specific flora and fauna. This unit also contains the Harney Lake RNA.

The Harney Lake Unit does not contain alterations by man-made features or biological agents. This unit retains much of its natural characteristics and will be further evaluated in Section D.2.5.

***Double-O-Stinking Lake Unit:*** The Double-O–Stinking Lake Unit is comprised of arid shrubland habitat and natural spring systems. This area includes the Stinking Lake RNA. This unit has a well-developed wetland system, and the springs have been significantly altered for water management. The unit has three water troughs or other watering developments and eight man-made wetland units. Water flows in these wetland units are manipulated by 35 water control structures and over 7 miles of levees/roads, one borrow ditch, and 19 miles of water delivery ditches. Improved roadways for administrative use total almost 10 miles, and public access is allowed along the southern boundary of the unit. There are two historic homesteads in the unit. Other developments include an osprey nesting platform, two wells, one fish screen, and two bridges. Power lines bisect the unit to service both Refuge and private facilities.

The unit contains approximately 17 miles of fencing with 75 percent of this as interior fence. Invasive plants are problematic, especially perennial pepperweed, reed canarygrass, and Canada thistle. Non-native common carp are present and represent a serious threat to the native biodiversity; this species requires continual and intensive control measures.

Within the unit is the Stinking Lake RNA. This portion of the unit retains its natural character and function; however, this 1,555-acre area does not meet the minimum wilderness size requirements.

Thus the Double-O–Stinking Lake Unit requires considerable management and contains developed features that compromise the natural qualities of the unit and will not be considered further for evaluation.

***Double-O–Chappo Unit:*** The Double-O–Chappo Unit lies adjacent to the Double-O–Stinking Lake Unit within the northeastern section of the Double-O Unit. The unit is comprised of arid shrubland habitat and outflows from the natural spring systems. This unit has a developed wetland system and has one water trough and seven man-made wetland units. Water flows in these wetland units are manipulated by 24 water control structures and over 6 miles of levees, 2.5 miles of water delivery ditches, and one borrow ditch. There are 4.3 miles of improved roadways for administrative use and public access is allowed along portions of these roads. Other developments include public use signage and two small bridges.

In the unit there is approximately 22 miles of fencing, half of which is interior fencing. The unit contains a mechanically leveled field used in the past for farming. Invasive plants are problematic, especially perennial pepperweed, reed canarygrass, and Canada thistle. Non-native common carp are present and represent a serious threat to the native biodiversity; this species requires continual and intensive control measures. The unit is intensively manipulated; all water flows are managed with numerous man-made structures. Past farming practices have altered the natural plant communities. Due to these factors, the unit does not contain the natural qualities to be further considered for evaluation.

***Sodhouse-West Unit:*** The Sodhouse-West Unit consists of lands west of the Center Patrol Road, in the northern portion of the Blitzen Valley. The unit has seven man-made wetlands that are manipulated by 25 water control structures, 3 miles of dikes, and 32 miles of canals and ditches. The unit contains about 20 miles of administrative roads, with an additional 15 miles of public roads along the unit boundary, including State Highway 205. Other developments include two historic lookout towers and 13 miles of interior fencing; portions of the unit are farmed and hayed. The unit contains large acres of invasive weeds, such as perennial pepperweed, reed canarygrass, thistles, and cheatgrass; carp are also a significant issue within the waterways and negatively impact the native flora and fauna of the site. Due to the presence of non-native species, the highly managed nature of the unit, and the man-made developments, this unit does not retain sufficient naturalness to be included for further wilderness evaluation.

***Sodhouse-East Unit:*** The Sodhouse-East Unit is comprised of a section of long linear lands east of the Center Patrol Road, including the waters of the Blitzen River. The unit contains one dam and five man-made wetlands that are manipulated by 23 water control structures, 8 miles of dikes, and 9 miles of canals and ditches. Portions of the unit are farmed for grain crops. The unit contains about 9 miles of administrative roads, with an additional 11 miles of public roads. Other developments include four bridges, a dam/fish ladder, a gravel pit, and 11 miles of interior fencing. The unit contains large acres of invasive weeds, such as perennial pepperweed, reed canarygrass, thistles, and cheatgrass; carp are also a significant issue within the waterways and negatively impact the native flora and fauna of the site. Due to the presence of non-native species and the highly managed nature of the unit with man-made developments, this unit does not retain sufficient naturalness to be included for further evaluation.

***Buena Vista–Unit 8:*** The Buena Vista–Unit 8 Unit is a linear unit of the Refuge containing one water trough, six man-made wetlands that are manipulated by 24 water control structures, 9 miles of dikes/levees, and many miles of canals and ditches. Portions of the unit are farmed for grain crops.

The unit contains about 12 miles of administrative roads, with an additional 5.5 miles of public roads and is bordered by State Highway 205. Other developments include four bridges, a dam, a fish ladder, two fish screens, a gravel pit, and 11 miles of interior fencing. The unit also contains large acres of invasive weeds, such as perennial pepperweed, reed canarygrass, thistles, and cheatgrass; carp are also a significant issue within the waterways and negatively impact the native flora and fauna of the unit. Due to the presence of non-native species requiring active control, man-made developments, and its highly managed nature, this unit does not retain sufficient naturalness nor is of sufficient size (4,520 acres) to be included for further evaluation.

***Upper Bridge Creek/Knox Springs Unit:*** The 1,206-acre Upper Bridge Creek/Knox Springs Unit is located adjacent to a BLM Wilderness Study Area. The unit contains one developed spring area and one culvert. A managed ditch delivers water from the spring to Refuge wetlands. The unit has 2 miles of exterior and 4 miles of interior fence. The unit also has six man-made rock weirs in Bridge Creek.

Ongoing restoration activities include the use of mechanized equipment for reconnecting creeks to floodplains, rehabilitation of waterway embankments, and tree/shrub plantings. Fencing enclosures are required for plant establishment during restoration activities. The upland vegetation of the site is dominated by non-native crested wheatgrass plantings with almost no remaining native plants. Invasive cheatgrass is also prevalent in the unit. Due to the unit’s highly altered ecosystem there is a long-term need for non-native grass eradication, revegetation with native forbs and grasses, and an ongoing riparian restoration program. Under current conditions, this unit cannot fulfill the Refuge purpose, or be considered to have biological integrity, diversity, and environmental health. Because of the lack of natural qualities, the Upper Bridge Creek/Knox Springs Unit will not be considered for further wilderness evaluation at this time.

***Barnes Springs Unit:*** The 426-acre Barnes Springs Unit is located adjacent to a BLM Wilderness Study Area. The unit contains one developed spring and an adjacent homestead site. Other developments include 3.8 miles of boundary fencing and 0.4 miles of roads/trails. This unit also contains large acres of invasive weeds, especially medusahead and cheatgrass. The former originates and re-infests the Refuge from large infestations on adjacent BLM lands. Medusahead is a particularly difficult species to eradicate/control, requiring mechanized spraying and manipulation. Juniper encroachment onto this unit requires mechanical thinning and prescribed burning regimes. Under current conditions, this unit cannot fulfill the Refuge purpose, or be considered to have biological integrity, diversity, and environmental health. Because of the lack of natural qualities, the Barnes Springs Unit will not be considered for further wilderness evaluation at this time.

## D.2.5 Evaluation of Opportunities for Outstanding Solitude or Primitive/Unconfined Recreation

### Criteria for Evaluation

In addition to size and naturalness, wilderness areas must provide outstanding opportunities for solitude or a primitive and unconfined type of recreation. The area does not need to have outstanding opportunities for both elements and does not need to have outstanding opportunities on every acre. An area also does not have to be open to public use and access to qualify under these criteria. Each area is assessed on its own merits and is not compared to other areas.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. Primitive recreation activities may provide opportunities to experience challenge and risk, self-reliance, and adventure.

### Results of Outstanding Solitude or Primitive/Unconfined Recreation Assessment

The Harney Lake Unit is not open to public use to protect the unit's unique micro-habitats and the importance of the site to wildlife species, such as nesting western snowy plovers. Public use and interpretive facilities are planned adjacent to, but not within, the unit. If the unit were open to public use, the size of the unit would provide outstanding opportunities for solitude and/or primitive recreation.

## D.2.6 Inventory Summary and Conclusion

Table D-1 summarizes the above evaluation factors for each of the units that were delineated and evaluated as described in Section D.2.2.

The majority of Malheur NWR is a highly altered wetland and upland system. The lands and waters were significantly altered both prior to and during Service ownership. The Refuge has actively managed these lands to meet the needs of wildlife species at both Refuge and Pacific Flyway levels to enable the Refuge to meet its establishing purposes. The effects of management have included changes to the soils, flora, and fauna. Man-made developments abound in the form of an extensive road system, hundreds of miles of primary dikes, ditches, and fences, altered creeks and river, and thousands of water-management structures.

In this inventory (Phase I) the Harney Lake Unit was found to meet the minimum wilderness criteria for size, naturalness, and outstanding opportunities for solitude and primitive/unconfined recreation. A total of 31,157 acres were found to have wilderness characteristics, which is 1,157 acres greater than the existing WSA proposed in 1969. Based on the findings in this inventory, Harney Lake will be further evaluated in the Wilderness Study Phase as a step-down process to the CCP.

**Table D-1. Results of Wilderness Inventory (Phase I) for Malheur NWR**

| Refuge Unit | Size | Naturalness | Outstanding opportunities for solitude or primitive/unconfined recreation | Summary: Area will move forward for Phase II Wilderness Study |
|---|---|---|---|---|
| Malheur Lake | Yes | Yes | NE | No* |
| Harney Lake | Yes | Yes | Yes | Yes |
| Double-O–Stinking Lake | Yes | No | NE | No |
| Double-O–Chappo | Yes | No | NE | No |
| Sodhouse-West | Yes | No | NE | No |
| Sodhouse-East | Yes | No | NE | No |
| Upper Bridge Creek/Knox Springs | No* | No | NE | No |

| Refuge Unit | Size | Naturalness | Outstanding opportunities for solitude or primitive/unconfined recreation | Summary: Area will move forward for Phase II Wilderness Study |
|---|---|---|---|---|
| Barnes Spring | No** | No | NE | No |
| Buena Vista–Unit 8 | No | No | NE | No |
| P Ranch–East | No | NE | NE | No |

Notes:
NE – Not evaluated (once any wilderness criteria was not met, further evaluation was not conducted.)
* USFWS will delay further wilderness evaluation until ecological integrity is restored.
**Located adjacent to existing wilderness area or wilderness study area; size requirement does not apply.

## D.3 References

U.S. Department of the Interior (USDI). 1967. Wilderness Study Areas: Malheur National Wildlife Refuge. Fish and Wildlife Service. Bureau of Sport Fisheries and Wildlife. Unpublished report on file at Refuge office.

USDI. 1973. Draft Environmental Statement. Proposed Malheur Wilderness Area, Harney County, Oregon. Bureau of Sport Fisheries and Wildlife. Unpublished report on file at Refuge office. 24 pp.

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*White pelican*
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# Appendix E

## Biological Integrity, Diversity, and Environmental Health


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The Refuge System Administration Act directs managers to maintain the biological integrity, diversity, and environmental health (BIDEH) on refuges for the benefit of present and future Americans. Accordingly, the following assessment of BIDEH has been prepared for each of the major habitats at Malheur National Wildlife Refuge.

**Table E-1. Biological Integrity, Diversity, and Environmental Health for Malheur National Wildlife Refuge**

| Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class) | Natural Processes Responsible for these Conditions | Limiting Factors |
|---|---|---|
| **Lacustrine (Lakes)** | | |
| Malheur Lake fluctuates greatly in size, from a typical minimum pool of 500 acres to approximately 90,000 acres in the mid-1980s. It has also been completely dry (1934) and has extended up to 170,000 acres (mid-1980s).<br><br>Historically, a chemical and physical gradient could be observed from west (Mud Lake and directly east of Hwy 205) to east. The far west side consisted of a complex network of ponds, islands, and peninsulas. The center of the lake was dominated by emergent (e.g., hardstem bulrush) marshes and interspersed open water areas. The eastern side has been highly alkaline and contains large areas of open water.<br><br>Common emergent species included hardstem bulrush, cattail, bur-reed, Baltic rush, and various sedges. Open water areas included submergent plants such as watermilfoil, sago pondweed, horned pondweed, coontail, small and leafy pondweed, white water buttercup, bladderwort, and widgeongrass.<br><br>Soil surveys indicate that emergent vegetation responded to existing water levels and did not persist in specific areas with the exception of river inlets and significant spring sources. | Inflow sources include the Blitzen and Silvies rivers and Sodhouse Spring. River flows are predominantly influenced by snowpacks on Steens Mountain and Malheur Forest.<br><br>Shallow water levels, annual and seasonal fluctuations in water depth, and a mosaic of permanent and cyclical water levels.<br><br>The prevailing chemical gradient and variable water depths determined the composition of plant communities throughout the lake.<br><br>Ice movement/scouring following flood events impact topography and reduce the presence and cover of emergent vegetation. | Common carp (introduced to the system in the early 1900s) has decimated the productivity of this marsh/lake system. They root up submergent vegetation and dramatically increase turbidity.<br><br>Hydrological inputs to the lake, particularly from the Silvies River, have been altered. |

| Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class) | Natural Processes Responsible for these Conditions | Limiting Factors |
|---|---|---|
| **Riverine** | | |
| Waterways support riparian communities that are appropriate to stream channel type. The hydrologic floodplains are intact with balanced pool/riffle/glide ratios depending on slope and substrate. Water turbidity is typically low with an appropriate level of sediment storage, which buffers against the sediment loading of critical rearing pools and spawning gravels for native fish.<br><br>Boulders, undercut banks, logs, and vegetation provide ample hiding cover for native fish and other aquatic species. Eddies and other slow current areas contain abundant populations of various aquatic invertebrates.<br><br>Low turbidity also allows a variety of native aquatic vegetation to establish and propagate in suitable micro niches. | Streams such as Bridge and Mud had 1%-4% gradients and were dominated by boulders, cobbles, and gravel. The Blitzen River had a low gradient (<1%) and was dominated by gravel and silt substrates. Sediment discharge and particle size as well as streamflow and slope were in balance.<br><br>Balance between sinuosity and percent slope maintained the physiological integrity of the channel by reducing velocity while intact floodplains disperse energy. | Common carp<br><br>There has been a loss of riparian plant diversity due to past management and competition with invasive plant species.<br><br>Channelization of the Blitzen River has compromised in-stream habitat and the system's ability to disperse energy during high flow events.<br><br>Incised channel.<br><br>Most floodplains are no longer functionally active as a result of altered hydrology from ditching, diversions, and dams along the river. |
| **Woody Riparian** | | |
| The Refuge hosts a variety of riparian/riverine systems, ranging from the Blitzen River itself to various tributaries that flow into it from neighboring valleys and canyons on the northern side of Steens Mountain.<br><br>Although many plant associations are found within this broader community, the principal woody species include various species of willow, redosier dogwood, Woods' rose, golden currant, common snowberry, Lewis' mock orange, water birch, and alder. Herbaceous groundcover characterized by Nebraska sedge, yellow monkey-flower, Northwest cinquefoil, American speedwell, woolly sedge, slenderbeak sedge, meadow barley, | Stream bank soils consist of gravel and cobble due to common flooding disturbance, alluvial bars, and very little soil development.<br><br>Within the active floodplain, the soils are deep and consist of pluvial deposits on alluvium. | Reed canarygrass, hemlock, perennial pepperweed, and other invasives are able to out-compete native vegetation following most disturbances.<br><br>River channelization<br><br>Historical livestock grazing<br><br>Lowered groundwater table<br><br>Infrastructure (ditches, dams, roads)<br><br>Water quality impairments |

| Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class) | Natural Processes Responsible for these Conditions | Limiting Factors |
|---|---|---|
| tufted hairgrass, western yarrow, and Baltic rush. | | Altered hydrology and minimum flows<br><br>Broad-scale loss of functional connectivity between rivers and streams, and their floodplains |
| **Palustrine Emergent (Seasonally Flooded Wet Meadows)** | | |
| Wet meadows typically occupy the transition zone between marsh and moist meadow plant communities.<br><br>Native vegetation includes Baltic rush, woolly sedge, Nebraska sedge, slenderbeak sedge, arrowgrass, meadow barley, tufted hairgrass, Nevada bluegrass, western yarrow, slender cinquefoil, largeleaf avens, Oregon checker mallow, and fringed willowherb. | Surface water is generally present during the growing season (at least 2 months). Only isolated depressions or sloughs hold water into the early fall.<br><br>Soils are derived from alluvium and are very deep and poorly drained (pH of 6.6-7.0). | Introduced species such as Kentucky bluegrass and common timothy have become “naturalized” within these communities, but offer habitat structure similar to that of many native species.<br><br>Invasive species such as reed canarygrass (an introduced cultivar), phragmites, and perennial pepperweed displaced native species.<br><br>Cattails appear to encroach on areas that are inundated for longer than two months.<br><br>Altered hydrology through river channelization and ditching as well as agricultural practices including livestock grazing. |
| **Palustrine Emergent (Seasonally Flooded Marsh associated with Wet Meadows)** | | |
| This habitat type commonly exists within mosaics of wet meadow and open water. Stand density varies greatly and has a maximum height of approximately 3 meters (9.8 feet).<br><br>Common emergent plant species include bur-reeds, bulrushes, cattails, sedges, rushes, and spikerushes. | Emergent vegetation can typically tolerate fluctuations in water availability, ranging from approximately 1 meter above to 10-12 cm (4-5 inches) below the soil surface. Extended periods of standing water aid in preventing the transition to mesophytic plant communities. | The maintenance of existing emergent communities is artificial, requiring extensive infrastructure and active water diversion from the Blitzen River, its tributaries, and springs. All water delivery in the Double-O Unit, including Silver Creek flows, is highly manipulated. |

| Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class) | Natural Processes Responsible for these Conditions | Limiting Factors |
|---|---|---|
| Submergent plants such as pondweeds, bladderworts, waterweeds, and duckweeds occur in nearby open water. Willow species can occur along elevated ecotones along marsh perimeters. | Emergent marshes existed throughout the lower Blitzen Valley and became less extensive north of Buena Vista.<br><br>Associated with very deep, very poorly drained soils that formed in alluvium, alluvium over lacustrine deposits derived from igneous rock, or organic matter. These soils are located on low stream terraces and their depressions as well as lake basins.<br><br>The natural hydroperiod for most marsh communities likely existed from spring through mid-summer. | Increased densities of emergent vegetation reduce boundary habitat for wildlife and decrease the diversity of this community type.<br><br>Historical livestock grazing and haying practices favored the establishment of meadows. Altered hydrology via river channelization and the creation of irrigation ditches. |
| **Palustrine Emergent (Semipermanent Flooded Wetland Impoundments)** | | |
| These open water habitats are semipermanently flooded at depths that preclude the development of extensive stands of emergent vegetation.<br><br>Submerged and floating plants such as common and greater duckweed; Canadian waterweed; coontail; watermilfoil; common bladderwort; white water crowfoot; and sago, longleaf, and small pondweed regularly occur in open water. Emergent plants (e.g., bulrushes, cattails, sedges, rushes, spikerushes) occupy shallow areas within and alongside open water communities. | With the exception of small natural depressions next to springs (i.e., Double-O Spring), this community type has been maintained through active and intensive management.<br><br>Occasional drawdowns (drought) oxidize and consolidate substrates to facilitate the germination of submergent vegetation such as sago pondweed. When pond and lake bottoms are exposed, production of smartweed and other desirable native colonizers also is often quite high, especially on mudflats in shallow benches. | Aging infrastructure and management of vegetation within water delivery systems pose challenges in ensuring ready and consistent water availability.<br><br>Invasive species such as carp and reed canarygrass.<br><br>Historical ditches and canals and the removal of beaver have altered hydrology. |

| **Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class)** | **Natural Processes Responsible for these Conditions** | **Limiting Factors** |
|---|---|---|
| **Dry Meadow** | | |
| Moist meadows typically occupy the transition zone between wet meadow and upland plant communities.<br><br>Dominant native grass species include creeping wildrye, bluejoint, and Nevada bluegrass. Native forbs include slender cinquefoil, western yarrow, and lanceleaf goldenweed. | Soils are similar to those of wet meadow communities, but are generally located in slightly elevated areas with increased aerobic conditions during the growing season.<br><br>Depth to water table typically ranges from 0 to -12 inches during the growing season. | Native forb understory has been greatly decreased through competition with invasive species and noxious weed treatment.<br><br>These communities are highly susceptible to invasion by perennial pepperweed.<br><br>Due to the introduction of irrigation infrastructure and the leveling of some meadows in the early twentieth century, the extent of this community has likely been reduced. |
| **Salt Desert Scrub** | | |
| This plant community resides in barren alkali flats or alkaline valley bottomlands. It consists of widely spaced shrubs with dense patches of rhizomatous grasses with low densities of other annual and perennial grasses and succulent forbs.<br><br>Plant species include black greasewood, inland saltgrass, alkali sacaton, alkali cordgrass, and alkali bluegrass. Mat muhly and Sandberg bluegrass may be present in mosaics, which exhibit more moderate conditions (lower pH). | Infrequent inundation of outer playa areas or wind erosion from these playas distributes salts to nearby low-lying areas, causing elevations in alkalinity and pH, which favor this community association. | Heavy livestock grazing may compromise plant species diversity in more moderate areas within this plant community type. |
| **Sagebrush Lowland** | | |
| Commonly found in swales, toeslopes, the base of alluvial fans, and adjacent to moist meadow communities within the Blitzen Valley.<br><br>Native plant species include native | Sites are moist or wet in the spring and dry by mid-summer.<br><br>Associated species are fairly tolerant of high soil sodium | Susceptible to invasive plants such as cheatgrass and perennial pepperweed invasion.<br><br>Historical livestock grazing |

| Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class) | Natural Processes Responsible for these Conditions | Limiting Factors |
|---|---|---|
| shrubs (e.g., Wyoming big sagebrush, basin big sagebrush, rabbitbrush, bitterbrush, and horsebrush) interspersed with bunchgrasses such as basin wildrye, Sandberg bluegrass, crested wheatgrass, needle and thread, and Indian ricegrass.<br><br>These sites are typically forb-poor. | content and alkalinity.<br><br>Soils are generally deep and have moderate water-holding capacity (sandy loams). | decreased plant species diversity in many of these areas. |
| **Sagebrush Steppe** | | |
| This community is dominated by shrubs with an understory of various bunchgrass and forb species found within interspaces. It can be found above greasewood/basin big sagebrush communities on various aspects, slopes, and soil types.<br><br>Plant species include Wyoming big sagebrush, low sagebrush, bluebunch wheatgrass, Sandberg bluegrass, bottlebrush squirreltail, Idaho fescue, needle and thread, Thurber's needlegrass, western yarrow, arrowleaf balsamroot, and various locoweed and phlox species. | A gradient in soil depth determines whether Wyoming big sagebrush or low sagebrush dominates a site. Low sagebrush sites typically host higher densities of forbs due to higher concentrations of available soil moisture due to shallow, rocky conditions.<br><br>These communities depend on natural fire cycles or equivalent disturbances to maintain a balance between shrub, grass, and forb components. A lack of disturbance lends itself to high shrub densities with sparse vegetation in the interspaces. | Invasive plants (especially cheatgrass) have compromised many sites from recovering naturally from wildfire.<br><br>Livestock grazing<br><br>Juniper encroachment from historical fire suppression greatly reduced native shrub densities and increased soil erosion.<br><br>Medusahead infests clay sites and is capable of out-competing native grasses and forbs in the understory.<br><br>Much of this habitat has been replaced on the Refuge with crested wheatgrass monocultures after wildfires. |
| **Dune** | | |
| Open sand dunes hosting with widely spaced shrubs, grasses, and forbs located adjacent to playa basins.<br><br>Shrubs include shortspine horsebrush, fourwing saltbush, bud sagebrush, green and gray rabbitbrush, and basin big sagebrush. Grasses include Indian | These plant communities are created by wind erosion off nearby dry playa bottoms (i.e., Stinking Lake and Harney Lake).<br><br>As sites deteriorate (loss of vegetative cover and increased | Susceptible to invasion by halogeton, povertyweed, and Russian thistle<br><br>Agricultural practices have altered plant community composition and succession in many dune areas. |

| Characteristics of the Community (Structure, Seral Stage, Species Composition, Age Class) | Natural Processes Responsible for these Conditions | Limiting Factors |
|---|---|---|
| ricegrass, needle and thread, bottlebrush squirreltail, and alkali sacaton. Forbs include tufted evening primrose, Paiute suncup, Geyer's milkvetch, sharpleaf penstemon, and various lupines. | wind erosion), a shift toward black greasewood and inland saltgrass is possible.<br><br>Soils are formed by lacustrine sands and are neutral to moderately alkaline (pH 8.2). They are moist in the winter and spring and are usually dry June through October.<br><br>Low available water capacity on or near the soil surface limits the survival of seedlings.<br><br>Drought-prone | |
| **Playa** | | |
| Virtually no vascular plants reside within Harney and Stinking lakes, with the exception of spring areas where steady freshwater inflows modify water chemistry.<br><br>High water events provide temporary opportunities for aquatic plants and animals (i.e., sago pondweed and tui chub) to increase.<br><br>These systems are rich in invertebrates such as brine flies and brine shrimp. | Evaporation of closed basin water results in high levels of alkalinity and associated pH.<br><br>Dilution during high water events stimulates temporary production of aquatic species.<br><br>Soils are typically very deep and poorly drained and were formed in volcanic lacustrine deposits. Texture commonly consists of silty clay loam and is strongly alkaline (10.5), with pH dropping to 8.0 at approximately 50 inches depth. | Altered irrigation/water movement patterns may have disrupted natural water level cycles (particularly in Stinking Lake). |

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*Mule deer buck*
©Barbara Wheeler

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## *Statement of Compliance*


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The following executive orders and legislative acts have been reviewed as they apply to the implementation of the Comprehensive Conservation Plan (CCP) for Malheur National Wildlife Refuge, located in Oregon.

**National Environmental Policy Act (1969) (42 U.S.C. 4321 et seq.).** The planning process has been conducted in accordance with National Environmental Policy Act (NEPA) Implementing Procedures, with Department of Interior and Fish and Wildlife Service procedures, and in coordination with the affected public. The requirements of NEPA (42 U.S.C. 4321 et seq.) and its implementing regulations in 40 C.F.R. 1500-1508 have been satisfied in the procedures used to reach this decision. These procedures included the development of a range of alternatives for the Malheur Refuge CCP; analysis of the likely effects of each alternative; and public involvement throughout the planning process. The affected public was notified of the availability of documents through Federal Register notices, news releases to local newspapers, the Service's refuge planning website, and planning updates. Copies of the final CCP have been distributed to an extensive mailing list. In addition, the Service hosted a variety of public scoping events in 2009 (see Appendix J).

**National Historic Preservation Act (1966) (16 U.S.C. 470 et seq.).** The management of the archaeological and cultural resources of Malheur Refuge will comply with the regulations of Section 106 of the National Historic Preservation Act (NHPA). No historic properties are known to be affected by the proposed action based on the criteria of an effect or adverse effect as an undertaking defined in 36 C.F.R. 800.9 and Service Manual 614 FW 2; however, determining whether a particular action has the potential to affect cultural resources is an ongoing process that occurs as step-down and site-specific project plans are developed. Should historic properties be identified or acquired in the future, the Service will comply with the NHPA if any management actions have the potential to affect any of these properties.

**Endangered Species Act (16 U.S.C. 1531-1544).** This Act provides for the conservation of threatened and endangered species of fish, wildlife, and plants by Federal action and by encouraging the establishment of state programs. Documentation is required under Section 7 of the Act. Refuge policy requires the Refuge Manager to document issues that affect or may affect endangered species before initiating projects. At this time there are no species listed as endangered or threatened inhabiting the Refuge. Effects to candidate species have been considered and are described in Chapter 6 of the CCP/EIS and in the Compatibility Determinations (Appendix B). Consultation on specific projects will be conducted prior to implementation to avoid any adverse impacts to these species and their habitat.

**Executive Order 12372, Intergovernmental Review.** Coordination and consultation with affected tribal, local, and state governments, other Federal agencies, and local interested persons has been completed through personal contact by Refuge staff and Refuge supervisors.

**Executive Order 11988, Floodplain Management.** Under this order, Federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." The CCP is consistent with Executive Order 11988 because CCP implementation would maintain a number of dams and diversions on the Blitzen River system, which would minimize impacts to human safety, health, and welfare, from floods. The proposed action may restore floodplain connectivity along the Blitzen River system when and where feasible. In the interim, managed wetlands, marshes, and meadows located in the historical floodplain will continue to contribute to the natural and beneficial fish and wildlife resource values unique to the area.

**Wilderness Act of 1964.** The Service has evaluated the suitability of the Refuge for wilderness designation (Appendix D) through the "Inventory" phase according to the guidelines of the Wilderness Review process as described in 610 FW 4. In this inventory (Phase I), the Harney Lake Unit was found to meet the minimum wilderness criteria for size, naturalness, and outstanding opportunities for solitude and primitive/unconfined recreation. A total of 31,157 acres were found to have wilderness characteristics. Based on the findings in this inventory, Harney Lake will be further evaluated in the "Study" phase as a step-down process to the CCP.

**Executive Order 11990, Protection of Wetlands.** The CCP is consistent with Executive Order 11990 because CCP implementation would potentially enhance and restore wetland resources on the Refuge.

**National Wildlife Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee).** The National Wildlife Refuge System Improvement Act (Public Law 105-57, Improvement Act) requires the Service to develop and implement a CCP for each refuge. The CCP identifies and describes Refuge purposes; Refuge vision and goals; fish, wildlife, and plant populations and related habitats in the Refuge; archaeological and cultural values of the Refuge; issues that may affect populations and habitats of fish, wildlife, and plants; actions necessary to restore and improve biological diversity on the Refuge; and opportunities for wildlife-dependent recreation, as required by the Act. During our planning process, the Refuge Manager evaluated all the Refuge's existing and proposed uses for appropriateness. The Refuge's priority wildlife-dependent uses—wildlife observation, interpretation, photography, environmental education, waterfowl hunting, upland game hunting, and fishing—are automatically deemed appropriate under Service policy. Other uses were found to be appropriate, including commercial tours and photography, grazing and haying, gathering culturally important plants, conducting research, and farming. We completed compatibility determinations for all of the appropriate uses.

**Executive Order 12898. Federal Actions to Address Environmental Justice in Minority and Low-Income Populations.** All Federal actions must address and identify, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations, low-income populations, and Indian tribes in the United States. The CCP was evaluated, and no adverse human health or environmental effects were identified for minority or low-income populations, Indian tribes, or anyone else.

**Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds.** This Order directs agencies to take certain actions to further implement the Migratory Bird Treaty Act. A provision of the Order directs Federal agencies to consider the impacts of their activities, especially in reference to birds on the Fish and Wildlife Service's list of Birds of Conservation Concern. It also directs agencies to incorporate conservation recommendations and objectives in the North American Waterbird Conservation Plan and bird conservation plans developed by Partners in Flight into agency planning as described in Chapter 1. The effects of all alternatives to Refuge habitats used by migratory birds were assessed within the CCP/EIS.

**Executive Order 13175, Consultation and Coordination with Indian Tribal Governments.** As required under the Secretary of the Interior's Secretarial Order 3206—American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act—the Project Leader notified and consulted interested tribes. The Service consulted with the Burns Paiute Tribe throughout the Service's planning process.

**Architectural Barriers Act of 1968.** This Act requires facilities designed, built, altered, or leased with Federal funds to be accessible for persons with mobility impairments. Accessibility planning was integrated into our CCP process, and specific actions are identified in Chapter 2 of the CCP.

**Integrated Pest Management.** This plan conforms to Department of the Interior Pesticide Use Policy as described in 517 DM 1.1 and the Service's Integrated Pest Management (569 FW 1) policy. An integrated pest management approach has been adopted to eradicate, control, or contain pest and invasive species on the Refuge. In accordance with 517 DM 1, only pesticides registered with the Environmental Protection Agency (EPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act and as provided in regulations, orders, or permits issued by EPA may be applied on lands and waters under Refuge jurisdiction.

Chief, Division of Planning
Visitor Services and Transportation

1-24-2013
Date

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*Carp*
USFWS

# Appendix G
## Integrated Pest Management Plan


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# G.1 Background

Integrated Pest Management (IPM) is an interdisciplinary approach using methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on refuge lands and waters to achieve wildlife and habitat management goals and objectives. IPM is also a scientific, adaptive management process where available scientific information and best professional judgment of the refuge staff as well as other resource experts are used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. In accordance with 43 CFR 46.145, adaptive management is particularly relevant where long-term impacts may be uncertain, and future monitoring will be needed to make adjustments in subsequent implementation decisions. After a tolerable pest population (threshold) is determined considering the achievement of refuge resource objectives and the ecology of pest species, one or more methods, or combinations thereof, will be selected that are feasible, efficacious, and most protective of non-target resources, including native species (fish, wildlife, and plants), and Service personnel, Service-authorized agents, volunteers, and the public. Staff time and available funding will be considered when determining feasibility/practicality of various treatments.

IPM techniques to address pests are presented as CCP strategies (see Chapter 2 of this CCP) in an adaptive management context to achieve refuge resource objectives. In order to satisfy requirements for IPM planning as identified in the Director's Memo (dated September 9, 2004) entitled *Integrated Pest Management Plans and Pesticide Use Proposals: Updates, Guidance, and an Online Database*, the following elements of an IPM program have been incorporated into this CCP:

- Habitat and/or wildlife objectives that identify pest species and appropriate thresholds to indicate the need for and successful implementation of IPM techniques; and
- Monitoring before and/or after treatment to assess progress toward achieving objectives including pest thresholds.

Where pesticides would be necessary to address pests, this appendix provides a structured procedure to evaluate the potential effects of proposed uses involving ground-based applications to refuge biological resources, and environmental quality in accordance with effects analyses which were presented in Chapter 6, Environmental Effects, of the Final Malheur Refuge CCP/EIS. Only pesticide uses that would likely cause minor, temporary, or localized effects to refuge biological resources and environmental quality with appropriate best management practices (BMPs), where necessary, would be allowed for use on the refuge.

This appendix does not describe the more detailed process to evaluate potential effects associated with aerial applications of pesticides. Moreover, it does not address the effects of mosquito control with pesticides (larvicides, pupacides, or adulticides) based upon identified human health threats and presence of disease-carrying mosquitoes in sufficient numbers from monitoring conducted on a refuge. However, the basic framework to assess potential effects to refuge biological resources and environmental quality from aerial application of pesticides or use of insecticides for mosquito management would be similar to the process described in this appendix for ground-based treatments of other pesticides.

## G.2 Pest Management Laws and Policies

In accordance with Service policy 569 FW 1 (Integrated Pest Management), plant, invertebrate, and vertebrate pests on units of the National Wildlife Refuge System can be controlled to ensure balanced wildlife and fish populations in support of refuge-specific wildlife and habitat management objectives. Pest control on federal (refuge) lands and waters also is authorized under the following legal mandates:

- National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd-668ee);
- Plant Protection Act of 2000 (7 USC 7701 et seq);
- Noxious Weed Control and Eradication Act of 2004 (7 USC 7781-7786, Subtitle E);
- Federal Insecticide, Fungicide, and Rodenticide Act of 1996 (7 USC 136-136y);
- National Invasive Species Act of 1996 (16 USC 4701);
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC 4701);
- Food Quality Protection Act of 1996 (7 USC 136);
- Executive Order 13148, Section 601(a);
- Executive Order 13112; and
- Animal Damage Control Act of 1931 (7 USC 426-426c, 46 Stat. 1468).

Pests are defined as "…living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety" by Department policy 517 DM 1 (Integrated Pest Management Policy). Similarly, 569 FW 1 defines pests as "…invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." 517 DM 1 also defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Throughout the remainder of this CCP, the terms *pest* and *invasive species* are used interchangeably because both can prevent/impede achievement of refuge wildlife and habitat objectives and/or degrade environmental quality.

In general, control of pests (vertebrate or invertebrate) on a refuge would conserve and protect the nation's fish, wildlife, and plant resources as well as maintain environmental quality. Per 569 FW 1, animal or plant species that are considered pests may be managed if the following criteria are met:

- Threat to human health and well-being or private property, the acceptable level of damage by the pest has been exceeded, or state or local government has designated the pest as noxious;
- Detrimental to resource objectives as specified in a refuge resource management plan (e.g., comprehensive conservation plan, habitat management plan), if available; and
- Control would not conflict with attainment of resource objectives or the purposes for which the refuge was established.

The specific justifications for pest management activities on the refuge are the following:

- Protect human health and well-being;
- Prevent substantial damage to important refuge resources;
- Protect newly introduced native species or re-establish them;

- Control non-native (exotic) species in order to support existence for populations of native species;
- Prevent damage to private property; and
- Provide the public with quality, compatible wildlife-dependent recreational opportunities.

In accordance with Service policy 620 FW 1 (Habitat Management Plans), there are additional management directives regarding invasive species found on refuges:

- "We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere."
- "Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and prevent new and expanded infestations of invasive species. Conduct refuge habitat management activities to prevent, control, or eradicate invasive species..."

Animal species damaging/destroying federal property and/or detrimental to the management program of a refuge may be controlled as described in 50 CFR 31.14 (Official Animal Control Operations). For example, the incidental removal of beavers damaging refuge infrastructure (e.g., clogging, with subsequent damage of water control structures) and/or negatively affecting habitats (e.g., removing woody species from existing or restored riparian zones) managed on refuge lands may be conducted without a pest control proposal. We recognize beavers are native species and most of their activities on refuge lands represent a natural process beneficial for maintaining wetland habitats. Though currently not found on the refuge, exotic nutria can also be controlled using the most effective techniques considering site-specific factors without a pest control proposal. Along with the loss of quality wetland habitats associated with breaching of impoundments, the safety of refuge staff and the public (e.g., auto tour routes) can be under threat when they drive on structurally compromised levees and dikes that may result in sudden and unexpected cave-ins.

Trespass and feral animals also may be controlled on refuge lands. Based upon 50 CFR 28.43 (Destruction of Dogs and Cats), dogs and cats running at large on a national wildlife refuge and observed in the act of killing, injuring, harassing, or molesting humans or wildlife may be disposed of in the interest of public safety and protection of the wildlife. Feral animals should be disposed by the most humane method(s) available and in accordance with relevant Service directives (including Executive Order 11643). Disposed wildlife specimens may be donated or loaned to public institutions. Donation or loans of resident wildlife species will only be made after securing state approval (50 CFR 30.11 [Donation and Loan of Wildlife Specimens]). Surplus wildlife specimens may be sold alive or butchered, dressed, and processed subject to federal and state laws and regulations (50 CFR 30.12 [Sale of Wildlife Specimens]).

## G.3 Strategies

To fully embrace IPM as identified in 569 FW 1, the following strategies, where applicable, would be carefully considered on the refuge for each pest species:

- **Prevention.** This would be the most effective and least expensive long-term management option for pests. It encompasses methods to prevent new introductions or the spread of established pests to un-infested areas. It requires identifying potential routes of invasion to reduce the likelihood of infestation. Hazard Analysis and Critical Control Points (HACCP) planning can be used to determine if current management activities on a refuge may introduce and/or spread invasive species in order to identify appropriate BMPs for prevention. See http://www.haccp-nrm.org/ for more information about HACCP planning.

Prevention may include source reduction, using pathogen-free or weed-free seeds or fill, exclusion methods (e.g., barriers), and/or sanitation methods (e.g., wash stations) to prevent re-introductions by various mechanisms including vehicles, personnel, livestock, and horses. Because invasive species are frequently the first to establish newly disturbed sites, prevention would require a reporting mechanism for early detection of new pest occurrences with quick response to eliminate any new satellite pest populations. Prevention would also require consideration of the scale and scope of land management activities that may promote pest establishment within un-infested areas or promote reproduction and spread of existing populations. Along with preventing initial introduction, prevention would involve halting the spread of existing infestations to new sites (Mullin et al. 2000). The primary reason for prevention would be to keep pest-free lands or waters from becoming infested. Executive Order 11312 emphasizes the priority for prevention with respect to managing pests.

The following would be methods to prevent the introduction and/or spread of pests on refuge lands:

- Before beginning ground-disturbing activities (e.g., disking, scraping), inventory and prioritize pest infestations in project operating areas and along access routes. Refuge staff would identify pest species on-site or within reasonably expected potential invasion vicinity. Where possible, the refuge staff would begin project activities in un-infested areas before working in pest-infested areas.
- The refuge staff would locate and use pest-free project staging areas. They would avoid or minimize travel through pest-infested areas or restrict it to those periods when spread of seed or propagules of invasive plants would be least likely.
- The refuge staff would determine the need for and, when appropriate, identify sanitation sites where equipment can be cleaned of pests. Where possible, the refuge staff would clean equipment at on-refuge approved cleaning site(s) before entering project lands. This practice does not pertain to vehicles traveling frequently in and out of the project area that will remain on roadways. Seeds and plant parts of pest plants would need to be collected, where practical. The refuge staff would remove mud, dirt, and plant parts from project equipment before moving it into a project area.
- The refuge staff would clean all equipment before leaving the project site, if operating in areas infested with pests. The refuge staff would determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned.
- Refuge staff, their authorized agents, and refuge volunteers would, where possible, inspect, remove, and properly dispose of seed and parts of invasive plants found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and then properly discarding of them (e.g., incinerating).
- The refuge staff would evaluate options, including closure, to restrict the traffic on sites with ongoing restoration of desired vegetation. The refuge staff would revegetate disturbed soil (except travel ways on surfaced projects) to optimize plant establishment for each specific site. Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching as necessary. The refuge staff would use

native material, where appropriate and feasible. They would also use certified weed-free or weed- and seed-free hay or straw where certified materials are reasonably available.

- The refuge staff would provide information, training, and appropriate pest identification materials to permit holders and recreational visitors. The refuge staff would educate them about pest identification, biology, impacts, and effective prevention measures.
- The refuge staff would require grazing permittees to use preventative measures for their livestock while on refuge lands.
- The refuge staff would inspect borrow material for invasive plants prior to use and transport onto and/or within refuge lands.
- The refuge staff would consider invasive plants when planning for road maintenance activities.
- The refuge staff would restrict off-road travel to designated routes.

The following are methods to prevent the introduction and/or spread of pests into refuge waters:

- The refuge staff would inspect boats (including air boats), trailers, and other boating equipment. Where possible, the refuge staff would remove any visible plants, animals, or mud before leaving any waters or boat launching facilities. Where possible, the refuge staff would drain water from motor, live well, bilge, and transom wells while on land before leaving the site. If possible, the refuge staff would wash and dry boats, downriggers, anchors, nets, floors of boats, propellers, axles, trailers, and other boating equipment to kill pests not visible at the boat launch.
- Where feasible, the refuge staff would maintain a l00-foot buffer of aquatic pest-free clearance around boat launches and docks or quarantine areas when cleaning around culverts, canals, or irrigation sites. Where possible, the refuge staff would inspect and clean equipment before moving to new sites or one project area to another.

These prevention methods to minimize/eliminate the introduction and/or spread of pests were taken verbatim or slightly modified from Appendix E of the *Pacific Northwest Region Invasive Plant Program Final Environmental Impact Statement* (U.S. Forest Service 2005).

- **Mechanical/Physical Methods.** These methods would remove and destroy, disrupt the growth of, or interfere with the reproduction of pest species. For plant species, these treatments can be accomplished by hand, hand tools (manual), or power tools (mechanical) and include pulling, grubbing, digging, tilling/disking, cutting, swathing, grinding, sheering, girdling, mowing, and mulching of the pest plants.

  For animal species, Service employees or their authorized agents could use mechanical/physical methods (including trapping) to control pests as a refuge management activity. Based upon 50 CFR 31.2, trapping can be used on a refuge to reduce surplus wildlife populations for a “balanced conservation program” in accordance with federal or state laws and regulations. In some cases, non-lethally trapped animals would be relocated to off-refuge sites with prior approval from the state.

  Each of these tools would be efficacious to some degree and applicable to specific situations. In general, mechanical methods can effectively control annual and biennial pest plants. However, to control perennial plants, the root system has to be destroyed or it would re-sprout and continue to grow and develop. Mechanical controls are typically not capable of destroying a perennial plant's root system. Although some mechanical tools (e.g., disking, plowing) may damage root systems, they may stimulate regrowth, producing a denser plant population that may aid in the spread of the plant, depending upon the target species (e.g., Canada thistle). In addition, steep terrain and soil conditions would be major factors that can limit the use of many mechanical control methods.

Some mechanical control methods (e.g., mowing), which would be used in combination with herbicides, can be very effective techniques to control perennial species. For example, mowing perennial plants followed sequentially by treating the plant regrowth with a systemic herbicide would often improve the efficacy of the herbicide compared to herbicide treatment alone.

- **Horticultural Methods.** These methods involve manipulating habitat to increase pest mortality by reducing its suitability to the pest. Horticultural methods would include water-level manipulation, mulching, planting winter cover crops, changing planting dates to minimize pest impact, prescribed burning (which facilitates revegetation, increases herbicide efficacy, and removes litter to assist in emergence of desirable species), flaming with propane torches, planting trap crops, introducing crop rotations that include non-susceptible crops, moisture management, addition of beneficial insect habitat, reducing clutter, proper trash disposal, planting or seeding desirable species to shade or outcompete invasive plants, applying fertilizer to enhance desirable vegetation, prescriptive grazing, and other habitat alterations.

- **Biological Control Agents.** Classical biological control would involve the deliberate introduction and management of natural enemies (parasites, predators, or pathogens) to reduce pest populations. Many of the most ecologically or economically damaging pest species in the United States originated in foreign countries. These newly introduced pests, which are free from natural enemies found in their country or region of origin, may have a competitive advantage over cultivated and native species. This competitive advantage often allows introduced species to flourish, and they may cause widespread economic damage to crops or outcompete and displace native vegetation. Once the introduced pest species' population reaches a certain level, traditional methods of pest management may be cost prohibitive or impractical. Biological controls typically are used when these pest populations have become so widespread that eradication or effective control would be difficult or no longer practical.

  Biological control has advantages as well as disadvantages. Benefits include reducing pesticide usage, host specificity for target pests, long-term self-perpetuating control, low cost per acre, capacity for searching and locating hosts, synchronizing biological control agents to hosts' life cycles, and the unlikelihood that hosts will develop resistance to agents. Disadvantages would include the following: limited availability of agents from their native lands, the dependence of control on target species density, slow rate at which control occurs, biotype matching, the difficulty and expense of conflicts over control of the target pest, and host specificity when host populations are low.

  A reduction in target species' populations from biological controls is typically a slow process, and efficacy can be highly variable. It may not work well in a particular area even though it works in another area. Biological control agents require specific environmental conditions to survive over time. Some of these conditions are understood, whereas others are only partially understood or not at all.

Biological control agents do not eradicate a target pest. When using biological control agents, residual levels of the target pest typically are expected; the agent population level or survival would be dependent upon the density of its host. After the pest population decreases, the population of the biological control agent would decrease correspondingly. This is a natural cycle. Some pest populations (e.g., invasive plants) tend to persist for several years after a biological control agent becomes established due to seed reserves in the soil, inefficiencies in the agent's search behavior, and the natural lag in population buildup of the agent.

The full range of pest groups potentially found on refuge lands and waters include microorganisms, invertebrates (insects, mollusks), vertebrates, and invasive plants (the most common group). Often it is assumed that biological control would address many, if not most, of these pest problems. There are several well-documented success stories of biological control of invasive weed species in the Pacific Northwest including Mediterranean sage, St. John's wort (Klamath weed), and tansy ragwort. Emerging success stories include Dalmatian toadflax, diffuse knapweed, leafy spurge, purple loosestrife, and yellow star thistle. However, historically, each new introduction of a biological control agent in the United States has only about a 30 percent success rate (Coombs et al. 2004). Refer to Coombs et al. (2004) for the status of biological control agents for invasive plants in the Pacific Northwest.

Introduced species without desirable close relatives in the United States would generally be selected as biological controls. Natural enemies that are restricted to one or a few closely related plants in their country of origin are targeted as biological controls (Center et al. 1997; Hasan and Ayres 1990).

The refuge staff would ensure introduced agents are approved by the applicable authorities. Except for a small number of formulated biological control products registered by U.S. Environmental Protection Agency (USEPA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), most biological control agents are regulated by the U.S. Department of Agriculture's (USDA's) Animal Plant Health Inspection Service - Plant Protection and Quarantine (APHIS-PPQ). State departments of agriculture and, in some cases, county agricultural commissioners or weed districts have additional approval authority.

Federal permits (USDA-APHIS-PPQ Form 526) are required to import biocontrol agents from another state. Form 526 may be obtained by writing to:

> USDA-APHIS-PPQ
> Biological Assessment and Taxonomic Support
> 4700 River Road, Unit 113
> Riverdale, MD 20737

or

> through the Internet at:
> http://www.aphis.usda.gov/ppq/permits/bioligical/weedbio.html.

The Service strongly supports the development and legal and responsible use of appropriate, safe, and effective biological control agents for nuisance and non-indigenous or pest species.

State and county agriculture departments may also be sources for biological control agents or they may have information about where biological control agents may be obtained. Commercial sources should have an Application and Permit to Move Live Plant Pests and Noxious Weeds (USDA-PPQ Form 226 USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, MD 20737) to release specific biological control agents in a state and/or county. Furthermore, certification regarding the biological control agent's identity (genus, specific epithet, subspecies, and variety) and purity (e.g., parasite free, pathogen free, and biotic and abiotic contaminants) should be specified in purchase orders.

Biological control agents are subject to 7 RM 8 (Exotic Species Introduction and Management). In addition, the refuge staff would follow the International Code of Best Practice for Classical Biological Control of Weeds as ratified by delegates to the International Symposium on Biological Control of Weeds (Balciunas 2000). This code identifies the following:

- Release only approved biological control agents,
- Use the most effective agents,
- Document releases, and
- Monitor for impact to the target pest, non-target species, and the environment.

Biological control agents formulated as pesticide products and registered by the USEPA (e.g., Bti) are also subject to pesticide use proposals (PUP) review and approval (see below).

A record of all releases would be maintained with date(s), location(s), and environmental conditions of the release site(s); the identity, quantity, and condition of the biological control agents released; and other relevant data and comments such as weather conditions. Systematic monitoring to determine the establishment and effectiveness of the release is also recommended.

National Environmental Policy Act (NEPA) documents regarding biological and other environmental effects of biological control agents prepared by another federal agency, where the scope is relevant to evaluation of releases on refuge lands, would be reviewed. Possible source agencies for such NEPA documents include the Bureau of Land Management (BLM), the U.S. Forest Service, the National Park Service, the USDA-APHIS, and the military services. It might be appropriate to incorporate, by reference, parts or all of existing document(s) from the review. Incorporating by reference (43 CFR 46.135) is a technique used to avoid redundancies in analysis. It also can reduce the bulk of a Service NEPA document, which must only identify the documents that are incorporated by reference. In addition, relevant portions must be summarized in the Service NEPA document to the extent necessary to provide the decision maker and public with an understanding of the relevance of the referenced material to the current analysis.

- **Pesticides.** The selective use of pesticides would be based upon pest ecology (including mode of reproduction), the size and distribution of pest populations, site-specific conditions (e.g., soils, topography), known efficacy under similar site conditions, and the capability to use BMPs to reduce/eliminate potential effects to non-target species and sensitive habitats, and the potential to contaminate surface and groundwater. All pesticide usage (pesticide, target species, application rate, and method of application) would comply with the applicable federal (FIFRA) and state regulations pertaining to pesticide use, safety, storage, disposal, and reporting. Before pesticides can be used to eradicate, control, or contain pests on refuge lands and waters, PUPs would be prepared and approved in accordance with 569 FW 1. PUP records would provide a detailed time-, site-, and target-specific description of the proposed use of pesticides on the refuge. All PUPs would be created, approved, or disapproved, and stored in the pesticide use proposal system (PUPS), which is a centralized database only accessible on the Service's intranet (https://systems.fws.gov/pups). Only Service employees would be authorized to access PUP records for a refuge in this database.

Application equipment would be selected to provide site-specific delivery to target pests while minimizing/eliminating direct or indirect (e.g., drift) exposure to non-target areas and degradation of surface and groundwater quality. Where possible, target-specific equipment (e.g., backpack sprayer, wiper) would be used to treat target pests. Other target-specific equipment to apply pesticides would include soaked wicks or paint brushes for wiping vegetation and lances, hatchets, or syringes for direct injection into stems. Granular pesticides may be applied using seeders or other specialized dispensers. In contrast, aerial spraying (e.g., fixed wing or helicopter) would only be used where access is difficult (remoteness) and/or the size/distribution of infestations precludes practical use of ground-based methods.

Because repeated use of one pesticide may allow resistant organisms to survive and reproduce, multiple pesticides with variable modes of action would be considered for treatments on refuge lands and waters. This is especially important if multiple applications within years and/or over a growing season would likely be necessary for habitat maintenance and restoration activities to achieve resource objectives. Integrated chemical and non-chemical controls also are highly effective, where practical, because pesticide-resistant organisms can be removed from the site.

Cost may not be the primary factor in selecting a pesticide for use on a refuge. If the least expensive pesticide would potentially harm natural resources or people, then a different product would be selected, if available. The most efficacious pesticide available with the least potential to degrade environment quality (soils, surface water, and groundwater) as well as the least potential to impact native species and communities of fish, wildlife, plants, and their habitats would be acceptable for use on refuge lands in the context of an IPM approach.

- **Habitat Restoration/Maintenance.** Restoration and/or proper maintenance of refuge habitats associated with achieving wildlife and habitat objectives would be essential for long-term prevention, eradication, or control (at or below threshold levels) of pests. Promoting desirable plant communities through the manipulation of species composition, plant density, and growth rate is an essential component of invasive plant management (Brooks et al. 2004; Masters and Sheley 2001; Masters et al. 1996). The following three components of succession could be manipulated through habitat maintenance and restoration: site availability, species availability, and species performance (Cox and Anderson 2004). Although a single method (e.g., herbicide treatment) may eliminate or suppress pest species in the short term, the resulting gaps and bare soil create niches that are conducive to further invasion by the species and/or other invasive plants. On degraded sites where desirable species are absent or in low abundance, revegetation with native/desirable grasses, forbs, and legumes may be necessary to direct and accelerate plant community recovery and achieve site-specific objectives in a reasonable time frame. The selection of appropriate species for revegetation would be dependent on a number of factors including resource objectives and site-specific abiotic factors (e.g., soil texture, precipitation/temperature regimes, and shade conditions). Seed availability and cost, ease of establishment, seed production, and competitive ability would also be important considerations.

## G.4 Priorities for Treatments

For many refuges, the magnitude (number, distribution, and sizes of infestations) of pest problems is too extensive and beyond the available capital resources to effectively address during any single field season. To manage pests in the refuge, it would be essential to prioritize treatment of infestations. Highest priority treatments would be focused on early detection and rapid response to eliminate infestations of new pests, if possible. This would be especially important for aggressive pests potentially impacting species, species groups, communities, and/or habitats associated with refuge purpose(s), NWR System (NWRS) resources of concern (federally listed species, migratory birds, selected marine mammals, and interjurisdictional fish), and native species used for maintaining/restoring biological integrity, diversity, and environmental health.

The next priority would be treating established pests that appear in one or more previously un-infested areas. Moody and Mack (1988) demonstrated through modeling that small, new outbreaks of invasive plants eventually infest an area larger than the established source population. They also found that control efforts focusing on the large, main infestation rather than the new, small satellites reduced the chances of overall success. The lowest priority would be treating large infestations (sometimes monotypic stands) of well-established pests. In this case, initial efforts would focus upon containment of the perimeter followed by work to control/eradicate the established infested area. If containment and/or control of a large infestation is not effective, then efforts would focus on halting pest reproduction or managing source populations. Maxwell et al. (2009) found that treating fewer populations that are sources represents an effective long-term strategy to reduce total number of invasive populations and decreasing meta-population growth rates.

Although state-listed noxious weeds would always be of high priority for management, other pest species known to cause substantial ecological impact would also be considered. For example, cheatgrass may not be listed by a state as noxious, but it can greatly alter fire regimes in shrub steppe habitats resulting in large monotypic stands that displace native bunch grasses, forbs, and shrubs. Pest control would likely require a multi-year commitment from the refuge staff. Essential to the long-term success of pest management would be pre- and post-treatment monitoring, assessment of the successes and failures of treatments, and development of new approaches when proposed methods do not achieve desired outcomes.

## G.5 Best Management Practices

BMPs can minimize or eliminate the possible effects associated with pesticide usage to non-target species and/or sensitive habitats as well as the degradation of water quality from drift, surface runoff, or leaching. Based upon the Department of Interior Pesticide Use Policy (517 DM 1) and the Service Pest Management Policy and Responsibilities (30 AM 12), the use of applicable BMPs (where feasible) also would likely ensure that pesticide uses may not adversely affect federally listed species and/or their critical habitats through determinations made using the process described in 50 CFR 402.

The following are BMPs pertaining to mixing/handling and applying pesticides for all ground-based treatments of pesticides, which would be considered and used, where feasible, based upon target- and site-specific factors and time-specific environmental conditions. Although not listed below, the most important BMP to eliminate/reduce potential impacts to non-target resources would be an IPM approach to prevent, control, eradicate, and contain pests.

## G.5.1 Pesticide Handling and Mixing

- As a precaution against spilling, spray tanks would not be left unattended during filling.
- All pesticide containers would be triple rinsed and the rinsate would be used as water in the sprayer tank and applied to treatment areas.
- All pesticide spray equipment would be properly cleaned. Where possible, rinsate would be used as part of the make-up water in the sprayer tank and applied to treatment areas.
- The refuge staff would triple rinse and recycle (where feasible) pesticide containers.
- All unused pesticides would be properly discarded at a local “safe send” collection.
- Pesticides and pesticide containers would be lawfully stored, handled, and disposed of in accordance with the label and in a manner safeguarding human health, fish, and wildlife, and preventing soil and water contamination.
- The refuge staff would consider water quality parameters (e.g., pH, hardness) that are important to ensure greatest efficacy where specified on the pesticide label.
- All pesticide spills would be addressed immediately using procedures identified in the refuge spill response plan.

## G.5.2 Applying Pesticides

- Pesticide treatments would only be conducted by or under the supervision of Service personnel and non-Service applicators with the appropriate state certification to safely and effectively conduct these activities on refuge lands and waters.
- The refuge staff would comply with all federal, state, and local pesticide use laws and regulations as well as departmental, Service, and NWRS pesticide-related policies. For example, the refuge staff would use application equipment and apply rates for the specific pest(s) identified on the pesticide label as required under FIFRA.
- Before each treatment season and prior to mixing or applying any product for the first time each season, all applicators would review the labels, material safety data sheets (MSDSs), and PUPs for each pesticide, determining the target pest, appropriate mix rate(s), personal protective equipment (PPE), and other requirements listed on the pesticide label.
- A 1-foot no-spray buffer from the water’s edge would be used, where applicable and where it does not detrimentally influence effective control of pest species.
- Low-impact herbicide application techniques (e.g., spot treatment, cut stump, oil basal, Thinvert system applications) would be used rather than broadcast foliar applications (e.g., boom sprayer other larger tank wand applications), where practical.
- Low-volume rather than high-volume foliar applications would be used where low-impact methods listed above are not feasible or practical, to maximize herbicide effectiveness and ensure correct and uniform application rates.
- Applicators would use and adjust spray equipment to apply the coarsest droplet size spectrum with optimal coverage of the target species while reducing drift.
- Applicators would use the largest droplet size that results in uniform coverage.

- Applicators would use drift reduction technologies such as low-drift nozzles, where possible.
- Where possible, spraying would occur during low (average <7 mph and preferably 3 to 5 mph) and consistent direction wind conditions with moderate temperatures (typically <85°F).
- Where possible, applicators would avoid spraying during inversion conditions (often associated with calm and very low wind conditions) that can cause large-scale herbicide drift to non-target areas.
- Equipment would be calibrated regularly to ensure that the proper rate of pesticide is applied to the target area or species.
- Spray applications would be made at the lowest height for uniform coverage of target pests to minimize/eliminate potential drift.
- If windy conditions frequently occur during afternoons, spraying (especially boom treatments) would typically be conducted during early morning hours.
- Spray applications would not be conducted on days with >30 percent forecast for rain within 6 hours, except for pesticides that are rapidly rain fast (e.g., glyphosate in 1 hour) to minimize/eliminate potential runoff.
- Where possible, applicators would use drift retardant adjuvants during spray applications, especially adjacent to sensitive areas.
- Where possible, applicators would use a non-toxic dye to aid in identifying target area treated as well as potential overspray or drift. A dye can also aid in detecting equipment leaks. If a leak is discovered, the application would be stopped until repairs can be made to the sprayer.
- For pesticide uses associated with cropland and facilities management, buffers, as appropriate, would be used to protect sensitive habitats, especially wetlands and other aquatic habitats.
- When drift cannot be sufficiently reduced through altering equipment set up and application techniques, buffer zones may be identified to protect sensitive areas downwind of applications. The refuge staff would only spray adjacent to sensitive areas when the wind is blowing in the opposite direction.
- Applicators would utilize scouting for early detection of pests to eliminate unnecessary pesticide applications.
- The refuge staff would consider the timing of the application such that native plants are protected (e.g., senescence) while effectively treating invasive plants.
- Rinsate from cleaning spray equipment after application would be recaptured and reused or applied to an appropriate pest plant infestation.
- Application equipment (e.g., sprayer, ATV, tractor) would be thoroughly cleaned and PPE would be removed/disposed off on-site by applicators after treatments to eliminate the potential spread of pests to un-infested areas.

## G.6 Safety

### G.6.1 Personal Protective Equipment

All applicators would wear the specific PPE identified on the pesticide label. The appropriate PPE will be worn at all times during handling, mixing, and applying. PPE can include the following: disposable (e.g., Tyvek) or laundered coveralls; gloves (latex, rubber, or nitrile); rubber boots; and/or a National Institute for Occupational Safety and Health (NIOSH)–approved respirator. Because exposure to concentrated product is usually greatest during mixing, extra care should be taken while preparing pesticide solutions. Persons mixing these solutions can be best protected if they wear long gloves, an apron, footwear, and a face shield.

Coveralls and other protective clothing used during an application would be laundered separately from other laundry items. Transporting, storing, handling, mixing, and disposing of pesticide containers will be consistent with label requirements, USEPA and Occupational Safety and Health Administration (OSHA) requirements, and Service policy.

If a respirator is necessary for pesticide use, then the following requirements would be met in accordance with Service safety policy: a written Respirator Program, fit testing, physical examination (including pulmonary function and blood work for contaminants), and proper storage of the respirator.

## G.6.2 Notification

The restricted entry interval (REI) is the time period required after the application before someone may safely enter a treated area without PPE. Refuge staff, authorized management agents of the Service, volunteers, and members of the public who could be in or near a pesticide-treated area within the stated re-entry time period on the label would be notified about treatment areas. Posting would occur at any site where individuals might inadvertently become exposed to a pesticide during other activities on the refuge. Where required by the label and/or state-specific regulations, signs would also be posted on its perimeter and at other likely locations of entry. The refuge staff would also notify appropriate private property owners of an intended application, including any private individuals who have requested notification. Special efforts would be made to contact nearby individuals who are beekeepers or who have expressed chemical sensitivities.

## G.6.3 Medical Surveillance

Medical surveillance may be required for Service personnel and approved volunteers who mix, apply, and/or monitor use of pesticides (see 242 FW 7 [Pesticide Users] and 242 FW 4 [Medical Surveillance]). In accordance with 242 FW 7.12A, Service personnel would be medically monitored if one or more of the following criteria are met: exposed or may be exposed to concentrations at or above the published permissible exposure limits or threshold limit values (see 242 FW 4); use pesticides in a manner considered “frequent pesticide use”; or use pesticides in a manner that requires a respirator (see 242 FW 14 for respirator use requirements). In 242 FW 7.7A, frequent pesticide use means “when a person applying pesticide handles, mixes, or applies pesticides, with a Health Hazard rating of 3 or higher, for 8 or more hours in any week or 16 or more hours in any 30-day period.” Under some circumstances, individuals may be medically monitored even if they use pesticides infrequently, experience an acute exposure (sudden, short term), or use pesticides with a health hazard ranking of 1 or 2. This decision would consider the individual’s health and fitness level, the pesticide’s specific health risks, and the potential risks from other pesticide-related activities. Refuge cooperators (e.g., cooperative farmers) and other authorized agents (e.g., state and county employees) would be responsible for their own medical monitoring needs and costs.

Standard examinations (at refuge expense) of appropriate refuge staff would be provided by the nearest certified occupational health and safety physician as determined by Federal Occupational Health.

## G.6.4 Certification and Supervision of Pesticide Applicators

Appropriate refuge staff or approved volunteers handling, mixing, and/or applying or directly supervising others engaged in pesticide use activities would be trained and state or federally (BLM) licensed to apply pesticides to refuge lands or waters. In accordance with 242 FW 7.18A and 569 FW 1.10B, certification is required to apply restricted use pesticides based upon USEPA regulations. For safety reasons, all individuals participating in pest management activities with general use pesticides also are encouraged to attend appropriate training or acquire pesticide applicator certification. The certification requirement would be for a commercial or private applicator depending upon the state. New staff unfamiliar with proper procedures for storing, mixing, handling, applying, and disposing of herbicides and containers would receive orientation and training before handling or using any products. Documentation of training would be kept in the files at the refuge office.

## G.6.5 Record Keeping

### G.6.5.1 Labels and material safety data sheets

Pesticide labels and MSDSs would be maintained at the refuge shop and laminated copies kept in the mixing area. These documents also would be carried by field applicators, where possible. A written reference (e.g., note pad, chalk board, dry erase board) for each tank to be mixed would be kept in the mixing area for quick reference while mixing is in progress. In addition, approved PUPs stored in the PUPS database typically contain website links (URLs) to pesticide labels and MSDSs.

### G.6.5.2 Pesticide use proposals

A PUP would be prepared for each proposed pesticide use associated with annual pest management on refuge lands and waters. A PUP would include specific information about the proposed pesticide use including the common and chemical names of the pesticide(s), target pest species, size and location of treatment site(s), application rate(s) and method(s), and federally listed species determinations, where applicable.

In accordance with Service guidelines (Director's memo [December 12, 2007]), refuge staff may receive up to 5-year approvals for Washington Office– and field–reviewed proposed pesticide uses based upon meeting identified criteria including an approved IPM plan, where necessary (see http://www.fws.gov/contaminants/Issues/IPM.cfm). For a refuge, an IPM plan (requirements described herein) can be completed independently or in association with a CCP or a habitat management plant (HMP) if IPM strategies and potential environmental effects are adequately addressed within appropriate NEPA documentation.

PUPs would be created, approved or disapproved, and stored as records in the PUPS, a centralized database on the Service's intranet (https://systems.fws.gov/pups). Only Service employees can access PUP records in this database.

### G.6.5.3 Pesticide usage

In accordance with 569 FW 1, the refuge Project Leader would be required to maintain records of all pesticides annually applied on lands or waters under refuge jurisdiction. This would encompass pesticides applied by other federal agencies, state and county governments, and nongovernment applicators including cooperators and their pest management service providers with Service permission. For clarification, “pesticide” refers to all insecticides, insect and plant growth regulators, dessicants, herbicides, fungicides, rodenticides, acaricides, nematicides, fumigants, avicides, and piscicides.

The following usage information can be reported for approved PUPs in the PUPS database:

- Pesticide trade name(s)
- Active ingredient(s)
- Total acres treated
- Total amount of pesticides used (lbs or gallons)
- Total amount of active ingredient(s) used (lbs)
- Target pest(s)
- Efficacy (percentage control)

To determine whether treatments are efficacious (eradicating, controlling, or containing the target pest) and achieving resource objectives, habitat and/or wildlife response would be monitored both pre- and post-treatment, where possible. Information regarding available annual funding and staffing, characteristics (attributes) of pest infestations (e.g., area, perimeter, degree of infestation, percentage cover, density), and habitat and/or wildlife response to treatments may be collected and stored in a relational database (e.g., Refuge Habitat Management Database), preferably a geo-referenced data management system (e.g., Refuge Lands geographic information system [GIS]) to facilitate data analyses and subsequent reporting. In accordance with adaptive management, data analysis and interpretation would allow treatments to be modified or changed over time, as necessary, to achieve resource objectives considering site-specific conditions in conjunction with habitat and/or wildlife responses. Monitoring could also identify short- and long-term impacts to natural resources and environmental quality associated with IPM treatments in accordance with adaptive management principles identified in 43 CFR 46.145.

## G.7 Evaluating Pesticide Use Proposals

Pesticides would only be used on refuge lands for habitat management and croplands/facilities maintenance after approval of a PUP. In general, proposed pesticide uses on refuge lands would only be approved where there would likely be minor, temporary, or localized effects to fish and wildlife species as well as minimal potential to degrade environmental quality. Potential effects to listed and nonlisted species would be evaluated with quantitative ecological risk assessments and other screening measures. Potential effects to environmental quality would be based upon pesticide characteristics of environmental fate (water solubility, soil mobility, soil persistence, and volatilization) and other quantitative screening tools. Ecological risk assessments as well as characteristics of environmental fate and potential to degrade environmental quality for pesticides would be documented in Chemical Profiles (see Section G.7.6 of this appendix). These profiles would include threshold values for quantitative measures of ecological risk assessments and screening tools for environmental fate that represent minimal potential effects to species and environmental quality. In general, only pesticide uses with appropriate BMPs (see Section G.5 of this appendix) for habitat management and cropland/facilities maintenance on refuge lands that would potentially have minor, temporary, or localized effects on refuge biological and environmental quality (threshold values not exceeded) would be approved.

## G.7.1 Overview of Ecological Risk Assessment

An ecological risk assessment process would be used to evaluate potential adverse effects to biological resources as a result of a pesticide(s) proposed for use on refuge lands. It is an established quantitative and qualitative methodology for comparing and prioritizing risks of pesticides and conveying an estimate of the potential risk for an adverse effect. This quantitative methodology provides an efficient mechanism to integrate best available scientific information regarding hazard, patterns of use (exposure), and dose-response relationships in a manner that is useful for ecological risk decision making. It provides an effective way to evaluate potential effects where there is missing or unavailable scientific information (data gaps) to address reasonable, foreseeable adverse effects in the field as required under 40 CFR 1502.22. Protocols for ecological risk assessment of pesticide uses on the refuge were developed through research and established by the U.S. Environmental Protection Agency (2004). Assumptions for these risk assessments are presented in Section G.7.2.3 of this appendix.

The toxicological data used in ecological risk assessments are typically the results of standardized laboratory studies provided by pesticide registrants to the USEPA to meet regulatory requirements under FIFRA. These studies assess the acute (lethality) and chronic (reproductive) effects associated with short- and long-term exposure to pesticides on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. Other effects data publicly available would also be used for risk assessment protocols described herein. Toxicity endpoint and environmental fate data are available from a variety of resources.

**Table G-1. Ecotoxicity Tests Used to Evaluate Potential Effects to Birds, Fish, and Mammals to Establish Toxicity Endpoints for Risk Quotient Calculations**

| Species Group | Exposure | Measurement endpoint |
|---|---|---|
| Bird | Acute | Median Lethal Concentration ($LC_{50}$) |
| | Chronic | No Observed Effect Concentration (NOEC) or<br>No Observed Adverse Effect Concentration (NOAEC)[1] |
| Fish | Acute | Median Lethal Concentration ($LC_{50}$) |
| | Chronic | No Observed Effect Concentration (NOEC) or<br>No Observed Adverse Effect Concentration (NOAEC)[2] |
| Mammal | Acute | Oral Lethal Dose ($LD_{50}$) |
| | Chronic | No Observed Effect Concentration (NOEC) or<br>No Observed Adverse Effect Concentration (NOAEC)[3] |

[1]Measurement endpoints typically include a variety of reproductive parameters (e.g., number of eggs, number of offspring, eggshell thickness, and number of cracked eggs).
[2]Measurement endpoints for early life stage/life cycle typically include embryo hatch rates, time to hatch, growth, and time to swim-up.
[3]Measurement endpoints include maternal toxicity, teratogenic effects or developmental anomalies, evidence of mutagenicity or genotoxicity, and interference with cellular mechanisms such as DNA synthesis and DNA repair.

## G.7.2 Determining Ecological Risk to Fish and Wildlife

The potential for pesticides used on the refuge to cause direct adverse effects to fish and wildlife would be evaluated using USEPA's Ecological Risk Assessment Process (USEPA 2004). This deterministic approach, which is based upon a two-phase process involving estimation of environmental concentrations and then characterization of risk, would be used for ecological risk assessments. This method integrates exposure estimates (estimated environmental concentration [EEC] and toxicological endpoints [e.g., $LC_{50}$ and oral $LD_{50}$]) to evaluate the potential for adverse effects to species groups (birds, mammals, and fish) representative of legal mandates for managing units of the NWRS. This integration is achieved through risk quotients (RQs) calculated by dividing the EEC by acute and chronic toxicity values selected from standardized toxicological endpoints or published effect (Table G-1).

$$RQ = EEC/Toxicological\ Endpoint$$

The level of risk associated with direct effects of pesticide use would be characterized by comparing calculated RQs to the appropriate Level of Concern (LOC) established by USEPA (1998 [Table G-2]). The LOC represents a quantitative threshold value for screening potential adverse effects to fish and wildlife resources associated with pesticide use. The following are four exposure-species group scenarios that would be used to characterize ecological risk to fish and wildlife on the refuge: acute-listed species, acute-nonlisted species, chronic-listed species, and chronic-nonlisted species.

Acute risk would indicate the potential for mortality associated with short-term dietary exposure to pesticides immediately after an application. For characterization of acute risks, median values from $LC_{50}$ and $LD_{50}$ tests would be used as toxicological endpoints for RQ calculations. In contrast, chronic risks would indicate the potential for adverse effects associated with long-term dietary exposure to pesticides from a single application or multiple applications over time (within a season and over years). For characterization of chronic risks, the No Observed Concentration (NOAEC) or No Observed Effect Concentration (NOEC) for reproduction would be used as toxicological endpoints for RQ calculations. Where available, the NOAEC would be preferred over a NOEC value.

Listed species are those federally designated as threatened, endangered, or proposed in accordance with the Endangered Species Act of 1973 (16 USC 1531-1544, 87 Stat. 884, as amended-Public Law 93-205). For listed species, potential adverse effects would be assessed at the individual level because loss of individuals from a population could detrimentally impact a species. In contrast, risks to nonlisted species would consider effects at the population level. An RQ<LOC would indicate the proposed pesticide use "may affect, not likely to adversely affect" individuals (listed species) and it would not pose an unacceptable risk for adverse effects to populations (nonlisted species) for each taxonomic group (Table G-2). In contrast, an RQ>LOC would indicate a "may affect, likely to adversely affect" for listed species and it would also pose unacceptable ecological risk for adverse effects to nonlisted species.

**Table G-2. Presumption of Unacceptable Risk for Birds, Fish, and Mammals**

| Risk Presumption | | Level of Concern | |
|---|---|---|---|
| | | Listed Species | Nonlisted Species |
| Acute | Birds | 0.1 | 0.5 |
| | Fish | 0.05 | 0.5 |
| | Mammals | 0.1 | 0.5 |
| Chronic | Birds | 1.0 | 1.0 |
| | Fish | 1.0 | 1.0 |
| | Mammals | 1.0 | 1.0 |

Source: U.S. Environmental Protection Agency 1998.

## G.7.2.1 Environmental exposure

Following release into the environment through application, pesticides experience several different routes of environmental fate. Pesticides that are sprayed can move through the air (e.g., particle or vapor drift) and may eventually end up in other parts of the environment such as non-target vegetation, soil, or water. Pesticides applied directly to the soil may be washed off the soil into nearby bodies of surface water (e.g., surface runoff) or may percolate through the soil to lower soil layers and groundwater (e.g., leaching) (Baker and Miller 1999; Butler et al. 1998; EXTOXNET 1993; Pope et al. 1999; Ramsay et al. 1995). Pesticides injected into the soil may also be subject to the latter two fates. The aforementioned possibilities are by no means exhaustive, but they do indicate the movement of pesticides in the environment is very complex, with transfers occurring continually among different environmental compartments. In some cases, these exchanges occur not only between areas that are close together, but may also involve transportation of pesticides over long distances (Barry 2004; Woods 2004).

### *G.7.2.1.1 Terrestrial exposure*

The EEC for exposure to terrestrial wildlife would be quantified using an USEPA screening-level approach (USEPA 2004). This screening-level approach is not affected by product formulation because it evaluates pesticide active ingredient(s). This approach would vary depending upon the proposed pesticide application method: spray or granular.

#### *G.7.2.1.1.1 Terrestrial: spray application*

For spray applications, exposure would be determined using the Kanaga nomogram method (Pfleeger et al. 1996; USEPA 2004, 2005a) through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3 (USEPA 2005b). To estimate the maximum (initial) pesticide residue on short grass (<20 cm tall) as a general food item category for terrestrial vertebrate species, T-REX input variables would include the following from the pesticide label: maximum pesticide application rate (pounds of active ingredient [acid equivalent] per acre) and pesticide half-life (days) in soil. Although there are other food item categories (tall grasses; broadleaf plants and small insects; and fruits, pods, seeds and large insects), short grass was selected because it would yield maximum EECs (240 ppm per lb active ingredient [a.i.]/acre) for worst-case risk assessments. Short grass is not representative of forage for carnivorous species (e.g., raptors), but it would characterize the maximum potential exposure through the diet of avian and mammalian prey items. Consequently, this approach would provide a conservative screening tool for pesticides that do not biomagnify.

For RQ calculations in T-REX, the model would require the weight of surrogate species and Mineau scaling factors (Mineau et al. 1996). Body weights of bobwhite quail and mallard are included in T-REX by default, but body weights of other organisms (Table G-3) would be entered manually. The Mineau scaling factor accounts for small-bodied bird species that may be more sensitive to pesticide exposure than would be predicted only by body weight. Mineau scaling factors would be entered manually with values ranging from 1 to 1.55 that are unique to a particular pesticide or group of pesticides. If specific information to select a scaling factor is not available, then a value of 1.15 would be used as a default. Alternatively, zero would be entered if it is known that body weight does not influence toxicity of pesticide(s) being assessed. The upper bound estimate output from the T-REX Kanaga nomogram would be used as an EEC for calculation of RQs. This approach would yield a conservative estimate of ecological risk.

**Table G-3. Average Body Weight of Selected Terrestrial Wildlife Species Frequently Used in Research to Establish Toxicological Endpoints**

| Species | Body Weight (kg) |
|---|---|
| Mammal (15 g) | 0.015 |
| House sparrow | 0.0277 |
| Mammal (35 g) | 0.035 |
| Starling | 0.0823 |
| Red-winged blackbird | 0.0526 |
| Common grackle | 0.114 |
| Japanese quail | 0.178 |
| Bobwhite quail | 0.178 |
| Rat | 0.200 |
| Rock dove (aka pigeon) | 0.542 |
| Mammal (1,000 g) | 1.000 |
| Mallard | 1.082 |
| Ring-necked pheasant | 1.135 |

Source: Dunning 1984.

#### *G.7.2.1.1.2 Terrestrial: granular application*

Granular pesticide formulations and pesticide-treated seed would pose a unique route of exposure for avian and mammalian species. The pesticide is applied in discrete units, which birds or mammals might ingest accidentally with food items or intentionally as in the case of some bird species that actively seek and pick up gravel or grit to aid digestion or eat seed as a food source. Granules may also be consumed by wildlife foraging on earthworms, slugs, or other soft-bodied soil organisms to which the granules may adhere.

Terrestrial wildlife RQs for granular formulations or seed treatments would be calculated by dividing the maximum milligrams of a.i. exposed (e.g., EEC) on the surface of an area equal to 1 square foot by the appropriate $LD_{50}$ value multiplied by the surrogate's body weight (Table G-3). An adjustment to surface area calculations would be made for broadcast, banded, and in-furrow applications. An adjustment also would be made for applications with and without incorporation of the granules. Without incorporation, it would be assumed that 100 percent of the granules remain on the soil surface available to foraging birds and mammals. Press wheels push granules flat with the soil surface, but they are not incorporated into the soil. If granules are incorporated into the soil during band or T-band applications or after broadcast applications, it would be assumed only 15 percent of the applied granules remain available to wildlife. It would be assumed that only 1 percent of the granules are available on the soil surface following in-furrow applications.

EECs for pesticides applied in granular form and as seed treatments would be determined considering potential ingestion rates of avian or mammalian species (e.g., 10%–30% body weight/day). This would provide an estimate of maximum exposure that may occur as a result of granule or seed treatment spills such as those that commonly occur at end rows during application and planting. The availability of granules and seed treatments to terrestrial vertebrates would also be considered by calculating the loading per unit area ($LD_{50}/ft^2$) for comparison to USEPA LOCs (USEPA). T-REX version 1.2.3 (USEPA 2005b) contains a submodel that automates Kanaga exposure calculations for granular pesticides and treated seed.

The following formulas will be used to calculate EECs depending upon the type of granular pesticide application:

- In-furrow applications assume a typical value of 1 percent granules, bait, or seed remaining unincorporated.

$$\text{mg a.i./ft.}^2 = [(\text{lbs. product/acre})(\%\ \text{a.i.})(453{,}580\ \text{mg/lbs})(1\%\ \text{exposed}))] / \{[(43{,}560\ \text{ft.}^2/\text{acre})/(\text{row spacing (ft.)})] / (\text{row spacing (ft.)})\}$$

*or*

$$\text{mg a.i./ft}^2 = [(\text{lbs product/1,000 ft. row})(\%\ \text{a.i.})(1{,}000\ \text{ft row})(453{,}580\ \text{mg/lb})(1\%\ \text{exposed})$$

$$EEC = [(\text{mg a.i./ft.}^2)(\%\ \text{of pesticide biologically available})]$$

- Incorporated banded treatments assume a typical value of 15 percent of granules, bait, and seeds remaining unincorporated.

$$\text{mg a.i./ft.}^2 = [(\text{lbs. product/1,000 row ft.})(\%\ \text{a.i.})(453{,}580\ \text{mg/lb})(1-\%\ \text{incorporated})] / (1{,}000\ \text{ft.})(\text{band width (ft.)})$$

$$EEC = [(\text{mg a.i./ft.}^2)(\%\ \text{of pesticide biologically available})]$$

- Broadcast treatment without incorporation assumes 100 percent of granules, bait, seeds are unincorporated.

$$\text{mg a.i./ft.}^2 = [(\text{lbs. product/acre})(\%\ \text{a.i.})(453{,}590\ \text{mg/lb})] / (43{,}560\ \text{ft.}^2/\text{acre})$$

$$EEC = [(\text{mg a.i./ft.}^2)(\%\ \text{of pesticide biologically available})]$$

Where:

- o Percentage of pesticide biologically available = 100 percent without species-specific ingestion rates
- o Conversion for calculating mg a.i./ft.$^2$ using ounces is 453,580 mg/lb/16 = 28,349 mg/oz.

The following equation would be used to calculate an RQ based on the EEC calculated by one of the above equations. The EEC would be divided by the surrogate $LD_{50}$ toxicological endpoint multiplied by the body weight (Table G-3) of the surrogate.

$$RQ = EEC / [LD_{50} (mg/kg) * body\ weight\ (kg)]$$

As with other risk assessments, an RQ>LOC would be a presumption of unacceptable ecological risk. An RQ<LOC would be a presumption of acceptable risk with only minor, temporary, or localized effects to species.

### *G.7.2.1.2 Aquatic exposure*

Exposures to aquatic habitats (e.g., wetlands, meadows, ephemeral pools, water delivery ditches) would be evaluated separately for ground-based pesticide treatments of habitats managed for fish and wildlife compared with cropland/facilities maintenance. The primary exposure pathway for aquatic organisms from any ground-based treatments likely would be particle drift during the pesticide application. However, different exposure scenarios would be necessary due to contrasting application equipment and techniques as well as pesticides used to control pests on agricultural lands (especially those cultivated by cooperative farmers for economic return from crop yields) and facilities maintenance (e.g., roadsides, parking lots, trails) compared with other managed habitats on the refuge. In addition, pesticide applications may be done at <25 feet of the high water mark of aquatic habitats for habitat management treatments, whereas, no-spray buffers (≥25 feet) would be used for croplands/facilities maintenance treatments.

#### *G.7.2.1.2.1 Habitat treatments*

For the worst-case exposure scenario to non-target aquatic habitats, EECs (Table G-4) would be derived from Urban and Cook (1986), which assumes an intentional overspray to an entire, non-target water body (1 foot depth) from a treatment <25 feet from the high water mark using the max application rate (acid basis [see above]). However, use of BMPs for applying pesticides (see Section G.5.2) would likely minimize/eliminate potential drift to non-target aquatic habitats during actual treatments. If there would be unacceptable (acute or chronic) risk to fish and wildlife with the simulated 100 percent overspray (RQ>LOC), then the proposed pesticide use may be disapproved, or the PUP would be approved at a lower application rate to minimize/eliminate unacceptable risk to aquatic organisms (RQ = LOC).

**Table G-4. Estimated Environmental Concentrations (ppb) of Pesticides in Aquatic Habitats (1 foot depth) Immediately after Direct Application**

| Lbs/acre | EEC (ppb) |
|---|---|
| 0.10 | 36.7 |
| 0.20 | 73.5 |
| 0.25 | 91.9 |

| Lbs/acre | EEC (ppb) |
|---|---|
| 0.30 | 110.2 |
| 0.40 | 147.0 |
| 0.50 | 183.7 |
| 0.75 | 275.6 |
| 1.00 | 367.5 |
| 1.25 | 459.7 |
| 1.50 | 551.6 |
| 1.75 | 643.5 |
| 2.00 | 735.7 |
| 2.25 | 827.6 |
| 2.50 | 919.4 |
| 3.00 | 1,103.5 |
| 4.00 | 1,471.4 |
| 5.00 | 1,839 |
| 6.00 | 2,207 |
| 7.00 | 2,575 |
| 8.00 | 2,943 |
| 9.00 | 3,311 |
| 10.00 | 3,678 |

Source: Urban and Cook 1986.

#### *G.7.2.1.2.2 Cropland/facilities maintenance treatments*

Field drift studies conducted by the Spray Drift Task Force, which is a joint project of several agricultural chemical businesses, were used to develop a generic spray drift database. From this database, the AgDRIFT computer model was created to satisfy USEPA pesticide registration spray drift data requirements and to provide a scientific basis to evaluate off-target movement of pesticides from particle drift and assess potential effects of exposure to wildlife. Several versions of the computer model have been developed (i.e., versions 2.01 through 2.10). The Spray Drift Task Force AgDRIFT model version 2.01 (Spray Drift Task Force 2003; Teske et al. 2002) would be used to derive EECs resulting from drift of pesticides to refuge aquatic resources from ground-based pesticide applications >25 feet from the high water mark. The Spray Drift Task Force AgDRIFT model is publicly available at http://www.agdrift.com. At this website, click “AgDRIFT 2.0” followed by “Download Now,” and follow the instructions to obtain the computer model.

The AgDRIFT model is composed of submodels called tiers. Tier I ground submodel would be used to assess ground-based applications of pesticides. Tier outputs (EECs) would be calculated with AgDRIFT using the following input variables: maximum application rate (acid basis [see above]), low boom (20 inches), fine to medium droplet size, EPA-defined wetland, and a ≥25-foot distance (buffer) from treated area to water.

### G.7.2.2 Use of information on effects of biological control agents, pesticides, degradates, and adjuvants

In accordance with the requirements set forth in 43 CFR 46.135, the Service would specifically incorporate through reference ecological risk assessments prepared by the U.S. Forest Service and BLM. These risk assessments and associated documentation are also available with the administrative record for the Final Environmental Impact Statement entitled *Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants* (U.S. Forest Service 2005) and *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS (PEIS)* (BLM 2007). In accordance with 43 CRF 46.120(d), use of existing NEPA documents by supplementing, tiering to, incorporating by reference, or adopting previous NEPA environmental analyses would avoid redundancy and unnecessary paperwork.

As a basis for completing “Chemical Profiles” for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide and adjuvant uses prepared by the U.S. Forest Service would be incorporated by reference:

- 2,4-D
- Chlorsulfuron
- Clopyralid
- Dicamba
- Glyphosate
- Imazapic
- Imazapyr
- Metsulfuron methyl
- Picloram
- Sethoxydim
- Sulfometuron methyl
- Triclopyr
- Nonylphenol polyethylate (NPE)–based surfactants

As a basis for completing Chemical Profiles for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide uses as well as evaluation of risks associated with pesticide degradates and adjuvants prepared by the BLM would be incorporated by reference:

- Bromacil
- Chlorsulfuron
- Diflufenzopyr
- Diquat
- Diuron
- Fluridone
- Imazapic
- Overdrive (diflufenzopyr and dicamba)
- Sulfometuron methyl

- Tebuthiuron
- Pesticide degradates and adjuvants (*Appendix D – Evaluation of risks from degradates, polyoxyethylene-amine (POEA) and R-11, and endocrine disrupting chemicals*)

### G.7.2.3 Assumptions for ecological risk assessments

There are a number of assumptions involved with the ecological risk assessment process for terrestrial and aquatic organisms associated with using the USEPA's (2004) process. These assumptions may be risk neutral or may lead to an over- or under-estimation of risk from pesticide exposure depending upon site-specific conditions. This section describes these assumptions, their application to the conditions typically encountered, and whether they may lead to recommendations that are risk neutral, or that underestimate or overestimate ecological risk from potential pesticide exposure.

- Indirect effects would not be evaluated by ecological risk assessments. These effects include the mechanisms of indirect exposure to pesticides: consuming prey items (fish, birds, or small mammals), reductions in the availability of prey items, and disturbance associated with pesticide application activities.
- Exposure to a pesticide product can be assessed based upon the active ingredient. However, exposure to a chemical mixture (pesticide formulation) may result in effects that are similar or substantially different from exposure to only the active ingredient. Non-target organisms may be exposed directly to the pesticide formulation or only various constituents of the formulation as they dissipate and partition in the environment. If toxicological information for both the active ingredient and the formulated product are available, then data representing the greatest potential toxicity would be selected for use in the risk assessment process (USEPA 2004). As a result, this conservative approach may lead to an overestimation of risk characterization from pesticide exposure.
- Because toxicity tests with listed or candidate species or closely related species are not available, data for surrogate species would be most often used for risk assessments. Specifically, bobwhite quail and mallard duck are the most frequently used surrogates for evaluating potential toxicity to federally listed avian species. Bluegill sunfish, rainbow trout, and fathead minnow are the most common surrogates for evaluating toxicity for freshwater fish. Sheep's head minnow can be an appropriate surrogate marine species for coastal environments. Rats and mice are the most common surrogates for evaluating toxicity for mammals. Interspecies sensitivity is a major source of uncertainty in pesticide assessments. As a result of this uncertainty, data is selected for the most sensitive species tested within a taxonomic group (birds, fish, and mammals), given the quality of the data is acceptable. If additional toxicity data for more species of organisms in a particular group are available, the selected data will not be limited to the species previously listed as common surrogates.
- The Kanaga nomogram outputs maximum EEC values that may be used to calculate an average daily concentration over a specified interval of time, which is referred to as a time-weighted average (TWA). The maximum EEC would be selected as the exposure input for both acute and chronic risk assessments in the screening-level evaluations. The initial or maximum EEC derived from the Kanaga nomogram represents the maximum expected instantaneous or acute exposure to a pesticide. Acute toxicity endpoints are determined using a single exposure to a known pesticide concentration typically for 48 to 96 hours. This value is assumed to represent ecological risk from acute exposure to a pesticide. On the other hand, chronic risk from pesticide exposure is a function of pesticide concentration and duration of

exposure to the pesticide. An organism's response to chronic pesticide exposure may result from the concentration of the pesticide, the length of exposure, or some combination of both factors. Standardized tests for chronic toxicity typically involve exposing an organism to several different pesticide concentrations for a specified length of time (days, weeks, months, years, or generations). For example, avian reproduction tests include a 10-week exposure phase. Because a single length of time is used in the test, time-response data is usually not available for inclusion in risk assessments. Without time-response data it is difficult to determine the concentration that elicits a toxicological response.

- Using maximum EECs for chronic risk estimates may result in an overestimate of risk, particularly for compounds that dissipate rapidly. Conversely, using TWAs for chronic risk estimates may underestimate risk if it is the concentration rather than the duration of exposure that is primarily responsible for the observed adverse effect. The maximum EEC would be used for chronic risk assessments although it may result in an overestimate of risk. TWAs may be used for chronic risk assessments, but they would be applied judiciously considering the potential for an underestimation or overestimation of risk. For example, the number of days exposure exceeds a LOC may influence the suitability of a pesticide's use. The greater the number of days the EEC exceeds the LOC, the greater the ecological risk. This is a qualitative assessment and is subject to reviewers' expertise in ecological risk assessment and tolerance for risk.
- The length of time used to calculate the TWA can have a substantial effect on the exposure estimates and there is no standard method for determining the appropriate duration for this estimate. The T-REX model assumes a 21-week exposure period, which is equivalent to avian reproductive studies designed to establish a steady-state concentration for bioaccumulative compounds. However, this does not necessarily define the true exposure duration needed to elicit a toxicological response. Pesticides that do not bioaccumulate may achieve a steady-state concentration earlier than 21 weeks. The duration of time for calculating TWAs would require justification and would not exceed the duration of exposure in the chronic toxicity test (approximately 70 days for the standard avian reproduction study). An alternative to using the duration of the chronic toxicity study is to base the TWA on the application interval. In this case, increasing the application interval would suppress both the estimated peak pesticide concentration and the TWA. Another alternative to using TWAs would be to consider the number of days that a chemical is predicted to exceed the LOC.
- Pesticide dissipation is assumed to be first-order in the absence of data suggesting alternative dissipation patterns such as bi-phasic. Field dissipation data would generally be the most pertinent for assessing exposure in terrestrial species that forage on vegetation. However, these data are often not available and can be misleading, particularly if the compound is prone to "wash-off." Soil half-life is the most common degradation data available. Dissipation or degradation data that reflect the environmental conditions typical of refuge lands would be used, if available.
- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column.
- Actual habitat requirements of any particular terrestrial species are not considered, and it is assumed that species exclusively and permanently occupy the treated area or adjacent areas receiving pesticide at rates commensurate with the treatment rate. This assumption would produce a maximum estimate of exposure for risk characterization. This assumption would likely lead to an overestimation of exposure for species that do not permanently and exclusively occupy the treated area (USEPA 2004).

- Exposure through incidental ingestion of pesticide-contaminated soil is not considered in the USEPA risk assessment protocols. Research suggests <15 percent of the diet can consist of incidentally ingested soil depending upon species and feeding strategy (Beyer et al. 1994). An assessment of pesticide concentrations in soil compared to food item categories in the Kanaga nomogram indicates incidental soil ingestion will not likely increase dietary exposure to pesticides. Inclusion of soil into the diet would effectively reduce the overall dietary concentration compared to the present assumption that the entire diet consists of a contaminated food source (Fletcher et al. 1994). An exception to this may be soil-applied pesticides in which exposure from incidental ingestion of soil may increase. Potential for pesticide exposure under this assumption may be underestimated for soil-applied pesticides and overestimated for foliar-applied pesticides. The concentration of a pesticide in soil would likely be less than predicted on food items.
- Exposure through inhalation of pesticides is not considered in the USEPA risk assessment protocols. Such exposure may occur through three potential sources: spray material in droplet form at time of application, vapor phase with the pesticide volatilizing from treated surfaces, and airborne particulates (soil, vegetative matter, and pesticide dusts). The USEPA (1990) reported that exposure from inhaling spray droplets at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size (particles reaching the lung) in birds is limited to maximum diameter of 2 to 5 microns. The spray droplet spectra covering the majority of pesticide application scenarios indicate that less than 1 percent of the applied material is within the respirable particle size. This route of exposure is further limited because the permissible spray drop size distribution for ground pesticide applications is restricted to American Society of Agricultural Engineering medium or coarser drop size distribution.
- Inhalation of a pesticide in the vapor phase may be another source of exposure for some pesticides under certain conditions. This mechanism of exposure to pesticides occurs post application, and it would pertain to those pesticides with a high vapor pressure. The USEPA is currently evaluating protocols for modeling inhalation exposure from pesticides including near-field and near-ground air concentrations based upon equilibrium and kinetics-based models. Risk characterization for exposure with this mechanism is unavailable.
- The effect from exposure to dusts contaminated with the pesticide cannot be assessed generically as partitioning issues related to application site soils and chemical properties of the applied pesticides render the exposure potential from this route highly situation specific.
- Dermal exposure may occur through three potential sources: direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, incidental contact with contaminated vegetation, or contact with contaminated water or soil. Interception of spray and incidental contact with treated substrates may pose a risk to avian wildlife (Driver et al. 1991). However, available research related to wildlife dermal contact with pesticides is extremely limited, except dermal toxicity values, which are common for some mammals used as human surrogates (rats and mice). The USEPA is currently evaluating protocols for modeling dermal exposure. Risk characterization may be underestimated for this route of exposure, particularly with high-risk pesticides such as some organophosphates or carbamate insecticides. If protocols are established by the USEPA for assessing dermal exposure to pesticides, they would be considered for incorporation into pesticide assessment protocols.
- Exposure to a pesticide may occur from consuming surface water, dew, or other water on treated surfaces. Water-soluble pesticides have the potential to dissolve in surface runoff, and puddles in a treated area may contain pesticide residues. Similarly, pesticides with lower organic carbon partitioning characteristics and higher solubility in water have a greater

potential to dissolve in dew and other water associated with plant surfaces. Estimating the extent to which such pesticide loadings to drinking water occurs is complex and would depend upon the partitioning characteristics of the active ingredient, soils types in the treatment area, and the meteorology of the treatment area. In addition, the use of various water sources by wildlife is highly species-specific. Currently, risk characterization for this exposure mechanism is not available. The USEPA is actively developing protocols to quantify drinking water exposures from puddles and dew. If and when protocols are formally established by the USEPA for assessing exposure to pesticides through drinking water, these protocols would be incorporated into pesticide risk assessment protocols.

- Risk assessments are based upon the assumption that the entire treatment area would be subject to pesticide application at the rates specified on the label. In most cases, there is potential for uneven application of pesticides through such plausible incidents as changes in calibration of application equipment, spillage, and localized releases at specific areas in or near the treated field that are associated with mixing, handling, and application equipment as well as applicator skill. Inappropriate use of pesticides and the occurrence of spills represent a potential underestimate of risk. It is likely not an important factor for risk characterization. All pesticide applicators are required to be certified by the state in which they apply pesticides. Certification training includes the safe storage, transport, handling, and mixing of pesticides; equipment calibration; and proper application, with annual continuing education.
- The USEPA relies on Fletcher (1994) for setting the assumed pesticide residues in wildlife dietary items. The USEPA (2004) "believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify." Fletcher's (1994) research suggests that the pesticide active ingredient residue assumptions used by the USEPA represent a 95th percentile estimate. However, research conducted by Pfleeger et al. (1996) indicates that USEPA residue assumptions for short grass were not exceeded. Baehr and Habig (2000) compared USEPA residue assumptions with distributions of measured pesticide residues for the USEPA's UTAB database. Overall residue selection level will tend to overestimate risk characterization. This is particularly evident when wildlife individuals are likely to have selected a variety of food items acquired from multiple locations. Some food items may be contaminated with pesticide residues, whereas others are not contaminated. However, it is important to recognize differences in species feeding behavior. Some species may consume whole aboveground plant material, but others will preferentially select different plant structures. Also, species may preferentially select a food item although multiple food items may be present. Without species-specific knowledge regarding foraging behavior, characterizing ecological risk other than in general terms is not possible.
- Acute and chronic risk assessments rely on comparisons of wildlife dietary residues with $LC_{50}$ or NOEC values expressed as concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods are not accounting for a potentially important aspect of food requirements.
- There are several other assumptions that can affect non-target species not considered in the risk assessment process. These include possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the

environment, cumulative effects from pesticides with the same mode of action, and effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic and biotic factors) and behavioral changes induced by exposure to a pesticide. These factors may exist at some level contributing to adverse effects to non-target species, but they are usually characterized in the published literature in only a general manner, limiting their value in the risk assessment process.

- It is assumed that aquatic species exclusively and permanently occupy the water body being assessed. Actual habitat requirements of aquatic species are not considered. With the possible exception of scenarios where pesticides are directly applied to water, it is assumed that no habitat use considerations specific for any species would place the organisms in closer proximity to pesticide use sites. This assumption produces a maximum estimate of exposure or risk characterization. It would likely be realistic for many aquatic species that may be found in aquatic habitats within or in close proximity to treated terrestrial habitats. However, the spatial distribution of wildlife is usually not random because wildlife distributions are often related to habitat requirements of species. Clumped distributions of wildlife may result in an under- or over-estimation of risk depending upon where the initial pesticide concentration occurs relative to the species or species habitat.
- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column. Additional chemical exposure from materials associated with suspended solids or food items is not considered because partitioning onto sediments is likely minimal. Adsorption and bioconcentration occur at lower levels for many newer pesticides compared with older, more persistent bioaccumulative compounds. Pesticides with RQs close to the listed species LOC have the potential for additional exposure from these routes and may be a limitation of risk assessments, where potential pesticide exposure or risk may be underestimated.
- Mass transport losses of pesticide from a water body (except for losses by volatilization, degradation, and sediment partitioning) would not be considered for ecological risk assessment. The water body would be assumed to capture all pesticide active ingredients entering as runoff and drift, and adsorbed to eroded soil particles. It would also be assumed that the pesticide active ingredient is not lost from the water body by overtopping or flow-through, nor is concentration reduced by dilution. In total, these assumptions would lead to a near maximum possible water-borne concentration. However, this assumption would not account for the potential to concentrate pesticide through evaporative loss. This limitation may have the greatest impact on water bodies with high surface-to-volume ratios such as ephemeral wetlands, where evaporative losses are accentuated and applied pesticides have low rates of degradation and volatilization.
- For acute risk assessments, there would be no averaging time for exposure. An instantaneous peak concentration would be assumed, where instantaneous exposure is sufficient in duration to elicit acute effects comparable to those observed over more protracted exposure periods (typically 48 to 96 hours) tested in the laboratory. In the absence of data regarding time-to-toxic event and analyses and latent responses to instantaneous exposure, risk would likely be overestimated.
- For chronic exposure risk assessments, the averaging times considered for exposure are commensurate with the duration of invertebrate life cycle or fish early life stage tests (e.g., 21–28 days and 56–60 days, respectively). Response profiles (time to effect and latency of effect) to pesticides likely vary widely with mode of action and species and should be evaluated on a case-by-case basis as available data allow. Nevertheless, because the USEPA

relies on chronic exposure toxicity endpoints based on a finding of no observed effect, the potential for any latent toxicity effects or averaging time assumptions to alter the results of an acceptable chronic risk assessment prediction is limited. The extent to which duration of exposure from water-borne concentrations overestimate or underestimate actual exposure depends on several factors. These include the following: localized meteorological conditions, runoff characteristics of the watershed (e.g., soils, topography), the hydrological characteristics of receiving waters, the environmental fate of the pesticide active ingredient, and the method of pesticide application. It should also be understood that chronic effects studies are performed using a method that holds water concentration in a steady state. This method is not likely to reflect conditions associated with pesticide runoff. Pesticide concentrations in the field increase and decrease in surface water in a cycle influenced by rainfall, pesticide use patterns, and degradation rates. As a result of the dependency of this assumption on several undefined variables, risk associated with chronic exposure may be underestimated in some situations and overestimated in others.

- There are several other factors that can affect non-target species not considered in the risk assessment process. These would include the following: possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic [not pesticides] and biotic factors), and sub-lethal effects such as behavioral changes induced by exposure to a pesticide. These factors may exist at some level, contributing to adverse effects to non-target species, but they are not routinely assessed by regulatory agencies. Therefore, information on the factors is not extensive, limiting their value for the risk assessment process. As this type of information becomes available, it would be included, either quantitatively or qualitatively, in this risk assessment process.
- USEPA is required by the Food Quality Protection Act to assess the cumulative risks of pesticides that share common mechanisms of toxicity, or act the same within an organism. Currently, USEPA has identified four groups of pesticides that have a common mechanism of toxicity requiring cumulative risk assessments. These four groups are: the organophosphate insecticides, N-methyl carbamate insecticides, triazine herbicides, and chloroacetanilide herbicides.

## G.7.3 Pesticide Mixtures and Degradates

Pesticide products are usually a formulation of several components generally categorized as active ingredients and inert, or other, ingredients. The active ingredient is defined by the FIFRA as preventing, destroying, repelling, or mitigating the effects of a pest, or as a plant regulator, defoliant, desiccant, or nitrogen stabilizer. In accordance with FIFRA, the active ingredient(s) must be identified by name(s) on the pesticide label along with its relative composition expressed in percentage(s) by weight. In contrast, inert ingredients are not intended to affect a target pest. Their role in the pesticide formulation is to act as a solvent (keep the active ingredient in a liquid phase), an emulsifying or suspending agent (keep the active ingredient from separating out of solution), or a carrier (such as clay in which the active ingredient is impregnated on the clay particle in dry formulations). For example, if isopropyl alcohol would be used as a solvent in a pesticide formulation, then it would be considered an inert ingredient. FIFRA only requires that inert ingredients identified as hazardous, their associated percentage composition, and the total percentage of all inert ingredients be declared on a product label. Inert ingredients that are not classified as hazardous are not required to be identified.

The USEPA (September 1997) issued Pesticide Regulation Notice 97-6, which encouraged manufacturers, formulators, producers, and registrants of pesticide products to voluntarily substitute the term "other ingredients" for "inert ingredients" in the ingredient statement. This change recognized that all components in a pesticide formulation potentially could elicit or contribute to an adverse effect on non-target organisms and, therefore, are not necessarily inert. Whether referred to as "inerts" or "other ingredients," these constituents within a pesticide product have the potential to affect species or environmental quality. The USEPA categorizes regulated inert ingredients into the following four lists (http://www.epa.gov/opprd001/inerts/index.html):

- List 1: Inert Ingredients of Toxicological Concern
- List 2: Potentially Toxic Inert Ingredients
- List 3: Inerts of Unknown Toxicity
- List 4: Inerts of Minimal Toxicity

Several of the List 4 compounds are naturally occurring earthen materials (e.g., clay materials, simple salts) that would not elicit toxicological response at applied concentrations. However, some of the inerts (particularly the List 3 compounds and unlisted compounds) may have moderate to high potential toxicity to aquatic species based on MSDSs or published data.

Comprehensively assessing potential effects to non-target fish, wildlife, plants, and/or their habitats from pesticide use is a complex task. It would be preferable to assess the cumulative effects from exposure to the active ingredient, its degradates, inert ingredients, and other active ingredients in the spray mixture. However, it would only be feasible to conduct deterministic risk assessments for each component in the spray mixture singly. Limited scientific information is available regarding ecological effects (additive or synergistic) from chemical mixtures that typically rely upon broadly encompassing assumptions. For example, the U.S. Forest Service (2005) found that mixtures of pesticides used in land (forest) management likely would not cause additive or synergistic effects to non-target species based upon a review of scientific literature regarding toxicological effects and interactions of agricultural chemicals (ATSDR 2004). Moreover, information on inert ingredients, adjuvants, and degradates is often limited by the availability of and access to reliable toxicological data for these constituents.

Toxicological information regarding "other ingredients" may be available from sources such as the following:

- TOMES (a proprietary toxicological database including USEPA's IRIS, the Hazardous Substance Data Bank, and the Registry of Toxic Effects of Chemical Substances [RTECS]).
- USEPA's ECOTOX database, which includes AQUIRE (a database containing scientific papers published on the toxic effects of chemicals to aquatic organisms).
- TOXLINE (a literature-searching tool).
- MSDSs from pesticide suppliers.
- Other sources such as the *Farm Chemicals Handbook*.

Because there is a lack of specific inert toxicological data, inerts in a pesticide may cause adverse ecological effects. However, inert ingredients typically represent only a small percentage of the pesticide spray mixture, and it would be assumed that negligible effects would be expected to result from inert ingredients.

Although the potential effects of degradates should be considered when selecting a pesticide, it is beyond the scope of this assessment process to consider all possible breakdown chemicals of the various product formulations containing an active ingredient. Degradates may be more or less mobile and more or less hazardous in the environment than their parent pesticides (Battaglin et al. 2003). Differences in environmental behavior (e.g., mobility) and toxicity between parent pesticides and degradates would make assessing potential degradate effects extremely difficult. For example, a less toxic and more mobile bioaccumulative or persistent degradate may have potentially greater effects on species and/or degrade environmental quality. The lack of data on the toxicity of degradates for many pesticides would represent a source of uncertainty for assessing risk.

A USEPA-approved label specifies whether a product can be mixed with one or more pesticides. Without product-specific toxicological data, it would not possible to quantify the potential effects of these mixtures. In addition, a quantitative analysis could only be conducted if reliable scientific information allowed a determination of whether the joint action of a mixture would be additive, synergistic, or antagonistic. Such information would not likely exist unless the mode of action is common among the chemicals and receptors. Moreover, the composition of and exposure to mixtures would be highly site- and/or time-specific and, therefore, it would be nearly impossible to assess potential effects to species and environmental quality.

To minimize or eliminate potential negative effects associated with applying two or more pesticides as a mixture, the use would be conducted in accordance with the labeling requirements. Labels for two or more pesticides applied as a mixture should be completely reviewed, where products with the least potential for negative effects would be selected for use on the refuge. This is especially relevant when a mixture would be applied in a manner that may already have the potential for an effect(s) associated with an individual pesticide (e.g., runoff to ponds in sandy watersheds). Use of a tank mix under these conditions would increase the level of uncertainty in terms of risk to species or potential to degrade environmental quality.

Adjuvants generally function to enhance or prolong the activity of pesticide. For terrestrial herbicides, adjuvants aid in the absorption into plant tissue. Adjuvant is a broad term that generally applies to surfactants, selected oils, anti-foaming agents, buffering compounds, drift control agents, compatibility agents, stickers, and spreaders. Adjuvants are not under the same registration requirements as pesticides, and the USEPA does not register or approve the labeling of spray adjuvants. Individual pesticide labels identify types of adjuvants approved for use with the pesticide. In general, adjuvants compose a relatively small portion of the volume of pesticides applied. Selection of adjuvants with limited toxicity and low volumes would be recommended to reduce the potential for the adjuvant to influence the toxicity of the pesticide.

## G.7.4 Determining Effects to Soil and Water Quality

The approval process for pesticide uses would consider potential to degrade water quality on and off refuge lands. A pesticide can only affect water quality through movement away from the treatment site. After application, pesticide mobilization can be characterized by one or more of the following (Kerle et al. 1996):

- Attach (sorb) to soil, vegetation, or other surfaces and remain at or near the treated area;
- Attach to soil and move off-site through erosion from runoff or wind;
- Dissolve in water that can be subjected to runoff or leaching.

As an initial screening tool, selected chemical characteristics and rating criteria for a pesticide can be evaluated to assess potential to enter ground and/or surface waters. These would include the following: persistence, sorption coefficient ($K_{oc}$), groundwater ubiquity score (GUS), and solubility.

Persistence, which is expressed as half-life ($t_{½}$), represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially). Persistence in the soil can be categorized as the following: non-persistent is less than 30 days, moderately persistent is 30 to 100 days, and persistent is over 100 days (Kerle et al. 1996). Half-life data is usually available for aquatic and terrestrial environments.

Another measure of pesticide persistence is dissipation time ($DT_{50}$). This represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site, whereas half-life describes the rate for degradation only. As for half-life, units of dissipation time are usually expressed in days. Field or foliar dissipation time is the preferred data for use to estimate pesticide concentrations in the environment. However, soil half-life is the most common persistence data cited in published literature. If field or foliar dissipation data is not available, soil half-life data may be used. The average or representative half-life value of the most important degradation mechanism will be selected for quantitative analysis for both terrestrial and aquatic environments.

The mobility of a pesticide is a function of how strongly it is adsorbed to soil particles and organic matter, its solubility in water, and its persistence in the environment. Pesticides strongly adsorbed to soil particles, relatively insoluble in water, and not environmentally persistent would be less likely to move across the soil surface into surface waters or to leach through the soil profile and contaminate groundwater. Conversely, pesticides that are not strongly adsorbed to soil particles, are highly water soluble, and are persistent in the environment would have greater potential to move from the application site (off-site movement).

The degree of pesticide adsorption to soil particles and organic matter (Kerle et al. 1996) is expressed as the soil adsorption coefficient ($K_{oc}$). The $K_{oc}$ is measured as micrograms of pesticide per gram of soil (μg/g) and can range from near zero to the thousands. Pesticides with higher $K_{oc}$ values are strongly adsorbed to soil and, therefore, would be less subject to movement.

Water solubility describes the amount of pesticide that will dissolve in a known quantity of water. The water solubility of a pesticide is expressed as milligrams of pesticide dissolved in a liter of water (mg/L or parts per million [ppm]). Pesticide with solubility <0.1 ppm are virtually insoluble in water; those with solubility from 100 to 1,000 ppm are moderately soluble and those with solubility over10,000 ppm are highly soluble (U.S. Geological Survey [USGS] 2000). As pesticide solubility increases, there would be greater potential for off-site movement.

The GUS is a quantitative screening tool to estimate a pesticide's potential to move in the environment. It uses soil persistence and adsorption coefficients in the following formula.

$$GUS = \log_{10}(t_{½}) \times [4 - \log_{10}(K_{oc})]$$

The potential pesticide movement rating would be based upon its GUS value. Pesticides with a GUS less than 0.1 would be considered to have an extremely low potential to move toward groundwater. Values of 1.0 to 2.0 would be low, 2.0 to 3.0 would be moderate, 3.0 to 4.0 would be high, and over 4.0 would have a very high potential to move toward groundwater.

Water solubility describes the amount of pesticide dissolving in a specific quantity of water, where it is usually measured as mg/L or ppm. Solubility is useful as a comparative measure because pesticides with higher values are more likely to move by runoff or leaching. GUS, water solubility, $t_{½}$, and $K_{oc}$ values are available for selected pesticides from the Oregon State University (OSU) Extension Pesticide Properties Database at http://npic.orst.edu/ppdmove.htm. Many of the values in this database were derived from the SCS/ARS/CES Pesticide Properties Database for Environmental Decision Making (Wauchope et al. 1992).

Soil properties influence the fate of pesticides in the environment. The following six properties are mostly likely to affect pesticide degradation and the potential for pesticides to move off-site by leaching (vertical movement through the soil) or runoff (lateral movement across the soil surface).

- Permeability is the rate of water movement vertically through the soil. It is affected by soil texture and structure. Coarse-textured soils (e.g., high sand content) have a larger pore size and are generally more permeable than fine textured soils (i.e., high clay content). The more permeable soils would have a greater potential for pesticides to move vertically down through the soil profile. Soil permeability rates (inches/hour) are usually available in county soil survey reports.
- Soil texture describes the relative percentage of sand, silt, and clay. In general, greater clay content with smaller pore size would lower the likelihood and rate at which water would move through the soil profile. Clay also serves to adsorb (bind) pesticides to soil particles. Soils with high clay content would adsorb more pesticide than soils with relatively low clay content. In contrast, sandy soils with coarser texture and lower water holding capacity would have a greater potential for water to leach through them.
- Soil structure describes soil aggregation. Soils with a well-developed soil structure have looser, more aggregated structure that would be less likely to be compacted. Both characteristics would allow for less restricted flow of water through the soil profile, resulting in greater infiltration.
- Organic matter would be the single most important factor affecting pesticide adsorption in soils. Many pesticides are adsorbed to organic matter, which reduces their rate of downward movement through the soil profile. Also, soils high in organic matter tend to hold more water, which may make less water available for leaching.
- Soil moisture affects how fast water moves through the soil. If soils are already wet or saturated before rainfall or irrigation, excess moisture would become runoff rather than infiltrate into the soil profile. Soil moisture also influences microbial and chemical activity in soil, which affects pesticide degradation.
- Soil pH influences chemical reactions that occur in the soil, which in turn determines whether a pesticide will degrade, the rate of degradation, and, in some instances, which degradation products are produced.

Based upon the aforementioned properties, soils most vulnerable to groundwater contamination would be sandy soils with low organic matter. In contrast, the least vulnerable soils would be well-drained clayey soils with high organic matter. Consequently, pesticides with the lowest potential for movement in conjunction with appropriate BMPs (see below) would be used in an IPM framework to treat pests while minimizing effects to non-target biota and protecting environmental quality.

Along with soil properties, the potential for a pesticide to affect water quality through runoff and leaching would be affected by site-specific environmental and abiotic conditions including rainfall, water table conditions, and topography (Huddleston 1996).

- Water is necessary to separate pesticides from soil. This can occur in two basic ways. Pesticides that are soluble move easily with runoff water. Pesticide-laden soil particles can be dislodged and transported from the application site in runoff. The concentration of pesticides in the surface runoff would be greatest for the first runoff event following treatment. The rainfall intensity and route of water infiltration into soil, to a large extent, determine pesticide concentrations and losses in surface runoff. The timing of the rainfall after application also would have an effect. Rainfall interacts with pesticides at a shallow soil depth (0.25 to 0.5 inch), which is called the mixing zone (Baker and Miller 1999). The pesticide/water mixture in the mixing zone tends to leach down into the soil or runoff depending upon how quickly the soil surface becomes saturated and how rapidly water can infiltrate into the soil. Leaching would decrease the amount of pesticide available near the soil surface (mixing zone) to runoff during the initial rainfall event following application and subsequent rainfall events.
- Terrain slope would affect the potential for surface runoff and the intensity of runoff. Steeper slopes would have greater potential for runoff following a rainfall event. In contrast, soils that are relatively flat would have little potential for runoff, except during intense rainfall events. In addition, soils in lower areas would be more susceptible to leaching as a result of receiving excessive water from surrounding higher elevations.
- Depth to groundwater would be an important factor affecting the potential for pesticides to leach into groundwater. If the distance from the soil surface to the top of the water table is shallow, pesticides would have less distance to travel to reach groundwater. Shallower water tables that persist for longer periods would be more likely to experience groundwater contamination. Soil survey reports are available for individual counties. These reports provide data in tabular format regarding the water table depths and the months during which they persist. In some situations, a hard pan exists above the water table that would prevent pesticide contamination from leaching.

## G.7.5 Determining Effects to Air Quality

Pesticides may volatilize from soil and plant surfaces and move from the treated area into the atmosphere. The potential for a pesticide to volatilize is determined by the pesticide's vapor pressure, which is affected by temperature, sorption, soil moisture, and the pesticide's water solubility. Vapor pressure is often expressed in mm Hg. To make these numbers easier to compare, vapor pressure may be expressed in exponent form ($I \times 10^{-7}$), where *I* represents vapor pressure index. In general, pesticides with I less than 10 would have a low potential to volatilize, whereas pesticides with I greater than 1,000 would have a high potential to volatilize (Oregon State University 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database.

## G.7.6 Preparing a Chemical Profile

The following instructions would be used by Service personnel to complete Chemical Profiles for pesticides. Specifically, profiles would be prepared for pesticide active ingredients (e.g., glyphosate, imazapic) that would be contained in one or more trade name products that are registered and labeled with USEPA. All information fields under each category (e.g., toxicological endpoints, environmental fate) would be completed for a Chemical Profile. If no information is available for a specific field, then “No data is available in references” would be recorded in the profile. Available scientific information would be used to complete Chemical Profiles. Each entry of scientific information would be shown with applicable references.

Completed Chemical Profiles would provide a structured decision-making process using quantitative assessment/screening tools with threshold values (where appropriate) that would be used to evaluate potential biological and other environmental effects to refuge resources. For ecological risk assessments presented in these profiles, the “worst-case scenario” would be evaluated to determine whether a pesticide could be approved for use considering the maximum single application rate specified on pesticide labels for habitat management and croplands/facilities maintenance treatments pertaining to refuges. Where the worst-case scenario likely would only result in minor, temporary, and localized effects to listed and nonlisted species with appropriate BMPs (see Section G.5 of this appendix), the proposed pesticide’s use in a PUP would have a scientific basis for approval under any application rate specified on the label that is at or below rates evaluated in a Chemical Profile. In some cases, the Chemical Profile would include a lower application rate than the maximum labeled rate in order to protect refuge resources. As necessary, Chemical Profiles would be periodically updated with new scientific information or as pesticides with the same active ingredient are proposed for use on the refuge in PUPs.

Throughout this section, threshold values (to prevent or minimize potential biological and environmental effects) would be clearly identified for specific information presented in a completed Chemical Profile. Comparison with these threshold values provides an explicit scientific basis to approve or disapprove PUPs for habitat management and cropland/facilities maintenance on refuge lands. In general, PUPs would be approved for pesticides with Chemical Profiles where threshold values would not be exceeded. However, BMPs are identified for some screening tools that would minimize/eliminate potential effects (exceeding the threshold value) as a basis for approving PUPs.

**Date:** Service personnel would record the date when the Chemical Profile is completed or updated. Chemical Profiles (e.g., currently approved PUPs) would be periodically reviewed and updated, as necessary. The most recent review date would be recorded on a profile to document when it was last updated.

**Trade Name(s):** Service personnel would accurately and completely record the trade name(s) from the pesticide label, which includes a suffix that describes the formulation (e.g., WP, DG, EC, L, SP, I, II, or 64). The suffix often distinguishes a specific product among several pesticides with the same active ingredient. Service personnel would record a trade name for each pesticide product with the same active ingredient.

**Common chemical name(s):** Service personnel would record the common name(s) listed on the pesticide label or MSDS for an active ingredient. The common name of a pesticide is listed as the active ingredient on the title page of the product label immediately following the trade name, and in Section 2 of the MSDS (Composition/Information on Ingredients). A Chemical Profile is completed for each active ingredient.

**Pesticide Type:** Service personnel would record the type of pesticide for an active ingredient as one of the following: herbicide, dessicant, fungicide, fumigant, growth regulator, insecticide, piscicide, or rodenticide.

**EPA Registration Number(s):** This number (EPA Registration Number) appears on the title page of the label and in Section 1 of the MSDS (Chemical Product and Company Description). It is not the EPA Establishment Number, which is usually located near it. Service personnel would record the EPA Reg. No. for each trade name product with an active ingredient based upon PUPs.

**Pesticide Class:** Service personnel would list the general chemical class for the pesticide (active ingredient). For example, malathion is an organophosphate and carbaryl is a carbamate.

**CAS (Chemical Abstract Service) Number:** This number is often located in the second section (Composition/Information on Ingredients) of the MSDS. The MSDS table listing components usually contains this number immediately prior to or following the percentage composition.

**Other Ingredients:** Based on the most recent MSDS for the proposed pesticide product(s), Service personnel would include any chemicals in the pesticide formulation not listed as an active ingredient and described as toxic or hazardous or regulated under the Superfund Amendments and Reauthorization Act (SARA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substances Control Act (TSCA), OSHA, State Right-to-Know, or other listed authorities. These are usually found in MSDS sections titled "Hazardous Identifications", "Exposure Control/Personal Protection," and "Regulatory Information." If concentrations of other ingredients are available for any compounds identified as toxic or hazardous, then Service personnel would record this information in the Chemical Profile by trade name. MSDSs may be obtained from the manufacturer, manufacturer's website, or an online database maintained by Crop Data Management Systems, Inc. (see list below).

### G.7.6.1 Toxicological Endpoints

Toxicological endpoint data would be collected for acute and chronic tests with mammals, birds, and fish. Data would be recorded for species available in the scientific literature. If no data are found for a particular taxonomic group, then "No data available in references" would be recorded as the data entry. Throughout the Chemical Profile, references (including toxicological endpoint data) would be cited using parentheses (#) following the recorded data.

**Mammalian $LD_{50}$:** For test species in the scientific literature, Service personnel would record available data for oral lethal dose ($LD_{50}$) in mg/kg-bw (body weight) or ppm-bw. The most common test species in scientific literature are the rat and mouse. The lowest $LD_{50}$ value found for a rat would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk to mammals (see Table G-1 in Section G.7.1).

**Mammalian $LC_{50}$:** For test species in the scientific literature, Service personnel would record available data for dietary lethal concentration ($LC_{50}$) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species in scientific literature are the rat and mouse. The lowest $LC_{50}$ value found for a rat would be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

**Mammalian Reproduction:** For test species listed in the scientific literature, Service personnel would record the test results (e.g., Lowest Observed Effect Concentration [LOEC], Lowest Observed Effect Level [LOEL], No Observed Adverse Effect Level [NOAEL], NOAEC) in mg/kg-bw or mg/kg-diet for reproductive test procedure(s) (e.g., generational studies [preferred], fertility, newborn weight). The most common test species available in scientific literature are rats and mice. The lowest

NOEC, NOAEC, NOEL, or NOAEL test results found for a rat would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

**Avian $LD_{50}$:** For test species available in the scientific literature, Service personnel would record values for oral lethal dose ($LD_{50}$) in mg/kg-bw or ppm-bw. Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest $LD_{50}$ value found for an avian species would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

**Avian $LC_{50}$:** For test species available in the scientific literature, Service personnel would record values for dietary lethal concentration ($LC_{50}$) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest $LC_{50}$ value found for an avian species would be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

**Avian Reproduction:** For test species available in the scientific literature, Service personnel would record test results (e.g., LOEC, LOEL, NOAEC, NOAEL) in mg/kg-bw or mg/kg-diet consumed for reproductive test procedure(s) (e.g., early life cycle, reproductive). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for an avian species would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

**Fish $LC_{50}$:** For test freshwater or marine species listed in the scientific literature, Service personnel would record the $LC_{50}$ in ppm or mg/L. The most common test species available in the scientific literature are the bluegill, rainbow trout, and fathead minnow (marine). Test results for many game species may also be available. The lowest $LC_{50}$ value found for a freshwater fish species would be used as a toxicological endpoint for RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

**Fish Early Life Stage (ELS)/Life Cycle:** For test freshwater or marine species available in the scientific literature, Service personnel would record test results (e.g., LOEC, NOAEL, NOAEC, LOAEC) in ppm for test procedure(s) (e.g., early life cycle, life cycle). The most common test species available in the scientific literature are bluegill, rainbow trout, and fathead minnow. Test results for other game species may also be available. The lowest test value found for a fish species (preferably freshwater) would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table G-1 in Section G.7.1).

**Other:** For test invertebrate as well as non-vascular and vascular plant species available in the scientific literature, Service personnel would record $LC_{50,}$ $LD_{50,}$ LOEC, LOEL, NOAEC, NOAEL, or $EC_{50}$ (environmental concentration) values in ppm or mg/L. The most common test invertebrate species available in scientific literature are the honey bee and the water flea (*Daphnia magna*). Green algae (*Selenastrum capricornutum*) and pondweed (*Lemna minor*) are frequently available test species for aquatic non-vascular and vascular plants, respectively.

**Ecological Incident Reports:** After a site has been treated with pesticide(s), wildlife may be exposed to these chemical(s). When exposure is high relative to the toxicity of the pesticides, wildlife may be killed or visibly harmed (incapacitated). Such events are called ecological incidents. The USEPA maintains a database (Ecological Incident Information System) of ecological incidents. This database stores information extracted from incident reports submitted by various federal and state agencies and nongovernment organizations. Information included in an incident report is the date and location of the incident, the type and magnitude of effects observed in various species, the use(s) of pesticides known or suspected of contributing to the incident, and results of any chemical residue and cholinesterase activity analyses conducted during the investigation.

Incident reports can play an important role in evaluating the effects of pesticides by supplementing quantitative risk assessments. All incident reports for pesticide(s) with the active ingredient and associated information would be recorded.

### G.7.6.2 Environmental Fate

**Water Solubility:** Service personnel would record values for water solubility ($S_w$), which describes the amount of pesticide that dissolves in a known quantity of water. $S_w$ is expressed as mg/L (ppm). Pesticide $S_w$ values would be categorized as one of the following: insoluble <0.1 ppm, moderately soluble = 100 to 1,000 ppm, highly soluble >10,000 ppm (USGS 2000). As pesticide $S_w$ increases, there would be greater potential to degrade water quality through runoff and leaching.

$S_w$ values would be used to evaluate the potential for bioaccumulation in aquatic species (see **Octanol-Water Partition Coefficient [$K_{ow}$]** below).

**Soil Mobility:** Service personnel would record available values for soil adsorption coefficient ($K_{oc}$ [µg/g]). It provides a measure of a chemical's mobility and leaching potential in soil. $K_{oc}$ values are directly proportional to organic content, clay content, and surface area of the soil. $K_{oc}$ data for a pesticide may be available for a variety of soil types (e.g., clay, loam, sand).

$K_{oc}$ values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

**Soil Persistence:** Service personnel would record values for soil half-life ($t_{½}$), which represents the length of time (days) required for 50 percent of the deposited pesticide to degrade (completely or partially) in the soil. Based upon the $t_{½}$ value, soil persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

***Threshold for Approving PUPs:***

- If soil $t_{½}$ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
- If soil $t_{½}$ >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:

  - Do not exceed one application per site per year.
  - Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
  - Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

Along with $K_{oc}$, soil $t_{½}$ values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

**Soil Dissipation:** Dissipation time ($DT_{50}$) represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site, whereas soil $t_{½}$ describes the rate for degradation only. As for $t_{½}$, units of $DT_{50}$ are usually expressed in days. Field dissipation time would be the preferred data for use to estimate pesticide concentrations in the environment because it is based upon field studies unlike soil $t_{½}$, which is derived in a laboratory. However, soil $t_{½}$ is the most common persistence data available in the published literature. If field $DT_{50}$ is not available, soil $t_{½}$ data would be used in a Chemical Profile. The average or representative $t_{½}$ value of the most important degradation mechanisms would be selected for quantitative analysis for both terrestrial and aquatic environments.

Based upon the $DT_{50}$ value, environmental persistence in the soil also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

***Threshold for Approving PUPs:***

- If soil $DT_{50}$ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
- If soil $DT_{50}$ >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:
    - Do not exceed one application per site per year.
    - Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
    - Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

Along with $K_{oc}$, soil $DT_{50}$ values (preferred over soil $t_{½}$) would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below), if available.

**Aquatic Persistence:** Service personnel would record values for aquatic $t_{½}$, which represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially) in water. Based upon the $t_{½}$ value, aquatic persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

***Threshold for Approving PUPs:***

- If aquatic $t_{½}$ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.
- If aquatic $t_{½}$ >100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:

- o Do not exceed one application per site per year.
- o Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
- o Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

**Aquatic Dissipation:** Dissipation time ($DT_{50}$) represents the time required for 50 percent of the deposited pesticide to degrade or move (dissipate); whereas, aquatic $t_{½}$ describes the rate for degradation only. As for $t_{½}$, units of $DT_{50}$ are usually expressed in days. Based upon the $DT_{50}$ value, environmental persistence in aquatic habitats also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

***Threshold for Approving PUPs:***

- If aquatic $DT_{50} \leq 100$ days, then a PUP would be approved without additional BMPs to protect water quality.
- If aquatic $DT_{50} > 100$ days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:

  - o Do not exceed one application per site per year.
  - o Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
  - o Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

**Potential to Move to Groundwater:** Groundwater Ubiquity Score (GUS) = $\log_{10}(\text{soil } t_{½}) \times [4 - \log_{10}(K_{oc})]$. If a $DT_{50}$ value is available, it would be used rather than a $t_{½}$ value to calculate a GUS. Based upon the GUS, the potential to move toward groundwater would be recorded as one of the following categories: extremely low potential<1.0, low = 1.0 to 2.0, moderate = 2.0 to 3.0, high = 3.0 to 4.0, or very high >4.0.

***Threshold for Approving PUPs:***

- If GUS $\leq 4.0$, then a PUP would be approved without additional BMPs to protect water quality.
- If GUS >4.0, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to minimize potential surface runoff and leaching that can degrade water quality:

  - o Do not exceed one application per site per year.
  - o Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
  - o Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is saturated.

**Volatilization:** Pesticides may volatilize (evaporate) from soil and plant surfaces and move off-target into the atmosphere.

***Threshold for Approving PUPs:***

- If I $\leq$1,000, then a PUP would be approved without additional BMPs to minimize drift and protect air quality.
- If I >1,000, then a PUP would only be approved with additional BMPs specifically to minimize drift and protect air quality. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to reduce volatilization and potential to drift and degrade air quality:

    - Do not treat when wind velocities are <2 or >10 mph with existing or potential inversion conditions.
    - Apply the largest diameter droplets possible for spray treatments.
    - Avoid spraying when air temperatures are >85°F.
    - Use the lowest spray height possible above target canopy.
    - Where identified on the pesticide label, soil-incorporate pesticide as soon as possible during or after application.

**Octanol-Water Partition Coefficient ($K_{ow}$):** The octanol-water partition coefficient ($K_{ow}$) is the concentration of a pesticide in octanol and water at equilibrium at a specific temperature. Because octanol is an organic solvent, it is considered a surrogate for natural organic matter. Therefore, $K_{ow}$ would be used to assess potential for a pesticide to bioaccumulate in tissues of aquatic species (e.g., fish). If $K_{ow}$ >1,000 or $S_w$<1 mg/L and soil $t_{½}$ >30 days, then there would be high potential for a pesticide to bioaccumulate in aquatic species such as fish (USGS 2000).

***Threshold for Approving PUPs:***

- If potential for a pesticide to bioaccumulate in aquatic species is not high, then the PUP would be approved.
- If there is a high potential to bioaccumulate in aquatic species ($K_{ow}$ >1,000 or $S_w$ <1 mg/L and soil $t_{½}$ >30 days), then the PUP would not be approved, except under unusual circumstances where approval would only be granted by the Washington Office.

**Bioaccumulation/Bioconcentration:** This is the physiological process where pesticide concentrations in tissue increase in biota because they are taken and stored at a faster rate than they are metabolized or excreted. The potential for bioaccumulation would be evaluated through bioaccumulation factors (BAFs) or bioconcentration factors (BCFs). Based upon BAF or BCF values, the potential to bioaccumulate would be recorded as one of the following: low: 0 to 300, moderate: 300 to 1,000, or high: >1,000 (Calabrese and Baldwin 1993).

***Threshold for Approving PUPs:***

- If BAF or BCF $\leq$1,000, then a PUP would be approved without additional BMPs.
- If BAF or BCF> 1,000, then a PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

### G.7.6.3 Worst-Case Ecological Risk Assessment

**Max Application Rates (acid equivalent):** Service personnel would record the highest application rate of an active ingredient (ae basis) for habitat management and cropland/facilities maintenance treatments in this data field of a Chemical Profile. These rates can be found in Table CP.1 under the column heading “Max Product Rate – Single Application (lbs/acre – active ingredient on acid equiv basis).” This table would be prepared for a Chemical Profile from information specified in labels for trade name products identified in PUPs. If these data are not available in pesticide labels, then Service personnel would write “NS” for “not specified on label” in this table.

**EECs:** An ECC represents potential exposure to fish and wildlife (birds and mammals) from pesticide use. EECs would be derived by Service personnel using a USEPA screening-level approach (USEPA 2004). For each maximum application rate (see description under “Max Application Rates [acid equivalent]”), Service personnel would record two EEC values in a Chemical Profile; these would represent the worst-case terrestrial and aquatic exposures for habitat management and croplands/facilities maintenance treatments. For terrestrial and aquatic EEC calculations, see description for data entry under “Presumption of Unacceptable Risk/Risk Quotients,” which is the next field for a Chemical Profile.

**Presumption of Unacceptable Risk/Risk Quotients:** Service personnel would calculate and record acute and chronic RQs for birds, mammals, and fish using the provided tabular formats for habitat management and/or cropland/facilities maintenance treatments. RQs recorded in a Chemical Profile would represent the worst-case assessment for ecological risk. See Section G.7.2 of this appendix for a discussion regarding the calculations of RQs.

For aquatic assessments associated with habitat management treatments, RQ calculations would be based upon selected acute and chronic toxicological endpoints for fish, and the EEC would be derived from Urban and Cook (1986) assuming 100 percent overspray to an entire 1-foot-deep water body using the max application rate (ae basis [see above]).

For aquatic assessments associated with cropland/facilities maintenance treatments, RQ calculations would be done by Service personnel based upon selected acute and chronic toxicological endpoints for fish, and an EEC would be derived from the aquatic assessment in AgDRIFT version 2.01 under Tier I ground-based application with the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium/coarse droplet size, 20 swaths, EPA-defined wetland, and 25-foot distance (buffer) from treated area to water.

See Section G.7.2.1.2 of this appendix for more details regarding the calculation of EECs for aquatic habitats for habitat management and cropland/facilities maintenance treatments.

For terrestrial avian and mammalian assessments, RQ calculations would be done by Service personnel based upon dietary exposure, where the “short grass” food item category would represent the worst-case scenario. For terrestrial spray applications associated with habitat management and cropland/facilities maintenance treatments, exposure (EECs and RQs) would be determined using the Kanaga nomogram method through the USEPA’s T-REX version 1.2.3. T-REX input variables would include max application rate (acid basis [see above]) and pesticide half-life (days) in soil to estimate the initial, maximum pesticide residue concentration on general food items for terrestrial vertebrate species in short (<20 cm tall) grass.

For granular pesticide formulations and pesticide-treated seed with a unique route of exposure for terrestrial avian and mammalian wildlife, see discussion on terrestrial granular application in Section G.7.2.1.1 of this appendix for the procedure that would be used to calculate RQs.

All calculated RQs in both tables would be compared with LOCs established by USEPA (see Table G-2 in Section G.7.2). If a calculated RQ exceeds an established LOC value (in parentheses inside the table), then there would be potential for an acute or chronic effect (unacceptable risk) to federally listed (T&E) species and nonlisted species. See Section G.7.2 of this appendix for detailed descriptions of acute and chronic RQ calculations and comparisons to LOCs to assess risk.

***Threshold for approving PUPs:***

- If RQs≤LOCs, then a PUP would be approved without additional BMPs.
- If RQs>LOCs, then a PUP would only be approved with additional BMPs specifically to minimize exposure (ecological risk) to bird, mammal, and/or fish species. One or more BMPs such as the following would be included in the "Specific Best Management Practices" section to reduce potential risk to nonlisted or listed species:
    - Lower application rate and/or fewer number of applications so RQs≤LOCs.
    - For aquatic assessments (fish) associated with cropland/facilities maintenance, increase the buffer distance beyond 25 feet so RQs≤LOCs.

**Justification for Use:** Service personnel would describe the reasons for using pesticide-based control of specific pests or groups of pests. In most cases, the pesticide label will provide the appropriate information regarding control of pests to describe in the section.

**Specific Best Management Practices (BMPs):** Service personnel would record specific BMPs necessary to minimize or eliminate potential effects to non-target species and/or degradation of environmental quality from drift, surface runoff, or leaching. These BMPs would be based upon scientific information documented in previous data fields of a Chemical Profile. Where necessary and feasible, these specific practices would be included in PUPs as a basis for approval.

If there are no specific BMPs that are appropriate, then Service personnel would describe why the potential effects to refuge resources and/or degradation of environmental quality is outweighed by the overall resource benefit(s) from the proposed pesticide use in the BMP section of the PUP. See Section G.5 of this appendix for a complete list of BMPs associated with mixing and applying pesticides appropriate for all PUPs with ground-based treatments that would be additive to any necessary, chemical-specific BMPs.

**References:** Service personnel would record scientific resources used to provide data/information for a Chemical Profile. Use the number sequence to uniquely reference data in a chemical profile.

The following online data resources are readily available for toxicological endpoint and environmental fate data for pesticides:

1. California Product/Label Database. Department of Pesticide Regulation, California Environmental Protection Agency. (http://www.cdpr.ca.gov/docs/label/labelque.htm#regprods)

2. ECOTOX database. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. (http://cfpub.epa.gov/ecotox/)

3. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. Cooperative effort of University of California-Davis, Oregon State University, Michigan State University, Cornell University, and University of Idaho through Oregon State University, Corvallis, Oregon. (http://extoxnet.orst.edu/pips/ghindex.html)

4. FAO specifications and evaluations for plant protection products. Pesticide Management Unit, Plant Protection Services, Food and Agriculture Organization, United Nations. (http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPP/Pesticid/)

5. Human health and ecological risk assessments. Pesticide Management and Coordination, Forest Health Protection, U.S. Department of Agriculture, U.S. Forest Service. (http://www.fs.fed.us/foresthealth/pesticide/risk.htm)

6. Pesticide Chemical Fact Sheets. Clemson University Pesticide Information Center. (http://entweb.clemson.edu/pesticid/Document/Labels/factshee.htm)

7. Pesticide Fact Sheets. Published by Information Ventures, Inc. for Bureau of Land Management, Department of Interior; Bonneville Power Administration, U.S. Department of Energy; and U.S. Forest Service, U.S. Department of Agriculture. (http://infoventures.com/e-hlth/pesticide/pest-fac.html)

8. Pesticide Fact Sheets. National Pesticide Information Center. (http://npic.orst.edu/npicfact.htm)

9. Pesticide Fate Database. U.S. Environmental Protection Agency, Washington, D.C. (http://cfpub.epa.gov/pfate/home.cfm).

10. Pesticide product labels and material safety data sheets. Crop Data Management Systems, Inc. (CDMS) (http://www.cdms.net/pfa/LUpdateMsg.asp) or multiple websites maintained by agrichemical companies.

11. Registered Pesticide Products (Oregon database). Oregon Department of Agriculture. (http://www.oda.state.or.us/dbs/pest_products/search.lasso)

12. Regulatory notes. Pest Management Regulatory Agency, Health Canada, Ontario, Canada. (http://www.hc-sc.gc.ca/pmra-arla/)

13. Reptile and Amphibian Toxicology Literature. Canadian Wildlife Service, Environment Canada, Ontario, Canada. (http://www.cws-scf.ec.gc.ca/nwrc-cnrf/ratl/index_e.cfm)

14. Specific Chemical Fact Sheet – New Active Ingredients, Biopesticide Fact Sheet and Registration Fact Sheet. U.S. Environmental Protection Agency, Washington, D.C. (http://www.epa.gov/pestidides/factsheets/chemical_fs.htm)

15. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Invasive Species Initiative. The Nature Conservancy. (http://tnsweeds.ucdavis.edu/handbook.html)

16. Wildlife Contaminants Online. U.S. Geological Survey, Department of Interior, Washington, D.C. (http://www.pwrc.usgs.gov/contaminants-online/)

17. One-liner database. 2000. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, D.C.

**Chemical Profile**

| | | | |
|---|---|---|---|
| **Date:** | | | |
| **Trade Name(s):** | | **Common Chemical Name(s):** | |
| **Pesticide Type:** | | **EPA Registration Number:** | |
| **Pesticide Class:** | | **CAS Number:** | |
| **Other Ingredients:** | | | |

**Toxicological Endpoints**

| | |
|---|---|
| **Mammalian $LD_{50}$:** | |
| **Mammalian $LC_{50}$:** | |
| **Mammalian Reproduction:** | |
| **Avian $LD_{50}$:** | |
| **Avian $LC_{50}$:** | |
| **Avian Reproduction:** | |
| **Fish $LC_{50}$:** | |
| **Fish ELS/Life Cycle:** | |
| **Other:** | |

**Ecological Incident Reports**

| |
|---|
| |

**Environmental Fate**

| | |
|---|---|
| **Water solubility ($S_w$):** | |
| **Soil Mobility ($K_{oc}$):** | |
| **Soil Persistence ($t_{½}$):** | |
| **Soil Dissipation ($DT_{50}$):** | |
| **Aquatic Persistence ($t_{½}$):** | |
| **Aquatic Dissipation ($DT_{50}$):** | |
| **Potential to Move to Groundwater (GUS score):** | |
| **Volatilization (mm Hg):** | |
| **Octanol-Water Partition Coefficient ($K_{ow}$):** | |
| **Bioaccumulation/Bioconcentration:** | **BAF:`**<br>**BCF:** |

**Worst-Case Ecological Risk Assessment**

| | |
|---|---|
| **Max Application Rate (ai lbs/acre – ae basis)** | **Habitat Management:**<br>**Croplands/Facilities Maintenance:** |
| **EECs** | **Terrestrial (Habitat Management):**<br>**Terrestrial (Croplands/Facilities Maintenance):**<br>**Aquatic (Habitat Management):**<br>**Aquatic (Croplands/Facilities Maintenance):** |

Habitat Management Treatments:

| **Presumption of Unacceptable Risk** | | **Risk Quotient (RQ)** | |
|---|---|---|---|
| | | **Listed (T&E) Species** | **Nonlisted Species** |
| Acute | Birds | [0.1] | [0.5] |
| | Mammals | [0.1] | [0.5] |
| | Fish | [0.05] | [0.5] |
| Chronic | Birds | [1] | [1] |
| | Mammals | [1] | [1] |
| | Fish | [1] | [1] |

Cropland/Facilities Maintenance Treatments:

| **Presumption of Unacceptable Risk** | | **Risk Quotient (RQ)** | |
|---|---|---|---|
| | | **Listed (T&E) Species** | **Nonlisted Species** |
| Acute | Birds | [0.1] | [0.5] |
| | Mammals | [0.1] | [0.5] |
| | Fish | [0.05] | [0.5] |
| Chronic | Birds | [1] | [1] |
| | Mammals | [1] | [1] |
| | Fish | [1] | [1] |

| | |
|---|---|
| **Justification for Use:** | |
| **Specific Best Management Practices (BMPs):** | |
| **References:** | |

**Table CP.1 Pesticide Name**

| Trade Name[a] | Treatment Type[b] | Max Product Rate - Single Application (lbs/acre or gal/acre) | Max Product Rate - Single Application (lbs/acre - active ingredient on acid equiv basis) | Max Number of Applications Per Season | Max Product Rate Per Season (lbs/acre/season or gal/acre/season) | Minimum Time Between Applications (Days) |
|---|---|---|---|---|---|---|
| | | | | | | |

[a]From each label for a pesticide identified in PUPs, Service personnel would record application information associated with possible/known uses on Service lands.
[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

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*Turkey vultures*
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# Appendix H
## Glossary of Terms and Acronyms


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# H.1 Glossary

**303(d) –** A section of the Clean Water Act that required states, territories, and authorized tribes to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes.

**4th level HUC –** The fourth level of classification is the cataloging unit, the smallest element in the hierarchy of hydrologic units.

**Adaptive Management –** The rigorous application of management, research, and monitoring to gain the information and experience necessary to assess and modify management activities. It refers to a process that uses feedback from refuge research and monitoring, and evaluation of management actions to support or modify objectives and strategies at all planning levels (602 FW 1.4).

**Adjudicated water right –** An adjudication is an administrative or judicial determination of all rights to use water in a particular stream system or watershed, to establish the priority, point of diversion, place and nature of use and the quantity of water used among the various claimants. These stream or watershed adjudications can be initiated by a water user (including the United States) or by the State. The United States may be joined in an adjudication if the requirements of the McCarran Amendment are met.

**Aerenchyma –** Modified parenchymatous tissue having large intracellular air spaces that is found especially in aquatic plants where it facilitates gaseous exchange and maintains buoyancy.

**Alternative –** Different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues (602 FW 1.6). The "no action" alternative is current refuge management, while the "action" alternatives are all other alternatives.

**Alluvial –** Made up of or found in the materials that are left by the waters of rivers, floods, etc.

**Appropriate Use –** A proposed or existing use on a refuge that meets at least one of the following four conditions:

(1) The use is a wildlife-dependent recreational use as identified in the Improvement Act.
(2) The use contributes to fulfilling the refuge purpose(s), the Refuge System mission or goals, or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
(3) The use involves the take of fish and wildlife under State regulations.
(4) The use has been found to be appropriate as specified in Section 1.11 of the U.S. Fish and Wildlife Service (USFWS) Appropriate Use Policy (603 FW 1).

**Approved Acquisition Boundary –** National Wildlife Refuge boundary approved by the National or Regional Fish and Wildlife Service Director for potential acquisition of lands by the Service.

**Approved Refuge Boundary –** A National Wildlife Refuge boundary approved by the National or Regional Fish and Wildlife Service Director. Within this boundary, the Service may negotiate with landowners to acquire lands not already owned by the Service.

**Benthic –** The collection of organisms living on or in sea or lake bottoms.

**Big Six –** Wildlife-dependent recreational uses under Refuge System Improvement Act. This includes hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

**Biological Diversity (also Biodiversity) –** The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur (601 FW 3). The Refuge System's focus is on indigenous species, biotic communities, and ecological processes.

**Biological Integrity –** Biotic composition, structure, and functioning at the genetic, organism, and community levels comparable with historical conditions, including the natural biological processes that shape genomes, organisms, and communities (601 FW 3).

**Colluvium –** Soil and debris that accumulate at the base of a slope by mass wasting or sheet erosion. It generally includes angular fragments, not sorted according to size, and may contain slabs of bedrock that dip back toward the slope, indicating both their place of origin and that slumping was the process of transportation. At the edges of valleys, colluvium may be interfingered with and almost indistinguishable from alluvium.

**Compatibility Determination –** A written determination signed and dated by the refuge manager and regional chief signifying that a proposed or existing use of a National Wildlife Refuge is or is not a compatible use. The director makes this delegation through the Regional Direction (603 FW 2).

**Compatible Use –** A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgment of the director, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge (603 FW 3.6). A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

**Conservation Targets (also see Resources of Concern; Priority Species; Species Groups; and Communities) –** This is the term used by land management agencies and conservation organizations to describe the resources (ecological systems, ecological communities, species, species groups, or other natural resources) selected as the focus of conservation actions.

**Consumptive Use –** Recreational activities, such as hunting and fishing that involve harvest or removal of wildlife or fish, generally to be used as food by humans.

**Consumptive Use Rate –** Consumptive use rate represents the difference between the amount of water diverted and the amount of the return flow to the system (e.g., surface stream or underground basin). It is that amount by which the total resource is depleted.

**Cover –** The estimated percent of an area, projected onto a horizontal surface, that is occupied by a particular plant species.

**Decadent –** Undergoing a process of decline or decay.

**Dissolved Oxygen –** The concentration of oxygen dissolved in water, expressed in mg/L or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature.

**Duripan –** A horizon in mineral soil characterized by cementation by silica.

**Ecotourism –** Tourism that is designed to contribute to the protection of the environment or at least minimize damage to it, often involving travel to areas of natural interest in developing countries or participation in environmental projects.

**Effect (impact) –** A direct result of an action that occurs at the same time and place; or an indirect result of an action that occurs earlier in time or in a different place and is reasonably foreseeable; or the cumulative results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions (40 Code of Federal Regulations (CFR) 1508.8).

**Emergent –** Erect plants rooted underwater that grow above (emerge from) the surface of the water (e.g., cattails).

**Emissions Scenarios –** Climate change term that is group into four categories of cumulative $CO_2$ emissions (all sources) between 1990 and 2100: low, medium low, medium high, and high emissions. Each category contains situations with a range of different driving forces yet similar cumulative emissions.

**Eolian –** Borne, deposited, produced, or eroded by the wind.

**Exotic –** From another part of the world; foreign.

**Fecundity –** The quality or power of producing abundantly; fruitfulness or fertility.

**Flood Irrigation –** A method of irrigation using water released into a field and allowed to flood over its entire surface.

**Fluvial –** Of or pertaining to a river.

**Focal Species (also Priority Resources of Concern or Focal Conservation Target) –** A suite of conservation targets that, for the purposes of planning, are sorted and condensed to represent threats to biological integrity, diversity, and environmental health at the refuge level.

**Goal –** Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (620 FW 1.6).

**Greenhouse effect –** The greenhouse effect refers to circumstances where the short wavelengths of visible light from the sun pass through a transparent medium and are absorbed, but the longer wavelengths of the infrared re-radiation from the heated objects are unable to pass through that medium. The trapping of the long wavelength radiation leads to more heating and a higher resultant temperature.

**Habitat Management Plan –** A plan that provides refuge managers a decision-making process; guidance for the management of refuge habitat; and long-term vision, continuity, and consistency for habitat management on refuge lands (620 FW 1.4).

**Habitat Restoration –** Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

**Historical Conditions –** Composition, structure, and functioning of ecosystems resulting from natural processes that are believed, based on sound professional judgment, to have been present prior to substantial human-related changes to the landscape (601 FW 3).

**Idle –** Not working or active; in the context of the Malheur Refuge comprehensive conservation plan (CCP), fields that are not receiving grazing or haying treatment in the current year.

**Important Bird Areas –** A site, designated by the National Audubon Society, that provides essential habitat for one or more species of birds and that is recognized as being important on a global, continental, or state level.

**Integrated Pest Management (IPM) –** The use of pest and environmental information in conjunction with available pest control technologies to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to persons, property, and the environment.

**Interpretation –** A teaching technique that combines factual information with stimulating explanation. Frequently used to help people understand natural and cultural resources.

**Inundation –** To cover with water, especially floodwaters.

**Invasive –** Marked by the tendency to spread. As applied to plant or animal species, *invasive* connotes a species (often but not always non-native) that rapidly takes over a habitat or area, often crowding out other species and reducing diversity and ecosystem health.

**Inviolate Sanctuary –** The original intent of the term *inviolate sanctuary* is found in the Migratory Bird Conservation Act (first passed in 1918 as the Migratory Bird Treaty Act and amended in 1934 and 1938). This Act originally required that all refuges be inviolate sanctuaries and deemed that refuges' primary purposes were as breeding grounds and habitat for migratory birds. Migratory bird hunting was prohibited in migratory waterfowl areas by the Act, but most other human uses were not addressed. The 1938 amendment to the Act gave refuge managers authority to decide if, when, and how bird hunting would be allowed. After World War II, public demand for opening refuges to recreation increased. The 1949 Duck Stamp Act allowed waterfowl hunting on refuges, but restricted the percentage of each refuge open to hunting. Current policy states that portions of a refuge are considered "inviolate sanctuaries" if they were (a) acquired with the approval of the Migratory Bird Conservation Commission (MBCC) for the purpose of an inviolate sanctuary; (b) acquired with MBCC approval or Land and Water Conservation Funds to protect a threatened or endangered species; or (c) established by an instrument or document that states the intent to manage the area as an "inviolate sanctuary for migratory birds" or to fulfill the purpose of the Migratory Bird Conservation Act. Policy further allows migratory game bird hunting on no more than 40 percent of the area considered inviolate sanctuary if it is compatible with a refuge's purposes and mission. Inviolate sanctuary classification imposes no limits on hunting non-migratory birds, fur bearers, or other game species.

**Lacustrine –** Of or relating to a lake.

**Lithology –** The study of the general physical characteristics of rocks.

**Lunette dune –** Accumulations of semiconsolidated fine sand, silt, and clay-pellet aggregates that form rounded, low (meters high) dunes on the downwind sides of playas.

**Macrophyte –** A plant that is large enough to be visible to the naked eye. A macrophyte may be an emergent, submergent, or floating type of aquatic plant. Its ecological significance is providing cover for fish and acting as substrate for aquatic invertebrates, as well as producing oxygen and serving as food for some fish and other wildlife.

**Meristematic tissue –** Embryonic tissue located at the tips of stems and roots and occasionally along their entire length; can divide to produce new cells; one of the four main tissue systems in plants.

**Mesic –** Characterized by, relating to, or requiring a moderate amount of moisture.

**Migratory birds –** Those species of birds listed under 50 CFR 10.13 (as defined by various treaties) (720 FW 1).

**Monotypic –** The sole member of a group, such as a single species that constitutes a genus.

**National Register of Historic Places –** The nation's master inventory of known historic properties administered by the National Park Service. Includes buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archeological, or cultural significance at the national, state, and local levels.

**National Wildlife Refuge –** A designated area of land, water, or an interest in land or water within the Refuge System, excluding coordination areas (601 FW 1.3).

**National Wildlife Refuge System –** Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management areas; or waterfowl production areas.

**National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) –** A federal law that amended and updated the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668).

**Native –** With respect to a particular ecosystem, a species that historically occurred or currently occurs (other than as a result of an introduction) in that ecosystem (601 FW 3).

**Non-consumptive Recreation –** Recreational activities that do not involve harvest, removal, or consumption of fish, wildlife, or other natural resources.

**Non-native species –** A species that is present in the planning area but was not known to exist prior to Euro-American settlement of the Americas.

**Novel community –** Made up of either native and non-native species or native species outside historical spatial distributions.

**Noxious Weed –** A plant species designated by Federal or state law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insect or disease; or non-native, new, or not common to the United States. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has adverse effects on man or his environment and is therefore detrimental to the agriculture and commerce of the United States and to the public health.

**Objective –** A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Objectives should be attainable, time-specific, and measurable (620 FW 1.6).

**Outcropping –** A portion of bedrock or other stratum protruding through the soil level.

**Pacific Decadal Oscillation (PDO) –** Described as a long-lived El Niño-like pattern of Pacific climate variability. As seen with the better-known El Niño/Southern Oscillation (ENSO), extremes in the PDO pattern are marked by widespread variations in the Pacific Basin and the North American climate.

**Pacific Flyway –** One of several major north-south travel corridors for migratory birds. The Pacific Flyway is west of the Rocky Mountains.

**Paleontological –** The study of the forms of life existing in prehistoric or geologic times, as represented by the fossils of plants, animals, and other organisms.

**Palustrine –** Relating to a system of inland, nontidal wetlands characterized by the presence of trees, shrubs, and emergent vegetation (vegetation that is rooted below water but grows above the surface).

**Pedogenic –** The formation and development of soil.

**Phreatophyte –** A deep-rooted plant that obtains water from a permanent ground supply or from the water table.

**Physiographic Province –** A region in which the landforms are similar in geologic structure and differ significantly from the landform patterns in adjacent regions.

**Phytoplankton –** Photosynthetic or plant constituent of plankton; mainly unicellular algae.

**Piezometric –** Of or relating to pressure.

**Plant Community –** An assemblage of plant species unique in its composition, occurring in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community (e.g., Oregon white oak woodland).

**Playa –** Enclosed shallow depressions in desert basins, tectonic lows, interdune flats, wadis, and abandoned channels that contain deposits and evaporate from the impoundment of episodic stream flow or near-surface groundwater.

**Priority Public Uses –** Hunting, fishing, wildlife observation and photography, and environmental education and interpretation, where compatible, are identified under the National Wildlife Refuge System Improvement Act of 1997 as the six priority public uses of the National Wildlife Refuge System.

**Priority Resources of Concern –** See *Resources of Concern* and *Focal Species* definitions.

**Proving up (on water rights) –** The state process of meeting all the conditions placed on water right permits.

**Rake-bunch grazing –** A form of treatment where meadow hay is mowed and raked into windrows, but left in place to be consumed by livestock during the late fall and winter.

**Refuge Purpose(s) –** The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit. For refuges that encompass congressionally designated wilderness, the purposes of the Wilderness Act are additional purposes of the refuge (620 FW 1.6).

**Residuum –** Something remaining after removal of a part; a residue.

**Resource of Concern (ROC) –** This refers to all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), the Refuge System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are ROCs on a refuge whose purpose is to protect “migrating waterfowl and shorebirds.” Federal or state threatened and endangered species on that same refuge are also an ROC under terms of the respective endangered species acts (620 FW 1.4).

**Rested –** Allowed to be inactive in order to regain strength, health, or energy.

**Riverine –** Relating to or resembling a river. Located on or inhabiting the banks of a river; riparian.

**Scoping –** Early in the planning process, this is the phase of notifying the public of the opportunity to participate in the planning process to help identify issues, concerns, and opportunities related to the project.

**Seasonal Moisture Deficit –** The difference between the amount of water that is in a soil and the amount needed for crops to grow successfully.

**Seasonal Wetlands –** Areas that are periodically inundated or have soils saturated to the surface at some time during the growing season (but not year-round).

**Senescent –** Growing old; aging. As applied to plants, when they are in a dormant phase (often during winter).

**Sen-Theil-Kendall Line –** A type of statistical analysis for water resources.

**Significant Effect –** Use of this term in the National Environmental Policy Act (NEPA) requires consideration of both context and intensity (40 CFR 1508.27). The significance of an action must be analyzed in its current and proposed short- and long-term effects on the whole of a given resource (e.g., affected region) (context). Intensity is the severity of the effect.

**SLR Line –** A simple linear regression line.

**Snow Water Equivalents –** A common snowpack measurement. It is the amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if the entire snowpack were melted instantaneously.

**Species of Concern (Federal) –** Taxa whose conservation status is of concern to the USFWS (many previously known as Category 2 candidates), but for which further information is still needed. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing.

**Steppe –** Arid land with xerophilous vegetation, found usually in regions of extreme temperature range and loess soil.

**Strategy –** A specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives (620 FW 1.6).

**Subirrigated –** To irrigate (land) by means of an underground system of pipelines or by natural moisture in the subsoil.

**Submergent –** A plant that is completely beneath the surface of water.

**Successional –** The gradual and orderly process of ecosystem development brought about by changes in community composition and the production of a climax characteristic of a particular geographic region.

**Telemetry –** The science and technology of automatic measurement and transmission of data by wire, radio, or other means from remote sources, such as from space vehicles, to receiving stations for recording and analysis.

**THEIL –** A nonparametric statistical test that can be used instead of regression-based methods for discerning a monotonic trend.

**TMDL (total maximum daily load) –** A calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

**Tolerance thresholds –** The maximum amount of disturbance a suite of plant species can tolerate before an irreparable shift in plant community composition takes place.

**Transpiration –** The passage of water through a plant from the roots through the vascular system to the atmosphere.

**Tuff –** A rock composed of the finer kinds of volcanic detritus usually fused together by heat.

**Wetlands –** Wetlands are lands transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface or the land is covered by shallow water at some time during the growing season of each year (660 FW 2).

**Wildlife-dependent Recreational Use –** A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation. These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. The Service will also consider these other uses in the preparation of refuge CCPs; however, the six priority public uses always will take precedence (620 FW 1.6).

## H.2 Acronyms

| | |
|---|---|
| Act | National Wildlife Refuge System Improvement Act of 1997 (also Improvement Act or NWRSIA) |
| ADA | Americans with Disabilities Act |
| AM | Adaptive Management |
| ARPA | Archaeological Resources Protection Act |
| AUD | Appropriate Use Determination |
| BCR | Bird Conservation Region |
| BIDEH | Biological Integrity, Diversity, and Environmental Health |
| BLM | Bureau of Land Management |
| BMP | Best Management Practice |
| CCC | Civilian Conservation Corps |
| CCP | Comprehensive Conservation Plan |
| CEQ | Council on Environmental Quality |
| C.F.R. | Code of Federal Regulations |
| cfs | Cubic Feet per Second |
| CIG | Climate Information Group at the University of Washington |
| COA | Conservation Opportunity Area |
| CPR | Center Patrol Road |
| DDT | Dichlorodiphenyltrichloroethane |
| DPS | Distinct Population Segment |
| EE | Environmental Education |
| EIS | Environmental Impact Statement |
| EMS | Environmental Management System |
| ENSO | El Niño/Southern Oscillation |
| EOLC | Eastern Oregon Livestock Company |
| FIFRA | Federal Insecticide, Fungicide, and Rodenticide Act |
| HACCP | Hazard Analysis and Critical Control Points Planning |
| HCHS | Harney County Historical Society Museum |
| HCWC | Harney County Watershed Council |
| HUC | Hydrologic Unit Code |
| I&M | Inventory and Monitoring |
| IBA | Important Bird Area |
| Improvement Act | National Wildlife Refuge System Improvement Act (P.L. 105-57) |
| IPM | Integrated Pest Management |
| IPCC | Intergovernmental Panel on Climate Change |
| LCC | Landscape Conservation Cooperative |
| LEIS | Legislative Environmental Impact Statement |
| MBCC | Migratory Bird Conservation Commission |
| MPH | Miles Per Hour |
| msl | Mean Sea Level |
| NAGPRA | Native American Graves Protection and Repatriation Act |
| NAS | National Academy of Sciences |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |
| NOAA | National Oceanic and Atmospheric Administration |
| NRCS | Natural Resources Conservation Service |

| | |
|---|---|
| NRHP | National Register of Historic Places |
| NWR | National Wildlife Refuge |
| NWRS | National Wildlife Refuge System or the Refuge System |
| NWS | National Weather Service |
| OCS | Oregon Conservation Strategy |
| ODEQ | Oregon Department of Environmental Quality |
| ODFW | Oregon Department of Fish and Wildlife |
| ODOT | Oregon Department of Transportation |
| O-M pcp | October-March Precipitation |
| OPDR | Oregon Parks and Recreation Department |
| OWRD | Oregon Water Resources Department |
| PCB | Polychlorinated Biphenyl |
| PDO | Pacific Decadal Oscillation |
| PIF | Partners in Flight |
| P.L. | Public Law |
| PLO | Public Land Order |
| PPM | Parts Per Million |
| PRISM | Parameter-elevation Regressions on Independent Slopes Model |
| PRPA | Paleontological Resources Preservation Act |
| PUP | Pesticide Use Proposal |
| RAPP | Refuge Annual Performance Plan |
| Refuge Administration Act | National Wildlife Refuge System Administration Act of 1966 as amended (16 U.S.C. 668dd-668ee) |
| Refuge System | National Wildlife Refuge System or NWRS |
| RNA | Research Natural Areas |
| ROC | Resource of Concern |
| SCORP | Oregon Statewide Comprehensive Outdoor Recreation Plan |
| Service | United States Fish and Wildlife Service or USFWS |
| SLR | Sea Level Rise |
| SNOTEL | Snowpack Telemetry (designed to collect snowpack and related climatic data in the Western United States and Alaska) |
| STM | State and Transition Model |
| SWE | Snow Water Equivalent |
| TLDEIS | Transmission Line Project Draft Environmental Impact Statement |
| TMDL | Total Maximum Daily Load |
| U.S.C. | United States Code |
| USEPA | U.S. Environmental Protection Agency |
| USFS | U.S. Forest Service |
| USFWS | United States Fish and Wildlife Service or the Service |
| USGS | United States Geological Survey |
| USHCN | United States Historical Climatology Network |
| WSA | Wilderness Study Areas |
| YCC | Youth Conservation Corp |

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Ross' geese landing at Malhuer NWR ©Dan Dzurisin

# Appendix I
## Contributors


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**Table I-1. Core Planning Team**

| Name | Title | Organization |
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| Dan Nichols | Private Land Owner | Harney County Court |
| Matt Obradovich | Biologist | BLM |
| Julia Olsen | Former Director | Harney County Chamber of Commerce |
| Dan Otley | Private Land Owner | Rancher |
| Virginia Parks | Regional Refuge Archaeologist | USFWS |
| Clay Pierce | Assistant Unit Leader, Fisheries | Iowa Cooperative Fish and Wildlife Research Unit |
| Anan Raymond | Regional Cultural Resources Manager | USFWS |
| Andy Renc | Buena Vista Substation Manager, Malheur Refuge | USFWS |
| Robert Renchler | Realty Specialist | BLM |
| William Renwick | MWA Board Member | High Desert Partnership/MWA |
| Shannon Richardson | Fish Biologist | USFWS |
| Steve Robertson | Education Director | Audubon Society of Portland |
| Dan Roby | Associate Professor Fisheries & Wildlife | OSU |
| Chris Rombough | Herpetologist | Private Contractor |
| Pete Runnels | County Commissioner | Harney County Court/Business Owner |
| Zola Ryan | District Conservationist | Natural Resources Conservation Service |
| Bob Sallinger | Conservation Director | Audubon Society of Portland |
| Rudy Schuster | Branch Chief of Policy Analysis and Science Assistant | USGS |

| Name | Title | Organization |
|---|---|---|
| Mike Shannon | Regional Biologist | Ducks Unlimited |
| Steve Shunk | Naturalist | Paradise Birding |
| Angela Sitz | Ecological Services Office Assistant | USFWS |
| Peter Sorensen | Professor | University of Minnesota |
| Al Smith | Mussel Biologist | Retired - ODFW |
| Erin Stockenberg | Geographic Information Specialist | USFWS |
| Martin St. Louis | Summer Lake Wildlife Area Manager | ODFW |
| Marty Suter | District Manager | Harney County Soil and Water Conservation District |
| Tony Svejcar | Research Leader | ARS |
| Bruce Taylor | Oregon Biodiversity Program Director, Executive Director | Oregon Defenders of Wildlife, Oregon Habitat Joint Venture |
| Rick Thein | Subject Matter Expert | Private Citizen |
| Rick Vetter | Fish Biologist | US Forest Service |
| Lacey Wall | Planning Assistant | USFWS |
| Tim Walters | Former District Fish Biologist | ODFW |
| Julie Weikel | Board Member | ONDA |
| Robin West | Refuge Supervisor | USFWS |

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Northern pintail
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# Appendix J
## Public Involvement


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Public involvement was sought throughout the development of the comprehensive conservation plan (CCP). A collaborative process was defined as a goal early in the planning process and was an integral aspect of the planning process. Public involvement strategies included face-to-face meetings with community organizations, local, State, and Federal agencies, elected officials (or their aides), tribal governments, and Refuge users. The planning team also held open houses, conducted listening posts, provided newsletters, and gave presentations to inform the public, invite discussion, and solicit feedback. The Refuge maintained a website where CCP information could be found and where the public could print out comment forms or submit emails during the scoping phase. Below is a brief summary of the events, meetings, and outreach tools that were used in our scoping public involvement efforts.

## Meetings with Congressional Representatives and/or their Aides

- July 2009. Met with U.S. Representative Greg Walden's aide Colby Marshall, Burns, OR
- October 2010. Met with U.S. Representative Greg Walden's aide Nick Strader, Bend, OR
- October 2010. Met with U.S. Senator Ron Wyden's aide Wayne Kennedy, Bend, OR
- October 2010. Met with U.S. Senator Jeff Merkley's aide, Bend, OR
- February 2011. Met with U.S. Senator Jeff Merkley's aide Elizabeth Scheeler, Pendleton, OR
- September 2011. Met with U.S. Representative Greg Walden's aide Nick Strader, Bend, OR

## Meetings with Tribes

- April 2009. Met with Burns Paiute staff, Burns, OR
- November 2009. Open house at Burns Paiute Tribe Gathering Center, Burns, OR
- June 2010. Meet with Burns Paiute Tribe at council meeting, Burns, OR
- April 2012. Met with Burns Paiute Tribe at council meeting, Burns, OR

## Meetings with Elected Officials

- February 2009. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- April 2009. Met with Harney County Court (County Commissioners), Burns, OR
- July 2009. Met with Steve Grasty, Harney County Court (County Commissioners), Burns, OR
- January 2010. Met with Harney County Court (County Commissioners), Burns, OR
- August 2010. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- September 2010. Met with Harney County Court (County Commissioners), Burns, OR
- January 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- February 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- March 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR
- May 2011. Met with Steve Grasty, Harney County Court (County Commissioners), Burns, OR

- May 2011. Met with Dan Nichols, Harney County Court (County Commissioners), Burns, OR

## Meetings with Community/Business Organizations

- April 2009. Met with the board of the High Desert Partnership, Burns, OR
- August 2009. Met with Lions Club, Burns OR
- October 2009. Met with Burns/Hines Kiwanis Club, Burns, OR
- October 2009. Met with various merchants, Burns, OR
- October 2009. Met with the board of Portland Audubon Society, Portland, OR
- October 2009. Met with Harney County Chamber of Commerce.
- October 2009. Met with Harney County Historical Society, Burns OR
- November 2009. Met with Harney County Stockgrowers, Burns, OR
- December 2009. Met with Harney County Farm Bureau, Burns, OR
- January 2010. Met with Lions Club, Burns, OR
- January 2010. Met with Ducks Unlimited, Burns, OR
- April 2010. Met with the Oregon Natural Desert Association, Burns, OR
- May 2010. Met with Malheur Wildlife Associates, Frenchglen, OR
- June 2010. Met with Central Oregon Flyfishers, Princeton, OR
- June 2010. Met with Oregon Natural Desert Association, Bend, OR
- August 2010. Met with Oregon Natural Desert Association, Bend, OR
- August 2010. Met with Bureau of Land Management (BLM) Steens Mountain Advisory Council, Burns, OR
- September 2010. Met with East Cascades Audubon Chapter, Bend, OR
- September 2010. Met with Ducks Unlimited and Defenders of Wildlife, Burns, OR
- September 2010. Met with Oregon Natural Desert Association, Burns, OR
- October 2010. Met with Oregon Natural Desert Association, Burns, OR
- October 2010. Met with Portland Audubon Society, Burns, OR
- January 2011. Met with Ducks Unlimited, Burns, OR
- January 2011. Met with Oregon Natural Desert Association, Burns, OR
- January 2011. Met with Defenders of Wildlife, Burns, OR
- February 2011. Met with Lions Club, Ontario, OR
- February 2011. Met with High Desert Partnership, Burns, OR
- March 2011. Met with Harney County Soil and Water Conservation District (HCSWCD), Burns Oregon
- May 2011. Met with Ducks Unlimited, Vancouver, WA
- May 2011. Met with Ducks Unlimited, Princeton, OR
- May 2011. Met with Oregon Natural Desert Association, Burns, OR
- June 2011. Met with Ducks Unlimited, Burns, OR

## Meetings with Collaborators

- May 2009. Met with collaborators, Prineville, OR
- October 2009. Met with collaborators, Prineville, OR
- May 2010. Met with collaborators, Harney County Chamber of Commerce, Burns, OR
- June 2010. Met with collaborators, Harney County Chamber of Commerce, Burns, OR

- September 2010. Met with collaborators, Harney County Chamber of Commerce, Burns, OR
- January 2011. Met with collaborators, Agriculture Research Station, Burns, OR
- March 2011. Met with collaborators, Senior Citizen Center, Burns, OR
- April 2011. Met with collaborators, High Desert Partnership, Burns, OR
- May 2011. Met with collaborators, U.S. Forest Service (USFS) Office, Prineville, OR
- September 2011. Met with collaborators and High Desert Partnership about Harney Basin Wetlands Initiative, Harney County Chamber of Commerce, Burns, OR
- October 2011. Met with collaborators, Harney County Chamber of Commerce, Burns, OR

## Meetings with Agencies and Academia

- January 2009. Met with Oregon Department of Fish and Wildlife (ODFW) staff, Burns, OR
- February 2009. Met with Harney County Soil and Water Conservation District, Burns, OR
- March 2009. Met with Oregon Natural Desert Association, Bend, OR
- April 2009. Met with Agricultural Research Service staff, Burns OR.
- October 2009. Met with various Oregon State University (OSU) professors and students from wildlife department (34), Corvallis, OR
- October 2009. Met with Harney County school educators in Burns and Crane OR
- October 2009. Met with U.S. Geological Survey (USGS) staff, Forest and Range Resources Center, Corvallis, OR
- January 2010. Met with University of Minnesota Staff, St. Paul, MN
- January 2010. Met with Iowa State University Staff, Ames, IA
- February 2010. Conference call with USGS staff, Forest and Range Resources Center, and OSU Co-Op, Corvallis, OR
- March 2010. Met with USFS Staff, Burns, OR
- March 2010. Met with Harney County Soil and Water Conservation District, Burns, OR
- April 2010. Conference call with USGS staff and Forest and Range Resources Center, Corvallis, OR
- April 2010. Conference call with Aquatic Health Funding and Partnership Work Group
- April 2010. Conference call with Aquatic Health Carp Control Work Group
- April 2010. Presented at NWR-CRFPO 2010 Workshop, Vancouver, WA
- April 2010. Met with Harney County Soil and Water Conservation District, Burns, OR
- May 2010. Conference call with Fish Carcass Users Group
- May 2010. Met with U.S. Army Corp of Engineers, Princeton, OR
- June 2010. Conference call with Aquatic Health Assessment Work Group
- June 2010. Met with Genie Monteblanc, Science Delivery Project Coordinator, Princeton, OR
- July 2010. Met with David Dobkin and Lewis & Clark College students, Princeton, OR
- September 2010. Met with ODFW, BLM, and Aquatic Health Group Chair, Burns, OR
- September 2010. Conference call with Aquatic Health Funding and Partnership Work Group
- October 2010. Met with University of Minnesota staff, Princeton, OR
- October 2010. Met with Central Utah Water Conservancy District, Orem, UT
- October 2010. Met with ODFW, Burns, OR
- November 2010. Met with ODFW, Burns, OR
- December 2010. Met with ODFW, Burns, OR

- January 2011. Met with ODFW Directorate, Tualatin National Wildlife Refuge (NWR), Tualatin, OR
- January 2011. Met with DU, Burns, OR
- January 2011. Met with ODFW, BLM, HCSWCD, HCWSC, FS, Oregon Natural Desert Association, DU, The Nature Conservancy, BPT, USGS, OSU, HDP, Defenders of Wildlife for NAWCA Funding, BLM District Office, Burns, OR
- February 2011. Met with OSU and USGS scientists, Corvallis, OR
- February 2011. Met with American Fisheries Society, Bend, OR
- March 2011. Met with ODFW, BLM, HCSWCD, HCWSC, FS, Oregon Natural Desert Association, DU, The Nature Conservancy, BPT, USGS, HDP, Defenders of Wildlife for NAWCA Funding, BLM District Office, Burns, OR
- April 2011. Met with ODFW, Burns Office.
- May 2011. Met U.S. Fish and Wildlife Service Regional Office for Brown Bag carp presentation, Portland, OR
- May 2011. Met with fisheries professionals, Vancouver, WA
- June 2011. Met with HCSWD, Natural Resource Conservation Society (NRCS), and ODFW, Burns, OR
- June 2011. Met with Bill Renwick, Burns, OR

## Ecology Work Group

- January 2010. Teleconference with Tony Svejcar (Agricultural Research Service), Esther Lev (Wetlands Conservancy), John Christy (Oregon Natural Heritage Program), and Mike Shannon (Ducks Unlimited), Burns, OR
- July 2010. Teleconference with Tony Svejcar, Esther Lev, John Christy, and Gary Ivey (independent wildlife biologist), Burns, OR
- May 2011. Telephone discussions with core group (see January 2010 attendees) regarding May 2011 update
- September 2011. Telephone discussions with core group (see January 2010 attendees) regarding September 2011 update
- October 2011. Refuge field trip and inventory and monitoring planning by core group. Princeton, OR

## Public Open Houses/Scoping Sessions

- February 2008. Presentation and public open houses for CCP scoping afternoon and evening sessions. Salem, OR
- February 2008. Presentation and public open houses for CCP scoping afternoon and evening sessions. Corvallis, OR
- September 2009. Presentation and public open house, Harney County Chamber of Commerce, Burns, OR
- October 2009. Presentation and public open house, Central Oregon Environmental Center, Bend, OR
- October 2009. Presentation and public open house, Doubletree Hotel-Lloyd Center, Portland, OR
- October 2009. Presentation and public open house, Golden Eagle Audubon Society, Boise, ID

## Listening Posts/Displays

- September 2009. Held at Harney County Fair, Burns, OR
- September 2009. Held at Harney County Library, Burns, OR
- September 2009. Held at Harney County Senior Citizens Center, Burns, OR
- September 2009. Held at Harney County Chapter of the Oregon Hunters Association, Burns, OR
- September 2009. Held at The Narrows Restaurant, Princeton, OR
- September 2009. Held at Round Barn Visitor Center, Diamond, OR
- September 2009. Held at Lane County Audubon Society, Eugene, OR
- September 2009. Held at Harney County Chamber of Commerce, Burns, OR
- September 2009. Held at Frenchglen Hotel, Frenchglen, OR
- September 2009. Held at Harney County Courthouse, Burns, OR
- October 2009. Held at Thriftway Grocery Store, Hines, OR
- October 2009. Held at Central Oregon Environmental Center, Bend, OR
- October 2009. Held at Crane High School, Crane, OR
- October 2009. Held at Portland Audubon Society, Portland, OR
- October 2009. Held at Corvallis Audubon Society, Corvallis, OR
- March 2010. Redmond Sports Show, Redmond, OR
- August 2010. Harney County Library Foundation, Burns, OR
- August 2010. Invasive Carp Awareness Day, Princeton, OR

## Meetings with Individuals

- February 2009. Met with Gary Marshall, Refuge permit holder, Princeton, OR
- March 2009. Met with Dick Jenkins, local rancher, Diamond, OR
- July 2009. Met with John and Laurie O’Connor, former Refuge employees, Burns, OR
- July 2009. Met with Dick Jenkins, owner of Round Barn Interpretive Center, longtime resident, current Refuge haying/grazing permit holder, Diamond, OR
- July 2009. Met with John and Cindy Witzel, lifelong residents of Frenchglen, descendents of former Refuge haying/grazing permit holder, Frenchglen, OR
- July 2009. Met with Malena Koenik, Frenchglen General Store owner, Frenchglen, OR
- July 2009. Met with Steve, Dwight, and Susie Hammond, neighboring landowners and former permit holders, Frenchglen, OR
- July 2009. Met with Guy Sheeter, retired school teacher and hunter, Burns, OR
- July 2009. Met with Joe Hendry, retired BLM biologist, Burns, OR
- September 2009. Met with Stacy Davies, local rancher, Catlow Valley, OR
- September 2009. Met with Tom Downs, former Refuge employee, Fields, OR
- October-November 2009. Met with several Refuge permit holders (G. Marshall, G. Miller, Tyler family, R. Dunbar, Buck Taylor, and Don Opie), rural Harney County, OR
- November 2009. Met with Mark and Susan Doverspike, ranchers, rural Harney County, OR
- March 2010. Met with Bill Renwick, community activist, Burns, OR
- March 2010. Met with Gary Marshall, Refuge permit holder, Princeton, OR
- August 2010. Met with Gary Marshall, Refuge permit holder, Princeton, OR
- October 2010. Met with past Refuge managers, Princeton, OR
- January 2011. Met with Tom Downs, former Refuge employee, Fields, OR

- February 2011. Met with past Refuge biologists, Princeton, OR
- March 2011. Met with Bill Renwick, Burns, OR
- March 2011. Met with Dan Otley, Diamond, OR
- March 2011. Met with Dick Jenkins, Diamond, OR
- May 2011. Met with Nancy Fine, *Ruralite* writer, Burns, OR
- May 2011. Met with Gary Marshall, Refuge permit holder, Burns, OR
- June 2011. Met with Wayne Baron, entrepreneur, Burns, OR

## Workshops/Field Reviews

- June 2009. Conducted a Wildlife and Habitat Program Review with approximately 40 participants, Princeton, OR
- July 2009. Conducted a Visitor Services Program Review with approximately 40 participants, Princeton, OR
- October 20, 2009. Conducted a Priority Resources of Concern workshop with approximately 40 participants, Prineville, OR
- March 2010. Conducted an Invasive Carp workshop with 64 participants, Burns, OR
- January 2011. Presented Aquatic Health and Habitat CCP goals, objectives, and progress made to Science in the Service meeting, Stevenson, WA

## Press Coverage

- Fall 2009. Various notices of CCP open houses and listening posts printed in the local *Burns-Times Herald*, *The Oregonian*, and online (Oregon Birders' online network, National Rifle Association online notice, online notice of CCP public open house in Salem's *Statesman Journal*).
- March 2012. Press releases printed in the *Burns-Times Herald* and the *Bend Bulletin* about the availability of the draft CCP for review and comments.

## Planning Updates

- September 2009. Planning Update 1 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.
- November 2009. Creation of Carp Coalition Listserve. Updates sent at least monthly to approximately 150 members from creation to present.
- May 2010. Planning Update 2 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various

locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.

- February 2012. Planning Update 3 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.
- December 2012. Planning Update 4 mailed to approximately 400 persons, organizations, and officials. Copies of the planning update were also placed at key Refuge points, including the Visitor Center and brochure boxes, and copies were made available to people at listening posts and public meetings. Copies of the planning update were also placed at various locations in Burns, Oregon, and surrounding locations, including: Chamber of Commerce, BLM office, ODFW office, USFS office, HCSWCD office, NRCS office, Big R store, Rite Aid store, King's store, B&B Sporting Goods store, District Hospital, High Desert Medical Center, Library, Burns Post Office, Hines Post Office, Narrows Restaurant, Round Barn Visitor Center, Malheur Field Station, Diamond Hotel, Steens Mountain Resort, Fields store, Frenchglen Hotel, and Crane store.

## Other Tools

- June 2009. Updated Refuge website to include CCP information.
- March 2011. Central Oregon Sportsman Show, Redmond, OR

## Federal Register Notices

- June, 2009. Federal Register published Notice of Intent to prepare a CCP and environmental impact statement (EIS); request for comments.
- March, 2012. Federal Register published Notice of Release of draft CCP and EIS; request for comments.
- December, 2012. Federal Register published Notice of Availably of the final CCP and EIS.

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# Appendix K

## Wet Meadow Treatment Ratios

*Hay at P Ranch*
©Barbara Wheeler

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# K.1 Refuge Management Treatments

## K.1.1 Management Treatment Acres

The following table (Table K-1) will be used to track acres treated by various management strategies throughout the life of the CCP. It will enable Refuge staff, collaborators, and interested public to understand if and how management may change over time in striving toward or maintaining met objectives in various habitat types.

**Table K-1. Management Treatment Acres per Treatment Year**

| Treatment | Acres per Treatment Year | | | | | |
|---|---|---|---|---|---|---|
| | 2013-2014 | 2014-2015 | 2015-2016 | 2016-2017 | 2018-2019 | 2019-2020 |
| Rakebunch (DS) | | | | | | |
| True Graze (DS) | | | | | | |
| True Graze (WS) | | | | | | |
| Haying (DS) | | | | | | |
| Seeding | | | | | | |
| Grain Farming | | | | | | |
| Shrub Planting | | | | | | |
| Disking | | | | | | |
| Chemical-Habitat | | | | | | |
| Chemical-Fisheries | | | | | | |
| Rx Fire | | | | | | |
| Commercial Fishing | | | | | | |
| Juniper Control | | | | | | |
| Carp Objectives Met | | | | | | |

DS: Dormant Season; WS: Warm Season as described in Appendix B Haying and Grazing CD

# K.2 Dormant Season Haying and Grazing in Wet Meadows

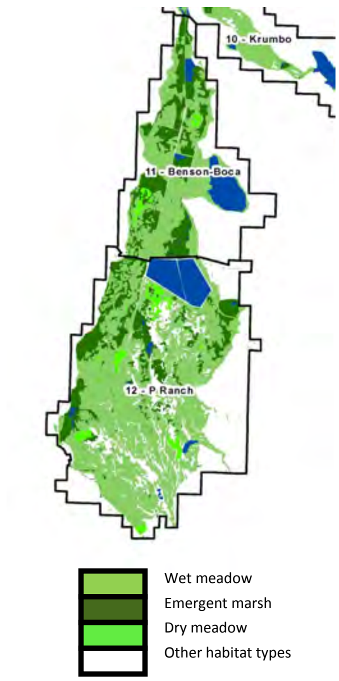
The initial ratio of wet meadows receiving haying and rake-bunch grazing treatments on an annual basis to those left idle will be 60:40 (±10 percent). This translates to 12,000 to 15,000 of 20,000 to 25,000 acres being treated in a given year[1]. This figure is based on the sound professional judgment of seven past and present Refuge wildlife biologists with 50 collective years of experience managing

[1] Acreage ranges exist to provide needed flexibility to account for (1) acreage refinement as the Refuge's GIS layers become more precise, (2) the possible need of reclassifying some acreages as inventory and monitoring data continues to be collected (e.g., existing emergent marsh that has resulted from cattail encroachment into wet meadow), and (3) climatic conditions or other unforeseen restraints that may hinder the Refuge's ability to treat all targeted acres.

Refuge meadows. This ratio is relevant only when considering all wet meadows within the Refuge and differs across fields and area-specific management units. The needs of focal species, the suite of wildlife they represent, and the nature of habitats they depend on determines the use and extent of these tools in realizing or maintaining attributes identified under Objective 4a. The ratio itself is not prescriptive. It serves as an indicator of treatment changes over time.

The purpose of this appendix is to provide an overarching rationale behind the initial 60:40 ratio by highlighting four major areas (southern, central, and northern Blitzen Valley and Double-O Unit) and identifying associated needs for treated and/or untreated acres for wet meadow focal species (i.e., bobolink, greater sandhill crane, and cinnamon teal). It is not intended to replace established Refuge management units, but is designed specifically to facilitate greater understanding of how management needs change as one moves across the Refuge landscape.

## K.2.1 South Blitzen Valley




***Total wet meadow area:*** Out of 20,300 total acres in this management area, 8,000 will be occupied by wet meadow habitat.

***Focal species as identified in the CCP for wet meadow habitats[2]:***

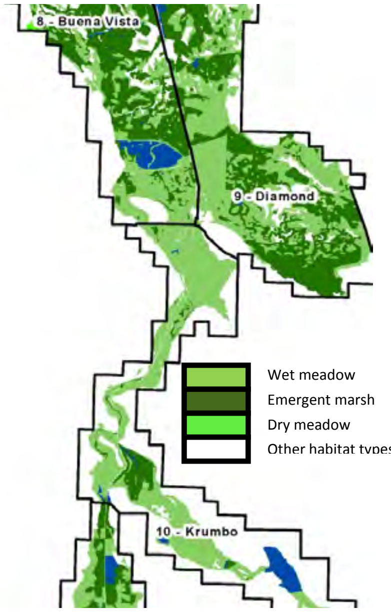
- **Bobolink:** Concentrated populations are found in mesic wet meadows, totaling approximately 3,500 acres. Nesting/feeding habitat is dependent on short vegetation heights achieved via treatments (populations decrease substantially under non-treated status). The Blitzen Valley hosts the largest bobolink population west of the Great Plains and has over 90 percent of the bobolinks that breed in Oregon. They only occur at approximately six other sites supporting numbers of less than 20 individuals (Marshall et al. 2006). Approximately 85 percent of the Refuge bobolinks are found in this area (2,471 out of 2,902, Refuge unpublished data).
- **Greater sandhill crane:** A 1999 Refuge summary report found 99 out of 235 pairs (42 percent) using this area. Nesting occurs in adjacent emergent marsh vegetation. Crane pairing and young-rearing takes place on approximately 6,000 acres of meadows with an overall treated vegetation height of <6 inches. Acreage overlaps bobolink use areas.
- **Cinnamon teal**: Primarily dry meadow habitats and secondarily, upland habitats provide a majority of this species' nesting habitat in this area. Mallards, which are represented by this focal species, do commonly nest in emergent marsh habitat. Mesic wet meadows less prone to flooding provide suitable nesting habitat (approximately 800 acres) for some waterfowl species. Areas susceptible to nest loss via water management are treated to provide waterfowl pairing/pre-nesting habitat (overlap above treated acreages).

***Treated:Untreated ratio for this area:*** 90:10 for wet meadow, 35:65 for total area

[2] Basic habitat principles discussed in regard to the southern Blitzen Valley generally apply to all units.

## K.2.2 Mid-Blitzen Valley

***Total wet meadow area:*** Out of 19,600 total acres, 6,400 will be occupied by wet meadow habitat.




***Focal species as identified in the CCP for wet meadow habitats:***

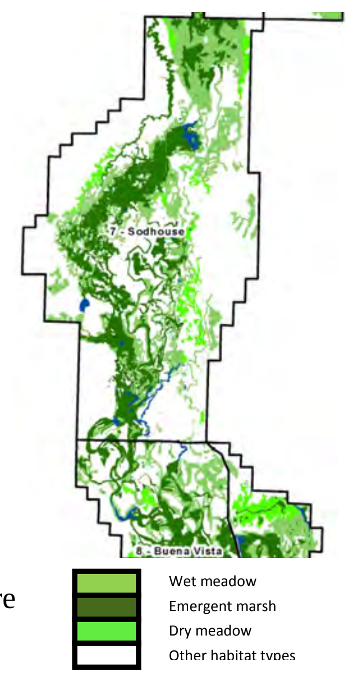
- **Bobolink**: Approximately 50 to 100 acres of suitable, used mesic wet meadow habitat are known to exist in this area. Less than 1 percent of Refuge bobolinks are found in this area (14 out of 2,902, Refuge unpublished data).
- **Greater sandhill crane:** Concentrations of greater sandhill crane territories remain high, but are a little lower in this area compared to the south Blitzen Valley (62 out of 235 pairs, or 26 percent). Approximately 4,000 acres of wet meadow are treated to provide crane pairing/pre-nesting habitat.
- **Cinnamon teal:** Approximately 2,300 acres of mesic wet meadow is left untreated to provide nesting habitat.

An increase in reed canarygrass dominance in many meadows greatly minimizes their value in regard to waterfowl nesting habitat and overall wildlife use if left untreated. Currently approximately 4,000 acres (out of approximately 6,000 total acres) of reed canarygrass is located in this area.

***Treated:Untreated ratio for this area:*** 64:36 for wet meadow, 21:79 for total area.

## K.2.3 North Blitzen Valley

***Total wet meadow area:*** Out of 24,000 total acres, 4,600 will be occupied by wet meadow habitat.

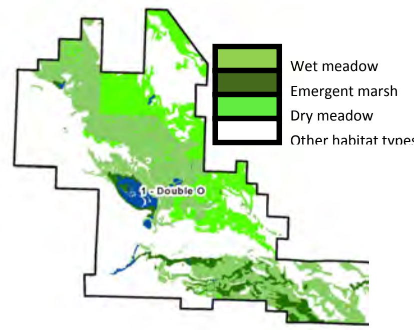



***Focal species as identified in the CCP for wet meadow habitats:***

- **Bobolink**: The use of this species is focused on expansive wet meadows on the north end of this area (approximately 600 acres). Approximately 14 percent of the Refuge bobolinks are found in this area (417 out of 2,902, Refuge unpublished data).
- **Greater sandhill crane:** Crane territories are less concentrated in this area (28 out of 235 pairs, or 12 percent) so approximately 1,200 acres of treatment are targeted for pairing/pre-nesting habitat.
- **Cinnamon teal:** Many wet meadow communities in this area are very small and less prone to extensive nest flooding because of the prevailing dichotomy of elevations found throughout its fields and the greater edge of surrounding dry meadow nesting habitats. Approximately 3,200 acres of the area's wet meadows are left untreated to provide nesting habitat.

***Treated:Untreated ratio for this area:*** 30:70 for wet meadow, 6:94 for total area.

### K.2.4 Double-O




***Total wet meadow area:*** Out of 20,000 total acres, 4,600 will be occupied by wet meadow habitat.

***Focal species as identified in the CCP for wet meadow habitats:***

- **Bobolink**: 0 acres.
- **Greater sandhill crane:** Crane territories concentrate in the southern fields where water is provided by Double-O Spring as well as the northwestern meadows maintained by Silver Creek. Approximately 2,000 acres are treated for pairing and young-rearing. Twenty percent, or 46 out of 235 crane pairs use this area
- **Cinnamon teal:** 300 acres of wet meadow areas north and east of the central ponded area (Martha, Warbler, and Derrick ponds) are managed primarily for waterfowl nesting.

***Treated:Untreated ratio for this area:*** 40:60 for wet meadow, 10:90 for total area.

***Total Treated:Untreated ratio across all habitat types within the Refuge:*** **8:92**

## K.3 References

Marshall, D.B., M.G. Hunter, and A. Contreras. 2006. Birds of Oregon: a general reference. Corvallis, O: Oregon State University Press 752 pp.

*Northern shoveler*
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# *Appendix L*

## *The Ecology Work Group and the State and Transition Model*


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# L.1 Adaptive Management and the State and Transition Model

Habitat management within the Malheur Refuge comprehensive conservation plan (CCP) will rest on an inductive ecological framework that uses a broad spectrum of relevant research from similar systems. This will enable the Refuge to form premises that assist in developing reasonable management strategies to meet various identified habitat objectives. The foundation from which habitat management approaches will arise within this CCP is “adaptive management.”

The U.S. Department of the Interior recognizes that this concept “is much more than simply tracking and changing management direction,” and that it “focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable resource systems” (Williams et al. 2007).

The Malheur State and Transition Model (STM) will play a vital role in achieving this. The STM is a framework that is being developed by the Service with the assistance of ecologists from various State and Federal agencies and non-government organizations. As illustrated conceptually in Figure L-1, STM will:

(1) describe various habitat types and associated plant communities;
(2) discuss the conditions that likely cause transitions[1] to other plant assemblages;
(3) identify existing information gaps in the scientific knowledge base that need to be addressed in further understanding the functionality of these habitat types and possible strategies for obtaining this critical information;
(4) develop management strategies by combining individual tools/treatments to meet the objectives specified in this plan;
(5) analyze the success of initiated management strategies; and
(6) modify management over time to meet CCP objectives.

The benefits of the STM concept for Malheur Refuge expand beyond greater ecological understanding of Refuge habitat. It also provides transparency, heightened and continued interaction with partnering agencies/organizations (i.e., Oregon State University, U.S. Department of Agriculture’s Agricultural Research Service, Oregon Heritage Program, Ducks Unlimited, Wetlands Conservancy, etc.), and accountability for continued monitoring of management actions. The STM is a living model that is continually transformed as new information is gleaned over time, and because of this, it introduces an amplified dependence on actualized adaptive management. It also provides us with a framework for organizing our results and reporting them to the interested public.

# L.2 The Ecology Work Group

As mentioned above, the STM is developed by ecologists and fish/wildlife biologists from the Service and partnering entities. It is a product of the Service, created in cooperation with the Ecology Work Group, which was created during the development of the 2012 Malheur CCP. This group is designed to assist Refuge staff in carrying out adaptive management by providing experience, vital

[1] These transitions are called thresholds when severe climatic or management stresses cause the composition of species within a particular assemblage to change radically, and they are often difficult to reverse without a lot of external input (labor and funding).

connections to best available science, and increased opportunities for acquiring the resources needed in pursuing dynamic management of Refuge habitats. The Ecology Group will meet prior to each field season to discuss data gathered in previous seasons and assess the effectiveness of current strategies. It will assist the Service in determining if objectives are being met or, in instances where long-term tenacity is required, if existing management is moving target habitats toward desired conditions over time. The Ecology Group will also analyze data and discuss management successes and challenges at the conclusion of each field season and consider if alterations to the STM need to be made as more information becomes available.

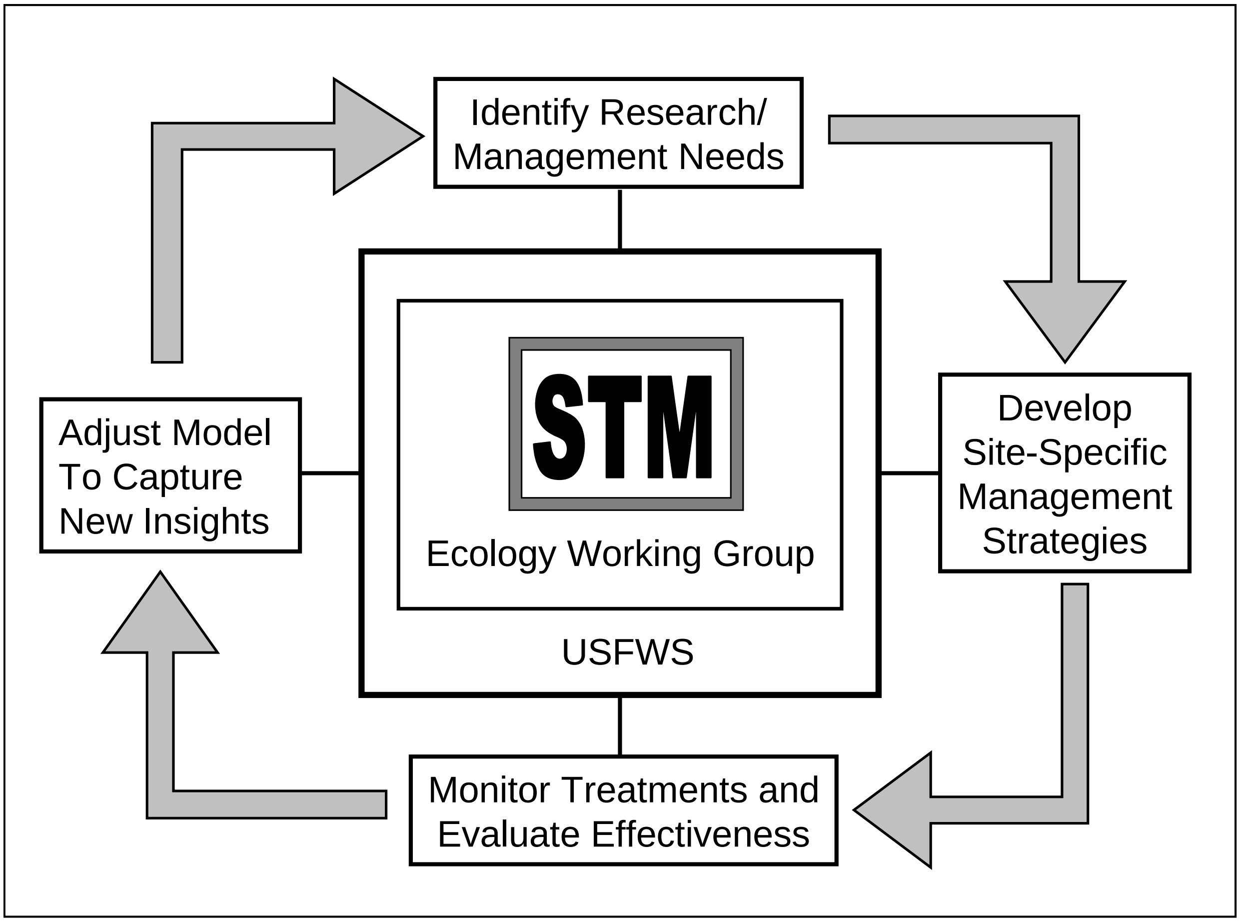


**Figure L-1. A conceptual diagram of the State and Transition Model as an adaptive management tool.**

## L.3 References

Williams B.K., R.C. Szaro, and C.D. Shapiro. 2007. Adaptive management: the U.S. Department of Interior technical guide. Adaptive Management Working Group, U.S. Department of the Interior. Washington D.C.

Western frittilary
©Roger Baker

# Appendix M
## Climate Change


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# M.1 Introduction

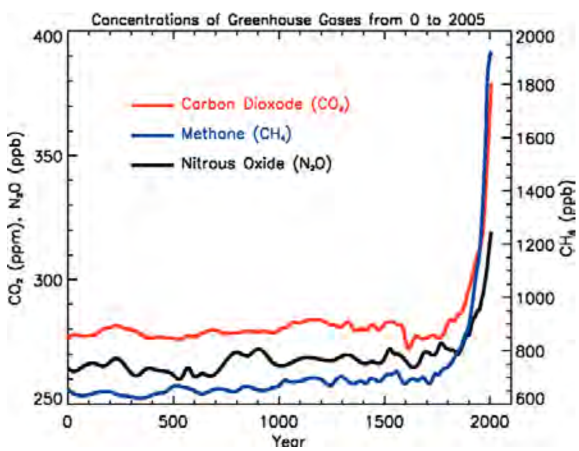
As required by DOI Secretarial Order 3226, issued in 2001, the Service requires consideration and analysis of climate change in long-range planning.

## M.1.1 Global Greenhouse Gases

The greenhouse effect is a natural phenomenon that assists in regulating and warming the temperature of our planet. Just as a glass ceiling traps heat inside a greenhouse, certain gases in the atmosphere, called greenhouse gases (GHGs), absorb heat from sunlight, trapping heat in the atmosphere and warming the planet. The primary GHGs occurring in the atmosphere include carbon dioxide ($CO_2$), water vapor, methane, and nitrous oxide. $CO_2$ is produced in the largest quantities, accounting for more than half of the current impact on the Earth's climate.

A growing body of scientific evidence from basic theory, climate model simulations, and observations has emerged to support the idea that humans are changing the Earth's climate (U.S. Global Change Research Program [USGCRP] 2009; Intergovernmental Panel on Climate Change [IPCC] 2007; National Academy of Sciences [NAS] 2008). The concentrations of heat-trapping GHGs have increased significantly over the last several hundred years due to human activities such as deforestation and the burning of fossil fuels (Figure M-1).

Although climate alterations are well documented in the Earth's history, even in relatively recent geologic time (e.g., the Ice Age of 10,000 years ago), the current warming trend differs from earlier shifts in two ways. First, this recent change in climate appears to be driven primarily by human activity, particularly the burning of fossil fuels, which results in a higher concentration of atmospheric GHGs). Second, atmospheric $CO_2$ and other GHGs, levels of which are strongly correlated with the Earth's temperature, are now higher than at any time in at least the last 420,000 years (Figure M-2) (USGCRP 2009).



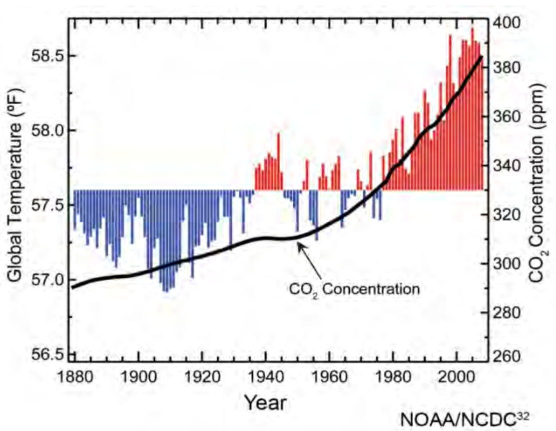

Source: IPCC 2007.

**Figure M-1. Concentrations of important heat-trapping greenhouse gases over the last 2,000 years.**

Prior to the start of the Industrial Revolution in 1750, the amount of $CO_2$ in the atmosphere was about 280 parts per million (ppm). Current levels are about 390 ppm and are increasing at a rate of about 2 ppm/year. Data from ice cores, which record prehistoric atmospheric conditions, show that for the last 800,000 years, $CO_2$ concentrations have ranged from 180 ppm during cold, glacial periods to 300 ppm during warm, interglacial periods. The current concentrations of $CO_2$ and other GHGs, as well as the rapid rate of increase in recent decades, are unprecedented in the prehistoric record.

## M.1.2 Temperature and Precipitation

There is a direct correlation between GHG concentrations and the temperature of the Earth's surface. Global surface temperatures have increased about 1.3°F since the late nineteenth century (USGCRP 2009), and the rate of temperature increase has risen in more recent years (Figure M-2). The IPCC, a large group of scientists in a panel created by the United Nations to evaluate the risk of climate change caused by human activities, reported in 2007 that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level." (IPCC 2007).




Global annual average temperature (as measured over both land and oceans). Red bars indicate temperatures above and blue bars indicate temperatures below the average temperature for the period 1901-2000. The black line shows atmospheric carbon dioxide ($CO_2$) concentration in parts per million (ppm). While there is a clear long-term global warming trend, each individual year does not show a temperature increase relative to the previous year, and some years show greater changes than others.[33] These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niños, La Niñas, and the eruption of large volcanoes.

Source: USGCRP 2009.

**Figure M-2. Global average temperature and $CO_2$ concentrations from 1880 to 2008.**

In the northern hemisphere, recent decades appear to be the warmest since about A.D. 1000, and the warming since the late nineteenth century is unprecedented over the last 1,000 years. Globally, 2010 and 2005 tie as the warmest years in the instrumental record (1880 to the present), while 2009 was only a fraction of a degree cooler, matching 1998, 2002, 2003, 2006, and 2007 for the second-warmest year on record, according to independent analyses by the National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space Administration (NASA) (Table M-1). The new 2010 record is particularly noteworthy because it occurred in the presence of a La Niña and a period of low solar activity, two factors that have a cooling influence on the planet. However, in general, decadal trends are far more important than any particular year's ranking.

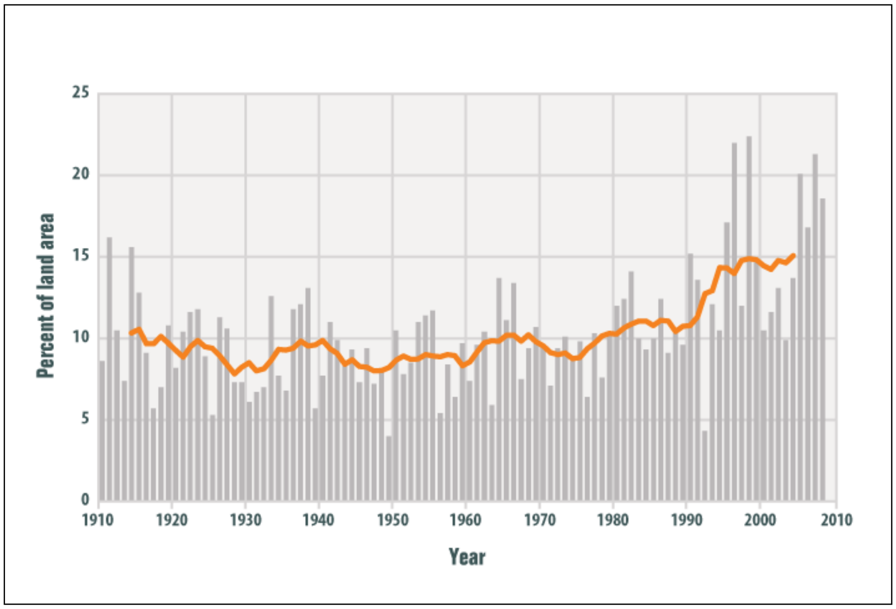
**Table M-1. Top 10 Warmest Years in the Instrumental Record from 1880 to 2010[a]**

| Global Top 10 Warmest Years (Jan-Dec) | Anomaly (°C) | Anomaly (°F) |
|---|---|---|
| 2010 | 0.62 | 1.12 |
| 2005 | 0.62 | 1.12 |
| 1998 | 0.60 | 1.08 |
| 2003 | 0.58 | 1.04 |
| 2002 | 0.58 | 1.04 |
| 2009 | 0.56 | 1.01 |
| 2006 | 0.56 | 1.01 |
| 2007 | 0.55 | 0.99 |
| 2004 | 0.54 | 0.97 |
| 2001 | 0.52 | 0.94 |

Source: National Climatic Data Center 2010.
[a] The instrumental record refers to the period with recorded temperatures.

Trends in precipitation are more difficult to detect than changes in temperature because precipitation is generally more variable. Over the last century, there have been increases in annual precipitation in the higher latitudes of both hemispheres and decreases in the tropical regions of Africa and southern Asia (USGCRP 2009). Most of the increases have occurred in the first half of the twentieth century, and it is not clear if this trend is due to increasing GHG concentrations.

Just as important as precipitation totals are changes in the intensity, frequency, and type of precipitation. Warmer climates, owing to increased water vapor, lead to more intense precipitation events, including more snowstorms and possibly more flooding, even with no change in total precipitation (Figure M-3). On the other hand, more droughts and heat waves can be expected as hotter, longer-lasting high-pressure systems dry out the land.




Source: EPA 2010.

**Figure M-3. Percent of land area in the lower 48 states that has experienced greater than normal precipitation for the period 1910 to 2008.**

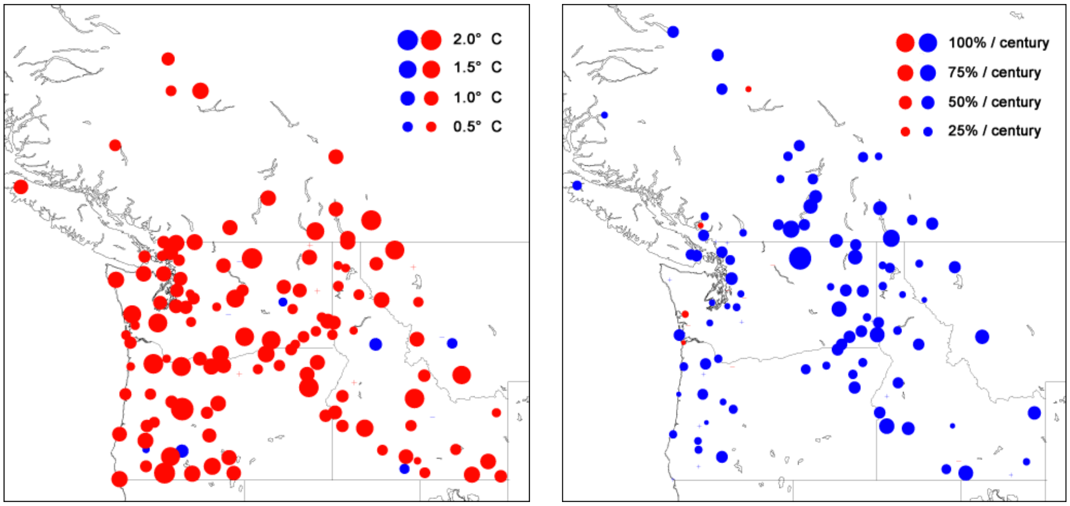
### M.1.3 Emissions Scenarios

When climate modelers project future climate, they make assumptions about future GHG emissions. These assumptions are called emission scenarios. A common set of emissions scenarios was developed in 2000 by the IPCC. Three scenarios from this set are frequently used by the modeling community: the A2 (high emissions scenario), A1B (medium emissions scenario), and B1 (low emissions scenario). Because of a lag between GHG emissions and climate response, the assumptions about future emissions will not influence the next 30 years or so. GHG concentrations and climate in the short term will be determined by emissions that have already occurred. Longer-term climate projections are more uncertain and vary because of uncertainty in future GHG emissions (and therefore future concentrations of GHGs). This is why, typically, there are differences in climate model projections beyond 2050.

## M.2 Pacific Northwest Climate Indicators and Observed Trends

### M.2.1 Observed Temperature and Precipitation Changes

From a climate change perspective the Refuge is more closely aligned with changes that have occurred in the Pacific Northwest, rather than the desert regions of the Southwest. In the Pacific Northwest, the regionally averaged temperature rose 1.5°F between 1920 and 2000 (Figure M-4), slightly more than the global average. Warming was greatest for the winter months of January to March. Minimum daily temperatures have increased faster than maximum daily temperatures. Longer-term precipitation trends in the Pacific Northwest are more variable and vary with the period of record analyzed (Mote et al. 2005). Looking at the period 1920 to 2000, precipitation has increased almost everywhere in the region. Most of that increase occurred during the first part of the record.




Source: Climate Impacts Group 2011.
Note: Red (blue) circles indicate warming (cooling) air temperatures or decreasing (increasing) precipitation.

**Figure M-4. Trends in annual temperature or precipitation from 1920 to 2000.**

In the Pacific Northwest, increased GHGs and warmer temperatures have resulted in a number of physical and chemical impacts to the region. These include changes in snowpack, streamflow timing and volume, flooding and landslides, sea levels, ocean temperatures and acidity, and disturbance regimes like wildfires and insect and disease outbreaks (USGCRP 2009).

## M.2.2 Observed Snowpack, Streamflow, and Glacial Changes

***Snowpack Changes:*** One of the most important responses to warmer winter temperatures in the Pacific Northwest has been the loss of spring snowpack (Mote et al. 2005). As temperatures rise, the likelihood of winter precipitation falling as rain rather than snow increases. This is especially true in the Pacific Northwest where mountainous areas of snow accumulation are at relatively low elevations and winter temperatures are near freezing. Small increases in average winter temperatures can lead to increased rains, reduced snowpack, and earlier snowmelt. The loss of spring snowpack in the Pacific Northwest has been significant, with most stations showing, on average, a decrease (Figure M-5). Data recorded each April 1st show that snowpacks have declined 25 percent over the past 40 to 70 years (Mote et al. 2005). The fact that the declines are greatest at low elevation sites and the trend has occurred in the absence of significant decreases in winter precipitation implicates temperature rather than precipitation as the cause of the trend.

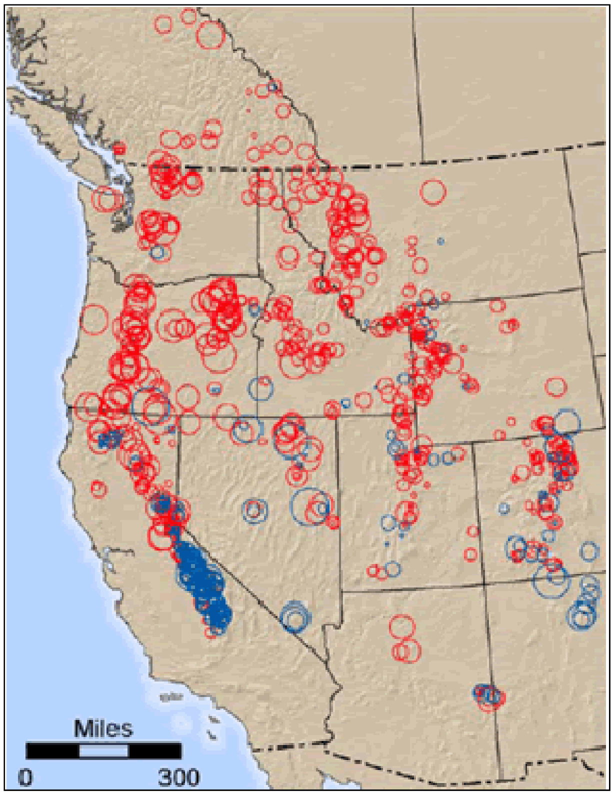
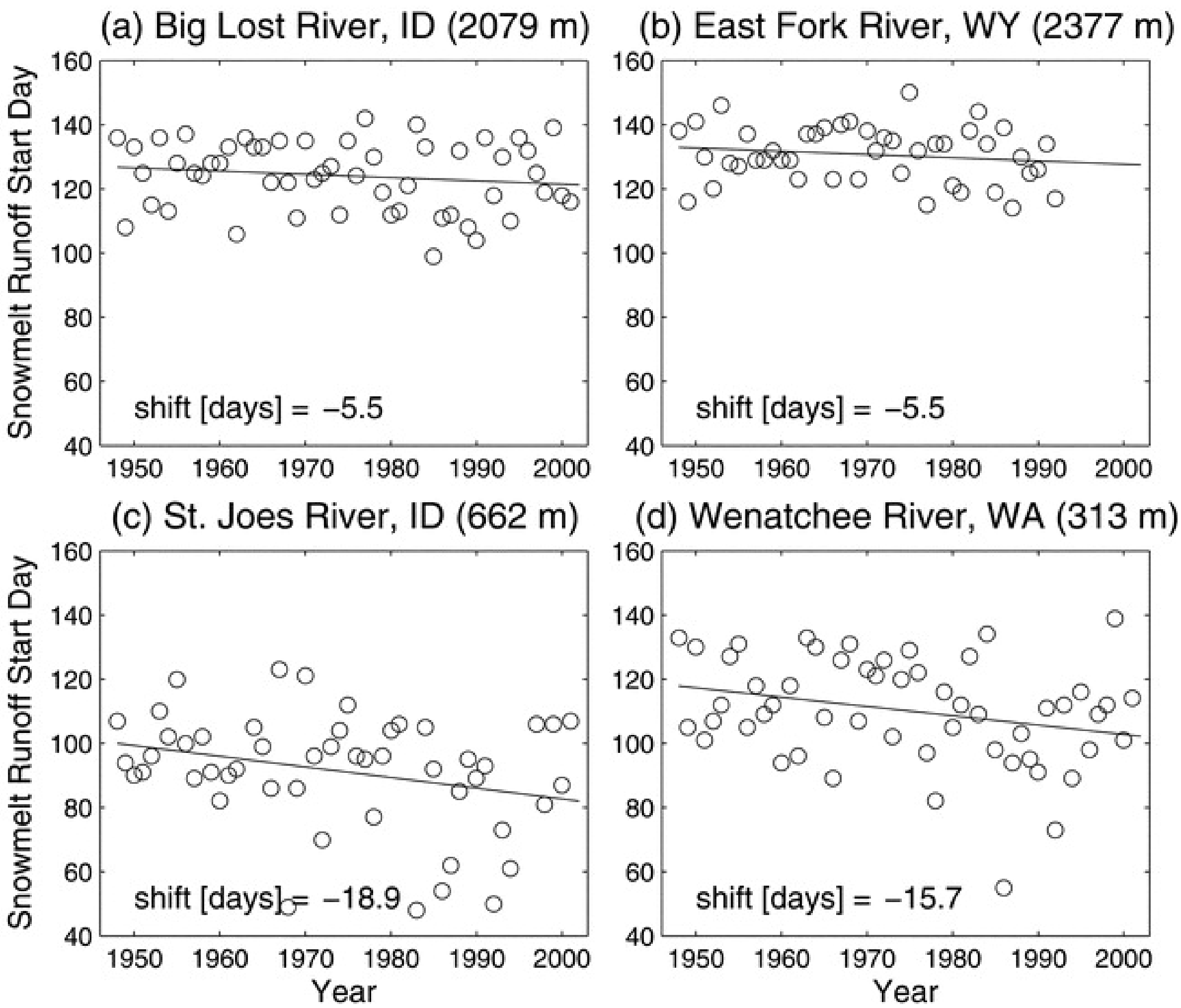



**Figure M-5. Trends in April 1st snow water equivalent (SWE) in the western United States from 1950 to 1997. Red (blue) circles indicate decreasing (increasing) SWE, with the size of the symbol indicating the magnitude of the trend**

Source: Mote et al. 2005.

***Streamflow Changes:*** The decrease in spring snowpack and earlier snowmelt have led to a change in streamflow in many systems, including earlier spring runoff peaks, increased winter streamflow, and reduced summer and fall streamflows. Stewart et al. (2005) examined 302 streamflow gages in the western United States and reported that the timing of winter runoff and annual streamflow had advanced by 1 to 4 weeks from 1948 to 2002. The degree of change depends on the location and elevation of the specific river basin. Basins located significantly above freezing levels have been much less affected by warmer temperatures than those located at lower elevations (Figure M-6). River basins whose average daily winter temperatures are close to freezing are the most sensitive to climate change, as is apparent from the dramatic shifts in streamflow timing that have resulted from relatively small increases in winter temperatures.




Source: Stewart et al. 2005.

**Figure M-6. Observed spring pulse of snowmelt-generated streamflow for (a) and (b) two high and (c) and (d) two mid-elevation Pacific Northwest streams, illustrating the much greater advance in timing in the mid-elevation streams.**

The advance in streamflow timing also results in decreased summer and fall base flows, at precisely the time when streamflow is needed most. In addition, warmer temperatures have lengthened the growing season (defined as the time between the last frost of spring and the first frost of fall) in the western United States by an average of about 10 to 15 days. Warmer temperatures and longer growing seasons increase water requirements for evapotranspiration, hydropower, and irrigation, resulting in potential water supply shortages and conflicts.


**Figure M-7. Grinnell Glacier, Glacier National Park, photographs from 1940 and 2006.**

Source: U.S. Geological Survey (USGS) Northern Rocky Mountain Science Center 2011.

***Glacier Changes:*** Another indication of climate change in the Pacific Northwest is the decline and retreat of many of the region's iconic glaciers, including those in Glacier National Park. Models predict that all of the Park's glaciers will melt by 2030 (Hall and Fagre 2003). Scientists have begun the task of documenting glacial decline through repeat photographic images such as the pair shown in Figure M-7.

# M.3 Climate Change Indicators and Trends at Malheur Refuge

## M.3.1 Sources and References for Refuge Climate Data

***PRISM:*** There are several sources of historical climate data for the Refuge. The main data source used here is the Parameter-elevation Regressions on Independent Slopes Model (PRISM) (Daly 2002; Daly et al. 2008). PRISM provides a complete record (i.e., no missing data) of temperature and precipitation data at 4-km resolution for the entire conterminous United States. We used monthly minimum and maximum temperature and monthly precipitation PRISM data from 1950 to 2009. Geographic information system (GIS) was used to delineate two areas—the area encompassed by the Refuge boundary and the Blitzen watershed upstream of the Refuge and Page Springs. We then intersected the 4-km gridded PRISM data and queried temperature and precipitation for all grid points within the boundaries of these two areas at each monthly time step, to calculate an average monthly temperature and total monthly precipitation for both the Refuge and the Blitzen watershed for every month from 1950 to 2009.

PRISM is a method developed by Oregon State University researchers for generating gridded estimates of historical precipitation and temperature at monthly and daily time steps. The method interpolates between point data from thousands of weather stations using a digital elevation model (DEM) and many other geographic data sets. The gridded estimates account for spatial variations in climate caused by elevation, terrain orientation, effectiveness of terrain as a barrier to flow, coastal proximity, moisture availability, atmospheric inversions, and topographic position (valley, mid-slope, ridge). PRISM provides a complete record (no missing data) of monthly minimum and maximum temperature and monthly precipitation data from 1895 to the present at a 4-km resolution for the conterminous United States. In addition to the time series data at a 4-km resolution, 30-year average monthly temperature and precipitation, based on the period 1971-2000, are available at an 800-m resolution for any point in the conterminous United States and the Pacific Islands. Because of the complete geographic coverage, PRISM can provide estimates of climate data for remote areas where there is often little or no data available.

***USHCN:*** A second source of daily and monthly climate data is the individual weather stations in the area. This includes Burns Municipal Airport, four National Weather Service/National Oceanic and Atmospheric Administration (NWS/NOAA) government weather stations on the Refuge (Buena Vista Station, P Ranch Substation, Double-O Station, and Refuge Headquarters), and the United States Historical Climatology Network (USHCN) Malheur Refuge Headquarters station (Station No. 355162). We mainly relied on the USHCN station data because this station provides a complete record of high-quality climate data (Menne et al. 2009). The PRISM method described above likely used data from all these local stations, as well as snowpack telemetry (SNOTEL) station data described below, to develop the interpolated data set for the area.

The USHCN is a high-quality data set of daily and monthly records of basic meteorological variables from 1,218 observing stations across the conterminous United States (Menne et al. 2011). The USHCN data have been corrected to remove biases or heterogeneities from non-climatic effects such as urbanization or other landscape changes, station moves, and instrument and time of observation changes. The network has been developed over the years at the NOAA National Climatic Data Center (NCDC) to assist in the detection of regional climate change. It is used by NOAA to monitor temperature and precipitation over the United States. This includes the calculation of trends over roughly the last century and regular updates to yearly and monthly state/regional rankings of temperature and precipitation. The USHCN network includes a complete record (no missing data) of monthly maximum, mean, and minimum temperature and monthly precipitation for the period 1895 to the present. The only USHCN station close to Malheur is the Malheur Refuge Headquarters (USHCN Station No. 355162).

Both the PRISM and USHCN have the advantage of being complete data sets with no missing records. In each of these data sets, missing data have been estimated in a sophisticated procedure using a weighted average of values from highly correlated neighboring stations. This is often a problem when using data from local stations. The estimation of missing data involves considerable effort and too often the problem is ignored, with no attempt to estimate missing values. This can skew estimates of averages and trends.

***SNOTEL:*** A third source of climate data is the two Natural Resources Conservation Service (NRCS) SNOTEL sites, Silvies SNOTEL (Site No. 759) and the Fish Creek SNOTEL (Site No. 477), located on Steens Mountain within the Blitzen watershed (NRCS 2011). The Silvies site is slightly lower (6,990 feet) than the Fish Creek site (7,660 feet) but both sites are at relatively high elevations for SNOTEL sites in Oregon. These sites have April 1 snow water equivalent measurements (SWE) from 1939 to the present, with daily SWE, precipitation, and air temperature measurements beginning in 1984. The statistically significant trend in the monthly temperature and precipitation PRISM data for the area of the Malheur Refuge from 1950 to 2009 is a 3.5°F increase (0.6°F per decade) in March monthly temperatures (Figure M-8).

## M.3.2 Observed Trends in Refuge Climate Data

The PRISM data for the Blitzen watershed area show a statistically significant increase in March monthly temperatures (Figure M-8), as do the USHCN data from the Malheur Refuge Headquarters station (data not shown). The USHCN station data also show statistically significant increases in several other months. Precipitation data from PRISM and USHCN show opposite trends (one increasing and one decreasing) from 1950 to 2009, but neither trend is statistically significant. As discussed above, winter temperatures, particularly in January and March, have been shown by other studies to be increasing in the West (Hamlet and Lettenmaier 2007; Knowles et al. 2006). The increases can cause more precipitation to fall as rain instead of snow, resulting in reduced April 1st snow water equivalent (SWE), earlier snowmelt, and changes in streamflow.

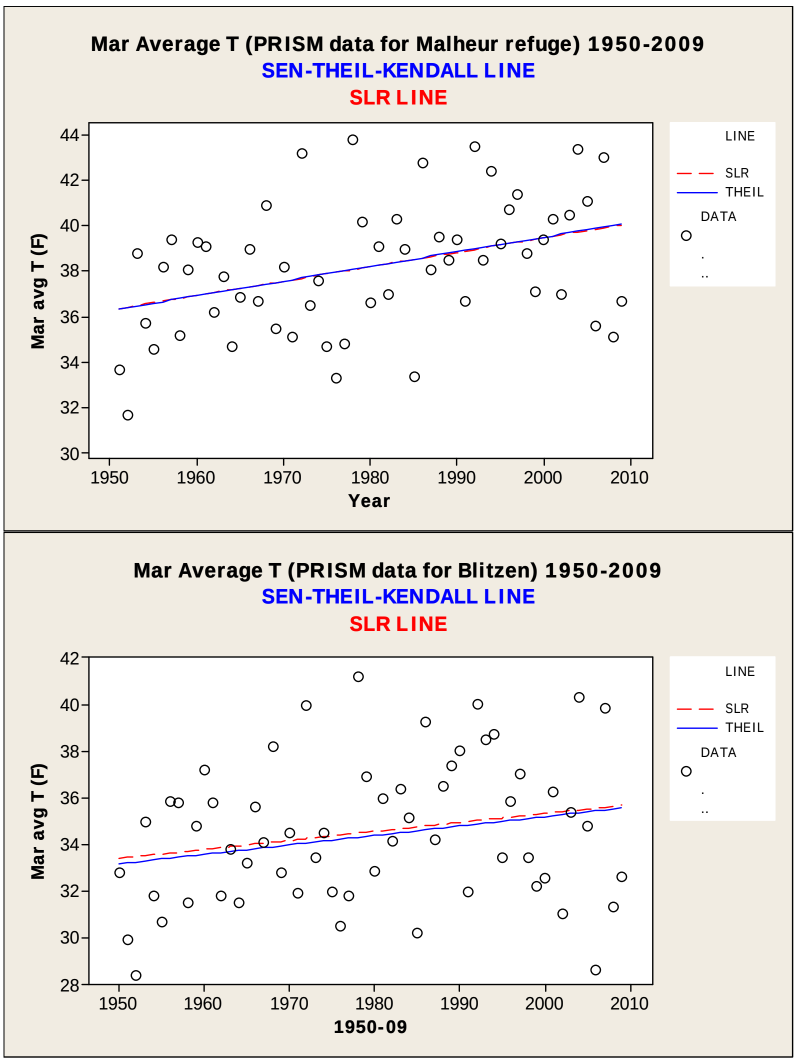
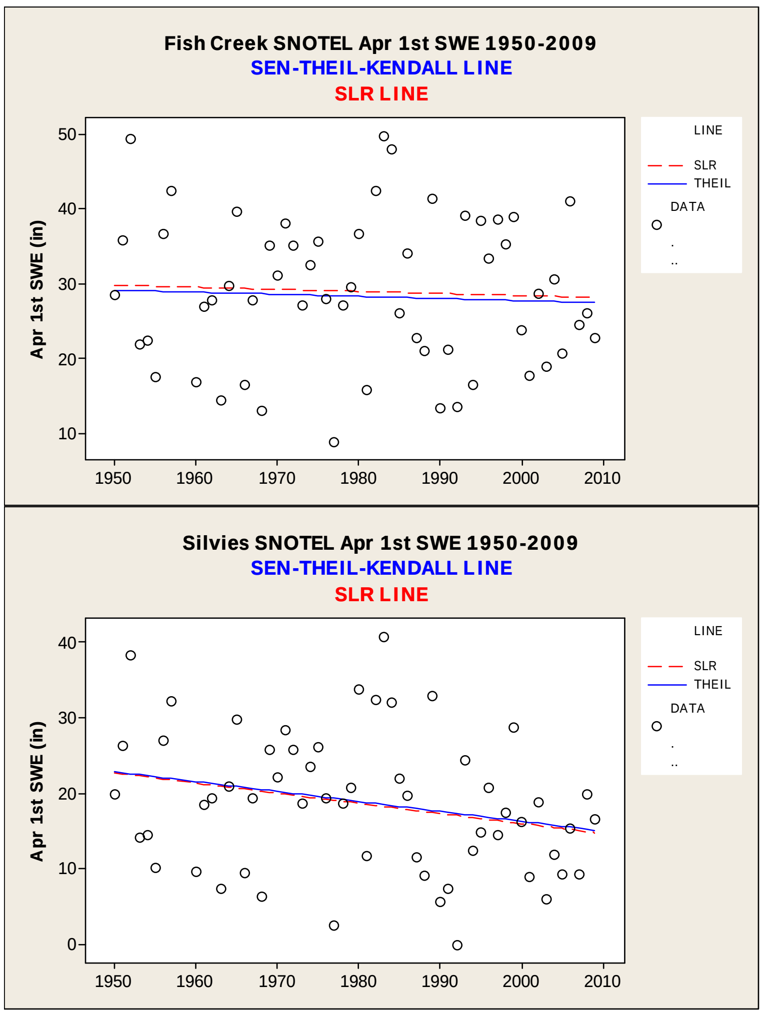



**Figure M-8. Trend in March monthly temperature for the Refuge and the Blitzen watershed (PRISM data) from 1950 to 2009.**

The SNOTEL data on Steens Mountain suggest that warmer March temperatures may have impacted snowpack at least at lower elevations in the Blitzen watershed (NRCS 2011). There is a statistically significant decreasing trend (−5 percent per decade, or −34 percent) from 1950 to 2009 in the April 1st SWE at the Silvies SNOTEL, the lower elevation site (Figure M-9). April 1st SWE at Fish Creek, the higher elevation site, shows a very slight decrease from 1950 to 2009, but the trend is not statistically significant. Note that the Blitzen PRISM data set shows an increase in precipitation over the same period. The fact that precipitation in the Blitzen watershed has increased or at least not changed while the SWE at the lower elevation site has decreased significantly indicates that the decreasing trend at the Silvies SNOTEL site is most likely related to warmer temperatures. Because of the relatively high elevation and cold climate of the Blitzen watershed and the Steens Mountain area, snowpack has not been affected by warming temperatures to the degree it has in other, lower elevation areas around the Pacific Northwest. However, as temperatures continue to warm, snowpack will likely continue to decline.




Source: NRCS 2011.

**Figure M-9. April 1st SWE at Fish Creek SNOTEL (elevation 7,660 ft.) and Silvies SNOTEL (elevation 6,990 ft.) for the period 1950 to 2009.**

One of the expected impacts of declining snowpacks and earlier snowmelt is a change in streamflow timing and volume, specifically higher winter flows, an earlier snowmelt runoff peak, and reduced late season base flows. Because the USGS Blitzen River stream gage has a long period of record (continuous measurements from 1939 onward) and is upstream of any significant diversions or regulation, it provides an excellent record of the response of the river to climate. To date, few climate change impacts can be observed in the Blitzen River streamflow record, in contrast to other stream systems in the Pacific Northwest. There is no trend in the annual streamflow centroid (the date on which approximately half of the annual volume of streamflow occurs for the water year) or the annual minimum 7-day average flow (Figure M-10). There has been no change in the percentage of monthly flows to total annual flow for March to September over the same period (data not shown). There has been a slight decrease in the ratio of June/May flows, as might be expected with earlier runoff, and an increase in the annual maximum daily flow, as might be expected with more winter/spring rains (Figure M-11), but the statistical significance of both of these trends is weak (p = 0.14).

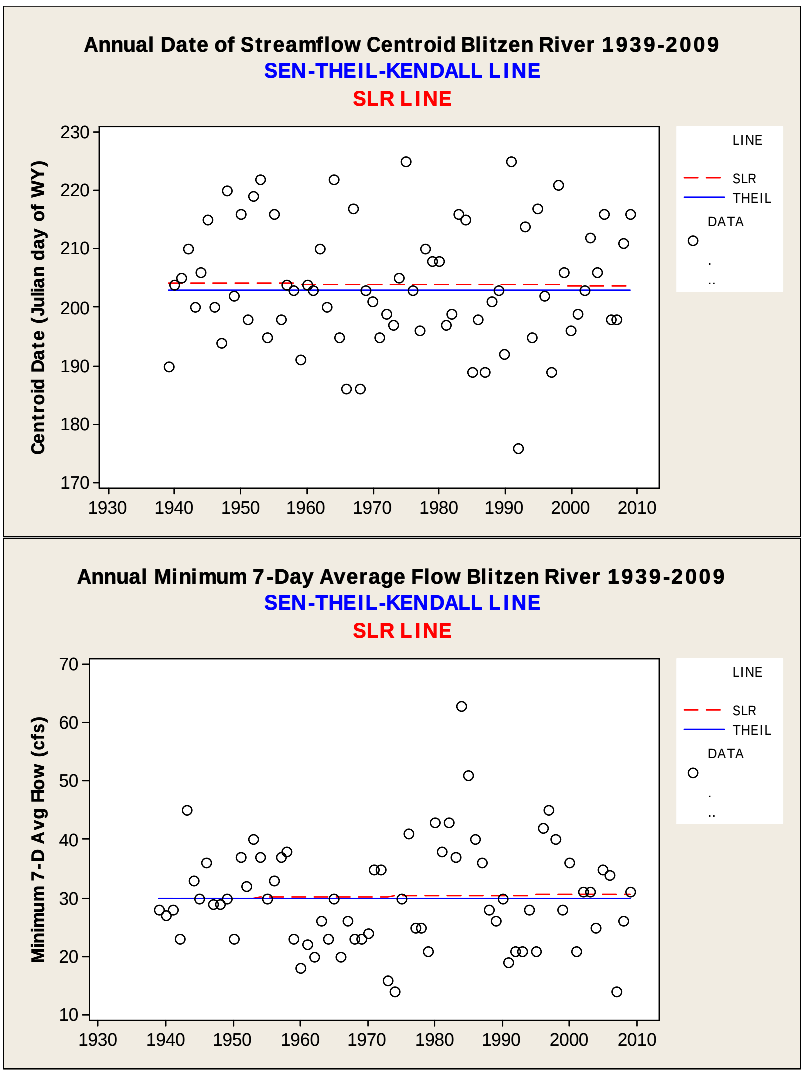



**Figure M-10. Trends in the annual streamflow centroid (the date on which approximately half of the annual streamflow occurs) and the annual minimum 7-day average flow for the Blitzen River near Frenchglen, 1939 to 2009. Both data sets show no statistically significant changes for the period.**

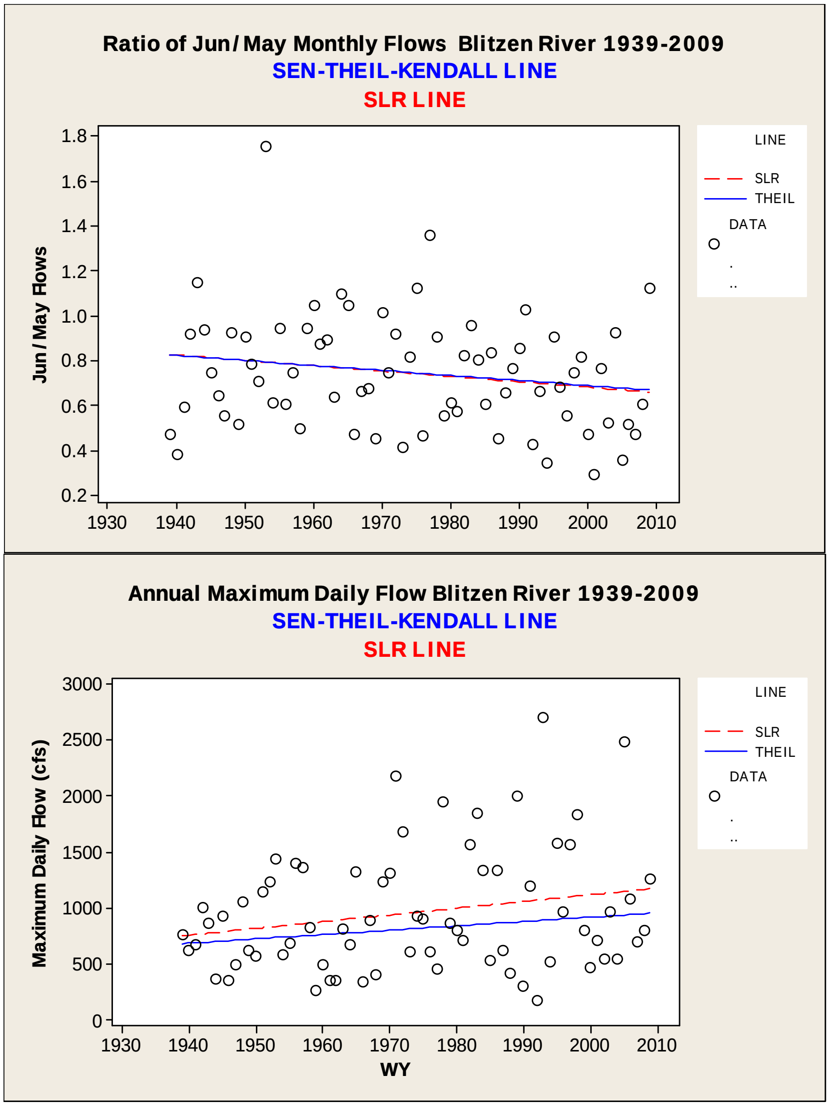
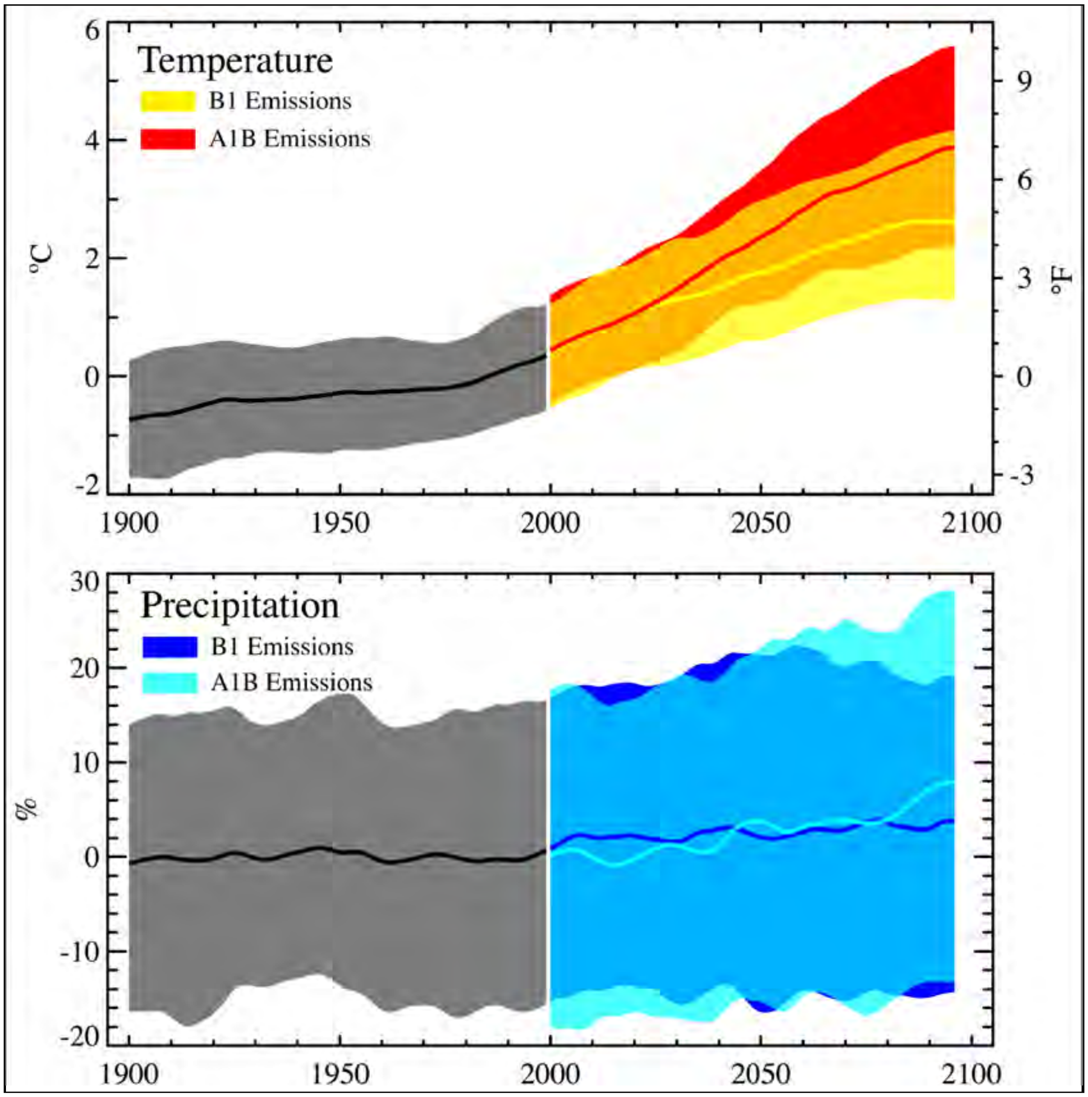



**Figure M-11. Trends in the annual ratio of June/May monthly flows and the annual maximum daily flow for the Blitzen River near Frenchglen, 1939 to 2009. Both trends are only weakly significant.**

# M.4 Projected Climate Changes for the Pacific Northwest and Malheur Refuge

The Climate Impacts Group (CIG) has projected changes in mean annual temperature for the Pacific Northwest, based on several climate models and two emissions scenarios as described in Mote and Salathe (2010). By the 2080s, the temperature increase is about 6°F under the A1B medium emissions scenario and 4.5°F under the B1 low emissions scenario. Considering both scenarios, average annual temperature is projected to increase 2.0°F by the 2020s, 3.2°F by the 2040s, and 5.3°F by the 2080s, relative to the 1970 to 1999 average temperature. The projected changes in average annual temperature are substantially greater than the 1.5°F (0.8°C) increase in average annual temperature observed in the Pacific Northwest during the twentieth century. The mean rate of warming is 0.5°F per decade through mid twenty-first century. Seasonally, summer temperatures are projected to increase the most. It is important to note that actual global emissions of GHGs in the past decade have exceeded even the highest emissions scenario (the A2 scenario), resulting in a scenario that wasn't modeled by CIG. If this trend continues, the temperature increases could actually turn out to be much greater than those projected in Figure M-12.

Projected changes in mean annual precipitation are less clear (Figure M-12). Precipitation trends are very small relative to the interannual variability in precipitation. Seasonally, precipitation is projected to decrease in the summer and increase in the winter by most climate models, although the average shifts are small. However, even small changes in seasonal precipitation could have impacts on streamflow flooding, summer water demand, drought stress, and wildland fire frequency.

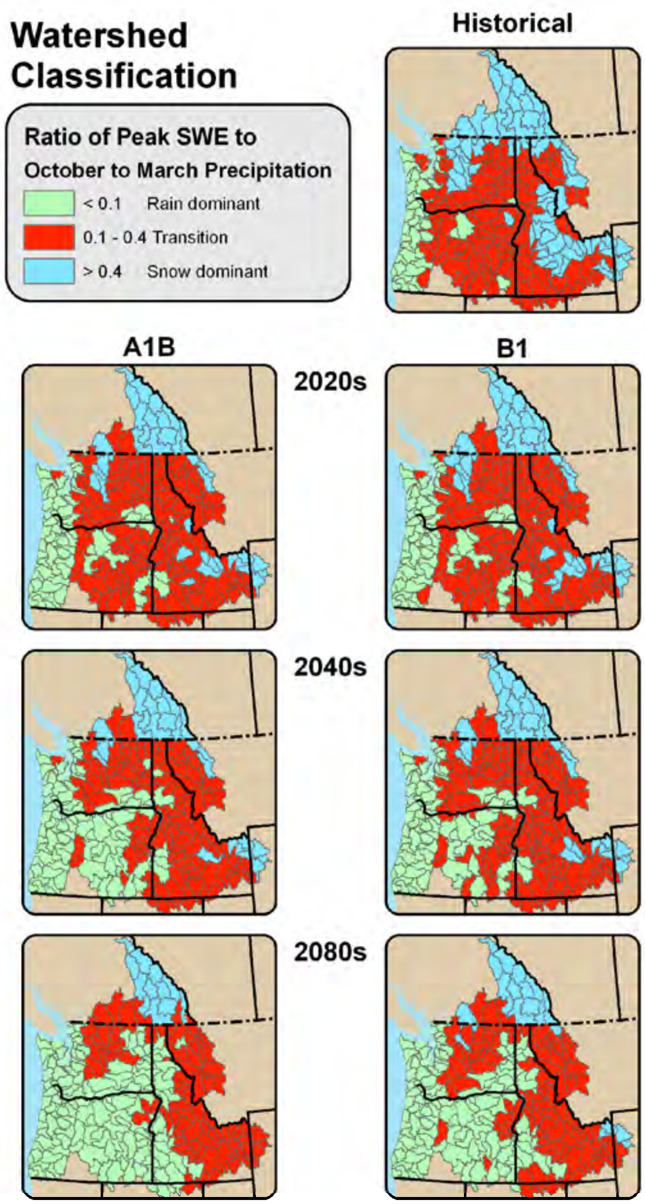



Source: Mote and Salathe 2010.
Note: The black curve for each panel is the weighted average of all models during the twentieth century. The colored curves are the weighted average of all models in that emissions scenario ("low" or B1, and "medium" or A1B) for the twenty-first century. The colored areas indicate the range (5th to 95th percentile) for each year in the twenty-first century. All changes are relative to 1970 to 1999 averages.

**Figure M-12. Simulated temperature change (top panel) and percent precipitation change (bottom panel) in the Pacific Northwest using twentieth and twenty-first century global climate model simulations.**

In addition to changes in the amount of precipitation, a major concern in the Pacific Northwest is the change in the form of winter precipitation expected due to warmer temperatures. CIG has modeled changes in the current and future peak SWE versus October to March precipitation for fourth-level HUC watersheds in the Columbia Basin Area, including the Blitzen watershed (Figure M-13). They have classified watersheds into three categories to reflect projections of the dominant precipitation regime: snow (peak SWE/O-M pcp >0.4), transition (peak SWE/O-M pcp = 0.1 to 0.4), and rain (peak SWE/O-M pcp <0.1). Generally, there is a large shift in the Pacific Northwest from snow and transition basins to rain basins. In basins where these changes occur, there will likely be a tendency for higher winter flows and possible increased risk of flooding, earlier snowmelt and runoff peaks, and lower summer streamflows.

The Blitzen watershed is currently classified as a transition basin and is projected to remain that way until the 2080s under the A1B scenario and through the 2080s under the B1 scenario, when it will become a rain basin. This shift to a rain basin occurs more slowly than in many of the surrounding basins in the Pacific Northwest, and the Blitzen watershed appears to be more resilient to climate change, probably because of the higher elevation and cooler climate in the Steens Mountain area.




Note: The Blitzen watershed is not identified in this figure; however, it is the small, isolated basin in southeastern Oregon shown in red in the lowest right figure.

**Figure M-13. Ratio of April 1st SWE to total March to October precipitation for the historical period (1916–2006) for the A1B scenario (left panel), and for the B1 scenario (right panel) at three future time periods (2020s, 2040s, 2080s).**

## M.5 Observed and Predicted Ecological Response to Climate Change in the Region

An emerging body of literature indicates that over the past three decades, the changes in the climate system described above—including the anthropogenic component of warming— have caused physical and biological changes in a variety of ecosystems (IPCC 2007; Parmesan 2006; Root et al.

2003) that are discernable at the global scale. These changes include shifts in genetics (Bradshaw and Holzapfel 2006), species' ranges, phenological patterns, and life cycles (reviewed in Parmesan 2006). Most (85 percent) of these observed ecological responses have been in the expected direction (e.g., poleward shifts in species distributions) and are very likely due to climate change. Climate change has and will continue to combine with other non-climate stressors to impact ecosystems and threaten biodiversity. In the Great Basin, climate change, invasive species, habitat fragmentation, and rangeland and riparian degradation have placed numerous species at risk, including sage grouse and redband trout (Chambers and Pellant 2008).

Disturbances, both natural and human-induced, shape ecosystems by influencing their composition, structure, and function. One observed response to climate change in the Pacific Northwest is the change in disturbance regimes like fire and insect/disease outbreaks. Increased spring and summer temperatures, earlier snowmelt, and prolonged drought, have contributed to longer fire seasons and an increase in wildfire activity in the Pacific Northwest. Westerling et al. (2006) evaluated the effects of both land use histories and climate on wildfire and concluded that the increase in fire frequency in the past two to three decades has been driven primarily by recent changes in climate. Areas in southern Oregon, northern California, and the northern Rockies have been especially vulnerable to these changes.

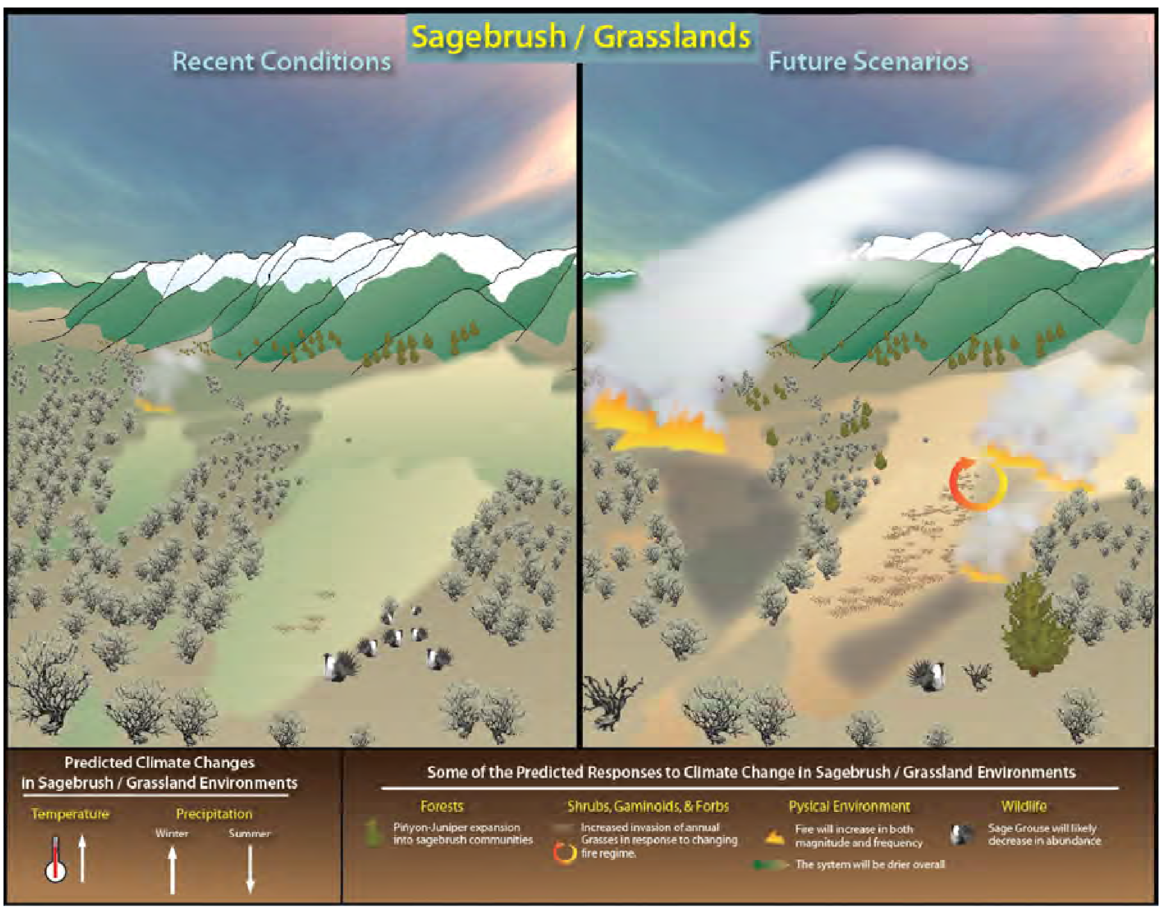
Since the mid-1990s, an outbreak of mountain pine beetles has reached unprecedented levels in terms of acreage, northern expansion and distribution, and number of trees killed (Bentz 2008) (Figure M-14). In addition to lodgepole pine, the beetle is starting to cause mortality in whitebark and limber pine at high elevations. Climate change is partly responsible for these trends. Warmer temperatures have facilitated bark beetle outbreaks in three ways: 1) drought stress makes trees more vulnerable to attack; 2) warmer winters mean less mortality for overwintering insects; and 3) insect populations respond to increased temperatures by speeding up their reproductive cycles (e.g., to one-year life cycles).

Source: British Columbia Ministry of Forests, Lands, and Natural Resource Operations 2011.

**Figure M-14. Mountain pine beetle damage in British Columbia.**

The effects of climate change and non-native invasive species may combine to increase invasion risk to ecosystems. Bradley (2009) showed that the potential area for cheatgrass (*Bromus tectorum*) invasion, which is sensitive to precipitation and temperature, increased up to 45 percent in the western United States with decreasing summer precipitation and warmer winter temperatures. Cheatgrass invasion also works in conjunction with climate change to alter fire regimes. Frequent fires promote invasive grasses like cheatgrass, and large grassland fires are more likely in a warmer, drier climate with exotic grasses present. The cheatgrass fire cycle has been a major factor in the decline of sagebrush steppe ecosystems, and climate change is likely to exacerbate this decline (Chambers and Pellant 2008).

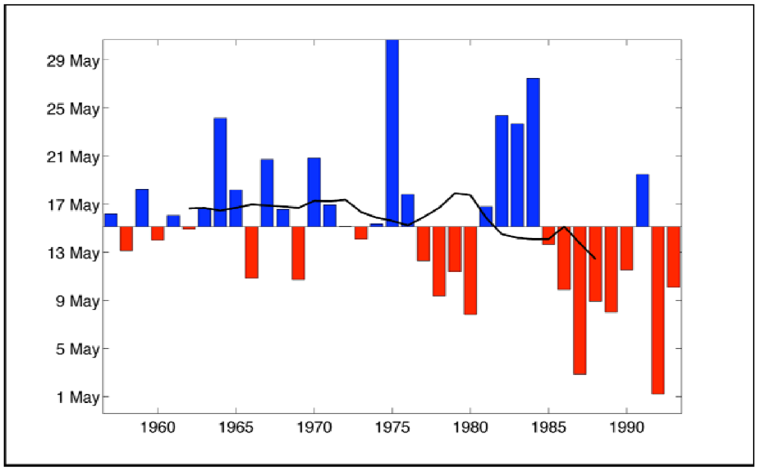
Climate change is also expected to cause major changes in grassland and sagebrush distribution across the landscape (Bachelet et al. 2001). Range expansions of woody species are predicted to continue, particularly the expansion of pinyon-juniper into sagebrush steppe and grasslands (Rowland et al. 2008), resulting in a decrease in sagebrush and an increase in woodlands across the West (Figure M-15). More frequent wildfires may favor non-native invasives and exacerbate the loss of big sagebrush, a keystone species that is not very fire-tolerant. In the Great Basin, current sagebrush habitat is predicted to decrease 12 percent for each 1°C increase in temperature, partly because of these factors (Chambers and Pellant 2008). However, more frequent fires might also limit juniper expansion.




Source: Ashton 2010.

**Figure M-15. Illustration of climate change impacts to sagebrush/grassland communities.**

Another ecological response to climate change is the change in timing of phenological events like leaf-out, flowering, senescence, migration, hibernation, and insect emergence. These events are often sensitive to variations in temperature and precipitation. There are indications that some of these events are responding to climate change. From 1957 to 1994, flowering of lilacs (*Syringa vulgaris*) and honeysuckle (*Lonicera tatarica* and *L. korolkowii*) have shown an advance of 7.5 and 10 days, respectively, in the West. This is most likely due to the 2°F-5°F increase in spring temperatures during that period (Cayan et al. 2001). In Idaho, the average bloom date for lilacs advanced one week from 1957 to 1993 (Figure M-16). Warmer temperatures will continue to affect the timing of reproduction, emergence, and migration of numerous species, which may affect community structure and function. On the other hand, phenological events that are tied to day length rather than climate, such as the emergence of many plants, are not expected to change. These asynchronous responses of different species to climate change may alter species' interactions (e.g., predator–prey relationships and competition) and have unforeseen consequences.

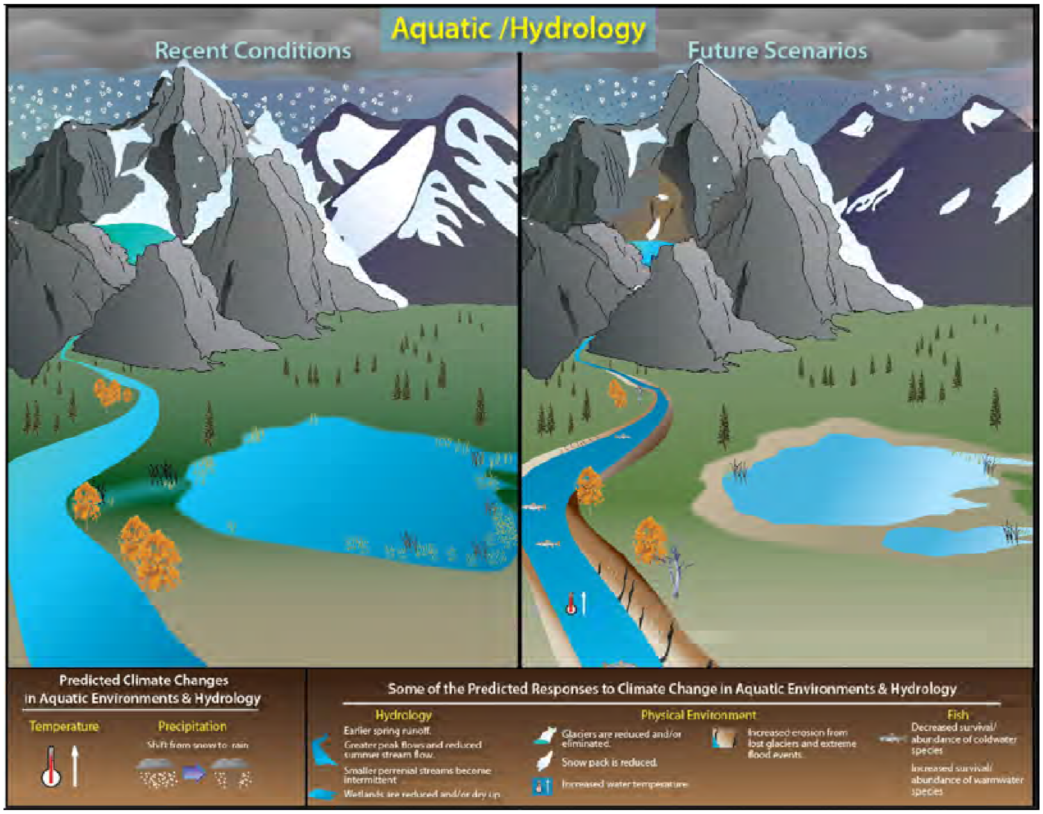



Source: Gillis et al. 2011.

**Figure M-16. Average statewide bloom date of lilacs in Idaho, 1957 to 1993.**

Climate change has a large potential to impact aquatic ecosystems in the Pacific Northwest (Figure M-17). Although there have been few climate change impacts on Blitzen streamflow to date, aquatic habitats at Malheur NWR, including rivers, streams, springs, wetlands, and wet meadows, face future threats from climate change. River and stream temperatures may increase with warmer air temperatures and longer growing seasons, threatening redband trout. Water temperatures in the Blitzen River are already quite warm; 7-day average maximum temperatures are frequently near 25°C in the summer (Mayer et al. 2007). Even at the upstream end, where the river enters the Refuge from the canyon, water temperatures exceeded the state standard of 20°C for an average of 64 days during the summers of 2003 and 2005 (Mayer et al. 2007).

Evaporative and seepage losses in wetlands and wet meadows may increase due to warmer temperatures, longer growing seasons, drier soils, and lower water tables, potentially limiting the available habitat that can be sustained for migratory waterfowl. Changes in transpiration are uncertain. There may be less transpiration because of greater photosynthetic efficiency from higher $CO_2$ concentrations in the atmosphere, but higher $CO_2$ concentrations could also mean more plant growth, plant leaf area, and increased transpiration. Earlier runoff and higher evaporation losses could cause a decrease in wetland acreage that can be maintained on the Refuge given the Refuge's water supply.




Source: Ashton 2010.

**Figure M-17. Illustration of climate change impacts to aquatic communities.**

## M.6 Climate Change Adaptation Strategies

The slower response and apparent resilience of the Blitzen watershed to climate change may provide the Refuge with an opportunity to develop and implement climate change adaptation strategies (or adjustments in management). The goal of adaptation is to reduce the risk of adverse environmental outcomes through activities that increase the resilience of ecosystems to climate change and other stressors (United States Climate Change Science Program [USCCSP] 2008). Resilience is defined as the amount of change or disturbance a system can absorb without undergoing a fundamental shift to a different set of processes and/or structures. One of the most effective means of increasing resilience is to reduce or eliminate non-climate stressors.

Climate change will combine with other non-climate stressors to exacerbate existing problems with water supply, aquatic resources, invasive weeds, and ecosystem function on the Refuge. Even now, there are difficulties balancing the needs of water management for wetlands with the needs of in-stream flows for fish. Wetland irrigation and water management on the Refuge decrease river flows, exacerbate high water temperatures, and reduce dissolved oxygen concentrations in the river (Mayer et al. 2007). River temperatures are already at or near the limit of tolerance for redband trout on most of the Refuge. The river has been channelized to facilitate drainage and water delivery. Riparian vegetation is limited and the river habitat is degraded, with little complexity. Wetland and wet meadow habitats on the Refuge are threatened by several non-native invasive plant species including perennial pepperweed, Russian olive, and reed canarygrass. Aquatic and riverine habitats are threatened by non-native carp.

Reducing non-climate stressors means controlling invasive species and could include restoring the river, rehabilitating riparian vegetation, reestablishing, where possible, the natural sinuosity of the channel, and reconnecting, where viable, valley wetlands and floodplains with the river channel. Reducing the impacts of current stressors is a "no regrets" adaptation strategy that could be taken now to enhance ecosystem resilience to climate change. These activities will require time. Fortunately, the fact that climate change impacts are slower to manifest themselves here compared with other areas would allow more time to implement these restoration activities.

Key to the successful implementation of these adaptation and restoration strategies will be the monitoring of results. The National Weather Service (NWS) weather stations, the USGS Blitzen River gage, and the two Natural Resources Conservation Services (NRCS) SNOTEL sites on Steens Mountain will continue to provide very valuable climate and streamflow information on the local impacts of climate change. It is in the Refuge's best interest to see that these sites are maintained and monitored in the future. The Water Resources Branch monitors streamflows and diversions at several sites on the Refuge—this should be continued as well. The Branch also monitored water temperatures in the river during the summers of 2002, 2003, and 2005. This seasonal water temperature monitoring should be continued in the future. Finally, ongoing efforts to monitor and contain invasive species will be important for providing information on the status of non-climate stressors.

Monitoring may provide information that will require modification of adaptation strategies or point to new restoration needs. One method for integrating new information into resource management decisions, given uncertainty, is adaptive management. Adaptive management is a process that promotes flexible decision making so that adjustments are made to decisions as outcomes from management actions and other events are better understood. This method supports managers in taking action today using the best available information while also providing the possibility of ongoing future refinements through an iterative learning process.

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White-faced ibis
©Dan Dzurisin

# Appendix N
## List of Common and Scientific Names Used in the Malheur National Wildlife Refuge CCP


Appendix A
Appropriate Use Findings

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Response to Comments

**Table N-1. Birds**

| Common Name | Scientific Name |
|---|---|
| American bittern | *Botaurus lentiginosus* |
| American coot | *Fulica americana* |
| American white pelican | *Pelecanus erythrorhynchos* |
| American wigeon | *Anas americana* |
| Bobolink | *Dolichonyx oryzivorus* |
| Burrowing owl | *Athene cunicularia* |
| California quail | *Callipepla californica* |
| Canada goose | *Branta canadensis* |
| Canvasback | *Aythya valisineria* |
| Cinnamon teal | *Anas cyanoptera* |
| Common raven | *Corvus corax* |
| Common snipe | *Gallinago gallinago* |
| Eastern kingbird | *Tyrannus tyrannus* |
| Gadwall | *Anas strepera* |
| Great horned owl | *Bubo virginianus* |
| Greater sandhill crane | *Grus canadensis tabida* |
| Lark sparrow | *Chondestes grammacus* |
| Long-billed curlew | *Numenius americanus* |
| Long-eared owl | *Asio otus* |
| Mallard | *Anas platyrynchos* |
| Northern harrier | *Circus cyaneus* |
| Northern pintail | *Anas acuta* |
| Northern shoveler | *Anas clypeata* |
| Pied-billed grebe | *Podilymbus podiceps* |
| Redhead | *Aythya americana* |
| Red-winged blackbird | *Agelaius phoeniceus* |
| Ring-necked pheasant | *Phasianus colchicus* |
| Ruddy duck | *Oxyura jamaicensis* |
| Sharp-tailed grouse | *Tympanuchus phasianellus* |
| Trumpeter swan | *Cygnus buccinator* |
| Western grebe | *Aechmophorus occidentalis* |

| Common Name | Scientific Name |
|---|---|
| White-faced ibis | *Plegadis chihi* |
| Willow flycatcher | *Empidonax traillii* |
| Wilson's phalarope | *Phalaropus tricolor* |
| Yellow warbler | *Dendroica petechia* |

**Table N-2. Mammals**

| Common Name | Scientific Name |
|---|---|
| American badger | *Taxidea taxus* |
| American mink | *Neovison vison* |
| Beaver | *Castor canadensis* |
| Bighorn sheep | *Ovis canadensis* |
| Black-tailed jackrabbit | *Lepus californicus* |
| Bobcat | *Lynx rufus* |
| Bushy-tailed woodrat | *Neotoma cinerea* |
| Coyote | *Canis latrans* |
| Deer mouse | *Peromyscus maniculatus* |
| Desert woodrat | *Neotoma lepida* |
| Dusky-footed woodrat | *Neotoma fuscipes* |
| Elk | *Cervus canadensis* |
| Golden-mantled ground squirrel | *Callospermophilus lateralis* |
| Great Basin pocket mouse | *Perognathus parvus* |
| Kangaroo rat | *Dipodomys* spp. |
| Least chipmunk | *Neotamias minimus* |
| Malheur shrew | *Sorex preblei* |
| Merriam’s shrew | *Sorex merriami* |
| Montane vole | *Microtus montanus* |
| Mountain lion (Cougar) | *Puma concolor* |
| Mule deer | *Odocoileus hemionus* |
| Muskrat | *Ondatra zibethica* |
| Northern grasshopper mouse | *Onychomys leucogaster* |
| Northern pocket gopher | *Thomomys talpoides* |
| Nuttal’s cottontail | *Sylvilagus nuttallii* |

| **Common Name** | **Scientific Name** |
|---|---|
| Preble’s shrew | *Sorex preblei* |
| Pronghorn antelope | *Antilocapra americana* |
| Pygmy rabbit | *Brachylagus idahoensis* |
| Raccoon | *Procyon lotor* |
| Red fox | *Vulpes vulpes* |
| River otter | *Lontra canadensis* |
| Sagebrush vole | *Lemmiscus curtatus* |
| Townsend’s ground squirrel | *Urocitellus townsendii* |
| Townsend’s pocket gopher | *Thomomys townsendii* |
| Weasel | *Mustela* spp. |
| Yellow-bellied marmots | *Marmota flaviventris* |

**Table N-3. Bats**

| **Common Name** | **Scientific Name** |
|---|---|
| Fringed myotis | *Myotis thysanodes* |
| Long-legged myotis | *Myotis volans* |
| Spotted bat | *Euderma maculatum* |
| Townsend’s big-eared bat | *Corynorhinus townsendii* |
| Western small-footed myotis | *Myotis ciliolabrum* |
| Yuma myotis | *Myotis yumanensis* |

**Table N-4. Fish**

| **Common Name** | **Scientific Name** |
|---|---|
| Bluegill | *Lepomis macrochirus* |
| Bridge lip sucker | *Catostomus columbianus* |
| Brown bullhead | *Ictalurus nebulosus* |
| Chisel mouth sucker | *Acrocheilus alutaceus* |
| Coarse scale sucker | *Castostomus macrocheilus* |
| Common Carp | *Cyprinus carpio* |
| Green sunfish | *Lepomis cyanellus* |
| Large-mouthed bass | *Micropterus salmoides* |
| Longnose dace | *Rhinichthys cataractae* |

| Common Name | Scientific Name |
|---|---|
| Malheur mottled sculpin | *Cottus bendirei* |
| Mosquito fish | *Gambusia affinis* |
| Mountain whitefish | *Prosopium williamsoni* |
| Northern pike minnow | *Ptychocheilus oregonensis* |
| Pumpkinseed | *Lepomis gibbosus* |
| Rainbow trout | *Oncorhynchus mykiss* |
| Red-band trout | *Oncorhynchus mykiss gairdnerii* |
| Red-sided shiner | *Leuciscus elongatus* |
| Speckled dace | *Rhinichthys osculus* |
| Tui Chub | *Gila bicolor* |
| White crappie | *Pomoxis annularis* |
| Yellow bullhead | *Ictalurus natalis* |
| Yellow perch | *Perca flavescens* |

**Table N-5. Mollusks**

| Common Name | Scientific Name |
|---|---|
| Bivalve mollusk | *Musculium* spp. |

**Table N-6. Reptiles and Amphibians**

| Common Name | Scientific Name |
|---|---|
| American bullfrog | *Rana catesbeiana* |
| Collared lizard | *Crotaphytus collaris* |
| Columbian spotted frog | *Rana luteiventris* |
| Common garter snake | *Thamnophis sirtalis* |
| Desert horned lizard | *Phrynosoma platyrhinos* |
| Gopher snake | *Pituophis catenifer catenifer* |
| Great basin spadefoot | *Spea intermontana* |
| Leopard lizard | *Gambelia wislizenii* |
| Long-toed salamander | *Ambystoma macrodactylum* |
| Night snake | *Hypsiglena torquata* |
| Pacific tree frog | *Pseudacris regilla* |
| Racer | *Drymobius* spp. |

| Common Name | Scientific Name |
|---|---|
| Rubber boa | *Charina bottae* |
| Sagebrush lizard | *Sceloporus graciosus* |
| Short-horned lizard | *Phrynosoma hernandesi* |
| Side-blotched lizard | *Uta stansburiana* |
| Spade-foot toads | *Spea hammondii* |
| Striped whipsnake | *Masticophis taeniatus* |
| Western fence lizard | *Sceloporus occidentalis* |
| Western ground snake | *Sonora semiannulata* |
| Western rattlesnake | *Crotalus oreganus* |
| Western skink | *Plestiodon skiltonianus* |
| Western terrestrial garter snake | *Thamnophis elegans* |
| Western toad | *Anaxyrus boreas* |
| Western whiptail | *Aspidoscelis tigris* |

**Table N-7. Invertebrates**

| Common Name | Scientific Name |
|---|---|
| Brine fly | *Ephydra* spp. |
| Brine shrimp | *Artemia* spp. |
| Thistle beetle | *Ceutorhynchus litura* |
| Thistle stem gall fly | *Urophora cardui* |
| Thistle weevil | *Rhinocyllus conicus* |

**Table N-8. Plants**

| Common Name | Scientific Name |
|---|---|
| Alder | *Alnus* |
| Alkali bluegrass | *Poa juncifolia* |
| Alkali cordgrass | *Spartina gracilis* |
| Alkali sacaton | *Sporobolus airoides* |
| Alkali saltgrass | *Distichlis spicata* |
| American sloughgrass | *Beckmannia syzigachne* |
| American speedwell | *Veronica americana* |
| Antelope bitterbrush | *Purshia tridentata* |

| **Common Name** | **Scientific Name** |
|---|---|
| Arrow-grass | *Triglochin palustris* |
| Arrowleaf balsam root | *Balsamorhiza sagittata* |
| Baltic rush | *Juncus balticus* |
| Basin big sagebrush | *Artemisia tridentata* |
| Basin wildrye | *Leymus cinereus* |
| Bladderwort | *Utricularia* spp. |
| Bluebunch wheatgrass | *Pseudoroegneria spicata* |
| Bluejoint | *Calamagrostis canadensis* |
| Bottlebrush squirreltail | *Elymus elymoides* |
| Bud sagebrush | *Picrothamnus desertorum* |
| Bull thistle | *Cirsium vulgare* |
| Bur-reed | *Sparganium eurycarpum* |
| Canada thistle | *Cirsium arvense* |
| Canadian waterweed | *Elodea canadensis* |
| Cattail | *Typha* spp. |
| Cheatgrass | *Bromus tectorum* |
| Chokecherry | *Prunus virginiana L.* var. *demissa* |
| Cinquefoil | *Potentilla L.* |
| Common duckweed | *Lemna minor* |
| Common reed | *Phragmites australis* |
| Common snowberry | *Symphoricarpos albus* |
| Coontail (Hornwart) | *Ceratophyllum demersum* |
| Coyote willow | *Salix exigua Nutt.* |
| Creeping wildrye | *Leymus triticoides* |
| Crested wheatgrass | *Agropyron cristatum* |
| Diffuse knapweed | *Centaurea diffusa* |
| False lupine (bush pea) | *Thermopsis villosa* |
| Fourwing saltbush | *Atriplex canescens* |
| Fringed willow-herb | *Epilobium ciliatum* |
| Geyer’s milkvetch | *Astragalus Geyeri* |
| Golden currant | *Ribes aureum Pursh* |
| Goose berry | *Ribes hirtellum* |

| **Common Name** | **Scientific Name** |
|---|---|
| Greasewood | *Sarcobatus* spp. |
| Greater duckweed | *Spirodela polyrhiza* |
| Hardstem bulrush | *Scirpus acuta* |
| Hawthorn | *Crataegus L.* |
| Horned pondweed | *Zannichellia palustris* |
| Hornwort fruits | *Ceratophyllum* |
| Indian ricegrass | *Achnatherum hymenoides* |
| Inland saltgrass | *Distichlis spicata* |
| Italian thistle | *Carduus pynocephalus* |
| Kentucky bluegrass | *Poa pratensis* |
| Lanceleaf goldenweed | *Pyrrocoma lanceolata* |
| Large-leafed avens | *Geum macrophyllum* |
| Leafy pondweed | *Potamogeton foliosus* |
| Lewis' mock orange | *Philadelphus lewisii Pursh* |
| Locoweed | *Astragalus* spp. |
| Lupine | *Lupinus* spp. |
| Malheur wire-lettuce | *Stephanomeria malheurensis* |
| Mat muhly | *Muhlenbergia richardsonis* |
| Meadow barley | *Hordeum brachyantherum* |
| Meadow foxtail | *Alopecurus pratensis* |
| Medusahead rye | *Taeniatherum* spp. |
| Milkweed | *Asclepias* spp. |
| Oregon checkermallow | *Sidalcea oregana* |
| Mountain big sagebrush | *Artemisia tridentata* ssp. *vaseyana* |
| Nebraska sedge | *Carex nebraskensis* |
| Needle-and-thread grass | *Stipa comata* |
| Nevada bluegrass | *Poa nevadensis* |
| Northwest cinquefoil | *Potentilla gracilis* |
| Orchardgrass | *Dactylis glomerata* |
| Paiute suncup | *Camissonia scapoidea* |
| Perennial pepperweed | *Lepidium latifolium* |
| Phlox | *Phlox* spp. |

| **Common Name** | **Scientific Name** |
|---|---|
| Pinyon | *Pinus* spp. |
| Poison hemlock | *Conium maculatum* |
| Pondweed | *Potamogenton* |
| Povertyweed | *Iva axillaris* |
| Puncture vine | *Tribulus terrestris* |
| Quackgrass | *Agropyron repens* |
| Rabbitbrush | *Chrysothamnus* spp. |
| Red top | *Agrostis gigantea* |
| Redosier dogwood | *Cornus sericea L.* |
| Reed canarygrass | *Phalaris arundinacea L.* |
| Russian knapweed | *Acroptilon repens* |
| Russian olive | *Elaeagnus angustifolia L.* |
| Russian thistle | *Salsola kali L.* |
| Sago pondweed | *Stuckenia pectinata* |
| Salt cedar | *Tamarix ramosissima* |
| Saltlover | *Halogeton glomeratus* |
| Sandberg’s bluegrass | *Poa secunda* |
| Saskatoon serviceberry | *Amelanchier alnifolia* |
| Scotch thistle | *Onopordum acanthium* |
| Scouler’s willow | *Salix scouleriana* |
| Sedge | *Scirpus* |
| Seepweed (wada) | *Sueda depressa* |
| Sharpleaf penstemon | *Penstemon acuminatus* |
| Shortspine horsebrush | *Tetradymia spinosa* |
| Shrubby cinquefoil | *Dasiphora fruticosa* |
| Silver buffaloberry | *Shepherdia argentea* |
| Silver sagebrush | *Artemisia cana* |
| Slender cinquefoil | *Potentilla gracilis* |
| Slender-beaked sedge | *Carex athrostachya* |
| Small pondweed | *Potamogeton pusillus* |
| Smooth brome | *Bromus inermis* |
| Spike bentgrass | *Agrostis exarata* |

| **Common Name** | **Scientific Name** |
|---|---|
| Three-tip sagebrush | *Artemisia tripartita* |
| Thurber's needlegrass | *Achnatherum thurberianum* |
| Timothy grass | *Phleum pratense* |
| Tufted evening primrose | *Oenothera caespitosa* |
| Tufted hairgrass | *Deschampsia caespitosa* |
| Water birch | *Betula occidentalis* |
| Water milfoil | *Myriophyllum* spp. |
| Water sedge | *Carex aquatilis* |
| Waterweed | *Elodea canadensis* |
| Western horsetail | *Equisetum arvense* |
| Western juniper | *Juniperus occidentalis* |
| Western needlegrass | *Achnatherum occidentale* ssp. |
| Western yarrow | *Achillea millefolium* |
| Wheat sedge | *Carex atherodes* |
| White water buttercup | *Ranunculus aquatilis* |
| White water crowfoot | *Ranunculus aquatilis* |
| Whitetop | *Cardaria* spp. |
| Widgeongrass | *Ruppia* |
| Willow | *Salix* spp. |
| Wood's rose | *Rosa woodsii* |
| Wooly sedge | *Carex pellita* |
| Wyoming big sagebrush | *Artemisia tridentata Nutt.* ssp. *wyomingensis* |
| Yellow monkey-flower | *Mimulus guttatus* |

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# Appendix O

## Advancing Sustainability-Based Approaches and Practices

*Cinnamon teal*
©Peter Baer


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# O.1 Sustainability Philosophy

From local to global and back again, our National Wildlife Refuges are a sanctuary of the past, a bridge to the future, and a natural laboratory with real consequences in which we test our ability to navigate successfully between the past and the future for the sake of our own and all other species.

Refuge policy and practice are directly and indirectly responsible for being part of the solution and/or part of the problem. For example, what makes us think that the majesty of the Refuge is sustainable in the face of uncontrolled carp populations, or that polar bears are sustainable in the face of an ice-free Arctic Ocean?

The word “sustainability” has come into common use only in the past 25 years, most formally in 1987 when the Brundtland Commission defined sustainable development as “… meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

This widely published definition says much about the ethics and responsibility of one generation to the next. Sustainability is how we commonly think in terms of leaving the nation and world a better place for our children and grandchildren, whether in regard to family, land, and finances, or in terms of public lands and resources.

As such, it is a reinforcement of traditional American values of protection of our natural and cultural resources, self-sufficiency, self-determination, ingenuity, and responsibility in balance with life, liberty, and the pursuit of happiness.

At the core of our deliberations must be how sustainability-based planning, design, and management practices are absolutely essential to biodiversity and to native species, the viability of their populations, and the habitats that must be conserved, protected, restored, and expanded if we are to live up to the traditional American values that preserved them in the first place.

Sustainability-based planning, design, and management are also essential for, if not synonymous with, the local communities and native tribes and cultures that were indigenous to these lands for thousands of years before European settlement. All of these are major partners in Refuge sustainability initiatives.

The planning, design, and management practices of the past have served us well. However, the best available science now indicates that there are fundamentally different questions that we need to address in regards to emerging issues, many of which have profound implications.

Besides water, the most clear and present danger to the future of America’s natural heritage, if not our entire national security, is fossil fuel energy dependence (especially oil and coal) and climate change. If ever there was a role for America’s public lands to play in meeting both the natural and cultural heritage priorities of the past and present, it is now.

There are numerous policy statements and initiatives that call for integrating sustainability-based principles and practices within the CCP.

- Malheur Refuge is one of seventeen U.S. Fish and Wildlife Service (USFWS) facilities chosen to implement the U.S. Department of the Interior's (DOI's) Environmental Management System;
- Executive Order directing Federal Leadership in Environment, Energy, and Economic Performance (October 5, 2009);
- Secretary of Interior Salazar's speech at the United Nations Conference on Climate Change in Copenhagen (December 10, 2009), entitled "New Energy Future: The Role of Public Lands in Clean Energy Production and Carbon Capture";
- USFWS Directorate Working Group, and Strategic Plan for Climate Change; and
- USFWS development of Landscape Conservation Cooperatives.

The Refuge is taking a holistic systems approach to carbon neutrality (targeting carbon negative) and energy and material efficiency in all facets of Refuge planning, design, operation, and management for meeting our mission in collaboration with our local, regional, and national stakeholders. The latest scientific data and analysis regarding the rapid scale and impact of foreign energy dependence, climate change, and associated challenges leave us little room for compromise.

As such, in the interest of contributing to national security and economic competitiveness through our mission, the Refuge must do its part in producing more energy than it consumes, storing more carbon than it produces, rapidly adapting to the range of projected climate change models, and maximizing the delivery of all other ecologic services, especially biodiversity and clean water.

The Refuge is taking the approach of the old adage that if we are not part of the solution, then we are part of the problem. If we are part of the problem, then we risk being irrelevant, if not disposable, in the eyes of the general public. Our intent is to lead.

## O.2 Sustainability Actions

By integrating our conservation-based mission with the best available science, the Refuge will become a leader in advancing best design and management practices for an innovative, sustainable Refuge and community development opportunities.

- Achieve carbon neutrality (striving for carbon negative), meeting and exceeding energy and material efficiency and effectiveness as defined by U.S. DOI policies for all facets of refuge management.
- Establish performance benchmarks within our Environmental Management Plan as part of the Environmental Management System's critical first step, and then create metrics and benchmarks for all other sustainability-based practices (environmental, social, economic, and community).
- Complete energy and material use, carbon footprint, and biomass-based carbon sequestration audits.
- Integrate sustainable-based approaches and practices into partnerships, contracts, and other external stakeholder efforts.
- Provide staff and external stakeholder training for sustainability-based principles and practices, ecosystem services, social justice/equity, community development, and partnership performance standards.
- Develop projects to refit and right-size facilities, infrastructure, and vehicle fleet to maximize energy efficiency and production. Seek funding through Refuge Operations Needs and

Deferred Maintenance databases, Federal Business Management System, and other opportunistic/entrepreneurial funding sources.

# O.3 Sustainability Assessments

The Refuge has already initiated steps toward improving sustainability. These steps are primarily focused on sustainability assessments and planning. Sustainability assessments include conducting a comprehensive energy and water evaluation as well as preparing a greenhouse gas (GHG) emission inventory.

The findings of a Tier 1 energy and water evaluation indicate that there are many low-cost opportunities to improve energy and water performance within the Refuge's building portfolio. Many opportunities have payback periods of less than five years while other opportunities require larger capital investment and have 5- to 20-year payback periods.[1] Malheur NWR has initiated efforts to implement the energy and water conservation measures recommended by the Tier 1 energy and water evaluation.

The findings of a fiscal year (FY) 2008 baseline GHG emission inventory indicate that the Refuge's scope 1 and scope 2 GHG emissions stem primarily from building energy consumption and fleet fuel consumption.[2] Scope 1 and scope 2 GHG emissions totaled 310 metric tons of carbon dioxide equivalent (MTCO2E).

In accordance with Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, the Refuge also estimated GHG emissions for six scope 3 emission sources, including employee commuting, contracted solid waste (*landfilled waste*), business air travel, business ground travel, transmission and distribution losses (*electricity transmission*), and contracted wastewater treatment (*not applicable*). GHG emissions from scope 3 emission sources totaled 158 MTCO2E. Scope 1, scope 2, and scope 3 emission sources totaled 468 MTCO2E (Figure O-1).

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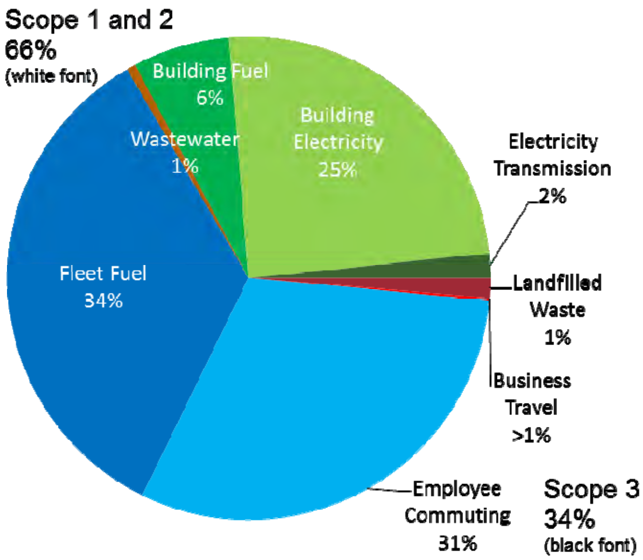
[1] U.S. Fish and Wildlife Service, 2010.

[2] Scope 1 and 2 GHG emissions are primarily associated with on-site fossil fuel combustion and electricity consumption from the grid, respectively.




| | MTCO2E |
|---|---|
| Scope 1 | 194 |
| Building Fuel Combustion | 30 |
| Fleet Fuel Combustion | 161 |
| Wastewater | 3 |
| Scope 2 | 115 |
| Building Electricity | 115 |
| Scope 3 | 158 |
| Employee Commuting | 144 |
| Business Travel | 1 |
| Electricity Transmission | 8 |
| Landfilled Waste | 6 |
| **Total** | **468** |

**Figure O-1. Malheur NWR FY 2008 Greenhouse Gas Emission Inventory Results by Source**

Fleet fuel combustion was the single largest emission source. Malheur NWR is a large refuge that requires considerable staff travel to conduct routine management activities such as trail maintenance, patrols, and resource management. An analysis of 25 gasoline fleet vehicles driven from April 2011 to September 2011 (6 months) indicated that on average each vehicle drives about 4,350 miles and consumes about 275 gallons of fuel—for an average fleet fuel economy of 15.8 miles per gallon (MPG), which is lower than the national average fuel economy for light-duty trucks (24.8 MPG) and passenger cars (32.9 MPG).[3] Fifteen of the gasoline vehicles had a fuel economy that fell below the refuge average while ten had a fuel economy that was above the refuge average. The most fuel-efficient vehicle was a 2008 Ford Escape Hybrid, which was also one of the top three most driven vehicles. The vehicle that was driven the most during this period was a 2010 Ford F250 (11,416 miles) (Figure O-2).

[3] Bureau of Transportation Statistics, 2012

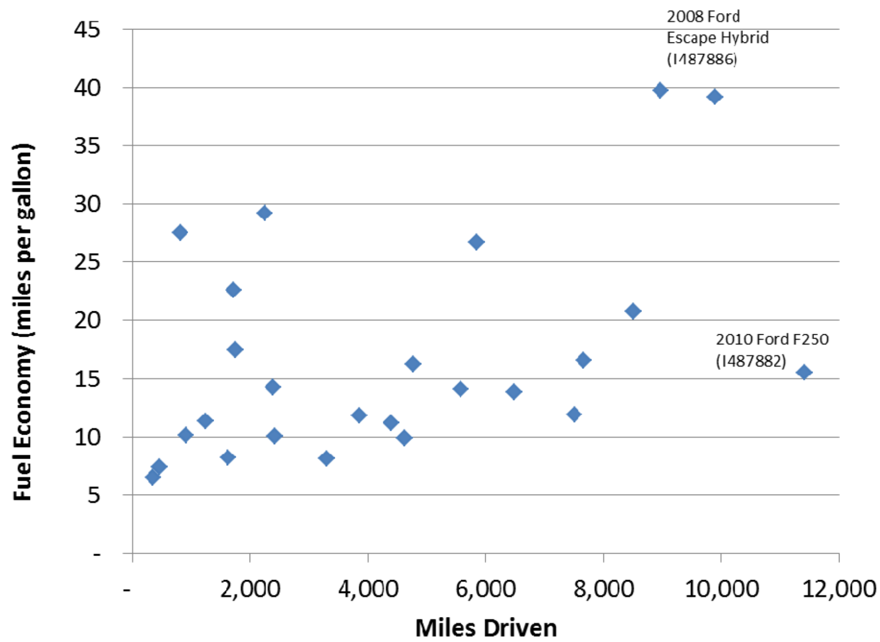



**Figure O-2. Gasoline Fleet Vehicle Fuel Economy and Miles Driven by Vehicle (Apr 2011 through Sept 2011)**

The GHG emission inventory also assessed the GHG emission footprint of visitor vehicle travel to and within the Refuge. These estimates were prepared using data provided by the *National Wildlife Refuge Visitor Survey (2010/2011): Individual Refuge Results for Malheur National Wildlife Refuge* (Appendix Q). GHG emissions from visitor travel to the Refuge were approximated to be 9,500 MTCO2E, annually, while emissions from visitor travel within the Refuge were approximated to be 630 MTCO2E, annually.

All GHG emission estimates were prepared using the draft *Climate Leadership in Refuges* (CLIR) Tool, which is a GHG management tool developed by the Fish and Wildlife Service in partnership with the Federal Lands Highway Program as part of the *Climate Friendly Refuges* (CFR) pilot initiative.

## O.4 Sustainability Planning

The Refuge recognizes that to move toward a more sustainable future, sustainability-based practices must be integrated into the Refuge culture. Sustainability-based practices will address, and seek to improve performance within, the four aspects of sustainability identified by the Refuge—environmental, social, economic, and community. Our approach to improving environmental, social, economic, and community performance will rest on five management areas—*Purpose, Performance, Resources*, *People*, and *Leadership* (Figure O-3). These management areas are introduced below:

- *Purpose* refers to the drivers of the Refuge's sustainability commitment. These drivers will establish a vision for instituting a culture of sustainability.
- *Performance* refers to the Refuge's efforts to demonstrate, implement, and measure the Refuge's sustainability progress.

- *Resources* refers to the materials and information that will be needed to support the Refuge's sustainability commitment.
- *People* refers to the organizational capacity that is needed to support the Refuge's sustainability commitment.
- *Leadership* refers to the Refuge's efforts to demonstrate leadership through the sustainability commitment.

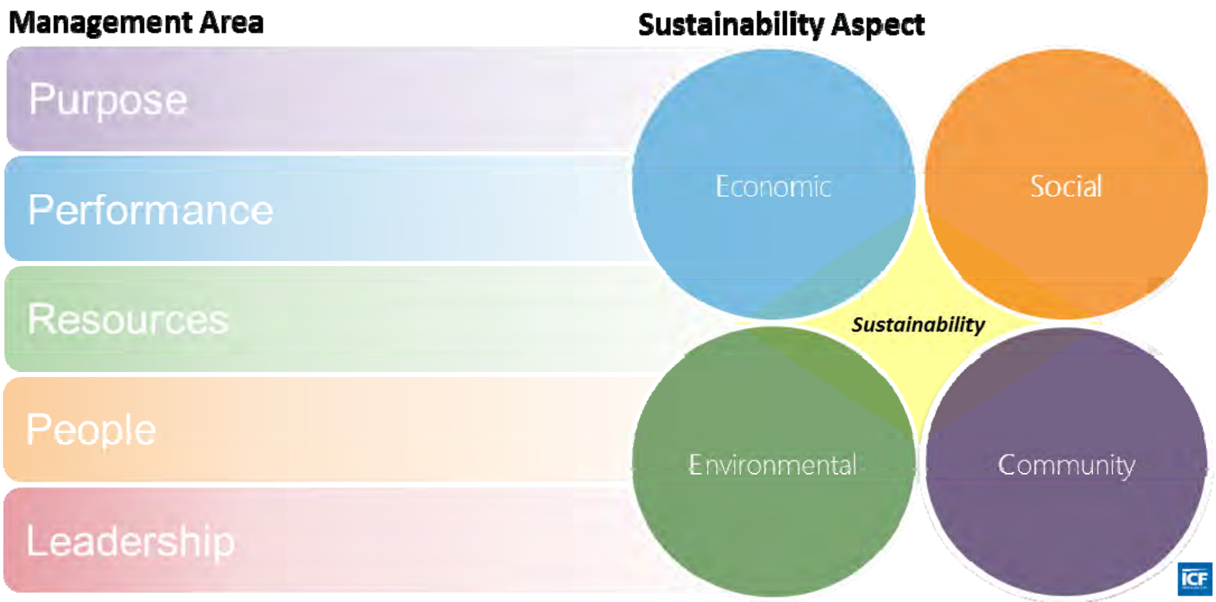



**Figure O-3. Sustainability Management Areas and Aspects**

We have begun to identify sustainability practices within each of the management areas to further integrate sustainability into the Refuge culture, as described below:

**Purpose:** The Refuge will clearly define the drivers of the Refuge's sustainability commitment. Drivers include the USFWS mission, to "work with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people", federal mandates, a commitment to improving refuge operational efficiency, and Malheur NWR's enabling legislation.

**Performance:** The Refuge will implement processes that allow the Refuge to implement, measure, and demonstrate sustainability performance. The primary implementation mechanism will be the Refuge's Environmental Management System—Malheur NWR is one of seventeen refuges that are required to use an Environmental Management System to improve environmental performance. The Refuge will use sustainability indicators to measure performance. Sustainability indicators identified include building energy intensity (energy consumption per gross square foot of building space); scope 1, scope 2, and scope 3 GHG emissions; fleet fuel consumption; and solid waste diversion.[4] The Refuge will demonstrate performance by tracking progress with respect to the sustainability indicators over time.

[4] Solid waste diversion is the percent of total solid waste generated that is diverted from a landfill through recycling, composting, and other means.

**Resources:** The Refuge will stay informed of resources (e.g., materials and information) that will assist the Refuge in improving sustainability performance. The Refuge will work with Region 1 staff to identify resource needs, such as information on best available technologies; expert consultations for fleet optimization, partnership development, renewable energy assessments, visitor engagement, and building commissioning; grant exposure and writing support; and case studies and lessons learned from other FWS sustainability activities.

**People:** Malheur NWR's staff consists of approximately 16 full-time employees as well as seasonal employees and volunteers. Refuge staff recognize the importance of integrating sustainability into the Refuge's operations and have committed to identifying and implementing personal sustainability projects (PSPs). Examples of Malheur NWR staff PSPs include:

- Prepare monthly energy consumption reports by building to help staff evaluate and monitor monthly energy consumption.
- Coordinate travel across program areas to combine trips and combine tasks across program areas to reduce trips.
- Monitor buildings for efficient use of lighting.
- Review manufacturer specifications for vehicles and equipment to make sure they are being maintained and operated efficiently. Post instructions for proper use on dashboard and ensure a proper maintenance schedule.
- Conduct or obtain a site evaluation of headquarters to look for opportunities to replace inefficient boiler system and use renewable energy.
- Review fleet fuel consumption to look for optimization opportunities.

**Leadership:** The Refuge will look for opportunities to engage with partners, the public, private landowners, sister agencies, and other individuals and organizations to collaborate on sustainability programs and practices. The Refuge will share best management practices, success stories, and lessons learned from implementing sustainability practices with interested parties using existing outreach mechanisms and media such as the Refuge website, local newspaper, school visits, and Friends Newsletter to highlight sustainability practices at Malheur NWR.

We will use this management approach as a framework for further incorporating sustainability into Refuge culture while emphasizing continual improvement and striving to meet Objective 14a, Achieve Carbon Neutrality (striving for carbon negative), meeting and exceeding all energy and material efficiency and effectiveness as defined by 565 FW 1 and Executive Order 13514 for all facets of refuge management and operations.

## O.5 References

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*Ring-necked pheasant*
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# *Appendix P*

## *Hunting Plan*


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# Hunting Plan

# for

# Malheur National Wildlife Refuge

## UNITED STATES FISH AND WILDLIFE SERVICE

**2012**

Recommended by _______________ Date: 1/24/13

(Acting) Project Leader

Reviewed by _______________ Date: 1/24/13

Refuge Supervisor

Approved by _______________ Date: 1-24-13

Regional Chief, National Wildlife Refuge System

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# P.1 Overview

Malheur National Wildlife Refuge was created in 1908 primarily as a preserve and breeding ground for native birds at Malheur, Mud, and Harney lakes. In 1935, the Blitzen Valley was established as a refuge and breeding ground for migratory birds and other wildlife, and the Double-O Unit was established as a reservation for migratory birds in 1941. Map 1 in the Comprehensive Conservation Plan (CCP), shows the location of Malheur Refuge.

The hunt programs addressed in this plan incorporate the hunt features (spatial layout, timing, types of hunts, etc.) as designed in the management direction of the CCP. Under the CCP, hunting will occur only in the Malheur Lake and Buena Vista hunt units.

This hunt plan has been prepared as a step-down plan to the CCP. Further descriptions of Refuge history, programs, and habitats can be found in Chapters 1, 4, and 5 of the CCP. A detailed analysis of the effects of the hunt program is found in the compatibility determinations for upland game and waterfowl hunting. Pertinent conclusions of these analyses are presented below in Section P.6 (Assessment).

## P.1.1 Species Covered by this Plan

The species listed below have populations sufficient to allow for recreational harvest. No commercial harvesting of wildlife or use of hunting guides will be allowed, to ensure continued healthy populations and general public opportunity.

### Species That Can be Hunted on Buena Vista Hunt Unit

- Dove, geese, duck, coot, snipe, pigeon, pheasant (rooster), California quail, and partridge (chukar and Hungarian partridge).

### Species That Can be Hunted on Malheur Lake Hunt Unit

- Dove, geese, duck, coot, snipe, pigeon, pheasant (rooster), California quail, and partridge (chukar and Hungarian partridge).

### Species That Can be Hunted on Boundary Hunt Unit

- Dove, geese, duck, coot, snipe, pigeon, pheasant, California quail, partridge, deer, pronghorn, coyote, black-tailed jackrabbit, and Nuttall’s cottontail.

## P.1.2 Game Species not Hunted

Due to conflicts with Refuge purposes and other forms of wildlife-dependent recreation, hunting of any other species is not allowed on the Refuge.

# P.2 Conformance with Statutory Authority

## P.2.1 Conformance with Statutory Objectives

Any use of a national wildlife refuge must be compatible with resource protection and conform to applicable laws, regulations, and Fish and Wildlife Service (FWS) policies. Recreational use, in this case hunting, is allowed under the Refuge Recreation Act of 1962 (16 U.S.C. 460K, amended), which authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use. The Refuge Recreation Act requires: 1) that any recreational use permitted will not interfere with the primary purpose for which the refuge was established; and 2) that funds are available for the development, operation, and maintenance of the permitted forms of recreation.

Likewise, statutory authority for FWS management and associated habitat/wildlife management planning on units of the National Wildlife Refuge System is derived from the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee). The National Wildlife Refuge System Improvement Act provided a mission for the Refuge System and clear standards for its management, use, planning, and growth. The National Wildlife Refuge System Improvement Act recognizes that wildlife-dependent recreational uses—including hunting, fishing, wildlife observation and photography, environmental education, and interpretation—when determined to be compatible with the mission of the Refuge System and the purposes of the refuge are legitimate and appropriate public uses of national wildlife refuges. Sections 5(c) and (d) of the National Wildlife Refuge System Improvement Act state "compatible wildlife-dependent recreational uses are the priority general public uses of the National Wildlife Refuge System and shall receive priority consideration in planning and management; and when the Secretary [of the Interior] determines that a proposed wildlife-dependent recreational use is a compatible use within a refuge, that activity should be facilitated, subject to such restrictions or regulations as may be necessary, reasonable, and appropriate."

## P.2.2 Conformance with Refuge Purposes

Conformance of refuge uses with refuge purposes is determined through a formal compatibility determination process. Compatibility means that the use would not materially interfere with or detract from the fulfillment of the purposes of the refuge(s) or mission of the National Wildlife Refuge System (603 FW 2).

Both the upland game and waterfowl hunts, as described below in Section P.4, were determined to be compatible with Malheur Refuge purposes, with stipulations. See the compatibility determinations in Appendix B for more detail.

# P.3 Statement of Goals and Objectives

## P.3.1 Refuge Goals

Thirteen goals were developed for Malheur Refuge during the CCP process. They are:

1. Enhance aquatic health and habitat conditions essential to the conservation of the flora and fauna that depend on Malheur Lake and associated water bodies.
2. Protect, maintain, and rehabilitate riverine and riparian habitats to conditions essential for the conservation of native fish and wildlife species.
3. Protect, maintain, and rehabilitate riparian habitats to conditions essential for the conservation of wildlife species.
4. Enhance, protect, and/or maintain primary habitats essential to the conservation of a diversity of aquatic and terrestrial wildlife species.
5. Enhance and maintain rare and unique habitats.
6. Welcome visitors and help them safely experience the Refuge's outstanding features—diversity of wildlife, signs of earlier inhabitants, scenic landscapes, and solitude. As a result, visitors will leave the Refuge with a memorable experience that fosters a connection between themselves and nature, and an appreciation of Malheur Refuge's unique resources.
7. Connect the hearts and minds of visitors with places and resources the Refuge protects, and enlighten visitors' experiences with an understanding, appreciation, and knowledge of historical and natural resources, and the importance of conservation and stewardship.
8. Provide reasonable challenges and opportunities, and provide uncrowded conditions for the hunting and fishing public.
9. Initiate and nurture relationships to build support of the Refuge, and fortify Refuge programs and activities to achieve the Refuge's mission and goals.
10. Manage prehistoric and historic cultural resources for their educational, scientific, and cultural values for the benefit of present and future generations of Refuge users and for the communities that are connected to these resources.
11. Identify and protect prehistoric and historic resources on the Refuge that are eligible for or listed in the National Register of Historic Places.
12. Manage the Refuge's paleontological resources for their educational and scientific values for the benefit of present and future generations of Refuge users.
13. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

## P.3.2 Refuge Objectives for Hunting

Goal 8 pertains directly to the provision of wildlife-dependent recreational opportunities on the Refuge. Two Refuge hunt program objectives were developed as part of the CCP development process and are repeated below. The objective numeric identifier (e.g., 8a, 8b) is consistent with the objective numbering system in the CCP. A more complete program description is found in Section P.4 of this hunt plan.

| **Objective 8a. Provide Hunting Opportunities for Upland Game** |
|---|
| Provide high-quality hunting opportunities for upland game hunting in the Malheur Lake, Buena Vista, and Boundary hunt units, for the species, seasons, and other details described in the Hunt Plan. The program shall be managed such that:<br>• Youth are provided added emphasis;<br>• Conditions are uncrowed, with abundant opportunities for solitude on over 58,000 allowable hunting acres;<br>• The hunt is safe and managed to minimize conflicts with wildlife and other priority wildlife- |

| Objective 8a. Provide Hunting Opportunities for Upland Game |
|---|
| dependent recreational uses;<br>• Access is provided on suitable all-weather access roads;<br>• Game are wild or naturalized (not stocked);<br>• Most hunters reach their quota each day;<br>• Refuge staff engages in close cooperation and coordination with State fish and wildlife management agencies for management of hunting opportunities on the Refuge and in setting population management goals and objectives; and<br>• The hunt is consistent with State fish and wildlife laws, regulations, and management plans. |

| Objective 8b: Provide Hunting Opportunities for Waterfowl |
|---|
| Provide high-quality opportunities for waterfowl hunting in the Malheur Lake, Buena Vista, and Boundary hunt units for the species, seasons, and other details described in the Hunt Plan. The program shall be managed such that:<br>• Youth are provided added emphasis;<br>• Conditions are uncrowded, with abundant opportunities for solitude on over 63,000 allowable hunting acres;<br>• The hunt is safe and managed to minimize conflicts with wildlife and other priority wildlife-dependent recreational uses;<br>• Access is provided on suitable all-weather roads;<br>• Hunters can enjoy a range of waterfowl hunting experiences, from traditional setup with decoys and dogs to jump-shooting;<br>• Parking areas are adequate, with parking at three existing locations and one new parking area and boat launch at the airboat launch site to access a new hunt opportunity on the southern side of Malheur Lake;<br>• Most hunters reach their quota each day;<br>• Refuge staff engages in close cooperation and coordination with State fish and wildlife management agencies for management of hunting opportunities on the Refuge and in setting population management goals and objectives;<br>• Hunt is consistent with State fish and wildlife laws, regulations, and management plans. |

## P.4 Description of Hunting Program

The areas open to upland game and waterfowl hunting on the Refuge are shown in Map 3a.

### P.4.1 Upland Game Hunting: Proposed Program

Tables P-1, P-2, and P-3 describe the proposed upland game hunt in the Malheur Lake, Buena Vista, and Boundary hunt units.

**Table P-1. Northern Portion of Malheur Lake Hunt Unit**

| Aspect | Description |
|---|---|
| Location | A total of 22,500 acres (14% of the Refuge) would be open to upland game hunting on the northern portion of Malheur Lake (See Map 3b) |
| Allowable species | Pheasant, quail, chukar and partridge |
| Season | State pheasant season |
| Bag Limits | State upland game limits |
| Fees | None |
| Permits | None |
| Other hunt regulations | Per State regulations |

**Table P-2. Buena Vista Hunt**

| Aspect | Description |
|---|---|
| Location | A total of 36,000 acres (19% of the Refuge) would be open to upland game hunting (See Map 3b) |
| Allowable species | Pheasant, quail, chukar and partridge |
| Season | Fourth Saturday of October to the end of the State pheasant season |
| Limits | State upland game limits |
| Fees | None |
| Permits | None |
| Other hunt regulations | Per State regulations |

**Table P-3. Boundary Hunt Unit**

| Aspect | Description |
|---|---|
| Location | A total of 2,626 acres (1.4% of the Refuge) would be open to upland game hunting (See Map 3b) |
| Allowable species | Pheasant, quail, chukar, partridge, deer, pronghorn, coyote, black-tailed jackrabbit, and Nuttall's cottontail |
| Season | State seasons |
| Limits | State upland game limits |
| Fees | None |
| Permits | None |
| Other hunt regulations | Per State regulations |

### Stipulations Necessary to Ensure Compatibility

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles would be allowed only on maintained public roadways. Parking is allowed only within one vehicle length of the roadway. Hunters would be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires would not be permitted on the Refuge.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Hunting closures would be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. Shooting from or across public roads or road rights-of-way would be prohibited.
- Law enforcement patrols would ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information would be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

## P.4.2 Waterfowl Hunting: Proposed Program

Tables P-4, P-5, and P-6 describe the proposed waterfowl hunting program on the Malheur Lake and Buena Vista hunt units, and Table P-7 describes the proposed youth hunt on the Malheur Lake Hunt Unit.

**Table P-4. Northern Portion of Malheur Lake Hunt Unit**

| Aspect | Description |
|---|---|
| Location | A total of 26,200 acres (14% of the Refuge) would be open to waterfowl hunting on the northern portion of Malheur Lake (See Map 4a) |
| Allowable species | Doves, geese, ducks, coots, snipe, and pigeons |
| Season | State waterfowl season |
| Limits | State waterfowl limits |
| Boats | Nonmotorized or electric boats will be permitted |
| Blinds | Temporary blinds may be erected on a day-to-day basis |
| Fees | None |
| Permits | None |
| Other hunt regulations | Per State regulations; at low water (<10,000 acres), Malheur Lake Hunt Unit will be closed to waterfowl hunting |

**Table P-5. Southern Portion of Malheur Lake Hunt Unit**

| Aspect | Description |
|---|---|
| Location | A total of 4,600 acres (2% of the Refuge) would be open to waterfowl hunting on the southern portion of Malheur Lake (see Map 3b) |
| Allowable species | Doves, geese, ducks, coots, snipe, and pigeons |
| Season | Fourth Saturday of October to the end of the State waterfowl season |
| Limits | State waterfowl limits |
| Boats | Nonmotorized or electric boats will be permitted |
| Blinds | Temporary blinds may be erected on a day-to-day basis |
| Fees | None |
| Permits | None |
| Other hunt regulations | Per State regulations; at low water (<10,000 acres), Malheur Lake Hunt Unit will be closed to waterfowl hunting |

**Table P-6. Buena Vista Hunt Unit**

| Aspect | Description |
|---|---|
| Location | A total of 36,000 acres (19% of the Refuge) would be open to waterfowl hunting (see Map 3b) |
| Allowable species | Doves, geese, ducks, coots, snipe, and pigeons |
| Season | Fourth Saturday of October to the end of the State waterfowl season |
| Bag Limits | State waterfowl limits |
| Boats | Not permitted |
| Blinds | Not permitted |
| Fees | None |
| Permits | None |
| Other hunt regulations | Per State regulations |

**Table P-7. Malheur Lake Youth Hunt**

| Aspect | Description |
|---|---|
| Location | A total of 26,200 acres (14% of the Refuge) would be open to waterfowl hunting on the northern portion of Malheur Lake (see Map 4a) |
| Allowable species | Doves, geese, ducks, coots, snipe, and pigeons |
| Season | State-designated weekend |
| Bag Limits | State waterfowl limits |

| Aspect | Description |
|---|---|
| Boats | Nonmotorized or electric boats will be permitted |
| Blinds | Temporary blinds may be erected on a day-to-day basis |
| Fees | None |
| Permits | None |
| Other hunt regulations | Per State regulations; at low water (<10,000 acres), Malheur Lake Hunt Unit will be closed to waterfowl hunting |

### Stipulations Necessary to Ensure Compatibility

- Only federally approved nontoxic shot may be used or be in possession while hunting on the Refuge.
- Vehicles would be allowed only on maintained public roadways. Parking would be allowed only within one vehicle length of the roadway. Hunters would be instructed to not block dike and field accesses.
- Overnight parking, camping, and campfires would not be permitted on the Refuge.
- Access would be by walk-in only. Electric motorized boating or nonmotorized boating would be permitted on Malheur Lake during the waterfowl hunt season.
- Hunting dogs are strongly encouraged to increase hunter success and retrieval rate. Dogs must be kept under close control.
- Seasonal hunting closures may occur to protect waterfowl populations when the Malheur Lake water level drops below 10,000 acres.
- Hunting closures would be in effect near Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. The new Caspian tern island in the South Malheur Lake Unit will be permanently closed to hunting. Shooting from or across public roads or road rights-of-way is prohibited.
- Law enforcement patrols would ensure safety and minimize conflicts with other priority public uses by providing information about hunting boundaries and seasons to the general public and those using other Refuge programs. Information would be provided at interpretive kiosks, on the Refuge website, and in Refuge offices.

## P.4.3 Procedures for Consultation and Coordination with Oregon Department of Fish and Wildlife

FWS staff will coordinate with Oregon Department of Fish and Wildlife (ODFW) staff regarding annual hunt season dates, areas open to hunting, etc. ODFW will publish information on the Refuge upland game and waterfowl hunts annually in State hunting regulations.

# P.5 Measures Taken to Avoid Conflicts with Other Management Objectives

## P.5.1 Measures to Avoid Biological Conflicts

The hunts have been designed to minimize biological conflicts through a variety of measures. A large portion of the Refuge, including the southern part of the Blitzen Valley, Harney Lake, and the Double-O Unit, will remain closed to hunting and will provide undisturbed habitat for migrating birds. In addition, at low water (<10,000 acres), Malheur Lake will be closed. The new Caspian tern island in the South Malheur Lake Unit will be permanently closed to hunting. Vehicles will be limited to roads. Boats will be restricted to Malheur Lake, and only electric or nonmotorized boats will be permitted. The opening date for both the waterfowl and upland game hunts for the Buena Vista Hunt Unit and the southern portion of Malheur Lake Hunt Unit is set as the last Saturday in October, which will prevent disturbance to staging sandhill cranes, who use these areas in early fall. Only federally approved nontoxic shot will be permitted to be in hunters' possession while on the Refuge.

Outreach with hunting brochures and timely information on the website would help educate hunters on hunting opportunities, regulations, and ethical hunter behavior. Youth hunters will also be required to complete a hunter education course.

## P.5.2 Measures to Avoid Public Use Conflicts

Various aspects of the proposed hunt programs, including temporal restriction and spatial restrictions, combined with the seasonal nature of other wildlife-dependent recreation activities on the Refuge, will reduce the potential for conflict. Generally, late fall and winter use on the Refuge is only a fraction of the use during the spring and fall seasons.

Hunting regulations would be established to provide a no-hunt buffer zone around the airboat launch site and observation tower. Persons not engaged in hunting would not be permitted to access the Malheur Lake Hunt Unit or the Buena Vista Hunt Unit, except where public roads border or traverse these units. State regulations also prohibit shooting from on and across roads, which would limit conflicts. Fishing along the Blitzen River from Sodhouse Lane to the Boat Landing Road would conclude prior to the hunting season opener.

Other measures taken to avoid or reduce potential conflicts with other Refuge visitors include law enforcement patrols, posting hunt signs to maintain public awareness during the hunting seasons, and providing descriptive brochures explaining hunting opportunities. Regulations will be printed and dispensed at Refuge Headquarters and brochure boxes at Refuge parking lots, entrances to the hunt units, or online at the Refuge website.

Conflicts between hunters themselves will be minimized by providing the staggered season openers described above. In addition, the relatively large hunt area compared to the expected number of hunters will minimize crowding and safety conflicts.

### P.5.3 Measures to Avoid Administrative Conflicts

Hunt closures will be in effect around Refuge Headquarters, Buena Vista Station, and the Malheur Field Station. The hunt program has the potential to conflict with some of the normal management, maintenance and biological monitoring activities that might be occurring in the same vicinity as the hunt program. Safety briefings for Refuge staff working in hunt areas will occur. Hunters will be warned of Refuge activities that might be occurring in the hunt units. These measures will ensure the safety of Refuge staff and Service-authorized agents and will allow for the completion of Refuge management activities as well as other Refuge uses. The project leader will retain the discretion to close areas to hunting when necessary for the protection of Refuge staff and authorized agents who are conducting Refuge management activities or for the safety of hunters who could be at risk from Refuge management activities (e.g., prescribed fire). Overall, there will be minimal administrative conflicts expected.

## P.6 Assessment

### P.6.1 Compatibility with Refuge Objectives

Hunting is one of the six wildlife-dependent recreational uses included in the National Wildlife Refuge System Improvement Act of 1997. Conducting well-managed hunts on the Refuge will assist the Refuge in meeting one of the Refuge System's primary goals (namely, providing the public opportunities to participate in compatible wildlife-dependent recreational programs). The State-designated youth waterfowl hunt also provides a unique opportunity for the Refuge to introduce young hunters to the Refuge System and educate them on the importance of wildlife conservation.

Compatibility with other Refuge programs is addressed below.

### P.6.2 Biological and Other Considerations

#### Upland Game

Potential effects of upland game hunting to target populations, non-target species, listed species, Refuge habitats, and other public use programs are summarized below. Section P.5 examines measures to avoid conflicts with these resources. Also see the compatibility determination for upland game hunting (Appendix B in the CCP) for a detailed effects analysis.

| Effects Analysis | Summary Conclusion |
|---|---|
| Effects to target populations | The estimated harvest for upland game birds would not likely increase from the current levels because the program would not markedly expand. The earlier season opening would provide additional hunting opportunities during the season and may increase hunters' success rate, but the harvest is small overall; the estimated Refuge harvest of <600 gamebirds would only be likely to be <5% of the entire harvest in Harney and Malheur counties.<br><br>Given the wide range of upland gamebirds and an average of 49,000 acres available to hunt, it is expected that the overall upland game hunting pressure under would be low. Given the small amount of the estimated take and the distribution of the hunt units, the hunt program as designed is not expected to |

| Effects Analysis | Summary Conclusion |
|---|---|
| | adversely affect the Refuge's ability to sustain optimum population levels for maintaining populations of upland gamebirds.<br><br>Although Refuge-specific population and past harvest data are unavailable for coyote and rabbits, neither of these hunts on the Boundary Unit is expected to negatively affect populations of the target species.<br><br>Refuge-specific harvest data are also unavailable for deer and pronghorn. Pronghorn have showed a gradual increase in populations statewide, while mule deer are on a prolonged decline. However, given the low level of harvest that is expected to occur on these species on the available Refuge hunt area, hunting is not expected to significantly impact target populations. |
| Effects to non-target species | Potential minor disturbance to other foraging or resting birds would occur from dogs, human activity, and noise associated with hunting. Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. A late season opener for the southern portion of Malheur Lake and the Buena Vista Unit would allow sufficient protection of the sandhill cranes until they migrate farther south. Since most birds have migrated during the fall season, disturbance level would be minor overall. Disturbance to other taxa would be unlikely or negligible. |
| Effects to Refuge habitats, vegetation, soil, and water | No facilities would be added to support this use; therefore, there is no additional amount of habitat that will be lost due to facilities. Foot travel associated with upland game hunting could result in temporary and minor vegetation trampling. No impact is expected to soil or water resources as a result of this use. |
| Effects to listed species | Due to the slight increase in upland game hunting opportunities, access, and visitation projected, disturbance impacts to greater sage-grouse would be expected to increase, although sage-grouse is not a huntable species on the Refuge and does not readily occur within Refuge boundaries. If off-trail use results in unacceptable adverse effects to candidate species or habitats, the Refuges would limit use to the trails. ODFW continues to closely track sage-grouse populations to ensure the numbers stay and increase to a sustainable level. |
| Effects to other priority public uses | Use of the Refuge by non-hunting visitors is very light during hunting season, and this is expected to mitigate any conflict between hunting and other uses in the Buena Vista Unit. Hunt closures will be in effect around high-use areas such as the Headquarters and airboat launch/viewing tower. |

## Waterfowl/Migratory Birds

Potential effects of waterfowl hunting to target populations, non-target species, listed species, Refuge habitats, and other public use programs are summarized below. Section P.5 examines measures to avoid conflicts with these resources. Also see the compatibility determination for waterfowl hunting (Appendix B in the CCP) for more detail.

| Effects | Summary Conclusion |
|---|---|
| Effects to target populations | Near-term, the number of birds harvested would be expected to increase slightly but would still likely be <250 ducks and <200 geese annually. These estimated harvests represent <1% of the total midwinter population of wintering ducks and geese in the Regional Survey Unit (Klamath, Lake, and Harney counties) and an even smaller fraction of the State of Oregon and Pacific Flyway population. The overall impacts from the harvest estimates would be minor to negligible. Longer-term, as management activities work to control carp in Malheur Lake over the next 15 years, it would be expected that the number of nesting birds in this area would increase and consequently harvests would also increase. There are many unknowns in carp control, and an accurate estimate of waterfowl to be harvested under this scenario cannot be predicted at this time. In addition to direct mortality, hunting could result in redistribution of waterfowl and waterbirds at the Refuge. |
| Effects to non-target species | Potential minor disturbance to other foraging or resting birds would occur from dogs, human activity, and noise associated with hunting. Hunting seasons do not coincide with the nesting season; thus, reproduction will not be reduced by hunting. Disturbance to the foraging or resting activities of migrating or resident birds will increase with the new access for boats at the south end of Malheur Lake and the new opening of the Buena Vista Hunt Unit to waterfowl hunters. However, even with these changes, hunting is still expected to involve a small numbers of participants. On the north side of Malheur Lake, many of the hunters hunt the shoreline rather than using boats on Malheur Lake, thus limiting the area disturbed on that side. The Buena Vista Unit will remain a walk-in hunt, and hunters do not generally walk distances of more than a mile from roads to access hunting areas. Prohibiting overnight camping would also decrease the likelihood of hunters roaming long distances on the Refuge, particularly in the Buena Vista Unit.<br><br>Disturbance to other taxa would be unlikely or negligible. Sandhill cranes stage on the southern portion of Malheur Lake and in the Buena Vista wetlands until mid-October. A late season opener for the southern portion of Malheur Lake and the Buena Vista Unit would allow sufficient protection of the sandhill cranes until they migrate. Other birds using the area may be disturbed from noise and human presence; however, since most birds have migrated during the fall, disturbance effects would be minor overall. |
| Effects to Refuge habitats | No facilities would be added to support this use; therefore, there is no additional amount of habitat that will be lost due to facilities. Foot travel associated with accessing Malheur Lake for waterfowl hunting could potentially result in temporary and minor vegetation trampling. Limiting boat type to electric or nonmotorized boats will prevent exhaust and emissions from entering Refuge waters. |
| Effects to listed species | Due to the increase in waterfowl hunting opportunities, access, and visitation projected, disturbance impacts to the candidate species greater sage-grouse and Columbia spotted frog would be expected to increase, but the total impacts related to waterfowl hunting are expected to be minor. Impacts can be reduced by locating public facilities away from habitats that host candidate species. Increasing specific public education can also assist in raising awareness and preventing undue impacts to the species. |

| Effects | Summary Conclusion |
|---|---|
| Effects to other priority public uses | Hunting has the potential to disturb Refuge visitors engaged in other priority public uses; however, given the season during which hunting occurs, the likelihood of conflicts is low. Hunt closures will be in effect around high-use areas such as the Headquarters and airboat launch/viewing tower. |

### P.6.3 Funding and Staffing Requirements for the Hunt

The proposed upland game hunt program at the Refuge would require administrative staff time from a biologist, visitor services manager, maintenance staff, and a law enforcement officer. The total annual cost to administer the hunt with the changes proposed is projected to be approximately $2,000 per year. There are currently enough funds in Refuge operations to implement this program.

The proposed waterfowl hunt at the Refuge would require administrative staff time from a biologist, visitor services manager, maintenance staff, and a law enforcement officer. With facility improvements, approximately $282,000 in one-time costs are projected, and the total annual cost to operate this program is estimated at $8,000. There are not currently enough funds in Refuge operations to implement this program; additional sources will be sought.

Outreach about the new hunting programs will require minimal reprogramming of existing resources.

## P.7 Conduct of the Hunt

Like any use of public lands, location-specific regulations allow for the safety of visitors and the accommodation of many uses. Hunting on the Refuge is no exception.

### P.7.1 Anticipated Public Reaction to the Hunt

The existing hunting program is generally accepted locally and does not generate anti-hunting controversy. Nationally, there is a component of the population that is opposed to hunting, and some organizations are opposed to hunting, or at least expansion of hunting, on national wildlife refuges and other public lands. Thus, it is expected that some objections may be voiced to some or all of the hunts within this plan.

### P.7.2 Hunter Application Process

No permits or fees are required to participate in the hunt. Areas available are open each day on a first-come, first-served basis.

### P.7.3 Media Selection for Publicizing the Hunt

Newspapers and TV/radio stations throughout Oregon will be provided copies of an annual news release covering the hunts. Descriptive brochures explaining hunting opportunities and regulations will be printed and dispensed at Refuge Headquarters and brochure boxes at Refuge parking lots, entrances to the hunt units, or online at the Refuge website.

### P.7.4 Hunter Requirements and regulations

1. Age: Youths must be accompanied by an adult, 21 years of age or older.

2. All hunters must obtain a hunting or combination license and participate in the Harvest Information Program (HIP). Because of season dates and hunting regulations change annually, hunters must review all information and regulations in the Oregon’s statewide hunting booklets before the hunts.

Wildlife observers
©Barbara Wheeler

# Appendix Q

## National Wildlife Refuge Visitor Survey


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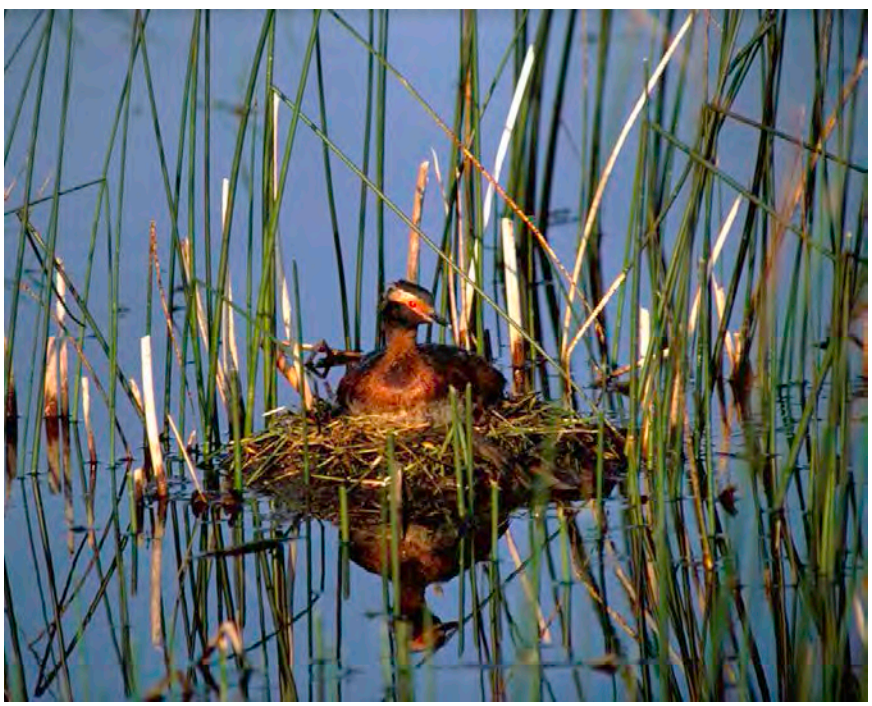
# National Wildlife Refuge Visitor Survey 2010/2011: Individual Refuge Results for Malheur National Wildlife Refuge

By Natalie R. Sexton, Alia M. Dietsch, Andrew W. Don Carlos, Lynne Koontz, Adam N. Solomon and Holly M. Miller

*I love this refuge. The experience is life affirming. Not only do we love the experience of being in the unique landscape and viewing the birds, we have loved getting to know some of the local people we connect with again each year, and meeting other travelers.. Some years we have gone twice. Each trip I learn something new (often from another visitor) or recognize a bird that I could not identify before. It is an opportunity to be with our friends in an environment we love and appreciate. It is so interesting to see the differences through the years... Are the owls nesting in the same place? Will the area be dry or wet? Will the number of birds returning be similar in number or will events (natural or not) over the last year affect their population? My life experience would be greatly diminished if I could not come here.*—Survey comment from visitor to Malheur National Wildlife Refuge.



Horned Grebe at Malheur National Wildlife Refuge. Photo credit: U.S. Fish and Wildlife Service.

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# Introduction

The National Wildlife Refuge System (NWRS), established in 1903 and managed by the U.S. Fish and Wildlife Service (FWS), is the largest system of lands in the world dedicated to the conservation of wildlife. There are over 550 National Wildlife Refuges (NWRs) nationwide, encompassing more than 150 million acres. The mission of the NWRS is to "administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." Part of achieving this mission is the goal "to foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use" (Clark, 2001). About 98% of the system is open to the public, attracting nearly 40 million visitors annually. More than 25 million people per year visit refuges to observe and photograph wildlife, 8 million to hunt and fish, and more than half a million to participate in educational and interpretation programs (Uniack, 1999; U.S. Fish and Wildlife Service, 2007). Understanding visitors and characterizing their experiences on National Wildlife Refuges are critical elements of managing these lands and meeting the goals of the NWRS.

To address such information needs, the FWS Division of Visitor Services and Communications partnered with the Policy Analysis and Science Assistance Branch (PASA) of the U.S. Geological Survey's Fort Collins Science Center to collect data on visitor experiences across the NWRS. PASA scientists have conducted biological, social, economic, and institutional analyses of conservation policies and management practices on numerous refuges across the nation in support of refuge planning and management. PASA's mission is to integrate biological, social, and economic research so that natural resource professionals can use the resulting information to make informed decisions and resolve related conflicts.

The goal of the 2010/2011 National Visitor Survey is to provide refuge managers, planners, and visitor services specialists with reliable baseline data about refuge visitors and their experiences. The survey was conducted to provide information both at a national level *and* at a field station level to more effectively manage visitor services and facilities across the System and to inform site-specific management and planning decisions such as Comprehensive Conservation Plans (CCPs), Visitor Services step-down plans, and transportation plans.

# Organization of Results

These results are for Malheur NWR (this refuge) and are part of USGS Data Series 643 (Sexton and others, 2011). All refuges participating in the 2010/2011 surveying effort will receive individual refuge results specific to the visitors to that refuge. Each set of results is organized by the following categories:

- **Introduction:** An overview of the NWRS and the goals of the national surveying effort.
- **Methods:** The procedures for the national surveying effort, including selecting refuges, developing the survey instrument, contacting visitors, and guidance for interpreting the results.
- **Refuge Description:** A brief description of the refuge location, acreage, purpose, recreational activities, and visitation statistics, including a map (where available) and refuge website link.
- **Sampling at This Refuge:** The sampling periods, locations, and response rate for this refuge.
- **Selected Survey Results:** Key findings for this refuge, including:
    - Visitor and Trip Characteristics
    - Visitor Spending in the Local Communities
    - Visitors Opinions about This Refuge
    - Visitor Opinions about National Wildlife Refuge System Topics

- **Conclusion**
- **Acknowledgements**
- **References**
- **Survey Frequencies (Appendix A):** A copy of the survey instrument with the frequency results for this refuge.
- **Visitor Comments (Appendix B):** The verbatim responses to the open-ended survey questions for this refuge.

# Methods

## Selecting Participating Refuges

The National Visitor Survey was conducted from July 2010 – August 2011 on 53 refuges across the NWRS (table 1). Based on the Division of Refuge's 2008 Refuge Annual Performance Plan (RAPP; U.S. Fish and Wildlife Service, 2011, personal communication), 192 refuges with a minimum visitation of 25,000 visitors were considered. This criterion was the median visitation across the NWRS and the minimum visitation necessary to ensure that the surveying would be logistically feasible onsite. Thirty-five of the participating refuges were randomly selected for national-level analyses. Fifteen additional refuges were selected for participation by regional office Visitor Services Chiefs based on the need to inform individual refuge planning processes. An additional three refuges were added to the effort by an interagency agreement with USGS.

## Developing the Survey Instrument

PASA researchers developed the survey in consultation with FWS managers, planners, and visitor services professionals. The survey was peer-reviewed by academic and government researchers and was further pre-tested with NWRS Friends Group representatives from each region to ensure readability and overall clarity. The survey and associated methodology were approved by the Office of Management and Budget (OMB control #: 1018-0145; expiration date: 6/30/2013).

## Contacting Visitors

Refuge staff identified two separate 15-day sampling periods and one or more locations that best reflected the unique visitation patterns of each participating refuge. Sampling periods and locations were identified by refuge staff and submitted to PASA via an internal website that included a customized mapping tool. A standardized sampling schedule was created for all refuges that included eight systematically selected sampling shifts during each of the two sampling periods. Sampling shifts were three- to five-hour time bands that were stratified across AM and PM, as well as weekend and weekdays. Any necessary customizations were made, in coordination with refuge staff, to the standardized schedule to accommodate the identified sampling locations and to address unique spatial and temporal patterns of visitation.

Twenty visitors per sampling shift were targeted, for a total of 320 willing participants per refuge—160 per sampling period—to ensure an adequate sample of completed surveys. When necessary, shifts were moved, added, or extended to alleviate logistical limitations (for example, weather or low visitation at a particular site) in an effort to reach target numbers.

Table 1. Participating refuges in the 2010/2011 National Wildlife Refuge Visitor Survey.

| | |
|---|---|
| **Pacific Region (R1)** | |
| Kilauea Point National Wildlife Refuge (HI) | William L. Finley National Wildlife Refuge (OR) |
| Deer Flat National Wildlife Refuge (ID) | McNary National Wildlife Refuge (WA) |
| Cape Meares National Wildlife Refuge (OR) | Turnbull National Wildlife Refuge (WA) |
| Malheur National Wildlife Refuge (OR) | |
| **Southwest Region (R2)** | |
| Bitter Lake National Wildlife Refuge (NM) | Aransas National Wildlife Refuge (TX) |
| Bosque del Apache National Wildlife Refuge (NM) | San Bernard/ Brazoria National Wildlife Refuge (TX) |
| Wichita Mountains Wildlife Refuge (OK) | |
| **Great Lakes-Big Rivers Region (R3)** | |
| Desoto National Wildlife Refuge (IA) | Upper Mississippi River National Fish and Wildlife Refuge - McGregor District (MN) |
| Neal Smith National Wildlife Refuge (IA) | |
| Muscatatuck National Wildlife Refuge (IN) | Big Muddy National Wildlife Fish and Wildlife Refuge (MO) |
| Rice Lake National Wildlife Refuge (MN) | Horicon National Wildlife Refuge (WI) |
| Tamarac National Wildlife Refuge (MN) | Necedah National Wildlife Refuge (WI) |
| **Southeast Region (R4)** | |
| Wheeler National Wildlife Refuge (AL) | Banks Lake National Wildlife Refuge (GA) |
| Big Lake National Wildlife Refuge (AR) | Noxubee National Wildlife Refuge (MS) |
| Pond Creek National Wildlife Refuge (AR) | Cabo Rojo National Wildlife Refuge (Puerto Rico) |
| Merritt Island National Wildlife Refuge (FL) | Pea Island National Wildlife Refuge (NC) |
| St. Marks National Wildlife Refuge (FL) | Cape Romain National Wildlife Refuge (SC) |
| Ten Thousand Islands National Wildlife Refuge (FL) | Reelfoot National Wildlife Refuge (TN) |
| **Northeast Region (R5)** | |
| Stewart B. McKinney National Wildlife Refuge (CT) | Moosehorn National Wildlife Refuge (ME) |
| Bombay Hook National Wildlife Refuge (DE) | Great Swamp National Wildlife Refuge (NJ) |
| Monomoy National Wildlife Refuge (MA) | Montezuma National Wildlife Refuge (NY) |
| Parker River National Wildlife Refuge (MA) | Wertheim National Wildlife Refuge (NY) |
| Patuxent Research Refuge (MD) | Occoquan Bay/ Elizabeth Hartwell Mason Neck National Wildlife Refuge (VA) |
| **Mountain-Prairie Region (R6)** | |
| Monte Vista National Wildlife Refuge (CO) | Sand Lake National Wildlife Refuge (SD) |
| Quivira National Wildlife Refuge (KS) | National Elk Refuge (WY) |
| Charles M. Russell National Wildlife Refuge (MT) | |
| **Alaska Region (R7)** | |
| Alaska Maritime National Wildlife Refuge (AK) | Kenai National Wildlife Refuge (AK) |
| **California and Nevada Region (R8)** | |
| Lower Klamath/Tule Lake National Wildlife Refuge (CA) | Ruby Lake National Wildlife Refuge (NV) |
| Sonny Bono Salton Sea National Wildlife Refuge (CA) | |

Refuge staff and/or volunteers (survey recruiters) contacted visitors on-site following a protocol provided by PASA to ensure a diverse sample. Instructions included contacting visitors across the entire sampling shift (for example, every $n^{th}$ visitor for dense visitation, as often as possible for sparse visitation), and only one person per group. Visitors were informed of the survey effort, given a token incentive (for example, a small magnet, temporary tattoo), and asked to participate. Willing participants provided their name, mailing address, and preference for language (English or Spanish) and survey mode (mail or online). Survey recruiters also were instructed to record any refusals.

Visitors were mailed a postcard within 10 days of the initial on-site contact thanking them for agreeing to participate in the survey and inviting them to complete the survey online. Those visitors choosing not to complete the survey online were sent a paper copy a week later. Two additional contacts were made by mail during the next seven weeks following a modified Tailored Design Method (Dillman, 2007): 1) a reminder postcard one week after the first survey, and 2) a second paper survey two weeks after the reminder postcard. Each mailing included instructions for completing the survey online and a postage paid envelope for returning the paper version of the survey. Those visitors indicating a preference for Spanish were sent Spanish versions of all correspondence (including the survey). Finally, a short survey of six questions was sent to nonrespondents four weeks after the second survey mailing to determine any differences between respondents and nonrespondents at the national level. Online survey data were exported and paper survey data were entered using a standardized survey codebook and data entry procedure. All survey data were analyzed by using SPSS v.18 statistical analysis software.

## Interpreting the Results

The extent to which these results accurately represent the total population of visitors to this refuge is dependent on 1) an adequate sample size of those visitors and 2) the representativeness of that sample. The adequacy of the sample size for this refuge is quantified as the margin of error. The composition of the sample is dependent on the ability of the standardized sampling protocol for this study to account for the spatial and temporal patterns of visitor use unique to each refuge. Spatially, the geographical layout and public use infrastructure varies widely across refuges. Some refuges only can be accessed through a single entrance, while others have multiple unmonitored access points across large expanses of land and water. As a result, the degree to which sampling locations effectively captured spatial patterns of visitor use will likely vary from refuge to refuge. Temporally, the two 15-day sampling periods may not have effectively captured all of the predominant visitor uses/activities on some refuges during the course of a year. Therefore, certain survey measures such as visitors' self-reported "primary activity during their visit" may reflect a seasonality bias.

Herein, the sample of visitors who responded to the survey are referred to simply as "visitors." However, when interpreting the results for Malheur NWR, any potential spatial and temporal sampling limitations specific to this refuge need to be considered when generalizing the results to the total population of visitors. For example, a refuge that sampled during a special event (for example, birding festival) held during the spring may have contacted a higher percentage of visitors who traveled greater than 50 miles to get to the refuge than the actual number of these people who would have visited throughout the calendar year (that is, oversampling of nonlocals). In contrast, another refuge may not have enough nonlocal visitors in the sample to adequately represent the beliefs and opinions of that group type. If the sample for a specific group type (for example, nonlocals, hunters, those visitors who paid a fee) is too low ($n < 30$), a warning is included. Additionally, the term "*this* visit" is used to reference the visit on which people were contacted to participate in the survey, which may or may not have been their most recent refuge visit.

## Refuge Description for Malheur National Wildlife Refuge

Malheur National Wildlife Refuge is located in the sagebrush country of eastern Oregon. The Refuge was established by Theodore Roosevelt in 1908 as a preserve and breeding ground for native birds. The Refuge has since grown through a 65,000-acre purchase in 1935 and a 14,000-acre purchase in 1942, covering a total of 187,000 acres. Malheur NWR attracts a variety of visitors, from bird watchers, hikers and bicyclists, to anglers and hunters. Over 320 species of birds and 58 mammal species call the refuge home, providing hunters and birders with ample recreation opportunities. Flocks of waterfowl and sandhill cranes use Malheur NWR as a resting point and feeding ground during their migration along the Pacific Flyway in the spring and fall, providing a range of visitors with unique recreation experiences. Malheur NWR attracts 65,000 annual visitors (based on 2008 RAPP database; U.S. Fish and Wildlife Service, 2011, written comm.). Figure 1 depicts a map of Malheur NWR. For more information, go to *http://www.fws.gov/malheur/*.

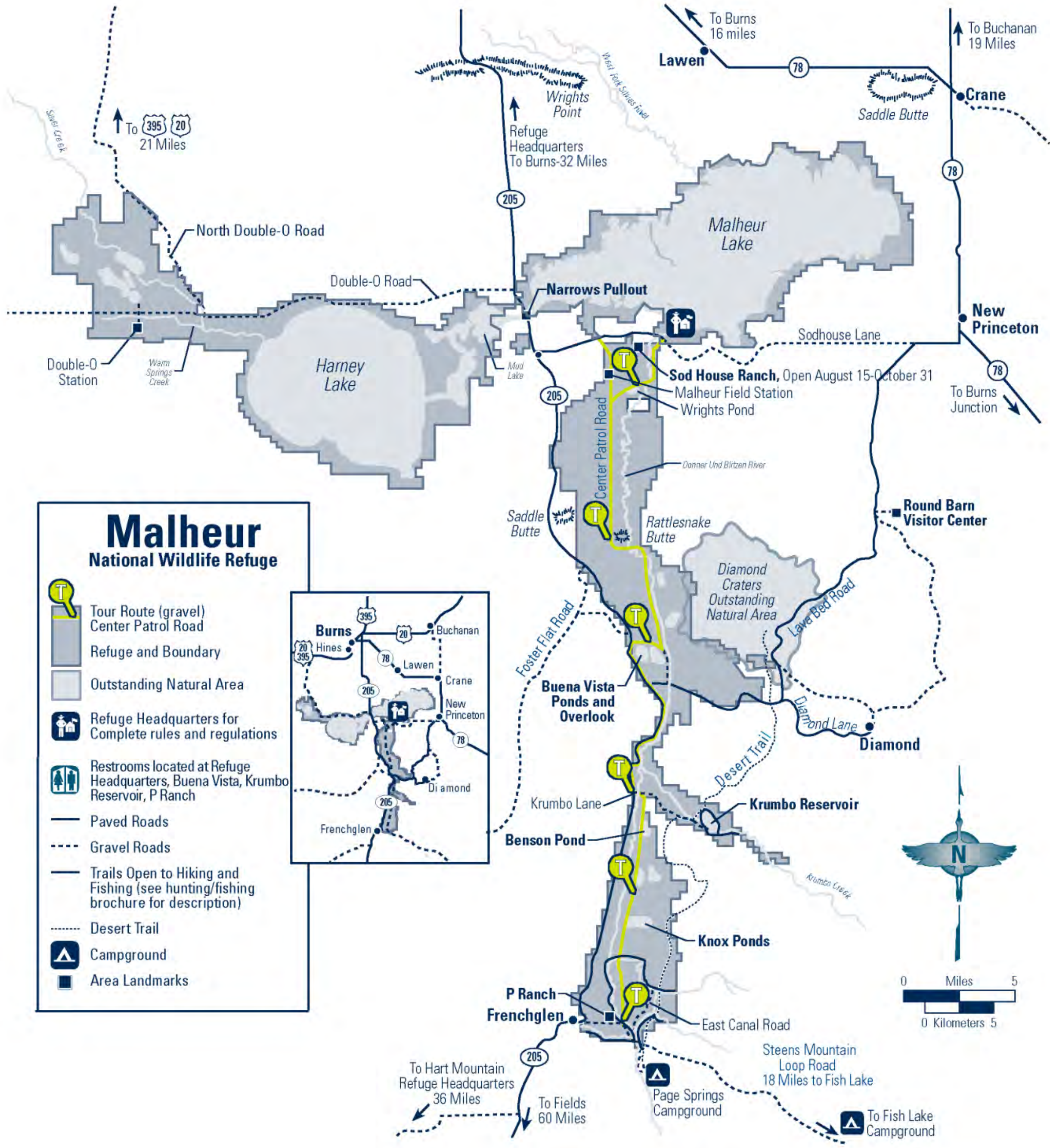



Figure 1. Map of Malheur NWR, courtesy of U.S. Fish and Wildlife Service.

## Sampling at Malheur National Wildlife Refuge

A total of 315 visitors agreed to participate in the survey during the two sampling periods at the identified locations at Malheur NWR (table 2). In all, 276 visitors completed the survey for an 89% response rate and ±5% margin of error at the 95% confidence interval.[1] The majority of the contacts were made at the Visitor Center (68%), whereas 20% were made at Krumbo Reservoir, 7% at Historic P Ranch, 3% along the Auto Tour Route, and 2% at the Historic Sod House Ranch. The refuge experienced flooding during sampling period 2 which may have affected participation in some activities on the refuge, such as use of the autor tour route.

Table 2. Sampling and response rate summary for Malheur NWR.

| Sampling period | Dates | Locations | Total contacts | Undeliverable addresses | Completed surveys | Response rate |
|---|---|---|---|---|---|---|
| **1** | 8/28/10 to 09/11/10 | Auto Tour Route, Center Patrol Road<br>Historic Sod House Ranch<br>Krumbo Reservoir<br>Visitor Center/Refuge HQ | 144 | 2 | 126 | 89% |
| **2** | 05/21/11 to 06/04/11 | Historic P Ranch<br>Krumbo Reservoir<br>Visitor Center/Refuge HQ | 171 | 3 | 150 | 89% |
| **Total** | | | **315** | **5** | **276** | **89%** |

## Selected Survey Results

### Visitor and Trip Characteristics

*A solid understanding of refuge visitors and details about their trips to refuges can inform communication outreach efforts, inform visitor services and transportation planning, forecast use, and gauge demand for services and facilities.*

### Familiarity with the NWRS

Visitors to Malheur NWR reported that before participating in the survey, they were aware of the role of the U.S. Fish and Wildlife Service in managing National Wildlife Refuges (92%) and that the Refuge System has the mission of conserving, managing, and restoring fish, wildlife, plants and their habitat (95%). Positive responses to these questions concerning the management and mission of the NWRS do not necessarily indicate that these visitors fully understand the day-to-day management practices of individual

[1] The margin of error (or confidence interval) is the error associated with the results related to the sample and population size. A margin of error of ± 5%, for example, means if 55% of the sample answered a survey question in a certain way, then 50–60% of the entire population would have answered that way. The margin of error is calculated with an 80/20 response distribution, assuming that for any given dichotomous choice question, approximately 80% of respondents selected one choice and 20% selected the other (Salant and Dillman, 1994).

refuges, only that visitors feel they have a basic knowledge of who manages refuges and why. Compared to other public lands, many visitors feel that refuges provide a unique recreation experience (96%; see Appendix B for visitor comments on "What Makes National Wildlife Refuges Unique?"); however, reasons for why visitors find refuges unique are varied and may not directly correspond to their understanding of the mission of the Refuge System. Most visitors to Malheur NWR had been to at least one other National Wildlife Refuge in the past year (78%), with an average of 6 visits to other refuges during the past 12 months.

### Visiting This Refuge

Most visitors (72%) had only been to Malheur NWR once in the past 12 months, while others had been multiple times (28%). These repeat visitors went to the refuge an average of 3 times during that same 12-month period. Visitors used the refuge during only one season (79%) and during multiple seasons (21%).

Most visitors first learned about the refuge from friends/relatives (59%), refuge printed information (15%), or a recreation club/organization (13%; fig. 2). Key information sources used by visitors to find their way to this refuge include a road atlas/highway map (56%), previous knowledge (55%), or signs on highways (52%; fig. 3).

Few visitors (4%) live in the local area (within 50 miles of the refuge), whereas 96% are nonlocal visitors. For most local visitors, Malheur NWR was the primary purpose or sole destination of trip (80%; table 3). For most nonlocal visitors, the refuge also was the primary purpose or sole destination of trip (50%). Local visitors (n = 10) reported that they traveled an average of 41 miles to get to the refuge, while nonlocal visitors (n = 266) traveled an average of 437 miles. ***It is important to note that summary statistics based on a small sample size (n < 30) may not provide a reliable representation of the population.*** **F**igure 4 shows the residence of visitors travelling to the refuge. About 60% of visitors travelling to Malheur NWR were from Oregon.

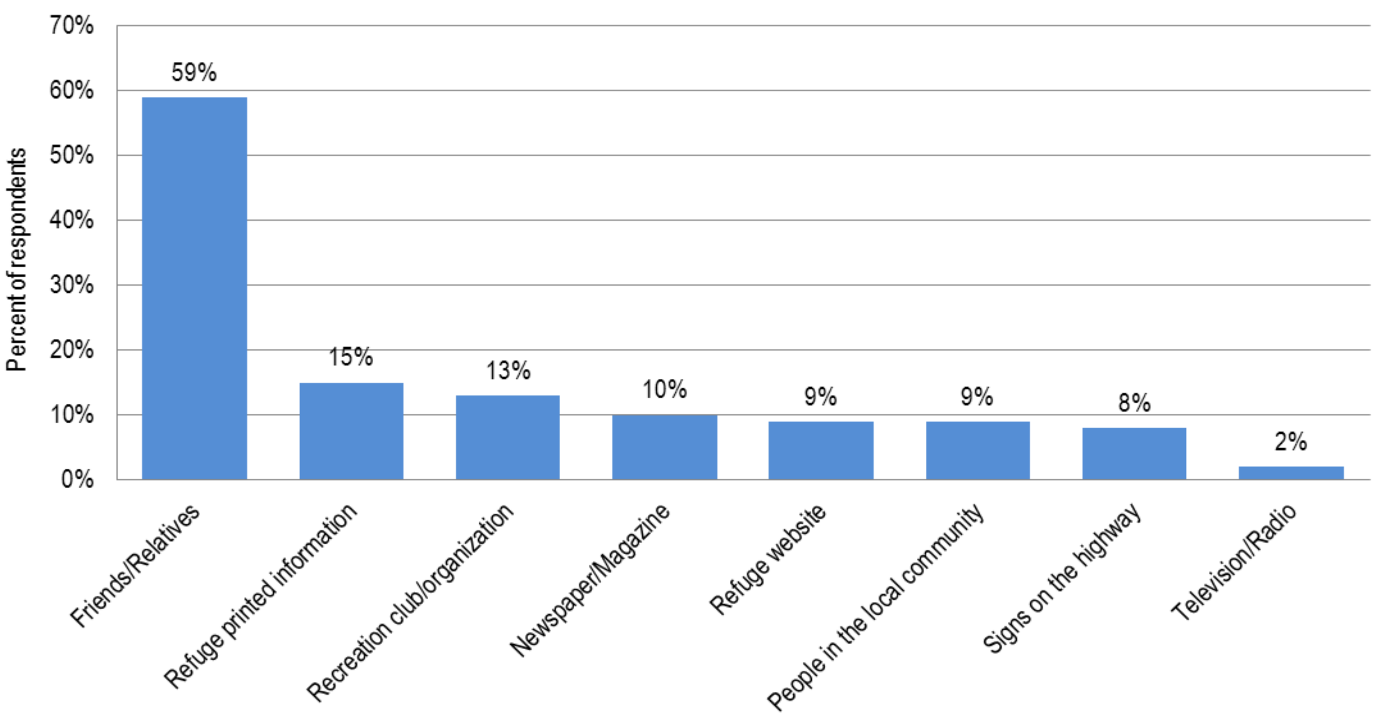



Figure 2. How visitors first learned or heard about Malheur NWR (n = 271).

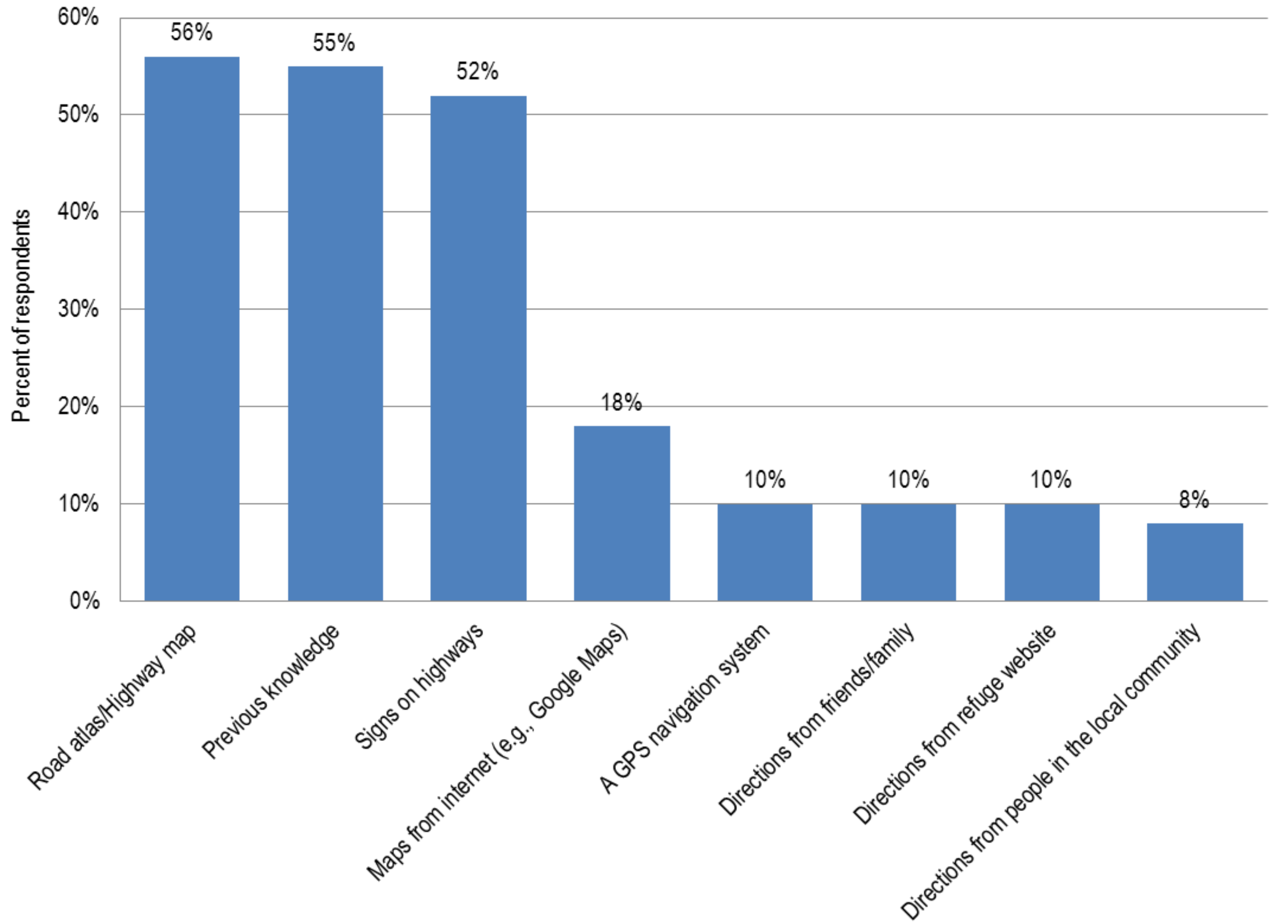
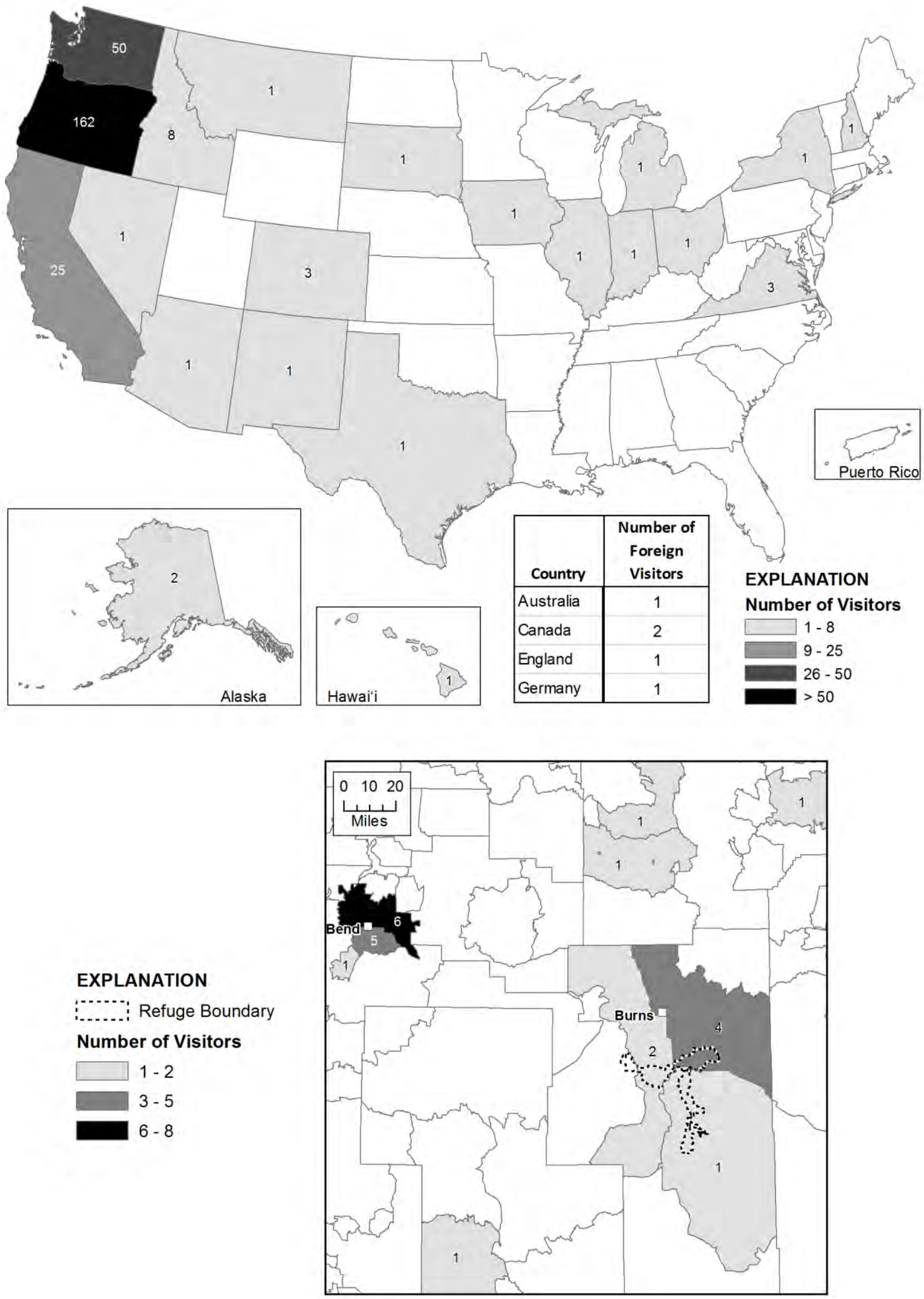



Figure 3. Resources used by visitors to find their way to Malheur NWR during *this* visit (n = 272).

Table 3. Influence of Malheur NWR on visitors' decision to take *this* trip.

| Visitors | Visiting this refuge was... | | |
|---|---|---|---|
| | the primary reason for trip | one of many equally important reasons for trip | an incidental stop |
| Nonlocal | 50% | 44% | 7% |
| Local | 80% | 20% | 0% |
| Total | 51% | 43% | 6% |




| Country | Number of Foreign Visitors |
|---|---|
| Australia | 1 |
| Canada | 2 |
| England | 1 |
| Germany | 1 |

Figure 4. Number of visitors travelling to Malheur NWR by residence. Top map shows residence by state and bottom map shows residence by zip codes near the refuge (n = 276).

Visitors reported that they spent an average of 7 hours at Malheur NWR during one day there (a day visit is assumed to be 8 hours). However, the most frequently reported length of visit during one day was actually 8 hours (76%). The key modes of transportation used by visitors to travel around the refuge were private vehicle (83%) and walking/hiking (42%; fig. 5). Most visitors indicated they were part of a group on their visit to this refuge (74%), travelling primarily with family and friends (table 4).

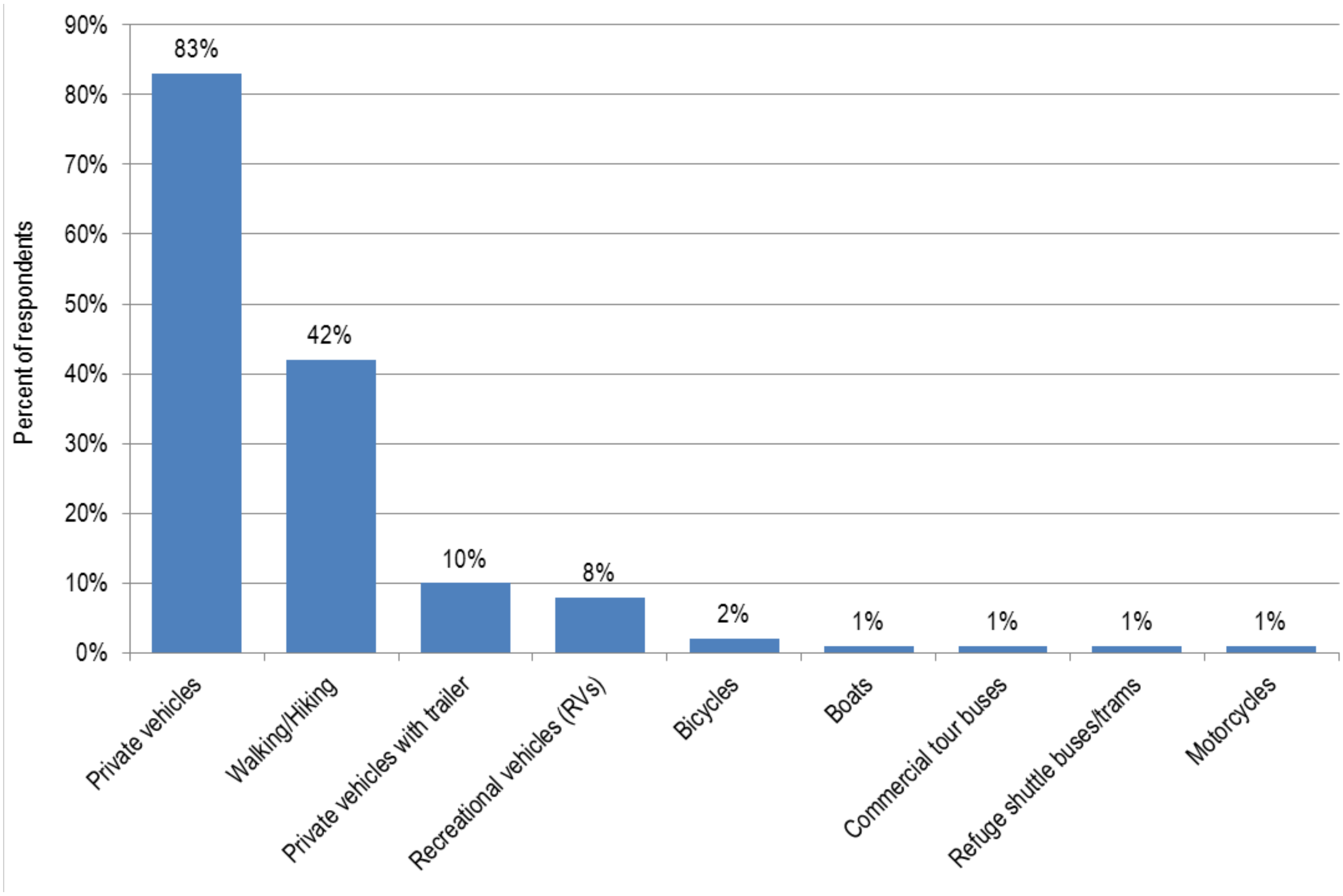



Figure 5. Modes of transportation used by visitors to Malheur NWR during *this* visit (n = 273).

Table 4. Type and size of groups visiting Malheur NWR (for those who indicated they were part of a group, n = 202).

| Group type | Percent (of those traveling in a group) | Average group size | | |
|---|---|---|---|---|
| | | Number of adults | Number of children | Total group size |
| Family/Friends | 85% | 4 | 0 | 4 |
| Commercial tour group | 1% | 10 | 0 | 10 |
| Organized club/School group | 11% | 12 | 1 | 13 |
| Other group type | 2% | 11 | 0 | 11 |

Visitors participated in a variety of refuge activities during the past 12 months (fig. 6); the top three activities reported were bird watching (93%), wildlife observation (87%), auto tour route/driving (61%) and photography (60%). The primary reasons for their most recent visit included bird watching (68%), wildlife observation (11%), and fishing (5%; fig. 7). The visitor center was used by 93% of visitors, mostly to visit the gift shop/bookstore (87%), stop to use the facilities (84%), and ask information of staff/volunteers (81%; fig. 8).

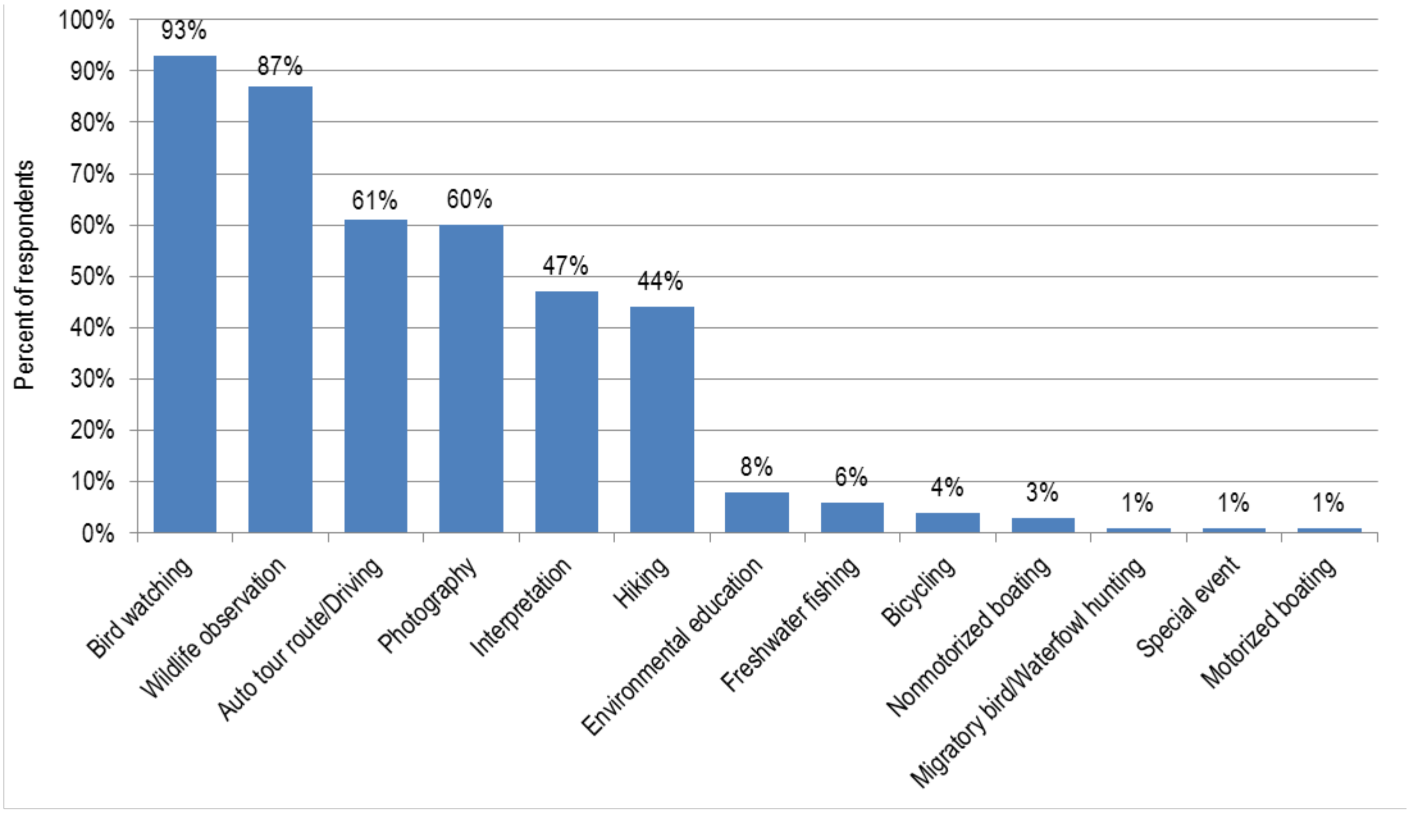



Figure 6. Activities in which visitors participated during the past 12 months at Malheur NWR (n = 271). See Appendix B for a listing of “other” activities.

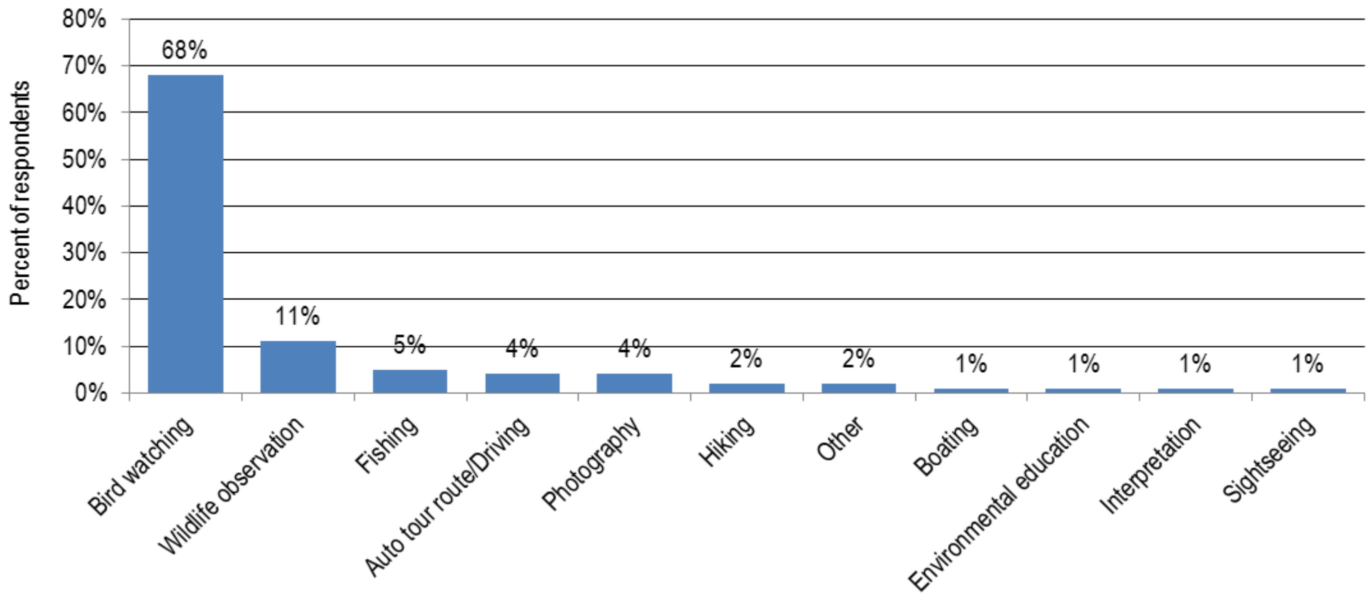



Figure 7. The primary activity in which visitors participated during *this* visit to Malheur NWR (n = 260). See Appendix B for a listing of "other" activities.

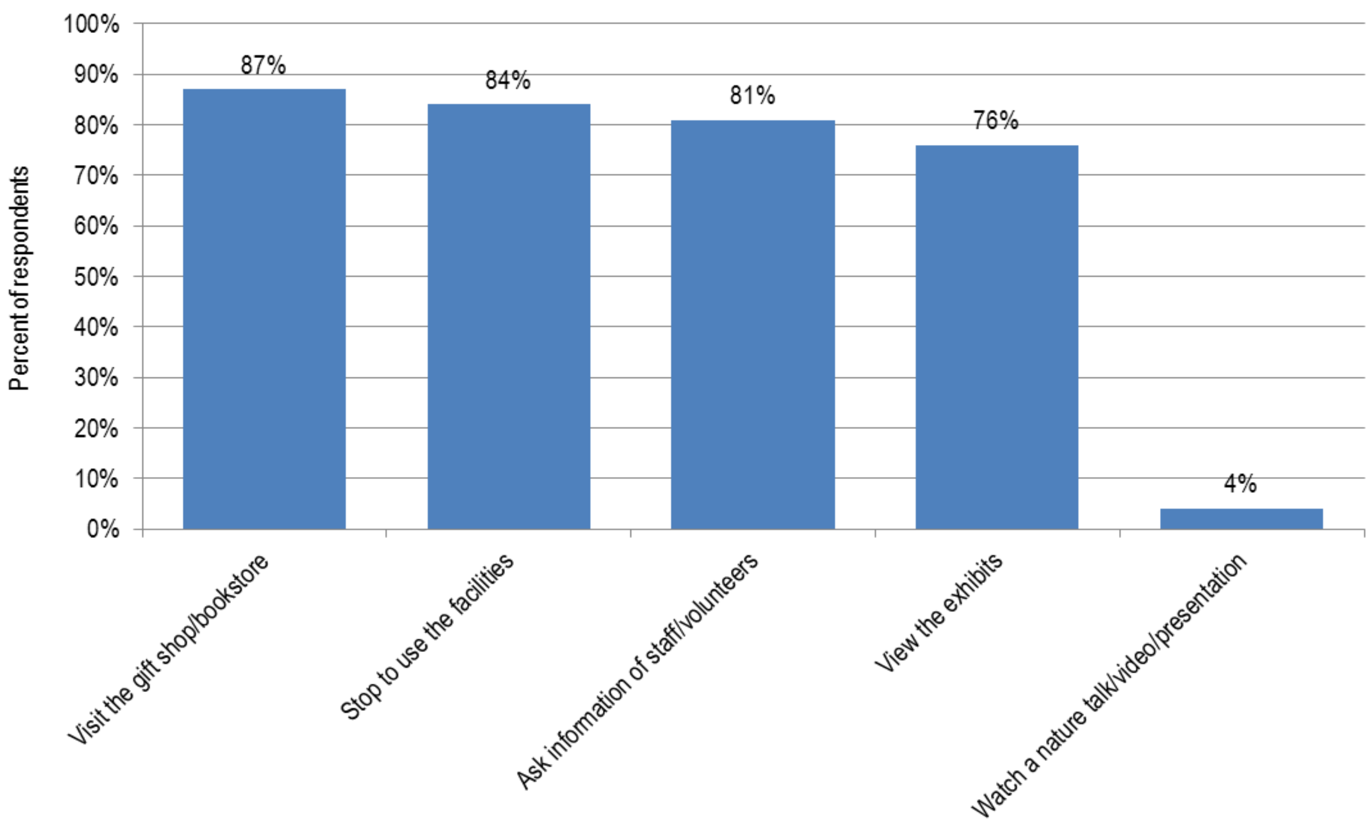



Figure 8. Use of the visitor center at Malheur NWR (for those visitors who indicated they used the visitor center, n = 253).

## Visitor Characteristics

Nearly all (98%) visitors to Malheur NWR indicated that they were citizens or permanent residents of the United States. Visitors were a mix of 53% male with an average age of 58 years and 47% female with an average age of 59 years. Visitors, on average, reported they had 17 years of formal education (graduate or professional school). The median level of income was $75,000–$99,000. See Appendix A for more demographic information. In comparison, the 2006 National Survey of Fishing, Hunting and Wildlife-Associated Recreation found that participants in wildlife watching and hunting on public land were 55% male and 45% female with an average age of 46 years, an average level of education of 14 years (associate degree or two years of college), and a median income of $50,000–$74,999 (Harris, 2011, personal communication). Compared to the U.S. population, these 2006 survey participants are more likely to be male, older, and have higher education and income levels (U.S. Department of Interior and U.S. Department of Commerce, 2007).

## Visitor Spending in Local Communities

*Tourists usually buy a wide range of goods and services while visiting an area. Major expenditure categories include lodging, food, supplies, and gasoline. Spending associated with refuge visitation can generate considerable economic benefits for the local communities near a refuge. For example, more than 34.8 million visits were made to National Wildlife Refuges in fiscal year 2006; these visits generated $1.7 billion in sales, almost 27,000 jobs, and $542.8 million in employment income in regional economies (Carver and Caudill, 2007). Information on the amount and types of visitor expenditures can illustrate the economic importance of refuge visitor activities to local communities. Visitor expenditure information also can be used to analyze the economic impact of proposed refuge management alternatives.*

A region (and its economy) is typically defined as all counties within 50 miles of a travel destination (Stynes, 2008). Visitors that live within the local 50-mile area of a refuge typically have different spending patterns than those that travel from longer distances. Approximately 4% of visitors to Malheur NWR indicated that they live within the local area. Nonlocal visitors (96%) stayed in the local area, on average, for 3 days. Table 5 shows summary statistics for local and nonlocal visitor expenditures, with expenditures reported on a per person per day basis. ***It is important to note that summary statistics based on a small sample size (n < 30) may not provide a reliable representation of that population.*** Nonlocal visitors spent an average of $65 per person per day and local visitors spent an average of $60 per person per day.

**Table 5.** Total visitor expenditures for Malheur NWR expressed in dollars per person per day.

| Visitors | n[1] | Median | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Nonlocal | 240 | $52 | $65 | $51 | $0 | $375 |
| Local | 9 | $44 | $60 | $53 | $8 | $155 |

[1]n = number of visitors who answered both locality *and* expenditure questions.

## Visitor Opinions about This Refuge

*National Wildlife Refuges provide visitors with a variety of services, facilities, and wildlife-dependent recreational opportunities. Understanding visitors' perceptions of their refuge experience is a key component of the NWRS mission as it pertains to providing high-quality wildlife-dependent recreational opportunities. Having a baseline understanding of visitor experience can inform management decisions to better balance visitors' expectations with the NWRS mission. Recent studies in outdoor recreation have included an emphasis on declining participation in traditional activities such as hunting and an increasing need to connect the next generation to nature and wildlife. These factors highlight the importance of current refuge visitors as a key constituency in wildlife conservation. A better understanding is increasingly needed to better manage the visitor experience and to address the challenges of the future.*

Visitors' overall satisfaction with the services, facilities, and recreational opportunities provided at Malheur NWR were as follows (fig. 9):

- 97% were satisfied with the recreational activities and opportunities,
- 94% were satisfied with the information and education about the refuge and its resources,
- 94% were satisfied with the services provided by employees or volunteers, and
- 92% were satisfied with the refuge's job of conserving fish, wildlife and their habitats.

Though 14% of visitors indicated that they paid a fee to enter the refuge, Malheur NWR does not charge an entrance fee.

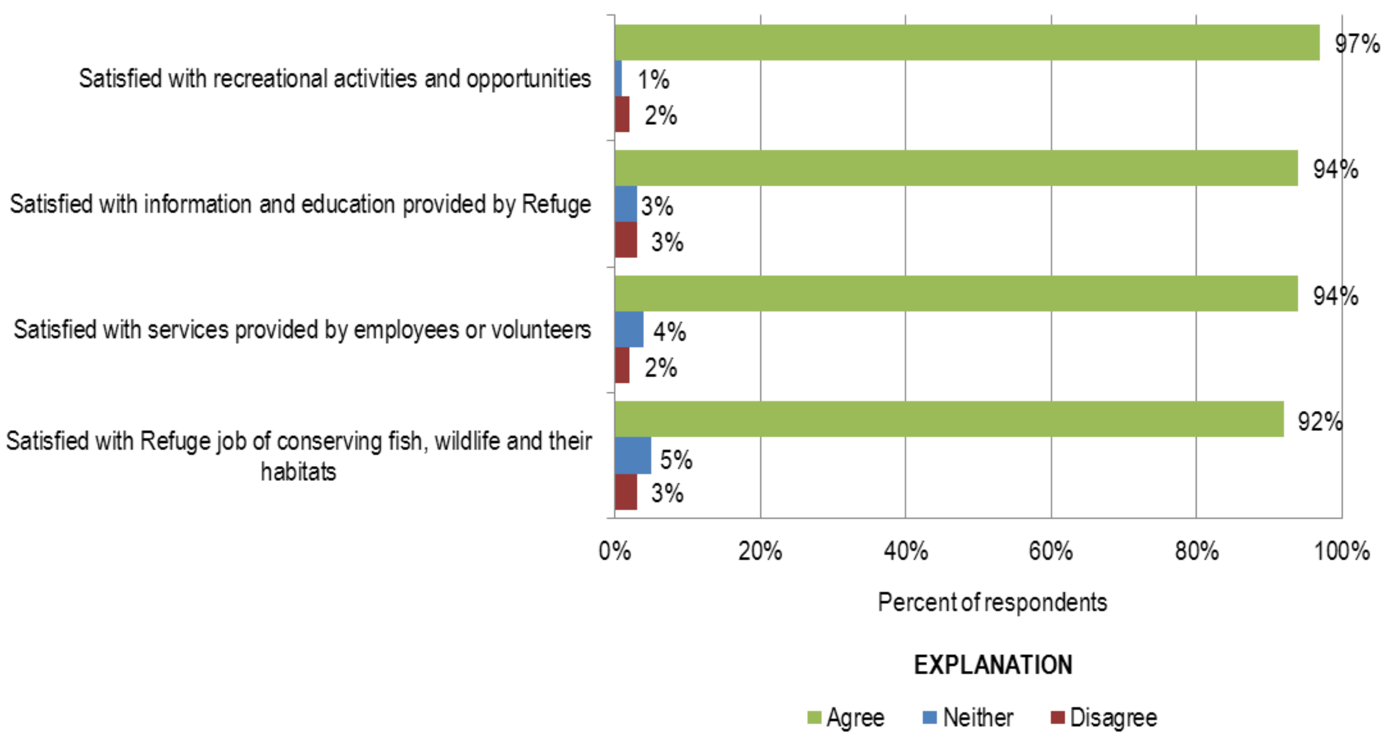



Figure 9. Overall satisfaction with Malheur NWR during *this* visit (n ≥ 269).

## Importance/Satisfaction Ratings

*Comparing the importance and satisfaction ratings for visitor services provided by refuges can help to identify how well the services are meeting visitor expectations. The importance-performance framework presented in this section is a tool that includes the importance of an attribute to visitors in relation to their satisfaction with that attribute. Drawn from marketing research, this tool has been applied to outdoor recreation and visitation settings (Martilla and James, 1977; Tarrant and Smith, 2002). Results for the attributes of interest are segmented into one of four quadrants (modified for this national study):*

- Keep Up the Good Work = high importance/high satisfaction;
- Concentrate Here = high importance/low satisfaction;
- Low Priority = low importance/low satisfaction; and
- Look Closer = low importance/high satisfaction.

*Graphically plotting visitors' importance and satisfaction ratings for different services, facilities, and recreational opportunities provides a simple and intuitive visualization of these survey measures. However, this tool is not without its drawbacks. One is the potential for variation among visitors regarding their expectations and levels of importance (Vaske et al., 1996; Bruyere et al., 2002; Wade and Eagles, 2003), and certain services or recreational opportunities may be more or less important for different segments of the visitor population. For example, hunters may place more importance on hunting opportunities and amenities such as blinds, while school group leaders may place more importance on educational/informational displays than would other visitors. This potential for highly varied importance ratings needs to be considered when viewing the average results of this analysis of visitors to Malheur NWR. This consideration is especially important when reviewing the attributes that fall into the "Look Closer" quadrant. In some cases, these attributes may represent specialized recreational activities in which a small subset of visitors participate (for example, hunting, kayaking) or facilities and services that only some visitors experience (for example, exhibits about the refuge). For these visitors, the average importance of (and potentially the satisfaction with) the attribute may be much higher than it would be for the overall population of visitors.*

Figures 10-12 depict importance-satisfaction results for refuge services and facilities, recreational opportunities, and transportation-related features at Malheur NWR, respectively. All refuge services and facilities fell in the "Keep Up the Good Work" quadrant (fig. 10). Many refuge recreational opportunities fell in the "Keep Up the Good Work" quadrant except hunting, fishing, bicycling, and volunteering opportunities, which fell into the "Look Closer" quadrant (fig. 11). The average importance of X activities in the "Look Closer" quadrant may be higher among visitors who have participated in these activities during the past 12 months; however, there were not enough individuals in the sample to evaluate the responses of such participants. Nearly all transportation-related features fell in the "Keep Up the Good Work" quadrant except condition of parking areas, which fell into the "Look Closer" quadrant (fig. 12).

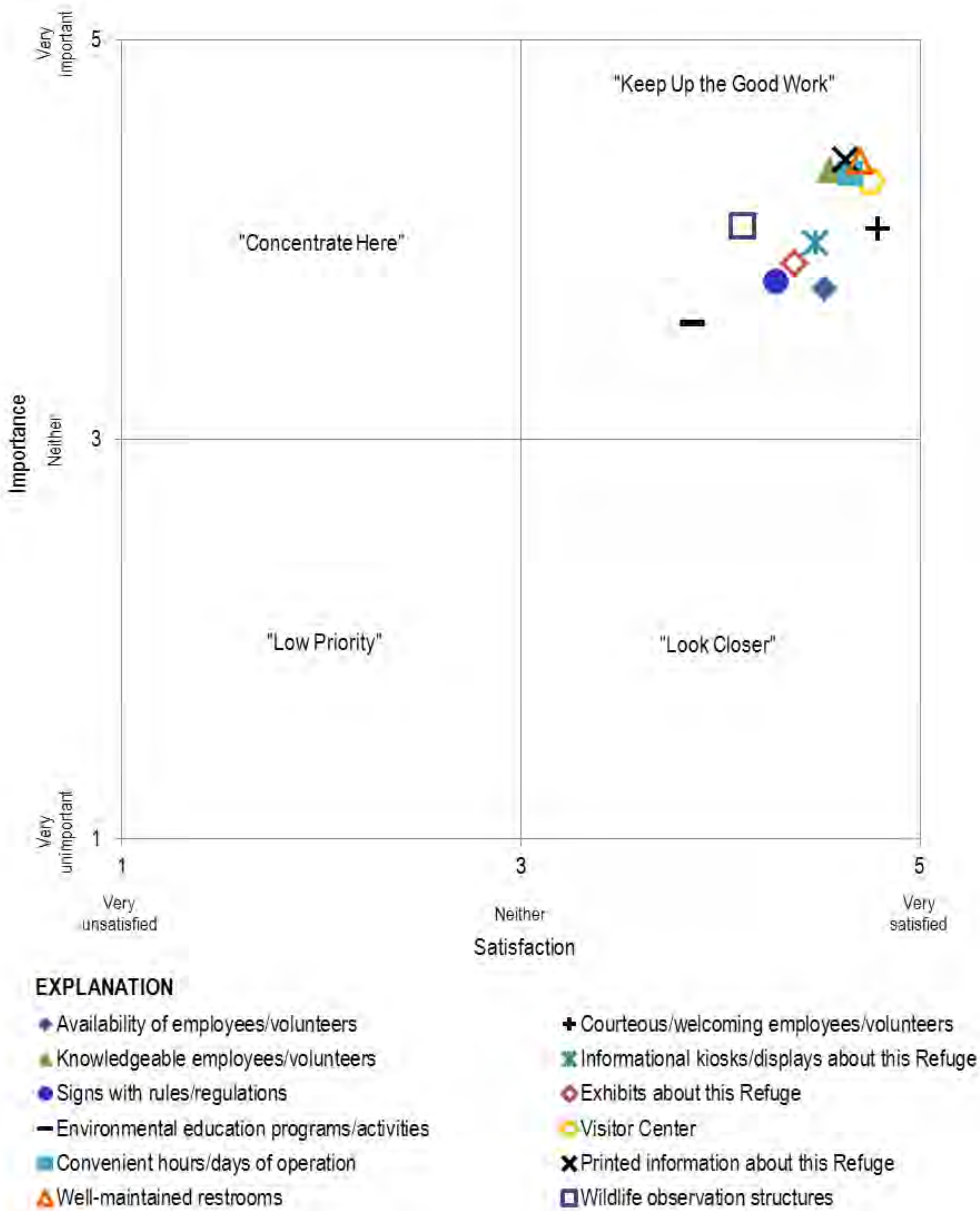



Figure 10. Importance-satisfaction ratings of services and facilities provided at Malheur NWR.

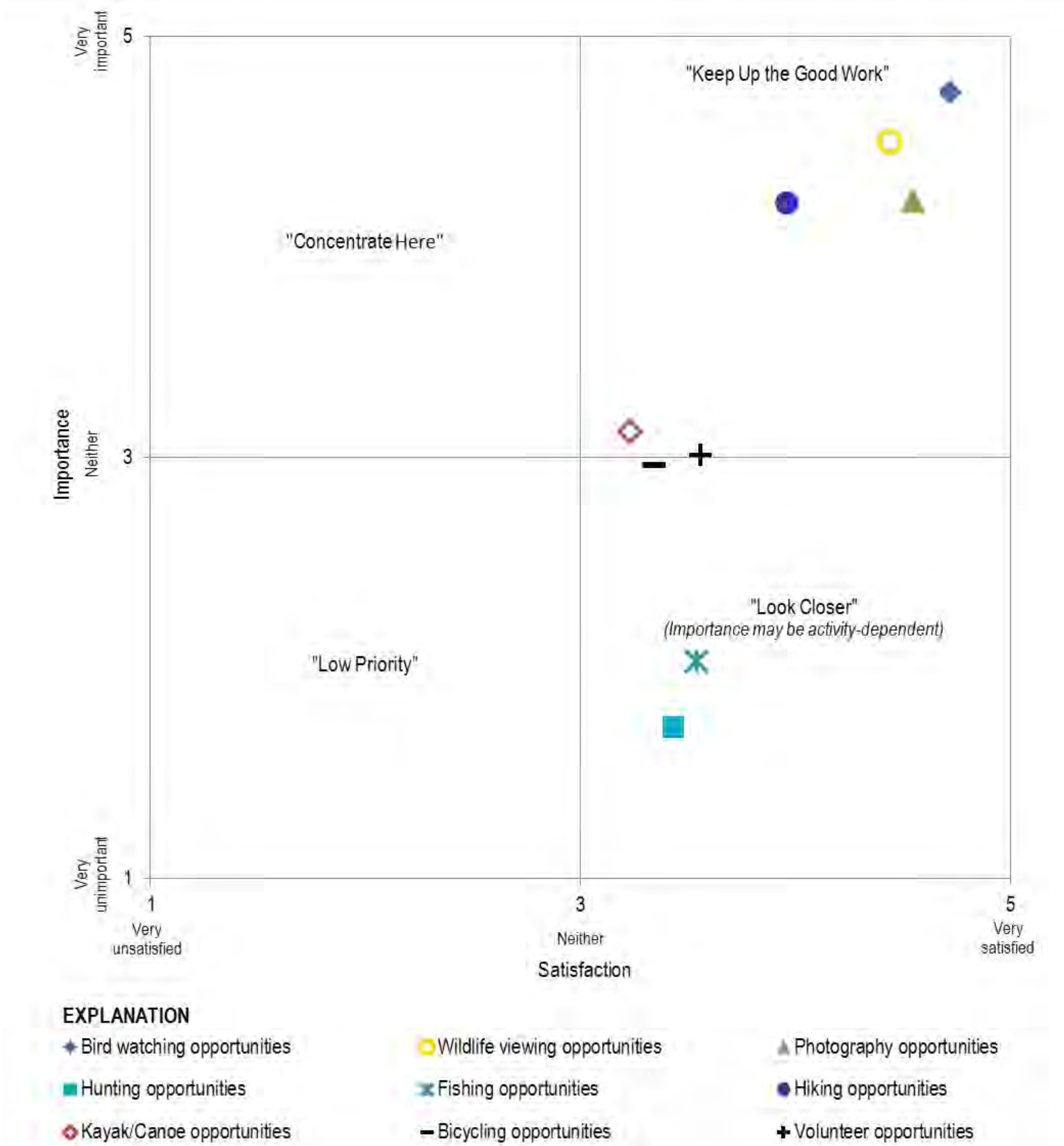



Figure 11. Importance-satisfaction ratings of recreational opportunities provided at Malheur NWR.

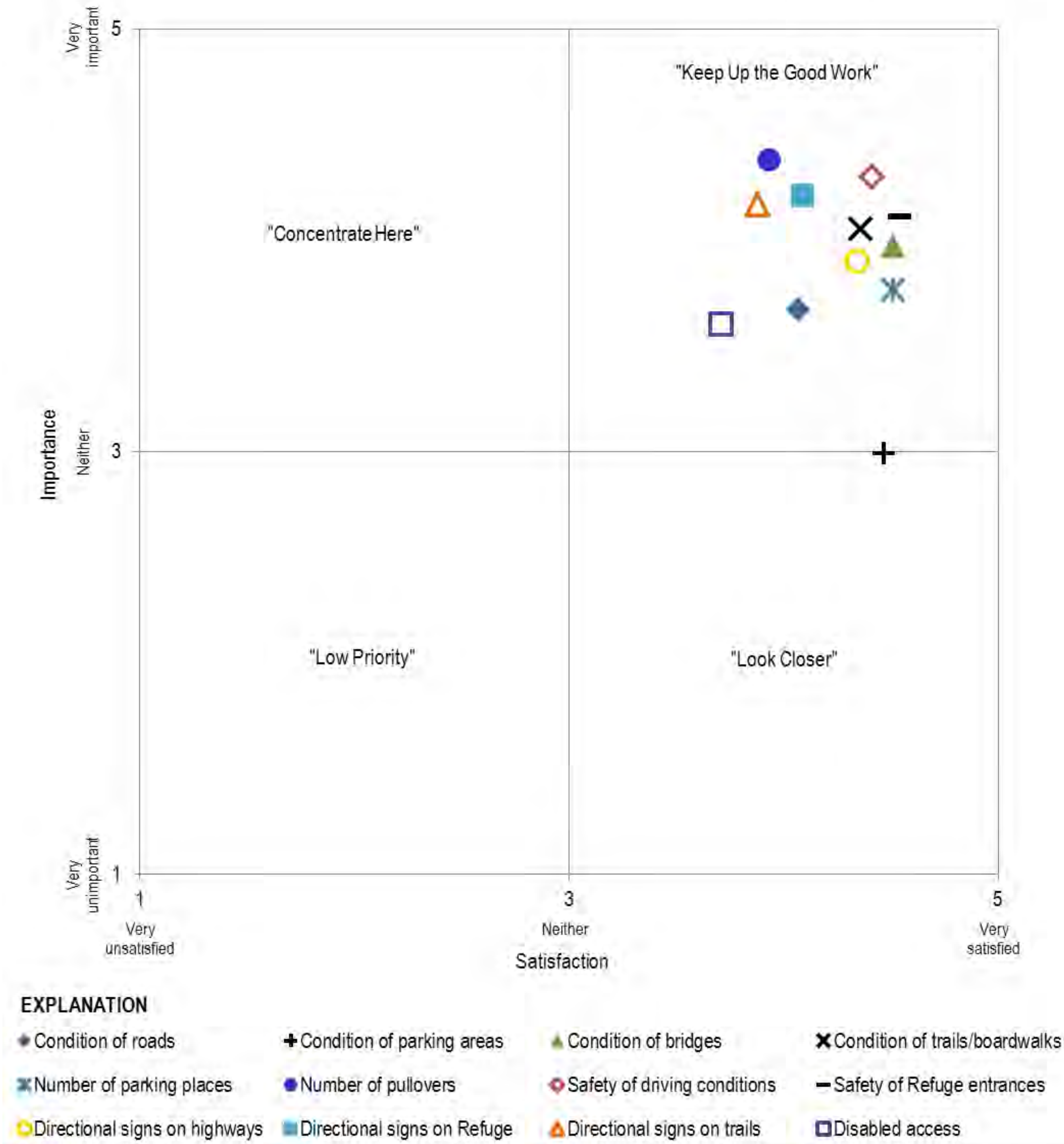



Figure 12. Importance-satisfaction ratings of transportation-related features at Malheur NWR.

## Visitor Opinions about National Wildlife Refuge System Topics

*One goal of this National Visitor Survey was to identify visitor trends across the NWRS to more effectively manage refuges and provide visitor services. Two important issues to the NWRS are transportation on refuges and communicating with visitors about climate change. The results to these questions will be most meaningful when they are evaluated in aggregate (data from all participating refuges together). However, basic results for Malheur NWR are reported here.*

### Alternative Transportation and the National Wildlife Refuge System

*Visitors use a variety of transportation means to access and enjoy National Wildlife Refuges. While many visitors arrive at the refuge in a private vehicle, alternatives such as buses, trams, watercraft, and bicycles are increasingly becoming a part of the visitor experience. Previous research has identified a growing need for transportation alternatives within the refuge system (Krechmer et al., 2001); however, less is known about how visitors perceive and use these new transportation options. An understanding of visitors' likelihood of using certain alternative transportation options can help in future planning efforts. Visitors were asked their likelihood of using alternative transportation options at National Wildlife Refuges in the future.*

Of the seven NWRS-wide alternative transportation options listed on the survey, the majority of Malheur NWR visitors were likely to use the following options at National Wildlife Refuges in the future (fig. 13):

- an offsite parking lot that provides trail access;
- a boat that goes to different points on Refuge waterways; and
- a bike share program.

The majority of visitors were *not* likely to use a bus/tram that takes passengers to different points on National Wildlife Refuges in the future (fig. 13).

When asked about using alternative transportation at Malheur NWR specifically, 38% of visitors indicated they were unsure whether it would enhance their experience; however, some visitors thought alternative transportation would enhance their experience (25%) and others thought it would not (37%).

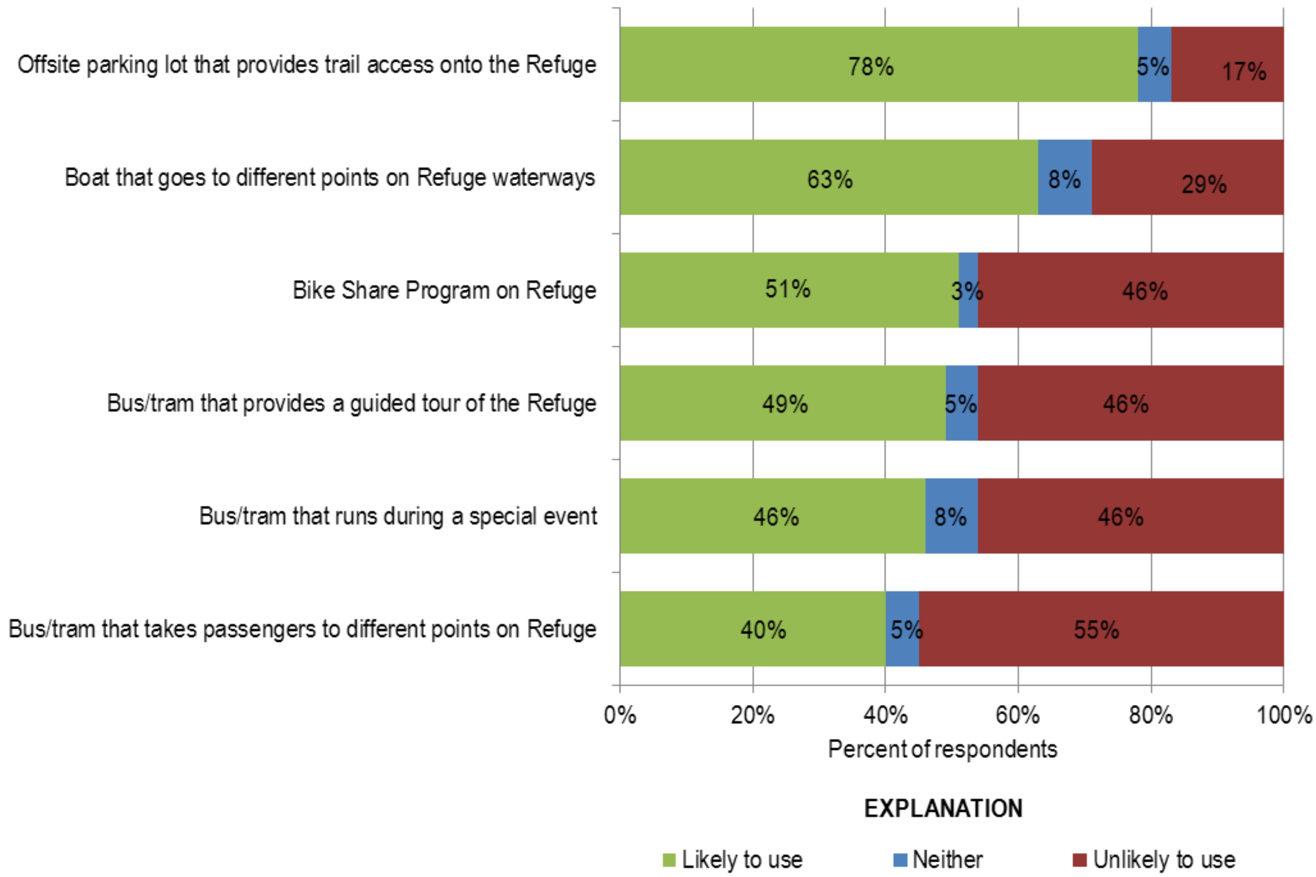



Figure 13. Visitors' likelihood of using alternative transportation options at National Wildlife Refuges in the future (n ≥ 261).

## Climate Change and the National Wildlife Refuge System

*Climate change represents a growing concern for the management of National Wildlife Refuges. FWS' climate change strategy, titled "Rising to the Urgent Challenge," establishes a basic framework for the agency to work within a larger conservation community to help ensure wildlife, plant, and habitat sustainability (U.S. Fish and Wildlife Service, 2010). To support the guiding principles of the strategy, refuges will be exploring options for more effective engagement with visitors on this topic. The National Visitor Survey collected information about visitors' level of personal involvement in climate change related to fish, wildlife and their habitats and visitors' beliefs regarding this topic. Items draw from the "Six Americas" framework for understanding public sentiment toward climate change (Leiserowitz, Maibach, and Roser-Renouf, 2008) and from literature on climate change message frames (e.g., Nisbet, 2009). Such information provides a baseline for understanding visitor perceptions of climate change in the context of fish and wildlife conservation that can further inform related communication and outreach strategies.*

Factors that influence how individuals think about climate change include their basic beliefs, levels of involvement, policy preferences, and behaviors related to this topic. Results presented below provide baseline information on visitors' levels of involvement with the topic of climate change related to fish, wildlife and their habitats. The majority of visitors to Malheur NWR agree with the following statements (fig. 14):

- "I am personally concerned about the effects of climate change on fish, wildlife and habitats;"
- "I stay well-informed about the effects of climate change;"
- "I take actions to alleviate the effects of climate change;" and
- "My experience would be enhanced if the Refuge provides information about how I can help address climate change effects."

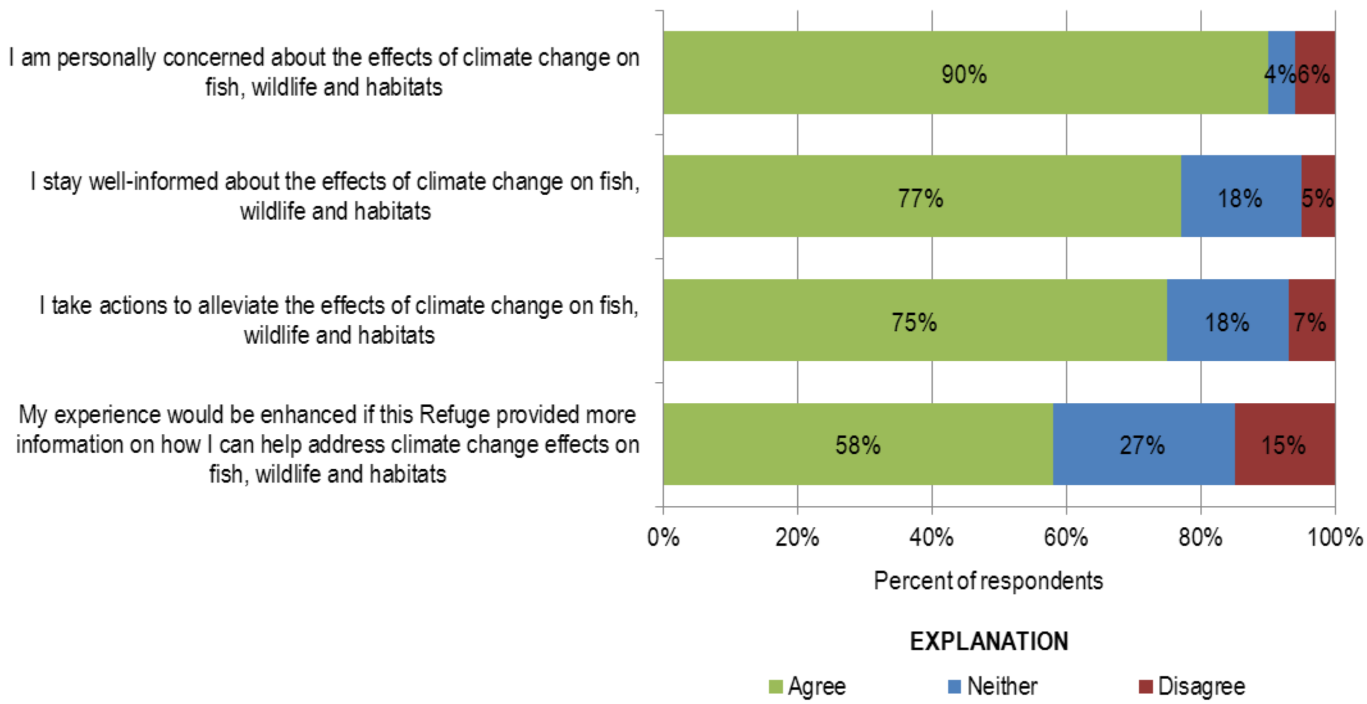



Figure 14. Visitors' personal involvement with climate change related to fish, wildlife and their habitats (n ≥ 264).

These results are most useful when coupled with responses to belief statements about the effects of climate change on fish, wildlife and their habitats, because such beliefs may be used to develop message frames (or ways to communicate) about climate change with a broad coalition of visitors. Framing science-based findings will not alter the overall message, but rather place the issue in a context in which different audience groupings can relate. The need to mitigate impacts of climate change on Refuges could be framed as a quality-of-life issue (for example, preserving the ability to enjoy fish, wildlife, plants, and their habitat) or an economic issue (for example, maintaining tourist revenues, supporting economic growth through new jobs/technology).

For Malheur NWR, the majority of visitors believe the following regarding climate change related to fish, wildlife and their habitats (fig. 15):

- "Future generations will benefit if we address climate change effects;"
- "We can improve our quality of life if we address the effects of climate change;" and
- "It is important to consider the economic benefits to local communities when addressing climate change effects."

The majority of visitors do *not* believe:

- "There has been too much emphasis on the catastrophic effects of climate change;" or
- "There is too much scientific uncertainty to adequately understand climate change effects."

Such information suggests that certain beliefs resonate with a greater number of visitors than other beliefs do. This information is important to note because the majority of visitors (58%) indicated that their experience would be enhanced if Malheur NWR provided information about how they could help address the effects of climate change on fish, wildlife, and their habitats (fig. 14), and framing the information in a way that resonates most with visitors may result in a more engaged public who support strategies aimed at alleviating climate change pressures. Data will be analyzed further at the aggregate, or national level, to inform the development of a comprehensive communication strategy about climate change.

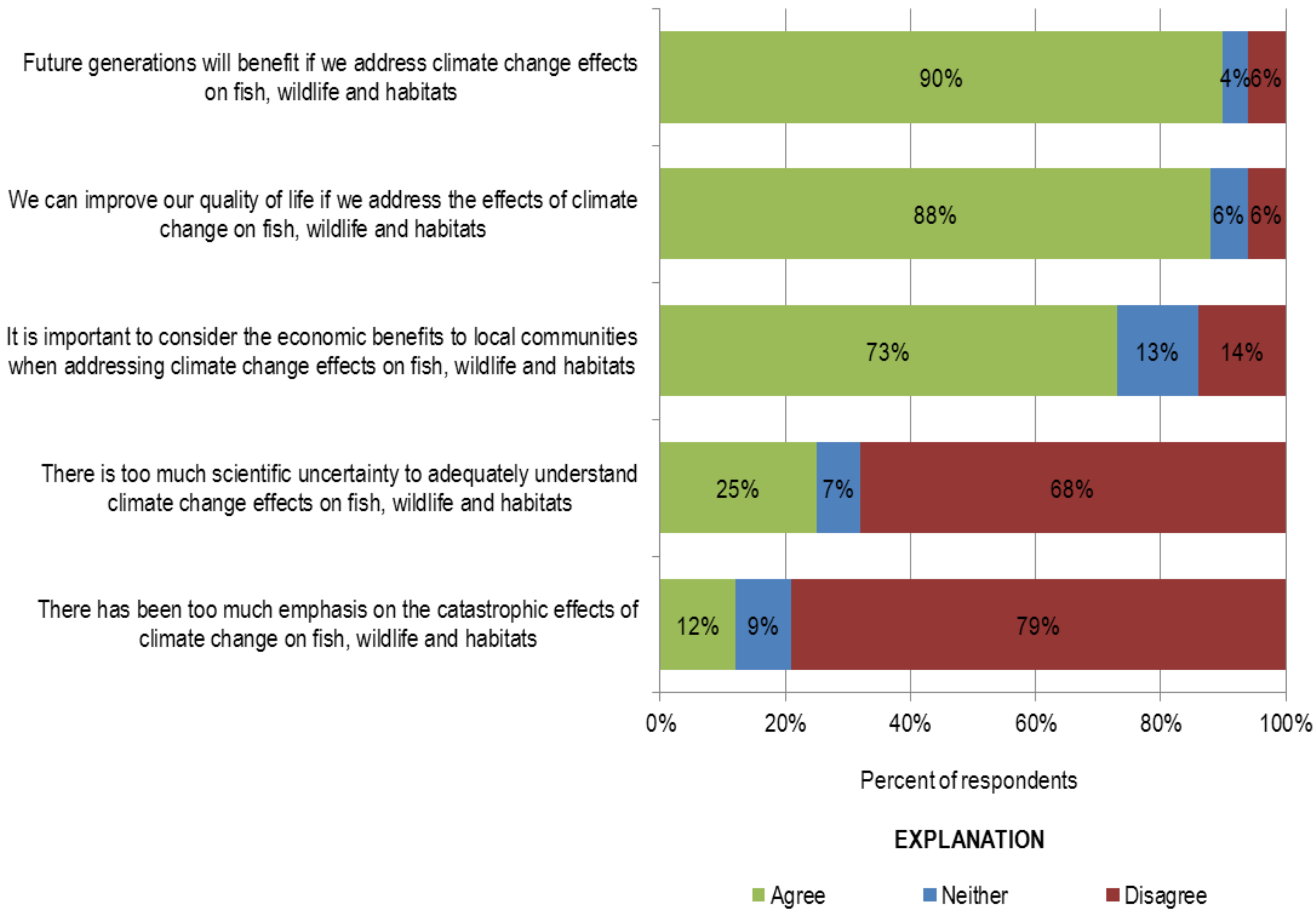



Figure 15. Visitors' beliefs about the effects of climate change on fish, wildlife and their habitats (n ≥ 264).

## Conclusion

These individual refuge results provide a summary of trip characteristics and experiences of a sample of visitors to Malheur NWR during 2010–2011. These data can be used to inform decision-making efforts related to the refuge, such as Comprehensive Conservation Plan implementation, visitor services management, and transportation planning and management. For example, when modifying (either minimizing or enhancing) visitor facilities, services, or recreational opportunities, a solid understanding of visitors' trip and activity characteristics, their satisfaction with existing offerings, and opinions regarding refuge fees is helpful. This information can help to gauge demand for refuge opportunities and inform both implementation and communication strategies. Similarly, an awareness of visitors' satisfaction ratings with refuge offerings can help determine if any potential areas of concern need to be investigated further. As another example of the utility of these results, community relations may be improved or bolstered through an understanding of the value of the refuge to visitors, whether that value is attributed to an appreciation of the refuge's uniqueness, enjoyment of its recreational opportunities, or spending contributions of nonlocal visitors to the local economy. Such data about visitors and their experiences, in conjunction with an understanding of biophysical data on the refuge, can ensure that management decisions are consistent with the NWRS mission while fostering a continued public interest in these special places.

Individual refuge results will be available for downloading as they are completed during fall/winter 2011 at *http://pubs.usgs.gov/ds/643/*. Aggregated data from all participating refuges will be used to inform national-level NWRS goals, such as Goal 4: Welcome and Orient Visitors; Goal 5: Provide Quality Wildlife Dependent Recreation and Education Programs; and Goal 8: Provide Infrastructure and Equipment Adequate to Support Mission. The national-level report will be available spring 2012. PASA researchers are available at any time at *national_visitor_survey@usgs.gov* or 970.226.9205 to discuss the site-specific surveying effort at this refuge or the national-level results.

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# National Wildlife Refuge Visitor Survey

## PLEASE READ THIS FIRST:

Thank you for visiting a National Wildlife Refuge and for agreeing to participate in this study! We hope that you had an enjoyable experience. The U.S. Fish and Wildlife Service and the U.S. Geological Survey would like to learn more about National Wildlife Refuge visitors in order to improve the management of the area and enhance visitor opportunities.

**If you have recently visited more than one National Wildlife Refuge or made more than one visit to the same Refuge, *please respond regarding only the Refuge and the visit when you were asked to participate in this survey*. Any question that uses the phrase "this Refuge" refers to the Refuge and visit when you were contacted.**

## SECTION 1. Your visit to this Refuge

1. Including your most recent visit, which activities have you participated in during the past 12 months at this Refuge? (*Please mark **all that apply**.*)

- 0% Big game hunting
- 0% Upland/Small-game hunting
- 1% Migratory bird/Waterfowl hunting
- 87% Wildlife observation
- 93% Bird watching
- 6% Freshwater fishing
- 0% Saltwater fishing
- 60% Photography
- 44% Hiking
- 4% Bicycling
- 61% Auto tour route/Driving
- 0% Motorized boating
- 3% Nonmotorized boating (including canoes/kayaks)
- 47% Interpretation (for example, exhibits, kiosks, videos)
- 8% Environmental education (for example, classrooms or labs, tours)
- 1% Special event (*please specify*) See Appendix B
- 4% Other (*please specify*) See Appendix B
- 1% Other (*please specify*) See Appendix B

2. Which of the activities above was the ***primary*** purpose of your visit to this Refuge?

(*Please write **only one activity** on the line.*) See report for categorized results; see Appendix B for miscellaneous responses

3. Did you go to a Visitor Center at this Refuge?

- 7% No
- 93% Yes → If yes, what did you do there? (*Please mark **all that apply**.*)
  - 87% Visit the gift shop or bookstore
  - 76% View the exhibits
  - 81% Ask information of staff/volunteers
  - 4% Watch a nature talk/video/presentation
  - 84% Stopped to use the facilities (for example, get water, use restroom)
  - 26% Other (*please specify*) See Appendix B

4. Which of the following best describes your visit to this Refuge? (*Please mark **only one**.*)

| Nonlocal | Local | Total | |
|---|---|---|---|
| 50% | 80% | 51% | It was the primary purpose or sole destination of my trip. |
| 44% | 20% | 43% | It was one of many equally important reasons or destinations for my trip. |
| 7% | 0% | 6% | It was just an incidental or spur-of-the-moment stop on a trip taken for other purposes or to other destinations. |

5. Approximately how many **miles** did you travel to get to this Refuge?

**Nonlocal** 437 number of miles

**Local** 41 number of miles

6. How much time did you spend at this Refuge on your visit?

See Report for Results

7. Were you part of a group on your visit to this Refuge?

26% No (*skip to question #9*)

74% Yes → What **type of group** were you with on your visit? (*Please mark **only one**.*)

- 85% Family and/or friends
- 11% Organized club or school group
- 1% Commercial tour group
- 2% Other (*please specify*) See Appendix B

8. How many people were in your group, including yourself? (*Please answer each category.*)

5 number 18 years and over    0 number 17 years and under

9. How did you **first learn or hear about** this Refuge? (*Please mark **all that apply**.*)

- 59% Friends or relatives
- 8% Signs on highway
- 13% Recreation club or organization
- 9% People in the local community
- 15% Refuge printed information (brochure, map)
- 9% Refuge website
- 3% Other website (*please specify*) See Appendix B
- 2% Television or radio
- 10% Newspaper or magazine
- 20% Other (*please specify*) See Appendix B

10. During which seasons have you visited this Refuge in the last 12 months? (*Please mark **all that apply**.*)

- 58% Spring (March-May)
- 25% Summer (June-August)
- 43% Fall (September-November)
- 0% Winter (December-February)

11. How many times have you visited…

…this Refuge (including this visit) in the last 12 months? 2 number of visits

…other National Wildlife Refuges in the last 12 months? 5 number of visits

## SECTION 2. Transportation and access at this Refuge

1. What **forms of transportation** did you use on your visit to this Refuge? (*Please mark **all that apply**.*)

| | | |
|---|---|---|
| 83% Private vehicle without a trailer | 1% Refuge shuttle bus or tram | 2% Bicycle |
| 10% Private vehicle with a trailer (for boat, camper or other) | 0% Motorcycle | 42% Walk/Hike |
| | 0% ATV or off-road vehicle | 3% Other (*please specify below*) See Appendix B |
| 1% Commercial tour bus | 1% Boat | |
| 8% Recreational vehicle (RV) | 0% Wheelchair or other mobility aid | |

2. Which of the following did you use to find your way to this Refuge? (*Please mark **all that apply**.*)

| | |
|---|---|
| 52% Signs on highways | 10% Directions from Refuge website |
| 10% A GPS navigation system | 8% Directions from people in community near this Refuge |
| 56% A road atlas or highway map | 10% Directions from friends or family |
| 18% Maps from the Internet (for example, MapQuest or Google Maps) | 55% Previous knowledge/I have been to this Refuge before |
| | 5% Other (*please specify*) See Appendix B |

3. Below are different alternative transportation options that could be offered at some National Wildlife Refuges in the future. Considering the different Refuges you may have visited, please tell us **how likely you would be to use each transportation option**. (*Please circle one number for each statement.*)

| How likely would you be to use… | Very Unlikely | Somewhat Unlikely | Neither | Somewhat Likely | Very Likely |
|---|---|---|---|---|---|
| …a bus or tram that takes passengers to different points on the Refuge (such as the Visitor Center)? | 34% | 21% | 5% | 28% | 12% |
| …a bike that was offered through a Bike Share Program for use while on the Refuge? | 33% | 12% | 3% | 31% | 20% |
| …a bus or tram that provides a guided tour of the Refuge with information about the Refuge and its resources? | 30% | 15% | 5% | 35% | 15% |
| …a boat that goes to different points on Refuge waterways? | 19% | 9% | 8% | 41% | 22% |
| …a bus or tram that runs during a special event (such as an evening tour of wildlife or weekend festival)? | 28% | 18% | 8% | 31% | 15% |
| …an offsite parking lot that provides trail access for walking/hiking onto the Refuge? | 10% | 6% | 5% | 35% | 44% |
| …some other alternative transportation option? (*please specify*) See Appendix B | 17% | 9% | 0% | 30% | 43% |

4. If alternative transportation were offered at *this* Refuge, would it enhance your experience?

25% Yes 37% No 38% Not Sure

5. For each of the following transportation-related features, first, **rate how important** each feature is to you when visiting this Refuge; then **rate how satisfied** you are with the way this Refuge is managing each feature.
*If this Refuge does not offer a specific transportation-related feature, please rate how important it is to you and then circle NA "Not Applicable" under the Satisfaction column.*

| **Importance** *Circle one for each item.* | | | | | | **Satisfaction** *Circle one for each item.* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Very Unimportant | Somewhat Unimportant | Neither | Somewhat Important | Very Important | | Very Unsatisfied | Somewhat Unsatisfied | Neither | Somewhat Satisfied | Very Satisfied | Not Applicable |
| 3% | 16% | 12% | 50% | 19% | Surface conditions of roads | 3% | 14% | 5% | 30% | 48% | NA |
| 15% | 22% | 17% | 40% | 6% | Surface conditions of parking areas | 3% | 0% | 8% | 24% | 65% | NA |
| 3% | 11% | 11% | 36% | 39% | Condition of bridges | 1% | 1% | 10% | 20% | 67% | NA |
| 2% | 7% | 8% | 50% | 33% | Condition of trails and boardwalks | 0% | 3% | 9% | 35% | 52% | NA |
| 5% | 11% | 9% | 54% | 21% | Number of places for parking | 1% | 2% | 7% | 24% | 66% | NA |
| 3% | 2% | 3% | 39% | 53% | Number of places to pull over along Refuge roads | 2% | 15% | 8% | 39% | 36% | NA |
| 2% | 4% | 6% | 39% | 49% | Safety of driving conditions on Refuge roads | 0% | 4% | 8% | 31% | 57% | NA |
| 1% | 9% | 8% | 41% | 41% | Safety of Refuge road entrances/exits | 0% | 1% | 8% | 25% | 66% | NA |
| 6% | 9% | 11% | 39% | 36% | Signs on highways directing you to the Refuge | 1% | 6% | 8% | 29% | 56% | NA |
| 4% | 4% | 4% | 42% | 45% | Signs directing you around the Refuge roads | 2% | 12% | 6% | 37% | 44% | NA |
| 2% | 4% | 12% | 39% | 43% | Signs directing you on trails | 1% | 12% | 18% | 35% | 34% | NA |
| 6% | 9% | 29% | 33% | 23% | Access for people with physical disabilities or who have difficulty walking | 0% | 7% | 42% | 24% | 27% | NA |

6. If you have any comments about transportation-related items at this Refuge, please write them on the lines below.

See Appendix B

## SECTION 3. Your expenses related to your Refuge visit

1. Do you live in the local area (within approximately 50 miles of this Refuge)?

   4% Yes

   96% No → How much time did you spend **in local communities** on this trip?

   4 number of hours OR 3 number of days

2. Please record the amount that **you and other members of your group** with whom you shared expenses (for example, other family members, traveling companions) spent in the local 50-mile area during **your most recent visit** to this Refuge. (*Please enter the amount spent to the nearest dollar in each category below. Enter 0 (zero) if you did not spend any money in a particular category.*)

| Categories | Amount Spent in <u>Local Communities & at this Refuge</u> ***(within 50 miles of this Refuge)*** |
|---|---|
| Motel, bed & breakfast, cabin, etc. | |
| Camping | |
| Restaurants & bars | |
| Groceries | |
| Gasoline and oil | |
| Local transportation (bus, shuttle, rental car, etc.) | See Report for Results |
| Refuge entrance fee | |
| Recreation guide fees (hunting, fishing, wildlife viewing, etc.) | |
| Equipment rental (canoe, bicycle, kayak, etc.) | |
| Sporting good purchases | |
| Souvenirs/clothing and other retail | |
| Other (*please specify*)________________________________ | |

3. Including yourself, how many people in your group shared these trip expenses?

   3 number of people sharing expenses

4. As you know, some of the costs of travel such as gasoline, hotels, and airline tickets often increase. If your total trip costs were to increase, what is the maximum extra amount you would pay and still visit this Refuge? (*Please circle the highest dollar amount.*)

| $0 | $10 | $20 | $35 | $50 | $75 | $100 | $125 | $150 | $200 | $250 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1% | 1% | 5% | 2% | 16% | 5% | 34% | 2% | 7% | 8% | 19% |

5. If you or a member of your group paid a fee or used a pass to enter this Refuge, how appropriate was the fee? (*Please mark **only one**.*)

5% Far too low 18% Too low 77% About right 0% Too high 0% Far too high 86% Did not pay a fee (*skip to Section 4*)

6. Please indicate whether you disagree or agree with the following statement. (*Please mark **only one**.*)

**The value of the recreation opportunities and services I experienced at this Refuge was at least equal to the fee I paid.**

0% Strongly disagree 0% Disagree 5% Neither agree or disagree 36% Agree 59% Strongly agree

## SECTION 4. Your experience at this Refuge

1. Considering your visit to this Refuge, please indicate the extent to which you disagree or agree with each statement. (*Please circle one number for each statement.*)

| | Strongly Disagree | Disagree | Neither | Agree | Strongly Agree | Not Applicable |
|---|---|---|---|---|---|---|
| Overall, I am satisfied with the recreational activities and opportunities provided by this Refuge. | 1% | 1% | 1% | 26% | 71% | NA |
| Overall, I am satisfied with the information and education provided by this Refuge about its resources. | 0% | 3% | 3% | 29% | 65% | NA |
| Overall, I am satisfied with the services provided by employees or volunteers at this Refuge. | 0% | 2% | 4% | 25% | 69% | NA |
| This Refuge does a good job of conserving fish, wildlife and their habitats. | 1% | 2% | 6% | 23% | 68% | NA |

2. For each of the following services, facilities, and activities, first, **rate how important** each item is to you when visiting this Refuge; then, **rate how satisfied** you are with the way this Refuge is managing each item.
*If this Refuge does not offer a specific service, facility, or activity, please rate how important it is to you and then circle NA "Not Applicable" under the Satisfaction column.*

| **Importance** *Circle one for each item.* | | | | | | **Satisfaction** *Circle one for each item.* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Very Unimportant | Somewhat Unimportant | Neither | Somewhat Important | Very Important | **Refuge Services, Facilities, and Activities** | Very Unsatisfied | Somewhat Unsatisfied | Neither | Somewhat Satisfied | Very Satisfied | Not Applicable |
| 5% | 11% | 11% | 47% | 25% | Availability of employees or volunteers | 1% | 4% | 6% | 19% | 70% | NA |
| 5% | 6% | 5% | 44% | 39% | Courteous and welcoming employees or volunteers | 1% | 0% | 4% | 8% | 87% | NA |
| 3% | 4% | 3% | 33% | 56% | Knowledgeable employees or volunteers | 1% | 3% | 4% | 24% | 68% | NA |
| 2% | 4% | 2% | 35% | 56% | Printed information about this Refuge and its resources (for example, maps and brochures) | 1% | 2% | 3% | 23% | 72% | NA |
| 3% | 8% | 7% | 52% | 30% | Informational kiosks/displays about this Refuge and its resources | 0% | 2% | 7% | 31% | 59% | NA |
| 4% | 11% | 13% | 44% | 28% | Signs with rules/regulations for this Refuge | 0% | 2% | 18% | 31% | 50% | NA |
| 3% | 9% | 10% | 53% | 24% | Exhibits about this Refuge and its resources | 0% | 4% | 10% | 29% | 56% | NA |
| 6% | 11% | 24% | 36% | 22% | Environmental education programs or activities | 2% | 2% | 37% | 26% | 33% | NA |
| 3% | 3% | 4% | 43% | 48% | Visitor Center | 0% | 1% | 2% | 18% | 79% | NA |
| 3% | 1% | 5% | 44% | 48% | Convenient hours and days of operation | 0% | 1% | 5% | 22% | 72% | NA |
| 3% | 2% | 3% | 37% | 55% | Well-maintained restrooms | 0% | 1% | 4% | 16% | 78% | NA |
| 3% | 7% | 8% | 44% | 38% | Wildlife observation structures (decks, blinds) | 1% | 7% | 14% | 34% | 43% | NA |
| 2% | 1% | 2% | 11% | 84% | Bird-watching opportunities | 0% | 0% | 2% | 21% | 76% | NA |
| 1% | 2% | 2% | 35% | 60% | Opportunities to observe wildlife other than birds | 0% | 2% | 8% | 34% | 56% | NA |
| 4% | 4% | 6% | 38% | 48% | Opportunities to photograph wildlife and scenery | 1% | 1% | 7% | 26% | 66% | NA |
| 70% | 3% | 15% | 7% | 4% | Hunting opportunities | 4% | 1% | 62% | 14% | 19% | NA |
| 56% | 10% | 17% | 10% | 8% | Fishing opportunities | 2% | 3% | 59% | 13% | 24% | NA |
| 2% | 3% | 7% | 47% | 41% | Trail hiking opportunities | 3% | 8% | 13% | 43% | 33% | NA |
| 18% | 15% | 19% | 36% | 13% | Water trail opportunities for canoeing or kayaking | 5% | 11% | 52% | 20% | 12% | NA |
| 23% | 13% | 21% | 30% | 13% | Bicycling opportunities | 3% | 10% | 53% | 20% | 15% | NA |
| 20% | 10% | 35% | 22% | 14% | Volunteer opportunities | 1% | 3% | 57% | 17% | 22% | NA |

3. If you have any comments about the services, facilities, and activities at this Refuge, please write them on the lines below.

See Appendix B

## SECTION 5. Your opinions regarding National Wildlife Refuges and the resources they conserve

1. Before you were contacted to participate in this survey, were you aware that National Wildlife Refuges…

| | | |
|---|---|---|
| …are managed by the U. S. Fish and Wildlife Service? | 92% Yes | 8% No |
| …have the primary mission of conserving, managing, and restoring fish, wildlife, plants and their habitat? | 95% Yes | 5% No |

2. Compared to other public lands you have visited, do you think Refuges provide a unique recreation experience?

96% Yes 4% No

3. If you answered "Yes" to Question 2, please briefly describe what makes Refuges unique.

See Appendix B

4. There has been a lot of talk about climate change recently. We would like to know what you think about climate change as it relates to fish, wildlife and their habitats. To what extent do you disagree or agree with each statement below? (*Please circle one number for each statement.*)

| **Statements about climate change** | **Strongly Disagree** | **Disagree** | **Neither** | **Agree** | **Strongly Agree** |
|---|---|---|---|---|---|
| I am personally concerned about the effects of climate change on fish, wildlife and their habitats. | 2% | 4% | 4% | 25% | 66% |
| We can improve our quality of life if we address the effects of climate change on fish, wildlife and their habitats. | 3% | 3% | 6% | 27% | 61% |
| There is too much scientific uncertainty to adequately understand how climate change will impact fish, wildlife and their habitats. | 36% | 32% | 7% | 17% | 9% |
| I stay well-informed about the effects of climate change on fish, wildlife and their habitats. | 0% | 5% | 18% | 50% | 26% |
| It is important to consider the economic costs and benefits to local communities when addressing the effects of climate change on fish, wildlife and their habitats. | 2% | 12% | 13% | 49% | 23% |
| I take actions to alleviate the effects of climate change on fish, wildlife and their habitats. | 1% | 6% | 17% | 51% | 24% |
| There has been too much emphasis on the catastrophic effects of climate change on fish, wildlife and their habitats. | 50% | 29% | 9% | 7% | 5% |
| Future generations will benefit if we address the effects of climate change on fish, wildlife and their habitats. | 2% | 4% | 4% | 25% | 65% |
| My experience at this Refuge would be enhanced if this Refuge provided more information about how I can help address the effects of climate change on fish, wildlife and their habitats. | 6% | 9% | 27% | 43% | 14% |

## SECTION 6. A Little about You

***** Please tell us a little bit about yourself. Your answers to these questions will help further characterize visitors to National Wildlife Refuges. Answers are not linked to any individual taking this survey. *****

1. Are you a citizen or permanent resident of the United States?

98% Yes 2% No → *If not, what is your home country?* See Figure 4 in Report

2. Are you? 53% Male 47% Female

3. In what year were you born? 1952 (YYYY)

4. What is your highest year of formal schooling? (*Please circle one number.*)

| 1 2 3 4 5 | 6 7 8 | 9 10 11 12 | 13 14 15 16 | 17 18 19 20+ |
|---|---|---|---|---|
| (elementary) | (junior high or middle school) | (high school) | (college or technical school) | (graduate or professional school) |
| | 0% | 5% | 39% | 56% |

5. What ethnicity do you consider yourself? 0% Hispanic or Latino 100% Not Hispanic or Latino

6. From what racial origin(s) do you consider yourself? (*Please mark **all that apply**.*)

- 2% American Indian or Alaska Native
- 0% Black or African American
- 99% White
- 3% Asian
- 1% Native Hawaiian or Pacific Islander

7. How many members of your household contribute to paying the household expenses? 2 persons

8. Including these members, what was your approximate household income from all sources (before taxes) last year?

- 0% Less than $10,000
- 3% $10,000 - $24,999
- 6% $25,000 - $34,999
- 10% $35,000 - $49,999
- 26% $50,000 - $74,999
- 21% $75,000 - $99,999
- 19% $100,000 - $149,999
- 7% $150,000 - $199,999
- 7% $200,000 or more

9. How many outdoor recreation trips did you take in the last 12 months (for activities such as hunting, fishing, wildlife viewing, etc.)?

15 number of trips

**Thank you for completing the survey.**

**There is space on the next page for any additional comments you may have regarding your visit to this Refuge.**

See Appendix B for Comments

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Malheur Lake
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# Appendix R

## Improving the Aquatic Health of Malheur National Wildlife Refuge


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# Improving the Aquatic Health of Malheur National Wildlife Refuge



Authored by Linda Beck, Adam Daniel, and Shannon Hurn

Acknowledgements: Malheur National Wildlife Refuge would like to thank all the collaborators who contributed to the completion of this document. A special thanks goes to Bruce Taylor, Gary Ivey, Jenny Barnett, Peter Sorensen, Bridgette Flanders-Wanner, Joe Engler, Tim Mayer, Lara Bjork, and Sharon Selvaggio for providing edits.

Title page photos, clockwise from top left: 1. Canvasback duck, 2. Western grebes, 3. American white pelican, 4. White-faced ibis and snowy egret, 5. River otter, 6. American coot with chicks, 7. American avocet with chicks.

# R.1 Executive Summary

This plan for carp control and improving aquatic health in the Harney Basin (the Basin) was formulated by melding information from the Malheur National Wildlife Refuge 2010 Invasive Common Carp Workshop, the 2008 *Refuge Carp Management Plan* (updated from January 1998), the 2010 *Harney Basin Common Carp Management Plan to Improve Malheur Lake Water Quality*, and the 2012 *Malheur National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Impact Statement*.

The non-native common carp (*Cyprinus carpio*, L.) established breeding populations in the Basin during the first half of the twentieth century. As a result, Malheur Lake (the Lake) and most connecting waterways and water bodies have transitioned from a macrophyte-dominated, clear-water state to a phytoplankton-dominated, turbid-water state. The ecological collapse caused by common carp has reduced waterfowl production at Malheur National Wildlife Refuge (the Refuge) to an estimated one-tenth of the average 100,000 ducklings produced annually in the 1940s, before carp populations reached high densities (Cornely 1982). After decades of opportunistic carp control (including five rotenone treatments), managers, partners, and other collaborators are proposing a Basin-wide, long-term carp control plan to improve water quality not only on the Refuge, but also within the surrounding Basin. The Refuge's highest priority management action is to control the carp population to return the Refuge to its full biological potential as habitat for migratory and resident birds. If the overall aquatic health of Refuge waters is improved, bird populations would have the habitat they need. This document outlines the historical perspective, management action priorities, and a path forward to address this invasive species problem. This plan's integrated pest management control strategy is based on the assumption that eradication is realistic in some areas but not in other areas due to the high degree of complexity and extreme variability in waterway and water body interconnectivity within the Basin. The plan's sustainable carp control priorities and actions are congruent with the Refuge's Comprehensive Conservation Plan aquatic health goals and objectives. Although there is wide recognition and support for a comprehensive carp control management program in the Basin, implementation is challenged by a lack of funding. Sustainable implementation funding would need to be acquired opportunistically and entrepreneurially from public and private funding sources.

**Figure R-1. Refuge Manager herding carp to sample for fish health and population dynamics at Crane Pond in 2010.**

The Refuge was established because it provided outstanding habitat for wildlife, particularly migratory birds, but because of common carp, the Refuge's aquatic health has deteriorated greatly since its establishment. Controlling carp is not simple, but the Refuge's carp population *must be controlled*, so that these lands and waters can once again be home to flourishing populations of native species that the Refuge is intended to support.

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## R.2 Introduction

The vast wetlands and wet meadows of the Harney Basin (the Basin) in southeast Oregon have long been recognized as some of the most important wetland habitat for migratory birds in the Pacific Flyway. The lakes, rivers, and marshes within the Malheur National Wildlife Refuge (the Refuge), and other seasonal floodplain wetlands and wet meadows found on private lands across the Basin, are used by hundreds of thousands of migrating and breeding waterfowl, shorebirds, and other water birds. These same wetted habitats sustain a rich diversity of native fish and wildlife, ranging from redband trout to yellow-headed blackbirds and spotted frog. However, invasion of the Basin's wetlands by non-native common carp (*Cyprinus carpio*) in the late 1930s triggered long-term negative ecological changes that have dramatically reduced wetland habitat productivity for migratory birds and other native fish and wildlife.

**Figure R-2. East Knox Pond flourishes with life due to water manipulations.**

High densities of common carp in Malheur Lake (the Lake), a 32,000-acre marsh at average water levels, have caused increased turbidity in the Lake, which in turn has harmed the Lake in three key ways: the Lake is void of submergent and emergent aquatic vegetation, water quality is degraded, and waterfowl productivity has severely decreased. These impacts can also be found in other wetlands and rivers throughout the Basin. The Lake and its connecting waterways and water bodies have transitioned from a macrophyte-dominated, clear, stable state to a phytoplankton-dominated turbid state. The ecological collapse of this highly productive system is reflected in waterfowl production on the Refuge, which has declined by an estimated 90 percent from its historically documented peak (Cornely 1982).

From an ecological perspective, the highest priority is to restore water quality in the Lake, the biological heart of the Refuge and historically the most productive wetland habitat in the Basin. Efforts to reach this goal will rely on three key principles. First, control is more realistic than complete eradication. Second, collaboration throughout the Basin is essential. Finally, all decisions and actions must be part of a cycle of adaptive management that is informed by scientifically valid data and analysis.

Eradication of common carp in the Basin as a whole is considered nearly impossible using current methods, because of the complexity of the waterways connecting to the Lake and wide annual fluctuations in water levels (Figure 3). Carp control technologies are evolving, and may eventually provide methods to control carp populations over large water systems. The relatively long life-span and high fecundity of common carp will require a multifaceted sustainable approach to population control, including but not restricted to harvesting, trapping, piscicide application, hormone attractants, and barrier infrastructure, all of which could be employed to remove carp from the Basin.

Implementation of carp control efforts to restore the health of aquatic habitats in the Lake and Basin wetland systems will require investments on a scale that is beyond the capacity of any single agency or organization. Successful, sustainable implementation will require partnerships among public agencies, nongovernmental organizations, and private landowners, with funding from a variety of Federal, state, and private sources. Development of these collaborative partnerships is already underway.

In March 2010, the Refuge hosted an invasive common carp workshop that produced broad agreement among a wide variety of stakeholders, collaborators, and interested parties about the pressing need to improve the Refuge's and the Basin's aquatic health by controlling carp. This workshop also spurred the establishment of the Aquatic Health Coalition.

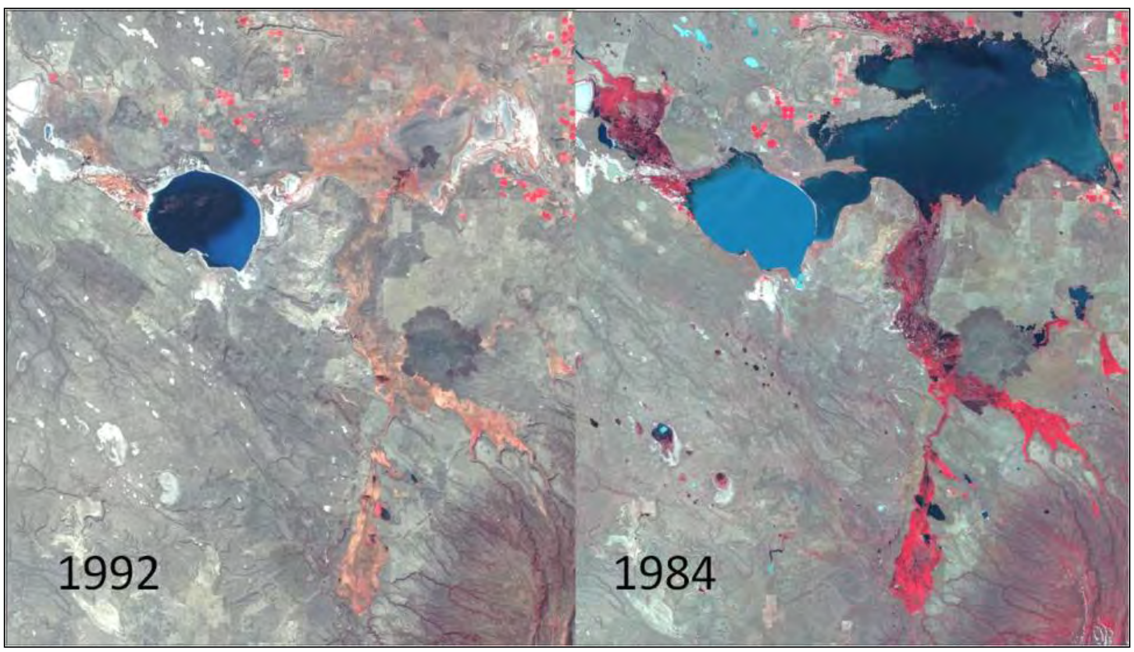


**Figure R-3. Examples of the 1992 drought year and 1984 high water levels at Malheur Refuge.**

The Refuge, with its 60 collaborators, has drafted a comprehensive conservation plan (CCP) that will guide Refuge management over the next 15 years. This collaborative planning group quickly identified the Refuge's poor aquatic health as the most pressing and immediate issue to address. The CCP's management direction focuses future staff time and resources on reducing the carp density to ≤100 pounds per acre. A study by Bajer et al. (2009) suggests that at this biomass level, the negative impacts of carp are mitigated, allowing aquatic plant and animal populations to maintain reasonable levels. The Refuge, in cooperation with its public and private collaborators, will seek to achieve this goal using replicable protocols for data gathering during inventory and monitoring, as well as testable methods of carp control. Through the combination of maintaining biological integrity, using best available science, and employing adaptive management, the Refuge will make data-driven adjustments to carp control.

This document is considered a “step-down” plan from the CCP, which means that this plan provides additional details on how the Refuge will implement strategies to reduce carp biomass to <100 pounds per acre. The CCP goals and objectives that relate to carp management are presented in Chapter 2 of the CCP, and information on the implementation and priorities related to aquatic health is included in Appendix C. This document also complements the 2010 *Harney Basin Common Carp Management Plan to Improve Malheur Lake Water Quality* developed by the Natural Resources Conservation Service (NRCS). The NRCS and the Refuge will work together closely to implement these two plans; in fact, the Refuge is the lead agency for the NRCS plan. The carp control strategy outlined in this document focuses heavily on the Lake and other wetlands within the Refuge. These aquatic habitats were identified as the highest priority for initial control efforts. Initial population assessment work is already underway, and the Refuge has identified specific options for carp control at numerous sites, including some on adjacent lands. In the long run, however, control of carp will require cooperative efforts across the Basin with involvement of private landowners as well as public agencies. Because funding for these efforts will necessarily come from a variety of sources, implementation will occur as opportunities arise. As part of the work of the Aquatic Health Coalition, collaborators will coordinate their efforts to identify, pursue, and direct funding to the highest priority actions.

## R.3 The Problem: Carp Impacts

The negative impacts of common carp have been apparent at the Lake for decades. The Silvies River provided an entry point into the Lake, where carp were acknowledged to be invasive in 1952 (Thompson and Littlefield 1980). Due to a lack of natural or artificial physical barriers, carp migrated up the Blitzen River and spread throughout the Blitzen Valley wetlands over the next 10 years. During the years of 1952, 1957, and 1958, the natural land bridge between Harney and Mud lakes was breached, allowing carp to invade the Double-O Unit wetlands. By the early 1960s, carp were established in large numbers throughout the Refuge and began to have an adverse impact on production of aquatic plants and aquatic invertebrates. In the 1980s, high water levels again resulted in a barrier breach. At that time, ice shears may have changed both the bathymetry and chemistry of the Lake; since that time, the water has been very turbid (Figure S-4).

**Figure R-4. Carp research being conducted by Refuge staff and a University of Minnesota post-doctoral fellow in Malheur Lake. Notice no vegetation and very turbid water.**

Carp have many negative impacts on aquatic habitats, namely by competing with other species for food, causing turbidity to increase, and ultimately decreasing waterfowl productivity and use (Figure S-5). As carp search for aquatic invertebrates, they compete directly with other aquatic wildlife by consuming and uprooting submersed aquatic plants. These plants, especially sago pondweed (*Potamogeton pectinatus*), are important foods for other wildlife and provide a critical part of the subsurface habitat used by aquatic invertebrates and native fish.

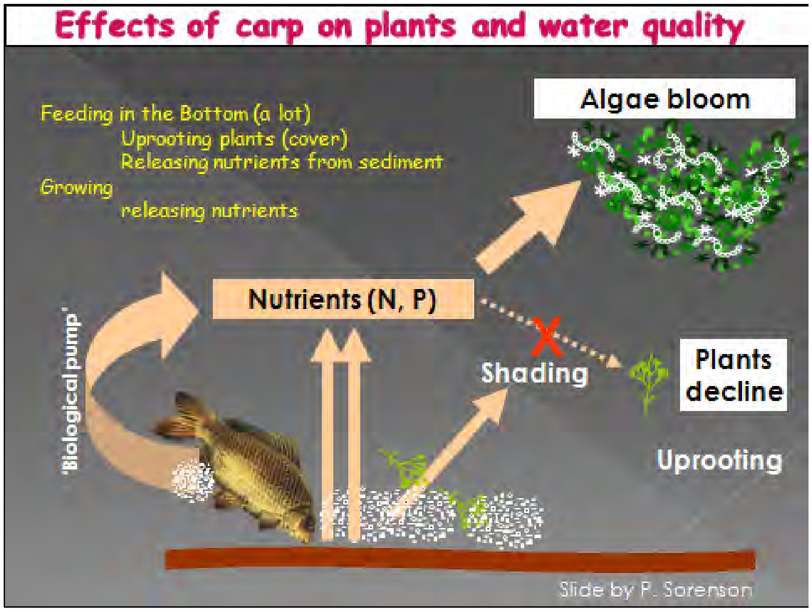


**Figure R-5. Explanation of common carp impacts on the aquatic environment.**

Carp alter the aquatic ecosystem when feeding by causing water turbidity. While feeding on the bottom, they vigorously roil the water in search of food, which stirs up the sediment and organic material and suspends this material in the water column. Consequently, subsurface sunlight needed for plant growth is reduced or eliminated, and photosynthetic plant production and oxygen levels decrease. With high concentrations of carp, the effects of swimming and spawning also contribute to increased turbidity. Eventually carp can change the physical environment of an aquatic system to a point where only a few species of fish, invertebrates, and plants can survive in low numbers; the Lake and other water bodies on the Refuge have reached these conditions. Even after carp are removed from a wetland system it may take several years for the wetland to return to a clear-water system. This is a result of the long-term presence of carp, the shift from a submerged aquatic vascular plant–dominated system to one dominated by phytoplankton, and the loss of wave dissipation provided by the submerged aquatic plants.

Habitat impacts of carp at the Refuge have been monitored using data collected from annual pond surveys, which measure several factors affecting water quality, including carp numbers, temperature, turbidity, pH, plant cover, abundance, and diversity. These surveys indicate that ponds with high carp numbers have poor quality rating (Wenick 2010).

During the 1940s, duck production on the Refuge averaged over 100,000 ducklings[1] (Cornely 1982). Today, the Refuge annually produces approximately 10 percent of the ducklings (8,000 to 12,000) it

[1] Cornely (1982) notes that methods of estimating duck and goose production varied through the years:
- 1942-1945: Estimates based on general field observations; no standardized sampling procedures were used.

is estimated to have produced annually during the 1940s, with breeding primarily restricted to the managed wetlands in the Blitzen Valley and Double-O units. Waterfowl production and waterfowl use are directly related to the total number of acres of sago pondweed produced annually on the Refuge; the more aquatic vegetation available, the higher the level of waterfowl use. Prior to a major influx of carp in 1952, the Lake was noted for high levels of vegetation, especially sago pondweed. Between 1953 and 1954, sago pondweed declined by 80 percent, with no evidence of this plant remaining in the Lake by 1955 (Ivey et al. 1998). However, sago pondweed will rebound if carp biomass is decreased. As shown from analysis of historical data from the Refuge (see Chapter 6 of the Malheur Refuge CCP/EIS), there is a statistically significant relationship between acres of sago pondweed and breeding pairs of diving ducks on the Lake (Ivey et al. 1998).

Previous Refuge experience has shown that reducing the number of carp has a positive effect on bird populations and vegetation. There have been several good years of production (up to 60,000 birds) after large rotenone projects on the Lake (Ivey et. al.1998). The use of the Lake by dabbling ducks and diving ducks post-rotenone treatment increased by as much as 116 percent and 70 percent, respectively. Sago pondweed acreage has also increased substantially after carp control treatments; in 1955 and 1992, for instance, there was no sago pondweed in the Lake, but after rotenone treatments in those years, sago pondweed covered 16,900 and 10,000 acres, respectively (Ivey et al. 1998). Unfortunately, positive responses to carp control treatments have been short-lived.

**Figure R-6. An estimated 1.5 million mortalities caused by 1955 rotenone treatment.**

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- 1946-1952: Estimates based on nest success from nesting studies. No standardized routes were used for breeding pair or brood counts.
- 1953-1955: Dearth of information. Estimate based on general observations during routine field activities.
- 1956 -1960: Estimates based on pair, nest, and brood observations from sample plots checked twice a month during the breeding and brooding season. Those results were supplemented with general observations during aerial, boat, and ground surveys.
- 1961-1967: Estimates based on random ground and aerial surveys of breeding pairs and random brood counts on the principal brooding areas.
- 1968-1971: Breeding pairs and broods were censused along standard aerial, boat, and ground routes, and nesting success was determined from sample plots. Production estimates were based on extensive brood counts.
- 1972-1980: Estimates calculated by multiplying the breeding pair estimate by nest success by mean brood size just prior to fledging.

Avian species are particularly important because the Refuge was established to protect birds (see Chapter 1). Improved aquatic health results in better habitat for these birds, as well as other native species of fish, macroinvertebrates, plants, and other organisms that are currently being negatively affected by carp.

**Figure R-7a. Trumpeter swan with cygnets swimming in a healthy, vegetated water body.**
**Figure R-7b. A view of a healthy marsh with open water and islands of vegetation.**

## R.4 Plan Goals and Management Priorities

To improve aquatic health, the Refuge has established a quantitative objective of reducing carp in lacustrine habitats to a level not to exceed 100 pounds of carp per acre. The 100 pounds per acre figure is an estimate of the appropriate threshold, or the theoretical biomass of common carp that can be tolerated by the system and still maintain acceptable conditions for aquatic vegetation and waterfowl use. This estimate was made based on the 100 kilogram per hectare threshold noted in Bajer et al. (2009). The Bajer study was based on observations of a smaller Midwestern system in decline as opposed to a large Great Basin system in recovery, so the figure may need adjustment over time. The Refuge has set this goal as a means to restore the biological integrity of its water bodies and adjacent lands in a way that should be sustainable for the long term. If achieved and sustained over time, the Refuge should have increased bird use, increased vegetation, larger populations of native fish, better water quality, and a healthier ecosystem. Although it is recognized that other factors may be contributing to declining waterfowl use, carp are known to be a dramatic perturbation in the system that must be addressed.

The different areas impacted by carp have been identified by level of importance to help formulate a strategic path forward. The most ecologically important portion of the Basin impacted by carp is Malheur Lake. The Refuge and collaborating members of the Aquatic Health Coalition have agreed that funding should be prioritized based on connectivity and potential impacts to water quality within the Lake, as follows: 1) Malheur Lake, 2) Blitzen Valley, 3) Silvies River, and 4) Double-O (Figure S-8).

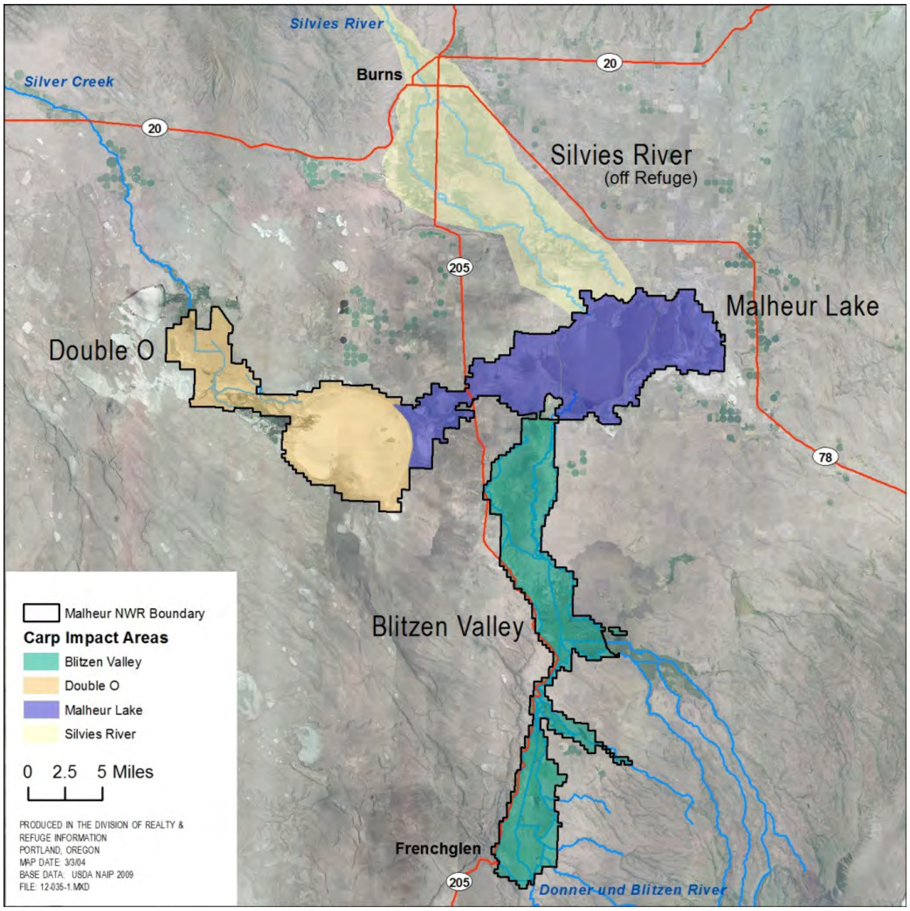


**Figure R-8. Common carp impact areas.**

## R.5 Information Needs

To reach the goal of improved aquatic health (with attendant benefits to waterfowl and other native species), the Refuge needs pre-treatment data (current or baseline conditions) and post-treatment data for the following parameters:

- Water quality, as indicated by dissolved oxygen, conductivity, water temperature, and salinity, pH, turbidity, chlorophyll A, and total suspended solids
- Aquatic vegetation abundance and species types
- Macroinvertebrate abundance and family to genus types
- Point count for passerines and secretive marsh birds
- Total count for large birds (waterfowl, water birds, wading birds)
- Bird brood counts (productivity estimates)
- Fish assemblage
- Carp age structure
- Carp location and movement patterns
- Carp biomass

Estimating the biomass of carp before and after treatment is especially important for assessment of success toward the 100 pounds per acre target. Removing the first 80 percent of the carp population will be exponentially cheaper than eradicating the last 20 percent, so it will be important for managers to determine the most cost-effective methods for reducing carp biomass in the Lake and the Basin. The Refuge has two key questions to answer in pursuing the 100 pounds per acre threshold:

- How many pounds of carp must be removed each year to reach the 100 pounds per acre threshold?
- Do the key biotic and abiotic parameters listed above improve sufficiently with a threshold of 100 pounds per acre, or should the threshold be adjusted? In essence, is 100 pounds per acre the right threshold for the Refuge's water bodies?

To obtain all of this information, the Refuge needs a scientifically valid approach to data gathering. Please see Appendix C for the implementation table of CCP goals and objectives that pertain to aquatic health improvement.

## R.6 The Solution: A Scientific, Strategic Approach to Aquatic Health Improvement

This plan differs from previous management plans by acknowledging that complete eradication of common carp is impractical, that much collaboration throughout the Basin is needed for long-term success, and that scientifically valid approaches must be employed. Adaptive management and integrated pest management (IPM) will be applied throughout these efforts to optimize applied science and aquatic health. All protocols and data gathering will follow strict quality control and quality assurance guidelines.

**Figure R-9. Refuge fish biologist in the process of implanting a telemetry tag in a fish caught and released in Boca Lake.**

## R.6.1 Overview of Approach

While exact time lines are dependent on many factors (most notably funding), the Refuge's approach will consist of the following steps:

**Figure R-10. Refuge Manager and fish biologist removing fish netted in a trammel net on Boca Lake.**

1. Compilation of historical data on aquatic health on the Refuge, evaluation of the protocols used to collect those data, and development of protocols to collect new data that will be comparable to historical data.
2. Pilot study at Boca Lake, because it is similar to Malheur Lake but smaller, easier to access, and therefore more manageable. The pilot study will involve:

   A. Baseline data inventory
   B. Implementation of carp control strategies
   C. Effectiveness evaluation and monitoring

3. Application of Boca Lake protocols to other Refuge locations, with Malheur Lake as the top priority, including the following steps:

   A. Review of Boca Lake results to determine applicability to new setting(s): What adjustments, if any need to be made?
   B. Baseline data inventory
   C. Implementation of carp control strategies
   D. Effectiveness evaluation and monitoring

4. Review of Refuge results to determine applicability to locations in the Harney Basin outside the Refuge. This review will be conducted by the Refuge and collaborating members of the Aquatic Health Coalition, with implementation steps to be followed in the NRCS Harney Basin plan.

Although this approach is presented here as distinct steps, the process of implementation will be more dynamic and iterative, to account for learning, adjustments and funding availability along the way, in part because of the use of adaptive management and IPM.

## R.6.2 Role of Adaptive Management and Integrated Pest Management

The Refuge will be melding adaptive management principles with IPM to restore the aquatic health and biological integrity of Refuge habitats. *Adaptive management* is a decision process that promotes flexible, informed decision making and that allows adjustment as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a "trial and error" process but, rather, emphasizes learning while doing. Adaptive management does not represent an end in itself, but is a means to more effective decision making, more efficient management, and other enhanced benefits. It helps meet environmental, social, and economic goals; increases scientific knowledge; and reduces tensions among stakeholders (Williams et al. 2007).

*IPM* is an interdisciplinary approach using methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on Refuge lands and waters to achieve wildlife and habitat management goals and objectives. IPM is also a scientific, adaptive management process where available scientific information and best professional judgment of the Refuge staff as well as other resource experts are used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. An IPM approach will be used, where practicable, to eradicate, control, or contain pest and invasive species on Refuge lands. IPM involves using methods based upon effectiveness, cost, and minimal ecological disruption, which consider minimum potential effects to non-target species and the Refuge environment in accordance with 517 DM 1 and 569 FW 1.

Adaptive management and IPM both rely on scientifically verifiable information to determine a method's effectiveness, and they both involve taking a system-level perspective to understand impacts. The management approaches differ in that IPM can provide a great deal of detail about particular methods and how to evaluate their impacts, whereas adaptive management takes a broader view of methods and their impacts. For example, IPM provides a structured procedure to evaluate the potential effects of proposed uses of a pesticide on biological resources and environmental quality; an IPM approach to pesticide use involves determining the smallest amount of a chemical that would have the desired effect on the target species. After a pesticide is applied according to an IPM protocol, the adaptive management framework involves evaluating the technique's success and, if appropriate, identifying either modifications to the technique or a new method to be used in the future.

## R.6.3 Methods for Baseline Data Inventories and Ongoing Monitoring

Together, baseline inventory data and ongoing monitoring data will present a complete picture of the effectiveness of carp control methods and the state of aquatic health before and after carp control treatments.

*Inventory* is defined as: "a survey that documents the presence, relative abundance, status, and/or distribution of abiotic resources, species, habitats, or ecological communities at a particular time" (701 FW 2, in draft). Inventories will be conducted prior to any control measures for common carp.

*Monitoring* is defined as "a survey repeated through time to determine changes in the status and/or demographics of abiotic resources, wildlife or plants, habitats, or ecological communities" (701 FW 2, in draft). The Refuge will monitor all baseline data parameters for specific amounts of time post-treatment. Collaborators will assist the Refuge in determining the methods and duration of monitoring for specific projects.

The following methods will be used to establish baseline data and conduct post-treatment monitoring. Note that these methods may be modified if evaluation of historical collection protocols reveals a meaningful difference that would prevent comparison between new and old data.

### Water Quality

Using ArcGIS-generated randomized sampling locations in a given water body, water samples will be collected at the same time as vegetation samples. The number of sampling locations will be determined for each water body, depending on its size. Using a YSI 85 digital meter, the following parameters will be tested: dissolved oxygen (percent and mg/L), conductivity (μS), water temperature (°C), and salinity (ppt); pH will be tested using a Piccolo plus HI 1295 amplified electrode. Turbidity will also be evaluated using a secchi disc. Samples of chlorophyll A and total suspended solids taken at a subset of the randomized points will be collected in accordance with laboratory sampling procedures of the contracted laboratory (available online at http://www.aquaticresearchinc.com/).

### Aquatic Vegetation

At the same locations where water samples will be collected for the water body being studied, aquatic vegetation will be sampled following the method described below. The site will be sampled once during the peak annual abundance (mid to late June). A 1 $m^2$ polyvinyl chloride (PVC) pipe–constructed square will be placed at the global positioning system (GPS)–identified sample location. A visual estimate to the nearest 10 percent of vegetative cover will be made. A rake will be used to sample the benthic vegetation by twisting the rake three times in the square and pulling it up. The water will be drained for 20 seconds, and the weight of the vegetation will be collected using a digital scale. Species collected will be identified, and all data recorded, as outlined in Bajer et al. (2009).

**Figure R-11. Submergent vegetation in Malheur Lake.**

### Macroinvertebrates

Using a D-frame aquatic net, 15 samples of 1 $m^2$ of benthic environment in a given water body will be sampled for 30 seconds using a randomized sampling design for quantitative numbers of taxa and individuals, as explained by Rabeni (1996). The samples collected will be stored in 1,000-mL heavy-duty, wide-mouth Nalgene high-density polyethylene (HDPE) bottles. Two identical labels will be used, one on the inside and one attached to the outside of the container. The samples will be preserved in 95 percent ethanol and shipped to a contracted lab for

**Figure R-12a. Collaboration by USGS and USFWS collecting aquatic macroinvertebrates on the Refuge.**
**Figure R-12b. Collaboration with retired ODFW biologist on native freshwater mussel monitoring.**

identification. Different protocols for flowing water and standing water will be observed, following Rabeni (1996).

**Birds**

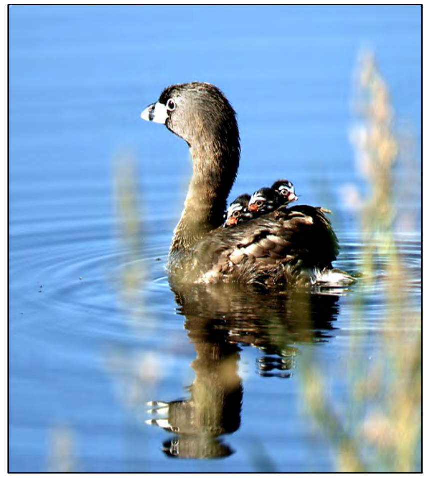

**Figure R-14. Pied billed grebe with chicks getting a ride from mom.**

The Refuge will use standardized protocols to determine baseline relative bird abundance by habitat type for each water body being studied. These data will be compared to post-treatment data to assess the effects of carp control practices and to determine long-term trends after carp removal. Under the important bird area (IBA) protocol, each observation point will be recorded with a GPS unit and marked with a survey marker around the perimeter of the given water body. Each point shall be monitored for 8 minutes after waiting 1 minute post arrival to the point. The points will be surveyed from sunrise till 10 am during suitable weather conditions. Points will be monitored a maximum of once a week for the duration of the project. Data collected will be the date, name of observer(s), start time and end time of survey, weather conditions (drizzle, overcast, broken, scattered, clear), air temperature at start and end of survey, and wind speed (0-5 miles per hour [mph] or 6-12 mph). Counts of passerines, secretive marsh birds, waterfowl, water birds, wading birds, and broods will be conducted.

**Fish**

Multiple methods are necessary to obtain all the data needed regarding fish species. At least nine species of fish could be encountered during fish assemblage work. Data collected will be species, length, and sex when visible.

**Figure R-13. Youth Conservation Corp students helping collect fish data.**

## R.6.4 Carp Population Determination

Prior to treatment, it is important to obtain an accurate estimate of the total biomass of carp present in Refuge water bodies. These data will be essential for assessing whether the 100 pounds per acre target has been achieved and whether this threshold of carp biomass is sufficient to the overall goal of improved aquatic health.

For small water bodies, carp population will be determined by sampling annually for 1 year pre-carp removal and 2 years post-removal; these methods are summarized from Hayes et al. (1996). For young-of-the-year and 1-year-old carp and other smaller sized fish, three trap nets will be set for 24 hours at two positions in a given water body pre-carp removal. Post-treatment monitoring will entail using the same protocol and sampling each fall. Fish species and length data will be collected. All carp will be culled from the water body, anesthetized, and measured. Adult carp will be netted using a 100-m trammel net. Any non-carp fishes captured will be identified, measured, and released.

For Malheur Lake, the Refuge will conduct a mark-recapture study. Mark-recapture studies require a significant investment of time and labor that could be used to remove carp from Malheur Lake, but without a solid estimate of carp biomass, such carp removal actions would not be grounded in data and it would be difficult, if not impossible, to assess success or failure.

The mark-recapture study will involve netting fish, taking lengths, clipping a fin or putting a tag in the dorsal muscle, and releasing the fish. It will be important to use numbered tags or unique marks for each tagging location in the mark-recapture study to identify movement within and between management units. It is also important to sample multiple locations within each management unit to better estimate the biomass over varied habitat rather than marking all of the fish at the most convenient location. The recapture phase should be scheduled between 2 weeks and 1 month after marking.

If connectivity exists between Malheur Lake and other management units, it will be important to mark individuals from all connected units. It would be ideal to mark at least 5 percent of the estimated population for each management unit. If Malheur Lake is the only management unit evaluated for a biomass estimate, it will be essential to monitor a subset of fish from connecting management units to estimate immigration (through a habitat use study).

Because access to Malheur Lake can be difficult, it may be advantageous to conduct the marking and/or recapture during freezing temperatures. Carp typically aggregate when temperatures are low and can be easier to find; for instance, if a portion of a lake is frozen, carp will often cluster in the portion that still has open water. Under such conditions, it may be possible to identify aggregations located in deep holes or springs within each management unit. It may be possible to forego the initial mark-recapture study in the Malheur Lake management unit if Malheur Lake is at a very low level and a thorough chemical treatment can be conducted. An aerial count of carcasses could then be conducted (with ground verification in vegetated areas), and population structure could be determined from carcasses (length, weight, and age). However, unless the Blitzen Valley can be treated, it will still be necessary to conduct a separate population estimate and determine immigration rates using telemetry before the chemical treatment.

**Figure R-15. Mark and recapture study being conducted by the University of Minnesota. Fish are netted below the ice, fins are clipped, and fish are measured prior to being rereleased.**

## R.6.5 Carp Movement and Aggregation Determination

Forty-one advanced telemetry systems (ATS) low-frequency body cavity telemetry tags will be surgically implanted into the peritoneal cavity of adult common carp (larger than 1.5 pounds) randomly dip-netted out of the given water body. Fish will be caught, measured, and anesthetized. A 1.5-inch superficial incision will be made behind the pelvic fin in the ventral surface. A telemetry tag will be aseptically planted into the cavity, and the incision will be sutured. The fish will be allowed to recover and then released. The telemetry tracking will be performed once a week to once a month for the life of the tags (~2 years). Results will be tracked by GPS units, and evidence of aggregations will be determined (Guy et al. 1996).

**Figure R-16. Summer interns collecting water chemistry and telemetry data.**

## R.6.6 Carp Dynamics Modeling

Due to the size and the dynamic fluctuations of water in the Harney Basin, a dynamic model of carp population/biomass based on estimated common carp immigration, emigration, growth, mortality, and recruitment (population structure and habitat use data) would be a powerful tool for the management of carp in the Harney Basin. Such a model has been developed by Iowa State University doctoral student Mike Colvin to aid the Refuge in understanding its carp population(s) (Figure S-17). To inform adaptive management decisions, the data collected for the baseline inventory and post-treatment monitoring will be integrated into this model as results are available. It is relatively easy to update models with refined data on an annual basis, and assuming funding is available for ongoing data collection, this model will be a valuable tool for the Refuge and its collaborators to use during ongoing carp management.

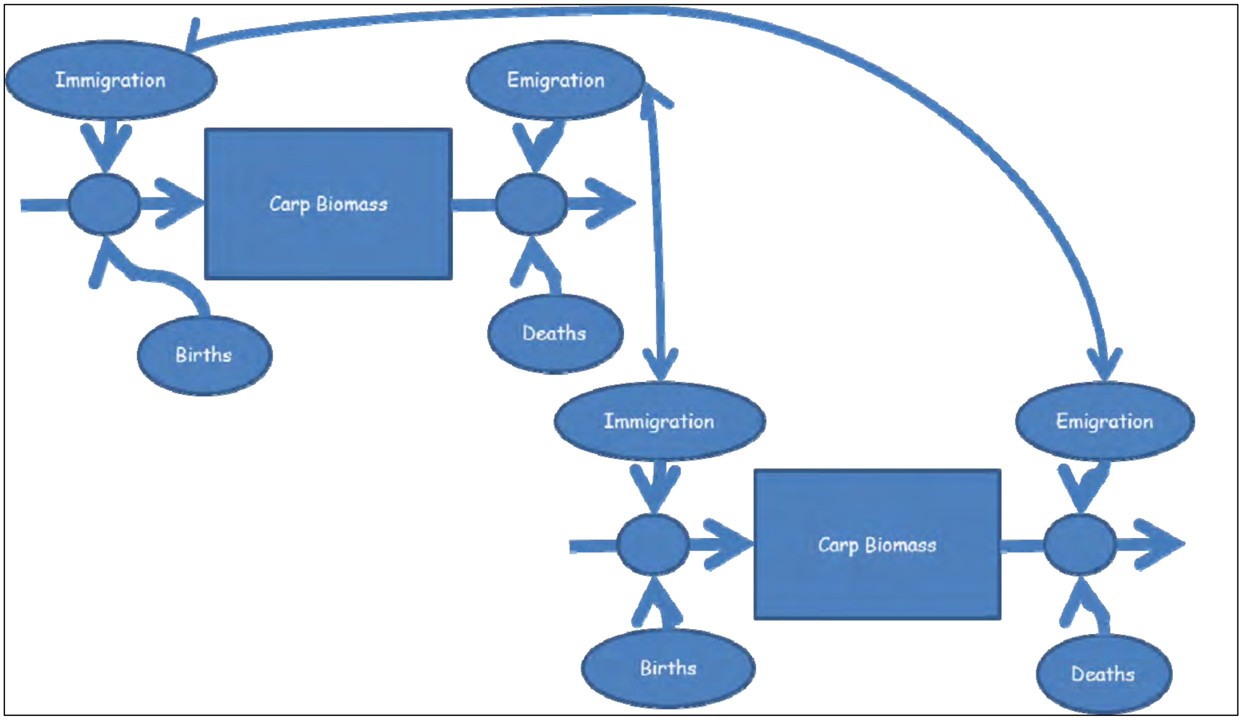


**Figure R-17. A simplified visual representation of the carp modeling system.**

## R.7 Carp Control Strategies

The current aquatic ecosystem of the Refuge is out of balance due to the invasive common carp. Native fish species are being outcompeted by the highly fecund invasive carp. In addition, the environmental instability of the watershed due to extreme drought and wet years constitutes the perfect scenario for carp super-reproduction. Bajer et al. (in review) determined that in a stable environment, native predatory fish species prey on carp eggs and fry to suppress the population. However, in locations around the world that have environmental instability (i.e., winter hypoxia), the native predatory fish die during the winter due to lack of oxygen in cold water, while the carp migrate outside those areas in the winter, moving to deep water. The carp then spawn in the spring where native predation is suppressed. The Refuge's carp control strategy must focus on a long-term sustainable solution, such as increasing native predatory fish species and finding ways to regain the balance of native organisms to keep the carp species suppressed.

Under this plan, carp control will focus not only on immediately suppressing common carp, but also on impeding carp recovery. Carp control at the Refuge will include the following types of strategies, among others:

- Manipulating water levels to reduce amount of carp habitat.

- Annually removing carp, with nets, traps, commercial fishing, or other techniques.
- Removing connectivity between water bodies.
- Improving environmental conditions to favor native predatory fish.
- Preventing successful spawning through chemical spot treatment.

A multifaceted, sustainable approach will be the key to sustaining acceptable water quality in Malheur Lake. Additional techniques for carp control may be added if inventory and monitoring results show that adjustments are appropriate, as is consistent with adaptive management. A more in-depth explanation of the control techniques, and the Refuge's experiences with them, is provided below.

## R.7.1 Techniques and Technologies in Use

These techniques have been used at some point on the Refuge and will continue to be part of carp control efforts.

**Water Manipulation**

The most effective and commonly used method on the Refuge has been seasonal or prescriptive draining of ponds and canals. The irrigation schedule alters from year to year depending on water availability and habitat needs; before manipulating water levels, the Refuge has to consider overall aquatic habitat needs as well as any bird species that have been identified as high priorities for the Refuge (also called focal species) when planning carp control. Yearly seasonal draining of water bodies is optimal, but some water bodies may only be drained and dried every 5 to 6 years due to the need for waterfowl habitat.

**Figure R-18. A water control structure at Barn Yard Spring in the Double-O Unit.**

**Traps**

Fish traps used on the Refuge have produced limited success, because they only catch a small proportion of fish and require daily maintenance when in use. Large permanent metal traps have been designed for Sodhouse, Busse, and Grain Camp dams on the Blitzen River to aid in the control of carp movement and will be installed as funding becomes available.

### Netting

Multiple types of netting have been used in the past and will continue to be used in the future. Hoop nets have been used in the main channel of the Blitzen River to collect carp. Gill nets have been used experimentally but proved unsuccessful. Trammel nets, which are a modified gill net, are very successful in netting carp and other species of fish. These nets are set up and checked daily for catch. Most fish can be released with minimal or no damage, but some incidental mortality to native species has occurred. Block nets are used to block off sections of the river for population surveys, creating a temporary barrier for all fish passage.

### Fish Screens and Barriers

Fish screens and barriers are essential elements for the success of carp control efforts because they prevent movement of carp from one water body to another. A major factor that probably contributed to the short-term benefits to any previous treatments at the Refuge was the lack of properly designed, constructed, and maintained infrastructure to prevent carp re-invasion post-treatment. Vertical rotational screens have been highly effective at decreasing the spread of carp and decreasing the entrainment of native fish species by acting as barriers to fish movement. For smaller diversion ditches off the mainstem of the Blitzen River and canals, these screens have been highly efficacious, require minimal maintenance, and can be fabricated at the Refuge by the maintenance staff.

**Figure R-19. Operating fish screen on the West Canal at Page Springs Dam.**

Vertical traveling screens have been placed at the west canal diversion at Page Springs Dam. The Highline Ditch, Stubblefield Canal, Rheinman Ditch, and Buena Vista Canal are all in different stages of screen construction. Although these screens are very expensive and require power via solar collector or power line, they are very effective at screening the large water volumes being diverted from the Blitzen River. Priority areas for additional screening, barriers, and/or other infrastructure changes have been identified. These infrastructure elements will be added as time and funding allow.

### Electro-shocking

Fish electro-shockers are effective tools for removing carp from water systems that contain non-target species. They are also useful in conducting fish surveys to determine the presence or absence of target and non-target species in a specific project area. The Refuge owns a backpack electro-shocker and an electrofishing barge.

**Figure R-20. Electro-shocking for carp below Sodhouse Dam.**

### Bait Stations

Bags of corn are set out in specific areas of the Refuge to attract higher numbers of fish into the area. Food types that have also been tried, but have not been as successful as corn, include dog food, flavored commercial foods, and dough balls. These stations have been used when trying to catch carp in specific areas in Malheur Lake for telemetry work.

## R.7.2 Techniques and Technologies That May Be Used to a Limited Extent

These techniques and technologies have been a part of the Refuge's carp control efforts in the past. As discussed below, their use will be minimal under this plan.

### Rotenone

Rotenone is a biodegradable pesticide used to kill undesirable fish. It is extremely toxic to fish and other organisms that require dissolved oxygen. It should be used in closed systems or predetermined reaches of rivers that have been surveyed for non-target species. Rotenone has been used in the Blitzen River and many small ponds, canals, ditches, and lakes on the Refuge from 1955 to 1999. Training is required to plan and execute a rotenone treatment, and a certified applicator is needed. Accurate determination of the volume of water to be treated is essential for calculating the correct amount of rotenone to apply. Normally 1 gallon of rotenone treats 6 acre-feet, or 2 to 8 parts per million of a 2.5 percent concentrate. The amount of rotenone necessary varies depending on the water temperature, turbidity, pH, aquatic vegetation, and oxygen levels. Live-boxes containing the target species provide a test for determining exact levels of toxicity during a project. Any application of rotenone will be conducted consistent with the procedures outlined under the Refuge's IPM plan (see Appendix G of the CCP). Use of rotenone may only occur under low-water conditions and when 100 percent mortality of carp can be achieved. Due to the non-selectivity of fish species targeted by rotenone, the project would have to determine risks and potential successes of the treatment.

Application techniques include backpack pumps, drip stations, all-terrain vehicles (ATV) sprayers, aerial sprayers, and fire engine pumps. Application by boats in deep water requires the use of an ATV sprayer with a weighted discharge hose.

**Figure R-21. In 1992 Refuge staff made a huge effort to drain Headquarters Pond with two Crissafulli pumps to remove carp.**

### Water Pumping

Pumping is the most effective control method for small to medium-sized ponds that cannot be completely drained or treated with rotenone, but the labor required is substantial, especially when compared to the results. Due to the size and bulk of the equipment involved in this type of operation, significant time is required for site preparation. This includes developing access to the site for heavy equipment, construction of a ramp and suction hole, and construction of a trench connecting the deepest part of the pond to the pump intake. Depending on the site, an outlet ditch may be required in conjunction with the use of outlet hoses.

## R.7.3 Techniques and Technologies That Are Unlikely to Be Used Again

The Refuge has already determined that certain techniques are not appropriate for carp control. These techniques and technologies have been ruled out as options for future carp control efforts.

### Poison Bait Stations

When using carp feeding stations in the past, the Refuge has sometimes laced the food with small amounts of rotenone to kill carp. A feeding station was tested at Double-O Spring, but it was abandoned when large numbers of native fish were observed feeding at the station, which is not consistent with the Refuge's IPM approach. Because this type of control also attracts and kills non-target species, it is unlikely that rotenone or other piscicides will be added to the bait at any carp feeding stations in the future.

## R.7.4 Planned New Techniques and Technologies

### Commercial Harvest

Seine nets operated by commercial fishing operations are effective for carp removal and for catching carp during mark-recapture studies. After telemetry studies identify carp aggregations, a commercial fisherman will be contracted to fish carp aggregates out with a seine net (see section S.6.3). This will theoretically happen in the winter or early spring. The Refuge will record the total weight of fish caught during commercial fishing, as well as the species of fish (because this method cannot be limited to carp completely). A subset of carp caught during commercial fishing will also be tagged as part of mark-recapture studies.

### Robotic Carp

In addition to the techniques and technologies that have already been used at the Refuge, a new method will also be tested. The robotic carp is a proposed technology from the University of Minnesota that attempts to develop a new generation of robotic sensors that could track, record data, and evaluate carp behavior in Malheur Lake. This will be a non-disruptive way to continually track telemetry-tagged fish throughout the year and receive data in real time to determine management actions. The University of Minnesota was recently awarded a grant of $2.2 million by the National Science Foundation to develop and test this technology. Field testing at the Refuge will begin in the summer of 2013.

**Figure R-22. Prototype of the robotic carp.**

### Fish Piscivory

Pending funding, a study will be conducted in collaboration with the University of Minnesota to evaluate the probability that other fish on the Refuge will prey on the invasive common carp eggs and fry. There is evidence that sustainable control may occur if there are enough piscivorous fish species to decrease carp numbers (Bajer et al. in review). The fish that would be evaluated are native tui chub, redband trout, dace, and non-native sunfish.

**Figure R-23. Native redband trout.**

## R.7.5 Potential New Techniques and Technologies

Common carp have invaded water bodies in many locations throughout the world. As a result, there are numerous ongoing efforts to develop new methods of reducing their impact. As is consistent with adaptive management, the Refuge is committed to incorporating new methods that have scientific merit and are appropriate for the Refuge's physical and biological conditions. Generally, upon learning about a new technique or technology, the Refuge reviews available information to determine if the method is likely to be effective in a setting that is present on the Refuge. If a suitable location or use can be identified, the Refuge and other members of the Aquatic Health Coalition will pursue funding. Any of the following new methods could become part of the Refuge's strategy if a suitable use can be found and a corresponding funding source can be secured.

### Catchment Basins

A field or pond will be used to attract carp and hold them, and they will be harvested fresh. Carp would be attracted to the area by water temperature, flow, or bait. Crane Pond will be an excellent site to perform this technique.

### Barriers

There are two types of barriers that could potentially be used at the Refuge (pending further analysis): electrical barriers and bubble barriers. Electrical barriers restrict upstream migration and can be designed to fit rivers as large as the Blitzen River. They operate on AC or DC power and are the most effective fish barriers because they do not interfere with aquatic debris. State-of-the-art design includes backup generators that provide electricity during power failures; however, these barriers are very expensive, and depending on location, they could pose a safety risk to visitors.

The bubble barrier, which has been used in Minnesota to stop the spread of Asian carp, uses air bubbles to create sound and water displacement to deter carp movement with much success (More information is available at http://carpbarriers.com). These barriers or bubble curtains are safer and more cost effective than other barrier technology and can be portable.

### Fish Wheels

In 2010, Industrial Power Systems donated over 200 hours of time to develop an electronic portable fish wheel design for the Refuge's carp control program. This fish wheel will use cutting-edge technology to sort fish species by color. Fish migrating upstream would swim into the fish wheel, and as the wheel rotates, the fish would be picked up by the wheel, sorted by color, and released. Carp would be culled from the wheel, and native fish would be released upstream (Figure S-24). If funding is obtained, a fish wheel will be built according to this design.

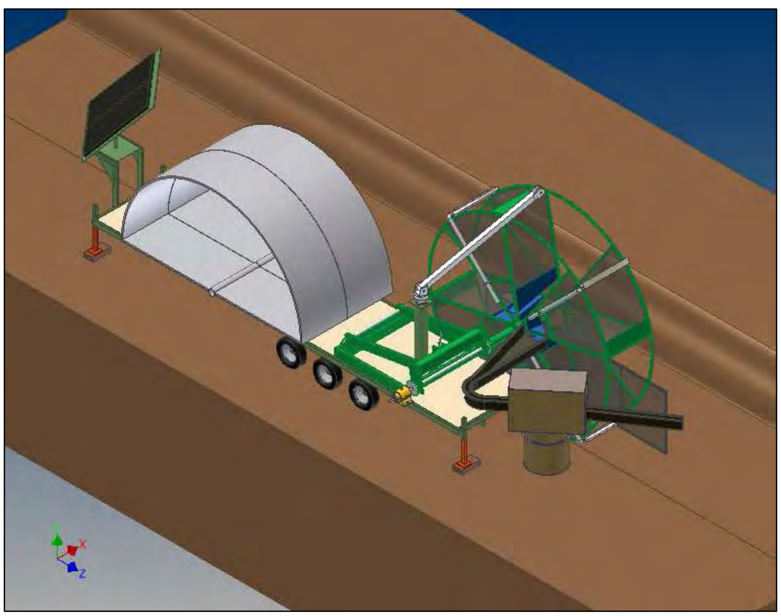

**Figure R-24. Computer simulated design of experimental carp wheel.**

### Sex Pheromones/Attractant

Carp sex pheromone technology developed by Dr. Peter Sorensen's laboratory at the University of Minnesota has been laboratory- and field-tested. This technique uses a pheromone plug surgically implanted into a female to simulate ovulation and to attract other carp. This will be a potential strategy to attract carp in low density areas. Pheromones used for pest control in the United States are considered "pesticides" by the Environmental Protection Agency (EPA) and must pass through the normal pesticide registration process. Normal procedures prior to use of a pesticide would apply, requiring considerable time and funds. Experimental use in the research phase may be possible at the Refuge, but must be approved for use under a special permit. Pheromones and identical or substantially similar compounds labeled for use only in pheromone traps and pheromone traps in which those chemicals are the sole active ingredients are not subject to regulation under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (40 CFR 152.25 (b)).

**Figure R-25. Blood sample of common carp submitted to Oregon State University for koi herpes virus genetic testing.**

**Koi Herpes Virus**

Koi herpes virus is a DNA virus that is highly pathogenic to common carp, causing mass mortality. In Australia this biological agent is being tested in laboratory conditions as a potential biological control for common carp. It has not been approved as a biological control in the United States, and it may take years to get approval in the United States if it is proved efficacious in Australia.

**Daughterless Carp**

A genetic manipulation with aromalase stops estrogen production, which biases the carp population to all males. Daughterless carp technology is just in the beginning phases of being tested by a laboratory in Australia in collaboration with Auburn University.

## R.8 Summary

The Refuge is committed to implementing effective solutions for sustainable carp control; the value of the Refuge’s lands and waters to native species demands this commitment. Realizing this goal is possible, but only with the help of other stakeholders who are concerned about the aquatic health of the Refuge and the Harney Basin.

This plan is best viewed as a living document, because each phase of data gathering will change our understanding of the dynamic forces involved in the Refuge’s complex ecosystem. With information grounded in the best available science, the Refuge and its partners will be able to respond to these forces and make decisions that take new information into account, which is a key aspect of applying adaptive management. Together, we will be able to re-establish the biological integrity of the Refuge.

## R.9 References

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Killdeer
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# *Appendix S*

## *Response to Comments*


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Appendix S
Response to Comments

Input was encouraged and used throughout the entire development of the Malheur Refuge comprehensive conservation plan/environmental impact statement (CCP/EIS). Input was incorporated through a transparent collaborative process beginning with scoping and continuing with finalization of the CCP/EIS alternatives and through the determination of the final management direction. A formal public comment period was also used upon release of the Draft CCP/EIS in March 2012.

The Service issued a planning update summarizing the CCP/EIS preliminary draft alternatives developed through the collaborative process in March 2012. In this planning update, the Service informed the public that comments and suggestions would continue to be incorporated through the collaborative process with other comments received during the formal public comment period required by the National Environmental Policy Act (NEPA). The Service released the Draft CCP/EIS on March 15, 2012, for formal public review and comment. This comment period closed on May 4, 2012. During the formal comment period, the Service received 136 comments from 41 agencies, organizations, and individuals.

The majority of comments focused on respondents' opinions toward support of the collaborative process and Alternative 2 of the Draft CCP/EIS. Many of the substantive comments were directed toward carp control, grazing and haying management tools, inventory and monitoring processes, and river functionality. Where the opinion expressed provided some level of detail or was based on a real or perceived fact, the Service has provided a response. Where the comment expressed solely an opinion and was not supported by any assertion, the Service considered the comment in selection of the management direction, but did not respond to the comment in this appendix.

A minority of comments provided factual information (both real and perceived), questioned statements and facts presented in the Draft CCP/EIS, or questioned the accuracy of information used in formulating the alternatives and/or conducting analyses as part of the EIS.

Comments received were grouped into 13 categories based upon actions considered in the Draft CCP/EIS alternatives or based on topics of particular interest as indicated by comments themselves. These categories are: Aquatic Health/Carp; Collaboration/Process; Meadow Management/Grazing and Haying; Inventory/Monitoring/Adaptive Management; Wildlife; River Function; Hunting; Fishing; Interpretation; Facilities; Wilderness; Water Management; and General. Comments presented in this appendix have been paraphrased from the originals, and in some cases were consolidated with others where the Service's response is the same.

## S.1 Aquatic Health/Carp

1. **Comment:** The Service should consider placing a greater emphasis on water manipulation as a viable carp control method.

   **Response:** The term "lacustrine" within the CCP addresses Malheur and Mud Lakes. Water manipulation does take place throughout other parts of the Refuge as a means for controlling carp and would continue to be used under this plan (Chapter 2 Objective 4c). The number one focus area for carp control is Malheur Lake; the Blitzen Valley is second and Double-O third inside refuge boundaries. The goal in the next 15 years is to acquire the resources necessary to implement science-based changes for the improvement of bird habitat. The Refuge will pursue carp control strategies in Malheur and Mud Lakes that are science based and enable biological objectives to be met while keeping costs to a minimum. With the development of new technologies for controlling carp, the Refuge will be exploring new alternatives before strategies such as repairing Cole Island dike and pumping water are pursued. Water manipulation/control in other portions of the Refuge that already have existing infrastructure will be a key component of a comprehensive carp management strategy.

2. **Comment:** The Service should consider using commercial harvest of carp as part of a strategy to improve aquatic health on the refuge.

   **Response:** Commercial harvest is one option for controlling carp. The Refuge has received many inquiries from commercial fish operations since the beginning of the planning process. Many structures within the Refuge and outside of its boundaries, such as along Rue Red Road, have been identified as possible sites for physical barriers/screens through Refuge and The Natural Resources Conservation Service carp management plans.

3. **Comment:** Commercial carp fishing is not a viable option in Malheur Lake because it already failed in the 1980s.

   **Response:** The Refuge is exploring the possibilities of commercial fishing strategies that have been recently developed specifically for carp. The latest scientific research indicates that carp concentrate in small areas underneath the ice during winter months. Commercial fishermen have developed techniques to net carp under the ice. Other commercial technologies such as fish wheels with electronic scanning eyes and portable fish processing plants are also examples of the more recent technologies the Refuge is exploring.

4. **Comment:** The Proposed Staffing in Appendix C under Alternative 2 does not reflect an adequate number of staff for the fisheries program if aquatic health is a priority.

   **Response:** All additional positions are aligned with the Refuge Operational Needs database. Positions that will help support the aquatic health program are Geographic Information System Specialist, Natural Resource Specialist, Private Lands Biologist, Volunteer Coordinator, Hydrological Technician, and the Biological Technician (habitat). The Refuge also will continue to hire temporary staff and interns (not reflected in Table C-1) to assist with fieldwork. There is also the possibility that private sector contractors will be engaged in carp control strategies.

5. **Comment:** Tables C-2 and C-3 in Appendix C should be revised to reflect the high priority of aquatic health.

   **Response:** In the Final CCP, Table C-2 was adjusted to reflect the most recent cost estimates for the aquatic health/carp program. Table C-3 deals specifically with visitor services and cultural resources.

## S.2 Collaboration/Process

6. **Comment:** The Service is strongly encouraged to build on the very successful collaborative planning process throughout the entire implementation of the CCP. Implementation needs to include strong facilitation, independent science advisory process and addressing issues in an open transparent manner.

**Response:** The Refuge recognizes the significance of the highly successful collaborative planning process. Continuing relationships with organizations such as the High Desert Partnership and Oregon Consensus will enable the Refuge to move forward with implementation in a transparent manner. The already established Ecology Working Group and Carp Coalition are examples of how the science advisory process will continue through implementation. A visual of this overall collaborative process can be found in Figure 2.1 in Chapter 2 of the CCP.

## S.3 Meadow Management/Grazing and Haying

7. **Comment:** More information is needed about the potential impacts to current refuge haying and grazing permit holders with the expiration of current cooperative land management agreements when the final CCP is signed.

   **Response:** There will be no impact to Refuge permittees in regard to the land exchange between the Refuge and the Bureau of Land Management (BLM). These areas fall outside of the habitat treated via the haying and grazing program.

8. **Comment:** Include a clause in the compatibility determination for the haying and grazing program that cooperative land management agreements could be modified within the initial 5-year timeframe if significant unanticipated impacts to plant communities are documented.

   **Response:** Changes to the haying and grazing compatibility determination were made to differentiate between trend and operational changes to CLMAs. Trend involves the 5-year timeline for assessing response of plant communities to treatment. Operational changes will take place within the 5-year window if the physical management of the CLMAs needs to be adjusted (e.g., are non-target habitats being impacted?).

9. **Comment:** The compatibility determination for grazing and haying on the refuge is not supported by information in the CCP.

   **Response:** In Chapter 6 of the CCP and in the compatibility determination for haying and grazing, the anticipated environmental effects associated with the haying and grazing program are described in detail. Based on the effects disclosed in the CCP, the haying and grazing program as described in the management direction will contribute to achieving Refuge purposes and the Refuge System mission by providing valuable foraging, resting, pairing, nesting, and brood-rearing areas and conditions for the sandhill crane, bobolink, cinnamon teal, and other meadow-dependent species. The benefits of using grazing and haying as appropriate management tools on Malheur Refuge are based on Refuge-specific knowledge from seven former biologists with 50 collective years of experience along with the sound professional judgment of current biologists and ecologists using the best available science to manage the site-specific conditions on Malheur Refuge. The Refuge has also committed to an adaptive management process that allows for future changes based on site-specific science.

10. **Comment:** The Service should conduct pre-treatment inventories of wildlife populations as well as monitoring during and after haying and grazing treatments.

    **Response:** The following language has been added to the Haying and Grazing Compatibility Determination under Stipulations Necessary to Ensure Compatibility (page B-102): “A pre-treatment inventory of local wildlife populations within the proposed warm season treatment area will take place prior to the initiation of treatments." This will aid in understanding potential wildlife impacts to ensure that the specific habitat improvements that are being sought justify localized, short-term wildlife production losses.

11. **Comment:** In the justification section of the haying and grazing compatibility determination concerning the impacts of treatments on wildlife populations, behavior and welfare were not supported by data currently available from the refuge.

    **Response:** Conclusions drawn within the second paragraph of the justification found within the haying and grazing compatibility determination are based on 50 collective years of experience of past and present Refuge wildlife biologists and ecologists for dormant season haying and rake-bunch grazing and associated wildlife monitoring. The Refuge has also committed to the implementation of an extensive neutral third-party habitat inventory and monitoring program. The results of this program will be reviewed on an annual base through a continuing collaborative process with Refuge stakeholders. Experimental warm-season treatments will occur only on a very small scale (approximately <500 acres). Please refer to Section B-7 of the CCP, "Overview of the Four Treatment Types."

12. **Comment:** The Service should insert a Table in Appendix K - Wet Meadow Treatment Ratios comparing the present acreages hayed, grazed or farmed under Alternative 1 with the corresponding acres planned for Alternative 2.

    **Response:** Appendix K now includes a table that will be used to capture all treatments during the life of the CCP.

13. **Comment:** The Service should increase the use of fire and decrease the use of haying and grazing.

    **Response:** Prescribed fire is a tool that is pursued to the fullest extent feasible within the CCP. Funding limitations, site-specific issues (e.g., dominance of annual grasses in sagebrush lowlands, perennial pepperweed in wet meadows), and strategic containment requirements prevent this tool from being used in a way that replaces other vegetation management strategies such as haying and grazing.

14. **Comment:** The CCP needs to reference the grazing plans developed for the Blitzen Valley and Double-O portions of the Refuge.

    **Response:** The Blitzen Valley and Double-O management plans were utilized in the development of the CCP. They are cited as Rule et al. 1990 and David J. and Gary Ivey 1995, respectively.

## S.4 Inventory/Monitoring/Adaptive Management

15. **Comment:** Through inventory and monitoring data should be collected to determine the effectiveness of all treatment tools such as fire, flooding, prescribed drought, grazing etc.

**Response:** This suggestion will be given to the Ecology Work Group and will be factored into the continued formulation of the Inventory and Monitoring Plan. It is agreed that documentation of all management activities will be critical in developing the State-and-Transition Model and understanding habitat responses.

16. **Comment:** Are survey transects for wildlife use as outlined in the draft Inventory and Monitoring plan large enough to sufficiently determine the effectiveness of treatment tools.

    **Response:** The Refuge's inventory and monitoring program will be based on established scientific protocols used to evaluate effectiveness of management strategies.

17. **Comment:** Are species identified in the Draft Inventory and Monitoring plan representative of the full suite of species for which the refuge is managed?

    **Response:** The process used for selecting priority resources of concern (i.e., focal species) is found in Section 4.2 of the CCP. The tables that follow identify a suite of other benefiting species that are represented by the focal species chosen.

18. **Comment:** The Service needs to consider identifying area-specific vulnerabilities (habitats and species) in developing adaptive management strategies.

    **Response:** Goals and objectives found within the CCP are organized by habitat types (e.g., lacustrine, wet meadow, etc.). Each objective and corresponding management strategies have been established with consideration to the unique needs and sensitivities of the plant communities and associated wildlife (i.e., habitat) within which they are placed.

19. **Comment:** The use of cattle as a tool to meet habitat objectives needs to scientifically justified.

    **Response:** In adopting the 60:40 ratio to begin the implementation of the CCP, the Refuge relied on the reasonable opinions of its own qualified experts, both past and present. Appendix K states that "this figure is based on the sound professional judgment of seven past and present Refuge wildlife biologists with 50 collective years of experience managing Refuge meadows. This ratio is relevant only when considering all wet meadows within the Refuge and differs across fields and area-specific management units. The needs of focal species, the suite of wildlife they represent, and the nature of habitats they depend on determines the use and extent of these tools in realizing or maintaining attributes identified under Objective 4a." This ratio provides an understanding of the overall use of haying and grazing but does not address the specific needs of wildlife in specific areas. This is why the ratio is only being used as a starting point. The meadow treatments will be adjusted as area-specific needs and Inventory and Monitoring data are considered during the annual review process involving the agency, the Ecology Work Group, and the collaborative group. This will lead to an adjustment to the ratio to provide clarity regarding the extent of treatments taking place over time. As discussed in Appendix K, the actual ratio currently varies widely from 90:10 in wet meadows within the southern Blitzen Valley to 30:70 in the North Blitzen Valley. The 60:40 ratio is meant to be illustrative, not definitive. The CCP has been revised to eliminate describing the 60:40 ratio as an objective.

20. **Comment:** The implementation priority for studies of seasonally flooded wet meadows should be "very high" instead of "high."

**Response:** Because inventory and monitoring activities associated with wet meadows are centered on third-party science and are being established based on a commitment of continuity, it is appropriate to classify the implementation priority for this habitat type as "very high."

21. **Comment:** The Service should use the National Vegetation Classification System for identifying vegetation types.

    **Response:** The Cowardin system (1979) recognizes hydrological features within its classifications, which aligns naturally with the habitat types identified within this CCP (differentiating lakes versus small ponds, wet meadows versus marshes, etc.). The National Vegetation Classification System is based on the expression of vegetation and does not lend itself as naturally to separating habitats across hydrological gradients. Crosswalks can be provided to enable land managers and interested public to understand how habitats and associated vegetation communities fall within both widely used systems.

22. **Comment:** The Service needs to establish a scientifically based inventory and monitoring plan that will allow for informed adaptive management decisions. The inventory and monitoring process needs to be done in collaboration with both scientist and stakeholders.

    **Response:** The collaborative nature of the Inventory and Monitoring Plan will be a tremendous strength as the Refuge moves forward with the implementation of the CCP. Third-party experts from various universities, nongovernmental organizations, and other government entities have become very active in assisting in the design and methodology of the Inventory and Monitoring Plan to maximize the efficiency of data collection and analysis in addressing whether management actions are meeting objectives and, ultimately, if the objectives themselves are sufficient. Finalizing the Inventory and Monitoring Plan is a top priority for the upcoming 2013 field season.

## S.5 Wildlife

23. **Comment:** Additional rational is needed in the compatibility determination for grain farming to show what the impacts would be to sandhill cranes and waterfowl species if farming is not conducted on the refuge.

    **Response:** The rationale for the use of grain on Malheur NWR is based on both Refuge and Pacific Flyway Council plans (see Farming Compatibility Determination, Section B.10 of the CCP). In the Pacific Flyway Plan, Malheur Refuge is identified as one of only four autumn staging and migration stopover sites for greater sandhill cranes. It is also recognized for the ability to provide the necessary feeding/grain sites adjacent to large isolated wetlands secure from human disturbance. If Malheur Refuge does not provide both feeding and roosting sites for greater sandhill cranes, the birds will be required to seek other areas to meet these needs. These areas will not likely be under management strategies with a primary purpose of providing for the needs of wildlife and therefore are at risk of not being secure in meeting the needs of migrating cranes.

24. **Comment:** The three focal species listed for wet meadows all prefer short vegetation and do not reflect species which may use the taller, untreated vegetation in wet meadows. The focal species

used for monitoring this habitat type should reflect the entire guild of birds which may be present.

**Response:** Cinnamon teal was selected to represent the suite of species that use idle meadows (tall vegetation for nesting cover). The Draft CCP Table 4-4 did not provide a description of habitat structure and attributes that describe breeding habitat. This has been addressed in the Final CCP.

25. **Comment:** The Service should remove abandoned and interior fences to reduce impacts to wildlife.

    **Response:** The Refuge incorporates the removal of old fences with any new replacement fence projects. The Refuge continues to work on the removal of fences that were abandoned many years ago as resources are available. Through the use of interior fence the Refuge is better able to achieve habitat objectives. Herding has and will continue to be used in specific situations.

26. **Comment:** The Refuge should use artificial goose nest structures.

    **Response:** Waterfowl populations nest very successfully on the Refuge. Artificial nesting structures are generally used as a substitute for the lack of proper or sufficient conditions for a group of birds or an individual nesting species. Structures also require cleaning, maintenance, and replacement, which cannot be justified with limited refuge resources available and nesting waterfowl populations doing well.

27. **Comment:** Opening Krumbo reservoir to winter vehicle access will cause negative impacts to wintering waterfowl.

    **Response:** The Refuge is not known as a large wintering waterfowl area. The birds using the refuge during this period scatter throughout the Blitzen Valley and Double-O area. They remain on the Refuge over the winter period only as long as there is open water available. During the winter, consistent open water is available around hot springs, the river, and a few channels with flowing water. The Refuge has a number of impoundments and water bodies such as Boca Lake used by wintering waterfowl as roosting sites that are close to these open water areas. Opening Krumbo Reservoir to winter vehicle access will not negatively impact refuge overwintering waterfowl populations.

## S.6 River Function

28. **Comment:** The CCP should reflect a stronger commitment to the restoration of the Blitzen River to natural conditions.

    **Response:** The Refuge recognizes the importance of proper functioning ecological systems. The Refuge is committed to prioritizing and refining a set of priority questions/objectives creating a scientific foundation to construct a comprehensive riverine strategy. Based on these questions/objectives the Refuge will take advantage of new resource opportunities to implement appropriate science-based steps to continue the advancement of a comprehensive river strategy. To reflect this, adjustments were made to Goal 2 Objective 2a.

## S.7 Hunting

29. **Comment:** The Service should use a 5 year average of hunting conditions on the refuge to better discuss waterfowl hunt days and hunter usage rather than using only 2011 data which only represents one year for a hunting program that has taken place over many years.

    **Response:** Since the flood events in the late 1980s, the lake topography has been altered due to ice and wave action. Changes in topography combined with dramatic fluctuations in water level and impacts of common carp have had a negative impact to the plant communities that support waterfowl. During this same timeframe, dramatic fluctuations in water levels have also limited hunting access to the lake. These two factors (limited waterfowl food and reduced access) have in general resulted in low hunter use of the area during most years. An exception would be in the year 2011 when higher numbers of waterfowl hunters did use the area because of improved conditions. It is also possible hunter visits may increase with the addition of a stable boat launch site and a larger hunting area. Waterfowl and associated hunting use of the area would also be expected to increase as habitat conditions improve as a result of carp control.

30. **Comment:** The Double-O unit of the Refuge should be opened for public hunting.

    **Response:** The Double-O Unit was excluded due to the conflict with the values in the area, both biological and cultural. Allowing hunting in this area was not determined to be appropriate through our compatibility determinations.

31. **Comment:** The area between Diamond Lane and Krumbo Lane should be open to upland game hunting.

    **Response:** The existing upland game hunt in the Buena Vista hunt unit consists of 36,000 acres and is a quality program. Additionally, under Objective 8a, the hunt season will extend the season opener from the fourth Saturday of October to the end of the State pheasant season, which will provide an additional hunting opportunity. The P Ranch Unit was also considered for hunting opportunity, but was rejected due to conflicts with wintering waterfowl, which use the P Ranch Unit more heavily than other units because of the access to open water.

32. **Comment:** The Buena Vista unit should not be open to public hunting to avoid conflicts with photographers.

    **Response:** The Buena Vista Unit hunt season will be from the fourth Saturday of October to the end of the State pheasant season. The hunt area contains 36,000 acres, which allows hunters to disperse. This dispersed hunting activity is not expected to conflict with other compatible wildlife-dependent recreation, including viewing wildlife or photography.

## S.8 Fishing

33. **Comment:** The Service should consider opening Malheur Lake to carp and trout fishing.

    **Response:** Per the management direction, the Refuge will be creating additional fishing opportunities. Krumbo Reservoir will now be open to year-round fishing and the Blitzen River from Sodhouse Lane to the boat landing bridge will be open from August 1 to September 15 to enhance carp fishing opportunities. The Refuge may at some future point reevaluate fishing in Malheur Lake as carp control strategies become finalized.

34. **Comment:** The Service should consider not opening the Krumbo Road during winter months to vehicle access to prevent road damage.

    **Response:** Year-round access to Krumbo Reservoir would provide greater opportunity for wildlife viewing, boating, and fishing. As noted in Objective 8d, the access would close when road conditions are hazardous to prevent road damage. We also expect wintertime visitor use to be light, and any road damage that may occur is not expected to significantly impact the road.

35. **Comment:** Opening East canal to vehicle access will ruin the fisheries.

    **Response:** Prior to 1999 East Canal was open to vehicle access. During this time East Canal was a good fishery. Since 1999 additional habitat improvement projects have occurred in East Canal to improve upon the existing fishery.

36. **Comment:** The East Canal access should allow vehicle access to public lands south of Bridge Creek.

    **Response:** The opening of East Canal to vehicle access will allow the public to access the crossing south of Bridge Creek that could access Granddad Reservoir on BLM lands (dependent upon BLM regulations). East Canal road north of Bridge Creek will remain closed to vehicle access to enable the Refuge to meet wildlife objectives.

## S.9 Interpretation

37. **Comment:** The Service should incorporate interpretive themes that include the importance and connectivity of Basin and upland watershed agricultural flood irrigation practices.

    **Response:** Please see Objective 7c.

38. **Comment:** A high priority should be placed on interpretation that engages the public in the specific priorities of the CCP (for example carp control) as well as on the cultural, historic, natural history and ecology of the area.

    **Response:** Please see Objectives 7c and 7d.

39. **Comment:** Outreach materials should be developed that promote the broadest aspirations of the CCP including restoration in the Blitzen River Valley and the Double-O.

    **Response:** Please see Objective 7c.

40. **Comment:** Brush should be removed to improve wildlife viewing/photography opportunities along center patrol road.

**Response:** Under Objective 7a, it is stated that we will provide a variety of vehicle pull-offs on the 42-mile Blitzen Valley auto tour route (Center Patrol Road) at key locations to enhance the birding experience, including photography; this will include clearing areas of willow overgrowth.

## S.10 Facilities

41. **Comment:** The Service should consider creation of additional pullouts along State Highway 205 north of the Narrows.

    **Response:** Under Objective 7a, it is stated that we will participate in the Basin and Range Birding Trail on-refuge with Harney County Chamber of Commerce and other partners. This will include providing additional areas for vehicle access and pull-offs. The consideration to provide pull-offs off-Refuge, including along State Highway 205, was addressed. However, to accomplish public use goals and objectives identified within the 15-year plan, we focused on enhancing experiences on-Refuge.

42. **Comment:** Signage should be increased to support direct engagement of Refuge visitors.

    **Response:** Please see Objective 6a.

43. **Comment:** The wildlife observation blind at the Headquarters should be reconstructed.

    **Response:** A wildlife observation blind on the pond at Headquarters, with an accompanying trail, was completed in September 2012.

## S.11 Wilderness

44. **Comment:** Would wilderness designation benefit Refuge management?

    **Response:** On a national wildlife refuge, a unit of land must meet the “purpose” for which the refuge was created. If a parcel of land is not meeting refuge purpose it cannot be moved forward for potential wilderness designation. Currently the only portion of Malheur Refuge that is meeting Refuge purpose and has wilderness character is the Harney Lake Unit. Wilderness designation of this unit would not impact Refuge management. Malheur Lake may have wilderness character but is not currently meeting Refuge purposes due to impacts from invasive species.

## S.12 Water Management

45. **Comment:** There are opportunities in the Double-O portion of the Refuge to manage water jointly while meeting objectives on both private and Refuge lands.

    **Response:** Because of a lack of a defined water delivery system in the Double-O area it is necessary to manage water jointly between private and public (Refuge) or private and private water users. There are a variety of mechanisms such as easements, water sharing agreements, etc. that would have to be put in place. For these mechanisms to be implemented there would have to be benefits to the involved parties.

## S.13 General

46. **Comment:** Portland Audubon Society's Dave Marshall Internship should be added to the list of objectives under Goal 9a.

    **Response:** Because the Portland Audubon Dave Marshall Internship is not specific to Malheur NWR, this internship along with all other possible internships is included in the more general heading of building partnerships and public outreach.

47. **Comment:** Maintenance costs and staffing of facilities were not included in the plan under Appendix C - Implementation.

    **Response:** Staffing needs/costs are reflected in Appendix C Table C-1. Facilities costs are shown in Appendix C Table C-3.

48. **Comment:** CCP/EIS document needs to be formatted in a manner the reader can find important information.

    **Response:** It is acknowledged that the CCP/EIS is a very large document. The complexity of management at Malheur NWR combined with the legal requirements of the National Environmental Policy Act has resulted in a lengthy document.

## S.14 References

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. Available at: http://www.npwrc.usgs.gov/resource/1998/classwet/classwet.htm (Version 04DEC98).