Fish Springs National Wildlife Refuge

Draft Comprehensive Conservation Plan
and
Environmental Assessment

Prepared by U.S. Fish & Wildlife Service

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Summary

Fish Springs National Wildlife Refuge (NWR), located in western Utah in Juab County (see Figure 1 on page 1 and Figure 2 on page 2), is one of the most isolated refuges in the lower 48 states. The nearest neighbors reside in Callao, Utah, a ranching community of about 45 people, 24 miles west of the Refuge. The nearest communities with services are Dugway Proving Ground, Utah, 63 miles to the northeast and Delta, Utah, 78 miles to the southeast. The Refuge consists of 17,992 acres of fee-title land surrounded on the east, west, and south by Bureau of Land Management (BLM) holdings and on the north by the U.S. Army's Dugway Proving Ground. Springs flowing from the eastern base of the Fish Springs Range feed a 10,000-acre saline marsh divided into nine impoundments (see Figure 3 on page 3). The remaining portion comprises 6,000 acres of mud and alkali flat and 2,000 acres of semidesert upland.

The Refuge was established because of its historical attraction of waterfowl. Since Refuge establishment, more than 278 species of birds have been seen at Fish Springs NWR, 61 of which nest on the Refuge. The Refuge provides the only important wetland habitat for a 70-mile radius. Consequently, the Refuge attracts hundreds of wetland-dependent species during migration. During fall migrations, 30,000 ducks have been recorded. More than 40 species spend the winter at the Refuge. The Refuge also provides habitat for threatened and endangered species including bald eagle and least chub.

Fish Springs NWR has a rich and diverse human history. It has likely been a focal point of human existence as long as 11,000 years. Evidence of pre-historical occupation is found over nearly all of the Refuge.

Euro-American history of the Refuge begins in 1827 with the first documented visit to the marsh by famed mountain man and pioneering explorer Jedediah Smith. In 1860, Fish Springs became a stop on the Pony Express Route and Overland Stage routes. In 1861, the Transcontinental Telegraph line passed through Fish Springs. In 1913, the Lincoln Highway, the nation's first transcontinental automobile road, passed through Fish Springs.

This Draft Comprehensive Conservation Plan (CCP) for the Fish Springs NWR discusses the planning process, Fish Springs NWR characteristics, and the U.S. Fish & Wildlife Service's (Service) proposed management for the Fish Springs NWR for the next 15 years. An Environmental Assessment describing the anticipated effects of the Service's proposed management and other alternatives is incorporated into this document.

The purpose of the proposed CCP is to describe the goals established for Fish Springs NWR, and the objectives and strategies needed to meet the goals. The goals for Fish Springs NWR include five focus areas: habitat, ecological integrity, visitor services, cultural resources, and partnerships.

The purpose of developing the CCP is to provide the Refuge Manager with a 15-year management plan for the conservation of wildlife, fish, and plant resources and their related habitats, while providing opportunities for compatible wildlife-dependent recreational uses.

The Environmental Assessment conducted for this CCP evaluates three alternatives:

- Alternative A – No Action
- Alternative B – Refuge Restoration
- Alternative C – Management for Wildlife Diversity (Proposed Action)

Table S-1 provides a summary comparison of alternatives.

In the No Action alternative, the Service would not implement any new management, restoration, and visitor service programs at the Refuge. The current management as described

in the Marsh Management Plan (1991), the Wildland Fire Management Plan (2002), and the Integrated Pest Management Plan (2003) would continue.

Restoration of Refuge habitats to pre-Refuge conditions would be the focus of Alternative B. Marsh restoration would consist of removing all dikes and water control structures, and allowing restoration of pre-Refuge hydrology and landforms. All interior Refuge roads would be removed and native vegetation restored. Habitat management would strive to eliminate invasive weed species and restore pre-Refuge vegetation communities in the marshes and high desert shrubland community.

In Alternative C, Refuge management would focus on providing habitat for the maximum diversity of wildlife, including migratory birds, and native mammal, mollusk, invertebrate, and amphibian communities. Under this alternative, habitat needs for species other than migratory birds that had not been addressed adequately in past management efforts would be fully integrated into management efforts. Ensuring that the full complements of fauna and flora historically represented on the Refuge are recognized and that full efforts to understand and meet the habitat requirements for these species would be made a priority.

The environmental consequences of each alternative were evaluated and compared. A summary comparison of environmental consequences is presented in Table S-2.

Table S-1. Summary comparison of alternatives.

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Marsh Management	• Continue current management of marsh for waterfowl, shorebirds, and water birds - mosaic of deep water, shallow water, and mud flats • Continue seasonal drawdowns on 5-year cycle • Prescribed burning in different units	• Remove all dikes and water control structures to bring Refuge lands back, as much as possible, to its original natural hydrology • Water would flow from springs unimpeded	• Continue current management of marsh for waterfowl, shorebirds, and water birds - mosaic of deep water, shallow water, and mud flats • Restore Harrison Unit to historical hydrological, physical, and biological conditions • Enhance areas of potential colonial wading bird habitat • Seasonal drawdowns or water increases in some units • Prescribed burning in different units • Consider subdividing some impoundments for more efficient use of limited water inflows • Conduct bathymetric survey of all marsh impoundments • Identify and monitor species indicative of habitat
Uplands High Desert Shrubland	• No active management – passive management and wildfire suppression	• Determine historical native floristic complement of high desert shrubland community • Research appropriate restoration methods • Restore to appropriate floral complement	• Determine historical native floristic complement of high desert shrubland community • Research appropriate restoration methods • Restore to appropriate floral complement

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Ecological Integrity	• Assess population levels and trends of birds using the Refuge - continue bimonthly bird counts/index, spring mist-netting, and shorebird surveys • Continue work to minimize impacts of military overflights • Continue to manage invasive plant species • Continue to monitor and protect sensitive species habitat	• Institute complete and comprehensive biological monitoring plan - monitoring of waterfowl, shorebirds, passerines and other birds; predators; small mammals, reptiles and amphibians, and invertebrates • Develop complete GIS-based vegetation mapping for all Refuge lands • Manage lands for native plant and animal species, taking steps to limit impacts of nonnatives • Continue work to minimize impacts of military overflights	• Institute complete and comprehensive biological monitoring plan - monitoring of waterfowl, shorebirds, passerines and other birds; predators; small mammals, reptiles and amphibians, and invertebrates • Develop complete GIS-based vegetation mapping for all Refuge lands • Manage lands for native plant and animal species, taking steps to limit impacts of nonnatives • Continue work to minimize impacts of military overflights • Implement habitat initiatives on behalf of threatened and endangered species, specifically snowy plover, bald eagle, and least chub • Establish a baseline for hydrological, chemical, physical, and biological conditions of Harrison Unit in three phases • Restore unimpeded flows to Harrison Unit • Identify and monitor indicator species to evaluate biota response to habitat change • Monitor hydrological, physical and biological conditions of Harrison Unit • Establish an adaptive management approach to restored flows in the Harrison Unit
Roads	• No changes - all roads outside sanctuary areas open to public, with some limited seasonal closures	• All dike roads would be removed	• Dike roads in Harrison Unit would be removed

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Sanctuary Areas-Closed to Public	• No changes - 10,746 acres or 60% of Refuge	• Undetermined until marsh restoration completed	• Undetermined until marsh restoration in Harrison unit is complete
Hunting	• Waterfowl hunting (no swans or snipe) • Three universally accessible blinds	• Waterfowl hunting (no swans or snipe) • Institute a goose hunt • One universally accessible blind	• Waterfowl hunting (no swans or snipe) • Institute a goose hunt • Three universally accessible blinds
Fishing	• None	• None	• None
Wildlife Observation, Photography and Interpretation	• Thomas Ranch Watchable Wildlife Area • Limited boating • Three universally accessible blinds • Visitor contact kiosk • International Migratory Bird Day event • Annual public visitor event • Auto-tour route	• Thomas Ranch Watchable Wildlife Area • Expanded Boating • One universally accessible blind • Visitor contact kiosk • International Migratory Bird Day event • Annual public visitor event • Construct universally accessible interpretive boardwalk • Construct viewing platform	• Thomas Ranch Watchable Wildlife Area • Limited boating • Three universally accessible blinds • Visitor contact kiosk • International Migratory Bird Day event • Annual public visitor event • Auto-tour route • Construct universally accessible interpretive boardwalk • Construct two viewing platforms
Environmental Education	• Host Boy and Girl Scouts as requested • Occasional tours for other groups as requested • Host visits by school groups as requested	• Host Boy and Girl Scouts as requested • Occasional tours for other groups as requested • Host one to two visits from school groups annually • Conduct two to four in-school programs annually	• Host Boy and Girl Scouts as requested • Occasional tours for other groups as requested • Host one to two visits from school groups annually • Conduct two to four in-school programs annually
Other	• Maintain current outreach and volunteer program	• Expand outreach and volunteer programs	• Expand outreach and volunteer programs

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Cultural Resources	• Continue current level of cultural resource protection • Host University of Utah archaeological summer field school as opportunities arise • Cultural resources display and Lincoln Highway marker and sign in Headquarters building	• Increase protection of known resources • Host University of Utah archaeological summer field school as opportunities arise • Cultural resources display and Lincoln Highway marker and sign in Headquarters building • Work with partners to excavate two archaeologically important caves on Refuge • Perform a complete cultural resources inventory • Possibly nominate entire Refuge as a National Archeological District • Produce interpretive brochure about prehistoric and historic cultural resources of the Refuge • Construct turnout along county road with panel interpreting use of area as a transportation area through time • Interpretive panel at Watchable Wildlife Area focusing on uses of area from prehistoric occupation up to early days of Refuge	• Increase protection of known resources • Host University of Utah archaeological summer field school as opportunities arise • Cultural resources display and Lincoln Highway marker and sign in Headquarters building • Work with partners to excavate two archaeologically important caves on Refuge • Perform a complete cultural resources inventory • Possibly nominate entire Refuge as a National Archeological District • Produce interpretive brochure about prehistoric and historic cultural resources of the Refuge • Construct turnout along county road with panel interpreting use of area as a transportation area through time • Interpretive panel at Watchable Wildlife Area focusing on uses of area from prehistoric occupation up to early days of Refuge

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Partnerships	• Continue partnerships with University of Utah Museum of Natural History, Brigham Young University, and Southern Utah University for archaeological, geomorphological, and biological research • Continue Partners for Fish and Wildlife with Utah DWR for least chub re-introduction and other projects	• Continue partnerships with University of Utah Museum of Natural History, Brigham Young University, and Southern Utah University for archaeological, geomorphological, and biological research • Continue Partners for Fish and Wildlife with Utah DWR for various projects • Assist in formation of Eastern Bonneville Basin partnership • Renew participation in Partners in Flight, Intermountain West Joint Venture All Birds Conservation, and Intermountain West Regional Shorebird Plan team	• Continue partnerships with University of Utah Museum of Natural History, Brigham Young University, and Southern Utah University for archaeological, geomorphological, and biological research • Continue Partners for Fish and Wildlife with Utah DWR for least chub re-introduction and other projects • Assist in formation of Eastern Bonneville Basin partnership • Renew participation in Partners in Flight, Intermountain West Joint Venture All Birds Conservation, and Intermountain West Regional Shorebird Plan team

Table S-2. Summary of environmental consequences.

Goal Area	Alternative A (Current Management)	Alternative B	Alternative C (Proposed Action)
Marsh	• Slow erosion of waterfowl wintering, migration, and nesting habitat • Decreased aquatic invertebrate productivity • Decreased quality of foraging in some units • Shorebird and colonial waterbird nesting habitats maintained at existing levels • Substantial degradation of shorebird migration habitat • Degradation of marsh upland habitat • Less saltgrass and Baltic rush	• Open water and islands replaced by braided channels • Drastic reductions in wintering, migration, and nesting habitat for waterfowl and shorebirds • Reduction in use of Refuge by waterfowl and shorebirds to fraction of present • Less foraging habitat for wading birds • Increase in habitat preferred by wetland-nesting passerines • Indeterminate effect on habitat needs of piscivorous birds	• Improved wintering, migration, and nesting habitat for waterfowl • Increased production of aquatic invertebrates • Increased brood survival rates for waterfowl and shorebirds • Increased spring migration habitat for shorebirds • Nesting habitat for up to 150 more pairs of colonial water birds • Enhanced potential habitat for colonial waterbirds • Restoration of historical marsh hydrology and wildlife communities in Harrison Unite • Increased biodiversity of native flora and fauna and a diverse mosaic of habitat • Decreased flora and fauna dependent on open water habitat
High Desert Shrubland	• Unpredictable restoration of native grasses • Native plants slowly increase in abundance • Very limited expansion of cheatgrass	• Historical native plant composition restored • Increase in native grasses • Improvement in relative abundance of native to nonnative plants • Improved quality of habitat for high desert shrubland dependent bird, mammal, and invertebrate species	• Same as Alternative B

Goal Area	Alternative A (Current Management)	Alternative B	Alternative C (Proposed Action)
Ecological Integrity	• Spread of *Phragmites australis* • Decline in native snail diversity • Possible decline in least chub population • No increases in snowy plover nesting success • No bald eagle roosting sites free from disturbance	• Greatly improved natural ecosystem integrity • Reductions in *Phragmites australis*, whitetop, and tamarisk • Preservation of native spring snail species richness • Drastic decline in least chub population • Large increase in mosquito fish population • Possible degraded foraging and nesting habitat for snowy plover • No bald eagle roosting sites free from disturbance • Smaller prey base for bald eagles and other birds of prey, coyotes, and red fox • Increase in native marsh plants • Increased wetland-nesting passerine populations	• Reduction in *Phragmites australis*, whitetop, and tamarisk • Preservation of native spring snail species richness • Increase in least chub population • Increased snowy plover nesting success • Disturbance-free bald eagle roosting sites • Slight increases in prey base for bald eagles and other birds of prey, coyotes, and red fox • Increase in native marsh plants • Improved habitat for wetland-nesting passerines, waterfowl, shorebirds, and water birds • Increased protection for breeding waterbirds
Visitor Services	• Currently ranges between 2,000-3,100 annual visitations • Increased hunting opportunities • 50 students/year reached through environmental education programs	• Decrease to 1,500 annual visitations • Increased hunting opportunities • Vehicle access to Refuge limited, due to elimination of roads • Increased boat and foot access opportunities • Loss of open water for boating • 200 students/year reached through environmental education programs	• Increase to 5,000 annual visitations • Increased hunting opportunities • Increased opportunities for wildlife observation and photography • 200 students/year reached through environmental education programs • Opportunities for boating closed until August 15
Cultural Resources	• Continued loss of cultural artifacts due to theft • Better protection of important sites • No significant disturbance to wildlife resources	• Decreased loss of cultural artifacts due to theft • Improved protection of all sites • Increased opportunities for learning about cultural significance of Fish Springs area • No significant disturbance to wildlife resources	• Same as Alternative B

Goal Area	Alternative A (Current Management)	Alternative B	Alternative C (Proposed Action)
Partnerships	• More informed management of Refuge biological and cultural resources • Higher likelihood of achieving Refuge objectives	• More informed management of Refuge biological and cultural resources • Higher likelihood of achieving Refuge objectives • Greater regional contribution by Refuge	• Same as Alternative B

Chapter 1 Introduction, Purpose of and Need for Action

1.1 Background

Fish Springs National Wildlife Refuge (NWR), located in western Utah in Juab County (Figure 1 and Figure 2), is one of the most isolated refuges in the lower 48 states. The nearest neighbors reside in Callao, Utah, a ranching community of about 45 people, 24 miles west of the Refuge. The nearest communities with services are Dugway Proving Ground, Utah, 63 miles to the northeast and Delta, Utah, 78 miles to the southeast. The Refuge consists of 17,992 acres of fee-title land surrounded on the east, west, and south by Bureau of Land Management (BLM) holdings and on the north by the U.S. Army's Dugway Proving Ground. Springs flowing from the eastern base of the Fish Springs Range feed a 10,000-acre saline marsh divided into nine impoundments (Figure 3). The remaining portion comprises 6,000 acres of mud and alkali flat and 2,000 acres of semidesert upland.

Fish Springs NWR sits in a valley at the eastern front of the Fish Springs Range. The Great Salt Lake Desert is to the north, with the small Thomas and Dugway Ranges to the east and the House Range to the south closing the basin. The valley is about 10 miles wide and 20 miles long. The Fish Springs Range is characterized by rocky outcroppings and lava peaks with some areas devoid of vegetation. The Refuge is entirely within the Interior Basins ecoregion. Within the expanse of that ecoregion, the Refuge lies within the sub-unit known as the Bonneville Basin.

The Refuge was established because of its historic attraction to waterfowl. During fall migrations, 30,000 ducks have been recorded. Since establishment, more than 278 species of birds have been seen at Fish Springs NWR, 61 of which are known to nest on the Refuge. The Refuge provides the only important wetland habitat for a 70-mile radius. Consequently, the Refuge attracts hundreds of wetland-dependent species during migration. More than 40 species spend the winter at the Refuge.

Fish Springs NWR has an extraordinarily rich and diverse human history. As a source of bountiful resources in a very arid and often hostile environment, it has likely been a focal point of human existence as long as 11,000 years. Evidence of such pre-historic occupation can be found over nearly all of the Refuge. Two caves within the Refuge boundary, located on the east face of the northern tip of the Fish Springs Range, are part of a National Archaeological District.

Figure 1. Interior Basin Ecosystem and National Wildlife Refuges in Utah.

Fish Springs NWR

Figure 2. Ancient Lake Bonneville.

Figure 3. Fish Springs National Wildlife Refuge Units and Pools.

Euro-American history of the Refuge begins in 1827 with the first documented visit to the marsh by famed mountain man and pioneering explorer Jedediah Smith. Smith stopped at Fish Springs on one of his trips to California. The first documented occupation at the marsh was in existence by 1858. In 1860, Fish Springs became a stop on the Pony Express Route and Overland Stage routes. In 1861, the Transcontinental Telegraph line passed through Fish Springs. In 1913, the Lincoln Highway, the nation's first transcontinental automobile road, would pass through Fish Springs to skirt the often impassable salt flats to the north. It is estimated that at the peak usage period for the Lincoln Highway, over 5,000 cars passed each year, compared to less than 2,500 cars currently. Several segments of the Lincoln Highway are still visible in Refuge uplands.

1.2 Comprehensive Conservation Plans

This Draft Comprehensive Conservation Plan (CCP) for the Fish Springs NWR discusses the planning process, Fish Springs NWR characteristics, and the U.S. Fish & Wildlife Service's (Service) proposed management for the Fish Springs NWR for the next 15 years. An Environmental Assessment describing the anticipated effects of the Service's proposed management and other alternatives is incorporated into this document.

The National Wildlife Refuge System Improvement Act (Refuge Improvement Act), an amendment to the National Wildlife Refuge Administration Act of 1966, was passed in 1997. This historic "organic act," the first in the National Wildlife Refuge System's history, required that a CCP be prepared for each refuge within 15 years. Lands covered by this Act include National Wildlife Refuges and Wetland Management Districts, including grassland, wetland, and conservation easements. The Refuge Improvement Act also clarified compatibility and public use issues on Refuge System lands.

The Service worked with Congress to craft the Refuge Improvement Act and supported the planning requirement. This planning effort will assist each refuge, and the entire National Wildlife Refuge System, to meet the changing needs of wildlife and the public. Public input during the CCP process provides opportunities to consult with neighbors, visitors, and other agencies to ensure that plans are relevant and address natural resource issues and public interests.

1.3 Purpose of and Need for the Comprehensive Conservation Plan

The purpose of the proposed CCP is to describe the goals established for Fish Springs NWR, and the objectives and strategies needed to meet the goals. The goals for Fish Springs NWR are presented in Section 1.9.

The CCP is needed for several reasons. Loss of habitat in the Pacific Flyway has been substantial and continuous, primarily through conversion of wetlands to agriculture. The scope of Federal trust resources has expanded to include threatened and endangered species. Knowledge among wildlife professionals has expanded. Legislative mandates to protect cultural resources must be met. A need exists to describe how Fish Springs NWR can best contribute to efforts to protect our wildlife resources for present and future generations.

The purpose of developing the CCP is to provide the Refuge Manager with a 15-year management plan for the conservation of wildlife, fish, and plant resources and their related habitats, while providing opportunities for compatible wildlife-dependent recreational uses. The CCP, when fully implemented, should achieve refuge purposes; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System; and meet other mandates.

1.4 National Wildlife Refuge System Mission, Goals, and Guiding Principles

The National Wildlife Refuge System was started 100 years ago with an Executive Order,

signed by President Theodore Roosevelt, protecting pelicans, ibises, and spoonbills on a small and unpretentious island from market hunters. In '1997, the mission and administrative policy for all refuges in the Refuge System was established with the passage of the National Wildlife Refuge System Improvement Act. It also outlined the importance of the six priority public uses (hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation) and how they should be promoted, except where incompatible with the purpose of the individual refuge or the Refuge System as a whole. A formal process for determining compatibility was also established with this Act. From the first Executive Order to the most recent Act, the overriding principle that guides the Refuge System is that wildlife comes first.

The Service, which administers the Refuge System, is the only Federal agency whose primary responsibility is fish, wildlife, and plant conservation. The National Wildlife Refuge System is the world's largest and most diverse collection of lands set aside specifically for wildlife. 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."* Goals of the Refuge System are aimed at fulfilling this mission. Some major goals are to provide for specific classes of wildlife species for which the Federal government is ultimately responsible. These "trust resources" are defined by the purpose of the refuge and include threatened and endangered species, migratory birds, and anadromous fish. Most refuges provide breeding, migration, or wintering habitat for these species. Nearly all refuges also supply habitat for big game species and resident or non-migratory wildlife as well.

Goals of the National Wildlife Refuge System are:

1. To fulfill our statutory duty to achieve refuge purpose(s) and further the Refuge System mission.
2. Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
3. Perpetuate migratory bird, interjurisdictional fish, and marine mammal populations.
4. Conserve a diversity of fish, wildlife, and plants.
5. Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
6. 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. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

Individual refuges provide specific requirements for the preservation of trust resources. For example, migratory bird refuges in Utah provide important wetland habitats to support populations of birds as required by the Migratory Bird Conservation Act (MBCA). Fish Springs NWR supports migrating and breeding populations of waterfowl, shorebirds, and water birds. These birds migrate to and from at least 10 different states and several Canadian provinces. After visiting Fish Springs NWR, many move on to winter on refuges in the southwest or breed on refuges in Alaska. This network of lands is critical to these birds' survival; any deficiency in one location will affect these species and the entire network's ability to maintain adequate populations.

Other refuges may provide habitat for endangered plants or animals that exist in unique habitats found only in very few locations. Refuges in these situations promote the protection of local populations and their habitat. By providing a broad network of lands throughout the United States with secure habitat and opportunities for recovery, refuges help prevent species from being listed as endangered.

Under the National Wildlife Refuge System Improvement Act of 1997, six wildlife-dependent recreational uses are recognized as priority public uses of refuge lands. These are hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation. These and other uses are allowed on refuges only after finding that they are compatible with the purpose of the refuge. Uses are allowed through a special regulation process, individual special use permits, and sometimes through State fishing and hunting regulations.

1.5 History of Refuge Establishment, Acquisition, and Management

The lands comprising Fish Springs NWR have been part of the Service's National Wildlife Refuge System since 1959. The authorization for the creation of the Fish Springs NWR dates from Migratory Bird Conservation Commission approval on June 18, 1958. The first property acquisition was recorded on March 10, 1959, when 2,160 acres were purchased from the Fish Springs Livestock and Fur Company, and 160 acres were purchased from Charles and Buelah Walker of Salt Lake City, Utah. On March 12, 1959, about 1,455 acres were purchased from the State of Utah. During that same time period, 14,097 acres were withdrawn from existing public domains under Public Land Order 1942 for inclusion in the Refuge. An additional 120 acres of lands were withdrawn from public domain holdings under Public Land Order 2563 in 1961, bringing the acreage total to the present 17,992.

Interest in the possibility of establishing a national wildlife refuge at the base of the Fish Springs Range was as early as 1934. During that year, J. Clark Salyer, Director of the Migratory Bird Program under the U.S. Department of Agriculture's Bureau of Biological Survey, became aware of land in the area with potential waterfowl values that might be for sale. He directed George Mushback, Game Management Agent-In-Charge of the Bear River Migratory Bird Refuge, to visit the area and file a report. While Mushback reported that he felt that it would "offer very good possibilities for nesting, feeding, and concentration" of waterfowl, no further action was taken on acquisition at that time.

Renewed interest by Director Ira Gabrielson in 1938 led to additional on-site surveys. Charles C. Sperry, tasked with assessing waterfowl food supplies, reported that they were quite limited and that Fish Springs should not be considered for addition to the National Wildlife Refuge System. A visit by C. S. Williams, a wildlife biologist assigned to the Wildlife Research Lab at Bear River Migratory Bird Refuge, in September of 1938 resulted in a report that indicated that Fish Springs "in the past has been a good waterfowl area. By proper management it can be made even better." However, Vanez T. Wilson, the Bear River Migratory Bird Refuge Manager, visited the area in December of 1938 and reported that "the Fish Springs area, in my opinion, does not lend itself to extensive development." No further reconnaissance of the Fish Springs area was noted until a summer visit in 1941 by Reuel Janson who reported that "the Fish Springs marsh possesses considerable qualification for a waterfowl refuge." No further written record has been found until 1958 when acquisition of the Refuge was approved.

A Master Plan for the "Physical and Biological Development" of the Refuge was written in 1960. Construction of the physical infrastructure for impounding the springs was implemented in three phases between 1961 and 1965. Phase One included the excavation of the Main Distribution Canal, which runs through the center of the Refuge and the north dike on Harrison Unit. Phase Two, begun in 1962, included the construction of the north dike of Avocet Unit and the north dike of Curlew Unit. Phase Three, completed from 1963 to 1965, involved the construction of all remaining major dikes and structures for Mallard, Shoveler, Egret, Pintail, Ibis, and Gadwall Units.

Biological "objectives," identified in the original Master Plan, included providing resting and feeding areas for tundra swans, Canada geese, redheads, mallards, and greater sandhill cranes; to induce Canada goose nesting; and to

re-establish nesting use of the area by greater sandhill cranes.

Public Use plans in the original Master Plan included parking areas and designated access routes to the public hunting area, preservation of items of historical interest, establishment of a picnic area near the Thomas Ranch house, and designation of a tour route through the marsh.

1.6 Legal and Policy Guidance

Administration of the Department of the Interior, the Service, and the National Wildlife Refuge System is guided by international treaties, Federal laws, and Presidential Executive Orders. Refuge management options are further refined by administrative guidelines established by the Secretary of the Interior and policy guidelines established by the Director of the Service.

Treaties, laws, administrative guidelines, and policy guidelines assist the Refuge Manager in making decisions pertaining to soil, water, air, flora, fauna, and other natural resources, historic and cultural resources, research, and recreation on refuge lands.

Other key legislative policies that direct management of refuges include the Endangered Species Act (1973), Clean Water Act (1977), Land and Water Conservation Fund Act (1965), Migratory Bird Treaty Act (1918), and Executive Order 12996 Management and General Public Use of the National Wildlife Refuge System (1996). These and other Acts and Executive Orders that guide Refuge System activities are listed in Appendix A. The Service also provides its own policy guidelines, which can be found in Refuge Manuals.

1.7 Refuge Purpose

Fish Springs NWR was established under the MBCA by the Migratory Bird Conservation Commission. The stated purpose is "…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds" (16 U.S.C. 715d). Past management at the Refuge was focused on waterfowl production. However, after many years of trying, waterfowl production never reached a substantial level. From 1991 to 1995, the Refuge Manager and the Regional Office of the Service reviewed and discussed the best use for the Refuge. It was decided that marsh management should be altered to accommodate the habitat needs of other migratory birds as well, namely shorebirds and water birds. The MBCA supports this because the Refuge supports many birds other than waterfowl.

1.8 Refuge Vision Statement

Fish Springs NWR will continue to conserve native fish, wildlife, plants and their habitats. Water and a diversity of habitats will be available to migratory birds and other indigenous wildlife within the physiographic region known as the Bonneville Basin of the Interior Basin eco region. The Refuge is vital to the conservation of migratory birds, interjurisdictional fish, threatened and endangered species, and the habitats on which these species depend. The Refuge will continue to be managed in accordance with sound management principals to provide a wide range of wildlife-related recreation and learning opportunities, including hunting, wildlife observation, and connecting with nature. The preservation and sharing of the cultural past of the area, both on a local and national scale, is an added benefit of Fish Springs NWR.

1.9 Refuge Management Direction Goals

- **Habitat**: Improve and maintain habitat for nesting and wintering migratory birds and other wildlife populations of the Bonneville Basin.
- **Ecological Integrity**: Perpetuate the native biodiversity and physical characteristics of the Bonneville Basin as represented on Fish Springs NWR.
- **Cultural Resources**: Preserve and protect cultural resources on Fish Springs NWR.
- **Visitor Services**: Promote an understanding and appreciation of the fish, wildlife, and natural and cultural

history of Fish Springs NWR by providing high quality environmental education, interpretation, and wildlife-dependent recreational opportunities for persons of all abilities.

- **Partnerships**: Promote partnerships to preserve and enhance the natural characteristics of the Bonneville Basin ecosystem in which Fish Springs NWR plays a key role.

1.10 Step-down Management Plans

The Fish Springs NWR CCP is intended to be a broad umbrella plan that outlines general concepts and objectives for habitat, wildlife, public use, cultural resources, and partnerships that will guide Refuge management over the next 15 years. Step-down management plans provide greater detail for implementing specific actions authorized by the CCP. Table 1 presents those plans needed for Fish Springs NWR, their current status, and next revision date.

1.11 Description of Planning Process

Table 1. Step-down management plans for Fish Springs NWR.

Step-Down Management Plan	Status of Plan Year Completed	Proposed Revision Date
Safety Program/Operations	1990	Not Necessary
Hazardous Materials Operations	1998 HAZCOM	MSDS updated yearly as needed
Law Enforcement	No Plan	2006
Spill Prevention Control and Countermeasure Plan	2003	2008
Integrated Pest Management	2003	2008
Refuge Uses (Compatibility)	2003 (with CCP)	2013
Visitor Services Plan	No Plan	2007
Hunting	1981	2005
Habitat Management Plan	1990 (Marsh Management Plan)	2009
Fire Management	2002	2007 (update annually)
Wildlife Inventory Plan	1990	2007
Exotic Species	No Comprehensive Plan, IPM for exotic vegetation	2009
Cultural Resource Management Plan	No Plan	2010

Comprehensive Conservation Plans (CCPs) provide a clear and comprehensive statement of desired future conditions for each refuge or planning unit. CCPs provide long-range guidance and management direction to achieve refuge purposes, help fulfill the Refuge System mission, and maintain or restore the ecological integrity of each refuge and the Refuge System. Additional goals of the CCP process include using science and sound professional judgment to support management decisions, ensuring the six priority public uses receive consideration during the preparation of the CCP, providing a public forum for stakeholders and interested parties to have input into refuge management decisions, and providing a uniform basis for funding.

The CCP planning process consists of the following eight steps. Although the steps are listed sequentially, CCP planning and National Environmental Policy Act (NEPA) documentation can be iterative. Some of the steps may be repeated, or more than one step can occur at the same time.

1. **Preplanning -** form core team, identify needs
2. **Identify Issues and Develop Vision -** gather public input on issues
3. **Develop Goals and Objectives -** from issues, resource relationships, legal responsibilities
4. **Develop and Analyze Alternatives -** including the Proposed Action

5. **Prepare Draft Plan and NEPA Document -** assess environmental effects, gather public comments on draft plan
6. **Prepare and Adopt Final Plan**
7. **Implement Plan, Monitor and Evaluate**
8. **Review and Revise Plan**

Comprehensive conservation planning efforts for Fish Springs began in March 1999 with a meeting of regional management and planning staff and field station employees from Fish Springs NWR at Refuge headquarters in Utah. At that meeting, a Core Planning Team, consisting of the Service, Bureau of Land Management, Utah Division of Wildlife Resources, U.S. Army Dugway Proving Ground, and the Utah State Historical Society was designated. A Notice of Intent to prepare a CCP was published in the Federal Register in September of that same year (64 Fed. Reg. 49228 (September 10, 1999)). Public Issues Workbooks were distributed during the Refuge's annual Open House, also in September. From there, work progressed on developing draft Refuge vision, goals, and objectives. However, work was discontinued in September 2000 due to changes in Refuge management and priorities for the regional planning division.

Planning efforts were re-initiated in November of 2001. Issues Workbooks were sent to 40 individuals and organizations in February 2002, followed by two public meetings in March—one in Salt Lake City, the other in Partoun, Utah. Neither public meeting was attended by the public. Eight completed Issues Workbooks were returned to the Core Planning Team. Further scoping was conducted during a Core Planning Team meeting in April 2002 where each Team member was given the opportunity to discuss concerns, recommendations, and ideas. The Core Planning Team then revised the draft Refuge vision, goals, and management alternatives and evaluated the environmental consequences of each alternative.

The CCP, once finalized, will be signed by the Regional Director, thus providing Regional direction to the Refuge Manger and staff. Copies of the CCP will be provided upon request to all interested parties.

1.12 Planning Issues

Issues identified during the scoping process are presented here. This is a synopsis of all comments received, including those from individuals, organizations, State agencies, and other Federal agencies.

Wildlife and Habitat

There was support for managing the Refuge for a diversity of wildlife, with the current emphasis in marsh areas on waterfowl, shorebirds, and other water birds. The quality of the high desert shrubland habitat should be improved. Some concern exists for the well-being of endangered and threatened species and State species of concern. Additionally, some respondents called for protecting invertebrates in the springs, with particular emphasis given to controlling the spread of the nonnative snail, *Melanoides tuberculata*. A number of respondents saw the need for a greatly enhanced biological inventory and assessment program. Some support occurred for expanding the Refuge into nearby salt-flats and springs.

Exotic Species

Concern about the spread of exotic species, both plant and animal, was expressed. Increased control efforts are needed. However, concern with the use of chemicals to control weeds was also expressed.

Cultural Resources

There was support for the University of Utah to continue its archaeological summer field school on the Refuge. The two caves on the Refuge should be excavated. Interpretation of cultural and historic resources should be improved and expanded.

Public Use

Respondents were happy with the level of public access on the Refuge. Development of a nearby off-site campground to accommodate visitors was recommended. Conflicting

opinions on hunting and trapping were voiced. Some felt a goose hunt should be implemented in addition to current hunting opportunities. Others supported no hunting or trapping on the Refuge, believing these activities are incompatible with the purpose of the Refuge. It was also requested that the Service work on eliminating the inconsistencies in hunting regulations on different refuges within Utah.

Administration/Operations

The need for additional staff for the Refuge was a concern for some respondents. The Refuge is especially in need of a biologist. A request was made to break down the Refuge budget into administration, conservation, and public use/hunting for comparison purposes. Partnerships with Dugway Proving Ground should be expanded in light of the commonality between the two regarding habitat types and species present, especially threatened and endangered species.

1.13 Plan Amendment and Revision

The Fish Springs NWR Manager will use the CCP to ensure Refuge priorities and work is consistent with the CCP goals, objectives and strategies. Appropriate staff members will be assigned tasks and projects, identified in the CCP, to accomplish the objectives stated in the CCP**.** The Refuge staff will review the CCP at least annually to decide if it requires any revisions as new information becomes available, ecological conditions change, major or Refuge expansion occurs. At a minimum, the CCP will be revised every 15 years.

Chapter 2 Alternatives, Including the Service's Proposed Action

2.1 Description of Each Alternative

In response to the planning issues discussed in Chapter 1, the Service developed three alternatives for Refuge management. Each alternative varies in its emphasis and objectives and strategies. The three alternatives are:

- Alternative A – No Action
- Alternative B – Refuge Restoration
- Alternative C – Management for Wildlife Diversity (Proposed Action)

2.2 Alternative A - No Action (Current Management)

In the No Action alternative, the Service would not implement any new management, restoration, and visitor service programs at the Refuge. The current management as described in the Marsh Management Plan (1991), the Wildland Fire Management Plan (2002), and the Integrated Pest Management Plan (2003) would continue. Existing water management of the nine ponds (Figure 3) would include the 5-year drawdown rotation and associated burning (Table 2). Water levels in the ponds would be maintained to create optimum conditions for waterfowl production. The goal would be to maintain waterfowl migration, wintering, and production habitat. Water management would also maintain water salinity at minimum levels through winter flushing and maintaining water flows throughout the Refuge.

Studies indicate that full pool management is not as productive as management involving drawdowns, whereby management intentionally simulates wet and dry cycles of a natural wetland. McKnight and Low (1969) conducted a study within the Fish Springs NWR marsh from 1966 to 1968. Their study revealed that marsh units that had been drained, allowed to dry, and then flooded showed a tremendous increase in waterfowl use and production. Brood census data showed that the newly flooded areas were much more attractive to duck broods than the undisturbed marsh areas, and were more heavily used by waterfowl in general.

Drawdowns play an important role in the rate at which nutrients are released into the food chain. The rate of plant material decay is increased. This in turn provides more food to invertebrates in the form of decaying organic matter or detritus. According to Refuge surveys, invertebrates experience a subsequent population explosion upon reflooding, with both species richness and abundance increasing (Ward and Ward 1996). This provides improved foraging for waterfowl, shorebirds, and water birds. Drawdown in many units results in an invasion of the original pool bottom by opportunistic vegetation, primarily fivehook bassia (*Bassia hyssopifolia)* and summer cypress (*Kochia scoparia)*. These plants produce a seed crop that is used by migrating waterfowl when these units are reflooded. The weed crop also provides critical structural habitat used by the burgeoning populations of aquatic invertebrates after reflooding. Salt cedar (*Tamarisk ramosissima*) also appears within most units when the ponds are drawn down; however, this species is killed at nearly 100% after refilling before the plants have developed enough to provide structural habitat for invertebrates or a food source (seed) for waterfowl.

Fire, another important marsh management tool, increases the rate at which nutrients are returned back to the soil, setting back succession and invigorating new plant growth. As wetland vegetation becomes rank it is of

little value to many marsh birds and prescribed burning can improve marsh habitat for migratory waterbirds.

Since 1988, the marsh units at Fish Springs NWR have been dewatered and burned on a set 5-year rotation (Table 2). Draining the units begins in February and reflooding begins between late September and December. Target levels are reached between March and mid-April. These target levels are flexible based on specific seasonal conditions and the professional judgment of the Refuge Manager. Not enough water is available to have all units completely filled during summer and early fall, so some units are left at less than target levels during those times. This actually creates better shorebird nesting and foraging habitat in the spring.

Prior to the summer of 2003, efforts to control *Phragmites* were spring chemical applications of a glyphosate herbicide after the unit had been dewatered and subject to a spring prescribed burn. This method proved to be ineffective in controlling the spread o f *Phragmites* on the Refuge. In July 2003, the Refuge experimented with a new approach to the control of *Phragmites*. Stands of *Phragmites* were mowed in July and August, and glyphosate herbicide was applied in September after the re-growth had reached 2 to 3 feet tall. Five areas were treated with this method in FY 2003 and will be monitored for 2 years to determine the effectiveness. Initial results appear encouraging.

This new method of a late summer/early fall manipulation (mowing or burning) to the *Phragmites*, combined with a fall or spring application of a glyphosate herbicide, will be used in FY 2004 on several sites. The Refuge also will incorporate new techniques in the Avocet Unit, which is scheduled to be burned in September 2004. Several dense *Phragmites* stands on higher sites in the unit will be disked after the burn in late September. Some sites will be disked once, and other site will be disked twice to expose the roots to hot desiccating temperatures. Disking will be followed by an application of a glyphosate herbicide in October on some sites, and in the spring on other sites after re-growth starts. All sites will be monitored for 2 years to determine the effectiveness of the control methods used. The high desert shrubland is defined for management purposes as the combined Great Basin Arid Shrubland and Great Basin Cold Desert Shrubland described in Section III, Affected Environment and presented on Figure 11. These two shrublands are found on the west side of the Refuge and in smaller patches along the north, east and south sides of the marshlands. Dominant shrubs include Mormon tea, rabbitbrush species, greasewood, shadscale and fourwing saltbrush.

Currently, the high desert shrubland community on Fish Springs NWR is not actively managed. This community historically had been a low management priority and management has been passive. Historical grazing was removed when Service acquired the Refuge (Banta, pers. comm. 2004). A fence was constructed in the mid-1990s to remedy illegal trespass from livestock on surrounding BLM and U.S. Army properties. Overgrazing of desert shrublands can significantly reduce vegetation diversity and species composition (Bock and Bock 1993; Fleischner 1994). Past

Table 2. Unit drawdown and prescribed burning sequence.

Unit(s)	Year[1]	Drain	Burn	Fill
Mallard - Gadwall	2003	Feb	Sept	Oct
Avocet - Spring[2]	2004	Feb	Sept	Oct
Curlew-Ibis	2005	Feb	Sept	Oct
Pintail - Shoveler	2006	Feb	Sept	Oct
Egret - Harrison	2007	Feb	Sept	Oct

[1]This sequence is repeated every 5 years. Dry units are burned according to an approved Prescribed Burning Plan. Currently, however, units with large dense stands of *Phragmites australis* (Avocet, Mallard, Curlew, Shoveler, and Harrison) are not burned due to concerns that fire aids the spread of this invasive species.

[2]Spring unit is not drawn down, but 1/3 is burned during the same year that Avocet is drawn down.

cattle grazing and current sheep drives along the county road (Pony Express Trail) on the west side of the Refuge have promoted the spread of invasive weeds and the understory of large patches of the high desert shrubland community is dominated by cheatgrass.

Fires in western high desert shrubland communities have had a profound impact on vegetation composition and structure. Young and Evans (1978) found that cheatgrass (*Bromus tectorum*) increases on post burned areas, frequently out-competing native flora. An increase in fire frequency in shrublands can cause a gradual loss or in some cases dramatic change from a shrub community to an annual dominated community. This shift in plant species composition alters competitive and fire dynamics to maintain annual dominance on the affected sites (Taush et al. 1995). Young and Evans (1978) found that cheatgrass increases rapidly on post-burned areas, out competing native flora. Fire management is conducted on Fish Springs NWR in accordance with the Wildlife Fire Management Plan (2001). Fire is suppressed in shrubland habitats and used as a tool to achieve identified management goals. Prescribed burning of dewatered units is conducted in the fall.

Habitat

Goal: Improve and maintain habitat for nesting and wintering migratory birds and other wildlife populations of the Bonneville Basin.

Rationale: Fish Springs NWR, by virtue of its substantial wetlands, is one of the most important habitats in the eastern Bonneville Basin. Use of these wetlands by migrating, wintering, and nesting birds is critical to many species that are found in western Utah. The Refuge is the largest wetland for a radius of over 70 miles and provides such habitat to literally tens of thousands of migratory birds as well as being a true oasis in a very arid region which supports a very diverse population of native wildlife. Efforts to maintain and improve a diverse mosaic of habitats are critical to providing high quality habitat in an area where wetlands and relatively pristine desert shrub communities are exceptionally limited compared to surrounding areas.

Objectives:

1. Maintain existing acreage of nesting and brood-rearing habitat for waterfowl, shorebirds, and water birds within Fish Springs seven units.

Strategies:

- Bring six to seven units to target stable water levels (Table 3) by mid-April when waterfowl, shorebirds, and water birds are selecting nest sites.

Table 3. Target water elevations for marsh units under 1991 Marsh Management Plan.

Unit	Target Water Elevation	Water Surface Acres	Average Depth (feet)	Acre-feet
Avocet	4298.50	575	1.6	920
Mallard	4298.74	192	1.5	288
Curlew	4294.50	480	1.5	720
Shoveler	4295.60[1]	245	1.5	368
Pintail	4286.00	395	1.7	672
Egret	4291.39	380	1.5	570
Ibis	4288.80	235	2.2	517
Harrison	4282.00	620	1.7	1,054
Gadwall	4282.00[2]	430	1.8	774
Total		3,552		5,883

[1] Target Water Elevation shown here for Shoveler Unit is 0.26 feet lower than originally designated in the Marsh Management Plan. With this slight modification, more islands pop-up or are just below the water, creating better foraging for shorebirds.

[2] Gadwall Unit is actually managed at a much lower water elevation in order to create 25 to-35 more acres of shallowly flooded mudflats for western snowy plover foraging. The Refuge Manager determines at which level to stop filling this unit on a yearly basis according to water availability.

- Maintain stable water levels through mid-June for shorebirds and water birds in six to seven units to prevent flooding or drying of nests.
- Maintain stable water levels through mid-July for waterfowl in three to four designated units to prevent flooding or drying of nests.
- Drawdown two units each year (Table 2) to maintain an adequate invertebrate supply as a food source and to recycle nutrients through decomposition and prescribed burning.

2. Over the next 15 years, maintain existing seasonal closures to minimize disturbance to nesting, wintering, and migrating waterfowl, shorebirds, and waterbirds.

Strategies:

- Close entire Refuge to all forms of boating May 15 to July 15.
- Keep 10,746 acres (60 percent of the Refuge) as year-round sanctuary areas.
- Close all roads except the Pony Express Road and the core auto-tour route from May 15 to August 15.

3. Maintain the existing mosaic of spring and fall migration foraging habitat for waterfowl, shorebirds, and water birds. This involves providing a variety of habitat in each marsh unit, including shallowly flooded (≤ 4 inches) and sub-irrigated saltgrass for shorebirds, and emergent vegetation in water 4 to 12 inches deep for water birds.

Strategies:

- Drawdown two units each year (Table 2) to maintain an adequate invertebrate supply as a food source and to recycle nutrients through decomposition and prescribed burning.
- Partially drawdown water in the early spring to exploit resources not normally available, providing new foraging areas. Where and to what extent water is drawn down will be based on the condition and topography of each unit.
- Cut-off water to three to four units in mid-to-late June to allow natural drawdown through evapotranspiration

and evaporation to create mudflats in late summer and into fall.

- Allow water to drop in three to four other units following waterfowl nesting in mid-July. During this time, water is still allowed to flow in, but at a rate less than evapotranspiration and evaporation. Begin refilling units after mid-September.

4. Maintain existing management in all high desert shrubland communities on the Refuge over the 15-year life of the CCP.

Strategies:

- Continue to exclude grazing to allow for natural succession of native grasses.
- Continue passive management of all high desert shrubland communities; no prescribed burning, grazing, or farming.
- Continue suppression of wildfires to prevent the spread of cheatgrass.

Ecological Integrity

Goal: Perpetuate the native biodiversity and physical characteristics of the Bonneville Basin as represented on Fish Springs NWR.

Rationale: Having been protected for nearly 45 years. Fish Springs NWR contains one of the most diverse and complete complements of native flora and fauna to be found in the eastern Bonneville Basin. More than 275 species of migratory birds, 44 species of mammals, 12 species of reptiles, four species of fish, and more than 140 different plant species are found within the Refuge boundaries.

The Refuge also contains populations or potential habitat for threatened, endangered and sensitive species, including bald eagle, least chub, spotted frog and snowy plover. Current management for sensitive involves cooperation with UDWR on the introduction of least chub and maintenance of shallow nesting and foraging habitat for snowy plovers in the Gadwall Unit. No information is currently available on production, predation of mortality of plovers on the Refuge.

Efforts to gather both inventory data on current use by wildlife species and attempting to reduce the deleterious impacts of influences, such as military overflights and invasive vegetation, will be vital to trying to maintain this outstanding ecological complement.

Objectives:

1. Annually assess population levels and trends of bird species using the Refuge.

Strategies:

- Conduct bi-monthly bird counts.
- Conduct spring mist nesting in Refuge housing area, expanding into the high desert shrubland community by 2004.
- Conduct shorebird surveys during weeks alternating with the bi-monthly bird survey between March 15 and May 1 and between July 15 and September 1.

2. Continually work to minimize impacts of military overflights on wildlife.

Strategies:

- Monitor violations of established rules stipulating flying at least 3,000 feet above the Refuge.
- Continue dialog with the U.S. Air Force when violations occur and discuss ways to avoid future violations.
- Request involvement of the Service's Utah Resident Agent in Charge when needed.

3. Reduce whitetop by 90 percent, contain squarrose knapweed to the livestock corridor, control the spread of Phragmites australis, and prevent tamarisk from spreading and reinfesting areas from which it has been eliminated according to the Integrated Pest Management Plan.

Strategies:

- Cooperate with the Bureau of Land Management to treat area above the Refuge for squarrose knapweed.
- Treat invasive species with appropriate chemical control agents and mechanical methods.

- Investigate feasibility of using biological controls for squarrose knapweed and tamarisk.
- Do not conduct prescribed burns in units with large dense stands of *Phragmites australis* until effective control methods are available.
- Implement *Phragmites* control in 2006 based on results of experimental control conducted in the Avocet Unit.

4. Inventory, monitor and protect habitat for threatened, endangered and sensitive wildlife species native to the Bonneville Basin.

Strategies:

- Continue to monitor annually habitat and populations of wintering bald eagles and least chub.
- Continue to cooperate with UDWR on the introduction/re-introduction of least chub, spotted frog and other sensitive wildlife native to the Bonneville Basin.
- Continue to work with the U.S. Fish and Wildlife Service Regional Office of Ecological Services, and UDWR to address endangered species issues as they arise.

Visitor Services

Goal: Promote an understanding and appreciation of the fish, wildlife, and natural and cultural history of Fish Springs NWR by providing high quality environmental education, interpretation, and wildlife-dependent recreational opportunities for persons of all abilities.

Rationale: Visitation to Fish Springs NWR currently ranges between 2,000 and 3,100 visitors each year. Most come to enjoy the opportunities for wildlife-dependent recreational opportunities in the Refuge's uncrowded environment. Waterfowl hunting remains the greatest recreational use. Many come to the Refuge in the process of exploring the rich human history of the area. Passive recreational uses, such as wildlife observation and photography, continue to expand each year. Continuing to provide educational and interpretive opportunities for visitors enhances understanding and appreciation of the wildlife and cultural resources represented on the Refuge.

Objectives:

1. Within units currently open to hunting, provide waterfowl hunting opportunities for up to 2,000 visits annually (Figure 4).

Figure 4. Hunting —— Alternatives A and C.

Duck Blind on Fish Springs NWR

Strategies:

- Continue to open up to 40 percent of the Refuge for duck and coot hunting (no swans or snipe).
- Continue annual youth hunt.
- Maintain current levels of law enforcement presence during hunting season.
- Maintain and promote the availability of three universally accessible hunting blinds.
- Maintain parking areas and roads for hunter vehicle access.
- Maintain hunting related signs on the Refuge.
- Identify areas open to hunting and inform the public about Refuge hunting regulations through signs, news releases, pamphlets, and printed State hunting regulations.
- Post hunting information, such as harvest data and availability of universally accessible hunting blinds, on the Refuge web site.
- Develop a hunting tear sheet.
- Post hunting information, such as harvest data and availability of universally accessible hunting blinds, on the Refuge web site.

2. To foster public appreciation of wildlife, provide opportunities for up to 4,000 visitors per year to participate in wildlife observation, wildlife photography, and interpretation (Figure 5).

Strategies:

- Maintain Refuge roads to public access as shown on Figure 5.
- Maintain directional signs on the Refuge.
- Maintain 11-mile self-guided auto-tour route with four interpretive signs.
- Maintain universally accessible Thomas Ranch Watchable Wildlife Area.
- Maintain current levels of law enforcement presence and preparedness throughout the year.
- Allow boating (no gas motors) on areas open to the public except for the period from May 15 to July 15 and exclude year-round sanctuary areas.
- Maintain three universally accessible wildlife observation and photography blinds.
- Maintain cultural resources display, Lincoln Highway marker and sign, and native plants exhibit in Headquarters building.
- Maintain the Visitor Contact kiosk.
- Conduct a special event each year for International Migratory Bird Day.

Figure 5. Public Use —— Alternative A.

- Host an annual Refuge Open House or similar public event.
- Provide interpretive or environmental education discussions and/or tours for groups as requested. Include discussions about contribution of the Refuge to wildlife resources and ecosystem functioning.
- Co-sponsor other special events as opportunities arise.
- Develop and general brochure in the Service graphic standard.
- Update and reprint the Wildlife List.

3. Continue to provide outreach to foster appreciation for the resources of Fish Springs NWR, the National Wildlife Refuge System, and the Service.

Strategies:

- Write press releases announcing public events.
- Maintain a Refuge web site with current information.
- Accommodate and host Boy and Girl Scout groups as requested. Trips usually include a Refuge tour, service project, merit badge counseling, and environmental education activities. Allow troops to camp at Thomas Ranch Watchable Wildlife Area with special permit when deemed compatible.
- Host school visits to the Refuge as requested.
- Conduct a special event each year for International Migratory Bird Day.
- Host an annual Refuge Open House or similar public event.

4. Continue the Refuge volunteer program of 1300+ donated hours/year. The volunteer program expands the capabilities of the Refuge's limited staff, collects important data, and instills a sense of stewardship for wildlife resources.

Strategies:

- Organize volunteer days each year with the goal of accomplishing a major task during each event. Provide necessary training, materials and lodging as required. Schedule the event in conjunction with national volunteer efforts, such as Volunteer Week, National Public Lands Day or Earth Day, or in conjunction with special events on the Refuge, such as Migratory Bird Day or the Open House. Write a press release announcing each Volunteer Day and project to be accomplished. Write a press release after each Volunteer Day that recognizes volunteer efforts and what was accomplished during the event.
- Notify area schools, civic groups, and hunting, birding, and environmental organizations, of volunteer opportunities on the Refuge.
- Work with the Service's Regional Volunteer Coordinator to develop a volunteer program that meets Refuge needs.
- Provide room and board for volunteers working on the Refuge for extended periods.

Cultural Resources

Goal: Preserve and protect cultural resources on Fish Springs NWR.

Rationale: The environs of Fish Springs NWR contain a number of important cultural resources. While it has been known that the Refuge contains a large number of cultural sites, recent cultural resource inventory results have revealed how the Refuge fits into the broader regional context. Cultural resource sites identify early occupation was present. Continued effort to inventory and analyze unmapped cultural resource sites, fully understand known sites and protection of these resources are an important factor in understanding the human history of the eastern Bonneville Basin.

Objectives:

1. Continue to prevent loss or destruction of all cultural resources by preserving and protecting known archaeological resources on the Refuge.

Strategies:

- Maintain barricades on two caves known to have been used by prehistoric cultures.
- Enforce closures of year-round sanctuary areas; most known archaeological sites are within these areas.
- Use standard law enforcement practices to protect known resources on the Refuge.

2. Continue to maintain opportunities to study and protect cultural resources on the Refuge.

Strategies:

- Continue to host the University of Utah archaeological summer field school whenever possible.

Partnerships

Goal: Promote partnerships to preserve and enhance the natural characteristics of the Bonneville Basin ecosystem in which Fish Springs NWR plays a key role.

Rationale: It is not enough that staff from Fish Springs NWR simply strive to provide critical habitats in a very arid and harsh environment. Coordination with a diverse array of partners is necessary to ensure that the Refuge can maximize its contribution to natural resource conservation at the landscape level. Continuing to foster and increase opportunities for participation in and contribution to larger landscape and regional level conservation initiatives, such as the Eastern Bonneville Basin partnership, will help ensure that the Refuge meets this obligation. Opportunities for academic institutions, other Federal, State, and county agencies, non-governmental organizations (NGOs) and private citizens to partner with the Refuge to further this goal are nearly unlimited and can provide an important leveraging of resources toward this end. Current staffing allows for limited participation in national and international partnerships, such as Partners in Flight.

Objectives:

1. Participate in local partnering opportunities over the next 15 years that will benefit the Refuge by increasing knowledge of Refuge resources or accomplishing specific tasks.

Strategies:

- Continue partnership with University of Utah's Utah Museum of Natural History. Currently, this partnership has resulted in archaeological, geomorphological, and small mammal research being conducted on the Refuge, but the Cooperative Agreement covers many other disciplines.
- Continue partnerships with Brigham Young University and Southern Utah University, which focus on biological research projects.
- Continue cooperative efforts with Utah Division of Wildlife Resources (e.g., least chub re-introduction, fencing, Partners for Fish and Wildlife).
- Assist in the formation of the Eastern Bonneville Basin partnership with Dugway Proving Grounds, Utah Division of Wildlife Resources, and The Nature Conservancy. The focus of this partnership is common natural resources management issues.

2.3 Alternative B – Refuge Restoration

Restoration of Refuge habitats to mimic pre-settlement conditions would be the focus of Alternative B. Marsh restoration would consist of removing all dikes and water control structures, and allowing restoration of pre-settlement hydrology and landforms. All interior Refuge roads would be removed and native vegetation restored. The county road between Tooele and Calleo would remain. Relatively unaltered hydrology and landforms are shown in Figure 6. The headquarters building would remain. Water salinity levels would not be managed. Habitat management would strive to eliminate invasive weed species and restore pre-settlement vegetation

communities in the marshes and high desert shrubland community.

Habitat

Goal: Improve and maintain habitats for nesting and wintering migratory birds and other wildlife populations of the Bonneville Basin.

Rationale: Restoration, to the degree it is possible, of the Refuge's original hydrological system and high desert shrubland will ensure that habitat that mimics the levels of flora and fauna that historically inhabited the Refuge is provided. This alternative takes the Refuge System goal of ecosystem conservation and restoration to its highest level possible at Fish Springs NWR. As a result, marsh and open water habitat that supports waterfowl and shorebirds would be reduced, while habitat for species that prefer braided-channel wetlands and dense emergent vegetation, such as rails and some songbirds, would increase. Thus, the Refuge would still provide a 10,000-acre marsh system, though of a different character. This alternative also improves high desert shrubland habitat.

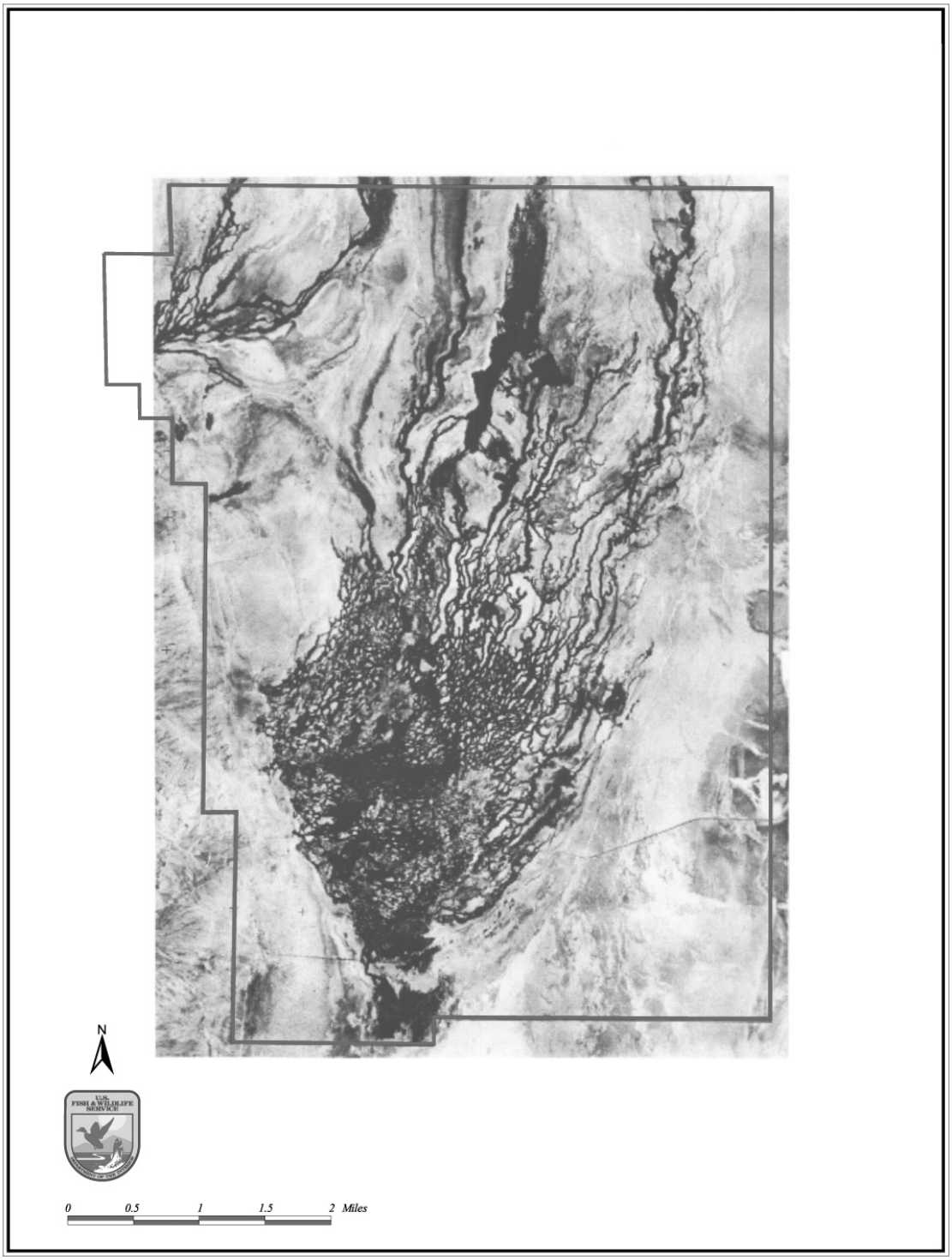
Objectives:

1. During the course of one complete 5-year marsh drawdown rotation (Table 2), conduct a complete on-the-ground assessment for each unit to determine which major original watercourses can be restored and how to restore them.

Strategies:

- Compare aerial photos from pre-development with current aerial photos. Overlay original pre-development marsh photos on structural/dike map to identify natural watercourses and any remnants that may remain.
- Survey remnant channels.
- Conduct fly-over to see how much integrity exists in main drainages.
- Create GIS overlays for current and historical channels.
- Contract with a hydrologic engineering firm to conduct complete assessment.
- Assess what vegetation restoration is necessary in each unit and in areas where dikes will be removed.
- Assess complications associated with invasive species introduction resulting from soil and vegetation disturbance from restoration of the landscape.

Figure 6. Fish Springs NWR about 1958 at Time of Refuge Establishment.



2. Within 4 years of completion of the assessment, conduct public scoping to determine the appropriate level of analysis for NEPA documentation.

Strategies:

- Determine public scoping methods and schedule.

3. Within 7 years of CCP approval, develop a plan to restore the high desert shrubland community to the historical native composition.

Strategies:

- Determine historical native floral composition of the high desert shrubland community, within 3 years.
- Conduct a complete vegetation survey to determine current composition of the high desert shrubland community and create a layer for the GIS database.
- Compare current and desired conditions to determine how much restoration is necessary.
- Research appropriate restoration methods.
- Determine necessary resources, budget, specific actions, and time frame for project.
- Determine indicator species (e.g., plants, birds, invertebrates) for monitoring health of restored communities.
- Begin implementation of selected appropriate restoration actions.
- Ensure that control of invasive plant species is feasible.

4. Within 10 years of approval of the CCP, develop a plan to mimic the Refuge's original hydrological system of a series of springs with braided channel wetlands.

Strategies:

- Based on the assessment of original watercourses and public scoping comments obtained under objectives 1 and 2, develop a Habitat Management Plan.
- Consult with experts and regional Refuge staff to develop the Habitat Management Plan.

Ecological Integrity

Goal: Perpetuate the native biodiversity and physical characteristics of the Bonneville Basin as represented on Fish Springs NWR.

Rationale: Fish Springs NWR historically contained one of the largest spring-fed braided-channel type wetlands in the Bonneville Basin, providing habitat for one of the most diverse and complete complements of native flora and fauna to be found in the eastern Bonneville Basin. The physical environment of the Refuge also contains several sites of importance to the understanding of the history of Lake Bonneville. Ensuring that these sites are protected from unreasonable degradation will ensure that the scientific values are maintained for future research needs and interpretation.

Efforts to gather inventory data on historical distribution, use of Refuge habitats by native flora and fauna, and current habitat conditions will be critical to ensure that the historical diversity and distribution is restored and protected.

Once these factors are analyzed, management practices will require managing the restoration effort versus the intensively managed impounded wetland complex that existed previously. Assessing the impacts of and applying suitable control efforts for invasive species and negative human disturbances, such as military overflights, and understanding the needs of populations with limited numbers and/or distributions will be critical to successfully accomplishing this restoration effort.

Objectives:

1. Within 5 years of CCP approval, rewrite the Marsh Management Plan as part of the Habitat Management Plan to maintain the native diversity and distribution of marsh plant communities. Review, and revise if necessary, within 1 year of the completion of marsh hydrology restoration work.

Strategies:

- Develop GIS-based vegetation database showing current diversity and distribution of marsh plant communities. Determine if any relict populations exist and map locations and distribution. Update database as necessary.
- Consult with experts on how to restore and maintain native marsh plant communities. Gather input on what should be done before, during, and after marsh hydrology restoration work.
- Determine the appropriate use of prescribed fire in maintaining healthy native plant communities.

2. Every 5 years, monitor the biological impacts of marsh and high desert shrubland restoration efforts and determine any changes in species composition.

Strategies:

- Conduct initial community level biological surveys, for comparison, before any actual restoration work is undertaken. Include surveying for small mammals, waterfowl, shorebirds, marsh birds, water birds, raptors, passerines, reptiles and amphibians, carnivores, and invertebrates. Create appropriate layers for the GIS database.
- Repeat complete set of community level surveys every 5 years during and after restoration work. Update GIS database accordingly.
- Continue bimonthly bird counts/index, spring and fall mist-netting, and spring and fall shorebird surveys.

3. Within 5 years of CCP approval, develop a plan to maintain the diversity and distribution of native spring snails as part of the Habitat Management Plan.

Strategies:

- Establish current distribution and densities of all spring snails and create a layer for the GIS database.
- Identify very limited native species, monitor them for population declines and threats, and determine appropriate protection and restoration actions.
- Refer to historical snail surveys on snail distribution in springs, including work done by the Smithsonian.
- Determine the impact of nonnative snails (*Melanoides tuberculata*) on native snails and other species.
- Investigate ways to eliminate nonnative snails.

4. Reduce whitetop by 60 percent and squarrose knapweed by 60 percent within 3 years, tamarisk by 90 percent within 15 years, and cattail stand density by 50 percent within 15 years.

Strategies:

- Develop GIS-based vegetation database showing current distribution as a baseline. Update database as necessary.
- Cooperate with the Bureau of Land Management to treat area above the Refuge for squarrose knapweed.
- Treat invasive species with appropriate chemical control agents and mechanical methods.
- Investigate feasibility of using biological controls for squarrose knapweed and tamarisk.
- Once target levels are reached, continue to treat invasive species as needed to prevent re-spreading.
- Implement *Phragmites* control in 2006 based on the results of experimental control conducted in the Avocet Unit.

5. Within 6 years of CCP approval, determine the effects of management practices on the spread of Phragmites australis.

Strategies:

- Develop GIS-based vegetation database showing current distribution as a baseline. Update database as necessary.
- Monitor spread of *Phragmites australis* after prescribed fire and pool drawdowns, as feasible during marsh

restoration. After restoration, monitor spread of *Phragmites australis* after prescribed burning to the extent possible.
- Experiment with chemical and mechanical (mowing) control on *Phragmites australis* to determine if there is any effective level of control.
- Set target for *Phragmites australis* reduction upon completion of above efforts.

6. Continually preserve sites of geological significance for geomorphological research; both known sites and those identified by experts in the future.

Strategies:

- Do not disturb sites through any earthmoving operations.
- Do not fill, level, or flood sites.

7. Continually work to minimize impacts of military overflights on wildlife.

Strategies:

- Monitor violations of established rules stipulating flying at least 3,000 feet above the Refuge.
- Continue dialog with the U.S. Air Force when violations occur and on how to avoid future violations.
- Request involvement of the Service's Utah Resident Agent in Charge when needed.

Visitor Services

Goal: Promote an understanding and appreciation of the fish, wildlife, and natural and cultural history of Fish Springs NWR by providing high quality environmental education, interpretation, and wildlife-dependent recreational opportunities for persons of all abilities.

Rationale: Visitor services will change slightly under the marsh restoration alternative, with more emphasis placed on passive recreational uses such as environmental education, interpretation, wildlife observation and photography. The change in visitor services is due mainly to the removal of existing water control structures (i.e., dikes and roads), which will limit vehicle access to the Refuge. Restoration and subsequent monitoring of the marsh ecosystem will provide expanded opportunities for interpretation and environmental education. The Pony Express road crossing on the south end of the Refuge will provide wildlife viewing opportunities. Additional viewing opportunities will occur where the road passes near North Spring and its associated drainage at the Thomas Ranch Watchable Wildlife Area. An interpretive boardwalk and an observation tower near remaining roads will provide opportunities for wildlife observation and photography. Access to hunting areas will be via boat and/or foot passage, providing a remote hunting experience. Hunter parking areas will be located near remaining roads. Scout troop service projects on the Refuge will be encouraged. Efforts to provide service projects, merit badge counseling, and expanded interpretation and environmental education programs will enhance the visitor experience and understanding of the Refuge for scout troop service project participants. Additional staff, as requested (see Funding and Personnel section), will make increased efforts in outreach and off-Refuge environmental education possible, thereby enhancing public understanding and appreciation for Fish Springs NWR and the National Wildlife Refuge System.

Objectives:

1. Provide waterfowl hunting opportunities on 40 percent of the Refuge for up to 500 visits annually (Figure 7).

Strategies:

- Continue to open up to 40 percent of the Refuge for duck and coot hunting (no swans or snipe).
- Institute a goose hunt on the Refuge.
- Continue an annual youth hunt.
- Maintain current levels of law enforcement presence during hunting season.

Pony Express Route Marker

- Provide a minimum of one universally accessible hunting blind.
- Produce a new Refuge Hunt Plan within 2 years of the completion of marsh restoration.
- Produce a hunting tear sheet meeting Service graphic standards.
- Hunting by foot and/or boat access upon initiation of marsh restoration work.
- Designate and maintain hunter parking areas for walk-in access.
- Maintain all hunting related signs on the Refuge.
- Identify areas open to hunting and inform the public about Refuge hunting regulations through signs, news releases, pamphlets, and printed State hunting regulations.
- Post hunting information, such as harvest data and availability of universally accessible hunting blinds, on the Refuge web site.

Figure 7. Public Use/Hunting —— Alternative B.

- Expand boating (no gas motors) opportunities on areas open to the public except for the period from May 15 to August 15. Excludes year-round sanctuary areas.

2. Within 5 years of the completion of marsh restoration, provide opportunities for up to 1,500 visitors annually to participate in wildlife observation, wildlife photography, and interpretation (Figure 7).

Strategies:

- Maintain universally accessible Thomas Ranch Watchable Wildlife Area.
- Maintain current levels of law enforcement presence and preparedness throughout the year.
- Upon completion of marsh restoration work, construct a universally accessible interpretive boardwalk trail that extends into the marsh area and a viewing platform. Include interpretive panels along the boardwalk and at the viewing platform that discuss natural and human history of the Fish Springs area.
- Provide a minimum of one universally accessible wildlife observation and photography blind.
- Maintain native plant exhibit next to the Headquarters building.
- Maintain the Visitor Contact kiosk.
- Produce a Refuge general brochure in the Service graphic standard.
- Update and reprint the Refuge Wildlife List as needed.
- Maintain all directional signs on the Refuge.
- Conduct a special event each year for International Migratory Bird Day.
- Host an annual Refuge Open House or similar public event.
- Provide interpretive or environmental education discussions and/or tours for groups as requested. Include discussions about contribution of the Refuge to wildlife resources and ecosystem functioning.
- Co-sponsor other special events as opportunities arise.
- Expand boating opportunities (no gas motors) on areas open to the public except for the period from May 15 to August 15. Excludes year-round sanctuary areas.

3. Upon approval of the CCP, implement at least five different outreach efforts to foster appreciation for the resources of Fish Springs NWR, the National Wildlife Refuge System, and the Service.

Strategies:

- Accommodate and host Boy Scouts and Girl Scouts as requested. Trips usually include a Refuge tour, service project, merit badge counseling, and environmental education activities. Allow troops to camp at Thomas Ranch Watchable Wildlife Area with special permit when deemed compatible.
- Host one to two school visits to the Refuge and make two to four visits to area schools annually, with the target being to increase the number of students reached each year from 50/year currently to 200/year.
- Make three presentations to professional and/or civic organizations annually.
- Write press releases announcing public events.
- Visit County Commissioners at least once a year.
- Visit regional offices of State and Federal Congressional representatives once a year.
- Maintain a Refuge web site with current information.

4. Within 3 years of CCP approval, increase the Refuge volunteer program to reach 1,000 donated hours/year.

Strategies:

- Organize three volunteer days each year with the goal of accomplishing a major task during each event. Provide all necessary training, materials, and lodging as required. Schedule the event in conjunction with national volunteer

efforts, such as Volunteer Week, National Public Lands Day or Earth Day, or in conjunction with special events on the Refuge, such as Migratory Bird Day or the Open House. Write a press release announcing each Volunteer Day and project to be accomplished. Write a press release after each Volunteer Day that recognizes volunteer efforts and what was accomplished during the event.

- Notify area schools, civic groups, and hunting, birding, and environmental organizations, of volunteer opportunities on the Refuge.
- Work with the Service's Regional Volunteer Coordinator to develop a volunteer program that meets Refuge needs.
- Provide room and board for volunteers working on the Refuge for extended periods.
- Develop two or more trailer pads for volunteer use.

Cultural Resources

Goal: Preserve and protect cultural resources on Fish Springs NWR.

Rationale: Under this alternative, access for archaeologists will be limited but the majority of the cultural resources would still be reasonably accessible due to their proximity to roads that would remain on the Refuge's west side. Enhanced and expanded efforts to inventory and analyze yet unmapped cultural resources sites, fully understanding known sites, and vigilant protection of these critical and irreplaceable trust resources will allow a better understanding of the human history of the eastern Bonneville Basin. This additional information, coupled with that which is already known about the area, can provide for a richer and more complete interpretation of the Fish Springs area. Efforts to provide increased interpretation of important sites and a cultural resources brochure that provides an overview of the Refuge's substantial cultural resource values will increase the public's understanding of the important role Fish Springs has played for humans through the ages and appreciation for the Service's responsibility to protect some of this nation's important cultural resources.

Previous work done on the Refuge has suggested that with such a rich assemblage of prehistorical and historical cultural resource sites and resources, the entire Refuge should be nominated as a National Archeological District. Such a designation would bring increased visibility to the tremendous cultural resources protected within the Refuge's boundary and would likely be valuable in ensuring in the future that full consideration of management project impacts is given in relation to these resources.

Objectives:

1. Increase preservation and protection of known archaeological resources on the Refuge, within 10 years.

Strategies:

- Increase law enforcement presence during peak times of public use.
- Use standard law enforcement practices to protect known resources on the Refuge.
- Upgrade existing barricades on two caves known to have been used by prehistoric cultures; replace vertical barricades with horizontal barricades to allow use by bats.
- Install remote-sensing devices on the two caves.
- Catalog, map, and remove surface artifacts in limited cases where public use poses a severe threat.
- Enforce closures of year-round sanctuary areas; most known archaeological sites are within these areas.
- Consult with the Regional Historic Preservation Officer prior to all proposed ground disturbing actions.
- Avoid areas of known cultural resources and potential sensitive areas when practical during management actions.
- Investigate the suitability of nominating the entire Refuge as a Historic District eligible for listing the National Register

of Historic Places.

2. Within 15 years of CCP approval, perform a complete cultural resources survey to identify important cultural resources on the Refuge.

Strategies:

- Continue to host the University of Utah archaeological summer field school whenever possible.
- Contract with a qualified organization to complete a cultural resources inventory.
- Produce a cultural resources overlay for the GIS database.

3. Within 15 years of CCP approval, have two known archaeologically important caves excavated.

Strategies:

- Work with existing partners, such as University of Utah, Brigham Young University, Institute of Archaeology at University of Nevada - Las Vegas, and University of Nevada - Reno, to develop a grant proposal to fund the project.
- Provide non-monetary support to partners, such as vehicles, lodging, and computer support.

4. Within 7 years of CCP approval, develop and implement an expanded cultural and historic interpretation program to include four new initiatives.

Strategies:

- Design and install an interpretive display at the Thomas Ranch Watchable Wildlife Area. Display will discuss the uses of the Fish Springs area from prehistoric occupation up to the early days of the Refuge.
- Construct a turnout along the Pony Express Route where the Lincoln Highway runs close by. Include an interpretive display that discusses the Fish Springs area as a major transportation corridor through time and a foot trail to the remnant portion of the Lincoln Highway.
- Design and install an interpretive sign for the Fish Springs Pony Express site.
- Produce a leaflet that provides information on the rich prehistoric and historic cultural resources of the Refuge.
- Maintain existing cultural resources display and Lincoln Highway marker and sign in the Headquarters building.

Partnerships

Goal: Promote partnerships to preserve and enhance the natural characteristics of the Bonneville Basin ecosystem in which Fish Springs NWR plays a key role.

Rationale: Coordination with a diverse array of partners is necessary to ensure that the Refuge can maximize its contribution to natural resource conservation at the landscape level. It is not enough that staff from Fish Springs NWR simply strive to provide critical habitats in a very arid and harsh environment. Continue to foster and increase opportunities for participation in and contribution to larger landscape and regional level conservation initiatives will help ensure that the Refuge meets this obligation. Opportunities for academic institutions, other Federal, State, and county agencies, NGOs and private citizens to partner with the Refuge to further this goal are nearly unlimited and can provide an important leveraging of resources toward this end.

Objectives:

1. Participate in local partnering opportunities over the next 15 years that will benefit the Refuge by increasing knowledge of Refuge resources or accomplishing specific tasks.

Strategies:

- Continue partnership with University of Utah's Museum of Natural History. Currently, this partnership has resulted in archaeological, geomorphological, and small mammal research being conducted on the Refuge, but the Cooperative Agreement covers many other disciplines.
- Continue partnerships with Brigham Young University and Southern Utah

University, which focus on biological research projects.
- Continue cooperative efforts with Utah Division of Wildlife Resources (e.g., fencing, Partners for Fish and Wildlife).
- Assist in the formation of the Eastern Bonneville Basin partnership with Dugway Proving Grounds, Utah Division of Wildlife Resources, and The Nature Conservancy. The focus of this partnership is common natural resources management issues.

2. Within 3 years of CCP approval, renew participation in existing national and international partnerships at the regional level.

Strategies:

- Renew participation in Partners in Flight, an international bird conservation program.
- Initiate participation in the Intermountain West Regional Shorebird Plan team.
- Renew participation in the Intermountain West Joint Venture All Bird Conservation planning efforts.

2.4 Alternative C - Management for Wildlife Diversity (Proposed Action)

In Alternative C, Refuge management would focus on providing habitat for maximum wildlife diversity including migratory birds, and native mammal, mollusk, invertebrate, and amphibian communities. Under this alternative, habitat needs for species other than migratory birds that had not been addressed adequately in past management efforts would be fully integrated into management efforts. Ensuring that the full complements of fauna and flora historically represented on the Refuge are recognized and that full efforts to understand and meet the habitat requirements for these species would be made a priority.

This alternative is similar to A; however minor changes in water regimes and management activities at eight of the nine ponds would be directed toward creating diverse habitats in terms of water depth, vegetation composition, and habitat structure. Other new strategies include enhancing areas to provide potential rookeries for nesting colonial wading birds, expanding efforts in threatened and endangered species recovery, and conducting a bathymetric survey.

Additionally, restoration components of Alternative B would be incorporated into this alternative on a smaller, experimental basis within the Harrison Unit. Efforts within the Harrison Unit would focus on restoring to the extent possible historical hydrological, physical and biological conditions to the marsh.

Refuge management would also focus more on enhancing the native high desert shrubland community. Natural and prescribed fires would be managed in accordance with the Wildland Fire Management Plan (2002). Weed management described in the Integrated Pest Management Plan (2003) would continue.

Overall Goal: Provide habitat for maximum wildlife diversity.

Rationale: Shifting the focus of Refuge management from enhancing and protecting breeding, wintering and migration habitat primarily for migratory birds to providing habitat to a maximum wildlife diversity will require a substantive shift in management practices. Restoration of a large portion of the Refuge to mimic historical conditions would be a departure from management objectives and prescriptions of the last 40 years. To successfully implement marsh restoration, it is critical to prepare a detailed Habitat Management Plan that will carefully develop and implement habitat management goals, objectives, and strategies.

Objective: Within 5-years develop a Habitat Management Plan that provides the following:

- Specific characterization of the existing biological conditions, including: vegetation composition, distribution, and abundance of exotics (plant and animal); vegetation structure (e.g., height, density); and wildlife

occurrence, distribution, abundance, productivity and seasonal habitat use patterns.
- Description of existing ecological structure and functions, including food web interactions, predator-prey relationships, foraging patterns and relationships, competition.
- Detailed objectives and strategies and the rational to support the strategies.
- Detailed description of the expected outcome of habitat management strategies.
- Detailed methods and management tools to be used to meet objectives.
- Detailed inventory and monitoring surveys to evaluate the success of selected strategies, a discussion on how surveys will be used and data assumptions associated with surveys.

Habitat

Goal: Improve and maintain habitats for nesting and wintering migratory birds and other wildlife populations of the Bonneville Basin.

Rationale: This rationale is similar to that for habitats under Alternative A since the two have similar, but not identical, habitat management scenarios.

Fish Springs NWR, by virtue of its substantial wetlands, is one of the most important habitats in the eastern Bonneville Basin. Use of these wetlands by migrating, wintering, and nesting birds is critical to many species found in western Utah. The Refuge is the largest wetland for a radius of more than 70 miles and provides such habitats to literally tens of thousands of migratory birds as well as being a true oasis in a very arid region that supports a very diverse population of native wildlife. Efforts to maintain and improve a diverse mosaic of habitats are critical to providing high quality habitat in an area where wetlands and relatively pristine desert shrub communities are exceptionally limited compared to surrounding areas.

Objectives:

1. Provide nesting and brood-rearing habitat for waterfowl, shorebirds, and water birds.

Strategies:

- Bring five to six units to optimal stable water levels (Table 3) by mid-April when waterfowl, shorebirds, and water birds are selecting nest sites.
- Maintain stable water levels through mid-June for shorebirds and water birds in five to six units to prevent flooding or drying of nests.
- Maintain stable water levels through mid-July for waterfowl in three to four designated units to prevent flooding or drying of nests.
- Drawdown two units each year (Table 2) to maintain an adequate invertebrate supply as a food source and to recycle nutrients through decomposition and prescribed burning.
- Seek expert consultation on subdividing northern impoundments (Pintail, Ibis, and Gadwall Units) to improve production habitat (i.e., stabilized water through hatching) for waterfowl.
- Within 12 years, provide suitable habitat components (dense hardstem bulrush stands, appropriate water depths, lack of disturbance, protection from prescribed burns) to support expansion of existing rookeries for colonial nesting wading birds (great blue heron, snowy egret, cattle egret, white-faced ibis).

2. Over the next 15 years, maintain existing seasonal closures to minimize disturbance to nesting, wintering, and migrating waterfowl, shorebirds, and waterbirds.

Strategies:

- Close entire Refuge to all forms of boating April 15 to August 15 to protect breeding waterbirds (Table 4).
- Keep 10,746 acres (60 percent of the Refuge) as year-round sanctuary areas.
- Close all roads except the Pony Express Road and the core auto-tour route from

May 15 - August 15.

3. Within 5 years of CCP approval, consult with experts and conduct a bathymetric survey to better characterize the Refuge and its resources.

Strategies:

- Identify and monitor indicator species that best represent the various refuge habitats. Indicator species, such as suggested in Table 4, would be developed in consultation with appropriate experts and a better understanding of the specific habitat dynamics of the Refuge and species that best represent selected habitat.
- Conduct a complete bathymetric survey of all marsh impoundments in order to determine how much habitat, or water, at different depths is created at different water elevations for each unit.

4. Provide spring and fall migration foraging habitat for waterfowl, shorebirds, and water birds. This involves providing a variety of habitat in each marsh unit, including shallowly flooded (≤ 4 inches) and sub-irrigated saltgrass for shorebirds, and emergent vegetation in water 4 to 12 inches deep for water birds.

Strategies:

- Drawdown two units each year (Table 2) to maintain an adequate invertebrate supply as a food source and to recycle nutrients through decomposition and prescribed burning.
- Partially drawdown water in some units and increase water in other units during the early spring (March) to exploit resources not normally available, providing new foraging areas. Where and to what extent water is drawn down will be based on the condition and topography of each unit.
- Delay impoundment drawdowns until March 15 or later in those units scheduled for full drawdown but not scheduled for prescribed burning.
- Cut off water to three to four units in mid-to-late June to allow shrinkage through evapotranspiration and evaporation to create mudflats in late summer and into fall.
- Allow water to drop in three to four other units after mid-July when waterfowl nesting is completed until mid-September. During this time, water is still allowed to flow in, but at a rate less than evapotranspiration and evaporation. Begin refilling units after

Table 4. Suggested indicator species.

Species	Arrival	Nest	Eggs	Hatch	Fledge
American Bittern	April	April-June	May-Mid July	June-August	July-August
Virginia Rail/Sora	April	April-Early May	June-Early July	July-August	August
Common Yellowthroat	April	May-July	June-July	June-July	July-August
Marsh Wren	April	Mid April-Early May			
Mallard	March	April	April-July	May-July	July-August
Least Chub	Resident				
Utah Chub	Resident				
Possible Negative Indicators					
Gambusia					
Muskrat					

mid-September.

5. Within 3 years of CCP approval, identify any threatened, endangered or sensitive plant species or rare plant communities identified by the Service or Utah Department of Natural Resources that exist on the refuge, particularly within the high desert shrubland community.

Strategies:

- Determine historical native floral composition of the high desert shrubland community, within 3 years.
- Conduct a complete vegetation survey to determine current composition of the high desert shrubland community and create a layer for the GIS database.

6. Within 7 years of CCP approval, develop a plan to restore the high desert shrubland community to the historical native composition.

Strategies:

- Compare current and desired conditions to determine how much restoration is necessary.
- Research appropriate restoration methods such as herbicides, prescribed fire, biological controls or mechanical controls. Refuge managers can use some of these control methods to stimulate new growth, remove unhealthy vegetation, recycle soil nutrients, or create fuel breaks to isolate or protect critical shrub communities from cheatgrass invasion.
- Determine necessary resources, budget, specific actions, and time-frame for project.
- Determine indicator species (e.g., plants, birds, invertebrates) for monitoring health of restored communities.
- Begin implementation of selected appropriate restoration actions.

Ecological Integrity

Two goals have been developed under the Ecological Integrity Management Direction. A Refuge-wide goal and a specific goal for restoring the Harrison Unit to natural marsh conditions.

Refuge-wide Goal: Perpetuate the native biodiversity and physical characteristics of the Bonneville Basin as represented on Fish Springs NWR.

Rationale: Efforts to gather inventory data on current use by avian species and attempting to reduce the impacts of various influences such as military overflights and invasive vegetation will be vital to maintain the ecological systems at Fish Springs NWR. The physical environment of the Refuge also contains several sites of importance to the understanding of the history of Lake Bonneville. Ensuring that these sites are protected from unreasonable degradation will ensure that the scientific values are maintained for future research needs and interpretation.

Specific actions would be taken on behalf of species of concern, including federally listed species or species proposed for listing. Listed species are Federal trust resources, with the Service having a responsibility to aid their recovery whenever possible. Species proposed for listing are not officially Federal trust resources but are species of concern. Any efforts the Service can make on their behalf is appropriate, and may even help prevent the species from being listed. Certainly, these efforts are compatible with the Refuge's purpose.

Objectives:

1. Within 5 years of CCP approval, and every 5 years thereafter, assess the status of native biodiversity on the Refuge.

Strategies:

- Conduct community level biological surveys. Include surveying for small mammals, waterfowl, shorebirds, marsh birds, water birds, raptors, passerines, reptiles and amphibians, carnivores, and invertebrates. Create appropriate layers for the GIS database.
- Repeat a complete set of community level surveys every 5 years. Update GIS database accordingly.

- Continue bimonthly bird counts/index, spring and fall mist-netting, and spring and fall shorebird surveys.

2. Within 5 years of CCP approval, develop a plan to maintain the diversity and distribution of native spring snails.

Strategies:

- Establish current distribution and densities of all spring snails and create a layer for the GIS database.
- Identify very limited native species, monitor them for population declines and threats, and determine appropriate protection and restoration actions.
- Refer to historical snail surveys on snail distribution in springs, including work done by the Smithsonian.
- Determine the impact of nonnative snails (*Melanoides tuberculata*) on native snails and other species.
- Investigate ways to eliminate nonnative snails.

3. Within 5 years of CCP approval, rewrite the Marsh Management Plan to maintain native species richness of the marsh plant communities.

Strategies:

- Develop GIS-based vegetation database showing current diversity and distribution of marsh plant Communities. Determine if any relict populations of endemic species exist. Update database as necessary.
- Consult with experts on how to restore and maintain native marsh plant communities and relict populations.
- Evaluate the use of prescribed fire in maintaining native plant communities through a review of the existing literature, experimentation and monitoring, and opportunistically through research.

4. Reduce whitetop by 60 percent and squarrose knapweed by 60 percent within 3 years, tamarisk by 90 percent within 15 years, and cattail stand density by 50 percent within 15 years

Strategies:

- Develop GIS-based vegetation database showing current distribution as a baseline. Update database as necessary.
- Cooperate with the Bureau of Land Management to treat area above the Refuge for squarrose knapweed.
- Treat invasive species with appropriate chemical control agents and mechanical methods.
- Based on results of experimental control conducted in the Avocet Unit, investigate feasibility of using biological controls for squarrose knapweed and tamarisk.
- Once target levels are reached, continue to treat invasive species as needed to prevent re-spreading.

5. Within 6 years of CCP approval, determine the effects of management practices on the spread of Phragmites australis.

Strategies:

- Develop GIS-based vegetation database showing current distribution as a baseline. Update database as necessary.
- Monitor spread of *Phragmites australis* after prescribed fire and pool drawdowns.
- Experiment with chemical and mechanical control on *Phragmites australis* to determine if there is any effective level of control.
- Set target for *Phragmites australis* reduction upon completion of above efforts.

6. Continually preserve sites of geological significance for geomorphological research; both known sites and those identified by experts in the future.

Strategies:

- Do not disturb sites through any earthmoving operations.

- Do not fill, level, or flood sites.

7. Continue to work to minimize impacts of military overflights on wildlife.

Strategies:

- Monitor violations of established rules stipulating flying at least 3,000 feet above the Refuge.
- Continue dialog with the U.S. Air Force when violations occur and how to avoid future violations.
- Request involvement of the Service's Utah Resident Agent in Charge when needed.

8. Within 10 years of CCP approval, achieve a nesting success rate of 40 percent for snowy plovers nesting on the Refuge.

Strategies:

- Measure current nesting success rates of snowy plovers.
- Construct elevated nest sites in suitable nesting units.
- Install electric fencing around nesting areas and experiment with the use of scents to condition predators to the presence of the fence.
- Conduct an annual census in cooperation with staff of Dugway Proving Ground.

9. Within 15 years of CCP approval, establish future roosting sites for bald eagles, a threatened species, on the Refuge.

Strategies:

- Plant three to four Fremont cottonwood trees in two sites in areas with minimum potential for disturbance (e.g., Spring Unit).

10. Re-establish the least chub, a candidate species, in North, Deadman, Walter, House, and Percy Springs over the next 10 years.

Strategies:

- Continue to make structural adaptations of water management facilities to create structural barriers to mosquito fish (*Gambusia affinis)* infestation.
- Conduct multiple removal treatments of nonnative fishes to try and eradicate invasive species in the target springs.
- Move fish from existing Refuge stocks, or from other stocks through Utah DWR, to enhance genetic diversity in nonsystemic sites.

11. Continually inventory, monitor and protect habitat for threatened, endangered and sensitive wildlife species.

Strategies:

- Continue to monitor habitat and populations of wintering bald eagles and least chub.
- Look for new opportunities to cooperate with UDWR on the introduction/re-introduction of spotted frog and other sensitive wildlife native to the Bonneville Basin.
- Continue to look for additional cooperative opportunities with UDWR, universities and other agencies to inventory, monitor and enhance sensitive species habitat.

Marsh Restoration of Harrison Unit Goal: Restore a portion of Fish Springs NWR to the native biodiversity and physical characteristics of the Bonneville Basin as represented on Fish Springs, including unimpeded hydrological, physical and biological components (Figure 8).

Rationale: The Harrison Unit is supplied by a single, isolated spring (North Spring) and retains much of the drainage topography evident in pre Refuge aerial photography making this unit suitable for restoration. Consistent with and complementary to the Ecological Integrity goal and current Service guidance, marsh restoration of the Harrison Unit will perpetuate the native biodiversity and physical characteristics endemic to the area. Little information is available on the specific

ecological conditions of the Refuge prior to Refuge development and the restoration goal has little to no baseline available to establish objectives or measure success. The Refuge is also unique within the Bonneville Basin limiting the Refuge's ability to use a similar site for comparison.

Restoration ecology can be defined as "The return of an ecosystem to a close approximation of its conditions prior to disturbance" (U.S. Natural Resource Council 1992). Ecological systems are dynamic and the restoration objectives will focus on restoring the ecological functions and processes that permit natural succession. The restoration of the Harrison Unit will involve four primary steps:

1) Establishing a baseline inventory to include 3 years of data collection of the flora and fauna prior to any direct management implementation of the restoration process.

2) Conducting management activities, such as dike removal, to restore unimpeded hydrological, physical, chemical, and biological processes.

3) Designing monitoring strategies to evaluate both short term and long-term trends in ecosystem (community) structure and functions (water table dynamics, biodiversity, complete food web, resilience to invasive species). Short-term (1 to 3 years) monitoring to determine establishment and recovery of hydrological and biological components, and long-term (10 years and more) monitoring to determine management effects on community structure and functions.

Figure 8. Alternative C.—Harrison Unit Restoration

4) Refining and establishing new objectives and success criteria based on monitoring that leads to new management activities.

These primary steps would be implemented in a phased approach with monitoring and evaluation of the success of each phase being conducted before proceeding to the next phase. Phase I would remove check dikes and water control structures from water channels to restore unimpeded flow to braided channels. Phase II would breach dikes in the Harrison Unit at natural drainage channels. Phase III, if data indicate restoration is warranted, would remove the entire dike system.

Objectives:

1. Establish a 3-year baseline inventory of existing soil, water, vegetation and fauna conditions of the North Springs stream channels and Harrison Unit pool within 4 years of CCP approval.

Strategies:

- Obtain various expert opinions on the likelihood of a successful restoration effort and relative benefits to the wildlife using that area being considered for restoration.
- Establish Refuge-wide baselines to be used for comparison and monitoring purposes.
- Partner with the Natural Resources Conservation Service to characterize current soil conditions.
- Gather existing data by 2009 on current flows using portable flumes from a minimum of four locations within the unit (spring, midway on feeder canal, inlet to Harrison Pool, below Harrison Pool).
- Establish a minimum of ten shallow ground water monitoring locations by 2006 using simple, inexpensive measuring techniques such as drive point piezometers. This monitoring would provide a simple assessment of changes in water tables and ground water flow that could be correlated with changes in vegetation and community structure
- Coordinate with U.S. Army Dugway Proving Ground during 3-year baseline inventory period to address issues related to water flow onto Army property.
- Establish a baseline inventory for vegetation within the Harrison Unit. Establish long-term (permanent) transects that traverse all macro vegetation communities for monitoring. Map all plant communities within the Harrison Unit, both native and non-native species.
- Conduct weed and invasive plant mapping by 2008 when the Integrated Pest Management Plan is developed, including areas of tamarisk, *Phragmites*, knapweed, fivehook bassia and summer cypress.
- Monitor response of invasive plant species to large-scale soil disturbance.
- Conduct yearly bi-monthly bird surveys of Harrison Unit during refuge-wide surveys conducted between March 15 and May 1 and between July 15 and September 1.
- Conduct yearly shorebird surveys specific to Harrison Unit on weeks opposite the bi-monthly bird survey.
- Establish a baseline inventory of small mammals found within the plant communities in the Harrison Unit. Establish long term (permanent) transects or grids, and predator scent stations within the Harrison Unit when the Wildlife Inventory Plan is developed by 2007. Transects will be co-located with vegetation transects.

2. Within 3 years of approval of the CCP, develop a set of indicator species that best represent habitat within the Harrison Unit and Refuge-wide as described earlier, and that also provide response data for habitat change.

Strategies:

- Consult with experts to develop a list of indicator species (Table 4) that best indicate changes in hydrologic factors, vegetation cover, and composition, wetland salinity, and biodiversity.

- Develop indicator metrics and methods for monitoring indicator species that best meet objectives such as number of individuals per unit, by season, reproductive success, species distribution, and seasonal habitat.
- Conduct pre- and post-monitoring of target indicator species.

3. During the course of one complete drawdown of Harrison Pool in 2007 (Table 2), conduct a complete on-the-ground assessment of the unit to evaluate current conditions and how the major original watercourses can be restored and how to restore them.

Strategies:

- Compare aerial photos from pre-development with current aerial photos. Overlay original pre-development marsh photos on structural/dike map to identify natural watercourses and any remnants that may remain.
- Survey remnant channels.
- Conduct fly-over to see how much integrity exists in main drainages.
- Create GIS overlays for current and historical channels.
- Contract with a hydrologic engineering firm to conduct complete hydrologic assessment.
- Assess complications associated with invasive species introduction resulting from soil and vegetation disturbance from restoration of the landscape.

4. Restore unimpeded hydrological processes to the North Spring (Harrison Unit) in three phases to be completed in 5-year increments.

Strategies:

- Remove check dikes and water control structures by 2010 to restore unimpeded flow to braided channels (Phase I).
- Breach dikes at natural drainage channels by 2015 (Phase II).
- Remove dike system and any berm that diverts, channelizes, or prevents natural flows by 2020 (Phase III).
- Allow unimpeded hydrological processes to restore natural channels.
- Monitor and evaluate success of each phase before proceeding to next phase.

5. Monitor natural vegetation succession within the Harrison Unit.

Strategies:

- Continue to monitor vegetation composition, and community structure on a yearly basis using the line transects established in the baseline inventory. Additional vegetation transects will have to be established once the pool is removed. Plant community (vegetation) characteristics that may be monitored can include: species richness, ocular estimates of ground cover (bare ground, grass/forbs, exotic, and litter), shrub cover, shrub height.
- Establish research partnerships with local colleges and universities to monitor and research vegetation communities and ecological functions.
- Evaluate the need to plant native vegetation by 2009 when the Habitat Management Plan is developed.

6. Upon implementation of the restoration of the Harrison Unit, annually monitor wildlife presence, abundance, and areas of use based on the evaluation of the original watercourses within 5 years of CCP approval.

Strategies:

- Continue to monitor small mammal transects or grids and predator scent stations on a yearly basis. Additional small mammals transects will have to be established once the pool is removed. Data collected on the small mammals may include species richness, abundance, and guilds.
- Continue annual refuge-wide bird surveys and shorebird surveys specific to Harrison Unit on weeks opposite the bi-monthly bird survey between March 15 and May 1 and between July 15 and September 1.

- Map and monitor wading bird nesting colonies (if any) that become established.
- Establish research partnerships with local colleges and universities to monitor and research animal communities and ecological functions, such as predator-prey relationships, competition, resource partitioning.

7. Develop and implement an invasive species plan for the Harrison Unit to annually monitor the effects of restoration on the resource.

Strategies:

- Map and control the spread of non-native and invasive plant species, including tamarisk, knapweed, bassia and summer cypress with appropriate chemical control agents and mechanical methods, according to the Integrated Pest Management Plan (drop down plan).
- Establish study plots to evaluate the efficacy of noxious weed treatments and weed responses to altered hydrology and disturbed soils.
- Identify and contain any non-native animal species with the Harrison Unit, including house mice, mosquito fish, bull frog, leopard frog and non-native snails, according to the Habitat Management Plan

8. Consult with Utah DWR to explore the potential for restoration of least chub in the Harrison Unite over the next 10 years.

- Annually monitor the least chub in the Harrison Unit over the next 10 years and benchmark data against recovery rates in other units.

9. Develop adaptive management simultaneously with the three phases of marsh restoration described in Objective 4, which allows the Refuge Manager to adapt strategies to better meet objectives or determine whether to proceed with restoration.

Strategies:

- Evaluate quality of monitoring data.
- Re-evaluate restoration approach.
- Evaluate if further restoration is warranted.

Visitor Services

Goal: Promote an understanding and appreciation of the fish, wildlife, and natural and cultural history of Fish Springs NWR by providing high quality environmental education, interpretation, and wildlife-dependent recreational opportunities for persons of all abilities.

Rationale: Increased efforts in visitor services and the addition of a goose hunt will attract more visitors in this alternative. The Refuge will maintain an auto-tour route that traverses a cross section of the habitats and provides opportunity for wildlife viewing and photography. The construction of an interpretive boardwalk and an observation platform will further enhance wildlife viewing and photography. Scout groups visiting Fish Springs will find the Refuge to be a wonderful outdoor classroom. Providing service projects, merit badge counseling, and environmental education will enhance the visitor experience and understanding of the Refuge for most of these young visitors. Additional staff, as requested (see Funding and Personnel section), will make increased efforts in outreach and environmental education possible, thereby enhancing public understanding and appreciation for Fish Springs NWR and the National Wildlife Refuge System.

Objectives:

1. Provide waterfowl hunting opportunities for up to 2,000 visits annually (Figure 4).

Strategies:

- Continue to open up to 40 percent of the Refuge to duck and coot hunting (no swans or snipe).
- Institute a goose hunt on the Refuge.
- Continue an annual youth hunt.
- Increase law enforcement presence during hunting season.

- Maintain and advertise availability of three universally accessible hunting blinds.
- Maintain parking areas and roads for hunter vehicle access.
- Maintain all hunting related signs on the Refuge.
- Identify areas open to hunting and inform the public about Refuge hunting regulations through signs, news releases, pamphlets, and printed State hunting regulations.
- Produce a new Refuge Hunt Plan within 2 years.
- Produce a hunting tear sheet meeting Service graphic standards.
- Post hunting information, such as harvest data and availability of universally accessible hunting blinds, on Refuge web site.

2. Within 5 years of CCP approval, provide opportunities for up to 5,000 visitors annually to participate in wildlife observation, wildlife photography, and interpretation (Figure 9).

Figure 9. Public Use —— Alternative C.

Strategies:

- Open Refuge roads to public access as described on Figure 9. Only core auto-tour route open from May 15 to August 15; all other roads closed during that period.
- Maintain all directional signs on the Refuge.
- Maintain 11-mile self-guided auto-tour route with interpretive signs.
- Maintain universally accessible Thomas Ranch Watchable Wildlife Area.
- Increase law enforcement presence and preparedness throughout the year.
- Allow boating (no gas motors) on areas open to the public except for the period from May 15 to August 15.
- Exclude year-round sanctuary areas.
- Maintain three universally accessible wildlife observation and photography blinds.
- Maintain a native plant exhibit near the Headquarters building.
- Maintain the Visitor Contact Kiosk and Headquarters exhibits.
- Construct a universally accessible interpretive boardwalk trail that extends into the marsh area and two viewing platforms. Include interpretive panels along the boardwalk and at the viewing platforms that discuss natural and human history of the Fish Springs area.
- Produce a Refuge general brochure in the Service graphic standard.
- Update and reprint the Refuge Wildlife List as needed.
- Conduct a special event each year for International Migratory Bird Day.
- Host an annual Refuge Open House or similar public event.
- Provide interpretive or environmental education discussions and/or tours for groups as requested. Include discussions about contribution of the Refuge to wildlife resources and ecosystem functioning.
- Cosponsor other special events as opportunities arise.

3. Upon approval of the CCP, implement at least five different outreach efforts to foster appreciation for the resources of Fish Springs NWR and the National Wildlife Refuge System.

Strategies:

- Accommodate and host Boy Scouts and Girl Scouts as requested. Trips usually include a Refuge tour, service project, merit badge counseling, and environmental education activities. Allow troops to camp at Thomas Ranch Watchable Wildlife Area with special permit when deemed compatible.
- Host one to two school visits to the Refuge and make two to four visits to area schools annually, with the target being to increase the number of students reached each year from 50/year currently to 200/year.
- Make three presentations to professional and/or civic organizations annually.
- Write press releases announcing public events.
- Visit County Commissioners at least once a year.
- Visit regional offices of State and Federal Congressional representatives once a year.
- Maintain a Refuge web site with current information.

4. Within 3 years of CCP approval, increase the Refuge volunteer program to reach 1,000 donated hours/year.

Strategies:

- Organize three volunteer days each year with the goal of accomplishing a major task during each event. Provide all necessary training, materials, and lodging as required. Schedule the event in conjunction with national volunteer efforts, such as Volunteer Week, National Public Lands Day or Earth Day, or in conjunction with special events on the Refuge, such as Migratory Bird Day or the Open House. Write a press release announcing each Volunteer Day and project to be accomplished.

Write a press release after each Volunteer Day that recognizes volunteer efforts and what was accomplished during the event.

- Notify area schools, civic groups, and hunting, birding, and environmental organizations of volunteer opportunities on the Refuge.
- Work with the Service's regional volunteer coordinator to develop a volunteer program that meets Refuge needs.
- Provide room and board for volunteers working on the Refuge for extended periods.
- Provide two or more trailer pads for volunteer use.

Cultural Resources

Goal: Preserve and protect cultural resources on Fish Springs NWR.

Rationale: This rationale and objectives are the same as that under Alternative B since the full range of needed improvements in cultural resources management is compatible with both habitat management scenarios.

Previous work done on the Refuge has suggested such a rich assemblage of prehistoric and historic cultural resource sites and resources that the entire Refuge should be nominated as a National Archeological District. Such a designation would bring increased visibility to the tremendous cultural resources protected within the Refuge's boundary and would likely be valuable in ensuring in the future that full consideration of management project impacts is given in relation to these resources.

Objectives:

1. Increase preservation and protection of known archaeological resources on the Refuge, within 10 years.

Strategies:

- Increase Law Enforcement presence during peak times of public use.
- Use standard law enforcement practices to protect known resources on the Refuge.
- Upgrade existing barricades on two caves known to have been used by prehistoric cultures; replace vertical barricades with horizontal barricades to allow for use by bats.
- Install remote sensing devices on the two caves.
- Catalog, map, and remove surface artifacts in limited cases where public use poses a severe threat.
- Enforce closures of year-round sanctuary areas; most known archaeological sites are within these areas.
- Consult with the Regional Historic Preservation Officer prior to all proposed ground disturbing actions.
- Avoid areas of known cultural resources and potential sensitive areas when practical during management actions.
- Investigate the suitability of nominating the entire Refuge as a National Archeological District.

2. Within 15 years of CCP approval, perform a complete cultural resources survey to identify important cultural resources on the Refuge.

Strategies:

- Continue to host the University of Utah archaeological summer field school whenever possible.
- Contract with a qualified organization to complete a cultural resources inventory.
- Produce a cultural resources overlay for the GIS database.

3. Within 15 years of CCP approval, have two known archaeologically important caves excavated.

Strategies:

- Work with existing partners, such as University of Utah, Brigham Young University, Institute of Archaeology at University of Nevada - Las Vegas, and

University of Nevada - Reno, to develop a grant proposal to fund the project.
- Provide nonmonetary support to partners, such as vehicles, lodging, and computer support.

4. Within 7 years of CCP approval, develop and implement an expanded cultural and historic interpretation program to include four new initiatives.

Strategies:

- Design and install an interpretive display at the Thomas Ranch Watchable Wildlife Area. Display will discuss the uses of the Fish Springs area from prehistoric occupation up to the early days of the Refuge.
- Construct a turnout along the Pony Express Route where the Lincoln Highway runs close by. Include an interpretive display that discusses the Fish Springs area as a major transportation corridor through time and a foot trail to the remnant portion of the Lincoln Highway.
- Design and install an interpretive sign for the Fish Springs Pony Express site.
- Produce a leaflet that provides information on the rich prehistoric and historic cultural resources of the Refuge.
- Maintain cultural resources display and Lincoln Highway marker and sign in Headquarters building.

Partnerships

Goal: Promote partnerships to preserve and enhance the natural characteristics of the Bonneville Basin ecosystem in which Fish Springs NWR plays a key role.

Rationale: It is not enough that staff from Fish Springs NWR simply strive to provide critical habitat in a very arid and harsh environment. Coordination with a diverse array of partners is necessary to ensure that the Refuge can maximize its contribution to natural resource conservation at the landscape level. Fostering and increasing opportunities for participation in and contribution to larger landscape and regional level conservation initiatives will help ensure that the Refuge meets this obligation. Opportunities for academic institutions, other Federal, State, and county agencies, NGO's and private citizens to partner with the Refuge to further this goal are nearly unlimited and can provide a important leveraging of resources toward this end.

The capability of the Refuge staff to participate in and contribute to these potential partnerships, which are all geared towards protecting wildlife, cultural, and physical resources at the landscape level, will be maximized under this alternative. The capability of the Refuge to provide critical habitats for the full complement of native flora and fauna will be enhanced and a broader array of species of concern will be a focus of management. Increased participation in partnerships will enable the Refuge to realize more fully the context of its habitats and populations relative to landscape level efforts and should allow it to focus resources to best complement those efforts and the National Wildlife Refuge System and Service missions.

Objectives:

1. Participate in local partnering opportunities over the next 15 years that will benefit the Refuge by increasing knowledge of Refuge resources or accomplishing specific tasks.

Strategies:

- Continue partnership with University of Utah's Museum of Natural History. Currently, this partnership has resulted in archaeological, geomorphological, and small mammal research being conducted on the Refuge, but the Cooperative Agreement covers many other disciplines.
- Continue partnerships with Brigham Young University and Southern Utah University, which focus on biological research projects.
- Continue cooperative efforts with Utah Division of Wildlife Resources (e.g., least chub re-introduction, fencing, Partners for Fish and Wildlife).

- Assist in the formation of the Eastern Bonneville Basin partnership with Dugway Proving Grounds, Utah Division of Wildlife Resources, and The Nature Conservancy. The focus of this partnership is common natural resources management issues.

2. Within 3 years of CCP approval, renew participation in existing national and international partnerships at the regional level.

Strategies:

- Renew participation in Partners in Flight, an international bird conservation program.
- Renew participation in the Intermountain West Joint Venture All Birds Conservation planning efforts.
- Initiate participation in the Intermountain West Regional Shorebird Plan team.

2.5 Funding and Personnel

Personnel

Fish Springs NWR currently has a staff of four full-time employees and one career seasonal (8 to 9 months/year). Alternative B (Refuge Restoration) and C (Proposed Action) of the CCP call for the addition of three new full-time employees and converting the career seasonal to full-time, an overall increase of 3.5 FTE (Figure 10). These increases will greatly enhance the biological programs on the Refuge, which currently lacks any full-time biological staff.

Funding

In fiscal year 2003, Fish Springs NWR had a baseline budget of $330,000 to fund annual operating expenses, including staff salaries. Station backlogs are identified in two databases. The Maintenance Management System (MMS) identifies maintenance project needs for the Refuge. Currently, this database documents $9.5 million in maintenance backlogs for Fish Springs NWR. The Refuge Operations Needs System (RONS) identifies all other Refuge project needs, such as increased staffing and specific on-the-ground projects. This database currently documents $1.3 million in first year costs and $250,000 in recurring annual costs for project needs for Fish Springs NWR. The top 15 RONS and top 10 MMS priority projects are presented in Appendices B and C, respectively.

The cost of implementing the marsh restoration identified in Alternative B is $3.5 to $4.5 million. This involves removal of 28 miles of 8-foot dikes, 264 feet of smaller dikes, 42 concrete culverts, and 16 metal culverts. This cost estimate does not include vegetation restoration in restored areas such as where dikes are removed.

The cost of implementing Alternative C, the Proposed Action, will mean supplementing the current baseline budget with those funds needed to accomplish all projects identified in the RONS and MMS databases. As stated above, the Refuge Operations Needs Systems (RONS) identifies $1.3 million in first year costs and $250,000 in recurring annual costs for project needs for Fish Springs NWR. These costs include the expansion of habitat management activities, increased research and monitoring efforts, and the increased staffing level identified in this alternative.

The cost of implementing marsh restoration in the Harrison Unit is $390,000 to $500,000. This involves the removal of about 3 miles of 8-foot dikes, and about 20 check dams and water control structures (metal culverts, concrete culverts, etc.). This cost estimate does not include vegetation restoration in restored areas such as where the dikes are removed.

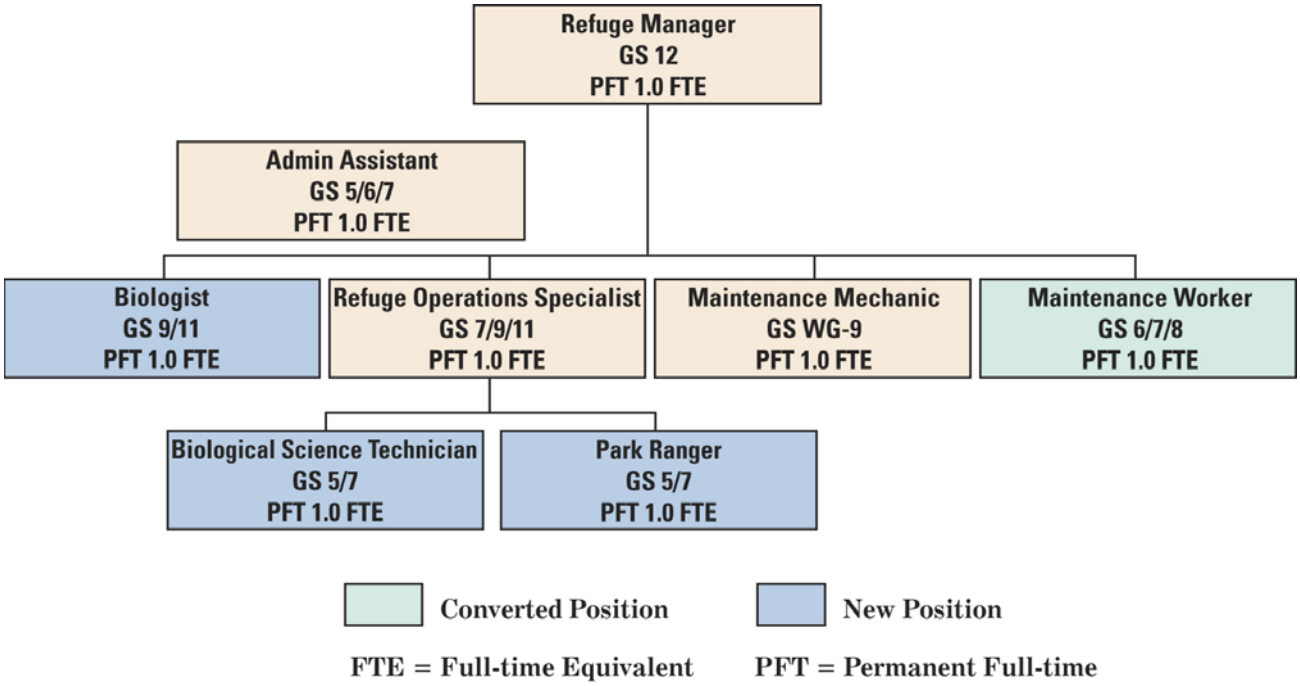


Figure 10. Proposed Organizational Chart for Fish Springs NWR under Alternative B (Restoration) and Alternative C (Proposed Action).

2.6 Partnership Opportunities

Partnerships are a key component of accomplishing the Refuge's mission. Existing partnerships will continue and, hopefully, new ones will be developed.

Currently, partnership opportunities for the Refuge have been limited, primarily due to its remoteness and small staff. However, there have been partnering successes with organizations and individuals with whom a common interest is shared. The Utah Division of Wildlife has worked with the Refuge on the reintroduction of the threatened least chub, fencing projects, Partners for Fish and Wildlife efforts, coordinating waterfowl hunting, and distributing information about the Refuge. The University of Utah Museum of Natural History has conducted several archaeological surveys, small mammal trapping, and geomorphological research. Brigham Young University and Southern Utah University have conducted various biological research projects. Volunteers have contributed thousands of hours in the past in support of Refuge biological inventories, habitat management, visitor services, and facility maintenance. These partnerships have proven fruitful for all parties. Every indication is that they will continue.

Undeveloped partnership opportunities exist throughout the region. Dugway Proving Grounds has expressed an interest in forming an Eastern Bonneville Basin Partnership with Fish Springs NWR, Utah Division of Wildlife Resources, and The Nature Conservancy. The focus of this partnership would be common natural resources management issues, such as landscape-level aspects of providing habitat for species of concern, control of invasive species, and joint law enforcement.

Additionally, the Refuge staff would like to renew participation in regional working groups of national and international partnerships. Partners in Flight, the Intermountain West Joint Venture, Lincoln Highway Association and the Intermountain West Regional Shorebird Plan team are all potential partners. These groups offer shared expertise, ideas, management

strategies, problem-solving, experience, and resources.

2.7 Monitoring and Evaluation

Appropriate monitoring and evaluation are key to meeting the mission of Fish Springs NWR because they provide the information necessary for adaptive management, a flexible approach to long-term management. Results from the monitoring program and other information will be used to evaluate the effectiveness of strategies laid out in this CCP and whether management goals and objectives are being met. Changes will be made to strategies and/or objectives as necessary based on this evaluation.

In this CCP, habitat management and monitoring receive the primary emphasis. Many of the wildlife species on the Refuge are migratory birds. Migratory birds are impacted by a variety of factors (drought, disease, pollution, habitat destruction, etc.) on their wintering and nesting grounds and all along their migration routes. Determining whether or not a specific habitat manipulation in a Refuge unit is wholly responsible for a change in a Refuge migratory bird population is difficult. Managers strive to gather current information about the critical habitat needs for targeted species and possible strategies for meeting those needs, and then design and implement a Habitat Management Plan. The development of a Habitat Management Plan is a critical step toward accomplishing the goals and objectives described in this CCP. The habitat can then be monitored to determine if the management strategies are providing the critical habitat needs identified. Whether or not migratory bird or other wildlife use of the manipulated unit increases may or may not be directly related to the manipulation. Monitoring populations in the manipulated unit over a long period of time can provide only some general local population trend information and document wildlife use. Managers must then carefully evaluate the data to try to determine if a direct correlation exists with the habitat manipulation.

Biological surveys will be conducted for small mammals, waterfowl, shorebirds, water birds, raptors, passerines, reptiles and amphibians, carnivores, and invertebrates. Additionally, a series of vegetative transects/plots in all habitat types will be established as a long-term monitoring tool. This information will be used to assess the effects of abiotic factors (e.g., weather) and habitat manipulation (e.g., water management, burning, invasive species control) on long-term habitat trends on the Refuge.

Much of the monitoring work will be conducted by Refuge staff. The Proposed Action calls for the addition of a full-time biologist and a biological technician, which would dramatically increase monitoring capabilities on the Refuge. Some monitoring projects will be conducted through partnerships with universities or with grant assistance. Other monitoring work will be completed by trained volunteers. Additional communication and cooperation with Service partners in the Bonneville Basin will assist in accomplishing landscape-level monitoring, resolving large scale questions, and testing assumptions.

2.8 Alternatives Considered, but Eliminated from Detailed Study

One additional alternative considered would have returned marsh management to what it used to be, impounding as much water as possible for as long as possible. Waterfowl production was the primary goal of this management regime. Refuge marshes were managed in this manner up until 1988 when the program was assessed for effectiveness and appropriateness. Waterfowl production never reached a substantial level, even after many years of managing for just that. Thus, it was decided that marsh management should be altered in order to accommodate the habitat needs of other migratory birds as well, namely shorebirds and water birds. The MBCA supports this as it encompasses many other birds other than waterfowl. This alternative, holding as much water as possible for waterfowl use, was thus eliminated from

further consideration. It was tried for many years and deemed not the best use for the marsh at Fish Springs NWR.

2.9 Summary Comparison of Alternatives

The three alternatives evaluated are No Action, Restoration, and the Proposed Action, which focuses management on maximum wildlife diversity. A comparison of these alternatives is shown in Table 5.

Table 5. Summary comparison of alternatives.

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Marsh Management	• Continue current management of marsh for waterfowl, shorebirds, and water birds - mosaic of deep water, shallow water, and mud flats • Continue seasonal drawdowns on 5-year cycle • Prescribed burning in different units	• Remove all dikes and water control structures to bring Refuge lands back, as much as possible, to its original natural hydrology • Water would flow from springs unimpeded	• Continue current management of marsh for waterfowl, shorebirds, and water birds - mosaic of deep water, shallow water, and mud flats • Restore Harrison Unit to historical hydrological, physical, and biological conditions • Enhance areas of potential colonial wading bird habitat • Seasonal drawdowns or water increases in some units • Prescribed burning in different units • Consider subdividing some impoundments for more efficient use of limited water inflows • Conduct bathymetric survey of all marsh impoundments • Identify and monitor species indicative of habitat
Uplands High Desert Shrubland	• No active management – passive management and wildfire suppression	• Determine historical native floristic complement of high desert shrubland community • Research appropriate restoration methods • Restore to appropriate floral complement	• Determine historical native floristic complement of high desert shrubland community • Research appropriate restoration methods • Restore to appropriate floral complement

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Ecological Integrity	• Assess population levels and trends of birds using the Refuge - continue bimonthly bird counts/index, spring mist-netting, and shorebird surveys • Continue work to minimize impacts of military overflights • Continue to manage invasive plant species • Continue to monitor and protect sensitive species habitat	• Institute complete and comprehensive biological monitoring plan - monitoring of waterfowl, shorebirds, passerines and other birds; predators; small mammals, reptiles and amphibians, and invertebrates • Develop complete GIS-based vegetation mapping for all Refuge lands • Manage lands for native plant and animal species, taking steps to limit impacts of nonnatives • Continue work to minimize impacts of military overflights	• Institute complete and comprehensive biological monitoring plan - monitoring of waterfowl, shorebirds, passerines and other birds; predators; small mammals, reptiles and amphibians, and invertebrates • Develop complete GIS-based vegetation mapping for all Refuge lands • Manage lands for native plant and animal species, taking steps to limit impacts of nonnatives • Continue work to minimize impacts of military overflights • Implement habitat initiatives on behalf of threatened and endangered species, specifically snowy plover, bald eagle, and least chub • Establish a baseline for hydrological, chemical, physical, and biological conditions of Harrison Unit in three phases • Restore unimpeded flows to Harrison Unit • Identify and monitor indicator species to evaluate biota response to habitat change • Monitor hydrological, physical and biological conditions of Harrison Unit • Establish an adaptive management approach to restore flows in Harrison Unit
Roads	• No changes - all roads outside sanctuary areas open to public, with some limited seasonal closures	• All dike roads would be removed	• Dike roads in Harrison Unit would be removed

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Sanctuary Areas-Closed to Public	• No changes - 10,746 acres or 60% of Refuge	• Undetermined until marsh restoration completed	• Undetermined until marsh restoration in Harrison unit is complete
Hunting	• Waterfowl hunting (no swans or snipe) • Three universally accessible blinds	• Waterfowl hunting (no swans or snipe) • Institute a goose hunt • One universally accessible blind	• Waterfowl hunting (no swans or snipe) • Institute a goose hunt • Three universally accessible blinds
Fishing	• None	• None	• None
Wildlife Observation, Photography and Interpretation	• Thomas Ranch Watchable Wildlife Area • Limited boating • Three universally accessible blinds • Visitor contact kiosk • International Migratory Bird Day event • Annual public visitor event • Auto-tour route	• Thomas Ranch Watchable Wildlife Area • Expanded Boating • One universally accessible blind • Visitor contact kiosk • International Migratory Bird Day event • Annual public visitor event • Construct universally accessible interpretive boardwalk • Construct viewing platform	• Thomas Ranch Watchable Wildlife Area • Limited boating • Three universally accessible blinds • Visitor contact kiosk • International Migratory Bird Day event • Annual public visitor event • Auto-tour route • Construct universally accessible interpretive boardwalk • Construct two viewing platforms
Environmental Education	• Host Boy and Girl Scouts as requested • Occasional tours for other groups as requested • Host visits by school groups as requested	• Host Boy and Girl Scouts as requested • Occasional tours for other groups as requested • Host one to two visits from school groups annually • Conduct two to four in-school programs annually	• Host Boy and Girl Scouts as requested • Occasional tours for other groups as requested • Host one to two visits from school groups annually • Conduct two to four in-school programs annually
Other	• Maintain current outreach and volunteer program	• Expand outreach and volunteer programs	• Expand outreach and volunteer programs

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Cultural Resources	• Continue current level of cultural resource protection • Host University of Utah archaeological summer field school as opportunities arise • Cultural resources display and Lincoln Highway marker and sign in Headquarters building	• Increase protection of known resources • Host University of Utah archaeological summer field school as opportunities arise • Cultural resources display and Lincoln Highway marker and sign in Headquarters building • Work with partners to excavate two archaeologically important caves on Refuge • Perform a complete cultural resources inventory • Possibly nominate entire Refuge as a National Archeological District • Produce interpretive brochure about prehistoric and historic cultural resources of the Refuge • Construct turnout along county road with panel interpreting use of area as a transportation area through time • Interpretive panel at Watchable Wildlife Area focusing on uses of area from prehistoric occupation up to early days of Refuge	• Increase protection of known resources • Host University of Utah archaeological summer field school as opportunities arise • Cultural resources display and Lincoln Highway marker and sign in Headquarters building • Work with partners to excavate two archaeologically important caves on Refuge • Perform a complete cultural resources inventory • Possibly nominate entire Refuge as a National Archeological District • Produce interpretive brochure about prehistoric and historic cultural resources of the Refuge • Construct turnout along county road with panel interpreting use of area as a transportation area through time • Interpretive panel at Watchable Wildlife Area focusing on uses of area from prehistoric occupation up to early days of Refuge

	Alternative A (No Action)	Alternative B (Restoration)	Alternative C (Proposed Action)
Partnerships	• Continue partnerships with University of Utah Museum of Natural History, Brigham Young University, and Southern Utah University for archaeological, geomorphological, and biological research • Continue Partners for Fish and Wildlife with Utah DWR for least chub re-introduction and other projects	• Continue partnerships with University of Utah Museum of Natural History, Brigham Young University, and Southern Utah University for archaeological, geomorphological, and biological research • Continue Partners for Fish and Wildlife with Utah DWR for various projects • Assist in formation of Eastern Bonneville Basin partnership • Renew participation in Partners in Flight, Intermountain West Joint Venture All Birds Conservation, and Intermountain West Regional Shorebird Plan team	• Continue partnerships with University of Utah Museum of Natural History, Brigham Young University, and Southern Utah University for archaeological, geomorphological, and biological research • Continue Partners for Fish and Wildlife with Utah DWR for least chub re-introduction and other projects • Assist in formation of Eastern Bonneville Basin partnership • Renew participation in Partners in Flight, Intermountain West Joint Venture All Birds Conservation, and Intermountain West Regional Shorebird Plan team

Chapter 3 Affected Environment

3.1 Geographic/Ecosystem Setting

Fish Springs NWR, located in western Utah in Juab County (Figure 1 and Figure 2), is one of the most isolated refuges in the lower 48 states. The nearest neighbors reside in Callao, Utah, a ranching community of about 45 people 24 miles west of the Refuge. The nearest communities with services are Dugway Proving Ground, Utah, 63 miles to the northeast and Delta, Utah, 78 miles to the southeast. The Refuge consists of 17,992 acres of fee-title land surrounded on the east, west, and south by Bureau of Land Management (BLM) holdings and on the north by the U.S. Army's Dugway Proving Ground. Springs flowing from the eastern base of the Fish Springs Range feed a 10,000-acre saline marsh divided into nine impoundments (Figure 3). The remaining of the Refuge comprises 6,000 acres of mud and alkali flat and 2,000 acres of semidesert upland.

The Refuge lies entirely within the Interior Basins ecoregion. Within the expanse of that ecoregion, the Refuge is within the subunit known as the Bonneville Basin. The Bonneville Basin comprises the area once covered by the prehistoric Lake Bonneville (Figure 2). Lake Bonneville, a landlocked basin about the size of the State of Montana, was filled about 35,000 years ago and fluctuated with wet and dry cycles until about 15,000 years ago inundating much of the eastern portions of the Great Basin. At that time, the lake rose to a level that breached a pass in southern Idaho, eroded a large cut, and began draining into the Snake and Columbia Rivers. After a period of about 6 months, Lake Bonneville dropped an estimated 400 feet.

Over the next 4,500 years, Lake Bonneville continued to drop from evaporative losses exceeding inflows. Based on consistent carbon dating for the first organic layer in soil coring samples, the University of Utah has determined that the lake receded to the point where Fish Springs became a marsh type wetland about 11,400 years ago.

Wetlands found at the Refuge are associated with of a series of thermal springs that emerge from a fault line at the base of the east slope of the Fish Springs Range. Five major and several minor springs and seeps provide an average flow of about 29 cubic feet per second resulting in an average annual inflow of about 22,000 acre-feet of water. All Refuge springs exhibit thermal influence with the average spring water temperature being 74 degrees Fahrenheit. The springs are high in dissolved minerals, which results in a water pH of about 7.8. Groundwater recharge for the Refuge springs is believed to be regional rather than local due to the large volume in such an arid climate. Carbon-14 analysis aging indicates that water emanating from the Refuge springs probably fell as precipitation from 9,000 to 14,000 years ago.

The wetlands of Fish Springs NWR are about 75 miles south of the Great Salt Lake and are a major migration point for wetland birds migrating to and from the lake. The wetlands of Fish Springs NWR comprise a greater acreage than all of the wetlands combined in all directions for a distance of more than 70 miles. As such, the Refuge provides critical migration habitat for a diverse array of wetland birds. Located on the eastern edge of the Pacific Flyway, the Refuge receives waterfowl from the Canadian Arctic and several Prairie Provinces, as well as birds originating in Idaho, Montana, Wyoming, and Utah.

3.2 Topography

Fish Springs NWR is located in a valley at the eastern front of the Fish Springs Range. The Great Salt Lake Desert to the north, the small Thomas and Dugway Ranges to the east, and the House Range to the south close the basin. The valley is about 10 miles wide and 20 miles

long. The Fish Springs Range is characterized by rocky outcroppings and lava peaks with some areas devoid of vegetation. The peaks are full of caves and crevices.

The Great Basin is composed topographically of long, narrow, and steep mountain ranges running north-south with fairly flat basins between these mountain ranges. The basin, where the Fish Springs marsh is found, is bordered on the west by the Fish Springs Range and on the east by the Dugway and Thomas Ranges. The Refuge Headquarters sits at an elevation of 4,330 feet and the highest point in the surrounding mountains is 8,523 feet. That portion of the Refuge consisting of wetlands is very flat with a minimum elevation of 4,287 feet and a maximum elevation of 4,305 feet.

Between the marsh and the Fish Springs Mountains to the west is a belt (about 6,000 acres) of semidesert uplands composed primarily of greasewood and shadscale. These uplands are flat to gently rolling and soon give way to the shallow marsh. Ancient Lake Bonneville once covered the area except for the peaks of the ranges. The elevation of the Refuge varies from 4,285 to 4,700 feet with a small portion of the Fish Springs Range accounting for elevations above 4,350 feet.

The Refuge's topography was significantly altered in the 1960s with the construction of nine dikes at varying distances from the springs. The dikes created nine impoundments on the Refuge (clockwise from Refuge headquarters: mallard, Shovler, Pintail, Harrison, Gadwall, Ibis, Egret, Curlew and Avocet (Figure 3).

3.3 Soils

The semidesert uplands leading from the Fish Springs Range to the marsh contain alluvial soils with a high gravel content. Mud and alkali flats surround the eastern, northern, and southern limits of the marsh areas. The marsh soils are generally sandy-clay, about 6 feet deep. These soils occur on top of an impervious hardpan layer. Peat deposits, 4 feet deep or less, occur in the drainage areas downstream from the major springs. These soils are mildly alkaline, having a pH of about 8.0.

In the southern part of the Refuge and along the northern boundary are extensive areas of extremely alkaline soil—the salt flats. On the western edge of the Refuge, rocky outcrops produce an accompanying ground cover of coarse fractured rock. Alluvial deposits of coarse gravel are located in two areas west of the marsh. These deposits were left when ancient Lake Bonneville receded.

3.4 Water

After establishment of Fish Springs NWR in 1959, the approximately 10,000-acre marsh was divided into nine units that receive their water supply from warm saline springs rising under artesian pressure and emanating at the base of the Fish Springs Range. These springs receive recharge from precipitation falling on the Fish Springs Range and Deep Creek Range 25 miles to the west. In addition, some spring recharge may occur from deep ground-water movement from Deep Creek, Snake and Tule Valleys. Movement of groundwater over these large distances is through unconsolidated basin fill as well as solution openings and fractures in the deep, consolidated carbonate rock. The age of the spring water is estimated to be about 10,000 years.

All excess water flows into the Great Salt Lake Desert, which adjoins the Refuge to the north. The Refuge is in an arid environment and is the only source of water for many miles. This oasis attracts a variety of species not common to the rest of the Service's Mountain-Prairie Region.

3.5 Water Rights

The Service holds water rights to 43.88 cfs of spring flow originating on the Refuge. The United States acquired the following three Certificates of Appropriation of Water (state perfected water rights) when land was purchased for the Refuge:

Certificate No: 1996
Application No: 9922
Flow Rate: 5.0 cfs North Spring

Priority Date: 04/16/1926

Certificate No: 2077-a
Application No: 10661
Flow Rate: 10 cfs South Spring
Priority Date: 04/30/1929

Certificate No: 2112
Application No: 11020
Flow Rate: 10 cfs Middle Spring
Priority Date: 11/13/1931

After Refuge establishment, the Service filed Application No. A33136 for an additional 18.88 cfs. This application also included the certificated rights for 25 cfs, for a total appropriation by the Refuge of 43.88 cfs. Application No. A-40386 (Water Users Claim 18-331), 0.1 cfs, is for a domestic well with a priority date of 10/08/1970.

The Service controls 100 percent of the water rights on the Refuge with no other users. While the Services' water right is roughly 44 cfs, the current annual flow from the springs is about 28.69 cfs. The spring water is warm (around 74 degrees Fahrenheit) and saline, with conductivity readings of 3,000 to 5,000 umhos at the source.

3.6 Climate

The climate at Fish Springs NWR is arid. The average annual precipitation is 8 inches, with most precipitation falling in the spring and fall. Wide temperature fluctuations typical of desert environments occur daily and seasonally. Temperatures can range from 109 degrees Fahrenheit in summer to minus 19 degrees Fahrenheit in winter. High moisture losses during the summer occur through evapotranspiration as a result of low humidity and high ambient temperatures. Dry thunderstorms are common during the summer. Winter temperatures can remain well below freezing for several days at a time with snowfall averaging 15 inches per year. The frost-free season generally runs from late-April through mid-October. Wind speeds are generally light-to-moderate.

3.7 Habitat and Vegetation

Six habitat types exist on the Refuge—five vegetation communities and open water (Figure 11). These habitat types are:

- Great Basin Arid Shrubland
- Great Basin Cold Desert Grassland
- Great Basin Cold Desert Shrubland
- Shallow Water Marsh and Wetland
- Alkali Mud Flat
- Open Water

Figure 11. Habitat Types.

The Great Basin Arid Shrubland habitat type (516 acres) is found on the west side of the Refuge in the uppermost reaches. Dominant species include Mormon tea (*Ephedra nevadensis*) and rabbit brush (*Chrysothamnus nauseous and C. albidus*). Forbs include globe mallow *(Sphaeralcea coccinea*) and evening primrose (*Oenothera caespitosa*).

The Great Basin Cold Desert Shrubland habitat type (1,577 acres) is found at slightly lower elevations than the Great Basin Arid Shrubland. This habitat type also occupies areas on the west side of the Refuge as well as much smaller patches along the north, east, and south sides of the marshlands. This community is dominated by greasewood (*Sarcobatus vermiculatus*), shadscale (*Atriplex confertifolia*), and fourwing saltbrush (*Atriplex canascens*).

The Great Basin Cold Desert Grassland habitat type (4,328 acres) is found in mostly large patches interspersed with open water, wetlands, and mud flats throughout the marsh area in all nine impoundments. The soil in these areas is sub-irrigated or flooded only seasonally. Primary plant species include saltgrass (*Distichlis stricta*), alkali sacaton (*Sporobolus airoides*), and Baltic rush (*Juncus arcticus*).

The Shallow Water Marsh and Wetland habitat type (3,225 acres) is found in much of the Refuge marsh where water depth is less than 18 inches. Included in this type are Olney's three-square bulrush *(Scirpus americanus*), alkali bulrush (*Scirpus paludosus*), hardstem bulrush (*Scirpus acutus*), common reed (*Phragmites australis*), cattail species (*Typha domingensis* and *T. latifolia*), and spike rush (*Eleocharis rostellata*).

Many Open Water (1,784 acres) areas contain submerged plant species. These communities are the most robust and diverse on the southern end of the Refuge where salt levels are lowest, and the least diverse in the northern reaches where salt levels in the late summer can be quite high. Plant species include wigeongrass (*Ruppia maritima*), coontail (*Ceratophyllum demersum*), spiny najad (*Najas marina*), sago pondweed (*Potamogeton pectinatus*), muskgrass (*Chara* spp.), and filamentous algae.

Alkali Mud Flat (6,437 acres), where subsaturated soils and very high salt levels are predominant, are found primarily on the east and south side of the Refuge. Vegetative diversity is severely limited under these conditions with pickle weed (*Allenrolfea occidentalis*) and samphire (*Salicornia utahensis*) being common in the lower portions and alkali sacaton, saltgrass and greasewood found in areas where dunes have formed.

The only trees native to the Fish Springs area are a few scattered junipers in the higher portions of the uplands. A turn of the century planting consisting of Fremont cottonwoods (*Populus fremonti*) and silverleaf poplars (*Populus alba*) exists at the Thomas Ranch Watchable Wildlife Area. This planting is of cultural significance because although Fremont cottonwoods are not native to Fish Springs, these were planted by early settlers to the area and provide a historical context for the Refuge consistent with the Refuge mission. A thin shelterbelt of Russian olive (*Elaeagnus angustifolia*) and Siberian elm (*Ulmus primula*) surrounds the Headquarters and residential area. Unlike other areas of the Great Basin, Russian olive does not readily spread into the marsh at Fish Springs (likely due to unfavorable soils). Several isolated patches of willow exist near the springs.

The primary noxious weeds in the area are saltcedar (*Tamarix ramossisima*), whitetop (*Cardaria draba*), and squarrose knapweed (*Centaurea virgata*). Mature stands of saltcedar exist along the north boundary with the majority of the Refuge containing only scattered young plants.

Whitetop is a recent invader that is confined to multiple small and discrete stands. This plant is a concern in other parts of the State because it is a noxious weed. It is hoped that annual chemical treatments by the Refuge staff will eradicate the plant. The isolation of the Refuge from other seed sources makes reinfestation in the near future unlikely.

Squarrose knapweed is also a recent invader. This plant first became established along the county road skirting the south and west boundaries of the Refuge. It can now be found

in the western uplands of the Refuge, as well as throughout the Fish Springs Range. Sheep, along the mandated livestock driveway, are believed to be the most important factor in its continued spread.

A list of plants on the Refuge can be found in Appendix D.

3.8 Wildlife

Birds

The Refuge was established because of the historical attraction to waterfowl to its wetland habitat. During fall migrations, up to 30,000 ducks— predominantly mallard, pintail, wigeon, and green-winged teal—have been recorded (Table 6). During the fall and winter, Great Basin Canada geese average around 1,000 birds, and 40 to 100 tundra swans are also present. Recent production records are indicated in Table 7.

Since establishment, more than 278 species of birds have been observed at Fish Springs (Appendix D); 61 are known to nest on the Refuge. The Refuge provides the only important wetland habitat for a 70-mile radius. Consequently, the Refuge attracts hundreds of wetland-dependent species during migration. More than 40 species spend the winter at the Refuge. Great blue herons and black-crowned night-herons are year-round marsh residents. A large variety of shorebirds are present during the summer months.

The Refuge hosts a surprisingly wide variety of songbirds. Breeding species include common yellowthroat, yellow warbler, marsh wren, house finch, yellow-headed and red-winged blackbirds, savannah sparrow, and Say's phoebe. Migrant and wintering species include loggerhead shrike, Wilson's warbler, yellow-rumped warbler, western tanager, pine siskin, and American goldfinch.

Table 6. Estimated waterfowl populations from 1997 to 2002.

Waterfowl	1997	1998	1999	2000	2001	2002
Coot	12,361	3,695	11,235	2,891	7,280	9,800
Tundra Swan	103	120	101	79	87	102
Canada Goose	847	598	858	445	760	1,060
Mallard	1,705	1,669	1,088	435	1,272	1,398
Gadwall	2,052	974	1,102	572	1,862	2,000
Pintail	4,275	1,927	4,609	1,333	7,895	3,267
Green-winged Teal	3,661	1,458	3,120	1,539	1,778	2,032
Cinnamon Teal	1,234	524	1,256	142	376	272
American Wigeon	4,805	281	2,367	495	2,754	5,443
Shoveler	804	883	847	389	374	180
Redhead	1,102	1,206	780	600	455	480
Canvasback	141	91	109	126	128	141
Ring-necked Duck	243	800	280	550	201	316
Lesser Scaup	11	58	140	89	222	72
Bufflehead	137	168	206	239	87	97
Ruddy Duck	287	96	440	119	128	79

Table 8. Estimated water fowl production from colonial nesting birds by species for the years 1994-1996

Waterfowl	1988	1989	1990	1991	1992	1993	1994	1995
	Number of Nests			Successful Nests			Nest Success (%)	
Unit	1994	1995	1996	1994	1995	1996	1994	1995	1996
Mallard	295	370	43	125	59	94	70	29	62	54
Pintail	0	0	0	181	N/A	N/A	N/A	N/A	N/A	N/A
Redhead	74	391	421	370	273	374	549	87	128	175
Canvasback	9	50	5	53	16	157	67	7	5	23
Shoveler	0	21	2	N/A	5	0	N/A	24	0	
Total	342	512	423	227	432	368	66	84	87	56
Gadwall		110	146	226	129	435	50	236	254	
Cinnamon Teal		120	123	328	161	209	35	144	156	
Ruddy Duck		50	24	47	52	168	6	17	35	
Subtotal		1,140	588	1,378	737	1,696	230	754	986	
Canada Goose		75	22	33	18	31	34	24	19	
American Coot		300	678	943	0	0	0	0	0	
Total		1,515	1,288	2,354	755	1,727	264	778	1,005	

Commonly observed year-round Refuge residents include northern harrier, golden eagles, bald eagles, red-tailed hawks, rough-legged hawks, and prairie falcons. Winter residents include rough-legged hawk, American kestrel, and prairie falcons. Great horned and short-eared owls are found on the Refuge but are seldom seen.

Colonial nesting wading birds were monitored at Fish Springs NWR from 1994 through 1996 (Ward and Ward 1996). The Service currently manages the marsh system to provide high quality habitat for colonial nesting birds, including white-faced ibis, snowy egret, black-crowned night heron, and great blue heron. The marsh system is spring-fed, providing consistent, year-to-year nesting habitat that is independent of annual and seasonal fluctuations in precipitation (Ward and Ward 1996). The number and locations of rookery sites varied over the 3 years of monitoring (Table 8). In 1994 the main rookery was in Pintail Slough, shifting to the Mallard Unit with some birds nesting in the south Curlew Unit in 1995, and by 1996 the Mallard Unit was virtually the only active rookery (Ward and Ward 1996). The total number of nests and nest success also varied between years with nest success relatively high for all species (Table 9).

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Mammals

Forty-eight species of mammals hav recorded on the Refuge. The majori species are small rodents (19) and b Coyotes, jackrabbits, and introduced muskrats are commonly seen residents. A small mule deer population uses the Refuge, primarily in late summer and fall. Pronghorn antelope are seen occasionally along the Refuge's western boundary.

Coyotes and badgers are regularly observed. Pocket gophers, wood rats, kangaroo rats, and antelope squirrels are among the more numerous smaller mammals. The Refuge supports a healthy muskrat population, which inadvertently assists in maintaining open water areas within the various units.

Reptiles, Fish, and Amphibians

Twelve reptiles, four fish, and two amphibian species are found at Fish Springs NWR (Appendix D). The small mosquito fish and both amphibian species (bullfrog and leopard frog) were likely introduced in a bullfrog farm that operated in a major portion of the Middle Springs area from the early 1950s until about 1970 (Hovingh 1993; Service 1987). The mosquito fish is found throughout the canals and water units. Bullfrogs occur in House Spring and Walter Spring and areas connected to the main channel by permanent water flow (McKell et al. undated). Bullfrogs are found in springs and the main channel where water temperatures were greater than 66 degrees Fahrenheit**:** bullfrogs are not found in Avocet, Curlew, Shoveler, Egret, Ibis, Gadwall, Pintail or Harrison Units or road side pools with water temperature less than 50 degrees Fahrenheit (McKell et al. undated). Leopard frogs occur along the main channel and in dense vegetation at the edge of canals and pools with water temperatures greater than 60 degrees Fahrenheit (McKell et al. undated).

Leopard frogs are native to Utah; however, according to Hovingh (1993), leopard frogs are believed to be introduced into Fish Springs NWR from nearby populations. Bullfrogs are introduced predators that prey on other frogs, fish and waterbirds, sometimes leading to the extirpation of native fauna (McKell et al. undated; Lawler et al. 1999). Bullfrogs and leopard frogs have restricted patterns of distribution and abundance, possibly due to bullfrog predation on leopard frogs (McKell et al. undated). There is no evidence that bullfrogs impact least chub (Banta, pers. comm. 2004).

The least chub, a candidate species, has been successfully reintroduced into Walter's Spring with additional releases planned in the coming years. The Utah chub, for which the springs were named, is the most numerous fish on the Refuge.

Invertebrates

Aquatic invertebrates (aquatic insects) are an important part of the diet of breeding migratory birds. Drawdowns and burns of marsh ponds simulate the wet/dry cycles of a natural wetland and release stored nutrients (Faulkner and Cruz 1992; Kadlec 1962). Aquatic invertebrate populations were monitored in 1983, 1984, and 1990-1997. Sampling of invertebrates at Fish Springs NWR in 1997 and a summary of data from 1990 to 1997 indicated that invertebrate abundance increases following drawdown and burning (Halley 1997). Nonaquatic insects have not been inventoried or monitored. Thirty-eight families of aquatic invertebrates have been identified from Refuge waters.

Threatened, Endangered, and Candidate Species

Three federally listed threatened and endangered species are found in Juab County: bald eagle, yellow-billed cuckoo, and Ute ladies'-tresses orchid. The bald eagle is listed as

Table 9. Nest success of colonial wading birds in Refuge units for the years 1994-1996.

Species	Number of Nests			Successful Nests†			Nest Success (%)		
	1994	1995	1996	1994	1995	1996	1994	1995	1996
W.F. Ibis	164	200	147	108	169	121	66	85	82
S. Egret	135	204	191	85	159	174	63	78	91
B.C.N. Heron	37	99	76	28	95	64	76	96	84
B.G. Heron	1	7	7	1	7	7	100	100	100
C. Egret	5	2	2	5	2	2	100	100	100
Total	342	512	423	227	432	368	66	84	87

†A nest in which one or more eggs hatch.

Source: Ward and Ward 1996.

a threatened species and is known to winter at Fish Springs NWR. The bald eagle was downlisted from endangered to threatened in 1995 and the Service has proposed to delist the species due to population recovery. The bald eagle is an opportunistic forager during winter, often relying on rabbits, injured waterfowl, and carrion and typically roosts communally during winter (Stalmaster 1987). Between two to five bald eagles are typically observed on the Refuge during winter. Currently, the trees at the Thomas Ranch Watchable Wildlife Area provide the only suitable roosting site for the eagles, although a recent pole planting near South Spring may provide an additional site in the future.

The yellow-billed cuckoo (cuckoo) is a neotropical migratory bird. The decline of the western population of the yellow-billed cuckoo due to loss of riparian habitat has been reported consistently (Tate and Tate 1982; Finch 1992). The Service identified a distinct western population segment of the cuckoo and determined that there was substantial information to indicate that the listing was warranted, but precluded by higher priority listing actions (66 Fed. Reg. 38611 (July 25, 2001)). This species has been added to the Service candidate list. Fish Springs NWR contains no potential habitat for the cuckoo.

The Ute ladies'-tresses orchid (orchid) is federally listed as threatened. The orchid occurs at elevations below 6,500 feet in moist to wet alluvial meadows, flood plains of perennial streams, and around springs and lakes (Service 1992a). Once thought to be fairly common in low elevation riparian areas in Colorado, Utah, and Nevada, the orchid is currently rare in all three states. Generally, the vegetative cover surrounding the orchid is relatively open. Dense, overgrown sites are not conducive to orchid establishment. Where the orchid is found, soils are typically alluvial deposits of sandy, gravelly material that are saturated to within 18 inches of the surface for at least part of the growing season. No surveys have been conducted on the Fish Springs NWR to determine the potential occurrence of the orchid on the Refuge.

It is believed that Fish Springs NWR once harbored the least chub, currently a proposed endangered fish found only in springs of the Bonneville Basin. The fish has been reintroduced into Deadman and Walter's Springs. Only the reintroduction into Walter's Spring has been successful. These populations are considered by UDWR as experimental.

The Fish Springs pond snail was described in 1890. Some empty shells were found by Russell (1971). Dr. D.W. Taylor declared the pond snail extinct after a 1986 survey.

No known resident endangered, threatened, or candidate plant species exist on the Refuge.

The Pacific Coast population of the western snowy plover (*Charadrius alexandrinus*) is considered a distinct population segment (DPS) and was listed as a federally threatened species in 1993 (58 Fed. Reg. 12864 (March 5, 1993)); however, the interior population of snowy plover was determined not to warrant listing (59 Fed. Reg. 58982 (November 15, 1994)). On March 22, 2004, the Service issued a 90-Day Finding on a Petition to Delist the Pacific Coast Population of the western snowy plover and initiated a 5-year review (69 Fed. Reg. 13326 (March 22, 2004)). The western snowy plover is a small shorebird that typically breeds on alkali flats and alongside reservoirs, sewage and evaporation ponds (Andrews and Righter 1992; Kingery 1998) in the interior U.S. This species nests on the ground on beaches, dry mud or salt flats and sandy shores of rivers lakes and ponds.

In northern Utah, snowy plovers usually nest in areas devoid of vegetation, generally in recently exposed alkaline flats (Paton and Edwards 1992). Nesting in northern Utah occurs from mid-April to mid July (Paton and Edwards 1991, 1992). Complete clutches may be lost due to high water, adverse weather, trampling by cattle and large mammals or disturbance by humans. Predation by gulls, common raven, red fox, skunk, raccoon and coyote can result in high rates of clutch failure in some years (Page et al. 1985; Paton and Edwards 1991, 1992). Predation by mammalian and avian predators, including coyote, ravens and possibly Great Basin gopher

snakes, appears to contribute to low production of plovers at Fish Springs NWR (Banta, pers. comm. 2004). The current annual success rate for snowy plovers nesting on Fish Springs NWR is unknown. Predator exclusion fences have proven effective for reducing mammalian predation on piping plovers (Mayer and Ryan 1991; Andrews et al. 1999) and have been proposed as a management tool to reduce nest losses for snowy plover (TNC 1998).

3.9 Cultural Resources and History of Refuge Lands

Fish Springs NWR has a very rich and diverse human history. Archaeological investigations on the Refuge have documented use of the area to the Early Archaic Period (ca. 7,000-8,000 B.P.). Recent studies have indicated that Lake Bonneville receded to expose the Fish Springs marsh about 11,400 years ago, which have led archaeologists to conclude that Paleo-Indian occupation within a few hundred years of that date was likely.

Evidence of human use of the area through the Late Archaic has been found on the Refuge. Evidence of more recent occupation by the Fremont culture has been documented at Fish Springs NWR as well. There are few Fremont culture sites from western Utah but they likely occupied the area from 700 to 1,500 years ago. The Goshiute tribe, an ethnographic branch of the Western Shoshonean culture, occupied the Refuge from the 1400s to the 1900s.

Two caves within the Refuge boundary, located on the east face of the northern tip of the Fish Springs Range, are part of a National Archeological District. Numerous other sites, evidenced by large expanses of lithic scatter, support occupation over thousands of years. Inventory efforts by the University of Utah Archaeology Field School over the last several years have documented 11 major sites. Most of the activity around the marsh is attributed to chipping artifacts and hunting, which assumes that the marsh supported a substantial wildlife population during the prehistoric period.

The first documented Euro-American occupation of the marsh was in 1858. George Chorpenning established a station on his mail route to Nevada. This outpost was little more than a thatched shed.

In 1860, the Pony Express and Overland Stage purchased Chorpenning's mail obligations, and Fish Springs became a stop of note on a very inhospitable section of that arduous route. In 1861, the Transcontinental Telegraph line passed through Fish Springs and that entity proved to be the death knell for the Pony Express. The Pony Express assets were sold and the mail delivery route shifted north of the Great Salt Lake to parallel the transcontinental railroad. The route through Fish Springs, however, proved to be a superior stage route for transporting passengers, and some form of stage service was maintained through the area until the 1920s.

There is little record of activities in the marshes of Fish Springs from 1870 through 1890. By the early 1890s, John Thomas established a ranch on the edge of the marsh and was raising cattle and horses, which he provided to the adjacent Utah and Galena mining operations. He also provided lodging, meals, and hay to the stage service, and sold supplies to the shepherds who wintered enormous flocks of sheep in the region during the winter. Thomas would occupy the ranch until his death in 1917.

In 1913, the Lincoln Highway, the nation's first transcontinental automobile road was built across the Thomas Ranch. This route became a very lucrative source of income for Thomas for several years. In 1919, the completion of the Goodyear Cutoff, about 20 miles north of the marsh, eliminated much of the Lincoln Highway traffic. However, due to the precariousness of that section during winter, a substantial amount of Lincoln Highway traffic continued to pass through the Fish Springs route until 1927. It is estimated that at the peak usage period for the Lincoln Highway more than 5,000 cars passed each year, compared to less than 2,500 cars currently. Several segments of the Lincoln Highway are still visible in Refuge uplands.

Between 1917, when John Thomas died, and 1925, the patented land around the marsh passed through several owners. By 1925 most

of that land was owned by Tass Claridge and Jim Harrison, doing business as the Fish Springs Livestock and Fur Company. This property remained in their possession until 1959 when it was purchased fee-title by the Service for inclusion in the Refuge.

3.10 Fire Occurrence and History

Fire records prior to Refuge establishment are not readily available. Due to topography and the sparse vegetation surrounding the Refuge, fire in the area was probably a localized phenomenon. With the abundant fuel in the form of dead dry marsh vegetation, frequent lightning storms, and the use of the area by nomadic tribes, all of the ingredients necessary for fires were present. It is assumed that fire historically was a relatively common occurrence in the marsh area and was a determinant in the existing vegetation. It is known that post-settlement landowners periodically burned the marsh to improve its grazing potential. Wildfires were "apparently not a problem" for these prior landowners (Service 1960).

Since Refuge establishment in 1959, 54 fires have been reported on the Refuge (50 prescribed burns within marsh units and four wildfires - all human caused). Prescribed burns have varied from 1 acre to 1,630 acres. Based on a review of the fire history, a wildfire frequency of one fire every 10 years has been established.

3.11 Visitor Services

In spite of its isolation, Fish Springs NWR has historically hosted 2,000 to 3,000 visitors each year (Table 10). Most come to enjoy wildlife-oriented recreational opportunities in the Refuge's uncrowded environment. Fish Springs public uses include waterfowl hunting, wildlife observation, wildlife photography, environmental education and interpretation.

Fish Springs NWR provides one of the highest quality public waterfowl hunting opportunities to be found in the western United States. Hunter densities rarely exceed one hunter per 200 acres. Opportunities exist for waterfowl hunting by hunters with mobility impairment. The hunting seasons do not conflict with the waterfowl nesting season.

Recreational use other than hunting in the spring and summer months have contributed to the overall increase. Many come to the Refuge in the process of exploring the rich human history of the area, reaching back into time to more than 11,000 years before present. The Refuge hosts two events annually to provide the public with special opportunities to learn first-hand about the Refuge's resource-rich environment.

The Refuge maintains an auto-tour route that traverses a good cross section of the diverse habitats and provides exceptional opportunities for wildlife viewing and photography. The Thomas Ranch Watchable Wildlife Area provides a welcomed shady respite for visitors who have traveled through the dusty, hot, and dry conditions that must be traversed from any cardinal direction to reach the Refuge.

While visits by scout groups and schools are not as frequent as is the case on many refuges, those that do visit finds the Refuge to be a wonderful outdoor classroom. Providing service projects, merit badge counseling, and environmental education enhances the visitor experience and understanding of the Refuge for most of these young visitors.

3.12 Wilderness

A wilderness review is the process used by the Service to determine whether to recommend lands or waters in the National Wildlife Refuge

Table 10. Public use at Fish Springs NWR, 1995-2002.

Year	Visits
1995	2,642
1996	2,982
1997	2,890
1998	2,957
1999	3,092
2000	2,881
2001	2,049
2002	2,376

System to Congress for designation as wilderness. The Service is required to conduct a wilderness review for each refuge as part of the CCP process. Land or waters that meet the minimum criteria for wilderness are identified in a CCP and further evaluated to determine whether they merit recommendation for inclusion in the Wilderness System. According to Section 13 of the Service's Director's Order No. 125 (July 2000), in order for a refuge to be considered for wilderness designation, all or part of the Refuge must:

- Be affected primarily by the forces of nature, with the human imprint substantially unnoticeable
- Have outstanding opportunities for solitude or primitive and unconfined type of recreation
- Have at least 5,000 contiguous acres or be sufficient in size to make practical its preservation and use in an unimpaired condition, or be capable of restoration to wilderness character through appropriate management, at the time of review
- Be a roadless island

Fish Springs NWR is not recommended for inclusion in the Wilderness System because it does not meet the above criteria. The Refuge has considerable evidence of past human use, and is not roadless.

3.13 Socioeconomics

Population and Demographics

Utah's 2003 population was estimated to be 2.39 million, increasing 2.0% from 2002. Although the state continues to experience net in-migration, natural increase accounts for the majority of Utah's population growth (Governor's Office of Planning and Budget 2004). According to the U.S. Census Bureau, Utah ranked eighth among states with a population growth rate of 1.4% from 2002 to 2003. During the same period, the U.S. rate of growth was 1.0%.

The Western region grew the fastest in the 1990s, with the population in the State of Utah growing from 1,722,850 in 1990 to 2,233,169 in 2000, an increase of 29.6%, while the national population growth rate was slightly less at 13.2%. The population in Juab County grew from 5,817 in 1990 to 8,238 in 2000, an increase of 42% for the 1990s (U.S. Census Bureau 2000). Utah's population is expected to increase about 2.6% annually through 2010.

About 96.6% of the Juab County population consider themselves to be white (compared to 75% nation wide). About 2.6% consider themselves to be Hispanic or Latino in origin (compared to 12.5% nation wide), and 1.0% consider themselves to be American Indian (compared to 0.9% nation wide)(U.S. Census Bureau 2000).

Employment

With about 22,000 employees, the State of Utah is the largest employer in Utah. Health care services and education are the next three top employers while the federal government (mainly defense) occupies the number five rank.

Since 1994, the rate of job growth has fallen from 6.2% to 0.9% in 2001. This is Utah's slowest job growth since 1983 and well below the long-term average of 3.5%. Education and health services led the state in job growth from 2000 to 2003. Financial activity, professional and business services, and government (except state government) experienced positive job growth, while many industries experienced a decline in job growth. Utah's 2003 unemployment rate was 5.8%. On average, there were 68,900 Utahans unemployed in 2003.

Income

Utah's average annual nonagricultural pay was $30,500 during 2003, up 1.4% from 2002. After seven years of solid gains in which wages grew faster than inflation, wages matched inflation during 2002, but grew less than inflation during 2003.

Chapter 4 Environmental Consequences

Environmental consequences for the three alternatives are discussed in this chapter. Table 11 summarizes the comparison of environmental consequences.

4.1 Alternative A - No Action (Current Management)

Marsh (Open Water, Shallow Water Marsh, and Wetland)

Under current management, there would be a slow continuous decrease in waterfowl wintering, migration, and nesting habitat due to the expansion of cattail and common reed (*Phragmites australis*). Cattails have greatly expanded under current marsh management, with some units developing very dense stands that are of lesser habitat quality. Control measures to date (mowing and some herbicide spraying) have failed. Plans are underway to try other control measures on a small experimental basis during the spring of 2004. However, even if these efforts prove effective, it is unlikely that control efforts would keep pace with cattail expansion if marsh water management remains as it is.

To date, Refuge staff has found no effective means to control common reed (*Phragmites australis)* on the Refuge. *Phragmites* can occupy upland sites with seeps, or grow in brackish to fresh water several feet deep. Large monocultures are usually associated with impounded areas with resultant stabilized water regimes (Cross and Fleming 1989). A possible contributing factor is the more recent drawdown schedule that permits *Phragmites* to invade and gain a foothold in former deep water areas unsuitable for the species. *Phragmites* seeds do not germinate and seedlings do not grow in completely saturated (0% oxygen) soils (Wijte and Gallagher 1996a, 1996b).

Due to concerns that prescribed burning is actually aiding the spread of *Phragmites australis*, no burning currently occurs in Avocet, Mallard, Curlew, Shoveler, or Harrison Units. This lack of burning decreases aquatic invertebrate productivity, thereby decreasing the quality of foraging habitats in those units. Fire as a control method for *Phragmites* has variable results. Generally fire is most effective in late summer; winter burning provides no control and often increases densities of *Phragmites* in spring (Cross and Fleming 1989; Frederick 2004). Spring and mid-summer burning without other control treatments is ineffective because burned stands are replaced with a more vigorous growth (Cross and Fleming 1989).

Under this alternative, it is highly unlikely that research into how best to control common reed (*Phragmites australis)* would be conducted over the length of time necessary to reach viable solutions.

Shorebird nesting habitats would be maintained at existing levels, with no opportunities for expansion. Shorebird migration habitat would be substantially degraded due to reductions in burning and resulting nutrient loss.

Current levels of potential nesting habitat for colonial water birds would be maintained. Enhancement of areas for potential rookery habitat would not be established and the failure to periodically burn rookeries under Alternative A may lead to a long-term decline in their productivity. Providing a diverse array of habitat with a mosaic of vegetation types and structure that provide cover, nesting substrate and protection from predators and human disturbance is optimal for maintaining/providing nesting habitat for colonial nesting waders. This may require periodic burning or mechanical disturbance of rookeries or patches within the rookeries to maintain preferred vegetation component

(hardstem bulrush), successional stage, and vegetation structure.

The quality of habitat in the marsh uplands (marsh meadows, sub-irrigated meadows) would decline due to the spread of *Phragmites australis* and cattail. The amount of saltgrass and Baltic rush would decline. Further decline would occur in those units that are not burned due to decadence and the lack of plant revitalization that burning brings.

Predator numbers are expected to remain about the same. The Refuge would continue to attract waterfowl, maintaining the primary prey base for raptors.

No baseline data is available to evaluate possible changes, if any, in the small mammal and invertebrate populations.

High Desert Shrubland (Great Basin Arid Shrubland and Great Basin Cold Desert Shrubland)

Under current management, the restoration of the high desert shrubland habitat would be passive (natural regeneration of native vegetation). Based on observations of shrubland restoration since the successful removal of cattle, passive restoration would result in a slow and unpredictable restoration of native grasses. Most native species still exist on the Refuge. With continued passive management, it is expected that they would slowly increase in abundance. The continued suppression of all wildfires would reduce cheatgrass expansion on the Refuge.

Ecological Integrity

Under this alternative, comprehensive biological assessments would not be conducted.

Phragmites australis would continue to expand due to lack of knowledge and resources to effectively control it.

Native snail diversity likely would continue to decline. Studies to date show a decrease in snail biodiversity over historical conditions. Without taking measures to control the invasion by and spread of nonnative snails, or to address possible habitat threats, there is no reason to expect the downward trend to reverse itself.

The least chub, a candidate species, would not be reintroduced into any additional Refuge springs, reducing the opportunity for recovery and recruitment of this species because other lands, where it occurs, offer less protection than does Fish Springs NWR. Measures to increase snowy plover nesting success would not take place, nor would new roosting sites for bald eagles be established. Fish Springs NWR would not be maximizing its contribution to the survival and recruitment of the snowy plover. Eagles would continue to have no daytime roosting places free from disturbance as the only current daytime roosting place is at the Thomas Ranch Watchable Wildlife Area where Refuge staff must drive directly under the roost several times a day. This arrangement is not beneficial for the eagles.

Visitor Services

Under this alternative, public use opportunities would remain stable. Waterfowl hunters in winter occasionally disturb loafing bald eagles at the Thomas Ranch Watchable Wildlife Area, particularly during weekends. Hunter activity likely displaces eagles from the roost or temporarily alters eagle behavior. Eagles may adjust the times they leave and enter the roost in response to visitor activity. It is expected that hunter visitation would remain at a level close to current numbers, about 1,000/year. Eventually hunter visitations may rise, but is not likely to exceed 2,000 during the life of the CCP (15 years).

No other plans are in place under current management to alter public use opportunities. The auto-tour route, boating with current restrictions, educational programs, public events, universally accessible hunting blinds, the Thomas Ranch Watchable Wildlife Area, cultural displays, and visitor kiosk would not change.

Visitation to Fish Springs NWR currently ranges between 2,000 and 3,100 visitors each year. Visitor use is generally low enough that no substantial impact is made upon the wildlife resources of the Refuge. No substantial changes are expected in these numbers under this alternative.

Permanent and temporary sanctuary areas would remain unchanged (Figure 5). Access to Refuge roads remain as described on Figure 5. Only the core auto-tour route would remain open during the spring nesting season, May 15 to August 15. This core auto-tour route would represent the primary disturbance to wildlife. Additional disturbance would result along other roads from staff activities (e.g., water control, weed control, surveys).

Cultural Resources

Continued surveying for cultural resources by the University of Utah would lead to improved protection of cultural resources by identifying an d prioritizing sites for protection. As important sites are discovered, the limited law enforcement resources on the Refuge would be directed to better monitor them. Additionally, identified sites would be protected from adverse harm due to Refuge management activities by avoiding either vulnerable sites, modifying activities, or clearing artifacts for curation, whichever is most appropriate. However, insufficient law enforcement capabilities would still exist on the Refuge Under current management, loss of cultural artifacts would continue due to theft. Two archaeologically important caves are occasionally breached and artifacts are removed from the ground in both opened and closed parts of the Refuge.

The University of Utah survey activities would not have an adverse impact on any wildlife resources. Crews generally would be small, 10 to 15 people, divided into small groups working in different areas on a daily basis. Most activities would be concentrated in the dunes and springs, away from the marsh. Crews would not use any equipment that would substantially alter the soil or plant communities, nor any that would substantially disturb wildlife.

Partnerships

Current partnership projects with the University of Utah Museum of Natural History would continue to provide the Service with a better understanding of the archaeological and geological significance of the Refuge. Projects conducted with Brigham Young University and Southern Utah University would provide biological information, which would allow for more informed management decisions on the Refuge. The Service also would work with the Utah Division of Wildlife Resources on specific projects such as least chub reintroduction and fencing.

All of these partnerships offer a network of resources and experts available to help achieve Refuge objectives. For instance, archaeological surveys conducted by the University of Utah help to better understanding the rich cultural resources found on Fish Springs NWR. This, in turn, helps the Refuge better interpret the cultural legacy of Fish Springs for the public.

Socioeconomics

Because all uses are maintained at current levels, there should be minimal to no socio-economic impacts under this alternative. This alternative would not increase infrastructure investment in the Refuge, nor increase Refuge staffing levels. The lack of these increases would not take anything away from the local economy, but at the same time, would not add any extra opportunities. Supplies necessary for management of public lands, (e.g., gas, seed, fence posts) would continue to be bought from the local area, maintaining current sources of revenue for area business. By maintaining public use at existing levels, the current tourism contribution to the economy from the Refuge would remain the same.

Protecting habitat and providing healthy ecosystems have additional socioeconomic benefits such as providing clean water and air, reducing soil erosion, increasing flood control and increasing the quality of life. These tangible benefits, as well as more intangible ones, would remain the same under this alternative.

4.2 Alternative B (Restoration)

Marsh

Marsh hydrological restoration would change the habitat qualities of the marsh. There would be no ability to control water levels and no water impoundments. Large expanses of open

water and islands would be replaced with deep narrow braided channels interspersed with marsh uplands and salt flats.

Wintering, migrating, and nesting habitat for waterfowl and shorebirds would be reduced without the ability to control water. This would lead to an inability to provide stable water during the waterfowl nesting season or shallow water and mud flats for shorebird foraging and nesting. It is expected that use by these birds would eventually return to levels similar to pre-development when inventories showed fewer numbers of waterfowls than currently use the Refuge. Historical records show only a few thousand waterfowl during spring and fall, versus peak usage of 18,000 to 20,000 currently. Shorebirds would be expected to decline given their foraging and nesting requirements. Foraging habitat, and perhaps nesting habitat, would likely be reduced for wading birds as well. For instance, the amount of open shallow water would decrease, causing the number of white-faced ibis to decline.

The effect on piscivorous birds (e.g., great blue herons, snowy egrets, black-crowned night-herons) is difficult to determine. The deep narrow water channels may or may not support fish. Deeper and, most likely, faster flowing channels would not be as conducive to foraging by these species, which usually forage in water less than 12 inches in depth and with very low flow rates. In addition, the surrounding habitat may not support their roosting and other needs.

Wetland nesting passerines (e.g., rails, marsh wrens, yellowthroats) would likely increase over the short-term as dense cover for nesting would expand with more marsh uplands. Populations would likely stabilize, or possibly decrease, as open water habitats would decrease and reducing the benefits of open water for providing warmer, sunnier conditions for increased productivity of food resources for these species.

High Desert Shrubland

The high desert shrubland would eventually be restored to a plant composition that more closely resembles its historical native composition. It is unlikely that it will ever be completely restored to its native composition as some level of invasive/nonnative species, especially cheatgrass, will always occur. Under this alternative, however, native grasses, already present but not widespread, would increase. The relative abundance of natives versus nonnatives would improve along with the percent of ground covered by native species. Very little is known about the wildlife component of the high desert shrubland, but a return to a more native floristic condition would provide better habitat for native bird, invertebrate, and mammal wildlife species.

Ecological Integrity

The least chub (candidate species), bald eagle (threatened species), and western snowy plover (State species of concern, species of high concern under the United States Shorebird Conservation Plan 2001) would be adversely impacted were this alternative to be implemented. The least chub would be more vulnerable to predation by the nonnative invasive mosquito fish. The bald eagle would have a smaller prey base with fewer waterfowl and other birds using the Refuge. The snowy plover may experience degraded foraging and nesting habitat. Water would flow unimpeded onto the salt flats, but it is difficult to predict if those areas would be wet or dry during nesting and brood rearing.

Opportunities to assist least chub, bald eagle, and snowy plover populations would be eliminated. Least chub reintroduction would not take place due to the inability to keep mosquito fish out of reintroduction sites without a water control infrastructure. This would further threaten the survival and recruitment of this species because other lands where it occurs offers less protection than does Fish Springs NWR. No new roosting sites would be established for the bald eagle. Eagles would continue to have no roosting places free from disturbance as the only roosting place would be at the Thomas Ranch Watchable Wildlife Area. This arrangement is not energetically beneficial for the eagles. Raised nesting sites and electric fencing around nesting areas for snowy plovers would be infeasible. Thus, Fish Springs NWR would not

be maximizing its contribution to the survival and recruitment of the snowy plover.

Migrating and wintering habitats for birds of prey, such as bald eagles, golden eagles, and harriers, would be reduced as their primary prey base, waterfowl, would shrink. The same is true for some other predators, namely coyotes and red fox. Predators such as kit fox and bobcat would be unaffected.

Native marsh plants would benefit under this alternative with management focusing on ways to promote native species. Invasive plants, such as whitetop and tamarisk, would be greatly reduced, minimizing the impacts of invasives that form large monotypic stands with little habitat value. However, their control would be much more difficult without the aid of roads and airboats for access to problem areas. Marsh restoration itself would probably allow *Phragmites australis* to continue spreading, but an aggressive research effort would reveal how best to control this species. The increase in native marsh plants will benefit some wildlife species such as wetland-nesting passerines.

Native spring snails would also benefit under this alternative, with species richness preserved and sustainable population levels supported. The overall number of *Melanoides tuberculata*, a nonnative snail, would decline if appropriate control measures can be developed and implemented. Eradication would be unlikely. Some *Melanoides tuberculata* would still exist in many springs, with the potential for distribution to other springs via avian species.

Visitor Services

Opportunities for wildlife-dependent recreation would be slightly different in this alternative from the current or proposed management. More emphasis would be placed on passive recreational uses such as environmental education, interpretation, wildlife observation and photography. The restoration and subsequent monitoring of the marsh ecosystem would provide expanded opportunities for interpretation and environmental education.

The addition of a goose hunt would expand hunting opportunities at the Refuge. Many of the existing roads on the Refuge would be eliminated as a result of marsh restoration, which will limit vehicle access to current hunting areas. Hunter parking areas would be located along remaining roads. Access to hunting areas would be via boat and/or foot passage. Boating opportunities would be expanded under this alternative although open water boating opportunities would decrease. Hunting opportunities for people with disabilities would continue, with a minimum of one accessible hunting blind. It is predicted that hunting visits may decrease from about 1,000/year currently to about 500/year due to limited vehicle access to the Refuge.

The Pony Express road crossing on the south end of the Refuge would provide wildlife viewing opportunities. Additional viewing opportunities would occur where the road passes near North Spring and its associated drainage at the Thomas Ranch Watchable Wildlife Area (Figure 7). The construction of an interpretive boardwalk and an observation platform would further enhance wildlife viewing and photography.

The number of students reached each year through environmental education programs would increase from 50/year currently to 200/year. Outreach efforts also would increase. The combined effect of these two programs should result in a greater understanding of Refuge resources and the National Wildlife Refuge System in general. Increased volunteer efforts would assist in achieving many Refuge habitat and visitor services objectives.

Cultural Resources

Protection of cultural resources would be improved under this alternative; less theft and damage will occur. Increased law enforcement capability, improved security at the caves, and better knowledge of the resources would aid Refuge staff in the goal to protect cultural resources.

There would be an increased awareness and appreciation of the cultural resources on the Refuge and the significance of the Fish Springs area through the ages. Visitors would realize that public land agencies are preserving, protecting, and interpreting the cultural legacy

of the areas they manage, which should translate into increased support for the National Wildlife Refuge System.

Continued surveying for cultural resources by the University of Utah would lead to improved protection of those resources. As important sites are discovered, the limited law enforcement resources on the Refuge would be directed to better monitor them. Additionally, identified sites would be protected from adverse harm due to Refuge management activities by avoiding either vulnerable sites, modifying activities, or clearing artifacts for curation, whichever is most appropriate.

The University of Utah survey activities would not be expected to have an adverse impact on any wildlife resources. Crews of 10 to 15 people would be divided into small groups working in different areas on a daily basis. Most activities would be concentrated in the dunes and springs, away from the marsh. Crews would not use any equipment that would substantially alter the soil or plant communities, nor any that would substantially disturb wildlife.

Any contracted archaeological organizations that may assist in Refuge survey activities would be required to follow guidelines designed to minimize disturbance to wildlife.

Partnerships

Current partnership projects with the University of Utah Museum of Natural History would continue to provide the Service with a better understanding of the archaeological and geological significance of the Refuge. Projects conducted with Brigham Young University and Southern Utah University would provide biological information that would allow for more informed management decisions on the Refuge. The Service also would work with the Utah Division of Wildlife Resources on specific projects such as least chub reintroduction and fencing.

All of these partnerships offer a network of resources and experts available to help achieve Refuge objectives. For instance, archaeological surveys conducted by the University of Utah help to better understanding the rich cultural resources found on Fish Springs NWR. This, in turn, helps the Refuge better interpret the cultural legacy of Fish Springs for the public.

Increased participation in regional partnerships, such as Partners in Flight and the Intermountain West Regional Shorebird Plan, would provide the Refuge with an even greater network of resources and experts, and make the Refuge and the Service a greater contributor at the regional level.

Socioeconomics

Under this alternative, marsh restoration will be accomplished through a major construction effort conducted throughout the 15-year life of this CCP and beyond. Construction services, labor, equipment, and supplies will be purchased and/or rented from local and regional area businesses, increasing revenue opportunities for businesses supporting the construction effort. Supplies necessary for management of public lands (e.g., gas, seed, fence posts, etc.) will continue to be bought from the local area for the life of the CCP, maintaining current sources of revenue for area businesses. As restoration nears completion and natural systems recover and require less intensive management, supply needs will decrease. Public use will decrease, decreasing the tourism contribution to the economy.

Protecting habitat and providing healthy ecosystems have additional socioeconomic benefits such as providing clean air and water, reducing sedimentation, and increasing the quality of life. These tangible benefits, as well as more intangible ones, will increase under this alternative.

4.3 Alternative C (Proposed Action)

Marsh

Under this alternative, the quality of waterfowl wintering, migration, and nesting habitat would improve due to reductions in cattail and *Phragmites australis*. Results from research on the effects of prescribed burning on the spread of *Phragmites australis* would help the Refuge staff design an effective control program. With this, prescribed fire would be used in all marsh

units, including Avocet, Mallard, Curlew, and Shoveler, allowing for enhanced production of invertebrates. This enhanced food resource is expected to increase brood survival rates for waterfowl and shorebirds.

Shorebird fall migration and nesting habitat would be maintained at existing levels, with no opportunities for expansion or improvement. Spring migration habitat would increase.

Nesting habitat for colonial water birds would increase through the creation of additional stands of hardstem bulrush for use as a second rookery. This would provide potential nesting for at least 150 more pairs.

Predator numbers are expected to remain about the same. The Refuge would continue to attract waterfowl, their primary prey base.

Marsh hydrology in the Harrison Unit would be restored. This would restore historical hydrological, physical, and biological processes, increasing the biodiversity of native flora and fauna communities. Flora and fauna communities and species dependent on open water habitats would decline.

Loss of peat by past burning would delay or preclude restoration.

No baseline data is available to evaluate possible changes, if any, in the small mammal and invertebrate populations.

High Desert Shrubland

The high desert shrubland would eventually be restored to a plant composition that more closely resembles its historical native composition. It is unlikely that it will ever be completely restored to its native composition as some level of invasive/nonnative species, especially cheatgrass, will always occur. Under this alternative, however, native grasses, already present but not widespread, would increase. The relative abundance of natives versus nonnatives would improve along with the percent of ground covered by native species. Very little is known about the wildlife component of the high desert shrubland, but it is reasonably expected that this return to a more native floristic condition would provide better habitat for native bird, invertebrate, and mammal wildlife species.

Ecological Integrity

The least chub (candidate species), bald eagle (threatened species), and western snowy plover (State species of concern, species of high concern under the United States Shorebird Conservation Plan 2001) would benefit under this alternative. Least chub reintroduction would take place in nonsystemic springs. Fish Springs NWR offers the best level of protection for this fish; other public and private lands where it is found do not offer the same level of protection as a National Wildlife Refuge. Populations at Fish Springs, once established and protected, could be used as gene stock for other areas.

New roosting sites would be established for the bald eagle. Raised nest sites and electric fencing around nesting areas for snowy plovers would be constructed, offering a level of protection not available in most of this bird's range.

Migrating and wintering habitats for birds of prey, such as bald eagles, golden eagles, and harriers, may be enhanced slightly as their primary prey base, waterfowl, experience slight gains due to improved habitat. The same is true for some other predators, namely coyotes and red fox. Predators, such as kit fox and bobcat, would be unaffected.

Native marsh plants would benefit under this alternative with management focusing on ways to promote native species. Invasive plants, such as whitetop and tamarisk, would be greatly reduced, minimizing the impacts of invasives that form large monotypic stands with little habitat value. The increase in native marsh plants would benefit many wildlife species such as wetland-nesting passerines, waterfowl, shorebirds, and water birds.

Native spring snails also would benefit under this alternative, with species richness preserved and sustainable population levels supported. The overall number of *Melanoides tuberculata*, a nonnative snail, would decline if appropriate control measures can be developed and implemented, as is hoped. Eradication is

highly unlikely. Some *Melanoides tuberculata* would still exist in many springs, with the potential for distribution to other springs via avian species.

Visitor Services

Opportunities for wildlife-dependent recreation would be improved under this alternative (Figure 8), including additional facilities for people with disabilities, increased outreach, and initiation of a goose hunt. The construction of an interpretive boardwalk and an observation platform would further enhance wildlife viewing and photography. Total annual visits are expected to increase up to 5,000 over the life of the CCP.

It is predicted that hunting visits would increase from about 1,000/year currently to about 2,000/year due to increased outreach efforts and the addition of a goose hunt. Hunting opportunities designed especially for people with disabilities would continue.

The number of students reached each year through environmental education programs would increase from 50/year currently to 200/year. Outreach efforts would also increase. The combined effect of these two programs should result in a greater understanding of Refuge resources and the National Wildlife Refuge System in general. Increased volunteer efforts will assist in achieving many Refuge habitat and visitor services objectives.

Cultural Resources

Protection of cultural resources would be improved under this alternative; less theft and damage would occur. Increased law enforcement capability, improved security at the caves, and better knowledge of the resources would aid Refuge staff in the goal to protect cultural resources.

There would be an increased awareness and appreciation of the cultural resources on the Refuge and the significance of the Fish Springs area through the ages. Visitors would realize that public land agencies are preserving, protecting, and interpreting the cultural legacy of the areas they manage, which should translate into increased support for the National Wildlife Refuge System.

Continued surveying for cultural resources by the University of Utah would lead to improved protection of those resources. As important sites are discovered, the limited law enforcement resources on the Refuge would be directed to better monitor them. Additionally, identified sites would be protected from adverse harm due to Refuge management activities by avoiding either vulnerable sites, modifying activities, or clearing artifacts for curation, whichever is most appropriate.

The University of Utah survey activities are not expected to have an adverse impact on any wildlife resources. Crews of 10 to 15 people divided into small groups would work in different areas on a daily basis. Most activities would be concentrated in the dunes and springs, away from the marsh. Crews would not use any equipment that would substantially alter the soil or plant communities, nor any that would substantially disturb wildlife.

Any contracted archaeological organizations that may assist in Refuge survey activities would be required to follow guidelines designed to minimize disturbance to wildlife.

Partnerships

Current partnership projects with the University of Utah Museum of Natural History would continue to provide the Service with a better understanding of the archaeological and geological significance of the Refuge. Projects conducted with Brigham Young University and Southern Utah University would provide biological information that would allow for more informed management decisions on the Refuge. The Service also would work with the Utah Division of Wildlife Resources on specific projects such as least chub reintroduction and fencing.

All of these partnerships offer a network of resources and experts available to help achieve Refuge objectives. For instance, archaeological surveys conducted by the University of Utah are invaluable in better understanding the rich cultural resources found on Fish Springs NWR. This, in turn, helps the Refuge better interpret the cultural legacy of Fish Springs for the public.

Increased participation in regional partnerships, such as Partners in Flight and the Intermountain West Regional Shorebird Plan, would provide the Refuge with an even greater network of resources and experts, and make the Refuge and the Service a greater contributor at the regional and landscape level.

Socioeconomics

Infrastructure investment in the Refuge and Refuge staffing levels will increase under this alternative. Additional housing, vehicle support, food and other staple items will be required to support three new full-time employees. These increases will create additional revenue opportunities for regional and local area businesses. New housing requirements will increase demand for construction services. Supplies necessary for management of the Refuge will increase with the expansion of management activities (e.g., grass, seed, fence posts, etc.). Supplies will continue to be bought from the local area, increasing revenue opportunities for area businesses.

Public use is expected to increase with the addition of a goose hunt and expanded wildlife observation opportunities. Construction services will be required to build the interpretive boardwalk and viewing platforms. Marsh restoration of the Harrison Unit will add to the increased demand for construction services. Labor, equipment and supplies will be purchased and/or rented from local and regional area businesses, increasing revenue opportunities for businesses supporting the construction effort. Increased public use will increase the tourism contribution to the economy from the Refuge.

Protecting habitat and providing healthy ecosystems have additional socioeconomic benefits such as providing clean water and air, reducing soil erosion, increasing flood control, and increasing the quality of life. These tangible benefits, as well as more intangible ones, will increase with expansion of habitat management, research, and monitoring programs in this alternative.

Table 11. Summary comparison of environmental consequences.

Goal Area	Alternative A (Current Management)	Alternative B	Alternative C (Proposed Action)

Goal Area	Alternative A (Current Management)	Alternative B	Alternative C (Proposed Action)
Marsh	• Slow erosion of waterfowl wintering, migration, and nesting habitat • Decreased aquatic invertebrate productivity • Decreased quality of foraging in some units • Shorebird and colonial waterbird nesting habitats maintained at existing levels • Substantial degradation of shorebird migration habitat • Degradation of marsh upland habitat • Less saltgrass and Baltic rush	• Open water and islands replaced by braided channels • Drastic reductions in wintering, migration, and nesting habitat for waterfowl and shorebirds • Reduction in use of Refuge by waterfowl and shorebirds to fraction of present • Less foraging habitat for wading birds • Increase in habitat preferred by wetland-nesting passerines • Indeterminate effect on habitat needs of piscivorous birds	• Improved wintering, migration, and nesting habitat for waterfowl • Increased production of aquatic invertebrates • Increased brood survival rates for waterfowl and shorebirds • Increased spring migration habitat for shorebirds • Nesting habitat for up to 150 more pairs of colonial water birds • Enhanced potential habitat for colonial waterbirds • Restoration of historical marsh hydrology and wildlife communities in Harrison Unite • Increased biodiversity of native flora and fauna and a diverse mosaic of habitat • Decreased flora and fauna dependent on open water habitat
High Desert Shrubland	• Unpredictable restoration of native grasses • Native plants slowly increase in abundance • Very limited expansion of cheatgrass	• Historical native plant composition restored • Increase in native grasses • Improvement in relative abundance of native to nonnative plants • Improved quality of habitat for high desert shrubland dependent bird, mammal, and invertebrate species	• Same as Alternative B

Goal Area	Alternative A (Current Management)	Alternative B	Alternative C (Proposed Action)
Ecological Integrity	• Spread of *Phragmites australis* • Decline in native snail diversity • Possible decline in least chub population • No increases in snowy plover nesting success • No bald eagle roosting sites free from disturbance	• Greatly improved natural ecosystem integrity • Reductions in *Phragmites australis*, whitetop, and tamarisk • Preservation of native spring snail species richness • Drastic decline in least chub population • Large increase in mosquito fish population • Possible degraded foraging and nesting habitat for snowy plover • No bald eagle roosting sites free from disturbance • Smaller prey base for bald eagles and other birds of prey, coyotes, and red fox • Increase in native marsh plants • Increased wetland-nesting passerine populations	• Reduction in *Phragmites australis*, whitetop, and tamarisk • Preservation of native spring snail species richness • Increase in least chub population • Increased snowy plover nesting success • Disturbance-free bald eagle roosting sites • Slight increases in prey base for bald eagles and other birds of prey, coyotes, and red fox • Increase in native marsh plants • Improved habitat for wetland-nesting passerines, waterfowl, shorebirds, and water birds • Increased protection for breeding waterbirds
Visitor Services	• Currently ranges between 2000-3100 annual visitations • Increased hunting opportunities • 50 students/year reached through environmental education programs	• Decrease to 1,500 annual visitations • Increased hunting opportunities • Vehicle access to Refuge limited, due to elimination of roads • Increased boat and foot access opportunities • Loss of open water for boating • 200 students/year reached through environmental education programs	• Increase to 5,000 annual visitations • Increased hunting opportunities • Increased opportunities for wildlife observation and photography • 200 students/year reached through environmental education programs • Opportunities for boating closed until August 15
Cultural Resources	• Continued loss of cultural artifacts due to theft • Better protection of important sites • No significant disturbance to wildlife resources	• Decreased loss of cultural artifacts due to theft • Improved protection of all sites • Increased opportunities for learning about cultural significance of Fish Springs area • No significant disturbance to wildlife resources	• Same as Alternative B

Goal Area	Alternative A (Current Management)	Alternative B	Alternative C (Proposed Action)
Partnerships	• More informed management of Refuge biological and cultural resources • Higher likelihood of achieving Refuge objectives	• More informed management of Refuge biological and cultural resources • Higher likelihood of achieving Refuge objectives • Greater regional contribution by Refuge	• Same as Alternative B

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