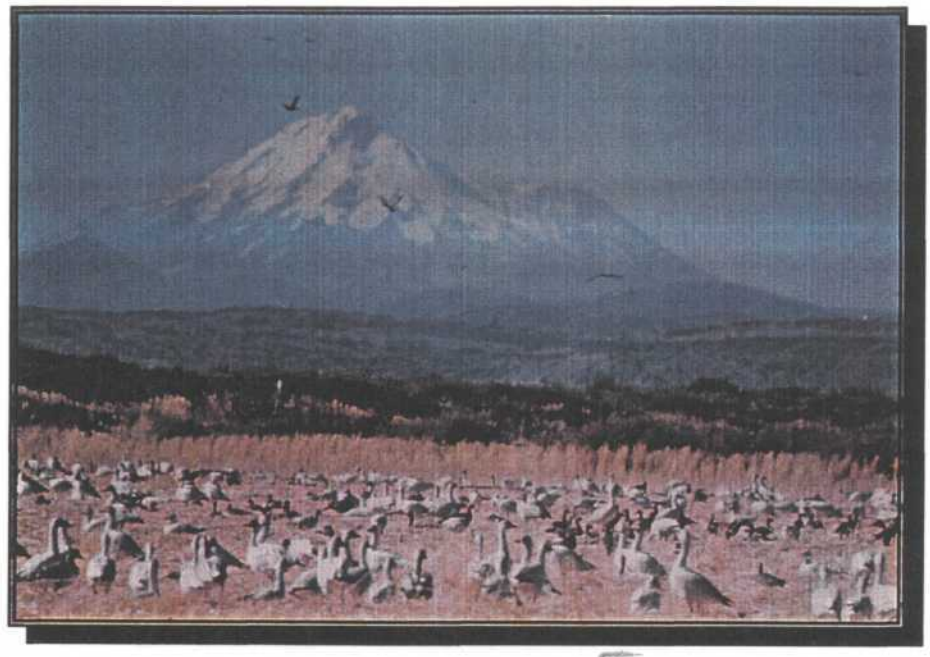
Integrated Land Management on Tule Lake National Wildlife Refuge

An alternative management strategy developed by the Integrated Land Management Working Group:

Promoting productive wetland habitats and sustainable agriculture on Tule Lake National Wildlife Refuge



October 30, 2000

EXECUTIVE SUMMARY

This document describes the rationale for and implementation of an Integrated Land Management (ILM) Plan for the Tule Lake National Wildlife Refuge (NWR). The proposal is the recommendation of 5 representative stakeholders in the Tule Lake area.

During the 1950's, 1960's, and early 1970's, Tule Lake NWR was considered the single most important waterfowl refuge in North America when peak populations exceeded 2.5 million ducks and 1.0 million geese. The Kuchel Act of 1964 was enacted to preserve these waterfowl values as well as the local agricultural economy dependent on Refuge lands. However, restrictive management of wetlands and water levels under the Kuchel Act has eliminated the ecological processes critical to the Refuge's sustained wetland diversity and productivity. Currently, Tule Lake NWR supports a fraction of its past waterfowl use, species diversity has declined, and its value to endangered species has diminished. Agricultural sustainability is also threatened. Increasing populations of soil pests and declining soil organic matter content necessitate increased production costs to maintain crop yields. Management issues on Tule Lake NWR are significant because continued declines in wetland productivity threaten the status of the Refuge as a major staging and breeding area for migratory birds on the Pacific Flyway. In addition, the further degradation of Refuge soils may negatively impact the highly productive agricultural economy that supports adjacent rural communities.

The goal of ILM is to revitalize wetlands and deep-water habitats while providing economically viable and sustainable agriculture. To achieve this goal, we believe it is necessary to combine wetland management strategies and agricultural practices in a synergistic manner which restores ecosystem health and creates an ecologically and economically sustainable landscape. Ramifications of such a program reach far beyond Refuge boundaries to other landscapes where wetlands and agriculture coexist.

Objectives of ILM include:

- ❑ Improve the Refuge's biological integrity and diversity, through the creation of productive wetland habitats.
- ❑ Provide deep-water habitat for the survival of endangered sucker fishes.
- ❑ Improve water quality.
- ❑ Increase the sustainability of agricultural operations on the Refuge.
- ❑ Improve the diversity and economic vitality of local rural communities.
- ❑ Improve the flood control and water storage capabilities of the Refuge.
- ❑ Provide flexibility in Refuge management.

ILM utilizes a variety of traditional as well as innovative management strategies including crop rotations, wetland/cropland rotation, flooding of subsided lands, routing of Refuge waters, and hydrologic diversity to mimic historic processes. These strategies will recreate the historic range of endemic fish and wildlife habitat while improving water quality and the sustainability of Refuge

farming operations. ILM calls for the drainage of some current wetland areas and the establishment of new deep-water habitat. It also calls for the creation of new, more vital permanent and seasonal wetland areas. Productive agricultural lands will be created and the proper coordination of water movement through these land forms will maximize water quality. ILM will provide enhanced fish and wildlife habitat and improved integrated pest management on agricultural lands.

The problems inherent in the coexistence of wetlands and agriculture are not restricted to the Klamath Basin; they are problems of national and international significance. Symptoms of these long standing problems include the high proportion of endangered plants and animals worldwide that are dependent on wetlands, declining quality of water in the world's streams and lakes, and the proliferation of pesticides and fertilizers in agricultural operations.

A Working Group, comprised of 5 stakeholders from the Tule Lake area, believes that the multiple mandates of the Kuchel Act represent a unique opportunity and challenge for the U.S. Fish and Wildlife Service take a lead role in developing and demonstrating techniques whereby management of wetlands and agricultural lands can be integrated in ways that maintain ecological integrity as well as the economic well being and sustainability of surrounding rural communities. ILM on Tule Lake NWR would transform the Refuge into a valuable demonstration area where techniques would be developed to solve these multiple problems.

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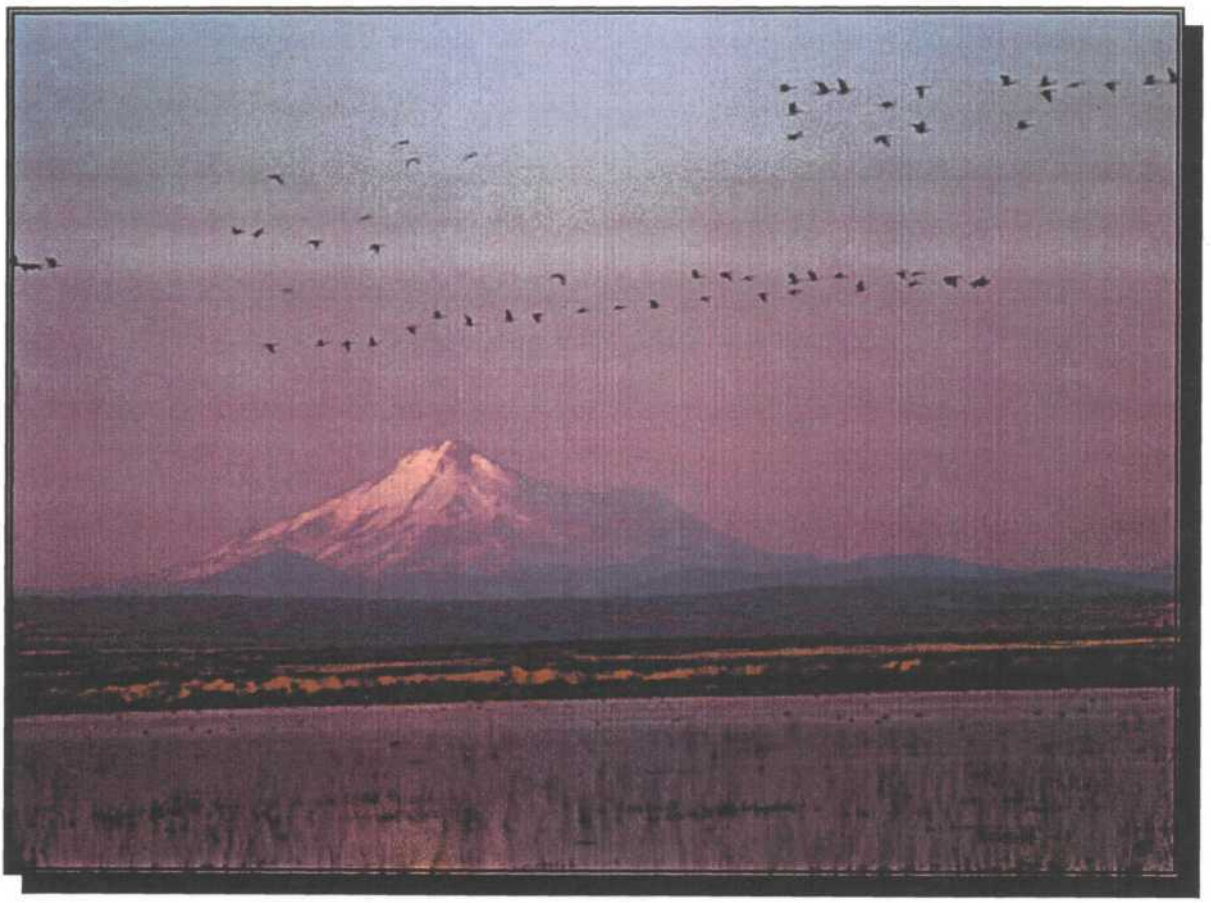


I. INTRODUCTION

> "In a mid-October day of almost any year when the southern migration along the Pacific Flyway is in mid-flight, a visitor to northern California's Tule Lake may still see a sight as full of wonder as that of the buffalo and [passenger] pigeons: the sight of some 6 million ducks and geese gathered in a single rendevous" (Sports Illustrated, December 1959)
>
> "Klamath Basin, an expanse of rich upland athwart the California-Oregon border, is today the scene of the world's most spectacular show on wings" (Readers Digest, November 1959)

These passages and similar writings were published in several national magazines of the day. At the time of these writings and through the 1960's and early 1970's, Tule Lake National Wildlife Refuge (NWR) was considered the single most important waterfowl refuge in North America when peak waterfowl concentrations exceeded 2.5 million ducks and 1.0 million geese. At this time, the Refuge consisted of productive wetland habitats surrounded by commercially valuable agricultural crops. In addition to waterfowl, Refuge wetlands provided habitat to a multitude of

wildlife species and was considered the most important diving duck breeding area in the Intermountain West. Refuge agricultural crops provided high carbohydrate foods to millions of waterfowl in the Pacific Flyway and delayed their southward migration into important agricultural areas of the California's Central and Imperial Valleys. Agricultural crop values and millions of dollars spent by waterfowl hunters and bird watchers spurred local business and provided a significant share of the region's economy.

Tule Lake NWR is located immediately south of the Oregon border in Modoc and Siskiyou Counties in California. The Refuge is part of the Klamath Basin NWR Complex and is jointly administered by the U.S. Fish and Wildlife Service (Service) and U.S. Bureau of Reclamation under a 1977 Cooperative Agreement. Tule Lake NWR is part of the Klamath Reclamation Project (U.S. Bureau of Reclamation) and is dependent on the Project for its supply of water (Fig. 1). The Refuge (Fig. 2) consists of 13,000 acres of wetlands with a 3,000-acre emergent marsh and the remaining acreage in open water. Agricultural lands (17,000 acres) on the Refuge are comprised of spring planted small grains (2/3 of acreage) with barley the predominate crop and row crops (potatoes, sugar beets, and onions) occupying the remaining acreage.

Over the last 35 years sedimentation and stabilized water levels on the Refuge have reduced wetland habitat quality and flood storage capability. In addition, declining soil organic matter and increasing levels of soil pests are necessitating increased production costs to maintain crop yields. Because of these problems, it has become increasingly difficult to meet the multiple mandates of legislation guiding Refuge management.

To address the multiple resource problems facing Tule Lake NWR, a working group comprised of 5 stakeholders from the Tule Lake area was formed in the late spring of 1999. The Working Group's purpose was to develop potential solutions for the multiple problems facing the Refuge. As a result of this process, a proposal called Integrated Land Management (ILM) was developed. This document describes the ILM proposal, its rationale, benefits, and a potential implementation and monitoring strategy.

Working Group Members:

- ❑ Harry L. Carlson, Ph.D, Superintendent, University of California Intermountain Research and Extension Center.
- ❑ Earl Danosky, District Manager, Tulelake Irrigation District.
- ❑ Robert Davis, Chief of Natural Resources Div., U.S. Bureau of Reclamation.
- ❑ David M. Mauser, Ph.D, Wildlife Biologist, U.S. Fish & Wildlife Service.
- ❑ Iva Rogers, Governmental Affairs, California Waterfowl Association.

In addition to the Working Group Members, Collin Bode served as Working Group Staff Analyst and Writer.

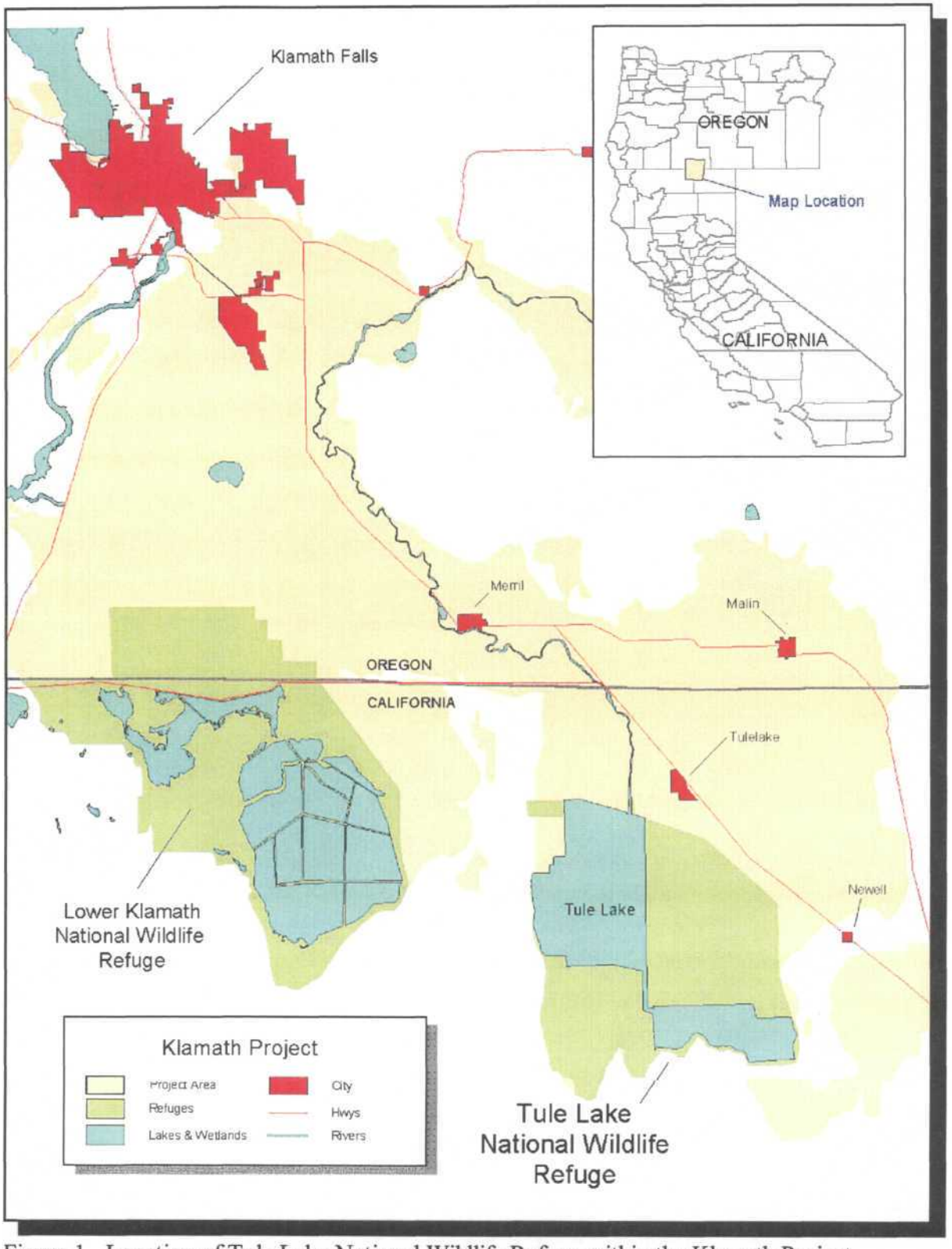


Figure 1. Location of Tule Lake National Wildlife Refuge within the Klamath Project, California and Oregon.

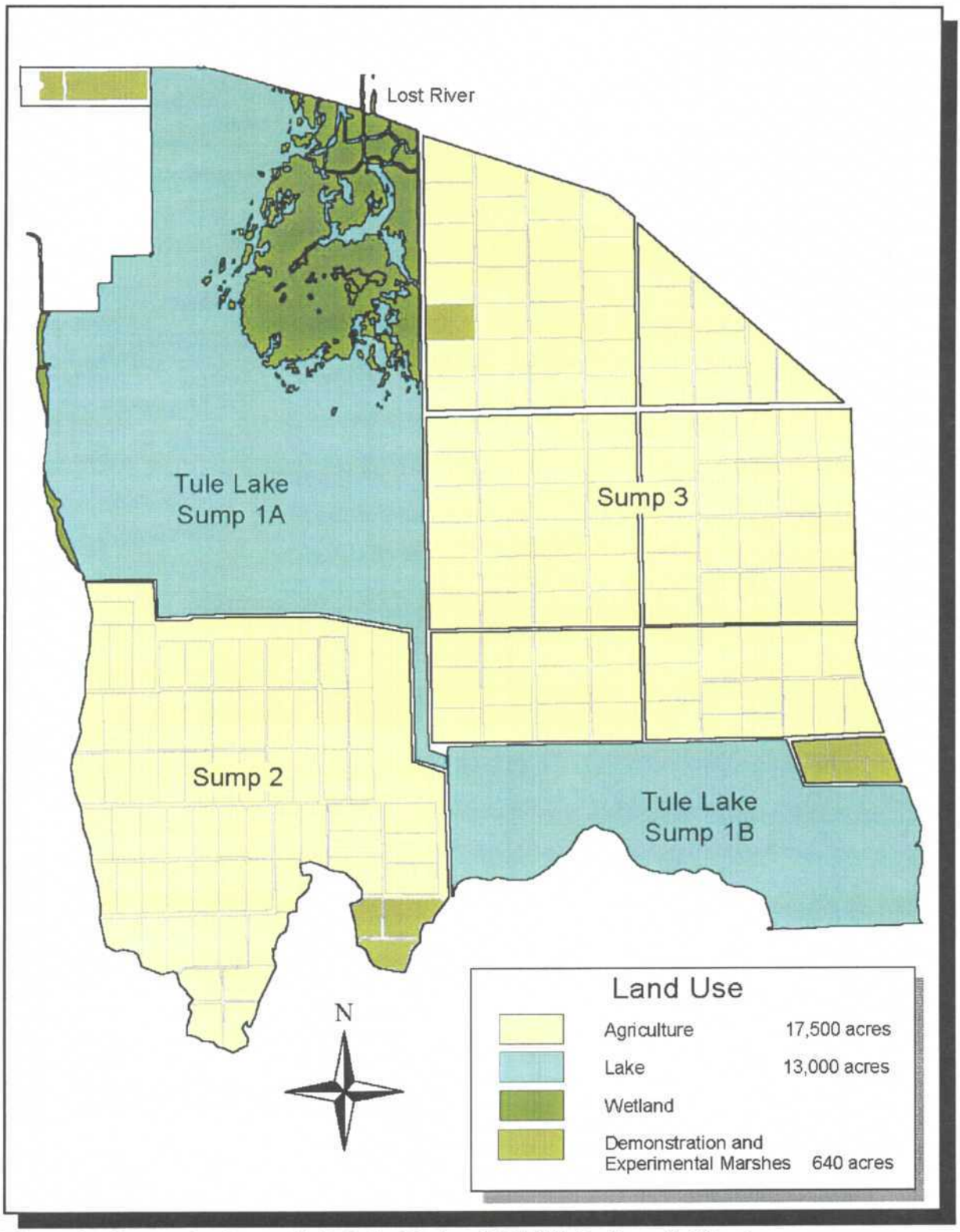


Figure 2. Current land uses, Tule Lake National Wildlife Refuge, California.

II. HISTORY

Prior to European settlement, Tule Lake fluctuated in surface area from 53,000 acres (1846) to more than 100,000 acres (1890). The fluctuation in surface area was key to maintaining the high aquatic productivity of this ecosystem. The historic lake was bounded on the north and west by vast expanses of tule marshes which supported tremendous populations of colonial nesting waterbirds and summer resident and migratory waterfowl. In addition, the large fish populations in the lake supported what was likely the largest concentration of nesting osprey in North America. The importance of the historic lake to resident and migratory waterbirds, including waterfowl, was documented by writings of early explorers:

> "October 7, 1854, raining morning, went 10 miles and came to Tule Lake. Nooned. After this had good road and went 12 miles around the lake. The most wild geese, ducks, and swans and brants I ever saw. " (Phoebe Hogeboon Terwilliger, early pioneer)

> "When I cruised across Tule Lake in 1908 it was a body of water about 12 or 15 miles long and 10 or 11 miles wide. It was supplied by the water of Lost River entering from the north. It will be remembered that Lost River was the outlet of Clear lake. The west side and the whole northern border was a vast tule marsh and a natural wildfowl nursery." (William L. Finley, early naturalist and writer)

This historic picture began to change in 1905 when the states of Oregon and California ceded to the United States the lands under Tule Lake and the Klamath Reclamation Project was initiated. As Tule Lake receded, parcels of the lake bottom were homesteaded. Between 1922 and 1948, 44,000 acres were homesteaded into 613 farm units. Despite this loss of habitat, Tule Lake NWR remained the premier waterfowl area in North America throughout the 1950s, 1960s, and early 1970s. In some years, greater than 3.5 million waterfowl were present during fall migration.

In the midst of homesteading and reclamation, Tule Lake NWR was created by Executive Order Number 4975 dated October 4, 1928. Subsequent Executive Orders expanded the Refuge in size. Presently, Tule Lake NWR is comprised of 39,117 acres superimposed on existing Klamath Reclamation Project lands. Although these Executive Orders protected wildlife from illegal shooting and other activities, reclamation and irrigation remained the primary focus of land management. Plans to homestead lands within the Refuge in the 1950's resulted in intense debate between agricultural interests and conservationists over the future of the Refuge. After more than a decade of debate, the Kuchel Act (Public Law 88-567) was enacted on September 2, 1964. The Act declared that the lands within Tule Lake NWR (as well as other nearby refuges) were dedicated to wildlife conservation for the major purpose of waterfowl management, but with full consideration to optimum agricultural use that is consistent with waterfowl management. The Act permanently placed the Refuge in governmental ownership, restricted wetland habitats to no less than 13,000 acres, and allowed the Secretary of Interior to continue, consistent with waterfowl management, the present pattern of leasing the agricultural lands of the Refuge. The following

narrative by Secretary of Interior Stewart Udall during congressional hearings for the Kuchel Act describes the values present on the Refuge during the early 1960s:

> "Tule Lake refuge, established in 1928, is famous as the site of the largest annual concentration of waterfowl on the continent. This refuge of more than 37,000 acres is set in the midst of rich grainlands that was once the bed of Tule Lake. The 13,000-acre sump filled with aquatic food plants, and the surrounding fertile grainfields, provide ideal habitat for waterfowl. Here the photographer can find flocks of ducks and geese that darken the sky-for millions of pintails and hundreds of thousands of mallard and geese gather in the refuge during the fall migration."

III. PRESENT CONDITIONS - TULE LAKE NWR

Wetland habitats

Refuge wetlands provide habitat to a host of wildlife species and are especially important to waterfowl during the spring and fall migrations. In recent years, peak populations have averaged 200,000 to 400,000 birds. In some cases, this Refuge is the first fall staging area waterfowl reach after leaving northern nesting areas. In addition to foods obtained in wetlands, agricultural crops left in the fields on Tule Lake NWR provide an important food resource for a host of Pacific Flyway waterfowl species. Of particular importance are the Arctic nesting geese; snow, Ross, and white-fronted geese. Geese begin arriving in late August, peak in early November, and have departed for southern wintering areas by mid-December. In recent years, goose populations have peaked at approximately 60,000 to 100,000 birds compared to 285,000 to 840,000 during the 1970's.

Aerial view of Tule Lake National Wildlife Refuge.

In addition to waterfowl, the Refuge is host to a multitude of other wetland birds such as ibis, herons, egrets, bitterns, rails, shorebirds, and terns which are dependent on wetlands for breeding and migrational habitat. Aquatic plants, fish, and invertebrates produced by these marshes are critical to the success of these birds in nesting, successfully rearing young, and obtaining the resources needed for migration. In addition to avian species, reptile, amphibian, mammal, and fish species are likewise dependent on Refuge wetlands.

Deep water habitats

Tule Lake contains a small population of endangered fish species: the shortnose sucker and the Lost River sucker. This population appears to be imported from the surrounding irrigation system. Although a small number of these fish move up the Lost River to Anderson-Rose Dam in spring, little successful recruitment has been documented. Recent monitoring of water quality and a sample of radio-marked suckers by Reclamation and the Service has indicated that an area termed the "Donut Hole" in central Sump 1A may be crucial to maintaining this population. Water quality (principally dissolved oxygen) in this area remains suitable for sucker survival during the hot summer months while areas outside the "Donut Hole" are unsuitable. In addition to suckers, Tule Lake also contains large populations blue and tui chubs, fathead minnows, and Sacramento perch. These fish are important food items to summer resident pelicans, cormorants, and grebes as well as to common mergansers in winter.

Agriculture

Consistent with the Kuchel Act, 15,500 acres of the Refuge are leased for agricultural production. Individual parcels, ranging from 100 to 300 acres in size, are leased from the Federal Government by commercial producers. The leases normally run from three to five years with the rental fees established by competitive bid. Restrictions are placed upon crop rotations and crop management practices to assure benefits to wildlife. For example, no more than one third of any one lot may be planted to row crops. The use of pesticides is also strictly regulated according to Federally approved integrated pest management practices (IPM).

This lease-land acreage is important to local farmers and to the rural communities surrounding the Refuge. The lease-land parcels are highly productive and represent a large part of the land of these farming operations. This is especially the case for the younger generation farmers with limited capital and land.

The majority of the acreage is planted to cereal grains. In 1999, approximately 10,500 acres were planted to wheat, oats, or barley. On the remaining lease-land acreage, approximately 1,000 acres were in alfalfa production. Row crops, potatoes, onions and sugar beets were grown on just over 2,800 acres. Grain stubble is left undisturbed over the winter to provide a feed source for migrating birds. Geese also feed on the potato crop residue remaining after harvest. Volunteer grain germinating in the spring is also an important food source for spring migrating waterfowl. Agricultural production on the lease lands had a gross value of nearly $50 million in 1999 and generated $1.43 million in lease revenue for the Federal government.

Recreation

Tule Lake and the neighboring Lower Klamath NWR are popular hunting and bird watching destinations. In 1999, Tule Lake NWR recorded the following number of visitors:

Wildlife observation	157,800
Environmental education	2,236
Waterfowl hunting	5,201
Visitor center	12,131
Tour route	14,500
Wildlife photography	663

Many of the wildlife observers or non-consumptive visitors also visited the neighboring Lava Beds National Monument. Recreation on the Refuge generates from $600,000 to $1 million annually for the local economy. Nineteen jobs were generated directly from visitor demand with a total employment income of $273,000 (1995 data). The decline in waterfowl use of Tule Lake NWR has resulted in a significant decline in hunter use of this refuge.

Flood control

The Refuge serves an important flood control function. Water levels are manipulated to achieve this purpose and are carried out via mutual agreement between Tule Lake Irrigation District (TID), Bureau of Reclamation, and the Fish and Wildlife Service. The current sumps are lowered by approximately 1 foot during winter to provide storage capacity for runoff resulting from heavy storms. If the levels in the sumps are exceeded, levees may be breached to release flood waters onto agricultural lands.

IV. DECLINING REFUGE RESOURCES

Although land use on Tule Lake NWR has not changed significantly over the last 35 years, wildlife use on the Refuge has declined primarily because past management of water has eliminated the ecological processes critical to the Refuge's sustained wetland diversity and productivity. Currently, Tule Lake NWR supports a fraction of its past waterfowl use (Fig. 3), species diversity has declined, and its usefulness to endangered species has diminished. In addition, agricultural production is impacted by increases in soil-born pathogens and decreases in soil organic matter. This reduction in soil productivity has led to increasing dependence on fertilizers and pesticides which drives up crop production costs and may negatively effect water and wetland habitat quality.

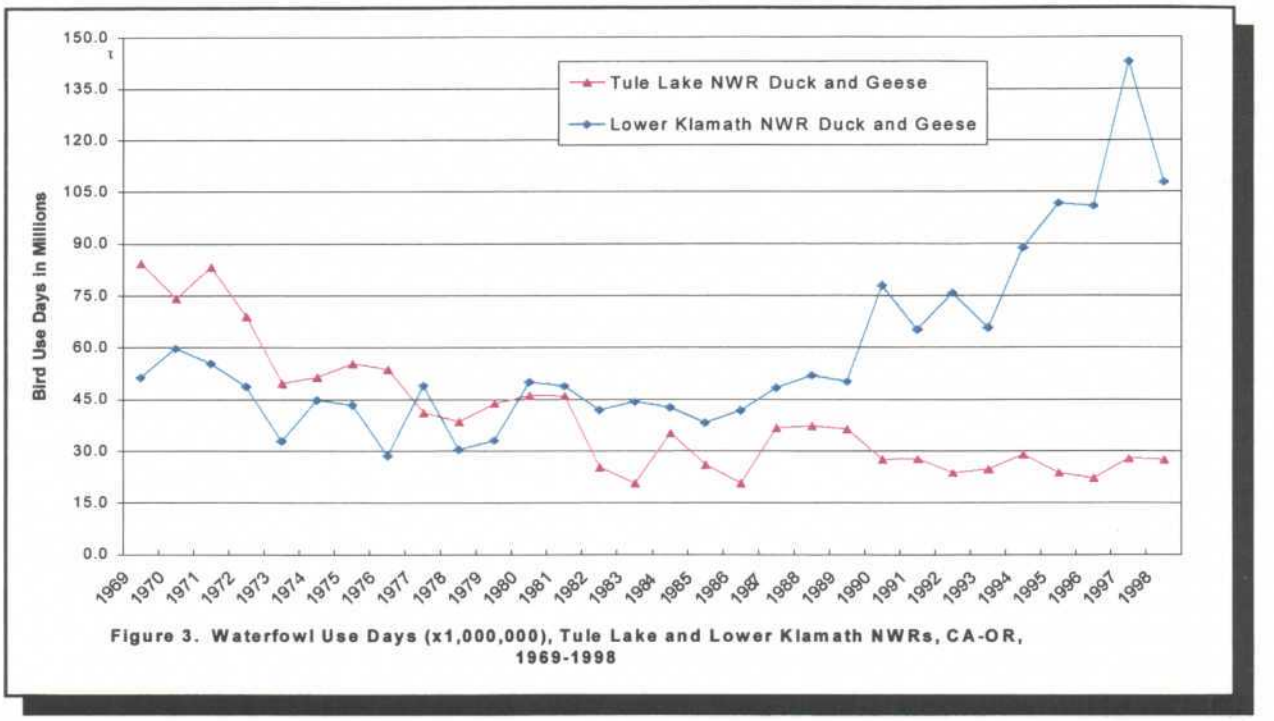


Figure 3. Waterfowl Use Days (x1,000,000), Tule Lake and Lower Klamath NWRs, CA-OR, 1969-1998

Water quality in Tule Lake is characterized by high pH, low dissolved oxygen, and high concentrations of unionized ammonia, similar to water quality conditions in Upper Klamath Lake (Tule Lake's primary water source). These conditions are considered stressful to aquatic life and results in a relatively simple assemblage of aquatic species.

Sedimentation in wetland areas has eliminated 90 percent of the water depth in emergent wetlands as well as open water areas of the sumps. This sedimentation reduced water storage capacity by an estimated 14 inches between the years 1958 and 1986 and represents a loss of 12,800 acre-feet of storage capacity. In addition to reducing flood water storage, sedimentation reduces the amount of deep water habitat available for the endangered suckers and reduces depth in emergent wetlands, thereby eliminating large areas of wetlands as breeding habitat for colonial nesting waterbirds and over-water nesting waterfowl.

Management issues on Tule Lake NWR are significant because continued declines in wetland productivity and agricultural sustainability threaten the status of the Refuge as a major fall and spring staging and breeding area for migratory birds on the Pacific Flyway and may negatively impact the highly productive agricultural economy that supports surrounding rural communities.

V. INTEGRATED LAND MANAGEMENT

To address the multiple resource problems facing Tule Lake NWR, the Working Group proposes a new management plan for Tulelake NWR called Integrated Land Management (ILM) (Fig. 4).

The goal of ILM is to revitalize wetlands and deep-water habitats while providing economically viable and sustainable agriculture. To achieve this goal, we believe it is necessary to combine wetland management strategies and agricultural practices in a synergistic manner which restores ecosystem health and creates an ecologically and economically sustainable landscape. Ramifications of such a program reach far beyond Refuge boundaries to other landscapes where wetlands and agriculture coexist.

Objectives of ILM include:

- ❑ Improve the Refuge's biological integrity and diversity, through the creation of productive wetland habitats.
- ❑ Provide deep-water habitat for the survival of endangered sucker fishes.
- ❑ Improve water quality.
- ❑ Increase the sustainability of Refuge agricultural operations.
- ❑ Improve the diversity and economic vitality of local rural communities.
- ❑ Improve the flood control and water storage capabilities of the Refuge.
- ❑ Provide flexibility in Refuge management.

While the total acreage of wetland habitat and agriculture will be unchanged, their relative locations within the Refuge will shift. This proposal focuses on the complementary interaction between management units with different habitat types and the rotation of habitats within units over time. To accomplish ILM, extensive structural changes are required to separate habitat types, such as wetland and deep water, to allow for cropland/wetland rotation, to promote hydrologic diversity, and to direct flows for water quality improvement. To the extent possible, proposed structural changes will take advantage of existing levees, pumps and water control facilities.

Habitats will be managed to promote the full successional range of endemic habitats and species that historically occupied the Tule Lake Basin including seasonally and permanently flooded wetland and deep-water habitat. Wetland/cropland rotations will be implemented to introduce disturbance regimes, thereby creating early successional habitats while providing conditions that control soil pests and enhance soil fertility. Water quality improvements occur by routing water between units to take advantage of the natural water filtration function of wetlands. These measures will have the added benefit of increasing water storage capacity for flood control. ILM has the additional benefit of creating the flexibility whereby future Refuge managers can alter Refuge habitats as new information is developed.

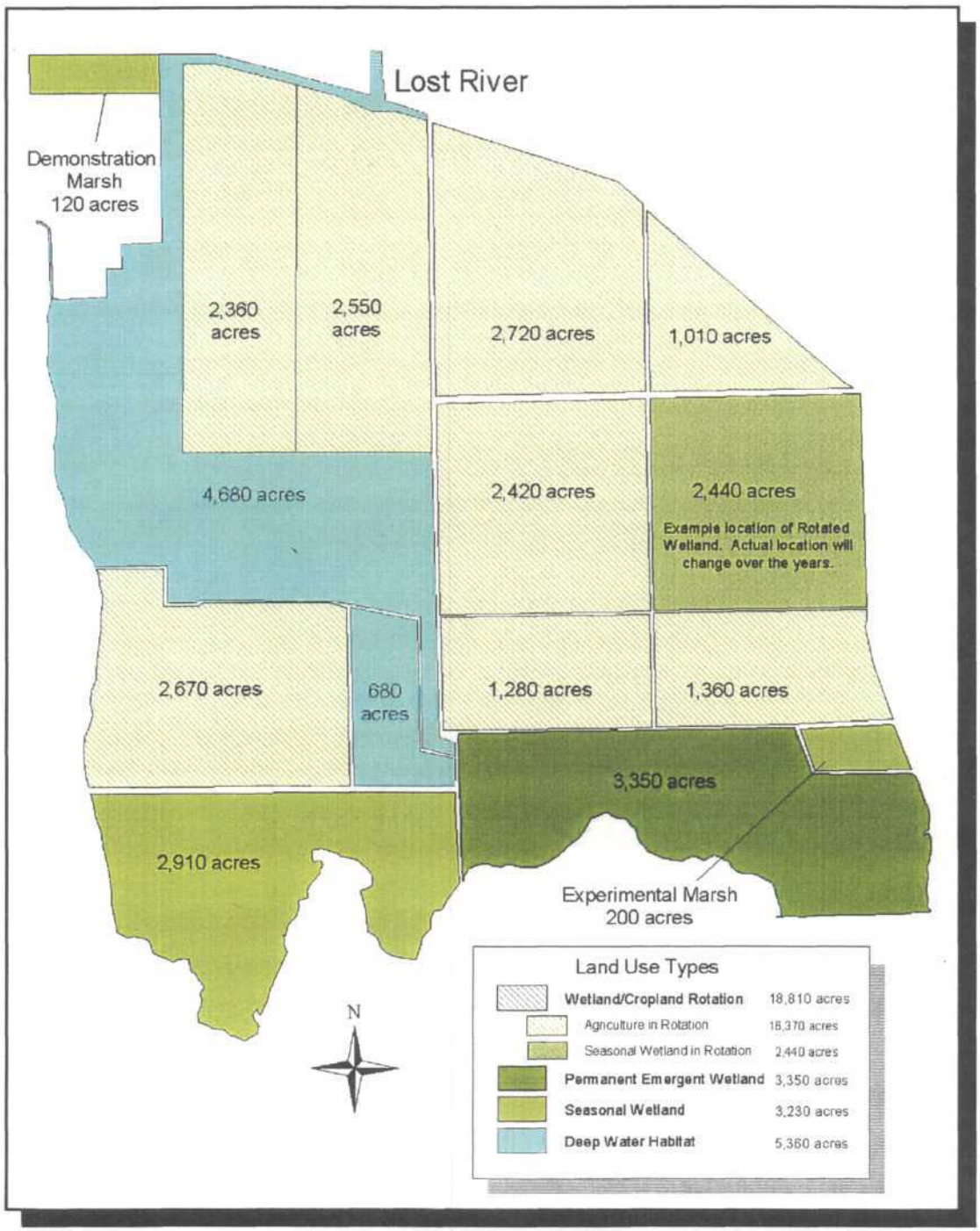


Figure 4. Land uses under proposed Integrated Land Management on Tule Lake National Wildlife Refuge, California.

VI. RATIONALE

The issues facing natural resource managers today have become extremely complex. Society must learn how to protect natural resources while meeting the socioeconomic needs of a rapidly increasing world population. The Service has recognized that the fee title purchase of fish and wildlife habitats by Federal, state, and private entities are not sufficient to restore ecological function. While tremendous areas have been preserved under these programs, ecosystem conservation will not be achieved through the preservation of isolated parcels of land. The Service in recognition of this fact has adopted an ecosystem approach to conservation.

An ecosystem approach to conservation

The primary goal of ecosystem conservation is conserving natural biological diversity and ecosystem integrity, while supporting a sustainable level of human use. In implementing ecosystem management, the Service emphasizes three major areas:

- ❑ Fulfill fish and wildlife needs in the context of the natural and human environment in which they occur.
- ❑ Increase cross-program collaboration within the Service.
- ❑ Communicate, coordinate, and collaborate more frequently, more consistently, and more effectively with our partners, affected stakeholders, and the public.

> "The Service is eager to work with others in exploring and adopting an ecosystem approach. Our society places great value on fish, plants, wildlife, and the ecosystems upon which all species, including humans, depend. An ecosystem approach to fish and wildlife conservation is a common-sense, long-term strategy designed to maintain natural communities, while at the same time providing a sustainable level of recreational and economic security for the future. This is no small challenge, but one in which the Service must play a crucial role." (U.S. Fish and Wildlife Service Refuge Manual).

The Working Group's perspective

To many individuals and interest groups, the Kuchel Act was and is controversial. When the Act was passed many agriculturalists felt they were denied the opportunity to homestead and farm the reclaimed bed of Tule Lake. To today's conservationists, the Act appears to contradict the spirit of the National Wildlife Refuge System; that national network of lands and waters that preserves the very best of North America's fish and wildlife habitats.

In contrast, the Working Group believes that the mandates of the Kuchel Act represent an opportunity and a challenge for the Service to take a lead role in developing and demonstrating techniques whereby wetlands and agricultural lands can be integrated in ways that maintain ecological integrity as well as the economic well being and sustainability of surrounding rural

communities. The problems inherent in the coexistence of wetlands and agriculture are not restricted to the Klamath Basin; they are problems of national and international significance. Symptoms of these long standing problems include the high proportion of endangered plants and animals worldwide that are dependent on wetlands, declining quality of water in the world's streams and lakes, and the proliferation of pesticides and fertilizers in agricultural operations.

VII. PRIMARY MANAGEMENT STRATEGIES

Many of the management strategies used in ILM are based on techniques used successfully in other areas of the Upper Klamath Basin. These and other strategies were also developed during feasibility research conducted through the mid 1990's on Tule Lake NWR by the University of Washington, Seattle; U.S. Geological Survey, Dixon, CA; and the University of California, Davis. This research was conducted on 4 pilot sites (640 acres) where previously farmed lands were restored to wetlands or a rotation of wetlands and agriculture.

Primary strategies used in ILM include:

- ❑ Creating hydrologic diversity (with resultant habitat diversity).
- ❑ Wetland/cropland rotation.
- ❑ Crop rotations.
- ❑ Flooding of subsided lands.
- ❑ Farming unproductive wetland habitats.
- ❑ Water routing to encourage nutrient uptake and filtering.

Creating hydrologic diversity

Water elevations on historic Tule Lake fluctuated several feet within a given year with larger fluctuations, up to 40 vertical feet, occurring between long-term wet and drought cycles. This hydrologic diversity created a diverse array of habitats ranging from seasonally and permanently flooded emergent wetlands to deep water lake habitats that supported a diversity of fish and wildlife species.

This natural process can be mimicked on the Refuge by having hydrologically separate management units that reflect particular habitats from the broad continuum that once existed on Tule Lake. Experimentation with varying water levels on the Refuge has proven to be extremely successful in restoring a host of native wetland plants and a large diversity of wildlife species. For example, seasonal water management on pilot research sites successfully reestablished Columbia cress, a rare native plant not seen in the Tule Lake Basin since the 1930's.

Wetland/cropland rotation

Decades of farming Refuge lands has decreased soil organic mater and built populations of soil pathogens to crops, decreased yields, and increased reliance on pesticides and fertilizers. To

revitalize cropland areas, large blocks (1,000-3,000 acres) of currently farmed lands would be converted to seasonal and year-round flooded wetland habitats for 5 years. Research into this practice on Tule Lake NWR has documented reductions of plant parasitic nematodes as well as elimination of other pests and plant diseases. In addition to the integrated pest management benefits of this technique, wetland plant establishment has proven to be rapid and robust, creating some of the most productive early successional wetland habitats in the Upper Klamath Basin. Although the experimental wetland restoration sites referenced above encompass less than 5% of Refuge wetlands, they have supported up to 57% of the Refuge's fall waterfowl population.

Crop rotations

Crop rotation is a long established IPM technique that maintains farmland productivity and reduces populations of pathogens and pests on crops, reducing fertilizer and pesticide inputs to crop production. This practice is currently established on the Refuge and would be continued and improved upon as new information becomes available. Studies have indicated, for example, that inserting cover crops such as rye or triticale in the rotation could provide additional suppression of plant parasitic nematodes, as well as reductions in soil erosion, and increases in soil organic matter. As an additional benefit, some cover crops are used extensively by ground nesting birds. With proper crop rotation and washing of equipment between fields, soil pests may be controlled for many years.

Flooding of subsided lands

Because of the high organic content of Refuge soils, decades of continuous farming has resulted in 4 to 6 feet of subsidence in agricultural lands. Coupled with sedimentation in current wetland areas, the differences in elevation between wetlands and farmlands has reached a maximum of 6 to 8 feet. Flooding of these subsided lands would create improved deep-water fish habitats as well as additional water storage and flood protection capability.

Farming unproductive wetland habitats

Sediment filled wetland habitats would be reclaimed for agricultural production. These areas would represent highly productive lands with reduced need for some classes of pesticides and fertilizers.

Water routing to encourage nutrient uptake and filtering

Research and monitoring conducted on the Refuge and within the Upper Klamath Basin has indicated that rotation of farming and seasonal water management as well as subsurface drainage in agricultural lands may release nutrients to drain water that may, in turn, exacerbate already poor water quality conditions. To alleviate this problem, water flow through the Refuge (Fig. 5) will be routed to reduce nutrient concentrations. By routing drainage water back into agricultural lands and through Refuge wetlands before reaching deep water habitats, nutrient

concentrations can be reduced. This water routing would take advantage of nutrient uptake by actively growing crops as well as the natural filtration function of emergent wetlands. Wetlands reduce nutrients through sedimentation, denitrification, microbial activity, and plant uptake. Because many endemic fish species in the Basin are adapted to the naturally eutrophic water quality conditions, relatively small improvements in water quality may greatly increase the suitability of aquatic environments to these species.

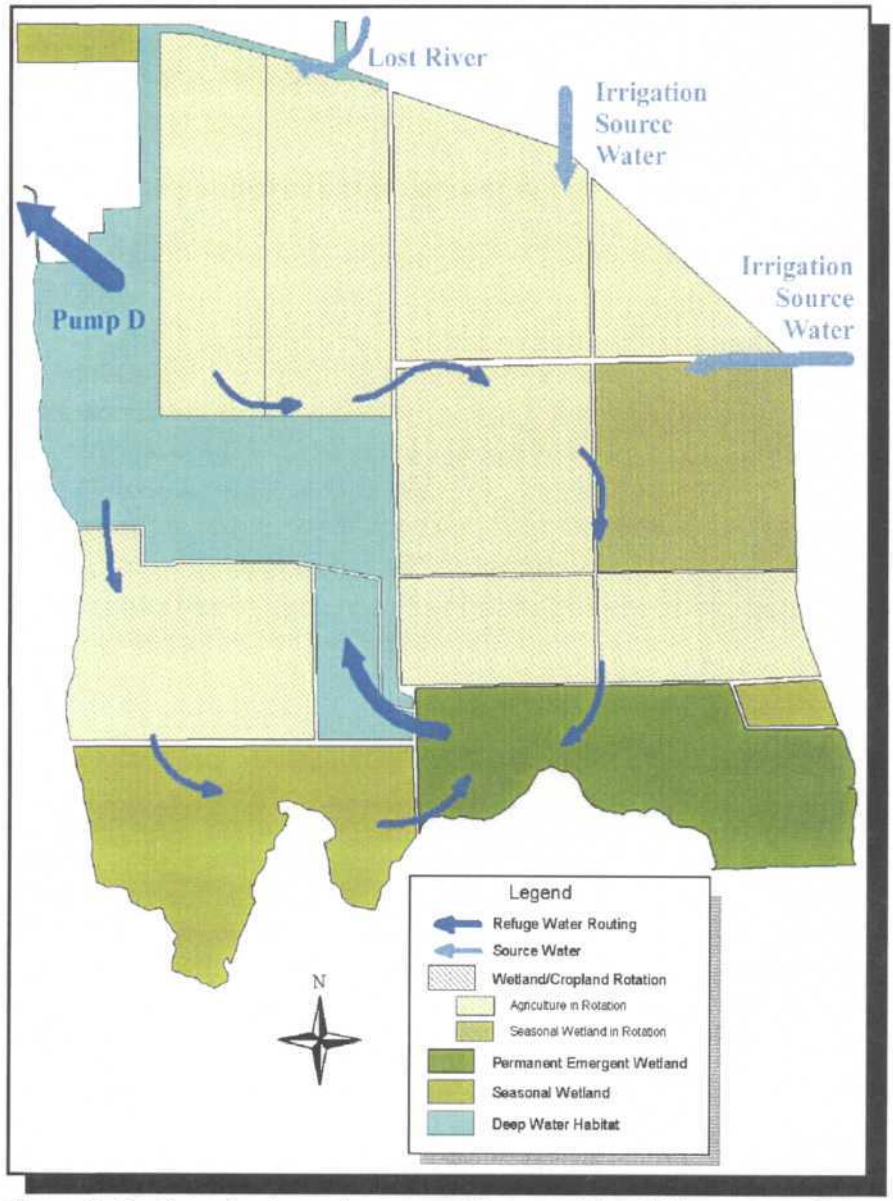


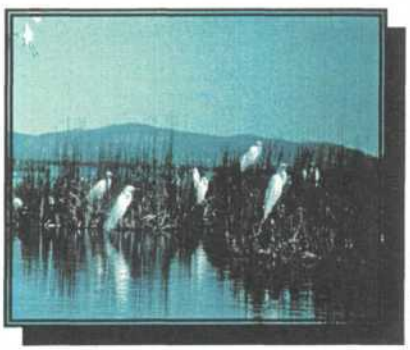
Figure 5. Routing of water under proposed Integrated Land Management plan on Tule Lake National Wildlife Refuge, California.

VIII. RESULTING FISH AND WILDLIFE HABITATS

The following is a more detailed description of habitat types that would result from implementing ILM on Tule Lake NWR. Most of this discussion is based on experience gained by managing these habitats on nearby Lower Klamath NWR as well as a series of research sites on Tule Lake NWR.

Permanent emergent wetlands

This habitat type is characterized by year round flooding and contains two major plant communities. The emergent plant community is composed of hardstem bulrush and cattail with minor inclusion of river bulrush. The dense emergent vegetation provides nesting substrate for many species of waterbirds as well as cover during periods of inclement weather. Of particular note are colonial nesting waterbirds such as great blue herons, great and snowy egrets, black-crowned night herons, and white-faced ibis.



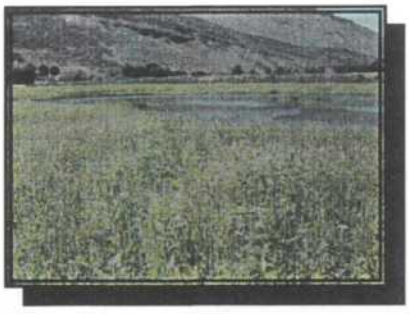
The submergent plant community is dominated by sago pondweed, a major food source to migrating canvasbacks, American widgeons, lesser scaup, mallards, American coots, and tundra swans. In addition, this plant community supports diverse aquatic invertebrate populations which are sought by many species of migratory waterfowl and other marsh birds. During the summer months, aquatic invertebrates are a critical food requirement of breeding waterfowl and most ducklings.

Late successional seasonal wetlands

Historic Tule Lake was characterized by emergent wetland vegetation and annual seed producing plants in a wide band across the north end of the lake with a narrower band down the west side. These seasonally flooded wetlands dried during summer, thus promoting the germination and growth of a variety of marsh plants. Under ILM, this historic hydrology would be mimicked with late spring/summer drawdowns of seasonally flooded wetlands. Food resources from resulting plant production would become available to fall migrant waterfowl upon re-flooding. Because disturbance regimes would be relatively infrequent within this habitat, dense emergent vegetation would develop over time. Species adapted to this habitat include nesting and migrating waterfowl, rails, bitterns, cranes, ibis, herons, and egrets.

Early successional seasonal wetlands

This habitat differs from late successional seasonal habitats in that more frequent disturbance patterns (in this case farming) maintain the plant community in fewer emergent wetland plants and more annual seed producing plants. Resulting habitats are, therefore, more open and benefit a slightly different array of wildlife species. Shorebirds and waterfowl in particular find this habitat attractive.



Similar to late successional seasonal habitats, this habitat is characterized by a flooding regime extending 6 to 11 months with at least 2 months being during the growing season (late spring and summer). Under the ILM proposal, this habitat would occupy previously farmed areas for a period of 5 years. After 5 years, the area would again be farmed with the wetland moving to other farmed areas. This rotation of wetlands and croplands prevents wetlands from reaching a late successional stage where dense emergent vegetation dominates the plant community. Historically, this habitat type occupied topographically higher elevations in the historic lake bed and/or was present when wet periods reflooded areas made dry during extended drought periods. Currently, stabilized water levels on Tule Lake have nearly eliminated this habitat type from the Refuge.

Agricultural lands

Agricultural crops would continue to be grown over a similar acreage and cropping pattern as the present. Dominant crops would remain small grains (barley, oats, and wheat), row crops (potatoes, sugar beets, and onions), and soil building crops (alfalfa), consistent with the mandates of the Kuchel Act. Agricultural operations would conform to Department of Interior policy regarding pesticide use and to a recently completed Integrated Pest Management Plan for Tule Lake NWR.

Arctic nesting geese (up to 100,000 birds) and several species of ducks utilize waste grains and potatoes left in the fields after harvest during their twice-a-day feeding forays. These high carbohydrate food resources are vital to providing the energy resources needed for the southward migration to wintering areas in California and Mexico. On the spring migration, Ross, snow, and white fronted geese use fall planted cover crops, alfalfa, and sprouting waste grains. This "green feed" tends to be high in protein and is needed as the birds prepare themselves

for the breeding season in Alaska and Canada. Reproductive success of these geese is dependent on the body reserves they have accumulated on spring staging areas because adequate food may not be available for several weeks in the northern breeding habitats. Foods obtained in wetlands and agricultural habitats in combination provide waterfowl a diversity of foods needed to obtain a nutritionally balanced diet.

In addition to waterfowl, high densities of micotine rodents in agricultural habitats make these areas attractive to wintering and breeding raptors. Species include redtail and rough legged hawks, northern harriers, great-horned and barn owls, and kestrels.

Deep water habitat

Under ILM, deep water habitat mimics the deeper unvegetated habitats present on the historic lake and would benefit a variety of endemic fish species including the endangered suckers. Water depths would range from 3 feet in the south portion of Sump 1A to 8 feet in formerly subsided agricultural lands. Water routing strategies in ILM use the natural water filtration properties of wetlands to improve water quality within this habitat type. Viable populations of endemic fishes also represent an important food resource to several species of colonial nesting waterbirds such as white pelicans, double-crested cormorants, and western grebes. The location of this habitat coincides with an area of Sump 1A that fisheries biologists believe to be critical to the summer survival of the endangered suckers on Tule Lake NWR.

IX. IMPLEMENTATION

The Working Group's primary goal was to develop an alternative management strategy for Tule Lake NWR and explore an implementation of this strategy. To address implementation, the Working Group developed a 3-phase process and defined pre-implementation and monitoring needs.

Pre-implementation

Project manager--Because of the size and complexity of the ILM proposal, it is recommended that the Service, or the Service and Reclamation in partnership, provide funding for a full-time project manager. This person would be responsible for coordinating all aspects of the project including environmental compliance, public participation, interagency coordination, and monitoring.

Lost River and shortnose sucker ecology studies--Studies of basic sucker habitat preferences and ecology are ongoing in the Tulelake sumps. Results of these studies will be used to modify ILM as needed to provide enhanced sucker habitat and to avoid negative impacts to both species.

Topographic surveys--Prior to construction within the farmlands of Tule Lake NWR, up-to-date topographic surveys should be conducted. This information is needed so the dimensions of levees and other infrastructure can be determined. The most recent survey conducted on the lease lands was during the 1950s. Given the subsidence in agricultural areas, it is likely that these surveys, now over 40 years old, are inaccurate.

Public participation--The Working Group's make-up represented different perspectives and experiences of individuals familiar with issues surrounding Tule Lake NWR. The group developed a proposal to meet the needs of most stakeholder groups while staying within the multiple mandates of the Kuchel Act. The development of this proposal, however, does not absolve the responsible agency(s) from utilizing public input to implement, improve, or change this project proposal, consistent with the National Environmental Policy Act (NEPA).

Environmental compliance--Clearly, a project of this size and scope will require compliance with a host of environmental regulations and laws including:

- ❑ National Environmental Policy Act
- ❑ Endangered Species Act
- ❑ National Wildlife Refuge Administration Act, as amended.
- ❑ Clean Water Act, Section 404 (dredge and fill permit)
- ❑ Clear Water Act , Section 401 (state water quality certification)
- ❑ National Historic Preservation Act
- ❑ Kuchel Act

Phase I: Preserving deep water fish habitat

The primary focus of Phase I (Fig. 6) is to construct the primary levees to allow for the preservation of critical fish habitat in Sump 1A and the creation of deep water fish habitat in a portion of Sump 2. The north half of Sump 1A would be reclaimed for agricultural use. While agricultural facilities are constructed in Sump 1A, this area would be managed as a seasonal wetland (dry in late spring and summer). Also included in Phase I is the construction of levees to redirect the Lost River around the reclaimed area.

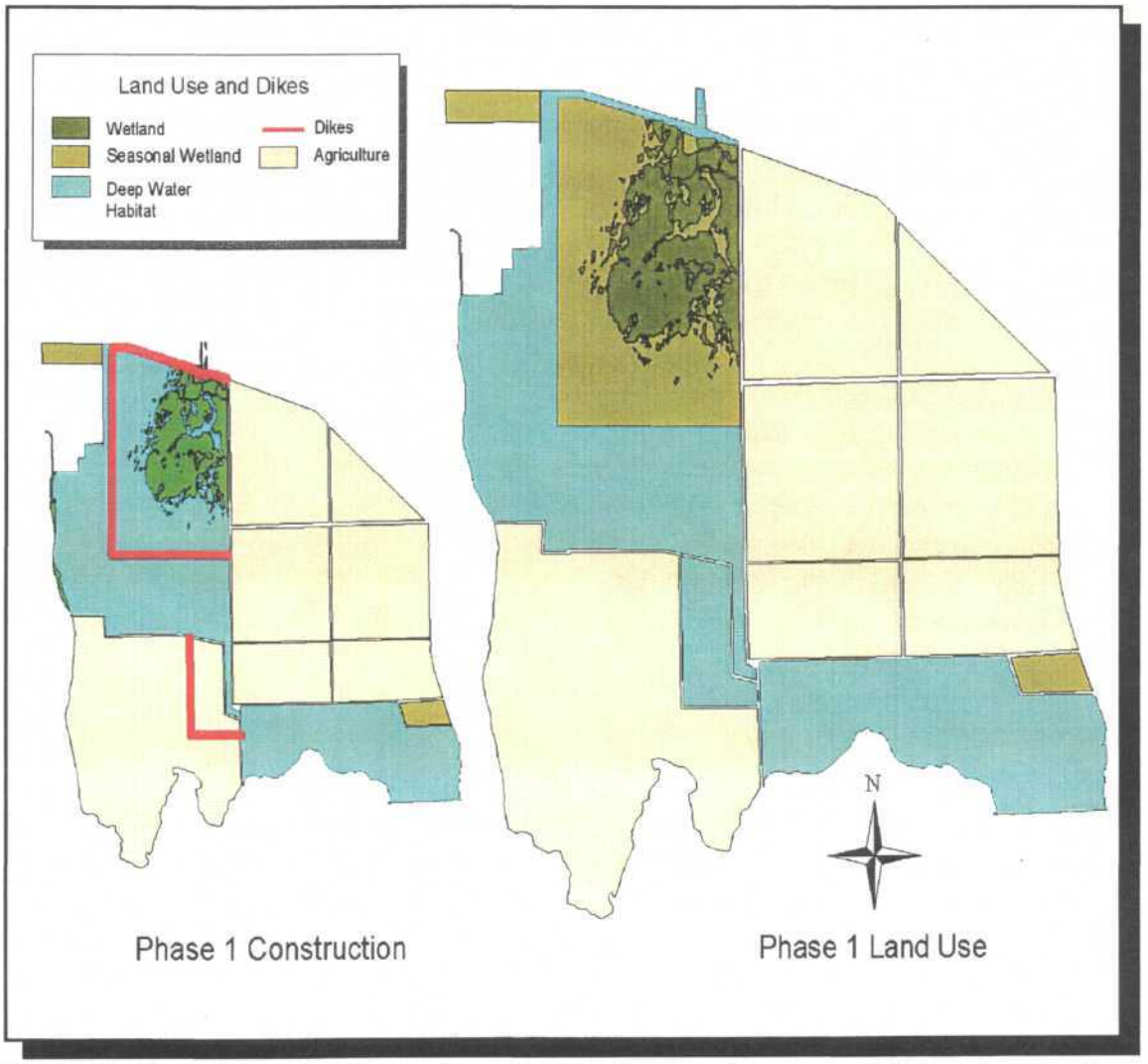


Figure 6. Phase 1 construction and resultant land use under proposed Integrated Land Management Plan on Tule Lake National Wildlife Refuge, California.

Phase II: Seasonal wetland construction

The primary activity in Phase II (Fig. 7) is construction of an east-west levee across the center of Sump 2. This levee would allow for the conversion of the southern half of Sump 2 to seasonal wetland to compensate for the reclamation and conversion to agriculture on the north half of Sump 1A. Secondly, drainage from Sump 3 and newly reclaimed lands in the north half of Sump 1A would be directed to Pump C (located on the north levee of Sump 1B). This action would redirect drainage flows to improve water quality.

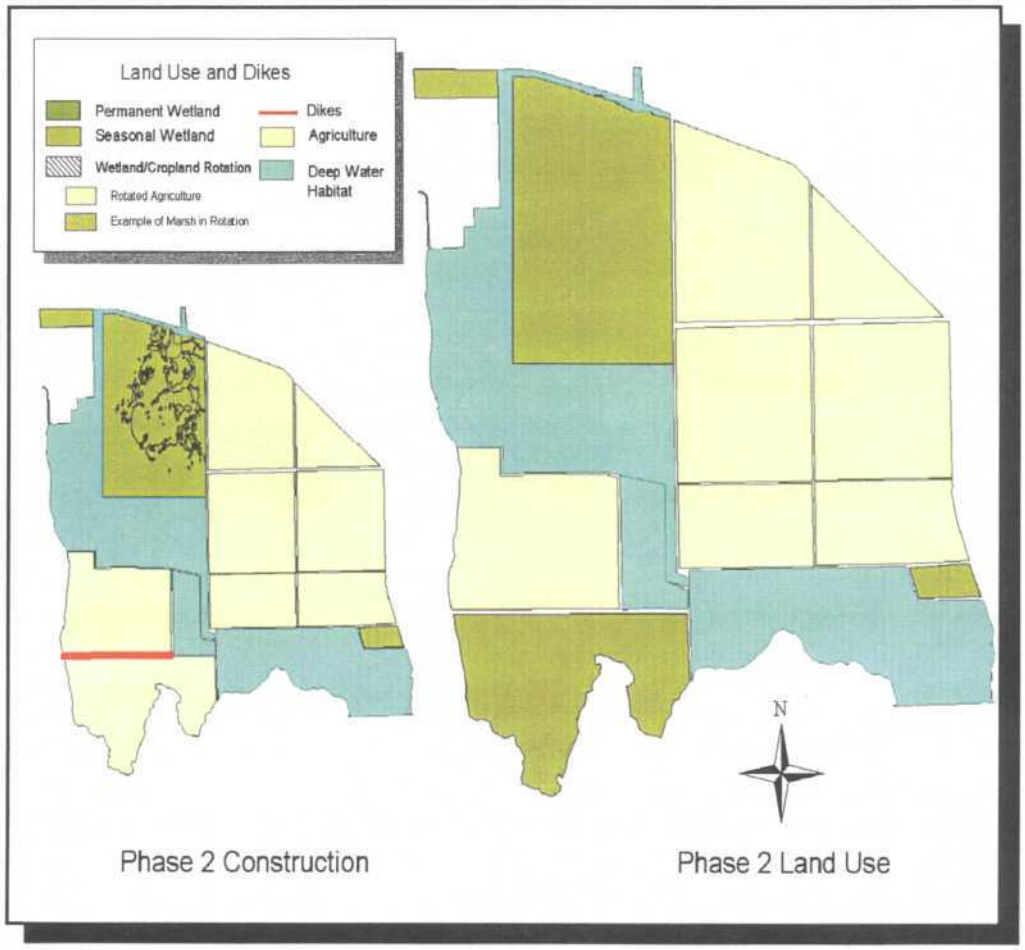


Figure 7. Phase 2 construction and resultant land use under proposed Integrated Land Management Plan on Tule Lake National Wildlife Refuge, California.

Phase III: Conversion of Sump 3 to wetland/cropland rotation

Phase III (Fig. 8) would involve construction of one north-south and two east-west levees in Sump 3 and a north-south levee in north Sump 1A. This would result in agricultural areas being divided into 1,010 to 2,714-acre management units which would be primarily farmed but would include 1 to 2 management units in seasonal wetland on a rotating basis.

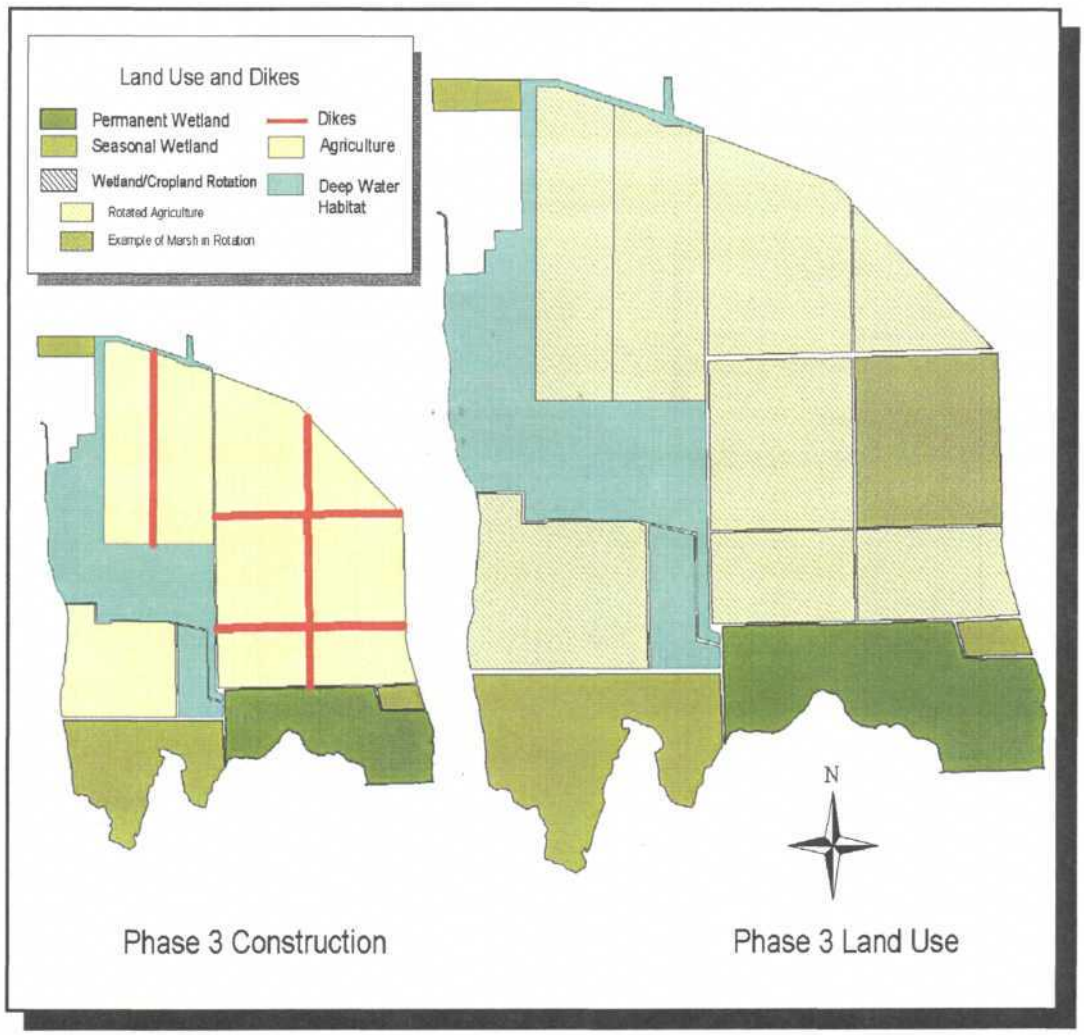


Figure 8. Phase 3 construction and resultant land use under proposed Integrated Land Management Plan on Tule Lake National Wildlife Refuge, California.

VIII. MONITORING

Unless specifically stated, monitoring will be ongoing throughout implementation. The phase in which the monitoring starts is noted in parenthesis.

Sucker movements in response to creation of deep water habitats (Phase I)

Phase I would create 683 acres of deep water (6 to 8 feet) habitat within Sump 2 thereby increasing deep water habitat available to the fish. A sample of radio-marked fish would be used to determine the degree of use of this habitat as well as the timing of use. Of principal concern is the summer period when water quality is its poorest (low dissolved oxygen).

Water quality in newly created deep water habitats (Phase I)

For comparative purposes, water quality within the "Donut Hole", Sump 1B, and the newly created deep water habitat would be monitored during summer in concert with sucker monitoring. Research conducted on the suckers of Tule Lake NWR indicates that individual fish are relatively parasite free and in better condition than suckers elsewhere in the Basin. This may be attributable to both the extreme productivity of the sumps to produce food resources and/or the relatively good summer water quality in the "Donut Hole". Because sedimentation and associated loss of depth may eventually make the "Donut Hole" unsuitable, the potential of improved water quality within created deep water habitats must be determined.

Seasonal wetland development (Phase II)

Monitoring would involve documenting wetland plant establishment and subsequent bird use of newly created seasonal wetlands. Bird monitoring would be accomplished as part of regular aerial waterfowl surveys conducted from September through April. Vegetation monitoring would be accomplished using aerial photography with ground-truthing to confirm plant communities.

Effectiveness of wetlands in improving water quality (Phase II)

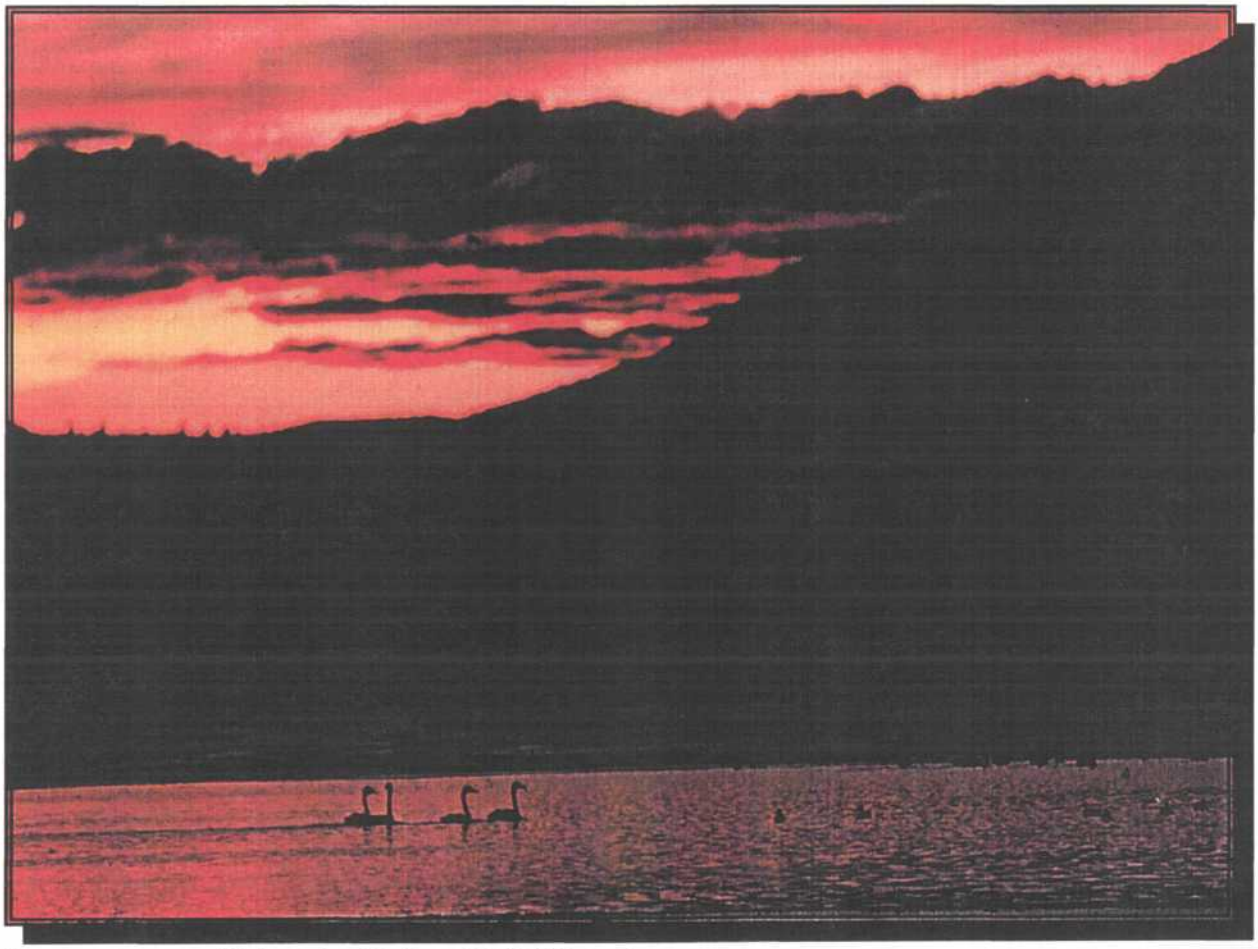
Water quality will be monitored in Sump 1B to determine its effectiveness in improving water quality. Points monitored will be Pump C entering Sump 1B, middle of Sump 1B, and water exiting into deep water habitat.

Habitat development in wetland/cropland rotational management areas (Phase III)

Monitoring would involve documenting wetland plant establishment and subsequent bird use of newly created seasonal wetlands . Bird monitoring would be accomplished as part of regular aerial waterfowl surveys conducted from September through April. Vegetation monitoring would be accomplished using aerial photography with ground-truthing to confirm plant communities.

Agricultural response to wetland/cropland rotation (Phase III)

Crop yields, soil quality, and pathogen levels would be monitored. The purpose would be to determine whether soil quality improves, pathogen levels are reduced, and fertilizer and pesticide input reduction occurs.



Swans at sunset, Tule Lake National Wildlife Refuge.

APPENDIX A: Working Group Criteria

To evaluate different management proposals, the working group arrived at 2 goals and then developed mandatory criteria and ranking criteria. Mandatory criteria were equally limiting and created boundaries on the group's discussions. Management options outside the jurisdiction of the U.S. Fish and Wildlife Service were not considered.

Goal 1 (Result): The end goal is to create productive wetlands and deep water habitats while providing economically viable and sustainable agriculture.

Goal 2 (Process): To achieve this goal, the Group believe's it is necessary to develop a management method which combines sustainable agricultural principles with ecosystem management methods to create synergistic benefits for both agriculture and wildlife.

Mandatory Criteria
Endangered Species Act (ESA) compliance
Flood Control
Productive wetlands (including Deep water habitats) >=13,000 acres
Sustainable Agriculture
Kuchel Act Compliance
Revenue Generation
Water Quality (May not be degraded)

Ranking Criteria	Weight
Improved Wetland Habitat	12
Improved Water Quality	11
Improved Fish Habitat	7
Improved Upland Habitats	5
Improved Flexibility	5
Engineering/Construction/Operations and maintenance costs	5
Socioeconomic	5

All proposals which fit the mandatory requirements were evaluated by the ranking criteria. Four possible rotation concepts, A-D (Figs. 9-12), were developed out of discussions and rated 1 to 10 points for each ranking criteria. Average ratings were multiplied by weight. The proposal reaching the highest combined score represented the preferred management option, Concept C. Concept C was later modified to incorporate sucker habitat concerns in the northwest corner of Sump 1A and some construction considerations not identified in early discussions.

APPENDIX B: Design alternatives

The working group deliberated over many potential land-use approaches. Of the concepts developed, four concepts seemed to best address the goals of the group. These concepts are described below with relative strengths and weaknesses.

Concept A

This plan maximized endangered fish habitat in the south ½ of Sump 1B and converts the north ½ of Sump 2 into deep water habitat. There was general agreement that Concept A over-emphasized deep open water habitat to the detriment of other wetland habitat values.

Concept B

Concept B reduces the acreage of deep water fish habitat in the south ½ of Sump 1A while creating a relatively large area of deep water habitat in Sump 2. Although this Concept is more balanced than Concept A, the reduction in currently used sucker habitat in Sump 1A was unacceptable.

Concept C

Concept C (preferred concept) was ranked as the most balanced option evaluated because it preserves important endangered fish habitat in Sump 1A while providing a balance of different habitats in the remainder of the Refuge. The concept of a treatment wetland in this concept was later modified in favor water routing (see Figure 5) to improve water quality. In addition, Concept C was ultimately further modified to reflect the need to preserve important sucker habitat at the northwest corner of Sump 1A and incorporate other construction needs not initially identified. The modifications to Concept C can be viewed in Figure 4.

Concept D

Concept D represented the minimum cost option (no cross-lake levees) among the alternatives. It included the largest acreage of deep water (6 to 8 ft) habitat and maximum acreage reclaimed for agriculture. However, this concept eliminates current summer sucker habitat in the south half of Sump 1A.

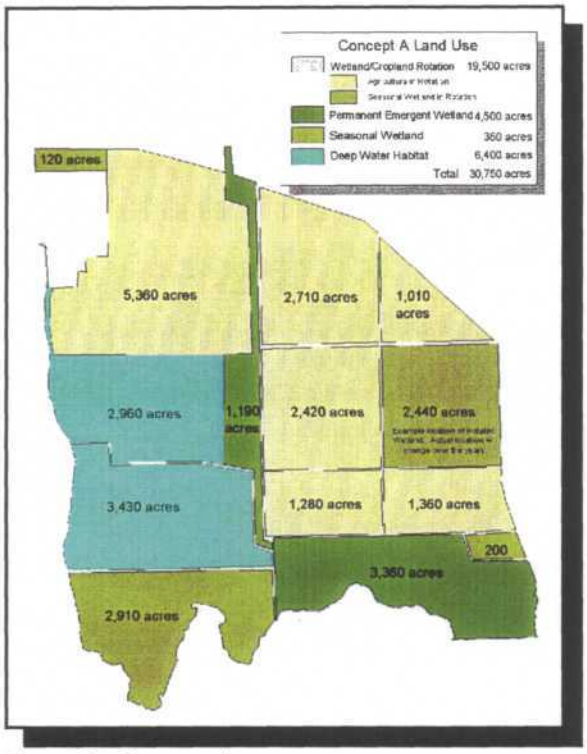


Figure 9. Concept A.

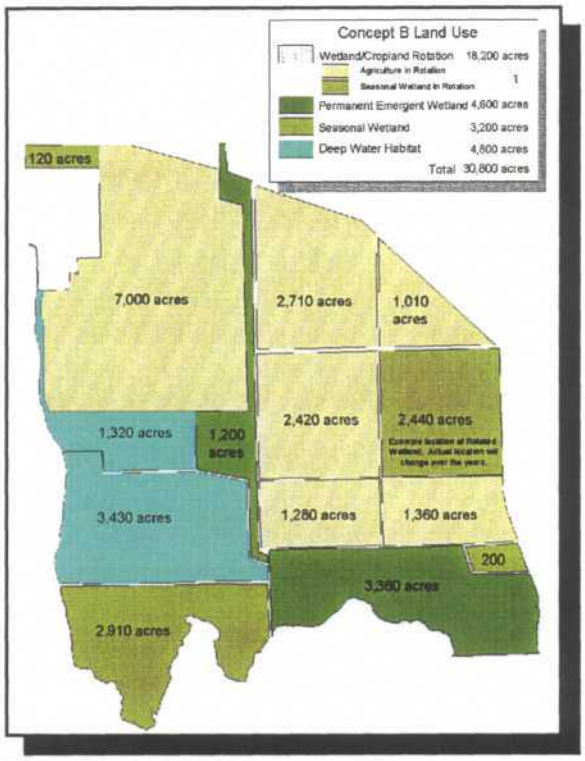


Figure 10. Concept B.

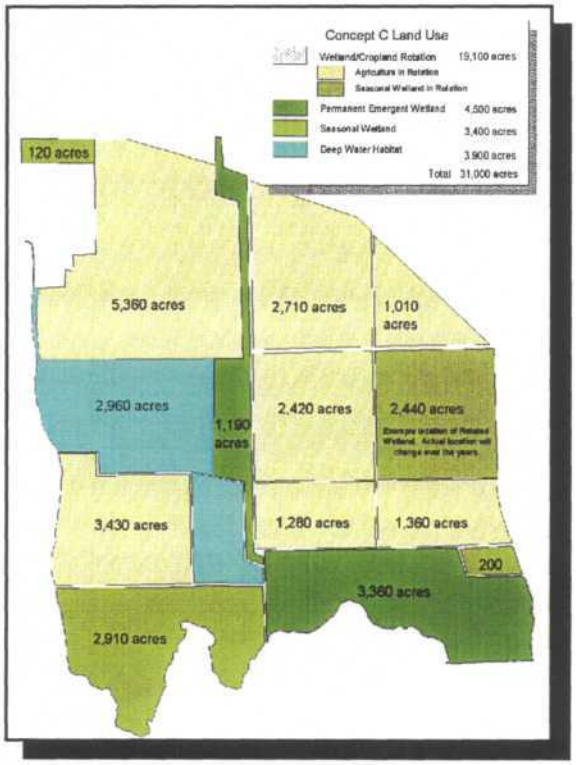


Figure11. Concept C.

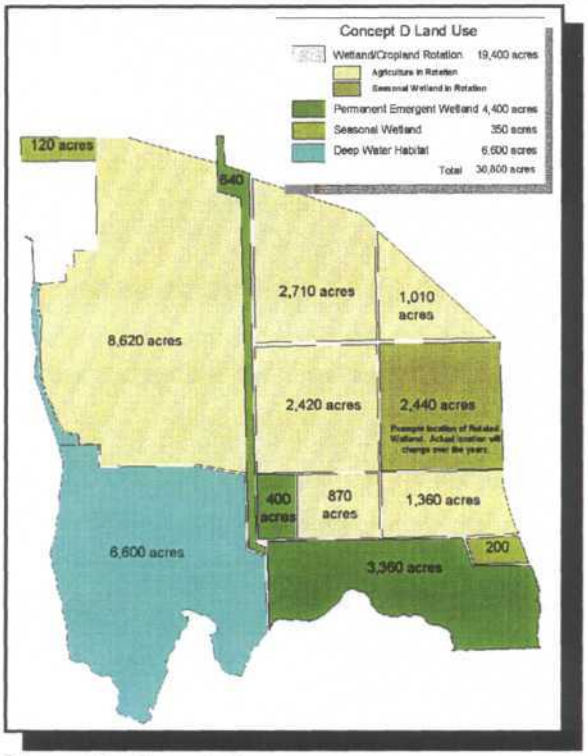


Figure 12. Concept D.

APPENDIX C: Kuchel Act of 1964

KUCHEL ACT (PL 88-567)

WILDLIFE MANAGEMENT, KLAMATH PROJECT

An act to promote the conservation of the Nation's wildlife resources on the Pacific Flyway in the Tule Lake, Lower Klamath, Upper Klamath, and Clear Lake National Wildlife Refuges in Oregon and California and to aid in the administration of the Klamath Reclamation Project. (Act of September 2, 1964, Public Law 88-567, 78 Stat. 850)

Sec. 1. [Policy of the Congress.] - It is hereby declared to be the policy of the Congress to stabilize the ownership of the land in the Klamath Federal reclamation project, Oregon and California, as well as the administration and management of the Klamath Federal reclamation project and the Tule Lake National Wildlife Refuge, Lower Klamath National Wildlife Refuge, Upper Klamath National Wildlife Refuge, and Clear Lake National Wildlife Refuge, to preserve intact the necessary existing habitat for migratory waterfowl in this vital area of the Pacific Flyway, and to prevent depredations of migratory waterfowl on agricultural crops in the Pacific Coast States. (78 Stat. 850; 16 U.S.C. §695k)

Sec. 2. [Areas preserved for migratory waterfowl - Agricultural use.] - Notwithstanding any other provisions of law, all lands owned by the United States lying within the Executive order boundaries of the Tule Lake National Wildlife Refuge, the Lower Klamath National Wildlife Refuge, the Upper Klamath National Wildlife Refuge and the Clear Lake National Wildlife Refuge are hereby dedicated to wildlife conservation. Such lands shall be administered by the Secretary of the Interior for the major purpose of waterfowl management, but with full consideration to optimum agricultural use that is consistent therewith. Such lands shall not be opened to homestead entry. The following public lands shall also be included within the boundaries of the area dedicated to wildlife conservation, shall be administered by the Secretary of the Interior for the major purpose of waterfowl management, but with full consideration to optimum agricultural use that is consistent therewith, and shall not be opened to homestead entry: Hanks Marsh, and first form withdrawal lands (approximately one thousand four hundred and forty acres) in Klamath County, Oregon, lying adjacent to Upper Klamath National Wildlife Refuge; White Lake in Klamath County, Oregon, and Siskiyou County, California; and thirteen tracts of land in Siskiyou County, California, lettered as tracts 'A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', and 'N' totaling approximately three thousand two hundred and ninety-two acres, and tract "P" in Modoc County, California, containing about ten acres, all as shown on plate 4 of the report entitled *"Plan for Wildlife Use of Federal Lands in the Upper Klamath Basin, Oregon-California,"* dated April 1956, prepared by the United States Fish and Wildlife Service. All the above lands shall remain permanently the property of the United States. (78 Stat. 850; 16 U.S.C. § 695l)

WILDLIFE MANAGEMENT, KLAMATH PROJECT

Explanatory Note

Klamath Project and Klamath Compact. All lands referred to in Section 2 above lie within, adjacent to or nearby the Klamath Federal reclamation project, Oregon-California. The project was authorized by the Secretary of the Interior, pursuant to the Reclamation Act of June 17, 1902, 32 Stat. 388, on May 15, 1905. The consent of Congress to the negotiation of a compact relating to the waters of the Klamath River by the States of Oregon and California was given by the Act of August 9, 1955, 69 Stat. 613. The consent of Congress to the resulting compact was given by the Act of August 30, 1957, 71 Stat. 497. Each of these acts appears herein in chronological order.

Sec. 3. [Payments to counties in lieu of taxes.] - Subject to conditions hereafter prescribed, and pursuant to such regulations as may be issued by the Secretary, 25 per centum of the net revenues collected during each fiscal year from the leasing of Klamath project reserved Federal lands within the Executive order boundaries of the Lower Klamath National Wildlife Refuge and the Tule Lake National Wildlife Refuge shall be paid annually by the Secretary, without further authorization for each full fiscal year after the date of this Act to the counties in which such refuges are located, such payments to be made on a pro rata basis to each county based upon the refuge acreage in each county: *Provided,* That the total annual payment per acre to each county shall not exceed 50 per centum of the average per acre tax levied on similar lands in private ownership in each county, as determined by the Secretary: *Provided further,* That no such payments shall be made which will reduce the credits or the payments to be made pursuant to contractual obligations of the United States with the Tulelake Irrigation District or the payments to the Klamath Drainage District as full reimbursement for the construction of irrigation facilities within said district, and that the priority of use of the total net revenues collected from the leasing of the lands described in this section shall be (1) to credit or pay from such revenues to the Tulelake Irrigation District the amounts already committed to such payment or credit; (2) to pay from such revenues to the Klamath Drainage District the sum of $197,315; and (3) to pay from such revenues to the counties the amounts prescribed by this section. (78 Stat. 850; 16 U.S.C. § 695m)

Sec. 4. [Leasing of reserved lands continued.] - The Secretary shall, consistent with proper waterfowl management, continue the present pattern of leasing the reserved lands of the Klamath Straits unit, the Southwest sump, the League of Nations unit, the Henzel lease, and the Frog Pond unit, all within the Executive order boundaries of the Lower Klamath and Tule Lake National Wildlife Refuges and shown in plate 4 of the report entitled *"Plan for Wildlife Use of Federal Lands in the Upper Klamath Basin, Oregon-California"*, dated April 1956. Leases for these lands shall be at a price or prices designed to obtain the maximum lease revenues. The leases shall provide for the growing of grain, forage, and soil-building crops, except that not more than 25 per centum of the total leased lands may be planted to row crops. All other reserved public lands included in section 2 of this Act shall continue to be managed by the Secretary for waterfowl purposes, including the growing of agricultural crops by direct planting and sharecrop agreements with local cooperators where necessary. (78 Stat. 851; 16 U.S.C. § 695m)

WILDLIFE MANAGEMENT, KLAMATH PROJECT

Sec. 5. [Areas not to be reduced.] - The areas of sumps 1(a) and 1(b) in the Klamath project lying within the Executive order boundaries of the Tule Lake National Wildlife Refuge shall not be reduced by diking or by any other construction to less than the existing thirteen thousand acres. (78 Stat. 851; 16 U.S.C. § 695o)

Sec. 6. [Water levels to be maintained.] - In carrying out the obligations of the United States under any migratory bird treaty, the Migratory Bird Treaty Act (40 Stat. 755), as amended or the Migratory Bird Conservation Act (45 Stat. 1222), as amended, waters under the control of the Secretary of the Interior shall be regulated, subject to valid existing rights, to maintain sump levels in the Tule Lake National Wildlife Refuge at levels established by regulations issued by the Secretary pursuant to the contract between the United States and the Tulelake Irrigation District, dated September 10, 1956, or any amendment thereof. Such regulations shall accommodate to the maximum extent practicable waterfowl management needs. (78 Stat. 851; 16 U.S.C. § 695p)

Explanatory Notes

Reference in the Text. The Migratory Bird Treaty Act of July 3, 1918, 40 Stat. 755, as amended, which is referred to in the text, does not appear herein. The Act is codified in 16 U.S.C. § 703, *it seq.*

Reference in the Text. The Migratory Birds Conservation Act of February 18, 1929, 45 Stat. 1222, as amended, which is referred to in the text, does not appear herein. The Act is codified in 16 U.S.C. § 715, *it seq.*

Sec. 7. [Clear Lake National Wildlife Refuge studies continued.] - The Secretary is hereby directed to complete studies that have been undertaken relating to the development of the water resources and waterfowl management potential of the Clear Lake National Wildlife Refuge. The results of such studies, when completed, and the recommendations of the Secretary shall be submitted to the Congress. (78 Stat. 851; 16 U.S.C. § 69rq)

Sec. 8. [Regulations to implement Act.] - The Secretary may prescribe such regulations as may be necessary to carry out the provisions of this Act. (78 Stat. 851; 16 U.S.C. § 695r)

Explanatory Notes

Editor's Note, Annotations. Annotations of opinions are not included because none were found dealing primarily with the activities of the Bureau of Reclamation under this statute.

Legislative History. S. 793, Public Law 88-567 in the 88th Congress. Reported in Senate from Interior and Insular Affairs June 28, 1963; S. Rept. No. 341. Passed Senate July 15, 1963. Reported in House from Interior and Insular Affairs Dec. 19, 1963; H.R. Rept. No. 1072. Passed House, amended, Apr. 20, 1964. Senate asks for a conference Apr. 23, 1964. House agrees to a conference May 7, 1964. Conference report filed Aug. 17, 1964; H.R. Rept. No. 1820. House agrees to conference report Aug. 18, 1964. Senate agrees to conference report Aug. 19, 1964.