Appendix A
Compatibility Determinations

Appendix A
Compatibility Determination

Compatibility Determination

Use: Environmental Education, Interpretation, Wildlife Observation and Photography

Refuge Name: Antioch Dunes National Wildlife Refuge

Establishing and Acquisition Authority: Endangered Species Act of 1973, as amended (16 U.S.C. 1531 - 1544)

Refuge Purpose(s): ... to conserve (A) fish or wildlife which are listed as endangered species or threatened species... or (B) plants...

National Wildlife Refuge System Mission: The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Description of Use(s): Environmental education, interpretation, wildlife observation, and wildlife photography would occur from outside the Refuge fence or under controlled visits since the Refuge is closed to the public. Antioch Dunes NWR provides an opportunity for increasing awareness of endangered plant and insect species through led tours and interpretive information. There would be a concurrent opportunity for wildlife observation and photography during any led tours. Establishing interpretive panels at a vehicle turnout would foster the above uses with little impact to the Refuge. The Refuge was established to protect the unique riverine dune ecosystem which provides habitat for the endangered Antioch Dunes evening primrose (*Oenothera deltoides howellii*), Contra Costa wallflower (*Erysimum capitatum angustatum*) and Lange's metalmark butterfly (*Apodemia mormo langei*). Environmental education and interpretation at the Refuge would focus on endangered species. In addition, the Refuge would educate the public about the National Wildlife Refuge System and the Service mission. Currently, there are no interpretive efforts and few led tours at the Refuge.

Availability of Resources: Minimal staff exists to manage for environmental education, interpretation, wildlife observation and wildlife photography at the Antioch Dunes National Wildlife Refuge. Increased funding would be required for interpretive materials and educational materials. Volunteers to lead tours would need to be recruited and trained.

Anticipated Impacts of the Use(s): The goals of the Refuge are:

1. To protect, restore, and manage the Antioch Dunes ecosystem for a diversity of native plant and animal species.

2. To protect, enhance, and maintain habitat for threatened and endangered species, emphasizing species known to inhabit the Refuge, including the Lange's metalmark butterfly, Contra Costa wallflower, and Antioch dunes evening primrose.

3. To establish an educational program for the public to foster an appreciation of the natural habitats and endangered species supported by the native riverine dune habitat of the Refuge.

Controlled access through led tours at appropriate times supports the third goal and should have minimal impacts upon the first two goals of the Refuge although the possibility exists of damaging endangered plants, disturbing endangered butterflies and introducing unwanted plants through seed transfer while on led tours.

Public Review and Comment: Would be conducted concurrently with the public review and comment period for the Comprehensive Conservation Plan.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible With Following Stipulations

Stipulations Necessary to Ensure Compatibility: The Refuge would remain closed to uncontrolled public use. Tours would be led by persons trained in identification, ecology, and necessary limited behavior in the vicinity of the endangered plants and butterfly. Protection of other native plants and animals on the Refuge would be incorporated into led tours.

Interpretive panels and educational materials used outside the fence require no stipulations.

Although the Refuge manager has the authority to close certain areas to public access, the State Lands Commission has reserved all lands below mean high water for public access. Thus, complete closure of the entire beach profile by the Service would not be possible. In an effort to control all access to the Refuge, the Refuge would pursue a lease of these lands.

Justification: The Refuge Improvement Act identifies environmental education, interpretation, wildlife observation, and wildlife photography as priority public uses for National Wildlife Refuges. As priority uses of the Refuge system, these uses take precedence over other potential public uses in Refuge planning and management. The Service strives to provide priority public uses when compatible with the purpose and goals of the Refuge. The above four priority uses support one of the goals of the Comprehensive Conservation Plan.

Mandatory Re-evaluation Date (provide month and year for "allowed" uses only):

October 2016 Mandatory 15-year Reevaluation Date (for priority public uses)

_____Mandatory 10-yr Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):
Conducted with the Comprehensive Conservation Plan

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X___Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

Refuge Determination

Prepared by:_____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor:_____ _____
(Signature) (Date)

Regional Chief,
National Wildlife
Refuge System:_____ _____
(Signature) (Date)

California/Nevada
Operations Manager
(for CA and NV):_____ _____
(Signature) (Date)

Compatibility Determination

Use: Scientific Research

Refuge Name: Antioch Dunes National Wildlife Refuge

Establishing and Acquisition Authority: Endangered Species Act of 1973, as amended (16 U.S.C. 1531 - 1544)

Refuge Purpose(s): ... to conserve (A) fish or wildlife which are listed as endangered species or threatened species... or (B) plants...

National Wildlife Refuge System Mission: The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Description of Use(s): Antioch Dunes NWR receives periodic requests to conduct scientific research. Priority would be given to studies that contribute to the enhancement, protection, preservation, and management of threatened and endangered species and their ecosystem. Research applicants must submit a proposal that would outline: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on Refuge endemics and their ecosystem, including disturbance (short and long term), injury, or mortality; (5) personnel required; (6) costs to Refuge, if any; and (7) end products (i.e. reports or publications). Research proposals would be reviewed by Refuge staff or others as appropriate.

Evaluation criteria would include, but not be limited to, the following:
1. Research that would contribute to Refuge goals would have higher priority than other requests.
2. Research that would conflict with other ongoing research, monitoring or management programs would not be granted.
3. Research projects that can be done elsewhere off-Refuge, are less likely to be approved.
4. Research which causes undue disturbance or is intrusive, would likely not be granted. Level and type of disturbance would be carefully weighed when evaluating a request.
5. Research evaluation would determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.
6. If staffing or logistics make it impossible for the Refuge to monitor researcher activity in a sensitive area this may be reason to deny the request depending on the circumstances.
7. The length of the project would be considered and agreed upon before approval. Projects would not be open ended and would be reviewed annually.

Availability of Resources: Adequate funding and staff exist to manage for research at Antioch Dunes National Wildlife Refuge.

Anticipated Impacts of the Use(s): The goals of the Refuge are:
1. To protect, restore, and manage the Antioch Dunes ecosystem for a diversity of native plant and animal species.
2. To protect, enhance, and maintain habitat for threatened and endangered species, emphasizing species known to inhabit the Refuge, including the Lange's metalmark butterfly, Contra Costa wallflower, and Antioch dunes evening primrose.
3. To establish an educational program for the public to foster an appreciation of the natural habitats and endangered species supported by the native riverine dune habitat of the Refuge.

Previous scientific research has directly contributed to the first two goals and provided information that would be used to support the third goal. The possibility exists of damaging endangered plants, disturbing endangered butterflies and introducing unwanted plants through seed transfer while doing research. There is also the potential for illegal collection of endangered plants and insects at the Refuge.

Minimal impact to Refuge resources is expected with scientific research studies. Some level of disturbance is expected with all research activities since most researchers would be entering areas that are normally closed to the public and may be collecting samples or handling wildlife. Special Use Permit conditions would include special conditions to ensure that impact to wildlife and habitats are kept to a minimum.

Public Review and Comment: Would be conducted concurrently with the public review and comment period for the Comprehensive Conservation Plan.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible With Following Stipulations

Stipulations Necessary to Ensure Compatibility: Threatened and endangered species and Refuge resources would be monitored by Refuge staff. If the proposed research methods would impact or could potentially impact refuge resources it must be demonstrated that the research is necessary, and the researcher must identify the issues in advance of the impact. Minimization measures for potential impacts would need to be developed and be listed as a condition on the Special Use Permit. Extremely sensitive areas would be considered when determining locations for proposed research. At any time, refuge staff may accompany the researchers to determine potential impacts. Staff may determine that previously approved research and special use permits be terminated due to impacts. All Refuge rules and regulations must be followed unless otherwise excepted by the Refuge Manager.

Justification: Restrictions would be placed on the researcher to ensure that disturbance is kept to a minimum. Concerns about protecting rare native plants and animals and the overall integrity of the dune ecosystem require that Refuge staff closely review proposed research projects and that research activities be monitored. Research projects would contribute to the enhancement, protection, preservation, and management of native Refuge populations.

Mandatory Re-evaluation Date (provide month and year for "allowed" uses only):

_____Mandatory 15-year Reevaluation Date (for priority public uses)

October 2011 Mandatory 10-yr Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

Conducted with the Comprehensive Conservation Plan

_____Categorical Exclusion without Environmental Action Statement

_____Categorical Exclusion and Environmental Action Statement

__X___Environmental Assessment and Finding of No Significant Impact

_____Environmental Impact Statement and Record of Decision

Refuge Determination

Prepared by:_____ _____
(Signature) (Date)

Refuge Manager/
Project Leader
Approval:_____ _____
(Signature) (Date)

Concurrence

Refuge Supervisor:
Regional Chief,
National Wildlife
Refuge System:_____ _____
(Signature) (Date)

California/Nevada
Operations Manager
(for CA and NV):_____ _____
(Signature) (Date)

Appendix B
Technical Panel

Appendix B
Technical Panel

Antioch Dunes Technical Panel Participants from 2 February 1999 Meeting

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Joelle Buffa	USFWS, San Francisco Bay National Wildlife Refuge Complex, Supervisory Biologist
Sally DeBecker	PG&E, Biologist
Joe DiTomaso, PhD	UC Davis, Biology Professor, Starthistle Specialist
Steve Edwards	Director, East Bay Regional Parks Botanic Garden
Barbara Ertter	Director, UC Berkeley - Jepson Herbarium
Erin Fernandez	USFWS Wildlife Biologist in charge of Antioch Dunes NWR
Holly Forbes	California Native Plant Society - East Bay Chapter President, and UC Botanical Garden (Berkeley)
Julie Greene	Center for Natural Lands Management, Assistant Reserve Manager
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Melody Kercheval	PG&E, Sr. Associate Planner
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Leslie Lew	USFWS, Refuge Planner for Antioch Dunes National Wildlife Refuge
Wesley A. Maffei	Napa Co. Mosquito Abatement District, Manager
Sandra Matasol	USFWS, Biologist
Rick Morat	USFWS, Wildlife Biologist, Public Affairs Specialist
Chuck Morton	Caltrans, Senior Biologist,
Michael Parker	USFWS, previous Wildlife Biologist in charge of Antioch Dunes NWR
Jerry Powell, PhD	UC Berkeley, Entomology Professor
John Randall, PhD	Nature Conservancy/UC Davis, Professor, Weed Specialist
John Rusmore	UC Davis, Graduate Student, Private Consultant, Weed Specialist
Victoria Slowik	USFWS, Biological Intern
Diane Thomson	UC Santa Cruz, Graduate Student
Louise Vicencio	San Pablo Bay NWR, Wildlife Biologist
Betty Warne	USFWS, Plant Biologist
Dave Wright	USFWS, Invertebrate Biologist
Loretta McCorkle	USFWS, Writer-Editor
Mark Pelz	USFWS, Refuge Planner
Don DeLong	USFWS, Supervising Refuge Planner

Antioch Dunes Technical Panel Participants from 16 November 1999 Meeting

Name	Affiliation
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Marge Kolar	USFWS, San Francisco Bay National Wildlife Refuge Complex Manager
John Lauenroth	Diablo Valley College, Student and Cryptogrammic Soils Expert
Leslie Lew	USFWS, Refuge Planner for Antioch Dunes National Wildlife Refuge
Ivette Loredo	USFWS, Wildlife biologist in charge of Antioch Dunes National Wildlife Refuge
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Chuck Morton	Caltrans, Supervising Biologist
Bruce Pavlik	Mills College, Conservation Biology Professor
Mark Pelz	USFWS, Refuge Planner
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Jerry Powell	UC Berkeley, Entolomolgy Professor
Diane Thomas	UC Santa Cruz, Graduate Student

Appendix C
Environmental Assessment

Appendix C
Environmental Assessment

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Draft Environmental Assessment
Antioch Dunes National Wildlife Refuge
Contra Costa County, California

Chapter 1. Purpose of and Need for Action

1.1 Introduction

This draft environmental assessment (EA) evaluates the alternatives and environmental effects of implementing a Comprehensive Conservation Plan (CCP) for Antioch Dunes National Wildlife Refuge (Refuge). This EA will be used by the US Fish and Wildlife Service (Service) to solicit public involvement in the refuge planning process and to determine whether the implementation of the CCP would have a significant effect on the quality of the environment. This EA is part of the Service's decision-making process in accordance with the National Environmental Policy Act (NEPA).

1.2 Proposed Action

The Service proposes implementing the actions of Alternative D, as described in this EA and the CCP for managing the Refuge. The CCP is incorporated into this EA by reference.

1.3 Purpose of and Need for the Proposed Action

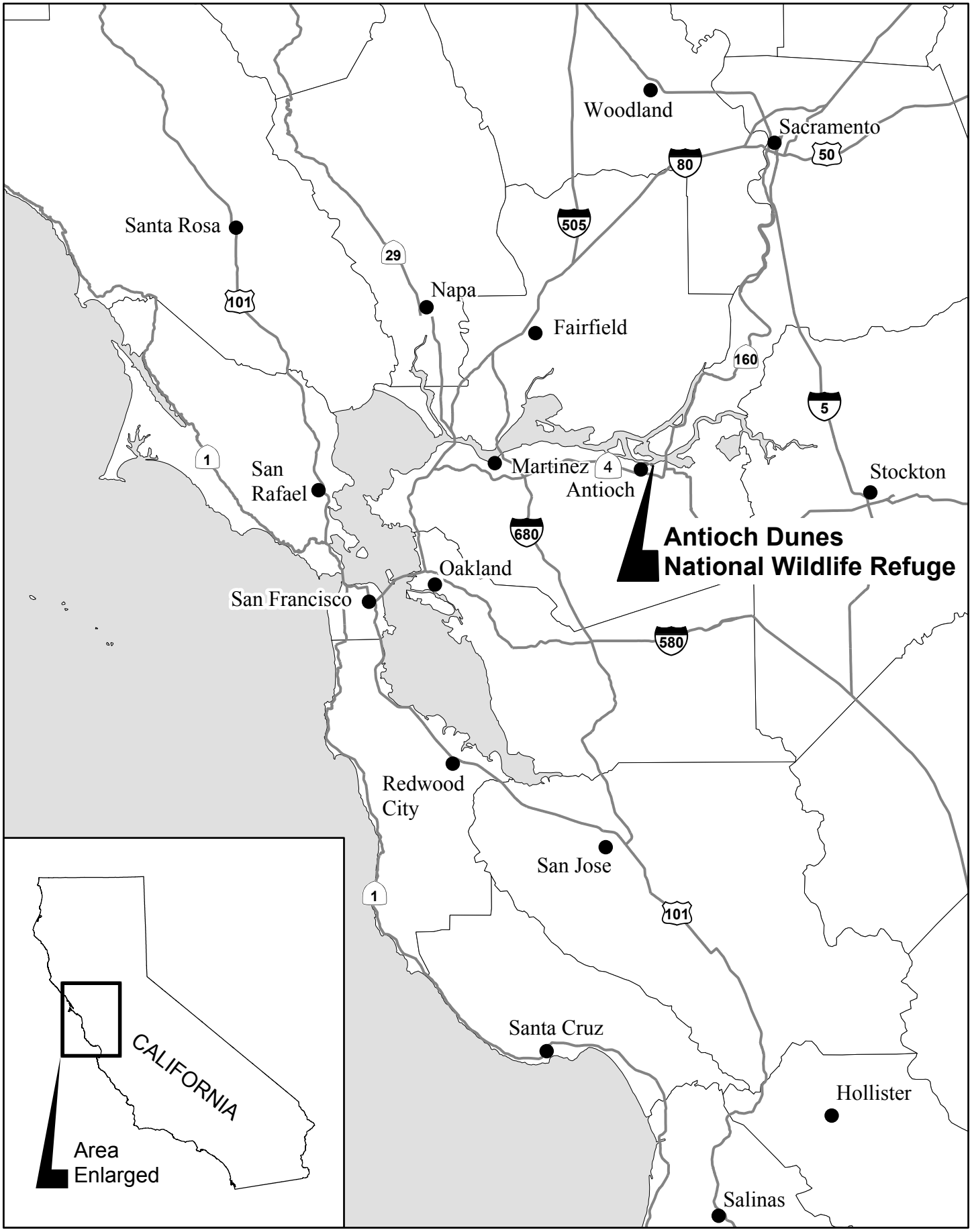
A plan is needed to guide Refuge management. In addition, the National Wildlife Refuge System Improvement Act of 1997, requires that every refuge have a CCP in place within 15 years of its enactment.

1.4 Project Area

The Refuge is located in Contra Costa County next to the City of Antioch along the south shore of the San Joaquin River in an area that was part of an expanse of aeolian glacial sand dunes deposited along the river (Figure 1). The Refuge consists of two disjunct parcels (Figure 2). The westernmost unit, called the Stamm Unit, is bordered to the west by the Fulton Shipyard, to the east by the Georgia-Pacific gypsum plant, to the south by Fulton Shipyard Road, Burlington Northern Santa Fe railroad, and a city wastewater treatment plant and transfer station, and to the north by the San Joaquin River. The easternmost unit is referred to as the Sardis Unit. This unit is bordered to the east and west by two parcels owned by Pacific Gas and Electric (PG&E), to the north by the San Joaquin River, and to the south by Wilbur Avenue.
The Refuge is managed out of the San Francisco Bay National Wildlife Refuge Complex in Fremont California.

The approved Refuge boundary encompasses 67 acres, 55 acres of which are owned in fee by the Service. The additional 12 acres are owned by PG&E and have been cooperatively managed in the past by the Service under a cooperative agreement with PG&E. The area includes remnant dunes, and riparian cover types.

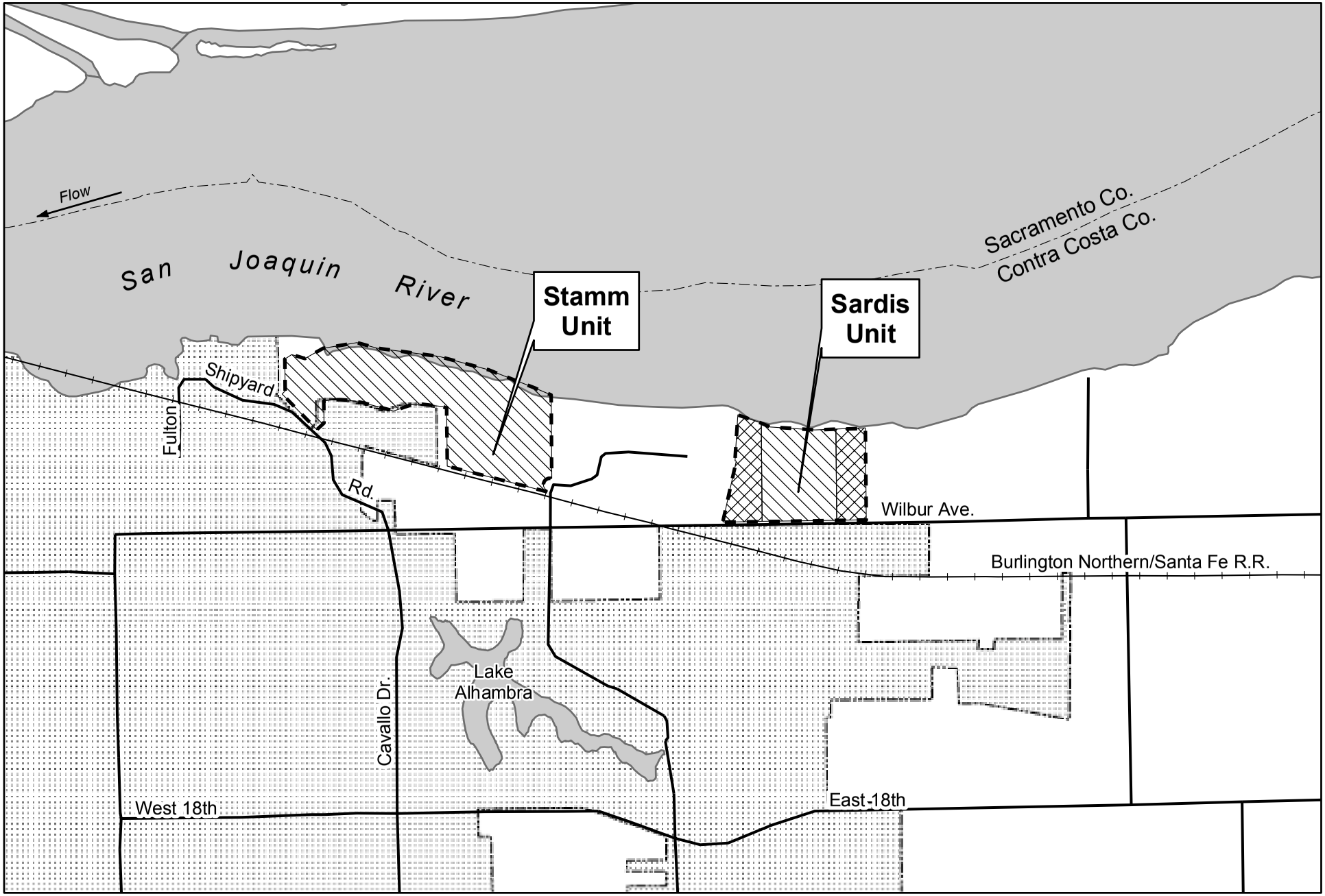
Figure 1. Location Map



CA/NV Refuge Planning Office - August 2001

10 5 0 10 20 Miles

Figure 2. Antioch Dunes National Wildlife Refuge



CA/NV Refuge Planning Office, July 2001

Approved Refuge Boundary | City of Antioch | Unincorporated Contra Costa County

U.S. Fish and Wildlife Service Lands | Pacific Gas and Electric Lands

1.5 Decisions to be Made

Based on the analysis documented in this draft EA, the California/Nevada Operations Manager must determine the type and extent of management and public access on the Refuge and whether the selected management alternative would have a significant effect on the quality of the environment.

1.6 Issue Identification

Issues, concerns, and opportunities were identified through early planning discussions and through the public scoping process, which began with the mailing of the first planning update in December 1998. The planning team convened two panels of experts in February and November 1999 described below in Public Involvement. Other comments were in writing and through personal communications. For a discussion of the issues, please see Chapter 2 of the CCP.

The planning team helped to further define the issues. Service employees from the San Francisco Bay National Wildlife Refuge Complex office in Fremont, California, field offices, and the California/Nevada Refuge Planning Office were on the team, as well as PG&E staff.

1.7 Public Involvement

Four planning updates for the Refuge were sent to a mailing list of about 100 individuals, groups, and agencies in December 1998, May 1999, June 2000, and July 2001. In addition, a panel of experts was convened in February 1999. The experts were primarily scientists who have conducted work on the Refuge and were familiar with Refuge issues. Scientists and others involved with the Refuge gave an overview of the planning and Refuge status. The group was then led through a facilitated discussion about possible ways to address Refuge issues. The group identified issues and discussed management ideas and research needs. Other scientists with expertise in endangered species conservation were also briefed and consulted. An additional scientific experts panel was convened on 16 November 1999. The purpose of this meeting was to share the draft alternatives developed by the planning team and to solicit comments from scientists regarding these draft alternatives.

Public input received in response to these updates, workshops, and briefings is incorporated into the CCP and EA, and a summary of comments is included in Chapter 2 of the CCP. The original comments are being maintained in planning team files at the California/Nevada Refuge Planning Office in Sacramento, California, and are available for review.

1.8 Related Actions

Please see Chapter 1 of the CCP for a description of related actions, projects, and studies in the area.

1.9 U.S. Fish and Wildlife Refuge Service and National Wildlife Refuge System

The mission of the Service is to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people. The Service is the primary Federal agency responsible for migratory birds, endangered plants and animals, certain marine mammals, and anadromous fish. This responsibility to conserve our nation's fish and wildlife resources is shared with other Federal agencies and State and Tribal governments.

As part of this responsibility, the Service manages the National Wildlife Refuge System (Refuge System). The Refuge System is the only nationwide system of Federal lands managed and protected for wildlife and their habitats. 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.

The Refuge is managed as part of the Refuge System in accordance with the National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, and other relevant legislation, Executive Orders, regulations, and policies. Chapter 1 of the CCP summarizes these major laws, regulations, and policies and also describes the goals of the Refuge System.

1.9.1 Purpose of Antioch Dunes National Wildlife Refuge

The Refuge was established under the authority of the Federal Endangered Species Act. In addition to providing a basis for making compatibility determinations, a refuge's purpose also serves as a guide for refuge management and public use.

The Refuge was established to protect a unique riverine dune ecosystem and three endangered species. The 67 acres within the approved refuge boundary, along with portions of the Georgia-Pacific gypsum plant and Kemwater properties, support the last known natural populations of the primrose, wallflower, and Lange's. Land and Water Conservation Fund money was used to acquire lands. The acquisition was in accordance with the recovery plan for the three species. The Refuge purpose is:

> "To conserve fish or wildlife which are listed as endangered species or threatened species or plants..." 16 USC § 1534 (Endangered Species Act of 1973).

1.9.2 Goals of the Refuge

There are three goals for the Refuge.

Goal 1: To protect, enhance, and maintain habitat for threatened and endangered species, emphasizing the Lange's metalmark butterfly, Contra Costa wallflower, and Antioch Dunes evening primrose (U.S. Fish and Wildlife Service 1984).

Goal 2: To protect, restore, and enhance the Antioch Dunes ecosystem for a diversity of native plant and animal species.

Goal 3: To establish interpretive and educational programs for the public to foster an appreciation of the natural habitats and endangered species supported by the Refuge's native riverine dune habitat.

Chapter 2. Alternatives, Including the Proposed Action

Chapter 2 describes four alternatives for the management of the Refuge. Alternative A, No Action; Alternative B, Manage the Refuge to Pre-Industrial conditions; Alternative C, Manage the Refuge as a Mosaic and Maximize Public Use; and Alternative D, Manage the Refuge as a Mosaic with Limited and Controlled Public Use. The alternatives are summarized in Table 1 and described below. The Proposed Action is Alternative D, Manage the Refuge as a Mosaic with Limited and Controlled Public Use.

Most proposed management activities and projects described below will be analyzed in this EA in sufficient detail to satisfy NEPA compliance. The CCP contains site plans and exact locations for certain projects, such as a visitor pull-out and sign placement. Major revisions to this plan will require additional NEPA compliance and public review, if needed.

Certain management activities described in the CCP may qualify as "categorical exclusions," provided that they meet certain conditions that include not adversely affecting a listed or proposed threatened or endangered species. This means they would not require review in an environmental assessment or impact statement because they are actions which typically do not individually or cumulatively have a significant effect on the human environment. The following activities are potential categorical exclusions: environmental education and interpretation, research, inventory, information collecting, operations, maintenance, and management of existing facilities, planting of vegetation, and activities directly related to enforcement of fish and wildlife laws. These activities will not be covered by this EA.

2.1 Features Common to Alternatives

All alternatives contain some common features. These are presented below to reduce the length and redundancy of the individual alternative descriptions.

2.1.1 Revegetation

The Refuge would continue to outplant endangered species until self sustaining populations are established.

2.1.2 Firebreaks

The Contra Costa Fire Protection District requires the Service to maintain a firebreak between the Refuge and the railroad tracks. The Service would continue to maintain this firebreak by scraping the soil.

2.1.3 Weed Control

Weed control would be necessary regardless of the alternative selected. The tools to be used would include prescribed fire, herbicide, hand weeding, and scraping (removing the top 1 to 2 inches of soil by scraping the soil surface with heavy equipment, such as a bulldozer with a blade). The specific tools and techniques used for weed control would vary with different alternatives. Weed control would result in a significant decrease in the amount of nonnative vegetation as well as an increase in native and endangered species with minimal costs environmentally.

Table 1. Summary of Alternatives

	Alternative A - No Action	Alternative B - Manage the Refuge to Pre-Industrial Conditions	Alternative C - Manage the Refuge as a Mosaic and Maximize Public Use	Alternative D -Preferred Alternative - Manage the Refuge as a Mosaic with Limited and Controlled Public Use.
Weed Control	Use a combination of prescribed fire, discing, scraping, mowing, dune reconstruction, hand-weeding, and herbicides.	**Same as Alternative A.**	Same as Alternative A.	Same as Alternative A. Also, remove dead invasive vegetation after spraying by mechanical means to reduce biomass. Remove Ailanthus and other woody nonnative plants.
Distur-bance	Discourage soil disturbance.	Same as Alternative A.	Create a cycle of distur-bance by scraping the soil in a mosaic pattern. Un-controlled public use would introduce an unknown level of disturbance.	Same as Alternative C. Except additional disturbance from controlled public use would be used.
Restoration /Dune construc-tion	No construction of new dunes. Recontour existing dune material as opportunities arise.	Same as Alternative A.	Construct additional dunes in areas that currently do not provide good habitat for endangered species using imported sand. Rebuild existing dunes to mimic natural conditions.	Same as Alternative C.
Site preparation for new or newly recontoure d dunes.	Burn or spray dunes of a manageable size every year until the nonnative seed bank is exhausted. Then burn on an as-needed basis.	Same as Alternative A.	Burn or spray newly created dunes. Then plant with native species and focus hand-weeding and spot-spraying efforts on it inten-sively to establish the native vegetation on the new dune. Monitor the success of the vegetation.	Same as Alternative C.
Outplanting	Continue to outplant primrose, wallflower, and buckwheat on an as-needed basis.	Same as Alternative A. Also, plant oak seedlings and native grasses. Replant native grasses as necessary. Outplant the primrose as necessary	Same as Alternative A. Also, plant other native plant species, especially plants that are either locally signifi-cant and/or were historically present. Seeds would be collected from as close to the Refuge as possible, propo-gated, and the seedlings planted on the Refuge.	Same as Alternative C.
Seed collection	Continue to collect up to 5% of seed from the primrose, wallflower and buckwheat at the Refuge to grow in the nursery for replanting at the Refuge.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A. Also, identify plants that are locally important and were historically present. Collect seed on site and, where necessary, off-site but close to the Refuge as possible. Maintain genetic diversity by practicing reciprocal transplanting between the Sardis and Stamm Units of the Refuge.

	Alternative A - No Action	Alternative B - Manage the Refuge to Pre-Industrial Conditions	Alternative C - Manage the Refuge as a Mosaic and Maximize Public Use	Alternative D -Preferred Alternative - Manage the Refuge as a Mosaic with Limited and Controlled Public Use.
Weed control research	Continue testing herbicides, hand weeding, mowing, scraping, biological controls (grazing, insects, bacteria, fungus), and prescribed fire (burning and flaming) in combination and by themselves. Monitor burn plots to analyze species richness and percent cover before and after burn to determine the response of primrose, wallflower, buckwheat, and nonnative vegetation (Fish and Wildlife Service 1997b). Monitor prescribed burns that have taken place since 1997. If the nonnative species and seed bank have been reduced, replant the areas with native vegetation and continue to burn other areas that are dominated by invasive nonnative vegetation (Fernandez 1997).	Same as Alternative A.	Same as Alternative A. Also, research the effect of prescribed fire on invertebrates.	Same as Alternative C.
Other Research	Investigate the primrose decline.	Same as Alternative A.	Same as Alternative A. Also research effects of gypsum, habitat patch size on insect populations, pollinators, seed germination limiting factors, demographic factors limiting seedling viability and reproductive success, effect of adjacent land uses on pollinators and other topics related to management.	Same as Alternative C.
Monitoring	Annual monitoring of Lange's, primrose, and wallflower.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Trespassing	Report trespassing to the county sheriff. The current frequency of law enforcement patrols would be continued.	Hire additional law enforcement personnel to patrol the Refuge. Work with Antioch police and county sheriffs. Train volunteers to report trespassing to the Service.	Hire law enforcement personnel to patrol the Refuge. Work with Antioch police and county sheriffs. Train volunteer to report trespassing to the Service.	Same as Alternative B.

	Alternative A - No Action	Alternative B - Manage the Refuge to Pre-Industrial Conditions	Alternative C - Manage the Refuge as a Mosaic and Maximize Public Use	Alternative D -Preferred Alternative - Manage the Refuge as a Mosaic with Limited and Controlled Public Use.
Firebreaks	Scrape firebreaks to control prescribed fire.	Scrape firebreaks to control prescribed burns, limit extent of wildfires and promote beneficial disturb-ance. Scrape fire-breaks around weed-free areas that are intensively managed for buckwheat and other native species.	Same as Alternative B.	Same as Alternative B.
Riparian Restoration	None	Remove nonnative vegetation along river shore. Allow parts of the shoreline to erode to create endangered plant habitat.	Same as Alternative B Also, plant native riparian species along the shoreline and leave the sandy areas in a disturbed state.	Same as Alternative C.
Refuge Boundary	Work with PG&E to finalize the cooperative agreement.	Same as Alternative A.	Same as Alternative A. Also, prepare a study report and preliminary project proposal to investigate riparian easement and dune habitat acquisition from adjacent landowners, and the portions of the river shore that are not owned by the Refuge.	Same as Alternative C.
Public Use				
Public Use	Limited public use program.	Do not encourage human disturbance on the upland component of the Refuge.	Open the Refuge to uncontrolled public use. 5 of the 6 public priority uses would be accommodated except for hunting.	Incorporate supervised public use on the Refuge. 4 of the 6 public priority uses would be accommo-dated excluding hunting and fishing.
Environ-mental Education	Limited environmental education.	Promote the Refuge with teachers. Develop an educator-led curriculum for Refuge resources.	Same as Alternative B.	Same as Alternative B.
Public Use Facilities	None	Install additional Refuge signs and construct an interpre-tive pullout on Minaker Dr. and improve existing gravel parking area at the Stamm Unit.	Same as Alternative B. Also, construct a fishing pier along the San Joaquin River. Construct an interpretive trail and restroom facility on the Stamm Unit.	Same as Alternative B. Except the existing gravel parking lot area at the Stamm Unit will not be improved.

All alternatives would use prescribed fire as one method of weed control. Selected sites of manageable size would be burned under predetermined conditions, every year, to remove nonnative vegetation until the nonnative seed bank is decreased (Fire Management Plan, Appendix I, Antioch CCP). Burning would then be conducted on an as-needed basis. This would enhance existing habitat and create more suitable habitat for endangered and native species, which are dependant on relatively open, sand-dune habitat.

Burning would primarily be conducted in May or June to achieve two objectives: (1) kill the existing nonnative plants prior to seed set; and (2) thereby reduce the nonnative seed bank. In May/June, the grasses would be dry enough to carry a fire hot enough to destroy the still green nonnative weeds. No more than five percent of the yellow star thistle should be in flower at this time This is the optimum time to burn because the fire would destroy the thistle before it produces seed, yet it will be late enough in the season to prevent further germination.

The Service would focus on burning sites on the Refuge that have already been burned and/or are dominated by nonnative vegetation, have very few natives, and few endangered species. The Service would establish, monitor, and analyze both burned plots and unburned control plots (similar in vegetative composition to the burn areas), for species richness, percent cover, and response of nonnative vegetation, before and after the prescribed fire. The Service would use randomized plots to monitor vegetation in the middle and edge of the burn plots. The Service would analyze differences in the amount of weeds resprouting from the residual seed source versus the amount encroaching on the burn area from peripheral areas. The Service would plant native and endangered species in these areas after the nonnative seed bank has been reduced. A Global Positioning System would be used to record environmental factors and locate sites, as well as track annual progress. Reducing the nonnative seed bank could take three or more consecutive years of burning.

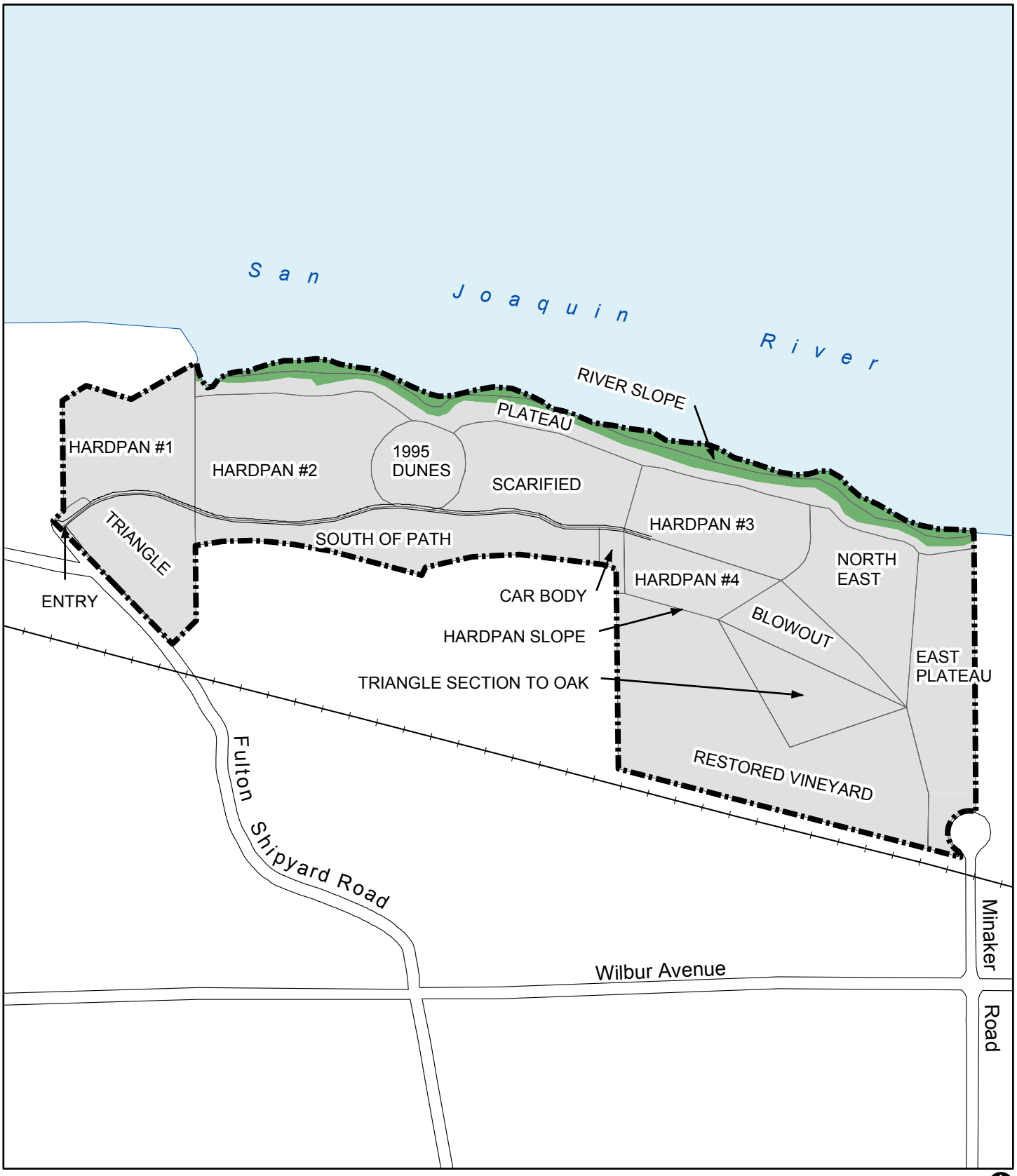
2.1.4 Endangered Species Monitoring

Refuge staff would continue to monitor the populations of the primrose, wallflower, and Lange's regardless of the alternative selected. Monitoring helps the Refuge determine the response of the endangered species to various management scenarios and other events such as wildfire and rainfall (see Table 4 of the CCP for monitoring protocols).

2.2 Alternative A: No Action

This alternative (Figures 3 and 4) describes the level of management activity currently being conducted by the Service. It is status quo. This alternative is required by NEPA and is included for the purposes of establishing a baseline condition for comparison. Under the No Action Alternative, the Refuge would continue to be managed without a management plan. Additional staff and funding would not be requested, a comprehensive effort towards implementing management strategies and monitoring the results to identify future management would not be undertaken. Native plants would likely continue to decline as nonnative weeds continue to expand at the Refuge.

Figure 3. Alternative A - Stamm Unit

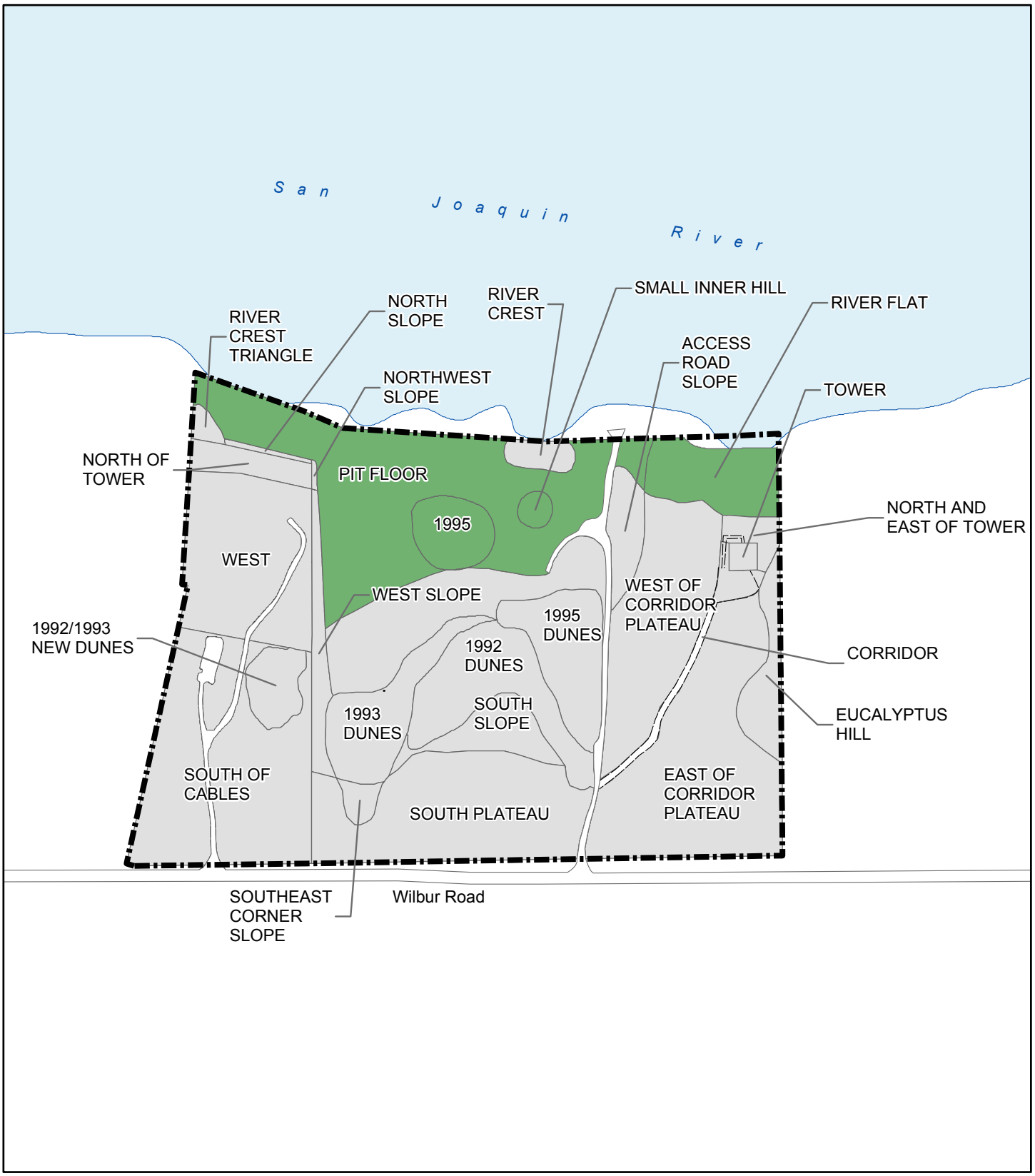


CA/NV Refuge Planning Office - July 2001

100 0 100 200 300 400 500 Feet

Approved Refuge Boundary | Riparian | Antioch Dunes Unique Stands (Sawyer, Keeler-Wolf 1995)

Figure 4. Alternative A - Sardis Unit



CA/NV Refuge Planning Office - July 2001

100 0 100 200 300 400 500 Feet

Riparian | Antioch Dunes Unique Stands | Approved Refuge Boundary | PG&E Access Roads

2.2.1 Weed Control

The Refuge would continue its current weed control program. Active management for the three endangered species involves a substantial amount of nonnative weed control. Various control methods would be used, including hand weeding, treating with herbicide, and prescribed fire. The prescribed fire program was started in 1997 as a result of literature review and consultations with weed scientists. Units would be burned for three consecutive years to reduce the nonnative seed bank. Nonnative weeds on the Refuge continue to outcompete native species such as primrose and would require extensive ongoing management into the foreseeable future (Fish and Wildlife Service, 1997b).

2.2.2 Restoration/Dune Construction

In the past, the Service has recontoured existing sand dunes at the Refuge by using heavy equipment to reshape existing sand substrate into steep dunes and by importing sand from off-site. The Refuge would continue to take advantage of opportunities like this as they occur.

2.2.3 Outplanting/Seed Collection

The Service would continue to propagate primrose, wallflower, and buckwheat. No more than 5 percent of the seeds would be collected from Refuge plants. These seeds would be grown in a nursery during the fall for replanting on the Refuge in the winter. Plants would be grown either in the Refuge greenhouse or contracted out to commercial nurseries.

2.2.4 Monitoring

Annual surveys of the three endangered species would continue.

2.2.5 Fire Breaks

Refuge staff would construct firebreaks by scraping to control prescribed fire.

2.2.6 Refuge Boundary

The Refuge boundary would remain the same. The Refuge would continue to work to finalize a Cooperative Agreement with PG&E.

2.2.7 Public Use

Under the No Action Alternative, very little public use or recreation occurs and no public use facilities would be developed. There is currently no public-use plan or coordinated public use of the Refuge. Occasionally, schools and other groups tour the Refuge by appointment and volunteers participate in various activities. No outreach programs would be developed to inform Antioch and the surrounding communities that the Refuge exists. Accordingly, there would continue to be little community knowledge or support of the Refuge. None of the six priority public uses identified in the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 would be implemented (hunting, fishing, wildlife observation, photography, interpretation, and environmental education), with the exception of environmental education and interpretation which would be provided on a limited basis by Refuge staff. Displays or interpretive brochures

would not be produced. Law enforcement services would be minimal and trespassing, along with wildfires caused by camping trespassers, would continue to occur. Litter would continue be a problem.

2.2.8 Costs

There would be no additional cost to the Service under the No Action Alternative.

2.3 Alternative B: Manage the Refuge to Pre-Industrial Conditions

Under this alternative (Figures 5 and 6), the Refuge would be restored and managed to pre-industrial natural conditions. The natural conditions have been identified as being oak woodland on sandy soils (Arnold et al. 1983). The endangered species likely existed in blowout areas, or pockets of sand along the riverside bluff that had eroded, exposing sand soils. Most of the Refuge would be managed as upland habitat and blowout areas along the shore would be allowed and encouraged to erode and be colonized by endangered species. The Refuge would be restored to these conditions, to the extent possible, within 10 years.

2.3.1 Weed Control

Nonnative weeds would continue to be controlled using the same measures as described in Alternative A. Weed control research would continue and would expand to determine the best methods or combination of methods for weed control.

2.3.2 Restoration/Dune Construction

Under Alternative B, the Refuge would be restored to pre-industrial conditions to the extent possible. Imported sand would be placed on Refuge lands. Oaks and native grasses would be planted over the Refuge, including on newly constructed dunes. Eroded areas or blowouts would be allowed to form on the Refuge to provide habitat for endangered species. Existing dunes would be recontoured into higher, steeper sided dunes.

2.3.3 Outplanting/Seed Collection

Initially, the Refuge would be outplanted with native grasses and oak seedlings to approximate the oak grassland that existed prior to sand mining on the Refuge. Once the oak seedlings and native grasses have become established and are self-sustaining, grasses would only be outplanted on an as-needed basis. It is assumed that the oak population would be self-sustaining. The primrose, wallflower, and buckwheat would also be planted on an as-needed basis to prevent extinction. Populations would likely not be self-sustaining because of the reduction of open sand dune habitat.

2.3.4 Wildlife and Plant Management/monitoring

The Refuge would continue wildlife protection and habitat management programs similar to those that occurred under the No Action Alternative (Alternative A). Activities include monitoring of the primrose, wallflower, and Lange's. The Service would continue to encourage research on the Refuge.

Figure 5. Stamm Unit Alternatives

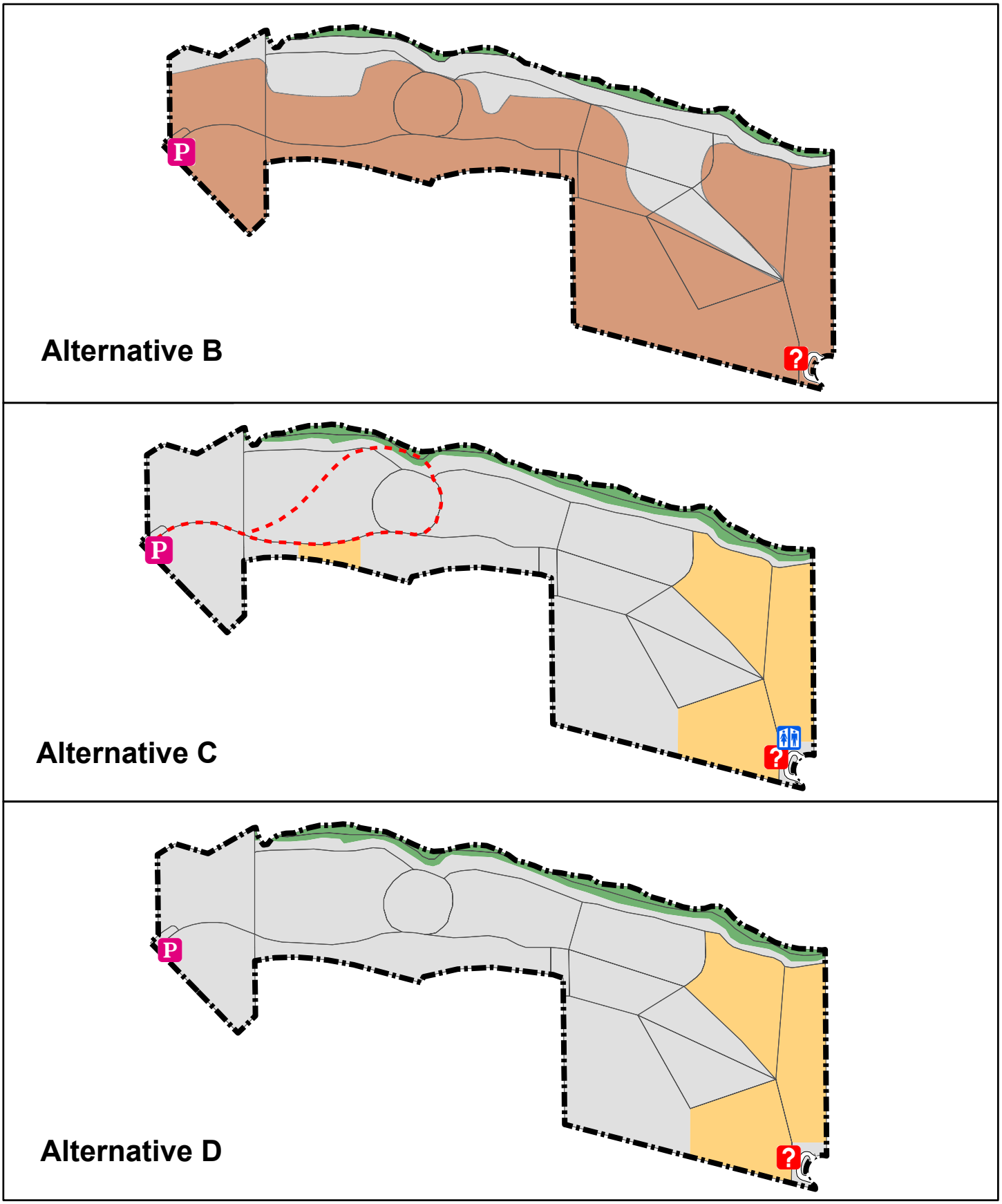
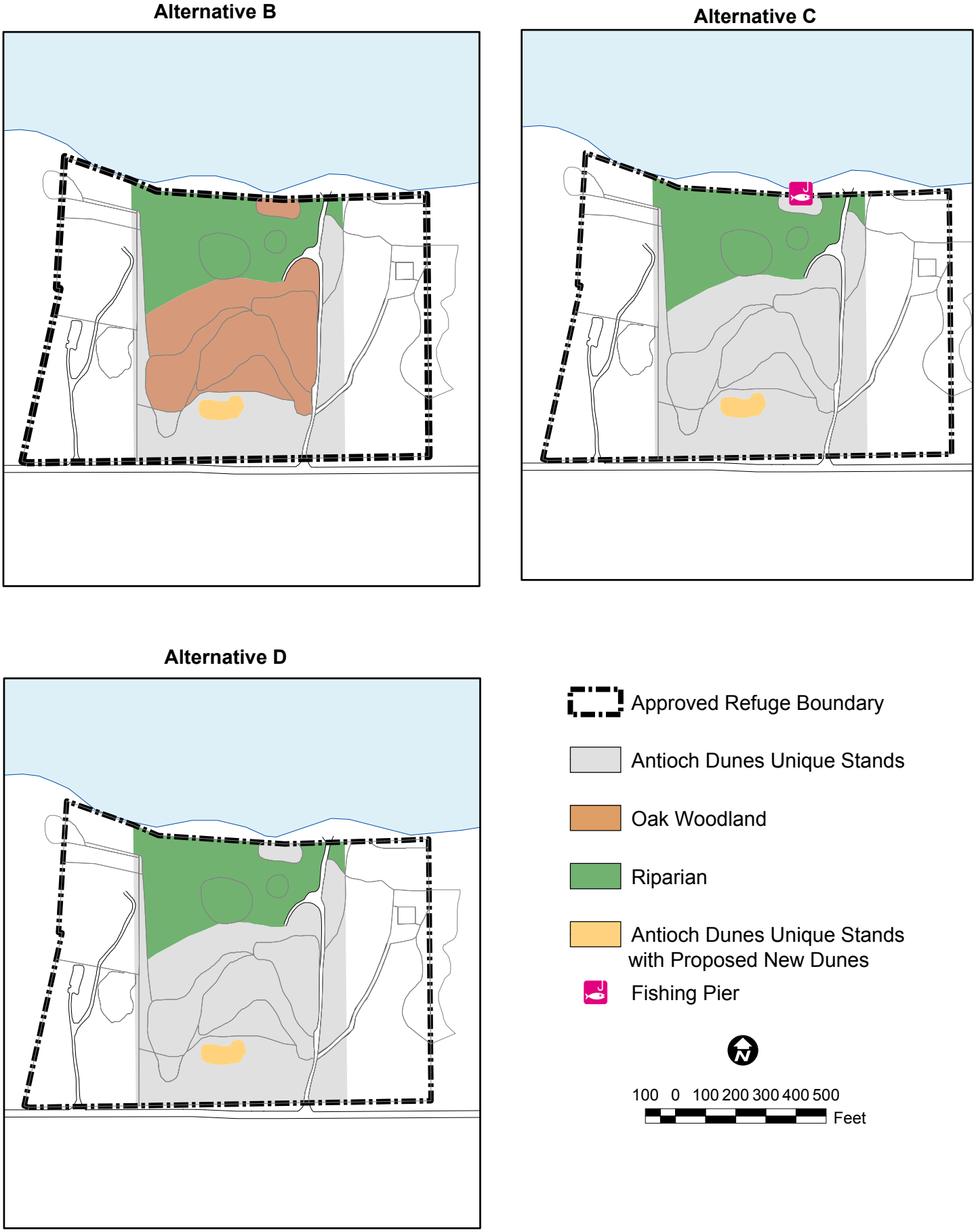


Figure 6. Sardis Unit Alternatives



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2.3.5 Firebreaks

Firebreaks around prescribed fires would be scraped to control the fire and to promote beneficial disturbance. Firebreaks would be scraped around weed-free areas that are intensively managed for buckwheat.

2.3.6 Riparian Restoration

Under this alternative, nonnative species would be removed from the river shore to the extent possible. No native species would be planted in their place. The bank would be allowed to experience erosion and blowouts so that the endangered plants could colonize them.

2.3.7 Refuge Boundary

Same as Alternative A.

2.3.8 Public Use

Limited public use would be allowed. The endangered plant habitat would be limited because the plants prefer the sandy areas of the Refuge, which would be less extensive under Alternative B. As a result, there would be fewer habitat areas, and these areas would be more sensitive to disturbance. Therefore, it would likely be harmful to the endangered species to open the area to uncontrolled public use. Regularly scheduled tours of the Refuge would be conducted by Refuge staff. An outreach program would be developed to help expand the Refuge's presence and support in the community.

The Service would provide additional law enforcement services. Refuge complex law enforcement officers, based in Fremont, would conduct occasional patrols, and the Refuge manager would be commissioned as a collateral-duty peace officer. The Refuge would request law enforcement and emergency support from the Antioch Police Department.

Interpretive programs and events would be developed, including an automobile pull-out with an interpretive kiosk, at the Stamm Unit on Minaker Drive and a parking area for school and other organized groups at the Stamm Unit on Fulton Shipyard Road. The interpretive kiosk would inform visitors about the significance of the Refuge and the role it plays in protecting the three endangered species and the unique ecosystem. A docent training program would be developed as part of the volunteer program.

A public outreach program would be developed to let the public know about the Refuge and to inform the public of the Refuge's role in threatened and endangered species protection and ecosystem management. Refuge staff would work with the local community to develop an effective outreach program and would write articles for local newsletters, and give talks describing the importance and uniqueness of the Refuge to local community groups. Volunteers would be solicited to assist with the outreach program.

Schools would be encouraged to use the Refuge to teach students about the natural world. Teachers would be recruited to use the Refuge as an outdoor classroom. A volunteer or staff would develop an educator-led age-appropriate curricula that is specific to the resources and resource objectives at the Refuge. A program to recruit teachers to use the Refuge would be developed. The program would identify, develop, and implement a teacher training program.

Environmental education efforts would be focused on the Stamm Unit because this unit is not located on a busy street and has more room for parking than the Sardis Unit.

A volunteer program would be fully developed. Volunteers would serve as docents, help with surveys, and help with Refuge management. Volunteers provide the Refuge with a group of people who can help the Refuge carry out programs that it would unable to carry out with existing staff. Volunteers can serve as advocates for the Refuge and help share their enthusiasm for the Refuge with other volunteers and community members. A volunteer outreach program would be implemented to recruit the local population to volunteer with the Refuge. Refuge staff would write articles for newsletters and meet with the local community to generate interest in volunteerism. Partnerships would be created with a docents friends group who can conduct environmental education programs and interpretive programs and train new docents. The Refuge would develop a program protocol for individuals with community service requirements to fulfill those requirements by working at the Refuge.

2.4 Alternative C: Manage the Refuge as a Mosaic and Maximize Public Use

Under this alternative (Figures 5 and 6), precisely duplicating the Refuge's pre-mining natural condition would not be the ultimate goal. The Refuge would instead be managed as a mosaic of dune habitat at varying successional stages. Since the Lange's and primrose both seem to require various successional stages to fulfill their requisite life cycle needs, managing the Refuge as a mosaic would allow different life stages of the dune habitat to be present on the Refuge at any given time. The Service would concentrate its efforts on the Refuge on adaptive management, performing a series of small experiments that would benefit the native species. By monitoring the response of the Refuge resources to these management actions, the Refuge would acquire more data and more tools with which to manage the Refuge.

2.4.1 Weed Control

Nonnative weeds would continue to be controlled using the same measures as described in Alternative A.

2.4.2 Restoration/Dune Construction

The Refuge's pre-sandmining condition, primarily oak woodland, would not be the ultimate goal under this alternative. Instead, the Refuge would be managed as a mosaic, with different parts of the Refuge being exposed to a regime of disturbance on a rotating basis. It is anticipated that areas of the Refuge that currently provide good habitat for species would be disturbed least or not at all.

Disturbance methods would likely include adding imported sand to the area, prescribed fire, scraping, and public use. The effect of human disturbance on the species would be monitored and may be modified depending on the results.

If supported by a U.S. Army Corps of Engineers (COE) beneficial reuse project, sand could be imported either from a borrow site owned by COE at Rio Vista or from dredge material from the deepwater ship channel. Montezuma Wetlands is also a potential source for clean sand. If dredge material were used, an impoundment for dewatering the sand would be constructed. The Refuge areas most suitable for this purpose would initially be East Plateau and Vineyard because they have the least endangered species. Dredge materials would be deposited on

Refuge lands or nearby lands that could be leased for the purpose. After the sand was allowed to decant for a period of less than a year, the dried sand could be used on the Refuge to create additional dunes. If material were imported from Rio Vista or Montezuma Wetlands, it would not need decanting. The material would be barged in and stockpiled on the Refuge or on nearby lands that could be leased for stockpiling material.

The newly created dunes would be burned or treated with herbicide. Portions of the dunes would then be planted with native species. Hand weeding and spot-spraying efforts would be focused intensely on new dunes to allow native vegetation to become established. The success of the native vegetation would then be monitored.

2.4.3 Outplanting/Seed Collection

Refuge staff would continue to outplant primrose, wallflower, and buckwheat on an as-needed basis. The Refuge would not outplant these species unless the population fell below the level that, in the best judgement of Refuge staff, is sustainable.

In addition to outplanting the endangered species and buckwheat, Refuge staff would plant other native plant species, especially plants that are either locally significant and/or were historically present. Seeds would be collected from as close to the Refuge as possible, propogated in a nursery, and the seedlings planted on the Refuge.

2.4.4 Wildlife and Plant Management/monitoring

The Refuge would continue wildlife protection and habitat management programs similar to those that occurred under the No Action Alternative (Alternative A). Activities would include monitoring the primrose, wallflower, and Lange's. Additional studies would be undertaken to assess the effects of management actions on other plants and animals, including reptiles and invertebrates, at the Refuge.

2.4.5 Firebreaks

Same as Alternative B.

2.4.6 Riparian Restoration

Under this alternative, nonnative species, such as *Ailanthus* and oleander would be removed from the river shore to the extent possible. Native species would be planted in their place. Parts of the bank would be allowed to experience erosion and blowouts so that the endangered plants could colonize them.

2.4.7 Refuge Boundary

The Refuge would continue to work with PG&E to finalize a cooperative management agreement for their lands adjacent to the Sardis Unit. In addition, a land protection plan would be prepared that identifies land adjacent to and near the Refuge with the potential to provide habitat similar to the dune habitat at the Refuge and would make good additions to the Refuge System. This plan would need to be approved before appreciable additions would be made to the Refuge. Part of this plan would include investigating the Kemwater property to determine the feasibility of incorporating portions of their lands into the Refuge and investigating obtaining

riparian easements from neighboring landowners, including the portions of the river shore that are not owned by the Refuge.

2.4.8 Public Use

The Refuge would be opened to unrestricted access by the public, as it was before 1986. Public use that is safe and compatible with the purposes of the proposed Refuge would be encouraged. Five of the Service's six priority public uses would be allowed. Environmental education, interpretation, wildlife observation, photography, and fishing would be allowed. Only hunting would not be allowed because there is no waterfowl habitat on the Refuge, and the Refuge has very limited space. Furthermore, free roam hunting would not be safe.

Public use facilities and programs would be developed and staffed as described under Alternative B except that there would be fewer guided tours. The Refuge's law enforcement effort would include more patrols. In addition, a fishing pier and restroom would be constructed along the San Joaquin River. A nature trail with interpretive signs that provide information about the unique species and habitats present at the Refuge would also be constructed.

Refuge resources would be carefully monitored to determine the effects, both positive and negative, of maximized public use.

2.5 Alternative D: Manage the Refuge as a Mosaic with Limited and Controlled Public Use.

Alternative D is very similar to Alternative C, except that public use would be limited and controlled. Alternative D would provide fewer visitor facilities than Alterative C.

2.5.1 Weed Control

Nonnative weeds would be controlled using the same measures as described in Alternative C. Also, nonnative weeds would be removed in some places after spraying by mechanical means to reduce biomass and woody nonnative plants would also be removed.

2.5.2 Restoration/Dune Construction

Under this alternative, restoration and dune construction would be implemented as in Alternative C. However, Alternative D, would require more soil scraping in a mosaic patter to create disturbance than Alternative C. Alternative C would be using uncontrolled public use as a major disturbance agent, which Alternative D would not.

2.5.3 Outplanting

Under this alternative, outplanting would be conducted as in Alternative C.

2.5.4 Monitoring

Under this alternative, monitoring would be conducted as in Alternative C.

2.5.5 Firebreaks

Same as Alternative B.

2.5.6 Riparian Restoration

Under this alternative, riparian restoration would be conducted as in Alternative C.

2.5.7 Land Protection

Same as Alternative C.

2.5.8 Public Use

Under this alternative (Figures 5 and 6), public use on the Refuge would be managed as in Alternative B. Unrestricted public access would not be allowed. The public would be allowed to use the Refuge only when guided by Refuge staff or trained volunteers. Various programs would be implemented, as described in Alternatives B and C, that would allow the Refuge to be used and enjoyed by the public.

Chapter 3. Affected Environment

This chapter briefly outlines the physical, biological, social, and economic environment that would most likely be affected by the alternatives. See Chapter 3 of the CCP for a more detailed description.

3.1 Physical Environment

Chapter 3 of the CCP provides a detailed description of the physical environment.

3.2 Biological Environment

Chapter 3 of the CCP provides a detailed description of the biological environment.

3.2.1 Vegetation

The baseline conditions for the primrose and wallflower are given in Chapter 3 of the CCP under Endangered Species.

3.2.2 Wildlife

The baseline conditions for the Lange's is given in Chapter 3 of the CCP under Endangered Species.

3.3 Contaminants

Chapter 3 of the CCP provides a detailed description of the contaminants on the Refuge.

3.4 Social and Economic Environment

3.4.1 Economy

Heavy industry was once the dominant employer in Antioch, but in recent years there has been a rapid expansion in the retail, light industrial, service, and office sectors altering the nature of business in Antioch (www.ci.antioch.ca).

The major employers in Antioch include the Antioch Unified School District, USS-POSCO, Sutter Delta Medical Center, E. I. Dupont and Co., Dow Chemical Co., Gaylord Container Corp., and California Delta Newspapers, Inc. (City of Antioch Development Dept. Employer Survey July 1995).

3.4.2 Land use

Chapter 3 of the CCP provides a detailed description of Land Use on the Refuge.

3.4.3 Population

During the 1990 census, Antioch had a population of 62,830; in 1997 it was 76,538; today the population is 84,485 (S. Dept. of Census, California Dept. of Finance, Projections '96

Association of Bay Area Governments (ABAG); Bill Gegg pers. comm. 2000). There are 29,853 households providing an employed workforce of 42,200, 70 percent of whom commute. The median household income is $46,433 (Bill Gegg, pers. comm. 2000).

There are 16 public schools in the Antioch Unified School District and 8 private schools (Harden Political Info Systems hpi@atlanta.com; Bill Gegg, pers. comm.). Antioch has 23 neighborhood parks, a city owned golf course, and a regional park that provides swimming, fishing, hiking, and windsurfing opportunities for the residents. There is a municipal marina that has 310 berths, a six-acre public park, a picnic area and a fishing pier.

3.4.4 Public Use

Chapter 3 of the CCP provides a detailed description of Public Use on the Refuge.

3.4.5 Cultural Resources

Chapter 3 of the CCP provides a detailed description of the Cultural Resources of the Refuge.

3.4.6 Environmental Justice

Executive Order 12898 ("Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations") which directs the US Environmental Protection Agency to ensure that agencies analyze environmental effects on minority and low-income communities. The purpose of the executive order is to avoid the disproportionate placement of any adverse environmental, economic, social, or health impacts resulting from Federal actions and policies on minority and low-income populations.

Chapter 4. Environmental Consequences

Chapter 4 discusses and analyzes the environmental impacts expected to occur from the implementation of Alternatives A through D as described in Chapter 2. Direct, indirect, and cumulative impacts are described where applicable for each alternative. Alternative A (No Action) is a continuation of the management practices that are in place today and serves as the baseline against which Alternatives B, C, and D are compared. Table 2 summarizes the environmental consequences of each alternative.

4.1 Effects on the Physical Environment

4.1.1 Soils

The soils report (Jones and Stokes Associates 2000) indicated that the Refuge lacks a true soils association. The native soils have been severely mined, from a height of about 120 feet to a current height at about 10 to 50 feet. Therefore, it is unlikely that soils would be appreciably disturbed under any alternative.

Under all Alternatives, existing sand would be used to create topography by pushing it up into dune formations. Alternatives B, C, and D would require importing additional sand to replace sand lost during mining operations. Care would be taken that imported sand is from the local area and does not contain contaminants or organic materials. Under Alternatives C and D, soil scraping would occur on approximately 5 acres per year on a rotational basis and under all alternatives firebreaks would be maintained by scraping. Sand contouring, sand placement, and scraping are not expected to appreciably affect the soil.

Service-approved herbicides would be used with all alternatives. Roundup®, Rodeo®, Transline®, Poast®, and Garlon® will be used. Glyphosate, the active ingredient in Roundup® and Rodeo®, is considered nonmobile in soils and sediments because it rapidly and strongly adheres to soil particles and degrades in the soil by normal soil microbial degradation. It is moderately persistent in the soil, with an estimated half-life of 47 days. Half-life is the length of time required after application for the chemical to decrease to one-half of its original concentration. Persistence is the length of time required for a chemical to degrade to the point it can no longer be detected. Glyphosate has no known effect on soil microorganisms.

Transline® is a selective, systemic post-emergent broadleaf herbicide that controls many broad-leafed invasive plants, yet does not affect a wide variety of herbaceous and woody plants, including grasses. It is applied as a foliar spray and translocates throughout the plant, affecting cell respiration and growth, thereby reducing the potential for resprouting in perennial plants. It controls many invasive plants, particularly in the Asteraceae (aster) and Fabaceae (pea) families. Clopyralid is the active ingredient in Transline® and may persist in soils under anaerobic conditions and in soils with a low microorganism content. The half-life of clopyralid in laboratory studies ranges from 15 to 287 days. Microbial degradation is the major route of degradation for clopyralid (Transline® MSDS). Treated soils would not be moved for a period of 9 months.

The active ingredient in Garlon® is triclopyr, a selective systemic herbicide used for control of woody and broadleaf plants along rights-of-way, in forests, on industrial lands, and on

grasslands and parklands. Triclopyr is active in the soil, is absorbed by plant roots, and is adsorbed by clay particles and organic matter particles in soil. Microorganisms degrade triclopyr rapidly; the average half-life in soil is 46 days. Triclopyr degrades more rapidly under warm, moist conditions, and is slightly toxic to practically non-toxic to soil microorganisms.

The active ingredient in Poast® is sethoxydim, a selective post-emergence herbicide used to control annual and perennial grass weeds. Sethoxydim is of low soil persistence, has a weak tendency to adsorb to soil particles, and has a field half-life are 5 to 25 days. Although laboratory leaching tests suggest that sethoxydim could leach in soil, field tests, show that sethoxydim did not leach below the top 4 inches of soil and did not persist. On soil, photodegradation of sethoxydim takes less than 4 hours. Poast® photodegrades on soil surfaces with a half-life of approximately 3.7 hours. Disappearance of sethoxydim is primarily due to action by soil microbes.

None of the alternatives are expected to result in adverse affects to soils.

4.1.2 Water Quality/Contaminants

Herbicides would be applied at the Refuge under every alternative. Glyphosate, the active ingredient in Roundup®, is strongly adsorbed to soil particles and is not expected to leach into groundwater. Tests show that the half-life for glyphosate in water ranges from 35 to 63 days (USDA).

Since clopyralid (Transline®) is highly soluble in water, does not adsorb to soil particles, and is not readily decomposed in some soils, it may leach into ground water. Ground water may be contaminated if clopyralid is applied to areas where soils are very permeable and the water table is shallow (USDA no year). However, clopyralid is generally not mobile in soil under typical prairie conditions (Province of Alberta 1999) and field dissipation and lysimeter studies show that potential for groundwater contamination is minimal (Dow Chemical 1999). Clopyralid could contaminate surface waters if applied directly to water or wetlands. However, since the only surface water on the Refuge, the San Joaquin River, would be avoided in Transline® application, no effects to water quality are anticipated. Since Transline® is not approved for use near water, it will not be applied within 100 feet of the river.

Triclopyr (Garlon®) is of moderate to low water solubility. The potential for leaching depends on the soil type, acidity, and rainfall conditions. Triclopyr should not be a leaching problem under normal conditions since it binds to clay and organic matter in soil. Triclopyr may leach from light soils if rainfall is very heavy. Sunlight rapidly breaks down triclopyr in water. The half-life in water is less than 24 hours. Since Triclopyr is not approved for use near water, it will not be applied within 100 feet of the river.

Photodegradation of sethoxydim (Poast®) in water takes less than 1 hour and is fairly stable to the chemical action of water, with a half-life of about 40 days. Since Poast® is not approved for use near water, it will not be applied within 100 feet of the river.

Within areas 100 feet of the river, Refuge staff will use only Rodeo® or Garlon 3a®, which are approved for use near water.

Herbicides would be applied at label rates and all label recommendations would be followed.

The Refuge would not spray when wind velocities exceed 5 miles per hour, when vegetation is wet, or when precipitation is occurring or is forecast in the following 24 to 36 hours. Wind direction and wind speed would be measured with wind meters. Nozzles with orifices of 1/16 or greater in diameter or low-drift flat spray nozzles would be used. When possible, the lowest possible pressure within the nozzle's ideal range would be used. Herbicides would be applied only at sites at least 100 feet from the river. If the Refuge needs to spray within 100 feet of the river, Rodeo® or Garlon 3a®, would be used as they are approved for use in aquatic areas. Every effort would be made to avoid impacts to sensitive plant species by concentrating spray efforts on weed-infested areas, using target specific herbicides, and/or temporarily covering sensitive plants while spraying. Herbicides would be applied properly by a licensed applicator. The plan is not expected to have an effect on water quality.

Alternatives C and D include the possibility of using dredged material to reconstruct dunes on the Refuge. Use of dredge material would require the construction of a dewatering area to dry the material prior to placement. The Service would obtain a Clean Water Act permit prior to decanting dredge material. Any discharge into the river would meet the requirements of the clean water act and are not expected to affect water quality in the San Joaquin River.

Alternative C includes a fishing pier to provide fishing access to the San Joaquin River. Site preparation and construction activities associated with boardwalk installation could increase delivery of sediment to the San Joaquin River. This increase is expected to be short term and small because the scope of the construction would consist of installing about 4 piers in the water. All necessary permits would be obtained prior to construction. Therefore, this alternative would not significantly impact water quality in the San Joaquin River.

None of the alternatives are expected to result in adverse effects to water quality.

4.1.3 Air Quality and Noise

4.1.3.1 Vehicle Emissions

Under all alternatives, there would be no significant change to current air quality or in noise levels over the long term. All alternatives identify some earth work and/or facilities construction, during which there would minor and temporary increased levels of emissions from construction equipment, dust from ground disturbance, and increased noise levels from heavy equipment.

Under Alternatives B and C, an interpretive pullout and improved gravel parking area would be constructed at the Stamm Unit. Alternative C also calls for construction of a restroom, fishing pier, and an interpretive trail on the Stamm Unit. Alternative D calls for construction of the interpretive pullout only. Under these alternatives, visitor use is expected to increase somewhat. However, the corresponding increase in user vehicle traffic would be limited because the capacity of the western Stamm parking area would not change and the pull out for the east side of the Stamm unit on Minaker drive would hold no more than five vehicles. The construction of visitor use facilities would generate construction-related vehicle emissions. The level of staffing for the Refuge would increase by as many as three people under Alternatives B, C, and D, resulting in a slight increase in emissions related to Service staff vehicles. Increased vehicle emissions under Alternatives B, C, and D (related to increased visitor use, construction, and increased staff) are not expected to have a significant impact on air quality in the Refuge area. Although this impact is not significant, the Service would implement avoidance measures during construction to reduce the effects of construction and construction vehicles on air quality.

Avoidance Measures for Alternatives B, C, and D. The Service would implement the following measures to mitigate construction-related impacts on air quality:

Water the active construction site at least once a day.
Cover all trucks hauling loose materials or require trucks to maintain at least 2 feet of freeboard.
Apply water to all unpaved access roads, parking lots, and staging areas at the construction site at least once a day.
Cover exposed stockpiles (dirt, sand, etc.)
Limit traffic speeds on unpaved roads to 15 miles per hour.

4.1.3.2 Prescribed Fire

All alternatives would use prescribed fire to control nonnative weeds. Burning vegetation could temporarily and substantially increase PM10 concentrations in the areas. Prior to conducting a burn, the Service would obtain a burn permit from the Bay Area Air Quality Management District. The Service would follow all conditions of the permit. PM10 emissions expected to result from prescribed burning of five to ten acres of Plains Grassland (FRES 38) will range from 110 to 220lbs/acre. However, the effects would be short term and since the Bay area is an attainment area for PM10, these impacts are not likely to be appreciable in the long term.

Furthermore, under all alternatives, measures to avoid and/or minimize adverse effects would include: (1) close coordination with the Service Regional Fire Management Officer, Contra Costa Fire Department, Bay Area Air Quality Management District, and the Service Ecological Services Office; (2) selection of a proper burn prescription and cessation of burn activities when conditions exceed predetermined prescription levels; (3) the use of firebreaks (cut line, existing roads) around burn units to minimize any potential for wildfire.

Prescribed fire would greatly mitigate potential future negative impacts resulting from wildfires by reducing a heavy fuel layer.

See Fire Management Plan (FMP) for more detailed information (Appendix I of CCP).

4.2 Effects on the Biological Environment

4.2.1 Vegetation

When conducting habitat management activities, the Service would make every effort to avoid those areas with high primrose populations or to protect these plants.

4.2.1.1 Weed Control

Alternative A provides some weed control, but does not provide staff and funding necessary to control weeds adequately. Nonnative weeds would continue to inhibit the survival of endangered species at the Refuge. Primrose and wallflower populations would continue to fluctuate and likely decline and the currently stable populations of buckwheat could begin to decline. Outplanting of primrose would continue, to prevent extinction, but populations would probably not become self-sustaining.

For Alternatives B, C, and D, weed control would result in a significant decrease in the amount of nonnative vegetation and an increase in native and endangered species with minimal

environmental cost. Similar weed control efforts would be undertaken for Alternatives B, C, and D. Without increased weed control, the extent and density of weedy vegetation is expected to increase over the Refuge with the listed and non-listed native plant populations decreasing.

If additional nonnative vegetation control measures are not taken, the problem will worsen, nonnative species would increase, and more frequent and costly control measures may need to be taken to halt the spread of nonnative species. Under the No Action Alternative, there is potential that the primrose would be eliminated from its historic range. This potential inability of the Refuge to provide suitable habitat for endangered species is inconsistent with the Refuge's goals and conflicts with Service goals of recovering endangered species.

The primrose requires clean shifting sand that is free of other vegetation to thrive and reproduce (Thompson 1997, Greene 1995). The presence of primrose has been correlated with low organic material in the soil (Jones and Stokes Associates 2000) and germination increases in disturbed soils (Loredo pers. comm. 2001). Therefore, it is likely that disturbance and weed removal would greatly enhance the primrose vigor.

On a long-term scale, endangered and other native species would benefit from the removal of exotic species by all methods, including fire, herbicide, scraping, and hand weeding.

4.2.1.2 Native Vegetation Restoration

Under Alternatives C and D, the refuge would be managed as a mosaic of native species and endangered plants at different successional stages. The primary vegetative cover type would be native dune species. Increases in native plants may benefit native pollinators, which would in turn, benefit native plants. Substrate disturbance would be used to encourage the growth of native species. Substrate disturbance could initially adversely affect primrose, wallflower, and other native plants, but would benefit them in the long run. In addition, under Alternative C and D, plants may benefit from the substrate disturbance caused by increased public use.

Under Alternative B, disturbance would be more limited than under Alternatives C and D and possibly Alternative A. Under Alternative B, the Refuge would be restored to natural conditions –a pre-industrial development state. Natural conditions would be an oak grassland with blowout areas that are encouraged to erode to their sand substrate. The blowout areas would support the endangered species. Under this alternative, it is expected that the endangered plants would primarily inhabit the blowout areas. However, since the land base of the dune habitat is more limited than it was in pre-industrial times, it is expected that the blowout areas would also be more limited, perhaps too limited to support a self-sustaining population. Furthermore, placement of substrate over the entire site would likely result in the mortality of at least some primrose. Primrose germination and recruitment would be expected to decline. Areas where primrose would be self-sustaining would likely be limited in extent.

Native vegetation restoration under Alternatives B, C, and D is also likely to boost populations of native pollinators, which may assist in increasing the primrose numbers.

The effects of the alternatives on the wallflower would be similar to the effects on the primrose and other native vegetation. Wallflower, like the primrose, is adapted to disturbance and would benefit from Alternatives C and D. However, the wallflower's preferred habitat, steep-sided north-facing slopes, would increase under Alternatives B, C, and D with the construction of new dunes.

Avoidance Measures for Alternatives B, C, and D. The Service would implement the following measures to avoid impacts to the primrose and wallflower:

Where possible, primrose and wallflower that would be disturbed by management activities would be relocated or otherwise protected.

No more than 5 percent of the baseline population of the primrose and wallflower would be lost during any 3-year period as result of management activities.

Weed control and other management activities in Alternatives B, C, and D could affect some individual plants of the primrose, wallflower, and buckwheat. However, the long-term effects would be beneficial to these species because a significant amount of nonnative vegetation would be removed which would decrease competition between these species.

4.2.1.3 Herbicide Use

Various herbicides would be used under all the alternatives. Roundup®, Rodeo®, Transline®, Poast®, and Garlon® will be used for this effort. Glyphosate and clopyralid have no known effect on soil microorganisms, however, contact with nontarget plants may injure or kill plants. Contact of clopyralid with nontarget plants may kill or injure the plants (USDA), and is not metabolized in plants (Dow Chemical 1999). Small amounts of drift may damage sensitive plants such as legumes (Province of Alberta 1999). Triclopyr is toxic to many plants. Even very small amounts of spray may injure some plants. It is expected that sethoxydim may injure or kill nontarget plants. Transline® (clopyralid) does not affect the primrose or wallflower.

Herbicides would be applied by hand using a backpack, truck, or a sprayer mounted on an all-terrain vehicle, allowing individual target plants (primarily yellow starthistle, ripgut brome, and vetch) to be treated selectively, while minimizing impacts to native vegetation. Trained applicators would apply herbicides following manufacturers' recommendations.

4.2.1.4 Prescribed Fire

The prescribed burn areas within the Refuge would be carefully selected to avoid endangered species. However, a few primrose, wallflower, and buckwheat plants could be within a burn area and could be temporarily adversely affected. Small firebreaks will be constructed around primrose, wallflower, and buckwheat. It is possible that some of these firebreaks may not hold and some plants would be killed. The Lange's could be detrimentally affected by burning its host plant the buckwheat. Although fire and scraping would have short term impacts on native vegetation, long-term, these weed treatments are recognized as being beneficial. Habitats, including designated critical habitat for the primrose and wallflower, would be enhanced by burning on a continual, rotational basis. High butterfly producing stands and areas with high density of endangered and native species would not be selected for burning. These sensitive areas would be maintained through hand-weeding efforts and, where appropriate, selective herbicide use.

Escaped fire has the potential to threaten endangered and native species and their habitat. Firelines, existing roads, and other control techniques would prevent prescribed fire from escaping into other areas where concentrations of endangered species occur. The adherence to a proper prescription and careful coordination with the Bay Area Air Quality Management District, the Contra Costa Fire Department, Service Ecological Services Office, and Service Regional Fire Management Officer would greatly limit the chance of an escaped burn.

For example, burning and scraping operations have both resulted in increased primrose germination the following winter. The soil would not be disturbed in areas which already have self-sustaining populations of primrose.

4.2.1.5 Dune Disturbance

Soil disturbance would at least initially be included under all alternatives. Under Alternative B, the Refuge would be restored to pre-sand-mining conditions to the extent possible by adding imported sand onto the existing topography. Once restoration is completed, there would be little or no additional disturbance under Alternative B. Soil scraping, dune recontouring, and adding imported sand would occur under Alternatives A, C, and D. These activities would affect any vegetation located where they take place. However, the primrose, wallflower, Lange's, and buckwheat require early successional habitat to survive. It is anticipated that the benefits of disturbing and possibly removing some vegetation out weighs any short term losses in vegetation. Without disturbance to the soil, the endangered species and probably other native vegetation that depends on shifting dune habitat would be hindered. New dunes would only be constructed in weedy areas.

Sand added to the Refuge to create new dunes may also adversely affect some individual primrose. Over the long term, however, conditions for the primrose would improve.

Adding sand to Refuge was one of the highest priorities of the panel of experts.

4.2.1.6 Public Use

Parking areas would be improved under Alternatives B and C. No long-term impact is expected with the parking area located at the western end of the Stamm parcel. This parking area already exists and currently has sparse or no vegetation. The West Stamm parking area would be graded and graveled. The new parking area and interpretive kiosk on Minaker Drive proposed under Alternatives B, C, and D and the restroom proposed under Alternative C would result in some disturbance to vegetation. However, no effects to endangered species are anticipated since no endangered species have been recorded in the immediate vicinity. The vegetation in this area primarily consists of nonnative weeds. The fishing pier proposed under Alternative C would be sited so that endangered species would not be affected. Any impacts to vegetation would be minor and short term.

4.2.2 Wildlife

4.2.2.1 Lange's Metalmark Butterfly

Implementing Alternative A would result in little change for the Lange's. The Lange's population would continue to exist at the Refuge. However, with no increase in patrol, wildfires would continue to be a problem, which can be extremely devastating to the Lange's. Lange's populations would probably continue to fluctuate. No additional high quality stands of buckwheat would be restored at the Refuge. Increased public use under Alternative C may result in an increased incidence of wildfires, which can be detrimental to Lange's populations. Alternatives B, C, and D include restoring native vegetation, which is expected to benefit the Lange's. Restoration efforts would include naked-stemmed buckwheat, the hostplant for Lange's, on areas of the Refuge that are currently poor butterfly habitat. Under Alternative B, Lange's would be limited to sandy blowout areas where buckwheat would grow well. Lange's populations would probably not change considerable. The substrate disturbance identified for Alternatives C and D are also likely to result in better growing conditions for the buckwheat, and therefore, better conditions for the Lange's. The resulting mosaic of buckwheat at different successional stages would benefit Lange's. Lange's population would be expected to increase and become more stable. Other high quality stands of buckwheat would be restored to benefit Lange's. However, there would likely be short term disturbances to the buckwheat similar to those described under 4.2.1 Vegetation. Under Alternative C, increased public use may offset habitat benefits because of increased possibility of wildfires. Similar avoidance measures would be deployed to avoid adverse effects to the Lange's. In addition, areas with high Lange's densities (Figures 9 and 10, CCP) would not be burned or receive additional sand.

4.2.2.2 Other Wildlife

Under Alternative A, there would no change in the status of other wildlife on the Refuge. Wildlife would continue at its current or lesser level because the habitat value provided by weeds is low.

Alternative B would result in more oak woodland habitat, and associated species such as ground squirrels, woodpeckers, raptors, and songbirds, may increase. Mammals, birds, and reptiles are expected to benefit the most from this alternative because of the increase in oak woodland habitat.

Mammals, insects, and reptiles are expected to benefit from increased native vegetation under Alternatives C and D. However, increased public use under Alternative C may result in disturbance to wildlife, such as coyotes. Increased use may also increase the likelihood of uncontrolled wildfires, which could harm the unique invertebrate populations on the Refuge. However, the additional disturbance resulting from uncontrolled public use may be more beneficial to some invertebrates by providing disturbed sandy substrate (Powell, pers. comm. 1999). Alternatives C and D would also provide for riparian restoration along the San Joaquin River which is expected to increase riparian associated species such as songbirds, wading birds, muskrats, racoons, and beavers. Alternatives C and D would provide more disturbed or open sandy areas which are favored by many native invertebrates including native bees and wasps. Reptiles, such as the California legless lizard and whipsnake would also likely benefit from Alternatives C and D, although habitat benefits may be offset by increased public use.

All alternatives identify herbicide use to control weeds. The glyphosate found in Roundup® is no more than slightly toxic to fish, and practically nontoxic to aquatic invertebrate animals. It does not build up (bioaccumulate) in fish. Glyphosate is moderately to slightly toxic to freshwater fish and aquatic invertebrate animals. Clopyralid is of low toxicity to fish and aquatic invertebrate animals, of low toxicity to birds and mammals and not toxic to bees (Pesticide Fact Sheet), and has very low acute mammalian toxicity and extremely low toxicity to fish (Province of Alberta 1999). Clopyralid is of low toxicity to fish and aquatic invertebrate animals and does not accumulate up in fish tissues. Triclopyr is low in toxicity to fish and does not bio-accumulate in fish, is slightly toxic to practically nontoxic to invertebrates, but has not been tested for chronic effects in aquatic animals. Triclopyr is slightly toxic to mammals, however, in mammals, most triclopyr is excreted, unchanged, in the urine. Triclopyr and its formulations have very low toxicity to birds and is nontoxic to bees. Sethoxydim is practically nontoxic to birds, has low toxicity to wildlife and is nontoxic to bees. It is moderately to slightly toxic to aquatic species. Only herbicides that are approved for use near water, such as Rodeo or Garlon 3a®, would be used on Refuge lands that are within 100 feet of the River. In addition, to further prevent water contamination and effects to aquatic species, the Refuge would not spray when wind velocities exceed 5 miles per hour, when vegetation is wet, or when precipitation is occurring or is forecast in the following 24 to 36 hours. Herbicide use is not expected to significantly affect wildlife.

Some negative effects to reproductive success of ground nesting birds such as mallards may occur during prescribed fires.

4.2.3 Fish

Fish species that use the San Joaquin River along the Refuge include winter-run chinook salmon (federally and state listed endangered), delta smelt (federally and state listed threatened), steelhead trout (federally threatened), and the federally proposed threatened Sacramento splittail. Alternative A is not likely to result in any change to these species. Alternative C would allow fishing at the Refuge, which is not expected to significantly affect these species because of the limited numbers of fish that would likely be taken. Alternatives B, C, and D would also restore native riparian species which may benefit these species by providing shaded riverine aquatic habitat which is especially beneficial to anadromous fish.

4.3 Effects on the Social and Economic Environment

4.3.1 Public Use

Implementing Alternative A would result in a very limited public use program which would include of volunteer program used to learn about and assist in habitat restoration projects, and a limited number of tours and school field trips. There would be no public use facilities constructed and no outreach efforts for environmental education. Under Alternatives, B, C, and D, there would be increased promotion of the Refuge with schools, the development of an educator-led curriculum for Refuge resources, additional Refuge signs installed, and an interpretive pullout would be constructed at the Stamm Unit for school and other organized groups. Also under Alternatives B and C, the gravel parking lot would be improved. Therefore, public use opportunities would increase under any alternative other than the No Action Alternative A.

Alternative C, however, would provide for the most public use opportunities. In addition to the above mentioned uses and facilities, Alternative C would allow unrestricted public access of the Refuge. The public would be allowed daytime access to the Refuge to engage in fishing, wildlife observation, photography, and interpretation. To facilitate fishing and provide for visitor safety, a fishing pier would be constructed along the San Joaquin River. An interpretive trail and restroom would be also constructed on the Stamm Unit.

4.3.2 Economy

Neither positive nor negative economic impacts are expected from implementation of Alternatives A, B, or D. Alternative C, which would increase public use on the Refuge may result in some increased economic activity to the local area. However, it is not anticipated to make a significant impact on the economy for two reasons: (1) total number of visitors per day is not expected to be high due to the size of the Refuge and limited beach access, and (2) visitors are expected to be primarily local residents, as was the case when the Refuge was previously open to the public.

Escaped fire could threaten private property and public safety. Firelines, existing roads, and other control techniques that would be used to prevent escaped burns would prevent the escape of fire into other areas. The selection of, and adherence to, a proper prescription and careful coordination with the Bay Area Air Quality Management District, the Contra Costa Fire Department, Service Ecological Services Office, and Service Zone Fire Management Officer would greatly limit the chance of an escaped burn.

4.3.3 Cultural Resources

No effect to cultural resources is anticipated. There are no known cultural resources within the approved Refuge boundary. Under Federal ownership, archaeological and historical resources within the Refuge receive protection under Federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act; the Archaeological and Historic Preservation Act; the Native American Graves Protection and Repatriation Act, and the National Historic Preservation Act. Should any cultural resources be discovered at the Refuge, the Service would take all necessary steps to comply with section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended for, for all alternatives.

4.3.4 Environmental Justice

No activities proposed in this CCP would have a disproportionately negative impact on low-income or minority populations.

4.4 Unavoidable Adverse Impacts

The proposed action would have a beneficial effect on endangered and native species and their habitat on a long-term scale. The action would not degrade habitats, water, or air quality, and would not disrupt or conflict with any land use, social, cultural or economic factors. No direct or indirect unavoidable adverse impacts to the biological environment would result from the selection of any of the alternatives. The Service would prevent incremental adverse impacts,

such as degradation and loss of habitat over time, to the lands and their associated native plants and animals.

4.5 Irreversible and Irretrievable Commitments of Resources

None of the proposed alternatives would result in an irreversible and irretrievable commitment of resources. The pullout and restroom would be situated to avoid listed and native species. Any listed species that are removed would be replanted.

4.6 Short-term Uses versus Long-term Productivity

The habitat protection and management program proposed as part of the Refuge System is permanent and exclusively dedicated to maintaining the long-term productivity of the Refuge habitats. The local short-term uses of the environment would include increased management of wildlife habitats and development of public use facilities. The resulting long-term productivity would include increased protection and management of endangered species and a myriad of plant and wildlife species. Under Alternative C, the public would gain long-term opportunities for wildlife-dependent recreational activities and enhanced quality of life.

4.7 Cumulative Impacts

The proposed management plan for the Refuge would have long-term cumulative benefits for native wildlife species and habitats within the area. The protection of wildlife habitats within the Refuge would represent a cumulative benefit to the long-term conservation of endangered and other native wildlife species.

Table 2. Summary of Environmental Consequences

Issue, Concern, Opportunity	Alternative A	Alterative B	Alternative C	Alternative D - Preferred Alternative
Soils, Water, Air Quality, Noise	No change from current management and conditions. Would not result in impacts to physical environment	Same as Alternative A.	Same as Alternative A, except temporary effects when building facilities.	Same as Alternative A.
Vegetation: Native	No change from current management. Native vegetation competes with nonnative weeds.	Vegetation would be restored to pre-industrial conditions of oak woodland with "blowout" pockets of sand. In general, native plants would benefit from weed reduction and restoration to natural conditions. However, primrose and wallflower would probably be adversely affected in the short term.	Same as Alternative D. Also, dune plant species may benefit from the substrate disturbance caused by uncontrolled public use.	Mosaic of native species and endangered plants at different successional stages. The vegetative cover type would be primarily native dune species. Increases in native plants may benefit native pollinators, which would, in turn, benefit native plants. Substrate disturbance would be used to encourage the growth of native species. Substrate disturbance could initially adversely affect primrose, wall-flower, and other native plants, but would benefit them in the long run.
Vegetation: Nonnative Weeds	Nonnative weeds would continue to invade the Refuge prescribed fire and herbicide application and hand weeding would be used to control weeds to some extent.	Vegetation would be restored to oak woodland with sandy areas. Weeds would be controlled to the extent possible using herbicide, prescribed fire, and hand weeding.	More intensive weed control would be used, including mechanical methods and disturbance. Nonnative vegetation would be controlled along the river shore. Aggressive weed control would benefit native plants, listed plants, and the Lange's.	Same as Alternative C.
Wildlife: Lange's	Lange's populations would continue to fluctuate. No additional high quality stands of buckwheat would be restored. Lange's populations would continue to be isolated to the high quality patches of buckwheat.	Lange's populations would be limited to sandy blowout areas where buckwheat would grow well. Lange's population overall may decline.	Same as Alternative D. Also, increased public use would likely offset habitat benefit, particularly because of the possibility of increased wildfires.	Mosaic of buckwheat at different successional stages would benefit Lange's. Lange's population would be expected to increase and become more stable. Other high quality stands of buckwheat would be restored to benefit Lange's.

Issue, Concern, Opportunity	Alternative A	Alterative B	Alternative C	Alternative D - Preferred Alternative
Wildlife: Other	Wildlife would continue at its current or lesser level because the habitat value provided by weeds is low.	Mammals, birds, and reptiles are expected to benefit the most from this alternative because of the increase in oak woodland habitat.	Mammals and reptiles are expected to benefit from increased native vegetation. Riparian vegetation restoration is expected to provide increased habitat for songbirds, muskrats, racoons, beavers, and wading birds. However, these benefits may be offset by uncontrolled public use.	Mammals, insects, and reptiles are expected to benefit from increased native vegetation. Riparian vegetation restoration is expected to provide increased habitat for songbirds, muskrats, racoons, beavers, and wading birds.
Fish	No effect.	Would restore native riparian species which would likely benefit fish by providing shaded riverine aquatic habitat which is especially beneficial to anadromous fish.	Same as Alternative B. Would allow fishing at the Refuge, which is not expected to significantly effect fish species	Same as Alternative B.
Socioeconomic: Public Use	No effect.	Increased promotion of the Refuge with schools and the development of an educator-led curriculum for Refuge resources. There would be additional Refuge signs installed and an interpretive pullout would be constructed at the Stamm Unit as well as a gravel parking area. Public use opportunities would increase.	Same as Alternative B. This alternative would provide for the most public use opportunities. Uncontrolled public use, as occurred on the Refuge prior to its closure in 1986. The public would be allowed daytime access to the Refuge to engage in fishing, wildlife observa-tion, photography, and wildlife interpretation. To facilitate fishing and provide for visitor safety, a fishing pier would be constructed along the San Joaquin River. An interpretive trail and rest-room would be constructed on the Stamm Unit.	Same as Alternative B, except the parking area would not be improved.
Socioeconomic: Economy	No effect.	Quality of life for Antioch residents may be enhanced by establishing a limited public use program.	Same as Alternative B.	Same as Alternative B.
Environmental Justice	No effect.	No effect.	No effect.	No effect.
Cultural Resources	No effect.	No effect.	No effect.	No effect.

Chapter 5. Consultations and Coordination with Others

5.1 Agency Coordination and Public Involvement

The CCP and EA were prepared with the involvement of technical experts, community groups, and private citizens. The Service has invited and continues to encourage public participation through the public involvement program consisting of technical panels and project planning updates.

5.2 Environmental Review and Coordination

As a Federal agency, the Service must comply with provisions of the NEPA. An environmental assessment is required under the NEPA to evaluate reasonable alternatives that would meet stated objectives and to assess the possible impacts to the human environment. The EA serves as the basis for determining whether implementation of the proposed action would constitute a major Federal action significantly affecting the quality of the human environment.

5.3 Other Federal Laws, Regulations, and Executive Orders

In undertaking the proposed action, the Service would comply with the following Federal laws, Executive orders (EO), and Legislative Acts: Floodplain Management (EO 11988), Intergovernmental Review of Federal Programs (EO 12372), Protection of Historical, Archeological, and Scientific Properties (EO 11593), Protection of Wetlands (EO 11990), Management and General Public Use of National Wildlife Refuge System (EO 12996), Environmental Justice in Minority Populations and Low-Income Populations (EO 12898), Endangered Species Act of 1973, as amended, Refuge Recreation Act, as amended, National Wildlife Refuge System Administration Act of 1966, as amended, National Historic Preservation Act of 1966, as amended, and the Coastal Zone Management Act of 1972, as amended.

5.3.1 Coastal Zone Management Act

The Refuge is not within the San Francisco Bay Conservation and Development Commission's San Francisco Bay Plan, and is therefore not within the jurisdiction of a Coastal Management Plan and is not subject to the Coastal Zone Management Act (Steve Goldbeck, pers com, 2000).

5.4 Distribution and Availability

This draft CCP and EA has been sent to various agencies, organizations, community groups, and individuals for review and comment.

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Appendix D
Vascular Plant List

Appendix D
Vascular Plant List

Current Plant Species at Antioch Dunes NWR. Compiled from CNPS surveys and other sources. 1974 - 2001.

SEAFIG FAMILY (AIZOACEAE)
Ice Plant *(Carpobrotus edulis)*

AMARANTH FAMILY (AMARANTHACEAE)
Tumbleweed (Pigweed) (*Amaranthus albus)*
Prostrate Amaranth *(Amaranthus blitoides)***N**
Amaranthus *(Amaranthus* sp.*)*

AMARYLLIS FAMILY (AMARYLLIDACEAE)
Naked Ladies (*Amaryllis belladonna)*

CASHEW FAMILY (ANACARDIACEAE)
California Pepper Tree (*Schinus molle)?***N**
Poison Oak *(Toxicodendron diversilobum*)**N**

CELERY(CARROT) FAMILY (APIACEAE)
Button-celery (Coyote Thistle) *(Eryngium aristulatum)***N**
Fennel *(Foeniculum vulgare)*
Floating Marsh Pennywort (*Hydrocotyle ranunculoides)***N**
Whorled Marsh Pennywort (*Hydrocotyle verticillata)***N**
Mason's Lilaeopsis (*Lilaeopsis masonii)****N** (CA RARE/CNPS 1B)
Water Parsley *(Oenanthe sarmentosa)***N**
Hemlock Water Parsnip (*Sium suave*)***N**

DOGBANE FAMILY (APOCYNACEAE)
Indian-hemp *(Apocynum cannabinum)***N**
Oleander *(Nerium oleander)*

MILKWEED FAMILY (ASCLEPIADACEAE)
Narrow-leaf Milkweed *(Asclepias fascicularis)***N**

ASTER FAMILY (ASTERACEAE)
Yarrow (*Achillea millefolium)***N**
Western Ragweed *(Ambrosia psilostachya*)
Unknown *(Ambrosia* sp.*)*
Mugwort (*Artemisia douglasiana)***N**
Suisun Marsh Aster *(Aster lentus)****N** (US ENDANGERED/CNPS 1B)

Coyote Brush *(Baccharis pilularis)***N**
Mule Fat (*Baccharis salicifolia)***N**
Bur Marigold *(Bidens laevis)***N**
Italian Thistle *(Carduus pycnocephalus)*
Slender-flowered Thistle *(Carduus teniflorus)*?
Tocalote *(Centaurea melitensis)*
Yellow StarThistle (*Centaurea solstitialis)*
Spikeweed *(Centromadia pungens ssp?*)**N**

Horseweed *(Conyza canadensis)*
Kellogg's Tarweed *(Deinandra kelloggii)* (formerly by *Hemizonia k.*)****N**
Western Goldenrod *(Euthamia occidentalis)****N
California Fluffweed *(Filago californica)***N**
Herba Impia (Fluffweed) *(Filago gallica)***N**
Fragrant Everlasting *(Gnaphalium canescens* ssp. *beneolens)***N
Common Cudweed (*Gnaphalium luteo-album*)
Cotton Batting Plant *(Gnaphalium stramineum)***N**
Cudweed *(Gnaphalium* sp.*)*
Gumplant *(Grindelia camporum* var. *camporum)N*
Hirsute Grindelia *(Grindelia hisutula* var. *h.)***N
Marsh Gumplant (*Grindelia stricta* var. *angustifolia)***N (CNPS 4)
Grindelia *(Grindelia* sp.*)***N**
California Matchweed (*Gutierrezia californica)****N
Bigelow's Sneezeweed *(Helenium bigelovii)***N
Hayfield Tarweed *(Hemizonia congesta* ssp. *c.)***N
Telegraph Weed (*Heterotheca grandiflora)***N**
Bristly Golden Aster (*Heterotheca sessiliflora* ssp. *echioides)****N
Tarweed *(Holocarpha* sp.*)***N**
Smooth Cat's Ear *(Hypochaeris glabra)*
Rough Cat's Ear *(Hypochaeris radicata)*
Prickly Lettuce *(Lactuca serriola*)
California Goldfields *(Lasthenia californica)***N**
Tidy-tips *(Layia platyglossa)****N
Glandular Lessingia *(Lessingia glandulifera* var. *g.)***N
Slender Cottonweed (*Micropus californicus* var. *c.)***N**
Cupped Monolopia *(Monolopia major)***N
Bristly Ox-tongue *(Picris echioides)*
Bush Groundsel (Shrubby Butterweed) *(Senecio flaccidus* var. *douglasii)***N
Alkali-marsh Butterweed *(Senecio hydrophilus)***N
Common Butterweed *(Senecio vulgaris)*
Unknown (wet grower) *(Senecio* sp.*)*
Prickly Sow Thistle (*Sonchus asper)*
Common Sow Thistle (*Sonchus oleraceus)*
Purple Salsify *(Tragopogon porrifolius)*
Cocklebur *(Xanthium strumarium)***N**

BIRCH FAMILY (BETULACEAE)
White Alder (*Alnus rhombifolia)***N**

BORAGE FAMILY (BORAGINACEAE)
Common Fiddleneck *(Amsinckia menziesii* var. *intermedia)***N**
Rancher's Fireweed *(Amsinckia menziesii* var. *menziesii)***N**
Devil's Lettuce *(Amsinckia tessellata* var. *t.)***N
Alkali Heliotrope *(Heliotropium curassavicum)***N**
Bracted Popcornflower (*Plagiobotrys bracteatus)*

MUSTARD FAMILY (BRASSICACEAE)
Black Mustard *(Brassica nigra)*
Hoary Cress *(Cardaria* sp.*)*
Contra Costa Wallflower *(Erysimum capitatum* ssp. *angustatum)***N**(US & CA ENDANGERED/CNPS 1B)
Summer Mustard (*Hirschfeldia incana)*
Wide-leaved Peppergrass *(Lepidium latifolium)*

Radish (*Raphanus sativus)*
Tumble Mustard *(Sisybrium altissimum)*
Oriental Sisybrium *(Sisybrium orientale)*

CACTUS FAMILY (CACTACEAE)
Prickly-pear Cactus *(Opunia ficus-indica)*

HONEYSUCKLE FAMILY (CAPRIFOLIACEAE)
Blue Elderberry (*Sambucus mexicana)***N**

PINK FAMILY (CARYOPHYLLACEAE)
Mouse-ear Chickweed *(Cerastium glomeratum)*
Windmill Pink *(Silene gallica)*
Sand-spurrey *(Spergularia rubra)*
Common Chickweed (*Stellaria media)*

(CASUARINACEAE)
Beefwood *(Casuarina* sp.*)*

GOOSEFOOT FAMILY (**CHENOPODIACEAE)**
Spearscale *(Atriplex triangularis)***N**
Goosefoot *(Chenopodium murale)*
Russian Thistle *(Salsola tragus)*

MORNING GLORY FAMILY (CONVOLVULACEAE)
Hedge Morning-glory *(Bindweed) (Calystegia sepium* ssp*. limnophila)*****N**
Bindweed *(Convolvulus arvensis)*

STONECROP FAMILY (CRASSULACEAE)
Pygmyweed *(Crassula connata)***N**
Pygmyweed *(Crassula tillaea)*

GOURD FAMILY (CUCURBITACEAE)
Man-root (Wild Cucumber)(*Marah fabaceus*)**N**

CYPRESS FAMILY (CUPRESSACEAE)
Cypress *(Cupressus* sp.*)*
Arbivitae (*Thuja* sp.)

DODDER FAMILY (CUSCUTACEAE)
Field Dodder *(Cuscuta pentagona)*****N**

SEDGE FAMILY (CYPERACEAE)
Sitka Sedge *(Carex aquatilis* var. *dives)*****N**
Nebraska Sedge *(Carex nebrascensis)*****N**
Sedge *(Carex* sp.*)***N**
Tall Cyperus (Nutsedge) (*Cyperus eragrostis*)**N**
Common Tule *(Scirpus acutus* var. *occidentalis)***N**
Three Square *(Scirpus americanus)***N**
California Tule (Cali. Bulrush) *(Scirpus californicus)***N**
Tule (Low Club Rush) *(Scirpus cernuus*)****N**
HORSETAIL FAMILY (EQUISETACEAE)
Smooth Scouring Rush *(Equisetum laevigatum)***N**

SPURGE FAMILY (EUPHORBIACEAE)
California Croton *(Croton californicus)***N**

LEGUME FAMILY (FABACEAE)
Bird-of-paradise Bush *(Caesalpinia gilliesii*)
French Broom *(Genista monspessulana)*
Leather Root *(Hoita macrostachya)***N**
Delta Tule Pea *(Lathyrus jepsonii* var*. jepsonii)***N** (CNPS 1B)
Birdfoot Trefoil (*Lotus corniculatus)*
Spanish-clover *(Lotus purshianus var. purshianus)***N**
Deerweed (*Lotus scoparius)***N**
Stipulate Trefoil *(Lotus stipularis var. stipularis)***N**
Strigose Trefoil *(Lotus strigosus)***N**
Common Trefoil (*Lotus wrangelianus)***N**
Silver Lupin *(Lupinus albifrons)***N**
Dove Lupine (Dwarf Lupine) *(Lupinus bicolor* var*. pipersmithii)***N**
Dove Lupine (Dwarf Lupine) (*Lupinus bicolor* var*. umbellatus*)***N**
Chamisso's Bush Lupine *(Lupinus chamissonis)***N**
Lupine *(Lupinus* sp.*)***N**
Arroyo Lupine (*Lupinus succulentus)***N**
Burr Clover (*Medicago polymorpha)*
Alfalfa *(Medicago sativa)*
White Sweetclover (*Melilotus alba)*
Yellow Sweetclover *(Melilotus indica)*
Black Locust (*Robinia pseudoacacia)*
Pin-point Clover *(Trifolium gracilentum)***N**
Rose Clover *(Trifolium hirtum)*
Cover *(Trifolium sp.)***N**
Tomcat Clover *(Trifolium willdenovii)***N**
Common Vetch *(Vicia sativa* ssp*. nigra)*
Spring Vetch (*Vicia sativa* ssp*. sativa*)
Winter Vetch *(Vicia villosa* ssp. *varia)*
Winter Vetch (*Vicia villosa* ssp*. villosa*)

BEECH FAMILY (FAGACEAE)
Coastal Live Oak *(Quercus agrifolia)***N**
Coastal Live Oak-Interior Live Oak Hybrid *(Quercus agrifolia* var. *wizliseni)***N**
Valley Oak *(Quercus lobata)*

GENTIAN FAMILY (GENTIANACEAE)
Monterey Centaury *(Centaurium muehlenbergii)****N**

GERANIUM FAMILY (GERANIACEAE)
Large-flowered Filaree *(Erodium botrys)*
Red-stemmed Filaree *(Erodium cicutarium)*
Cut-leaf Geranium *(Geranium dissectum)*

WATER-MILFOIL FAMILY (HALORAGACEAE)
Milfoil *(Myriophyllum sp.)*

WATERWEED FAMILY (HYDROCHARITACEAE)
Common Waterweed *(Elodea canadensis)*

IRIS FAMILY (IRIDACEAE)
Yellow Flag (*Iris pseudacorus)*

WALNUT FAMILY (JUGLANDACEAE)
N. Cali. Black Walnut *(Juglans californica* var. *hindsii)**N

RUSH FAMILY (JUNCACEAE)
Jointed Rush *(Juncus articulatus)***N
Baltic Rush (*Juncus balticus)***N**
Toad Rush *(Juncus bufonius* (var.?))**N**
Bog Rush *(Juncus effusus)*
Irisleaf Rush *(Juncus xiphioides)*?**N**

ARROW-GRASS FAMILY (JUNCAGINACEAE)
Flowering Quillwort *(Lilaea scilloides)?*
Arrow-grass *(Triglochin* sp.*)***N**

MINT FAMILY (LAMIACEAE)
Cutleaf Bugleweed *(Lycopus americanus)***N**
Horehound *(Marrubium vulgare)*
Field mint *(Mentha arvensis)*
Mint *(Mentha* sp.*)*
Hoary Hedge-nettle (White Hedge-nettle) *(Stachys albens)***N**
Vinegar Weed *(Trichostema lanceolatum)***N**

LILY FAMILY (LILIACEAE)
Asparagus *(Asparagus officinalis* ssp*. o.)*
Blue Dicks *(Dichelostemma capitatum)***N**

LOOSESTRIFE FAMILY (LYTHRACEAE)
California Loosestrife (*Lythrum californicum)***N**

MALLOW FAMILY (MALVACEAE)
Lavatera *(Lavatera arborea)*
Cretican Tree-mallow (Cretan lavatera) (*Lavatera cretica)*
Cheeseweed *(Malva parviflora)*

(MELIACEAE)
Chinaberry *(Melia azedanach)*

MYRTLE FAMILY (MYRTACEAE)
Blue Gum *(Eucalyptus globulus)*

OLIVE FAMILY (OLEACEAE)
Oregon Ash *(Fraxinus latifolia)***N**
Olive *(Olea europaea)*

EVENING-PRIMROSE FAMILY (ONAGRACEAE)
Contorted Primrose *(Camissonia contorta)*?****N**
Small-flowered Sun Cup (Small Primrose) *(Camissonia micrantha)*?****N**
Camissonia *(Camissonia* sp.*)***N**
Elegant Clarkia (*Clarkia unguiculata)***N**

Panicled Willowherb (*Epilobium brachycarpum)***N**
Willowherb *(Epilobium ciliatum* ssp. *ciliatum)***N**
Smooth Boisduvalia *(Epilobium pygmaeum)*****N**
Willowherb *(Epilobium* sp.*)***N**
Water Primrose *(Ludwigia peploides)*?****N**
Antioch Dunes Evening Primrose *(Oenothera deltoides ssp. howellii*)*****N** (US & CA ENDANGERED/CNPS 1B)
Hooker's Evening Primrose *(Oenothera elata ssp. hookeri*)****N**

OXALIS FAMILY (OXALIDACEAE)
Bermuda Buttercups (*Oxalis pes-caprae)*

POPPY FAMILY (PAPAVERACEAE)
California Poppy (*Eschscholzia californica)***N**
Narrow-leaved Meconella *(Meconella linearis)*****N**
Wind Poppy (Stylomecon heterophylla)**N**

PLANTAIN FAMILY (PLANTAGINACEAE)
Crownfoot Plantain (Cutleaf Plantain) *(Plantago coronopus)*
English Plantain *(Plantago lanceolata)*
Mexican Plantain *(Plantago subnuda)*****N**

SYCAMORE FAMILY (PLANTANACEAE)
Western Sycamore *(Platanus racemosa)*****N**

GRASS FAMILY (POACEAE)
Spike Redtop *(Agrostis exarata)***N**
Giant Reed (*Arundo donax)*
Slender Wild Oats *(Avena barbata)*
Wild oat (*Avena fatua)*
Bamboo (*Bambusa* sp.)
Ripgut Brome (*Bromus diandrus)*
Soft Brome (*Bromus hordeaceus)*
Red Foxtail Brome (*Bromus madritensis* ssp. *rubens)*
Pampas Grass *(Cortaderia selloana)*
Bermuda Grass *(Cynodon dactylon)*
Tufted Hairgrass (*Deschampsia cespitosa* ssp. *c.*)****N**
Tufted Hairgrass *(Deschampsia cespitosa* ssp. *holiciformis)?*****N**
Saltgrass *(Distichlis spicata)***N**
Meadow Barley *(Hordeum brachyantherum* ssp. *b.)***N**
Farmer's Foxtail (*Hordeum murinum* ssp. *leporinum)*
Farmer's Foxtail *(Hordeum murinum* ssp. *m.)*
Bristly Koeleria (*Koeleria phleoides)*
Alkali Rye (Creeping Ryegrass) *(Leymus triticoides)***N**
Italian Ryegrass (*Lolium multiflorum)*
Witchgrass (*Panicum capillare)*****N**
Canary Grass (*Phalaris canariensis)*
Common Reed *(Phragmites australis)*****N**
Smilo Grass *(Piptatherum miliaceum)*
Kentucky Bluegrass *(Poa pratensis)*
Pacific Fescue *(Vulpia microstachys* var. *pauciflora)***N**
Zorro Grass (*Vulpia myuros* var. *hirsuta*)
Zorro Grass *(Vulpia myuros* var. *m.)*

PHLOX FAMILY (POLEMONIACEAE)
Blue-headed Gilia (Range Gilia) *(Gilia capitata* ssp. *staminea)*****N**

KNOTPLANT FAMILY (POLYGONACEAE)
Slender Buckwheat *(Eriogonum gracile* var. *g.)*****N**
Coast Buckwheat (*Eriogonum nudum* var*. auriculatum)***N**
Coast Buckwheat *(Eriogonum nudum* var. *pubiflorum)*****N**
Willow Weed *(Polygonum lapathifolium)******N**
Water Smartweed *(Polygonum punctatum)*****N**
Knotweed *(Polygonum* sp.*)*
Curly Dock (*Rumex crispus)*

PICKEREL-WEED FAMILY (PONTEDERIACEAE)
Water-hyacinth *(Eichornia crassipes*)

PURSLANE FAMILY (PORTULACACEAE)
Red Maids *(Calandrinia ciliata)***N**
Miner's Lettuce *(Claytonia parviflora***)N**
Miner's Lettuce (*Claytonia perfoliata)***N**
Common Purslane *(Portulaca oleracea)*

ROSE FAMILY (ROSACEAE)
Toyon *(Heteromeles arbutifolia)***N**
Silverplant *(Potentilla anserina* ssp*. pacifica*)*****N**
Almond (*Prunus dulcis)*
Stone Fruit *(Prunus sp.)*
California Rose *(Rosa californica*)**N**
Himalayan Blackberry *(Rubus discolor*)
California Blackberry *(Rubus ursinus*)**N**

MADDER FAMILY (RUBIACEAE)
Button-willow *(Cephalanthus occidentalis* var. *californicus*)*****N**
Goose Grass (Common Bedstraw) (*Galium aparine)*
Bedstraw (*Galium* sp.*)*

WILLOW FAMILY (SALICACEAE)
Fremont Cottonwood *(Populus fremontii* ssp. *fremontii*)**N**
Narrow-leaved Willow (Sandbar Willow)*(Salix exigua)***N**
Arroyo Willow *(Salix lasiolepis*)**N**
Shining Willow *(Salix lucida* ssp*. lasiandra)******N**

SAXIFRAGE FAMILY (SAXIFRAGACEAE)
Fringe Cups *(Tellima grandiflora)*****N**

SNAPDRAGON FAMILY (SCROPHULARIACEAE)
Cream Sacs *(Castilleja attenuata)***N**
Purple Owlsclover *(Castilleja exserta (*ssp.?*))***N**
Delta Mudwort *(Limosella subulata)***N**
Yellow Monkeyflower *(Mimulus guttatus)***N**
Purslane Speedwell *(Veronica peregrina* ssp*. xalapensis)***N**
QUASSIA FAMILY (SIMAROUBACEAE)
Tree of Heaven (*Ailanthus altissima)*

NIGHTSHADE FAMILY (SOLANACEAE)
Thorn-apple (Tolguacha) *(Datura wrightii)***N**
Tree Tobacco (*Nicotiana glauca)*
Blue Witch *(Solanum umbelliferum)***N**

CATTAIL FAMILY (TYPHACEAE/SPARGANIACEAE)
Giant Burreed (*Sparganium eurycarpum or erectum)?***N**
Narrow-leaved Cattail *(Typha angustifolia)***N**
Southern Cattail *(Typha domingensis)***N**

ELM FAMILY (ULMACEAE)
Dwarf Asiatic Elm (*Ulmus pumila)*

NETTLE FAMILY (URTICACEAE)
Dwarf Nettle *(Urtica urens)*

GRAPE FAMILY (VITACEAE)
Cultivated Grape *(Vitis vinifera*)

RARE PLANTS OF HISTORICAL OCCURRENCE
Hoover's Cryptantha (*Cryptantha hooveri)* (CNPS 4)***N**
Small Spikerush (*Eleocharis parvula)* (CNPS 4)***N**
Diamond-petaled Calif.Poppy (Eschscholzia rhombipetala) (CNPS 1B)***N**
Contra Costa Goldfields (*Lasthenia conjugens)* (CA ENDANGERED/CNPS 1B)***N**
Showy Madia (*Madia radiata)* (CNPS 1B)***N**

N Native Species

* Rare, threatened or endangered in California. Special Plants List, July 2000, California Dept. of Fish and Game, Natural Diversity Database; and draft of CNPS Inventory of Rare and Endangered Vascular Plants of California, Sixth ed, due for publication 2001.

** Rare, threatened or endangered in Alameda and Contra Costa counties. Listed in Unusual and Significant Plants of Alameda and Contra Costa Counties, Dianne Lake, (CNPS, East Bay Chapter, sixth ed, 2001).

***Watch List for Alameda and Contra Costa counties. Unusual and Significant Plants of Alameda and Contra Costa Counties, Diane Lake, (CNPS, East Bay Chapter, sixth ed, 2001).

Appendix E
Bird Species List for Antioch Dunes National Wildlife Refuge

Appendix E

Bird Species List for Antioch Dunes National Wildlife Refuge

Red-throated loon *(Gavia stellata)*
Pied-billed grebe *(Podilymbus podiceps)*
Western grebe (*Aechmophorus occidentalis)*
Brown pelican *(Pelecanus occidentalis)*
Double-crested cormorant *(Phalacrocorax auritus)*
Black-crowned night-heron *(Nycticorax nycticorax)*
Unknown egret *(Egretta thula* or *Ardea alba)*?
Great blue heron (*Ardea herodias)*
Snow goose *(Anser caerulescens)*
Canada goose *(Branta canadensis)*
Mallard *(Anas platyrhynchos platyrhynchos)*
Greater scaup *(Aythya marila)*
Turkey vulture *(Cathartes aura)*
Osprey *(Pandion haliaetus)*
White-tailed kite (*Elanus leucurus)*
Black kite *(Milvus migrans)*
Marsh hawk (Northern harrier) *(Circus cyaneus)*
Cooper's hawk *(Accipiter cooperii)*
Red-tailed hawk *(Buteo jamaicensis)*
American kestrel (*Falco sparverius)*
Ring-necked pheasant *(Phasianus colchicus)*
California quail *(Callipepla californica)*
American coot *(Fulica americana)*
Killdeer *(Charadrius vociferus)*
Spotted sandpiper *(Actitis macularia)*
Common snipe *(Gallinago gallinago)*
Ring-billed gull *(Larus delawarensis)*
Herring gull - North American *(Larus argentatus smithsonianus)*
Caspian tern *(Sterna caspia)*
Forster's tern *(Sterna forsteri)*
Rock dove *(Columba livia)*
Mourning dove (*Zenaida macroura)*
Barn owl *(Tyto alba)*
White-throated swift *(Aeronautes saxatalis)*
Ruby throated hummingbird *(Archilochus colubris)*
Anna's hummingbird *(Calypte anna)*
Rufous hummingbird *(Selasphorus rufus)*
Belted kingfisher *(Ceryle alcyon)*
Nuttall's woodpecker *(Picoides nuttallii)*
Red-shafted flicker *(Colaptes cafer)*
Black phoebe *(Sayornis nigricans)*
Western kingbird *(Tyrannus verticalis)*
Loggerhead shrike *(Lanius ludovicianus)*
Blue jay *(Cyanocitta cristata)*
Western scrub-jay *(Aphelocoma californica)*
American crow *(Corvus brachyrhynchos)*
Common raven (*Corvus corax)*
Violet-green swallow *(Tachycineta thalassina)*
Cliff swallow *(Petrochelidon pyrrhonota)*
Northern rough-winged swallow *(Stelgidopteryx serripennis)*
Barn swallow *(Hirundo rustica)*
Bushtit - coastal (*Psaltriparus minimus minimus)*
Marsh wren *(Cistothorus palustris)*
Ruby-crowned kinglet *(Regulus calendula)*
American robin *(Turdus migratorius*)
Northern mockingbird *(Mimus polyglottos)*
European starling *(Sturnus vulgaris)*
Water pipit *(Anthus spinoletta)*
Cedar waxwing *(Bombycilla cedrorum)*
Orange-crowned warbler *(Vermivora celata)*
Yellow-rumped warbler *(Dendroica coronata)*
Yellow-throated warbler *(Dendroica dominica)*
Yellow warbler *(Dendroica petechia)*
Rufous sided towhee(Spotted) *(Pipilo maculatus)*
Song sparrow *(Melospiza melodia)*
Fox sparrow *(Passerella iliaca)*
White-crowned sparrow *(Zonotrichia leucophrys)*
Unknown sparrow (3)
Dark-eyed junco (*Junco hyemalis)*
Eastern meadowlark *(Sturnella magna)*
Western meadowlark *(Sturnella neglecta)*
Red-winged blackbird *(Agelaius phoeniceus)*
Tri-colored blackbird *(Agelaius tricolor)*
Brewer's blackbird *(Euphagus cyanocephalus)*
Bullock's oriole (*Icterus bullockii)*
Lawrence's goldfinch *(Carduelis lawrencei)*
Pine siskin *(Carduelis pinus)*
Lesser goldfinch *(Carduelis psaltria)*
American goldfinch *(Carduelis tristis)*
House finch *(Carpodacus mexicanus)*

Appendix F
Fish Species Found Offshore of the Refuge

Appendix F

Fish Species Found Offshore of the Refuge

American shad	*(Alosa sapidissima)*
Yellowfin goby	*(Acanthogobius flavimanus)*
Sacramento sucker	(*Catostomus occidantalis*)
Prickly sculpin	*(Cottus asper) (Richardson)*
Shiner surfperch	(*Cymatogaster aggregata)*
Threadfin shad	*(Dorosoma petenense)*
Sculpin family	(Family Cottidae)
Goby family	(Family Gobiidae)
Western mosquitofish	(*Gambusia affinis)*
Threespine stickleback	(*Gasterosteus aculeatus)* (Linnaeus)
Delta smelt	*(Hypomesus transpacificus)*
Tule perch	*(Hysterocarpus traski)* (Gibbons)
Hitch	(*Lavinia exilicauda)*
Bluegill	*(Lepomis macrochirus)*
Redear sunfish	*(Lepomis microlopus)*
Pacific staghorn sculpin	(*Leptocottus armatus)* (Girard)
Rainwater killifish	*(Lucania parva)*
Inland silverside	(*Menidia beryllina)*
Largemouth bass	*(Micropterus salmoides)*
Striped bass	*(Morone saxatilis)*
Hardhead	*(Mylopharodon conocephalus)*
Golden shiner	(*Notemigonus crysoleucas)*
Rosyface shiner	*(Notropis rubellus)*
Steelhead trout	(*Oncorhynchus mykiss)*
Chinook salmon	*(Oncorhynchus tshawytscha)*
Sacramento blackfish	(*Orthodon microlepidotus)* (Ayres)
Bigscale logperch	*(Percina macrolepida)* (Stevenson)
Starry flounder	*(Platichthys stellatus)*
Sacramento splittail	*(Pogonichthys macrolepidotus)*
Sacramento squawfish	(*Ptychocheilus grandis) (Ayres)*
Logfin smelt	*(Spirinchus thaleichthys*) (Ayres)
Goby shimofuri	*(Tridentiger bifasciatus)*
Chameleon goby	*(Tridentiger trigonocephalus)*
Unknown Bass	

Appendix G
Insect List

Appendix G
Insect List
Antioch Dunes Invertebrates Observed or Collected (1/95 - 6/97)

Order Hymenoptera (Bees, Wasps & Ants)

Family Andrenidae
- Andrena sp.
- Perdita sp. *

Family Anthophoridae
- Anthophora sp.
- Melissodes sp.
- Nomada sp. *
- Zacosmia maculata maculata

Family Apidae
- Apis mellifera
- Bombus sonorensis
- Bombus vosnesenskii
- Xylocopa brasilianorum @

Family Argidac
- Sterictophora sp. *

Family Braconidac
- Undetermined taxa

Family Chalcididac
- Undetermined taxon

Family Chrysididae
- Argochrysis mesillae *
- Chrysis lucidera *
- Chrysis vagabunda *
- Hedychridium fletcheri *
- Hedychrum boharti *
- Parnopes edwardsi *

Family Collctidae
- Colletes sp. @

Family Eumenidae
- Undetermined taxon

Family Halictidae
- Agapostemon sp. *
- Dieunomia nevadensis angelisis *
- Halictus sp. *
- Lassioglossum sp.
- Sphecodes sp. *

Family Ichneumonidae
- Diplazon laetatorius @
- Ophion sp @
- Undetermined taxa

Order Diptera (Flies)

Family Anthomyiidae
- Adia cinerella

Family Anthomyzidac
- Anthomyza sp. @

Family Apioceridac
- Apiocera chrysolasia *

Family Asilidae
- Asilus sp.
- Efferia albibarbis*
- Efferia antiochi *
- Efferia cana*
- Stenopogon breviusculus *
- Stenopogon obscuriventris *@

Family Bibionidac
- Bibio albipennis *

Family Bombyliidae
- Aphoebanius sp. *
- Bombylius sp. *
- Hemipenthes sp. *
- Thyridanthrax sp. *
- Toxophora sp. *
- Villa sp.
- Undetermined taxon

Family Calliphoridae
- Eucalliphora lilaea
- Phaenicia serricata

Family Cecidomyiidae
- Cordylomyia sp. *

Family Chironomidae
- Chironomus decorus
- Chironomus staegeri
- Hydrobaenus sp.
- Procladius sp. *
- Symbiocladius equitans @

Family Conopidae
- Physocephala texana *
- Physoconops fronto

Family Culicidae
- Aedes washinoi @
- Culex erythrothorax @
- Culex tarsalis

Order Hymenoptera Cont.

Family Mcgachilidae
- Anthidiellum notatum robertsoni *
- Anthidium utahense *
- Ashmeadiella sp.
- Megachile sp. *
- Osmia sp. *

Family Mutillidae
- Dasymutilla abdita
- Dasymutilla aureola pacifica @
- Dasymutilla coccineohirta
- Dasymutilla flammifera *
- Dasymutilla sackeni
- Sphaerophthalma sp.

Family Pompilidae
- Anoplius cleora *
- Anoplius nigritis *
- Aporniellus completus *
- Sericopompilus neotropicalis *
- Tachypompilus unicolor unicolor *
- Undetermined taxa

Family Sphecidae
- Ammophila sp.
- Bembix americana comata *
- Bembix occidentalis
- Bicyrtes ventralis *
- Cerceris californica *
- Cerceris finitima *
- Cerceris frontata *
- Cerceris vanduzeei
- Chalybion californica *
- Dryudella sp. *
- Clypeadon californica *
- Isodontia elegans *
- Philanthus multimaculatus *
- Philanthus pacifica *
- Podalonia luctuosa *
- Prionyx sp. *
- Sphex lucae
- Sphex pennsylvanica *
- Steniolia scolopacea *
- Undetermined taxa

Family Tenthredinidac
- Tenthredo sp. *

Family Tiphiidae
- Paratiphia nevadensis *

Family Vespidac
- Mischocyltarus flavitarsus @
- Polistes apachus *
- Polistes fuscatus aurifer
- Vespula pennsylvanica
- Undetermined taxa

Order Diptera Cont.

- Culiseta incidens
- Culiseta inornata
- Culiseta particeps @

Family Dolichopodiadae
- Dolichopus sp. @
- Hydrophorus sp. @
- Medetera sp. @

Family Empididae
- Platypalpus sp. *

Family Ephydridac
- Mosillus sp.

Family Helcomyzidae
- Pseudoleria sp. *
- Suillia limbata @

Family Muscidae
- Musca domestica

Family Mycetophilidae
- Mycomya sp.

Family Otitidae
- Ceroxys latiusculus *

Family Sarcophagidac
- Euphytomima sp.
- Liopygia sp. *
- Ravinia sp. @

Family Scathophagidac
- Scathophaga sp. @

Family Scpsidae
- Sepsis sp. @

Family Simuliidae
- Metacnephia sp.

Family Sphaeroceridac
- Leptocera fontinalils @
- Leptocera (Rachispoda) sp.

Family Syrphidae
- Epistrophe sp.
- Eristalinus aeneus
- Eristalis sp.
- Helophilus latifrons @
- Paragus tibialis
- Platycheirus sp. @
- Syritta pipiens

Family Tabanidae
- Chrysops coloradensis *

Order Coleoptera (Beetles)

Family Alleculidae
- Lopopoda sp.

Family Anthicidac
- Anthicus biguttulus
- Formicilla sp. *

Family Buprcstidae
- Acmaeodera sp.*
- Agrilus sp.

Family Carabidae
- Agonoderus sp.
- Agonum marginicolle
- Amara sp.
- Harpalus sp. @
- Pterostichus sp. @
- Scaphinotus striatopunctatus @
- Stenolophus maculatus

Family Chrysomelidae
- Altica lasulina
- Diabrotica undecimpunctata
- Monoxia consputa @

Family Coccinellidae
- Coccinella californica
- Coccinella septempunctata
- Hippodamia convergens
- Hipopodamia quinquesignata
- Olla v-nigrum
- Psyllobora vigintimaculata
- Stethorus pnctum picipes *
- Undetermined taxa

Family Curculionidae
- Apion proclive
- Paragoges maculata
- Sphenophorus aequalis *
- Tychius sp. @
- Undetermined taxa

Family Dermestidac
- Anthrenus sp. @

Family Dytiscidae
- Colymbetes sp. *
- Laccophilus decipiens
- Thermonectus basillaris

Family Elateridae
- Agriotes sp. *
- Euthysanius sp.

Family Heteroceridae
- Heterocerus sp.
- Orthellia caesarion *

Order Diptera Cont.

Family Tachinidae
- Archytas apicifer *
- Cylindromyia sp. @
- Gonia sp. *
- Gymnosoma sp. *
- Tachina sp. @

Family Tephritidae
- Dioxnya sororcula @
- Tephritis californica @

Family Therevidae
- Acrosathe sp. *

Family Tipulidae
- Tipula californica @
- Tipula sp. *

Order Dermaptera (Earwigs)

Family Forficulidae
- Forficula auricularia

Order Hemiptera (True Bugs)

Family Alydidac
- Alydus sp. *

Family Berytidae
- Jalysus sp. @

Family Corixidac
- Corisella decolor
- Trichocorixa reticulata

Family Cydnidae
- Microporus testudinatus @

Family Lygacidac
- Eremocoris sp. *
- Geocoris niger @
- Geocoris sp. @
- Lygaeus kalmii *
- Neocoryphus bicrucis
- Nyssius sp.

Family Miridae
- Adelphocoris superbus @
- Irbisia californica
- Lopidea sp.
- Lygus hesperus

Family Nabidae
- Nabis sp. @

Family Pentatomidae
- Chlorochroa ligata *
- Chlorochroa sayi *

Order Coleoptera Cont.

Family Hydrophilidae
- Enochrus diffusus
- Tropisternus lateralis
- Tropisternus sp.

Family Meloidac
- Lytta sp. *
- Nemognatha lurida apicalis

Family Scarabacidae
- Aphodius sp. @
- Coenonycha sp.
- Cyclocephala sp.
- Plectrodes pubescens @
- Polyphylla stellata
- Serica anthracina *

Family Tenebrionidae
- Amphidora littoralis @
- Blapstinus sp. @
- Coniontis sp.
- Eleodes sp.
- Eulabis bicarinata
- Nyctoporis sp. @

Order Lepidoptera (Butterflies & Moths)

Family Arctiidae
- Apantesis proxima *
- Estigmene acraea *

Family Danaidac
- Danaus plexippus

Family Hesperiidae
- Hylephila phyleus
- Pholisora cantullus *
- Pyrgus communis

Family Lycacnidae
- Callophrys affinis perplexa
- Everes amyntula *
- Plebejus acmoni
- Strymon melinus

Family Noctuidae
- Caenurgina crassiuscula
- Syneda sp. @
- Trichoplusia ni @

Family Nymphalidae
- Coenonympha californica
- Nymphalis antiopa
- Phyciodes mylitta
- Precis coenia
- Vanessa carye

Family Papilionidae

Order Hemiptera Cont.

- Murgantia histrionica

Family Rhopalidae
- Arhyssus sp. *

Family Saldidae
- Salduta pallipes @

Order Neuroptera (Lacewings, Antlions, etc)

Family Hemerobiidae
- Sympherobius sp. @

Family Myrmelcontidac
- Brachynemurus pregrinus

Family Raphidiidae
- Agulla sp. *

Order Odonata (Dragonflies & Damselflies)

Family Aeschnidae
- Aeshna multicolor
- Anax junius

Family Cocnagrionidae
- Enallagma carunculatum
- Enallagma civile

Family Libellulidae
- Pachydiplax longipennis *
- Tarnetrum costiferum
- Tramea sp.

Order Homoptera (Cicadas, Hoppers, etc)

Family Cicadcllidae
- Undetermined taxa

Family Cicadidae
- Okanagana sp. *

Family Dictyopharidae
- Scolops sp.

Family Membracidae
- Undetermined taxa @

Order Orthoptera (Crickets, Roaches, etc)

Family Acrididae
- Melanoplus cinereus dealbatus *
- Trimerotropis pallidipennis

Family Gryllacrididae
- Ceuthophilus sp. @
- Stenopelmatus sp. @

Order Lepidoptera Cont.

Papilio zelicaon

Family Pieridae
Colias eurytheme
Euchloe ausinoides
Pieris rapae
Pieris protodice

Family Riodinidae
Apodemia mormo langei

Family Sphingidae
Proserpinus clarkiae *

Order Orthoptera Cont.

Family Mantidae
Iris oratoria *

Family Phasmatidac
Parabacillus hesperus *

Family Polypagidae
Arenivaga sp. @

Spiders, Scorpions, Wind Scorpions, Centipedes, Millipedes and Isopods have not yet been identified.

Many small bees, wasps and ants have yet to be determined. A few small beetles are also unidentified.

It is estimated that approximately 260 different kinds of insects have currently been collected from the refuge.

The microlepidoptera have essentially been ignored Because of the detailed studies performed by Jerry Powell. Their current status may need to be considered.

* indicates collection or observation of taxon at the Stamm Parcel.

@ indicates collection or observation of taxon at the Sardis Parcel.

No symbol by a taxon indicates that it was found at both refuge parcels.

Appendix H
Glossary of Terms

Appendix H
Glossary of Terms

Adaptive Management	The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels.
Alternatives	Different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues.
Biological Diversity	The variety of life, including the variety of living organisms, the genetic differences among them, and the communities in which they interact.
Biological Integrity	Biotic composition, structure, and function at the genetic, organism, and community levels consistent with natural conditions, including the natural biological processes that shape genomes, organisms, and communities.
CFR	Code of Federal Regulations.
Compatible Use	A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgement of the Director, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purpose of the refuge unit (Service Manual 603 FW 3.6).
Comprehensive Conservation Plan (CCP)	A plan that: (1) describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management direction to achieve refuge purposes; (2) helps fulfill the mission of the Refuge System; (3) maintains and where appropriate restores the ecological integrity of each refuge and the Refuge System; (4) helps achieve the goals of the National Wilderness Preservation System; and (5) meets other mandates.

Concern	See Issue.
Coordination Area	A wildlife management are made available to a State, by "(A) cooperative agreement between the United States Fish and Wildlife Service and the State fish and game agency pursuant to Section 4 of the Fish and Wildlife Coordination Act (16 U.S.C. 664); or (B) long-term leases or agreements pursuant to the Bankhead-Jones Farm Tenant Act (50 Stat. 525; 7 U.S.C. 1010 et seq.)." States manage Coordination Areas, but they are part of the Refuge System. CCPs are not required for Coordination Areas.
Cultural Resource Overview	A comprehensive document prepared for a field office that discusses, among other things, and area's prehistory and cultural history, the nature and extent of known cultural resources in the area, relevant previous research, management objectives, and resource management conflicts or issues, and provides a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field offices background or literature search as described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).
Cultural Resource Inventory	A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Various levels of cultural resources inventories include background literature search, comprehensive filed examination to identity all exposed physical manifestations of cultural resources, and sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).
Designated Wilderness Area	An area designated by the United States Congress for management as part of the National Wilderness Preservation System (Service Manual 610 FW 1.5).
Ecological Integrity	

Ecosystem	The integration of biological integrity, natural biological diversity, and environmental health; replication of natural ecological conditions.
Ecosystem Approach	A biological community together with its environment, functioning as a unit. For administrative purposes, we have designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries, and their sizes and ecological complexity vary.
Environmental Health	An approach to conservation and restoration that focuses on protecting or restoring the natural function, structure, and species composition of an ecosystem, recognizing that all components are interrelated.
Environmental Impact Statement (EIS)	Abiotic composition, structure, and function of the environment consistent with natural conditions, including the natural abiotic processes that shape the environment.
Environmental Assessment (EA)	A detailed written statement, required by section 102(2)(C) of the National Environmental Policy Act, that analyzes the environmental impacts of a proposed action, including unavoidable adverse effects of the project, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).
Finding of No Significant Impact (FONSI)	A concise public document, prepared in compliance with the National Policy Act, that briefly discusses the purpose of and need for an action and the reasonable alternatives to the action, and analyzes the actions's potential impacts in sufficient detail to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).
	A document prepared in compliance with the National Environmental Policy Act and supported by an environmental assessment that briefly explains why a Federal action will have no significant effect on the natural or

	human environment (40 CFR 1508.13).
Goal	Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units.
Issue	Any unsettled matter that requires a management decision, such as an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict between uses, public concern, or the presence of an undesirable resource condition.
Management Alternative	See Alternative.
Management Concern	See Issue.
Management Opportunity	See Issue.
Mission Statement	Succinct statement of the unit's purpose and reason for being (Region 7 Planning Staff).
National Wildlife Refuge (refuge)	A designated area of land or water, or an interest in land or water, within the Refuge System (excluding Coordination Areas). Find a complete listing of all units of the Refuge System in the current Annual Report of Lands Under Control of the U.S. Fish and Wildlife Service.
National Wildlife Refuge System Mission (mission)	"The mission of the System is to administer a national network of lands and waters fro the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."
National Environmental Policy Act of 1969 (NEPA)	Requires all agencies, including the Service, to examine the environmental impacts of their actions and to incorporate environmental information and public participation into the planning and implementation of all actions. Federal agencies must integrate NEPA compliance with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (40 CFR 1500).

National Wildlife Refuge System, Refuge System, or System	Various categories of lands, waters, and interests therein that are administered by the Secretary of the Interior for the protection, conservation, and where appropriate, restoration of fish and wildlife including species that are threatened with extinction; includes wildlife ranges, game ranges, and wildlife management or waterfowl production areas.
No Action Alternatives	An alternative under which existing management would be continued.
Non-Priority Public Uses	Any use other than a compatible wildlife-dependent recreational use.
Notice of Intent (NOI)	A notice that an environmental impact statement will be prepared and considered (40 CFR 1508.22). Published in the Federal Register.
Objective	A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Objectives should be attainable, time-specific, and measurable.
Opportunities	Potential solutions to issues.
Planning Area	The area upon which a planning effort will focus. A planning area may include lands outside existing planning unit boundaries currently under study for future inclusion in the Refuge System and/or partnership planning efforts. It also may include watersheds or ecosystems that are outside our jurisdiction but affect the planning unit. At a minimum, the planning area includes all lands withing the authorized boundary of a refuge.
Planning Team	Planning teams are interdisciplinary in membership and function. Teams generally consist of a Planning Team Leader, the Refuge Manager and staff biologists, a state

natural resource agency representative, and other appropriate program specialists (e.g., social scientist, ecologist, recreation specialist). We also will ask other Federal and Tribal natural resource agencies to provide team members, as appropriate. The planning team prepares the CCP and appropriate NEPA documentation.

Planning Unit

A single refuge, an ecologically or administratively related refuge complex, or a distinct unit of a refuge. The planning unit also may include lands currently outside refuge boundaries.

Preferred Alternative

The Service's selected alternative at the draft CCP stage.

Prescribed Fire

The application of fire to wildland fuels to achieve identified land use objectives (Service Manual 621 FW 1.7). May be ignited naturally or intentionally.

Priority Public Uses

Compatible wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) are the priority general public uses of the System and shall receive priority consideration in refuge planning and management.

Proposed Action

The Service's proposed action for Comprehensive Conservation Plans is to prepare the CCP and implement the preferred alternative it outlines.

Public Involvement

The process by which interested and affected individuals, organizations, agencies, and governmental entities participate in the planning and decision-making process.

Public Involvement Plan

Broad long-term guidance for involving the public in the comprehensive planning process.

Public

Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Native American tribes; and foreign nations. It may include anyone outside the core planning team. It includes

those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Purpose of the Refuge

"The purpose specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit." For refuges that encompass wilderness designated by Congress, the purpose of the Wilderness Act are additional purposes of the refuge.

Refuge Operating Needs System (RONS)

The Refuge Operating Needs System is a national database that lists the unfunded operational needs of each refuge. We include projects required to implement approved plans and meet goals, objectives, and legal mandates.

Refuge Purposes

The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, a refuge unit, or refuge subunit (Service Manual 602 FW 1.5).

Refuge Goal

See Goal.

Step-Down Management Plan

A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives.

Stakeholders

The people who have a direct interest or involvement in something (usually open space or urban lands or a plan for the management of such lands). Stakeholders in a CCP usually include Service staff and members of the local community.

Strategy

A specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives.

Tiering	The practice of covering general matters in broader (“programmatic”) environmental impact statements with subsequent narrower (“focused”) statements addressing specific issues; focused documents incorporate by reference the general discussions in the broader document (40 CFR 1508.28).
Trust	Describes a resource that is committed to the stewardship of a legally responsible agency (trustee agency) to be cared for or preserved in the public interest. E.g., trust species.
Undertaking	A project or plan initiated or overseen by a Federal agency; roughly equivalent to the NEPA usage of action.
Unit Objective	See Objective.
U.S. Fish and Wildlife Service Mission	Our mission is working with others to conserve, protect, and enhance fish, wildlife, and plants and other habitats for the continuing benefit of the American people.
Vision Statement	A concise statement of the desired future condition of the planning unit, based primarily upon the Refuge System mission, specific refuge purposes, and other relevant mandates (Service Manual 602 FW 1.5).
Wilderness	See Designated Wilderness.
Wilderness Review	The process we use to determine whether we should recommend Refuge System lands and waters to Congress for wilderness designation. The wilderness review process consists of three phases: inventory, study, and recommendation. The inventory is a broad look at the refuge to identify lands and waters that meet the minimum criteria for wilderness. The study evaluates all values (ecological, recreational, cultural), resources (e.g., wildlife, water, vegetation, minerals, soils), and uses (management and public) withing the Wilderness Study Area. The findings of the study determine whether we will recommend the area for designation as wilderness.
Wildfire	A free-burning fire requiring a suppression response; all fire other than prescribed fire

	that occurs on wildlands (Service Manual 621 FW 1.7)
Wildland Fire	Every wildland fire is either a wildfire or a prescribed fire (Service Manual 621 FW 1.3).
Wildlife-Dependent Recreational Use	“A use of refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation.” These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. We consider these other uses in the preparation of refuge CCP’s; however, the six priority public uses will always take precedence.
Vision Statement	A concise statement of what the planning unit should be, or what we hope to do, based primarily upon the Refuge System mission, specific refuge purposes, and other mandates. We will tie the vision statement for the refuge to the mission of the Refuge System, the purpose(s) of the refuge, the maintenance or restoration of the ecological integrity of each refuge and the Refuge System, and other mandates.

Appendix I
Wildland Fire Management Plan

WILDLAND FIRE MANAGEMENT PLAN

ANTIOCH DUNES NATIONAL WILDLIFE REFUGE

2001

AUGUST 2001

WILDLAND FIRE MANAGEMENT PLAN

ANTIOCH DUNES NATIONAL WILDLIFE REFUGE

Prepared: _____ _____

Roger Wong — Date
Fire Management Officer
San Luis NWRC

_____ _____

Margaret Kolar — Date
Project Leader
San Francisco Bay NWRC

Concurred: _____ _____

Pam Ensley — Date
Regional Fire Management Coordinator
Pacific Region, US Fish and Wildlife Service

Approved: _____ _____

Steve Thompson — Date
Acting Manager
California/ Nevada Operation Manager
Pacific Region, US Fish and Wildlife Service

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EXECUTIVE SUMMARY

When approved, this document will become the Antioch Dune National Wildlife Refuge fire management plan. Major components include:

- updated policy for prescribed fires at Antioch Dunes National Wildlife Refuge.

- Antioch Dunes National Wildlife Refuge Comprehensive Conservation Plan (CCP).

- format changes under the direction of Fire Management Handbook (Release Date 6/1/00).

This plan is written to provide guidelines for appropriate suppression and prescribed fire programs at Antioch Dunes National Wildlife Refuge. Prescribed fires may be used to reduce hazard fuels, restore the natural processes and vitality of ecosystems, improve wildlife habitat, remove or reduce non-native species, and/or conduct research.

INTRODUCTION

The 55-acre Antioch Dunes National Wildlife Refuge (Refuge) and adjacent 12-acre Pacific Gas and Electric (PG&E) land support the last remaining populations of three endangered species including the Antioch Dunes evening primrose (*Oenothera deltoides* ssp. *howellii*), Contra Costa wallflower (*Erysimum capitatum* ssp. *angustatum*), and the Lange's metalmark butterfly (*Apodemia mormo* ssp. *langei*). The primary objective of the Refuge is to provide habitat for these three endemic endangered species. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently the primary threat to these species is the stabilization of the dunes and the subsequent encroachment of non-native vegetation such as rip-gut brome grass (*Bromus diandrus*) and yellow starthistle (*Centaurea solstitialis*).

The Fire Management Plan (FMP) for Antioch Dunes National Wildlife Refuge will help achieve resource management objectives by using prescribed fire to control non-native vegetation for the restoration of native riverine sand dune habitat. The Department of the Interior policy requires that all refuges with vegetation that can sustain fire must have a Fire Management Plan that details fire management policies, the use of prescribed fire for attaining resource management objectives, and fire program operational procedures. This plan meets NEPA/NHPA compliance (See Appendix C).

This plan is written as an operational guide for managing the refuge's wildland fire and prescribed fire programs. It defines levels of protection needed to ensure safety, protect facilities and resources, and restore and perpetuate natural processes, given current understanding of the complex relationships in natural ecosystems. It is written to comply with a service-wide requirement that refuges with burnable vegetation develop a fire management plan (620 DM 1).

There is no dedicated fire staff at Antioch Dunes NWR or San Francisco Bay NWRC. All wildland fires will be suppressed by local cooperating agencies (Contra Costa Fire Protection District) with the oversight of the Project Leader and Zone Fire Management Officer (FMO). All prescribed fires will be coordinated through the Zone FMO.

COMPLIANCE WITH USFWS POLICY

The Refuge was established in 1980 under the authority of the Endangered Species Act to preserve and protect two endangered plants, the Antioch Dunes evening-primrose and the Contra Costa wallflower, and an endangered butterfly, the Lange's metalmark butterfly. The primary management objective of the Refuge is to provide the necessary habitat for these and other native species through restoring native riverine sand dune habitat and controlling non-native vegetation.

This FMP has been completed in conjunction with the Comprehensive Conservation Plan (CCP) for the Refuge. It specifically addresses the use of prescribed fire for resource management purposes.

The objectives of the Refuge are to protect and restore riverine sand dune habitat for the three endangered species and other native dune species. Several operational plans are used by the Refuge to meet these objectives, including a recovery plan for the three endangered species, multiple internal Section 7 endangered species consultations, and an environmental assessment for the Refuge. The plans that currently apply to Fire Management include the Internal Section 7 Consultation for Prescribed Burning (Appendix D), Environmental Assessment (EA) for Prescribed Burning (Appendix C), the Prescribed Fire Plan (Appendix E), and the 1984 Fire Management Plan with 1997 Prescribed Burning Addendum.

The FMP is a detailed program of action to implement fire management policies and objectives, and addresses policy on prescribed burning to control non-native vegetation and restore native riverine sand dune habitat. The FMP meets the objectives of the Refuge's operational plans by supporting strategies which rely upon fire as a management tool and by identifying where and when fire is not wanted.

The Department Manual, DM 910 (USDI 1997) states the following regarding wildland fires:

> "Wildfires may result in loss of life, have detrimental impacts upon natural resources, and damage to or destruction of man-made developments. However, the use of fire under carefully defined conditions is to be a valuable tool in wildland management. Therefore, all wildfires within the Department will be classified either as wildfire or as prescribed fires.
>
> Wildfires, whether on lands administered by the Department or adjacent thereto, which threaten life, man-made structures, or are determined to be a threat to the natural resources or the facilities under the Department's jurisdiction, will be considered emergencies and their suppression given priority over normal Departmental programs.
>
> Bureaus will give the highest priority to preventing the disaster fire - the situation in which a wildfire causes damage of such magnitude as to impact management objectives and/or socio-economic conditions of an area. However, no wildfire situation, with the possible exception of threat to human survival, requires the exposure of firefighters to life threatening situations. Within the framework of management objective and plans, overall wildfire damage will be held to the minimum possible giving full consideration to (1) an aggressive fire prevention program; (2) the least expenditure of public funds for effective suppression; (3) the methods of suppression least damaging to resources and the environment; and (4) the integration of cooperative suppression actions by agencies of the Department among themselves or with other qualified suppression organizations.

> "Prescribed fires...may be used to achieve agency land or resource management objectives as defined in the fire management plans....Prescribed fires will be conducted only when the following conditions are met:
>
> a. Conducted by qualified personnel under written prescriptions.
> b. Monitored to assure they remain within prescription.
>
> Prescribed fires that exceed the limits of an approved prescribed fire plan will be reclassified as a wildfire. Once classified a wildfire, the fire will be suppressed and will not be returned to prescribed fire status."

The authority for funding (normal fire year programming) and all emergency fire accounts is found in the following authorities:

> Section 102 of the General Provisions of the Department of Interior's annual Appropriations Bill provides the authority under which appropriated monies can be expended or transferred to fund expenditures arising from the emergency prevention and suppression of wildland fire.
>
> P.L. 101-121, Department of the Interior and Related Agencies Appropriation Act of 1990, established the funding mechanism for normal year expenditures of funds for fire management purposes.
>
> 31 US Code 665(E)(1)(B) provides the authority to exceed appropriations due to wildland fire management activities involving the safety of human life and protection of property.

Authorities for procurement and administrative activities necessary to support wildland fire suppression missions are contained in the Interagency Fire Business Management Handbook.

The Reciprocal Fire Protection Act of May 27, 1955 (42 USC 815a; 69Stat 66) provides Authorities to enter into agreements with other Federal bureaus and agencies; with state, county, and municipal governments; and with private companies, groups, corporations, and individuals regarding fire activities. Authority for interagency agreements is found in AInteragency Agreement between the Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service of the United States Department of the Interior and the Forest Service of the United States Department of Agriculture@ (1996).

FIRE MANAGEMENT OBJECTIVES

Wildland fires probably did not occur very frequently on the historic dunes because they were much more sparsely vegetated than present day. Due to the ecology of the area, the sensitivity of the habitat, and the proximity of developed areas, all wildland fires will be suppressed. Prescribed fire will be used to reduce hazardous fuels, control non-native vegetation, prepare sites for seeding and planting, and enhance conditions for native dune species.

The Fire Management Objectives for this Refuge are:

1. Firefighter and public safety top priority. All Fire Management activities will reflect this commitment.

2. Integrate prescribed fire management actions with other management activities to provide for the protection, restoration and enhancement of native dune species. Wildland fire management actions will be consistent with personnel safety and resource protection objectives.

3. Actively suppress and prevent the occurrence of wildland fire that could seriously jeopardize populations of endangered species.

4. Protect important local resources and private lands from fire.

DESCRIPTION OF REFUGE

The Refuge is located along the southern shore of the lower San Joaquin river near the city of Antioch, Contra Costa County, California (Figure 1). The Refuge lies within an ecoregion described by Bailey (1995) as the Mediterranean Division, California Dry Steppe Province. Historically, the Antioch Dunes extended over two miles along the southern bank of the San Joaquin river and reached heights of 117 feet. The 55-acre Refuge was extensively mined for sand in the past and subsequently ranges in elevation from 0 to 50 feet. The Refuge currently exists as isolated habitat, surrounded by industrial development.

The Antioch area has a modified Mediterranean climate with warm to hot dry summers and moist, mild winters. Rainfall averages 12.53 inches annually, falling mainly during November-April. The average annual temperature is 61.8 degrees F with an average annual maximum temperature of 74 degrees F and an average annual minimum temperature of 47 degrees F. The hottest recorded temperature is 114 degrees F, and the lowest recorded temperature is 14 degrees F. Winds in the summer come off the river from the west or northwest at an average of 10-20 mph.

The Refuge is split into two units: Sardis and Stamm. Soils in the Refuge are representative of the Oakley sands interlaced with alluvial fan deposits. The Sardis unit (14 acre eastern parcel) was mined down to a clay/peat substrate for the most part and subsequently some sand was replaced over many of these areas. The perimeter still consists of sandy loam substrate. The Stamm unit (41 acre western parcel) was also mined down to a "hard pan" layer of varying thickness, but underneath this hard pan is sandy loam. Sand was replaced over a small portion of the mined area on the Stamm unit as well.

The Sardis Unit is bordered by Wilbur Avenue on the South, the San Joaquin River on the North, and PG&E on the East and West. The Stamm Unit is bordered by Fulton Shipyard to the West, Fulton Shipyard Rd. to the Southwest, The City of Antioch Public Works Disposal Site and Burlington Northern Railroad to the South, and Georgia Pacific Gypsum to the East.

CULTURAL RESOURCES

Under Federal ownership, archaeological and historical resources within the Refuge receive protection under Federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act; the Archaeological and Historical Preservation Act; the Native American Graves and Repatriation Act, and the National Historic Preservation Act of 1966. The Refuge has obtained Section 106 Compliance Permit (May 28, 1997; Appendix C).

Evidence of native settlements and Spanish exploration of the area has been documented. A native village is thought to have been located within the present-day Antioch area. The area was traveled and used by settlers for residence, grazing, and recreation. Railroad spurs and sand removal from the dunes (now located within the refuge) began in the 1890s.

Little evidence of human activity remains on the refuge due to the extensive sand mining that occurred until the early 1900's. Cultural artifacts can still be found among what remains of the leveled dunes. The refuge was used as a de facto garbage dump during the mining era.

FISH AND WILDLIFE

The Refuge lands support the last remaining populations of the Lange's metalmark butterfly (*Apodemia mormo* ssp. *langei*). The primary objective of the Refuge is to provide habitat for this endemic endangered species. Historically, many factors have contributed to the decline of the species, including human development and sand mining of the dunes.

The Refuge provides important habitat for many types of wildlife including nesting and migratory birds and the California legless lizard. In recent times, eight species of reptiles and no amphibians were identified on the refuge. Recent observations of mammals have been limited but include gopher, gray fox, red fox, coyote, Beechy ground squirrel, black-tailed jack rabbit, and muskrat. Bird species include Anna's hummingbird, western meadowlark, scrub jay, cedar waxwing, red-shafted flicker, belted kingfisher, northern rough-winged swallow, and other migratory and resident birds.

Federally listed or proposed fish species occurring in the waters adjacent to the Refuge include winter-run chinook salmon, delta smelt, steel-head trout, and Sacramento splittail. Surveys on the refuge have identified nearly 400 species of invertebrates. Changes in invertebrate species composition have been linked to changes in vegetation and the increase in weedy species.

VEGETATION

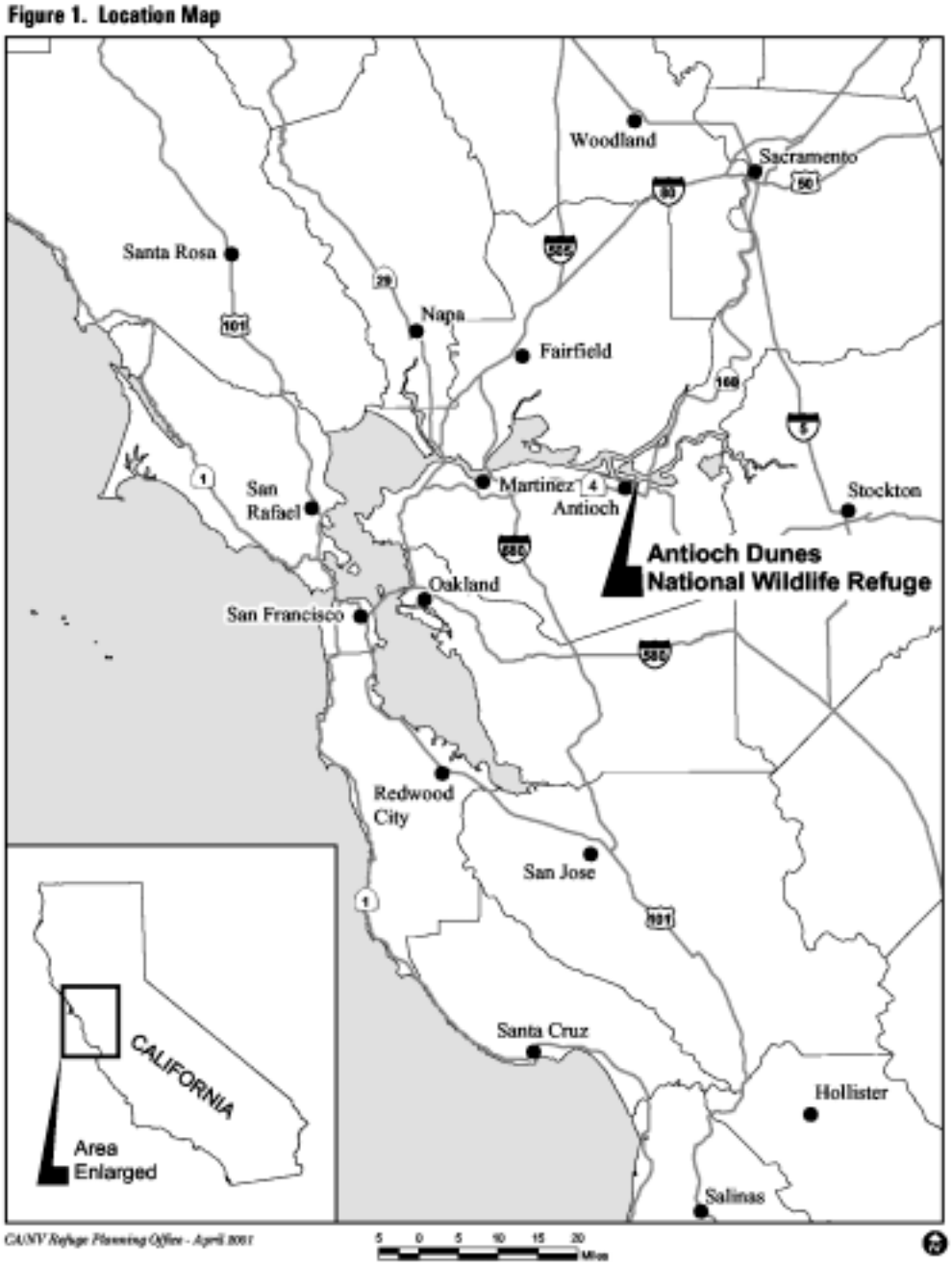
Six main habitat types are found within the 55-acre Refuge: littoral, riparian, open sand dunes, abandoned vineyard, disturbed/mined areas and grassland areas. The littoral zone contains a state listed rare plant: Mason's lilaeopsis (*Lilaeopsis masonii*). The riparian area is characterized by native species such as, but not limited to, coast live oak (*Quercus agrifolia*), red willow (*Salix laevigata*), narrow-leaved willow (*Salix exigua*), arroyo willow (*Salix lasiolepis*), California toyon (*Heteromeles arbutifolia*) and elderberry (*Sambucus mexicana*). The open dune areas consist of native species including: Antioch dunes evening primrose, Contra Costa wallflower (both federally listed as endangered), naked-stemmed buckwheat, host plant for the endangered Lange's metalmark butterfly, telegraph weed (*Heterotheca grandiflora*), *Senecio flaccidus* var. *douglasii*, deerweed (*Lotus scoparius*) and many others, as well as non-native grasses and other non-native species (see CCP, Appendix D). In the disturbed, grassland, and vineyard areas there is an abundance of non-native species including vetch (*Vicia* spp.), rip-gut brome grass, yellow starthistle, and Russian thistle (*Salsola tragus*), as well as some native species.

The Refuge and adjacent 12-acre Pacific Gas and Electric (PG&E) land support the last remaining populations of two endangered plant species including the Antioch Dunes evening primrose *(Oenothera deltoides ssp. howellii*) and the Contra Costa wallflower (*Erysimum capitatum* ssp. *angustatum*). The primary objective of the Refuge is to provide habitat for these endemic endangered species. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently the primary threat to these species is the stabilization of the dunes and the encroachment of non-native vegetation such as rip-gut brome grass (*Bromus diandrus*), yellow starthistle (*Centaurea solstitialis*), and vetch (*Vicia villosa*).

STRUCTURES AND FACILITIES

There are no buildings of any kind within the Refuge boundaries. However, on the Stamm Unit, the City of Antioch maintains a sewage outfall structure to the San Joaquin River. The refuge is also surrounded by industrial plants.

Figure 1: Vicinity Map



WILDLAND FIRE MANAGEMENT SITUATION

HISTORIC ROLE OF FIRE

The majority of the habitat on both units of the Refuge are highly susceptible to wildland fire. The dominant vegetation is composed of annual grasses and scattered brush. These fuels are highly flammable and would result in a high rate of spread should a wildland fire occur. The predominant, strong, northwest winds combined with the usual low humidity and high temperature during the summer would aid the spread and intensity of a fire.

Fire ignitions within the Refuge boundaries occur after curing of annual grasses and prior to normal beginning of fall precipitation (May - October; Loredo pers. comm. 2001)

Pre-settlement fires

The history of fire in the area is not well known. It could be assumed that since the area is situated so close to the water's edge and the vegetation was much sparser than it currently is, that there were few wildland fires. There is little information regarding Native American use of fire in the area.

Post-settlement Fire History

There is an extensive history of unplanned fires at the Refuge. The Refuge was originally open to the public, but due to the large amount of fires that were started by users, the Refuge was closed and subsequent unplanned fire frequency decreased. Table 1 is a complete history of fire at Antioch Dunes NWR since it's establishment in 1980.

Table 1: Fire History

Unit	Date	Location	Acres	Type	Cause
Stamm	6/01	Hardpan #1	3	Prescribed	
Stamm	6/01	Vineyard area along RR	8	Prescribed	
Stamm	6/00	Hardpan #1	3	Prescribed	
Stamm	6/00	Vineyard area along RR	8	Prescribed	
Stamm	6/99	Triangle Unit near gate	3	Prescribed	
Stamm	6/99	Vineyard area along RR	8	Prescribed	
Stamm	6/99	Hardpan #1	3	Prescribed	
Stamm	5/99	Hardpan #1 near water	<1	Wildland fire	industrial
Stamm	5/99	Hardpan/ NE	18	Wildland Fire	Escaped illegal campfire
Stamm	6/98	Triangle Unit near gate	3	Prescribed	
Stamm	6/98	Vineyard area along RR	5	Prescribed	
Stamm	10/97	NE Corner along river	1.0	Wildland fire	Escaped illegal campfire
Stamm	6/17/97	Triangle unit near gate	3	Prescribed	

Stamm	6/16/97	Vineyard area along RR	5.0	Prescribed	
Stamm	7/6/96	SE Corner near RR	.1	Wildland fire	Unknown
Stamm	10/31/90	Along railroad track	7.0	Wildland fire	Potential Arson
Stamm	12/31/90	Near river next to blowout	2.0	Wildland fire	Unknown
Stamm	3/28/88	Along river - west side	.5	Wildland fire	Campfire
Stamm	6/24/87	Triangle Unit near gate	3.0	Wildland fire	Fireworks
Stamm	6/7/85	Between river and access road, west end	10.0	Wildland fire	Unknown-suspicious
Sardis	6/99	South Plateau near gate	4.25	Prescribed	
Sardis	6/98	South Plateau near gate	4.25	Prescribed	
Sardis	6/16/97	South Plateau near gate	4.25	Prescribed	
Sardis	6/25/90	Along Wilbur, Little Corral Parking area.	3.0	Wildland fire	Unknown
Sardis	7/21/89	East of entrance gate along fence	.1	Wildland fire	Unknown
Sardis	7/21/88	West of entrance gate along fence	.2	Wildland fire	Cigarette from highway?
Sardis	6/5/85	West of entrance gate along fence	3.0	Wildland fire	Unknown -suspicious
Sardis	9/30/84	N. of old parking lot	1.0	Wildland fire	Unknown
Sardis	8/12/84	Near river against PG&E east boundary	1.5	Wildland fire	Unknown
Sardis	7/12/84	Beach fire	.1	Wildland fire	Unattended campfire
Sardis	5/10/84	East of gate onto PG&E east	2.5	Wildland fire	Arson
Sardis	7/5/83	Unknown	.1	Wildland fire	Staff caused-welding
Sardis	7/23/82	SE corner of pit area	2.25	Wildland fire	Unknown-suspicious
PG&E	3/3/85	Center of East Unit	.5	Wildland fire	Unattended campfire
PG&E	10/9/84	East Unit trees near river	.25	Wildland fire	Unknown
PG&E	6/18/84	East Unit around tower	1.0	Wildland fire	Downed electric line

Prescribed fire history
The prescribed burn program began in 1997 to manage non-native species. Table 1 above shows dates of past prescribed burns.

RESPONSIBILITIES
Antioch Dunes NWR does not have an onsite fire management staff or suppression equipment. There is a Service fire crew stationed part-time (late spring to early fall) at San Luis NWRC and "collateral duty" Refuge personnel stationed at San Francisco Bay NWRC. Both of these sites are approximately 90 miles from the Refuge. Wildland fires in this area are generally reported by the public and suppressed by firefighters from the Contra Costa County Fire Protection District (FPD) before Service staff can respond.

Responsibilities for fire management at Antioch Dunes are shared by: the Antioch Dunes Refuge Manager, Refuge Biologist, San Francisco Bay NWR Complex Project Leader, and the Zone Fire Management Officer stationed at San Luis NWRC (Appendix F-Fire Dispatch Plan for further detail). Primary wildland fire management responsibilities are:

- develop and cultivate working relationships with local fire departments in the area that can provide mutual aid
- maintain firebreaks on Refuge to prevent wildland fire
- conduct prescribed fire activities in support of refuge habitat management programs
- establish and maintain appropriate fire related agreements/contracts
- monitor results of wildland and prescribed fires
- update fire management and associated plans (dispatch, training, etc.), call-out lists, and mobilization guidelines, air quality certifications.
- continue to develop a cadre of "red-carded" firefighters for wildland fire, trained and equipped to accomplish the fire management program
- maintain the refuge fire cache and fire equipment in a ready state

Agency Administrator/ Project Leader (PL)

- Is responsible for implementation of all Fire Management activities within the Complex and will ensure compliance with Department, Service and refuge policies.
- Selects the appropriate management responses to wildland fire.

Deputy Project Leader (DPL)

- Coordinates Complex programs to ensure personnel and equipment are made available and utilized for fire management activities including fire suppression, prescribed burning and fire effects monitoring.
- Ensures that the fire management program has access to Refuge and complex resources when needed.
- Ensures that Refuge Managers and complex Staff consider the fire management program during Refuge related planning and implementation.

Refuge Manager (RM)

- Identifies prescribed burn units and biological objectives to Fire Management Officer (FMO) and Prescribed Fire Specialist (PFS), notifies FMO of prescribed fire project constraints, and ensures that Refuge resources are available to accomplish prescribed fire and fire suppression objectives.
- Acts as the primary Refuge Resource Management Specialist during fire management planning and operations.
- Prepares an annual report detailing fire occurrences and prescribed fire activities undertaken in each calendar year. This report will serve as a post-year's fire management activities review, as well as provide documentation for development of a comprehensive fire history record for the Refuge.
- Is responsible for planning, coordinating, and directing preparedness activities including fire training, physical fitness testing and Interagency Fire Qualification System (IFQS) data entry, fire cache and equipment inventory accountability, maintenance, and operation, cooperation with cooperative agencies.

Biologist

- Coordinates through Refuge Managers and Deputy Project Leader to provide biological input for the fire program with the FMO and PFS.
- Ensures fire effects monitoring is being implemented and drafts wildland fire Rehabilitation Plans for Deputy Project Leader.
- Assists in design and implementation of fire effects monitoring, with FMO and PFS.
- Participates, as requested, in prescribed burning and wildland fire suppression.

Zone Fire Management Officer (FMO)

- Responsible for all fire related planning and implementation for the Refuge.
- Integrates biological Refuge objectives into all fire management planning and implementation.
- Solicits program input from the RM and Biologist.
- Supervises prescribed fire planning.
- Coordinates fire related training.
- Coordinates with cooperators to ensure adequate resources are available for fire operational needs.
- Is responsible for implementation of this Plan. This responsibility includes coordination and supervision of all prevention, pre-suppression, detection, wildland fire, prescribed fire, suppression, monitoring, and post-fire activities involving Refuge lands.
- Is responsible for preparation of fire reports following the suppression of wildland fires and for operations undertaken while conducting prescribed fires.
- Submits budget requests and monitors FIREBASE funds.
- Maintains records for all personnel involved in suppression and prescribed fire activities, detailing the individual's qualifications and certifications for such activities.
- Updates all fire qualifications for entry into the Fire Management Information System.
- Nominates personnel to receive fire-related training, as appropriate.
- Designates the person to serve as Incident Commander (IC) for initial attack purposes. The FMO may assume the position of IC at his/her discretion or designate other personnel to take over that position at his/her discretion.

Prescribed Fire Specialist (PFS)

- Responsible for the planning and implementation of a program, which collects information for the documentation, analysis, and prediction of fire behavior and effects.
- Develops and recommends, plans, and schedules management ignited fire activities for the Refuge.
- Implements and directs burns.
- Plans and develops a program to collect information on the effects and behavior of prescribed fire.
- Plans and directs studies to monitor and analyze fire behavior parameters, then uses these data to support the development of fire plans.
- Plans and directs surveys for the collection, analysis and documentation of data relating to fire effects on biotic and abiotic resources.
- Organizes and performs studies to develop fire management prescriptions for prescribed burns.
- Is responsible for ensuring a cadre of qualified prescribed fire overhead by recommending personnel for training, through both formal in-house and field training assignments.
- Is responsible for record keeping associated with burn planning, fire occurrence reporting and fire weather.
- Identifies areas of fire management requiring research and works with research scientists in the development of project statements to accomplish this research.

Fire Management/Suppression Personnel

- Consist of all Refuge personnel, whether permanent or seasonal, who meet the minimum standard set by the National Wildfire Coordinating Group (NWCG) for firefighters.
- Are fully equipped with proper personal protective equipment, have taken and passed the minimum classroom training, and meet physical fitness standards required.
- Undertake fire management duties as assigned by the Prescribed Fire Burn Boss on each prescribed fire project.
- Are responsible for their personal protective equipment and physical conditioning, qualifying annually with the work capacity test before May 31.

Incident Commander

Incident Commanders (of any level) use strategies and tactics as directed by the Refuge Manager and WFSA where applicable to implement selected objectives on a particular incident. A specific Limited Delegation of Authority (Appendix G) will be provided to each Incident Commander prior to assuming responsibility for an incident. Major duties of the Incident Commander are given in NWCG Fireline Handbook, including:

- Brief subordinates, direct their actions and provide work tools
- Ensure that safety standards identified in the Fire Orders, the Watch Out Situations, and agency policies are followed at all times.
- Personally scout and communicate with others to be knowledgeable of fire conditions, fire weather, tactical progress, safety concerns and hazards, condition of personnel, and needs for additional resources.

- Decides when to request overhead or additional firefighting personnel and equipment.
- Order resources to implement the management objectives for the fire.
- Inform appropriate dispatch of current situation and expected needs.
- Coordinate mobilization and demobilization with dispatch and the FMO.
- Perform administrative duties; i.e., approving work hours, completing fire reports for command period, maintaining property accountability, providing or obtaining medical treatment, and evaluating performance of subordinates.
- Assure aviation safety is maintained to the highest standards.

Initial attack teams

Initial attack teams will consist of experienced, fully- qualified firefighters, those on their first fire, and well-qualified leadership. Teams will be prepared and equipped with hand and power tools as needed and will be dispatched with a day's supply of food and water, so they can continue work for 24 hours without additional support.

Employees participating in any wildland fire activities on Fish and Wildlife Service or cooperator=s lands will meet fitness and training requirements established in PMS 310-1, except where Service-specific fitness requirements apply.

INTERAGENCY OPERATIONS

There are no formal cooperative fire agreements in place at this time, however a Memorandum of Understanding is currently being established between the Refuge and the Contra Costa County FPD. The Contra Costa County FPD has traditionally responded to wildland fires at the Refuge because of their legal fire protection responsibility to the property surrounding the Refuge. Thus, any wildland fire originating on Refuge lands is considered a threat to their property.

Antioch Dunes NWR will use the Incident Command System (ICS) as a guide for fireline organization. Qualifications for individuals is per DOI Wildland Fire Qualifications and Certification System, part of NIIMS and the National Wildland Fire Coordination Group (NWCG) Prescribed Fire Qualification Guide. Depending on fire complexity, some positions may be filled by the same person.

A listing of key interagency contacts can be found in the Fire Dispatch Plan. The plan is an annual assembly of information required to facilitate a rapid response to a fire report and to coordinate the initial attack (Appendix F).

PROTECTION OF SENSITIVE RESOURCES

Aggressive attack of all unplanned ignitions with minimum acreage burned is the goal. Heavy equipment shall not be used due to the sensitivity of the habitat, except in cases where life or fire-fighter safety is threatened or when the Refuge Manager determines necessary. Suppression guidelines will be discussed with Contra Costa County FPD during annual operating plan meetings.

The Regional Archaeologist and/or his/her staff will work with fire staff, project leaders, and incident commanders to ensure that cultural resources are protected from fire and fire management activities. The "Request For Cultural Resource Compliance" form (RCRC, attached) will be used to inform the Regional Archaeologist of impending activities, thereby meeting the regulations and directions governing the protection of cultural resources as outlined in Departmental Manual Part 519, National Historic

Preservation Act (NHPA) of 1966, Code of Federal Regulations (36CFR800), the Archaeological Resources Protection Act of 1979, as amended, and the Archaeological and Historic Preservation Act of 1974. The NHPA Section 106 clearance will be followed for any fire management activity that may affect historic properties (cultural resources eligible to the National Register of Historic Places).

Impacts to archaeological resources by fire resources vary. The four basic sources of damage are (1) fire intensity, (2) duration of heat, (3) heat penetration into soil, and (4) suppression actions. Of the four, the most significant threat is from equipment during line construction for prescribed fires or wildfire holding actions (Anderson 1983).

The following actions will be taken to protect archaeological and cultural resources:

Wildland Fires

- Minimum impact fire suppression tactics will be used to the fullest extent possible.
- Resource Advisors will inform Fire Suppression personnel of any areas with cultural resources. The Resource advisor should contact the Regional Archaeologist and/or his/her staff for more detailed information.
- Foam use will be limited in areas known to harbor surface artifacts.
- Mechanized equipment should not be used in areas of known cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.
- Rehabilitation plans will address cultural resources impacts and will be submitted to the Regional Archaeologist using the RCRC.

Prescribed Fires

- The Refuge Fire staff will submit a completed RCRC to the Regional Archaeologist and/or his/her staff as soon as the burn area is identified (i.e., as soon as feasible).
- Upon receipt of the RCRC, the Regional Archaeologist and/or his/her staff will be responsible for consulting with the FMO and evaluating the potential for adverse impacts to cultural resources.
- When necessary, the Regional Archaeologist and/or his/her staff will coordinate with the State Historic Preservation Officer (SHPO). The SHPO has 30 days to respond. The Refuge will consider all SHPO recommendations.
- Mechanized equipment should not be used in areas of know cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.

WILDLAND FIRE ACTIVITIES

Fire program management describes the operational procedures necessary to implement fire management at Antioch Dunes NWR. Program management includes: fire prevention, preparedness, emergency preparedness, fire behavior predictions, step-up staffing plan, fire detection, fire suppression, minimum impact suppression, minimum impact rehabilitation, and documentation.

All fires not classified as prescribed fires are wildland fires and will be appropriately suppressed. Suppression operations will generally be conducted by Contra Costa County Fire Protection District (CCFD).

Records show that fire season is typically from May-October. Depending on the specific weather of any particular year the seasons may be shorter or longer and, therefore, may start earlier or last longer.

FIRE MANAGEMENT STRATEGIES

All unplanned wildland fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce fast, efficient action with minimum damage to resources using appropriate management strategies.

Fire suppression strategies at Antioch Dunes NWR will include a range of suppression techniques in order to provide for protection of values at risk, natural resources, firefighter safety and cost efficiency. Suppression strategies and tactics will be unique to each wildland fire, predicated by weather parameters, fuel conditions, safety considerations, resources, and threats to the endangered, threatened and sensitive species. Determination of strategies and tactics will be made by the Incident Commander on scene utilizing knowledge of Refuge fire management objectives and input from Refuge Manager or designate.

All wildland fires will be suppressed. However, there may be occasions when direct attack in high intensity, rapidly spreading wildland fire would jeopardize firefighter safety and may not be appropriate. In these cases indirect strategy will be employed utilizing natural and man-made firebreaks as wildland fire control points.

The following will be employed to meet fire management objectives:

1) Suppress all unplanned ignitions in a safe and cost effective manner consistent with resources and values at risk. Minimum impact strategies and tactics will be used, particularly in areas with high densities of endangered species.

2) Conduct all fire management programs in a manner consistent with applicable laws, policies and regulations.

3) Initiate cost effective fire monitoring which will inform managers if objectives are being met. Monitoring information will also be used to refine burn prescriptions to better achieve objectives.

4) Utilize prescribed fire as a management tool for achieving hazard fuel reductions and resource management objectives. To the extent possible, hazard fuel prescribed fire will be used to accomplish specific restoration objectives established for individual land units. Prescribed fires are fires which are deliberately set to burn under prescribed conditions in order to achieve pre-determined resource management objectives.

Although resource impacts of suppression alternatives must always be considered in selecting a fire management strategy, resource benefits will not be the primary consideration. Appropriate suppression action will be taken to ensure firefighter safety, public safety, and protection of resources.

Critical protection areas, such as adjacent properties and sensitive habitat will receive priority consideration in fire control planning efforts. In all cases, the primary concerns of fire suppression personnel shall be the safety, and if needed, all individuals not involved in the suppression effort may be evacuated.

Suppression strategies should be applied so that the equipment and tools used to meet the desired objectives are those that inflict the least impacts upon the natural and cultural resources. Minimum impact suppression tactics will be employed to protect all resources. Natural and artificial barriers will be used as much as possible for containment. When necessary, fire line construction will be conducted in such a way as to minimize long-term impacts to resources.

Heavy equipment such as crawlers, tractors, dozers, or graders will not be used within the refuge boundaries unless their use is necessary to prevent a fire from destroying privately-owned and/or government buildings and historic resources. The use of any heavy equipment requires approval from the Refuge Manager or designate.

Sites impacted by fire suppression activities or by the fire will be rehabilitated as necessary, based on an approved course of action for each incident.

PREPAREDNESS

Preparedness is the work accomplished prior to fire occurrence to ensure that the appropriate response, as directed by the Fire Management Plan, can be carried out. Preparedness activities include: budget planning, equipment acquisition, equipment maintenance, dispatch (Initial attack, extended, and expanded), equipment inventory, personnel qualifications, and training. The preparedness objective is to have a well trained and equipped fire management organization to manage all fire situations within the Refuge. Preparedness efforts are to be accomplished in the time frames outside the normal fire season dates.

The Fish and Wildlife Service has minimum training requirements for all fire positions. The Service is a member to the National Wildfire Coordinating Group (NWCG) and accepts its standards for interagency operations. There is required annual refresher training for all personnel that are involved with wildland fire activities. These requirements are found in the Service Fire Management Preparedness and Planning Handbook, Section 1.5; Training, Qualification, and Certification.

Annual fire readiness requires an inventory of existing cache items. The cache should be capable of outfitting six personnel for wildland fire activities and will be inventoried as ready by May 31 of each year. The cache is located at the San Francisco Bay National Wildlife Refuge Complex (San Francisco Bay NWRC) Headquarters in Newark over 90 miles from the Antioch Dunes NWR. There is no fire equipment stationed on site, therefore reliance on local fire departments for quick initial attack is of greater value.

Local conditions and the status of local fire department resource availability is a major indicator which would affect the level of fire management activities at the Refuge. Regional and National Preparedness Levels do play a role in determining the level of fire management operations at the Refuge, but less than the local conditions. Local fire restrictions imposed within the Antioch city limits are of greater significance due to the strong influence of Contra Costa County FPD.

Historical weather analysis
The fire season generally begins with the curing of annual grasses in late May and extends until the first rains in mid-October. East wind conditions in September and October increase the potential for large fires in the local area.

Contra Costa County Fire Department does not have any weather station data that reflects the conditions at the Refuge. The closest RAWS unit is located at Black Diamond Mine (1,600 foot elevation) but has little in common with the weather conditions at the refuge.

Fire Prevention
An active fire prevention program may be conducted in conjunction with other agencies to protect human life and property, and prevent damage to cultural resources or physical facilities.

A program of internal and external education regarding potential fire danger may be implemented. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and neighbor awareness of fire hazards. Employees need to relate to the public the beneficial effects of prescribed fires as opposed to unwanted human-caused fires, with emphasis on information, essential to understanding the potential severity of human-caused wildland fires and how to prevent them.

No formal prevention plan has been developed. However, fire lines are mowed along Wilbur Avenue and non-native vegetation control measures are implemented on an annual basis. Additionally, since most wildland fire on the Refuge has been caused by trespassers, Refuge personnel will take appropriate actions to prevent the entry of unauthorized persons.

Staffing Priority Levels
There is no fire-funded staffing stationed at the Refuge. Fire suppression response is provided by Contra Costa County FPD, therefore Contra Costa County FPD will adjust staffing levels based on current fire danger. The refuge is closed to the public and no Refuge facilities are located within the boundaries. Therefore, high fire danger will not require any additional closures.

Training
Departmental policy requires that all personnel engaged in suppression and prescribed fire duties meet the standards set by the National Wildfire Coordinating Group (NWCG). Antioch Dunes NWR will conform strictly to the requirements of the Wildland and Prescribed Fire Management Qualification and Certification System (PM 310-1) and USFWS guidelines.

Basic wildland fire training refreshers are offered annually for red-carded firefighters and records kept in a centralized database. Additional training is available from surrounding agencies in pump and engine operation, power saws, firefighter safety, fire weather and fire behavior, helicopter safety and prescribed fire objectives and activities. On-the job training is encouraged and will be conducted at the field level. Whenever appropriate, the use of fire qualification task books will be used to document fire experience of trainees. The FMO will coordinate fire training needs with those of other nearby refuges, cooperating agencies, and the RO.

The refuge supports the development of individual Incident Command System (ICS) overhead personnel from among qualified and experienced refuge staff for assignment to overhead teams at the local, regional, and national level.

Fire suppression is an arduous duty. On prescribed fires, personnel may be required to shift from implementation/monitoring activities to suppression. Poor physical condition of crew members can endanger safety and lives during critical situations.

Personnel performing fire management duties will maintain a high level of physical fitness. This requires successful completion of a fitness pack test. Personnel must complete a three mile hike with a 45 pound pack in less than 45 minutes.

Supplies and Equipment

A small, 10-person cache for the Refuge is located at the Complex headquarters in Newark. The cache is maintained by the Complex staff.

Additional equipment and supplies are available through cooperators and the interagency cache system. Requests for additional personnel and equipment are made through the Mendocino NF Dispatch. The contact list can be found in the Dispatch plan (Appendix F).

DETECTION

Most wildland fires are reported by the public to 9-1-1. The 9-1-1 dispatchers contact Contra Costa County FPD for suppression response. The refuge is contacted by Contra Costa County FPD to report all wildland fire activities.

The Fire Management Plan does not discriminate between human-caused and lightning caused fire. All wildland fires will be suppressed. However, detection shall include a determination of fire cause. Moreover, human-caused fires will require an investigation and report by law enforcement personnel. For serious human-caused fires, including those involving loss of life, a qualified arson investigator will be requested.

COMMUNICATIONS

There is no open radio communication frequency for Refuge personnel. Instead, staff utilize a direct connect cellular phone system.

Prescribed fire activities performed by Service personnel utilize the various NIFC Tactical channels as needed. Normally NIFC Tactical channels 2 (168.200 mhz) and 3 (168.600 mhz) are used depending upon the number of frequencies needed during prescribed burns.

CCPFD utilizes a ultra high frequency in the 800 mhz band. There is not a common link between Service personnel and CCPFD at this time.

PRE-ATTACK PLAN

The pre-attack plan is reflected by maps which include: locations of water sources, roads, private property, etc (fig. 2 and 3). Access to the Refuge is extremely limited. The San Joaquin River acts as the north boundary of the Refuge. Any wildland fire that cannot be contained from roads or natural

boundaries would probably be allowed to burn to the river since road access to the northern portions of the Refuge is extremely limited. However most wildland fires have been successfully contained by local fire department personnel from Wilbur Road and other roads that are open to the public. Contra Costa County FPD has maps and keys for the Refuge.

FIRE MANAGEMENT UNITS

The Refuge will be managed as two units, Sardis and Stamm. The overall objective for both units is to restore the native dune habitat. Suppression of all unplanned ignitions with minimum acreage loss will be employed over the entire Refuge.

During the fire season (May - October), prevailing winds come off the river from the west or northwest at an average of 10-20 mph (Loredo pers. comm. 2001). Mean daily humidities range from around 48 % in the winter to the mid-teens in the spring and summer. Wind conditions during the fall could bring humidities even lower. Typically, humidity is highest during the early morning hours and lowest during the mid-afternoon hours.

The Antioch area has a modified Mediterranean climate with warm to hot dry summers and moist, mild winters. Rainfall averages 12.53 inches annually, falling mainly during November-April. The average annual temperature is 61.8 degrees F with an average annual maximum temperature of 74 degrees F and an average annual minimum temperature of 47 degrees F. The hottest recorded temperature is 114 degrees F, and the lowest recorded temperature is 14 degrees F.

Sardis Unit

The Sardis Unit consists of 14 acres of varying topography. Fuel types in the South Plateau, a primarily flat area along Wilbur Avenue, consists of annual grassland and oak woodland. The rest of the Unit includes a deep pit located approximately 70 feet below the Plateau. Slopes leading down to the pit on the west, south, and east sides are greater than 50%. The slopes are heavily vegetated with annual grasses. The pit consists primarily of undulating shallow dunes covered with annual grasses and shrubby vegetation. To the north of the pit, a mixture of oak woodland, riparian vegetation, and shrub habitat stretch along the San Joaquin River.

In this unit, fire behavior under drought conditions is expected to range from a creeping/ spreading fire along the river to a fast running fire with 6 to 10 foot flame lengths in open grassland. In the drier riparian areas which are dominated by shrubs such as coyote brush and toyon, fire intensity would be significantly greater. Due to the character of the slope and heavy vegetation on the sides of the pit, erratic behavior should be anticipated in this area. In areas adjacent to the river, fire behavior could be expected to be slow and creeping.

Stamm Unit

The Stamm Unit consists of 41 acres of limited topography. Fuel types on the western half of the property consists of dense shrubby vegetation and grasslands over flat terrain. The eastern half of the property consists primarily of tall shrubby vegetation and grassland covering undulating and rolling dunes. Riparian vegetation along the river includes tules, willows, and low trees.

In this unit, fire behavior is expected to range from smoldering in moist vegetation along the river to running and spotting in the tall brush. Maximum expected flame lengths in the tall brush is 10-12'.

Figure 2: Sardis Unit

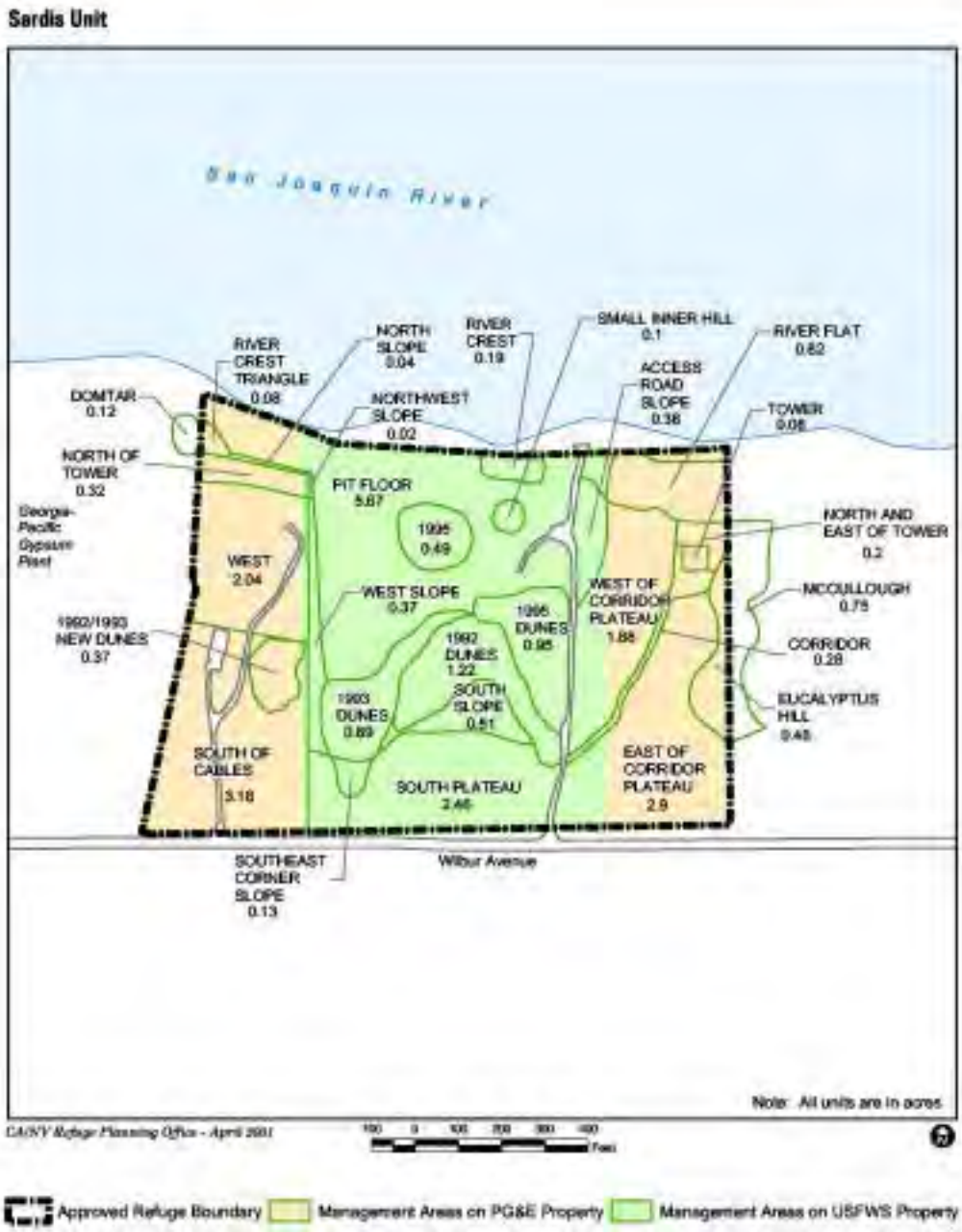


Figure 3: Stamm Unit

Due to staff limitations, relatively small land management parcels, long response times, valuable resources, and values at risk on neighboring lands, this plan does not recommend wildland fire managed for resource benefit as an option for any of the units. Wildland fires will be suppressed using the appropriate suppression response. Prescribed fires will be used to reduce hazardous fuels and to meet resource management objectives.

Fire Effects to Vegetation

The loss and modification of primrose habitat initially caused a decline in the species, eventually leading to its Federal Listing. Currently, the major threat to the primrose is the invasion of non-native plants such as yellow starthistle, vetch, and Ripgut brome. The burning of yellow-starthistle prior to seed production has been documented to reduce the seed bank. This burning needs to be conducted a minimum of three successive years to prove effective and must be followed up with spot herbicide application. Research into the effectiveness of prescribed burning on yellow starthistle continues at Antioch Dunes NWR.

The use of fire to treat yellow starthistle has caused some declines in ripgut brome. Unfortunately, other non-native weeds such as filaree and vetch may colonize the burn areas quickly. Primrose has responded favorably to fire treatments at Antioch Dunes NWR.

SUPPRESSION TACTICS

Wildland fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce fast, efficient action with minimum damage to resources. Suppression involves a range of possible actions from initial attack to final suppression. All wildland fires will be suppressed.

Personnel and equipment must be efficiently organized to suppress fire effectively and safely. To this end, the FMO assumes the command function on major or multiple fire situations, setting priorities for the use of available resources and establishing a suppression organization.

There will be only one Incident Commander responsible through the FMO to the Project Leader. The Incident Commander will designate all overhead positions on fires requiring extended attack. Reference should be made to a Delegation of Authority (Appendix G).

Suppression Conditions

The typical fire suppression response to a fire at Antioch Dunes NWR would consist of an IC provided by the Contra Costa County FPD and two engines. Water is the primary method for extinguishing fires. Handline is not usually needed for suppression efforts.

The goal for all unplanned ignitions is to control the fire with minimum acreage burned. Heavy equipment shall not be used due to the sensitivity of the habitat, except in cases where life or fire-fighter safety is threatened or when the Refuge Manager determines necessary. Suppression guidelines will be outlined in a future MOU with Contra Costa County FPD.

Wildland Fire Situation Analysis

For fires that cannot be contained in one burning period, a WFSA must be prepared. In the case of a wildland fire, the Incident Commander, in conjunction with the FMO, will prepare the WFSA. Approval of the WFSA resides with the Refuge Project Leader.

The purpose of the WFSA is to allow for a consideration of alternatives by which a fire may be controlled. Damages from the fire, suppression costs, safety, and the probable character of suppression actions are all important considerations.

Public safety will require coordination between all refuge staff and the IC. Traffic control will be necessary where smoke crosses roads, etc. Where wildland fires cross roads, the burned area adjacent to the road should be mopped up and dangerous snags felled. Every attempt will be made to utilize natural and constructed barriers, including changing fuel complexes, in the control of wildland fire. The first priority for rehabilitation efforts will concentrate on the damages done by suppression activities. A Burned Area Rehabilitation Plan will be prepared for damages caused by the fire itself.

Aircraft Operations

Aircraft may be used in all phases of fire management operations. All aircraft must be Office of Aircraft Services (OAS) or Forest Service approved. An OAS Aviation Policy Department Manual will be provided by OAS.

Helicopters may be used for reconnaissance, bucket drops and transportation of personnel and equipment. Natural helispots and parking lots are readily available in most cases. Clearing for new helispots should be avoided where possible. Improved helispots will be rehabilitated following the fire.

As in all fire management activities, safety is a primary consideration. Qualified aviation personnel will be assigned to all flight operations.

EMERGENCY STABILIZATION AND REHABILITATION

When suppression action is taken, rehabilitation is appropriate. The most effective rehabilitation measure is prevention of impacts through careful planning and the use of minimum impact suppression techniques.

Rehabilitation will be initiated by the Incident Commander, FMO, or Refuge Manager. Rehabilitation will be directed toward minimizing or eliminating the effects of the suppression effort and reducing the potential hazards caused by the fire. These actions may include:

1. Backfill control lines, scarify, and seed.
2. Install water bars and construct drain dips on control lines to prevent erosion.
3. Install check dams to reduce erosion potential in drainages.
4. Restore natural ground contours.
5. Remove all flagging, equipment and litter.
6. Consider and plan more extensive rehabilitation or revegetation to restore sensitive impacted areas.

If revegetation or seeding is necessary, only native plant species will be used.

If Emergency Stabilization and Rehabilitation (ESR) measures are needed or if rehabilitation is needed to reduce the effects of a wildland fire then the Refuge can request appropriate funding through the burned

area ESR fund. The ESR fund is administered through the Service's ESR coordinator at the National Interagency Fire Center.

Fire rehabilitation will be as prompt as possible to prevent erosion and spread of non-native plants. This will be developed by the Refuge staff and submitted to the Regional Fire Management Coordinator for review within 90 days of the unplanned ignition being declared out.

REQUIRED REPORTING

A DI-1202, fire report, will be filled out and submitted to the Regional Fire Management Officer for input into the Fire Management Information System (FMIS) within 20 days of the fire being declared out. Copies of reports from the Contra Costa County FPD will be obtained and report will be written to summarize the specifics of the fire, actions taken and outcomes from those actions. A formal review will be conducted on all serious injuries and losses of significant resources.

FIRE INVESTIGATION

Fire management personnel will attempt to locate and protect the probable point of origin and record pertinent information required to determine fire cause. They will be alert for possible evidence, protect the scene and report findings to the fireline supervisor.

The Refuge Manager, FMO, or IC may request a fire investigator through the Contra Costa County FPD. Prompt and efficient investigation of all suspicious fires will be carried out. However, fire management personnel should not question suspects or pursue the fire investigation unless they are currently law enforcement commission qualified.

Personnel and services of other agencies may be utilized to investigate wildland fire arson or fire incidents involving structures. All fire investigations should follow the guidelines outlined in 4.1-2 of the Fire Management Handbook (2000).

PRESCRIBED FIRE ACTIVITIES

PRESCRIBED BURN PROGRAM OBJECTIVES

Prescribed fire can be a useful tool for restoring and maintaining natural conditions and processes at Antioch Dunes NWR.

Specific management needs for the refuge as a whole and for specific areas will be determined annually. Specific burn objectives, fire frequency rotation, firing methodology, and prescriptions will vary from year to year. Burn plans will be updated to reflect any variations. Project Leader will approve prescribed fire plans.

There are two main objectives for the Antioch Dunes NWR: 1) To protect, enhance, and recover populations of endangered, threatened, and rare species of the Antioch Dunes Ecosystem, and 2) To protect, restore, and enhance the Antioch Dunes ecosystem for a diversity of native plant and insect species.

Historically, many factors have contributed to the decline of the three endemic endangered species: Antioch Dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Currently, however, the primary threat to these species is competition with non-native vegetation. The primrose appears to be particularly vulnerable to non-native vegetation encroachment. Despite Refuge management efforts to control non-native species by hand pulling and herbicide treatment, primrose numbers have decreased substantially in recent years. If non-native vegetation is not controlled, extinction of the primrose is highly likely.

While a wildland fire could negatively impact endangered plant populations, a properly timed prescribed fire would reduce competition from non-natives and create more suitable habitat for endangered and native species, which are dependant on relatively open, sand dune habitat. Objectives of prescribed fire in the Antioch Dunes NWR would be to: 1) Eliminate existing non-native plants and their seed heads, 2) Reduce hazardous fuels and organic matter, 3) Reduce the non-native seed bank, 4) stimulate native plant growth and 5) Prepare the area for transplanting endangered plants by exposing sandy soil substrate.

A multi-year prescribed burning program has been implemented encompassing both the Stamm and Sardis Units of the Antioch Dunes NWR. In the initial year, several sites (each approximately 3-5 acres in area) were burned according to a detailed prescribed burn plan. Sites selected had high densities of non-natives (primarily annual grasses, yellow star thistle, and Russian thistle), and few endangered species. A monitoring program was initiated to measure vegetation response in the burn areas and in non-burned control plots. If the results are favorable, additional areas on the Stamm and Sardis Units will be burned on a rotational basis in subsequent years. Endangered species and other native species would be planted in the burned areas after the non-native seed bank has been reduced.

Small experimental plots (each approximately 7 sq. yards) containing primrose and buckwheat were also burned in order to test the response of these native species to fire. This step is important because it is assumed that fire was not a component of these species' natural ecosystem, so the results on native species is difficult to predict.

All planned ignitions will be accomplished using qualified personnel. This will include annual refresher training as stated in the Service Fire Management Preparedness and Planning Handbook (See section 1.5.1).

Prescribed fires involve the use of fire as a tool to achieve management objectives. Research burning may also be conducted when determined to be necessary for accomplishment of research project objectives. Actions included in the prescribed burn program include: the selection and prioritization of prescribed burns to be carried out during the year, prescribed burn plans, burn prescriptions, burn operations, documentation and reporting, and burn critiques.

Several units of 3-5 acres each will be burned in any one season. Only one burn will be executed at a time. Fuel types are primarily annual grasses, annual forbs, and some perennial brush species (Fire Behavior Fuel Models 1 and 3). There are several smoke sensitive areas in the vicinity: The City of Antioch lies west, south and east of the Antioch Dunes NWR, and smoke could drift over the area. The railroad lies directly south of the Refuge. Due to the small size of the areas proposed for burn, and the fine nature of the fuels, consumption of target fuels would take a short time (about an hour), minimizing the amount of smoke. Public concern about prescribed burning is anticipated to be low because it will be over with quickly and without any lingering smoke. Past prescribed burns conducted at Antioch Dunes NWR have shown that smoke rapidly dissipates if burning occurs during unstable atmospheric conditions.

FIRE MANAGEMENT STRATEGIES

All prescribed fire activity will comply with applicable Federal, state, and local air quality laws and regulations. All prescribed fire projects will have a burn plan approved by the Project Leader. Each burn plan will be prepared using a systematic decision-making process, and contain measurable objectives, predetermined prescriptions, and using an approved environmental compliance document. Appropriate NEPA documentation and Section 7 consultation (see Refuge CCP) exist for this Fire Management Plan. Therefore, additional NEPA documentation will be necessary only for prescribed fire projects not meeting the criteria outlined in this Plan.

Prescribed Fire Burn Plans must include components such as a Go/ No-Go Checklist, contingency actions to be taken in the event the prescription is exceeded, and the need for alerting neighbors and appropriate public officials to the timing and the planning of the burn. A burn plan format meeting all required needs is located in Appendix E.

Fire monitoring will be used to evaluate the degree to which burn objectives are accomplished. Monitoring can assist managers in documenting success in achieving overall programmatic objectives and limiting occurrence of undesired effects.

PRESCRIBED FIRE PLANNING

The two existing Refuge units, Stamm Unit (41 acres) and Sardis (14 acres) also serve as discrete Fire Management Units. Within these units, there are currently two Prescribed Burn Areas identified for the Stamm Unit (Hardpan 1 and Vineyard), and one Prescribed Burn Area identified for the Sardis Unit (South Plateau; Figures 1-3). These will likely be expanded or additional units identified in the future.

The prescribed burning season is May-June. During these months, the grasses are dry enough to carry a hot fire that is required to reduce the non-native seed bank and the seed heads. Yellow star-thistle would

be approximately 5% flower during this time, which is the optimum time to burn it because the fire would destroy the thistle before it produces seed, yet it will have expended enough energy to prevent regrowth.

This correlates with overall Fire Management Objectives to: 1) Use prescribed fire to accomplish resource management objectives, and 2) Protect endangered species and other native species from a large scale wildland fire, which could potentially wipe out all, or major portions of, available habitat.

Annual Activities

The FMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary, personnel utilized, and fire effects.

The Refuge Manager, Biologist, and FMO will determine burn unit priorities, timing, and burn plan development schedule by February of each year. Burn Plans will be prepared and submitted for Project Leader review and approval by April. The Burn Plan will be submitted to the Air Quality District by April 30 for smoke management review and authorizing letter.

Prescribed Fire activities will be reviewed annually. Necessary updates or changes to the Fire Management Plan will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan.

Prescribed Burn Plan

The Prescribed Burn Boss will conduct a field reconnaissance of the proposed burn location with the FMO, AFMO, PFS, biologist, and/or Refuge Manager to discuss objectives and special concerns, and to gather all necessary information to write the Burn Plan. After completing the reconnaissance, the a qualified Burn Boss will write the Prescribed Burn Plan.

All prescribed fires will have Prescribed Burn Plans. The Prescribed Burn Plan is a site specific action plan describing the purpose, objectives, prescription, and operational procedures needed to prepare and safely conduct the burn. The treatment area, objectives, constraints, and alternatives will be clearly outlined. No burn will be ignited unless all prescriptions of the plan are met. Fires not within those parameters will be suppressed. Prescribed Burn Plans will follow the format contained in Appendix E. Each burn plan will be reviewed by the Refuge Manager, Biologist, FMO/AFMO, PFS, and Burn Boss. The Project Leader has the authority to approve the burn plan. The term Aburn unit@ refers to a specific tract of land to which a Prescribed Burn Plan applies.

Strategies and Personnel

Execution of prescribed burns will only be executed by qualified personnel. The Prescribed Burn Boss will fill all required positions to conduct the burn with qualified personnel. All personnel listed in the Burn Plan must be available for the duration of the burn or the burn will not be initiated. Personnel will meet minimum USFWS fitness and qualifications standards for prescribed burning.

Weather and fuel moisture conditions must be monitored closely in planned burn units to determine when the prescription criteria are met. A belt weather kit may also be utilized to augment monitoring. Fuel moisture samples of 10-, 100-, and 1000-hour down and dead logs (where applicable) and of live plants

may be monitored each week and percent moisture contents figured to help determine when the prescription criteria are met.

When all prescription criteria are within the acceptable range, the Prescribed Burn Boss will select an ignition date based on current and predicted weather forecasts. A thorough briefing will be given by the Prescribed Burn Boss and specific assignments and placement of personnel will be discussed. An updated spot weather forecast will be obtained on the day of ignition and all prescription elements will be rechecked to determine if all elements are still within the approved ranges. If all prescription elements are met, a test fire will be ignited to determine on-site fire behavior conditions as affected by current weather. If conditions are not satisfactory, the test fire will be suppressed and the burn will be rescheduled. If conditions are satisfactory the burn will continue as planned.

Depending upon the complexity of the burn, two or more fire crews (3 crew members per crew) from the Central Valley Refuges Zone and 3-4 collateral fire duty personnel from San Francisco Bay NWRC may be needed to ignite, hold, and mop-up the burn. In addition, personnel and equipment from Contra Costa County FPD shall be available in the event that fire spreads outside Refuge property and into their local responsibility area. A qualified Prescribed Burn Boss Type II or higher will be required to write the Burn Plan and serve as Burn Boss during any planned ignitions

One person with botanical/sampling design expertise will also be needed to conduct pre and post burn monitoring. One person with biological/botanical expertise will be needed to assist in developing site specific prescribed burn plans.

Only qualified personnel will be used to conduct burns on the Refuge. Pre- and post-fire briefings will be conducted on all planned ignitions.

Coordination needed with the following entities:

- Bay Area Air Quality Management District: Written approval required; Burn Plan needs to be submitted 30 days in advance of planned ignition; day of fire approval required.
- City of Antioch Public Works: Needs to be contacted 1 week prior to proposed burn date.
- City of Antioch Police Department: Needs to be contacted the day of the burn to notify them of potential smoke across roads.
- Contra Costa County FPD: Needs to receive copy of prescribed burn plan 1 month in advance.
- Burlington Northern Railroad: Needs to be contacted 1 week prior to burn to advise them of potential smoke across tracks.
- Pacific Gas and Electric Company; Georgia Pacific Company and other adjacent landowners: Adjacent or nearby landowners need to be contacted 1 week prior to the burn so that vehicles are moved and employees are aware of the burn.

The Refuge will procure burn permits and follow procedures in them. In addition, the Zone Fire Management Officer or an individual qualified at the Prescribed Burn Boss Type II level will write a Burn Plan to be approved by the Project Leader. The guidance and format for writing Burn Plans is found in the Service's Prescribed Fire Management Handbook, Section 2.2. All ignitions require a DI-1202 form to completed and returned to the responsible fire management officer for input into the Fire Management Information System (FMIS) within 20 days after the fire is declared out.

If the prescribed burn escapes the predetermined burn area, all further ignition will be halted except as needed for suppression efforts. Suppression efforts will be initiated, as discussed in the preburn briefing. The FMO will be notified immediately of any control actions on a prescribed burn. If the burn exceeds the initial suppression efforts, the burn will be declared a wildland fire and suppressed using guidelines established in this plan. If a prescribed burn is declared a wildland fire, all personnel must meet NWCG qualifications and fitness levels for wildland fire activities. A WFSA will be completed and additional personnel and resources ordered as determined by the Incident Commander. If the fire continues to burn out of control, additional resources will be called from the local cooperating agencies via the servicing dispatch. A management overhead team may be requested to assume command of the fire.

Recommendations of the Bay Area Air Quality Management District will be followed which will satisfy the District's criteria for use of the "72-Hour Outlook/48-Hour Decision" forecasting procedure. These may include restrictions on igniting under certain wind speeds/directions, humidity, or other conditions that would cause local air quality to be degraded. Other conditions under which fires will not be ignited include: east wind conditions, Red Flag Warnings /Watches as determined by Contra Costa County FPD, situations where local fire department resources are over committed to wildland fires in the Bay Area (i.e., Oakland Hills Fire 1991 or Vision -Pt. Reyes Fire 1995). The prescribed fire plan will also identify other "no-go" or suppression criteria. Prior to any planned ignitions, Burn Boss will contact Contra Costa County FPD Emergency Communications Center to determine resource availability in case of an escaped burn.

Monitoring and Evaluation

Monitoring of prescribed fires is intended to provide information for quantifying and predicting fire behavior and its ecological effects on refuge resources while building a historical record. Monitoring measures the parameters common to all fires: fuels, topography, weather and fire behavior. In addition, ecological changes such as species composition and structural changes will be monitored after a fire. This information will be very useful in fine-tuning the prescribed burn program.

All wildland fires will be appropriately suppressed. However, monitoring wildland fires may be appropriate and potentially valuable in mapping and documenting the growth of the fire, measuring on-site weather and fuel loading to provide the fire staff with present and expected fire behavior and effects. During prescribed burns, monitoring can serve as a precursor to invoking suppression action by determining if the fire is in prescription, assessing its overall potential, and determining the effects of the prescribed burn.

During prescribed burning, monitoring should include mapping, weather, site and fuel measurements and direct observation of fire characteristics such as flame length, rate of spread and fire intensity. Operational monitoring provides a check to insure that the fire remains in prescription and serves as a basis for evaluation and comparison of management actions in response to measured, changing fire conditions, and changes such as fuel conditions and species composition.

Fires may be monitored regardless of size. The FMO will establish specific fire information guidelines for each fire to update intelligence about the fire. Highest priority for monitoring will be assigned to large fires or fires which threaten to leave the refuge.

Short term: BEHAVE predictions will be used to model fire behavior, and a belt weather kit will be used to monitor actual burn day conditions.

Long term: The response of native and non-native vegetation to fire will be monitored. Plant species composition and percent cover will be measured pre- and post-burn for certain native and weed species of concern.

Monitoring must be done to document and verify that the stated objectives have been met. Plots, photo points, or other methods will be developed to document the results of the burn. These data will be stored for future refinement of prescriptions and to determine the success of the program.

Required Reports

All prescribed burn forms will be completed as outlined by the Prescribed Burn Boss. A monitor will be assigned to collect all predetermined information and complete all necessary forms prior to, during, and after the burn. All records will be archived in the refuge's fire records for future use and reference.

The Prescribed Burn Boss will prepare a final report on the prescribed burn. Reports will include a calculations of particulate matter emissions and a monitoring report. Information will include a narrative of the burn operation, a determination of whether objectives were met, weather and fire behavior data, map of the burn area, photographs of the burn, number of work hours, and final cost of the burn.

Prescribed Burn Critique

A report detailing the actual burn will accompany any recommendations or changes deemed necessary in the program. This report will be submitted to the Refuge Project Leader. A post-season critique of the fire management program, including the prescribed burn program, will be held each year at the conclusion of the fall fire season.

AIR QUALITY / SMOKE MANAGEMENT GUIDELINES

Air quality is monitored and managed by the Bay Area Air Quality Management District. Although they do not issue Burn Permits, they do grant permission to burn if a burn proposal falls under one of their open burning categories. In order to qualify for one of their open burning categories (Regulation 5), the Refuge needs to determine which category best meets the intent and objective of the project. Previous burns at Antioch Dunes NWR fell under Regulation 5-Open Burning, Section 8 Allowable Fires, Subsection P-Wildland Vegetation Management, 401.16. In addition, Section 5-408 sets forth those requirements needed to conduct prescribed burning. These requirements need to be adhered to in order to receive permission to conduct a prescribed burn.

In order to obtain permission to burn under this category, a Burn Plan must be submitted to the Enforcement Branch at least 30 days prior to burning. BAAQMD grants permission to burn on a case-by-case basis. There is no recurring or annual burn permit/ permission. The Refuge will need to obtain permission for each burn project planned. The Refuge will follow all conditions contained in the letter of permission.

Specific aspects of a Smoke Management Plan (wind, weather, visibility hazard, and residual smoke problems) will be addressed in Prescribed Burn Plans prepared for each burn.

FIRE RESEARCH

The Refuge will continue collecting data and monitoring the success or failure of burning conditions required to accomplish objectives of controlling non-native vegetation and restoring riverine sand dune habitat. Weather conditions will be recorded to establish future successful/ideal burning results. Normal fire program monies are not intended to fund fire research activities.

The Refuge has identified a research need to determine the short-term and long-term effects of prescribed burning on invertebrate abundance and diversity. Data collected will be presented to the refuge as results become available.

PUBLIC SAFETY

Antioch Dunes NWR is dedicated to ensuring the safety of all residents and property adjacent to the refuge's boundary.

Firefighter and pubic safety will always take precedence over property and resource protection during any fire management activity. For public safety, the fire scene will remain clear of unauthorized people. The responsibility for managing public safety lies with the Incident Commander (IC) or Burn Boss for wildland or prescribed fire. Public safety considerations will be included as part of the burn prescription.

Due to the proximity of Wilbur Road to the Refuge, Burn Boss and Refuge Manager will coordinate traffic control along Wilbur Road with Refuge Law Enforcement Officers and local law enforcement when burns are conducted.

Due to the proximity of the Burlington Northern Santa Fe Railroad to the Refuge, Burn Boss and Refuge Manager will notify Railroad Security Officers of planned burns.

See Appendix H for list of adjacent landowners with phone numbers and addresses for notification purposes.

During prescribed burns at least one burn team member will have first aid training. A first aid kit will be on-site for prescribed burns as well as wildland fires. The local police, fire, and emergency medical services will be notified prior to the ignition of any prescribed burn. They will also be notified of the location of any wildland fires.

PUBLIC INFORMATION AND EDUCATION

Educating the public on the value of fire as a natural process is important to increasing public understanding and support for the fire management program. The refuge will use the most appropriate and effective means to explain the overall fire and smoke management program. This may include supplemental handouts, signing, personal contacts, interpretive signs, or media releases. When deemed necessary, interpretive presentations will address the fire management program and explain the role of fire in the environment.

Informing the public is an important part of the fire management program. During a wildland fire, the IC is responsible for providing information to the public. Prescribed fire public information has been further addressed in the Prescribed Fire Plan and the Environmental Assessment (See Appendices C and D).

The public information program will be developed as follows:

1. Concepts of the prescribed burn program will be incorporated, as appropriate, in publications, brochures, and handouts.
2. The fire management program may be incorporated into visitor contacts. Particular attention will be given when fires are conspicuous from roads or visitor use areas.
3. News releases will be distributed to the media as appropriate.
4. The public information outlets of neighboring and cooperating agencies and the regional office will be provided with all fire management information.
5. The fire management program will be discussed in informal talks with all employees, volunteers, residents, and neighbors.

Prior to the lighting of any planned ignition, information will be made available to visitors, local residents, and/or the press about what is scheduled to happen and why. This information will include prescribed burn objectives and control techniques, fire location and expected behavior, effects caused by the fire, and potential impacts on private and public facilities and services.

FIRE CRITIQUES AND ANNUAL PLAN REVIEW

FIRE CRITIQUES

Fire reviews will be documented and filed with the final fire report. The FMO will retain a copy for the refuge files.

ANNUAL FIRE SUMMARY REPORT

The FMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary (prescribed burns and wildland fires), personnel utilized, and fire effects.

ANNUAL FIRE MANAGEMENT PLAN REVIEW

The Fire Management Plan will be reviewed annually. Necessary updates or changes will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan.

The fire management plan will be updated as major policy decisions are made. At a minimum, this plan will be reviewed once a year by the individual on the Refuge with fire responsibility to maintain the integrity of the plan. Amendments to the fire management plan itself will be made as needed by sending them to the Regional Fire Management Coordinator for concurrence and to be approved by the Regional Director in Portland. Minor changes to the appendices, such a phone number corrections and personnel changes, can be made at the Refuge level and attached to the plan during this yearly review process without involvement of the Regional Office.

CONSULTATION AND COORDINATION

The following agencies, organizations and/or individuals were consulted in preparing this plan.

Chris Bandy, Refuge Manager, Antioch Dunes NWR, Newark, CA

Roddy Baumann, Prescribed Fire Specialist, Pacific Region, USFWS, Portland, OR.

Rachel Hurt, Biologist, San Francisco Bay NWRC, USFWS, Fremont, CA.

Richard Hadley, Assistant Refuge Supervisor, California/ Nevada Operations, USFWS, Sacramento, CA.

Ivette Loredo, Refuge Biologist, Antioch Dunes NWR, USFWS, Fremont, CA

Amanda McAdams, Fire Planner, Pacific Region, USFWS, Portland, OR.

Tom Romanello, Assistant Fire Management Officer, Sheldon-Hart NWR, Lakeview, CA.

APPENDICES

APPENDIX A: REFERENCES CITED

Bailey, R.G. 1995. Description of the ecoregions of the United States. USDA Forest Service. 108 pp.

Green, J.A. 1995. Three reproductive ecology studies in the narrow endemic *Oenothera deltoides* ssp. *howellii* (Onagraceae). M.A. Thesis, Claremont Graduate School.

Loredo, Ivette. USFWS, Personal Communication, 7/2001.

APPENDIX B: DEFINITIONS

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices or services of the Department.

Class of Fire (as to size of wildland fires):
Class A - 3 acre or less.
Class B - more than 3 but less than 10 acres.
Class C - 10 acres to 100 acres.
Class D - 100 to 300 acres.
Class E - 300 to 1,000 acres.
Class F - 1,000 to 5,000 acres.
Class G - 5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC) A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.

Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.

Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.

Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.

Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.
Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

Natural fire. A fire of natural origin, caused by lightning or volcanic activity.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.

NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to realize maximize net benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.

Prevention Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation (1) Actions to limit the adverse effects of suppression on soils, watershed, or other values, or (2) actions to mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.

Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildfire. An unwanted wildland fire.

Wildland Fire. Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

Wildland/urban interface fire A wildland fire that threatens or involves structures.

APPENDIX C: NEPA COMPLIANCE

Final ENVIRONMENTAL ASSESSMENT

Prescribed Burn Program

Antioch Dunes National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex

Under the authority of the National Wildlife Refuge System Administration Act of 1966 and Endangered Species Act of 1973

Contra Costa County, California

Prepared by: Erin C. Fernández
Title: Wildlife Biologist
Duty Station: San Francisco Bay National Wildlife Refuge Complex
April 1997

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Figure 1. Antioch Dunes National Wildlife Refuge . . . . . (Please Refer to FMP)

ABSTRACT

This environmental assessment evaluates alternatives for managing non-native vegetation on the 55-acre Antioch Dunes National Wildlife Refuge (Refuge). The preferred alternative would utilize prescribed burning as a management tool to eliminate non-native vegetation from the Refuge. This unique Refuge was established in 1980 in order to protect three endemic endangered species: the Antioch Dunes evening primrose, Contra Costa wallflower, and the Lange's metalmark butterfly. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently, however, the primary threat to these species is competition with non-native vegetation. The preferred alternative will drastically reduce the amount of non-native vegetation present at the dunes. Prescribed burning will assist in restoration of the Refuge and enhance habitat for endangered and other native species. No significant adverse socioeconomic impacts to the area are anticipated.

Section I: PURPOSE AND NEED FOR ACTION

The 55-acre Antioch Dunes National Wildlife Refuge (Refuge) and adjacent 12-acre Pacific Gas and Electric (PG&E) land support the last remaining populations of three endangered species including the Antioch Dunes evening primrose (Oenothera deltoides ssp. howellii), Contra Costa wallflower (Erysimum capitatum ssp. angustatum), and the Lange's metalmark butterfly (Apodemia mormo ssp. langei). The primary objective of the Refuge is to provide habitat for these three endemic endangered species. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently the primary threat to these species is the encroachment of non-native vegetation such as rip-gut brome grass (Bromus diandrus) and yellow starthistle (Centaurea solstitialis).

United States Fish and Wildlife Service (Service) staff actively manages these endangered species by conducting annual population surveys and through habitat restoration. Management tools include the Non-native Vegetation Management Program, which currently includes hand pulling and herbicide treatment of non-natives. Despite our management efforts however, numbers of primrose continue to decline primarily due to competition with weed species.

Primrose numbers have decreased substantially in recent years. There were 5,800 mature primrose in 1984, and only 963 mature primrose in 1996, a decrease of 83%. Primrose appears particularly vulnerable to non-native vegetation encroachment. Green (1995) in her thesis, *Three Reproductive Ecology Studies in the Narrow Endemic Oenothera deltoides ssp. howellii*, found no primrose seedlings around mature primrose that were surrounded by weed species, yet seedlings were found around 40% of mature primrose that were not surrounded by weed species. If non-native vegetation is not controlled, extinction of natural populations of primrose is highly likely.

In order to restore the primrose, the Service must improve and expand our current non-native vegetation management techniques. Ecologists, including Joseph DiTomaso (University of California, Davis), John Rusmore (UC Davis), John Randall (UC Davis), Bruce Pavlik (Mills College) and Martha Hastings (California Department of Parks and Recreation), have advised the Service that prescribed burning will create more suitable habitat for endangered species dependant on the historic sand-dune environment. Prescribed burning of selected areas will control non-native vegetation which will serve to stabilize and increase populations of the primrose and other endangered native species.

Section II: ALTERNATIVES INCLUDING THE PROPOSED ACTION

A. No Action Alternative

This alternative would maintain the status quo of continued hand pulling of weeds and selective herbicide use only. Currently, volunteers and Refuge staff annually pull non-native vegetation approximatley once every two weeks in the spring and summer. Refuge staff spray weeds with herbicide once a year in the spring to create a small buffer zone between high desities of endangered species and non-native species.

B. Prescribed Burning Alternative (Proposed action)

This alternative would allow prescribed burning to be used as a tool for endangered species management. Selected dune sites of manageable size would be burned under predetermined conditions, every year or every other year, in order to remove non-native vegetation until the non-native seed bank is exhausted. Burning would then be conducted on an as-needed basis. This will enhance existing habitat and create more suitable habitat for endangered and native species, which are dependant on relatively open, sand-dune habitat.

The first year the Service proposes to burn three, approximately three acre sites on the Refuge that are dominated by non-native vegetation, have very few natives, and a few endangered species. We will establish non-burned control plots similar in vegetative composition to the burn areas. We will monitor both control and non-control areas for species richness and percent cover before and after the burn. We will analyze before and after burn data, as well as compare control areas to burned areas in order to determine the response of non-native vegetation to fire. We will plant native and endangered species in these areas after the non-native seed bank has been substantially diminished, which may take up to three years of burning. If this method proves successful, additional areas will be burned on a rotational basis and subsequently replanted with native and endangered species.
We also propose to burn 15 experimental plots (7 sq. y.) with primrose and buckwheat in order to test the response of primrose and buckwheat to fire. This will be done through the use of a burn box in which we can contain a small fire hot enough to scorch the existing vegetation. Ten of the plots will have one to two primrose, a few natives and many non-natives. Five of the plots will contain buckwheat in order to test the response of buckwheat to fire. We will establish 15 non-burned control plots similar in vegetative composition to the burn areas and monitor these areas for species richness and percent cover before and after the burn. We will analyze before and after burn data, as well as compare control areas to burned areas in order to determine the response of non-native and native vegetation to fire.

The Refuge will monitor prescribed burn plots by recording environmental factors and locating sites with a Global Positioning System. We will monitor areas for native and non-native species richness and percent cover before and after the burn in order to compare control areas to burned areas, as well as to track annual progress of the sites. We will use a combination of line transects and fixed plots to monitor vegetation. We will monitor vegetation both in the middle of these burn plots as well as toward the edge of the burn plot so that we may be able to detect differences in the amount of non-native vegetation resprouting from the residual seed source versus the amount of non-native vegetation encroaching on the burn area from peripheral areas.

Burning would primarily be conducted in May or June in order to achieve two objectives: 1) kill the existing non-native plants and their seed heads; and 2) exhaust the non-native seed bank. In May/June, the grasses will be dry enough to carry a hot fire that is required to destroy the non-native seed bed and the seed heads. The yellow-star thistle should be under 5% flower at this time. This is the optimum time to burn it because the fire would destroy the thistle before it produces seed, yet it will have expended enough energy that it should not regrow in that season. Burning may take place at a less optimum time depending on allowable burn days, however, any burn from spring through fall will help to reduce the non-native seed bank.

C. Increased Weeding Effort Alternative

This alternative would allow only for increased manual removal of exotic vegetation and would preclude prescribed burning as a tool in any management. Work crews would manually pull non-native vegetation every year in order to create suitable habitat for endangered species. The Refuge would require additional full time staff in order to reduce non-native vegetation through manual methods. Vegetation would be monitored using methods similar to that described in Alternative B.

D. Grazing Alternative

This alternative would allow grazing, in addition to ongoing weed control measures, and would preclude prescribed burning as a tool in any management. Livestock would graze selected areas on a rotational schedule to remove non-native vegetation. Vegetation would be monitored using methods similar to that described in Alternative B.

E. Heavy Equipment Alternative

This alternative would allow for the use of mowing, disking, and plowing at the Refuge to control non-native vegetation and would preclude prescribed burning as a tool in any management. Selected areas of the Refuge would be mowed, disked, and/or plowed to remove non-native vegetation. Vegetation would be monitored using methods similar to that similar to that described in Alternative B.

Section III: AFFECTED ENVIRONMENT

A. Background information

The Refuge is located along the southern shore of the lower San Joaquin river near the city of Antioch, Contra Costa County, California (Fig. 1). The Refuge lies within an ecoregion described by Bailey (1995) as the Mediterranean Division, California Dry Steppe Province. Historically, the Antioch Dunes extended over two miles along the southern bank of the San Joaquin river and reached heights of 117 feet. The 55-acre Refuge was extensively mined for sand in the past and subsequently ranges in elevation from 0 to 50 feet. The Refuge currently exists as an isolated habitat, surrounded by industrial development.

B. Climate

The Antioch area has a modified Mediterranean climate with warm to hot dry summers and moist, mild winters. Rainfall averages 12.53 inches annually, falling mainly during November-April. The average annual temperature is 61.8 degrees F with an average annual maximum temperature of 74 degrees F and an average annual minimum temperature of 47 degrees F. The hottest recorded temperature is 114 degrees F, and the lowest recorded temperature is 14 degrees F. Winds in the summer come off the river from the west or northwest at an average of 10-20 mph.

C. Soils

Soils in the Refuge are representative of the Oakley sands interlaced with alluvial fan deposits. The Sardis unit (14 acre eastern parcel) was mined down to a clay/peat substrate for the most part and

subsequently sand was replaced over many of these areas. The perimeter still consists of sandy loam substrate. The Stamm unit (41 acre western parcel) has a "hard pan" layer of varying thickness but underneath this hard pan is sandy loam. Sand was replaced over a small portion of the mined area of the Stamm unit as well.

D. Vegetation/Wildlife

Six main habitat types are found within the 55-acre Refuge: littoral, riparian, open sand dunes, abandoned vineyard, disturbed/mined areas and grassland areas. The littoral zone contains a state listed rare plant: Mason's lilaeopsis (Lilaeopsis masonii). The riparian area is characterized by native species such as, but not limited to, coast live oak (Quercus agrifolia), red willow (Salix laevigata), narrow-leaved willow (Salix exigua), arroyo willow (Salix lasiolepis), California toyon (Heteromeles arbutifolia) and elderberry (Sambucus mexicana). The open dune areas consist of primarily native species including: Antioch dunes evening primrose, Contra Costa wallflower, both federally listed as endangered, naked-stemmed buckwheat, host plant for the endangered Lange's metalmark butterfly, telegraph weed (Heterotheca grandiflora), Senecio flaccidus var. douglasii, deerweed (Lotus scoparius) and many others (see attachment A for complete list of plant species). In the disturbed, grassland, and vineyard areas there is an abundance of non-native species including rip-gut brome grass, yellow starthistle, Russian thistle (Salsola tragus), as well as some native species.

The Refuge provides important habitat for many types of wildlife including: nesting and migratory bird species and the California legless lizard (Aniella pulchra pulchra).

Section IV: ENVIRONMENTAL CONSEQUENCES

The principal environmental and socioeconomic effects are outlined in Table 1 and discussed in the following text.

A. No Action Alternative

The no action alternative would result in non-native vegetation continuing to inhibit the survival of endangered species at the Refuge. The Antioch dunes evening primrose would continue to decrease and the currently stable populations of Contra Costa wallflower and naked-stemmed buckwheat (host plant for the Lange's metalmark butterfly) could begin to decline. As non-native species encroach, the potential for a devastating wildland fire increases.

If additional non-native vegetation control measures are not taken now, the problem will only be exacerbated, non-native species will increase, and more frequent and costly control measures could have to be taken in order to halt the spread of non-native species. Under the No Action alternative, there is high potential that the Antioch dunes evening primrose would be eliminated from its historic range. This inability of the Refuge to provide suitable habitat for endangered species is inconsistent with the Refuge's goals and conflicts with Service goals of recovering endangered species.

B. Prescribed Burning Alternative

Cut firelines, existing roads, and other control techniques that will be utilized to prevent escaped burns will prevent the escape of fire into areas where concentrations of endangered species occur. The selection of, and adherence to, a proper prescription and careful coordination with the Bay Area Air Quality Management District, the Contra Costa Fire Department, Service Ecological Services Office, and Service Regional Fire Management Officer will greatly limit the chance of an escaped burn.

For the first three years, the large burn plot areas within the Refuge will be carefully selected to avoid endangered species. However, a few primrose, wallflower, and buckwheat plants could be within a burn area and would be temporarily adversely affected. The Lange's metalmark butterfly may be detrimentally affected by burning its host plant, naked stemmed buckwheat. The small burn plots will be selected to contain a few endangered species so that we can closely monitor their response to fire. These species would be temporarily adversely affected. During the first three years, only buckwheat that was hand planted by the Service approximately five years ago and poor butterfly production stands will be burned. A Section 7 consultation has been requested.

Proposed burn areas will be thoroughly surveyed for any native bird nests prior to burning. If any nests are found, these areas will not be burned.

On a long-term scale, endangered and other native species will benefit from the removal of exotic species. Also, habitats, including designated critical habitat for the primrose and wallflower, will be enhanced. If burning non-native vegetation proves successful at restoring native and endangered species habitat, further large plots and small experimental plots will be selected for burning. If endangered species respond favorably to burning methods, areas will be burned on a continual, rotational basis. High butterfly producing stands and areas with high density of endangered and native species will not be selected for burning methods of vegetation control. These sensitive areas will continue to be maintained through hand-weeding efforts.

Prescribed burning will entail some economic costs to the Service; however, this is considered the most cost effective method to remove large areas of exotic vegetation. The aesthetic quality (scenery and odor) of the Antioch area will be temporarily altered because of smoke from the fire. However, prescribed burning will greatly mitigate potential future negative impacts resulting from wildland fires by reducing a thick fuel layer.

C. Increased Weeding Effort Alternative

In some locations, this alternative would remove non-native vegetation and produce desired results. Endangered species, species of special concern, critical wildlife habitat, species diversity/abundance, and non-game species would all be positively affected by increased manual removal of non-native vegetation.

However, this would not fully solve the problems because manual removal of non-native vegetation would require a long period of time due to the large size of areas that need to be weeded and does not remove the non-native seed bank. During this period, the Antioch Dunes evening primrose could continue to decline and other currently stable species could begin to decline.

The Refuge would require two to three additional full time staff members to assist with non-native vegetation removal. This would require substantial additional funding.

D. Grazing Alternative

Endangered species, species of special concern, critical wildlife habitat, species diversity/abundance, and non-game species may be positively affected by cattle grazing due to the decrease in non-native species. However, this method would not effectively remove the non-native seed bank which may detrimentally affect endangered species. Additionally, if cattle escaped fenced areas they could cause vehicular highway accidents.

It would be difficult to contain cattle in areas devoid of endangered species. If cattle escaped from fenced areas they could severely detrimentally impact endangered and other native species at the Refuge by trampling them or directly consuming them. Since the only source of water for the cattle is the river, this alternative could result in detrimental impacts to the Mason's lilaeopsis, which grows in the littoral zone.

Because of the need to closely manage cattle rotations and the poor quality of forage, it would be difficult to find a rancher willing to meet these stringent requirements for such a small area. Grazing would require funds for the purchase and maintenance of fencing, and potentially for a contract with a cattle operator. The Refuge would require additional full time staff members to manage the grazing program.

E. Heavy Equipment Alternative

Endangered species, species of special concern, critical wildlife habitat, species diversity/abundance, and non-game species would all be positively affected by increased removal of non-native vegetation. Endangered species and species of special concern will be detrimentally affected if they are within a work site. Sites would be selected to minimize impacts to these species.
Heavy equipment could not effectively remove the non-native seed bank which may detrimentally affect endangered species.

Section V: CONSULTATION AND COORDINATION WITH OTHERS

All Refuge prescribed burns would be conducted under the restrictions imposed by the Bay Area Air Quality Management District, the Contra Costa County FPD, Fish and Wildlife Service Ecological Services Office, and the mandates of a Service Regional Fire Management Officer from preapproved plans by regional and on site biologists, to minimize any potential for negative impacts. The following ecologists were consulted in order to determine the optimum type and timing of the burn in order to eliminate exotic vegetation while enhancing endangered species habitat: Joseph DiTomaso (University of California, Davis), John Rusmore (UC Davis), John Randall (UC Davis), Bruce Pavlik (Mills College) and Martha Hastings (California Department of Parks and Recreation.

Prepared by: Erin Fernández
Title: Wildlife Biologist
Duty Station: San Francisco Bay National Wildlife Refuge Complex

Contributors: Harvey Hill, Deputy Project Leader
San Francisco Bay National Wildlife Refuge Complex

Margaret Kolar, Project Leader
San Francisco Bay National Wildlife Refuge Complex

Roger Wong, Fire Management Officer
San Luis National Wildlife Refuge Complex

Betsy Radtke, Refuge Manager
San Francisco Bay National Wildlife Refuge

Section VI: CONCLUSION AND RECOMMENDATIONS

Based on the analysis contained in this document, I find that implementation of the proposed action is compatible with the major purposes for which the Refuge was established. Alternative E (prescribed burning and the use heavy equipment) will improve habitat for endangered species and other wildlife in a cost effective manner. Therefore, Alternative E is the preferred alternative. It would not constitute an action significantly affecting the quality of the human environment and therefore, I recommend that a Finding of No Significant Impact (FONSI) be prepared.

_____*
Acting Project Leader
6/4/97
Date

_____*
Associate Manager
6/13/97
Date

* Original signatures on file at the Don Edwards San Francisco Bay NWR

LITERATURE CITED

Green, J.A. 1995. Three reproductive ecology studies in the narrow endemic Oenothera deltoides ssp. howellii (Onagraceae). M.A. Thesis, Claremont Graduate School.

Bailey, R.G. 1995. Description of the ecoregions of the United States. USDA Forest Service. 108 pp.

Attachment A
DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
Region 1, Portland, Oregon

FINDING OF NO SIGNIFICANT IMPACT

Final Environmental Assessment
for
Prescribed Burning of Dune Areas on
Antioch Dunes National Wildlife Refuge
Contra Costa County, California
P.O. Box 524
Newark, California 94560

The U.S. Fish and Wildlife Service has prepared an Environmental Assessment to evaluate the effects associated with prescribed burning on the Antioch Dunes NWR.

The U.S. Fish and Wildlife Service proposes to conduct an on going program of prescribed burning with a back up of heavy equipment use to restore dune habitat for endangered and other native species. Prescribed burns may be utilized throughout parts of the Refuge and will result in a significant decrease in the amount of non-native vegetation as well as an increase in native and endangered species with minimum costs economically and environmentally. The effects of burning on endangered and native species will be closely monitored. If burning proves beneficial, it will be continued on an on going rotational basis. If the window of opportunity to burn is missed in any given year, heavy equipment will be used as a back-up means to remove non-native vegetation as described in Alternative E.

The U.S. Fish and Wildlife Service has analyzed a number of alternatives to the proposal, including the following:

A) No Action
B) Prescribed Burning (Preferred Alternative)
C) Increased Weeding Effort
D) Cattle Grazing
E) Heavy Equipment Use

The preferred alternative was selected over the other alternatives because:

Prescribed burning is the most effective method to remove large amounts of non-native vegetation and the non-native seed bank. Other alternatives evaluated would not be effective in removing the seedbank. It is the most cost effective alternative and has minimal environmental and socioeconomic impacts.

Implementation of the preferred alternative would be expected to result in the following environmental and socioeconomic effects:

Study of the environmental effects of the proposal has shown that the preferred alternative could impact some individual plants of the Antioch dunes evening primrose, Contra Costa wallflower, and the naked stemmed buckwheat (host plant to the Lange's metalmark butterfly). However, the long-term effects will be beneficial to these species because a significant amount of non-native vegetation will be removed which will decrease competition between these species.

The aesthetic quality (scenery and odor) of the Antioch area will be temporarily altered because of smoke from the fire. Escaped fire could threaten endangered species and their habitat, private property, and public safety.

Measures to mitigate and/or minimize adverse effects have been incorporated into the proposal. These measure include:

Measures to mitigate and/or minimize adverse effects have been incorporated into the proposal. These measures include: 1) close coordination with the Service Regional Fire Management Officer, Contra Costa County FPD, Bay Area Air Quality Management District, and the Service Ecological Services Office; 2) selection of a proper burn prescription and cessation of burn activities when conditions exceed predetermined prescription levels; 3) the utilization of firebreaks (cut line, existing roads) around burn units to minimize any potential for wildland fire.

Prescribed burning will greatly mitigate potential future negative impacts resulting from wildland fires by reducing a thick fuel layer

The proposal is not expected to have any significant effects on the quality of the human environment because:

The action would have a beneficial effect on endangered and native species and their habitat on a long-term scale. The action would not degrade habitats, water, or air quality, and would not disrupt or conflict with any land use, social, cultural or economic factors.

Public Availability

A public notice was advertised in two newspapers, the Antioch Ledger and the Contra Costa Times, for three days to notify the public of the availability of the Draft Environmental Assessment and the 30 day comment period.

During a 30 day comment period, the draft Environmental Assessment was sent to the California State Clearing House, Pacific Gas & Electric, Santa Fe Rail Road, City of Antioch Public Works, Contra Costa County FPD, and G.P. Gypsum. Their comments were considered in the formation of the final Environmental Assessment.

Determination

Based on review and evaluation of the information contained in the Environmental Assessment, the U.S. Fish and Wildlife Service has determined that the proposed activity is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102 (2)(c) of the National Environmental Policy Act of 1969. Accordingly, the preparation of an Environmental Impact Statement on the proposed action is not required.

Issued in Portland, Oregon, June 13, 1997

_____*
Regional Director

6/13/97
Date

* Original signatures on file at the Don Edwards San Francisco Bay NWR

February 20, 1997

MEMORANDUM

To: Field Supervisor, Ecological Services, Sacramento, CA

From: Refuge Manager, San Francisco Bay NWR Complex S.F., CA

Subject: Review of the Intra-Service Section 7 Evaluation Form for prescribed burning at Antioch Dunes NWR

We are proposing to conduct prescribed burning and mowing/disking/plowing at Antioch Dunes NWR to control non-native vegetation and enhance endangered species habitat. All pertinent information related to endangered species is contained in this document. The Final Prescribed Fire Plan, which addresses the technical aspects and human safety issues of prescribed burning will follow later.

If you have any questions regarding this activity or its impacts, please contact Erin Fernández of my staff at (510) 792-0222.

Margaret T. Kolar

INTRA-SERVICE SECTION 7 EVALUATION FORM
CONSULTATION/CONFERENCE/CONCURRENCE

Originating Person: Erin Fernández, Wildlife Biologist

Date: February 20, 1997

I. Region: 1

II. U.S. Fish and Wildlife Service (Service) Activity:

Prescribed burning and mowing/disking/plowing at the Antioch Dunes National Wildlife Refuge to control non-native plant species and enhance habitat for three endangered species, the Antioch Dunes evening-primrose, Contra Costa wallflower, and the Lange's metalmark butterfly.

III. A. Listed Species which may be affected by the action:

Antioch Dunes evening-primrose (*Oenothera deltoides* ssp. *howellii*)
Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*)
Lange's metalmark butterfly (*Apodemia mormo* ssp. *langei*)

B. Proposed Species which may be affected by the action:

None

C. Category 1 Candidate Species which may be affected by the action:

None

IV. Geographic Area/Action:

Prescribed burning and mowing/disking/plowing at the Antioch Dunes NWR by the San Francisco Bay NWRC and the San Luis NWRC staff and fire crews to control non-native vegetation.

V. Location:

Sardis and Stamm units of the Antioch Dunes NWR, Contra Costa County (See attached map).

VI. Action Objectives:

The 55-acre Antioch Dunes National Wildlife Refuge (Refuge) was established to protect a unique riverine dune ecosystem, which in addition to adjacent Pacific Gas and Electric land, support the last natural populations of three endemic endangered species, the Antioch Dunes evening-primrose (*Oenothera deltoides* ssp. *howellii*), Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*), and the Lange's metalmark butterfly (*Apodemia mormo* ssp. *langei*). Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently, however, the primary threat to these species is the encroachment of non-native vegetation such as rip-gut brome grass (*Bromus diandrus*) and yellow starthistle (*Centaurea solstitialis*).

Fish and Wildlife Service staff actively manages these endangered species by conducting annual population surveys and through habitat restoration. Management tools include the Exotic Vegetation Management Program, which currently includes hand pulling and herbicide treatment of non-natives. Despite our management efforts, non-native plant species continue to outcompete with native species, such as the primrose.

Primrose numbers have decreased substantially in recent years. There were 5,800 mature primrose in 1984, and only 963 mature primrose in 1996, a decrease of 83%. Primrose appears particularly vulnerable to exotic vegetation encroachment. Green (1995) in her thesis, THREE REPRODUCTIVE ECOLOGY STUDIES IN THE NARROW ENDEMIC <u>OENOTHERA DELTOIDES</u> SSP. <u>HOWELLII</u>, found no primrose seedlings around mature primrose that were surrounded by weed species, yet seedlings were found around 40% of mature primrose that were not surrounded by weed species.

In order to restore endangered and native species habitat, the Service must improve and expand upon our current exotic vegetation management techniques. After consulting with ecologists, including Joseph DiTomaso (University of California, Davis), John Rusmore (UC Davis), John Randall (UC Davis), Bruce Pavlik (Mills College) and Martha Hastings (California Department of Parks and Recreation), it appears that prescribed burning and mowing/disking/plowing may enhance habitat restoration at the Refuge and create more suitable habitat for endangered and native species, which are dependant on the historic open, sand-dune environment. Burning and mowing/disking/plowing will remove non-native vegetation, and may subsequently decrease competition between endangered and exotic species. This may prove to be an effective method to stabilize and increase populations of endangered species.

Selected dune sites of manageable size would be burned under predetermined conditions, every year or every other year, in order to remove non-native vegetation until the non-native seed bank is exhausted. Burning would then be conducted on an as-needed basis. The first year the Service proposes to burn three, approximately three acre sites on the Refuge that are dominated by non-native vegetation, have very few natives, and no endangered species. We will establish non-burned control plots similar in vegetative composition to the burn areas. We will monitor both control and non-control areas for species richness and percent cover before and after the

burn. We will analyze before and after burn data, as well as compare control areas to burned areas in order to determine the response of non-native vegetation to fire. We will plant native and endangered species in these areas after the non-native seed bank has been substantially diminished, which may take up to three years of burning. If this

method proves successful, further areas will be burned on a rotational basis and subsequentially replanted with native and endangered species.

We also propose to burn 15 experimental plots (7 sq. y.) with primrose and buckwheat in order to test the response of primrose and buckwheat to fire. This will be done through the use of a burn box in which we can contain a small fire hot enough to scorch the existing vegetation. Ten of the plots will have one to two primrose, a few natives and many non-natives. Five of the plots will contain buckwheat in order to test the response of buckwheat to fire. We will establish 15 non-burned control plots similar in vegetative composition to the burn areas and monitor these areas for species richness and percent cover before and after the burn. We will analyze before and after burn data, as well as compare control areas to burned areas in order to determine the response of non-native and native vegetation to fire.

The Refuge will monitor prescribed burn plots by recording environmental factors and locating sites with a Global Positioning System. We will monitor areas for native and non-native species richness and percent cover before and after the burn in order to compare control areas to burned areas, as well as to track annual progress of the sites. We will use a combination of line transects and fixed plots to monitor vegetation. We will monitor vegetation both in the middle of these burn plots as well as toward the edge of the burn plot so that we may be able to detect differences in the amount of non-native vegetation resprouting from the residual seed source versus the amount of non-native vegetation encroaching on the burn area from peripheral areas.

Burning would be ideally conducted in May or June in order to achieve two primary objectives: kill the existing non-native plants and their seed heads and exhaust the non-native seed bank. In May/June, the grasses will be dry enough to carry a hot fire which is required to destroy the non-native seed bed and the seed heads. The yellow-star thistle should be under 5% flower at this time. This is the optimum time to burn it because the fire would destroy the thistle before it produces seed yet it will have expended enough energy that it should not regrow in that season. Burning may take place at a less optimum time depending on allowable burn days, however, any burn from Spring through Fall will help to reduce the non-native seed bank.

All Refuge prescribed burns would be conducted under the restrictions imposed by the Bay Area Air Quality Management District, the Contra Costa Fire Department, and the mandates of a FWS Regional Fire Management Officer from pre-approved plans by regional and on site biologists, to minimize any potential for negative impacts.

The preferred method of non-native vegetation removal is burning because it reduces the non-native seed bank at a faster rate than mowing. However, if we miss the acceptable burn window in any given year we will utilize mowing/disking/plowing methods in order to control non-native vegetation. This will at least remove the non-native vegetation and prevent it from adding further to the non-native seed bank in that year. Mowing/disking/plowing would be conducted and monitored in the same method as would burning.

VII. Impacts of Action:

Prescribed burning would adversely affect endangered species if the fire escapes a treatment area. Cut firelines and existing roads will be utilized to prevent escaped burns. The selection of, and adherence to, a proper prescription and careful coordination with the Bay Area Air Quality Management District, the Contra Costa Fire Department, and FWS Regional Fire Management Officer can greatly limit these threats.

For the first three years, the large burn plot areas within the Refuge will be carefully selected to avoid endangered species. However, a few primrose, wallflower, and buckwheat plants could be within a burn area and would be temporarily adversely affected. The Lange's metalmark butterfly may be detrimentally affected by burning its host plant, naked stemmed buckwheat. The small burn plots will be selected to contain a few endangered species so that we can closely monitor their response to fire. These species would be temporarily adversely affected. For the first three years, only buckwheat, hand planted by the Service approximately five years ago and poor butterfly production stands, will be burned.

On a long-term scale, endangered and other native species will benefit from the removal of exotic species. Also, habitats, including designated critical habitat for the primrose and wallflower, will be enhanced. If burning and mowing/disking/plowing methods of non-native vegetation control prove successful at restoring native and endangered species habitat, further large plots and smaller experimental plots will be selected for burning. If endangered species respond favorably to burning and mowing/disking/plowing methods, areas will be burned on a continual, rotational basis. High butterfly producing stands and areas with high density of endangered and native species will not be selected for burning or mowing methods of vegetation control. These sensitive areas will continue to be maintained through hand-weeding efforts.

Species of special concern that may be affected include: California legless lizard (*Aniella pulchra pulchra*), Middlekauf's Katydid (*Idiostatus middlekauffi*), Antioch Robber Fly (*Cophura hurdi*), Antioch Vespid Wasp (*Microdynarud arenicolus*), Antioch Tiphiid Wasp (*Myrmusula pacifica*), Antioch Sphecid Wasp (*Philanthus nasalis*), Yellow-banded Andrenid Wasp (*Perdita hirticeps luteocincta*), Antioch Andrenid Bee (*Perdita scitula antiochensis*), and all native bird species. The Service is currently monitoring the area to determine if these species occur at the

Refuge. If any legless lizards are found in a proposed burn site, fire breaks will be cut around the area in order to protect the lizards. The Service has not recently found any of the above insect species at the Refuge, some may be extinct. Proposed burn areas will be thoroughly surveyed for any native bird nests prior to burning. If any nests are found, these areas will not be burned.

The aesthetic quality (scenery and odor) of the Antioch area will be temporarily altered because of smoke from the fire. However, prescribed burning will greatly mitigate potential future negative impacts resulting from wildland fires.

Mowing/disking/plowing methods of non-native vegetation control has less inherent danger than prescribed burning because there is little risk of mowing outside of plot boundaries. Additionally aesthetic quality of the Antioch area will not be altered. Excluding these two reduced impacts of mowing/disking/plowing methods, the effects to species will be similar to the impacts induced by burning. The same precautions to protect native species will be used with mowing/disking/plowing methods as with burning methods.

VIII. Effect Determination and Response Requested:

A. Listed Species:

Determination	Response Requested
__ will not affect	__ concurrence
__ beneficial affect	__ concurrence
__ is not likely to adversely affect	___formal consultation
___ is likely to adversely affect	__ formal consultation

B. Proposed Species:

None

C. Category 1 Species:

None

Intra-Service Section 7 Evaluation Form for Region 1

Initiating _____ * Date 3/5/97
Officer

[X] Concur (mark one) [ ] Do not concur

Comments:

ES
Field Office _____ * Date 6/11/97
Supervisor

[X] Concur (mark one) [ ] Do not concur

Comments:

* Original signatures on file at Don Edwards San Francisco Bay NWC

December 29, 1998

MEMORANDUM

To: Field Supervisor, Sacramento Fish and Widlife Office
Attn: David Wright

From: Refuge Complex Manager, San Francisco Bay NWR Complex

Subject: Ammendment to the Intra-Service Section 7 for prescribed burning at Antioch Dunes NWR

In 1997, your office issued a finding of "not likely to adversely affect" in an Intra-Service Section 7 Consultation on the use of prescribed burning, mowing, discing, and plowing to control non-native plant species at the Antioch Dunes NWR (**1-1-97-F-75**)
We propose to amend the Section 7 Consultation by burning three additional areas (see attached map). Two areas are located in the "old vineyard" section of the Stamm Unit. One area does not not contain any Contra Costa Wallflower or Antioch Dunes Evening-primrose. It does however, contain Naked-stemmed buckwheat, host plant to the endangered Lange's Metalmark Butterfly. These areas do support a relatively small number of Lange's (see attached data sheet for 1997 and 1998 counts of these areas). This buckwheat was all planted by Refuge staff. The buckwheat, however, is being outcompeted by non-native vegetation including vetch, yellow starthistle, and rip-gut brome grass. The area became extremely dense with non-native vegetation this past season (98) due to large amounts of rainfall and now poses a large fire threat due to the accumulation of dry biomass. We propose to burn this area for two purposes, 1) to decrease the amount of accumulated biomass to decrease the threat of unplanned fire into adjacent areas that support high densities of butterflies, and 2) to reduce the amount of non-native vegetation and seed source to restore the area to a native community. Although any Lange's that are on the buckwheat would most likely be killed, the buckwheat itself has a high rate of survivorship and regeneration after being burned as documented from our previous prescribed burning experiments.

The second area has a small amount of naked stemmed buckwheat and primrose.

The third area has no buckwheat and some planted primrose and wallflower. These endangered plants were planted by the Refuge in 1997. Primrose have responded positively to prescribed burning.

We will follow all Terms and Conditions of the Biological Opinion 1-1-97-F-75.

For your information, we plan to do a comprehensive Section 7 Consultation on vegetation management once the Comprehensive Conservation Plan (CCP) for Antioch Dunes is completed. We are currently working on the CCP with the Sacramento Planning Office and plan to have this completed by FY 2000. Please contact Erin Fernández of my staff at (510) 792-0222 if you have any questions about this amendment. Thank you very much for your assistance.

APPENDIX E: SAMPLE BURN PLAN

Refuge or Station: San Francisco Bay NWR Complex

Unit : Antioch Dunes NWR 11646 Date:

Prepared By: _____ Date: _____
Roger P. Wong
Prescribed Fire Burn Boss

Reviewed By: _____ Date: _____
ADR Assistant Refuge Manager

The approved Prescribed Fire Plan constitutes the authority to burn, pending approval of Section 7 Consultations, Environmental Assessments, or other required documents. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Prescribed burning conditions established in the plan are firm limits. Actions taken in compliance with the approved Prescribed Fire Plan will be fully supported, but personnel will be held accountable for actions taken which are not in compliance with the approved plan.

Approved By: _____ Date: _____
Margaret Kolar
Project Leader
San Francisco Bay/Don Edwards NWR

PRESCRIBED FIRE PLAN

Refuge: San Francisco Bay NWR Complex Refuge Burn Number:

Sub Station: Antioch Dunes NWR Fire Number:
Name of Areas: Stamm Unit

Total Acres To Be Burned: 11 acres divided into 2 units to be burned over one day
Legal Description: Stamm Unit

T.2N; R.2E, Section 18
Lat. 38 01', Long. 121 48'

Is a Section 7 Consultation being forwarded to Fish and Wildlife Enhancement for review? Yes No (circle). **Biological Opinion dated June 11, 1997**

(Page 2 of this PFP should be a refuge base map showing the location of the burn on Fish and Wildlife Service land.)

The Prescribed Fire Burn Boss/Specialist must participate in the development of this plan.

I. GENERAL DESCRIPTION OF BURN UNIT

Physical Features and Vegetation Cover Types

Burn Unit 1B -- Stamm Unit - Hardpan (4 acres):
Predominantly annual grasses interspersed with YST and bush lupin "skeletons" from previous year's prescribed burn. Elevation approximately 15-20 feet. Primarily flat topography with some slight hummocks and elevational changes.
Sandy soils. This unit was burned in June 1999.

Burn Unit 2A -- Stamm Unit - Old Vineyard (7 acres):
Predominantly annual grasses interspersed with YST and non-native vetch. Elevation and soils same as above. This unit was burned in June 1997, 1998, 1999.

Map of Burn Units

Primary Resource Objectives of Unit

- Eliminate non-native vegetation and reduce seed bed of non-native forbs (YST, vetch etc.).

- Prepare the units for transplanting endangered plants by exposing the sandy soil substrate and reducing competition.

Objectives of Fire

1) Blacken at least 80% of overall unit.

2) Consume at least 70% of standing vegetation.

3) Remove at least 80% of accumulated litter in burned areas.

Acceptable Range of Results

1) 80% - 100% black acreage

2) 80% - 100% consumption of standing vegetation.

3) 80% - 100% litter removal in area burned.

II. PRE-BURN MONITORING

Hardpan

Vegetation Type		Acres	%	FBPS Fuel Model
annual grasses		70		1
star thistle		20		3
bush lupine		5		3
vetch		5		1
Total	4	100		1/3

Old Vineyard

vetch		70		1
annual grases		10		1
star thistle		20		3
Total	7	100		1/3

III. PLANNING AND ACTIONS

Complexity Analysis Results:

RISK -- MODERATE (due to urban interface and nearby smoke receptors)

Site preparation

Unit 1B -- Stamm Unit - Hardpan

The south boundary of this unit is an unimproved road that that will be opened up. Dozer line will be constructed along the east boundary of the unit leading down to the San Joaquin River. The north boundary will be the San Joaquin River. The west boundary will be the fenceline of Fulton Shipyard Road. A handcrew will lop and scatter any woody vegetation greater than 2 feet in height for distance of five feet from the east line..

Unit 2A -- Stamm Unit - Old Vineyard

A dozer line (1050 feet) will be constructed on the north side of this unit. A parking lot (Georgia Pacific Gypsum plant) and chain link fence borders the east flank. The south flank runs along the Santa Fe Railroad line. No site preparation is needed in that location. The boundary adjacent to the west line is a chain link fence separating the refuge from a borrow pit. A gate in the fence will provide access for engines and equipment.

Weather information required

No RAWS facilities are located in the area. The closest RAWS is located at Mount Diablo. Data collected from that site is of little value since Mount Diablo well above sea level of the burn site. Therefore all site specific weather data must be collected manually by a trained weather observer every hour. The Burn Boss will ensure weather data will be taken every hour while conducting the burn. Spot weather forecast from Sacramento Fire Weather Office (NWS) will be requested thru Contra Costa County Fire Department in Antioch. The battalion headquarters is located approximately 7 miles from the burn site. Spot weather forecasts can be received on their FAX machine.

Insert complexity Analysis

Safety considerations and protection of sensitive features

Unit 1B -- Stamm Unit - Hardpan.
The Refuge is closed to public entry at all times. The Refuge parking lot (SW corner) will serve as a safety zone. The access road will be cleared of vegetation to serve as an escape route to the safety zone. The San Joaquin River to the north will also act as a safety zone. AD Refuge Manager will be responsible for contacting the City of Antioch Public Works (510-779-6967) the day before the burn and notify them of increased activity along Fulton Shipyard Road. AD Refuge Manager will contact adjacent landowners and businesses to prevent the parking of vehicles near the burn unit on the day of the burn.

Unit 2A -- Stamm Unit - Old Vineyard
Access for engines and equipment is through a gate on the west boundary of the burn unit. This gate will provide access to a safety zone in the borrow pit on private property adjacent to the burn unit boundary. Escape routes to the borrow pit will be along the 1050 foot control line that makes up the north boundary. Chain link fences enclose the east and south flanks making escape in these directions extremely difficult. NO PERSONNEL WILL WORK INSIDE THE BURN UNIT NEAR THESE FLANKS, unless they have "straight line" access to the escape route or safety zone. Phone contacts for Unit 1 apply.

Special Safety Precautions Needing Attention:
The Burn Boss will coordinate with the Contra Costa County Fire Department well in advance of ignition date to ensure radio/communication compatibility.

Media Contacts:
The AD Refuge Manager is responsible for notifying local publics affected by the operation thru local newspaper and other media.

Communications and Coordination on the Burn:
The Burn Boss will review the burn plan, radios, PPE, escape routes, safety zones and engines prior to burning. NIFC Tac-2 will be assigned radio frequency for all firing and holding operations (154.200). The Burn Boss will call start and declare out to the Contra Costa County Fire Department. The Burn Boss will brief the County Battalion Chief 1 week in advance of planned ignition date and will supply a copy of this burn plan 2 months in advance. In the event of a medical emergency or burn injury, the County Fire Department will assume control of the medical incident.

The Burn Boss will contact the Bay Area Air Quality Management District prior to ignition on the day of the burn as required by Regulation 5, Open Burning, Section 8, Allowable Fires (5-401), P - Wildland Vegetation Management, Item 5, and to ensure Burn Day Status.

IV. IGNITION, BURNING AND CONTROL

	Planned or Proposed		Actual
Scheduling: Approx. Date(s)	June		
FBPS Fuel Model 1	Low	High	Actual
Temperature			
Relative Humidity			
Wind Speed (20' forecast)			
Wind Speed (mid-flame)			
Cloud Cover (%)			
ENVIRONMENTAL CONDITIONS			
Soil Moisture			
1 hr. Fuel Moisture			
10 hr. FM			
100 hr. FM			
Woody Live Fuel Moisture			
Herb. Live Fuel Moisture			
Litter/Duff Moisture			
FIRE BEHAVIOR			
Type of Fire (H,B,F)			
Rate of Spread			
Fireline Intensity			
Flame Length			

Ignition Technique:

WHEN WINDS ARE FROM THE WEST

Unit 1B -- Stamm Unit - Hardpan 1

Establish blackline along the east dozer line. Once fire has burned at least 20 feet on the east flank, strip headfire in S-N lines (unimproved road to San Joaquin River). Continue strip firing to Fulton Shipyard fenceline.

Unit 2A -- Stamm Unit - Old Vineyard.

Establish secure blackline along E boundary (adjacent to gypsum plant). Once backing fire has burned in at least 20 feet along E flank, begin strip headfire starting downwind working upwind. Widen strips as fire behavior and safety dictates. All strip fires should spread in a W - E direction bumping into black along the E flank.

Prescribed Fire Organization (See Section VII, Crew and Equipment Assignments. All personnel and their assignments must be listed. All personnel must be qualified for the positions they will fill.)

A minimum of 3 Type 4 engines will be on site during ignition. Personnel will rotate between ignition and holding actions.

Prescription monitoring (Discuss monitoring procedure and frequency to determine if conditions for the burn are within prescription):

BEHAVE predictions will model fire behavior. Belt weather kit will be used to monitor actual burn day weather conditions.

V. SMOKE MANAGEMENT

Permits required:

This burn plan will be submitted to the Bay Area Air Quality Management District (BAAQMD) 30 days in advance of planned ignition. Written approval by BAAQMD is required. The Burn Boss will submit a Controlled Burn Request Form 7 days prior to the proposed ignition date if there is any uncertainty regarding possibility of a "No-Burn Day". This burn plan meets criteria and will be submitted under Regulation 5, Open Burning, Section 8 Allowable Fires, P - Wildland Vegetation Management:

"application of fire to vegetation to achieve a specific natural resource management objective These fires are conducted within the limits of a written burn plan and prescriptionto achieve the desired effects."

Distance and Direction from Smoke Sensitive Area(s):

A large portion of the City of Antioch lies south and east of the proposed burn area. Smoke will inevitably drift towards these areas. Numerous smoke receptors will be effected by the burn.

Necessary Transport Wind Direction, Speed and Mixing Height (Explain how this information will be obtained and used):

Winds will be NW to SE or W to E. When requesting the spot weather forecast mixing height and transport wind speed for that particular day will be requested. Actual mixing height will be determined by the test burn. A minimum of 1,000 foot mixing height is desired.

Visibility Hazard(s) (Roads, airports, etc.):
Santa Fe, Atchison and Topeka Railroad lies directly south of Burn Unit 2. Fulton Shipyard Road lies directly south of Burn Unit 1. Wilbur Road lies directly south of Burn Unit 3.

Actions to Reduce Visibility Hazard (s)

Burning will begin in late-morning (1100) to mid-afternoon (1300) when unstable atmospheric conditions enhance smoke dispersal. The Burn Boss will monitor the smoke dispersal from backing fires prior to interior firing. City of Antioch Public Works will be contacted approximately 1 week prior to the proposed burn date. The Refuge Manager will contact Public Works on the day of the burn to confirm the activity. The Refuge Manager will contact the City of Antioch Police Department the day of the burn to notify them of potential smoke across the roads. The Burn Boss will be responsible for contacting the Santa Fe Railroad 1 week prior and the day of the burn to advise them of smoke drifting across their tracks.

Residual Smoke Problems:

Mop up activities should be minimal due to almost complete consumption of 1 hour target fuels. All smokes and hot spots be mopped up (100% mop up) before moving on to burn next unit.

Particulate emissions in Tons/Acre and how calculated:

Assume Total PM Emission Factor for grass is 10 lbs/ton; assume 100% consumption. Estimated fuel loading for the entire burn is 200 lbs/ac.

CALCULATIONS:

200 lbs/ac X 1 ton/2000 lbs = 0.1 tons/ac TOTAL FUEL CONSUMED

Total Fuel Consumed (0.1 tons/ac) X Emission Factor (10 lbs/ton)
=1.0 lbs/ac TOTAL EMISSIONS

Total burned area acreage (11 ac) X Total emissions (1.0 lbs/ac) = 11.0 lbs of EMISSIONS RELEASED FOR ENTIRE BURN over a1 day period.

VI. FUNDING AND PERSONNEL

Activity Code: _____

Costs

	Equipment & Supplies	Labor	Overtime	Staff Days	Total Cost
Admin. (planning, permits, etc.)					
Site Preparation					
Ignition & Control					
Travel/Per Diem					
Total					

VI. BURN-DAY ACTIVITIES

Public/Media Contacts on Burn Day (List with telephone numbers):

Santa Fe Railroad (Pittsburg, CA)
Bob Tidwell, Security Agent - 510-231-2754
John Cockle, Train Master - 510-231-2603
Contra Costa County Fire Department
Tony Cambell, Chief Officer - 510-930-5551
Jay Highson, Training Officer - 510-930-5500
Operations Officer - 510-757-1303
Bay Area Air Quality Management District
Daniel Belick, Air Quality Specialist - 415-749-4786
Doug Tolar, Enforcement Program Specialist - 415-749-5118
(FAX) 415-928-0338
Burn Day Status Pre-recording 1-800-435-7247
City of Antioch Public Works
Mike Bechteloldt, Supervisor - 510-779-6967

Crew & Equipment Assignments (List all personnel, equipment needed, and assignments. The following is not an all-inclusive list for what you may need.)

See chart

Crew Briefing Points:

Communications - NIFC Tac-2 (154.200) to be designated operations frequency
Hazards - LCES will be reviewed for each individual burn unit. Specific hazards pertaining to each unit will be discussed.
Escape Fire - Holding Boss will be identified and actions will be discussed.
Coordination - County Fire personnel to be available for medical response if necessary.

Personnel Escape Plan:

Discussed in Safety Considerations in Planning Actions.

Special Safety Requirements:

There are clearly identifiable safety concerns on all 2 burn units. Though these units are small in size, FIREFIGHTER SAFETY WILL BE PARAMOUNT when conducting this burn. Fuels are flashy with rapid rates of spread. For that reason, NO ONE WILL WORK ALONG THOSE FLANKS WHERE ESCAPE ROUTES ARE NOT DIRECTLY ACCESSIBLE.

Holding and Control:

Critical Control Problems:

The key to holding the Hardpan 1 fire will be in the integrity of the control line along the east boundary. The critical holding point on the Old Vineyard fire will be west and north boundaries. As long as winds are west or northwest we will not have any control problems.

Water Refill Points:

Water may be drafted from nearby fire hydrant at Fulton Shipyard Road
500 gallon "pumpkin" tank may be set up on site.

Contingency Plan for Escaped Fire (Are there crews standing by to initial attack or will people doing other jobs be called upon to do initial attack, who must be called in case of an escape, what radio frequencies will be used, etc.)

If the fire escapes the burn unit and remains within the refuge boundary, FWS will assume the command of the incident. If the fire escapes the burn unit and threatens local responsibility protection area, Unified Command between FWS and County Fire will be assumed. In the event of an escaped fire, direct attack methods will be used. Contra Costa County Fire Dept will be contacted immediately for any structural protection needs or reinforced attack in the case of vegetation fire. SNL staffed engines will be primary initial attack units if the fire escapes. SFR Pumper will be used for mop up and patrol only.

Mop Up and Patrol:

All smokes will be put out by the holding crew prior to leaving the site. The Burn Boss and Refuge Manager will patrol the burn site the next morning to check for smokes or hot spots that may have been missed the day before.

VIII. CRITIQUE OF BURN

Were burn objectives within acceptable range of results? (Refer to Section I):

What would be done differently to obtain results or get better results?

Was there any deviation from plan? If so, why?

Problems and general comments:

X. POST-BURN MONITORING

Date:_____ Refuge Burn Number: _____

Length of Time after Burn: _____

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Other:

X. FOLLOW-UP EVALUATION

Date: _____ Refuge Burn Number: _____

Length of Time after Burn: _____

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Other:

APPENDIX F: DISPATCH PLAN

When a report of smoke or fire on the Refuge is received, get as much information from the caller or messenger as possible:

Location of smoke or fire?
Location of caller?
Name and telephone number or contact point of the caller or messenger?
Color of smoke?
Size of fire?
Type of fuel (What is burning?)
Character of the fire (Active, smoldering, etc.)?
Is anyone fighting the fire? How many personnel? Equipment?
Did they see anyone in the vicinity or vehicles leaving the area?
Is the fire site accessible by a slip-on unit?
What are the weather conditions at the fire?

1) Report to:

Contra Costa County Fire Protection District (510)930-5500 or 9-1-1

The Contra Costa County Fire Protection District is dispatched through this central system. They have a lock on the Stamm gate and the key to the lock box for the Sardis gate.

Addresses:	Sardis Unit	#1551 Wilbur Avenue
	Stamm Unit	#501 Fulton Shipyard road

2. Due to the distance of Antioch Dunes NWR from the Fremont HQ, the fire will likely have already been extinguished before Refuge personnel arrive. However, a Refuge police officer and Refuge firefighter unit should be dispatched for mop-up, fire investigation and report purposes.

3. If discovered while on the Refuge, call 911 or the Protection District at (510)930-5500 or Refuge Headquarters (510)792-0222 for assistance.

4. Dispatch Refuge firefighters if the fire is on the Refuge or threatens Refuge property.

5. Notify Refuge Manager, Project Leader, on-duty Police Officer, and Zone Management Officer (Roger Wong -209/826-3508; Home (209) 827-4390).

6. For fires occurring at night or on weekends, the following individuals should be notified in order:

a. On-call Refuge Officer: Call Park Police Dispatch (415)561-5510

Headquarters (510)792-0222
Barry Tarbet (510)247-3357
Jon Adamson (510)782-1154

b. Refuge Manager
Chris Bandy (510) 377-5928

c. Refuge Officers:
Barry Tarbet (510)247-3357
Jon Adamson (510)782-1154

d. Project Leader
Marge Kolar (510)745-0332 (Cell) 510-377-9450

e. Wildlife Biologist
Ivette Loredo (510)377-5956

f. Zone Fire Management Officer
Roger Wong (209)826-3508 (Cell) 209-704-4508

g. Refuge Firefighters: Juan Flores, Chris Bandy, Joy Albertson,, Mike Parker, Arthur Chan, Joelle Buffa

7. Other Refuge Personnel (cell phone #):

Clyde Morris	510-377-2781
Carmen Leong	510-377-9229
Brian Allen	510-377-5926
Bryan Winton	707-975-5521
Joelle Buffa	510-377-5958
Joy Albertson	510-377-5693
Art Chan	510-377-3119
Juan Flores	510-377-5891

8. Other personnel to be involved if necessary:

Pam Ensley, Regional Fire Management Coordinator,
Regional Office: (503) 231-6174 or residence (360) 835-7004

Andy Anderson, Regional Fire Management Officer
Regional Office: (503) 231-6175 or (360) 666-5031 residence

Roddy Baumann, Regional Prescribed Fire Specialist
Regional Office: (503) 231-2075 or (360) 573-9444 residence

Mendocino National Forest Communications Center, Willows, CA
1-888-663-3479

APPENDIX G: DELEGATION OF AUTHORITY

Antioch Dunes NWR

Delegation of Authority
for

_____ Incident

_____ is assigned as Incident Commander. You have full authority and responsibility for managing the fire suppression activities within the framework of laws, Agency policy, and direction provided in the Wildland Fire Situation Analysis and the Agency Administrator Briefing.

Your primary responsibility is to organize and direct your assigned resources for efficient and effective suppression of the fire. You are accountable to the Agency Administrator or the representatives designated below.

Specific direction for this incident covering management and environmental concerns are:

1. Protection of life and private property is your highest priority task.
2. Give special consideration to firefighter safety, especially with respect to aviation operations, working around dozers, snags, and entrapments. Avoid sensitive environmental areas. When in doubt, sacrifice acres not people in your strategic and tactical decisions.
3. You are authorized to utilize helicopters, chainsaws, portable pumps, fireline explosives, and retardant at Antioch Dunes NWR. You are not authorized to use equipment within the _____.
4. Manage human resources assigned to the fire in a manner that promotes mutual respect and is consistent with the enclosed U.S. Fish & Wildlife Service "Harassment-Free Workplace" policy.
5. Be cost effective; Final costs should be no more than 120% of the preferred WFSA alternative.
6. Manage equipment and supplies to ensure losses are within Acceptable Fire Loss/Use Rates.

You should takeover management of the incident on or before _____, _____.

_____ _____

Marge Kolar, Project Leader, Antioch Dunes NWR Date

Delegation of Authority - Guidelines for Mitigating the Effects of Fire Suppression

LINE BUILDING

1. Do not fall snags on the outside of the line unless they are an obvious safety hazard.
2. On the inside of the line, fall only those snags that would reach the fire line should they burn and fall over, or if they are an obvious safety hazard.

3. Don’t cut live trees over 12" d.b.h. unless deemed absolutely necessary by the Complex Manager. Limbing of these trees, as necessary, should be the first choice.
4. Cut brush or small trees flush with the ground if the area is visible from roads.
5. Lop and scatter cut limbs so the depth will not exceed 15 inches.

MOP-UP

1. Extinguish fire in living trees or snags within 200 feet of the fires perimeter with water or dirt. Fell those trees as a last resort.
2. If felling occurs in the vicinity of service roads/trails, cut the stumps flush with the ground.
3. Buck fallen trees across service roads/trails only to the extent necessary to facilitate road/trail passage.

AIR OPERATIONS

1. Consider fixed wing delivery of water vs. standard colored retardant.
2. When possible, use long line slings instead of cutting helispots.
3. ETC. ADD ANY OTHERS HERE.

APPENDIX H: NOTIFICATION LIST FOR PRESCRIBED BURNING

Pacific Gas and Electric Company, Attn: Sally de Becker, Biologist
3400 Crow Canyon Road
San Ramon, CA 94583
(925) 866-5836

Santa Fe Railroad, Attn: Larry Hartman, Terminal Manager
303 South Garrard Blvd.
Richmond, CA 94801
(510) 231-2603/2601/2754

Contra Costa Fire Department, Attn: Tony Cambell
2010 Geary Rd.
Pleasanthill, CA 94523
(925) 930-5551

City of Antioch Public Works, Attn: Ron Ullman, Supervisor
P.O. Box 5007
Antioch, CA 94531-5007
(925) 779-6967

GP Gypsum Plant, Attn: Tim Trichart
P.O. Box 460
Antioch, CA 94509
(925) 757-2870
(925) 757-8540 (fax)
Ask them to move cars from west boundary

Kemwater
2151 Wilbur Ave.
Antioch, CA 94509
(925) 757-8230

Fulton Shipyard Inc., Attn: Leslie Fulton
307 Fulton Shipyard Rd.
Antioch, CA 94509
(925) 757-2611

Inland Marine
801 Fulton Shipyard Road
Antioch, CA 94509
(925) 757-1714

REQUEST FOR CULTURAL RESOURCE COMPLIANCE

U.S. Fish and Wildlife Service, Region 1

Project Name:					**Program:** (Partners, Refuges, JITW, WSECP, etc.)	
State: CA, ID, HI, NV, OR, WA		**EcoRegion:** CBE, IPE,KCE, NCE			**FWS Unit:** **Org Code:**	
Project Location:	**County**	**Township**	**Range**	**Section**	**FWS Contact:** Name, Tel#, Address	
USGS Quad:					**Date of Request:**	
Total project acres/linear ft/m:		**APE Acres / linear ft/m (if different)**			**Proposed Project Start Date:**	

MAPS Attached	**Check below**		
Copy of portion of USGS Quad with project area marked clearly **(required)**			Project (sketch) map showing Area of Potential Effect with locations of specific ground altering activities **(required)**
Photocopy of aerial photo showing location **(if available)**			Any other project plans, photographs, or drawings that may help CRT in making determination **(if available)**

Directions to Project: (if not obvious)	
Description of Undertaking:	Describe proposed project and means to facilitate (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25' of 3' high check dam)?

Area of Potential Effects (APE):	Describe where disturbance of the ground will occur. What are the dimensions of the area to be disturbed? How deep will you excavate? How far apart are fenceposts? What method are you using to plant vegetation? Where will fill be obtained? Where will soil be dumped? What tools or equipment will be used? Are you replacing or repairing a structure? Will you be moving dirt in a relatively undisturbed area? Will the project reach below or beyond the limits of prior land disturbance? Differentiate between areas slated for earth movement vs. areas to be inundated only. Is the area to be inundated different from the area inundated today, in the recent past, or under natural conditions? Provide acres and/or linear ft/m for all elements of the project.
Environmental and Cultural Setting:	Briefly describe the environmental setting of the APE. **A)** What was the natural habitat prior to modifications, reclamation, agriculture, settlement? **B)** What is land-use history? When was it first settled, modified? How deep has it been cultivated, grazed, etc.? **C)** What is land use and habitat today? What natural agents (e.g., sedimentation, vegetation, inundation) or cultural agents (e.g., cultivation) might affect the ability to discover cultural resources? **D)** Do you (or does anybody else) know of cultural resources in or near the project area?

Antioch Dunes National Wildlife Refuge
CA/NV Refuge Planning Office
2800 Cottage Way, W-1916
Sacramento, CA 95825
(916) 414-6503 Fax (916) 414-6512

U.S. Fish & Wildlife Service
http://www.fws.gov
1 (800) 344-WILD

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