Compensatory Wetland Mitigation and Monitoring Plan

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Acronyms and Abbreviations

CESA	California Endangered Species Act
CLR	Campus Land Reserve
CNR	Campus Natural Reserve
Conservation Strategy	*Proposed Conservation Strategy for the UC Merced Project*
Corps	U.S. Army Corps of Engineers
CRT	California Rangeland Trust
CST	Cyril Smith Trust lands
CWMMP	Compensatory Wetlands Mitigation and Monitoring Plan
DA	Department of the Army
DFG	California Department of Fish and Game
EIP	EIP Associates
EPA	U.S. Environmental Protection Agency
ESA	federal Endangered Species Act
FCI	functional capacity index
FCU	functional capacity units
GIS	geographic information systems
HGM	Hydrogeomorphic Model
lbs/acre	pounds per acre
m^2	square meters
NCAA	National Collegiate Athletics Association
NRCS	Natural Resources Conservation Service
Plan	Compensatory Wetland Mitigation and Monitoring Plan
RDM	residual dry matter
SNRI	Sierra Nevada Research Institute
SUDP	Specific Urban Development Plan
TNC	The Nature Conservancy
UC Merced	University of California, Merced
USFWS	U.S. Fish and Wildlife Service
VST	Virginia Smith Trust lands
WCB	California Wildlife Conservation Board

Chapter 1
Introduction

Purpose and Objectives

The purpose of this document is to describe the proposed Compensatory Wetland Mitigation and Monitoring Plan (CWMMP) for mitigating the potential impacts to wetlands that would result from the proposed University of California, Merced (UC Merced) project. The UC Merced project consists of the establishment of a major research university in Merced County that would ultimately support 25,000 full-time equivalent students and a contiguous, associated community needed to support the university. This plan is intended to satisfy the anticipated mitigation requirements of the Department of the Army (DA) permit for UC Merced.

The proposed mitigation measures set forth in this Plan are intended to compensate for UC Merced project impacts that would result from both the Campus and the Community North. The proposed compensatory mitigation measures described in this Plan address the direct, indirect, and cumulative impacts associated with the proposed Campus and the Community North. A separate plan will be prepared for impacts resulting from the Community South and will incorporate preservation, enhancement, and restoration measures similar to those contained in this Plan to the extent applicable.

The overall objective of the CWMMP is to ensure that there will be no net loss of wetland function or area resulting from the construction and long-term operation of UC Merced in accordance with the U.S. Army Corps of Engineers (Corps) compensatory mitigation policies as set forth in Regulatory Guidance Letter No. 02-2, (USACE 2002) as well as the Memorandum of Agreement between the U.S. Environmental Protection Agency (EPA) and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines dated November 15, 1989. This Plan was designed to be consistent with the Corps Sacramento District's Habitat Mitigation and Monitoring Proposal Guidelines, dated October 25, 1996 as updated on December 30, 2004. On April 10, 2008, The Corps of Engineers and Environmental Protection Agency issued a Final Rule governing compensatory mitigation for activities authorized by permits issued by the Department of the Army (Corps of Engineers 2008). Although this Final Rule does not apply to applications received prior to the effective date of the regulation (June 9, 2008),

this plan is intended to substantially comply with many of the provisions of that Final Rule.

This document is a revision to the CWMMP submitted with the original Department of the Army permit application. The Department of the Army permit application for the UC Merced project has been subsequently revised. The revised application modified the campus footprint with resulting in substantially reduced wetland impacts. It also incorporated a portion of the University Community (the Community North) into the application. The primary purpose of this revision to the CWMMP, is to reflect the impacts that would result from the modified Campus footprint and the Community North.

Scope

This CWMMP:

1. classifies the wetlands existing within the project area and assesses their functions under baseline conditions,
2. quantitatively assesses the direct and indirect impacts of the project in terms of area of wetlands lost and wetland functions lost,
3. identifies proposed mitigation measures believed necessary to achieve the goal of "no net loss," and
4. summarizes the results of a functional assessment that quantitatively assesses the efficacy of the proposed compensatory mitigation measures.

Functional Assessment

Traditionally, the Corps has evaluated wetland impacts and proposed compensatory mitigation based primarily on an acre basis. This comparison has often been expressed in terms of the ratio of acres of wetlands preserved, restored, created, and/or enhanced per each acre of wetlands directly impacted. Given the currently proposed mitigation, such a comparison would yield a wetland preservation ratio of greater than 29 acres preserved and enhanced per each acre directly impacted (29:1), and a minimum of 1 acre of wetlands restored or created per each acre of wetlands directly impacted (1:1).

In order to provide a quantitative basis for assessing wetland impacts and proposed mitigation in terms of wetland function, the Corps directed that a wetland functional assessment methodology be developed based on the Hydrogeomorphic Model (HGM). Such a methodology would consider both direct and indirect impacts to wetland function. The functional assessment methodology that was developed is used as the basis for quantitatively assessing potential losses in wetland function that would result from the proposed UC Merced project as well as the potential gain in wetland function that would result from the proposed mitigation measures.

Relationship to the USFWS Biological Opinion and Conservation Strategy

This plan is further intended to complement, and integrate with, the overall mitigation plan for biological resources for UC Merced required by the August 19, 2002 U.S. Fish and Wildlife Service (USFWS) *Final Biological Opinion on the Proposed University of California Merced Campus, Phase 1 and Campus Buildout (Corps #199900203) and Infrastructure Project (Corps #200100570)* (Biological Opinion), and to be consistent with the *Proposed Conservation Strategy for the UC Merced Project* (Conservation Strategy) for threatened and endangered species (Jones & Stokes 2008), the Management Plan for Conservation Lands and the Adjacent Campus Buildout for the University of California Merced (Airola 2008a), and the 2008 Supplement to the Biological Assessment for the University of California Merced Campus and University Community North (Airola 2008b).

The project area contains habitat supporting threatened and endangered species listed under the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA) as well as habitat for species that are proposed for, or candidates for, listing. Federally listed species are:

- succulent owl's clover (*Castilleja campestris* ssp. *succulenta*),
- Colusa grass (*Neostapfia colusana*),
- San Joaquin Valley Orcutt grass (*Orcuttia inequalis*),
- vernal pool fairy shrimp (*Branchinecta lynchi*),
- Conservancy fairy shrimp (*Branchinecta conservatio*),
- vernal pool tadpole shrimp (*Lepidurus packardi*),
- valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*),
- California tiger salamander (*Ambystoma californiense)*, and
- San Joaquin kit fox (*Vulpes macrotis mutica*).

Nothing in this CWMMP is intended to supersede or otherwise be inconsistent with the Conservation Strategy. The mitigation and management measures identified in this Plan will also mitigate potential impacts to various threatened and endangered species. A more detailed description of potential impacts to threatened and endangered species, as well as the proposed mitigation measures corresponding to these impacts, is provided in the Conservation Strategy.

Chapter 2
Project Summary

Location of Project

The proposed UC Merced project is located in eastern Merced County, on the northeastern edge of the City of Merced growth boundary, known as the Specific Urban Development Plan (SUDP) limits. The proposed Campus and Community North are situated east of Lake Yosemite and Lake Road. The proposed locations of UC Merced and the University Community are shown in Figure 2-1.

Project Purpose

The overall project purpose is:

> To establish a major research university in Merced County that would ultimately support 25,000 full-time equivalent students with a contiguous, associated community needed to support the university.

Project Description

The revised UC Merced project consists of three major components: the Campus (815 acres); the Community North (833 acres); and, the Community South (1,118 acres). The lands comprising the Campus are owned by the University. The lands comprising the Community North are owned by the University Community Land Company, LLC (UCLC), a not-for-profit corporation. The Community South is owned by LWH Farms, LLC.

The revised application for a Department of the Army permit seeks authorization for those portions of the proposed project controlled by the University (the UC Merced Campus and the Community North). A Department of the Army permit is not being requested at this time for the Community South because that area is not under the control of the University. Nonetheless, because the Community South is an interdependent and interrelated activity to the UC Merced Campus and Community North, it is considered part of the proposed project, not for purposes of the permit, but for purposes of NEPA review. The additional project

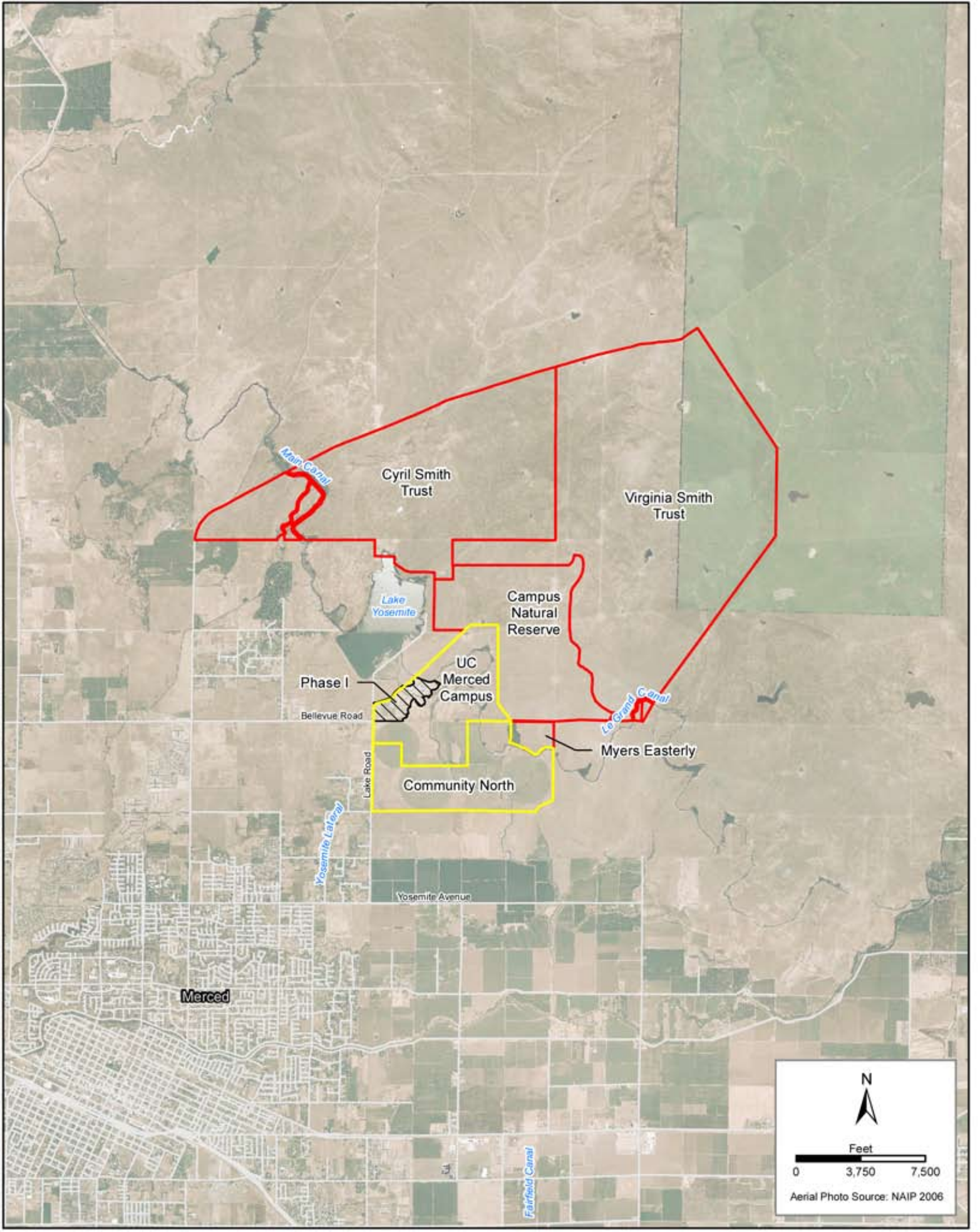

Figure 2-1
Regional Location of the UC Merced Project

description provided below, as well as the description of the impacts, applies to all three major components of the proposed project.

The new plan will consolidate the campus and its reserve development capacity onto 815 acres, buffered on the north and east from the natural landscape by a series of perimeter road and canals. UC Merced continues to employ best practices in sustainable development through on-site storm water management. Passive and active recreation areas are located to receive upland flows, along drainage pathways and at the western and eastern edges of development.

The application drawings show the locations of the five districts described below and provide conceptual descriptions of the block types within the districts. The following is a general description of each district and the corresponding block type(s).

The LRDP describes a campus community built around a 200-acre academic core that houses classrooms, laboratories, administration, research and development and related activities. The core will consist of four parts:

- The North (current) Campus, which is largely complete.
- The Central West Campus, to be built just south of the current campus. This section, to be built during phase 2.0, will take the university to the 10,000-student level. It will have a north-south grid system featuring a prominent mixed-use main street and a variety of arcades, courtyards and small open spaces.
- The Central East Campus, which will be just east of the West Campus and take the campus to full build-out, estimated at 25,000 students. This section, the largest of the academic core components, will become the heart of the campus in the long term. It will also feature a prominent main street, student union and recreation center facing a large formal open space to be called Central Park.
- The Gateway District, situated along Lake Road near the Bellevue Road intersection. This area will serve as primary campus entrance and "public face" of the university, with links to the community and to private-sector partners vital to the university's mission.

Bordering the academic core to the north, northwest and northeast will be four student neighborhoods comprising approximately 225 acres. The housing options will include traditional residence halls, apartments, townhouses, stacked flats and walk-up units in various high-, medium- and low-density configurations. The goal is to house half of the UC Merced student population in campus housing facilities.

The balance of the campus's 815 acres will be allocated to athletics and recreation (140 acres), parking (110 acres), passive open space (100 acres) and campus services (40 acres).

As described above, the University does not control the Community South portion of the University Community and a Department of the Army Permit application is not being submitted at this time. For this reason, this Plan only pertains to mitigation proposed for Campus and Community North. The

Community South portion of the University Community may be subject to a future permit and environmental review process at such time as the LWH Farms LLC may decide to submit an application. It is anticipated that the Community South will be developed in accordance with the adopted University Community Plan which designates the Community South property for Multiple Use Urban Development and agricultural uses and establishes planning principles and policies consistent with planned development of the Community-North.

The revised application no longer proposes the 340-acre Campus Land Reserve that was included in the original application as a contingency against long-term future needs. The 340-acre Campus Land Reserve as well as the previously proposed 750-acre Campus Natural Reserve have been incorporated into the overall Virginia Smith Trust mitigation lands along with additional lands owned by the University that were included within the originally proposed Campus footprint. It is expected that future long term land needs of the campus and community will be accommodated through increases in development density, rather than expansion of development areas.

Development of the University Community includes certain infrastructure necessary to serve the Campus. This infrastructure includes construction of a major north-south arterial north of Yosemite Drive, portions of two additional minor arterial roadways and collector streets, and construction of utility lines (storm drainage, sewer, potable water, fire and irrigation water, telecommunications, electric and gas) within the rights-of-way secured for those roadways. Although this infrastructure is required for the Campus alone, it is proposed to be located and configured in a manner as to allow expansion to serve the proposed University Community. The proposed backbone infrastructure, and alternatives to its proposed size and location, will be considered in the Section 404(b)(1) analysis prepared for the UC Merced Campus and University Community North application.

Background of Mitigation Plan Development

In 1999, $30 million was appropriated by the State of California legislature to fund the acquisition of conservation easements in eastern Merced County to mitigate for the effects of UC Merced and support regional conservation efforts. Accordingly, the University of California, in cooperation with the California Department of Fish and Game (DFG) and the California Wildlife Conservation Board (WCB), and the Packard Foundation embarked on a program to secure the permanent protection and preservation of a large tract of land supporting a concentration of vernal pools and related aquatic habitats in the vicinity of the proposed UC Merced Project. Such acquisitions assure the preservation, in perpetuity, of their ecosystems and habitats as well as the species that depend on them.

To help guide the acquisition of properties in eastern Merced County, a conceptual area protection plan was developed by the DFG. The overall objective of the plan is to protect grasslands in eastern Merced County through acquisition of easements and fee title on properties containing high conservation

values. The plan envisioned the promotion of grazing practices and land use management regimes that would improve the ecological health, biodiversity, and diversity of the habitat, including implementation of specific enhancement or restoration projects.

Chapter 3

The Hydrogeomorphic Methodology Approach to Wetland Functional Assessment

Introduction

The HGM Assessment methodology is an approach to wetland functional assessment that typically includes the following components:

- classify wetlands into regional subclasses consistent with the HGM classification system,
- identify wetland functions appropriate to each regional subclass,
- identify variables affecting these functions,
- develop assessment models and indices,
- identify reference wetlands, and
- develop application protocols.

These components are then consolidated into a regional guidebook for each regional subclass. These regional guidebooks are then used to conduct functional assessments for specific projects. The regional guidebooks are developed by an assessment team whereas the functional assessments can be conducted by a multitude of end users including agency personnel, applicants, consultants, etc.

There are no regional guidebooks that have been developed for the regional subclasses of wetlands existing within the project area. The Corps initiated a pilot project in 1995 to develop a regional guidebook for vernal pools in California. That effort proceeded as far as development of initial function models and field data gathering but was never completed. Without a regional guidebook, the Corps determined that a modified project-specific functional assessment methodology should be developed for the UC Merced project. The intent was to devise a functional assessment methodology based on HGM concepts but in an abbreviated form that would not include preparation of a regional guidebook and would be based, in part, on best professional judgment. Because of the number of discrete wetlands existing within the project area (thousands) and the number of discrete wetlands existing on the mitigation lands (tens of thousands), it is not practicable to implement an assessment methodology requiring an on-site evaluation of each wetland. It was therefore imperative that

a functional assessment methodology be designed so that it can be performed using geographic information systems (GIS) technology.

Pursuant to the Corps directive, a modified HGM functional assessment (the functional assessment) was developed to assess the efficacy of the proposed compensatory mitigation measures (USACE 2006). The functional assessment was developed by Mr. Tom Skordal of Gibson & Skordal, LLC, Ms. Nancy Haley and Mr. Kevin Roukey of the Corps Sacramento District, and Mr. Ellis Clairain, Ph.D. of the U.S. Army Engineer Research and Development Center Environmental Laboratory in consultation with an interagency Technical Advisory Committee composed of representatives of the Corps, the EPA, USFWS, and DFG. The functional assessment has been completed and a report has been prepared. A copy of the report is included in Appendix A. The report provides a detailed description of how the methodology was developed and the protocol for implementing the methodology. The following sections provide an overview of the HGM approach used and the results obtained for the functional assessment.

HGM Classification

The HGM Classification of wetlands was designed to classify groups of wetlands that function similarly based on shared criteria. Those criteria are geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the landscape position of the wetland. Water source refers to the dominant source of water for the wetland (i.e., groundwater, precipitation from runoff, backwater flooding, and overbank flooding). Hydrodynamics refers to the direction in which water moves into, through, and out of the wetland and the energy associated with that movement.

There are seven hydrogeomorphic classes of wetlands (Brinson 1993). Table 3-1 lists these classes, their dominant water sources, and dominant hydrodynamics. Of these seven classes, three are found within the project area: depressional, slope and riverine.

Table 3-1. Hydrogeomorphic Classes

Hydrogeomorphic Class	Water Source (dominant)	Hydrodynamics (dominant)
Riverine	Overbank flow from channel	Unidirectional and horizontal
Depressional	Return flow from groundwater and interflow	Vertical
Slope	Return flow from groundwater and interflow	Unidirectional, horizontal
Mineral Soil Flats	Precipitation	Vertical
Organic Soil Flats	Precipitation	Vertical
Estuarine Fringe	Overbank flow from estuary	Bidirectional, horizontal
Lacustrine Fringe	Overbank flow from lake	Bidirectional, horizontal

Source: Adapted from Smith 1995.

The jurisdictional waters of the United States, including wetlands, existing within the project area were delineated by EIP Associates (EIP) and verified by the Corps. Separate delineations were completed for the Campus including the Campus Land Reserve and the Campus Natural Reserve, the Merced Hills Golf Course and the associated community. EIP classified the delineated waters/wetlands as vernal pools, vernal pools/swales, vernal swales, swales, clay playas, clay flats, seasonal wetlands, freshwater marsh, marsh, stock ponds, drainages, wooded channels, and canals (Figure 3-1).

The functional assessment team reviewed the characteristics of each of the wetland classifications used by EIP to determine their appropriate HGM classification. All of the wetlands were then classified into five regional subclasses: vernal pools (depressions class), irrigation wetlands (depression class), clay slope wetlands (slope class), swale wetlands (slope class), intermittent channel (riverine class), and canal wetlands (riverine class) (Figure 3-2).

Vernal pools are abundant within the project area. Vernal pools occur within defined topographic depressions and their water source is direct precipitation, run-off from precipitation, and/or inter-flow. The clay playa classification used by EIP delineation would also fall into this regional subclass. Clay playas are essentially very large vernal pools. In some cases (e.g., the delineation of the wetlands on the former Merced Hills Golf Course), the seasonal wetland classification used by EIP refers to seasonally flooded depressions similar to vernal pools except the plant community is more characteristic of generic seasonal wetlands than vernal pools. Accordingly, these depressional seasonal wetlands were considered to be degraded vernal pools and most appropriately classified as such for HGM purposes.

Irrigation wetlands are the second regional subclass of depression wetlands. Irrigation wetlands are highly disturbed wetlands occurring within depressions that are influenced directly or indirectly by flood and/or sprinkler irrigation. They differ from degraded vernal pools in that they appear to have been created as a by-product of land leveling and irrigation activities. Some of the wetlands classified as seasonal wetland and freshwater marsh by EIP are included in the irrigation wetland subclass.

There are two distinct types of slope wetlands located within the project area, those that occur in narrow, topographically distinct drainage ways (swale wetlands) and those that occur as broad, poorly defined features that are subject to sheet flow (clay slope wetlands). The swale and vernal pool/swale classifications used by EIP would fall within the swale subclass. The swale and drainage classifications used by EIP would also fall within the swale subclass. Some of the wetlands classified as seasonal wetlands by EIP (e.g., those in the Campus delineation) are included within the clay slope regional subclass.

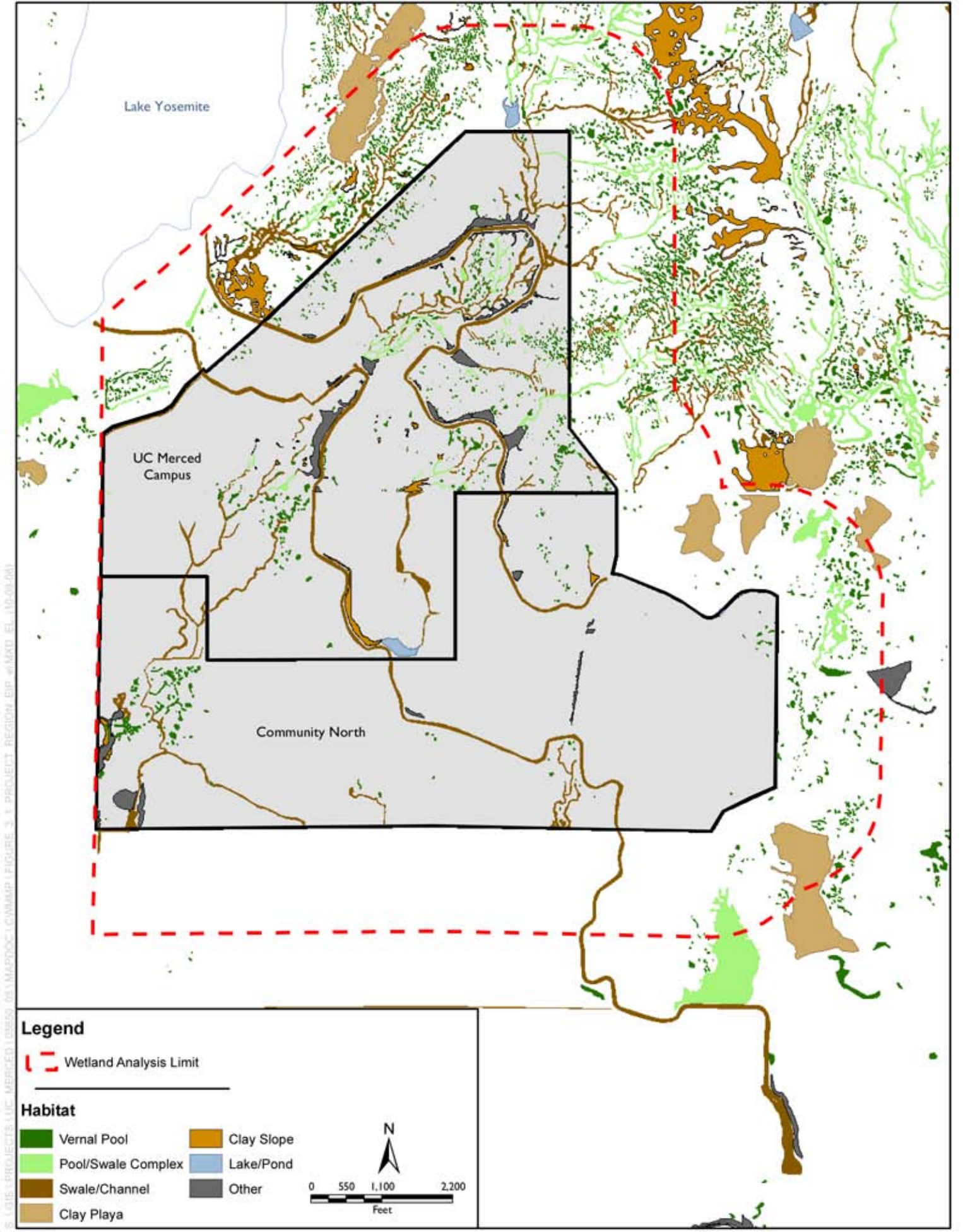

Figure 3-1
Wetlands in Project Region, EIP Classification

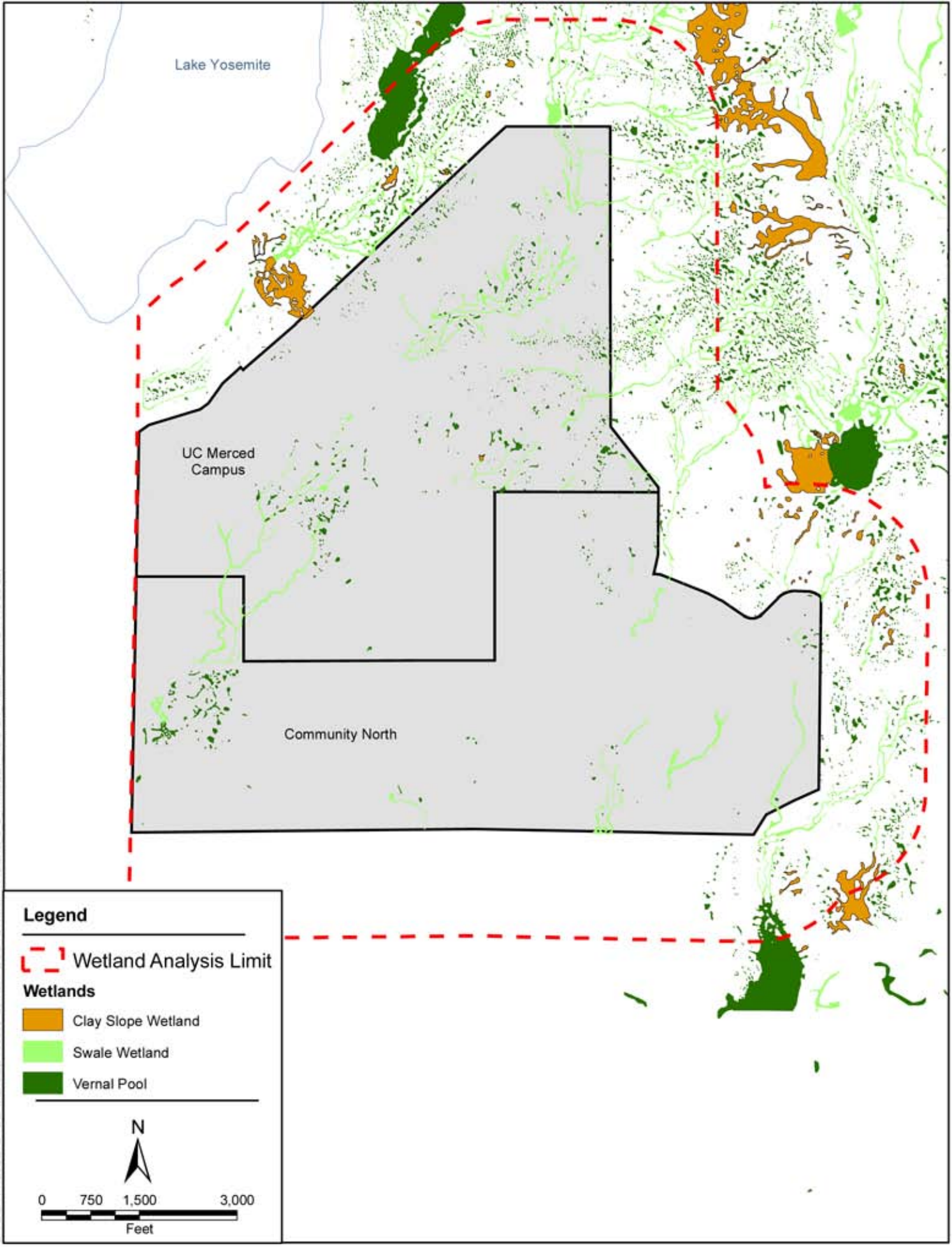

Figure 3-2
Waters of the United States in Project Area, HGM Classification

Table 3-2 is a list of the HGM classes and regional subclasses, cross-referenced to the classification used by EIP in each of their jurisdictional delineations. Table 3-3 is a key for identifying these regional subclasses.

Table 3-2. Comparison of HGM Regional Wetland Subclasses and Wetland Delineation Classifications

HGM Class	HGM Subclass	Campus Delineation Classification	Golf Course Delineation Classification	Community Delineation Classification
Depression	Vernal Pool	Vernal Pool	Vernal Pool	Vernal Pool
		Clay Playa	Seasonal Wetland	
	Irrigation Wetland	–	–	Stock Pond
				Freshwater Marsh
				Seasonal Wetland
				Wooded Channel
Slope	Clay Slope	Seasonal Wetland	–	–
	Swale	Swale	Swale	Swale
		Vernal Pool/Swale	Vernal Pool/Swale	Drainage
Riverine	Intermittent Channel	Freshwater Marsh	Marsh	Wooded Channel
	Canal Wetland	Freshwater Marsh	Marsh	Wooded Channel

Table 3-3. Key to Regional Subclasses

1a	Wetland located in a depression that has closed contours and may or may not have an inlet or outlet. (Go to 2, Depression Class)
1b	Wetland does not have closed contours. (Go to 3)
2a	Wetland located within closed contours and dominated by non-persistent emergent vegetation. (D-Vernal Pool)
2b	Wetland located within closed contours and hydrologically influenced by irrigation. (D-Irrigation Wetland)
3a	Wetland lacking closed contours and located on a slope without well-defined bed, banks, and ordinary high water line. (Go to 4, Slope Class)
3b	Wetland lacking closed contours and located on a slope within or adjacent to a watercourse with well-defined bed, banks, and ordinary high water line. (Go to 5, Riverine)
4a	Seasonally inundated/saturated wetland located on sloping ground that conveys water in somewhat narrow, linear drainage ways. (S-Swale Wetland)
4b	Seasonally inundated/saturated wetland located on sloping ground that conveys surface water as primarily sheet flow across a relatively broad, poorly defined plane. (S-Clay Slope Wetland)
5a	Wetland located within or adjacent to and intermittent drainage course whose hydrology is derived from precipitation and interflow. (R-Intermittent Channel Wetlands)
5b	Wetland adjacent to an irrigation canal whose hydrology is primarily derived from that irrigation canal. (R-Canal Wetlands)

The functional assessment was designed for the naturally occurring regional wetland subclasses existing within the project area. Those regional subclasses are vernal pools, swale wetlands, and clay slope wetlands. Canals, canal wetlands, irrigation wetlands, and intermittent channel wetlands are all artificially created and as such are not included in this functional assessment.

Functions, Variables, and Models

The following is a discussion of the functions likely to be performed by one or more of the regional wetland subclasses and the variables that affect a given wetland's capability to perform the function. Table 3-4 provides a summary of the wetland functions likely to be performed by each regional subclass.

Table 3-4. Wetland Function by Regional Subclass

Regional Subclass	SWS	SSWS&I	MS&SSWF	E&CC	OCE	MCPC	MCFC	FHI&C
Vernal Pools	X	X		X	X	X	X	X
Swales			X	X	X	X	X	X
Clay Slopes			X	X	X	X	X	X

Notes:

SWS	=	Surface Water Storage.
SSWS&I	=	Subsurface Water Storage and Interchange.
MS&SSWF	=	Moderation of Surface and Shallow Subsurface Water Flow.
E&CC	=	Element and Compound Cycling.
OCE	=	Organic Carbon Export.
MCPC	=	Maintenance of Characteristic Plant Communities.
MCFC	=	Maintenance of Characteristic Faunal Communities.
FHI&C	=	Faunal Habitat Interspersion and Connectivity

Surface Water Storage (SWS)

Definition: This function refers to the capability of a wetland or other water to collect and retain surface and shallow subsurface water as static water above the soil surface. The volume of the basin determines the potential volume of storage while surface water from the contributing watershed plus the infiltration of shallow subsurface water from the adjacent uplands determines the volume of water potentially contributing to the basin.

Variables Affecting Surface Water Storage: The average depth of a wetland multiplied by its area yields an estimate of the volume of surface storage within the wetland. The surface water storage capacity of a wetland can be modified by altering the amount of surface and shallow subsurface water entering it, raising or

lowering the elevation that water will spill from it, raising or lowering its bed, or eliminating the restrictive layer in the soil. Therefore, a model of this function should include a variable for the depth of the wetland, the elevation of the outlet (if present), the integrity of the wetland's watershed, and the integrity of the soil profile (particularly the restrictive layer) both within and adjacent to the wetland.

Applicable Regional Subclasses: Vernal pools and irrigation wetlands.

Subsurface Water Storage and Interchange (SWS&I)

Definition: This function refers to the capability of a wetland to store water below the soil surface and allow exchange of shallow subsurface water laterally with the contributing uplands bordering the wetland.

Variables Affecting Subsurface Water Storage and Interchange: The soil profile within the vernal pool as well as bordering uplands largely determines the capability of a given wetland to perform this function. If the soil profiles in either the wetland or its adjacent upland are substantially disrupted, this function will be impaired.

Applicable Regional Subclasses: Vernal pools and irrigation wetlands.

Moderation of Surface and Shallow Subsurface Water Flow (MS&SSWF)

Definition: This function refers to a slope wetland's capacity to moderate the rate at which water passes through the wetland and the watershed.

Variables Affecting Moderation of Surface Flow and Shallow Subsurface Water: The slope of a wetland, the cross-sectional area of a wetland, the condition of its watershed, and the integrity of the soil profile both within the wetland and in its surrounding uplands significantly affect the capacity of a wetland to perform this function.

Applicable Regional Subclasses: Swale wetlands and clay slope wetlands.

Element and Compound Cycling (E&CC)

Definition: Element and compound cycling refers to the biological and physical processes that convert compounds from one form to another. These processes cycle various elements and compounds between the atmosphere, soil, water, and vegetation. This cycling contributes to the nutrient capital of the ecosystem and reduces downstream particulate loading and thereby helps to maintain and improve water quality.

Variables Affecting Element and Compound Cycling: The physical and biological variables that determine the capability of a particular wetland to perform this function are the vegetation in the vernal pool and the contributing watershed and the soil in the wetland and the contributing watershed. The plants absorb, transform, and temporarily store various elements and compounds. The soil contains various microorganisms that are critical to the cycling of these nutrients. The soil also provides a medium for short and long-term storage of elements and compounds.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Organic Carbon Export (OCE)

Definition: This function refers to amount of dissolved or particulate organic carbon that is exported from a wetland. The export of carbon enhances the decomposition and mobilization of metals and supports aquatic food webs and downstream biogeochemical processes.

Variables Affecting Organic Carbon Export: The amount of organic carbon available for export is the sum of the input from the watershed and the biomass produced within the wetland itself. The degree to which this carbon can be exported downstream is affected by whether there is an outlet to convey water from the wetland to downstream waters.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Maintenance of Characteristic Plant Communities (MCPC)

Definition: This function refers to the capability of wetlands to support and sustain endemic plant communities that are characteristic of the regional wetland subclass with respect to species composition, abundance, and structure. This, in turn, helps to maintain ecosystem health and biodiversity.

Variables Affecting Maintenance of Characteristic Plant Communities: The soil profile and its integrity, the integrity of the watershed, the duration and depth of ponding, and the degree of disturbance of the wetland and its adjacent uplands can all have a profound affect on the plant community that a wetland supports.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Maintenance of Characteristic Faunal Communities (MCFC)

Definition: This function refers to the capability of wetlands to support and sustain endemic faunal communities that are characteristic of the regional subclass with respect to species composition, abundance, and age structure. For purposes of this assessment, this function includes both vertebrate and invertebrate fauna.

Variables Affecting the Maintenance of Characteristic Faunal Communities: The soil profile and its integrity, the integrity of the watershed, the duration and depth of ponding, and the degree of disturbance of the wetland and its adjacent uplands can all have a profound affect on the faunal community that a wetland is capable of sustaining.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Faunal Habitat Interspersion and Connectivity (FHI&C)

Definition: This function refers to the capability of a wetland to act as a conduit of interspersion and connectivity for vertebrates and invertebrates normally associated with wetlands. This, in turn, supports landscape and regional faunal biodiversity.

Variables Affecting Faunal Habitat Interspersion and Connectivity: The capability of a wetland to perform this function is affected by the integrity of the watershed, the presence or absence of an outlet and a mechanism for longitudinal connectivity, and the proximity of other wetland habitats.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Functional Assessment Methodology

The functional assessment for the UC Merced project focuses on identifying and assessing the various disturbances that can potentially reduce the capacity of wetlands to perform one or more of the various functions identified above. Table 3-5 is a list of the disturbance index ratings used in the functional assessment. The disturbance index ratings were assigned based on the relative extent each type of disturbance is expected to impair the functional capacity of a wetland. A rating of 0.00 indicates that the disturbance is so severe that no wetland functional capacity remains. A rating of 1.00 indicates that there is no diminution of wetland function. Both the severity of impairment to any given

function as well as the number of wetland functions impaired were considered in assigning these disturbance index ratings.

Table 3-5. Disturbance Index

Disturbance Factors	Index Rating
Agriculture	
None	1.00
Mowing	0.70
Disking/Harrowing/Chiseling	0.40
Plowing/Planting	0.25
Chemical Spraying	0.10
Deep Plowing, Restoration Possible	0.10
Land Leveling	0.10
Deep Ripping and Leveling	0.00
Grazing	
Specially Managed to Benefit Wetlands	1.00
Managed per NRCS Standards*	0.80
Moderate Grazing	0.70
No Grazing	0.50
Severe Grazing	0.50
Landscape Modification	
None	1.00
Non-graded Roads/Trails	0.75
Scraping	0.25
Excavating in Wetland	0.10
Filling in Wetland	0.00
Hydrologic Modifications	
None	1.00
Irrigation	0.25
Diversions of Flows Away	0.10
Impounding Wetland	0.10
Interceptions of Inflows	0.10
Wetland Drained	0.00

*NRCS = Natural Resources Conservation Service.

The magnitude of disturbance both within and outside of the wetland was considered in assessing wetland function. All of the disturbances under baseline

conditions were mapped from aerial photography and digitized for GIS analysis. A grid of 3–square meter (m^2) cells was established over the project area. Each 3-m^2 cell was then assigned a corresponding disturbance index rating. Where more than one disturbance was present within a given 3-m^2 cell, the most severe index rating was assigned. Where only a portion of a given 3-m^2 cell was disturbed, the whole cell was considered to be disturbed.

The disturbance index ratings were then used to calculate the functional capacity index (FCI) for each wetland. The range of the FCI is 0.00–1.00. The FCI is calculated as the square root of the product of:

1. the average index ratings of all 3-m^2 cells within the wetland, and
2. the average decayed index ratings of all 3-m^2 cells outside the wetland out to a distance of 500 meters.

Any 3-m^2 cell containing a portion of a wetland was considered to be within that wetland. For purposes of this functional assessment, we assumed that any disturbances beyond 500 meters would have a negligible effect on wetland function.

It should be noted that several different distance standards have been used in reference to indirect impacts to vernal pools and/or the species supported by these vernal pools. The *Biological Assessment CWA Section 404 Permit Applications for UC Merced Campus Project and County of Merced Infrastructure in Support of UC Merced Project* (Biological Assessment) used a standard of 250 feet and the Conservation Strategy used a standard of 200 meters (656 feet). The 250-foot standard was derived from the USFWS's programmatic consultation for fairy shrimp, which assumes that disturbances within 250 feet of vernal pools may result in take as defined for purposes of Section 9 of the ESA. The Conservation Strategy used the 200-meter standard as the basis for evaluating potential indirect effects to the broad list of threatened or endangered species potentially occurring within wetlands in the project area, whether or not those impacts would result in a take as defined by Section 9 of the ESA. The functional assessment's use of a broader 500-meter standard is based on the potential indirect effects to the previously discussed wetland functions that could result from various disturbances. It is not intended to imply that disturbances within 500 meters will result in a take or even necessarily a measurable effect to any threatened or endangered species.

The disturbance indices of all 3-m^2 cells outside the wetland but within 500 meters of the wetland are decayed based on their distance from the wetland. In other words, the further a given disturbance is from a given wetland, the less effect that disturbance has on wetland function. These disturbance indices are decayed on an exponential curve so that there is a negligible decay in the disturbance index out to approximately 100 meters with the rate of decay progressively increasing beyond 100 meters. This type of curve was selected because the watersheds of a large majority of wetlands extend less than 100 meters beyond the edge of the wetland. An exponential curve results in a negligible decay of the disturbance indices within the approximate watersheds of

a large majority of the wetlands. In other words, the exponential curve is an attempt to factor in the watersheds of various wetlands without actually mapping them.

Calculating the FCI based on the square root of the product often results in a lower FCI as compared to calculating it based on an average of the index ratings within and outside the wetland. Where the disturbance index ratings within and outside a wetland are identical, the FCI will be the same. Where there is a difference between the two disturbance index ratings, calculating the FCI based on the square root of the product yields a lower FCI. For instance, if a wetland has a disturbance index rating of 0.10 and outside the wetland has a decayed disturbance index rating of 0.90, the FCI will be 0.30. The same would be true if the disturbance index rating within the wetland is 0.10 and the decayed disturbance index rating outside the wetland is 0.90. If the FCI were to be calculated based on the average of the two, the FCI would be 0.50 under either scenario. Thus, although the disturbance index ratings within and outside the wetland are given equal weight, the FCI is more influenced by greater disturbance.

The formula for calculation of the FCI is as follows:

$$FCI = \sqrt{\left[\frac{\sum_{1}^{n_{cw}} I_{cw}}{n_{cw}}\right]\left[\frac{\sum_{1}^{n_{cnw}} I_{cnw} + \left((1 - I_{cnw})\left(\frac{D_{cw-cnw}}{D_m}\right)^2\right)}{n_{cnw}}\right]}$$

where:

FCI = Functional capacity index of wetland

I_{cw} = Disturbance index rating of cell in wetland

I_{cnw} = Disturbance index rating of cell not in wetland but within 500 meters (D_m)

n_{cw} = Number of cells in wetland

n_{cnw} = Number of cells not in wetland but within the maximum distance

$D_{cw\text{-}cnw}$ = Distance from non-wetland cell to nearest wetland cell

D_m = Maximum distance is 500 meters

Figure 3-3 illustrates the effect of a disturbed area on the FCI for wetlands at varied distances.

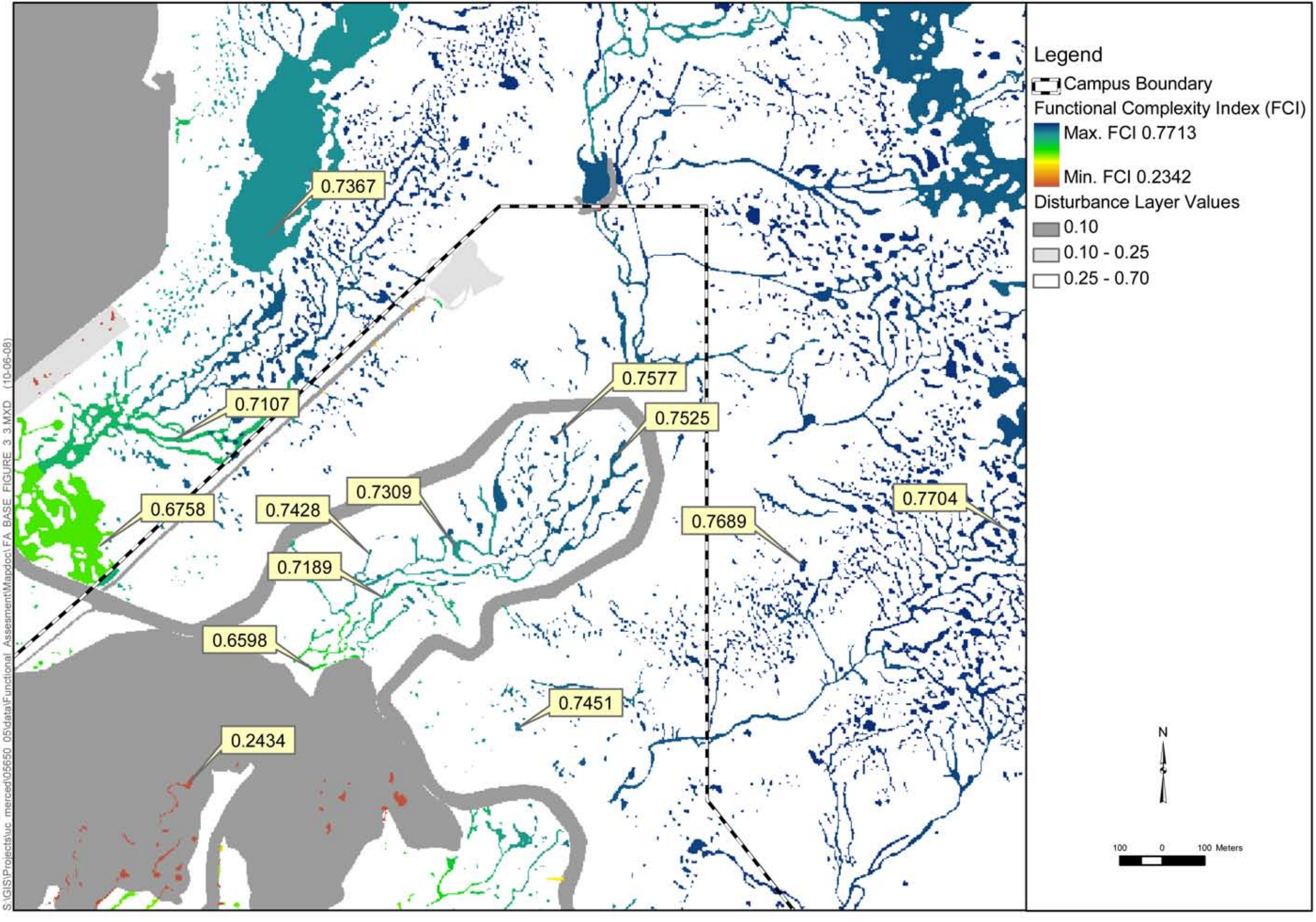

Figure 3.3
Functional Assesment Example
Baseline Scenario

Once the FCI is calculated for each wetland, functional capacity units (FCUs) are calculated by multiplying the FCI of each wetland times its area (in acres). The formula for calculation of FCUs is as follows.

$$FCU = [(FCI)(A)]$$

where:

FCU = Functional capacity units of wetland

FCI = Functional capacity index of wetland

A = Area of the wetland (acres)

The sum of all FCUs represents the functional capacity under baseline conditions. To calculate the impact of the project, the FCUs are recalculated for all wetlands using new disturbance index ratings based on the proposed campus. The difference between FCUs with the proposed campus and FCUs under baseline conditions represents the wetland functional impacts of the proposed project.

Chapter 4
Impacts

For purposes of the revised application the project area was redefined to include the proposed Campus, the Community North and surrounding lands extending laterally to a point 500 meters from the footprint of the edge of proposed development excluding those lands lying west of Lake Drive and the Community South. The proposed Campus and Community North would directly impact 77.79 acres of wetlands of which 40.41 acres are vernal pools, swale wetlands and clay slope wetlands. Table 4-1 provides a summary of the direct impacts, by Regional Subclass, to waters of the United States within the footprint of the Campus and Community North.

Table 4-1. Summary of Wetland Areas Impacted

Regional Subclass	Impacted (acres)
Vernal Pools	15.03
Swale Wetlands	25.05
Clay Slope Wetlands	0.33
Irrigation Wetlands	12.23
Canal Wetlands	25.15
Total	**77.79**

The HGM functional assessment protocol was used to calculate the FCUs for the vernal pools, swale wetlands, and clay slope wetlands within the revised project area under baseline conditions. Baseline conditions are defined as existing conditions without the proposed UC Merced project. The assessment protocol was then used to calculate the FCUs with the proposed Campus and Community North. To calculate the FCUs within the Campus and Community North, those wetlands lying within the footprint were assigned an FCI of 0.00 yielding FCU values of 0.00. The FCUs of all wetlands lying with 500 meters of the footprint were then recalculated using the functional assessment model with the Campus and Community North added as a new disturbance layer.

The difference between the two FCU totals is the projected loss of wetland function, expressed as FCUs, for the vernal pool, swale wetland, and clay slope wetland regional subclasses that would result from the proposed project. It is

important to remember that the functional assessment does not evaluate the loss of non-naturally occurring wetlands (i.e. canal wetlands and irrigation wetlands).

Under baseline conditions, the highest FCU for vernal pools, swale wetlands, and/or clay slope wetlands was 0.771. This FCU was achieved where the only disturbance within 500 meters is moderate grazing. The lowest FCUs for vernal pools, swale wetlands, and clay slope wetlands were 0.234, 0.242 and 0.631, respectively.

Tables 4-2, 4-3 and 4-4 provide a summary of the functional impacts under the baseline and with-project scenarios for clay slope wetlands, swale wetlands and vernal pools, respectively. These tables summarize impacts to wetland functions in FCUs by regional wetland subclass categorized in terms of within the proposed campus footprint, outside the proposed campus footprint but within 500 meters, and more than 500 meters from the proposed campus footprint. The wetland acreages cited in these tables are slightly higher than the acreages cited in Table 4.1 above, because they are based on $3M^2$ cells occurring within and partially within each wetland polygon. Since a fraction of some of the 3M cells also include upland, this methodology slightly overestimates wetland area.

As shown in Table 4-5, the total difference between baseline conditions and with the proposed campus is 28.8 FCUs. This represents the loss of functional capacity from direct and indirect impacts attributable to the proposed UC Merced Campus, without implementation of the compensatory mitigation measures presented in this Plan.

Table 4-2. Functional Impacts to Clay Slope Wetlands

			Mean FCI		Range of FCI (min-max)		Total FCUs[1]	
Location	No.	Area[2]	Existing	With Project	Baseline	With Project	Baseline	With Project
Within footprint	3	0.363	0.707	0.000	0.634–0.771	0.000–0.000	0.258	0.000
Within 500 meters of footprint	40	62.567	0.759	0.749	0.676–0.770	0.648–0.770	46.570	46.233
Total	43	62.930	-	–	-	-	46.828	46.233

Notes:

[1] Total FCUs are the sum of the individual wetland FCUs, which are the product of wetland area and FCI.

[2] Values are in acres.

Table 4-3. Functional Impacts to Swale Wetlands

			Mean FCI		Range of FCI (min-max)		Total FCUs[1]	
Location	No.	Area[2]	Existing	With Project	Baseline	With Project	Baseline	With Project
Entirely Within Campus Footprint	144	25.026	0.691	0.000	0.243–0.771	0.000–0.000	15.328	0.000
Within 500 meters of Campus	387	57.249	0.759	0.744	0.258–0.771	0.255–0.771	42.359	41.235
Total	531	82.275	-	–	-	-	57.687	41.235

Notes:

[1] Total FCUs are the sum of individual wetland FCUs, which are the product of wetland area and FCI.

[2] Values are in acres.

Table 4-4. Functional Impacts to Vernal Pools

			Mean FCI		Range of FCI (min-max)		Total FCUs[1]	
Location	No.	Area[2]	Existing	With Project	Baseline	With Project	Baseline	With Project
Entirely Within Campus Footprint	750	15.379	0.715	0.000	0.246–0.771	0.000–0.000	10.718	0.000
Within 500 meters of Campus	2,131	102.450	0.757	0.742	0.252–0.771	0.235–0.771	70.453	69.419
Total	2,881	117.829	-	–	-	-	81.171	69.419

Notes:

[1] Total FCUs are the sum of the individual wetland FCUs, which are the product of wetland area and FCI.

[2] Values are in acres.

Table 4-5. Wetland Functional Capacity Units Baseline and Proposed Project Scenarios

Regional Subclass	Baseline (FCUs)	Proposed Project (FCUs)	Difference (FCUs)
Vernal Pools	81.171	69.419	11.752
Swale Wetlands	57.687	41.235	16.452
Clay Slope Wetlands	46.828	46.233	0.595
Total	185.686	156.887	28.799

Chapter 5
Proposed Mitigation Measures

Overview of Mitigation Plan

The CWMMP consists of two major components: (1) preservation and management to prevent reasonably foreseeable degradation of existing wetlands, and (2) restoration of previously existing wetlands and/or establishment of new wetlands. From a broad perspective, the preservation and management component is primarily intended to ensure that there will be no net loss of wetland functions for naturally occurring wetlands (vernal pools, swale wetlands and clay slope wetlands). The restoration and creation component is primarily intended to ensure that there will be no net loss in the overall areal extent of wetlands. From a functional standpoint, the wetland creation is also intended to compensate for the loss of function to non-naturally occurring wetlands (canal wetlands and irrigation wetlands).

This CWMMP is based on a comprehensive ecosystem approach focusing on the watershed level involving a wide range of aquatic habitats and their surrounding upland environments. In selecting and securing mitigation areas, emphasis has been placed on securing large parcels encompassing intact watersheds. Securing larger parcels allows for a more comprehensive ecosystem landscape approach and increases the opportunity to minimize indirect impacts and perturbations from adjacent lands. In many instances, these mitigation measures will serve a dual function in mitigating impacts to rare, threatened, or endangered species. The mitigation will not be "on-site" in that it will not be located within the confines of the proposed campus. It will be located within the same general watershed, geographical regions, soil types, and environments as UC Merced, often on adjacent lands.

Background on Preservation and Enhancement

Corps mitigation policy provides some flexibility in terms of the types of strategies that can be utilized to mitigate the impacts of a project. It allows the use of preservation of existing wetlands and other aquatic resources in conjunction with restoration, rehabilitation, establishment and enhancement activities where "it is demonstrated that the preservation will augment the functions of the established, restored, rehabilitated or enhanced aquatic resource"

(U.S. Army Corps of Engineers 2002). Corps policy allows for preservation as the sole basis of mitigation. Corps policy also allows mitigation credit to be given for the preservation of upland areas to the degree that the protection and management of such upland areas is an enhancement of the overall value of the mitigation project.

Approximately 40.41 acres of the aquatic habitats that would be impacted by UC Merced are vernal pools, swale wetlands and clay slope wetlands. Preservation of these types of wetlands and their surrounding uplands to compensate for wetland impacts is consistent with Corps mitigation policy for the following reasons:

- There are numerous agricultural activities, such as grazing, normal plowing, and disking that are not regulated under Section 404 of the Clean Water Act. These activities can seriously degrade the functional capacity of these wetlands. Therefore, preservation and enhancement of such lands can reduce or eliminate this potential degradation.
- Certain wetlands may not be regulated under Section 404 of the Clean Water Act because they are isolated and do not otherwise have a nexus to interstate commerce. Therefore, preservation and enhancement of such wetlands would also protect them from potential degradation.
- The uplands surrounding these wetlands are not regulated pursuant to Section 404 of the Clean Water Act. As a result, these uplands can be substantially modified to such an extent that the adjacent aquatic habitats would be significantly impacted. With respect to non-vernal aquatic habitats, the USFWS routinely recommends, and the Corps Sacramento District routinely requires, the preservation of upland buffers adjacent to the preserved aquatic resources.
- The USFWS routinely requires preservation of vernal pools and seasonal wetlands as the cornerstone of mitigation projects designed to compensate for impacts to these wetlands where such wetlands are considered habitat for threatened or endangered species. Similar requirements are anticipated for UC Merced.

Proposed Preservation

Figure 5-1 is a map showing the location and boundaries of the lands to be preserved and managed ("Conservation Lands"). The proposed Conservation Lands include the following:

- Lands which are owned wholly or in part by UCM and will be managed by UCM for conservation purposes with granted conservation easements (hereinafter referred to as Tier 1a lands);

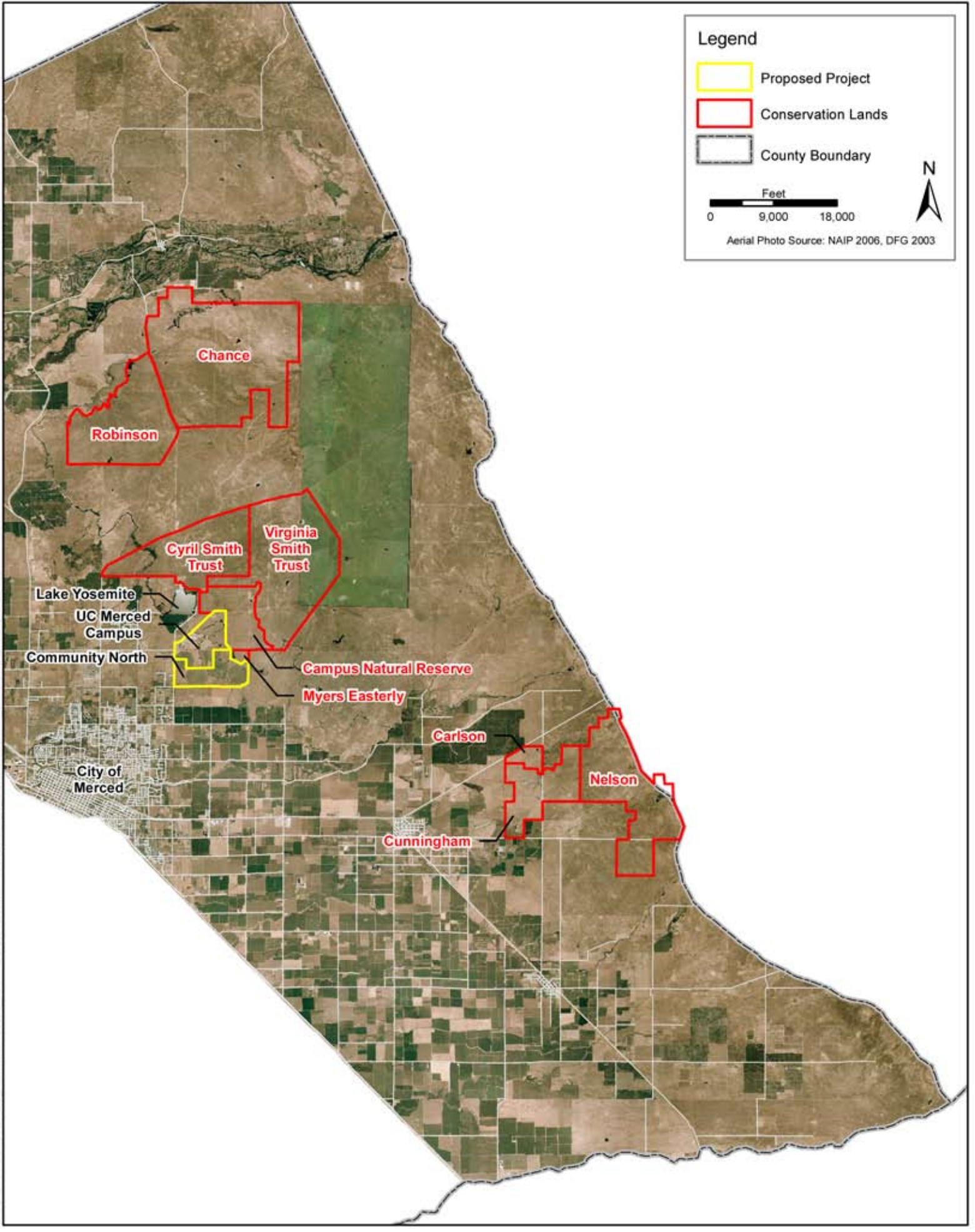

Figure 5-1
UC Merced Project and Proposed Mitigation Lands

- Lands currently owned in fee title by The Nature Conservancy (TNC), to be protected by a comprehensive conservation easement (hereinafter referred to as Tier 1b lands); and,

- Lands under private ownership currently protected under conservation easements (hereinafter referred to as Tier 2 lands).

The Tier 1a lands include the Virginia Smith Trust (VST) property (5,030 acres), 1,307 acres of lands previously proposed as the Campus Natural Reserve (750 acres) and the Campus Land Reserve (338 acres), 221 acres of land that were included in the originally proposed Campus and 91 acres of land known as the Myers Easterly property. Tier 1b lands are the Cyril Smith Trust (CST) property (3,074 acres). The CST property is currently owned in fee title and managed for grazing and habitat protection by TNC.

Tier 2 lands are comprised of five properties encompassing 17,141 acres that were selected for mitigation because of the high value of their existing biological resources. The Tier 2 lands include the Carlson (305 acres), Chance (7,619 acres), Cunningham (1,761 acres), Nelson (3,861 acres) and Robinson (3,595 acres) properties.

A plan has been prepared which describes the proposed long-term management of these lands (Airola 2008a). A copy of the Management Plan is attached as Appendix B. The management objectives and mitigation potential for Tier 1a, Tier 1b and Tier 2 lands, will vary because of ownership status and the presence or absence of existing conservation easements. Tier 1a lands are owned wholly or in part by UCM (Tier 1a) thereby allowing for a more active and adaptive approach to long-term management. Tier 1b lands will be protected under a conservation easement that will provide for long-term management and insure agency access to monitoring results. The conservation easements for Tier 2 lands have already been granted and, as a result, management discretion is substantially less detailed and less flexible.

The wetlands and other aquatic resources on the Conservation Lands were delineated by EIP for Merced County as part of a preliminary delineation of all wetlands in western Merced County. Figures 5-2a–5-2h are maps showing the wetlands delineated by EIP. Table 5-1 is a tabulation of the wetlands delineated on the Tier 1 lands. Table 5-2 is a tabulation of the wetlands delineated on the Tier 2 lands. The wetland classifications used by EIP preceded and are not consistent with the HGM regional subclasses adapted for the functional assessment. Generally speaking, the vernal pool and clay playa classifications used by EIP are equivalent to the HGM vernal pool subclass, the pool/swale and swale/channel classifications used by EIP are equivalent to the HGM swale subclass, and the seasonal wetland EIP classification is equivalent to the HGM clay slope subclass. The “other” category encompasses several EIP classifications for wetlands that have been created or substantially influenced by anthropogenic modifications to the landscape such as farm ponds, irrigation wetlands, etc.

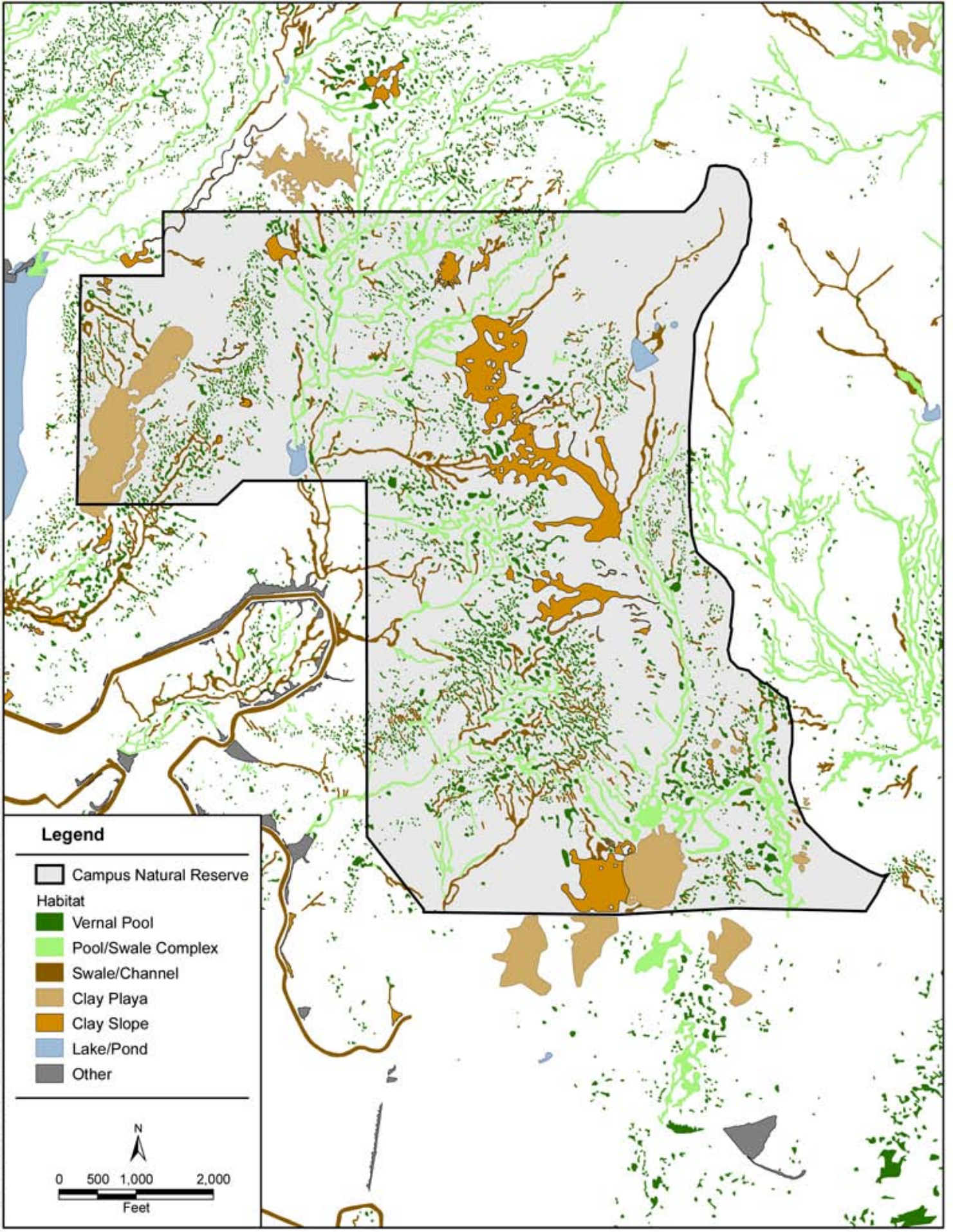

Figure 5-2a
Waters of the United States
Campus Natural Reserve

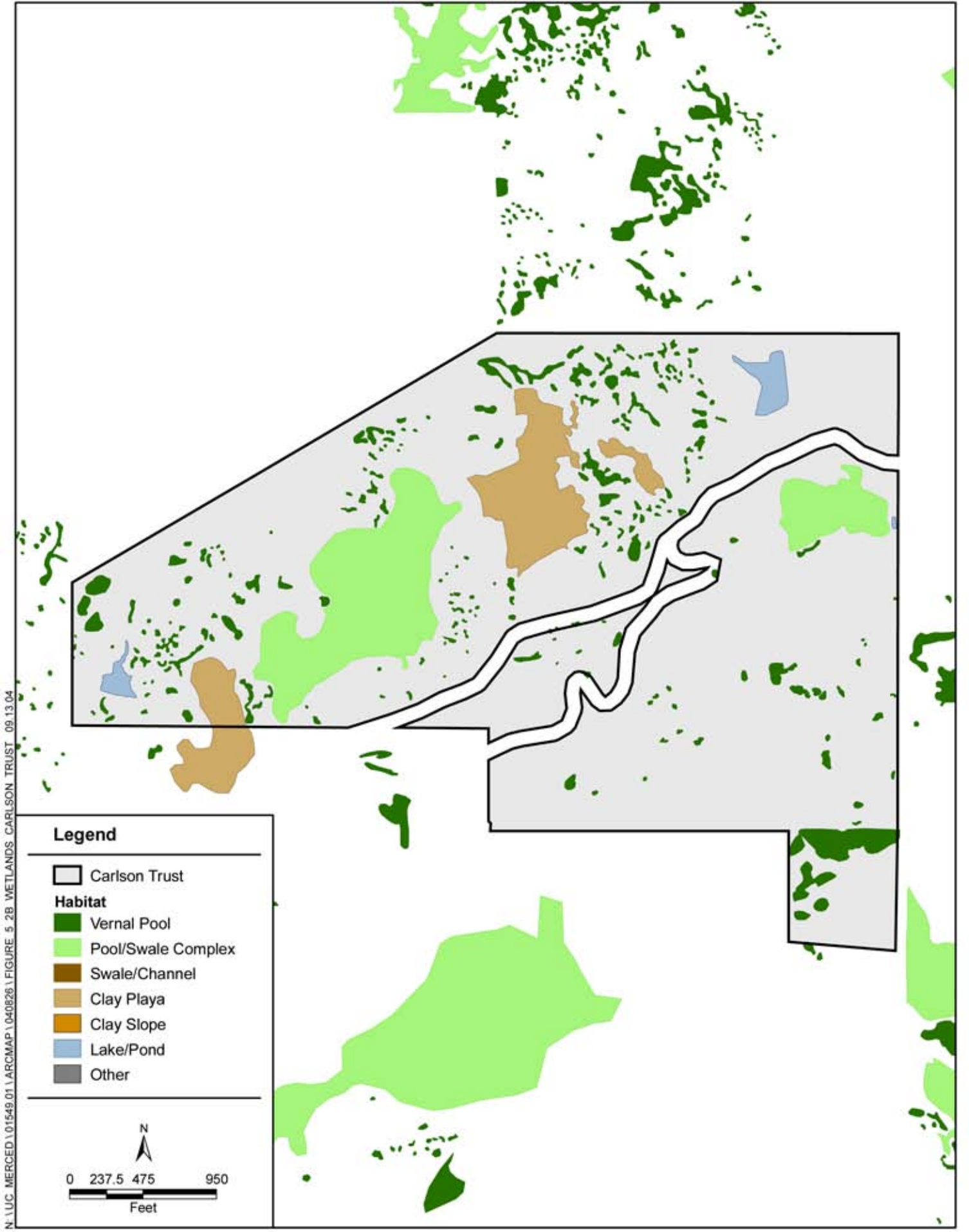

Figure 5-2b
Waters of the United States
Carlson Trust

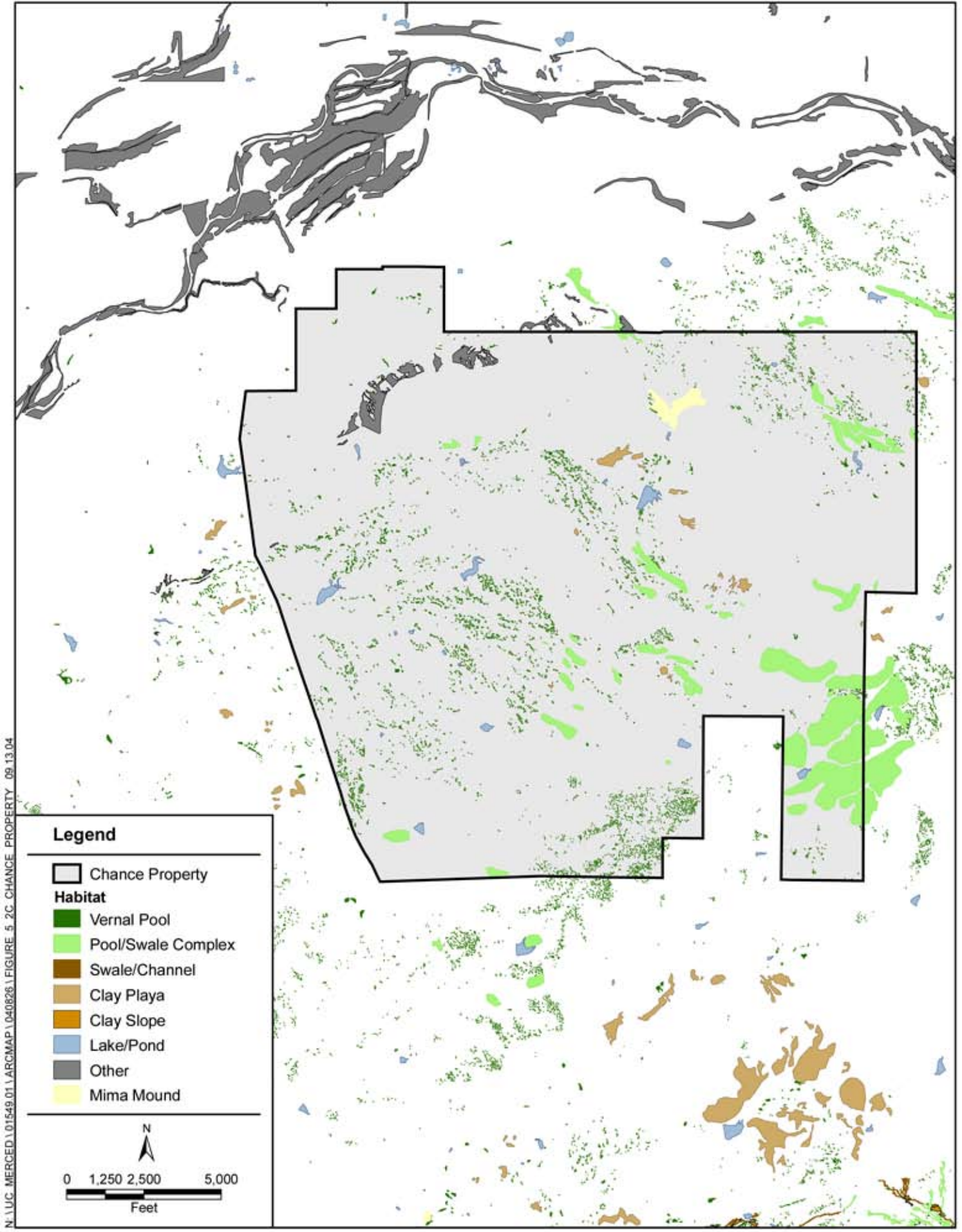

Figure 5-2c
Waters of the United States
Chance Property

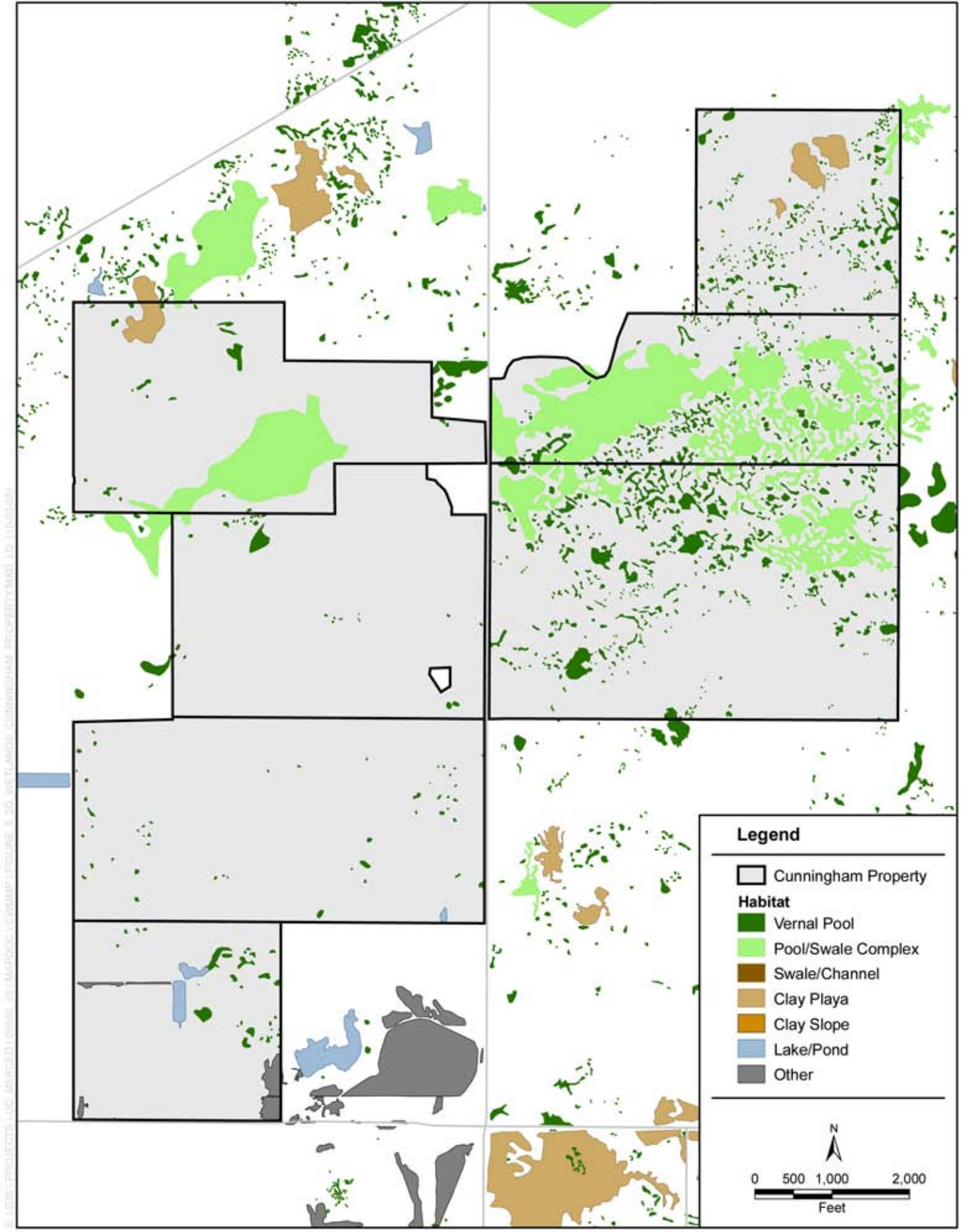

Figure 5-2d
Waters of the United States
Cunningham Property

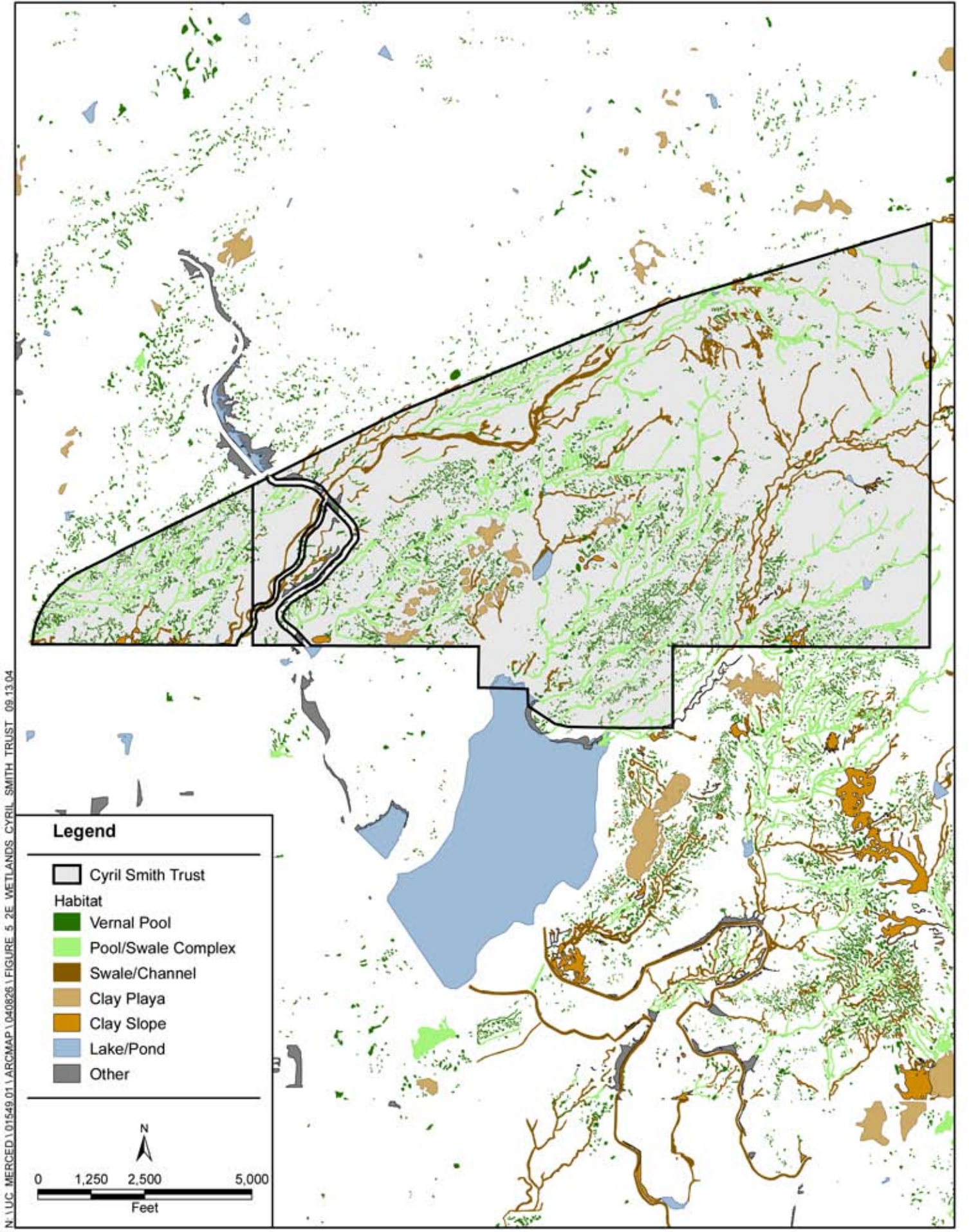

Figure 5-2e
Waters of the United States
Cyril Smith Trust

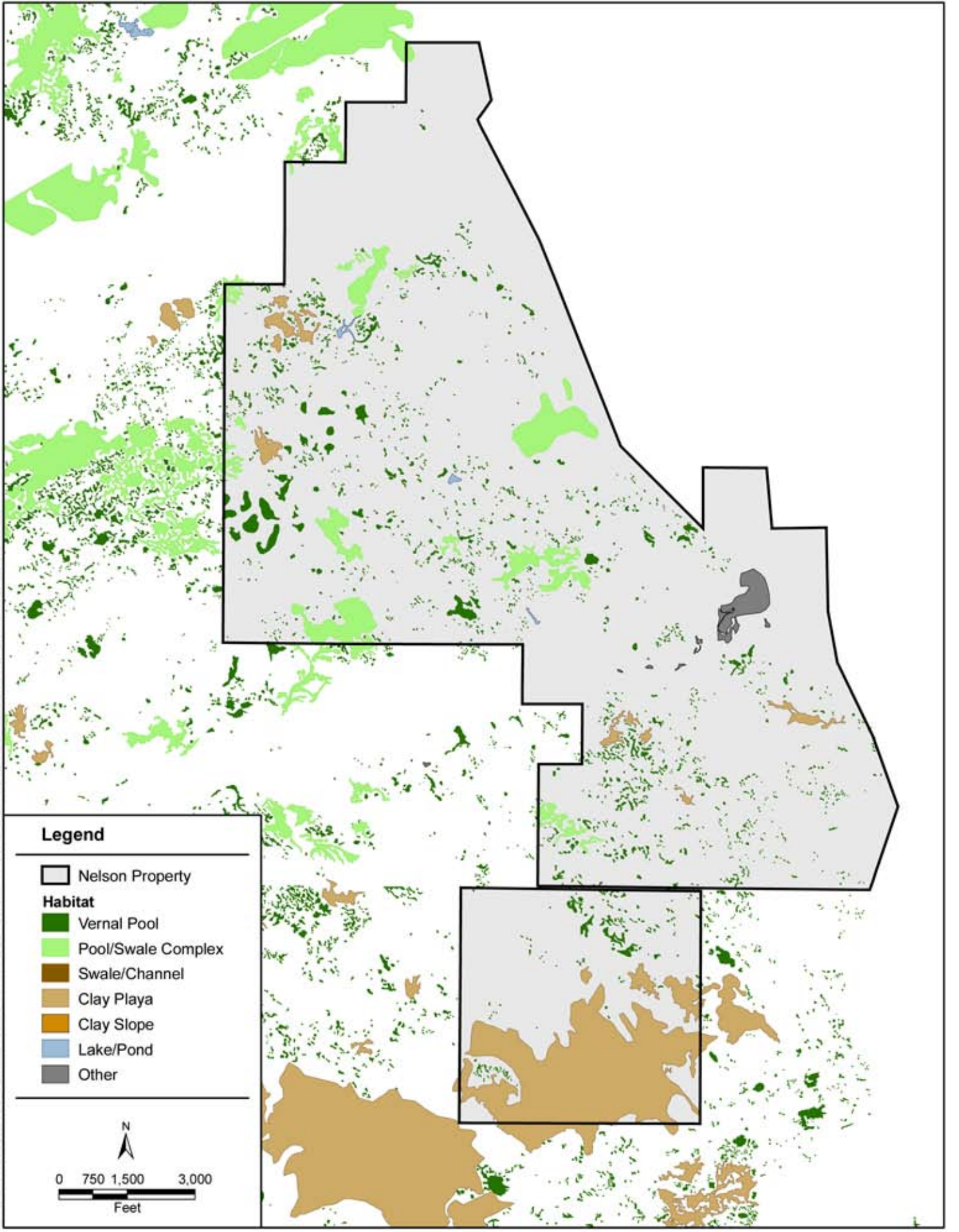

Figure 5-2f
Waters of the United States
Nelson Property

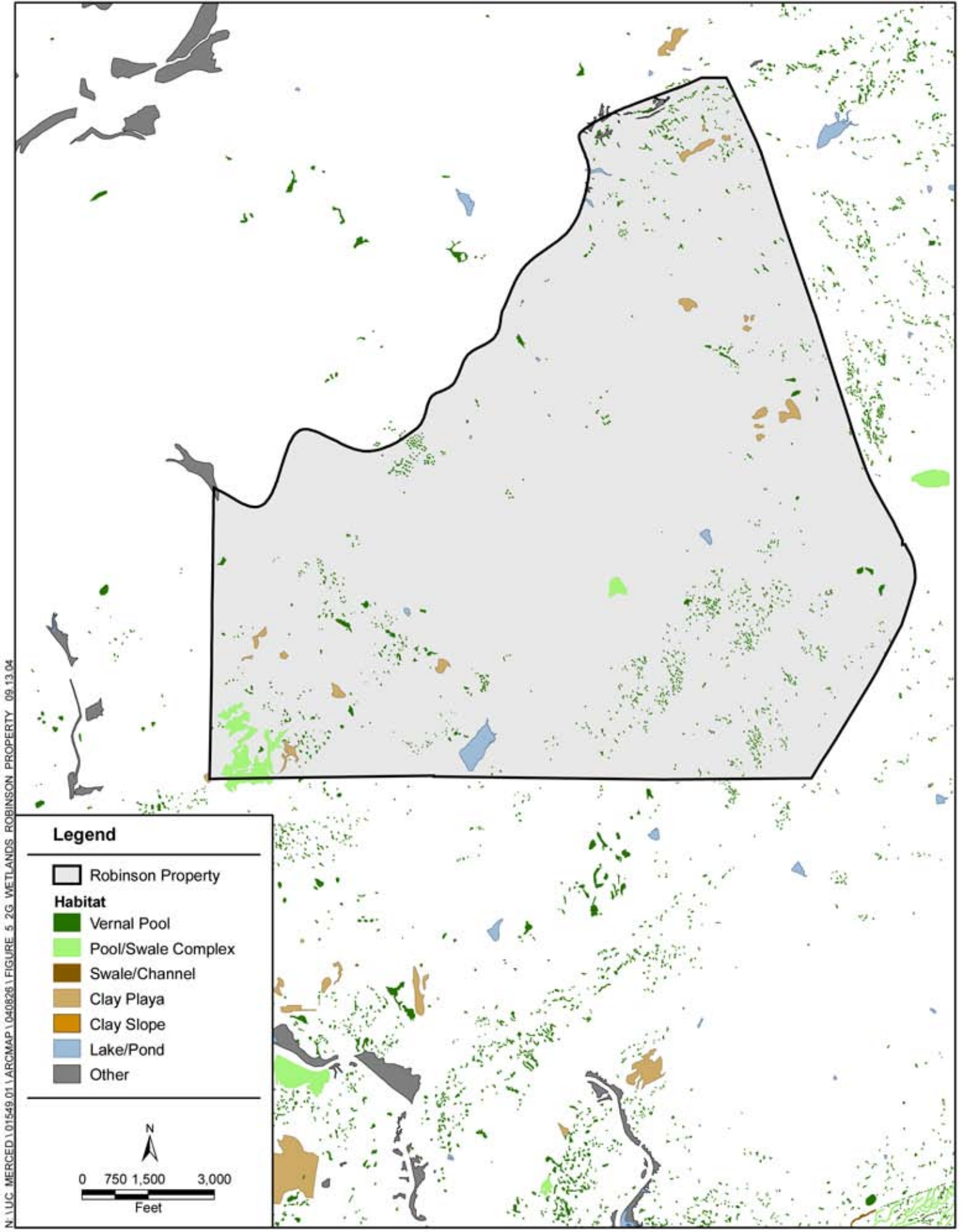

Figure 5-2g
Waters of the United States
Robinson Property

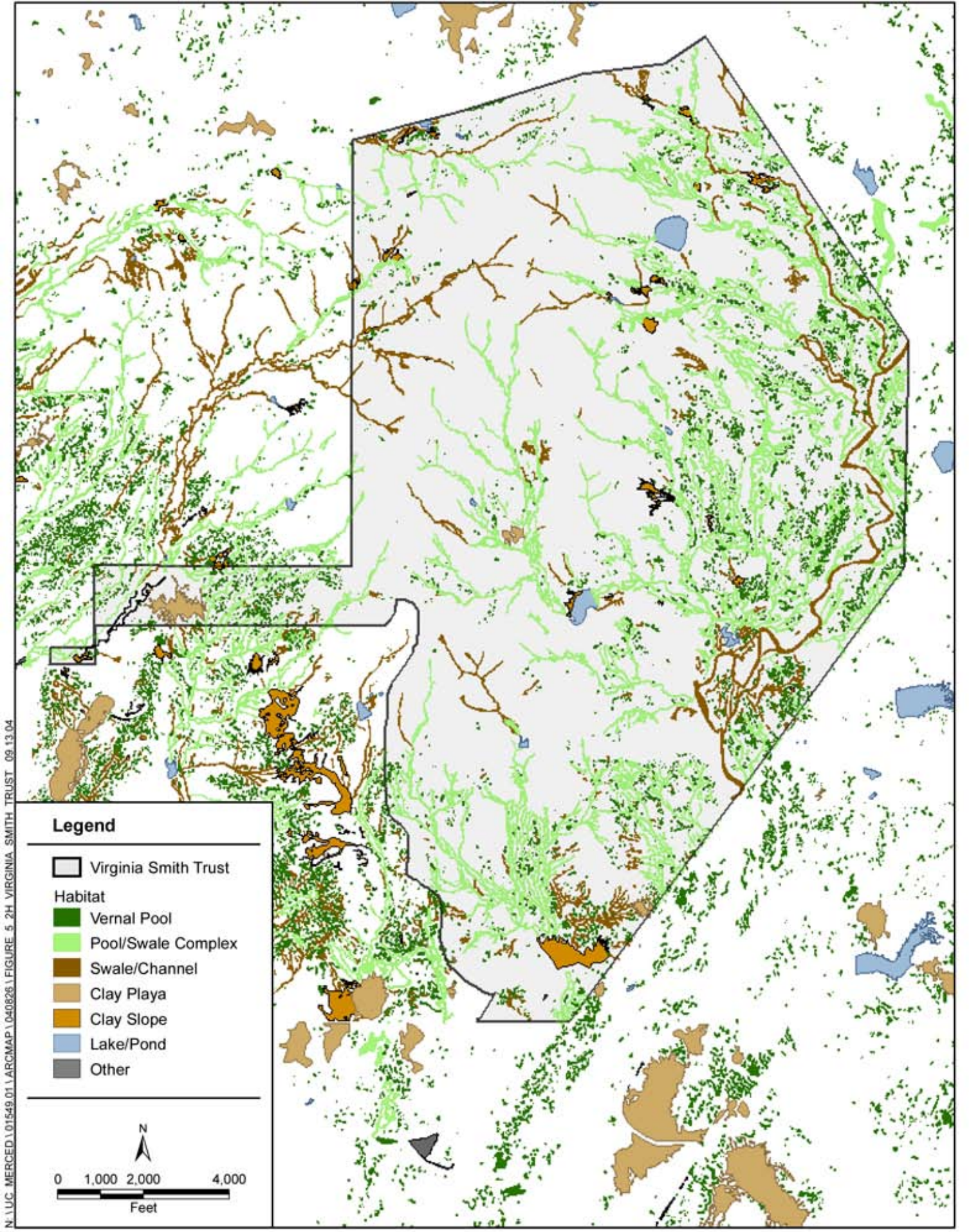

Figure 5-2h
Waters of the United States
Virginia Smith Trust

Table 5-1. Wetland Areas (acres) on Tier 1 Lands

Name	Vernal Pool	Swale Wetlands	Clay Slope Wetlands	Other	**Total**
Tier 1a	181	437	104	16	**738**
Tier 1b	106	173	15	16	**310**
Total	**287**	**610**	**119**	**32**	**1,048**

Table 5-2. Wetland Areas (acres) on Tier 2 Lands

Property	Vernal Pool	Swale Wetlands	Clay Slope Wetlands	Other	**Total**
Carlson	13	26	13	2	**54**
Chance	63	301	18	68	**450**
Cunningham	47	141	12	7	**207**
Nelson	79	137	246	25	**487**
Robinson	22	19	16	13	**70**
Total	**224**	**624**	**305**	**115**	**1,268**

These delineations were reviewed in the field jointly by Corps staff and Gibson & Skordal. Based on this field review and subsequent aerial photo interpretation, it is our opinion, concurred with by the Corps, that the delineations are sufficiently accurate for assessment of the adequacy of the mitigation. It was also the opinion of Gibson & Skordal and Corps staff that the relative levels of disturbance and wetland functional performance at each of the Conservation Lands is approximately equal to the disturbance level and wetland functional performance within the project area.

Calculation of Functional Replacement

The functional replacement derived from preservation and management can be calculated based on enhancement of existing values or on prevention of degradation. The calculation of increased function from enhancement would involve lowering disturbance ratings (i.e. increasing the disturbance index rating) over existing conditions. The calculation of functional replacement from prevention of degradation would involve implementing measures designed to preclude reasonably foreseeable activities that would result in increase disturbance ratings (i.e. decreasing the disturbance index rating) over existing conditions. In estimating functional replacement derived from preservation and management of the Conservation Lands, we based our calculations primarily on the benefits derived from implementing an adaptive grazing management program, relying more on the benefits of preventing degradation rather than enhancement of existing (baseline) conditions.

Under the functional assessment methodology, the current grazing regime (moderate) is assigned a disturbance index rating of 0.70. The optimum condition (1.00 disturbance index rating) would theoretically be achieved through an adaptive grazing management program designed to maximize wetland function. This would result in an incremental functional improvement of 0.30 which would be an approximate 43 percent improvement. Given the relatively high level of existing wetland function, it is uncertain whether an adaptive grazing management program would actually result in this level of improvement. For this reason, we have opted to use the more conservative approach of basing the calculation of functional replacement on prevention of degradation through maintenance of current grazing regimes and the prevention of potential future overgrazing and undergrazing as well as implementation of additional management measures designed to maintain existing resource values in perpetuity.

A copy of the proposed Management Plan is attached as Appendix B. The Management Plan describes the various management goals, objectives and management guidelines for Tier 1 and Tier 2 lands. The assumptions used for projecting functional replacement from preservation and management are derived from the Management Plan.

Under the functional assessment methodology, severe grazing is assigned a disturbance index rating of 0.50. This index rating assumes a level of grazing that is so severe that there is an obvious substantial degradation of both the upland and wetland plant communities. The functional assessment assigns a disturbance index rating of 0.70 to moderate grazing. This index rating is intended to encompass the broad range of grazing conditions observed within the project area and on the preservation lands, without specific institutionally required and managed grazing regimes. Absence of grazing is assigned a disturbance index rating of 0.50.

The assigned index ratings are, in large part, based on research by Dr. Jaymee Marty (Marty 2005). Dr. Marty's research examined the effect of different grazing treatment (ungrazed, continuously grazed, wet-season grazed, and dry-season grazed) on vernal pool plant communities and vernal pool aquatic faunal diversity in the Central Valley of California. Dr. Marty found that removal of grazing results in significant reductions in native plant species richness and aquatic invertebrate species richness as compared to moderate grazing. The research also documented a significant reduction in vernal pool inundation periods resulting from cessation of grazing. These findings strongly indicated that cessation of grazing results in significant reductions in overall wetland function.

Cessation of grazing, diminished grazing, and severe grazing are all plausible future scenarios that would adversely impact overall wetland function. Both reduced grazing and no grazing conditions were observed during field surveys conducted in development of the HGM functional assessment methodology. Severe overgrazing conditions, as defined per the functional assessment methodology, were not observed within the project area or on any of the Conservation Lands but have been observed in other vernal pool landscapes and

are considered to be a potential future scenario. The livestock industry responds to specific market changes that occur from year to year. Additionally, the livestock industry is undergoing substantial long-term changes and has become less viable in many areas, particularly those areas in proximity to urban expansion.

The HGM functional assessment methodology assigns a small incremental improvement to the disturbance index rating for a grazing regime designed to be consistent with Natural Resources Conservation Service (NRCS) guidelines for management of annual rangelands (Cooperative Extension 1982). These standards are based on the amount of residual dry matter (RDM), measured in pounds per acre (lbs/acre) and are adjusted for various precipitation regions and topographies. In the Central Valley (10 to 40 inches of precipitation annually) the standards are 400 lbs/acre in lower or flat slopes, 600 lbs/acre in average to gentle slopes, and 800 lbs/acre in upper or steep slopes. These are considered to be minimum standards necessary to prevent degradation of range land. They are not necessarily indicative of standards that would maximize wetland function or species habitat.

The assigned disturbance index rating for grazing managed to meet NRCS standards (0.80) is only slightly higher than the index rating for moderate grazing (0.70). Managing grazing to meet NRCS standards could enhance the condition of the watersheds somewhat and therefore enhance related functions (e.g., subsurface water storage and interchange, element and compound cycling, organic carbon transport, etc.). However, it cannot necessarily be assumed that the overall net functions within the wetlands themselves would be substantially enhanced. The conservation easements that have been established over the Tier 2 lands require that the NRCS's RDM standards be met. For this reason, the incremental functional benefit on Tier 2 lands was assumed to be 0.10.

On the Tier 1a lands, the University of California is proposing to establish, in coordination with TNC, a standard to assure that the NRCS's RDM standards are met and that grazing be maintained at its current levels. By maintaining grazing at its current levels, the degradation that could result from removal of grazing and overgrazing will be prevented. Preventing this degradation will result in an incremental functional benefit of 0.20.

In order to quantitatively assess the adequacy of the proposed mitigation, we calculated the number of replacement FCUs that would result from preventing degradation that would result from overgrazing and/or ceasing or significantly reducing grazing for the Tier 1 lands. On Tier 1a and Tier 1b lands, the average reduction in FCI that would result from cessation or significantly reducing grazing intensity would be approximately 0.20. Table 5-3 lists the resulting increase in terms of FCUs, by regional subclass on Tier 1a lands. Table 5-4 lists the resulting increase in terms of FCUs, by regional subclass on Tier 1b lands. The total functional replacement on Tier 1 lands resulting from assuring that moderate grazing practices continue would be 203.2 FCUs.

Table 5-3. Replacement in FCUs from Prevention of Overgrazing and Undergrazing on Tier 1a Lands

Regional Subclass	Area (acres)	Replacement FCUs[1]
Vernal Pools	181	36.2
Swale Wetlands	437	87.4
Clay Slope Wetlands	104	20.8
Total	722	144.4

[1] Assumes an average FCI change of 0.20.

Table 5-4. Replacement in FCUs from Prevention of Overgrazing and Undergrazing on Tier 1b Lands

Regional Subclass	Area (acres)	Replacement FCUs[1]
Vernal Pools	106	21.2
Swale Wetlands	173	34.6
Clay Slope Wetlands	15	3.0
Total	294	58.8

[1] Assumes an average FCI change of 0.20.

Table 5-5 is a comparison of the projected loss in FCUs attributable to the proposed Campus and Community North compared to the replacement of FCUs that would result from prevention of overgrazing and undergrazing on Tier 1 lands.

Table 5-5. Comparison of Project Impacts and Resulting Compensation from Preservation and Management of Tier 1 Lands

Regional Subclass	Projected Functional Impact (FCUs)	Projected Functional Replacement (FCUs)[1]	Net Projected Functional Increase (FCUs)[2]
Vernal Pools	11.7	57.4	45.7
Swale Wetlands	16.5	122.0	105.5
Clay Slope Wetlands	0.6	23.8	23.2
Total	28.8	203.2	174.4

[1] Total increase in FCUs on all preservation lands resulting from modified grazing regimes.

[2] Total increase in FCUs minus projected loss in FCUs.

As is shown in Table 5-5, the preservation and management of Tier 1 lands alone would result in a net increase of 174.4 FCUs, assuming an incremental

improvement of 0.2 in the FCI. Even if the incremental improvement in FCI were halved (0.1), there would be a net increase of 72.8 FCUs. Assigning an incremental improvement of only 0.03 in the FCI would still result in full functional replacement. Based on this, the proposed preservation and management of Tier 1 lands alone would fully compensate for the loss of wetland function of vernal pools, swale wetlands and clay slope wetlands.

The Management Plan also proposes to develop and implement an adaptive grazing management program on the Tier 1a lands (see Appendix B of Management Plan). The intent of this adaptive management program will be to maintain and enhance the existing wetlands, their surrounding grasslands and their associated resource values, including the conservation values. Because of the uncertainty in projecting the scale and extent to which wetland function would be enhanced from implementation of the adaptive management program, we have not attempted to quantify the resulting functional replacement that would result from implementation of the adaptive grazing management program. We, likewise, have not attempted to quantify the functional benefit of implementing other aspects of the Management Plan designed to minimize degradation and maintain habitat values.

As stated previously Tier 2 lands are comprised of 5 separate properties under private ownership currently protected under conservation easements. These lands will remain in private ownership but their use will be restricted by conservation easements. TNC is the easement holder for the Chance, Carlson, Cunningham, and Robinson properties. The California Rangeland Trust (CRT) is the easement holder for the Nelson property. These conservation easements are similar for each of the properties but there are differences. Each of the conservation easements places restrictions on grazing. None of these restrictions necessarily allow for an adaptive grazing management program designed to optimize wetland function nor do they contain a requirement that grazing must be maintained at current levels. These restrictions require that grazing be limited to the extent that the RDM standards specified in the NRCS guidelines are met. These minimum standards vary from 600 lbs/acre to 800 lbs/acre in normal and wet years and 400 lbs/acre in drought years.

Because of the limitations of the existing conservation easements, the same level of incremental improvement projected for the Tier 1 lands should not be projected for the Tier 2 lands. Although severe grazing would be prevented, there are no assurances that moderate grazing will be maintained. There are approximately 224 acres of vernal pools, 624 acres of swale wetlands, and 305 acres of clay slope wetlands existing on the on the Tier 2 lands. A small incremental benefit of 0.10 in FCI would, result in an increase of 22.4 FCUs for vernal pools, 62.4 FCUs for swale wetlands, and 30.5 FCUs for clay slope wetlands. Thus the total increase in FCUs on the easement lands would be approximately 115.3. A very minor incremental improvement of 0.01 in the FCI would result in an increase of 11.5 FCUs.

Preservation and management of Tier 1 and Tier 2 lands may also provide compensatory mitigation by eliminating other potential future degradation from unregulated activities such as sprinkler irrigation or plowing. While some level

of future degradation would be likely over time, it is impossible to predict with any reasonable degree of accuracy when or to what extent these degradations would occur. For that reason, we have not attempted to quantify any resulting benefits to wetland function attributable to preventing potential degradation from other unregulated activities.

Proposed Restoration and Creation

Both restoration and creation involve manipulation of existing physical, chemical, and/or biological characteristics to establish wetlands. Restoration activities seek to re-establish a previously existing wetland or wetland landscape that has been destroyed or degraded to the extent that wetland functions are minimal. Creation activities seek to establish functioning wetlands where they previously did not exist or where that type of wetlands did not previously exist.

The goal of the proposed restoration and creation efforts will be to establish wetlands that are similar to the impacted wetlands in terms of their physical and biological characteristics. To the extent that the characteristics of the mitigation site(s) allow, the composition of the restored and created wetlands will be roughly proportional to the impacted wetlands in terms of their hydrogeomorphic characteristics and plant communities. In other words, the wetlands restoration and creation will be "in-kind." It may not be practicable or possibly desirable to establish certain types of impacted aquatic habitats such as ephemeral channels or seasonally saturated wetlands occurring on convex surfaces underlain by clay soils (clay slope wetlands). In those cases, out-of-kind wetland restoration and/or creation would be preferable. Out-of-kind wetland restoration and/or creation may also be preferable if there is insufficient or inadequate land available to satisfy the requirements to successfully restore or create certain types of wetlands.

Restoration of wetlands will be the mitigation methodology for impacts to naturally occurring wetlands (vernal pools, swale wetlands and clay slope wetlands). The intent is to select a mitigation site or sites where similar wetlands previously existed but have subsequently been eliminated or substantially reduced in extent and degraded in terms of function. As discussed in the preceding paragraph, restoration of clay slope wetlands is not feasible. Because of this, it is anticipated that the restoration goal will be re-establishment of a vernal pool landscape containing vernal pools and swale wetlands.

Creation of wetlands will be the mitigation methodology for impacts to non-naturally occurring wetlands (irrigation wetlands and canal wetlands). Because these wetland types are not naturally occurring, restoration would be oxymoronic. The goal will be to create seasonal wetlands and/or emergent marsh similar to the impacted wetlands.

A sufficient amount of wetlands will be restored and/or constructed to assure that there is no net loss in functioning wetland area. Wetlands will be considered functioning when they have met or exceeded the performance criteria. In order to achieve this goal, more wetlands will be constructed than is necessary to meet

the 1:1 replacement goal. The amount of wetlands that must ultimately meet all performance criteria will be equal to the total area of wetlands impacted by the project. The intent is to restore and construct enough wetlands to provide an adequate allowance for failure given reasonable expectations derived from other similar mitigation projects.

In many cases, it may not be desirable to attempt to restore or create wetlands on the lands that have been secured for preservation because of potential indirect impacts. In order to avoid indirect impacts to existing wetlands and the sensitive biota they support, it will be necessary to secure additional lands to accommodate the restoration and creation. The amount of land that will need to be secured will depend on the restoration and creation potential of the mitigation lands to be acquired.

Gibson & Skordal conducted an initial review of potential mitigation sites using aerial photography and field reconnaissance to determine whether there is a sufficient area of land amenable to wetland restoration/creation. Based on this, it appears that there is sufficient acreage within close or reasonable proximity to accomplish this purpose. The University has contacted and received several expressions of interest from the owners or agents of suitable restoration and creation sites to satisfy these requirements. Although negotiations with these landowners are in the preliminary stages, it appears that the University should be able to secure an appropriate site or sites without great difficulty. When a potential site(s) has been tentatively selected, it will be presented to the Corps, EPA, USFWS, and DFG for approval. Once a site(s) has been approved and secured, detailed site plans will be prepared by UC Merced to implement the restoration and creation measures. This plan will be forwarded to the Corps for review and approval (see Implementation Schedule).

Implementation Schedule

In addition to revising the Campus and Community footprint to further avoid and minimize impacts to pristine vernal pool habitat on the VST and UCLC properties, to date, UC Merced and the State of California have secured more than 26,000 acres for the preservation of vernal pool grassland habitat in Eastern Merced County. UC Merced proposes a phased implementation schedule for the restoration and creation efforts contemplated in the CWMMP within the context of UC Merced's prior commitments to habitat preservation and conservation in Eastern Merced County. Such prior and ongoing commitments include:

- UC's redesign of the Campus and Community footprint to reduce impacts to aquatic resources,
- the State's funding and acquisition of mitigation lands for impacts to aquatic resources in advance of permit issuance, and

- the substantial amount of vernal pool habitat preservation in Eastern Merced County implemented by the UC Merced Project in furtherance of recovery.

Although construction of the project will be phased over many years, UC Merced proposes to complete construction of all of the wetlands restoration/creation within three to four years of initiation of project construction. UC Merced plans to begin construction of Phase II during the first construction seasonal following issuance of the DA permit. The following restoration/creation implementation schedule takes into account the considerable lead time needed to select and secure the mitigation site(s), prepare and obtain approval of site-specific addendums to the CWMMP, and mobilize the construction of a mitigation project of this size.

Tentative site selection. Within one year of issuance of the permit, UC Merced will select, identify and characterize preferred restoration/creation sites and submit them to the Corps, Service and CDFG for approval.

Submit site specific plans. Within six months of receiving agency approval of the mitigation sites, UC Merced will secure the mitigation sites and prepare site-specific addendums to the CWMMP and submit them to the Corps, Service and CDFG for approval.

Begin Mitigation Construction. UC Merced will begin construction of the restoration/creation in May immediately following agency approval of the site-specific addendums to the CWMMP. This assumes that agency approval is received by at least January 1 of that year to allow sufficient time to prepare for mobilization of mitigation construction.

Complete Mitigation Construction. Because all work will be done during the dry season (May – October), it is anticipated that the mitigation construction will require two construction seasons.

Responsibilities for Implementing Plan

The University of California will be responsible for implementing all aspects of the mitigation plan except for the management of the Tier1b and Tier 2 lands. Tier 1b will be managed by the TNC unless the land is sold with a conservation easement, in which case TNC or another conservation entity would administer the terms of the easement. Tier 2 lands will be managed by the conservation easement holders (TNC and CRT) pursuant to grant agreements they have in place with the WCB. In the event management of any of the Tier 2 lands is transferred to another conservation organization, the new managing organization will be responsible for managing the lands pursuant to the grant agreements.

Estimated Cost of Mitigation

The total cost of the restoration/creation component of the mitigation is the sum of the estimated cost of land acquisition, designing, and constructing the wetlands, monitoring their success for a minimum of five years, and long-term management. The estimated cost of implementing the proposed mitigation measures, exclusive of long-term monitoring and management, would range from $18,675,000 up to $20,675,000. A discussion of these estimated costs is provided below.

Creation/Restoration

The estimated cost of acquiring the land will range from $1,000,000 up to $3,000,000. The estimated cost of designing, constructing, and monitoring these wetlands for five years is $2,675,000. The combined estimated cost would range from $3,675,000 up to $5,675,000.

Preservation/Enhancement

The total cost of the preservation/enhancement component of the mitigation is the sum of the costs of acquiring titles and securing the conservation easements and the costs of the long-term management of these lands. A total of more than $15,000,000 has been spent to date acquiring titles and conservation easements.

Long-Term Maintenance

These costs will include the cost of maintaining the restoration/creation lands as well as maintaining the preservation/enhancement lands that are owned by the University. These costs, which can be substantial, have not been estimated at this time.

Chapter 6
Performance Standards

Creation/Restoration

As stated previously, the restoration/creation element of the CWMMP is primarily intended to assure that there will be no net loss of wetland acreage resulting from construction of the UC Merced project. The restoration component for naturally occurring wetlands (vernal pools, swale wetlands and clay slope wetlands) is not necessarily intended to replace losses of wetland function; though, as discussed in previous chapters, some lost functions will be replaced in the restored wetlands. The creation component for non-naturally occurring wetlands is intended to replace functional losses of canal wetlands and irrigation wetlands. The following standards will be used to assess the relative success of the wetland creation and restoration components of the CWMMP.

Creation

1. To achieve a 1:1 replacement for impacts to non-naturally occurring wetlands (27.76 acres) with an adequate margin of error, a minimum of 34.7 acres of wetlands will be constructed.
2. To achieve a 1:1 replacement of lost wetland area, a minimum of 27.76 acres of constructed wetlands (80% of total constructed) must satisfy the following criteria.
    a. The plant community within the constructed wetlands must be dominated by species with a wetland indicator status of Facultative, Facultative Wetland, or Obligate (Reed 1998)
    b. The absolute plant cover within the constructed wetland must be at least 70 percent.
    c. The wetlands must be inundated and/or saturated to the surface for a minimum duration of approximately 14 days during the growing season in normal rainfall years.

The above standards must be met for three successive years without human intervention.

Restoration

1. To achieve a 1:1 replacement for impacts to vernal pools, swale wetlands and clay slope wetlands (40.01 acres) with an adequate margin of error, a minimum of 50.01 acres will be constructed.
2. To achieve a 1:1 replacement of lost wetland area, a minimum of 40.01 acres of restored vernal pools and swale wetlands (80% of total constructed) must satisfy the following criteria.
    a. The plant community within the restored vernal pools and swale wetlands must be dominated by species with a wetland indicator status of Facultative, Facultative Wetland, or Obligate (Reed 1998).
    d. The plant communities within the restored vernal pools and swale wetlands must be dominated by vernal pool endemics and vernal pool associates. For purposes of this criterion, vernal pool endemics are defined to be native species commonly found in vernal pools and swale wetlands. Vernal pool associates are defined to be non-native, naturalized species commonly found in vernal pools and swale wetlands.
    e. The absolute plant cover within the restored vernal pools and swale wetlands must be at least 70 percent.
    f. The wetlands must be inundated (vernal pools) and/or saturated (swale wetlands) for a minimum duration of approximately 14 consecutive days during the growing season in normal rainfall years.

The above standards must be met for three successive years without human intervention.

Preservation and Management

The performance standard proposed for the preservation and management of Tier 1 and Tier 2 lands is necessary to assure that the assumptions used to predict functional replacement are met. As discussed in Chapter 5, full functional replacement is anticipated to result from maintenance of the current moderate grazing regime on Tier 1a and 1b lands and prevention of cessation of grazing, significant reduction in grazing intensity or severe over-grazing. While additional benefits to wetland function are also likely to result from the prevention of other potential degradations to Tier 1 and Tier 2 lands and from the implementation of the adaptive grazing management program on Tier 1a lands, these functional benefits are not quantified and are not necessary to compensate for the projected loss of wetland function.

Based on the above rationale, it is proposed that the performance standard for preservation and management be the maintenance of moderate grazing regime on Tier 1 lands. Based on an examination of existing grazing practices, a

standard(s) will be developed that provides a quantitative metric that reasonably reflects moderate grazing under baseline conditions. This standard can either be based on the timing and intensity of grazing, on measurements of residual dry matter and/or on plant community composition.

No specific performance criteria are proposed for Tier 2 lands because no functional improvement was quantified for these lands and the functional improvement derived from these lands is not necessary to compensate for projected impacts. Additionally, although TNC and the CRT are legally responsible for assuring compliance with the conservation easements, the easements do not require compliance reporting. The conservation easements for each of the Tier 2 lands establish minimum RDM requirements. Table 6-1 summarizes the minimum RDM requirements for each of these properties as specified in the approved conservation easements.

Table 6-1. Minimum RDM Requirements for Conservation Easement Lands

Property Under Easement	Area (acres)	Easement Holder	RDM Requirement (lbs/acre)
Carlson	305	TNC	800 (400 in drought years)
Chance	7,619	TNC	600 (400 in drought years)
Cunningham	1,761	TNC	800 (400 in drought years)
Nelson	3,861	CRT	600 (400 in drought years)
Robinson	3,595	TNC	600

Notes:
CRT = California Rangeland Trust.
lbs/acre = pounds per acre.
TNC = The Nature Conservancy.
RDM = Residual Dry Matter.

Chapter 7
Monitoring

Monitoring Protocol

Restoration/Creation

The University of California, Merced will be responsible for monitoring the constructed wetlands. The constructed wetlands will be monitored for a period of five years or until all performance criteria have been met for three successive years without human intervention, whichever is longer. The purpose of the monitoring is to assess the relative success of the mitigation as compared to performance criteria described in Chapter 6 and to determine whether remedial actions are necessary to assure the performance criteria are met.

Monitoring of the constructed wetlands will consist of collecting and evaluating quantitative data on the hydrology and plant communities within the constructed wetlands. Photographic points will be established to qualitatively monitor trends in the establishing plant communities. Aerial photography will be used to monitor the areal extent of constructed wetlands.

Monitoring of the hydrology of the constructed wetlands will be emphasized in the first growing season following construction. Sampling will be conducted at a frequency sufficient to document the depth and duration of inundation within the constructed wetlands. Once the hydrology of the constructed wetlands has been adequately characterized, additional detailed hydrology monitoring will not be conducted over subsequent growing seasons unless specific problems are identified that warrant further monitoring.

Vegetation monitoring will be conducted during each growing season throughout the monitoring period. The plant communities in the constructed and reference wetlands will be characterized. Each plant observed will be identified and its relative cover will be recorded. The total cover of all species will also be estimated.

Preservation Lands Compliance Monitoring

The monitoring programs for the Tier 1a, Tier 1b and Tier 2 lands will vary in intensity due to differences in ownership and varying degrees of management. A detailed description of the monitoring programs is presented in the Management Plan (Appendix B). The main body of the Management Plan addresses the management of Tier1a and Tier1b lands while Appendix A of the Management Plan addresses management of the Tier 2 lands. Appendix B of the Management Plan describes the Adaptive Grazing Management Plan. The following is a brief summary description of the proposed monitoring program.

Tier 1a Lands

UC Merced, through its Sierra Nevada Research Institute (SNRI) will be responsible for the monitoring program on Tier 1a lands. The monitoring program for Tier 1a lands will incorporate annual monitoring activities (performed at least once each year), regular periodic monitoring activities (performed at regular intervals, e.g., every 5 years), and irregular activities (actions conducted in response to specific conditions that do not occur on a predictable basis. Compliance with the Management Plans requirements will be documented by completing an annual reporting checklist that verifies and discusses management activities that were undertaken as well as those not undertaken.

An annual reporting checklist, schedule and reporting form is included in the Management Plan. The form provides the following:

- a concise summary list of required actions;
- a checklist of completed management actions; and,
- a checklist of items that may require modification through adaptive management.

Effectiveness monitoring will evaluate how well the Management Plan performs in meeting its ultimate goals. Effectiveness monitoring will evaluate the physical, biological and cultural conditions of the Tier 1a lands. Effectiveness monitoring requires specific monitoring protocols. These protocols will be developed under the leadership of the SNRI to be consistent with the goals and objectives of the Management Plan. Individual monitoring protocols will be developed to address specific resource issues and management actions. These protocols will share the basic framework listed below.

- Monitoring goals and objectives.
- Monitoring locations.

- Monitoring methods.
- Analysis and reporting.
- Success criteria.
- Recommendations for future management actions and monitoring.

Tier 1b Lands

The CST easement holder will be responsible for the monitoring program on Tier 1b lands. The CST easement holder will conduct annual monitoring to determine compliance with the terms of the easement and effectiveness of management actions taken. The primary focus of annual monitoring will be on compliance. In addition to compliance, monitoring should also include important resource issues to include the presence and extent of noxious weeds and the presence of non-native reptiles, amphibians, and fish.

Where monitoring identifies non-compliance with easement terms that has or is likely to adversely affect wetlands and/or species of conservation concern, the easement holder should, in a timely manner, proceed to work directly with the landowner or take other actions to achieve compliance.

Tier 2 Lands

TNC and the CRT are responsible for monitoring Tier 2 lands to assure compliance with the conditions of the conservation easements on an annual basis throughout the life of the conservation easements. Random samples will be taken on each of these properties consistent with the methodologies outlined in Guidelines for Residue Management on Annual Range (Cooperative Extension 1982). RDM may be estimated by direct clipping and weighing, double sampling (visual estimates with clipped herbage reference points) and, with sufficient field experience, visual estimates. The normal procedure for determining the RDM is to use 0.10 square meter circular plots where the vegetation within each plot is clipped as close to the ground as possible and weighed. Sampling is conducted in late summer or early fall when forage is dead and dried. The number of samples collected is determined based on the size of the property.

Easement compliance monitoring will involve, not just RDM monitoring, but also monitoring to ensure that the other terms of the easement are being met, such as restrictions on various activities such as road building, use of pesticides and herbicides, etc.

Reporting

Restoration/Creation Reporting

UC Merced will be responsible for preparing and submitting monitoring reports results of each year's monitoring which will be compiled into an annual monitoring report. The annual monitoring reports will present all monitoring data, assess the implications of that data, and make recommendations for remedial actions, where warranted. The annual reports will be submitted to the Corps, Service and CDFG no later than January 1 for the preceding year's monitoring.

Preservation/Management Reporting

The University of California, Merced will be responsible for report submittal for Tier 1a lands. TNC will be responsible for report submittal for the Tier 1b lands. As stated previously, although TNC and the CRT are responsible for assuring compliance with the conditions of the conservation easements on Tier 1 lands, neither the easements nor the grant agreements with the WCB require submittal of reports. The University does not have legal authority to conduct monitoring or require monitoring reports on Tier 2 lands.

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Appendix A
FUNCTIONAL ASSESSMENT METHODOLOGY

April 2006

A Guidebook for Applying a Modified Hydrogeomorphic Approach to Assessing Wetlands Functions for the UC Merced Project, Merced, California.

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Final Report
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CHAPTER 1 – INTRODUCTION

The Hydrogeomorphic (HGM) Approach is a collection of concepts and methods used to develop and apply functional indices to the assessment of wetlands. The approach was initially designed for use in the Clean Water Act Section 404 Regulatory Program including: reviewing permits to consider alternatives, minimizing impacts, assessing unavoidable project impacts, determining mitigation requirements, and monitoring the success of mitigation projects. However, a variety of other potential applications for the HGM Approach have been identified including: determining minimal effects under the Food Security Act, designing mitigation projects, and aiding in wetlands restoration and management.

On June 20, 1997, the National Action Plan (NAP) to implement the HGM Approach was published (National Interagency Implementation Team 1997). The NAP was developed cooperatively by the U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency (USEPA), Natural Resources Conservation Service (NRCS), Federal Highways Administration (FHWA), and U.S. Fish and Wildlife Service (USFWS). Publication of the NAP was designed to outline a strategy and promote the development of Regional Guidebooks for assessing the functions of regional wetland subclasses using the HGM Approach, solicit the cooperation and participation of Federal, State, and local agencies, academia, and the private sector in this effort, and update the status of Regional Guidebook development.

Objectives

There are no regional guidebooks that have been developed for the regional subclasses of wetlands existing within the UC Merced project area. The Corps initiated a pilot project in 1995 to develop a regional guidebook for vernal pools in the Central Valley of California. That effort proceeded as far as development of initial function models and field data gathering but was never completed. Without a regional guidebook, the Corps determined that a modified project-specific functional assessment methodology should be developed for the UC Merced project. The intent was to devise a functional assessment methodology based on HGM concepts but in an abbreviated form that would not include preparation of a regional guidebook and would be based, in part, on best professional judgment. Because of the large number of discrete wetlands existing within the project area (thousands) and the much larger number of discrete wetlands existing on the mitigation lands (tens of thousands), it is not practicable to implement an assessment methodology requiring an on-site evaluation of each wetland. It was therefore imperative that a functional assessment be devised based on geographic information system (GIS) technology.

Pursuant to the Corps' directive, a modified HGM functional assessment methodology was developed to assess the efficacy of the proposed compensatory mitigation measures. This methodology is intended to provide a basis for qualitatively assessing relative reductions in function that could result from both the direct and indirect impacts from the proposed project and its on-site alternatives. It is also intended to provide a basis for qualitatively assessing the relative functional replacement that would result from proposed mitigation measures. It should be noted that this modified HGM functional assessment methodology is not intended to provide an absolute measure or threshold of wetland impact. This functional assessment methodology

was developed by Mr. Tom Skordal (Gibson & Skordal, LLC), Mr. Ellis Clairain, Ph.D. (ERDC), and Sacramento District Corps of Engineers staff (Ms. Nancy Haley, Mr. Kevin Roukey and Mr. Mike Jewell) in consultation with an Interagency Technical Committee composed of representatives from the Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (FWS) and California Department of Fish and Game (CDFG).

Organization

This document is organized in the following manner: Chapter 1 provides the background, objectives, and organization of the document. Chapter 2 provides a brief overview of the major components of the HGM Approach and the Development and Application Phases required to implement the approach. Chapter 3 characterizes the naturally occurring wetlands within the UC Merced project area in terms of geographical extent, climate, geomorphic setting, hydrology, vegetation, soils, and other factors that influence wetland function. Chapter 4 discusses each of the wetland functions, model variables, and functional indices. This discussion includes a definition of the function, a quantitative, independent measure of the function for the purposes of validation, a description of the wetland ecosystem and landscape characteristics that influence the function, a definition and description of model variables used to represent these characteristics in the assessment model, a discussion of the assessment model used to derive the functional index, and an explanation of the rationale used to calibrate the index with reference wetland data. Chapter 5 outlines the steps of the assessment protocol for conducting a functional assessment for the UC Merced project area. Appendix A contains a glossary.

CHAPTER 2 – OVERVIEW OF THE HGM APPROACH

The Hydrogeomorphic (HGM) Approach to Wetland Functional Assessment is a collection of concepts and methods that are used to develop and apply functional indices to the assessment of wetlands (Smith et al. 1995). The HGM Approach includes four integral components: 1) HGM classification, 2) reference wetlands, 3) assessment variables and assessment models from which functional indices are derived, and 4) application protocols. The four components of the HGM Approach are integrated into a regional, subclass-specific guidebook.

In the Development Phase of the HGM Approach, research scientists and regulatory managers work cooperatively to select a list of functions and indicators of function that will best represent the functional range of variation among wetlands of the subclass and region. Data are gathered by an Assessment Team from an array of wetlands that represent that range of variation; the Assessment Team then establishes a data set of Reference Wetlands. The assessment models and data are combined, along with field protocols and methods for analysis, to formulate a Regional Guidebook. In this case, the goal was to develop a modified HGM functional assessment methodology for the UC Merced project. The end-users of Regional Guidebooks then use the models during the Application Phase to conduct HGM functional assessments on project wetlands. In this case, the modified HGM functional assessment methodology will be used to assess functional losses that would result from the proposed UC Merced project and its on-site alternatives and assess the efficacy of proposed mitigation measures. Each of these components of the HGM Approach is discussed briefly below. More extensive discussions of these topics can be found in Brinson (1993, 1995a, 1995b), Brinson et al. (1995, 1996 1998), Hauer and Smith (1998), Smith et al. (1995), Smith (2001), Smith and Wakeley (2001), and Wakeley and Smith (2001).

The task of the Assessment Team is to develop and integrate the classification, reference wetland, assessment variables, models, and application protocol components of the HGM Approach into a Regional Guidebook. In developing a Regional Guidebook, the team completes the tasks outlined in the National Action Plan (National Interagency Implementation Team 1996). These tasks include:

Task 1: Organize the Assessment Team.

A. Identify team members.
B. Train team in the HGM Approach.

Task 2: Select and Characterize Regional Wetland Subclass.

A. Identify and prioritize regional wetland subclasses.
B. Select regional wetland subclass and define reference domain.
C. Initiate literature review.
D. Develop preliminary characterization of regional wetland subclass.
E. Identify and define wetland functions.

Task 3: Select Assessment Variables and Metrics and Construct Conceptual Assessment Models.

A. Review existing assessment models.
B. Identify assessment variables and metrics.
C. Define initial relationship between assessment variables and functional capacity.
D. Construct conceptual assessment models for deriving functional capacity indices.
E. Complete Pre-calibrated Draft Regional Guidebook (PDRG).

Task 4: Conduct Peer Review of PDRG.

A. Distribute PDRG to peer reviewers.
B. Conduct interdisciplinary, interagency workshop of PDRG.
C. Revise PDRG to reflect peer review recommendations.
D. Distribute revised PDRG to peer reviewers for comment.
E. Incorporate final comments from peer reviewers on revisions into the PDRG.

Task 5: Identify and Collect Data From Reference Wetlands.

A. Identify reference wetland field sites.
B. Collect data from reference wetland field sites.
C. Analyze reference wetland data.

Task 6: Calibrate and Field Test Assessment Models.

A. Calibrate assessment variables using reference wetland data.
B. Verify and validate (optional) assessment models.
C. Field test assessment models for repeatability and accuracy.
D. Revise PDRG based on calibration, verification, validation (optional), and field testing results into a Calibrated Draft Regional Guidebook (CDRG).

Task 7: Conduct Peer Review and Field Test of CDRG.

A. Distribute CDRG to peer reviewers.
B. Field test CDRG.
C. Revise CDRG to reflect peer review and field test recommendations.
D. Distribute CDRG to peer reviewers for final comment on revisions.
E. Incorporate peer reviewers' final comments on revisions.
F. Publish Operational Draft Regional Guidebook (ODRG).

Task 8: Technology Transfer.

A. Train end users in the use of the ODRG.
B. Provide continuing technical assistance to end users of the ODRG.

The development of this modified HGM functional assessment methodology followed these tasks up to a point. Tasks 1, 2, 3, and 5 were completed. Tasks 4 and 7 were not performed per the Corps of Engineers direction. Task 6 was initiated but was abandoned after it was determined by the Assessment Team that calibration of the models was not practicable (see discussion below in Chapter 5). Instead, the Assessment Team elected to develop a modified methodology based on rating disturbances that degrade the aggregate of wetland functions. Task 8 is not applicable since a Regional Guidebook was not prepared.

CHAPTER 3 – CHARACTERISTICS OF REGIONAL SUBCLASSES

As indicated in Chapter 1, the HGM Approach is a collection of concepts and methods for developing functional indices and subsequently using them to assess the capacity of a wetland to perform functions relative to similar wetlands in a region. The HGM Approach includes four integral components: (a) the HGM classification, (b) reference wetlands, (c) assessment models/functional indices, and (d) assessment protocols. During the development phase of the HGM Approach, these four components are integrated in a Regional Guidebook for assessing the functions of a regional wetland subclass. Subsequently, during the application phase, end users, following the assessment protocols outlined in the Regional Guidebook, assess the functional capacity of selected wetlands. Each of the components of the HGM Approach and the development and application phases are discussed in this chapter.

Hydrogeomorphic Classification

Wetland ecosystems share a number of features, including relatively long periods of inundation or saturation, hydrophytic vegetation, and hydric soils. In spite of these common attributes, wetlands occur under a wide range of climatic, geologic, and physiographic situations and exhibit a wide variety of physical, chemical, and biological characteristics and processes (Cowardin et al. 1979; Ferren et al. 1996a,b,c; Mitsch and Gosselink 2000; Semeniuk 1987). The variability of wetlands makes it challenging to develop assessment methods that are both accurate (i.e., sensitive to significant changes in function) and practical (i.e., can be completed in the relative short time available for conducting assessments). Existing "generic" methods designed to assess multiple wetland types throughout the United States are relatively rapid, but lack the resolution necessary to detect significant changes in function. However, one way to achieve an appropriate level of resolution within the available time frame is to reduce the level of variability exhibited by the wetlands being considered (Smith et al. 1995).

The HGM Classification was developed specifically to accomplish this task (Brinson 1993). It identifies groups of wetlands that function similarly using three criteria that fundamentally influence how wetlands function: geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the landform and position of the wetland in the landscape. Water source refers to the primary water source in the wetland, such as precipitation, overbank floodwater, or groundwater. Hydrodynamics refers to the level of energy and the direction that water moves in the wetland. Based on these three classification criteria, any number of "functional" wetland groups can be identified at different spatial or temporal scales. For example, at a continental scale, Brinson (1993) identified five hydrogeomorphic wetland classes. These were later expanded to the seven classes (Smith et al. 1995). In many cases, the level of variability in wetlands encompassed by a continental scale hydrogeomorphic class is still too great to allow development of assessment models that can be rapidly applied while being sensitive enough to detect changes in function at a level of resolution appropriate to the 404 review process.

To reduce both inter- and intra-regional variability, the three classification criteria are applied at a smaller, regional geographic scale to identify regional wetland subclasses. Regional

subclasses, like the continental classes, are distinguished on the basis of geomorphic setting, water source, and hydrodynamics. In addition, certain ecosystem or landscape characteristics may also be useful for distinguishing regional subclasses in certain regions. For example, depressional subclasses might be based on water source (i.e., groundwater versus surface water), or the degree of connection between the wetland and other surface waters (i.e., the flow of surface water in or out of the depression through defined channels). Slope subclasses might be based on the degree of slope, landscape position, the source of water (i.e., throughflow versus groundwater), or other factors. Riverine subclasses might be based on water source, position in the watershed, stream order, watershed size, channel gradient, or floodplain width. Examples of potential regional subclasses are shown in Table 1, Smith et al. (1995). Regional Guidebooks include a thorough characterization of the regional wetland subclass in terms of its geomorphic setting, water sources, hydrodynamics, vegetation, soil, and other features that were taken into consideration during the classification process.

Table 1. Potential Regional Subclasses in Relation to Geomorphic Setting, Dominant Water Source and Hydrodynamics.

Geomorphic Setting Source	*Dominant Water*	*Dominant Hydrodynamics*	*Potential Regional Wetland Subclasses*	
			Eastern USA	**Western USA/Alaska**
Depression	Groundwater or interflow	Vertical	Prairie potholes, marshes, Carolina bays	California vernal pools
Fringe (tidal)	Ocean	Bidirectional, horizontal	Chesapeake Bay and Gulf of Mexico tidal marshes	San Francisco Bay marshes
Fringe (lacustrine)	Lake	Bidirectional, horizontal	Great Lakes marshes	Flathead Lake marshes
Slope	Groundwater	Unidirectional, horizontal	Fens	Avalanche chutes
Flat (mineral soil)	Precipitation	Vertical	Wet pine flatwoods	Large playas
Flat (organic soil)	Precipitation	Vertical	Peat bogs, portions of Everglades	Peatlands over permafrost
Riverine	Overbank flow from channels	Unidirectional, horizontal	Bottomland hardwood forest	Riparian wetlands

Reference Wetlands

Reference wetlands are wetland sites selected to represent the range of variability that occurs in a regional wetland subclass as a result of natural processes and disturbance (e.g., succession, channel migration, fire, erosion, and sedimentation) as well as cultural alteration. The reference domain is the geographic area occupied by the reference wetlands (Smith et al. 1995). Ideally, the geographic extent of the reference domain will mirror the geographic area encompassed by

the regional wetland subclass; however, this is not always possible because of time and resource constraints.

Reference wetlands serve several purposes. First, they establish a basis for defining what constitutes a characteristic and sustainable level of function across the suite of functions selected for a regional wetland subclass. Second, they establish the range and variability of conditions exhibited by model variables and provide the data necessary for calibrating model variables and assessment models. Finally, they provide a physical representation of wetland ecosystems that can be observed and measured.

Reference standard wetlands are the subset of reference wetlands that perform the suite of functions selected for the regional subclass at a level that is characteristic in the least altered wetland sites in the least altered landscapes. Table 2 outlines the terms used by the HGM Approach in the context of reference wetlands.

Table 2. Wetland Reference Terms and Definitions

Term	*Definition*
Reference domain	The geographic area from which reference wetlands representing the regional wetland subclass are selected (Smith et al. 1995).
Reference wetlands	A group of wetlands that encompass the known range of variability in the regional wetland subclass resulting from natural processes and disturbance and from human alterations.
Reference standard wetlands	The subset of reference wetlands that perform a representative suite of functions at a level that is both sustainable and characteristic of the least human altered wetland sites in the least human altered landscapes. By definition, the functional capacity index for all functions in reference standard wetlands is assigned a 1.0.
Reference standard wetland variable condition	The range of conditions exhibited by model variables in reference standard wetlands. By definition, reference standard conditions receive a variable sub-index score of 1.0.
Site potential (mitigation project context)	The highest level of function possible, given local constraints of disturbance history, landuse, or other factors. Site potential may be less than or equal to the levels of function in reference standard wetlands of the regional wetland subclass.
Project target (mitigation project context)	The level of function identified or negotiated for a restoration or creation project.
Project standards (mitigation context)	Performance criteria and/or specifications used to guide the restoration or creation activities toward the project target. Project standards should specify reasonable contingency measures if the project is not being achieved.

For purposes of this functional assessment methodology, the Corps of Engineers has determined that the reference domain encompasses the UC Merced project area which includes the proposed Campus, the proposed Campus Land Reserve, the proposed Campus Natural Reserve and the proposed support community. The total area comprising this reference domain is approximately 4,000 acres. Figure 1 is a map illustrating the approximate limits of the reference domain.

The jurisdictional waters of the United States, including wetlands, existing within the reference domain have been delineated by EIP Associates (EIP). Separate delineations were completed for: the Campus which included the Campus Land Reserve and the Campus Natural Reserve

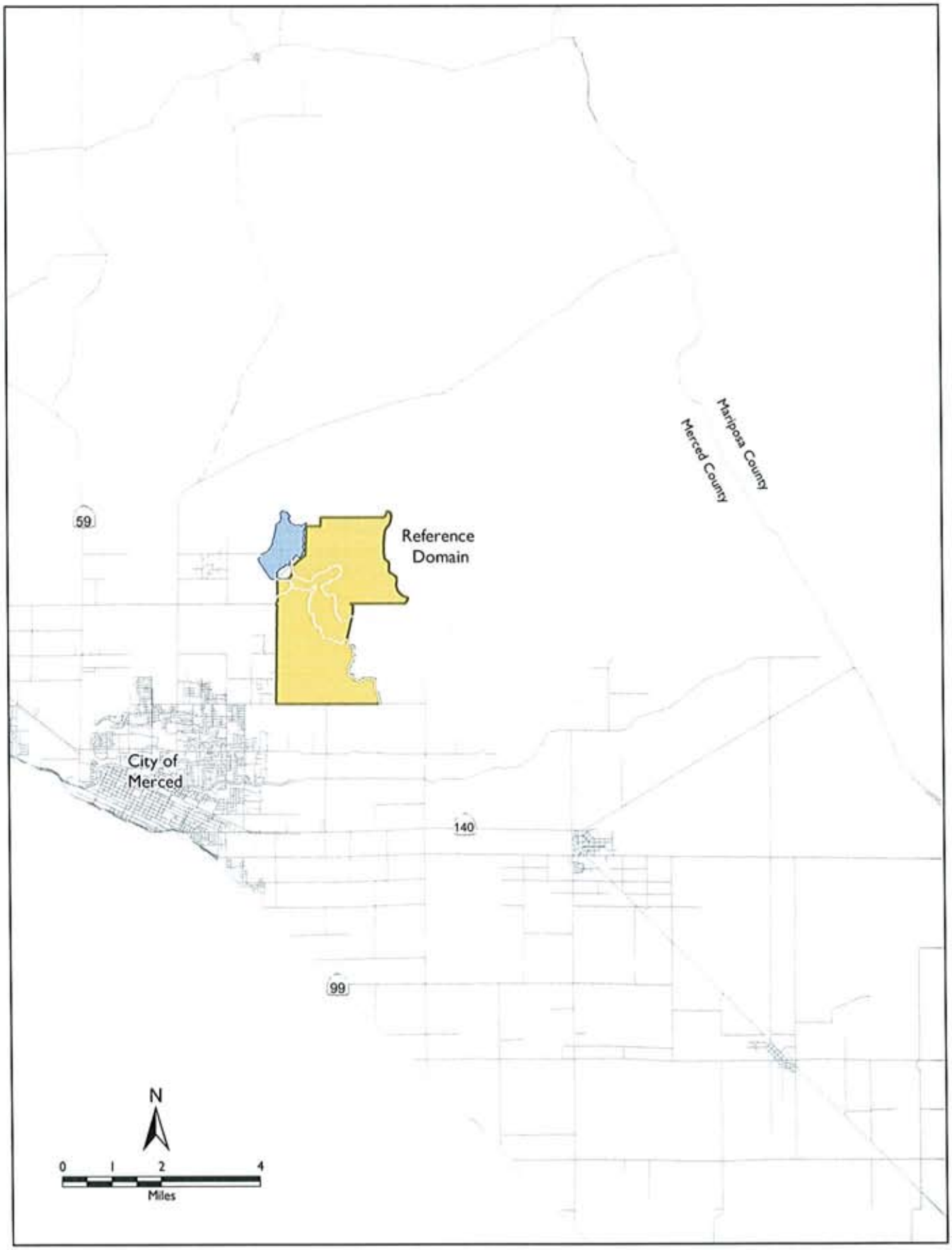

Figure 1
Reference Domain

(EIP 2001a); the Merced Hills Golf Course (EIP 2001b); and, the support community (EIP 2001c). EIP classified the delineated waters/wetlands as vernal pools, vernal pools/swales, vernal swales, swales, clay playas, clay flats, seasonal wetlands, freshwater marsh, marsh, stock ponds, drainages, wooded channels and canals. Figure 2 is a map showing the wetlands within the UC Merced project area as delineated by EIP.

The assessment team then reviewed the regional subclasses in the Borden Ranch HGM Assessment (Lee 1997). Lee used three regional subclasses for depression wetlands, two regional subclasses for slope wetlands, and one regional subclass for riverine wetlands. The three regional subclasses of depression wetlands used by Lee were; 1) closed and/or hydrologically isolated (perched) depressions; 2) surface and/or shallow sub-surface flow through depressions; and, 3) discharge depressions with or without outlets. The discharge depressions with or without outlets are often regionally referred to as groundwater seeps. This type of wetland is not present within the UC Merced reference domain. The first two regional subclasses are types of vernal pools found within the UC Merced reference domain.

Vernal pools are present in abundance within the UC Merced reference domain. In addition to the wetlands classified as vernal pools, the clay playa classification used by EIP in the Campus delineation would also fall into this regional subclass and is appropriately considered a type of vernal pool. The seasonal wetland classification used by EIP in the Golf Course delineation refers to seasonally flooded depressions similar to vernal pools except the plant community is more characteristic of other types of seasonal wetlands. The Assessment Team concluded that these seasonal wetlands are degraded vernal pools and most appropriately classified as such for HGM purposes.

While classifying depression wetlands (vernal pools) as either isolated or flow through may have been appropriate for the Borden Ranch functional assessment, the Assessment team did not consider it appropriate for this functional assessment for several reasons. The primary reason is that there are approximately 4,000 vernal pools within the reference domain. Unless a vernal pool is contiguous with a delineated swale or channel, it is very difficult to determine whether or not it is isolated by photo interpretation or other remote sensing techniques. In addition, even if it were feasible to visit each vernal pool in the field, it is often not possible to determine with certainty the extent to which a vernal pool is, in fact, hydrologically linked to other wetlands. In some cases, a topographically distinct outlet may be present (e.g. swale) while in other situations it may not. The absence of a topographically distinct outlet does not necessarily mean that a vernal pool does not spill and flow into other, down-gradient waters. Conversely, even where a topographically distinct outlet is present, it does not necessarily mean that water spills regularly on an annual basis. For this reason, the assessment team chose to establish a vernal pool regional subclass but not to distinguish between isolated and flow-through vernal pools for classification purposes. Using the vernal pool subclass by itself, however, will not provide the Corps the resolution needed to distinguish between the functional capacities of vernal pools located within various portions of the reference domain, thus defeating the primary purpose of the functional assessment. Because of this, additional stratification is needed to differentiate between the functional capacities of vernal pools located within the reference domain.

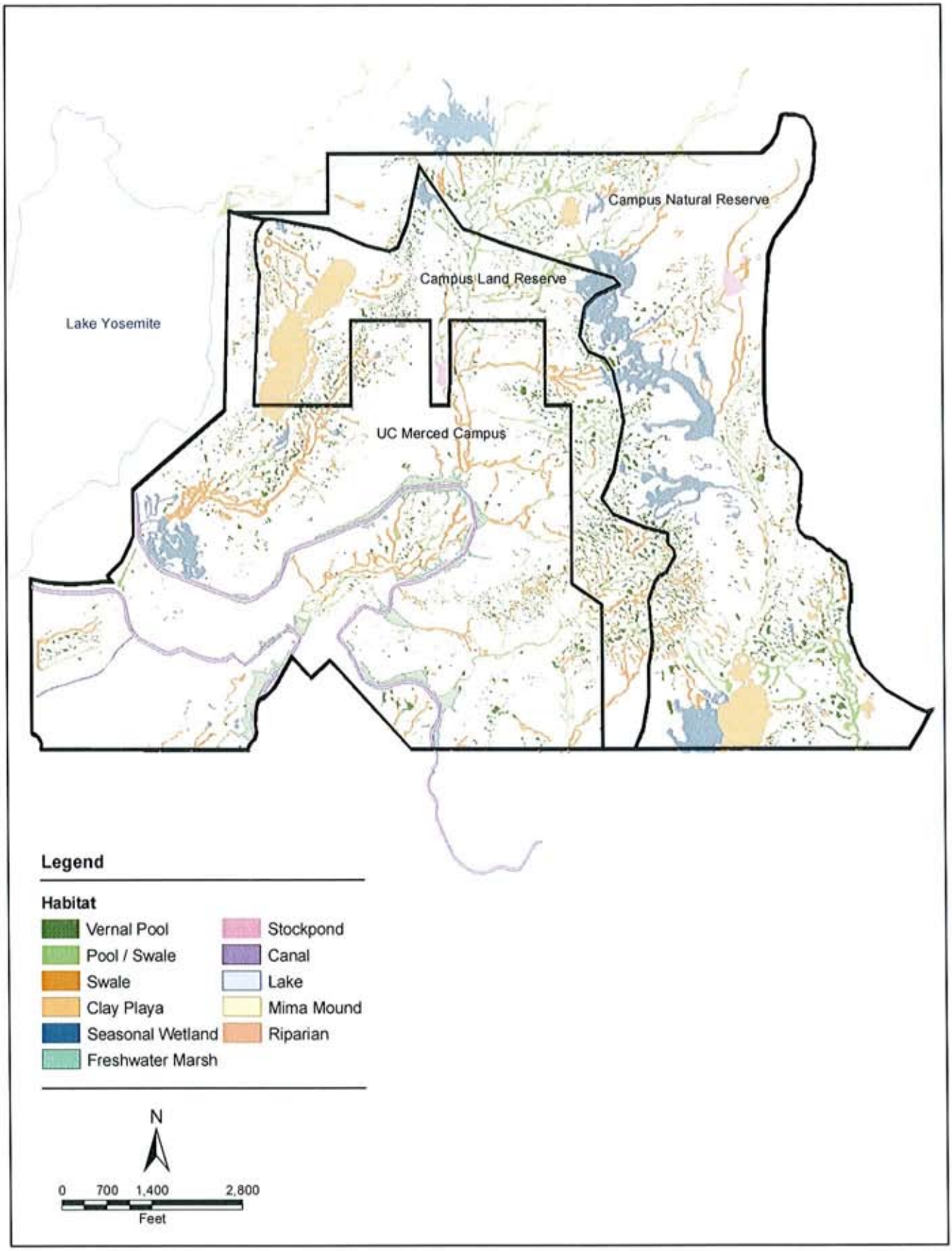

Figure 2
Wetland Delineation Map

Soil mapping units provide an additional level of resolution. Vernal pools within given soil types share a common soil profile, parent material and topography and often approximately share other characteristics such as hydrology. These physical variables, in turn, affect the functional capacity of the vernal pools. Table 3 is a list of soil mapping units within the reference domain. These soil mapping units are taken from Soil Survey, Merced Area, California (USDA 1962). While this is not a modern soil survey and some of the soil names are no longer valid (e.g. Raynor), it provides an extra level of stratification to facilitate comparison of vernal pool functions within the reference domain.

Table 3. Soil Mapping Units (USDA 1962)

Mapping Symbol	*Soil Name*
CgB	Corning gravelly loam, 0-8% slopes
CkB	Corning gravelly sandy loam, 0-8% slopes
3HA	Hopeton clay loam, 0-3% slopes
2HB	Hopeton clay loam, 0-8% slopes
3HB	Hopeton clay loam, 3-8% slopes
MrA	Montpelier course sandy loam, 0-3% slopes
MrB	Montpelier course sandy loam, 3-8% slopes
PkD	Pentz gravelly loam, 0-8% slopes
PnB	Peters clay, 0-8% slopes
PoB	Peters cobbly clay, 0-8% slopes
RaA	Raynor clay, 0-3% slopes
RbA	Raynor cobbly clay, 0-3% slopes
ReB	Redding gravelly loam, 0-8% slopes
RgA	Rocklin loam, 0-3% slopes
WhB	Whitney fine sandy loam, 3-8% slopes

The second type of wetland occurring in depressions within the reference domain is irrigation wetlands. This type of wetland was not present in the reference domain assessed by Lee and consequently was not classified by Lee. These irrigation wetlands are highly disturbed wetlands occurring within depressions that are influenced directly or indirectly by flood and/or sprinkler irrigation. They differ from degraded vernal pools in that they appear to have been created as a by product of land leveling and irrigation activities. The seasonal wetland and freshwater marsh classifications used by EIP in the Community delineation are included in the irrigation wetland

subclass. As stated above, the seasonal wetland classification used by EIP in the Golf Course delineation refers to seasonally flooded depressions similar to vernal pools except the plant community is more characteristic of seasonal wetlands as opposed to vernal pools. For HGM purposes, we classified these seasonal wetlands as vernal pools because they are shallow seasonally inundated depressional wetlands.

The two regional subclasses of slope wetlands used by Lee are slope wetlands that are located at the headwater extent of riverine waters/wetlands and slope wetlands that form as inter-connections between or among depressions. Because of problems in differentiating between these two subclasses similar to that discussed above with vernal pools, the assessment team elected to not use these subclasses. There are two distinct types of slope wetlands located within the reference domain, those that occur in narrow, topographically distinct drainage ways (swale wetlands) and those that occur as broad, poorly defined features that are subject to sheet flow (clay slope wetlands). The Assessment Team elected to use swales and clay slope wetlands as regional subclasses for slope wetlands. The swale and vernal pool/swale classifications used by EIP on the Campus and Golf Course delineations would fall within the swale subclass. The swale and drainage classifications used by EIP in the Community delineation would also fall within the swale subclass.

Table 4 is a list of the regional subclasses selected by the assessment team. The regional subclasses are cross-referenced to the classification used by EIP in each of their jurisdictional delineations. Table 5 is a key to identifying these regional subclasses.

Table 4. Comparison of HGM Regional Wetland Subclasses and Wetland Delineation Classifications

HGM Class	*HGM Subclass*	*Campus Delineation Classification*	*Golf Course Delineation Classification*	*Community Delineation Classification*
Depression	Vernal Pool	Vernal Pool	Vernal Pool	Vernal Pool
		Clay Playa	Seasonal Wetland	
	Irrigation Wetland	–	–	Stock Pond
				Freshwater Marsh
				Seasonal Wetland
				Wooded Channel
Slope	Clay Slope	Seasonal Wetland	–	–
	Swale	Swale	Swale	Swale
		Vernal Pool/Swale	Vernal Pool/Swale	Drainage
Riverine	Intermittent Channel	Freshwater Marsh	Marsh	Wooded Channel
	Canal Wetland	Freshwater Marsh	Marsh	Wooded Channel

Table 5. Key to Regional Subclasses

1a	Wetland located in a depression that has closed contours and may or may not have an inlet or outlet. (Go to 2, Depression Class)
1b	Wetland does not have closed contours. (Go to 3)
2a	Wetland located within closed contours and dominated by non-persistent emergent vegetation. (D-Vernal Pool)
2b	Wetland located within closed contours and hydrologically influenced by irrigation. (D-Irrigation Wetland)
3a	Wetland lacking closed contours and located on a slope without well-defined bed, banks and ordinary high water line. (Go to 4, Slope Class)
3b	Wetland lacking closed contours and located on a slope within or adjacent to a watercourse with well-defined bed, banks and ordinary high water line. (Go to 5, Riverine)
4a	Seasonally inundated/saturated wetland located on sloping ground that conveys water in somewhat narrow, linear drainage ways. (S-Swale Wetland)
4b	Seasonally inundated/saturated wetland located on sloping ground that conveys surface water as primarily sheet flow across a relatively broad, poorly defined plane. (S-Clay Slope Wetland)
5a	Wetland located within or adjacent to an intermittent drainage course whose hydrology is derived from precipitation and interflow. (R-Intermittent Channel Wetlands)
5b	Wetland adjacent to an irrigation canal whose hydrology is primarily derived from that irrigation canal. (R-Canal Wetlands)

As stated previously, this functional assessment methodology has been designed to address wetland functions in naturally occurring wetlands. Of the regional subclasses described above, vernal pools, swale wetlands and clay slope wetlands are naturally occurring. The other regional subclasses (irrigation wetlands and canal wetlands) are wetlands which have been created as a by-product of physical modifications to the landscape. Using the Key to Regional Subclasses, the wetlands delineated by EIP were reclassified into HGM regional subclasses. Table 6 provides a listing of the total area of wetlands within the UC Merced project area as delineated and classified by EIP. Table 7 lists the respective areas of the vernal pool, swale wetland and clay slope wetland subclasses. Figure 3 is a map showing the vernal pool, swale wetland and clay slope wetland regional subclasses as well as canal wetlands and intermittent channel within the UC Merced project area.

Table 6. Wetland Areas as Delineated by EIP (Acres)

Water/Wetland Type	*Main Campus*	*Land Reserve*	*Natural Reserve*	*Total*
Canals	22.64	0.00	0.00	**22.64**
Channels	0.00	0.00	0.00	**0.00**
Clay Playas	1.01	27.51	15.45	**43.97**
Marsh	16.77	0.00	0.00	**16.77**
Seasonal Wetlands	11.35	7.94	49.88	**69.17**
Stockponds	0.00	1.63	2.20	**3.83**
Swales	22.18	8.87	11.67	**42.72**
Vernal Pools	23.97	18.67	27.93	**70.57**
Pools/Swales	10.75	10.38	28.51	**49.64**
Total	**108.67**	**75.00**	**135.64**	**319.31**

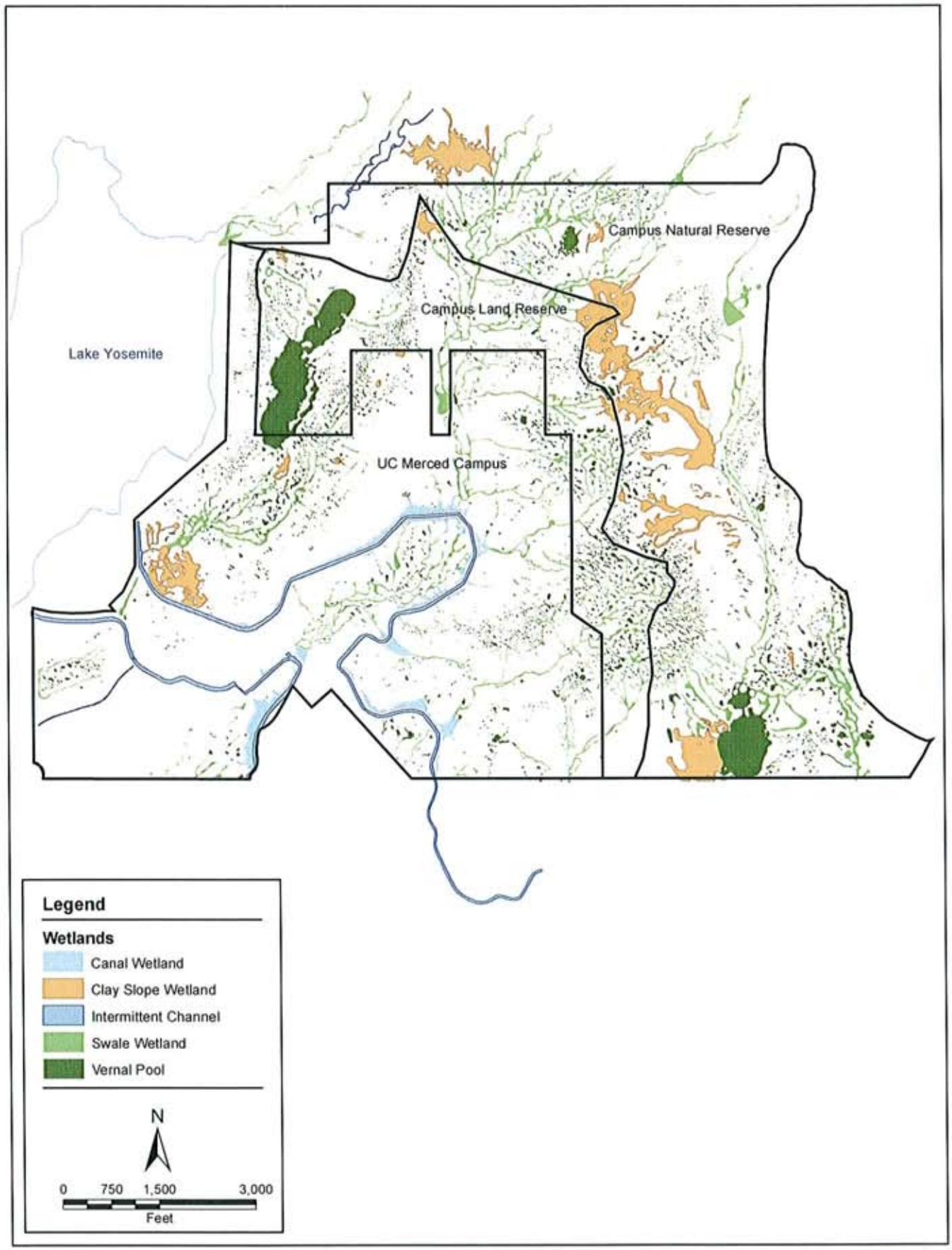

Figure 3
HGM Regional Wetlands Subclasses

Table 7. Areas of HGM Regional Subclasses

Regional Subclass	*Area (acres)*
Vernal Pools	112.98
Swale Wetlands	92.37
Clay Slope Wetlands	62.79
Total	**268.14**

Community Profiles of Regional Subclasses

Vernal Pools

There have been numerous studies of vernal pools and their ecology including Barry (1995), Bauder (1987), Bliss and Zedler (1988), Griggs and Holland (1976), Helm (1998), Holland (1976 and 1986), Holland and Jain (1981), Holland and Dains (1990), Jain (1976), Jokerst (1990), Keeler-Wolf et al. (1998), Keeley (1981 and 1990), Lin (1970), Macdonald (1976), Macior (1978), McClintock (1976), Marty (in prep), Medeiros (1976a and 1976b), Morey (1998), Platenkamp (1988), Robins and Vollmar (in print), Rosario and Lathrop (1981), Silveira (1998), Taylor et al (1992), Thorpe and Loeng (1994 and 1998), Vollmar (1999 and 2001), Wiggens et al. (1980), Winfield et al. (1998), and Zedler (1987, 1990 and 1998). Vollmar (2002) provides a comprehensive synopsis of the wildlife and rare plant ecology of Eastern Merced County's vernal pools grasslands.

Vernal pools are shallow, seasonally inundated depressions underlain by an impervious soil layer (aquatard) that typically flood in the winter and early spring and dry out in the late spring. Zedler (1987) defines vernal pools in California as "a natural habitat of the Mediterranean climate region of the Pacific Coast covered by shallow water for extended periods during the cool season but completely dry for most of the warm season drought." They are typically dry by late spring or early summer (May-June) and remain so until throughout the summer and fall. Vernal pools occur throughout the Central Valley of California, south to San Diego and north to the Modoc Plateau. Vernal pools range is size from as small as 1 m^2 and as large as 0.5 hectare. They can occur as isolated features or in large complexes.

Vernal pools typically are characterized by unique plant assemblages composed primarily of endemic annuals including many rare, threatened and endangered species. Invertebrate faunal communities also consist of many endemic species including rare, threatened and endangered species. These endemic plants and animals have life cycles that are specifically adapted to the wetting and drying cycles governing the hydrology of vernal pools.

The hydrology of vernal pools is determined by the Mediterranean climate and the presence of an aquatard in the soil which restricts the vertical infiltration of water. In soils that have moderately deep to deep profiles above the hardpan such as within the UC Merced reference domain, water exchange between the pool and surrounding upland plays a major role in

controlling the water level relationships as compared to relatively minor watershed contributions. From a volumetric perspective, direct rainfall is sufficient to fill vernal pools beyond capacity in most years and overland flows are excess to that needed to flood vernal pools (Haines and Stromberg 1998).

Vernal pools typically undergo four distinct phases each year: wetting; aquatic; drying; and drought (Zedler 1987). The wetting phase occurs after the rains begin in the fall or early winter. Initially, the vernal pools do not flood as the rainwater percolates downward to the aquatard.

The aquatic phase begins once the soils have absorbed enough water to create a perched water table restricting vertical infiltration of water at or near the surface of the soil. In years with above normal early rainfall, the aquatic phase can begin in early December. In years where there is below normal rainfall in early winter, the aquatic phase can be delayed until late January. At this point, the vernal pools will begin to pond water and will continue to do so with additional rainfall. It is during this period that many of the plants germinate and sprout. It is also during this period that aquatic invertebrates hatch and complete their life cycle.

As rainfall decreases, temperatures rise and evapotransporation increases in the late spring, the drying phase begins. It is during this phase, that vernal pools develop the concentric rings of blossoming plants relative to the moisture gradient. However, due to sporadic rainfall patterns, it is not unusual for vernal pools to begin drying out earlier in the winter and then subsequently reflood with additional rainfall. In normal years, the drying phase typically ends by late April or early May.

The drought phase occurs after the soils within the vernal pools have dried out. The annual plants that germinated, blossomed, and set seed during the aquatic and drying phases die. Some upland species that germinate later may be present during the drought phase but little other live vegetation is present.

Swale Wetlands

Swale wetlands are sloped wetlands underlain by an impervious soil layer occurring on convex surfaces. They are subject to seasonal inundation in the winter and early spring and dry out in the late spring. Unlike vernal pools, the water moves down gradient as shallow sheet flow rather than impounding. Swale wetlands may have vernal pools in shallow depressions within their beds. Water flowing in swale wetlands is rarely deeper than 2 to 3 centimeters.

Topographically, swale wetlands are narrow (1 to 10 meters in width) linear features with a bed and gently sloping banks. They range, in length, from tens to thousands of meters. They are differentiated from ephemeral and intermittent stream channels in that their beds are composed of loams and clays as opposed to gravels and cobbles and channels have steeper banks. Swale wetlands are also well-vegetated across their beds whereas the beds of channels are sparsely to not vegetated.

Swales occur in the same soils and landscape positions as vernal pools and have similar hydrology phases. Unlike vernal pools, individual swales are generally located in multiple soil types and landscape positions. While swale wetlands typically have plant communities composed, in part, of species common to vernal pools, they often are not dominated by such

species. Introduced non-native species such as perennial rye (*Lolium perenne*) and Mediterranean barley (*Hordeum hystrix*) are commonly dominants in swale wetlands.

Clay Slope Wetlands

Clay slope wetlands are large, broad, and sloping wetlands that occur on convex surfaces in deeper clay soils. The hydrology of clay slope wetlands is quite similar to swale wetlands except that they appear to be, as a group, subject to shorter durations of inundation. Inundation results from very shallow sheet flow (less than 1 centimeter). While clay slope wetlands may experience shorter durations of sheet flow as compared to swale wetlands, their deeper profile stores more water for a longer duration than do the shallower soils in swales.

The primary source of water sustaining sheet flow appears to be infiltration from adjacent uplands. As the soils in adjacent uplands near their water holding capacity, groundwater is discharged from the toe of the slopes around the periphery of the clay slope wetlands. Direct rainfall on clay slope wetlands appears to be insufficient to solely sustain wetland hydrology.

The plant communities in clay slope wetlands are dominated by non-native species such as perennial rye and Mediterranean barley. Plants common to vernal pools are rare in clay slope wetlands and never dominant.

CHAPTER 4 – FUNCTIONS AND VARIABLES

Overview of Wetland Functions

In the HGM Approach, an assessment model is a simple representation of a function performed by a wetland ecosystem. It defines the relationship between one or more characteristics or processes of the wetland ecosystem. Functional capacity is simply the ability of a wetland to perform a function compared to the level of performance in reference standard wetlands.

Model variables represent the characteristics of the wetland ecosystem and surrounding landscape that influence the capacity of a wetland ecosystem to perform a function. Model variables are ecological quantities that consist of five components: (a) a name, (b) a symbol, (c) a measure of the variable and procedural statements for quantifying or qualifying the measure directly or calculating it from other measures, (d) a set of variables (i.e., numbers, categories, or numerical estimates (Leibowitz and Hyman 1997)) that are generated by applying the procedural statement, and (e) units on the appropriate measurement scale. Table 8 provides several examples.

Table 8. Examples of Model Variable Components

Name (Symbol)	*Measure / Procedural Statement*	*Resulting Values*	*Units (Scale)*
Substrate Disturbance ($V_{DISTURB}$)	The alteration of the soils by activities such as addition of fill material, soil oxidation, rock plowing, or removal of sediment.	present absent	Unitless (nominal scale)
Presence of Ditches (V_{DITCH})	The presence of ditches within a certain distance of the wetland.	1.0 0.8 0.3	Unitless (interval scale)
Cover of Woody Vegetation (V_{WOODY})	The average percent aerial cover of leaves and stems of shrubs and trees (> 1 m).	0 to >100	Percent

Model variables occur in a variety of states or conditions in reference wetlands. The state or condition of the variable is denoted by the value of the measure of the variable. For example, percent herbaceous groundcover, the measure of the percent cover of herbaceous vegetation, could be large or small. Based on its condition (i.e., value of the metric), model variables are assigned a variable subindex. When the condition of a variable is within the range of conditions exhibited by reference standard wetlands, a variable subindex of 1.0 is assigned. As the condition deflects from the reference standard condition (i.e., the range of conditions within which the variable occurs in reference standard wetlands), the variable subindex is assigned based on the defined relationship between model variable condition and functional capacity. As the condition of a variable deviates from the conditions exhibited in reference standard wetlands, it receives a progressively lower subindex, reflecting its decreasing contribution to functional capacity.

Model variables are combined in an assessment model to produce a Functional Capacity Index (FCI) that ranges from 0.0 to 1.0. The FCI is a measure of the functional capacity of a wetland relative to reference standard wetlands in the reference domain. Wetlands with an FCI of 1.0 perform the function at a level characteristic of reference standard wetlands. As the FCI decreases, it indicates that the capacity of the wetland to perform the function is less than that of reference standard wetlands.

The Assessment Team identified and defined eight functions that are performed by the vernal pool, swale wetland, or clay slope wetland regional subclasses within the UC Merced project area. These functions were selected based on best professional judgment after reviewing regional guidebooks developed for hydrogeomorphically similar wetlands (Hauer, et al. 2002, Noble et al. 2004 and Stutheit et al. 2004). The team also examined the guidebook for assessing vernal pools and seasonal wetland swales developed for the Borden Ranch near Sacramento, California (Lee, et al 1997). The guidebooks were examined in light of the characteristics of these regional subclasses within the UC Merced project area. The functions are as follows:

- Surface Water Storage
- Subsurface Water Storage and Interchange
- Moderation of Surface and Shallow Subsurface Water Flow
- Element and Compound Cycling
- Organic Carbon Export
- Maintenance of Characteristic Plant Communities
- Maintenance of Characteristic Faunal Communities
- Faunal Habitat Interspersion and Connectivity

Each of these functions is defined and discussed below. The variables affecting the capacity of particular wetlands are defined and discussed and conceptual models describing how these variables influence functional attainment are presented.

Functions

Surface Water Storage (SWS)

Definition: This function refers to the capability of a wetland or other water to collect and retain surface and shallow subsurface water as static water above the soil surface. The volume of the basin determines the potential volume of storage while surface water from the contributing watershed plus the infiltration of shallow subsurface water from the adjacent uplands determines the volume of water potentially contributing to the basin.

Variables Affecting Surface Water Storage: The average depth of a wetland multiplied by its area yields an estimate of the volume of surface storage within the wetland. The surface water storage capacity of a wetland can be modified by altering the amount of surface and shallow subsurface water entering it, raising or lowering the spill elevation, raising or lowering its bed, or eliminating the restrictive layer in the soil. Therefore, a model of this function should include a variable for the depth of the wetland, the elevation of the outlet (if present), the integrity of the wetland's watershed, and the integrity of the soil profile (particularly the restrictive layer) both within and adjacent to the wetland.

Applicable Regional Subclasses: Vernal pools.

Subsurface Water Storage and Interchange (SWS&I)

Definition: This function refers to the capability of a wetland to store water below the soil surface and allow exchange of shallow subsurface water laterally with the contributing uplands bordering the wetland.

Variables Affecting Subsurface Water Storage and Interchange: The soil profile within the vernal pool as well as bordering uplands largely determines the capability of a given wetland to perform this function. If the soil profiles in either the wetland or its adjacent upland are substantially disrupted, this function will be impaired.

Applicable Regional Subclasses: Vernal pools.

Moderation of Surface and Shallow Subsurface Water Flow (MS&SSWF)

Definition: This function refers to a slope wetland's capacity to moderate the rate at which water passes through the wetland and the watershed.

Variables Affecting Moderation of Surface Flow and Shallow Subsurface Water: The slope of a wetland, the cross-sectional area of a wetland, the condition of its watershed, and the integrity of the soil profile both within the wetland and in its surrounding uplands significantly affect the capacity of a wetland to perform this function.

Applicable Regional Subclasses: Swale wetlands and clay slope wetlands.

Element and Compound Cycling (E&CC)

Definition: Element and compound cycling refers to the biological and physical processes that convert compounds from one form to another. These processes cycle various elements and compounds between the atmosphere, soil, water, and vegetation. This cycling contributes to the nutrient capital of the ecosystem and reduces downstream particulate loading and thereby helps to maintain and improve water quality.

Variables Affecting Element and Compound Cycling: The physical and biological variables that determine the capability of a particular wetland to perform this function are the vegetation in the vernal pool and the contributing watershed and the soil in the wetland and the contributing watershed. The plants absorb, transform, and temporarily store various elements and compounds. The soil contains various microorganisms that are critical to the cycling of these nutrients. The soil also provides a medium for short and long-term storage of elements and compounds.

Applicable Regional Subclasses: Vernal pools, swale wetlands, and clay slope wetlands.

Organic Carbon Export (OCE)

Definition: This function refers to amount of dissolved or particulate organic carbon that is exported from a wetland. The export of carbon enhances the decomposition and mobilization of metals and supports aquatic food webs and downstream biogeochemical processes.

Variables Affecting Organic Carbon Export: The amount of organic carbon available for export is the sum of the input from the watershed and the biomass produced within the wetland itself. The degree to which this carbon can be exported downstream is affected by whether there is an outlet to convey water from the wetland to downstream waters.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Maintenance of Characteristic Plant Communities (MCPC)

Definition: This function refers to the capability of wetlands to support and sustain endemic plant communities that are characteristic of the regional wetland subclass with respect to species composition, abundance, and structure. This, in turn, helps to maintain ecosystem health and biodiversity.

Variables Affecting Maintenance of Characteristic Plant Communities: The soil profile and its integrity, the integrity of the watershed, the duration and depth of ponding, and the degree of disturbance of the wetland and its adjacent uplands can all have a profound affect on the plant community that a wetland supports.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Maintenance of Characteristic Faunal Communities (MCFC)

Definition: This function refers to the capability of wetlands to support and sustain endemic faunal communities that are characteristic of the regional subclass with respect to species composition, abundance, and age structure. For purposes of this assessment, this function includes both vertebrate and invertebrate fauna.

Variables Affecting the Maintenance of Characteristic Faunal Communities: The soil profile and its integrity, the integrity of the watershed, the duration and depth of ponding, and the degree of disturbance of the wetland and its adjacent uplands can all have a profound affect on the faunal community that a wetland is capable of sustaining.

Applicable Regional Subclasses: Vernal pools, swale wetlands, and clay slope wetlands.

Faunal Habitat Interspersion and Connectivity (FHI&C)

Definition: This function refers to the capability of a wetland to act as a conduit of interspersion and connectivity for vertebrates and invertebrates normally associated with wetlands. This, in turn, supports landscape and regional faunal biodiversity.

Variables Affecting Faunal Habitat Interspersion and Connectivity: The capability of a wetland to perform this function is affected by the integrity of the watershed, the presence or absence of an outlet and a mechanism for longitudinal connectivity, and the proximity of other wetland habitats.

Applicable Regional Subclasses: Vernal pools, irrigation wetlands, swale wetlands, and clay slope wetlands.

Table 9 provides a tabular summary of the wetlands wetland functions for vernal pools, swale wetlands and clay slope wetlands and the variables affecting these functions.

Table 9. Summary of Wetland Functions

Regional Subclass	SWS	SWS&I	MS&SSWF	E&CC	OCE	MCPC	MCFC	FHI&C
Vernal Pools	X	X		X	X	X	X	X
Swales			X	X	X	X	X	X
Clay Slopes			X	X	X	X	X	X

Notes:
SWS = Surface Water Storage.
SWS&I = Subsurface Water Storage and Interchange.
MS&SSWF = Moderation of Surface and Shallow Subsurface Water Flow.
E&CC = Element and Compound Cycling.
OCE = Organic Carbon Export.
MCPC = Maintenance of Characteristic Plant Communities.
MCFC = Maintenance of Characteristic Faunal Communities.
FHI&C = Faunal Habitat Interspersion and Connectivity

Variables

The following is a discussion of each of the variables affecting wetland function in vernal pools, swale wetlands and clay slope wetlands.

Estimated Depth of Wetland (V_{DW}). This variable is an approximation of the average depth of depression class wetlands. It represents the average elevational difference between the bed of the wetland and it upper edge. This variable would be scaled by plotting the range of depths observed within depressional wetlands. The greatest depth would be assigned a score of 1.0 while the shallowest would be assigned a score of 0.1. The remainder of the depths would be scaled accordingly.

Outlet (V_{OUT}). This variable refers to the presence or absence of a natural or constructed outlet for surface water. This variable would be scaled with a score of 1.0 assigned where an outlet is present and a score of 0.0 where no outlet is present.

Inlet (V_{IN}). This variable refers to the presence or absence of a natural or constructed inlet for surface water. This variable would be scaled with a score of 1.0 assigned where an inlet is present and a score of 0.0 where no inlet is present.

Bed Restrictive Layer (V_{BEDRL}). This variable refers to the presence or absence of an intact layer in the upper soil horizon restricting the downward movement of shallow subsurface water. This restrictive layer can be a hard pan, duripan or clay pan, depending on the soil type. This layer is naturally present in soils supporting vernal pools. It can be destroyed by deep ripping or land leveling. Where this restrictive layer is destroyed within the bed of a vernal pool, the capability of the vernal pool to pond water for long duration is also destroyed.

The presence of a restrictive layer is determined by examination of the soil profile within the vernal pool. If the soil profile reveals an intact restrictive layer, it will be assumed that that layer is intact throughout the bed of the vernal pool, absent an observable indication that the soil profile of the vernal pool has been disturbed. Likewise, an intact restrictive layer can be assumed in undisturbed vernal pools.

The presence of an intact restrictive layer underlying the wetland would be assigned a score of 1.0. The absence of an intact restrictive layer underlying the bed of the vernal pool would be assigned a score of 0.0.

Bank Restrictive Layer (V_{BANKRL}). This variable refers to the presence or absence of an intact layer in the upper soil horizon of adjacent uplands restricting the downward movement of shallow subsurface water. This restrictive layer can be a hard pan, duripan or clay pan, depending on the soil type. This layer is naturally present in soils adjacent to vernal pools. It can be destroyed by deep ripping or land leveling. Where this restrictive layer is destroyed in the lands bordering a vernal pool, the capability of the vernal pool to pond water for long duration is adversely affected.

The presence of a restrictive layer is determined by examination of the soil profile in the uplands bordering the vernal pool. If the soil profile reveals an intact restrictive layer, it will be assumed that that layer is intact in all of the lands bordering the vernal pool, absent an observable indication that the soil profile has been disturbed.

The presence of an intact restrictive layer underlying the uplands bordering a wetland will be given a score of 1.0. The absence of an intact restrictive layer underlying the bed of the vernal pool will be given a score of 0.0.

Available Water Capacity of the Bed (V_{BEDAWC}). This variable refers to the capacity of the upper soil profile within the vernal pool to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at the wilting point. It is commonly expressed as inches of water per inch of soil.

The available water capacity of a given soil profile down to the restrictive layer can range from very low – 0.0″ to 2.5″; low – 2.5″ – 5.0″; moderate – 5.0″ to 7.5″; high – 7.5″ to 10.0″; to very high – more than 1.0″.

Available Water Capacity of the Bank ($V_{BANKAWC}$). This variable refers to the capacity of the upper soil profile of the uplands bordering vernal pools to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at the wilting point. It is commonly expressed as inches of water per inch of soil. The available water capacity of a given soil profile down to the restrictive layer can range from very low – 0.0″ to 2.5″; low – 2.5″ – 5.0″; moderate – 5.0″ to 7.5″; high – 7.5″ to 10.0″; to very high – more than 1.0″.

Bed Soil Profile Integrity (V_{BEDP}). This variable refers to the degree to which the observed soil profile within the wetland is consistent with the established range of conditions for the soil type. It will be determined by excavating a soil test pit within the vernal pool and noting the characteristics of the soil profile down to the restrictive layer. The textures and chromas and depths of each profile will be determined. This will then be compared to the range of conditions normal to the respective soil. The test pit will be characterized by a qualified soil scientist.

This variable would be scaled according to the estimated relative variation from the established range of conditions normally present within the appropriate soil type. A complete and intact soil profile would be assigned a score of 1.0 and a soil profile that has been ripped or otherwise compromised so that the restrictive layer is no longer acts as a barrier to the infiltration of water would be assigned a score of 0.00. Where the restrictive layer is still intact but the soil profile has been truncated or filled, the values will be scaled accordingly to the degree to which they deviate from the range of conditions present in the soil profiles of the least disturbed sites.

Bank Soil Profile Integrity (V_{BANKP}). This variable refers to the degree to which the observed soil profile in the uplands adjacent to the wetland is consistent with the established range of conditions for the soil type. It will be determined by excavating a soil test pit within the vernal pool and noting the characteristics of the soil profile down to the restrictive layer. The textures and chromas and depths of each profile will be determined. This will then be compared to the range of conditions normal to the respective soil. The test pit will be characterized by a qualified soil scientist.

This variable would be scaled according to the estimated relative variation from the established range of conditions normally present within the appropriate soil type. A complete and intact soil profile would be assigned a score of 1.0 and a soil profile that has been ripped or otherwise compromised so that the restrictive layer is no longer acts as a barrier to the infiltration of water would be assigned a score of 0.00. Where the restrictive layer is still intact but the soil profile has been truncated or filled, the values will be scaled accordingly to the degree to which they deviate from the range of conditions present in the soil profiles of the least disturbed sites.

Sediment Deposition (V_{SED}). This variable is an estimate of the depth and areal extent of sedimentation within a vernal pool. Sedimentation within vernal pools degrades the vernal pools capability to retain and pond surface water. Normally, observable sedimentation does not occur within vernal pools. Any observable sedimentation would therefore be an indication of

disturbance within the contributing watershed of the vernal pool and an increase in sedimentation rates. The areal extent of sediment deposits within the vernal pool will be estimated along with its maximum depth.

The variable would be scaled where no observable sedimentation is given a score of 1.00 and sedimentation resulting in elimination of the inundated basin of the vernal pool will be given a score of 0.00.

Watershed Disturbance Quotient ($\mathbf{V_{WDQ}}$). This variable refers to disturbances within the contributing watershed of the vernal pool. It factors in the type of disturbance, the weighted distance of that disturbance from the wetland and the relative proportion of the watershed affected by that disturbance. A disturbance index (Table 10) is used to weight the types of disturbances. Where several types of disturbance are noted, the most severe level is used for calculating this function. This variable is adapted from Clairain (2000). This variable incorporates elements of numerous variables potentially affecting wetland function including watershed condition, buffer condition, buffer continuity, and buffer width. The highest calculated value(s) would be assigned a score of 1.0 and the lowest would be assigned a score of 0.1 with the remaining value scaled accordingly.

The contributing watershed is characterized by measuring the distance to disturbances within the contributing watershed of the vernal pools in four sectors established at 45 degrees starting north of the observation point. The observation point is the downhill edge of the vernal pool. Disturbances are characterized as to type and proximity to the vernal pool. Proximity is characterized as to whether the disturbance occurred within the vernal pool, within the immediate basin of the vernal pool or within the contributing watershed of the vernal pool.

Using these data, the Watershed Disturbance Quotient is calculated using the following formula.

$$Vwdq = \frac{\sum ni=1((3xI) + (2xWx((SQRT(1/(0.9999+(D))-0.0001))))+(K))/6}{8}$$

Where;

$\sum ni=1$ = summation of the disturbance components for sectors 1 to n

n = number of sectors where some type of disturbance is observed

I = disturbance index for the most sever type of disturbance occurring within the vernal pool for each sector

W = disturbance index for the most severe type of disturbance occurring within the immediate basin of the vernal pool for each sector

SQRT = square root

D = distance in meters from the edge of the vernal pool to the nearest most severe disturbance; anything less than one meter is zero and then in whole numbers thereafter with 1 = 1 to < 2 meter, 2 = 2 to < 3 meters, etc.

K = disturbance index for the most severe type of disturbance occurring within the contributing watershed within one kilometer of the outside edge of the vernal pool for each sector

Table 10. V_{WDQ} Disturbance Index

DISTURBANCE FACTORS	*DISTURBANCE INDEX*
AGRICULTURE	
CHEMICAL SPRAYING	
None	1.00
Within one km but out of complex	0.75
Within the vernal pool complex	0.10
TILLAGE	
None	1.00
Harrowing	0.75
Mowing	0.75
Chiseling/disking	0.50
Plowing	0.25
Deep plowing, restoration possible	0.10
Deep Ripping and Leveling	0.00
Land Leveling	0.25
GRAZING	
None	0.75
Light	1.00
Moderate	0.50
Severe	0.10
SPECIAL MNGT. PRACTICES	1.00 or 0.00
DEVELOPMENT	
RESIDENTIAL/COMMERCIAL:NONE	1.00
Low-density Residential	0.50
High-Density Residential	0.25
Low-density Commercial	0.50
High-density Commercial	0.25
PUBLIC ACCESS	
None	1.00
Limited	0.75
Open w/disturbance	0.50
HYDROLOGIC MODIFICATIONS	
None	1.00
Interceptions of Inflows	0.10
Diversions of Flows Away	0.10
Irrigation within Vernal Pool Subclass	0.10*
Irrigation within Slope Class	0.50*
Wetland Drained	0.00*

* Where these disturbances occur in the wetland they will be considered to have occurred in all 8 sectors.

Organic Matter (V_{OM}). This variable refers to the amount of detritus (primarily algal matting) within the wetland. It is a variable reflecting a portion of the total primary productivity of a wetland. During the wetted phase, algae develops in the water column. After the vernal pool dries out, this algae leaves thin dried mats on the bed of the wetland. The areal coverage by algal matting will be estimated as a percentage of the total area of the wetland. The highest percentage observed would be assigned a score of 1.0. Since organic matter is always present, whether or not it is visually observable, a score of 0.1 would be assigned where no organic matter is observed. The remainder of the percentages would be scaled accordingly.

Percent Cover ($V_{\%COV}$). This variable refers to the estimated absolute cover by vascular plants within the vernal pool. This along with Organic Matter is a variable reflecting a portion of the total primary productivity of a vernal pool. The percent absolute cover of vascular plants will be visually estimated. The range of percent cover observed in the least disturbed wetlands would be assigned a score 1.0 while the remaining values will be scaled according to the degree to which they vary from the range in the least disturbed wetlands.

Vernal Wetland Plant Index (V_{VWPI}). This variable is a measure of the degree to which the plant community is dominated by species normally found in vernal pools. The index is calculated by the following formula:

$$V_{VWPI} = \frac{(No.\ VPE\ Dom.\ Species) + (.25)(No.\ VPA\ Dom.\ Species)}{Total\ No.\ of\ Dom.\ Species}$$

Where: VPE = Vernal pool endemic species
VPA = Vernal pool associate species

Vernal pool endemic species are those plants that are endemic to vernal pools whereas vernal pools associate species are those plants that are commonly found in vernal pools but are also found in other types of wetlands. Appendix C is a master plant list that have been observed within vernal pools within the reference domain along with a notation as to whether each plant is considered to be a vernal pool endemic or associate.

For purposes of this variable, dominant species will be assumed to be those plants comprising an estimated 50 percent of the total vegetative cover as well as any other species having an estimated cover of at least 10 percent. The highest possible V_{VWPI} (1.0) would be where all dominant plants are vernal pool endemic species. The lowest calculated V_{VWPI} would be assigned a score of 0.1. The remaining values would be scaled appropriately.

Native Plant Index (V_{NPI}). This variable is a measure of the relative dominance of native plants. Native plants are considered to be those species that are considered to be indigenous to California. The source used for making these determinations was The Jepson Manual (Hickman 1993). The V_{NPI} is calculated by dividing the number of dominant native species by the total number of dominant species. The highest possible V_{NPI} (1.0) would be where all dominant

plants are native species. The lowest V_{NPI} would be assigned a score of 0.1. The remaining values would be scaled appropriately.

Wetland Density (V_{WD}). This variable refers to the proximity and relative abundance of other wetlands. This variable would be measured using GIS. It would be calculated as the percent of the total wetland area within a specific radius of the centroid of the wetland. The greatest percentage of wetland area would be assigned a score of 1.0 while the lowest percent wetland would be assigned a score of 0.1. The remainder would be scaled appropriately.

Conceptual Function Models

A series of conceptual models were developed to describe how the variables discussed above influence wetland function. In almost all cases, these models were constructed using variables that influence their functional capacity rather than directly measure the function. In one case (MCPC) the variables used provide a direct measure of the function. The models are designed so that they will yield a score ranging from 0.0 up to 1.0. A score of 0.0 implies that the wetland would not perform that particular function. A score of 1.0 implies that the wetland would perform the function at maximum capacity relative to the reference standards. Various components of these models are comprised of single and/or multiple variables. Where these components are multiplied, a value of zero for one of the components will result in a functional rating of zero. Where the components are added, a value of zero for one of the components will not result in a function rating of zero unless all components are rated as zero. The following is a description of each of the conceptual function models.

Surface Water Storage (SWS)

$$SWS = \sqrt{(V_{BEDRL})\left(\frac{V_{WDQ} + V_{BEDP} + V_{SED}}{3}\right)}$$

Where: V_{BEDRL} = Restrictive layer within the wetland
V_{WDQ} = Watershed Disturbance Quotient
V_{BEDP} = Bed soil profile integrity
V_{SED} = Sediment deposition

A vernal pool's capacity to store water is dependent on the presence of an intact restrictive layer in the soil (V_{BEDRL}) and is substantially influenced by the condition of its watershed (V_{WDQ}) and the integrity of its soil profile (V_{BEDP}). If disturbance to the watershed increases sedimentation within the vernal pool, it will reduce the capacity of the vernal pool to store surface water (V_{SED}).

Subsurface Water Storage and Interchange (SWS&I)

$$SWS\ \&\ I = \sqrt{\left(\frac{V_{BEDRL} + V_{BEDAWC}}{2}\right)\left(\frac{V_{BANKRL} + V_{BANKAWC} + V_{WDQ}}{3}\right)}$$

Where: V_{BEDRL} = Restrictive layer within the wetland

V_{BEDAWC} = Available water capacity in the wetland soils
V_{BANKRL} = Restrictive layer in the adjacent upland
$V_{BANDAWC}$ = Available water capacity in adjacent upland soils
V_{WDQ} = Watershed Disturbance Quotient

There are two main components of the model: the capacity of the soil profile above the restrictive layer within the wetland to retain perched groundwater (V_{BEDRL}, V_{BEDAWC}); and, the condition of the watershed including the capacity of the soil profile above the restrictive layer in the adjacent uplands to retain perched groundwater (V_{WDQ}, V_{BANKRL} and $V_{BANDAWC}$).

Moderation of Surface and Shallow Subsurface Water Flow (MS&SSWF)

$$MS\ \&\ SSWF = \frac{V_{SLOPE} + V_{\%COV} + V_{\%COB}}{3}$$

Where: V_{SLOPE} = Slope within the wetland
$V_{\%COV}$ = Percent plant cover in wetland
$V_{\%COB}$ = Percent cover by cobbles in wetland

The degree to which a sloped wetland moderates surface water flow is determined primarily by its slope (V_{SLOPE}) and the hydraulic roughness within the wetland ($V_{\%COV}$ and $V_{\%COB}$).

Element and Compound Cycling (E&CC)

$$E\ \&\ CC = \left(\frac{V_{WDQ} + V_{OUT} + V_{BEDRL} + V_{SED} + \left(\frac{V_{OM} + V_{\%COV}}{2} \right)}{5} \right)$$

Where: V_{WDQ} = Watershed Disturbance Quotient
V_{OUT} = Presence or absence of an outlet
V_{BEDRL} = Restrictive layer within the wetland
V_{SED} = Sediment deposition
V_{OM} = Organic matter in wetland
$V_{\%COV}$ = Percent plant cover in wetland

There are five components of the model: the overall condition of the watershed influences the amount of water and its element and compound constituents (V_{WDQ}); the presence or absence of an outlet determines whether these elements and compounds can be transported to down-gradient waters (V_{OUT}); the presence or absence of a restrictive layer determines the wetlands ability to pond water (V_{BEDRL}), the presence or absence of recently deposited (V_{SED}) and the vascular and non-vascular plant community influences how elements and compounds are cycled (V_{OM} and $V_{\%COV}$).

Organic Carbon Export (OCE)

$$OCE = \sqrt{\left(\frac{V_{WDQ} + V_{BEDRL} + V_{OM} + V_{\%COV}}{4}\right)(V_{OUT})}$$

Where: V_{WDQ} = Watershed Disturbance Quotient
V_{BEDRL} = Restrictive layer within the wetland
V_{OM} = Organic matter in wetland
$V_{\%COV}$ = Percent plant cover in wetland
V_{OUT} = Presence or absence of an outlet

The primary factors influencing this function include the organic contribution derived from adjacent uplands ($\mathbf{V_{WDQ}}$); the organic matter contribution within the wetland ($\mathbf{V_{OM}}$ and $\mathbf{V_{\%COV}}$); and the topographic conveyance by which the organic matter can be transported to down-gradient waters/wetlands ($\mathbf{V_{OUT}}$).

Maintenance of Characteristic Plant Communities (MCPC)

$$MCPC\ (Vernal\ Pools) = \frac{V_{VWPI} + V_{\%COV}}{2}$$

$$MCPC\ (Swale\ \&\ Clay\ Slope) = \frac{V_{NPI} + V_{\%COV}}{2}$$

Where:

V_{VWPI} = Vernal pool plant index
$V_{\%COV}$ = Percent plant cover in wetland
V_{NPI} = Native plant index

There are two main components of this model; the species composition of the plant community relative to the least disturbed plant reference plant communities ($\mathbf{V_{VWPI}}$ and $\mathbf{V_{NPI}}$); and, the percent cover of the plant community relative to the cover in the least disturbed plant communities ($\mathbf{V_{\%COV}}$).

Maintenance of Characteristic Faunal Communities (MCFC)

$$MCFC\ (Vernal\ Pools) = \sqrt{(V_{BEDRL})\left(\frac{V_{VWPI} + V_{WDQ} + V_{\%COV}}{3}\right)}$$

$$MCFC\ (Slope\ wetlands) = \sqrt{(V_{BEDRL})\left(\frac{V_{NPI} + V_{WDQ} + V_{\%COV}}{3}\right)}$$

Where:

V_{BEDRL} = Restrictive layer within the wetland

V_{VWPI} = Vernal pool plant index
V_{NPI} = Native plant index
V_{WDQ} = Watershed Disturbance Quotient
$V_{\%COV}$ = Percent plant cover in wetland

Faunal Habitat Interspersion and Connectivity (FHI&C)

$$FHI\ \&\ C = \frac{\left(\frac{V_{OUT} + V_{IN}}{2}\right) + V_{WDQ} + V_{WD}}{3}$$

Where:

V_{IN} = Presence or absence of an outlet
V_{OUT} = Presence or absence of an inlet
V_{WDQ} = Watershed Disturbance Quotient
V_{WD} = Wetland density

There are three components of this model, all pertaining to the mechanisms by which faunal species can move or be transported from one wetland to another. They include the overall condition of the adjoining uplands ($\mathbf{V_{WDQ}}$), the presence or absence of an inlet and/or an outlet contributing flow to up-gradient and/or down-gradient waters/wetlands ($\mathbf{V_{IN}}$ and $\mathbf{V_{OUT}}$), and the proximity of other wetlands ($\mathbf{V_{WD}}$).

CHAPTER 5 – ASSESSMENT METHODOLOGY

Field Sampling Protocol

Sample Site Selection. A field testing protocol was established to sample the variables discussed in Chapter 4 representing the broad range of conditions existing within the reference domain. The purpose of the field sampling was to collect data on the variables within reference wetlands to calibrate these models. Sample sites were established based on a stratified random sampling protocol. Sample sites were first stratified based on regional subclasses. The number of wetlands to be sampled within each regional subclass was determined based on the proportional distribution of that regional subclass relative to the total number of wetlands.

The samples were then stratified based on relative disturbance zones. Three broad disturbance zones were established based on overall landscape conditions (e.g. proximity to roads, canals, irrigation, etc.). Generally speaking, Disturbance Zone 3 represents the least disturbed conditions within the reference domain. Therefore, the majority of the reference standards would be located within Disturbance Zone 3. Disturbance Zone 3 encompasses those wetlands occurring north and east of the old Merced Hills Golf Course (what is now Phase I of the UC Merced campus) but north of the Flying M Ranch lands. Disturbance Zone 2 represents a greater level of disturbance than Disturbance Zone 3. Disturbance Zone 1 encompasses those areas that were previously part of the Flying M Ranch in the area proposed for the campus support community. Disturbance Zones 1 and 2 are both substantially more disturbed than Zone 3. The disturbances within Zone 1 are generally associated with development (grading, filling, excavating, paving, etc.) whereas the disturbances in Zone 2 are associated with agriculture (e.g. irrigation, drainage, and land leveling, etc.)

The third stratification was based on soil type. As shown in Table 3, there are fifteen soil mapping units within the reference domain. The decision to stratify the sample sites based on soil mapping units was made in an effort to capture some of the variability based on topography and soils. The large majority of wetlands are located within a few soil mapping units and there are many soil mapping units with only a few wetland polygons located within them. The large majority of vernal pools are located totally within one soil mapping unit whereas many of the swale and clay slope wetlands are located in more than one soil mapping unit.

Sample sites were randomly selected within each strata using GIS software. Each sample site was assigned a number reflecting the above stratification. The first digit of the sample site number reflects the Disturbance Zone in which the wetland is located (i.e. 1, 2 or 3). The next two characters of the sample site designation refer to the regional subclass of the wetland (i.e. VP for vernal pools, SW for swale wetlands, or CS for clay slope wetlands). The next three characters refer to the soil mapping unit in which the wetland is located. The next one to two digits refer to the sequential number of that sample site. For example, for sample site number 3VPCgB4, refers to Disturbance Zone 3, the regional subclass is vernal pool (VP), the soil mapping unit is CgB (Corning gravelly loam, 0-8 % slopes) and the site number is 4.

Data Sampled. A data form was prepared to facilitate collecting field data for the model variables influencing wetland function at each of the designated sample sites. A blank copy of this data form, along with instructions for filling out the form in the field, is attached in Appendix B. The following is a listing of the specific data gathered, the associated regional subclass (VP, SW, or CS), and the model variable to which the data are applicable.

- Presence or absence of a topographically distinct inlet (vp, sw and cs - V_{IN}).
- Presence or absence of a topographically distinct outlet (vp, sw and cs - V_{OUT}).
- Estimated percent cover of recently deposited sediment (vp, sw, and cs - V_{SED})
- Estimated percent cover by algal matting (vp, sw and cs - $V_{\%OM}$).
- Estimated percent cover of vascular plants (vp, sw and cs - $V_{\%COV}$).
- Plants with and estimated cover of 10 percent or greater (vp, sw and cs – V_{VWPI} and V_{NPI}).
- Average depth of wetland (vp - V_{DW}).
- Percent slope (sw and cs - V_{SLOPE}).
- Disturbance(s) observed within the vernal pools and its contributing watershed (vp, sw and cs – V_{WDQ}). Disturbances were noted and recorded in Sectors consistent with the V_{WDQ} formula.
- Disturbance index rating for the most severe disturbance observed within the wetland by sector (vp, sw and cs - V_{WDQ}).
- Disturbance index rating for the most severe disturbance observed within the contributing watershed of the wetland by sector (vp, sw and cs - V_{WDQ}).
- Distance from the edge of the wetland to the nearest most severe disturbance in the contributing watershed by sector (vp, sw and cs - V_{WDQ}).
- A best professional judgment (BPJ) estimate of the overall functional rating of the wetlands. The scale of the rating was 0.0 – 1.0 where a rating of 0.0 equated to no wetland functions performed and a rating of 1.0 equated to maximum functional attainment. Each individual team member first rated each respective wetland. The team then discussed the basis for each member's ratings and agreed to a single group rating.

In addition to the above, soil profile descriptions for selected wetlands and their adjacent uplands were obtained. The descriptions included the depth, thickness and textural class of all soil horizons down to the restrictive layer. Other data obtained included the probable soil series and soil mapping unit, evidence of soil profile truncation or burying (filling), evidence of restrictive layer disturbance (ripping) and other observations, where appropriate. This soil data were collected for all regional subclasses (vp, sw and cs) and is applicable to the V_{BEDP}, V_{BANKP}, V_{BEDAWC}, and V_{BANKRL} model variables.

Field Sampling. The field surveys were conducted April 14-18 and April 21-23, 2003. These field surveys were scheduled to correspond with the period of time when the maximum number of plants was in flower. The surveys were conducted by the following participants.

- Mr. Tom Skordal, Gibson & Skordal, LLC
- Mr. Jim Gibson. Gibson & Skordal, LLC
- Dr. Buddy Clairain, Corps of Engineers, Environmental Laboratory
- Ms. Nancy Haley, Corps of Engineers, Sacramento District

- Mr. Matt Hirkala, Corps of Engineers, Sacramento District
- Dr. Rob Leidy, Environmental Protection Agency, Region 9
- Mr. Joel Butterworth, Jones & Stokes Associates
- Mr. Scott Fraser, Jones & Stokes Associates

The participants were organized into three survey teams. Two teams of three were responsible for collecting data other than soil profile data while one team of two was responsible for collecting all soil profile data. The team collecting soil profile data was composed of Messrs. Butterworth and Fraser. The other two teams rotated personnel but maintained a composition of one Corps of Engineers, Sacramento District representative and one Gibson & Skordal representative per team.

A total of 340 wetlands were surveyed by the two teams responsible for collecting other than soil profile data. This total consisted of 180 vernal pools, 121 swale wetlands and 39 clay slope wetlands. The soil profile team examined and described 91 wetlands in the field.

Data Analysis

Data from the field surveys were entered onto spreadsheets, one for vernal pools, one for swale wetlands and one for clay slope wetlands. Prior to entering plant data, all plants occurring in or near wetlands within the reference domain were classified as either vernal pool endemic species or non-vernal pool endemics and either native or non-native species. Appendix C contains a master plant list with these classifications listed. Using these plant classifications, the V_{VWPI} and V_{NPI} variables were calculated for each wetland and entered onto the appropriate spreadsheets. Using the disturbance data, a portion of the V_{WDQ} variables were calculated. During this process, we noted certain anomalies in the equation that did not appropriately account for disturbances observed in the field. Therefore, this variable was omitted from the field data compilations. Using the soil profile data, the V_{BEDAWC}, $V_{BANKAWC}$, and $V_{PROFILE}$ variables were calculated for each wetland sampled and entered onto the spreadsheets. Copies of these spreadsheets are included in Appendix D.

This reference wetland data were then analyzed to determine its suitability for calibrating the model variables and verifying/validating the assessment models. The Assessment Team examined the variables data from the least disturbed sites and compared them to the range of conditions in more disturbed sites for each regional wetland subclass. The analysis was further stratified by soil type. The data were also compared to the BPJ ratings recorded in the field. As stated previously, under the HGM methodology, the reference standards (least disturbed) wetlands should be used to scale the upper limits of assessment models while the more disturbed wetlands are used to scale the lower limits of the assessment models.

However, it was concluded that the data did not provide an adequate basis to discriminate between reference standard wetlands and more disturbed wetlands. Table 11 is a comparative listing, by regional subclass and disturbance zone, of the ranges and means of data observed for each model variable excluding those involving presence/absence data (V_{IN} and V_{OUT}), those for which there was very little variability between the large majority of reference wetlands (V_{SED}, $V_{\%OM}$, and $V_{\%COB}$), and those involving soil profile data (V_{BEDAWC}, $V_{BANKAWC}$, V_{BEDP}, and

V_{BANKP}). The BPJ functional rating of the survey teams is included within this table for a qualitative reference. As stated above, the V_{WDQ} model variable is not included in the table because subsequent evaluation of this variable revealed anomalies inconsistent with conditions observed at the site (see discussion in the following section).

Table 11. Ranges of Selected Variables by Regional Subclass and Disturbance Zones

Regional Subclass	Disturbance Zone	BPJ		V_{VWPI}		V_{DW}		V_{NPI}		V_{SLOPE}	
		High	Low	High	Low	High	Low	High	Low	High	Low
Vernal Pool	3	1.0	0.2	1.00	0.25	1.3	0.1	na	na	na	na
Vernal Pool	2	0.9	0.1	0.88	0.25	0.8	0.1	na	na	na	na
Vernal Pool	1	1.0	0.2	1.00	0.25	1	0.1	na	na	na	na
Swale Wetland	3	1.0	0.1	na	na	na	na	1.00	0.00	3.8%	0.1%
Swale Wetland	2	1.0	0.1	na	na	na	na	0.60	0.00	3.0%	0.1%
Swale Wetland	1	0.7	0.1	na	na	na	na	0.75	0.00	1.3%	0.1%
Clay Slope Wetland	3	0.9	0.4	na	na	na	na	0.67	0.14	3.9%	0.1%

The ranges of conditions observed in the least disturbed reference wetlands (Disturbance Zone 3) are so broad that they capture the ranges of conditions observed within the more disturbed wetlands (Disturbance Zones 1 and 2). For example, the number of vernal pool endemic plant species in Disturbance Zone 3 vernal pools ranges from 0 to 6 while the number in Disturbance Zones 1 and 2 vernal pools ranges from 0 to 4 and 0 to 5, respectively. Likewise, the V_{VWPI} variable ranges from 0.25 up to 1.0 in Disturbance Zone 3 vernal pools while the Disturbance Zones 1 and 2 range from 0.25 up to 1.0 and 0.25 up to 0.88, respectively. This same pattern is exhibited with respect to the other model variables in both the vernal pools and swale wetland subclasses. The only clay slope wetlands within the reference domain are all located within Disturbance Zone 3, so there is no comparative data for clay slope wetlands in Disturbance Zones 1 and 2. Although the BPJ ratings are subjective, they reveal a similar pattern for vernal pools and swales. The BPJ ratings of Disturbance Zone 3 vernal pools ranged from 0.2 up to 1.0 while the BPJ ratings of Disturbance Zone 1 and 2 vernal pools ranged from 0.1 up to 1.0 and 0.1 up to 1.0, respectively.

There are several possible initial explanations. They include the following.

- The natural variability within these regional subclasses is so great and the number of individual wetland polygons comprising the reference domain and reference standards is so large, that it may not be possible to accurately scale the model variables within the scope of this effort.

- The disturbance zones may not provide enough resolution to capture all of the disturbances affecting model variables. For instance, plowing, disking and deep ripping were not observed.
- Although a large number of wetlands were examined, they were stratified into three disturbance zones, three regional wetland subclasses, and fifteen soil types so that the number of samples within each stratified category may not have been large enough to calibrate the models.

Of the above, the Assessment Team considered the first to be the primary explanation. The Assessment Team examined the wetland-specific disturbance data taken in the field for individual wetlands within given disturbance zones and noted numerous examples where the only disturbance observed was grazing. The intensity of grazing in a large majority of the wetlands was similar but widely disparate data were obtained for given model variables. Conversely, the Assessment Team noted numerous examples where substantial disturbance was noted in close proximity to a particular wetland yet many or all model variables exceeded other wetlands of the same regional subclass where no disturbance was noted. Comparing BPJ ratings yielded similar results.

It is possible that a larger sample could yield results that allow calibration of the variables. As stated previously, a total of 180 vernal pools, 121 swale wetlands and 39 clay slope wetlands were sampled. Given the number of wetlands sampled and the lack of any resolution that would allow scaling, the number of wetlands that would have to be sampled would be extremely high and far beyond the scope of this study.

Because of the above, the Assessment Team decided to abandon the classic HGM assessment methodology and develop a modified assessment methodology that, while based on HGM principals, accounts for the broad range of functional performance found within large vernal pool landscapes. This methodology is discussed in the following section.

Functional Assessment Methodology

Overview. The Assessment Team initially examined the WDQ and subsequently modified it to more accurately assess conditions at the UC Merced project area. Rather than rating the individual functions of individual wetlands, this modified functional assessment methodology assesses and rates disturbances that from functional capacity In a large vernal pool landscape, there may be hundreds to thousands of broadly scattered wetlands performing a whole suite of functions. There are large variations in the degree to which individual wetlands are capable of performing these various functions. When these wetlands are disturbed, the degree to which they are capable of performing one or more of these functions can be diminished depending on the type of disturbance and its proximity to the wetlands.

This functional assessment methodology rates disturbances based on the extent to which they can detract from functional performance. It assumes that, absent disturbances, each wetland is at full functional capacity. Each disturbance is assigned a disturbance index (DI) rating based on the potential severity of functional impairment and number of functions that could be impaired (Table 12). Disturbances directly to the wetland as well as to the surrounding uplands are considered. For disturbances occurring in the surrounding upland, the DIs are decayed over

distance so that the same disturbance will have a lower disturbance index as distance from the wetland is increased. The combined functional capacity index (CFCI) of each wetland is derived from the disturbance index rating within the wetland combined with the functional rating of the surrounding uplands. The combined functional capacity units (CFCU) of each wetland are calculated by multiplying the functional capacity index of each wetland by its area.

Because of the size of the UC Merced Project as well as the number of wetlands existing within the reference domain, this functional assessment methodology has been designed so that it can be performed using Geographic Information System (GIS) software. It relies on aerial photographic interpretation of disturbances with limited ground truthing rather than field surveys and data gathered in the field.

Development of the Methodology. Initially, in development of this methodology, the watershed disturbance quotient (WDQ) developed by Clairain (2000) and previously adopted for the V_{WDQ} function variable was examined to determine if it could provide an adequate basis for calculating the CFCI of wetlands. After considerable review, several anomalies were identified that limit use of the WDQ for this assessment methodology. The following problems were identified.

Table 12. Disturbance Index

Disturbance Factors	Index Rating
Agriculture	
None	1.00
Mowing	0.70
Disking/Harrowing/Chiseling	0.40
Plowing/Planting	0.25
Chemical Spraying	0.10
Deep Plowing, Restoration Possible	0.10
Land Leveling	0.10
Deep Ripping and Leveling	0.00
Grazing	
Specially Managed to Benefit Wetlands	1.00
Moderate Grazing, Managed per NRCS Standards	0.80
Moderate Grazing	0.70
No Grazing	0.50
Severe	0.50
Landscape Modification	
None	1.00
Non-graded Roads/Trails	0.75
Scraping	0.25
Excavating in Wetland	0.10
Filling in Wetland	0.00
Hydrologic Modifications	
None	1.00
Irrigation	0.25
Diversions of Flows Away	0.10
Impounding Wetland	0.10
Interceptions of Inflows	0.10
Wetland Drained	0.00

- While the formula for calculating the WDQ provides for decay of disturbance indices over distance, upon further review the Assessment Team determined that this portion of the formula actually works inversely to its intended purpose.
- The WDQ formula relies on being able to distinguish the watershed of each individual wetland. Since this cannot be accomplished by GIS using available topographic map, the watershed of each wetland would have to be individually surveyed. Since there are thousands of individual wetlands within the UC Merced project area, this would be impracticable.
- While the WDQ does account for the areal extent of disturbance somewhat by rating disturbances within eight sectors, the Assessment Team desired a rating system that would more accurately account for the total area disturbed.
- The WDQ weights disturbances within the wetland, within uplands comprising the contributing watershed of the wetland and within uplands outside of the contributing watershed of the wetland. While this weighting does yield the intended results in some scenarios, it does not in others. For instance, where a wetland is undisturbed but all of its watershed and surrounding uplands are developed, the functional capacity of the wetland would be approximately halved. Likewise, where a disturbance within the wetland severely compromises its functional capacity but where the contributing watershed and surrounding uplands outside the watershed are not disturbed, the functional capacity of the wetland would be approximately halved. In both cases, we believe that the impact to the functional capacity of the wetland should be greater than that indicated by use of the WDQ formula. While this particular problem can be solved by changing the weighting, other similar problems are created.

For these reasons, the Assessment Team decided to discard the WDQ as the basis for calculating the CFCI of wetlands and developed an assessment protocol based on a formula derived from the WDQ. As stated previously, this methodology has been designed to be performed by GIS. All of the disturbances under baseline conditions are mapped from aerial photography and digitized for GIS analysis. A grid of 3–square meter (m^2) cells is then established over the project area. Each 3-m^2 cell is then assigned a corresponding disturbance index rating. Where more than one type of disturbance is present within a given 3-m^2 cell, the most severe index rating is assigned to that cell. Where only a portion of a given 3-m^2 cell is disturbed, the whole cell is considered to be disturbed.

In calculating the CFCI of a given wetland, a distinction is made between those cells occurring within the wetland being rated and those cells occurring in the uplands surrounding that wetland. Where any portion of a cell is located within the wetland being rated, the whole cell is considered to be within that wetland. These disturbance indices are then used to calculate the CFCI of the wetland.

Calculating the CFCI. The formula for calculating the CFCI is shown and explained below.

$$CFCI = \sqrt{\left[\frac{\sum_{1}^{n_{cw}} I_{cw}}{n_{cw}}\right]\left[\frac{\sum_{1}^{n_{cnw}} I_{cnw} + \left((1 - I_{cnw})\left(\frac{D_{cw-cnw}}{D_m}\right)^2\right)}{n_{cnw}}\right]}$$

where:

CFCI	=	Combined Functional Capacity Index of the wetland
I_{cw}	=	Disturbance index rating of a cell in the wetland
I_{cnw}	=	Disturbance index rating of a cell not in the wetland but within 500 meters (D_m)
n_{cw}	=	Number of cells in the wetland
n_{cnw}	=	Number of cells not in the wetland but within the 500 meters
$D_{cw\text{-}cnw}$	=	Distance from a non-wetland cell to the nearest wetland cell
D_m	=	Maximum distance is 500 meters

The CFCI is scaled to yield values ranging from 0.00 up to 1.00 with the lowest possible CFCI being 0.00 and the highest possible CFCI being 1.00.

To paraphrase this formula, the CFCI is calculated as the square root of the product of:

- the average index ratings of all 3-m^2 cells within the wetland, and
- the average decayed index ratings of all 3-m^2 cells located outside the wetland to a distance of 500 meters.

Within a 500-meter radius circle surrounding a given wetland, there is a minimum of 87,222 3-m^2 cells. As the size of the wetland increases, the number of 3-m^2 cells also increases.

Disturbance Index Ratings. Disturbance index ratings are obtained from the disturbance index (Table 12). This table was derived from the disturbance table used for calculating the WDQ with modifications to better address the characteristics of the UC Merced project area. Each type of disturbance is assigned a rating ranging from 0.00 to 1.00. A rating of 0.00 equates to a disturbance of such severity that no wetland function capacity remains. In essence, it means that the wetland and all its capacity for performing all wetland functions is be eliminated. A rating of

1.00 equates to no reduction in the capacity of the wetland to perform the whole suite of wetland functions.

The disturbance index ratings were assigned by the Assessment Team based on their best professional judgment including a review of relevant literature and communication with other experts in the field regarding the degree to which each disturbance could impair individual and collective functions. By considering functions collectively in assigning disturbance ratings, the CFCI values thusly obtained were averaged as opposed to generating individual values for each function. The Assessment Team concluded that this was appropriate since many of the variables affected by these disturbances influence numerous wetland functions and because the functional ratings must ultimately be combined (i.e. averaged) to determine the CFCI.

While the rationale for assigning many of the disturbance ratings listed in Table 11 is fairly straightforward and intuitive, the impacts to wetland function resulting from grazing are more problematic. There have been numerous anecdotal observations that grazing may benefit certain biological functions in vernal pools and swale wetlands. Recent research by Dr. Jaymee Marty, however, indicates that moderate levels of grazing benefit many of the functions performed by vernal pools and swale wetlands (Marty, J.T. In press). Dr. Marty's research examined the effect of different grazing treatments (ungrazed, continuously grazed, wet-season grazed and dry-season grazed) on vernal pool plant and aquatic faunal diversity in the Central Valley of California. Dr. Marty found that removal of grazing results in significant reductions in native plant species richness and aquatic invertebrate species richness as compared to continual grazing. The research also documented a significant reduction in the duration of vernal pool inundation resulting from removal of grazing. It should be noted that Dr. Marty's research examined only cattle grazing and did not address grazing by other livestock such as sheep or horses. However, no sheep or horse grazing was observed within the reference domain by the Assessment Team.

The disturbance index ratings are based primarily on Dr. Marty's research as well as direct consultation with her (Marty 2005). Severe grazing was assigned a disturbance index rating of 0.50. This index rating assumes a level of grazing that is so severe that there is an observable substantial degradation of both the upland and wetland plant communities. This level of grazing was not observed during the field surveys. No grazing was also assigned a disturbance index rating of 0.50. Moderate grazing was assigned a disturbance index rating of 0.70. This index rating is intended to encompass the broad range of grazing conditions observed within the project area. An adaptive grazing management program designed and implemented to maximize wetland functions was assigned an index rating of 1.0 since it would, by definition, represent maximum functional attainment.

Disturbance Index Decay Curve. The CFCI formula incorporates a decay curve that reduces the severity of disturbance relative to the distance that the disturbance is from the edge of the wetland being rated. The decay curve is a logarithmic curve that results in no disturbance (a 1.00 disturbance rating) at 500 meters or greater, irrespective of the severity of the impact. Since it is impracticable to map the contributing watersheds of thousands of individual wetlands accurately, a logarithmic curve was selected because it results in a negligible reduction in the disturbance rating out to approximately 50 meters. Beyond 50 meters, there is an accelerated reduction in the disturbance's effect. The large majority of wetlands do not have contributing watersheds extending beyond 50 meters. As a result, although watersheds are not directly factored into the formula, since a majority of watershed limits are within 50 meters of their receiving wetlands and since disturbances are only negligibly decayed within 50 meters, the formula indirectly

weights disturbances to watersheds similarly to disturbances within the wetlands. Figure 4 illustrates the decay curves for three levels of disturbance.

Weighting. The formula has been designed to weight the CFCI toward the most severe impact occurring either inside or outside the wetland. Rather than averaging the disturbance rating inside and outside the wetland, the CFCI is calculated as the square root of the product of the average rating within the wetland and the average decayed rating outside the wetland. This weights the CFCI toward the greater disturbance. Where the disturbance index ratings within and outside a wetland are identical, the CFCI will be the same. Where there is a difference between the two disturbance index ratings, calculating the CFCI based on the square root of the product yields a lower CFCI. For instance, if a wetland has an averaged disturbance index rating of 0.10 and outside the wetland has an averaged decayed disturbance index rating of 0.90, the CFCI will be 0.30. The result would be the same where the disturbance index ratings are reversed.

If the CFCI were to be calculated based on the average of the two, the CFCI would be 0.50 under either scenario instead of 0.30. Thus, although the disturbance index ratings within and outside the wetland are given equal weight, the CFCI is weighted toward greater disturbance. While disturbances within and outside the wetland are equally weighted, they are also equally important to the functional capacity of the wetland. So, if either is substantially more disturbed than the other, the CFCI should be reduced more than just the average of the two. Calculating the CFCI as the square root of the product of the two accomplishes that.

Figure 5 illustrates the reduction in CFCI for a portion of the project area as the distance from various degrees of disturbance is increased. In this figure, the ranges of disturbance are shown in gray scale ranging from dark gray (most severe) to white (least severe). The ranges of CFCI are shown in color. The spectrum ranges from dark blue representing the highest CFCIs to red representing the lowest CFCIs. Representative CFCIs are labeled.

Calculating CFCUs. Once the CFCI is calculated for each wetland, combined functional capacity units (CFCUs) are calculated by multiplying the CFCI of each wetland times its area (in acres). The formula for calculation of CFCUs is as follows:

$$CFCU = [(CFCI)(A)]$$

where:

$CFCU$ = Combined functional capacity units of wetland

$CFCI$ = Combined functional capacity index of wetland

A = Area of the wetland (acres)

The sum of the CFCUs for all wetlands then represents the wetland functional capacity under assessment conditions.

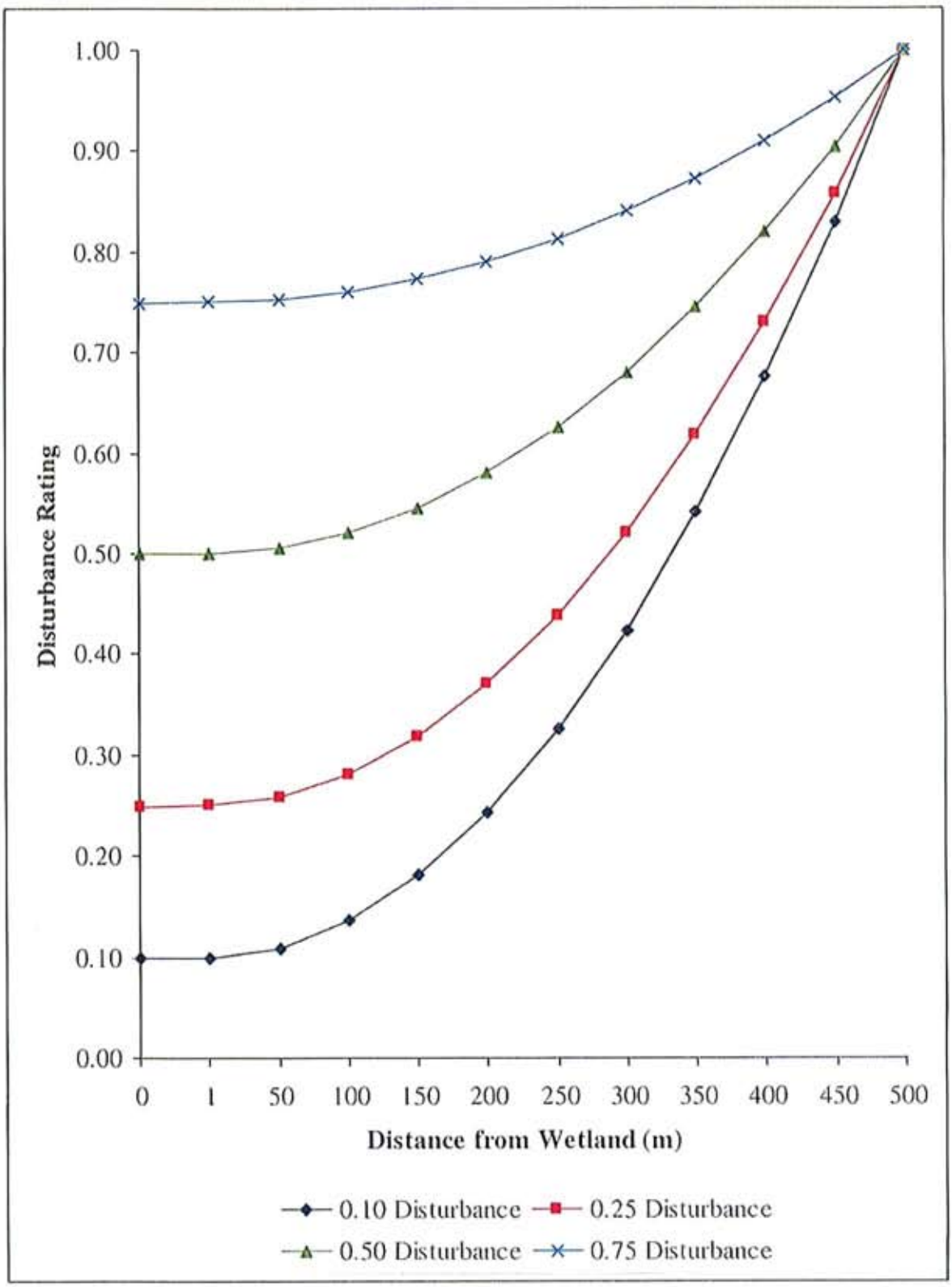

Figure 4
Disturbance Decay Curves

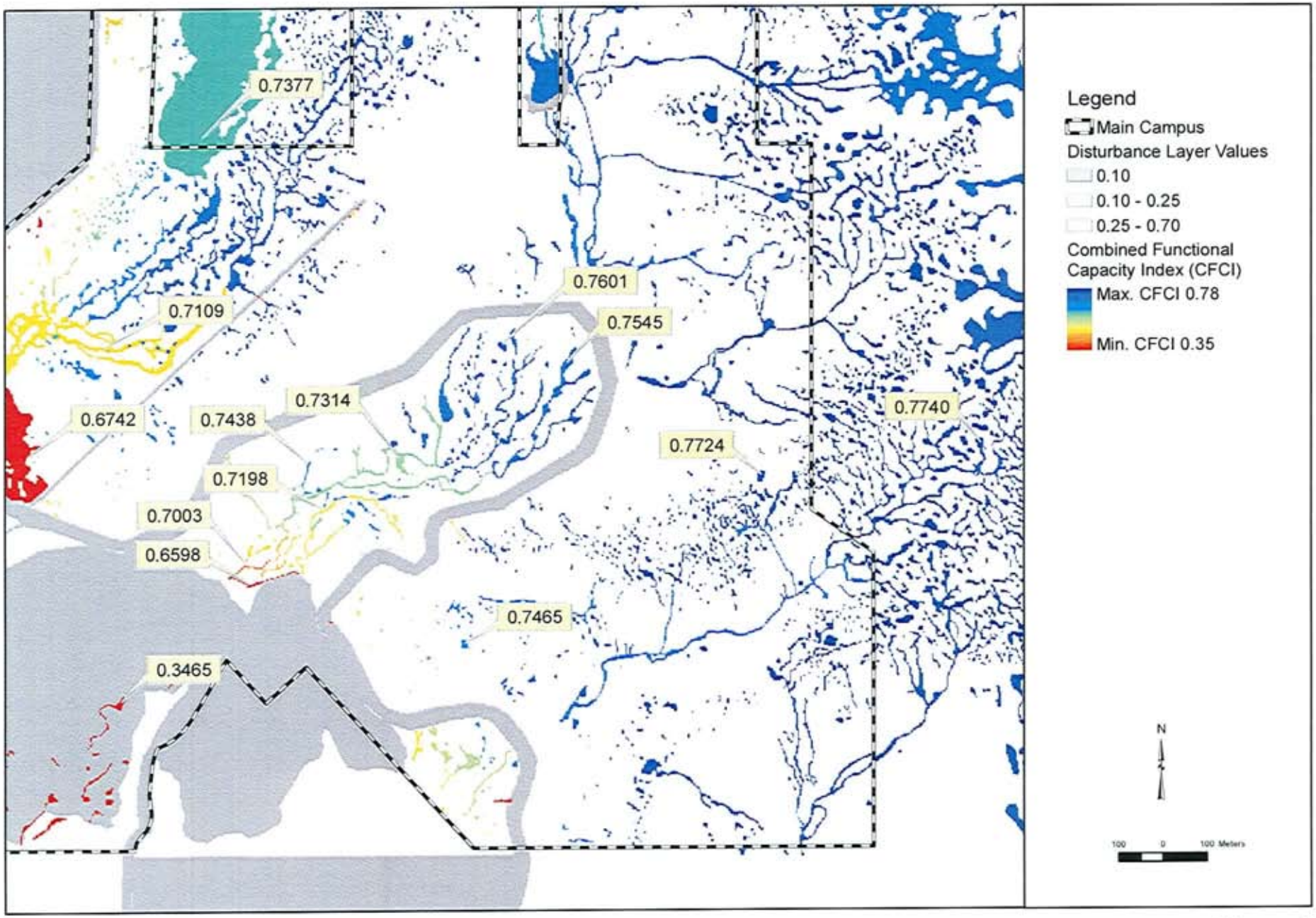

Figure 5
Reduction in CFCI

CHAPTER 6 – APPLICATIONS AND LIMITATIONS

Applications

The primary goal is to present a proposed functional assessment methodology. The goal of the functional assessment methodology is to provide a function-based method comparing the direct and indirect project impacts to vernal pools, swale wetlands and clay slope wetlands. This methodology is intended to provide the basis for assessing functional attainment of wetlands occurring in the UC Merced project area, reductions of function that would result from the proposed project and its on-site alternatives, and assessment of the efficacy of proposed compensatory mitigation measures.

Comparing Impacts. To calculate the impact of the proposed project, the CFCUs with the proposed project are subtracted from the CFCUs without the proposed project. The CFCUs with the proposed project would be calculated in three steps. First, all wetlands within the foot print of the proposed project are assigned a CFCU rating of 0.00. Second, the CFCUs of all wetlands lying within 500 meters of the footprint of the proposed project would then be calculated using revised disturbance ratings. Thirdly, the total of these revised CFCUs is then added to the total CFCUs of all wetlands occurring greater than 500 meters from the edge of the proposed project. This sum would then yield the total number of CFCUs with the proposed project. Comparison of different on-site alternatives can be conducted in a similar manner.

Assessing Adequacy of Mitigation. The compensatory mitigation that has been proposed for the UC Merced project incorporates both preservation/enhancement of existing wetlands and restoration/creation of wetlands. The preservation/enhancement component of the UC Merced compensatory mitigation plan has been proposed primarily to ensure that there will be no net loss of wetland functions for naturally occurring wetlands. The restoration and creation component is primarily intended to ensure that there will be no net loss in the overall areal extent of wetlands. From a functional standpoint, the restored/created wetlands are also intended to compensate for the impacts to non-naturally occurring wetlands.

This functional assessment methodology can be used to assess the adequacy of the proposed preservation/enhancement measures in two different ways. The first and probably most accurate and labor intensive way would be to calculate the baseline CFCUs for each preservation site and then calculate the CFCUs that would result from the preservation and/or enhancement measures. The difference between the two totals for all of the preservation properties would then be the total amount of compensatory mitigation. This total would then be compared to the loss of CFCUs resulting from the proposed project.

The second and somewhat less accurate but more cost-efficient method of calculating the replacement CFCUs resulting from the preservation/enhancement measures would be to estimate the incremental CFCI improvement that would result from these measures and then multiply that by the total area of vernal pools, swale wetlands and clay flats for each of the preservation properties.

Limitations

This functional assessment methodology was designed to rate wetland functions of naturally occurring wetlands within the UC Merced project area and bordering lands. Those naturally occurring wetlands include vernal pools, swale wetlands and clay slope wetlands. It does not provide a basis for rating other types of wetlands occurring within the project area that were created as a result of the activities of man. Such wetlands include irrigation induced seasonal wetlands and emergent marshes, seasonal wetlands and emergent marshes created by damming seasonal drainage courses, seasonal wetlands or marshes created by leakage from irrigation canals or ponds created by damming drainage courses. Likewise, this functional assessment methodology would not be appropriate for use with other types of wetlands not occurring within the UC Merced project area.

This functional assessment methodology was developed based on reference data collected within the UC Merced project area. Because of this, the disturbance index ratings and the CFCI formula are not directly applicable at regional scales or areas external the reference domain. This functional assessment methodology may be adaptable for use with the same regional subclasses elsewhere in the region but only after modifying the disturbance index ratings and CFCI formula to reflect the specific conditions present within the area being assessed. Such modifications would need to take into account the type and proximity of disturbances present within the assessment area and the projected severity of their effect on wetland function. For instance, plowing and disking disturbance was not evident within the UC Merced project area. In areas where wetlands have been plowed and/or disked at varying frequencies (e.g. only once, every year, intermittently over many years) it would be appropriate to assign different disturbance ratings to reflect their relative impact on wetland function.

Lastly, this functional assessment methodology is a relative assessment tool. It is not intended for use in absolute assessment of wetland impacts. It is also not intended for use in designing specific mitigation measures although it may be a valid tool for assessing the relative efficacy of mitigation measures.

CHAPTER 7 - REFERENCES

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APPENDIX A

GLOSSARY

Glossary

Aquatard: An impervious or nearly impervious layer in the soil that restricts the downward movement of water through the soil profile.

Assessment model: A simple model that defines the relationship between ecosystem and landscape scale variables and functional capacity of a wetland. The model is developed and calibrated using reference wetlands from a reference domain.

Assessment team: An interdisciplinary group of regional and local scientists responsible for classification of wetlands within a region, identification of reference wetlands, construction of assessment models, definition of reference standards, and calibration of assessment models.

Biotic: Of or pertaining to life; biological.

Combined Functional Capacity Index (FCI): An index of the capacity of an aggregate of wetlands to perform a suite of functions relative to other wetlands in a regional wetland subclass. Combined functional capacity indices are by definition scaled from 0.0 to 1.0. An index of 1.0 indicates the wetland is performing a suite of functions at the highest sustainable functional capacity, the level equivalent to a wetland under reference standard conditions in a reference domain. An index of 0.0 indicates the wetland does not perform the functions at a measurable level, and will not recover the capacity to perform these functions through natural processes.

Direct impacts: Project impacts that result from direct physical alteration of a wetland, such as the placement of dredge or fill.

Direct measure: A quantitative measure of an assessment model variable.

Exotics: See **Invasive Species.**

Facultative (FAC): Equally likely to occur in wetlands or non-wetlands (estimated probability 34-66 percent).

Facultative wetland (FACW): Usually occurs in wetlands (estimated probability 67-99 percent), but occasionally found in non-wetlands.

Functional assessment: The process by which the capacity of a wetland to perform a function is measured. This approach measures capacity using an assessment model to determine a functional capacity index.

Functional capacity: The rate or magnitude at which a wetland ecosystem performs a function or suite of functions. Functional capacity is dictated by characteristics of the wetland ecosystem and the surrounding landscape, and interaction between the two.

Functional Capacity Index (FCI): An index of the capacity of a wetland to perform a function relative to other wetlands in a regional wetland subclass. Functional

capacity indices are by definition scaled from 0.0 to 1.0. An index of 1.0 indicates the wetland is performing a function at the highest sustainable functional capacity, the level equivalent to a wetland under reference standard conditions in a reference domain. An index of 0.0 indicates the wetland does not perform the function at a measurable level, and will not recover the capacity to perform the function through natural processes.

Highest sustainable functional capacity: The level of functional capacity achieved across the suite of functions by a wetland under reference standard conditions in a reference domain. This approach assumes that the highest sustainable functional capacity is achieved when a wetland ecosystem and the surrounding area are undisturbed.

Hydrogeomorphic wetland class: The highest level in the hydrogeomorphic wetland classification. There are five basic hydrogeomorphic wetland classes: depression, riverine, slope, fringe, and flat.

Hydrogeomorphic unit: Hydrogeomorphic units are areas within a wetland assessment area that are relatively homogeneous with respect to ecosystem scale characteristics such as microtopography, soil type, vegetative communities, or other factors that influence function. Hydrogeomorphic units may be the result of natural or anthropogenic processes.

Hydroperiod: The annual duration of flooding (in days per year) at a specific point in a wetland.

Indicator: Indicators are observable characteristics that correspond to identifiable variable conditions in a wetland or the surrounding landscape.

Indirect measure: A qualitative measure of an assessment model variable that corresponds to an identifiable variable condition.

Indirect impacts: Impacts resulting from a project that occur concurrently or at some time in the future, away from the point of direct impact. For example, indirect impacts of a project on wildlife can result from an increase in the level of activity in adjacent, newly developed areas, even though the wetland is not physically altered by direct impacts.

Invasive species: Generally exotic species without natural controls that out-compete native species.

Jurisdictional wetland: Areas that meet the soil, vegetation, and hydrologic criteria described in the "Corps of Engineers Wetlands Delineation Manual" (Environmental Laboratory 1987),[1] or its successor.

Mitigation: Restoration or creation of a wetland to replace functional capacity that is lost as a result of project impacts.

Mitigation plan: A plan for replacing lost functional capacity resulting from project impacts.

Mitigation wetland: A restored or created wetland that serves to replace functional capacity lost as a result of project impacts.

Model variable: A characteristic of the wetland ecosystem or surrounding landscape that influences the capacity of a wetland ecosystem to perform a function.

Obligate wetland (OBL): Occurs almost always (estimated probability 99 percent) under natural conditions in wetlands.

Oligotrophic: Environments in which the concentration of nutrients available for growth is limited. Nutrient-poor habitats.

Oxidation: The loss of one or more electrons by an ion or molecule.

Project alternative(s): Different ways in which a given project can be done. Alternatives may vary in terms of project location, design, method of construction, amount of fill required, and other ways.

Project area: The area that encompasses all activities related to an ongoing or proposed project.

Red flag features: Features of a wetland or the surrounding landscape to which special recognition or protection is assigned on the basis of objective criteria. The recognition or protection may occur at a Federal, State, regional, or local level and may be official or unofficial.

Reference domain: All wetlands within a defined geographic area that belong to a single regional wetland subclass.

Reference standards: Conditions exhibited by a group of reference wetlands that correspond to the highest level of functioning (highest sustainable capacity) across the suite of functions of the regional wetland subclass. By definition, highest levels of functioning are assigned an index of 1.0.

Reference wetlands: Wetland sites that encompass the variability of a regional wetland subclass in a reference domain. Reference wetlands are used to establish the range of conditions for construction and calibration of functional indices and to establish reference standards.

Region: A geographic area that is relatively homogeneous with respect to largescale factors such as climate and geology that may influence how wetlands function.

Regional wetland subclass: Regional hydrogeomorphic wetland classes that can be identified based on landscape and ecosystem scale factors. There may be more than one regional wetland subclass for each of the hydrogeomorphic wetland classes that occur in a region, or there may be only one.

Soil surface: The soil surface is the top of the mineral soil; or, for soils with an O horizon, the soil surface is the top of the part of the O horizon that is at least slightly decomposed. Fresh leaf or needle fall that has not undergone observable

decomposition is excluded from soil and may be described separately (Carlisle and Collins 1995).

Variable: An attribute or characteristic of a wetland ecosystem or the surrounding landscape that influences the capacity of the wetland to perform a function.

Variable condition: The condition of a variable as determined through quantitative or qualitative measure.

Variable index: A measure of how an assessment model variable in a wetland compares to the reference standards of a regional wetland subclass in a reference domain.

Wetlands: "...areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (Corps Regulation 33 CFR 328.3 and EPA Regulations 40 CFR 230.3). In a more general sense, wetland ecosystems are three-dimensional segments of the natural world where the presence of water at or near the surface creates conditions leading to the development of redoximorphic soil conditions, and the presence of a flora and fauna adapted to the permanently or periodically flooded or saturated conditions.

Wetland functions: The normal activities or actions that occur in wetland ecosystems, or simply, the things that wetlands do. Wetland functions result directly from the characteristics of a wetland ecosystem and the surrounding landscape, and their interaction.

Wetland restoration: The process of restoring wetland function in a degraded wetland. Restoration is typically done as mitigation.

APPENDIX B

FIELD DATA FORM

UC MERCED
HGM FUNCTIONAL ASSESSMENT
FIELD DATA FORM (Sheet 1)

Wetland No: BPJ Rating: Photo No: Date:
Investigators (s):

V_{IN} - Is a topographically distinct inlet present? (Yes or No)

V_{OUT} - Is a topographically distinct outlet present? (Yes or No)

V_{SED} - Estimated cover of recently deposited sediment in the wetland (%, in increments of 10):

$V_{\%OM}$ - Estimated cover by algal matting in the wetland (%, in increments of 10):

$V_{\%COV}$ - Estimated cover by vascular plants in the wetland (%, in increments of 10):

$V_{\%COB}$ - What is the estimated cover by cobbles in the wetland (%, in increments of 10):

V_{VWPI} & V_{NPI} - List all plants with an estimated cover of 10 % or more:

V_{DW}- Depth of Wetland (Depression subclass only, in tenths of a foot):

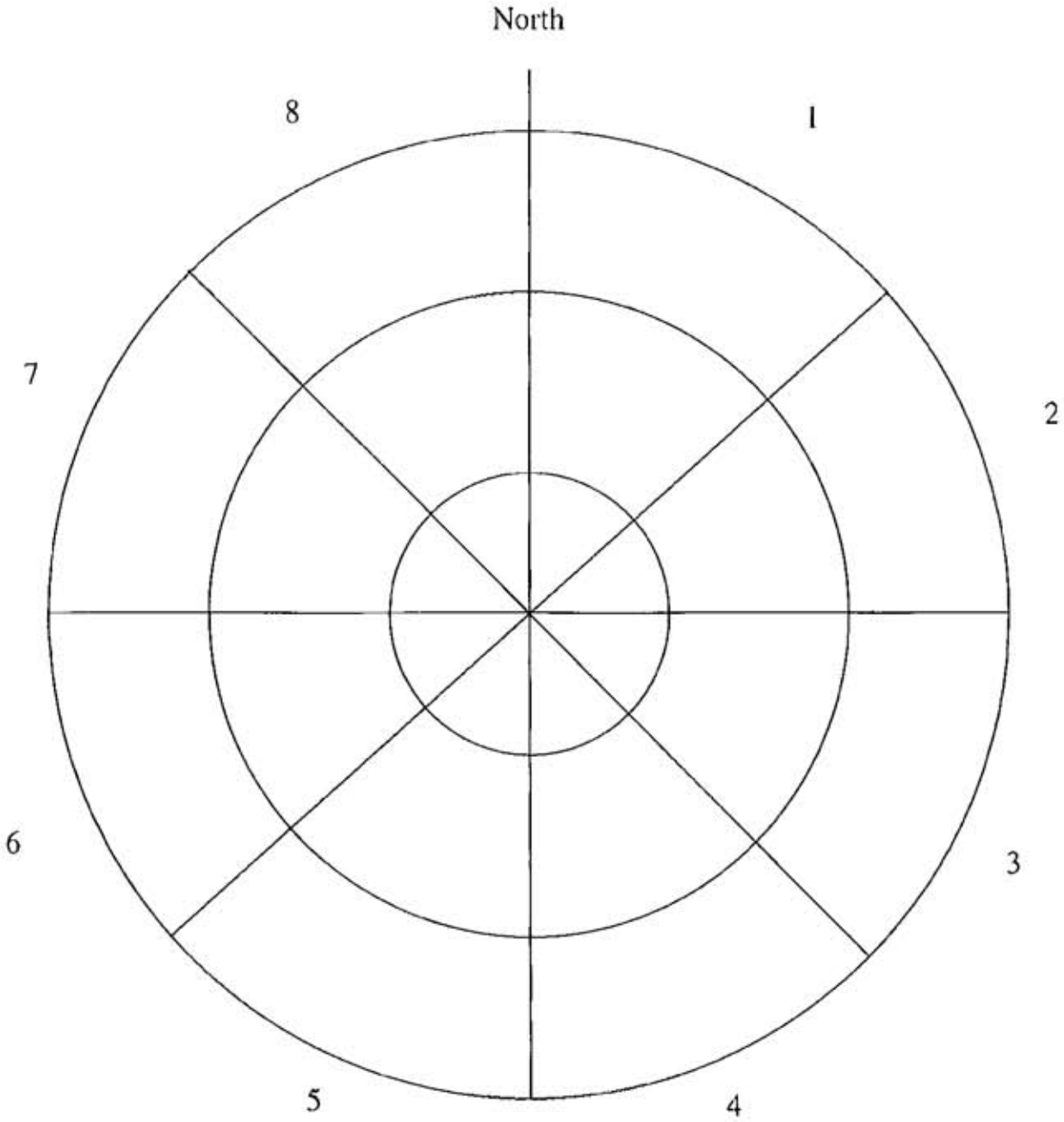
V_{SLOPE}- Slope (Slope subclass only, %):

V_{WDQ}-

- No. of sectors where some disturbance is observed (0 – 8):
- Disturbance index rating for the most severe type of disturbance within the wetland:
- Disturbance index rating for the most severe type of disturbance within the immediate basin of the wetland:
- Distance from the edge of the wetland to the nearest most severe disturbance:
- Disturbance index rating for the most severe type of disturbance within the contributing watershed within 100 meters of the edge of the wetland:

Comments:

DISTURBANCE GRID



Comments:

UC MERCED
HGM FUNCTIONAL ASSESSMENT
FIELD DATA FORM (Sheet 1)

Wetland No: BPJ Rating:*Avg of Investigators* Photo No:*Roll#-Exp#* Date:
Investigators (s):*Initials*

V_{IN} - Is a topographically distinct inlet present? (Yes or No): ***We are looking for a distinct topographic feature such as a swale that appears to transport surface flow (not sheet flow) during periods of precipitation.***

V_{OUT} - Is a topographically distinct outlet present? (Yes or No): ***We are looking for a distinct topographic feature such as a swale that appears to transport surface flow (not sheet flow) during periods of precipitation.***

V_{SED} - Estimated cover of recently deposited sediment in the wetland (%, in increments of 10): ***If it is not obvious, do not count it. Use the % cover template.***

$V_{\%OM}$ - Estimated cover by algal matting in the wetland (%, in increments of 10): ***We are looking for clear deposits of algae. If it is not obvious, do not count it. Use the % cover template.***

$V_{\%COV}$ - Estimated cover by vascular plants in the wetland (%, in increments of 10): ***Use the % cover template.***

$V_{\%COB}$ - What is the estimated cover by cobbles in the wetland (%, in increments of 10): ***Use the % cover template.***

V_{VWPI} & V_{NPI} - List all plants with an estimated cover of 10 % or more: ***Use the % cover template.***

V_{DW}- Depth of Wetland (Depression subclass only, in tenths of a foot): ***Stretch tape from edge to edge across the deepest point. Measure depth at deepest point and both midpoints and divide by three to obtain average.***

V_{SLOPE}- Slope (Slope subclass only, %): ***Δ elev.(ft) /distance(ft.).***

V_{WDQ}-

- No. of sectors where some disturbance is observed (0 – 8): ***Only contributing watershed.***
- Disturbance index rating for the most severe type of disturbance within the wetland: ***From table.***
- Disturbance index rating for the most severe type of disturbance within the immediate basin of the wetland: ***From table.***
- Distance from the edge of the wetland to the nearest most severe disturbance: ***Meters.***

- Disturbance index rating for the most severe type of disturbance within the contributing watershed within 100 meters of the edge of the wetland: *Meters*

Comments:

Any observations/clarifications that appear pertinent. These will not be electronically entered in the field.

APPENDIX C

MASTER PLANT LIST

MASTER PLANT LIST FOR UC MERCED FUNCTIONAL ASSESSMENT

Scientific Name	Abbreviation	Native?	VP Endemic?	Indicator Status
Achyrachaena mollis	Ach mol	Y	N	FAC
Agrostis hendersonii	Agr hen	Y	Y	FACW
Alopecurus howellii	Alo how	Y	Y	FACW+
Avena fatua	Ave fat	N	N	UPL
Bergia texana	Ber tex	Y	Y	OBL
Blennosperma nanum var. nanum	Ble nan nan	Y	Y	OBL
Boisduvalia cleistogamum	Boi cle	Y	Y	OBL
Briza minor	Bri min	N	N	FACW
Brodiaea minor	Bro min	Y	N	UPL
Bromus mollis	Bro mol	N	N	FACU-
Callitriche heterophylla	Cal het	Y	Y	OBL
Callitriche marginata	Cal mar	Y	Y	OBL
Castilleja campestris ssp. campestris	Cas cam cam	Y	Y	OBL
Castilleja campestris ssp. succulenta	Cas cam suc	Y	Y	OBL
Centunculus minimus	Cen min	Y	Y	FACW
Cerastium viscosum	Cer vis	N	N	UPL
Chamaesyce hooveri	Cha hoo	Y	Y	NI
Cicendia quadrangularis	Cic qua	Y	N	UPL
Convolvulus arvensis	Con arv	N	N	UPL
Cotula coronopifolia	Cot con	N	N	OBL
Crassula aquatica	Cra aqu	Y	Y	OBL
Cuscuta howelliana	Cus how	Y	Y	NI
Cynodon dactylon	Cyn dac	N	N	FAC
Cyperus eragrostis	Cyp era	Y	N	FACW
Damasonium californicum	Dam cal	Y	Y	OBL
Deschampsia danthonioides	Des dan	Y	Y	FACW
Downingia bella	Dow bel	Y	Y	OBL
Downingia bicornuta	Dow bic	Y	Y	OBL
Downingia concolor var. concolor	Dow con con	Y	Y	OBL
Downingia cuspidata	Dow cus	Y	Y	OBL
Downingia insignis	Dow ins	Y	Y	OBL
Downingia ornatissima	Dow orn	Y	Y	OBL
Downingia pulchella	Dow pul	Y	Y	OBL
Downingia pusilla	Dow pus	Y	Y	OBL
Eleocharis acicularis	Ele aci	Y	Y	OBL
Eleocharis macrostachya	Ele mac	Y	Y	OBL
Eleocharis montevidensis	Ele mon	Y	N	OBL
Epilobium ciliatum	Epi cil	Y	N	FACW
Eremocarpus setigerus	Ere set	Y	N	UPL
Erodium botrys	Ero bot	N	N	UPL
Erodium cicutarium	Ero cic	N	N	UPL
Eryngium castrense	Ery cas	Y	Y	FACW
Eryngium spinosepalum	Ery spi	Y	Y	NI
Eryngium vaseyi	Ery vas	Y	Y	FACW
Festuca arundinacea	Fes aru	N	N	FAC
Geranium dissectum	Ger dis	N	N	UPL

Scientific Name	Abbreviation	Native?	VP Endemic?	Indicator Status
Glyceria sp.	Gly sp	N	N	OBL
Gratiola ebracteata	Gra ebr	Y	Y	OBL
Hedypnois cretica	Hed cre	N	N	NI
Hemizonia pungens	Hem pun	Y	N	FAC
Hesperevax caulescens	Hes cau	Y	Y	NI
Holocarpha virgata	Hol vir	N	N	NI
Hordeum hystrix	Hor hys	N	N	FAC
Hypochaeris glabra	Hyp gla	N	N	NI
Isoetes howellii	Iso how	Y	Y	OBL
Isoetes nuttallii	Iso nut	Y	N	NI
Isoetes orcuttii	Iso orc	Y	Y	OBL
Juncus balticus	Jun bal	Y	N	OBL
Juncus bufonius	Jun buf	Y	N	FACW+
Juncus capitatus	Jun cap	N	N	FACU
Juncus effusus	Jun eff	Y	N	OBL
Juncus leiospermus var leiospermus	Jun lei lei	Y	Y	NI
Juncus leiospermus var. ahartii	Jun lei aha	Y	Y	NI
Juncus uncialis	Jun unc	Y	Y	OBL
Lactuca serriola	Lac ser	N	N	FAC
Lasthenia californica	Las cal	Y	N	UPL
Lasthenia chrysantha	Las chr	Y	Y	FACU
Lasthenia ferisiae	Las fer	Y	Y	NI
Lasthenia fremontii	Las fre	Y	Y	OBL
Lasthenia glaberrima	Las gla	Y	Y	OBL
Lasthenia glabrata	Las gla	Y	Y	FACW
Layia fremontii	Lay fre	Y	Y	NI
Leersia oryzoides	Lee ory	Y	N	OBL
Legenere limosa	Leg lim	Y	Y	OBL
Leontodon leysseri	Leo ley	N	N	FACU
Lepidium dictyotum	Lep dic	Y	N	UPL
Lepidium latipes var. latipes	Lep lat lat	Y	Y	OBL
Lepidium nitidum	Lep nit	Y	N	UPL
Lilaea scilloides	Lil sci	Y	Y	OBL
Limnanthes alba	Lim alb	Y	Y	OBL
Limnanthes douglasii var nivea	Lim dou niv	Y	Y	OBL
Limnanthes douglasii var. rosea	Lim dou ros	Y	Y	OBL
Limnanthes floccosa	Lim flo	Y	Y	OBL
Limnanthes floccosa ssp. floccosa	Lim flo flo	Y	Y	OBL
Lolium perenne	Lol per	N	N	FAC
Ludwigia peploides	Lud pep	Y	N	OBL
Lupinus bicolor	Lup bic	Y	N	UPL
Lythrum hyssopifolia	Lyt hys	N	N	FACW
Marsellia oligospora	Mar oli	Y	Y	FAC
Marsellia vestita	Mar ves	Y	Y	OBL
Medicago polymorpha	Med pol	N	N	UPL
Mimulus guttatus	Mim gut	Y	N	OBL
Mimulus tricolor	Mim tri	Y	Y	OBL
Montia fontana	Mon fon	Y	Y	OBL
Muilla maritima	Mui mar	Y	N	UPL
Myosurus minimus	Myo min	Y	Y	OBL

Scientific Name	Abbreviation	Native?	VP Endemic?	Indicator Status
Myosurus sessilis	Myo ses	Y	Y	NI
Navarretia intertexta ssp. intertexta	Nav int int	Y	Y	OBL
Navarretia leucocephala	Nav leu	Y	Y	OBL
Navarretia myersii	Nav mye	Y	Y	NI
Navarretia prostrata	Nav pro	Y	Y	OBL
Navarretia tagetina	Nav tag	Y	Y	NI
Neostapfia colusana	Neo col	Y	Y	OBL
Orcuttia inaequalis	Orc ina	Y	Y	NI
Orcuttia pilosa	Orc pil	Y	Y	NI
Orthocarpus erianthus	Ort eri	Y	N	UPL
Paspalum dilatatum	Pas dil	N	N	FAC
Phalaris lemmonii	Pha lem	Y	N	FACW-
Pilularia americana	Pil ame	Y	Y	OBL
Plagiobothrys acanthocarpus	Pla aca	Y	Y	OBL
Plagiobothrys austinae	Pla aus	Y	Y	NI
Plagiobothrys bracteatus	Pla bra	Y	Y	OBL
Plagiobothrys greenei	Pla gre	Y	N	FACW
Plagiobothrys humistratus	Pla hum	Y	Y	OBL
Plagiobothrys leptocladus	Pla lep	Y	Y	OBL
Plagiobothrys stipitatus var. micranthus	Pla sti mic	Y	Y	OBL
Plagiobothrys stipitatus var. stipatatus	Pla sti sti	Y	Y	OBL
Plagiobothrys trachycarpus	Pla tra	Y	Y	FACW
Plantago bigelovii	Pla big	Y	N	OBL
Plantago elongata	Pla elo	Y	Y	FACW
Poa annua	Poa ann	N	N	FACW-
Pogogyne zizyphoroides	Pog ziz	Y	Y	OBL
Polygonum aviculare	Pol avi	N	N	FAC
Polygonum sp.	Pol sp		N	NI
Polypogon monspeliensis	Pol mon	N	N	FACW+
Psilocarphus brevissimus	Psi bre	Y	Y	OBL
Psilocarphus oregonus	Psi ore	Y	Y	OBL
Psilocarphus tenellus var. tenuis	Psi ten ten	Y	Y	FAC
Ranunculus alveolatus	Ran alv	Y	Y	OBL
Ranunculus aquatilis	Ran aqu	Y	N	OBL
Ranunculus muricatus	Ran mur	N	N	FACW+
Rumex crispus	Rum cri	N	N	FACW
Sagina decumbens ssp. occidentalis	Sag dec occ	Y	Y	FAC
Scirpus acutus	Sci acu	Y	N	OBL
Sibara virginica	Sib vir	Y	Y	NI
Sidalcea calycosa	Sid cal	Y	Y	OBL
Sidalcea hirsuta	Sid hir	Y	Y	OBL
Soliva sessilis	Sol ses	N	N	UPL
Sonchus oleraceus	Son ole	N	N	NI
Trichostema lanceolatum	Tri lan	Y	N	UPL
Trifolium depauperatum	Tri dep	Y	N	FAC-
Trifolium sp.	Tri sp	N	N	UPL
Trifolium variegatum	Tri var	Y	N	FACW-
Triteleia hyacinthina	Tri hya	Y	Y	FACW
Tuctoria greenei	Tuc gre	Y	Y	OBL
Tuctoria mucronata	Tuc muc	Y	Y	NI

Scientific Name	Abbreviation	Native?	VP Endemic?	Indicator Status
Typha angustifolia	Typ ang	Y	N	OBL
Typha latifolia	Typ lat	Y	N	OBL
Veronica peregrina	Ver per	Y	N	OBL
Vulpia bromoides	Vul bro	N	N	FACW
Vulpia bromoides	Vul bro	N	N	FACW
Vulpia myouros	Vul myo	N	N	FACU

APPENDIX D

FIELD DATA SPREADSHEETS

UC MERCED
COMPILED VERNAL POOL FIELD DATA

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vvwpi	Vdw	#Vpe	#NonVpe	Total Dom
3VPRbA13	0.65	Y	Y	0	0	70	20	0.75	0.2	4	2	6
3VPRbA10	0.75	Y	Y	0	0	80	10	0.75	0.3	4	2	6
3VPRbA12	0.8	Y	Y	0	0	80	20	0.63	0.2	2	2	4
3VPReB2	0.7	Y	Y	0	0	70	20	0.75	0.3	4	2	6
3VPReB13	0.8	Y	N	0	0	70	20	0.85	0.3	4	1	5
3VPCgB5	0.5	N	Y	0	50	80	20	0.50	0.3	1	2	3
3VPCkB5	0.8	Y	N	0	0	60	40	0.81	0.5	3	1	4
3VPReB3	0.7	N	N	0	0	70	20	0.79	0.3	5	2	7
3VPCkB8	0.7	N	N	0	0	90	10	0.55	0.2	2	3	5
3VPBcA7	0.8	Y	Y	0	0	90	0	0.72	0.3	5	3	8
3VPBcA4	0.8	Y	Y	0	0	90	0	0.68	0.2	4	3	7
3VPBcA5	0.8	Y	Y	0	0	90	0	0.50	0.2	2	4	6
3VPReB6	0.5	Y	Y	0	0	90	10	0.50	0.4	1	2	3
3VPReB12	0.4	N	N	0	0	70	20	0.44	0.3	1	3	4
3VPReB14	0.5	Y	Y	0	0	100	0	0.63	0.3	3	3	6
3VPReB15	0.4	N	N	0	0	100	0	0.75	0.5	2	1	3
3VP2HB10	0.4	N	N	0	0	90	10	0.25	0.2	0	3	3
3VPReB10	0.8	N	Y	0	30	20	80	1.00	0.4	2	0	2
3VP2HB18	0.6	N	N	0	0	80	10	0.63	0.2	2	2	4
3VP2HB4	0.8	Y	N	0	0	50	30	1.00	0.3	4	0	4
3VPCkB4	0.7	Y	N	0	0	40	60	0.63	0.3	2	2	4
3VPCkB7	0.3	N	N	0	20	70	30	0.50	0.2	1	2	3
3VP2HB17	1	N	N	0	0	70	20	1.00	0.4	5	0	5
3VP2HB16	0.9	N	N	0	0	70	20	0.63	0.2	3	3	6
3VP2HB3	0.8	N	N	0	0	60	30	0.79	0.3	5	2	7
3VP2HB8	0.7	N	N	0	0	60	30	0.75	0.2	4	2	6
3VP2HB2	0.6	N	N	0	0	90	10	0.55	0.2	2	3	5
3VPRbA15	0.5	N	N	0	0	60	40	0.63	0.1	2	2	4
3VPCgD2	0.7	N	N	0	0	90	10	0.85	0.4	4	1	5
3VPCgD1	0.6	N	N	0	0	80	20	0.63	0.3	3	3	6
3VP2HB11	0.8	Y	Y	0	0	90	10	0.67	0.3	5	4	9
3VP2HB7	0.9	Y	Y	0	0	80	20	0.72	0.5	5	3	8
3VP2HB12	0.8	Y	Y	0	0	60	30	0.72	0.4	5	3	8

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vvwpi	Vdw	#Vpe	#NonVpe	Total Dom
3VPCgD4	0.7	Y	N	0	30	80	10	0.75	0.4	4	2	6
3VPReB11	0.6	N	Y	0	0	90	0	0.40	0.2	1	4	5
3VPCgB11	0.7	N	Y	0	10	90	0	0.63	0.3	3	3	6
3VPBcA1	0.8	Y	N	0	0	90	0	0.88	0.3	5	1	6
1VPRbA1	0.6	N	N	0	0	90	10	0.50	0.1	1	2	3
1VPRbA2	0.6	N	N	0	0	70	10	0.50	0.2	1	2	3
3VPRbA9	0.4	N	N	0	0	50	10	0.50	0.1	1	2	3
1VPCgB4	0.8	N	N	0	100	70	0	1.00	0.4	4	0	4
1VPRbA3	0.8	N	N	0	0	60	30	0.81	0.2	3	1	4
1VPCgB10	0.5	N	N	0	60	90	0	0.50	0.3	1	2	3
1VPCgB12	1	N	N	0	100	100	0	0.75	0.4	4	2	6
1VPCgB3	0.4	N	N	0	0	100	0	0.40	1.2	1	4	5
1VPCgB8	0.3	N	N	0	0	100	0	0.44	0.4	1	3	4
2VPMRa1	0.1	N	N	0	0	100	0	0.25	0.2	0	3	3
2VPMRa2	0.1	N	N	0	0	100	0	0.25	0.2	0	3	3
1VPCgB1	0.1	N	N	0	0	100	0	0.25	0.2	0	2	2
1VPCgB7	0.2	N	N	0	70	100	0	0.63	0.2	1	1	2
1VPCgB9	0.3	N	N	0	100	90	0	0.50	0.5	1	2	3
3VPRbA7	0.2	N	N	0	0	40	20	0.50	0.1	1	2	3
3VPReB1	0.8	N	N	0	0	100	0	0.81	0.2	3	1	4
1VPCkB1	0.5	N	N	0	0	90	10	0.63	0.3	2	2	4
3VPCkB10	0.8	Y	Y	0	0	50	50	0.85	0.4	4	1	5
3VPCkB14	0.6	Y	Y	0	0	20	30	1.00	0.7	4	0	4
3VPCkB11	0.5	N	N	0	0	80	10	0.63	0.3	2	2	4
3VPCkB12	0.7	Y	Y	0	0	50	40	0.85	0.4	4	1	5
3VPMRc1	0.6	N	N	0	0	90	0	0.55	0.3	2	3	5
3VPPoB5	0.5	N	N	0	0	90	0	0.50	0.3	1	2	3
1VP3HA1	0.3	N	N	0	0	100	0	0.25	0.2	0	3	3
1VPCgB13	0.7	Y	Y	0	80	90	10	0.63	0.3	1	1	2
1VPCgB6	0.3	N	N	0	0	100	0	0.25	0.1	0	3	3
2VPRgB1	0.5	N	N	0	0	90	0	0.25	0.3	0	1	1
2VPCgB4	0.4	N	N	0	30	90	0	0.44	0.7	1	3	4
1VPCgB5	0.4	N	N	0	0	100	0	0.25	0.2	0	2	2
2VPAcA3	0.7	N	N	0	0	100	0	0.63	0.2	2	2	4
2VPAcA4	0.6	N	N	0	50	90	0	0.70	0.2	3	2	5
2VPAcA11	0.7	N	Y	0	60	90	0	0.70	0.3	3	2	5

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vvwpi	Vdw	#Vpe	#NonVpe	Total Dom
2VPSbA10	0.6	N	N	0	0	100	0	0.81	0.3	3	1	4
2VPSbA8	0.5	N	N	0	0	90	0	0.63	0.2	2	2	4
2VPAcA12	0.4	N	N	0	0	100	0	0.25	0.3	0	2	2
2VPAcA14	0.2	N	N	0	10	100	0	0.63	0.1	3	3	6
2VPSbA11	0.5	N	N	0	0	90	0	0.44	0.1	1	3	4
2VPSbA5	0.4	N	N	0	20	100	0	0.50	0.2	1	2	3
2VPRgB4	0.8	N	N	0	0	80	0	0.63	0.7	3	3	6
2VPRgB5	0.7	N	N	0	0	90	0	0.63	0.2	2	2	4
2VPRgB2	0.6	N	N	0	0	90	0	0.63	0.4	2	2	4
2VPAcA8	0.6	N	N	0	0	90	0	0.50	0.3	1	2	3
1VPCgB11	0.3	N	N	0	0	100	0	0.50	0.5	1	2	3
1VPAcA6	0.6	N	N	0	0	100	0	0.63	0.2	2	2	4
2VPAcA5	0.1	N	N	0	0	100	0	0.25	0.2	0	3	3
2VPAcA1	0.3	N	N	0	0	90	0	0.63	0.4	2	2	4
2VPRgB3	0.7	N	N	0	10	90	0	0.70	0.5	3	2	5
2VPCgB12	0.6	N	N	0	0	100	0	0.25	0.4	0	3	3
2VPCgB16	0.7	Y	Y	0	0	100	0	0.70	0.4	3	2	5
2VPHtA2	0.3	N	N	0	0	100	0	0.50	0.2	1	2	3
2VPSbA13	0.3	N	N	0	0	100	0	0.50	0.2	1	2	3
2VPSbA14	0.3	Y	Y	0	0	100	0	0.44	0.7	1	3	4
2VPSbA2	0.2	N	N	0	0	90	0	0.25	0.2	0	2	2
2VPSbA4	0.3	N	N	0	0	100	0	0.50	0.2	1	2	3
3VPCgB6	0.6	Y	Y	0	10	70	0	0.81	0.3	3	1	4
3VPCgB1	0.7	N	N	0	0	90	0	0.68	0.3	4	3	7
3VPCgB14	0.9	Y	N	0	0	80	10	0.88	0.3	5	1	6
3VPBcA2	0.5	N	N	0	0	100	0	0.44	0.5	1	3	4
3VPBcA3	0.5	N	N	0	0	100	0	0.44	0.4	1	3	4
3VPCgB3	0.7	Y	Y	0	0	90	0	0.70	0.4	3	2	5
3VPRbA1	0.9	N	N	0	0	90	0	0.63	0.3	3	3	6
3VPRbA180	0.9	Y	Y	0	0	70	10	0.89	0.5	6	1	7
3VPRbA2	0.5	N	N	0	0	80	0	0.70	0.2	3	2	5
3VPRbA5	0.7	N	Y	0	10	60	30	0.79	0.5	5	2	7
3VPRbA4	0.8	N	N	0	0	90	0	0.79	0.3	5	2	7
3VPRbA11	0.9	N	N	0	0	80	0	0.88	0.4	5	1	6
3VPRbA14	0.9	N	Y	0	0	70	20	0.85	0.4	4	1	5
2VPRgA5	0.7	N	N	0	0	80	10	0.88	0.4	5	1	6

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vvwpi	Vdw	#Vpe	#NonVpe	Total Dom
2VPRgA2	0.4	N	N	0	0	100	0	0.75	0.3	2	1	3
2VPReB1	0.8	N	N	0	40	90	0	0.81	0.3	3	1	4
2VPReB6	0.8	N	N	0	20	70	0	0.81	0.4	3	1	4
2VPReB10	0.7	N	N	0	50	90	0	0.81	0.3	3	1	4
2VPReB7	0.5	N	N	0	0	100	0	0.63	0.2	2	2	4
2VPCkB4	0.4	N	N	0	0	100	0	0.50	0.4	1	2	3
2VPReB5	0.5	N	N	0	50	90	0	0.75	0.4	2	1	3
2VPReB4	0.4	N	N	0	0	100	0	0.50	0.2	1	2	3
2VPCgB1	0.5	N	N	0	0	100	0	0.63	0.4	2	2	4
2VPCgB9	0.3	N	N	0	40	100	0	0.25	0.1	0	2	2
2VPCgB11	0.9	N	N	0	0	100	0	0.79	0.8	5	2	7
2VPCgB3	0.3	N	N	0	0	100	0	0.25	0.2	0	2	2
2VPCgB2	0.5	N	N	0	0	90	0	0.81	0.4	3	1	4
2VPCgB10	0.3	N	N	0	0	100	0	0.50	0.4	1	2	3
2VPReB9	0.8	N	N	0	0	90	10	0.75	0.3	4	2	6
2VPReB12	0.5	N	N	0	0	100	0	0.63	0.3	2	2	4
2VPReB13	0.6	N	N	0	0	90	0	0.81	0.5	3	1	4
2VPCkB1	0.4	Y	Y	0	0	100	0	0.25	0.1	0	3	3
2VPReB8	0.6	N	N	0	0	90	0	0.70	0.3	3	2	5
2VPWhB2	0.6	N	N	0	10	90	0	0.50	0.3	1	2	3
2VPWhB1	0.3	N	N	0	0	100	0	0.25	0.4	0	5	5
2VPReB11	0.8	N	N	0	0	80	10	0.75	0.7	4	2	6
2VPCgB8	0.6	Y	Y	0	0	90	0	0.63	0.5	3	3	6
2VPCgB13	0.1	Y	Y	0	0	90	0	0.25	0.2	0	2	2
2VPCgB6	0.6	N	N	0	0	90	0	0.55	0.4	2	3	5
2VPAcA13	0.2	N	N	0	0	100	0	0.40	0.1	1	4	5
2VPAcA9	0.1	N	N	0	0	100	0	0.25	0.4	0	2	2
2VPAcA7	0.6	N	N	0	0	100	0	0.63	0.4	2	2	4
2VPCkB2	0.1	N	N	0	0	100	0	0.25	0.6	0	5	5
3VPRbA8	0.3	N	N	0	0	90	0	0.63	0.2	2	2	4
3VPRgA11	0.2	N	N	0	0	90	10	0.50	0.1	1	2	3
3VPCgB7	0.6	N	N	0	10	70	30	0.63	0.3	3	3	6
3VPCgB2	0.2	N	N	0	0	80	20	0.38	0.2	1	5	6
3VPCgB8	0.8	Y	Y	0	0	90	0	0.85	0.6	4	1	5
3VPReB60	0.9	N	N	0	0	70	10	0.70	1.3	3	2	5
3VPPoB6	0.2	N	Y	0	0	100	0	0.25	0.2	0	5	5

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vvwpi	Vdw	#Vpe	#NonVpe	Total Dom
3VPPoB3	0.3	N	N	0	0	100	0	0.81	0.2	3	1	4
3VPPoB2	0.8	N	N	0	60	80	10	0.88	0.3	5	1	6
3VPPoB1	0.7	N	N	0	60	100	0	0.79	0.3	5	2	7
3VPRbA16	0.9	N	N	0	0	90	0	0.81	0.3	3	1	4
3VPPoB4	0.8	N	N	0	0	80	0	0.75	0.4	4	2	6
3VPPoB7	0.5	N	N	0	0	80	0	0.25	0.3	0	4	4
3VPRbA6	0.6	N	N	0	20	70	20	0.70	0.4	3	2	5
3VPCgB4	0.6	Y	N	0	0	60	60	0.63	0.3	1	1	2
3VPRgA7	0.4	N	Y	0	0	100	0	0.57	0.2	3	4	7
3VPRgA13	0.4	Y	N	0	0	100	0	0.75	0.1	4	2	6
3VPRgA8	0.7	N	N	0	60	100	10	0.81	0.3	3	1	4
3VPRgA14	0.4	N	N	0	30	50	0	0.50	0.6	1	2	3
3VPRgA4	0.2	N	N	0	0	80	0	0.40	0.3	1	4	5
3VPRgA3	0.7	N	N	0	0	80	0	0.81	0.4	3	1	4
3VPRgA9	0.7	N	N	0	0	80	10	0.75	0.3	4	2	6
3VPRgA6	0.3	N	N	0	0	100	0	0.50	0.1	1	2	3
2VPRgA7	0.3	N	N	0	0	30	0	0.63	0.5	1	1	2
3VPRgA5	0.5	N	N	0	0	60	0	0.63	0.5	2	2	4
3VPRgA12	0.4	N	N	0	0	90	0	0.63	0.1	2	2	4
3VPReB9	0.9	Y	Y	0	0	80	20	0.85	0.4	4	1	5
3VPReB5	0.6	N	N	0	0	80	10	0.63	0.2	2	2	4
3VPReB4	0.3	N	N	0	0	50	50	0.44	0.4	1	3	4
3VPReB8	0.9	N	N	0	0	70	30	0.70	0.7	3	2	5
3VPReB7	0.4	N	N	0	0	70	40	0.75	0.4	2	1	3
3VPCkB2	0.6	Y	Y	0	0	80	30	0.70	0.2	3	2	5
3VPCgB10	0.6	N	N	0	0	100	0	0.75	0.3	4	2	6
3VPPkD3	0.2	N	N	0	0	90	10	0.44	0.1	1	3	4
3VP3HA12	0.5	N	N	0	0	80	20	0.44	0.3	1	3	4
3VP3HA13	0.3	N	N	0	0	90	10	0.50	0.1	1	2	3
3VP3HA15	0.6	N	N	0	0	60	30	0.75	0.2	4	2	6
3VP3HA14	0.5	N	N	0	0	80	20	0.44	0.3	1	3	4
3VP3HA6	0.5	Y	N	0	0	70	30	0.44	0.3	1	3	4
3VP3HA2	0.5	N	N	0	0	90	10	0.70	0.2	3	2	5
3VP3HA7	0.5	N	N	0	0	80	10	0.55	0.2	2	3	5
3VP3HA8	0.6	N	N	0	0	70	20	0.63	0.2	2	2	4
3VP3HA10	0.6	N	N	0	0	70	20	0.81	0.3	3	1	4

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vvwpi	Vdw	#Vpe	#NonVpe	Total Dom
3VP3HA5	0.6	N	Y	0	0	80	10	0.57	0.2	3	4	7
3VP3HA4	0.5	Y	Y	0	0	70	20	0.55	0.2	2	3	5
3VP3HA1	0.5	N	Y	0	0	80	10	0.38	0.2	1	5	6
3VPCgB9	0.9	N	N	0	0	70	10	0.89	0.4	6	1	7

UC MERCED
COMPILED SWALE FIELD DATA

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vnpi	Vslope	#Nat	#NonNat	Total Doms	Vertical	Horizontal
3SWCkB4g	0.8	Y	Y	0	0	60	30	0.67	0.5%	4	2	6	0.7	141
3SW2HB8g	0.6	Y	Y	0	0	90	10	0.25	1.7%	1	3	4	0.9	54
3SW2HB3g	0.9	Y	Y	0	0	60	30	0.75	0.5%	3	1	4	0.2	39
3SWRbA6g	0.6	Y	Y	0	0	70	0	0.50	2.7%	2	2	4	0.3	11
3SWRbA8g	0.8	Y	Y	0	0	70	10	0.67	1.1%	4	2	6	0.9	81
3SWReB3g	0.9	Y	Y	0	0	80	20	0.40	0.6%	2	3	5	0.6	96
3SWCkB15g	0.6	Y	Y	0	0	70	30	0.50	1.0%	3	3	6	0.6	60
3SWCkB9g	0.6	Y	Y	0	0	80	20	0.40	1.7%	2	3	5	1.3	78
3SWCkB13g	0.8	N	Y	0	0	40	50	0.80	1.0%	4	1	5	0.9	90
3SW2HB1g	0.8	Y	Y	0	0	80	20	0.50	2.1%	3	3	6	1.5	72
3SW2HB12g	0.8	Y	Y	0	0	70	30	0.43	1.6%	3	4	7	1.6	102
3SWRbA15g	0.8	Y	Y	0	0	80	0	0.50	1.1%	2	2	4	0.8	72
3SWCkB10g	0.2	Y	Y	30	10	50	10	0.40	0.6%	2	3	5	0.4	66
3SWCkB11g	0.2	Y	Y	0	0	10	90	0.00	0.4%	0	3	3	0.2	51
3SWCgD3g	0.6	Y	Y	0	0	70	30	0.25	2.9%	1	3	4	1.8	63
3SWCkB1g	0.8	Y	Y	0	0	90	10	0.57	0.4%	4	3	7	0.2	54
3SWCkB17g	0.6	Y	Y	0	0	90	10	0.60	0.3%	3	2	5	0.2	60
3SWRbA16g	1	Y	Y	0	0	60	20	0.67	0.5%	2	1	3	0.5	111
3SW2HB11g	0.5	Y	Y	0	0	80	10	0.20	0.6%	1	4	5	0.3	48
3SW2HB10g	0.6	Y	Y	0	0	70	20	0.25	0.7%	1	3	4	0.5	72
3SW2HB4g	0.6	Y	Y	0	0	70	30	0.20	2.1%	1	4	5	1.8	87
3SWCkB2g	0.8	Y	Y	0	0	90	10	0.67	1.4%	2	1	3	2.1	150
1SWCkB18g	0.7	Y	Y	0	0	100	0	0.67	0.6%	2	1	3	0.7	114
3SWCkB5g	0.8	Y	Y	0	0	100	0	0.33	0.3%	1	2	3	0.2	78
2SWReB16g	0.2	Y	N	0	0	60	0	0.60	0.5%	3	2	5	0.68	138
1SWCgB3g	0.3	Y	Y	0	0	100	0	0.00	0.6%	0	2	2	0.3	54
1SWCgB2g	0.3	Y	Y	0	0	100	0	0.33	0.1%	1	2	3	0.1	69
3SWReB2g	0.7	Y	Y	0	0	50	0	0.50	0.4%	3	3	6	0.3	78
3SWCkB7g	0.8	Y	Y	0	0	50	30	0.60	0.1%	3	2	5	0.1	72
3SWCkB12g	0.5	Y	Y	0	0	60	30	0.40	0.4%	2	3	5	0.3	78
3SWCkB9g	0.6	N	Y	0	0	80	20	0.80	2.4%	4	1	5	1.3	54
3SWPkD5g	0.6	Y	Y	0	0	90	10	0.60	0.1%	3	2	5	0.1	114
3SWPkD4g	0.5	Y	Y	0	0	60	20	0.50	0.4%	2	2	4	0.2	48

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vnpi	Vslope	#Nat	#NonNat	Total Doms	Vertical	Horizontal
3SWCkB3g	0.6	Y	Y	0	0	80	20	0.50	0.4%	2	2	4	0.2	54
3SWCkB16g	0.5	Y	Y	0	0	50	50	0.20	0.3%	1	4	5	0.2	72
3SWReB10g	0.6	Y	Y	0	0	100	0	0.25	0.3%	1	3	4	0.2	60
3SW3HA8g	0.6	Y	Y	0	0	60	40	0.50	0.3%	1	1	2	0.2	60
3SWReB14g	0.7	Y	N	0	0	90	20	1.00	0.3%	3	0	3	0.2	60
3SWCkB6g	0.7	Y	Y	0	0	100	0	0.33	0.3%	1	2	3	0.2	60
3SWPoB5g	0.6	Y	Y	0	0	100	0	0.60	1.4%	3	2	5	0.8	57
3SWReB12g	0.7	Y	Y	0	0	80	10	0.40	3.0%	2	3	5	1.6	54
3SWReB7g	0.7	Y	Y	0	0	60	50	0.33	0.4%	1	2	3	0.4	96
1SWCgB5g	0.7	Y	Y	0	0	80	10	0.25	0.6%	1	3	4	0.4	72
3SWReB9g	0.8	Y	Y	0	0	70	40	0.50	1.5%	2	2	4	0.9	60
3SWReB4g	0.8	Y	Y	0	0	60	60	0.75	0.3%	3	1	4	0.2	75
3SWMRB2g	0.5	Y	Y	0	0	100	0	0.25	1.4%	1	3	4	1	72
3SWMRB1g	0.6	Y	Y	0	0	100	0	0.50	1.7%	2	2	4	0.9	54
3SWAcA4g	0.3	Y	Y	0	0	90	0	0.50	0.7%	2	2	4	0.5	72
1SWCgB1g	0.4	Y	Y	0	0	100	0	0.00	1.3%	0	2	2	0.2	15
1SWCgB9g	0.4	Y	N	0	0	100	0	0.00	0.5%	0	2	2	0.3	57
1SWCgB13g	0.5	N	Y	0	0	100	0	0.00	0.3%	0	3	3	0.2	78
1SWCgB17g	0.6	Y	Y	0	50	100	0	0.60	1.1%	3	2	5	0.7	63
1SWCgB12g	0.4	Y	Y	0	0	100	0	0.20	0.1%	1	4	5	0.1	84
1SWCgB16g	0.3	Y	Y	0	0	100	0	0.00	0.1%	0	3	3	0.1	96
1SWCgB7g	0.1	Y	Y	0	0	100	0	0.25	0.2%	1	3	4	0.3	153
1SWCgB8g	0.2	Y	Y	0	30	100	0	0.75	0.2%	3	1	4	0.1	54
1SWCgB10g	0.1	Y	Y	0	30	100	0	0.60	0.8%	3	2	5	0.5	60
1SWCgB4g	0.1	Y	Y	0	0	100	0	0.50	1.3%	2	2	4	0.8	60
2SWCgB8g	0.6	Y	Y	0	0	100	0	0.00	1.8%	0	2	2	1.2	66
1SWCgB15g	0.4	Y	Y	0	0	100	0	0.33	0.2%	1	2	3	0.2	96
3SWReB8g	0.5	N	Y	0	0	90	0	0.60	1.1%	3	2	5	0.4	36
3SWReB5g	0.7	N	Y	0	0	90	0	0.50	1.0%	4	4	8	0.3	30
3SWBcA3g	0.7	Y	Y	0	20	100	10	0.43	0.3%	3	4	7	0.1	39
3SWReB1g	0.3	Y	Y	0	0	70	20	0.25	1.8%	1	3	4	0.8	45
3SWBcA6g	0.8	Y	Y	0	0	100	0	0.60	0.6%	3	2	5	0.3	48
3SWBcA4g	0.7	Y	Y	20	10	90	0	0.25	0.7%	1	3	4	0.4	54
3SW2HB15g	0.9	Y	Y	0	0	70	10	0.67	0.9%	6	3	9	0.9	105
3SW2HB6g	0.9	N	Y	0	0	80	10	0.67	0.9%	4	2	6	0.7	81
3SWRbA10g	0.7	Y	Y	0	0	60	40	0.33	2.9%	2	4	6	2	69

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vnpi	Vslope	#Nat	#NonNat	Total Doms	Vertical	Horizontal
3SWRbA9g	0.8	Y	Y	0	0	70	30	0.60	2.1%	3	2	5	1	48
3SWRbA3g	0.7	Y	Y	0	0	80	20	0.50	0.6%	3	3	6	0.4	72
2SWReB2g	0.2	Y	Y	0	0	100	0	0.00	1.5%	0	3	3	1.3	87
2SWCgB4g	0.7	Y	Y	0	0	80	10	0.00	0.1%	0	2	2	0.1	69
3SWCgB9	0.6	Y	Y	0	0	100	0	0.00	2.2%	0	2	2	0.8	36
2SWReB4	0.3	Y	Y	0	0	90	0	0.33	3.0%	1	2	3	0.9	30
2SWRgA1	0.2	Y	Y	0	0	100	0	0.33	0.9%	1	2	3	0.6	66
2SWCkB4	0.2	Y	Y	0	0	100	0	0.20	1.4%	1	4	5	0.9	66
2SWReB3	0.1	Y	Y	0	0	100	0	0.00	1.0%	0	3	3	1.1	108
2SWCgB3	0.2	Y	Y	0	0	100	0	0.25	0.4%	1	3	4	0.3	72
2SW3HA1	0.1	Y	Y	0	0	100	0	0.25	0.8%	1	3	4	1.2	144
2SWCgB10	0.2	Y	Y	0	0	100	0	0.40	0.6%	2	3	5	0.7	108
2SWCgB11	0.2	Y	Y	0	0	100	0	0.33	0.6%	1	2	3	0.9	150
2SWCgB12	0.2	Y	Y	0	0	90	0	0.33	0.3%	1	2	3	0.2	60
2SWAcA1	0.2	Y	Y	0	0	100	0	0.33	0.5%	1	2	3	0.4	78
2SWRgB1	0.2	Y	Y	0	0	100	0	0.33	0.9%	1	2	3	0.7	78
2SWAcA2	0.2	Y	Y	0	0	80	0	0.25	0.7%	1	3	4	0.5	72
2SW3HB1	0.1	Y	Y	0	0	100	0	0.33	0.8%	1	2	3	0.9	120
2SWCgB2	0.1	Y	Y	0	0	100	0	0.00	0.3%	0	3	3	0.3	120
2SWReB17	0.5	Y	N	0	0	40	0	0.33	0.5%	1	2	3	0.6	132
3SWRgA4	0.3	Y	Y	0	0	100	0	0.20	0.2%	1	4	5	0.2	96
3SWRgA10	0.4	Y	Y	0	0	90	10	0.40	1.3%	2	3	5	1.1	87
3SWRgA7	0.3	Y	Y	0	0	90	10	0.00	0.8%	0	5	5	0.5	60
3SWRgA1	0.4	Y	Y	0	0	90	0	0.20	0.3%	1	4	5	0.3	99
3SWRgA13	0.4	Y	Y	0	0	90	0	0.17	1.7%	1	5	6	1.3	78
3SWRgA3	0.2	Y	N	0	0	100	0	0.25	0.9%	1	3	4	0.7	78
3SWRgA16	0.3	Y	Y	0	0	50	0	0.33	0.8%	1	2	3	0.4	51
3SWCgB12	0.6	Y	Y	0	0	90	0	0.60	0.7%	3	2	5	0.5	72
3SWRbA1	0.7	Y	Y	0	0	80	10	0.50	1.0%	2	2	4	0.6	60
3SWPoB2	0.6	Y	Y	0	20	90	0	0.40	2.3%	2	3	5	0.7	30
3SWRbA4	0.7	Y	Y	0	0	70	0	0.25	0.2%	1	3	4	0.2	96
3SWCgB13	0.2	Y	Y	0	0	90	0	0.20	0.3%	1	4	5	0.2	60
3SWCgB15	0.6	Y	Y	0	0	90	10	0.33	1.1%	2	4	6	0.8	72
3SW3HA4	0.6	Y	Y	0	0	90	0	0.20	0.1%	1	4	5	0.1	72
3SW3HA7	0.6	Y	Y	0	0	100	0	0.40	0.4%	2	3	5	0.5	117
3SW3HA3	0.5	Y	Y	0	0	70	20	0.00	0.4%	0	5	5	0.5	120

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vnpi	Vslope	#Nat	#NonNat	Total Doms	Vertical	Horizontal
3SW3HA6	0.6	Y	Y	0	0	70	30	0.33	1.3%	2	4	6	0.8	60
3SWCgB5	1	Y	Y	0	0	70	30	0.83	0.7%	5	1	6	0.8	111
3SWRbA5	0.8	Y	Y	0	0	70	20	0.80	1.9%	4	1	5	1.3	69
3SWCgB4	0.6	Y	Y	0	0	90	10	0.20	2.9%	1	4	5	2.3	78
3SWRbA14	0.6	Y	Y	0	0	90	0	0.25	1.5%	1	3	4	0.7	48
3SWRbA11	0.6	N	N	0	0	100	0	0.20	0.7%	1	4	5	0.2	30
3SWReB6	0.7	Y	Y	0	0	100	10	0.60	0.4%	3	2	5	0.1	24
3SWRbA13	0.6	Y	Y	0	0	70	30	0.20	1.4%	1	4	5	1.6	114
3SWCgB11	0.7	Y	Y	0	0	80	10	0.50	1.7%	3	3	6	1.5	90
3SWRbA12	0.8	Y	Y	0	0	80	10	0.57	1.5%	4	3	7	0.8	54
3SWCkB1	0.8	Y	Y	0	0	70	30	0.67	0.4%	4	2	6	0.2	54
3SWCkB14	0.6	Y	Y	0	0	50	30	0.50	0.3%	3	3	6	0.2	66
3SWCgB6	0.6	Y	Y	0	0	50	50	0.57	1.9%	4	3	7	1	54
3SWCgB9	0.4	N	Y	0	0	90	10	0.40	3.3%	2	3	5	1.4	42
3SWMrC1	0.2	N	Y	0	0	100	0	0.25	3.8%	1	3	4	2.6	69
3SWCgB1	0.7	Y	Y	0	0	70	0	0.40	0.7%	2	3	5	0.2	30
3SWPoB1	0.1	Y	Y	10	0	40	0	0.33	3.8%	1	2	3	1.6	42

UC MERCED
COMPILED CLAY SLOPE FIELD DATA

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vnpi	Vslope	#Nat	#NonNat	Total Dom	Vertical	Horizontal
3CSReB10	0.6	N	N	0	0	80	0	0.50	0.8%	2	2	4	0.2	26
3CSReB14	0.7	N	N	0	0	80	10	0.60	0.5%	3	2	5	0.1	20
3CSRbA3	0.7	Y	Y	0	0	80	10	0.40	0.4%	2	3	5	0.4	96
3CSReB11	0.8	N	N	0	0	70	20	0.86	0.5%	6	1	7	0.4	87
3CSCgD2	0.6	Y	Y	0	0	60	30	0.25	3.3%	1	3	4	2	60
3CSCgD3	0.6	Y	N	0	0	90	0	0.50	2.0%	2	2	4	1.2	60
3CSRbA14	0.7	N	Y	0	0	80	0	0.50	0.9%	3	3	6	0.5	54
3CSRbA30	0.8	Y	Y	0	0	70	10	0.50	0.1%	2	2	4	0.1	81
3CSRbA9	0.7	N	Y	0	0	60	20	0.33	0.5%	1	2	3	0.4	75
3CS2HB16	0.6	N	Y	0	0	60	20	0.33	1.5%	1	2	3	0.9	60
3CS2HB5	0.9	N	Y	0	0	80	10	0.33	0.1%	2	4	6	0.2	141
3CSPoB4	0.6	N	N	0	0	90	0	0.33	3.2%	2	4	6	1.9	60
3CSPmD2	0.8	N	N	0	0	80	0	0.67	1.0%	4	2	6	0.5	51
3CSRbA7	0.6	N	N	0	0	70	10	0.14	0.2%	1	6	7	0.1	60
3CSRbA4	0.7	Y	N	0	0	70	0	0.75	0.6%	3	1	4	0.7	120
3CSCgA1	0.7	N	N	0	0	80	0	0.33	0.2%	1	2	3	0.3	132
3CSRbA2	0.8	N	N	0	0	70	0	0.67	0.4%	4	2	6	0.3	72
3CSRbA16	0.7	N	Y	0	0	70	0	0.40	0.2%	2	3	5	0.2	120
3CSRbA17	0.6	N	N	0	0	90	0	0.20	0.3%	1	4	5	0.2	60
3CSCgB2	0.6	N	N	0	0	90	0	0.25	0.4%	1	3	4	0.3	72
3CS3HA3	0.9	Y	N	0	0	70	30	0.50	1.1%	2	2	4	0.7	66
3CS3HA17	0.7	N	N	0	0	90	10	0.40	1.7%	2	3	5	0.7	42
3CS3HA2	0.7	N	N	0	0	70	30	0.40	0.4%	2	3	5	0.2	54
3CSReB7	0.8	N	N	0	0	90	10	0.50	0.3%	2	2	4	0.2	66
3CSReB13	0.9	N	N	0	0	90	10	0.50	0.1%	2	2	4	0.1	78
3CSReB6	0.8	N	Y	0	0	90	10	0.40	0.9%	2	3	5	0.9	102
3CSCgB5	0.7	N	Y	0	0	100	20	0.50	2.4%	2	2	4	2.2	90
3CSCgB4	0.7	Y	Y	0	0	80	10	0.43	1.2%	3	4	7	1.6	132
3CSRbA6	0.6	N	N	0	0	70	20	0.25	3.9%	1	3	4	2.8	72
3CSCgB1	0.7	Y	Y	0	0	70	30	0.25	3.0%	1	3	4	2.7	90
3CSRbA11	0.6	Y	N	0	0	90	10	0.50	1.3%	2	2	4	1.2	96
3CSRbA12	0.6	Y	N	0	0	90	10	0.33	0.2%	2	4	6	0.4	162
3CSReB5	0.5	N	Y	0	0	70	30	0.50	0.9%	3	3	6	0.7	81

SITE	BPJ	Vin	Vout	Vsed	V%om	V%cov	V%cob	Vnpi	Vslope	#Nat	#NonNat	Total Dom	Vertical	Horizontal
3CSCkB16	0.7	N	N	0	0	70	30	0.40	0.9%	2	3	5	0.7	78
3CSReB2	0.8	Y	N	0	0	80	10	0.50	0.4%	3	3	6	0.4	90
3CSReB9	0.6	Y	N	0	0	80	10	0.29	1.6%	2	5	7	0.8	51
3CSRbA13	0.5	N	N	0	0	90	0	0.20	0.1%	1	4	5	0.1	72
3CSRbA26	0.8	N	N	0	0	70	20	0.40	0.2%	2	3	5	0.2	114
3CSReB4	0.4	N	N	0	0	80	10	0.25	0.7%	1	3	4	0.7	94
3CS3HA16	0.4	N	N	0	0	80	0	0.33	2.6%	1	2	3	1	39

Appendix B
MANAGEMENT PLAN FOR CONSERVATION LANDS AND ADJACENT CAMPUS BUILDOUT LANDS FOR THE UNIVERSITY OF CALIFORNIA MERCED

Management Plan for Conservation Lands and the Adjacent Campus Buildout Lands for the University of California, Merced

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September 2008

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Acronyms

AUMs	animal-unit-months
BA	Biological Assessment
Cal Fire	California Department of Forestry and Fire Protection
CLR	Campus Land Reserve
CNR	Campus Natural Reserve
CRHR	California Register of Historic Resources
CRT	California Rangeland Trust
CWA	Clean Water Act
EIR	environmental impact report
EIS	environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
IPM	Integrated Pest Management
LRDP	Long Range Development Plan
NRS	Natural Reserve System
RDM	residual dry matter
RMP	Resource Mitigation Plan
SNRI	Sierra Nevada Research Institute
TNC	The Nature Conservancy
UCLC	University of California Land Company
USACE	U.S. Army Corps of Engineers
VST Preserve	Virginia Smith Trust Preserve property

Chapter 1
Introduction

This Management Plan (Plan) describes the management policy and actions for lands owned and protected by the University of California (UC), and other mitigation lands that have contributed to the establishment of the UC Merced (UCM) Campus. These lands comprise the following categories.

- **UCM Conservation Lands (Tier 1a Lands).** Lands owned by UC and committed for long-term management by UCM for conservation purposes under conservation easements; these lands comprise the Virginia Smith Trust (VST) Preserve and Campus Natural Reserve (CNR). This plan also includes the Myers Easterly property as part of the UCM Conservation Lands. This area is owned jointly by the UC and VST, and will be managed by UCM as a Tier 1a mitigation area.
- **CST Conservation Lands (Tier 1b Lands).** The Cyril Smith Trust (CST) lands that are currently owned by The Nature Conservancy (TNC) and would be protected by a conservation easement.
- **Tier 2 Conservation Lands.** Five properties not owned in fee title by UC or conservation entities, but for which conservations easements have been acquired.
- **Adjacent Campus Buildout Lands.** UC lands designated for future use as the UCM Campus that are located adjacent to the UCM Conservation Lands.

This Plan is intended to meet various project requirements, including development of an Adaptive Management Plan, set forth in the Biological Opinion (BO) issued for the project (U. S. Fish and Wildlife Service 2002) and the conservation easement for the VST Preserve lands. The plan will serve for an extended period, assumed at approximately 20 years, although it incorporates adaptive changes and periodic reviews to adjust management.

The Plan does not address interim management of lands previously designated as the University Community, including those recently proposed for addition to the campus. Similarly, the Plan does not address management of lands to be acquired for wetland restoration and creation, which will be addressed in the forthcoming *Final Compensatory Wetland Mitigation and Monitoring Plan*.

The Plan recognizes that management needs for different lands vary depending on resource values, regulatory requirements, location, ownership, and proposed uses. UCM Conservation Lands and Adjacent Campus Buildout Lands are

addressed together in this Plan because their ownership by UCM allows greater management flexibility and application of adaptive management.

Reliance on a conservation easement to protect CST Conservation Lands will limit management options for this property. Because the proposed easement has not yet been developed, the specific terms of the easement are not known. General discussion with TNC and the agencies regarding easement provisions and examination of easement documents for Tier 2 Conservation Lands have provided a basis for initial description of the likely easement conditions and resulting management program. This component of the Plan will likely require revision once the specific provisions of the CST easement are determined.

Management of the Tier 2 Conservation Lands is defined by terms of the conservation easements. Management provisions for these lands have been included in this Plan as Appendix A.

The Plan addresses policies regarding various land uses and management commitments to protect and maintain conservation values consistent with regulatory commitments and requirements for the UCM project. The Plan is anticipated to guide all future management, but is also designed to respond adaptively to changing conditions associated with campus development, regulatory requirements, and the results of monitoring.

Background on the project and its compliance history and requirements is available in the *Proposed Conservation Strategy for the UC Merced Project* (ICF Jones & Stokes 2008) (Conservation Strategy). Importantly, the BO for the project, issued in 2002 by the U.S. Fish and Wildlife Service (USFWS), identified a set of required parameters, which included preparation of the Conservation Strategy. One element of the strategy was the preparation of a management plan for mitigation lands.

Parameter 1 of the BO requires that:

> The Applicants will prepare and implement, in coordination with USFWS and the California Department of Fish and Game (DFG), a comprehensive strategy for the conservation of the San Joaquin kit fox, vernal pool branchiopods and plants and other protected species to guide the development and implementation of specific conservation for the Proposed Actions…

Parameter 1 also specifies that:

> The Conservation Strategy will include monitoring and adaptive management measures and be consistent with and intended to implement the Recovery Plan for Upland Species of the San Joaquin Valley, and any future federal recovery planning effort.

The Conservation Strategy, to which this Plan contributes, identifies 13 target species for conservation. Of these species, the nine species listed below are known to occur on conservation lands and are the focus of management attention.

- Succulent owl's-clover (*Castilleja campestris* ssp. *succulenta*).
- Colusa grass (*Neostapfia colusana*).
- San Joaquin Valley orcutt grass (*Orcuttia inaequalis*).
- Conservancy fairy shrimp (*Branchinecta conservatio*).
- Vernal pool fairy shrimp (*Branchinecta lynchi*).
- Midvalley fairy shrimp (*Branchinecta mesovallensis*).
- Vernal pool tadpole shrimp (*Lepidurus packardi*).
- California tiger salamander (*Ambystoma californiense*).
- San Joaquin kit fox (*Vulpes macrotis mutica*) (suitable habitat only).

Chapter 2
Plan Area Description

The UC Merced mitigation lands addressed in this Plan are located in eastern Merced County in an area recognized for its high-value vernal pool and associated wetland and grassland habitats.

The Tier 1 Conservation Lands addressed in the main portion of this Plan are adjacent to the north and east sides of the proposed UCM Campus (Figure 2-1). The area is also bordered by cultivated agricultural lands and grasslands used for livestock grazing. Elevations range from approximately 200 to 570 feet (75 to 140 meters). Topography is flat to moderately rolling. These lands are within the watersheds of Fahrens, Cottonwood, and Black Rascal Creeks, which flow generally southwest from the property to Bear Creek and the San Joaquin River.

Tier 1b and Tier 2 Conservation Lands—the CST lands and five other easement properties, respectively —are described in this chapter; management direction for CST Conservation Lands is discussed in Chapter 6, *Management Direction for CST Conservation Lands*, and the management requirements in easement agreements for Tier 2 Conservation Lands are summarized in Appendix A.

2.1 Management Units

The Plan Area consists of several categories of Conservation Lands, as well as Adjacent Campus Buildout Lands. As noted in Chapter 1, the Plan does not address lands south of the former campus boundary (including those that may be added into the campus), because interim management is expected to be a continuation of existing uses, and the lands are not closely connected to the UCM conservation lands.

The land classification scheme described below is refined from that described in previous documents. The Plan addresses four major land categories.

- **UCM Conservation Lands (Tier 1a).** Lands owned wholly or in part by the UC Regents (UC), and managed by UCM for conservation purposes with granted conservation easements.
- **CST Conservation Lands (Tier 1b).** Land currently owned in fee title by TNC, to be protected with a comprehensive conservation easement.

- **Tier 2 Conservation Lands.** Five other private mitigation ownerships under protective easements.
- **Adjacent Campus Buildout Lands (Non-Conservation Lands).** Lands owned by UC and planned for future campus development, but requiring specialized management during the interim period, because they are adjacent to conservation lands.

The following sections summarize the location, size, ownership, and management of all mitigation lands addressed in the Plan.

2.1.1 UCM Conservation Lands (Tier 1a)

Two Tier 1a mitigation land units addressed in the Plan have been committed to conservation uses as mitigation for proposed construction of the UCM Project: the VST Preserve and the CNR. These are collectively referred to as *UCM Conservation Lands.*

2.1.1.1 Virginia Smith Trust Preserve

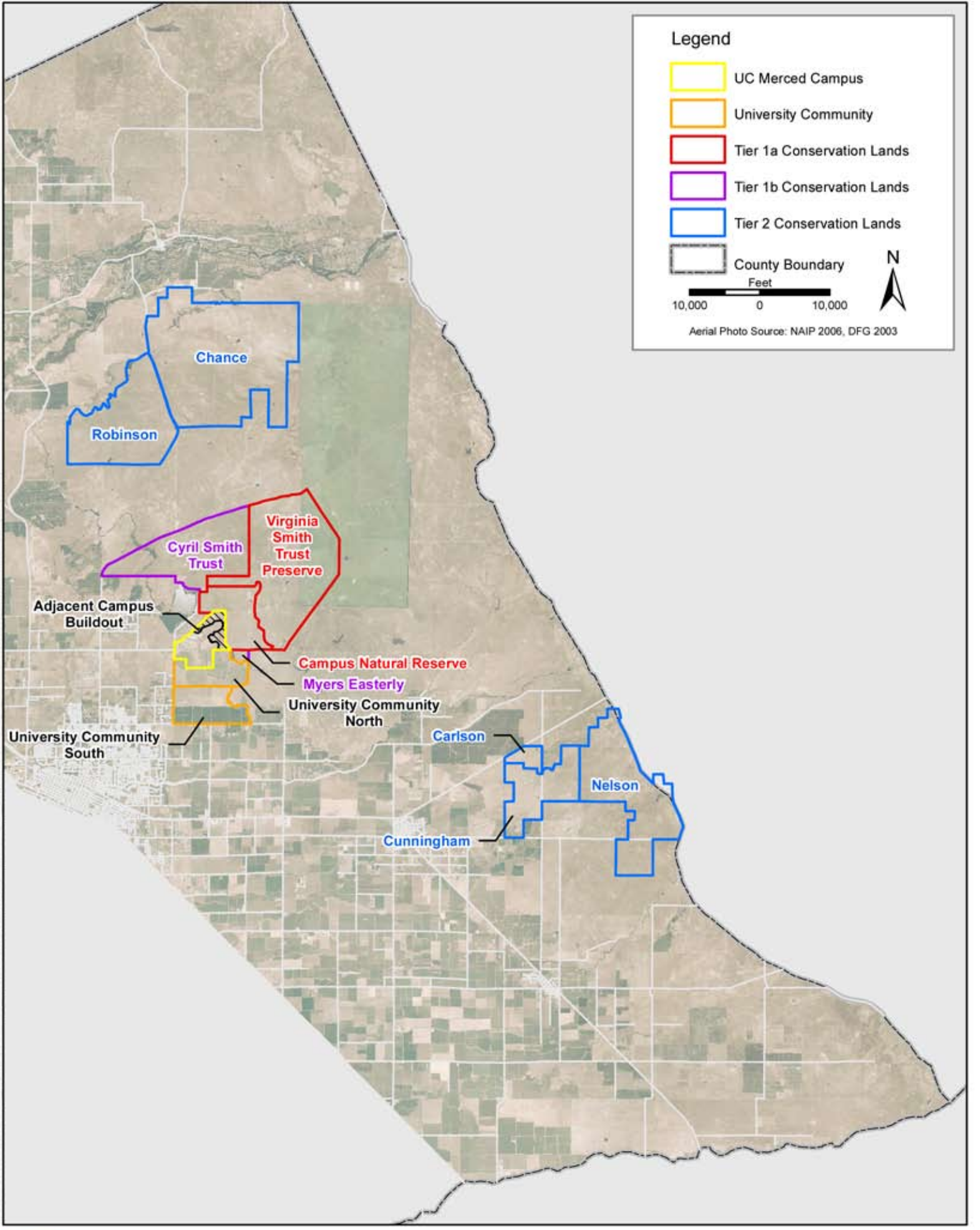
The 5,030-acre VST Preserve consists of the lands provided to UC by the VST, with the exception of those portions of the property that have been dedicated to the campus and the CNR. This property has been referred to as the *VST Remainder property* in previous documents (e.g., in the Biological Assessment [BA] and the BO). The VST Preserve is owned by UC and managed by UCM. The conservation easement on the property is owned by TNC.

2.1.1.2 Campus Natural Reserve

The CNR (a portion of the original VST property) was originally designated to encompass the watershed of the playa lake occupied by Conservancy fairy shrimp (*Branchinecta conservatio*). The 2007 campus reconfiguration expanded the CNR from 750 acres to 1,307 acres by incorporating the previously designated 340-acre Campus Land Reserve (CLR) and 221 acres of the originally proposed campus. New areas of the CNR will be protected under a conservation easement that is expected to be similar to that governing management of the VST lands.

2.1.1.3 Myers Easterly Property

The 91-acre Myers Easterly property is owned by the University of California Land Company (UCLC) LLC, an entity jointly owned by UC and the VST. The property was originally proposed as a mitigation area for vernal pool habitat impacts, but was determined to be unsuitable for this use. The UCLC has agreed



ICF Jones & Stokes

Figure 2-1
Conservation Lands for the UC Merced Project

that the land shall be treated as a Tier 1 mitigation area, and will be managed by UCM's SNRI Land Manager.

2.1.2 Adjacent Campus Buildout Lands

The Adjacent Campus Buildout Lands consist of the portion of the proposed campus footprint outside the boundaries of the existing Phase I campus that are adjacent to conservation lands and north of the extension of Bellevue Road. Originally, a proposed 910-acre campus footprint (including Phase 1 lands) was evaluated in the project environmental impact report (EIR) (UC Merced 2002) and analyzed in the BA (EIP Associates 2002; Jones & Stokes 2002a) and BO (U.S. Fish and Wildlife Service 2002). The portion of the campus footprint north of Bellevue Road was reduced by UCM to 579 acres in 2007 following extensive discussions with regulatory agencies and interested stakeholders.

To meet the area requirements of the campus, an additional 221-acre area that was previously allocated to the University Community has been added to the proposed campus (Figure 2-2).

The Adjacent Campus Buildout Lands will be developed over several decades. This phased development necessitates management of these lands during the interim period prior to their development. The lands slated for campus development are not physically separated (i.e., fenced) from the CNR, therefore, this Plan addresses the interim management of Adjacent Campus Buildout Lands as well as UCM Conservation Lands.

Adjacent Campus Buildout Lands are committed to campus development. Therefore, they provide an opportunity to test measures to reduce impacts of campus development, evaluate alternative management practices for UCM Conservation Lands, and support temporary educational and recreational activities, all with limited risk of long-term effects.

2.1.3 CST Conservation Lands (Tier 1b)

The CST property is a 3,070-acre parcel located adjacent to the VST and CNR lands that was purchased in fee title with a Wildlife Conservation Board grant. The land is currently owned in fee title and managed for grazing and habitat protection by TNC.

2.1.4 Tier 2 Conservation Lands

The five Tier 2 properties encompassing 17,141 acres were selected as mitigation lands because of their high-value biological resources (Vollmar 2002; ICF Jones & Stokes 2008). Protections for these lands are limited to the requirements in the

conveyed easements and therefore, management discretion is substantially less detailed and flexible than for UCM Conservation Lands. Management of these lands is addressed separately in Appendix A.

2.2 Ownership and Management Responsibilities

Current and expected future ownership and management responsibilities differ among the different mitigation properties.

2.2.1 UCM Conservation and Adjacent Campus Buildout Lands

UCM owns the VST Preserve, CNR, and Adjacent Campus Buildout Lands in fee title. The Myers Easterly is owned by the UCLC, an LLC owned jointly by UC and the VST. Conservation easements to the VST Preserve and Myers Easterly are held by TNC. UCM proposes to convey a conservation easement on the CNR to a conservation entity.

Currently, UCM Conservation and Adjacent Campus Buildout Lands are managed by the UCM Facilities Department and the Campus Director of Environmental Affairs. In the future, the Sierra Nevada Research Institute (SNRI), in cooperation with the Campus Director of Environmental Affairs and Facilities Department, will have management responsibility over the VST Preserve, CNR, Myers Easterly, and (prior to development) Adjacent Campus Buildout Lands.

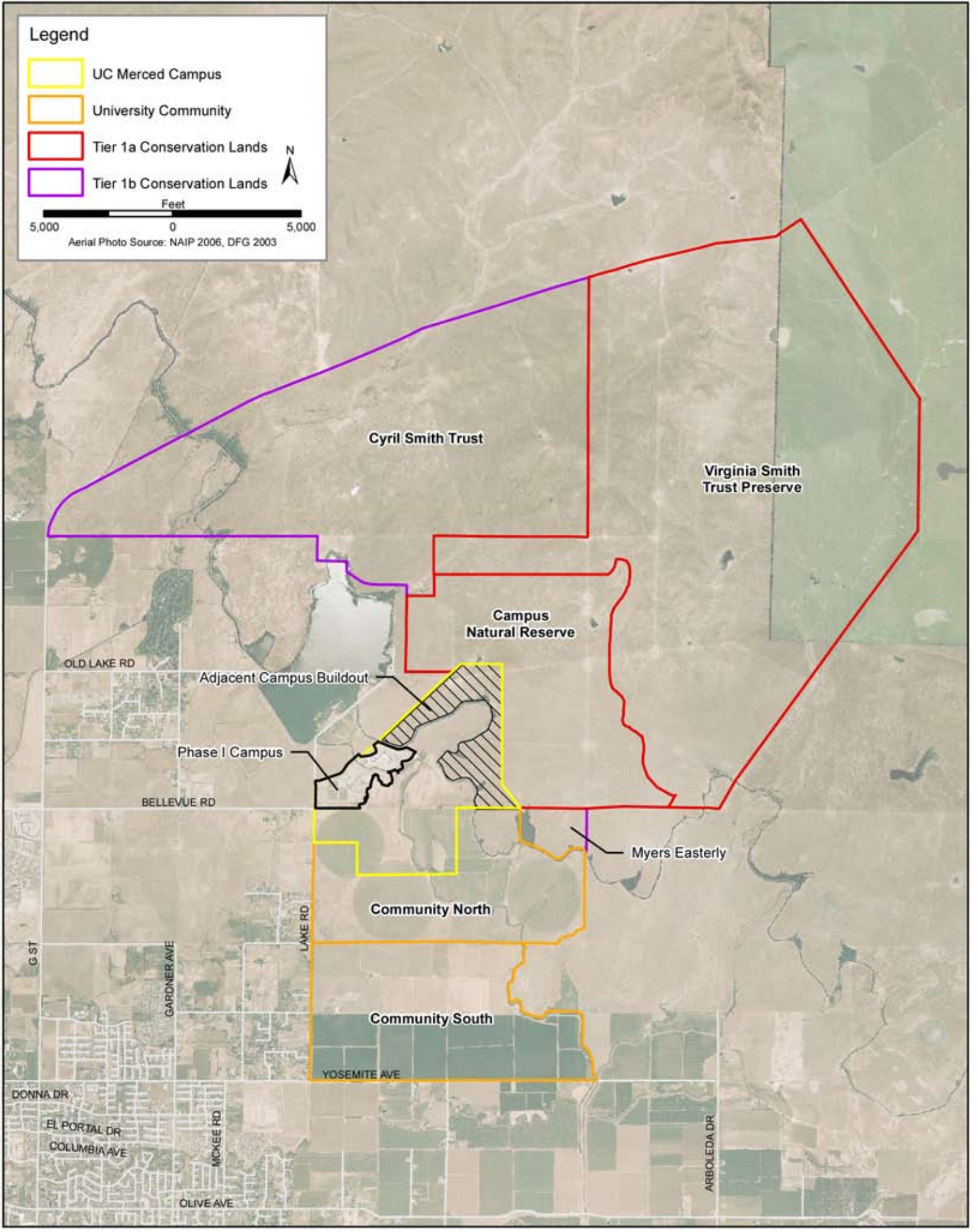
Formal designation of a portion of the UCM Conservation lands to the University of California Natural Reserve System (NRS) has been contemplated, but no proposal will be submitted until completion of the environmental permitting and planning process is completed.

All land management and protection requirements for mitigation purposes, as outlined in this Plan and in permit and compliance documents, would remain in place if any transfer to NRS status occurs. If such a transfer does occur, it is anticipated that SNRI will retain management responsibility.

2.2.2 CST Conservation Lands

No conservation easement currently exists on these lands. The WCB grant agreement that purchased the land provides for the permanent protection of the property's habitat values.

TNC, with permitting agency support, has proposed to protect the CST Conservation Lands through establishment of a conservation easement. The



ICF Jones & Stokes

Figure 2-2
Tier 1 Conservation Lands, Campus Buildout, and University Community

easement would provide USFWS and DFG with access to the property to conduct compliance monitoring (see Appendix A).

2.2.3 Tier 2 Conservation Lands

Management of Tier 2 Conservation Lands is under the direct control of the existing landowners. Conservation easements are held by TNC and the California Rangeland Trust (CRT). Easement requirements (Appendix F) must be legally met by landowners. As the easement holders, TNC and CRT are responsible for monitoring and ensuring that the terms of the easement are met.

2.3 Relationship of Plan Lands to Regional Landscape and Community

The UCM, CST, and Tier 2 Conservation Lands are recognized as important components of the proposed regional conservation efforts for eastern Merced County, as set forth in the Conservation Strategy (ICF Jones & Stokes 2008) and in keeping with the *Recovery Plan for Upland Species in the San Joaquin Valley* (U.S. Fish and Wildlife Service 1998) and the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (U.S. Fish and Wildlife Service 2005).

UCM Conservation Lands acquired in fee title by UC and UCLC and managed by UC for conservation purposes (VST, CNR, and Myers Easterly) comprise 6,430 acres. The CST lands currently owned by TNC comprise an additional 3,070 acres (ICF Jones & Stokes 2008). Existing acquired easements protect an additional 17,141 acres of the Plan Area. In total, the project's current mitigation lands constitute more than 13% of the roughly 200,000 acres of priority conservation lands in eastern Merced County (ICF Jones & Stokes 2008). Additional land are expected to be acquired and protected in wetland restoration and creation areas (Gibson and Skordal 2008).

These lands also play an important role as grazing lands in the agricultural economy of Merced County. Conservation and grazing uses are considered highly compatible in this area.

Contributions of UCM mitigation lands to the regional conservation of San Joaquin kit fox, as described in the Conservation Strategy (ICF Jones & Stokes 2008), are listed below.

- Protection of lands within the designated kit fox dispersal corridor.
- Implementation of management measures that will maintain suitable conditions for kit fox dispersal and potential for residence.
- Research and monitoring that may provide useful information to assist kit fox recovery.

Contributions of UCM mitigation lands to the conservation of vernal pool ecosystems and associated species are listed below.

- Protection of a variety of geographic and ecological conditions for vernal pool species, including the following listed species: succulent owl's-clover, Colusa grass, San Joaquin Valley Orcutt grass, Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, and California tiger salamander.
- Management of habitat through livestock grazing and other resource programs to maintain and, where possible, enhance habitat conditions and wetland functions for vernal pool species (especially listed species).
- Research and monitoring that will contribute to enhanced management practices for vernal pool ecosystems and species.

Chapter 3
Overview of Area Resources and Management

UCM and CST Conservation Lands (Tier 1 Lands) and Adjacent Campus Buildout Lands have been used primarily for livestock grazing over many years (Appendix B); this use has maintained the lands in generally natural conditions (see *Biological Resources* below). Improvements have been largely limited to fences, roads, stock ponds and other water sources, and a barn located on the Adjacent Campus Buildout Lands. The existing water delivery canals are primarily located on the Adjacent Campus Buildout Lands.

3.1 Biological Resources

Tier 1 Lands were selected for mitigation use on the basis of their biological values. Accordingly, the management requirements for these lands are intended to maintain and enhance values for endangered and other sensitive species and the ecosystems that support them. This section briefly describes these important biological resources. More detailed treatment is provided in the BA (EIP 2002a; Jones & Stokes 2002a); the BO (U.S. Fish and Wildlife Service 2002); and the Conservation Strategy (ICF Jones & Stokes 2008).

3.1.1 Habitats and Communities

Several methods have been used to classify ecosystems, habitats, and plant communities of Tier 1 Lands for the wetland delineation (EIP 2000, 2002b), Wetland Functional Assessment (Gibson and Skordal 2008), and Conservation Strategy (ICF Jones & Stokes 2008). Because the management requirements of this Plan do not require a finely differentiated basis for characterizing habitat conditions, a generalized classification for management purposes is provided below.

3.1.1.1 Annual Grasslands

The vast preponderance of Tier 1 Lands supports annual grassland habitat. This habitat occurs in upland (nonwetland) areas, but several of the characteristic species also invade vernal wetland habitats (vernal pools, swales, and clay slope

wetlands) under conditions of low grazing pressure. Annual grasslands in the project area are dominated by naturalized non-native Mediterranean grasses and forbs, but they also include a component of native species.

3.1.1.2 Native Vernal Wetlands

This category includes vernal pools, swales, pool/swale complexes, mima mound areas, clay slope wetlands, and clay playas as variously described in other UCM documents. These seasonal wetland types occur on soils with low permeability and support wetland species, including a number of the target species identified in the Conservation Strategy.

3.1.1.3 Artificial Wetlands

Artificial wetlands comprise a variety of wetland types with unnatural hydrologic conditions resulting from human activities. Artificial wetlands include stock ponds, irrigation canals, and tailing areas (generally formed by water ponding against or leaking from adjacent irrigation canals). Artificial wetlands generally do not support typical vernal pool plants, although some stock ponds are primary breeding areas used by California tiger salamanders.

3.1.2 Species for Management Emphasis

Nine of the 13 species addressed in the BO occur on UCM Conservation Lands, while five species occur on both CST and Adjacent Campus Buildout Lands. The quantitative distribution of habitat and occurrences for each species are summarized in Tables 3-1 and 3-2; these numbers reflect the 2007 revisions to the campus configuration and allocation of former campus lands to UCM Conservation Lands. Because the status and trends of these species are addressed in detail in the BA, the BO, and the Conservation Strategy, this Plan provides only a brief summary of the species' habitat associations, abundance, management importance, and management requirements.

In the following discussions, the characterizations of relative abundance reflect the abundance in the Plan Area or general region at a broader scale; all are listed species and thus are considered rare and sensitive to threats of potential extirpation.

3.1.2.1 Succulent Owl's-Clover

Succulent owl's-clover grows in a wide range of vernal wetland types. The species is relatively abundant on Tier 1 and Adjacent Campus Buildout Lands (Table 3-1), as well as regionally (ICF Jones & Stokes 2008: Figure 3-8a, b).

Table 3-1. Habitat Acreages for Conservation Species on Conservation Lands and on UCM Campus and University Community Lands

	Extent of Habitat (acres [percentage])[a]								
			UCM Conservation Lands						
Species	Project Region	Campus and University Community [b]	VST	CNR	Myers Easterly	Total UCM[c]	CST Conservation Lands	Tier 2 Conservation Lands	All Conservation Lands
Succulent owl's-clover	1,337	31 (2)	219 (16)	94 (7)	0 (0)	313 (23)	68 (5)	308 (23)	689 (52)
Colusa grass	282	0 (0)	117 (41)	39 (14)	0 (0)	156 (55)	0 (0)	0 (0)	156 (55)
San Joaquin Valley Orcutt grass	156	0 (0)	0 (0)	16 (10)	0 (0)	16 (10)	0 (0)	0 (0)	16 (10)
Conservancy fairy shrimp	107	0 (0)	0 (0)	14 (13)	0 (0)	14 (13)	0 (0)	0 (0)	14 (13)
Vernal pool fairy shrimp	2,384	61 (3)	349 (15)	139 (6)	2 (0)	490 (21)	137 (6)	516 (22)	1,143 (48)
Midvalley fairy shrimp	653	27 (4)	90 (14)	105 (16)	0 (0)	195 (30)	64 (10)	66 (10)	325 (50)
Vernal pool tadpole shrimp	318	4 (1)	14 (4)	0 (0)	0 (0)	14 (4)	0 (0)	0 (0)	14 (4)
California tiger salamander	69,406	1,884 (3)	4,904 (7)	1,254 (2)	84 (0)	6,242 (9)	2,545 (4)	11,349 (16)	20,136 (29)
San Joaquin kit fox (primary habitat)	180,431	1.354 (1)	4,933 (3)	1,156 (1)	91 (0)	6,180 (3)	2,997 (2)	15,082 (9)	24,259 (13)

[a] *Percentage* reflects the percentage of all the habitat type in the project region that is either conserved on conservation lands or removed by Campus Buildout.

[b] The total of each habitat type that would be directly or indirectly affected by development of the entire UCM Campus and University Community

[c] Total UCM Conservation Lands—i.e., the total of VST, CNR, and Myers Easterly lands.

Table 3-2. Numbers of Point Observations of Conservation Species on Conservation Lands and on UCM Campus and University Lands

	Occurrences							
		UCM Conservation Lands						
Species	Campus and University Community[a]	VST	CNR	Myers Easterly	Total UCM	CST Conservation Lands	Tier 2 Conservation Lands	Total
Succulent owl's-clover	9	119	125	0	244	41	454	739
Colusa grass	0	3	2	0	5	0	0	5
San Joaquin Valley Orcutt grass	0	0	1	0	1	0	0	1
Conservancy fairy shrimp	0	0	1	0	1	0	0	1
Vernal pool fairy shrimp	211	190	107	10	307	218	145	670
Midvalley fairy shrimp	19	26	34	0	60	15	12	87
Vernal pool tadpole shrimp	1	4	0	0	4	0	1	5
California tiger salamander	1	8	5	0	13	8	9	30

[a] The total number of point observations of each species that would be directly or indirectly affected by development of the entire UCM Campus and University Community.

Management requirements are for habitat protection and moderate grazing to reduce competition from other species.

3.1.2.2 Colusa Grass

Colusa grass grows in large or deep vernal pools that retain water until late spring. It occurs on the VST Preserve and CNR, but has not been found on the CST or Adjacent Campus Buildout Lands (ICF Jones & Stokes 2008: Figure 3-9a, b). Regionally, the species is uncommon.

3.1.2.3 San Joaquin Valley Orcutt Grass

San Joaquin Valley Orcutt grass grows in large or deep vernal pools that retain water into the late spring or early summer. It is one of the rarer listed species in eastern Merced County, with only eight records reported (ICF Jones & Stokes 2008: Figure 3-10a, b). The species is not present on the CST Conservation or Adjacent Campus Buildout Lands. A single occurrence is protected on UCM Conservation Lands.

3.1.2.4 Conservancy Fairy Shrimp

Conservancy fairy shrimp occurs mainly in large, turbid alkaline pools; vernal lakes; and vernal pools. It is a relatively rare fairy shrimp species, with only 28 known occurrences. Four occurrences are known from eastern Merced County (ICF Jones & Stokes 2008; Figure 3-11a, b). The species was avoided during establishment of the boundaries of the campus. The sole occurrence of Conservancy fairy shrimp on UCM Conservation Lands is within the CNR, where it occupies a large vernal pool. This occurrence is the only protected occurrence in eastern Merced County. Statewide, 10 other sites are protected.

3.1.2.5 Vernal Pool Fairy Shrimp

Vernal pool fairy shrimp is the most widely distributed special-status crustacean in eastern Merced County. It occupies vernal pools and a variety of other seasonal wetland types, including artificial depressions and drainages with suitable hydrology, on Tier 1 and Adjacent Campus Buildout Lands and other lands in eastern Merced County (ICF Jones & Stokes 2008: Figure 3-12a, b). Nearly 48% (1,143 acres) of the known occupied habitat in eastern Merced County is protected in conservation areas associated with the UCM project (including Easement Lands).

3.1.2.6 Midvalley Fairy Shrimp

Midvalley fairy shrimp occupies vernal pools and other seasonal wetland types. It tends to be associated with smaller, more ephemeral vernal wetlands than the other special-status crustaceans. It occurs on Tier 1 and Adjacent Campus Buildout Lands. Compared to the other special-status species, midvalley fairy shrimp is moderately abundant and widely distributed in eastern Merced County (Jones and Stokes 2008, Figure 3-13 a, b).

3.1.2.7 Vernal Pool Tadpole Shrimp

Vernal pool tadpole shrimp occurs in seasonal wetland habitats of widely varying sizes and conditions. A small amount of occupied habitat occurs on the VST Preserve. The species has not been identified on Tier 1b or Adjacent Campus Buildout Lands. Most of the occupied habitat for the species is located immediately southeast of the campus on unprotected lands (ICF Jones & Stokes 2008: Figure 3-14a, b).

3.1.2.8 California Tiger Salamander

California tiger salamander breeds in vernal pools, stock ponds, and other seasonal wetlands that are inundated for an average of 3–4 months annually. Salamanders use aestivation sites, primarily in soil crevices and burrows of ground squirrels and other fossorial mammals, during the nonbreeding season. Salamanders have been reported to travel more than 1 mile from breeding sites; however, evaluation of the levels of use and usage by various age classes that contribute differentially to population reproduction indicates that areas closer to breeding ponds have the highest value to populations (Searcy and Shaffer 2008). Tiger salamander populations in eastern Merced County have shown evidence of genetic contamination from introduced non-native eastern tiger salamanders (Fitzpatrick and Shaffer 2003), although the precise locations sampled in this study and the conditions within Conservation Lands is unknown.

Nearly all surveyed areas of lands of conservation interest in eastern Merced County are occupied tiger salamander habitat, based on the mapping in the Conservation Strategy that characterized lands within approximately 7,000 feet of breeding ponds as occupied (ICF Jones & Stokes 2008: Figure 3-15a, b). Most Tier 1 and Adjacent Campus Buildout Lands are considered tiger salamander habitat under this definition. Only one documented breeding site for California tiger salamander occurs on Adjacent Campus Buildout Lands, but a number of breeding sites are within 1 mile of the proposed campus (ICF Jones & Stokes 2008: Figure 3-15a, b).

3.1.2.9 San Joaquin Kit Fox

The known distribution of San Joaquin kit fox is limited to a few areas in eastern Merced County. It is unclear if this current localized distribution is a result of natural conditions (e.g., unfavorable soil conditions for burrowing, high water table); past land use; and mortality factors (especially rodent control); or the result of current land uses (ICF Jones & Stokes 2008). The *Recovery Plan for Upland Species in the San Joaquin Valley* has identified portions of eastern Merced County as a key dispersal corridor to maintain and restore occupancy of the east side of the San Joaquin Valley (U.S. Fish and Wildlife Service 1998).

Habitat suitability in eastern Merced County was characterized in the Conservation Strategy on the basis of the key variables of land cover type, slope, and adjacent land uses. All Tier 1 Lands and most undeveloped portions of the Adjacent Campus Buildout Lands are considered suitable for kit fox residency and dispersal (ICF Jones & Stokes 2008: Figure 2-2).

3.2 Cultural Resources

No intensive cultural resources surveys have been conducted on Tier 1 Lands for the UCM project. The Campus Long Range Development Plan (LRDP) EIR noted that, based on the presence of archeological sites on adjacent lands, "creek zones and other [natural] water sources in the project area should be considered archeologically sensitive" (UC Merced 2002). The EIR also noted that surveys of "a large block of land to the northeast of the [Campus and Community] project site did not reveal any historical resources." The Adjacent Campus Buildout Lands were extensively surveyed.

Overall, because the preponderance of Tier 1 and Adjacent Campus Buildout Lands are uplands or seasonal wetlands, they are not considered highly sensitive for archeological and historical resources. According to the Draft EIR, the "Smith Trust barn" on the Adjacent Campus Buildout Lands does not appear to qualify for inclusion in the California Register of Historic Resources (CRHR) because it is not associated with important people or events or distinguished by its type or method of construction (UC Merced 2002).

3.3 Visual Resources

The Tier 1 and Adjacent Campus Buildout Lands are not highly visible to off-campus observers because of relatively flat topography and screening by trees at the County's Yosemite Lake Park. The primary visual value of the UCM Conservation Lands is their function as the viewshed for the campus. The area provides sweeping views of open space areas supporting grasslands and vernal pools that provide a sense of space and visual interest to the University Community.

3.4 Livestock Grazing

Lands in the Plan Area have been grazed by livestock for more than 100 years. For many years prior to conveyance to UC, VST, CNR, and Myers Easterly lands were grazed under leases from the trust to a sequence of ranchers. Grazing has typically involved cow-calf and stocker operations that graze from late October through May.

Numbers of grazing animals and the duration of grazing in a given year varies depending on rainfall and other weather conditions (Appendix B). In the relatively dry 2006–2007 grazing season, lands were grazed at an intensity of approximately 1.0 animal-unit-months (AUMs; i.e., the equivalent of grazing by a cow and calf for 1 month) per acre (Appendix B).

UCM leases the VST Preserve for grazing using a competitive bidding process, while TNC administers grazing on the CST. Grazing is conducted in a manner intended to continue the previous practices on the lands, which are considered appropriate for conservation purposes. The grazing lease is monitored regularly for compliance with lease terms.

More detail on these grazing programs is provided in the *UCM Conservation Lands Grazing Management Plan* (Grazing Plan) (Appendix B).

3.5 Fire Control and Management

Fire is an inherent part of California's Mediterranean ecosystems, including the annual grassland–vernal wetland complexes in the Plan Area. Annual grasslands in the project area are not dependent on fire, but experience regular fire as a result of dry conditions during the summer. Most fires that occur are human caused, and typically burn quickly at low to moderate intensity.

Fire suppression on Tier 1 Lands has mostly been the responsibility of the California Department of Forestry and Fire Protection (Cal Fire). No detailed history of fire incidence has been summarized, but conditions are relatively easy to predict on the basis of the area's similarity to many other areas in California. Historical suppression methods were likely of relatively low intensity, commensurate with the relatively low value of resources at risk (primarily livestock forage). Suppression methods likely comprised using existing fuel breaks (e.g., roads, canals) in concert with new fire line construction, wet-lines (spraying a waterline to discourage fire spread), and backfiring.

Since establishment of Phase I campus, fire prevention and suppression efforts have increased to protect UC resources (human population, buildings) and in response to increased threats of ignition posed by the human population (Krippner pers. comm.). UCM annually disks connections with canals and roads to create a fuelbreak around the perimeter of the existing Phase I campus.

Campus police also provide complete fire prevention and detection through routine patrol of the campus perimeter lands.

3.6 Recreation and Prevention of Unauthorized Use

Historically, all lands in the Plan Area were privately owned and not available for general public recreation. Information on past private recreation uses is limited, but uses are believed to be few and carried out at minimal levels. No public recreation use has been authorized on UCM Conservation Lands since acquisition by UC. TNC allows only infrequent guided tours on CST Lands.

UCM monitors and patrols Conservation Lands to protect them from trespass, although relatively little trespassing (and associated resource damage) has occurred. UCM Conservation Lands, especially VST Preserve lands, are regularly monitored for unauthorized uses in compliance with existing environmental permitting requirements. TNC has identified trespass issues on CST Lands associated with unauthorized public access from adjacent Paloma Road.

3.7 Research and Educational Uses

Research and educational uses are restricted in the Plan Area. Procedures for permitting educational and recreation use are in place (Appendix C). UC will continue to employ these procedures, which are incorporated into this Plan, until SNRI adopts and implements its own procedures.

Chapter 4
Plan Purpose and Planning Principles

The broad purpose of the Plan for UCM Conservation Lands is to meet UCM's environmental commitments and agency permit requirements, and to provide a tool for resource managers to protect these lands and associated species of conservation concern. The specific purpose is to provide management direction to guide management over the life of the Plan.

4.1 Overview of Land Use Commitments for UCM Conservation Lands

Management of UCM Conservation Lands is guided by UCM's environmental commitments and agency permit requirements in previous and ongoing environmental approval processes. Because these requirements have been presented and repeated in multiple documents, they are only briefly summarized here. The goals, objectives, and guidance in Chapter 5 provide the direction for implementing these requirements.

4.1.1 Clean Water Act Section 404 Permit

In February 2008, following discussions with USFWS, the U.S. Army Corps of Engineers (USACE), the U.S. Environmental Protection Agency (EPA), DFG, and other interested stakeholders, UCM submitted a revised Clean Water Act (CWA) 404 permit application that proposed a smaller alternative to its previous 910-acre campus footprint to reduce impacts on wetland and biological resources. It also incorporated the previously designated CLR and the eliminated portions of the campus into an expanded CNR, with conservation easements applied. This permit application is the basis for the preparation of an amended joint EIR/environmental impact statement (EIS); a new project-specific BA supplement (Airola 2008), and BO; and revision of supporting documents, including the Conservation Strategy (ICF Jones & Stokes 2008), and Compensatory Wetland Mitigation and Monitoring Plan (Gibson and Skordal 2008). Both previous and current documents provide relevant direction for the Plan, as summarized below.

4.1.2 Biological Assessments, Biological Opinion, and Resource Mitigation Plan

The BA (EIP 2002), the BA supplement (Jones & Stokes 2002a), and the Resource Mitigation Plan (RMP) (Jones & Stokes 2002b) were prepared by UCM as part of the formal consultation process for the project under Section 7 of the federal Endangered Species Act (ESA). These documents promulgated a substantial number of conservation commitments, which served as the basis for the consultation process and USFWS's BO (2002).

The RMP was prepared in close coordination with USFWS and DFG in an attempt to address potential effects of the project on listed species. The RMP provides a broad program of measures that UCM proposed to avoid and minimize take of federally listed or proposed species that could be affected by the UCM project. In this context, the project comprises siting, design, construction, operations and maintenance of the campus and University Community, as well as activities associated with compensation for project impacts. The RMP was incorporated into the BA (EIP 2002).

The operations and maintenance mitigation element of the RMP provides the most relevant guidance to management of UCM Conservation Lands. The RMP identifies the following management measures.

- Develop a detailed management plan (i.e., this Plan) to describe the management and monitoring program to manage and protect listed species and other biological and wetland resources.
- Manage and monitor to control human uses.
- Control dogs and non-native wildlife.
- Control invasive non-native plants.
- Conduct and manage livestock grazing to meet habitat objectives for listed species.
- Control wildfires.
- Monitor populations of Conservancy fairy shrimp and other listed species.
- Adapt and modify protection and management practices in response to monitoring results (Jones & Stokes 2002b:13).

Each of these elements is described in greater detail in the RMP. The specific requirements and additional details of management practices and monitoring are incorporated into Chapter 5, *Management Program Direction*, of this Plan.

The Compensation Element of the RMP describes acquisition of compensation lands. The described goals for this acquisition are summarized below.

- Acquiring, protecting, and improving the quality of habitat for listed species to ensure that take and other project effects are successfully mitigated.

- Avoiding or minimizing any detrimental effects on habitats and populations of other listed and sensitive species.
- Ensuring that a detailed compensation plan is approved by USFWS before any take of federally listed species occurs or their habitats are disturbed (Jones & Stokes 2002b:19**)**.

Key requirements of the RMP Compensation Element are listed below.

- Placing the UCM Conservation Lands under a conservation easement that would impose restrictions on grazing, research, teaching, educational outreach, and recreational uses.
- Confining educational and recreational uses on the VST Preserve to docent-supervised activities and limiting controlled public access for hiking and nature observation along existing ranch roads.

Each of these elements is described in greater detail in the RMP. The specific requirements and additional details of management practices and monitoring are incorporated into Chapter 5, *Management Program Direction,* of this Plan.

Formal consultation by the USACOE with the USFWS under the ESA was reinitiated in July 2008. A BA Supplement (Airola 2008) has been prepared to address compliance of UC's revised Proposed Project with the conditions of the 2002 BO (including the Parameters and Conservation Measures incorporated into the 2002 BA and 2002 BO) and to evaluate effects on listed species and designated critical habitat.

4.1.3 Conservation Easements

Current uses of the VST Preserve and the Myers Easterly property are constrained by the terms of the conservation easements granted to TNC and applied to the lands as part of the mitigation for the UCM project. The Preserve easement documents are provided in Appendix F.

The CNR does not yet have a conservation easement on it. UCM has agreed to place conservation easements on the CNR; easement terms are expected to be similar to those that have been included within the conservation easement for the VST Preserve. Key elements of the VST conservation easements are discussed below.

The conservation easement recognizes the substantial conservation values of the lands, which are defined as "natural, hydrological, biological, ecological, and scientific values." The purposes of the conservation easement are to identify, monitor, study, preserve, protect, manage and, to the extent permitted or required, restore and enhance the conservation values. The easement holder is granted rights to engage in the activities listed below.

- Identify, monitor, study, preserve, protect, and manage the conservation values, consistent with the terms of the conservation easement.
- Access the property in perpetuity.
- Enforce the terms of the easement.
- Study and make scientific observations on the property.
- Participate in the development of this Management Plan ("adaptive management plan") and the protocol for evaluating research proposals.
- Be kept informed by UCM of progress in securing permits from resource agencies.

The VST Preserve easement specifies that the landowner preserve and maintain the conservation values of lands through compatible livestock grazing and other management. The easement restricts property uses and grants the easement holder a perpetual right to preserve, protect, identify, monitor, enhance, and restore the conservation values. The landowner retains the right to pursue a variety of land uses and exercise other rights, as long as they maintain the conservation values of the land. These permitted uses are listed below.

- Livestock grazing conducted according to the terms in Exhibit C, Schedule C-1 (see Appendix F), as listed below.
  - Only sheep or cattle will be grazed, except for use by horses, burros, or mules as needed to service ranching operations and by goats to control noxious weeds.
  - Prevent an increase in noxious weeds.
  - Retain 800 pounds per acre of residual dry matter at the end of the growing season.
  - Locate food supplements (e.g., salt and mineral licks, food supplements, supplemental feed) away from vernal pools.
- Prescribed burning.
- Use of herbicides (only to control non-native noxious weeds).
- Hunting and fishing (by "the landowner" under established regulations with restrictions on fish stocking).
- Control of predatory and problem animals using selective methods that target individuals causing damage.
- Water source maintenance for livestock and wildlife use and development of new water sources with the easement holder's approval.
- Passive recreation, including bird watching, hiking, horseback riding, and picnicking, except as prohibited under resource agency permits.
- Erection of signs.
- Rights to use the property for any purpose consistent with the conservation easement.

Prohibited uses (Appendix F) are listed below.

- Land subdivision.
- Transfer of development rights.
- Non-ranching commercial uses, including development of natural resources (minerals, aggregate, energy).
- Disposal of hazardous waste, refuse, etc.
- Long-term leasing (>5 years) without consent of the easement holder.
- Alteration of water courses, degradation of water quality, or impairment of water rights.
- Off-road vehicle use, except for use in ranching operations, or authorized management and research activities.
- Introduction of plant and animal species.
- Plowing, disking, land leveling, irrigation or other alterations, except disking for fire control as specified in the Management Plan.
- Conversion to crops, orchards, or vineyards.
- Junkyards.
- Destruction of native vegetation (except by grazing or burning).
- Harvesting timber.

4.1.4 Conservation Strategy

The Conservation Strategy (Jones & Stokes 2007) was prepared to fulfill requirements of the BO, and has been updated (ICF Jones & Stokes 2008) to reflect the project status as of the February 2008 404 permit application. The strategy provides guidance to develop and implement conservation measures for species affected by the UCM project. It also describes UCM's implementation of the strategy and the role of the strategy in regional conservation. The Conservation Strategy also provides the most up-to-date record of occurrences of species on conservation lands

The general relationship of the Conservation Strategy to the Plan is described in Chapter 1, *Introduction.* The previous version of the Strategy (Jones & Stokes 2007) identified the role and requirements of the management plan for Conservation lands. In summary, the Conservation Strategy called for preparation and implementation of this Plan for UCM Conservation Lands. It stated that the plan "generally should include" the elements listed below.

- Goals and measurable objectives.
- Maps and descriptions of the management area; compensation habitat on conserved lands; and any areas to be enhanced, restored, or used for habitat creation.

- Description of how conservation lands meet compensation requirements.
- Descriptions of how habitat will be protected in perpetuity and land use restrictions that will prevent incompatible activities.
- Identification of the parties responsible for implementing the Plan.
- Descriptions of and restrictions on recreational, educational, and scientific activities that will be permitted and protocols for approving specific research and educational uses.
- Methods for controlling and eliminating unwanted or illegal uses of the property.
- Details regarding planned habitat restoration and enhancement measures.
- Grazing management practices.
- Fuel management practices.
- Practices for controlling non-native plants and animals.
- Monitoring protocols and procedures for archiving, distributing, and reporting monitoring data.
- Adaptive management measures to adjust management actions based on monitoring results and procedures for reporting adaptive management actions.
- Funding assurances for restoration/enhancement, long-term monitoring, management, and reporting.

Since the preparation of this Conservation Lands Management Plan, the revised Conservation Strategy (ICF Jones & Stokes 2008) has been updated, and the section on the management plan now summarize the Plan contents.

4.1.5 UC Merced Long Range Development Plan and EIR

The LRDP Final EIR (UC Merced 2002) specified the proposed configuration of the campus and designated the former boundaries of the CLR and CNR. Requirements set forth in the Project Description and Mitigation Measures in the Draft EIR have been incorporated into subsequent documents. The LRDP will be modified to reflect the new campus footprint and subsequent environmental commitments. The previous LRDP EIR will be superseded by a joint EIS/EIR for the project to be completed in 2008, but many of the mitigation elements of the EIR will be incorporated into the EIS/EIR.

4.2 Other Needs for Plan Direction

For effective management of UCM Conservation and Adjacent Campus Buildout Lands, direction is needed on a variety of protection and management activities that are not specifically required by project permits and environmental documents. This direction includes practical, on-the-ground management requirements for fire protection, visual and cultural resource management activities, and administrative and education uses. This Plan identifies and incorporates these needs to direct all aspects of land management.

4.3 Planning Principles

At the broadest level, a set of principles governs the development of the more specific goals, objectives, and guidelines for management in the Plan. These major principles govern the desired outcomes of the Plan, as well as the processes by which Plan activities are designed, conducted, and evaluated. These planning principles are listed below.

- Comprehensively address all management needs by providing clear and practical policy-level direction to on-the-ground managers.
- Meet requirements in permits and environmental documents to emphasize protection of wetlands and biological resources.
- Anticipate future campus and community growth in evaluating effects of management decisions and actions.
- Accommodate other uses (research, educational, recreational) to the extent feasible consistent with the primary goals and with available budgetary and management resources.
- Emphasize early problem detection and response to issues before they become large problems.
- Actively collaborate and communicate with the permitting agencies, easement holders, adjacent landowners, and the University Community.
- Adopt an adaptive approach to management based on observation, monitoring, and research.

Chapter 5

Management Program Direction for UCM Conservation and Adjacent Campus Buildout Lands

This chapter provides direction for the management of lands, resources, and uses of the UCM Conservation Lands and Adjacent Campus Buildout Lands. CST Conservation Lands are addressed in Chapter 6. The chapter is organized around the major management programs that will be undertaken. Direction applying to all UCM Conservation Lands is presented first, followed by site-specific direction that applies to specific management units.

Although the guidance is organized by management program, some guidelines may properly apply to more than one program. Such guidelines are cross referenced where appropriate.

5.1 Grazing Management Program

Grazing is the primary management activity that has occurred and will continue to occur on the UCM Conservation Lands. Proper grazing is recognized as an essential tool for managing vegetation to benefit vernal pool plant species, control and prevent invasion by undesirable non-native plant species, provide desirable habitat conditions for target species, maintain and enhance overall wetland functions, and maintain a human presence to discourage trespass and vandalism. In general, it is recognized that historic and recent grazing practices were consistent with maintenance of conservation values (Marty pers. comm.).

5.1.1 Program Goals

The goals of the grazing management program are listed below.

- Maintain a grazing program that continues to provide high-quality habitat conditions for species of conservation concern.
- Utilize historical and recent grazing patterns that are considered beneficial for target species.
- Maintain and enhance overall wetland functions.

5.1.2 Program Objectives

The following objectives are characterized as goals in the Grazing Plan (Appendix B).

- Protect and enhance the biological values of preserved vernal pools and associated grasslands.
- Protect and enhance special-status species habitat.
- Promote the growth and cover of native plants by preventing the introduction and establishment of invasive non-native plant species.
- Remove/control existing invasive plant populations.
- Implement a program of long-term monitoring that will allow management techniques to be continually improved (i.e., adaptive management).
- Maintain the economic viability of livestock operations on UCM Conservation Lands.

5.1.3 Management Guidelines

Management guidelines for grazing are provided in the Grazing Plan (Appendix B). Key aspects of this guidance are summarized below.

G-1. Lessee Selection and Management. Select grazing lessees primarily on the basis of their ability and track record in conducting grazing to meet Plan objectives, rather than on bid price. Award longer-term ($\geq$5-year) leases with appropriate performance standards (subject to approval by the easement holder). Base fees on AUMs to encourage proper stocking and allow flexibility in setting annual grazing animal numbers (i.e., "stocking rates"). Provide incentives for lessee participation in resource management activities (e.g., noxious weed control). Prepare an annual grazing plan with lessees. Document annual levels of livestock use.

G-2. Livestock Type. Graze conservation lands with cattle, except where use of goats may be warranted in concentrated areas to control noxious weeds. Either stockers or cow-calf may be grazed, although differences in patterns of use and needed adjustments should be evaluated for each type of use.

G-3. Stocking Rates. Base initial stocking rates on the grazing capacity analysis described in the Grazing Plan (Appendix B). Adjust annual stocking rates in response to seasonal rainfall and monitoring of forage production by adjusting the numbers of animals or the length of the grazing season. Evaluate and adjust average annual stocking rates to meet conservation goals in consideration of experience acquired during management of the grazing lease.

G-4. Season of Use. Introduce livestock in the late fall or early winter (October–December) when adequate green-up of annual vegetation has occurred,

depending on weather conditions. Remove livestock in late spring (April–June) based on visual analysis of grassland conditions, so as to control invasive species and minimize effects on vernal pool flora.

G-5. Protection for Deep Pool Grasses. Continued grazing without special restriction is considered feasible for areas that support deep pool grasses San Joaquin Orcutt grass and Colusa grass, because populations have persisted under the typical grazing regime used on these lands. If monitoring indicates that detrimental impacts are occurring, managers should evaluate options to remove livestock from areas supporting San Joaquin Orcutt grass and Colusa grass before pools or ponds that support these species begin drying. Livestock removal can be achieved either by removing livestock from entire pastures that support these species or by erecting temporary electric fencing around occupied water bodies.

G-6. Residual Dry Matter Grazing Standards. Meet the residual dry matter (RDM) standard of 800 pounds per acre for grazing at the end of the grazing season to protect soils and mulch for the next year's vegetation (Appendix B, p.13). Coordinate with agencies and easement holder to allow flexibility in meeting standard to account for weather-related variations in forage production and differences in evenness of forage use, as potentially affected by distribution of water and supplements and the type of livestock grazed (stockers or cows and calves).

G-7. Supplemental Feeding. Supplemental foods may be used to improve livestock distribution and to supplement forage during periods of low forage production. Consistent with the conservation easement, food supplements will be placed at least 200 ft from the high water mark of vernal pools; where this distance cannot be met, the minimum distance will be 50 ft. Hay used for feeding will be certified weed-free (see IPM-2).

5.2 Fire Protection and Management Program

The fire protection and management program comprises activities conducted to protect life and property on and adjacent to the UCM campus and UCM Conservation Lands and to protect and maintain natural resource values. The fire protection program responds to the increased risk of fire resulting from the presence of the university and its associated sources of fire ignition, as well as the increased *values at risk* (including life and property) resulting from the proximity of the campus to open grassland habitat. Fire prevention and suppression are also necessary to maintain desirable habitat conditions for target species and to maintain livestock forage to support grazing activities. Prescribed burning may be needed to control noxious weeds.

In applying fire protection, the benefits of resource protection must be balanced with the resource damage caused by fire prevention and suppression methods. Although substantial increases in fire frequency may be harmful to grasslands and associated vernal pool habitats (i.e., by increasing potential for noxious weed

establishment) (Keeley 2001), existing fire frequencies or even moderate increases in frequency at the proper time of year are likely beneficial in controlling medusa-head and other non-native weeds (Pollak and Kan 1998, Marty 2007). Accordingly, use of ground-disturbing prevention and suppression methods (i.e., fuelbreaks and fire control lines) should be minimized to the level needed to prevent substantial increases in fire frequency, and to protect life and property on the campus and other adjacent lands.

5.2.1 Program Goal

The goal of the fire protection and management program is shown below.

- Conduct fire protection and management to protect human life and property, provide for public safety, and protect and enhance ecosystem values.

5.2.2 Program Objectives

The objectives of the fire protection and management program are as follows.

- Provide fire protection that emphasizes protection of life, public safety, and onsite and adjacent property values, particularly those that interface with the campus and other developed areas.
- Prevent a substantial increase in fire frequency and extent from preuniversity conditions in order to maintain habitat conditions.
- Minimize the excavation of fuelbreaks and fire suppression control lines beyond the level necessary to prevent substantial increases in fire frequency or severity.
- Use prescribed fire as a management tool where necessary to control invasive weeds that threaten biodiversity values.

5.2.3 Management Guidelines

5.2.3.1 Fuelbreaks

FPM-1. Fuelbreak Construction. Construct firebreaks to reduce the potential for spread of ignitions to UCM Conservation Lands from adjacent lands and vice-versa. Construct fuelbreaks in spring when soil moisture has declined sufficiently to prevent soil damage (generally late April-early May). Fuelbreaks will be designed and sited in response to the configuration of the campus over the life of the Plan (i.e., adjacent to developed areas) to minimize the area of ground disturbance. Do not construct fuelbreaks around all the property boundaries of conservation lands because the disturbance from repeated fireline construction exceeds the benefit achieved by reducing an already infrequent fire frequency in

remote areas. Design and locate fuelbreaks to incorporate existing protection features (e.g., canals, roads) and the varying level of risk for ignition and fire spread associated with existing land uses. Preferentially use Adjacent Campus Buildout Lands rather than UCM Conservation Lands for fireline construction during the period prior to full campus buildout (Figure 5-1). Note: Implementing the proposed initial fuelbreak will require cooperation of Merced County for use of its lands.

FPM-2. Resource Protection during Fuelbreak Construction. Locate fuelbreak routes to minimize disturbance of wetland areas. Have a qualified botanist flag the initial fuelbreak routes. Use existing trails, fencelines, and other higher use areas (where possible) to reduce disturbance of higher-quality habitats. Do not construct fuelbreaks in areas that remain wet through the fire season (permanent springs and associated wetlands). Evaluate the fuel loads in wetland areas within proposed fuelbreaks to determine if they can safely be left undisturbed. Use non-soil-disturbing techniques to reduce fuels in wetlands within fuelbreaks. In areas where wetlands cannot be avoided, conduct surveys for listed and other sensitive plant species on proposed and alternative routes and select routes that avoid or minimize impacts on these species. Do not construct fuelbreaks in areas that may result in take of state- of federally listed species unless such take is in compliance with the BO.

FPM-3. Fuelbreak Maintenance. Conduct annual maintenance (i.e., disking) during late spring to minimize potential for growth of noxious weeds.

FPM-4. Fuelbreak Monitoring for Noxious Weeds and Erosion. Monitor fuelbreaks annually during spring to identify noxious weed populations (see Guideline IPM-7). Use the updated list of known and potential noxious weeds (see Guideline IPM-1) as target species during fuelbreak monitoring. Use herbicides by hand spraying for targeted treatment of individual plants only if other measures are found to be infeasible.

In general, soil erosion in fuel break areas is not anticipated due to flatness of the terrain. If erosion is detected during surveys for noxious weeds, prescribe modifications to fuelbreak design (relocation, water barring) to reduce erosion. Control erosion through fuelbreak design (e.g., avoid disking perpendicular to steeper slopes; select size and spacing of disks to discourage runoff).

FPM-5. Onsite Protection of Other Developed Lands. If any non-UC campus or University Community lands adjacent to the conservation lands are proposed for development by other parties, strongly assert that any development must mitigate potential fire risks within the developed area rather than rather than necessitating additional protection measures within UCM Conservation Lands.

5.2.3.2 Patrol and Enforcement of Use Restrictions

FPM-6. Fire Prevention Security. The UCM police force will conduct a daily patrol of the campus perimeter to identify trespassers or maintenance activities that could pose a potential fire ignition threat to adjacent UCM Conservation Lands.

FPM-7. Fire Prevention Training for UCM Staff. In spring (March–April) during the period immediately preceding the start of the fire season, campus maintenance personnel who work in outdoor settings will annually review a fire prevention checklist that will focus on specific maintenance duties that could create sources of ignition (e.g., idling of vehicles, welding, use of mowers and other maintenance equipment adjacent to open grassland).

FPM-8. Fire Prevention Planning for Future Construction. Fire prevention plans will be incorporated into all construction and operation plans for future campus construction.

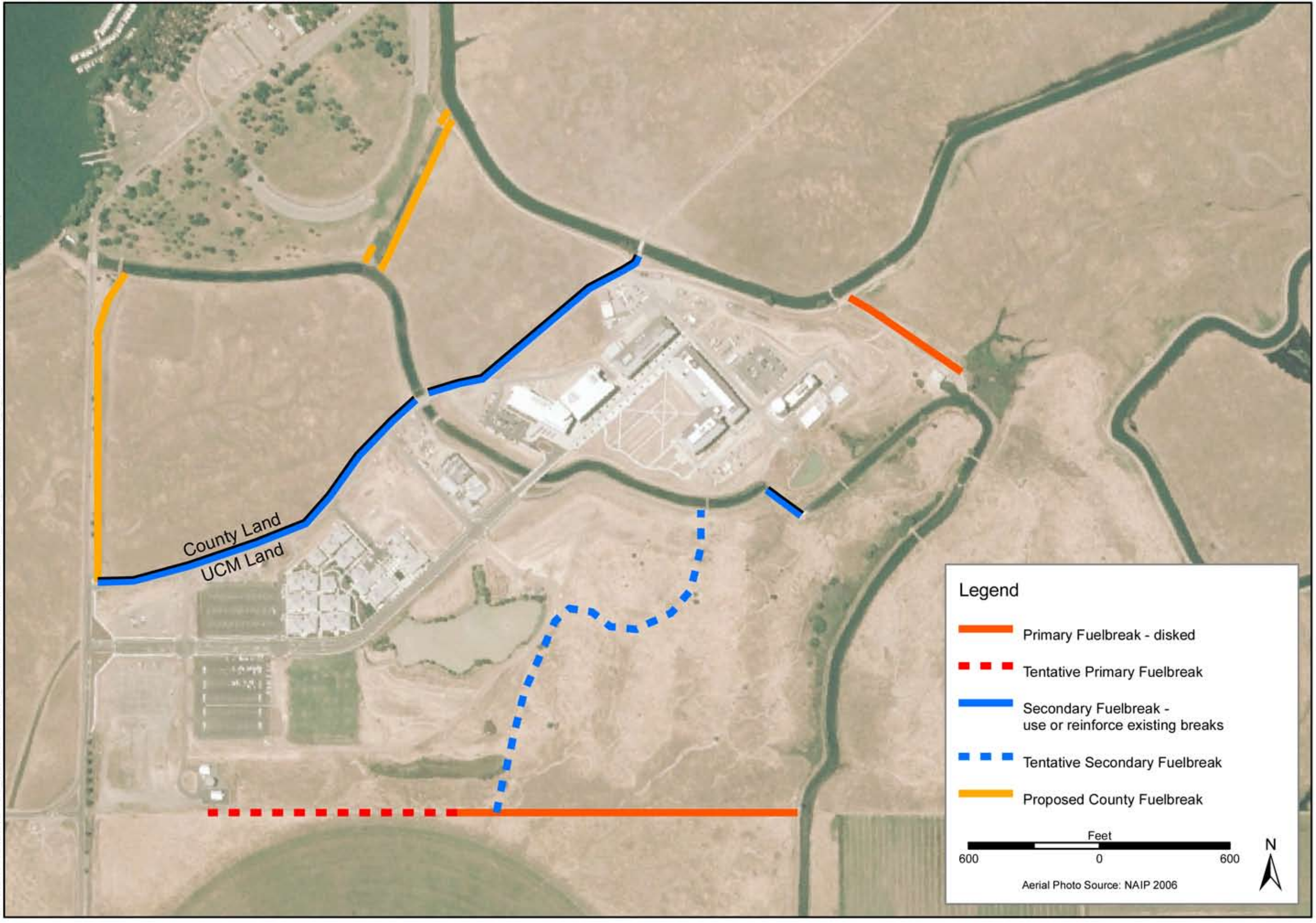
5.2.3.3 Suppression

FPM-9. Fire Suppression Capabilities. UCM will maintain capabilities to suppress grassfires on UCM Conservation Lands though fire protection service agreements with Cal Fire and the Merced County Fire Department. Available equipment will be capable of traveling on UCM Conservation Land roads, trails, and most overland areas. Available equipment will be sufficient to achieve an average fire incident response time of 30 minutes to the UCM Conservation Lands boundary.

FPM-10. Fire Suppression Methods. UCM will incorporate information specifying accepted and priority suppression methods into fire protection contracts with service providers. Suppression methods will give priority to non-ground-disturbing techniques (e.g., wetlines using water) over traditional ground-disturbing fireline construction to minimize disturbance. Use of suppression foam is prohibited. Providers will maintain adequate equipment and water to use in suppression efforts.

FPM-11. Authority over Suppression Operations. SNRI managers will maintain authority to approve suppression actions on their respective UCM Conservation Lands when fire does not pose a substantial threat to life and property. UCM will maintain updated information on the locations of sensitive resources to guide decisions of fire suppression entities so as to minimize disturbance of resource values.

FPM-12. Fire Restoration. Restoration needs for firelines and other areas disturbed during fire suppression activities will be evaluated by an interdisciplinary team within 2 weeks of a fire incident that required ground disturbance for fireline construction. Restoration efforts will be focused on restoring any disturbance of



Jones & Stokes

Figure 5-1
Generalized Fuelbreak System for UC Merced Phase 1 Campus

micro-typography that could alter wetland hydrology preventing erosion and colonization by invasive plant species (see Guideline IPM-7.)

5.2.3.4 Prescribed Fire

FPM-13. Prescribed Fire Uses. Use prescribed fire where appropriate to suppress undesirable weed populations that cannot be controlled through grazing management.

FPM-14. Prescribed Fire Planning and Approval. Prepare detailed burn plans for any proposed use of prescribed fire. Burn plans must meet Cal Fire standards be formally approved by Cal Fire. Plans should include ecological goals of burning, authorized personnel to conduct burning, resource protection measures, a fire safety and burn escape contingency plan, and liability specifications. Conduct interdisciplinary resource planning and prepare an environmental analysis document for all prescribed burns.

5.3 Unauthorized Uses Management Program

The presence of a growing campus and University Community will increase the potential for trespassing and other unauthorized uses on UCM Conservation Lands. The unauthorized uses management program is designed to reduce and control instances of unauthorized use through education and enforcement.

5.3.1 Program Goal

The goal of the unauthorized uses management program is the following.

- Protect UCM Conservation Lands from unauthorized uses though educational outreach and enforcement.

5.3.2 Program Objectives

The objectives of the unauthorized uses management program are listed below.

- Provide a multifaceted educational program for the campus and University Community regarding resource values of UCM Conservation Lands and inform users about restrictions in place to protect resource values.
- Maintain signage, surveillance, and enforcement at levels sufficient to detect, control, and discourage trespass uses on UCM Conservation Lands.

5.3.3 Management Guidelines

UUM-1. Public Education. Maintain a continuous public education program at the UCM campus and University Community to inform students, staff, and members of the general public concerning the sensitive resources within UCM Conservation Lands and the need for their protection. The campaign will use a variety of media, including orientation material to incoming students, outreach through campus publications and other media, interpretive facilities, and boundary signage. Incorporation of information on sensitive resources into educational programs and research (see *Research and Education Uses Program*) is also an integral part of the overall education of students regarding resource values of UCM Conservation Lands.

UUM-2. Training of Security Personnel. Personnel responsible for enforcing prohibitions on unauthorized uses will be regularly trained to ensure they understand use restrictions and reporting requirements for trespass and other infractions.

UUM-3. Public Use Security. The UCM police force will conduct routine daily and nighttime patrols of the campus perimeter to identify trespassers or maintenance activities that could pose a potential fire ignition threat to adjacent UCM Conservation Lands. Incidents of unauthorized entry or activities will be maintained and reported in annual monitoring reports. Police and the SNRI management staff will conduct regular observations of conservation lands from elevated sites (buildings) and by patrol of conservation lands.

UUM-4. Reporting by Authorized Users. Leases and use permits will specify that users promptly report any apparent unauthorized uses of UCM Conservation Lands.

UUM-5. Evaluation of Unauthorized Use Effects. Unauthorized uses other than simple trespassing will be evaluated by the SNRI Land Manager or a qualified individual to assess potential damage to soils, watershed conditions, and biota. Remediation of any resource damage will be conducted according to Plan guidance (e.g., Guideline HE-2)

5.4 Integrated Pest Management Program

A number of plant and animal species pose potential threats to resources of conservation value on Plan Area lands. Threats may occur directly though competition for space and predation or indirectly by affecting other management programs needed to manage habitats (i.e., grazing).

To minimize and avoid detrimental effects, UCM will employ an integrated pest management (IPM) program on UCM Conservation Lands. IPM involves the use of a variety of techniques in an integrated way to control damage from pest species, while minimizing the use of pesticides. The IPM program uses a variety

of means to prevent, detect, treat, monitor, and conduct research on pest species in ways that maximize impacts on target species while minimizing effects on species of conservation value potential safety issues.

This Plan focuses on identifying critical control points for introduction and establishment of pest species and applying management actions directed at these control points. Major modes of introduction and transport of various groups of pest species are shown in Table 5-1. A general strategy for preventing introductions and preventing establishment and spread of pest species is shown in Table 5-2.

Table 5-1. Importance of Various Modes of Dispersal and Introduction of Potential Pest Species Groups

	Modes of Dispersal and Introductions						
Pest Type	Intentional Human Introduction	Incidental Human Introduction	Livestock	Wildlife	Wind	Water	Self Propulsion
Plant	L	H	H	L	H	L	
Fish	H	M		L		M	
Amphibian	M	M		L		H	H
Reptile	M					M	L
Bird							L
Mammal	M	M					M

Notes: Assessment considers irrigation canals as sources of transport but not as a part of UCM Conservation Lands. Importance ratings: H = High, M = Moderate, L = Low.

UCM has prepared a Draft IPM manual for use on campus lands (UC Merced n.d.). While this manual focuses on control of pest species on campus facilities and lands, it also recognizes and incorporates objectives and actions to minimize the introduction and spread of pest species from the campus to conservation lands.

Potential pest species for TNC and UCM lands include a variety of invasive non-native plants, vertebrates, and other life forms (e.g., viruses). Targeted invasive plant species in Merced County (Shoenig and Skurka 2006) are listed below.

- Perennial pepperweed (*Lepidium latifolium*).
- Yellow star-thistle (*Centaurea solstitialis)*.
- Medusa-head (*Taeniatherum caput-medusae).*
- Water hyacinth (*Eichhorinia crassipes*).
- Russian thistle (*Salsola tragus)*.
- Salt cedar (*Tamarix* spp.).
- Poison hemlock (*Conium maculatum)*.
- Milkthistle (*Silybum marianum)*.

- Black mustard (*Brassica nigra*).
- Prickly lettuce (*Lactuca serriola*).
- Barb goatgrass (*Aegilops triuncialis*)

Noxious weeds with the greatest potential for disruption of communities on UCM mitigation lands are yellow star-thistle, Russian thistle, hemlock, milkthistle, black mustard, and prickly lettuce. Additional pest plants, however, are identified regularly, necessitating an active approach to identifying, surveying for, and controlling emerging pest species.

Major vertebrate pest species are mosquitofish (*Gambusia holbrooki*), various non-native warmwater game fish, bullfrog (*Rana catesbeiana*), non-native tiger salamander, non-native turtles, free-ranging and feral cats and dogs, red fox (*Vulpes vulpes*), and wild pig (*Sus scrofa*).

5.4.1 Program Goals

The goals of the IPM program are listed below.

- Develop and adaptively apply a comprehensive program capable of preventing, detecting, treating, and monitoring pest species.
- Conduct research to prevent introduction of noxious and invasive plants and animals into conservation lands.

5.4.2 Program Objectives

The objectives of the IPM program are listed below.

- Implement measures to prevent the introduction of non-native weeds by means of vehicles, equipment, footwear, or livestock feed.
- Maintain an ongoing, continuous monitoring and control program that provides early identification, detection, and control of noxious weeds and invasive non-native vertebrates.
- Maintain ongoing coordination with campus land planners, construction supervisors, and campus landscape management to enact on-campus measures to prevent and control noxious and invasive weeds on campus and University Community lands (and potential spread to Plan Area lands).
- Maintain coordination and consistency with California Noxious and Invasive Weed Action Plan (Schoenig 2005).

Table 5-2. Strategy for Monitoring and Treating Critical Control Points for Integrated Pest Managements

Key Resource	Key Pest Groups	Dispersal and Introduction Method	Critical Control Actions	Critical Control Point Sites	Monitoring Priority
Listed and special-status plants	Noxious weeds	Incidental human introduction	Remove soil and seed from equipment and footwear before entering UCM Conservation Lands Monitor for disposal of plants near UCM Conservation Land boundaries Monitor and control as needed	Lands adjacent to campus and Community, Yosemite Lake Park, LeGrande and Fairfield Canals, Paloma Road	Moderate–High
Listed and special-status plants	Noxious weeds	Introduction in supplemental livestock feed and feces	Require use of certified weed-free supplemental feed for livestock Select supplemental feeding sites on higher ground to minimize introduction of weeds to wetlands Focused weed monitoring at livestock concentration and supplemental feeding sites	Livestock concentration areas and supplemental feeding sites	Moderate
Listed and special-status plants	Noxious weeds	Wind dispersal	Minimize onsite ground disturbance Use certified weed-free materials for erosion control on adjacent construction sites Control weeds on adjacent disturbed construction sites	Livestock concentration areas, disturbed sites (including canals), adjacent construction areas	Moderate
Listed and special-status plants species	Wild pig	Self propulsion, purposeful introduction	Monitor for pig damage. Initiate professional control actions immediately upon detecting pig use	Throughout property, especially at boundaries	Moderate
California tiger salamander	Nonnative reptiles, amphibians, and fish	Purposeful and incidental introduction (including past introduction)	Prohibit fishing in UCM Conservation Land ponds that could encourage introduction of bait fish Prohibit disposal of pet reptiles, amphibians, and fish within UCM Conservation Lands Coordinate with Vector Control District to minimize any potential use of mosquitofish Monitor occupied breeding ponds to detect nonnative species and control introduced populations Modify stockponds that retain water year round to discourage competitive fish, reptiles, amphibians, and non-native eastern tiger salamander hybrids (if present)	Stock ponds and other wetlands	High

Table 5-2. Continued

Key Resource	Key Pest Groups	Dispersal and Introduction Method	Critical Control Actions	Critical Control Point Sites	Monitoring Priority
California tiger salamander	Nonnative reptiles, amphibians,	Self propulsion	Prohibit release of pest species (exotic turtles, bullfrogs, nonnative tiger salamanders) into aquatic habitats on the campus and within the community Control exotic turtles, bullfrogs, nonnative tiger salamanders in aquatic sites on the campus and community Monitor periodically for presence of pest species in adjacent aquatic habitats	Ponds and other aquatic habitats on the Campus and Community	Moderate
San Joaquin kit fox	Domestic and feral dogs and cats	Entry from campus and Community	Maintain effective animal control program on campus and UCM Conservation Lands	Campus and community and immediately adjacent lands throughout UCM Conservation Lands	High
San Joaquin kit fox	Red fox	Generalized range expansion	Initiate trapping and direct control when observed	Throughout UCM Conservation Lands	Moderate

5.4.3 Management Guidelines

5.4.3.1 Prevention of Pest Introduction

IPM-1. Pest Species List. Maintain an up-to-date list of potential pest species based on local, regional, and statewide information. The list should include species included on the California Invasive Plant Council's (Cal-IPC's) invasive species list, as well as emerging new pest species, to facilitate early detection and control. The lists of emerging invasive species should be developed and updated in cooperation with Merced County.

IPM-2. Use of Weed-Free Livestock Supplemental Feed. Require and verify use of certified weed-free hay and other supplemental feed sources for livestock within the Plan Area.

IPM-3. Cleaning of Plant Material from Equipment, Vehicles, and Footware. To minimize introduction of noxious and invasive weeds, require that equipment and vehicles entering the Plan Area from outside the campus and University Community be cleaned prior to entry. The lessee will be required to clean any accumulations of mud from beneath his/her vehicle. An on-campus wash station will be maintained. UCM will require cleaning of footwear by pedestrians prior to entry to the site. These conditions will be incorporated into all use agreements.

IPM-4. Prohibition on Purposeful Introductions of Detrimental Species. Prohibit purposeful introduction of noxious or invasive species or other species that would degrade conservation values of UCM Conservation Lands, including plant species for range forage enhancement and soil stabilization, bait fish, sport fish, mosquitofish, bullfrogs, and wild pigs.

IPM-5. Weed-Free Erosion Control Materials. Require certified weed-free sources for straw and other materials used for erosion control in construction areas.

IPM-6. Prohibition on Use of Invasive Species in Landscaping. Prohibit use of invasive species in landscaping on adjacent lands. Conduct education of landscape personnel and contractors and maintain an up-to-date list of prohibited landscape plant for campus and University Community use.

5.4.3.2 Detection

IPM-7. Early Detection of Pest Species Introductions. Maintain a regular monitoring program for noxious and invasive weeds on conservation lands and undeveloped campus and University Community lands that is adequate to provide early detection and rapid response to control pest species invasion. Emphasize areas where soil is disturbed or exposed, including fuelbreaks, areas adjacent to maintained canals, livestock feeding and watering areas, and burned

areas. If invasive weeds are detected, intensify surveys in the immediate area or in similar sites elsewhere to determine if other populations have invaded.

5.4.3.3 Treatment

IPM-8. Development of IPM Prescriptions for Each Pest Occurrence. Following detection of an invasive species, prepare a prescription describing the extent of the occurrence, potential risks, analysis of control options (e.g., grazing, fire, mechanical, herbicide), effectiveness and risks, and the proposed action and monitoring protocols.

IPM-9. Rapid Response to Control Detected Pest Invasions. Control actions for detected pest occurrences will be initiated quickly to prevent further spread. Timing of treatment will be determined on a species- or occurrence-specific basis.

IPM-10. Mosquito Control. Mosquito control on UCM Conservation Lands will be conducted only where significant threats to human health are demonstrated to exist (based on distance to human populations, mosquito abundance, prevailing winds, and/or other factors). Where control is essential, it will utilize methods that minimize effects on California tiger salamander and aquatic invertebrates. Use of mosquitofish in permanent ponds used by the California tiger salamander or during the period of salamander occupancy of intermittent ponds will require a determination of effects, and possibly take authorization from USFWS. Effects of treatment actions on listed aquatic species should be monitored.

IPM-11. Habitat Management and Direct Action to Control Aquatic Vertebrate Pests. If vertebrate pests (e.g., mosquitofish, bullfrogs) or non-native tiger salamander become established in suitable habitat for California tiger salamander, populations will be controlled using measures that result in the least amount of damage to salamander populations and target plant species. Control methods may include modifying pond configurations to discourage retention of water though the dry season, periodically draining ponds, or other treatment measures during the period when California tiger salamanders are not present (i.e., are aestivating in subterranean refugia) and after any wetland species of conservation concern have set seed or become dormant.

IPM-12. Coordination with Campus Authorities on Pet Control. Avoidance of conflicts between free-ranging pets and conservation species is best achieved through control of pets on campus. Incursions of free-ranging dogs will be minimized through enforcement of animal control regulations on the campus (UC Merced n.d). The SNRI land manager will coordinate regularly with the Public Safety Office to provide feedback and suggestions on pet control incidents, general pet control needs, and effectiveness of pet control techniques.

IPM-13. Direct Control of Non-native Terrestrial Vertebrate Pests. Upland terrestrial species that may pose threats to vertebrates of conservation concern,

approved management programs, or surrounding ecosystems may be directly controlled on site. Species that may be directly controlled include free-ranging dogs and cats, non-native red fox, and wild pigs. Incursions of free-ranging dogs will be minimized through enforcement of animal control regulations on the campus (see IPM-12). Land managers and grazing permittees will be authorized to shoot or otherwise eliminate any free-ranging dogs that harass livestock or wildlife, in accordance with relevant state and local laws. Control actions for non-native carnivores cannot include poisoning because of potential for effects on San Joaquin kit fox. Wild pigs will be immediately removed through trapping, shooting, or poisoning by a qualified and licensed pig control specialist. European starling (*Sturnus vulgaris*) and house sparrow (*Passer domesticus*) are considered infeasible to control in the Plan Area, but populations on campus should be minimized through design to discourage nesting in buildings.

IPM-14. Control of Non-native Rodents. Norway rat (*Rattus norvegicus*), black rat (*Rattus rattus*), and house mouse *(Mus musculus*) are likely to become localized inhabitants in lands adjacent to human dwellings and other buildings. They are difficult to control; at typical population levels, they are not considered a substantial threat to native species. Control efforts will focus on suppressing populations through on-campus efforts to protect human health (i.e., limitation of nesting sites, reduction in food availability, direct population control) (UC Merced n.d.).

IPM-15. Control of Native Rodents. Native rodents (ground squirrels [*Spermophilus beecheyi*], gophers [*Thomomys* spp.], voles [*Microtus* spp.]) are generally not considered pest species subject to control on UCM Conservation Lands, except in localized situations where they pose a direct threat to human health or important facilities. Use of rodenticides is prohibited under the terms of the VST easement. In particular, ground squirrels will not be controlled along farm roads or stock pond dams on VST lands. Any treatment to control rodents will avoid rodenticides that may be harmful to kit fox or other sensitive species. If any use of rodenticides is necessary on Adjacent Campus Buildout or CNR Lands to control rodent-transmitted diseases that could spread to the campus population, such application will be conducted in strict accordance with label instructions to minimize exposure of nontarget species and will be approved by USFWS.

5.5 Research and Educational Uses Program

The research and educational uses program allows scientific research and educational uses on UCM Conservation Lands while ensuring that these uses do not compromise the conservation and mitigation obligations for these lands. These programs are administered separately by TNC for the CST lands and UCM for the VST Preserve, CNR, and Adjacent Campus Buildout Lands. Research administration will also differ for UCM lands under the University of California Natural Reserve Program, if any UCM Conservation Lands are so designated.

Approved research and educational uses differ for UCM Conservation Lands and Adjacent Campus Buildout Lands.

5.5.1 Program Goals

The goals of the research and educational uses program are listed below.

- Provide opportunities for controlled scientific research on UCM Conservation Lands that contribute to basic knowledge and information useful for conservation management.
- Provide opportunities for UCM students and other students to learn about wetlands and other natural resources associated with grassland-wetland habitats.

5.5.2 Program Objectives

The objectives of the research and educational uses program are listed below.

- Ensure that all research and educational uses protect resource values of UCM Conservation Lands.
- Encourage research that provides both basic scientific information and information relevant to management to maintain environmental values of UCM Conservation Lands.
- Provide educational opportunities for UCM students, other student groups, and the general public to learn about and appreciate resources of vernal pool–grassland habitats.

5.5.3 Management Guidelines

5.5.3.1 Research Uses

REU-1. Appropriate Research Activities. Research conducted on UCM Conservation Lands must meet the following general conditions.

- Meet rigorous standards of scientific methods and merit.
- Address research questions including but not limited to those involving listed species, associated species, their habitats, and underlying physical and biological processes that contribute to an understanding and ultimately to the conservation of the species.

- Avoid or limit incidental take or other effects on listed species and their habitats to the minimum level feasible and consistent with limitations in the BO.
- Limit intentional take of listed species for scientific purposes to the minimum level necessary to address study objectives identified in an approved research proposal.
- Does not result in the introduction of non-native species.
- Ensure that any take for research purposes is authorized by USFWS under an approved ESA Section 10(a)(1)(B) permit for take for scientific purposes.
- Allow placement on conservation lands of measurement and sampling devices that are necessary to conduct approved research or educational uses and meet other requirements to minimize effects.
- Allow creation of grazing enclosures or exclosures as needed to protect research equipment or study grazing effects.

REU-2. Priorities for Locating Research Activities. From a resource protection standpoint, the priority locations for research use on UCM's lands (from most to least desirable) are Adjacent Campus Buildout Lands, CNR (outside the watershed of the Conservancy fairy shrimp pool), VST Preserve, and CNR (within the watershed of Conservancy fairy shrimp). Long-term research efforts, however, may require use of permanently protected lands. Research proposals should justify the use of lands outside Adjacent Campus Buildout Lands (e.g., needs for long-term studies that extend beyond the campus construction period, requirement for isolation from adjacent disturbance, needs for a large area or for conditions not supported on Adjacent Campus Buildout Lands) before such use is approved.

REU-3. Research Activities on Adjacent Campus Buildout Lands. Research activities on Adjacent Campus Buildout Lands can be less restricted because of the eventual development of, and "take" authorization granted for, these lands. Research on Adjacent Campus Buildout Lands should meet the following conditions.

- Research should meet the same requirements as listed for UCM Conservation Lands (see REU-1), except for specific approved uses.
- Some research that may be inappropriate for UCM Conservation Lands may be considered more appropriate for Adjacent Campus Buildout Lands, including experimental treatments that do not pose risks to resources on adjacent lands. Such research may include experimental treatments such as those listed below.
  - Evaluating effects of campus construction (e.g., impacts of noise, dust, and hydrologic disruption on species).
  - Testing methods to reduce construction impacts to improve their effectiveness (e.g., transplantation and seed collection for special-status plants, erosion control).

- Evaluating experimental land management methods for potential use on UCM Conservation Lands (e.g., fire control measures, prescribed burning and other IPM measures, experimental grazing regimes).

REU-4. Evaluation and Approval of Research Proposals. All research uses for UCM Conservation Lands will be approved by the SNRI land manager. The protocol for evaluation of research proposals is included in Appendix C. Individuals proposing research will submit a formal request for use with a research proposal. All approved research projects will have an approved research permit that identifies relevant conditions to minimize potential impacts on resources. In summary, the evaluation criteria listed below will be applied to research proposals.

- Sensitivity of the proposed site.
- Potential impacts of the activity on natural systems.
- Potential impacts on present or long-term research and educational uses.
- Compliance with laws, regulations, and project environmental commitments.
- Feasibility and scientific merit.
- Applicant's academic credentials.
- Certification of funding approval.
- Availability of suitable alternative sites.
- Compatibility with current leases and other uses.
- Potential conflicts with construction activities or creation of hazardous conditions.

REU-5. Availability of Research Results. To support management activities, results of research conducted on UCM Conservation Lands will be made available within a reasonable time period to UCM Conservation Land managers, the easement holder, and the agencies, consistent with the need to maintain researchers' rights to proprietary data. Reports approved for distribution will be made web accessible. Specific terms of information sharing will be outlined in the permit for each research project.

5.5.3.2 Educational Uses

The following guidelines govern general educational uses of UCM Conservation and Adjacent Campus Buildout Lands (i.e., other than formal research uses addressed above).

REU-6. Accepted Educational Uses—UCM Lands. Adjacent Campus Buildout and UCM Conservation Lands are available for supervised educational uses by university classes, as well as other users, including primary and secondary schools, youth groups, adult education, and other organized groups. Educational uses of UCM Conservation Lands are intended to be focused on

environmental values of the lands (e.g., basic biology, ecology, hydrology, geology, soil science, range management). The lands are not to be used for general purposes that could be met in less sensitive lands.

Priority locations for nonresearch educational use of UCM's lands (from most to least desirable) are Adjacent Campus Buildout Lands, CNR (outside Conservancy fairy shrimp watershed), VST Preserve, and CNR (within Conservancy fairy shrimp watershed). Educational use proposals should justify the use of lands outside the Adjacent Campus Buildout Lands. Use of the Adjacent Campus Buildout Lands for research may be infeasible where such uses conflict with, or would be compromised by, campus site preparation activities (including advanced tree planting) and construction.

REU-7. Educational Use Areas for UCM's Lands. Nonresearch educational uses are to be restricted to the Adjacent Campus Buildout Lands and designated areas of the CNR and VST Preserve to minimize impacts on resource values and avoid conflicts with approved research projects. Over time, as the campus is constructed, additional lands may be needed for educational uses to replace those lost to campus development and to serve a larger campus population. These needs should be reevaluated over time, and this Plan can be amended, as needed, with appropriate approvals.

REU-8. Approval Process and Requirements. All proposed educational uses require issuance of an annual education use permit by SNRI land managers. Applicants will submit a permit form (Appendix C) describing the desired use, its educational purpose, areas proposed for use, methods to be employed, measures to be incorporated to ensure protection of resource values, and disposition of any resulting data relevant to land management. Permits may be renewed annually if all terms have been met.

REU-9. Supervision of Educational Use of UCM Lands by Non-UC Groups. In addition to other guidelines applicable to all users, a trained environmental monitor provided by the SNRI land manager's staff will accompany non-UCM groups during use of UCM Conservation Lands.

5.6 Habitat Protection and Enhancement Program

The habitat protection and enhancement program consists of the broad categories of activities listed below.

- Measures to minimize, evaluate, and restore authorized or unauthorized human disturbance of soils and watershed conditions.
- Required or discretionary enhancement activities to improve or maintain habitat for wildlife and plant species and overall wetland functions.

The primary habitat enhancement program activities are construction of artificial kit fox dens and maintenance of stock ponds (see related management actions in

Appendix B). A related action occurring outside the Plan Area is installation of a canal crossing to enhance kit fox movements. A variety of other management activities that may enhance the overall value of habitats (e.g., grazing, fire control, invasive species control) are addressed in the discussions of other management programs in this chapter.

5.6.1 Program Goals

The goals of the habitat protection and enhancement program are listed below.

- Restore habitat function of areas of ground disturbance following completion of disturbing events.
- Enhance habitat quality for San Joaquin kit fox to meet requirements of the BA by providing artificial dens.
- Allow other wildlife enhancements that would not be detrimental to other target biological resources.

5.6.2 Program Objectives

The objectives of the habitat protection and enhancement program are listed below.

- Implement measures to minimize and restore areas of habitat disturbance.
- Construct eight artificial dens on UCM Conservation Lands to enhance habitat and provide protection for San Joaquin kit fox from free-ranging dogs.
- Allow artificial nesting sites to be placed for burrowing owls and nesting boxes to be erected for other cavity-nesting birds (e.g., bluebirds, swallows, wood ducks).

5.6.3 Management Guidelines

HE-1. Authorized Temporary Ground Disturbance. The following guidelines apply for all authorized activities that result in temporary ground disturbance (e.g., HE-3, *Construction of Kit Fox Burrows*, but not ongoing programs such as FPM-1, *Fuelbreak Construction*).

- Conduct required predisturbance surveys for target plan species (Table 3-1) and for suitable burrows for sensitive wildlife species. Preferentially select sites that do not support suitable burrows or dens for target species.
- Minimize the amount of area disturbed.
- Avoid wetland areas.

- Temporarily store top 6–10 inches of topsoil to replace after completion.
- Evaluate whether it is necessary to seed and/or mulch disturbed areas, and if so, use plant materials collected on site or from immediately adjacent areas.
- Use certified weed-free sources of local annual grassland mixture for reseeding where collection of plant materials from onsite or adjacent sources is not feasible or desirable.

HE-2. Evaluate and Restore Unauthorized Disturbances. Evaluate areas where unauthorized ground-disturbing uses are detected to assess damage to resources. Prescribe treatments to minimize damage and restore habitat functions, and conduct treatments with follow-up monitoring to assess effectiveness.

HE-3. Construction of Kit Fox Burrows. As required in the project BO, construct eight artificial burrow sites for San Joaquin kit fox on VST Preserve lands, at least 0.5 mile from the edge of the ultimate campus perimeter. Each den will be constructed of 6- by 12-inch diameter polyethylene drainage pipe connected to a plastic valve box (approximately 24 by 12 by 18 inches) to serve as a den chamber. Locations and final design will be approved by USFWS.

HE-4. Other Structural Habitat Improvements. Allow installation of secure artificial nest chambers for burrowing owls and nest boxes for bluebirds, tree swallows, wood ducks, and other species that will not disrupt existing grassland species communities. Box designs and locations should be selected to discourage use by non-native European starlings or house sparrows. To avoid potential conflicts with conservation species, nest structures should not be installed that could be used by Canada geese, nesting raptors, raccoons, or other mammalian predators.

5.7 Recreational and Other Public Uses Program

In general, recreation for the campus and University Community populations will be provided within the campus and University Community. Recreation and general public uses are not emphasized uses of UCM Conservation Lands but limited uses are permitted under the terms of the VST conservation easement. Recreation is more appropriate as an interim use on Adjacent Campus Buildout Lands because their resource values will eventually be eliminated through development of the campus.

Any recreational uses of UCM Conservation and Adjacent Campus Buildout Lands must be carefully managed to avoid impacts on resource values and on other management programs (livestock grazing, education and research, fire protection, and IPM). Recreation needs for the campus are relatively low at present (2007) because of the small student population, but they are expected to grow as the campus and enrollment grow. Consequently, the recreational use program and management direction in this Plan are intended for an interim period

of 5 years. At that point, recreation needs, effects, and management strategies may need to be revised.

5.7.1 Program Goals

The goals of the recreational and other public uses program are listed below.

- Provide recreational opportunities that are consistent with resource protection and management needs.
- Allow only those recreational uses on UCM Conservation Lands that would not diminish biological resource values or conflict with other required management activities.

5.7.2 Program Objectives

The objectives of the recreational and other public uses program are listed below.

- Provide opportunities for low-intensity recreation uses (hiking, running, nature study) on UCM Conservation Lands.
- Emphasize resource protection in all recreation use decisions on UCM Conservation Lands.
- Focus the recreation management program on an initial interim period of 2007–2012, with a subsequent plan revision.
- Focus consideration of more intensive recreational uses on Adjacent Campus Buildout Lands (because impacts of campus development are already incorporated into mitigation).
- Consider long-term implications of creating recreation demands before allowing interim use of Adjacent Campus Buildout Lands for recreation.
- Ensure that management requirements for a recreational use program do not result in allocation of funds needed to perform other resource management and monitoring efforts required by project mitigation.
- Focus recreation programs to serve the recreation needs of the campus and University Community.
- To the extent feasible, provide any offered recreational uses on an equal-access basis to users of a wide range of physical abilities.
- Monitor effects of recreation use, for use in adaptive management.

5.7.3 Management Guidelines

Management guidelines are provided separately for different groups of properties.

5.7.3.1 UCM Conservation and Adjacent Campus Buildout Lands

R-1. Restrict Recreation Uses to Those Low-Intensity Uses that Cannot Be Accommodated within the Campus and Community. Consideration of recreational uses on Plan Area lands will be limited to those uses that cannot be accommodated within the campus and University Community. In general, applicable uses are those that require or substantially benefit from natural lands or open space conditions. Examples of potential recreation uses that may be considered appropriate include hiking, birding, botanizing, trail running, and stargazing. Such uses will provide reasonable handicapped access.

R-2. Prohibited Uses. The following recreational activities and uses are prohibited as recreational uses. The list represents potential uses that may be likely to be requested, but is not a complete list of prohibited uses.

- Motorized vehicles.
- Fireworks, stoves, campfires, barbeques, and other activities that could create sources of fire ignition.
- Pet exercise or training.
- Plant collecting (except for scientific purposes).

R-3. Restrictions to On-Trail Use. Low-intensity uses will be restricted to existing roads and trails.

R-4. Application for Use. Potential recreation users must submit a request for use of UCM Conservation or Adjacent Campus Buildout Lands (Appendix C); the SNRI land manager will evaluate and either approve or deny each request.

R-5. Evaluation of Biological Effects and Agency Approval. Although recreational uses are not entirely precluded on UCM Conservation Lands, higher intensity uses are discouraged. Any proposed recreational uses will require careful evaluation of potential direct and indirect effects on wetland and federally listed species prior to approval. If the biological evaluation demonstrates potential for damage to wetland habitats or take of listed species, UCM will either deny the proposed use, modify the use to avoid these effects, or consult with the regulatory agencies to acquire approval for the activity. The costs for any consultation and permitting should be expected to be borne by the use applicant.

R-6. Recreation Plan Element Revision. This recreation program should be revisited within 5–10 years of Plan approval. An accelerated schedule for program reevaluation is warranted because expansion of the campus may reveal additional needs or conflicts that should be resolved in the Plan.

R-7. Restricted Recreation Use of UCM Conservation Lands. Recreation use is not precluded under the terms of TNC's easement on VST lands. Generally,

recreation use will be limited on UCM Conservation Lands. Recreational uses will be allowed on these lands only if the following criteria can be demonstrated.

- Their need cannot be fulfilled on campus and University Community lands or other non–UCM Conservation Lands.
- They will not result in impacts on biological resources or other management uses.
- Adequate supervision will be in place to minimize any detrimental effects.
- Monitoring will be conducted to detect any detrimental effects and to inform the permitting process.

R-8. Focused Recreation Use on Adjacent Campus Buildout Lands. Because the Adjacent Campus Buildout Lands are slated for eventual development, and because the effects of this development have already been evaluated and mitigated, these lands are considered substantially less sensitive than UCM Conservation Lands. Consequently, Adjacent Campus Buildout Lands should be considered first for proposed uses that require natural or open space lands. Other (i.e., UCM Conservation) lands should be considered only if the uses cannot be accommodated on Adjacent Campus Buildout Lands. Potential reasons for approving recreational uses of Adjacent Campus Buildout Lands could include the following.

- A need for an area of land that exceeds that available on the Future Campus.
- A need for special land characteristics that do not occur on the Future Campus.
- The use would conflict with campus construction or operation.

5.8 Cultural Resources Management Program

As noted in Chapter 3, no extensive cultural resources surveys have been conducted on UCM Conservation Lands because no substantial actions are proposed that would result in land disturbance. Based on surveys conducted on Adjacent Campus Buildout Lands and other sources, the preponderance of UCM Conservation Lands are not considered highly sensitive for archaeological and historic resources.

Limited potential exists for disturbance of archeological and historical resources during those few management actions that may result in ground disturbance, such as fuelbreak construction, stock pond maintenance, road maintenance, and soil disturbance to control noxious weeds. Therefore, management direction to protect cultural resources has been incorporated into the Plan.

As it pertains to Adjacent Campus Buildout Lands, this program addresses only interim measures to protect cultural resources prior to campus development. Measures to protect cultural resources during campus construction are addressed in the LRDP EIR (UC Merced 2002).

5.8.1 Program Goals

The goal of the cultural resources management program is shown below.

- Protect any sensitive cultural resources during implementation of other management and research activities on UCM Conservation Lands.

5.8.2 Program Objectives

The objectives of the cultural resources management program are listed below.

- Preserve and protect significant cultural resources
- Provide for appropriate research and educational uses of UCM Conservation Lands for cultural resources.
- Maintain relationships with Native Americans who have ancestral ties to UCM Conservation Lands.
- Ensure that interim management of the barn and other historic and cultural resources on Adjacent Campus Buildout Lands are managed in accordance with requirements of the LRDP EIR (UC Merced 2002) and the forthcoming EIS/EIR.

5.8.3 Management Guidelines

CR-1. Prevention of Vandalism of Cultural Resources. Protect cultural resources on site from vandalism through ongoing trespassing surveillance and enforcement and through monitoring of permitted uses.

CR-2. Cultural Resources Inventory. The SNIR land managers will maintain a confidential record of any known sensitive archeological and historic resources and their locations. Managers will use this information to evaluate potential effects of proposed management, research, and educational activities and as a focus for law enforcement.

CR-3. Records Search Requirements before New Ground Disturbance. Review the cultural resource inventory to identify potentially significant resources prior to approval of any ground disturbance associated with management activities or research.

CR-4. Surveys and Evaluation prior to Ground Disturbance. Qualified cultural resource specialists will examine any previously disturbed sites proposed for ground disturbance in excess of 0.2 acre. Any archeological or historical resources will be recorded and evaluated using standard procedures.

CR-5. Cultural Resources Protection during Ongoing Management Activities and Permitted Uses. Avoid disturbing significant cultural resources

sites and sites of unknown significance from ground disturbance during ongoing management activities (e.g., fuelbreak design, construction, and maintenance) and permitted uses.

CR-6. Mitigation Requirements where Sites Cannot Be Avoided. If identified cultural resource sites cannot be avoided or if the boundaries of a site are unknown, consult a qualified archaeologist (including tribal experts designated by the tribe) for mitigation recommendations. Mitigation measures may include performing subsurface testing to determine the extent of a site, recovering data through research and excavation, or "capping" sites with a protective layer of material.

CR-7. Procedures for Accidental Discoveries. Document existing procedures to be used if potentially significant cultural resources or human remains are discovered accidentally, and regularly review and update these procedures.

5.9 Visual Resources Program

The UCM Conservation and Adjacent Campus Buildout Lands provide an important natural viewshed for the campus. The visual value of these lands will increase as buildout occurs and more people occupy the campus. Also, the lands of greatest importance will change, as campus growth eliminates natural lands adjacent to previously developed portions of the campus and causes former background lands to become the foreground for new campus areas.

5.9.1 Program Goal

The goal of the visual resources program is shown below.

- Protect any visual resources during implementation of management and research activities on UCM Conservation and Adjacent Campus Buildout Lands prior to their development.

5.9.2 Program Objective

The objective of the visual resources program is shown below.

- Evaluate potential effects of management actions and permitted uses on visual resources of UCM Conservation and Adjacent Campus Buildout Lands, and minimize potential detrimental effects.

5.9.3 Management Guidelines

VR-1. Visual Resource Sensitivity Map. Prepare a map showing lands that are within the viewshed of the existing and future campus and that therefore warrant priority visual resource consideration in planning and implementing management programs and permitting uses. Separately designate areas of current high visual sensitivity (i.e., to occupants of the current campus facilities) and of future sensitivity (i.e., within areas visible from future facilities). Update this map in response to changes in the campus footprint as development proceeds.

VR-2. Visual Resources Protection for Management Actions and Permitted Uses. Consider effects on visual quality during planning and implementation of management actions and in evaluating research and other permitted uses. Seek ways to minimize effects on visual quality, while meeting needs for other management actions and uses. Notwithstanding the eventual need for disturbance to construct on Adjacent Campus Buildout Lands, to the extent feasible, maintain visual resource quality during the interim period prior to construction.

5.10 Interjurisdictional Coordination Program

This program differs from others in that it focuses on interactions of the SNRI land managers with external authorities and managers. In addition to simply maintaining good relations with neighboring landowners and land use authorities, this program is intended to ensure that the potential effects of actions on adjacent lands are recognized and that the SNRI managers provide input to protect mitigation lands from adverse effects.

5.10.1 Program Goal

The goal of the interjurisdictional coordination program is shown below.

- Maintain communications and cooperative relationships with adjacent landowners and managers and with authorities with jurisdiction over UCM lands to minimize detrimental effects of management actions on conservation resources.

5.10.2 Program Objectives

The goals of the interjurisdictional coordination program are listed below.

- Communicate and coordinate with owners, managers, and authorities of adjacent lands to minimize detrimental effects on UCM Conservation Lands and conflicts with adjacent landowners and to learn from each other's management experiences.

- Provide regular communication to easement holders and regulatory agencies as required by permits, easement terms, and other environmental commitments.

5.10.3 Management Guidelines

IC-1. Sharing of Management Information. Regularly share information between UCM, managers of adjacent lands, and easement holders regarding management practices, research and monitoring results, and adaptive management changes.

IC-2. Maintenance of Contacts with Adjacent Landowners and Jurisdictions. Make regular informal contacts with surrounding landowners and land management authorities, including County Parks (Yosemite Lake), irrigation districts, the Merced Mosquito Abatement District, other agencies, and private landowners, to learn about proposed management actions and offer assistance to minimize their effects. Seek opportunities to collaborate on and share management responsibilities across property lines to improve efficiency and reduce potential resource impacts.

IC-3. Monitoring of Adjacent Uses. Monitor land use proposals and land management actions of UCM, the University Community, the City of Merced, and Merced County, and provide input to ensure that the protection and management needs of UCM Conservation Lands are recognized and addressed.

IC-4. Submission of Compliance Reports. Submit regular compliance reports as specified in project permits and environmental documents

Chapter 6

Management Direction for CST Conservation Lands

The management program for CST Conservation Lands is consistent with the overall mitigation approach: to acquire and protect lands with high resource values and maintain the long-term management activities that have created and maintained these values. The primary protection provided to CST lands is the granting of a conservation easement with standard provisions required by the USFWS and DFG. Thus, management direction in the plan for CST lands focuses on provisions to be included in the proposed easement and on guidance regarding its administration to ensure protection of conservation values.

6.1 Protections Incorporated into the CST Conservation Easement

This section summarizes expected CST easement requirements to ensure consistency with USFWS and DFG standard easement provisions. The CST easement provisions included here could change prior to final adoption; such changes will be incorporated into a final version of this Plan.

6.1.1 Terms Expected to be Common to Easements for CST and Tier 2 Conservation Lands

The basic terms of the CST easement will require that the landowner preserve and maintain the conservation values of lands through compatible livestock grazing and other management practices. The easement will restrict property uses and grant the easement holder a perpetual right to preserve, protect, identify, monitor, enhance, and restore the conservation values. The landowner will retain the right to pursue a variety of land uses and exercise other rights, as long as they maintain the conservation values of the land. These permitted uses are listed below.

- Livestock grazing, subject to the following requirements.
  - Prevent an increase in noxious weeds.

  - Retain 800 pounds per acre of residual dry matter (RDM) at the end of the growing season.
  - Locate food supplements (e.g., salt and mineral licks, food supplements, and supplemental feed) away from vernal pools.
- Prescribed burning.
- Use of herbicides (only to control non-native noxious weeds).
- Occupancy of existing residential dwellings.
- Ability to plant and maintain gardens and raise other farm animals and pets that are confined to residential areas.
- Hunting and fishing (with restrictions on fish stocking).
- Water source development and maintenance for livestock and wildlife use.
- Passive recreation.

Prohibited uses are listed below.

- Land subdivision.
- Transfer of development rights.
- Non-ranching commercial uses, including development of natural resources (minerals, aggregate, energy).
- Disposal of hazardous waste, refuse, etc.
- Junkyards.
- Long-term leasing.
- Alteration of water courses, degradation of water quality, or impairment of water rights.
- Off-road vehicle use, except for use in ranching operations.
- Introduction of plant and animal species.
- Plowing, disking, land leveling, irrigation, or other alterations, except disking for fire control.
- Conversion to crops, orchards, or vineyards.
- Destruction of native vegetation (except by grazing or burning).
- Harvesting timber.

The easement holder will be granted the rights listed below.

- Reserve, protect, identify monitor, enhance, and restore in perpetuity the conservation values of the land.
- Conduct evaluations of wetland quantity and quality, evaluate habitat quantity and quality, survey for threatened and endangered species, and monitor their populations.

- Access the lands to monitor, assess compliance, and take all actions necessary to achieve the terms of the easement.
- Install and maintain signage.
- Employ controlled burning, pesticides, or other means to control noxious weeds (if grazing is found to be ineffective).
- Fence riparian habitats.

6.1.2 Additional Requirements Expected in the CST Easement

Consistent with the standard terms for conservation easements required by USFWS and DFG, the CST Easement Lands are expected to incorporate the provisions listed below.

- Access by the permitting agencies (USFWS, DFG) to the CST Easement Lands will be permitted to verify that the easement holder is enforcing the terms of the conservation easement and to facilitate frequent and flexible monitoring of resource conditions and management practices. This access will be coordinated through the easement holder with reasonable time allowed to arrange access.
- The CST conservation easement holder will submit regular and timely compliance monitoring reports to the permitting agencies and UCM.

Other provisions may be added during development of the specific easement language.

6.2 CST Easement Administration

The easement holder will conduct variety of routine tasks to administer easements. These activities are listed below.

- Annually remind the CST landowners of easement responsibilities and identify the easement holder's easement administrator.
- In the event of a proposed land sale, ensure that future landowners are notified of easement requirements.
- Coordinate regular monitoring to assess compliance with the terms of the conservation easement (see Chapter 7).
- Provide results of monitoring efforts to landowners, permitting agencies, and UCM.
- Coordinate with landowners to adjust their management activities in accordance with the terms of the easement.

Beyond strict legalistic administration of the easement, it is important that easement administrators maintain cooperative, goodwill relationships with the CST landowner and UCM (as the adjacent VST landowner) to facilitate beneficial resource management.

Chapter 7
Monitoring and Reporting

Monitoring programs for UCM and CST Conservation Lands differ in intensity, due to the difference emphasis on fee title ownership and management and reliance on a conservation easement for land protection. Consequently, the monitoring programs are discussed separately for the two categories of conservation lands.

7.1 UCM Conservation Lands

UCM has committed to a monitoring program for UCM Conservation Lands to demonstrate its compliance with environmental commitments and permit requirements and to evaluate the effectiveness of measures undertaken to protect and enhance resources. Key elements of an effective and efficient monitoring program for the UCM Conservation Lands are shown below.

- An appropriate measure of the baseline (preproject) conditions.
- An effective system for monitoring and reporting compliance with Plan requirements.
- A program to evaluate the effectiveness of management measures in achieving the desired resource conditions.

The monitoring program is designed to provide a level of focus, effort, and cost that is commensurate with the levels of uncertainty and potential for any substantial unintended consequences. Thus, the level of monitoring effort to assess potential outcomes that are more likely to occur and have greater potential impacts on resources will receive higher priority than efforts to assess other potential outcomes that are unlikely to occur or not likely to have significant consequences. The monitoring program also must be adaptive, because the potential for impacts on key resources in the Plan Area may change over time (for example, as the campus and University Community grow closer to conservation lands, or new invasive plant species arrive in the region).

This Plan outlines the key elements of the monitoring program for UCM Conservation Lands. To ensure consistency and efficiency, the specific monitoring protocols will be developed following approval of this Plan. This detailed monitoring protocol will be prepared as a separate Plan Element and appended to this Plan.

7.1.1 Baseline Monitoring

The purpose of baseline monitoring is to establish the resource conditions that will serve as the basis for evaluating the effectiveness of management activities set forth in the Plan. Baseline conditions for the UCM Conservation Lands will be based on previous inventories and analyses conducted for wetlands and special-status species. The metrics to be used in evaluating effectiveness will be chosen during development of detailed monitoring protocols. The management and monitoring commitments outlined in the Plan will determine the scope and focus of monitoring efforts. Accordingly, the baseline monitoring component of the Plan consists of identifying (1) the key program metrics to monitor for compliance, and (2) the resource conditions at specific monitoring sites that will serve as a basis of comparison for effectiveness monitoring.

7.1.2 Compliance Monitoring

Compliance monitoring can be divided into three basic types based on the frequency and regularity of the actions that it monitors: annual activities (performed at least once each year); regular periodic actions (performed at regular intervals, e.g., every 5 years), and irregular actions (actions conducted in response to conditions that do not occur on a predictable basis). Irregular management actions are those that are required only under certain conditions. Many of these are one-time actions conducted at the onset of Plan implementation, or they are triggered by irregularly occurring phenomenon such as treatment of detected invasive plants, active suppression of wildfire, construction of habitat improvements (e.g., kit fox dens), and maintenance of stock ponds.

Compliance with the Plan's management and monitoring requirements will be documented by completing an annual reporting checklist that verifies and reports on management activities that were undertaken, as well as those not undertaken. The checklist identifies all prescribed management, maintenance, and monitoring actions that are to be conducted on an annual, regular periodic, or irregular basis. A draft of the Annual Management Plan Compliance Checklist, Schedule, and Reporting Form (Annual Reporting Checklist) is included as Appendix D.

The monitoring checklist will serve several purposes. It will serve as a concise summary list of required management actions for the SNRI land manager. Also, annual completion of the checklist will document completion of required management actions for reporting to the UCM Environmental Affairs Director and to regulatory agencies. Finally, the checklist will provide a place for the land manager to identify any issues with any of the management requirements in the Plan that may require modification through adaptive management.

Compliance monitoring for the Plan will include the items listed below.

- Annual completion and submission of the Annual Reporting Checklist

- Verifiable on-the-ground evidence of management actions.
- Adaptive changes to the Plan as recommended in the monitoring checklist.

7.1.3 Effectiveness Monitoring

Effectiveness monitoring will evaluate how well the Plan performs in meeting its ultimate goals—or, in other words, in achieving the desired conditions on the ground. Effectiveness monitoring is centered on evaluating the conditions of physical, natural, and cultural resources (e.g., soils, watersheds, wetlands, special-status plants and animals, archeological and historical sites, and visual quality). Monitoring will be carefully designed and implemented to evaluate the effectiveness of specific management actions.

Effectiveness monitoring requires specific monitoring protocols. These protocols will be developed under the leadership of the SNRI to be consistent with the direction provided here, following approval of the Plan. Key management actions and resource conditions to be monitored are presented in Table 7-1. Individual monitoring protocols will be developed to address individual resources and management actions, but these protocols will share the basic framework summarized below.

- Monitoring goals and objectives.
- Locations.
- Monitoring methods.
- Analysis and reporting.
- Success criteria.
- Recommendations for future management and monitoring.

7.1.4 Data Management and Reporting

Monitoring protocols and results will be maintained by the SNRI land manager in an organized and accessible fashion (e.g., GIS files) to facilitate their ongoing use in managing lands and conservation resources. The land manager will prepare an annual report describing the monitoring that was conducted and summarizing results for distribution to the resource agencies, the easement holder, and general public. The annual report will specifically address the effectiveness of management actions implemented under the Plan, as well as remedial measures or modified management measures (see Chapter 8, *Adaptive Management*). Occurrences of special-status species, especially new species and locations, will be provided regularly to the California Natural Diversity Database. UCM also will host periodic meetings with regulatory agencies and other interested parties to evaluate plan effectiveness and discuss adaptive management responses.

7.2 CST Conservation Lands

The CST easement holder will conduct annual monitoring of compliance with the terms of the easements and the effectiveness of management actions taken. Annual monitoring efforts will focus mostly on compliance. Beyond simple compliance, the easement holder should focus monitoring on several conditions that may determine conservation values. Key resources for monitoring are listed below.

- Presence and extent of noxious weeds and potential threats they pose to species of conservation priority.
- Presence of non-native reptiles, amphibians, and fish in water bodies.

If monitoring of CST Conservation Lands identifies noncompliance with easement terms that is likely or is demonstrated to cause detrimental effects on species of conservation concern, the easement holder should, in a timely manner, proceed to work directly with landowners or take other actions as required to achieve compliance.

The CST easement should specify that annual compliance reports, based on monitoring conducted by the easement holder, be prepared annually and submitted to USFWS, DFG, and UCM.

Table 7-1. Effectiveness Monitoring Requirements for UCM Conservation Lands

Management Program	Activity	Frequency	Notes
Grazing	Evaluate RDM levels under various weather conditions to assess appropriateness of stocking rates	Annually	Conduct visual checks using photo points, calibrated with clipping plots
	If wetlands occupied by San Joaquin Orcutt grass and Colusa grass are grazed, evaluate grazing effects on seed production and subsequent year's growth	Per incident, if grazing occurs in occupied habitat	May be discontinued once effects are understood
	Monitor relationships between soil disturbance and noxious weed occurrence in high livestock use areas to evaluate whether moving high use areas reduces or increases incidence of noxious weeds	Report as meaningful information becomes available	Monitor using visual inspection of marted transects, photo-points, and visual inspection
Fire Protection and Management	Maintain records of fire occurrence (location, acreage) sufficient to evaluate changes in fire frequency	Per incident	Maintain in GIS
	Monitor firebreaks for noxious weeds	Annually	
	Evaluate effectiveness of non-ground-disturbing techniques to control wildfire	Per incident and generally	"Monitoring" based on reporting from Incident Commanders, experience of CDF fire personnel
	Monitor fire restoration efforts	Per incident	Monitor burned sites for invasion by noxious weeds, using visual evaluation and subsequent quantitative sampling of detected invasions
Integrated Pest Management	Conduct regular monitoring for noxious and invasive weeds, with intensive follow up surveys and quantitative monitoring if new weeds are detected. Monitor at higher intensity at critical control points including the Campus edge; fuelbreaks; lands adjacent to Paloma Road, Yosemite Lake Park, and canals; supplemental feed use and storage areas; and recent fires.	Semi-annually	
	Routinely monitor water bodies with known or potential use by the California tiger salamander to detect nonnative fish, amphibians, and reptiles.	Annually	
	Monitor effectiveness of specific non-native species control operations	Per incident; duration determined by individual plan	

Table 7-1. Continued

Management Program	Activity	Frequency	Notes
Research and Educational Uses	Monitor each permitted research and educational use to evaluate any effects on ecosystems (noxious weed introduction, soil disturbance and erosion, etc.).	Annually during and immediately following permitted use periods	
Habitat Enhancement and Management	Monitor artificial dens for use by kit foxes	Annually for 10 years	
	Maintain a sightings record database for observations of kit foxes and potential competitors and other species of conservation concern that may not be monitored systematically (i.e., burrowing owl, Swainson's hawk, mountain plover).	Continuously; summarized annually	
	Monitor populations of species of conservation concern including special-status plants, invertebrates, and California tiger salamander.	Annually	Develop a comprehensive monitoring protocol sufficient to detect long term population trends (i.e., >5 years)
Recreation and Other Public Uses	Monitor each permitted recreational use to evaluate any effects on ecosystems (noxious weed introduction, soil disturbance and erosion, etc.).	Annually during and immediately following permitted use periods	Focused on key used areas
	Monitor and report on any resource damage at any sites where unauthorized use is reported that results in disturbance of soil or vegetation.	Per incident	
Cultural Resources	Conduct archeological record and site surveys for any site that is proposed for >100 ft^2 ground disturbance	Per incident	
	Monitor for disturbance of archeological and historical sites during routine patrol	Weekly-monthly basis	

Chapter 8
Adaptive Management

8.1 UCM Conservation Lands

8.1.1 Rationale

The management outlined in this Plan represents UCM's best efforts to define management actions that will achieve the conservation purposes of the UCM Conservation Lands as reviewed and approved by the regulatory agencies. Nonetheless, the proposed management program is a first approximation based on available information from past management history in the Plan Area and the experiences of all parties in managing other similar lands. The parties, however, acknowledge that they cannot have foreseen all future management conditions and responses. Consequently, the Plan has adopted an adaptive strategy to refine the management program over the life of the Plan.

Adaptive management entails incorporating the results of empirical research and monitoring of previous management activities into future management activities. The information used to adapt management practices for the Plan may include results of formal research, monitoring results, or general observations of the SNRI land managers. .

Adaptive changes to management may be warranted for a variety of reasons, such as errors in assumptions regarding effects and efficacy of management practices or changes in environmental conditions (e.g., adjacent campus development, arrival of new invasive species).

While this plan emphasizes monitoring of management programs, active research on key issues also is an important component of a long-term conservation of UCM Conservation Lands. The presence of the University and its environmental research focus provides an ideal means to incorporate research into long-term adaptive management efforts.

8.1.2 Process for Adjusting Management Programs

Adaptive changes to management of Conservation Lands may be accomplished in several different ways, depending of the level of management change. As described below, minor changes may occur on an ongoing basis with appropriate documentation, while more major changes may be proposed for plan modification as they are documented or in regularly scheduled plan reviews.

Minor changes to the management measures for UCM Conservation Lands may be made without Plan amendment if they fall within the description of the direction provided in the Plan (and thereby meet the underlying environmental commitments and permit requirements). Minor changes can be made through simple mechanisms (e.g., errata sheets, letters of concurrence).

Necessary management changes that are inconsistent with the Plan's direction (but necessary in order to be consistent with the regulatory requirements of the BO and other environmental permits and requirements) will require a Plan amendment. Plan amendments may be initiated on an as-needed basis or through a regular 5-year plan review process.

Plan amendments should be formally proposed, reviewed, and approved as described below. In the unlikely event that necessary changes to the Plan would conflict with regulatory requirements, the Plan amendments would also require amendments to regulatory documents.

Proposed changes in Plan direction will be identified in the Annual Monitoring Report (see Chapter 6) to promote coordination with regulatory agencies and the easement holder.

Changes to the Plan will generally require the concurrence or approval of the regulatory agencies (USFWS and DFG) and the easement holder. Changes would not require approval in those limited circumstances when UC Merced determines that the change has no potential to affect conservation values.

Proposed Plan amendments will be distributed to the regulatory agencies, with a clear depiction of the language of the proposed changes, rationale for the change, and description of the expected outcome (e.g., effects on conditions of Plan Area resources). The regulatory agencies and easement holder will provide responses to the proposed amendment, and the parties will work cooperatively until consensus is reached.

Individual amendments can take the form of letters of agreement describing specific language changes. These accumulated amendments can be incorporated into Plan revisions over time as needed to facilitate Plan use for daily management.

8.1.3 Key Adaptive Management Topics

Key topics for application of monitoring to conduct adaptive management are encompassed in this plan (see Chapters 5 and 7) and in the Conservation Strategy (Jones & Stokes 2008: Chapter 8). Adaptive management of Conservation Lands inherently includes the future development and regular updating of a list of research priorities, along with pursuit of research funding, and coordination of approved research and management activities.

Some major areas of research to support adaptive management include the following.

- Evaluation of population sizes and genetic structure of species populations within Conservation Lands and among these populations and others elsewhere to determine species viability, effectiveness of existing conservation efforts, and priorities for future conservation actions.
- Specific habitat requirements of key conservation species, including relationships between geological formations and the rare or specialized vernal pool ecosystems in the project region within the eastern Merced County.
- Experimentally-based evaluation of responses to grazing management and other habitat management actions.
- Evaluations of interactions among invasive species and conservation species.
- Predicted responses of habitats and species populations to human-induced effects of light, noise, air quality, and climate change.

8.2 CST Conservation Lands

If monitoring identifies threats or suboptimal conditions for species of conservation concern that are occurring despite compliance with the terms of the CST conservation easement, the easement administrator should document a need for management changes in annual monitoring reports, and should propose modifications to management that are consistent with their authority under the conservation easements. These recommendations should be brought to the permitting agencies and UCM for consideration. Incorporation of new terms into the conservation easement would require landowner consent and possible compensation.

Under the likely future terms of the easement, the CST easement holder may conduct several management actions that are not requirements of landowners, such as use of controlled burning, pesticides, or other means to control noxious weeds (if grazing is found to be ineffective); and fencing of riparian habitats. These actions may benefit landowners, and thus may be performed by them or undertaken cooperatively with the easement holder. However, the easement holder is responsible for planning, funding, coordinating with landowners, and

implementing activities that are not required of landowners under the terms of the conservation easement.

If management needs for the CST Easement Lands are identified that are not within the legal authority of the conservation easement, the easement holder should attempt to work cooperatively with the landowners to determine if they are willing to make changes voluntarily.

If important management changes are needed that fall outside the authority of the conservation easement and will not be conducted voluntarily by the landowner, the easement holder will inform UC Merced and the permitting agencies of the need. These needs could be addressed through amendments to the conservation easement.

Chapter 9
Plan Implementation Schedule and Funding

This chapter presents an overview of the schedule and funding for implementing the plan. More specific information on specific funding sources and amounts to be used in implementing management is in development.

9.1 UCM Conservation Lands

This chapter presents a schedule and funding overview for implementing the management and monitoring actions described in Chapters 5 and 6. Accurate estimates of costs and a secure source of funding for management activities, monitoring, and reporting are essential for success of the Plan. The estimate of funding costs and sources will be revised following further discussion with the agencies, and following completion of the more detailed protocols for effectiveness monitoring discussed in Chapter 6.

The schedule for implementing the Plan is presented in Appendix D. This schedule separately lists initial Plan actions, annual activities, and periodic activities. This schedule serves as the basis for estimating funding needs for monitoring and management, as well as for reporting on compliance and effectiveness monitoring results (Chapter 6).

UCM is currently in discussions with USFWS, CDFG, and TNC concerning the appropriate funding structure to ensure that the management and monitoring is securely funded.

A preliminary schedule for implementing Plan actions is presented in the Management Plan Compliance Checklist (Appendix D). Implementation of activities will be initiated within 1 year of project approval.

9.2 CST Conservation Lands

Funding for the annual administration of the conservation easement on CST Conservation Lands will be provided from an endowment. The amount of the endowment will be determined on the basis of the specific terms of the easement and any monitoring and reporting plans developed to administer the easement.

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Appendix A

Management Plan for Tier 2 Conservation Lands

Appendix A

Management Plan for Tier 2 Conservation Lands for the UC Merced Project

This appendix addresses management of lands on five properties that are not owned by the University of California (UC), but for which the Wildlife Conservation Board acquired conservation easements from private landowners ("landowners") as mitigation for construction of the University of California, Merced (UCM). These lands are referred to as Tier 2 Conservation Lands because they permit less adaptive management than the Tier 1 Lands owned and managed either by UCM (UCM Conservation Lands) or The Nature Conservancy (TNC) (i.e., the Cyril Smith Trust [CST] property). The Tier 2 Lands are addressed separately from Tier 1 Lands because of the lower level of authority by the agencies or easement holders to direct and control management actions.

This plan summarizes the easement holders' management responsibilities for Tier 2 Lands and responsibilities of the permitting agencies and UCM.

WCB conveyed conservation easements on the five Tier 2 properties to TNC or the California Rangeland Trust (CRT). The Tier 2 Lands were selected for conservation on the basis of their substantial conservation values (Vollmar 2002); accordingly, the easements were intended largely to maintain existing management practices, which are considered highly compatible with conservation purposes (Jones & Stokes 2002, ICF Jones & Stokes 2008; Marty pers. comm.).

Lands Description

Tier 2 Conservation Lands are located north and southeast of the campus and UCM Conservation Lands (see Figure 2-1 in the Management Plan for Conservation Lands (Airola 2008) within a large area of intact grassland and seasonal wetland habitat that has been identified as high-priority conservation areas in the Conservation Strategy (ICF Jones & Stokes 2008).

The Tier 2 Lands encompass a total of 17,239 acres. Table A-1 summarizes the known occurrences of biological resources with conservation priority at the various properties. Several documents provide more detailed information on the biological and wetland resources that occur on Tier 2 Lands, including reports by Vollmar (2002); EIP Associates (2002); Jones & Stokes (2002a, 2002b); U.S.

Fish and Wildlife Service (2002); Vollmar Consulting (2008), and ICF Jones & Stokes (2008).

Table A-1. Summary of Key Information on Tier 2 Conservation Lands for the UC Merced Project

Property	Ownership Status	Conservation Values	Total Acreage	Easement Holder
Robinson	Privately owned with a conservation easement conveyed October 2001	Vernal pool fairy shrimp, midvalley fairy shrimp, California tiger salamander; suitable San Joaquin kit fox habitat	3,595	The Nature Conservancy
Chance	Privately owned with a conservation easement conveyed June 2002	Vernal pool fairy shrimp, California clam shrimp, California fairy shrimp, California tiger salamander, succulent owl's-clover, and Ewan's larkspur; suitable San Joaquin kit fox habitat.	7,619	The Nature Conservancy
Nelson	Privately owned with a conservation easement conveyed May 2002	Vernal pool fairy shrimp, midvalley fairy shrimp, vernal pool tadpole shrimp, western spadefoot, western pond turtle, western burrowing owl, California tiger salamander, succulent owl's-clover, Hoover's calycadenia, and other endangered or rare species; suitable San Joaquin kit fox habitat.	3,861	California Rangeland Trust
Carlson	Privately owned with a conservation easement conveyed February 2002	Vernal pool fairy shrimp, California clam shrimp, California fairy shrimp, midvalley fairy shrimp, California tiger salamander, succulent owl's-clover, and spiny-sepaled button-celery; suitable San Joaquin kit fox habitat.	305	California Rangeland Trust
Cunningham	Privately owned by rancher with a conservation easement conveyed February 2002	Vernal pool and midvalley fairy shrimp and other rare vernal pool branchiopods, California tiger salamander, succulent owl's-clover, and several other rare, threatened, and endangered plant species; suitable San Joaquin kit fox habitat.	1,761	California Rangeland Trust
Total			**17,141**	

Protections Incorporated into Conservation Easements

Conservation easements for Tier 2 Conservation Lands have been conveyed to TNC and CRT. Easement terms were summarized in the *UC Merced Resource Mitigation Plan* (RMP) (Jones & Stokes 2002). The easements for the various properties are similar in form, with minor differences.

This section summarizes easement requirements. The five individual easements are provided in Appendix G of the *Management Plan for Conservation Lands and the Campus Buildout Site for the University of California Merced* (ICF Jones & Stokes 2008).

The basic terms of the easements require that the landowner preserve and maintain the conservation values of lands through compatible livestock grazing and other management. The easements restrict property uses and grant the easement holders a perpetual right to preserve, protect, identify, monitor, enhance, and restore the conservation values. The landowners retain the right to pursue a variety of land uses and exercise other rights, as long as they maintain the conservation values of the land. These permitted uses are listed below.

- Livestock grazing, subject to the following requirements.
  - Prevent increase in noxious weeds.
  - Retain required amounts of residual dry matter (RDM) in pounds per acre at the end of the growing season (See Table A-2 for RDM requirements on Tier 2 properties).
  - Locate food supplements (e.g., salt and mineral licks, food supplements, supplemental feed) away from vernal pools.
- Prescribed burning.
- Use of herbicides (only to control nonnative noxious weeds).
- Occupancy of existing residential dwellings.
- Ability to plant and maintain gardens and raise other farm animals and pets that are confined to residential areas.
- Hunting and fishing (with restrictions on fish stocking).
- Water source development and maintenance for livestock and wildlife use.
- Passive recreation.

Table A-2. Minimum RDM Requirements for Conservation Easement Lands

Tier 2 Property	RDM Requirement (lbs/acre)
Carlson	800 (400 in drought years)
Chance	600 (400 in drought years)
Cunningham	800 (400 in drought years)
Nelson	600 (400 in drought years)
Robinson	600

Prohibited uses are listed below.

- Land subdivision.
- Transfer of development rights.
- Non-ranching commercial uses, including development of natural resources (minerals, aggregate, energy).
- Disposal of hazardous waste, refuse, etc.
- Junkyards.
- Long-term leasing.
- Alteration of water courses, degradation of water quality, or impairment of water rights.
- Off-road vehicle use, except for use in ranching operations.
- Introduction of plant and animal species.
- Plowing, disking, land leveling, irrigation, or other alterations, except disking for fire control.
- Conversion to crops, orchards, or vineyards.
- Destruction of native vegetation (except by grazing or burning).
- Harvesting timber.

As the easement holders, TNC and CRT are granted the rights listed below.

- Reserve, protect, identify, monitor, enhance, and restore in perpetuity the conservation values of the land.
- Conduct evaluations of wetland quantity and quality, evaluate habitat quantity and quality, survey for threatened and endangered species, and monitor their populations.
- Access the lands to conduct monitoring activities, assess compliance, and take all actions necessary to achieve the terms of the easement.
- Install and maintain signage.
- Employ controlled burning, pesticides, or other means to control noxious weeds (if grazing is found to be ineffective).
- Fence riparian habitats.

Management Program Direction

The management program for Tier 2 Conservation Lands is consistent with the overall mitigation approach employed for these lands: to acquire and protect lands with high resource values and maintain the long-term management activities that have created and sustained these values. Because available

management options are constrained by the conservation easements, the management program emphasizes monitoring to enforce the terms of the easements. If monitoring identifies issues regarding easement compliance and resulting resource conditions, a limited amount of active management is authorized.

Easement Administration

TNC and CRT will conduct variety of routine tasks to administer easements. These activities are listed below.

- Annually remind the owners of Tier 2 Lands of easement responsibilities and identify the TNC and CRT easement administrators.
- In the event of land sale, ensure that future landowners understand easement requirements.
- Coordinate monitoring visits to easement properties.
- Provide results of monitoring efforts to landowners.
- Coordinate with landowners to adjust their management in accordance with the terms of the easement.

Beyond strict legalistic administration of the easement, it is important that TNC and CRT easement administrators maintain cooperative, goodwill relationships with Tier 2 landowners to facilitate beneficial resource management.

Monitoring and Reporting

TNC and CRT will conduct annual monitoring and document monitoring results for compliance with the terms of the easements and the effectiveness of management actions taken. Monitoring will focus mostly on compliance, to document whether the landowner is adhering to the easement terms. Beyond simple compliance, easement holders should focus monitoring on several conditions that may determine conservation values. The key resources upon which monitoring should focus are listed below.

- Presence of and extent of noxious weeds and potential threats they pose to species of conservation priority.
- Presence of nonnative reptiles and amphibians in water bodies.

If monitoring of Tier 2 Conservation Lands identifies noncompliance with easement terms that is likely or is demonstrated to cause detrimental effects on species of conservation concern, TNC and CRT *should work directly with landowners or take other actions as necessary to achieve compliance*.

Adaptive Management

Opportunities to conduct adaptive management on Tier 2 Conservation Lands are limited, because the landowner is required only to comply with terms of the easement. Nonetheless, several opportunities are available to modify management on the basis of monitoring results.

If monitoring identifies that threats or suboptimal conditions for species of conservation concern are occurring under the terms of the easement, TNC/CRT easement administrators should document a need for management changes in annual monitoring reports and should propose management modifications that are consistent with their limited authority under the conservation easements.

Under the terms of the easements, TNC/CRT can conduct several management actions that are not requirements of landowners, such as use of controlled burning, pesticides, or other means to control noxious weeds (if grazing is found to be ineffective); and fencing of riparian habitats. As the easement holders, TNC and CRT would be responsible for planning, funding, coordinating with landowners, and implementing these activities.

If management needs are identified that are not within the legal authority of the conservation easement, TNC/CRT should attempt to work cooperatively with the landowners to determine if they are willing to make changes voluntarily.

Easement administration and monitoring are currently underway on Tier 2 Conservation Lands. Management of the easements is under the authority of the easement holder. A recommended annual schedule for activities is shown below.

Funding

TNC and CRT will be responsible for funding for the administration and monitoring of their easements and for conducting administration, monitoring, and adaptive management actions.

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Appendix B

Grazing Management Plan for UC Merced Conservation Lands

MANAGEMENT PLAN FOR CONSERVATION LANDS AND ADJACENT CAMPUS BUILDOUT LANDS FOR THE UNIVERSITY OF CALIFORNIA, MERCED

APPENDIX B

UCM CONSERVATION LANDS GRAZING MANAGEMENT PLAN

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LSA

August 8, 2008

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APPENDICES

1.0 INTRODUCTION

1.1 PURPOSE AND GOAL

This Grazing Management Plan (GMP) documents rangeland conditions and livestock use and provides a framework to direct future management activities for the Conservation Lands and Campus Buildout site for the University of California (UC), Merced. (See Appendix B-1 for definitions of "grazing management" and other range terms). Research and informed observations indicate that livestock grazing can be employed effectively to maintain vernal pool hydrology and ecosystem biodiversity and to preserve or enhance habitat conditions for special-status plants and animals associated with vernal pools (Barry 1996, Robins and Vollmar 2002, Marty 2004, Pyke and Marty 2004). Based on this knowledge, the Biological Opinion (BO) for the UC Merced Campus Project (USFWS 2002) required a management plan for conservation lands that specifies management policies and practices to conduct livestock grazing (among other activities) for habitat enhancement (see BO page 21). The goal of the GMP is to help fulfill that requirement for the Management Plan for Conservation Lands and the Future Campus Buildout for UC Merced (MPCL; Airola 2008).

1.2 METHODOLOGY AND INFORMATION SOURCES

Plan author, Richard Nichols is licensed by the State Board of Forestry as Certified Rangeland Manager #45. Mr. Nichols conducted a literature review of pertinent information (see Literature Cited). He conducted interviews with grazing lessees of the Conservation Lands and the adjacent Cyril Smith Trust (CST) owned by The Nature Conservancy (see Personal Communications) regarding past livestock operations, recent actual livestock use, and range improvement conditions and needs. A site visit was conducted on May 7, 2007, to tour the grazing lands to observe on a reconnaissance level rangeland forage composition and productivity, grazing utilization and distribution, and the condition and location of range improvements.

A range analysis was conducted to determine preliminary livestock carrying capacity levels (see Appendix B-1 for definitions). Rangeland forage production estimates (pounds of dry matter per acre) were obtained from Ecological Site Descriptions (NRCS 1983, 1984) which are groupings of soil types with similar productivity levels. Ecological Sites were mapped and acreages calculated for the site after grouping applicable soil types from digitized maps of the Soil Survey of Merced County (Arkley 1962). An Excel spreadsheet was then used to calculate carrying capacity based on total forage production for each Ecological Site and accounting for a target residual dry matter level of 800 pounds per acre and consumption of 1,000 pounds of dry matter per animal unit month which includes allowances for wastage, trampling and wildlife use (Table C).

2.0 SETTING

The physical and biological setting is described here briefly to provide a framework for understanding this plan as a stand alone document. This setting discussion is summarized from much more extensive discussions provided in the UC Merced Conservation Strategy (Jones & Stokes 2007), and the project BO (USFWS 2002) and other supporting documents, as described in the MPCL.

2.1 LOCATION AND CONFIGURATION OF MANAGEMENT AREAS

The Conservation Lands are located to the north, northeast, and east of the proposed UC Merced Campus and Yosemite Lake and east of the CST, approximately 5 miles northeast of the City of Merced (Figure B-1). They consist of the Virginia Smith Trust (VST) Preserve, the Campus Natural Reserve (CNR) and the Myers Easterly property. The lands currently under grazing lease proposed for ongoing future development of the campus ("Campus Buildout") (Figure B-2) are covered temporarily under this plan because grazing use is desirable there prior to development. Only the portion of the Campus Buildout that is fenced (cross-hatched in Figure B-2) is currently leased for grazing. For purposes of this plan, the VST Preserve, CNR, Myers Easterly and grazed portion of the Campus Buildout will constitute the UC Merced Grazing Management unit. The remainder of the Campus Buildout (not cross-hatched in Figure B-2) is not grazed and vegetation there is managed by other techniques.

The VST Preserve is owned and managed by UC Merced with a conservation easement granted to The Nature Conservancy. The Myers Easterly property is owned by the University Community Land Company (UCLC), owned by UC and The VST. A Conservation Easement has been granted to TNC. The CNR and Campus Buildout are owned and managed by UC Merced but are not under a conservation easement. The UC Merced Grazing Management Unit is leased to the Fagundes Brothers Dairy except for the Myers Easterly property which is separately leased. When development of the Campus Buildout commences, it will no longer be grazed and will not be covered under this GMP.

2.2 TOPOGRAPHY, GEOLOGY, SOILS

The project area is typical of the gently undulating topography of the eastern San Joaquin Valley which consists of broad alluvial fans, stream and river deposits, and different types of volcanic and sedimentary bedrock. Elevations in the study area range from approximately 280 feet in the CNR on the east shore of Yosemite Lake to 568 feet in the northern portion of the VST Preserve. An important feature of the study area is the "mima mound" micro-topography with low-lying basins that pond in the rainy season and evaporate by the summer (forming vernal pools) and intervening upland mounds (Vollmar 2002).

The geology of the study area varies by age, generally with the oldest surfaces to the west and youngest to the east (Vollmar 2002). The Mehrten formation to the west consists of redeposited

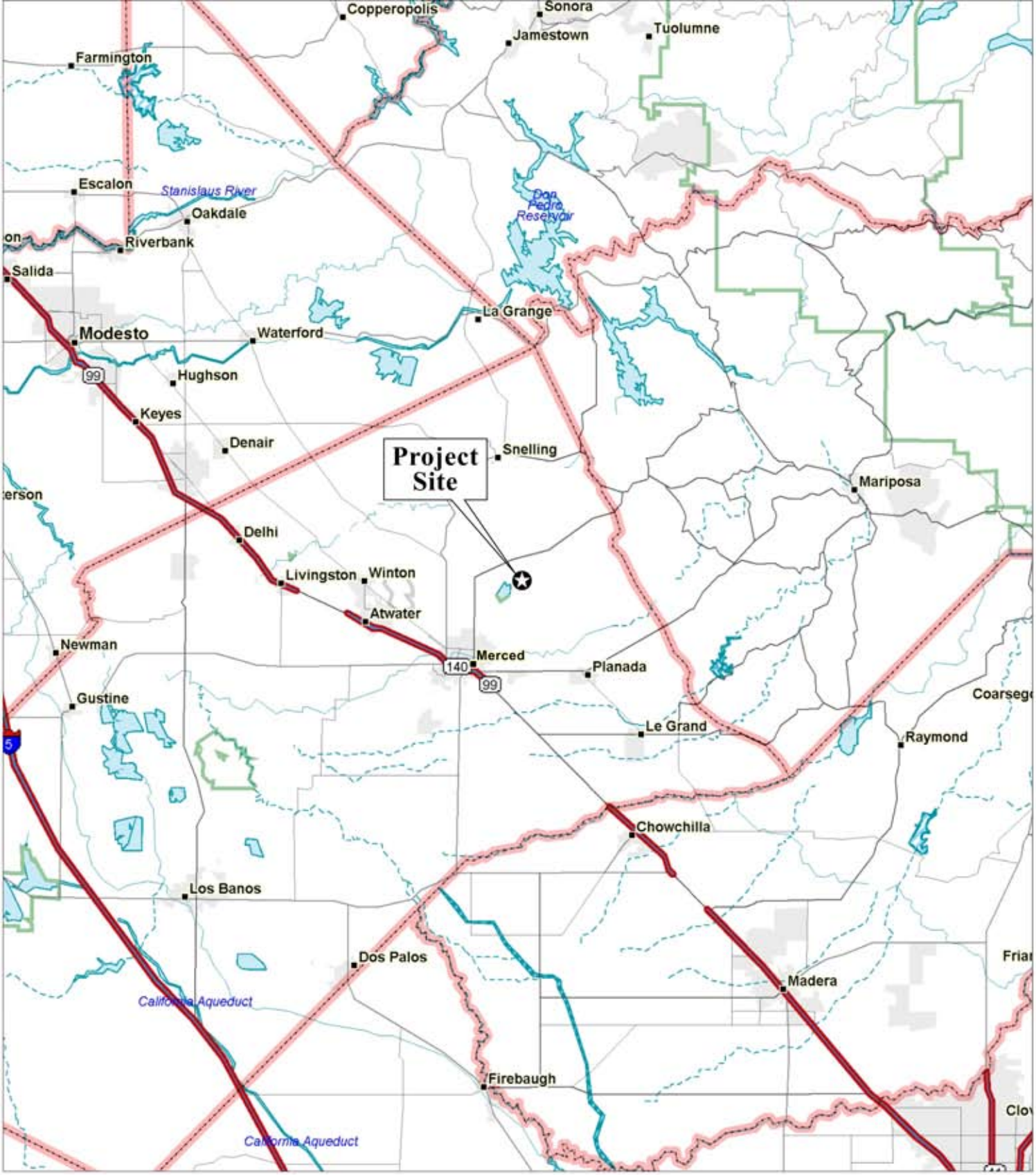

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FIGURE B-1

University of California, Merced
Conservation Lands Grazing Management Plan

Regional Location

N

0 10

MILES

SOURCE: ©2002 DeLORME. STREET ATLAS USA®2003.

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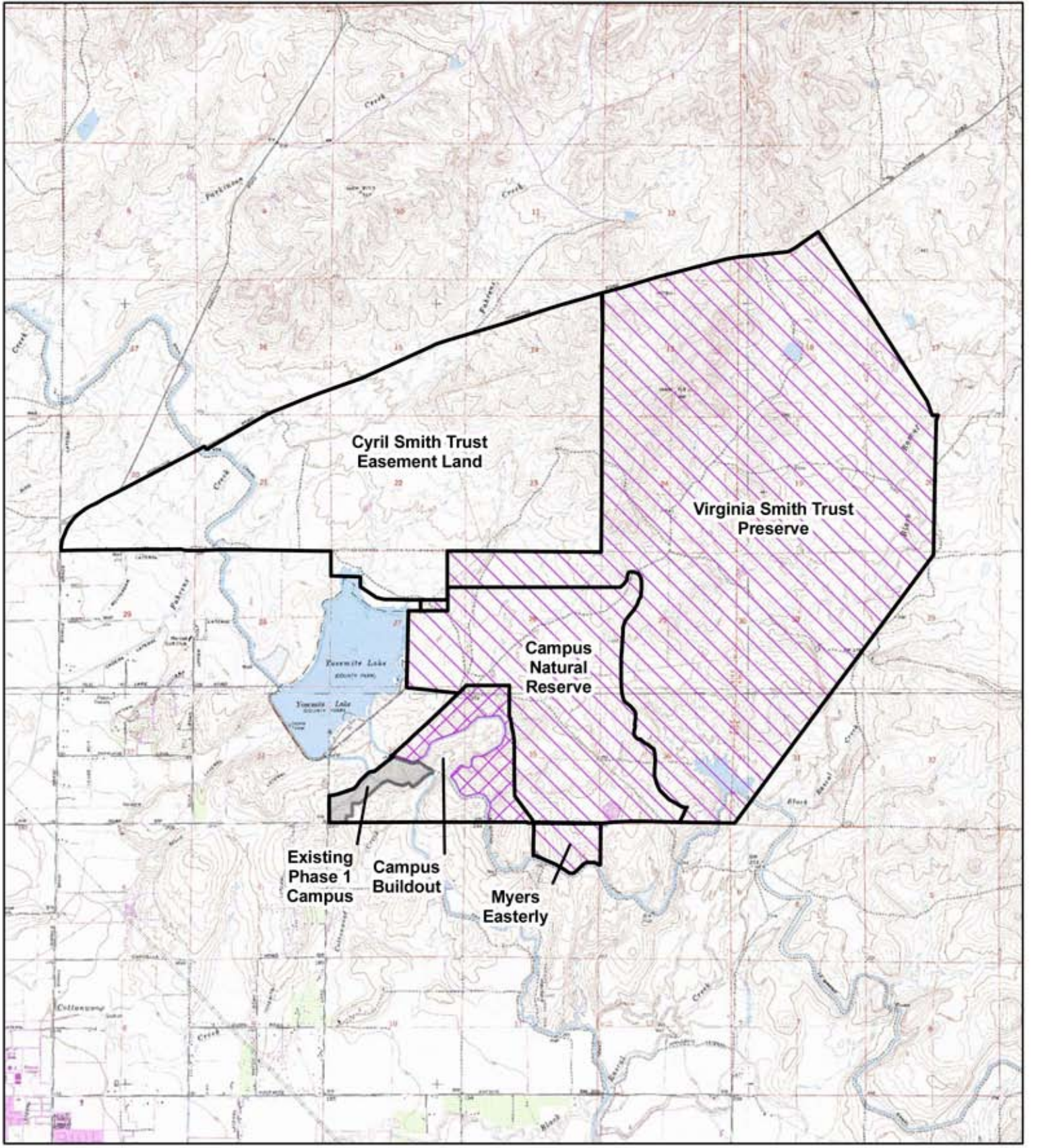

LSA

UC Merced Conservation Lands Unit

Campus Buildout Lands
Incorporated into Grazing Plan

Parcels (approximate)

Existing UC Merced Campus Development

0 0.5 1
MILES

FIGURE B-2

University of California Merced
Conservation Lands
Grazing Management Plan

Project Area

SOURCE: Jones and Stokes (2007); LSA (2007); USGS 7.5-minute Topo Quads - Yosemite Lake, Haystack Mtn, Merced, and Planada.

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alluvium from volcanic mudflows and ashflows resulting from volcanic eruptions in the Sierra Nevada from 10 to 25 million years ago. This geologic substrate developed into three soil types (Pentz, Peters, Raynor) generally characterized by dark heavy clays. The Laguna Formation was formed from gravel/cobble alluvium deposited from granitic glacial outwash originating in the Sierra about 3 to 10 million years ago. The Laguna Formation is associated with Redding and Corning soils typified by acidic gravelly loams, often with a thick well developed hardpan layer. These soils have eroded into some of the most well developed mima mound and vernal pool topography in the region. Hopeton soils consists of clays and clay loams that occur between the lower levels of the Laguna formation and the upper levels of the Mehrten formation. The North Merced gravels consist of a thin layer of locally derived gravel deposited about 1 million years ago. Some of this formation has weathered into Redding soils with a substantial hardpan and dense vernal pool/mima mound topography. Recent Holocene alluvium consists of loam soils deposited in the last 10,000 years along lower floodplains of creeks. This formation in the study area consists of Bear Creek soils deposited along Fahrens Creek and Black Rascal Creek. Anderson gravelly soils are derived from recent alluvial deposition along Fahrens Creek.

The nature of the soils directly affects production of livestock forage (consisting primarily of annual grasses and forbs). Deeper soils with finer textures (clay or clay loam) tend to be more productive because they have a higher moisture holding capacity and deeper rooting depth than shallow soils with coarser textures (sandy, gravelly or cobbly loam). Accordingly, the USDA Natural Resources Conservation Service (NRCS 1983, 1984) has grouped soil types into Ecological Sites with similar productivity levels. Acreages and estimated total annual forage production (air dry weight) for unfavorable, average, and favorable rainfall years for each Ecological Site in the UC Merced Grazing Unit are provided in Table C. Acreages of the Grazing Unit are based on current configurations formed by existing fencelines. These will be adjusted in the future to account for development of the Campus Buildout.

The most extensive Ecological Site in the study area, covering over 5,000 acres, is the Claypan Terrace (Figure B-3) consisting of Corning, Keyes, Montpelier, and Redding soils. The Hopeton soil was also placed in the Claypan Terrace group by NRCS staff (J. Foster pers. com.) due to similar production levels. In the study area, the Claypan Terrace Ecological Site consists of shallow soils (due to a clay layer that restricts rooting depth) typically with gravelly loam surface textures.

The Clayey Ecological Site is less extensive in the study area, covering about 1,000 acres (Figure B-3) consisting of Peters and Raynor soils. This Ecological Site is typically on shallow soils of clay or cobbly clay.

The Shallow Rocky Loam Ecological site, covering about 330 acres in the study area (Figure B-3), consists of Pentz soils. This Ecological Site consists of very shallow soils underlain by bedrock typically with gravelly loam textures.

The Upland Swale Ecological Site, covering about 190 acres of the study area (Figure B-3), consists of Bear Creek soils along Fahey and Black Rascal creeks. These soils are deep with loamy textures.

A small area of Anderson gravelly soils occurs in the northeast corner of the site, covering only 11 acres (Figure B-3). This soil was not placed in an Ecological Site by the NRCS, but according to the Merced Area Soil Survey (Arkley 1962) it produces more forage than the Claypan Terrace and

Shallow Rocky Loam sites but less forage than the Upland Swale Site. For a conservative analysis it was placed in the Claypan Terrace Ecological Site, estimated to produce approximately 2500 pounds per acre in a normal rainfall year (Table C).

Areas that produce no forage include open water and barren terrace escarpments (Figure B-3). The acreages of these areas were excluded from the grazing analysis to determine appropriate grazing capacities and corresponding recommended stocking rates.

2.3 BIOLOGICAL RESOURCES

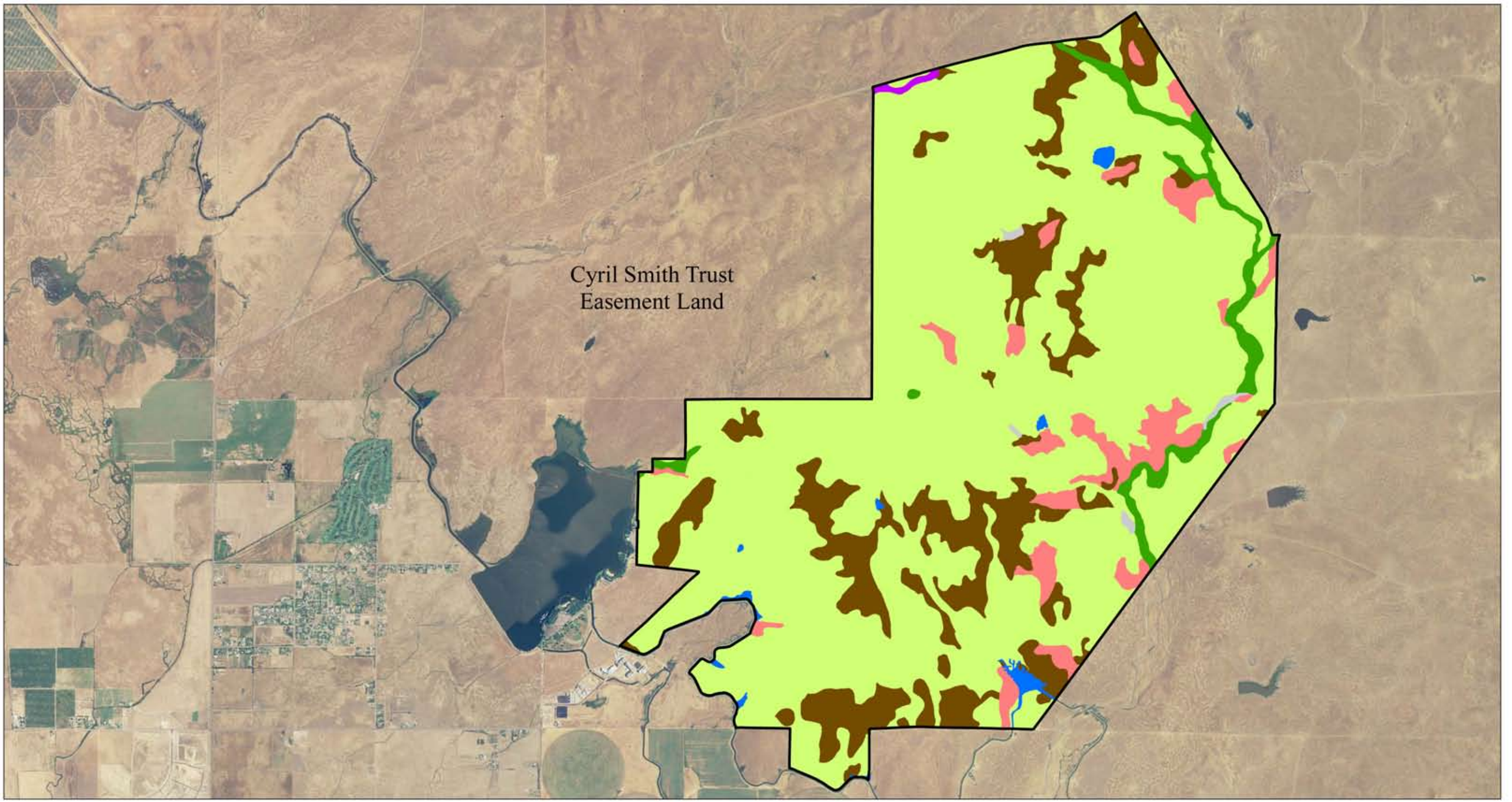
The biological resources of the study area have been extensively documented (USFWS 2002, Jones & Stokes 2007), so this brief summary focuses on issues most relevant to livestock grazing and conservation goals. Annual grasslands dominated by non-native grasses and forbs occupy the uplands of the study area and invade the vernal pools and swales under low grazing pressure. Annual grasses provide high quality and nutritious livestock forage when they are green during the rainy season, generally after late fall or winter (October-December). The grasses "cure" (dry) in the late spring or early summer (April-May), after which nutrition levels drop rapidly. Annual grasslands in the study area provide habitat for a wide variety of native reptiles, birds, and mammals. Many special-status species forage on small mammals in grazed grasslands in the study area including a variety of raptors (Sloat and Whisler 2002) and the federally endangered San Joaquin kit fox (Orloff 2002).

Native vernal pools and swales are seasonal wetlands that support a unique assemblage of native aquatic plants when they are inundated in the winter and display colorful native wildflowers as they dry in the spring. In the study area, they support three special-status plants and five special-status animals (four crustaceans and an amphibian) that are a focus of the MPCL and this GMP.

One of the special-status plants, succulent owl's clover, occurs in a wide range of vernal wetland habitats and is scattered throughout the plan area (Jones & Stokes 2007). This species benefits from habitat protection and moderate grazing to reduce competition with non-native annuals (Dittes and Guardino 2002).

Two of the special-status plants, Colusa grass and San Joaquin Valley Orcutt grass (both federal and State endangered species), have special habitat requirements because they occur only in large or deep vernal pools and stock ponds that are inundated for a longer period than most pools (Dittes and Guardino 2002). Occurrences in the study area are located in several large or deep natural pools and three stockponds (Figure B-4 derived from CDFG 2007). Although these species have survived in areas managed historically and recently for livestock grazing, certain grazing regimes are recognized as potential threats to these species (Dittes and Guardino 2002). Specifically, late spring and summer grazing may be detrimental to Orcutt and Colusa grasses because they are vulnerable to trampling during their terrestrial flowering and fruiting stages.

Observations by The Nature Conservancy staff in the Vina Plains Preserve in the upper Sacramento Valley indicated that trampling by cattle after vernal pools began drying (after May 15) adversely affected Orcutt grass populations (as reported in Robins and Vollmar 2002). These Orcutt grass populations recovered after a change in management strategy that required cattle to be removed no later than May 1st. It should be noted that no impacts from grazing on these Orcutt grasses have been observed on the UC Merced Conservation Lands and it may not be an issue. Moderate grazing earlier



LSA

0 1,500 3,000
FEET

Soils Grouped by Ecological Site Class

- Clayey
- Claypan Terrace
- Shallow Rocky Loam
- Upland Swale
- Anderson Gravelly Soils
- None (Barren)
- Water

UC Merced Conservation Lands Unit

FIGURE B-3

University of California Merced
Conservation Lands
Grazing Management Plan

Soils

SOURCE: Merced Area Soil Survey (NRCS); Aerial Imagery from USDA NAIP (2005)

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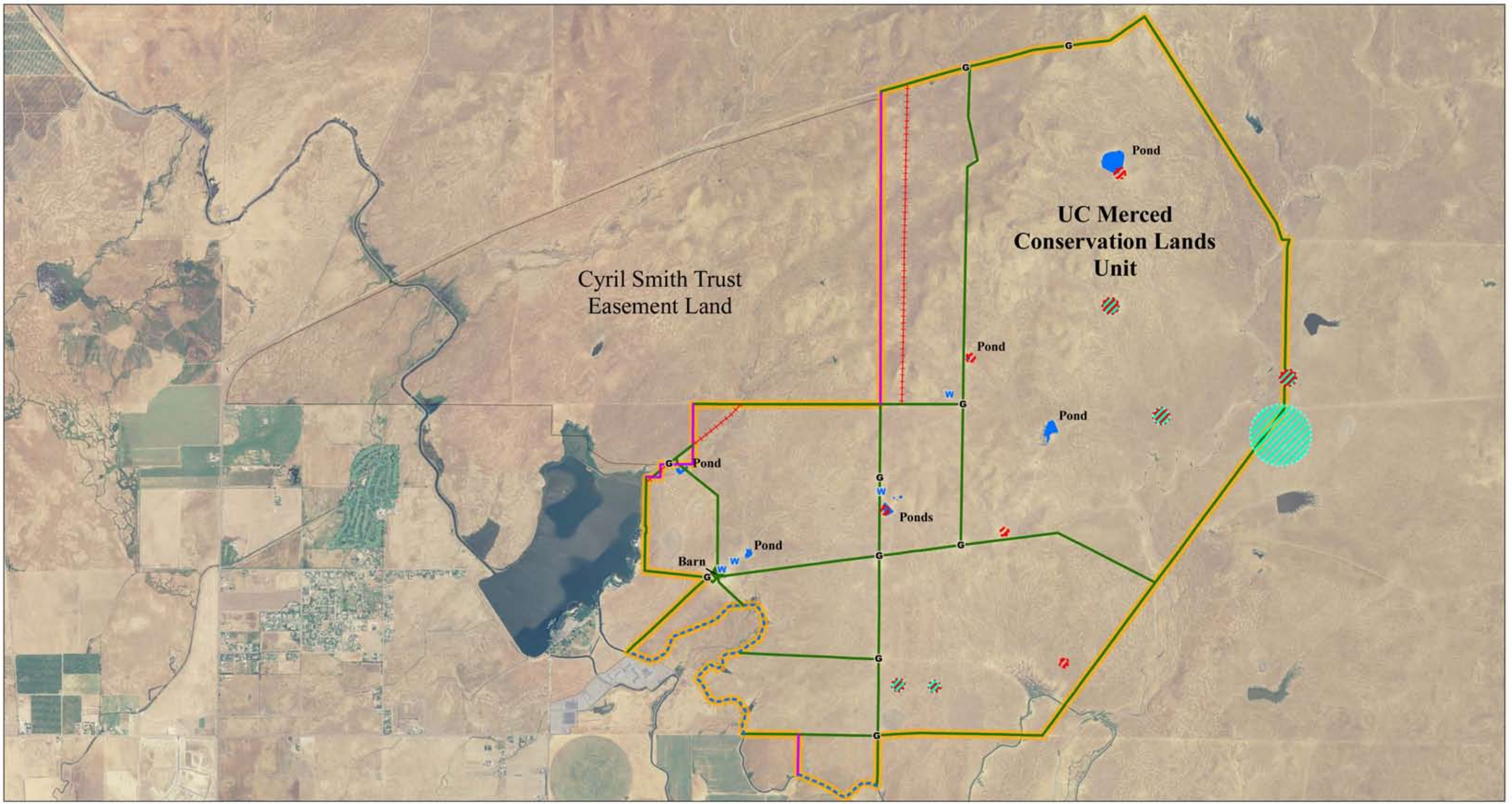

LSA

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- Existing Fence
- Proposed Fence
- Pasture Boundary (canal)
- Existing Fence - to be removed
- UC Merced Conservation Lands Unit
- Stock Pond
- W Water Trough
- G Gate
- Colusa Grass
- San Joaquin Valley Orcutt Grass

SOURCE: Aerial Imagery from USDA NAIP (2005); Special Status Plant Locations from CNDDB (CDFG 2008).
I:\AIE0701\GIS\Maps\FigureB-4_Range Improvements.mxd (08/05/2008)

FIGURE B-4

University of California Merced
Conservation Lands
Grazing Management Plan

Range Improvements and
Special-status Grass Occurrences

in the spring appears to be compatible because cattle do not concentrate on inundated pools when the juvenile Colusa and Orcutt grasses are in their aquatic stage. In addition, historic construction of stockponds for livestock grazing appears to have provided additional habitat for this species in the UC Merced Management Unit (Figure B-4). Continued future maintenance of ponds for livestock use also appears to be beneficial to these species.

Four special-status crustaceans that occur in the study are adapted to seasonally inundated habitats such as vernal pools (Jones & Stokes 2007:Figures 3-12 to 3-15). One of these, Conservancy fairy shrimp, is found in only one pool on the CST. The vernal pool tadpole shrimp is limited in the vicinity to a portion of the CST. Two species, the midvalley fairy shrimp and the vernal pool fairy shrimp, are more ubiquitous and scattered throughout the study area. Preserving habitat for vernal pool crustaceans is apparently compatible with livestock grazing because they have survived throughout a long history of ranching operations. Recent research in eastern Sacramento County indicates that moderate season-long (October-June) livestock grazing is beneficial for vernal pool invertebrates and vertebrates because it maintains the length of inundation in vernal pools. Taxa richness of invertebrates and vertebrates in pools where grazing was eliminated decreased significantly (Marty 2004).

Breeding habitat for the federally-threatened California tiger salamander (CTS), occurs in scattered vernal pools and stock ponds throughout the study area (Jones and Stokes 2007:Figure 3-16). Some researchers have speculated that excessive use by cattle could negatively affect this species by trampling of juveniles in the pools and adults migrating through grasslands (as reported in Robins and Vollmar 2002). Others have expressed concerns that light grazing pressure could lead to a build up of thatch around pool margins and in uplands that would impede overland migration of juveniles and adults *(*as reported in Robins and Vollmar 2002). Marty's (2004) research indicates that decreased hydroperiods in ungrazed and short-term, seasonally grazed pools may not be adequate in length to support breeding salamander populations. Stock ponds constructed and maintained for livestock grazing provide highly suitable breeding habitat for CTS (Bobzien and DiDonato 2007). Several stock ponds in the UC Merced grazing unit support CTS breeding habitat (CDFG 2007). Although more research is needed to clarify the relationship of CTS and livestock grazing, it is clear that CTS are at least tolerant of grazing because they have survived under a long-term regime of moderate season-long cattle grazing.

3.0 LAND USE

3.1 HISTORIC GRAZING USE

The vernal pool landscape of eastern Merced County and associated plant and animal species evolved and persisted with intense grazing pressure. Grasslands, dominated by perennial bunchgrasses, throughout California were grazed by large herds of megafauna in the late Pleistocene (300,000 to 10,000 years ago) including now extinct species of mammoth, mastodon, giant sloth, tapir, llama, horse, pronghorn, camel and bison (Edwards 1996). More recently, the explorer Jedediah Smith observed an abundance of tule elk, deer, and pronghorn antelope when traveling through the Merced region in 1827 (Outcalt 1925). Early settlers indicate that wild cattle and horses escaped from Spanish and Mexican era ranchos in the outer Coast Range and roamed in large numbers throughout the grasslands of Merced County. The History of Merced County (Outcalt 1925) states that wild horses were abundant during the Rancho period to the extent that tens of thousands were slaughtered between 1805 and 1810 to prevent the range from being overgrazed. It is likely that grazing use by wildlife and feral livestock in the study area during the historic period was generally confined to the winter and spring due to the low availability of permanent water sources in the summer and fall. Also during the historic period, native perennial grasslands throughout the Central Valley of California were converted to non-native annual grasslands. This vegetative type conversion resulted from accidental introduction and spread of vigorous Mediterranean annual grasses by European settlers and livestock, which replaced the native perennial grasses already weakened by prolonged overgrazing, other human disturbances, and extended drought (Heady 1988).

The livestock industry in Merced County grew exponentially after settlers imported bands of cattle and sheep into Merced County during the Gold Rush era to take advantage of the available range forage and the demand for meat. One of these settlers, J.M. Montgomery of Bear Creek (near the study area), was assessed for ownership of over 5,000 cattle and 1,700 sheep in 1854. During this period it was stated by a local cattleman that there were "…more cattle shipped within a radius of 25 miles from Merced than from any equal area in the world" (Outcalt 1925). The normal practice during this period, which persists today, was to run cattle and sheep on the eastern Merced County grasslands during the winter and early spring and drive them to meadows in the Sierra Nevada in the summer. According to the History of Merced County (Outcalt 1925), cattle were the basis of nearly all the fortunes acquired in the early settlement period.

In modern times, cattle grazing has become a marginal economic enterprise in the Central Valley due to elevated land prices and land use pressures. In addition, low beef prices and highly variable forage production due to rainfall extremes combine to make cattle ranching a borderline industry (Robins and Vollmar 2002). This is important to keep in mind for planning purposes to ensure that conservation grazing operations are conducted in a manner that contributes to economical viability.

The prevailing view is that historic grazing uses (i.e., seasonal patterns, intensities) have been compatible with the protection of conservation values for species of conservation interest in Eastern Merced County (Robins and Vollmer 2002, Dittes and Guardino 2002) and within the plan area (Jones & Stokes 2002, USFWS 2002; J. Marty, pers. comm.). The UC Merced Conservation lands are

considered to be in high quality condition, with minimal need and opportunity for enhancement or restoration.

3.2 RECENT LIVESTOCK USE

The UC Merced lands (about 6, 717 acres as currently configured with existing fence locations) have been leased since November 1, 2006, for three years with a three-year renewal option, to the Fagundes Brothers Dairy for a replacement heifer operation. Replacement heifers are placed as weanlings (i.e., at about 3 months of age) on the annual rangeland during the green growth period, typically in December or January, until they are removed in May or June. They are then sold or moved to irrigated pastures to be raised as cows for milk production. Approximately 1,500 replacement heifers averaging 600 pounds (the equivalent of yearlings at 0.75 animal units each) were run on the UC Merced lease (6,717 Acres) for about six months from December 2006 until removed in early June 2007 (R. Fagundes pers. com.). This stocking rate calculates to approximately 1.0 animal unit months (AUMs) per acre.

4.0 RANGE IMPROVEMENTS

Range improvements are the on-the-ground facilities required to conduct grazing operations. The current distribution and conditions of facilities influences livestock management options.

4.1 FENCES AND GATES

The UC Merced Management Unit is surrounded by five-strand barbed wire fences to prevent cattle from straying onto roads and adjacent properties. These fences were installed without surveys decades ago and have since been repaired and maintained in place. Therefore they do not always conform to property lines. This discrepancy is confirmed by comparison of the parcel boundaries (Figure B-2) with the actual fence locations determined from aerial photography and site visits (Figure B-4). Approximately 190 acres of UC Merced property is apparently fenced within the Cyril Smith Trust land and grazing leases have been adjusted to account for this variance in acreage. UC Merced is considering removing old fences that are not aligned with property boundaries while constructing new fences along the correct property lines. This would require removal of approximately 12, 840 linear feet of old fence and installation of approximately 13,825 linear feet of new fence (Figure B-4). Several informal gates along the perimeter fence allow for cattle to be released and removed from the grazing units and for access by vehicles and equipment.

The UC Merced grazing unit is divided into six pastures with internal five-strand barbed wire fences. Subdividing the grazing unit into pastures helps facilitate separation and movement of cattle. It also improves distribution of livestock within the pastures. Passage for cattle and vehicles between these pastures is facilitated through several informal gates (Figure B-4).

4.2 WATER SOURCES

Drinking water for livestock is supplied by troughs, stock ponds, irrigation canals. Three troughs on UC lands are filled with groundwater pumped from wells by windmills (Figure B-4). Seven stock ponds in the UC Merced Management Unit also supply drinking water on a seasonal basis. Cattle can also access water from flows in portions of Black Rascal Creek and from irrigation canal leakage in several locations of the southern pastures of the UC Merced unit (Figure B-4).

4.3 LIVESTOCK HANDLING FACILITIES

A barn is located within the Campus Buildout parcel (Figure B-4). It is not used by the current grazing lessee and will not need to be replaced if it is removed for campus expansion. If future lessees require livestock handling facilities, these could be provided using temporary corrals and chutes.

5.0 GRAZING MANAGEMENT PLAN

5.1 MANAGEMENT RESPONSIBILITIES

As described in the MPCL, the VST Preserve, CNR, and Campus Buildout are owned in fee title by UC (with conservation easements over VST Preserve granted to The Nature Conservancy). The Myers Easterly property will continue to be managed under a separate lease by the UCLC. The Sierra Nevada Research Institute (SNRI), in cooperation with the Campus Director of Environmental Affairs will have management responsibility over these UC Conservation lands. Therefore the following management activities for implementation of the GMP will be the responsibility of a UC Merced/SNRI designated Resource Manager who may assign them to the grazing tenants in accordance with lease terms:

- Maintain fencing, livestock water facilities, and signage.
- Coordinate and oversee trash removal.
- Coordinate and oversee thatch (residual dry matter-RDM) removal, invasive non-native plant species control, and native plant revegetation activities.
- Review biological/rangeland monitoring data.
- Maintain records of GMP activities, correspondence, and decisions.
- Conduct general inspections of the grazing units.
- Recommend and implement corrective actions to attain the goals of the GMP.
- Ensure compliance with rules and regulations protecting resource values and coordinate enforcement activities.
- Recommend and implement volunteer educational or habitat restoration programs.

5.2 MANAGEMENT GOALS

Grazing management within the UCM Conservation Lands will be based on defined biological goals, opportunities for management partnerships, and adaptive input from monitoring. Building partnerships with federal, state, local agencies, landowners, and non-governmental organizations will ensure long-term stewardship of the vernal pool ecosystem. General management goals are as follows:

- Protect and/or enhance the biological values of preserved vernal pools and associated grasslands.
- Protect and enhance special-status species habitat.
- Promote the growth and cover of native plants by preventing the introduction and establishment of invasive, non-native weeds.
- Remove/control existing invasive weed populations.

- Implement a program of long-term monitoring that will allow management techniques to continually improve.
- Manage grazing leases in a manner that contributes to the economic viability of livestock operations on the UC Merced lands.

5.3 RECOMMENDED GRAZING LEASE CRITERIA

The terms of grazing leases and the lessee selection process can substantially affect progress towards attainment of biodiversity goals. The lessee selection process and lease terms should favor a livestock operator who is motivated to help attain the plan goals and should provide incentives towards their attainment. The following criteria are recommended to develop a lease program that provides for those incentives:

- *The lessee selection process should be based on an appraisal method rather than an economic bid system*. Appraisal methods evaluate relevant criteria to select grazing tenants that are qualified and motivated to enhance vernal pool and grassland biodiversity values. Conversely, using a selection process that emphasizes bid value alone can encourage economic short cuts and improper grazing practices such as overstocking. Grazing tenant selection for new leases should be based on a proposal and interview process with a selection committee that includes the Resource Manager. Proposal evaluation criteria for selection of a grazing lessee should include:
  - accuracy and responsiveness of the proposal,
  - financial stability,
  - adjacency of existing grazing operations,
  - experience with invasive non-native weed control and revegetation activities,
  - ability to respond quickly to problems,, and
  - relevant experience with rangeland conservation practices.

  The proposal process may not be necessary if present grazing tenants on UC Merced property demonstrate effective and responsive records for conservation grazing practices and wish to renew their leases.
- *Leases should be awarded for long-terms (at least five years)*. Long-term leases provide grazing tenants with incentives to conduct maintenance and long-range management activities. Grazing history interviews for similar management plans in vernal pool ecosystems indicate that livestock operators will be more likely to overstock the range when they are uncertain about continuing operations in the following year (Witham 2006). Conversely, longer land tenure motivates the lessee to develop a sustainable operation conducive to attaining resource objectives. Of course, long-term leases should incorporate performance standards that allow early termination for noncompliance. Leases longer than five years must be approved by the easement holder on the VST Preserve.
- *Lease fee structures should be based on animal unit months (AUMs), not on acreage*. Because ecological sites vary significantly in forage production, the monetary value of a given area for grazing also varies. Grazing leases based purely on acreage are unfair and encourage overstocking. The lease fee structure should set stocking rates in AUMs and show how they are

calculated. The lessee should submit monthly use reports showing the number and class of livestock on the Conservation Lands which the can then be spot checked by the Resource Manager,

- *Grazing leases should provide incentives for lessees to participate in resource management activities*. The lease fee structure should provide a framework for the lessee to be compensated for labor and materials expended in installing or replacing range improvements and in conducting biodiversity enhancement activities such as weed control and native plant seeding under direction of the Resource Manager as appropriate. It should also define utilization levels using residual dry matter (RDM) levels as targets in pounds per acre.
- *The grazing leases should require that the lessees and management entity prepare an annual grazing plan (AGP) that is developed to incrementally attain the goals of the GMP*. The lessees should work with the Resource Manager to develop an AGP each year prior to introduction of livestock. The AGP should identify grazing schedules (including AUMs and pasture rotation schedules), RDM targets, range improvement installation and maintenance activities, invasive non-native plant control and native revegetation activities, and monitoring schedules.
- *The grazing leases should require that the lessee and Resource Manager document actual grazing use*. Records should be kept and documented each year in the AGP on the previous year's livestock use including animal types, numbers, and schedules.

5.4 MODIFICATIONS TO THE GMP

The grazing prescriptions outlined below may be modified by the Resource Manager in co-operation with the grazing lessee. Stocking rates will need to be adjusted periodically over the life of the plan as portions of the Campus Buildout are developed (see Section 5.5). Otherwise, however, the modifications should be minimal in order to avoid impacts to the biological resources on the property. The prescription may also be subject to change as a result of recent or future research or monitoring results and on-site adaptive management practices.

The grazing prescriptions recommended below are based on the use of cattle. If another type of livestock is used, the beginning and cut-off dates will be evaluated and potentially adjusted by the Resource Manager, in cooperation with the grazing lessees.

5.5 LIVESTOCK CARRYING CAPACITY/STOCKING RATES

A range analysis was conducted (Table C) to estimate forage production, livestock carrying capacity, and appropriate stocking rates. These are based on forage production estimates from ecological site descriptions (NRCS 1983, 1984) with a target RDM levels of 800 pounds per acre for consistency with resource management objectives and easement requirements. The acreages and resulting stocking rate recommendations are approximate and should be interpreted and applied with flexibility and adjusted based on monitoring results.

The stocking rates (i.e., number of grazing livestock per acre) calculated by this range analyses will be used as an approximate benchmark to establish initial stocking rates for average, favorable (wet) and unfavorable (dry) rainfall years. They can be achieved either by adjusting the grazing season (shorter for dry years) or the number of animals. These stocking rates will then be adjusted (up or

down) based upon flexible interpretation of annual monitoring results. The average stocking rates will be based on the number of pounds of forage available in each grazing unit in an average year. These base stocking rates are estimates subject to variability due to rainfall levels and other factors and will be revised in accordance with periodic monitoring throughout the grazing year. Estimates of forage production may be periodically calibrated during the grazing season based on grass heights and air-dried sample weights ("standing crop") collected periodically by the Resource Manager in ungrazed caged plots. The total available forage and resulting carrying capacity is partially based on acreage, which should be adjusted with gains or losses to the Grazing Units, such as when the Campus Buildout lands are developed.

During the spring months in an average year, green grass will likely grow faster than the cattle will consume it, and grass height will be at the high end of the desired range. During the late spring and early summer months, the grass will stop growing, die, and will be reduced in height by grazing. It will be the grazing lessee's responsibility to increase or decrease the number of cattle on a feasible schedule to achieve the standards for each management objective. Oversight will be provided by Resource Manager to ensure that the livestock tenant is making needed adjustments in a timely manner.

The results of the range analysis indicate that during a normal rainfall year, the UC Merced Management Unit would support about 1,900 yearlings (the rough equivalent of 600-pound replacement heifers) during a six-month grazing season (Table C). The stocking rate from the 2006 grazing season of 1,500 replacement heifers was lower than that, probably because of management adjustment in response to unfavorable rainfall levels.

To allow for flexibility for future management actions, the range analysis worksheets (Table C) also calculate stocking rates for other kinds and classes of animals. These calculated stocking rates are preliminary and will be adjusted based on actual use records and grazing utilization monitoring results.

It should also be noted that these recommendations for stocking rates should not be interpreted rigidly as they are rough guidelines subject to high variability resulting site and weather differences and changes in acreage. Continuing the viability of livestock operations requires flexibility in interpreting stocking rate guidelines. For example, stocking rates may exceed the carrying capacity for the first year of low rainfall following normal or high rainfall years, but such periodic heavy grazing will only have short term effects on grassland production and composition. Annual grassland and vernal pool ecosystems are adapted to such short-term events and recover quickly following relaxation of grazing pressure.

5.6 KIND OF ANIMAL

The VST Preserve easement allows general grazing use by cattle and sheep, as well as use by horses, burros, and mules to serve grazing operations and by goats only to control noxious weeds. Cattle (cow-calf, stockers, or replacement heifers) are preferred for grazing the UC Merced Management Unit for three reasons: 1) cattle prefer to graze grass rather than forbs (broadleaved plants), so they would be more effective in reducing non-native grass thatch and would have less impact on native wildflowers and special-status plants than sheep; 2) the demand for forage for cattle is greater than for sheep or goat forage, allowing more income from leases that could be available for range

improvements or ecological restoration; and 3) cattle have historically dominated range livestock operations in the area for a century or more and the vernal pool-grassland system has apparently adapted to that disturbance regime. Although likely to require a subsidy, goat grazing should be employed where useful and cost effective for small scale site-specific weed control treatments by confining goats to infested areas using temporary fencing and water trailers.

5.7 SEASON OF USE

Livestock should be introduced to the Management Unit in the late fall or early winter (October-December) after enough green vegetation (3 to 4 inches in height) has become established to provide soil protection and adequate forage. Livestock may also be turned out prior to the green grass season if enough RDM has been reserved to provide adequate forage and soil cover. The schedule for moving livestock onto the property will be determined based on visual estimates of grass height and forage biomass or RDM levels and will vary based on rainfall and temperature conditions.

Livestock will be removed in the late spring or early summer (April-June) also based on visual analysis and monitoring results to maximize resource management benefits (i.e., minimizing impacts on native vernal pool flora as well as controlling non-native invasive species) and to achieve an even distribution of grazing use levels as described above. Livestock should be removed later during favorable or late rainfall years and earlier during unfavorable or early rainfall years.

Monitoring should be conducted to determine if cattle are significantly damaging Orcutt grass or Colusa grass occurrences (Figure B-4). If so, cattle may need to be removed from those pastures before the pools dry. If early removal of cattle from these pastures is an excessive constraint on livestock operations and threatens economic viability, the portions of pools supporting Orcutt grass and Colusa grass should be excluded from late season grazing with temporary electric fencing or separated into smaller separate special management pastures with permanent barbed wire fencing. This measure should be considered carefully in context with the broader grazing program benefits because exclusion from these pools could restrict livestock access to late season water sources.

5.8 GRASS HEIGHT AND RESIDUAL DRY MATTER OBJECTIVES

To maintain optimum habitat conditions, grass height should generally be in the range of 2 to 12 inches on the basis of means (i.e., averages) for each Management Unit at any time of the year. The mean RDM at the end of the grazing season will be no less than about 800 pounds/acre depending on topographic position and slope steepness. A maximum grass height of 18 inches may be acceptable for short periods during the growing season if necessary because of feasibility limits on the livestock operation or higher than normal spring grass growth. Periodic adjustments in stocking rates should be used to balance grazing utilization with grass growth. When grass height begins to exceed these standards, additional cattle (ideally yearling stocker steers) may be introduced to the Management Unit.

The 3-inch minimum height and minimum of 800 pounds/acre correlates with moderate grazing pressure, which is required to achieve optimum forage production and good rangeland condition in California annual grassland and vernal pool ecosystems (Bartolome et al. 2002). Grazing variability at a moderate rate usually results in an uneven appearance with a mosaic of patches of longer and

shorter grass (Clawson et al. 1982). This is a desirable outcome for habitat objectives and will assure a moderate degree of landscape diversity or "patchiness" across the property. The desired minimum RDM level in this plan is consistent with the utilization level (800 lbs per acre) recommended in the previous Resource Mitigation Plan (Jones & Stokes 2002) and with results of scientific literature reviews (Bartolome et al. 2002, Edinger-Marshall and Macon 2003). Regardless, it is important to stress that these RDM objectives should be interpreted with flexibility because they are subject to variability due to site differences and weather fluctuations. As discussed previously, they may be exceeded in the short term during a dry year with no permanent damage to the ecosystem. What is important is that heavy grazing does not continue over a long period of time.

5.9 SUPPLEMENTAL FEEDING

Supplemental feeding of livestock with minerals, salt licks, and molasses/protein mixtures can be a useful tool to improve grazing distribution with locations moved periodically and placed away from water sources. Grazing use pattern maps (see monitoring discussion) will be used to determine optimal supplement locations. Supplementation with hay may be necessary during periods of low forage production. If so, certified weed-free hay should be used in accordance with Guideline IMP-2 of the MPCL (Airola 2008) and supplement locations monitored to detect and control any introductions of invasive non-native plants.

Seeding to provide supplemental forage for range improvement will not be allowed unless it is conducted as part of an approved action intended to enhance conditions for species of conservation concern (i.e., seeding after control of invasive plant species to discourage reestablishment).

5.10 INVASIVE NON-NATIVE PLANT CONTROL

Livestock grazing management is a key tool both to prevent the introduction and increase in invasive non-native weeds, and to treat infestations. Invasive plants are defined as those that are not native but can spread into wildland ecosystems and displace native species, hybridize with native plants and alter biological communities and ecosystem processes (Cal-IPC 2006, Airola 2008). For the purposes of the GMP they correspond with those species listed in Table 1 of the California Invasive Plant Inventory (Cal-IPC 2006).

Introductions of invasive plants will be minimized by avoiding to the extent possible the creation of bare ground from grading or disking or from over-grazing (i.e., forage consumption to levels below the RDM standard) and cattle concentration around water sources and supplemental feed stations. The prescription for stocking rates discussed above are designed to prevent over-grazing with the potential exception of the first year of unexpected drought. Cattle concentration areas for supplemental feeding will be placed away from water sources to the extent possible. Corrals for holding of cattle will be temporary and portable, and be situated when needed in areas designated for repeated use.

The Resource Manager will monitor areas of cattle concentration or other soil disturbances for introductions or expansion of pest plants on UC managed lands, as a part of the MPCL's IPM program (Airola 2008) and eradicate them when discovered. The lessee will be responsible for assisting the manager in identifying occurrences of pest plant species and in using grazing to control of new introductions and expansion of existing occurrences of invasive non-native plants, consistent

with the requirements and guidelines of the Integrated Pest Management (IPM) program of the UC Merced MPCL (Airola 2008). An inventory to locate and map infestations of invasive non-native weeds will be conducted annually and occurrences will be plotted using GPS technology. The invasive plant polygons will then be analyzed by the Resource Manager and grazing lessee to target and prioritize infestations for control. Weed control targets and priorities for the upcoming year will be documented in the Yearly Grazing Plan.

Grazing treatments to control invasive weeds will be applied, where appropriate, in an integrated fashion with other methods identified in the IPM guidance of the MPCL (Airola 2008). These other treatments may include mowing, herbicide use, burning, and biological controls. The Resource Manager may allow lessees to perform other forms of control if they are interested and qualified to do so.

Herbicide use will be conducted only with approved chemicals applied according to label requirements under direction of personnel with a Qualified Applicator's license. Herbicide use will follow U.S. Environmental Protection Agency (USEPA) guidelines, state and federal laws, and product labeling instructions. Any herbicides to be used near drainages, ponds, or wetlands will be labeled by the USEPA for use in or near aquatic environments. Herbicide application methods will be limited to the most target specific approaches practicable such as use of a wick applicator or spot spraying with a backpack sprayer. If these measures are followed, herbicide use will not require separate agency review and approval.

5.11 PEST ANIMAL CONTROL

Rodent burrows (created by California ground squirrels and pocket gophers) are important to several animals of conservation interest, including the California tiger salamander and (potentially) the burrowing owl. Rodent control will not be permitted within the grazing unit, except if necessary along the edges where ground squirrels and pocket gophers could conflict with adjacent land uses (See Guideline IPM-15 in the MPCL). The extent of the control will be determined by the Resource Manager in consultation with permitting agencies.

5.12 VANDALISM PREVENTION AND TRASH REMOVAL

Vandalism of range improvements such as cutting of fences has been reported as a frequent occurrence on the adjacent CST property, especially along La Paloma Road (L. Bartlett pers. com.). UC and the current UC lessee have less history on which to assess vandalism threats. The land manager will coordinate with County and campus law enforcement agencies to conduct regular patrols to discourage access and prevent vandalism (see Guidelines FPM-6, UUM-2, and UUM-3 in the MPCL). Currently the County closes the eastern portion of La Paloma Road during the fire season, generally after the grazing of the UCM Conservation Lands is completed. If problems are evident that affect UCM lands or adjacent CST lands, further coordination with the County may be warranted to discourage access, such as by closing off La Paloma Road at Snelling Road. The grazing parcels will also be periodically inspected by the land manager and grazing lessee to repair damaged facilities and remove trash or debris to facilitate livestock operations and repair resource damage (see Guideline UUM-4 in the MPCL).

6.0 MONITORING PLAN

Long-term monitoring is required to assess the effectiveness of management actions and to provide feedback information for adaptive grazing management. The primary management assumption is that the removal of annual grass thatch and control of invasive weeds through managed grazing will maintain the populations of native biological resources on the site within a natural range of variability. Should monitoring reveal that the goals and objectives of the GMP, and the MPCL as a whole, are not being achieved, current management activities will be adapted as warranted. Potential modifications include, but are not limited to:

- Changes in stocking rates, kind of animal, class of animal (as defined in Appendix B-1)
- Modification of grazing seasons
- Improved management of use through additional water sources, fencing or other range improvements
- Increased weed abatement activities

Monitoring will be focused on key management areas in each pasture that represent overall conditions, and will include photopoint documentation (Appendix B-1) in addition to actual measurements described below. Key management areas should be stratified by ecological site. All monitoring locations will be mapped using GPS systems and all data will be recorded and maintained in ARCView GIS format. Monitoring of the phenology of Orcutt grass and Colusa grass (Figure B-4) will be conducted periodically after the pools are inundated and until they begin to dry (January-May) to determine if and when cattle will be removed to protect those species.

6.1 UTILIZATION ASSESSMENTS

The monitoring program will be based on visual assessments calibrated with clipping and weighing of air-dried vegetation during the grazing season to ensure that desired grazing levels are attained but not exceeded. Monitoring visits will be made at least twice per grazing season: once in the fall or winter to determine if sufficient forage growth has occurred or enough RDM reserved from the previous year to support recommended levels of livestock grazing; and once in the summer towards the end of the grazing season to measure RDM and map grazing utilization patterns. Assessments of grass height and RDM standards will be based on an average of multiple monitoring samples (visual estimates calibrated with clipping as described below) distributed across the property in key management areas. Monitoring should be conducted so that it is inside designated key management areas that are stratified within each ecological site and do not cross site boundaries. Estimates can be facilitated using an RDM Monitoring Photo-Guide developed by Wildland Resource Solutions (Guenther 1998).

The visual estimates of RDM levels may be confirmed and calibrated by clipping plots in key locations in each grazing unit (Bartolome et al. 2002). This is conducted by placing a 0.96 square foot quadrat on the ground, removing all summer annuals (star-thistle, turkey mullein, etc.) from the

quadrat, clipping the remaining plant material as close to the ground as possible without disturbing the soil surface, and weighing the dry plant material (1 gram per 0.96 square foot = 100 pounds per acre).

The RDM levels at each plot location will be documented each year by photographs from permanent photo stations. Representative photographs of the RDM levels in each community type will be taken annually.

Grazing use patterns will also be mapped at the end of the grazing season prior to the first rains in the categories of light, moderate, and heavy use on standard aerial photographic base maps of the property. This mapping, based on visual RDM estimates, will be used to document grazing influence and use. Residual cover maps provide a useful tool for assessing livestock distribution, use, and the potential need for additional improvements (cross fencing, water sources, mineral supplements, etc.) to improve livestock distribution. In addition to mapping use levels, the average RDM will be calculated for each pasture and compared with the 800 lbs per acre minimum RDM standard.

6.2 INVASIVE NON-NATIVE PLANT MONITORING

As described under the IPM program in the MPCL (Guideline IPM-7), monitoring will be conducted annually for invasive non-native plant. This monitoring will be closely coordinated with the monitoring of grazing intensity. Monitoring prescriptions and schedules will vary by species depending on their distributions and phenologies. The goal of monitoring invasive plants is to determine if any new invasive plants are introduced to the Management Units, or if any existing occurrences are expanding.

The Management Units should be surveyed yearly by the Resource Manager and staff to locate any new infestations. All lands will be monitored, but areas emphasized will include disturbed areas (firebreaks, livestock concentration areas) and lands adjacent to potential introductions from adjacent lands (especially the campus, canals, and Yosemite Lake Park area). To monitor spread of existing infestations, the polygons of invasive weed populations will be mapped and, if necessary, individual plants counted within a polygon. The exact methods for invasive plant monitoring methods will be determined by the Resource Manager in a specific monitoring protocol to be developed based on the results of an initial inventory.

6.3 REPORTING

The Resource Manager will submit grazing program monitoring reports to the appropriate permitting agencies by December 15 of each monitoring year to describe management activities and results of monitoring. The reports will include the following information:

- a summary of grazing actions during the preceding year;
- a summary of all other management actions undertaken during the preceding year;
- a description of the methodology used to conduct the monitoring, including any changes to the methodology from that described herein;
- the results of the annual monitoring studies;

- copies of all data sheets and monitoring photographs;
- a list of all persons who participated in the monitoring and preparation of the annual report;
- a list of persons receiving the report; and
- recommendations for remedial actions and modifications to the GMP or monitoring plan.

7.0 PREPARERS

LSA ASSOCIATES

Project Manager: Richard Nichols, Certified Rangeland Manager #45

Principal-in-Charge: Roger Harris, Certified Wildlife Biologist

Geographic Information Systems: Greg Gallaugher, Senior GIS Specialist/Botanist

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Table B-1: Range Analysis for UC Merced Management Unit

Target RDM (lb/acre)	800
Dry-Matter (lb) per AUM	1000

Ecological Site	Acres	Dry-weight Production (lb/acre)			Available Forage (AUM/acre)			Total Available Forage (AUM)		
		Favorable Rainfall Year	Average Rainfall Year	Unfavorable Rainfall Year	Favorable Rainfall Year	Average Rainfall Year	Unfavorable Rainfall Year	Favorable Rainfall Year	Average Rainfall Year	Unfavorable Rainfall Year
Anderson Gravelly Soils	7.2	2750	2000	950	1.95	1.20	0.15	14.1	8.7	1.1
Clayey	982.7	3,150	2,500	1,500	2.35	1.70	0.70	2,309.3	1,670.6	687.9
Claypan Terrace	5,102.6	2,500	2,000	1,250	1.70	1.20	0.45	8,674.4	6,123.1	2,296.2
Shallow Rocky Loam	330.7	2,750	2,000	950	1.95	1.20	0.15	644.9	396.8	49.6
Upland Swale	190.1	3,500	2,650	1,450	2.70	1.85	0.65	513.1	351.6	123.5
Riverwash, Escarpments, Eroded	17.9	0	0	0	0.00	0.00	0.00	0.0	0.0	0.0
Water	42.7	0	0	0	0.00	0.00	0.00	0.0	0.0	0.0
Total	**6,673.9**							**12,155.9**	**8,550.8**	**3,158.3**

Carrying Capacity by Duration and Animal Type - Average year

Months	2	4	6	8	10	12	AUE
Cow/calves	4,275	2,138	1,425	1,069	855	713	1.00
Yearlings	5,701	2,850	1,900	1,425	1,140	950	0.75
Sheep	21,377	10,689	7,126	5,344	4,275	3,563	0.20

See Appendix B-1 for definitions of terms and abbreviations.

See Section 1.2 for methodology.

APPENDIX B-1

DEFINITIONS FOR THE UC MERCED CONSERVATION GRAZING MANAGEMENT PLAN

APPENDIX B-1

DEFINITIONS FOR THE UC MERCED TIER 1 GRAZING MANAGEMENT PLAN

TERM	DEFINITION
Air-dry weight	The weight of a substance (usually forage) after it has been allowed to dry to equilibrium with the atmosphere.
Animal-unit (AU)/ Animal Unit Equivalent (AUE)	Defines forage consumption on the basis of one standard mature 1,000-pound cow, either dry or with calf up to 6 months old; all other classes and kinds of animals can be related to this standard as animal unit equivalents (AUE), e.g., a bull equals 1.25 AU, a yearling steer or heifer equals 0.75 AU.
Animal-unit-month (AUM)	The amount (1,000 pounds) of air-dry forage calculated to meet one animal unit's requirement for one month with allowances for wastage and trampling.
Carrying capacity	The average number of livestock and wildlife that may be sustained on a management unit compatibly with management objectives. It is a function of site characteristics, and management goals and intensity.
Class of animal	Description of age and sex group for a particular kind of animal, e.g., cow, calf, yearling heifer, ewe, fawn.
Cover	(1) The plant or plant parts, living or dead, on the ground surface. (2) The proportional area of ground covered by plants on a stated area.
Ecological site	Land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in its ability to produce vegetation and to respond to management. Synonymous with range site.
Forage	Browse and herbage that are available for food for grazing animals or to be harvested for feeding.
Forage production	The weight of forage that is produced within a designated period of time on a given area (e.g., pounds per acre).
Forb	A non-woody, broad-leafed plant.
Grass	A plant with long, narrow leaves having parallel veins and nondescript flowers. Stems are hollow or pithy in cross-section.

TERM	DEFINITION
Grazing distribution	Dispersion of livestock grazing within a management unit.
Grazing management	The control of grazing and browsing animals to accomplish a desired result.
Grazing pressure	An animal-to-forage relationship measured in terms of animal units per unit weight of forage at any instant.
Key area	A relatively small potion of a management unit selected because of its location, use, or grazing value as a monitoring point for grazing use. It is assumed key areas will reflect the overall acceptability of current grazing management over the whole unit.
Kind of animal	An animal species or species group such as sheep, cattle, goats, deer, horses, elk, antelope.
Monitoring	The orderly collection, analysis, and interpretation of resource data over time to evaluate progress toward meeting management objectives.
Native species	A species that is a part of the original fauna or flora of a given area.
Overgrazing	Continued heavy grazing that exceeds the recovery capacity of individual plants in the community and creates a deteriorated range.
Overstocking	Placing a number of animals on a given area that exceeds the forage supply during the time they are present.
Overuse	Using an excessive amount of the current year's growth.
Palatability	The relish with which a particular species or plant part is consumed by an animal.
Pasture	A grazing area enclosed and separated from other areas by fencing or other barriers.
Photopoint	A point from which photos are periodically taken to monitor long-term management responses.
Plant community	An assemblage of plants occurring together at any point in time, denoting no particular ecological status.
Range (Rangeland)	Any land supporting grazable or browsable vegetation and managed as a natural ecosystem; can include grasslands, forestlands, shrublands, and pasture. "Range" is not a land use.
Range improvement	Any practice designed to improve range condition or allow more efficient

TERM	DEFINITION
	use.
Range management	A distinct discipline founded on ecological principles with the objective of sustainable use of rangelands and related resources for various purposes.
Residual dry matter (RDM)	Residual dry matter is the old plant material left standing or on the ground at the beginning of a new growing season (typically early fall immediately prior to the first rains).
Rest	Leaving an area ungrazed for a specified time.
Stocking rate	The number of specific kinds and classes of animals grazing a unit of land for a specified time period.
Use	The proportion of current years forage production that is consumed or destroyed by grazing animals.
Weed	(1) A plant growing where unwanted. (2) A plant having a negative value within a given management system.

Reference:
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Appendix D

Management Plan Compliance Checklist

		Management Activity		
Management Program	Guideline Number	Description	Frequency or Completion Date	Annual Compliance Reporting (Completion Status, Results, Issues)
Grazing				
	G-1	Lessee selection and management	At time of new lessee selection	
	G-2	Livestock type	Ongoing basis, report annually	
	G-3	Stocking rates	Ongoing basis, report annually	
	G-4	Season of use	Ongoing basis report annually	
	G-5	Protection for deep pool grasses	Ongoing basis, report annually	
	G-6	Residual dry matter grazing standards	Ongoing basis, report annually	
	G-7	Supplemental feeding	Ongoing, basis report annually	
Fire Protection and Management	FPM-1	Fuelbreak construction	Spring 2008 and as required subsequently	
	FPM -2	Resource protection during fuelbreak construction	Spring 2008 and as required subsequently	
	FPM-3	Conduct annual firebreak maintenance	Annually	
	FPM-4	Monitor firebreaks for noxious weeds and treat as needed	Annually	
	FPM-5	Protection from adjacent land use changes	As required	
	FPM-6	Routine daily law enforcement patrol	Daily, report annually	
	FPM-7	Staff training in fire protection	Spring 2008, and upon hire of each new employee	
	FPM-8	Fire prevention training for contractors	As required	
	FPM-9	Fire prevention planning for future construction	As required	
	FPM-10	Contract fire protection services	Annually	
	FPM-11	Incorporate resource protection into fire protection contracts	Biannually	
	FPM-12	Ensure compliance with resource protection requirements during fire suppression actions; provide resource information to suppression agency	Annually	

Management Program	Guideline Number	Management Activity: Description	Management Activity: Frequency or Completion Date	Annual Compliance Reporting (Completion Status, Results, Issues)
	FPM-13	Conduct fire rehabilitation planning	Initiated within 2 weeks after wildfire	
	FPM-14	Prescribed fire use to control noxious weeds	As needed	
	FPM-15	Conduct interdisciplinary analysis and meet CDF requirements for prescribed fire for weed control	As needed	
Unauthorized Uses Management	UUM-1	Develop and deliver continuous public education program	Ongoing basis, report annually	
	UUM-2	Routine security patrol (incl non-fire season)	Daily/weekly	
	UUM-3	Incorporate reporting of unauthorized use into leases and use agreements	On new lease issuance	
	UUM-4	Evaluate effects of unauthorized uses	Following incidents	
Integrated Pest Management	IPM-1	Maintain Pest Species list	Ongoing basis	
	IPM-2	Monitor to verify use of weed free hay	Ongoing basis, report annually	
	IPM-3	Require cleaning of vehicles and footware and operate and monitor a vehicle washing station	Ongoing basis, report annually	
	IPM-4	Prohibit introduction of non-native species	Ongoing basis, report annually	
	IPM-5	Require and verify use of weed free erosion control materials in adjacent construction areas	Ongoing basis, report annually	
	IPM-6	Prohibit invasive species in landscaping	Ongoing basis, report annually	
	IPM-7	Monitoring for weed invasions	Formal survey annually, informal monitoring continuously	
	IPM-8	Develop weed treatment prescriptions	As required	
	IPM-9	Control noxious weeds	As required	
	IPM-10	Coordinate mosquito control to minimize effects	As required	
	IPM-11	Control of aquatic vertebrate pests	As required	
	IPM-12	Coordinate on pet control	Ongoing basis, report annually	
	IPM-13	Direct control of pest vertebrates	Ongoing basis, report annually	

Management Program	Guideline Number	Management Activity: Description	Management Activity: Frequency or Completion Date	Annual Compliance Reporting (Completion Status, Results, Issues)
	IPM-14	Control of nonnative rodents	Ongoing basis, report annually	
	IPM-15	Control of native rodents	As required	
Research and Educational Uses	REU-1	Research uses approval and reporting	Annually	
	REU-2	Locations of research activities	Annually	
	REU-3	Research on Future Campus Lands	Annually	
	REU-4	Research proposal evaluation and approval	Annually	
	REU-5	Research Results	Annually, as available	
	REU-6	Educational uses – TNC lands	None required	
	REU-7	Educational uses – UC lands	Annually	
	REU-8	Educational uses – UC lands	Annually	
	REU-9	Approval process	Annually	
	REU-10	Supervision of Educational uses by non-UC groups	Annually	
Habitat Enhancement	HPE-1	Treatment of ground disturbance	As required	
	HPE-2	Restore unauthorized disturbance	As required	
	HPE-3	Install kit fox burrows	Within 1 year	
	HPE-4	Other habitat structural improvements	As desired	
	HPE-5	Complete kit fox canal crossings	Within 3 years ???	
Recreation and Other Public Uses	R-1	Limit recreation uses on Tier 1 lands	Incorporate into R-3 use application	
	R-2	Prohibited uses	Incorporate into R-3 use application	
	R-3	Use applications	Ongoing basis, report annually	
	R-4	Recreation use applications and approvals	Ongoing basis, report annually	
	R-5	Recreation plan element revision	Year 5–10	
	R-6	Restricted use of Tier 1 lands	Incorporate into R-3 use application	

Management Program	Guideline Number	Management Activity: Description	Management Activity: Frequency or Completion Date	Annual Compliance Reporting (Completion Status, Results, Issues)
	R-7	Recreation use on Future Campus lands	Ongoing basis, report annually	
Cultural Resources	CR-1	Protection from vandalism	Ongoing basis, report annually	
	CR-2	Maintain cultural resources inventory	Ongoing basis, report annually	
	CR-3	Records search prior to disturbance	As required	
	CR-4	Conduct ground surveys prior to disturbance	As required	
	CR-5	Protect cultural resources during ongoing activities	Ongoing basis, report annually	
	CR-6	Mitigation for cultural resource disturbance	As required	
	CR-7	Develop procedures for accidental discoveries	Within 1 year	
Visual Resources	VR-1	Prepare visual resource sensitivity map	Within 1 year	
	VR-2	Visual resource protection during management actions	Ongoing basis	
Interjurisdictional Coordination	IC-1	Share resource information	Ongoing basis, report annually	
	IC-2	Maintain contacts with adjacent landowners and jurisdictions	Ongoing basis, report annually	
	IC-3	Monitor and provide input to land use decisions	Ongoing basis, report annually	
	IC-4	Submit compliance reports	Annually	

Appendix E

List of Acronyms

List of Acronyms

AUMs – animal-unit-months
BA – Biological Assessment
BO – Biological Opinion
Cal Fire – California Department of Forestry and Fire Protection
CLR – Campus Land Reserve
CNR – Campus Natural Reserve
CRHR – California Register of Historic Resources
CRT – California Rangeland Trust
CST – Cyril Smith Trust
CWA – Clean Water Act
DFG – Department of Fish and Game
EIR – Environmental Impact Report
EIS – Environmental Impact Statement
EPA – Environmental Protection Agency
ESA – Endangered Species Act
IPM – Integrated Pest Management
LRDP – Long Range Development Plan
NRS – Natural Reserve System
PLAN – Management Plan
RDM – Residual Dry Matter
RMP – Resource Management Plan (see Jones & Stokes 2002)
SNRI – Sierra Nevada Research Institute
TNC – The Nature Conservancy
UC Merced – University of California Merced
USACE – U. S. Army Corps of Engineers
USFWS – U. S. Fish and Wildlife Service
VST – Virginia Smith Trust
WCB – Wildlife Conservation Board

Appendix F

Conservation Easements for Tier 2 Conservation Lands

As of September 2008, Appendix F is incomplete. It will be finalized following completion of remaining conservation easements for Conservation Lands properties.