David Magney Environmental Consulting

WETLAND MITIGATION AND MONITORING PLAN FOR NORTH VINEYARD GREENS DEVELOPMENT PROJECT

(CORPS REGULATORY #200600428)

Prepared for:

UNITED STATES ARMY CORPS OF ENGINEERS

and

CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD

On Behalf of:

NORTH VINEYARD GREENS

DMEC Mission Statement:

To provide quality environmental consulting services, with integrity, that protect and enhance the human and natural environment.

August 2007

DMEC

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Prepared for:

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SECTION 1. INTRODUCTION

PROJECT BACKGROUND

The ±206.3-acre North Vineyard Greens (NVG) project site is part of the ±1,594.5-acre North Vineyard Station Specific Plan (NVSSP) area in southern Sacramento County. The Project consists of NVG Unit 1 (±146.7 acres), NVG Unit 3 (±49.4 acres), and Gosal Estates (±10.2 acres). It is expected that approximately 750 dwelling units will be built on approximately 139 gross residential acres within the NVG project site. Single-family housing will account for about 525 dwelling units and multiple-family housing will account for about 225 units (County of Sacramento 2005).

The Specific Plan was prepared according to direction in the Sacramento County General Plan[1] and involved public input, extensive analyses of environmental conditions, adjacent land use, and area-wide infrastructure needs. It places a high priority on aesthetics, quality of life, and land use compatibility. The Specific Plan area is bounded by Florin Road to the north, Gerber Road and/or Gerber Creek on the south, the northerly extension of Vineyard Road on the east, and generally by Elder Creek on the west side. The Specific Plan consists of a 5,732-dwelling unit residential land use plan with supporting commercial, business professional, park, school, and open space uses.

The proposed project responds to the need for a well-planned, high quality suburban environment in the North Vineyard Station area. The NVSSP area is located within the County's Urban Services Boundary (USB) and the South Sacramento Habitat Conservation Plan (SSHCP) area. The North Vineyard Station Specific Plan Environmental Impact Report (County of Sacramento 1998) was prepared to identify potential environmental impacts from the development of the North Vineyard Station Area.

The Specific Plan includes a regional flood control plan for Gerber and Elder Creeks. The North Vineyard Station Drainage Master Plan identifies existing drainage facilities and flooding patterns and analyzes alternatives to recommend preferred flood control and conveyance facilities to serve the drainage needs of the Plan area. The County of Sacramento has submitted an individual permit application for the North Vineyard Station Drainage Master Plan project that includes the improvements to Gerber Creek and construction of the detention basin within the project area.

David Magney Environmental Consulting (DMEC) was contracted to prepared the Alternatives Analysis (AA) for the NVG project site (DMEC 2007) required by Section 404(b)(1) of the Clean Water Act for 404 individual permit applications[2]. The AA identified the filling of 1.60 acres of jurisdictional wetlands with onsite mitigation through the creation of wetland preserve as the least environmentally damaging practicable alternative (LEDPA). DMEC was also contracted to prepare this Wetland Mitigation Plan (Plan), which describes the proposed approach to the required onsite wetland mitigation. DMEC has not conducted focused biological resources surveys onsite; however, DMEC conducted a cursory site visit on 1 August and 21 September 2006 to generally assess conditions and habitats.

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[1] County of Sacramento, Planning and Community Development Department. www.saccounty.net/planning/gpupdate/gpu-index.html

[2] Section 404(b)(1) Guidelines. www.usace.army.mil/cw/cecwo/reg/40cfr230.pdf

PROJECT OBJECTIVES

Guidelines call for project objectives to be expressed in terms of basic and overall purpose. The basic project purpose is to provide housing in southern Sacramento County. The overall project purpose is to create a small, low density single-family subdivision as well as a high-density component, beginning in 2008, that is proximate to local and regional job centers and existing infrastructure in a manner that is consistent with Sacramento County's urban growth policies requiring compact urban form. The project is not dependent on water.

The NVG project would provide additional housing needed to accommodate job growth and housing demand within Sacramento County projected by the Sacramento Area Council of Governments (SACOG)[3]. Sacramento County continues to experience a dramatic population increase, with growth rates in the unincorporated areas of the County averaging 27.7% between 1970 and 1990. (Sacramento County General Plan[4], Housing Element p. 130-31; the Vineyard Community Planning Area, which contains Mequity, LLC's proposed NVG community, experienced a 116% growth rate between 1990 and 2000[5].)

SACOG projects that the Sacramento area will need to house more than 1 million additional people in the next 25 years. This population growth continues to put tremendous pressure on the housing market, and SACOG projects that current conditions would yield a shortfall of over 500,000 dwelling units for the Sacramento region by 2050. Rising housing demand, coupled with a shortage of approved residential development sites near established urban areas and regional job centers, have led to a rapid escalation in home prices. Also, homebuilders must look further from urban areas and job centers to find available homesites and developable land. Mequity, LLC conceived the proposed NVG community to provide new housing to accommodate some of the high demand for housing in the Sacramento region resulting from sustained population growth. NVG is located in an underdeveloped rural residential portion of South/Central Sacramento County that is proximate to established commercial/industrial uses and convenient to major regional job centers in downtown Sacramento, Rancho Cordova, and along the Highway 50 corridor. It is also proximate to existing infrastructure.

PROJECT LOCATION

The ±206.3-acre project site is located north of Gerber Road, west of Bradshaw Road, south of Florin Road, and east of Elk Grove Florin Road (Figure 1, General Location Map). The site corresponds to a portion of Section 6 of Township 7 North, Range 6 East of the Elk Grove, California 7.5-minute quadrangle (U.S. Department of the Interior, Geological Survey, photorevised 1979). The NVG site corresponds to Assessor's Parcel Numbers 066-0070-020, 043-046; 066-0080-001-003, 016; 065-080-027, 029, 057, 064, 070 and 080.

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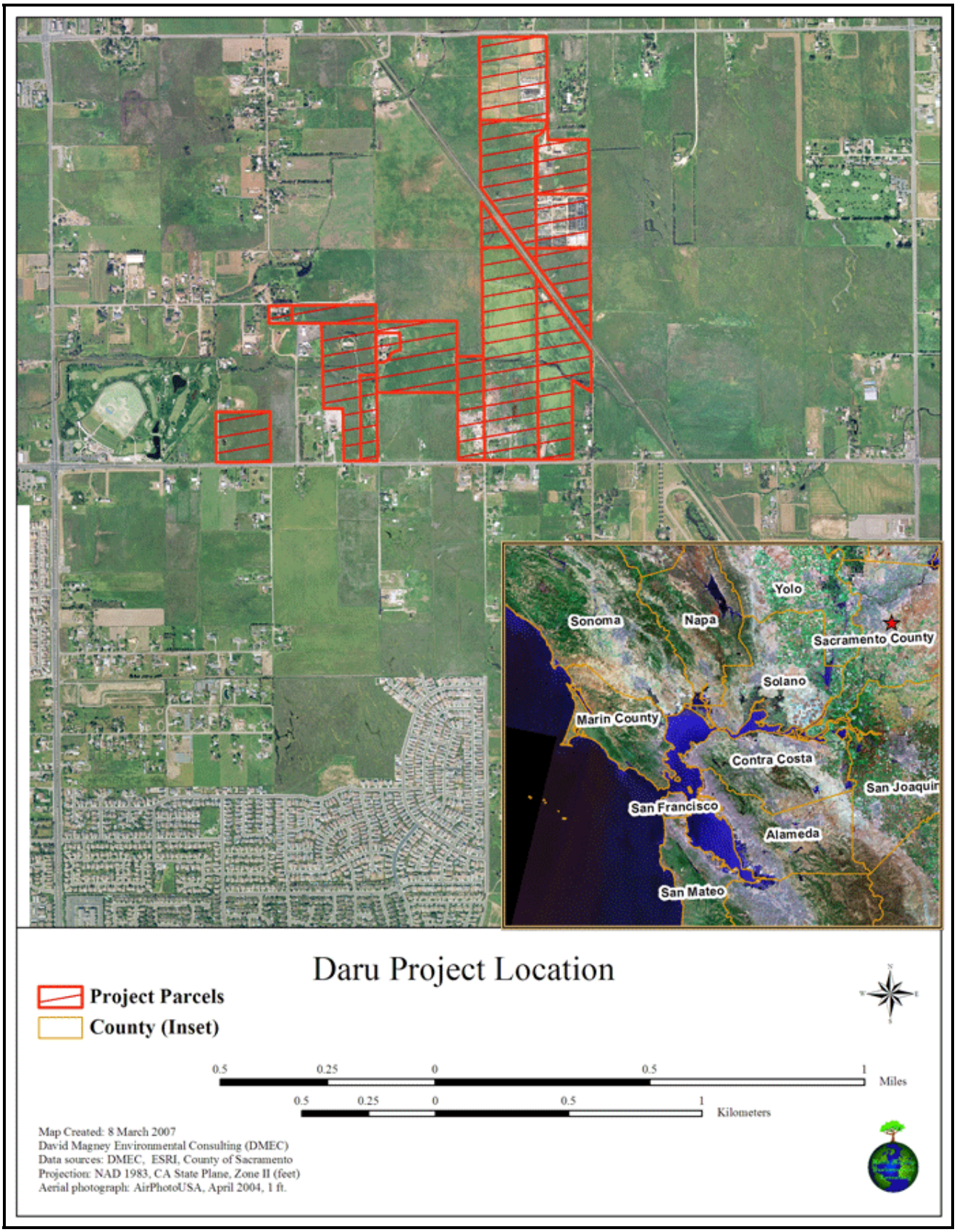
[3] Sacramento Area Council of Governments Employment and Housing Demand projections. www.sacog.org/demographics/projections/index.cfm

[4] Planning and Community Development Department, County of Sacramento. www.saccounty.net/planning/gpupdate/gpu-index.html

[5] Sacramento Area Council of Government Population projections. www.sacog.org/demographics/projections/index.cfm

Figure 1. General Location Map



SECTION 2. EXISTING CONDITIONS

This section describes the conditions currently existing onsite, including geology and soils, and botanical and wildlife resources, including special-status biological resources. DMEC has not conducted focused biological resources surveys onsite; however, DMEC conducted a cursory site visits on 1 August and 21 September 2006 to generally assess conditions and habitats onsite. In addition to the resources observed by DMEC, the following existing conditions are supported by findings reported by the South Sacramento Habitat Conservation Plan (SSHCP) and ECORP Consulting, Inc. (ECORP 2004, 2006).

SITE CHARACTERISTICS

Much of the site is leveled pasture and is currently fallow but was farmed and irrigated historically. Rural residences and plant nursery operations are located in the northern and southern portions of the site (Figure 2, Aerial Photograph of the NVG Project Site). The nurseries are currently active and several drainage ditches are located west of the northern nursery. The Central California Traction Railroad easement runs diagonally through NVG Unit 1, dividing it into two unequal portions.

The primary vegetation community present onsite is annual grassland. Within the annual grassland are ephemeral wetland features that include seasonal wetlands and vernal pools. Gerber Creek meanders through the southern and central portions of NVG Units 1 and 3. A non-jurisdictional man-made fish pond is situated in the southern portion of NVG Unit 1 and south of Gerber Creek. The site is situated at an elevation of approximately 50 feet (15 meters) above mean sea level.

GEOLOGIC SETTING AND SOILS

The NVG project site is located within the Lower Unit Riverbank Formation. This formation is characterized by a broad floodplain, very deep alluvial soils, lack of constraint to lateral channel migration, and frequent flooding. The Formation is made up of higher riverbank terraces and remnants of alluvial fans composed of alluviums containing claypans and duripans, soils that are capable of supporting seasonal wetlands, swales, and vernal pools (SSHCP).

According to the Soil Survey of Sacramento County, California (U.S. Department of Agriculture, Natural Resource Conservation Service 1993), three soil units, or types, have been mapped for the site (ECORP 2006), including: (213 [mapping unit designation]) San Joaquin silt loam, leveled, 0-1 percent slopes, (214) San Joaquin silt loam, 0-3% slopes and (216) San Joaquin-Durixeralfs complex, 0-1 percent slopes. The San Joaquin silt loam, 0-1% slopes is not listed as a hydric soil and does not contain listed hydric inclusions. The San Joaquin-Durixeralfs complex and San Joaquin silt loam, 0-3 % slopes are not considered to be hydric soils; however; they do contain listed hydric inclusions. This is summarized in Table 1, Soil Units Present at the NVG Site.

Figure 2. Aerial Photograph of the NVG Project Site

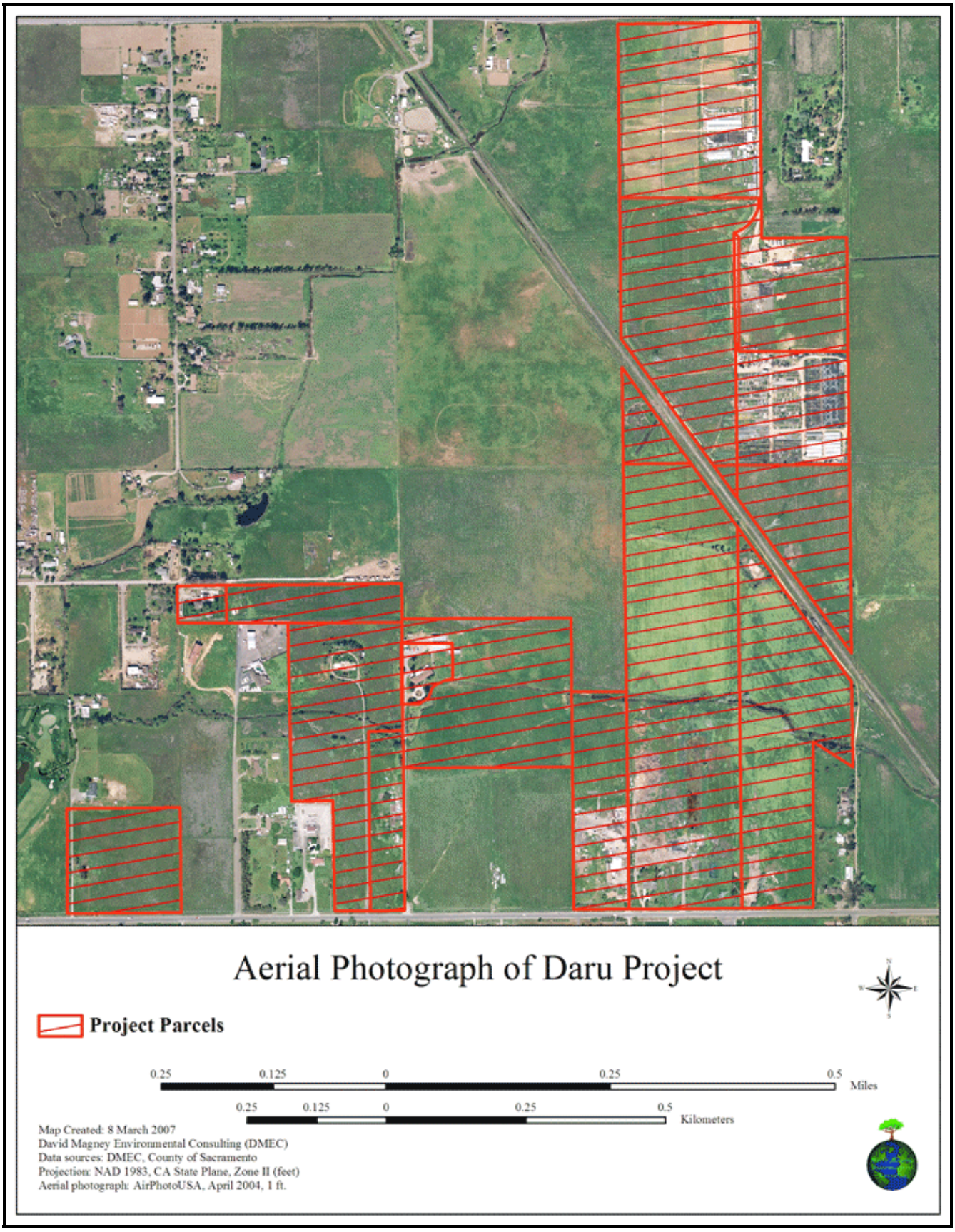


Table 1. Soil Units Present at the NVG Site

NVG Unit	Soil Units Present	Hydric Soil	Hydric Inclusions or Components
#1	(213) San Joaquin silt loam, leveled, 0-1% slopes	No	Not present
	(216) San Joaquin-Durixeralfs complex, 0-1% slopes	No	Present
#3	(213) San Joaquin silt loam, leveled, 0-1% slopes	No	Not present
	(214) San Joaquin silt loam, 0-3% slopes	No	Present
#11	(213) San Joaquin silt loam, leveled, 0-1% slopes	No	Not present
Gosal	(213) San Joaquin silt loam, leveled, 0-1% slopes	No	Not present

BOTANICAL RESOURCES

Botanical resources of the NVG project site include the property flora (or all plant taxa contributing to the plant communities onsite), and the habitats and plant alliances (plant communities) that occupy the property and provide resources to wildlife species frequenting and occupying the property.

Flora

The vascular plant species observed by DMEC and reported by ECORP during the NVG wetland delineations (ECORP 2004) and Section 404 Individual Permit Application (ECORP 2006), are listed in Table 2, Plant Species of the NVG Project Site. Table 2, which is alphabetized by scientific (botanical) name, includes the common name, growth habit, wetland indicator status, and botanical family name for each species reported onsite.

A total of 154 vascular plants have been observed and reported for the NVG project site. Of the 154 plant species onsite, sixty-three (63) species are native and ninety (91) are introduced species. The ratio of native to nonnative taxa for the project site (41% native to 59% non-native) is not representative of the ratio for the entire California flora (Hickman 1993) and other smaller regions within California (approximately 75% native to 25% nonnative). This is indicative of a site that has been substantially disturbed by human activities. Seventy-five (75) of the 154 taxa (49%) are considered hydrophytes, and are assigned a wetland indicator status of least FAC (including 24 FAC, 22 FACW, and 29 OBL species).

Table 2. Plant Species of the NVG Project Site

Scientific Name[6]	Common Name	Habit[7]	WIS[8]	Family
Acer negundo	Box Elder	T	FACW	Sapindaceae
*Aegilops triuncialis**	Barbed Goatgrass	AG	-	Poaceae
*Ailanthus altissima**	Tree-of-heaven	T	FACU	Hippocastinaceae
*Aira caryophyllea**	Silver Hairgrass	AG	-	Poaceae
*Alisma lanceolatum**	Lanceleaf Water Plantain	PH	OBL	Alismataceae
Alnus rhombifolia	White Alder	T	FACW	Betulaceae
Amaranthus retroflexus	Redroot Amaranth	AH	FACU	Amaranthaceae
Amsinckia menziesii	Rancher's Fire	AH	-	Boraginaceae
*Anagallis arvensis**	Scarlet Pimpernel	AH	FAC	Primulaceae
*Anthemis cotula**	Mayweed	AH	FACU	Asteraceae
*Arundo donax**	Giant Reed	PG	FACW	Poaceae
Asclepias fascicularis	Narrowleaf Milkweed	PH	FAC	Apocynaceae
*Asparagus officinalis**	Garden Asparagus	PG	FACU	Asparagaceae
*Avena barbata**	Slender Wild Oat	A/PG	-	Poaceae
*Avena fatua**	Wild Oat	AG	-	Poaceae
Azolla filiculoides	Pacific Mosquitofern	F	OBL	Azollaceae
*Brachypodium distachyon**	Purple False Brome	A/PG	-	Poaceae
*Brassica nigra**	Black Mustard	AH	-	Brassicaceae
*Brassica rapa**	Field Mustard	AH	-	Brassicaceae
*Briza minor**	Little Quakinggrass	AG	FACW-	Poaceae
Brodiaea coronaria	Harvest Brodiaea	PH	(FAC)	Liliaceae
Bromus carinatus	California Brome	AG	-	Poaceae
*Bromus diandrus**	Ripgut Brome	AG	(FACU)	Poaceae
*Bromus hordeaceus**	Soft Brome	AG	FACU-	Poaceae
Bromus madritensis ssp. *rubens**	Red Brome	AG	NI	Poaceae
Callitriche marginata	Winged Water-starwort	AH	OBL	Callitrichaceae
*Carduus pycnocephalus**	Italian Thistle	AH	-	Asteraceae
Castilleja attenuata	Valley Tassels	AH	-	Orobanchaceae
Castilleja campestris ssp. *campestris*	Field Owl's Clover	AH	OBL*	Orobanchaceae

[6] * = Introduced plant species that have become naturalized. Scientific names of the plant species follow Hickman (1993) and Flora of North America Committee (2001-2007). Brackets [ ] indicate updated nomenclature.

[7] Habit definitions: AG = annual graminoid; AH = annual herb; AV = annual vine; F = Fern; PG = perennial graminoid; PH = perennial herb; PV = perennial vine; S = shrub; T = tree.

[8] WIS = Wetland Indicator Status. The following code definitions are according to Reed (1988):
OBL = obligate wetland species, occurs almost always in wetlands (>99% probability).
FACW = facultative wetland species, usually found in wetlands (67-99% probability).
FAC = facultative species, equally likely to occur in wetlands or nonwetlands (34-66% probability).
FACU = facultative upland species, usually found in nonwetlands (67-99% probability).
UPL = obligate upland species in this region (99% probability), occurs in wetlands in another region
NI = no indicator status has been assigned due to a lack of information.
+ or - symbols are modifiers that indicate greater or lesser affinity for wetland habitats.
* = tentative assignment to that indicator status by Reed (1988).
( ) Parentheses indicate a wetland status suggested by David L. Magney based on extensive field observations.

Scientific Name[6]	Common Name	Habit[7]	WIS[8]	Family
*Centaurea solstitialis**	Yellow Star-thistle	AH	-	Asteraceae
Centaurium muhlenbergii	Monterey Centaury	AH	FAC	Gentianaceae
*Cerastium glomeratum**	Mouse-ear Chickweed	AH	FACU	Caryophyllaceae
*Chamomilla suaveolens**	Pineapple Weed	AH	FACU	Asteraceae
*Chenopodium album**	Lambsquarters	AH	FAC	Chenopodiaceae
*Cichorium intybus**	Chicory	PH	-	Asteraceae
*Cirsium vulgare**	Bull Thistle	PH	FACU	Asteraceae
*Convolvulus arvensis**	Bind Weed	PV	-	Convolvulaceae
*Cortaderia selloana**	Uruguayan Pampas Grass	PG	-	Poaceae
*Crassula tillaea**	Water Pygmy-weed	AH	NI*	Crassulaceae
*Crypsis schoenoides**	Swamp Grass	AG	OBL	Poaceae
*Cynodon dactylon**	Bermuda Grass	PG	FAC	Poaceae
Cyperus eragrostis	Umbrella-sedge	PG	FACW	Cyperaceae
*Daucus carota**	Queen Anne's Lace	PH	-	Apiaceae
Deschampsia danthonioides	Annual Hairgrass	AG	FACW	Poaceae
Eleocharis macrostachya	Creeping or Pale Spikerush	PG	OBL	Cyperaceae
Epilobium brachycarpum	Tall Annual Willow-herb	AH	UPL	Onagraceae
Epilobium ciliatum	Northern Willow-herb	PH	FACW	Onagraceae
Epilobium densiflorum	Dense-flowered Willow-herb	AH	OBL	Onagraceae
Epilobium pygmaeum	Smooth Spike-primrose	AH	OBL	Onagraceae
Eremocarpus setigerus	Dove Weed	AH	-	Euphorbiaceae
*Erodium botrys**	Broadleaf Filaree	AH	-	Geraniaceae
*Erodium moschatum**	Whitestem Filaree	AH	-	Geraniaceae
Eryngium vaseyi	Coyotethistle	PH	FACW	Apiaceae
*Eucalyptus globulus**	Blue Gum	T	-	Myrtaceae
Euphorbia spathulata	Warty Spurge	AH	-	Euphorbiaceae
*Festuca arundinacea**	Tall Fescue	PG	FAC-	Poaceae
Fraxinus latifolia	Oregon Ash	T	FACW	Oleaceae
Galium aparine	Goose Grass	AH	FACU	Rubiaceae
*Geranium dissectum**	Cut-leaved Geranium	AH	-	Geraniaceae
*Glyceria declinata**	Waxy Mannagrass	PG	-	Poaceae
Gnaphalium palustre	Lowland Cudweed	AH	FACW	Asteraceae
Gratiola ebracteata	Bractless Hedgehyssop	AH	OBL	Scrophulariaceae
Grindelia camporum	Great Valley Gumplant	PH	FACU	Asteraceae
Hemizonia fitchii	Fitch's Tarweed	AH	-	Asteraceae
*Hirschfeldia incana**	Summer Mustard	PH	-	Brassicaceae
Holocarpha virgata	Yellowflower Tarweed	AH	-	Asteraceae
Hordeum marinum ssp. *gussoneanum**	Mediterranean Barley	AG	FAC	Poaceae
*Hordeum murinum**	Summer Barley	AG	NI	Poaceae
*Hypochaeris glabra**	Smooth Cat's-ear	AH	-	Asteraceae
Juglans californica	Southern California Walnut	T	FAC	Juglandaceae
Juncus balticus	Baltic Rush	PG	OBL	Juncaceae
Juncus bufonius	Common Toad Rush	AG	OBL	Juncaceae

Scientific Name[6]	Common Name	Habit[7]	WIS[8]	Family
*Juncus capitatus**	Leafybract Dwarf Rush	AG	FACU	Juncaceae
Juncus effusus	Common Rush	PG	OBL	Juncaceae
Juncus xiphioides	Iris-leaved Rush	PG	OBL	Juncaceae
*Kickxia elatine**	Cancerwort	AH	NI*	Veronicaceae
*Lactuca serriola**	Prickly Wild Lettuce	AH	FAC	Asteraceae
Lasthenia fremontii	Fremont's Goldfields	A/PH	OBL	Asteraceae
Lasthenia glaberrima	Smooth Goldfields	AH	OBL	Asteraceae
*Lathyrus angulatus**	Angled Pea	AV	-	Fabaceae
Lemna minuscula	Least Duckweed	PH	OBL	Lemnaceae
*Leontodon taraxacoides**	Hawkbit	A/B/PH	FACU	Asteraceae
Lepidium nitidum	Common Peppergrass	AH	-	Brassicaceae
*Lolium multiflorum**	Italian Ryegrass	AG	FAC*	Poaceae
*Lotus corniculatus**	Birdsfoot Trefoil	PH	FAC	Fabaceae
Lotus purshianus	Spanish Clover	AH	UPL	Fabaceae
Ludwigia peploides	Floating Water-primrose	PH	OBL	Onagraceae
*Lythrum hyssopifolium**	Hyssop Loosestrife	AH	FACW	Lythraceae
*Malva parviflora**	Cheeseweed	AH	-	Malvaceae
*Medicago polymorpha**	Burclover	AH	-	Fabaceae
*Mentha pulegium**	Pennyroyal	PH	OBL	Lamiaceae
*Morus alba**	White Mulberry	T	NI	Moraceae
Navarretia leucocephala	Whitehead Navarretia	AH	OBL	Polemoniaceae
*Olea europaea**	Olive	T	-	Oleaceae
*Paspalum dilatatum**	Dallisgrass	PG	FAC	Poaceae
*Phalaris aquatica**	Bulbous Canarygrass	PG	FAC+	Poaceae
Phyla nodiflora	Turkey Tangle Fogfruit	PH	FACW	Verbenaceae
*Phytolacca americana**	American Pokeweed	PH	NI	Phytolaccaceae
*Picris echioides**	Bristly Ox-tongue	AH	(FAC)	Asteraceae
Pinus sabiniana	California Foothill Pine	T	-	Pinaceae
Plagiobothrys stipitatus	Stalked Popcornflower	AH	OBL	Boraginaceae
Plantago erecta	California Plantain	AH	-	Plantaginaceae
*Plantago lanceolata**	English Plantain	PH	FAC-	Plantaginaceae
*Poa annua**	Annual Bluegrass	AG	FACW-	Poaceae
*Polygonum arenastrum**	Common Knotweed	AH	FAC	Polygonaceae
Polygonum hydropiperoides	Swamp Smartweed	PH	OBL	Polygonaceae
Polygonum punctatum	Dotted Smartweed	A/PH	OBL	Polygonaceae
*Polypogon monspeliensis**	Rabbitsfoot Grass	AG	FACW+	Poaceae
*Populus alba**	White Poplar	T	-	Salicaceae
Populus fremontii	Fremont's Cottonwood	T	FACW	Salicaceae
*Pseudognaphalium luteo-album**	Everlasting Cudweed	AH	FACW-	Asteraceae
Psilocarphus brevissimus	Dwarf Woollyheads	AH	OBL	Asteraceae
*Punica granatum**	Pomegranate	S	-	Punicaceae
Quercus lobata	Valley Oak	T	FAC*	Fagaceae
Quercus wislizenii+	Interior Live Oak	S/T	-	Fagaceae

Scientific Name[6]	Common Name	Habit[7]	WIS[8]	Family
Ranunculus bonariensis	Carter's Buttercup	AH	OBL	Ranunculaceae
*Ranunculus muricatus**	Spinyfruit Buttercup	A/B/PH	FACW+	Ranunculaceae
*Raphanus raphanistrum**	Wild Radish	A/PH	-	Brassicaceae
*Raphanus sativus**	Radish	A/BH	-	Brassicaceae
*Robinia pseudoacacia**	Black Locust	T	FAC*	Fabaceae
Rosa spp.*	Cultivated Rose	S	-	Rosaceae
*Rubus discolor**	Himalaya Blackberry	S	FACW*	Rosaceae
*Rumex acetosella**	Common Sheep Sorrel	PH	FAC-	Polygonaceae
*Rumex crispus**	Curly Dock	PH	FACW-	Polygonaceae
*Rumex pulcher**	Fiddle Dock	PH	FAC+	Polygonaceae
Salix exigua	Narrow-leaved Willow	S/T	OBL	Salicaceae
Salix gooddingii	Goodding's Black Willow	T	OBL	Salicaceae
*Schinus molle**	Peruvian Pepper Tree	T	-	Anacardiaceae
Schoenoplectus [*Scirpus*] *acutus*	Hardstem Bulrush	PH	OBL	Cyperaceae
*Silene gallica**	Windmill Pink	AH	-	Caryophyllaceae
*Silybum marianum**	Milk Thistle	AH	-	Asteraceae
*Sonchus oleraceus**	Common Sow-thistle	AH	NI*	Asteraceae
*Sorghum halepense**	Johnsongrass	PG	FACU	Poaceae
*Spergularia rubra**	Purple (Red) Sandspurrey	A/PH	FAC-	Caryophyllaceae
*Stellaria media**	Common Chickweed	AH	FACU	Caryophyllaceae
*Taeniatherum caput-medusae**	Medusahead	AG	-	Poaceae
*Tanacetum parthenium**	Feverfew	PH	-	Asteraceae
*Taraxacum officinale**	Dandelion	PH	FACU	Asteraceae
Trichostema lanceolatum	Vinegarweed	AH	-	Lamiaceae
*Trifolium dubium**	Suckling Clover	AH	FACU*	Fabaceae
*Trifolium hirtum**	Rose Clover	AH	-	Fabaceae
*Trifolium repens**	White Clover	PH	FACU+	Fabaceae
Triteleia hyacinthina	White Brodiaea	PH	FACW*	Liliaceae
Triteleia laxa	Ithuriel's Spear	PG	-	Liliaceae
Typha latifolia	Cattail	PH	OBL	Typhaceae
*Veronica anagallis-aquatica**	Water Speedwell	PH	OBL	Veronicaceae
Veronica peregrina	Neckweed	AH	OBL	Veronicaceae
*Vicia sativa**	Common Vetch	AH	FACU	Fabaceae
*Vicia villosa**	Hairy Vetch	AH	-	Fabaceae
*Vinca major**	Greater Periwinkle	PH	(FAC)	Apocynaceae
Vitis californica	California Wild Grape	PV	FACW	Vitaceae
*Vulpia bromoides**	Brome Fescue	AG	FACW	Poaceae
Wyethia angustifolia	California Compassplant	PH	FACU-	Asteraceae
Xanthium strumarium	Cocklebur	AH	FAC+	Asteraceae

Habitats

General habitats found onsite, and in the immediate vicinity of the NVG project site, include grassland, wetland areas, and remnants of past agricultural operations. The habitat types and associated plant communities that contribute to the landscape of the project site and are discussed in the following subsections, include:

- Grassland
  - Valley Grassland
  - Vernal Pool Grassland
- Wetlands
  - Seasonal Wetlands and Swales
  - Seasonal Marsh
  - Vernal Pools
  - Riparian
- Agricultural
  - Fallow Land
  - Agricultural Wetlands

Grassland

Grassland consists of herbaceous vegetation dominated by annual grasses and forbs. Annual grasslands in the Central Valley grow primarily during the early spring through early summer, with most of the grass species completing their life cycles by the end of spring. Grasslands at the project site consist of Valley Grassland and Vernal Pool Grassland, which are described below.

VALLEY GRASSLAND

Valley Grassland habitat is the most widespread natural habitat throughout the undeveloped lowlands and rolling hills in the general area of the NVG project site. Valley Grassland is dominated by several common non-native annual grasses, with other native and non-native grasses and numerous forbs also present. Grasses typically dominant in Valley Grassland that have been reported onsite include bromes (*Bromus diandrus*, *B. hordeaceus*), wild oats (*Avena barbata, A. fatua*), barley (*Hordeum marinum, H. murinum*), ryegrass (*Lolium multiflorum*), and annual fescue (*Vulpia bromoides*).

Other non-native grasses that are commonly associated with Valley Grassland reported onsite include *Aira caryophyllea, Briza minor, Cynodon dactylon, Poa annua,* and *Taeniatherum caput-medusae.* Non-native forbs representative of this community onsite include: mustards (*Brassica* spp.), radishes (*Raphanus* spp.), filarees (*Erodium* spp.), clovers (*Trifolium* spp.), vetches (*Vicia* spp.), *Centaurea solstitialis*, as well as several other species. Associated native forbs onsite include: *Eremocarpus setigerus, Holocarpha virgata*, *Lotus purshianus,* and *Trichostema lanceolatum.*

Additional native species onsite that commonly occur in grasslands include: *Amsinckia menziesii, Asclepias fascicularis, Brodiaea coronaria, Bromus carinatus, Castilleja attenuata, Epilobium brachycarpum, Galium aparine, Grindelia camporum, Hemizonia fitchii, Lepidium nitidum, Plantago erecta, Triteleia laxa,* and *Wyethia angustifolia.*

VERNAL POOL GRASSLAND

The habitat subtype Vernal Pool Grassland occurs on a few distinctive landscape formations, most often alluvial formations such as the Lower Unit Riverbank Formation that includes the project site. Vernal Pool Grassland has two distinct components: an upland grassland component, and a wetland component associated with vernal pools and vernal swales. The upland grassland component is very similar to Valley Grassland (see Valley Grassland above), and only differs in areas influenced by and immediately adjacent to vernal pools and swales.

A distinctive association of grasses and forbs, both native and non-native, characterizes the wetland component. Native species commonly a part of this association onsite include *Deschampsia danthonioides*, *Lasthenia* spp., *Juncus bufonius*, and *Hemizonia fitchii,* with non-natives *Leontodon taraxacoides, Juncus capitatus, Lythrum hyssopifolium*, and *Hordeum marinum*.

Wetlands

Wetland plant communities onsite are found in seasonal wetland, seasonal wetland swale, seasonal marsh, vernal pool, and riparian habitats.

SEASONAL WETLANDS AND SWALES

Seasonal wetlands and swales are typically found in flat to gently rolling grasslands where water pools in depressions or flows overland via shallow, ephemeral drainages. These wetland habitats tend to form on shallow soils with an impermeable clay or hardpan layer below and are often associated with vernal pool complexes. Because of their close association with vernal pools, seasonal swales may serve as conduits for the movement of plant propagules and wildlife between vernal pools. These wetlands may fill and empty several times per year as a result of seasonal weather patterns. Soils remain saturated during cool, wet periods, and then dry through a combination of surface run-off and evapotranspiration in warm, dry periods.

Some seasonal wetlands develop as a result of human activities such as scraping or grading in grasslands, which creates artificial depressions with shallow soil. Disturbed wetlands tend to have weedy or ruderal plant species such as: *Lythrum hyssopifolium*, *Lolium multiflorum*, *Hordeum marinum*, *Polypogon monspeliensis, Glyceria declinata,* and *Rumex crispus*, all of which are reported or were observed on the NVG site. Seasonal swales associated with vernal pools support some of the same native plants commonly found in vernal pools, and two such plants, *Deschampsia danthonioides* and *Plagiobothrys stipitatus,* are known onsite.

Additional native species onsite that commonly occur in seasonal wetlands and swales include *Centaurium muhlenbergii, Cyperus eragrostis, Epilobium ciliatum, E. densiflorum, Gnaphalium palustre, Juncus balticus, J. bufonius, J. effusus, J. xiphioides, Phyla nodiflora, Triteleia hyacinthina, Veronica peregrina,* and *Xanthium strumarium.*

SEASONAL MARSH

Seasonal marshes have many of the characteristics of seasonal wetlands and swales described above. Seasonal marshes are seasonally flooded with shallow water (<2m depth) and soils are saturated most or all of the time. Soils are anaerobic clays and silts that support a characteristic assemblage of upright, perennial monocots. Representative species onsite include *Juncus effusus, J. xiphioides*,

Polygonum hydropiperoides, P. punctatum, Schoenoplectus [*Scirpus*] *acutus, Typha latifolia,* and *Xanthium strumarium.*

Additional native species onsite that commonly occur in seasonal marshes include: *Callitriche marginata, Cyperus eragrostis, Eleocharis macrostachya, Ludwigia peploides,* and *Ranunculus bonariensis.*

VERNAL POOLS

Vernal pools are characterized by their physical characteristics and the unique assemblages of highly specialized endemic plants and animals associated with them. Vernal pools develop in depressional basins on soils with an impermeable hardpan or claypan (or both) layer that restricts the downward percolation of water. Cool, wet winters and warm, extremely dry summers create cycles of inundation and drying of pool basins and soil profiles.

Species associated with smaller, shallower vernal pools intergrade with less specialized and often non-native seasonal wetland species, and, at higher and drier positions, with upland annual grassland vegetation (see Vernal Pool Grassland above). At lower, wetter positions, the species associated with larger and deeper vernal pools intergrade with seasonal marshes and swales (see descriptions above). The vernal pools onsite are of the small/shallow type.

Native species commonly associated with the vernal pools found in the area of the project site that are reported to be present include: *Callitriche marginata, Castilleja campestris* ssp. *campestris, Deschampsia danthonioides*, *Eleocharis macrostachya*, *Gratiola ebracteata, Lasthenia fremontii, L. glaberrima*, *Plagiobothrys stipitatus, Psilocarphus brevissimus,* and *Ranunculus bonariensis*. Several sensitive, uncommon plant species are known to occur in vernal pools in the vicinity of the project, but none are known on the NVG site.

Additional native species onsite that commonly occur in vernal pool habitat include: *Epilobium ciliatum, E. densiflorum, Juncus bufonius, Triteleia hyacinthina,* and *Veronica peregrina.*

RIPARIAN

Riparian vegetation typically intergrades with emergent marsh and permanent or seasonal wetlands at lower and wetter positions, and with upland vegetation types at higher and drier positions. Streambed sediment bars serve as recruitment surfaces for woody riparian species, particularly willows (*Salix* spp) and *Populus fremontii*. Riparian sites in a natural state located within the Lower Unit Riverbank Formation typically support thick riparian woodland and scrub associations. *Acer negundo, Alnus rhombifolia, Fraxinus latifolia, Juglans californica, Populus fremontii, Quercus* spp., *Salix* spp, and *Vitis californica* are native riparian woodland species that are found onsite, which may be remnants of historic riparian woodlands.

Seasonal drainages may have enough runoff to support some hydrophytic species, but may not be able to support riparian woodlands. These seasonal drainages can flow through annual grasslands that include marginally hydrophytic non-native species such as *Lolium multiflorum* and *Hordeum marinum* ssp. *gussoneanum*. Gerber Creek, which occurs onsite in the southern and central portions of NVG Units 1 and 3, is a seasonal drainage that is largely unvegetated, with non-native *Rubus discolor* present along the banks.

Agricultural

FALLOW LAND

Fallow land includes farmland temporarily held out of production, non-producing areas adjacent to land that is actively farmed, and abandoned farmlands that were once in production. In general, fallow agricultural lands support weedy species and annual grassland species, many of which were observed onsite. Fallow land is typically not tilled or irrigated, though sometimes it may be mowed or disced (especially along public roads and fence lines) to create firebreaks.

AGRICULTURAL WETLANDS

Agricultural wetlands are generally associated with irrigation canals, drainage ditches, and impoundments such as stock and tailwater ponds. The overall values of agricultural wetlands can be similar to those of naturally occurring wetlands as sources of seasonal or perennial water for dependent plant and wildlife species. The native species *Eleocharis macrostachya, Populus fremontii, Ranunculus bonariensis,* and *Salix* spp. are known onsite in association with agricultural wetlands.

WILDLIFE RESOURCES

The habitat features on the NVG project site attract a diversity of wildlife. Wildlife potentially occurring onsite are listed, and are identified either as individual species or by taxonomic groups that could include more than one species. Wildlife that are typically associated with the onsite habitat features are identified. Fish species are not included since onsite wetland habitats are not considered to be capable of supporting sustainable populations of fish.

Fauna

Wildlife known, or with the potential, to occur in the South Sacramento Habitat Conservation Plan area are discussed in the SSHCP Habitat Analysis Documents. Table 3, South Sacramento HCP Wildlife Potentially Occurring on the NVG Site, lists a total of 54 wildlife species and 7 taxonomic groups. Table 3 includes the scientific and common names of the amphibians, reptiles, birds, mammals, and invertebrates that are expected onsite based on the SSHCP information. Focused wildlife surveys would be required to determine the presence of the particular species that inhabit and frequent the project site. Surveys for *Branchinecta lynchi* and *Lepidurus packardi* are pending, and will be completed in June 2008 if required.

Table 3. South Sacramento HCP Wildlife Potentially Occurring on the NVG Site

Scientific Name[9]	Common Name
Amphibians	
Ambystoma californiense	California Tiger Salamander
Bufo boreas	Western Toad
Hyla regilla	Pacific Treefrog
Scaphiopus hammondii	Western Spadefoot Toad
Reptiles	
Emys [*Clemmys*] *marmorata marmorata*	Northwestern Pond Turtle
Thamnophis gigas	Giant Garter Snake
Birds	
Accipiter cooperii	Cooper's Hawk
Accipiter striatus	Sharp-Shinned Hawk
Aechmophorus spp.	Grebes
Agelaius tricolor	Tricolored Blackbird
Aquila chrysaetos	Golden Eagle
Ardea alba	Great Egret
Ardea herodias	Great Blue Heron
Asio flammeus	Short-eared Owl
Asio otus	Long-eared Owl
Athene cunicularia hypugea	Western Burrowing Owl
Buteo jamaicensis	Red-tailed Hawk
Buteo regalis	Ferruginous Hawk
Buteo swainsoni	Swainson's Hawk
Circus cyaneus	Northern Harrier
Egretta thula	Snowy Egret
Elanus leucurus	White-tailed Kite
Eremophila alpestris	Horned Lark
Euphagus cyanocephalus	Brewer's Blackbird
Falco columbarius	Merlin
Falco peregrinus anatum	American Peregrine Falcon
Fulica americana	American Coot
Grus canadensis tabida	Greater Sandhill Crane
Haliaeetus leucocephalus	Bald Eagle
Icteria virens	Yellow Breasted Chat
Lanius ludovicianus	Loggerhead Shrike
Pelecanus erythrorhyncos	American White Pelican
Plegadis chihi	White-faced Ibis
Rallus spp.	Rails
Sturnella neglecta	Western Meadowlark
*Sturnus vulgaris**	European Starling

[9] An asterisk (*) indicates introduced, non-native species.

Scientific Name[9]	Common Name
Mammals	
Antrozous pallidus	Pallid Bat
Bassariscus astutus	Ringtail
Canis latrans	Coyote
Castor canadensis	Beaver
Lasiurus blossevillii	Western Red Bat
Microtus californicus	California Vole
*Mus musculus**	House Mouse
Myotis yumanensis	Yuma Myotis Bat
Peromyscus maniculatus	Deer Mouse
Reithrodontomys megalotis	Western Harvest Mouse
Sorex ornatus	Ornate Shrew
Spermophilus beecheyi	California Ground Squirrel
Taxidea taxus	American Badger
Urocyon cinereoargenteus	Gray Fox
Invertebrates	
Andrenidae (Family)	Andrenid or Mining bees
Anisoptera (Suborder)	Dragonflies
Branchinecta mesovallensis	Mid-valley Fairy Shrimp
Branchinecta lynchi	Vernal Pool Fairy Shrimp
Corixidae (Family)	Water Boatman
Desmocerus californicus dimorphus	Valley Elderberry Longhorn Beetle
Dytiscidae (Family)	Predaceous Diving Beetle
Hydrochara rickseckeri	Ricksecker's Water Scavenger Beetle
Lepidurus packardi	Vernal Pool Tadpole Shrimp
Notonecta undulata	Backswimmer
Zygoptera (Suborder)	Damselflies

Wildlife Habitats

The onsite habitats described in the Botanical Resources section above contain numerous attributes and resources that are important for particular wildlife species. Aquatic habitats, in addition to directly supporting aquatic species, are also an important source of water for many upland wildlife species. The following subsections discuss the amphibians, reptiles, birds, mammals, and invertebrates typically associated with the habitats found on the NVG project site.

Annual Grassland

VALLEY GRASSLAND

The most numerous small mammal species that use Valley Grassland include *Spermophilus beecheyi, Microtus californicus, Peromyscus maniculatus,* and *Reithrodontomys megalotis,* with *Sorex ornatus* occurring in lesser numbers. *Mus musculus* also occurs regularly in Valley Grassland. These species are primarily herbivores; however, some, such as shrews, eat insects, and all are important prey for

other species, such as raptors. The most abundant bird species[10] occurring in Valley Grassland include: Brewer's Blackbird, European Starling, Horned Lark, Western Meadowlark, Red-tailed Hawk, and other raptors.

Sensitive species that complete their entire life cycle in Valley and Vernal Pool Grasslands include *Taxidea taxus* and *Athene cunicularia hypugea.* Sensitive species that use grasslands, primarily for foraging, and that nest or breed elsewhere, include: *Antrozous pallidus, Lasiurus blossevillii, Myotis yumanensis, Elanus leucurus, Accipiter cooperii, A. striatus, Buteo regalis, B. swainsoni, Aquila chrysaetos, Falco columbarius, Lanius ludovicianus, Asio otus,* and *Agelaius tricolor.*

VERNAL POOL GRASSLAND

See the Valley Grassland subsection above for wildlife associated with the grassland component of Vernal Pool Grassland. Refer to the Vernal Pool subsection below for wildlife associated with the vernal pool component.

Wetlands

SEASONAL WETLANDS AND SWALES

Seasonal wetlands and swales are highly productive habitats that offer food, cover, nesting sites, and other resources for numerous amphibians, reptiles, birds, mammals, and invertebrates. Many resident and migratory bird species use these wetlands, including: White-faced Ibis, rails, American Coot, Greater Sandhill Crane, grebes, Great Blue Heron, and Great Egret. Northern Harrier and Short-eared Owl are known to forage and nest in these emergent wetlands. The lack of predatory fish in seasonal wetlands and swales, if their hydroperiods are sufficient, make them excellent breeding habitats for amphibians. Wetlands with short hydroperiods tend to support more invertebrates, which comprise a large portion of the diet of many wetland birds and other wildlife.

The quality and number of connections between wetlands is important to many wildlife species. Seasonal swales are often closely associated with vernal pools and may provide corridors for the movement of amphibians such as *Ambystoma californiense*, *Scaphiopus hammondii,* and others between vernal pools. Snakes, salamanders, and turtles move between multiple wetlands to escape predation, heat stress, desiccation, or lack of food as wetlands dry. Many wetland birds move among wetlands to find better forage, avoid predators, and locate optimal nesting sites.

SEASONAL MARSH

Seasonal marsh habitat offers wildlife resources that are much the same as those provided by seasonal wetlands and swales, and can contribute to the diversity and connectivity of wetlands in an area. *Thamnophis gigas* requires freshwater marsh as its primary habitat. Habitat requirements include: adequate water and dense wetland vegetation, such as cattails and rushes; grassy banks and openings in waterside vegetation for basking; and vegetated uplands for cover and refuge from flood waters during winter dormancy.

10 Common names are used here for birds since it is the only group of wildlife for which one common name has been formally established for each taxon, unlike that for other groups of wildlife.

VERNAL POOLS

The following four species of amphibians are known to occur in vernal pools within the SSHCP area: *Bufo boreas* and *Hyla regilla,* along with the vernal pool-dependent species *Ambystoma californiense* and *Scaphiopus hammondii*. Adults lay eggs in vernal pools when they are inundated, the eggs hatch, and the tadpoles mature before the pools dry. The newly matured and older surviving adults then migrate to upland rodent burrows to spend the summer in a state of dormancy.

The crustacean species *Branchinecta mesovallensis, Branchinecta lynchi,* and *Lepidurus packardi* also occur in the area and are dependent on vernal pool habitat. Other invertebrates associated with vernal pools include *Hydrochara rickseckeri* and many other aquatic insects. Some vernal pool plant species (including *Lasthenia, Downingia, Blennosperma,* and *Limnanthes*) are pollinated by specialist solitary bees in the family Andrenidae. These solitary bees nest in small tunnels excavated in uplands near vernal pools, and their eggs and larvae are dependent on the pollen of vernal pool plants for development. The plants, in turn, depend on the bees for pollination.

Some vernal pool species require a relatively extended inundation period for completion of their life cycles, and some are adapted to shorter inundation durations. *Ambystoma californiense, Scaphiopus hammondii,* and *Lepidurus packardi* require longer development periods afforded by larger, deeper vernal pools. *Branchinecta mesovallensis* and *Branchinecta lynchi* complete their life cycles in less time and are adapted to smaller, shallower vernal pools that dry more quickly. The vernal pools onsite are the small/shallow type.

RIPARIAN

Riparian habitat perhaps supports the greatest diversity of wildlife species in California. Many amphibians, reptiles, birds, mammals, and invertebrates are typically associated with relatively undisturbed riparian habitats within the SSHCP area. The riparian areas on the NVG site have been significantly degraded by human activity, though some associated features are still present. Remaining riparian woodland species contribute to the structural diversity of the project site, and provide food, cover, nesting sites, and other resources for numerous resident and migratory wildlife species. Swainson's Hawk frequently nests in riparian woodland, often in *Populus fremontii* or *Quercus lobata*.

Agricultural

FALLOW LAND

Fallow agricultural land typically supports weedy and annual grassland plant species, as well as large rodent populations. Such fallow land can provide important foraging habitat for *Buteo swainsoni* and other raptors, and Short-eared Owl and Western Burrowing Owl may forage or nest in these areas. *Sambucus mexicana*, host plant and critical habitat for *Desmocerus californicus dimorphus*, can become established on fallow agricultural land.

AGRICULTURAL WETLANDS

Agricultural wetlands are generally associated with irrigation canals, drainage ditches, and impoundments such as stock and tailwater ponds. The overall values of agricultural wetlands can be similar to those of naturally occurring wetlands as sources of seasonal or perennial water for dependent plant and wildlife species. Sensitive wildlife species that can be associated with agricultural wetlands and potentially occur onsite include: *Emys marmorata marmorata, Thamnophis gigas,* Tricolored Blackbird, Greater Sandhill Crane, and White-faced Ibis.

SPECIAL-STATUS BIOLOGICAL RESOURCES

This section discusses the definitions of special-status biological resources and addresses the special-status biological resources observed, reported, or having the potential to occur on the project site. These resources include plant and wildlife species and habitats that have been afforded special-status and/or recognition by federal and state resource agencies, as well as private conservation organizations. In general, the principal reason an individual taxon (i.e. species, subspecies, or variety) is given such recognition is the documented or perceived decline or limitations of its population size, geographic range, and/or distribution resulting in most cases from habitat loss.

A literature review was conducted prior to the initiation of the general biological resources surveys in order to determine the potential special-status elements known to occur in the project region that may occur on the project site. The California Native Plant Society's (CNPS) *Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2001) and California Department of Fish and Game's California Natural Diversity Database (CNDDB) RareFind3 (CDFG 2007) were reviewed. Nine (9) California Quadrangles (USGS 7.5-minute Series Topographic Map) were queried for the CNDDB RareFind3 records search. The Elk Grove Quadrangle, in which the project site occurs, was searched, as well as the eight surrounding quadrangles, including Bruceville, Buffalo Creek, Carmichael, Clay, Florin, Galt, Sacramento East, and Sloughhouse. The CNDDB Special Animals List (CDFG 2006) was also referenced to determine if any wildlife species observed onsite are considered special-status.

Special-Status Definitions

Special-status habitats are vegetation types, associations, or sub-associations that support concentrations of special-status plant or wildlife species, are of relatively limited distribution, or are of particular value to wildlife. Special-status species are plants and animals that are at least one of the following:

- *Listed as endangered or threatened* under Federal or California Endangered Species Acts,
- *Listed as rare* under the California Native Plant Protection Act, or
- *Considered rare* (but not formally listed) by resource agencies, professional organizations (e.g. Audubon Society, CNPS, The Wildlife Society), and the scientific community.

Listed species are those taxa that are formally listed as endangered or threatened by the federal government (e.g. U.S. Fish and Wildlife Service), pursuant to the Federal Endangered Species Act or as endangered, threatened, or rare (for plants only) by the State of California (i.e. California Fish and Game Commission), pursuant to the California Endangered Species Act or the California Native Plant Protection Act. Special-status species are defined in Table 4 below.

Table 4. Definitions of Special-Status Species

○ Plants and animals legally protected under the California and Federal Endangered Species Acts or under other regulations. ○ Plants and animals considered sufficiently rare by the scientific community to qualify for such listing; or ○ Plants and animals considered to be sensitive because they are unique, declining regionally or locally, or are at the extent of their natural range.	
Special-Status Plant Species	**Special-Status Animal Species**
○ Plants listed or proposed for listing as threatened or endangered under the Federal Endangered Species Act (50 CFR 17.12 for listed plants and various notices in *Federal Register* for proposed species). ○ Plants that are Category 1 or 2 candidates for possible future listing as threatened or endangered under the Federal Endangered Species Act (55 CFR 6184, February 21, 1990). ○ Plants that meet the definitions of rare or endangered species under the CEQA (*State CEQA Guidelines*, Section 15380). ○ Plants considered by CNPS to be "rare, threatened, or endangered" in California (Lists 1B and 2 in CNPS 2001). ○ Plants listed by CNPS as plants needing more information and plants of limited distribution (Lists 3 & 4 in CNPS 2001). ○ Plants listed by CNPS as locally rare. ○ Plants listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 CCR 670.5). ○ Plants listed under the California Native Plant Protection Act (California Fish and Game Code 1900 et seq.). ○ Plants considered sensitive by other federal agencies (i.e. U.S. Forest Service, Bureau of Land Management) or state and local agencies or jurisdictions. ○ Plants considered sensitive or unique by the scientific community; occurs at natural range limits (*State CEQA Guidelines*, Appendix G).	○ Animals listed/proposed for listing as threatened/endangered under the Federal Endangered Species Act (50 CFR 17.11 for listed animals and various notices in *Federal Register* for proposed species). ○ Animals that are Category 1 or 2 candidates for possible future listing as threatened or endangered under Federal Endangered Species Act (54 CFR 554). ○ Animals that meet the definitions of rare or endangered species under the CEQA (*State CEQA Guidelines*, Section 15380). ○ Animals listed or proposed for listing by the State of California as threatened and endangered under the California Endangered Species Act (14 CCR 670.5). ○ Animal species of special concern to the CDFG. ○ Animal species that are fully protected in California (California Fish & Game Code, Sections 3511 [birds], 4700 [mammals], 5050 [reptiles, amphibians]).

The CNPS' *Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2001, 2006[11]) categorizes rare California plants into one of five lists (1A, 1B, 2, 3, and 4) representing five levels of species status, one of which is assigned to a sensitive species to indicate its status of rarity or endangerment and distribution. Most taxa also receive a threat code extension following the List (e.g. 1B.1, 2.3), which replaces the old R-E-D Code previously used by CNPS. Table 5, California Native Plant Society List, provides a definition for each List code number, and Table 6, California Native Plant Society List Threat Code Extensions defines the CNPS List Threat Code Extensions that indicates the level of endangerment within the state.

[11] Changes to the *Inventory* as published on the CNPS website: http://www.cnps.org/programs/Rare_Plant/inventory/changes/changes_accepted.htm.

Table 5. California Native Plant Society List (CNPS List)

CNPS List	Definition
1A	Presumed Extinct in California
1B	Rare, Threatened, or Endangered in California and elsewhere
2	Rare, Threatened, or Endangered in California, but more common elsewhere
3	Need more information (a Review List)
4	Plants of Limited Distribution (a Watch List)

Table 6. California Native Plant Society List Threat Code Extensions

CNPS Threat Code Extension	Definition
.1	Seriously endangered in California (over 80% of occurrences threatened / high degree and immediacy of threat)
.2	Fairly endangered in California (20-80% occurrences threatened)
.3	Not very endangered in California (<20% of occurrences threatened)

The CNDDB Element Ranking system provides a numeric global and state ranking system for all special-status species tracked by the CNDDB. The global rank (G-rank) is a reflection of the overall condition of an element (species or natural community) throughout its global range. The state rank (S-rank) is assigned much the same way as the global rank, except state ranks in California often also contain a threat designation attached to the S-rank. This Element Ranking system is defined in Table 7, California Natural Diversity Database Element Ranking System.

Table 7. California Natural Diversity Database Element Ranking System

Global Ranking (G)	
G1	Less than 6 viable elements occurrences (populations for species), OR less than 1,000 individuals, OR < 809.4 hectares (ha) (2,000 acres [ac]).
G2	6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac).
G3	21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac).
G4	Apparently secure; this rank is clearly lower than G3, but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).
G5	Population, or stand, demonstrably secure to ineradicable due to being commonly found in the world.
GH	All sites are **historic**; the element has not been seen for at least 20 years, but suitable habitat still exists.
GX	All sites are **extirpated;** this element is extinct in the wild.
GXC	Extinct in the wild; exists in cultivation.
G1Q	The element is very rare, but there is a taxonomic question associated with it.
Subspecies Level: Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety. * For example: *Chorizanthe robusta* var. *hartwegii* is ranked G2T1. The G-rank refers to the whole species range (*Chorizanthe robusta*), whereas the T-rank refers only to the global condition of the variety (var. *hartwegii*).	
State Ranking (S)	
S1	Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). S1.1 = very threatened S1.2 = threatened S1.3 = no current threats known
S2	6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). S2.1 = very threatened S2.2 = threatened S2.3 = no current threats known..
S3	21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). S3.1 = very threatened S3.2 = threatened S3.3 = no current threats known
S4	Apparently secure within California; this rank is clearly lower than S3 but factors exist to cause some concern (i.e., there is some threat, or somewhat narrow habitat). NO THREAT RANK.
S5	Demonstrably secure to ineradicable in California. NO THREAT RANK.
SH	All California sites are **historic**; the element has not been seen for at least 20 years, but suitable habitat still exists.
SX	All California sites are **extirpated;** this element is extinct in the wild.
Notes	
1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take an aerial view when ranking sensitive elements rather than simply counting element occurrences.	
2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (e.g. S2S3 means the rank is somewhere between S2 and S3), and by adding a ? to the rank (e.g. S2?). This represents more certainty than S2S3, but less than S2.	

Special-Status Plants

The literature review and CNDDB (CDFG 2007) search identified 13 special-status species of vascular plants known in the vicinity of the NVG project site. None of these federally or state listed plant species have been directly observed or reported onsite.

Table 8, Likelihood of Occurrence of Special-Status Plants Known in the Vicinity of the NVG Site, summarizes the status of these special-status plant species and includes scientific names, common names, species status, habitat requirements, and the likelihood of occurrence within the project boundaries.

Table 8. Likelihood of Occurrence of Special-Status Plants Known in the Vicinity of NVG Site

Scientific Name	Common Name	Species Status					Habitat Requirements	Likelihood of Occurrence[12]
		G-Rank[13]	S-Rank	Fed	CA	CNPS		
Carex comosa	Bristly Sedge	G5	S2?	-	-	2.1	Marshes and swamps. Lake margins, wet places; site below sea level is on a delta island. 5-1,005m.	Unlikely
Downingia pusilla	Dwarf Downingia	G3	S3.1	-	-	2.2	Valley and foothill grassland (mesic sites), vernal pools. Vernal lake and pool margins with a variety of associates. In several types of vernal pools. 1-485m.	Likely
Gratiola heterosepala	Boggs Lake Hedgehyssop	G3	S3.1	-	E	1B.2	Marshes and swamps (freshwater), vernal pools. Clay soils; usually in vernal pools, sometimes on lake margins. 5-2,400m.	Possible
Hibiscus lasiocarpus	Rose-Mallow	G4	S2.2	-	-	2.2	Marshes and swamps (freshwater). Moist, freshwater-soaked river banks & low peat islands in sloughs; in Calif., known from the Delta watershed. 0-150m.	Unlikely
Juglans hindsii	Northern California Black Walnut	G1	S1.1	-	-	1B.1	Riparian forest, riparian woodland. Few extant native stands remain; widely naturalized. Deep alluvial soil associated with a creek or stream. 0-395m.	Possible
Juncus leiospermus var. *ahartii*	Ahart's Dwarf Rush	G2T1	S1.2	-	-	1B.2	Vernal pools. Restricted to the edges of vernal pools. 30-100m.	Likely
Lathyrus jepsonii var. *jepsonii*	Delta Tule Pea	G5T2	S2.2	-	-	1B.2	Freshwater and brackish marshes. Often found w/ *Typha*, *Aster lentus*, *Rosa calif.*, *Juncus* spp., *Scirpus*, etc. Usually on marsh and slough edges.	Likely
Legenere limosa	Legenere	G2	S2.2	-	-	1B.1	Vernal pools. Many historical occurrences are extirpated. In beds of vernal pools. 1-880m.	Possible

[12] Likelihood of occurrence based on species' habitat requirements and presence of required habitat onsite.

Reported = Species has been reported onsite;

Likely = Required habitat exists onsite and the species is tracked by CNDDB onsite or nearby;

Possible = Marginal required habitat reported onsite, and/or required habitat is found in surrounding areas;

Unlikely = Required habitat not reported onsite, nor is it found nearby.

[13] See Tables 4 through 7 above for descriptions of rank and status categories. Federal (Fed) and State (CA) status listings: E = Endangered; T = Threatened; R = Rare; C = Candidate.

Scientific Name	Common Name	Species Status					Habitat Requirements	Likelihood of Occurrence[12]
		G-Rank[13]	S-Rank	Fed	CA	CNPS		
Lilaeopsis masonii	Mason's Lilaeopsis	G3	S3.1	-	R	1B.1	Freshwater and brackish marshes, riparian scrub. Tidal zones in muddy or silty soil formed by river deposition or river bank erosion. 0-10m.	Possible
Orcuttia tenuis	Slender Orcutt Grass	G3	S3.1	T	E	1B.1	Vernal pools. 30-1,735m.	Possible
Orcuttia viscida	Sacramento Orcutt Grass	G1	S1.1	E	E	1B.1	Vernal pools. 30-100m.	Possible
Sagittaria sanfordii	Sanford's Arrowhead	G3	S3.2	-	-	1B.2	Marshes and swamps. In standing or slow-moving freshwater ponds, marshes, and ditches. 0-610m.	Likely
Scutellaria lateriflora	Blue Skullcap	G5	S2S3	-	-	2.2	Meadows and seeps, marshes and swamps. Wet meadows and marshes. 3-500m.	Likely

Special-Status Habitats

Special-status habitat types include plant communities that are threatened by urbanization and are continually influenced by human activities. Table 9, Sensitive Habitats Known in the Vicinity of the NVG Site, lists the six (6) sensitive habitat types tracked by CNDDB that occur onsite or nearby. These habitats are either unique, of relatively limited distribution in the region, or of particularly high wildlife value. These resources have been defined by Federal, State, and local government conservation programs as sensitive.

Of the six sensitive habitat types known in the vicinity of the project site, only Northern Hardpan Vernal Pool was observed onsite. However, it should be noted that no soil survey was conducted in this habitat to definitively determine whether the vernal pool observed onsite is Northern Hardpan specifically. Regardless, DMEC expects that the vernal pool onsite is Northern Hardpan Vernal Pool. The freshwater marsh onsite is seasonal and not permanently flooded as indicated for Coastal and Freshwater Marsh.

Table 9. Sensitive Habitats Known in the Vicinity of the NVG Site

CNDDB Sensitive Habitat Name (Holland 1986, CDFG 2007)	G Rank[14]	S Rank	Reported Onsite?
Coastal and Valley Freshwater Marsh	G3	S2.1	Not observed
Elderberry Savanna	G2	S2.1	Not observed
Great Valley Mixed Riparian Forest	G2	S2.2	Not observed
Great Valley Oak Riparian Forest	G1	S1.1	Not observed
Northern Hardpan Vernal Pool	G3	S3.1	Observed
Valley Oak Woodland	G3	S2.1	Not observed

[14] See Tables 4 through 7 above for descriptions of rank categories.

Special-Status Wildlife

Twenty-seven (27) special-status wildlife species have potential to inhabit or frequent the NVG project site and surrounding areas (CDFG 2007). Several of the special-status wildlife species known to occur in the vicinity of the project require habitat consistent with the habitat types present onsite. For example, annual grassland habitat is found on most of the project site, and it can provide suitable resources for several wildlife species.

The 27 wildlife species with potential to occur on, or in the vicinity of, the project site are listed in Table 10, Likelihood of Occurrence of Special-Status Wildlife Known Near the NVG Site. Table 10 lists the scientific and common names, gives species status and habitat requirements, and provides each species' likelihood of occurrence onsite. No federally or state listed wildlife species have been directly observed or reported on the NVG site; however, five (5) of the 27 special-status wildlife species are mapped by CNDDB as having occurrences in the immediate vicinity of the NVG site.

The five species tracked and mapped by CNDDB immediately nearby include two (2) species of birds (*Agelaius tricolor* and *Elanus leucurus*) and three (3) species of aquatic invertebrates (*Branchinecta lynchi* [Federally Listed as Threatened], *Lepidurus packardi* [Federally Listed as Endangered], and *Linderiella occidentalis*), two of which are federally listed as indicated. The two federally listed species appear to be associated with seasonal wetlands along the Central California Traction Railroad right-of-way that transects the eastern portion of the project site but is not part of the site.

Table 10. Likelihood of Occurrence of Special-Status Wildlife Known Near the NVG Site

Scientific Name	Common Name	Species Status					Habitat Requirements	Likelihood of Occurrence[15]
		G-Rank[16]	S-Rank	Fed	CA	CDFG		
AMPHIBIANS								
Ambystoma californiense	California Tiger Salamander	G2G3	S2S3	T	-	SC	Central Valley DPS listed as threatened; Santa Barbara & Sonoma counties DPS listed as endangered. Need underground refuges, especially ground squirrel burrows & vernal pools or other seasonal water sources for breeding	Likely
Spea (=Scaphiopus) hammondii	Western Spadefoot Toad	G3	S3	-	-	SC	Occurs primarily in grassland habitats, but can be found in valley-foothill hardwood woodlands. Vernal pools are essential for breeding and egg-laying.	Likely
REPTILES								
Emys (=Clemmys) marmorata marmorata	Northwestern Pond Turtle	G3G4T3	S3	-	-	SC	Associated with permanent or nearly permanent water in a wide variety of habitats. Requires basking sites. Nest sites may be found up to 0.5 km from water.	Possible

[15] Likelihood of occurrence based on species' habitat requirements and presence of required habitat onsite.
Reported = Species is known to occur onsite;
Likely = Required habitat exists onsite and the species is tracked by CNDDB onsite or nearby;
Possible = Marginal required habitat reported onsite, and/or required habitat is found in surrounding areas;
Unlikely = Required habitat not reported onsite, nor is it found nearby.

[16] See Tables 4 through 7 above for descriptions of rank and status categories. Federal (Fed) and State (CA) status listings:
E = Endangered; T = Threatened; R = Rare; C = Candidate.

Scientific Name	Common Name	Species Status					Habitat Requirements	Likelihood of Occurrence[15]
		G-Rank[16]	S-Rank	Fed	CA	CDFG		
Thamnophis gigas	Giant Garter Snake	G2G3	S2S3	T	T	-	Prefers freshwater marsh and low gradient streams. Has adapted to drainage canals & irrigation ditches. This is the most aquatic of the garter snakes in California.	Likely
BIRDS								
Accipiter cooperii	Cooper's Hawk	G5	S3	-	-	SC	Woodland, chiefly of open, interrupted or marginal type. Nest sites mainly in riparian growths of deciduous trees, as in canyon bottoms on river floodplains; also, live oaks.	Possible
Agelaius tricolor	Tricolored Blackbird	G2G3	S2	-	-	SC	Highly colonial species, most numerous in Central Valley & vicinity. Largely endemic to California. Requires open water, protected nesting substrate, & foraging area with insect prey within a few km of the colony.	Likely (reported in immediate vicinity of NVG site)
Ardea alba	Great Egret	G5	S4	-	-	-	Colonial nester in large trees. Rookery sites located near marshes, tide-flats, irrigated pastures, and margins of rivers and lakes.	Likely
Ardea herodias	Great Blue Heron	G5	S4	-	-	-	Colonial nester in tall trees, cliffsides, and sequestered spots on marshes. Rookery sites in close proximity to foraging areas: marshes, lake margins, tide-flats, rivers and streams, wet meadows.	Likely
Athene cunicularia	Burrowing Owl	G4	S2	-	-	SC	Open, dry annual or perennial grasslands, deserts & scrublands characterized by low-growing vegetation. Subterranean nester, dependent upon burrowing mammals, most notably, the California Ground Squirrel.	Likely
Buteo regalis	Ferruginous Hawk	G4	S3S4	-	-	SC	Open grasslands, sagebrush flats, desert scrub, low foothills & fringes of pinyon-juniper habitats. Eats mostly lagomorphs, ground squirrels, and mice. Population trends may follow lagomorph population cycles.	Possible
Buteo swainsoni	Swainson's Hawk	G5	S2	-	T	-	Breeds in grasslands with with scattered trees, juniper-sage flats, riparian areas, savannahs, & agricultural or ranch sites. Requires adjacent suitable foraging areas such as grasslands, or alfalfa or grain fields supporting rodent populations.	Likely
Elanus leucurus	White-Tailed Kite	G5	S3	-	-	-	Rolling foothills and valley margins with scattered oaks & river bottomlands or marshes next to deciduous woodland. Open grasslands, meadows, or marshes for foraging close to isolated, dense-topped trees for nesting and perching.	Likely (reported in immediate vicinity of NVG site)
Nycticorax nycticorax	Black-Crowned Night Heron	G5	S3	-	-	-	Colonial nester, usually in trees, occasionally in tule patches. Rookery sites located adjacent to foraging areas: lake margins, mud-bordered bays, marshy spots.	Possible

Scientific Name	Common Name	Species Status					Habitat Requirements	Likelihood of Occurrence[15]
		G-Rank[16]	S-Rank	Fed	CA	CDFG		
Phalacrocorax auritus	Double-Crested Cormorant	G5	S3	-	-	SC	Colonial nester on coastal cliffs, offshore islands, & along lake margins in the interior of the state. Nests along coast on sequestered islets, usually on ground with sloping surface, or in tall trees along lake margins.	Unlikely
Progne subis	Purple Martin	G5	S3	-	-	SC	Inhabits woodlands, low elevation coniferous forest of Douglas-fir, Ponderosa Pine, & Monterey Pine. Nests in old woodpecker cavities mostly, also in human-made structures. Nest often located in tall, isolated tree/snag.	Possible
Riparia riparia	Bank Swallow	G5	S2S3	-	T	-	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, or ocean to dig nesting holes.	Unlikely
Xanthocephalus xanthocephalus	Yellow-Headed Blackbird	G5	S3S4	-	-	-	Nests in freshwater emergent wetlands with dense vegetation & deep water. Often along borders of lakes or ponds. Nests only where large insects such as Odonata are abundant, nesting timed with maximum emergence of aquatic insects.	Possible
MAMMALS								
Taxidea taxus	American Badger	G5	S4	-	-	SC	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils. Need sufficient food, friable soils & open, uncultivated ground. Prey on burrowing rodents. Dig burrows.	Possible
FISH								
Pogonichthys macrolepidotus	Sacramento Splittail	G2	S2	-	-	SC	Endemic to the lakes and rivers of the Central Valley, but now confined to the Delta, Suisun Bay, & associated marshes. Slow moving river sections, dead end sloughs. Require flooded vegetation for spawning & foraging for young.	Unlikely
INVERTEBRATES								
Andrena blennospermatis	A vernal pool Andrenid bee	G2	S2	-	-	-	This bee is oligolectic on vernal pool *Blennosperma*. Bees nest in the uplands around vernal pools.	Possible
Branchinecta lynchi	Vernal Pool Fairy Shrimp	G3	S2S3	T	-	-	Endemic to the grasslands of the Central Valley, Central Coast mtns, and South Coast mtns, in astatic rain-filled pools. Inhabit small, clear-water sandstone-depression pools and grassed swale, earth slump, or basalt-flow depression pools.	Likely (reported in immediate vicinity of NVG site)
Branchinecta mesovallensis	Midvalley Fairy Shrimp	G2	S2	-	-	-	Vernal pools in the Central Valley.	Likely

Scientific Name	Common Name	Species Status					Habitat Requirements	Likelihood of Occurrence[15]
		G-Rank[16]	S-Rank	Fed	CA	CDFG		
Desmocerus californicus dimorphus	Valley Elderberry Longhorn Beetle	G3T2	S2	T	-	-	Occurs only in the Central Valley of California, in association with Blue Elderberry (*Sambucus mexicana*). Prefers to lay eggs in elderberries 2-8 inches in diameter; some preference shown for "stressed" elderberries.	Possible
Dumontia oregonensis	A water flea	G1G3	S1	-	-	-	Vernal pools. In California, known only from Mather Field.	Unlikely
Hydrochara rickseckeri	Ricksecker's Water Scavenger Beetle	G1G2	S1S2	-	-	-	Aquatic.	Unlikely
Lepidurus packardi	Vernal Pool Tadpole Shrimp	G3	S2S3	E	-	-	Inhabits vernal pools and swales in the Sacramento Valley containing clear to highly turbid water. Pools commonly found in grass-bottomed swales of unplowed grasslands. Some pools are mud-bottomed & highly turbid.	Likely (reported in immediate vicinity of NVG site)
Linderiella occidentalis	California Linderiella	G3	S2S3	-	-	-	Seasonal pools in unplowed grasslands with old alluvial soils underlain by hardpan or in sandstone depressions. Water in the pools has very low alkalinity, conductivity, and TDS.	Likely (reported in immediate vicinity of NVG site)

WETLAND RESOURCES

A wetland delineation and assessment was submitted to the U.S. Army Corps of Engineers (Corps) for the entire North Vineyard Station Specific Plan Area and any other parcels affected by the North Vineyard Station Drainage Master Plan (NVS DMP) on December 31, 2002, as part of the NVS DMP Corps Application. The project site wetlands were delineated by ECORP, Inc., of Rocklin, California (ECORP 2004), and verified by U.S. Army Corps of Engineers (Corps), Sacramento District, in 2006.

A total of 1.60 acres of jurisdictional waters of the U.S., including wetlands, have been delineated on the NVG project site (Figure 3, NVG Project Site Wetland Delineation). Individual acreages for the onsite wetlands shown in Figure 3 are listed in Table 11, Acreages for Delineated NVG Wetlands.

Vernal pools totaling 0.15 acre have been mapped within the non-irrigated pastures. Vernal pools are topographic basins within annual grassland that are typically underlain with an impermeable or semi-permeable hardpan or duripan layer. Vernal pools are inundated to depths of up to one foot throughout the wet season and are dry by late spring through the following wet season. The plant species composition within vernal pools is predominantly native annuals. Refer to the Botanical Resources subsection (above) for detailed descriptions of the vegetation associated with the onsite wetlands discussed in this section.

Seasonal wetlands are ephemerally wet areas where surface runoff and rainwater accumulate within low-lying areas or adjacent to larger creeks and streams. Some seasonal wetlands develop as a result of human activities such as scraping or grading in grasslands, which creates shallow artificial depressions. Disturbed wetlands tend to be dominated by non-native annual species. Jurisdictional seasonal wetlands totaling 0.52 acre have been mapped onsite.

Table 11. Acreages for Delineated NVG Wetlands

Wetland Type	Code[17]	Acreage	Subtotals
Vernal Pool	V1	0.10	0.15
	V2	0.04	
	V3	<0.005	
Seasonal Wetland	S1	0.08	0.52
	S2	0.09	
	S3	0.16	
	S4	<0.005	
	S5	0.04	
	S6	0.01	
	S7	0.02	
	S8	0.01	
	S9	0.10	
	S10	<0.005	
	S11	0.01	
	Snj1*	(1.13)	
	Snj2*	(0.35)	
Seasonal Wetland Swale	Sw1	0.01	0.01
Seasonal Marsh	M1	0.92	0.92
Mitigation Plan Total Acres			**1.60**

A total of 0.01 acre of **seasonal wetland swale** was mapped on the project site. Seasonal swales are ephemerally wet, relatively shallow areas that often connect to other wetlands and/or drainages, and that typically occur as linear features. Seasonal swales generally have characteristics (depth, vegetation, hydrology, and soil) intermediate between associated wetlands and adjacent upland areas.

The **seasonal marsh** totals 0.92 acre, and is located just south of the Central California Traction Railroad Tracks. Plants within the seasonal marsh are typical seasonal wetland and moist soil species. This marsh is situated in a low-lying area of the project vicinity and, in addition to the runoff during the wet season, may also receive periodic runoff from the nursery throughout the year.

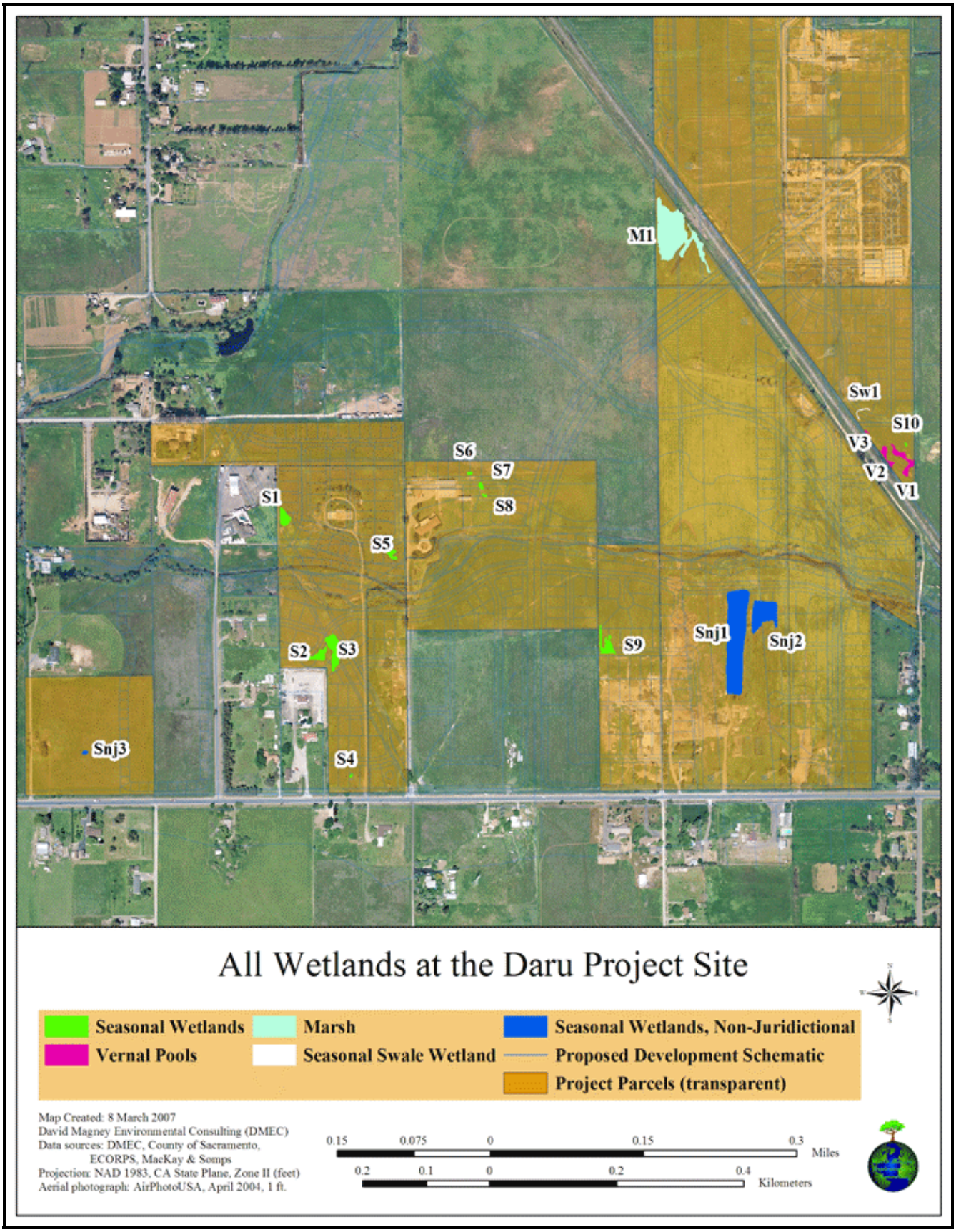
A man-made stock/fish pond and several drainage ditches are located in the eastern and northeastern portion of the project site. These waters are considered non-jurisdictional, as per the field verification visit on 12 August 2004 by the Corps. The man-made pond, and associated seasonal wetland adjacent to it in the southern portion of NVG Unit 1, is considered non-jurisdictional based on their isolation from waters of the U.S., and personal communication with Ms. Andrea Jones, Regulatory Project Manager, U.S. Army Corps of Engineers, Sacramento, California. Formal designation of these areas as non-jurisdictional, which total 1.48 acres (Figure 3, NVG Project Site Wetland Delineation), is expected.

Note: Gerber Creek is addressed by the North Vineyard Station Drainage Master Plan Individual Permit Application and the Vineyard Creek project (Corps Regulatory Branch #200300251) and is not included in the NVG project.

Impacts to wetlands onsite are discussed in the following Section 3, Impact Assessment.

[17] Labeling code used in Figure 3 to identify individual wetlands. * = Not included in the total of 1.60 acres of existing seasonal wetlands to be mitigated; 1.48 acres (Snj 1 and Snj 2) are expected to be classified as non-jurisdictional by the Corps.

Figure 3. NVG Project Site Wetland Delineation



SECTION 3. IMPACT ASSESSMENT

IMPACTS TO WATERS OF THE U.S., INCLUDING WETLANDS

A total of 1.60 acres of jurisdictional waters of the U.S., including wetlands, have been delineated on the NVG project site, and project implementation would result in direct impacts to all 1.60 acres of waters of the U.S, including wetlands. Figure 4, Proposed Development Plan and Associated Impacts, shows the proposed NVG development in relation to the existing jurisdictional waters and wetlands of the U.S.

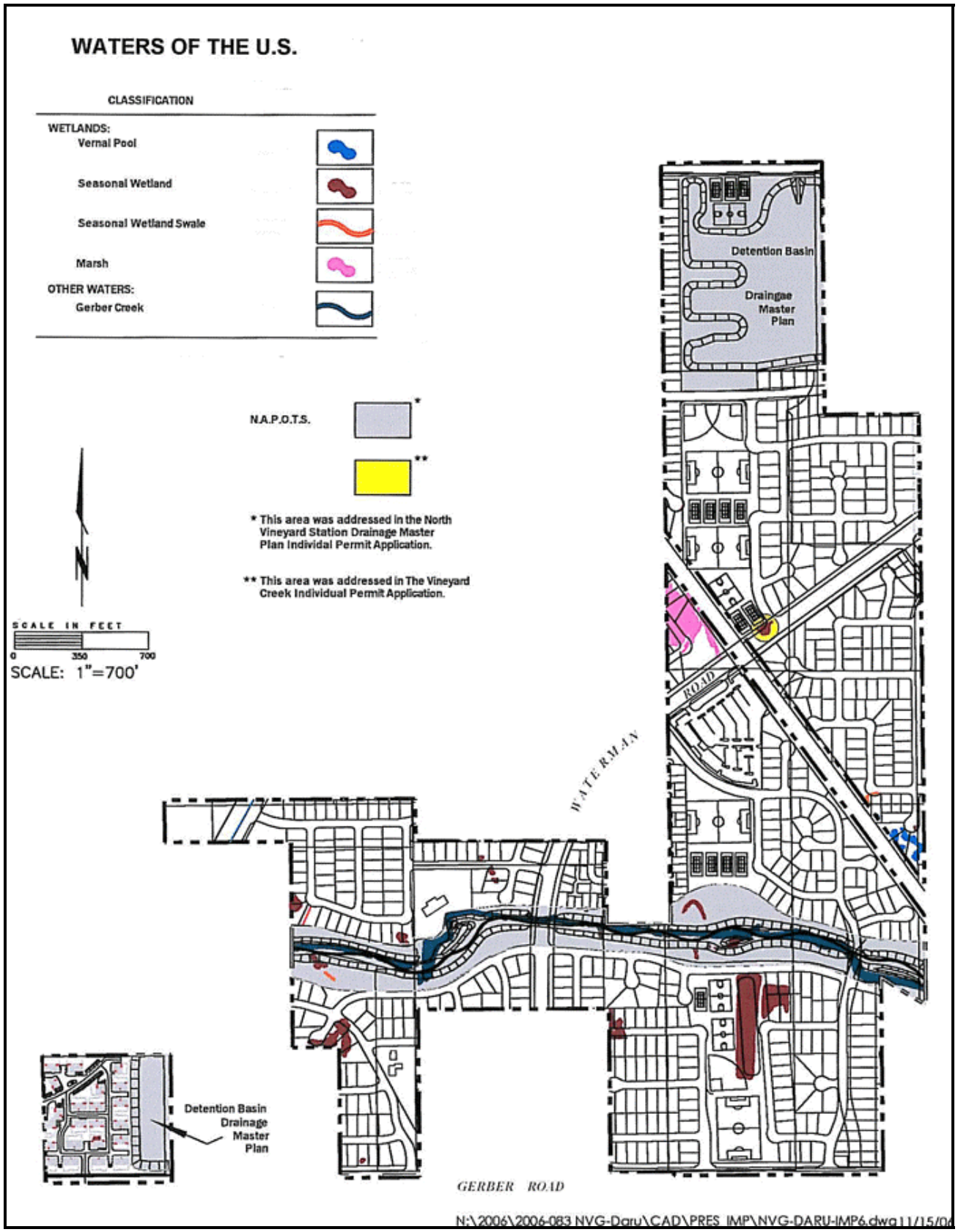
Note: Impacts to 0.52 acre of seasonal wetlands are addressed under the NVG project, with impacts to 0.32 acre addressed by other NVSSP projects. Impacts to less than 0.005 acre of seasonal wetland swale are addressed under another NVSSP project, leaving approximately 0.01 acre to be addressed under this NVG project. Impacts to Gerber Creek (2.20 acres), as well as seasonal wetlands (0.25 acre) and seasonal wetland swale (less than 0.005 acre) impacted by the proposed widening and realignment of Gerber Creek, will be assessed and mitigated separately as part of the North Vineyard Station Drainage Master Plan. Impacts to another onsite seasonal wetland totaling 0.07 acre have been mitigated in accordance with the Vineyard Creek project (Regulatory Branch Number 200300251), because the seasonal wetland was directly impacted by the construction of Waterman Road, an offsite improvement required by Sacramento County for the Vineyard Creek project.

ALTERNATIVES ANALYSIS

The purpose of the Alternatives Analysis (AA) (DMEC 2007) is to objectively evaluate the practicability of project alternatives and provide the Corps with documentation to be used in evaluating the proposed project permit application in compliance with 404(b)(1) guidelines (Guidelines).

The project, as proposed, would result in the discharge of dredged and fill material into 1.60 acres of waters of the U.S., including wetlands. In addition to requiring the identification of the least environmentally damaging practicable alternative (LEDPA), the Guidelines mandate that a project must not violate any applicable toxic effluent standard or prohibition, 40 C.F. R. §230.10(b)(2), jeopardize the continued existence of any endangered or threatened species (or destroy or adversely modify critical habitat), 40 C.F.R. §230.10(b)(1), or cause or contribute to significant degradation of waters of the U.S., 40 C.F.R. §230.10(c). Prior to completing its review, the Corps must also evaluate the proposed project in light of the public interest. Finally, the Corps must ensure that its environmental review complies with the National Environmental Policy Act (NEPA), codified at 42 U.S. C. §4321 et seq.

Figure 4. Proposed Development Plan and Associated Impacts



Note: This figure was adapted from Figure 7 in the 404 IP application prepared by ECORP Consulting, Inc. (ECORP 2006).

Proposed Project Alternatives

Six project alternatives were proposed to provide the required range of alternatives to satisfy NEPA and AA Guidelines. The least environmentally damaging practicable alternative was identified through the analysis of the proposed alternatives. The six project alternatives considered are summarized below:

Alternative 1 (No Project) does not impact the NVG site, nor does it provide housing or meet project objectives. Does not meet guidelines as LEDPA.

Alternative 2 (Alternate Site) does not impact the NVG site, has unknown potential impacts on alternate sites, and project objectives cannot be met because no suitable alternate sites are currently available. Does not meet guidelines as LEDPA.

Alternative 3 (Total Avoidance) significantly impacts avoided jurisdictional wetlands due to isolation and urban edge effects, provides less housing with significantly higher per-acre project development costs, and does not fully meet project objectives. Does not meet guidelines as LEDPA.

Alternative 4 (Partial Avoidance) impacts avoided wetlands, minimally restores wetland function onsite with mitigation, increases per-acre project costs, and partially meets project objectives. Does not meet guidelines as LEDPA.

Alternative 5 (Project with Onsite Mitigation) restores contiguous wetland ecosystem function onsite and meets project objectives. Meets guidelines as LEDPA.

Alternative 6 (Project with Offsite Mitigation) eliminates wetland function onsite, preserves wetland function at offsite locations, and meets project objectives. Does not meet guidelines as LEDPA.

Least Environmentally Damaging Alternative

The preferred alternative, Proposed Project with Onsite Mitigation (Alternative 5), represents a balanced approach that allows the NVG development project to meet the environmental, project purpose, logistics, availability, and cost evaluation criteria. Avoiding direct impacts to onsite wetlands is considered generally infeasible since the wetlands are scattered across the NVG project site in different areas and would result in the loss of dwelling units if the project were to be reconfigured.

The Proposed Project with Onsite Mitigation Alternative restores contiguous wetland ecosystem functions onsite and fully meets project objectives. Because the onsite mitigation provides the opportunity for connectivity among created wetlands and with Gerber Creek, the environmental effects appear to be low. Because this alternative is also highly practicable it meets guidelines as LEDPA. The LEDPA is represented in Figure 5, Proposed Project with Onsite Mitigation Alternative.

County of Sacramento Impact Assessment

The County of Sacramento prepared an EIR for the North Vineyard Station Specific Plan Area, which was approved in 1998 (County of Sacramento 1998). Subsequently, the County prepared a Supplemental EIR for the NVG project (County of Sacramento 2005), and imposed specific measures to protect or mitigate for significant adverse impacts to biological and cultural resources. These impacts are summarized below, and the County mitigation measures specifically pertaining to this wetland mitigation and monitoring plan are summarized under Section 4, Mitigation Plan.

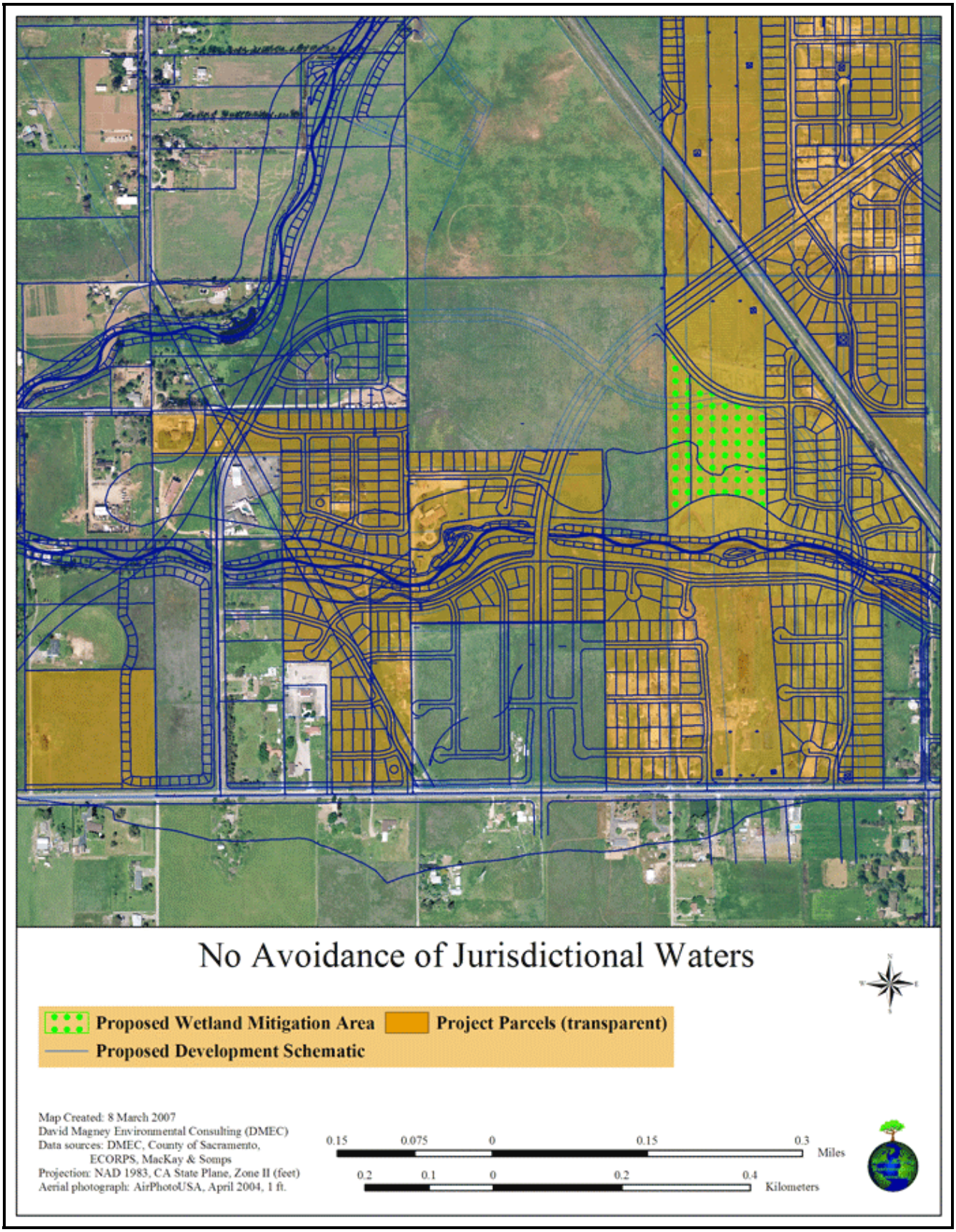
- **Impacts To Biological Resources**: Potentially Significant

  The proposed project is expected to result in the loss of jurisdictional wetlands, potentially impact special-status species, and result in the loss of native oak and black walnut trees. Special-status species potentially impacted include plants, wetland invertebrate species, and vertebrate species, including: Giant Garter Snake (*Thamnophis gigas*), Northwestern Pond Turtle (*Emys marmorata marmorata*), and Swainson's Hawk (*Buteo swainsoni*). Mitigation is recommended to reduce the potential impacts of the project to less than significant**.**

- **Impacts To Cultural Resources**: Potentially Significant

  The project is not expected to impact cultural resources. However, mitigation is recommended in the event that cultural resources are found during project construction. With mitigation as recommended, impacts to cultural resources are expected to be less than significant.

Figure 5. Proposed Project with Onsite Mitigation Alternative



SECTION 4. MITIGATION PLAN

This section discusses the regulatory context in which the mitigation plan will be implemented, the mitigation approach, existing constraints as to mitigation effectiveness, the mitigation design, and details, sequence, and scheduling of the mitigation effort, focusing on requirements of Section 401 and 404 of the Clean Water Act.

REGULATORY CONTEXT

This plan is prepared to meet regulatory requirements to mitigate for impacts to waters of the U.S., including wetlands, incurred as a result of the NVG development project. Historically, the effectiveness of mitigation of waters/wetlands has been measured using an area metric alone. However, the Clinton Administration Wetlands Policy (1993) mandates that:

- "…all wetlands are not the same…";
- a fair, flexible approach should be encouraged that allows restoration of waters/wetland functions; and
- a hydrogeomorphic approach to restoring waters/wetlands functions should be used.

The restoration of functions is a preferable alternative to habitat enhancement and/or creation (Kusler and Kentula 1989). This is reflected in the Memorandum of Agreement (MOA) on Mitigation of 6 February 1990 that guides policy nationally for the U.S. Environmental Protection Agency (EPA), the Corps, and the U.S. Fish and Wildlife Service (USFWS). The MOA sets forth specific guidelines to

> "…restore and maintain the chemical, physical, and biological integrity of the Nation's waters, including wetlands".

As indicated by the LEDPA analysis, the avoidance of wetlands with preservation and restoration of wetland functions in place on the NVG site was not found to be practicable. Instead, onsite mitigation through the creation of a wetland preserve was determined to be the superior alternative.

County of Sacramento Mitigation Measures

The County of Sacramento, through its environmental impact assessment of project-related impacts to biological and cultural resources, imposed specific measures to mitigate impacts that were considered significant pursuant to CEQA Guidelines (County of Sacramento 2005). The County biological and cultural resources mitigation measures that specifically pertain to this wetland mitigation and monitoring plan are summarized below:

- **BR-2:** The project applicant shall obtain all applicable jurisdictional wetlands permits from the U. S. Army Corps of Engineers and shall pay to the County of Sacramento a per acre fee if less than 1:1 replacement/compensation for the loss of jurisdictional wetlands occurs through the Federal permitting process.

- **BR-3:** The project site shall be surveyed by a qualified biologist prior to the start of construction activities within 200 feet of all jurisdictional wetlands to assess impacts to special-status plants and the habitats of special-status species. Permits must be obtained for the take of any protected species per USFWS, CDFG, or other jurisdictional requirements. Results of the pre-construction survey shall be reported within 24 hours to the County Department of Environmental Review and Assessment (DERA).
- **BR-4:** Prior to the start of construction activities, determinate-level special-status wetland invertebrate species surveys shall be conducted during the appropriate season(s) by a qualified biologist. If surveys are positive the applicant shall comply with USFWS requirements and obtain all applicable permits. A copy of the survey results and all required permits shall be submitted to DERA. Any incidental take shall be reported to USFWS and DERA within one working day.
- **BR-5:** The project site shall be surveyed for special-status reptiles by a qualified biologist within 24 hours prior to the start of construction activities within 200 feet of all jurisdictional wetlands. Survey of the area shall be repeated if a lapse in construction activity of two weeks or greater occurs. If a special-status reptile is encountered during construction activities shall cease until appropriate measures can be implemented. Special-status reptiles should be allowed to move away on their own, and, if necessary, capture and relocation shall only be attempted by personnel with current USFWS recovery permits. Any incidental take shall be reported to USFWS and DERA within one working day. Any special-status amphibian or reptile sightings shall be reported within 24 hours to DERA.
- **CR-1:** Should any cultural resources be encountered during any development activities, work shall be suspended and DERA shall be immediately notified. DERA will coordinate the investigation of cultural resources and the project applicant shall be required to implement any mitigation deemed necessary for their protection. In the event of the discovery of human remains, all work is to stop and the County Coroner shall be immediately notified.

OBJECTIVES

Wetland ecosystems that will be impacted as a result of project implementation are proposed to be recreated onsite and in-kind. The overall mitigation objective is to have no net loss of wetland extent or function resulting from project implementation. In addition, it is proposed that non-wetland areas of the mitigation site be restored as grassland with emphasis on the establishment of native species, particularly in the areas immediately surrounding the wetlands.

This project targets the restoration and enhancement of wetland ecosystem functions through the creation of geomorphic and biological attributes and processes on the NVG project site. Specifically, this project will restore natural wetland morphology and native plant communities in the mitigation area, resulting in the overall enhancement of ecosystem functions on the project site.

GENERAL APPROACH

The approach presented herein proposes to recreate and enhance the physical, chemical, and biological attributes and processes of the impacted waters of the U.S., including wetlands, on the NVG project site. The overall area of waters/wetlands will be increased, overall ecosystem function is expected to be enhanced by allowing connectivity among created wetlands and with Gerber Creek, and revegetation will result in a more appropriate assemblage of native plants associated with the wetlands.

The general approach of the NVG Wetland Mitigation Plan is to focus on the physical and biological factors involved in wetland function. Identifying specific locations within the mitigation site that have suitable wetland soil characteristics is critical to the success of this Plan. Many native, locally adapted plant species exist onsite that can be salvaged and/or propagated for use in vegetating the mitigation site. Working with naturally occurring physical and biological features will help to facilitate the success of this Mitigation Plan.

Each created wetland will be planted at appropriate densities with suitable indigenous plants commonly associated with each wetland type. The remaining upland areas are proposed to be restored as grassland, with emphasis on using suitable indigenous plants. The Botanical Resources section above identifies the plant species onsite that can be utilized to vegetate the mitigation site.

The mitigation approach for the NVG project site includes, but is not necessarily limited to:

- Identifying the specific locations within the mitigation area most suitable for creating particular wetland types;
- Establishing a landscape plan for the locations of wetlands and grassland that effectively provides connectivity among wetlands;
- Recontouring portions of the mitigation area to establish optimal conditions for wetland and grassland creation;
- Establishing functional wetland hydrology as a foundation for the mitigation effort;
- Removing existing non-native, exotic plants from the mitigation area;
- Collecting cuttings and seeds, and salvaging plants for propagation and planting;
- Allowing natural succession to play a governing role in supplemental mitigation efforts;
- Attempting to attract native pollinators by providing suitable habitat;
- Installing temporary irrigation systems, where appropriate or necessary;
- Monitoring the work of the grading and planting contractors; and
- Monitoring the created wetland ecosystem for a minimum of 5-year period.

Prior to any construction, biologists will survey for special-status and/or otherwise vulnerable wildlife species within the vicinity of the mitigation site. Wildlife species observed in the construction area will be relocated to a safe location with appropriate required habitat as feasible. Once the mitigation site has been prepared, it will be planted with appropriate indigenous plant species to promote the establishment of wetland and grassland habitat.

CONSTRAINTS

Considerable controversy exists regarding the ability to successfully create or restore vernal pool ecosystems and the appropriateness of using habitat creation and restoration for mitigating impacts to vernal pools. Many creation efforts have proven successful, while others have failed to meet the desired level of wetland function. Causes of failure include a lack of goal definition leaving interpretations of what a "successfully created vernal pool" is, or a lack of habitat variability in design and a lack of biodiversity in the created habitat. To meet required performance standards, created pools have often been built based on a single model with less diversity than natural complexes. Other efforts have suffered from insufficient geomorphic and soils analyses, and insufficient buffer areas and management guidelines (Sutter and Francisco 1998).

Typical problems with mitigation creation include (De Weese 1998):

- Lack of goal definition and goal documentation by mitigation designers and regulatory staff;
- Creation of pools on inappropriate geomorphic landform and/or soils;
- Failure to establish appropriate hydrology;
- Inappropriate pool densities (often due to high land costs and onsite mitigation requirements);
- Failure to recognize potential effects of land use changes in the area;
- Negative edge effects of human activity due to inadequate core area size and buffer; and
- Lack of consideration of grazing and fire management in long-term stewardship of mitigation.

Successful creation and restoration require clearly defined goals and conducting detailed geomorphic, topographic, and soils analyses as the dominant factors in design. The full range of variability in physical parameters (e.g. depth and size of pools), and ecological diversity in natural pool complexes, should be considered as the primary design goal for creation (Sutter and Francisco 1998).

MITIGATION DESIGN

This section discusses the methods used to design the physical and biological mitigation plans for mitigating wetland habitats on the NVG project site. Also presented below is the wetland mitigation design that will guide the mitigation efforts.

Design Methods

Based on De Weese's (1998) findings, DMEC evaluated the proposed mitigation site for suitability, and as a guide for this plan. These potential problems were discussed with the Corps and wetland and vernal pool creation experts (such as Joel Butterworth, Matt Gause, Mark Rains) to support DMEC's own experience and expertise.

Soil profiles on the approximate 4.2-acre mitigation site were evaluated for their wetland creation suitability in May of 2007 (Valley Environmental Consulting 2007).

The data gathered from the soil pits excavated onsite include:

- Thickness of topsoil present;
- Depth to the upper restrictive layer (Bt horizon);
- Thickness of the upper restrictive layer (Bt horizon); and
- Depth to the lower restrictive horizon (Bqm).

The entire mitigation area is located on San Joaquin silt loam, leveled, 0-1 percent slopes. The moderately permeable silt loam has a depth of approximately 23 inches where it has not been disturbed by leveling. A very slowly permeable clay or clay loam claypan (Bt horizon) exists at a depth range of approximately 23 to 28 inches, and in some profiles the claypan is absent. Beneath the claypan is a very slowly permeable iron-silica cemented duripan (Bqm horizon), which ranges in thickness from 12 to 72 inches. Both the Bt and Bqm horizons are considered restrictive layers with respect to wetlands. Fifteen (15) of the seventeen (17) soil profiles evaluated within the mitigation site were found to be suitable for wetland creation, subject to excavation or filling to create optimal conditions.

All variables, both quantitative and qualitative, helped to determine which areas are most suitable for wetland mitigation. The quantitative measurements were taken for each pit excavated; however, in a

number of pits, certain horizons were absent or not discernable, resulting in null values for these variables. In addition, two qualitative measurements were taken at each pit:

- Suitability of the restrictive layers for wetland development (e.g., how well-cemented they were and how well they would prove to be impermeable); and
- Overall suitability for wetland creation, which takes into consideration the strength, depth, and thickness of the restrictive layers present.

For all variables (with the exception of the thickness of topsoil present, which correlated exactly with depth of upper restrictive layer), spline interpolation was used to estimate the value of the variables in areas between the excavated soil pits. *Spline interpolation* is an interpolation method that estimates values using a mathematical function that minimizes variability in the dataset; it minimizes curvature within the variable space, resulting in a smooth surface. The spline method is best suited for gently varying natural phenomenon, such as data associated with elevation, water table heights, or pollution concentrations. DMEC found that this method was also accurately applied to data pertaining to depth and thickness of soil horizons, especially in areas with little surface contouring (as would result from a stream channel, for example).

Using ArcGIS software, data from the soil pits was successfully interpolated across the project space using the *tension spline method*. This method creates a smooth "variable surface" with values that are closely constrained by the sample data range. (The *regularized spline method*, on the other hand, creates a smoother surface with less fluctuation, but with resultant values that could fall far out of the sample data range. The regularized method was not appropriate in this case, especially since the data was collected as positive integers, and some hypothetical range values would be negative using the regularized method).

The two qualitative measurements (layer suitability and overall suitability) were likewise interpolated across the project space. In order to perform this interpolation, the data had to be converted to numerical values. Thus, "high" or "good" was tabulated as having a score of 100, whereas "low" or "bad" was assigned a value of 0. "Medium" was assigned 50, and "medium-high" was assigned 75.

Using this method, DMEC and Valley Environmental Consulting LLC are able to recommend that wetland creation be focused in specific areas onsite. Additional soil pits may need to be excavated, however, to determine the accuracy of the interpolated data.

Since the majority of the wetlands to be created are not vernal pool, wetland to upland area ratio consideration is not as important than if the majority of wetlands to be created were vernal pool types. Hydrology is the primary factor that will determine the success of establishing seasonal wetlands within the proposed mitigation site. The fact that two seasonal wetlands onsite that pond water for the longest duration are man-made (with almost no supporting upland habitat), and functioning relatively well, it is reasonable to conclude that creation of similar habitat types on the same soil formation has a high likelihood of success within the proposed mitigation site.

Wetland Mitigation Design

Wetland ecosystem function will be restored by the following measures: (1) creating approximately 1.75 acres of wetlands onsite, including 0.30 acre of vernal pool wetland, 0.52 acre of seasonal wetland, 0.01 acre of seasonal wetland swale, and 0.92 acre of seasonal marsh; (2) establishing functional wetland hydrology; (3) eradicating invasive non-native plants in the mitigation area; and (4) revegetating the wetland types with more compositionally and structurally diverse assemblages of

plant communities. The proposed mitigation ratios and acreages for each wetland type are presented in Table 12, Proposed Wetland Mitigation Ratios and Acreages.

Seven (7) vernal pools are proposed for the mitigation site and will be excavated to a depth of approximately 12 to 14 inches, with approximately 3 to 4 inches of soil remaining above the claypan/duripan layer. The existing seasonal wetlands onsite tend to be shallow and excavation of the created seasonal wetlands will be to a depth of approximately 12 inches or less. The seasonal marsh will be excavated to a depth of approximately 25 inches. Seasonal swales will be excavated to a minimal depth that will allow hydrologic connectivity between adjacent wetlands and with Gerber Creek to the south. The will be many transitional areas between wetlands and adjacent uplands that will add to the mitigation site's geomorphic complexity. Figure 6, Proposed NVG Wetland Mitigation, illustrates the general locations of each wetland type proposed for the mitigation site.

Since the project site is essentially flat, and the design depths are known, and since hydrology is the key component to successful seasonal wetland creation, a detailed grading plan was not considered necessary at this time. On-the-ground conditions will determine the exact locations and depths and widths of each created wetland. The design as described in concept above will be used as a template for the grading contractor and DMEC to determine the final configuration and layout of the wetlands created as mitigation during the first phase of wetland construction.

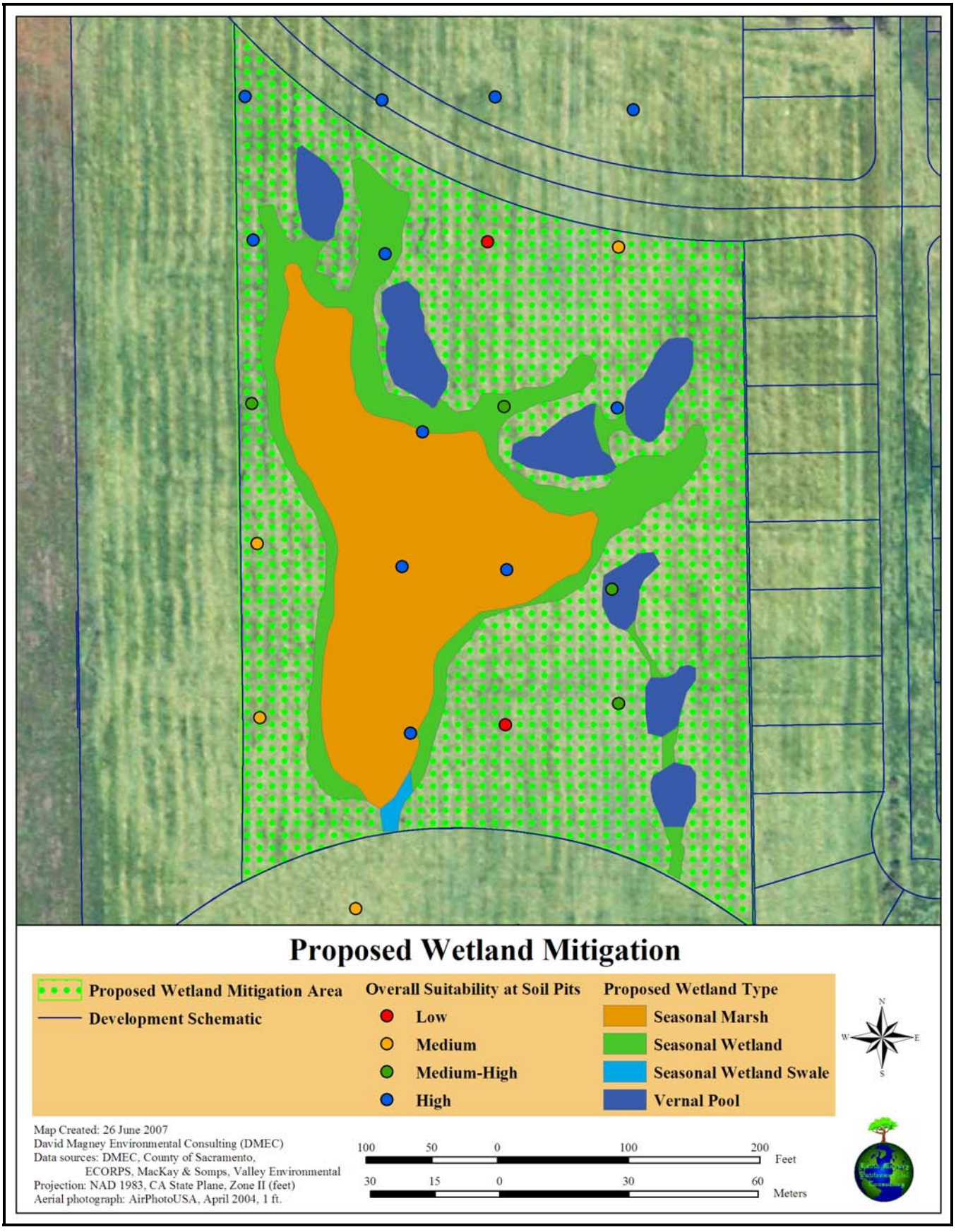
In order for correct wetland hydrology to be achieved, extreme caution and precision in grading and excavation will be necessary to prevent disturbance of the claypan/duripan layer and to establish suitable soil conditions, elevations, and connectivity for each of the wetlands relative to adjacent features.

Table 12. Proposed Wetland Mitigation Ratios and Acreages

Wetland Type	**Number of Existing Wetlands**	**Impacted Area** (Acres)	**Mitigation Ratio**	**Mitigation Area** (Acres)
Vernal Pool	3	0.15	2:1	0.30
Seasonal Wetland	11	0.52	1:1	0.52
Seasonal Wetland Swale	1	0.01	1:1	0.01
Seasonal Marsh	1	0.92	1:1	0.92
Total	**16**	**1.60**	**1.1:1**[18]	**1.75**

18 Determined by calculating area created with area impacted.

Figure 6. Proposed NVG Wetland Mitigation Design



Restoration of Mitigation Site Uplands

In addition to the creation of the wetlands, DMEC proposes that the remaining approximately 2.4 acres of upland on the mitigation site be restored as grassland that includes a diversity of native grasses and forbs. It will be attempted to establish suitable native species in upland areas to the extent practicable, especially in the wetland buffers. The vegetation in the buffers surrounding the wetlands is closely associated with wetland vegetation, and high populations of exotic plants in the uplands may have a negative impact on overall ecosystem function and mitigation success. Though not directly included in the regulatory mitigation requirements, restoration of the upland areas will enhance wetland mitigation efforts as well as improve the overall habitat value of the mitigation site. Many species of wildlife that occur in the area utilize or depend on grassland for cover and foraging.

Vernal pool specialist bees of the family Andrenidae are often the pollinators that most frequently visit the flowers of their preferred hosts. Among the vernal pool plants on the NVG site, the two *Lasthenia* species are pollinated by several species of specialist Andrenid bees. Many non-specialist pollinators, including other bees and members of several other insect families, also visit *Lasthenia.* Andrenid bees, often the most important *Lasthenia* pollinators, build shallow nests in upland soils near host plant populations close to the time the plants begin to bloom in the spring. Larvae develop in the nests on a diet of pollen and then overwinter there as adults to allow rapid emergence as their hosts start to bloom the following spring. Andrenid bees may naturally colonize new sites that offer suitable habitat, and there appears to have been some success with their artificial transplantation. Upland habitats support both specialist and non-specialist pollinators of vernal pool plants and are an important consideration when creating vernal pools (Thorp and Leong 1998).

Plant Palettes

The wetland areas resulting after hydrology assessment and grading is completed will be planted at varying densities with suitable indigenous wetland species. Since the wetland types to be created onsite have varying hydrology, soil moisture, and soil depth requirements, the recommended plants specific for each wetland type are listed in Table 13, Wetland Plant Palette for the NVG Mitigation Effort. The recommended native grasses and forbs for the approximately 2.4 acres of uplands proposed to be restored as grassland are listed in Table 14, Restored Grassland Native Plant Palette for the NVG Mitigation Site.

The mitigation areas will be planted with a combination of seed and vegetative material of plant species with local provenance so that the genetic integrity of the local habitat is preserved in the restored wetland ecosystem.

Table 13. Wetland Plant Palette for the NVG Mitigation Effort

Scientific Name	Common Name	Habit[19]	WIS[20]	Propagation Method
Vernal Pool				
Callitriche marginata	Winged Water-starwort	AH	OBL	Seed
Castilleja campestris ssp. *campestris*	Field Owl's Clover	AH	OBL*	Seed
Deschampsia danthonioides	Annual Hairgrass	AG	FACW	Seed
Eleocharis macrostachya	Creeping Spikerush	PG	OBL	Seed/Cuttings
Epilobium ciliatum	Northern Willow-herb	PH	FACW	Seed
Epilobium densiflorum	Dense-flowered Willow-herb	AH	OBL	Seed
Epilobium pygmaeum	Smooth Spike-primrose	AH	OBL	Seed
Eryngium vaseyi	Coyote-thistle	PH	FACW	Seed
Gratiola ebracteata	Bractless Hedge Hyssop	AH	OBL	Seed
Hordeum brachyantherum	Meadow Barley	PG	FACW	Seed
Hordeum depressum	Alkali Barley	AG	FACW	Seed
Juncus bufonius	Common Toad Rush	AG	OBL	Seed/Cuttings
Lasthenia fremontii	Fremont's Goldfields	A/PH	OBL	Seed
Lasthenia glaberrima	Smooth Goldfields	AH	OBL	Seed
Navarretia leucocephala	Whitehead Navarretia	AH	OBL	Seed
Plagiobothrys stipitatus	Stalked Popcornflower	AH	OBL	Seed
Psilocarphus brevissimus	Dwarf Woollyheads	AH	OBL	Seed
Ranunculus bonariensis	Carter's Buttercup	AH	OBL	Seed
Triteleia hyacinthina	White Brodiaea	PH	FACW*	Seed
Veronica peregrina	Neckweed	AH	OBL	Seed

[19] Habit definitions: AG = annual grass or graminoid; AH = annual herb; F = Fern; PG = perennial grass or graminoid; PH = perennial herb; PV = perennial vine; S = shrub; T = tree.

[20] WIS = Wetland Indicator Status. The following code definitions are according to Reed (1988):

OBL = obligate wetland species, occurs almost always in wetlands (>99% probability).

FACW = facultative wetland species, usually found in wetlands (67-99% probability).

FAC = facultative species, equally likely to occur in wetlands or nonwetlands (34-66% probability).

FACU = facultative upland species, usually found in nonwetlands (67-99% probability).

UPL = obligate upland species in this region (99% probability), occurs in wetlands in another region

NI = no indicator status has been assigned due to a lack of information.

+ or - symbols are modifiers that indicate greater or lesser affinity for wetland habitats.

* = tentative assignment to that indicator status by Reed (1988).

( ) Parentheses indicate a wetland status suggested by David L. Magney based on extensive field observations.

Scientific Name	Common Name	Habit[19]	WIS[20]	Propagation Method
Seasonal Wetland & Seasonal Wetland Swale				
Centaurium muhlenbergii	Monterey Centaury	AH	FAC	Seed
Cyperus eragrostis	Umbrella-sedge	PG	FACW	Seed/Cuttings
Epilobium ciliatum	Northern Willow-herb	PH	FACW	Seed
Epilobium densiflorum	Dense-flowered Willow-herb	AH	OBL	Seed
Gnaphalium palustre	Lowland Cudweed	AH	FACW	Seed
Hordeum brachyantherum	Meadow Barley	PG	FACW	Seed
Hordeum depressum	Alkali Barley	AG	FACW	Seed
Juncus balticus	Baltic Rush	PG	OBL	Seed/Cuttings
Juncus bufonius	Common Toad Rush	AG	OBL	Seed/Cuttings
Juncus effusus	Common Rush	PG	OBL	Seed/Cuttings
Juncus xiphioides	Iris-leaved Rush	PG	OBL	Seed/Cuttings
Phyla nodiflora	Turkey Tangle Fogfruit	PH	FACW	Seed/Cuttings
Triteleia hyacinthina	White Brodiaea	PH	FACW*	Seed
Veronica peregrina	Neckweed	AH	OBL	Seed
Xanthium strumarium	Cocklebur	AH	FAC+	Seed
Seasonal Marsh				
Callitriche marginata	Winged Water-starwort	AH	OBL	Seed
Cyperus eragrostis	Umbrella-sedge	PG	FACW	Seed/Cuttings
Eleocharis macrostachya	Creeping Spikerush	PG	OBL	Seed/Cuttings
Epilobium pygmaeum	Smooth Spike-primrose	AH	OBL	Seed
Juncus effusus	Common Rush	PG	OBL	Seed/Cuttings
Juncus xiphioides	Iris-leaved Rush	PG	OBL	Seed/Cuttings
Lemna minuscula	Least Duckweed	AH	OBL	Transplant
Ludwigia peploides	Floating Water-primrose	PH	OBL	Seed
Polygonum hydropiperoides	Swamp Smartweed	PH	OBL	Seed
Polygonum punctatum	Dotted Smartweed	A/PH	OBL	Seed
Ranunculus bonariensis	Carter's Buttercup	AH	OBL	Seed
Schoenoplectus [*Scirpus*] *acutus*	Hardstem Bulrush	PG	OBL	Seed/Cuttings
Typha latifolia	Cattail	PG	OBL	Seed/Cuttings
Xanthium strumarium	Cocklebur	AH	FAC+	Seed

Table 14. Restored Grassland Native Plant Palette for the NVG Mitigation Site

Scientific Name	Common Name	Habit[21]	WIS[22]	Propagation Method
Grasses				
Bromus carinatus	California Brome	AG	-	Seed
Deschampsia danthonioides	Annual Hairgrass	AG	FACW	Seed
Elymus glaucus	Blue Wildrye	PG	FACU	Seed
Elymus multisetus	Big Squirreltail Grass	AG	-	Seed
Hordeum brachyantherum	Meadow Barley	PG	FACW	Seed
Hordeum depressum	Alkali Barley	AG	FACW	Seed
Leymus triticoides	Creeping Wildrye	PG	FAC+	Seed/Sod/Rhizome
Poa secunda	Sandberg Bluegrass	PG	FACU	Seed
Vulpia microstachys	Small Fescue	AG	-	Seed
Vulpia octoflora	Slender Fescue	AG	UPL	Seed
Forbs				
Amsinckia menziesii	Rancher's Fire	AH	-	Seed
Asclepias fascicularis	Narrowleaf Milkweed	PH	FAC	Seed/Rhizome
Brodiaea coronaria	Harvest Brodiaea	PH	(FAC)	Seed
Castilleja attenuata	Valley Tassels	AH	-	Seed
Epilobium brachycarpum	Panicled Willow-herb	AH	UPL	Seed
Eremocarpus setigerus	Dove Weed	AH	-	Seed
Galium aparine	Goose Grass	AH	FACU	Seed
Grindelia camporum	Great Valley Gumplant	PH	FACU	Seed
Hemizonia fitchii	Fitch's Tarweed	AH	-	Seed
Holocarpha virgata	Yellowflower Tarweed	AH	-	Seed
Lepidium nitidum	Common Peppergrass	AH	-	Seed
Lotus purshianus	Spanish Clover	AH	UPL	Seed
Plantago erecta	California Plantain	AH	-	Seed
Trichostema lanceolatum	Vinegarweed	AH	-	Seed
Triteleia laxa	Ithuriel's Spear	PH	-	Seed
Wyethia angustifolia	California Compassplant	PH	FACU-	Seed

[21] Habit definitions: AG = annual grass or graminoid; AH = annual herb; F = Fern; PG = perennial grass or graminoid; PH = perennial herb; PV = perennial vine; S = shrub; T = tree.

[22] WIS = Wetland Indicator Status. The following code definitions are according to Reed (1988):

OBL = obligate wetland species, occurs almost always in wetlands (>99% probability).

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FAC = facultative species, equally likely to occur in wetlands or nonwetlands (34-66% probability).

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( ) Parentheses indicate a wetland status suggested by David L. Magney based on extensive field observations.

DETAILS, SEQUENCE, AND SCHEDULE

This subsection discusses administrative activities, onsite activities prior to implementation, onsite activities during implementation, and post-implementation activities. Finally, this section provides the mitigation schedule.

Administrative Activities

Administrative activities include obtaining appropriate permits and approvals, and implementing the contracting process.

Permits and Approvals

DMEC will assist Mr. Daru in securing necessary permits from the Corps, USFWS, and the Regional Water Quality Control Board for the NVG project.

Contracting

Mr. Daru will prepare a request for bids to Corps-approved qualified landscape contractors that are experienced with wetland mitigation projects. To minimize delays in executing a contract, DMEC recommends that Mr. Daru request all necessary contract information from each bidder as part of their bid submittal, rather than waiting until a contractor is selected.

Onsite Activities Prior to Implementation

Once this mitigation and monitoring plan is approved, the wetland functional assessment and vegetation surveys will be conducted on the existing wetlands to establish a set of baseline data. Sediment and erosion control measures may need to be implemented, trash will need to be removed, work areas will need to be marked (delineate the different proposed wetland types), and plant collection, propagation, and salvage operations will need to be conducted. These measures and tasks are discussed in the following subsections.

Assessment of Baseline Conditions

Prior to grading activities onsite, a wetland functional assessment and vegetation surveys will be conducted on the existing wetlands to establish a set of baseline data to be compared against post-implementation conditions. These comparisons will help determine the level of wetland function present prior to mitigation work and will aid in determining mitigation success over the five-year monitoring period. Refer to Section 5, Monitoring Plan, for more details.

Sediment and Erosion Control

Best Management Practices (BMPs) with regard to sediment and erosion control shall be employed prior to initiation of construction on the mitigation site. The construction area shall be inspected and maintained throughout the mitigation effort to ensure that BMPs are being implemented correctly. If necessary, silt fencing shall be installed along the perimeter of the work area to keep sediments contained on the mitigation site, and measures to prevent erosion shall be employed.

Delineate Work Areas

All work areas shall be demarcated with flags or stakes prior to construction activities. All contractors, subcontractors, and equipment operators shall be instructed to remain within the flagged boundaries. Vegetation and soils shall not be disturbed outside of the flagged boundaries. All debris, such as wood debris, non-native gravel, cured or uncured concrete, and trash shall be removed from the mitigation site prior to mitigation activities described in this plan. The proposed wetland areas will be delineated to facilitate implementation of the grading plan.

Plant Collection, Propagation, and Salvage Operations

Plant material will primarily be derived from seeds or cuttings obtained from plants on the project site. Salvage and translocation of native perennial species will aid in the planting effort. Collection of plant material should be done during the fall and winter when the plants are dormant or have gone to seed. If necessary, a qualified nursery facility experienced in growing California native plants can be contracted to store and/or propagate plant material collected from the project site.

Any plant stock that cannot be collected from the project site shall be obtained from an approved native plant nursery and derived from native sources within the local watershed. The contractor shall provide a detailed list of all materials prior to planting, and unacceptable plant material will be rejected, at the contractor's expense, by DMEC restoration specialists or other qualified individuals contracted by Mr. Daru.

Onsite Activities During Implementation

All mitigation activities within the proposed wetland areas of the NVG project site will be supervised by DMEC personnel or other qualified restoration ecologists approved by the Corps. Activities during the implementation of the mitigation include grading, hydrology assessment, removal and control of exotic plant species, initial functional and vegetation assessments, and planting implementation. These activities are discussed in the subsections below.

Grading

A general engineering contractor (yet to be determined) will develop the grading plan for this project. The following is a summary of the general grading activities proposed for the NVG project mitigation site. Seven (7) vernal pools are proposed for the mitigation site and will be excavated to a depth of approximately 12 to 14 inches, with approximately 3 to 4 inches of soil remaining above the claypan/duripan layer. Excavation of the seasonal wetlands will be to a depth of approximately 12 inches or less, and the seasonal marsh will be excavated to a depth of approximately 25 inches. Seasonal swales will be excavated to a minimal depth that will allow hydrologic connectivity between the wetlands and with Gerber Creek to the south (see Figure 6, Proposed NVG Wetland Mitigation).

In order for correct wetland hydrology to be achieved, extreme caution and precision in grading and excavation will be necessary to prevent disturbance of the claypan/duripan layer and to establish suitable soil conditions, elevations, and connectivity for each wetland relative to adjacent features.

Hydrology Assessment

After initial mitigation site grading and preparation is complete, the hydrology of the wetlands will need to be assessed to assure that proper excavation depths, relative elevations, connectivity, and soil conditions have been achieved. Piezometers, flow meters, and depth gauges will be utilized as necessary to evaluate hydrologic factors. Water depth and duration of inundation will be closely monitored. It is preferable for the wetlands to be charged as the result of rainfall, and if precipitation is inadequate to fully charge the wetlands it may be necessary to postpone the hydrology assessment until conditions are suitable. Normal peak precipitation occurs from November to March, when approximately fifteen (15) of the annual eighteen (18) inches of rain falls[23]. Artificial introduction of supplemental water is an option that may be considered. Based on the hydrology assessment any necessary design and grading adjustments will then be made. Mitigation site hydrology will be monitored throughout the five-year monitoring period as necessary, especially in the first season.

Removal and Control of Exotic Plants

Exotic plant species targeted for regular removal and control on the mitigation site primarily include those already occurring on the NVG project site. Many of these non-native plants have invasive characteristics and some are highly invasive, and none of them are desired species in the plant communities to be established on the mitigation site. Because the mitigation site is a disturbed area that will undergo additional disturbance as a result of mitigation activities, any of these exotic species could occur there and interfere with revegetation efforts. The list of target exotic plants to be eradicated and controlled is presented in Table 15, Target Exotic Plant Species. Species listed by the California Invasive Plant Council (Cal-IPC 2006) as invasive and threatening to wildlands in California are highlighted with bold type.

All non-native plants, including any that are not listed in Table 15, shall be removed from the work areas and disposed of in a manner consistent with pertinent regulations, using practices that prevent their re-establishment. Removal will be conducted at least twice annually during spring and summer seasons, and as needed over the five-year monitoring period. Plants shall be removed or controlled by hand or mechanical means whenever possible, rather than with the use of herbicides. If surface water is present and control of exotic plants using herbicides is required within wetlands, a licensed pesticide applicator shall be hired and only those herbicides and surfactants that are approved for aquatic use shall be applied.

Reducing populations of exotic species in the restored grassland will enhance its habitat value and reduce the potential for infestation of wetland areas. Emphasis will be placed on controlling invasive and exotic species in the created wetlands and the vegetated buffers immediately surrounding them. These buffers include portions of the upland areas proposed for restoration as grassland. Though restoration of uplands is not directly included in the regulatory mitigation requirements, high populations of exotic species in these areas can affect overall wetland ecosystem function. As a result, it will be necessary to reduce the levels of exotic species in upland areas as much as is practicable, though some common exotics will undoubtedly persist despite control efforts.

[23] http://www.idcide.com/weather/ca/elk-grove.htm

Table 15. Target Exotic Plant Species

Scientific Name[24]	Common Name	Habit[25]	Family
Aegilops triuncialis	Barbed Goatgrass	AG	Poaceae
Ailanthus altissima	Tree-of-heaven	T	Hippocastinaceae
Aira caryophyllea	Silver Hairgrass	AG	Poaceae
*Alisma lanceolatum**	Lanceleaf Water Plantain	PH	Alismataceae
Anthemis cotula	Mayweed	AH	Asteraceae
Arundo donax	Giant Reed	PG	Poaceae
Asparagus officinalis	Garden Asparagus	PG	Asparagaceae
Anagallis arvensis	Scarlet Pimpernel	AH	Primulaceae
Avena barbata	Slender Wild Oat	A/PG	Poaceae
Avena fatua	Wild Oat	AG	Poaceae
Brachypodium distachyon	Purple False Brome	A/PG	Poaceae
Brassica nigra	Black Mustard	AH	Brassicaceae
Brassica rapa	Field Mustard	AH	Brassicaceae
Briza minor	Little Quakinggrass	AG	Poaceae
Bromus diandrus	Ripgut Brome	AG	Poaceae
Bromus hordeaceus	Soft Brome	AH	Poaceae
Bromus madritensis* ssp. *rubens	Red Brome	AG	Poaceae
Carduus pycnocephalus	Italian Thistle	AH	Asteraceae
Centaurea solstitialis	Yellow Star-thistle	AH	Asteraceae
Cerastium glomeratum	Mouse-ear Chickweed	AH	Caryophyllaceae
Chamomilla suaveolens	Pineapple Weed	AH	Asteraceae
Chenopodium album	Lambsquarters	AH	Chenopodiaceae
Cichorium intybus	Chicory	PH	Asteraceae
Cirsium vulgare	Bull Thistle	PH	Asteraceae
Convolvulus arvensis	Bind Weed	PV	Convolvulaceae
Cortaderia selloana	Uruguayan Pampas Grass	PG	Poaceae
Crassula tillaea	Water Pygmy-weed	AH	Crassulaceae
Crypsis schoenoides	Swamp Grass	AG	Poaceae
Cynodon dactylon	Bermuda Grass	PG	Poaceae
Daucus carota	Queen Anne's Lace	PH	Apiaceae
Erodium botrys	Broadleaf Filaree	AH	Geraniaceae
Erodium moschatum	Whitestem Filaree	AH	Geraniaceae
Eucalyptus globulus	Blue Gum	T	Myrtaceae
Festuca arundinacea	Tall Fescue	PG	Poaceae
Geranium dissectum	Cut-leaved Geranium	AH	Geraniaceae
Glyceria declinata	Waxy Mannagrass	PG	Poaceae
Hirschfeldia incana	Summer Mustard	PH	Brassicaceae
Hordeum marinum	Mediterranean Barley	AG	Poaceae
Hordeum murinum	Summer Barley	AG	Poaceae
Hypochaeris glabra	Smooth Cat's-ear	AH	Asteraceae
Juncus capitatus	Leafybract Dwarf Rush	AH	Juncaceae
Kickxia elatine	Arrowleaf Fluvellin	AH	Veronicaceae

[24] **Bold** = Cal-IPC invasive threat to wildlands. * = Obligate wetland species potentially a problem in mitigation site wetlands.

[25] Habit definitions: AG = annual grass or graminoid; AH = annual herb; AV = annual vine; PG = perennial grass graminoid; PH = perennial herb; S = shrub; T = tree.

Scientific Name[24]	Common Name	Habit[25]	Family
Lactuca serriola	Prickly Wild Lettuce	AH	Asteraceae
Lathyrus angulatus	Angled Pea	AV	Fabaceae
Leontodon taraxacoides	Hawkbit	A/B/PH	Asteraceae
Lolium multiflorum	Italian Ryegrass	AG	Poaceae
Lotus corniculatus	Birdsfoot Trefoil	PH	Fabaceae
Lythrum hyssopifolium	Hyssop Loosestrife	AH	Lythraceae
Malva parviflora	Cheeseweed	AH	Malvaceae
Medicago polymorpha	Burclover	AH	Fabaceae
Mentha pulegium*	Pennyroyal	PH	Lamiaceae
Morus alba	White Mulberry	T	Moraceae
Olea europaea	Olive	T	Oleaceae
Paspalum dilatatum	Dallisgrass	PG	Poaceae
Phalaris aquatica	Bulbous Canarygrass	PG	Poaceae
Phytolacca americana	American Pokeweed	PH	Phytolaccaceae
Picris echioides	Bristly Ox-tongue	AH	Asteraceae
Plantago lanceolata	English Plantain	PH	Plantaginaceae
Polygonum arenastrum	Common Knotweed	AH	Polygonaceae
Polypogon monspeliensis	Rabbitsfoot Grass	AG	Poaceae
Populus alba	White Poplar	T	Salicaceae
Pseudognaphalium luteoalbum	Everlasting Cudweed	AH	Asteraceae
Punica granatum	Pomegranate	S	Punicaceae
Ranunculus muricatus	Spinyfruit Buttercup	A/B/PH	Ranunculaceae
Raphanus raphanistrum	Wild Radish	A/PH	Brassicaceae
Raphanus sativus	Radish	A/BH	Brassicaceae
Robinia pseudoacacia	Black Locust	T	Fabaceae
Rosa spp.	Cultivated Rose	S	Rosaceae
Rubus discolor	Himalaya Blackberry	S	Rosaceae
Rumex acetosella	Common Sheep Sorrel	PH	Polygonaceae
Rumex crispus	Curly Dock	PH	Polygonaceae
Rumex pulcher	Fiddle Dock	PH	Polygonaceae
Schinus molle	Peruvian Pepper Tree	T	Anacardiaceae
Silene gallica	Windmill Pink	AH	Caryophyllaceae
Silybum marianum	Milk Thistle	AH	Asteraceae
Sonchus oleraceus	Common Sow-thistle	AH	Asteraceae
Sorghum halepense	Johnsongrass	PG	Poaceae
Spergularia rubra	Purple Sandspurrey	A/PH	Caryophyllaceae
Taeniatherum caput-medusae	Medusahead	AG	Poaceae
Tanacetum parthenium	Feverfew	PH	Asteraceae
Taraxacum officinale	Dandelion	PH	Asteraceae
Trifolium dubium	Suckling Clover	AH	Fabaceae
Trifolium hirtum	Rose Clover	AH	Fabaceae
Trifolium repens	White Clover	PH	Fabaceae
*Veronica anagallis-aquatica**	Water Speedwell	PH	Veronicaceae
Vicia sativa	Common Vetch	AH	Fabaceae
Vicia villosa	Hairy Vetch	AH	Fabaceae
Vinca major	Greater Periwinkle	PH	Apocynaceae
Vulpia bromoides	Brome Fescue	AG	Poaceae

Initial Functional and Vegetation Assessments

Prior to planting and after the hydrology of the mitigation site has been evaluated and final design and grading adjustments have been made, an initial assessment of the mitigation site will be conducted. Wetland functionality and the general status of any vegetation present before planting, though expected to be sparse, will be evaluated. The purpose of these assessments is to document initial mitigation site conditions prior to revegetation and establish another benchmark to help gauge mitigation success. These assessments may also reveal unexpected issues and yield information that will be useful in guiding subsequent mitigation site activities. In particular, any especially problematic exotic plant species can be identified, as well as any desirable native species that are able to become established on their own. Refer to Section 5, Monitoring Plan, for more details.

Planting Implementation

Planting shall not proceed until the hydrology of the mitigation site has been evaluated and final design and grading adjustments have been made. All planting areas will then be staked and flagged to ensure that the appropriate species are planted within them. Planting activities should take place during fall and winter (November to March) when normal precipitation is the greatest and produces adequate soil moisture. Within this window of opportunity, planting shall begin as soon as possible following the completion of the staking and flagging of the planting zones. Supplemental planting shall be conducted after the first year to fill in areas of the mitigation site that have not adequately revegetated. Supplemental irrigation may be necessary depending on soil moisture and timing of expected rainfall at the time of planting, but is not expected.

Onsite Activities After Implementation

The activities required after the implementation of the wetland mitigation include documentation of as-built conditions, installing a temporary irrigation system, and performing mitigation maintenance to achieve mitigation objectives.

Documentation of As-Built Conditions

After mitigation site grading and planting are complete, as-built conditions will be described, photographed, and mapped. This information will serve as a basis to gauge any changes in landscape features over time, as well as provide a qualitative look at the initial success of vegetative plantings and the initial levels of vegetative cover.

Hydrology Assessment

Mitigation site hydrology will continue to be monitored through the five-year monitoring period as needed to assure that proper excavation depths, relative elevations, connectivity, and soil conditions have been achieved. This will be especially important in the first season or two to verify that the wetland hydrology is functional. Piezometers and depth gauges will be utilized as necessary to evaluate hydrologic factors. Water depth and duration of inundation will be closely monitored during the wet season.

Irrigation

Supplemental irrigation is typically supplied in habitat restoration sites where trees and shrubs are used primarily. Since the seasonal wetlands planned as mitigation here, dominated by annual hydrophyte species that are dependent solely on precipitation, and that the plants proposed for mitigation are mostly annual species, the need for supplemental irrigation at this mitigation site is not necessary. A temporary irrigation system will not be installed. However, temporary irrigation will be supplied, if necessary, by water trucks in the unlikely event that supplemental irrigation is deemed necessary in certain parts of the mitigation site, to be determined by the monitor. If at some point an irrigation system for parts of the site is needed, it will be installed in only those areas necessary.

Mitigation Maintenance

Maintenance of the mitigation area is essential to achieve mitigation objectives, and failure to perform adequate maintenance is likely to result in non-attainment of the performance criteria as determined by compliance monitoring. The landscape contractor assigned to implement this plan must be approved as qualified and experienced with native habitat (including wetlands) mitigation and maintenance. Included maintenance measures are weed control, trash removal, replanting, and irrigation upkeep, as described below:

- **Weed Control.** Planted areas shall be weeded regularly to reduce plant competition. Weeding is necessary to encourage the success of planted native plant material and to discourage nonnative ruderal or invasive species from establishing populations at the mitigation site. Plants shall be removed or controlled by hand or mechanical means whenever possible, rather than with the use of herbicides. Weed control shall only be conducted by persons able to recognize native plant seedlings in order to prevent mortality of native plants onsite. Plants that are removed shall be disposed of in a manner that prevents recontamination of the site.
- **Trash Removal.** All foreign material used during the mitigation effort shall be removed from the project site during and after mitigation implementation. All trash shall also be removed in all mitigation areas on a regular basis, particularly following significant windstorm events.
- **Replanting.** Replanting and reseeding native species onsite shall be necessary if the mitigation site is not achieving success based on compliance monitoring. Replacement plantings and additional seeding shall be required if a significant portion of the plantings in the mitigation area die off or do not resprout the next wet season, and the mitigation effort is not replacing ecological function onsite.
- **Irrigation Upkeep.** Irrigation components, if installed, shall be monitored on a regular basis to verify that equipment is in working order. Replacement or repair of broken irrigation components will be completed as necessary. All site visits by contractors shall be documented and submitted to the compliance monitor.
- **Scheduling.** Maintenance of all habitat mitigation plantings shall be conducted according to the following schedule: maintenance shall be performed weekly for the first three (3) months after planting, quarterly for the remainder of the first year, and semiannually thereafter for the duration of the compliance monitoring period. The timing and frequency of maintenance activities may need to be modified based on site conditions.

Mitigation Schedule

The mitigation activities will be completed in as timely a fashion as possible. The rough grading portion of the project will commence on or before 1 September 2008 and be completed by 31 October 2008. Initial planting will begin once grading is completed and the initial functional and vegetation survey has been conducted. The majority of seeding will be conducted one year after initial grading has been completed, to allow careful monitoring of the hydrology of each created wetland before sowing seeds. All grading and planting is expected to be completed by 31 October 2009.

The proposed implementation schedule is provided below as Table 16, Suggested NVG Mitigation Implementation Schedule. This schedule may be modified as necessary to properly implement all aspects of this mitigation plan. This particularly applies to planting, since planting should take place under optimum conditions. The schedule does not show weeks 16 through 31; which are essentially identical to the bounding weeks.

Table 16. Suggested NVG Mitigation Implementation Schedule

Task	Schedule of Tasks by Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	32
Submit Bid Request(s)																
Select Contractor(s)																
Execute Contract(s)																
Conduct Start-up Meeting(s)																
Conduct Baseline Survey																
Install Sediment/Erosion Controls																
Collect Plant Propagules																
Remove/Control Exotic Plants																
Monitor Planting, Grading, and Maintenance Operations																
Rough Grading																
Evaluate/Monitor Hydrology																
Fine Grading/Adjust Design																
Initial Function/Vegetation Survey																
Install Plantings[26]																
Install Irrigation System (optional)																
Mitigation Maintenance																
Collect As-Built Data																

26 Only plants that are salvaged from other onsite wetlands to be filled/destroyed by development will be planted in the created wetlands at this time. Most planting and sowing of seeds will be conducted the following fall.

SECTION 5. MONITORING PLAN

GENERAL MONITORING APPROACH

The MOA on Mitigation of 6 February 1990 that guides policy for the U.S. Environmental Protection Agency (EPA), the Corps, and the U.S. Fish and Wildlife Service (USFWS) states:

> "Monitoring should be directed toward determining whether permit conditions are complied with and whether the purpose intended to be served by the condition is actually achieved."

In this regard, monitoring protocols need to be established that allow effective and efficient analyses of the project insofar as the project purposes are concerned. Thus, monitoring protocols include project standards (i.e. success criteria) that are triggers for more detailed analyses and/or the implementation of contingency measures.

Corps compliance will be based on the creation of approximately 1.75 acres of wetlands and the restoration of their associated wetland ecosystem functions after a period of five (5) years. Prior to project implementation DMEC will assess the general level of wetland ecosystem function on the existing 1.60 acres of wetlands onsite proposed for filling using the hydrogeomorphic method (HGM) to establish a basis for comparison with the created wetlands on the mitigation site. The HGM methodology that DMEC proposes to use was developed for depressional waters and wetlands in Sacramento and San Joaquin Counties, with the potential reference domain including most of the Central Valley (L.C. Lee et al. 1997). DMEC will also survey additional plant community characteristics associated with the wetlands that are not completely captured by the HGM methodology.

Once the approximate 1.75 acres of created wetland depressions and swales have been graded on the mitigation site, the hydrology of the site will be evaluated, any grading adjustments will be made, and then initial HGM and plant community assessments on the created wetlands will be conducted. Revegetation efforts and yearly monitoring for a period of five (5) years will begin thereafter.

MONITORING METHODS AND PROJECT STANDARDS

The focus of the monitoring plan is to determine the success of the restoration of wetland ecosystem functions to the North Vineyard Greens project site through the five-year monitoring period. The monitoring protocol is based on the physical and biological attributes and processes of the wetland ecosystem. Comparing the assessment results of baseline conditions to the assessment results on the mitigation site provides an objective and duplicable means of determining mitigation success.

The mitigation site will be expected to meet an increasing percentage of the baseline assessment results annually for five years for each applicable metric. Mitigation success can then be determined on the basis of the reestablishment of wetland ecosystem functions as quantified by HGM methodology and the vegetation survey assessments.

HGM Wetland Functional Assessment

The HGM method identifies nine (9) depressional wetland ecosystem functions that are derived from fifteen (15) variables that are assessed for the wetland site, which is a holistic approach. These functions and variables are listed in Table 17, HGM Functions and Variables for Depressional Wetlands. The HGM assessment methodology and worksheets can be found as Appendix B, HGM Methodology. The benefit of using this model is that it provides a systematic and objective method to measure the relative change in wetland ecosystem functions related to the project that may not be readily detectable by other methods, provide a more holistic assessment. Numerical comparisons of pre- and post-implementation conditions can be made and mitigation success over the required five-year monitoring period can be determined in an objective manner. This information may also be used to effectively guide mitigation efforts throughout the course of the project.

Table 17. HGM Functions and Variables for Depressional Wetlands

Functions	Variables
Hydrologic Functions	1. Buffer Condition 2. Buffer Continuity 3. Buffer Width 4. Indicator Species 5. Vegetation Abundance 6. Land Use or Condition 7. Longitudinal Connections 8. Organic Material 9. Outlet 10. Percent Native Plant Species 11. Sediment Deposition 12. Soil Profile Integrity 13. Wetland Density 14. Watershed Condition 15. Swale/Channel Cross-Section
1. Surface and Shallow Subsurface Water Storage and Exchange 2. Landscape Hydrologic Connections	
Biogeochemical Functions	
3. Element and Compound Cycling 4. Organic Carbon Export	
Plant Community and Habitat Functions	
5. Plant Community 6. Faunal Habitat 7. Faunal Habitat Interspersion and Connectivity 8. Invertebrate Assemblage 9. Vertebrate Assemblage	

HGM Definitions

The HGM functions and variables for depressional wetlands are briefly described below:

HGM FUNCTIONS

Hydrologic Functions

1. Surface and Shallow Subsurface Water Storage and Exchange: The capacity to capture surface and shallow subsurface water and to allow for exchange between these components.
2. Landscape Hydrologic Connections: The hydrologic connectivity with source areas and downgradient features.

Biogeochemical Functions

3. Element and Compound Cycling: The biotic and abiotic processes that cycle compounds between atmosphere, water, soil, and vegetation.
4. Organic Carbon Export: The mechanisms for export of organic carbon in dissolved and particulate forms.

Plant Community and Habitat Functions

5. Plant Community: The species composition and physical characteristics of vegetation.
6. Faunal Habitat: The capacity to provide habitats that support animal populations and guilds.
7. Faunal Habitat Interspersion and Connectivity: The capacity to permit movement of and access by aquatic and terrestrial vertebrates and invertebrates.
8. Invertebrate Assemblage: The aquatic and terrestrial invertebrate population.
9. Vertebrate Assemblage: The aquatic and terrestrial vertebrate population.

HGM VARIABLES

1. Buffer Condition: The predominant land use or condition in the wetland buffer (20 feet perpendicular to and outward from the wetland boundary, or to the top of the source area divide, whichever is less).
2. Buffer Continuity: The proportion of the wetland buffer that is intact.
3. Buffer Width: The mean width of the wetland buffer.
4. Indicator Species: The dominant plant taxa (>50% vegetative cover or >20% total cover) in plots within the assessment area (AA, or the area within the boundary of the wetland) that are restricted to or typically associated with the depressional wetland.
5. Vegetation Abundance: The percent cover and species composition of the dominant plant taxa in plots within the AA, as well as the nature of the boundary between the vegetation in the AA and that in the surrounding buffer.
6. Land Use or Condition: The predominant land use or condition within a 3,000-foot radius from the center of the AA.
7. Longitudinal Connections: The predominant land use or condition in the longitudinal connections to downgradient waters/wetlands within 500 feet of the AA.
8. Organic Material: The percent cover of the accumulated organic detrital matter on the soil surface in the AA.
9. Outlet: The presence or absence and elevation of hydrologic outlets or swale features that connect the wetland to other waters/wetlands.
10. Percent Native Plant Species: The percent of the dominant plant taxa in plots within the AA that are native species.
11. Sediment Deposition: The area and/or rate of sediment deposition in the AA.
12. Soil Profile Integrity: The condition of the soil profile in a soil pit representative of the AA.
13. Wetland Density: The percent of the total area that is occupied by depressional, slope, and riverine waters/wetlands within a 3000-foot radius from the center of the AA.

14. Watershed Condition: The predominant land use or condition in the watershed source area of the wetland.
15. Swale/Channel Cross-Section: The condition of a swale or channel cross-section in terms of its width, depth, cross-sectional area, and width:depth ratio.

HGM Functional Scores

The HGM variables are scaled on the basis of their characteristics relative to those established for the depressional wetland class within the Sacramento/San Joaquin County reference domain. Each variable is assigned a value between 0 and 1.0 depending upon how closely it conforms to defined functional levels for depressional wetland ecosystems based on reference standard conditions. The values of the variables are then used to calculate the values of the HGM functions. Equations have been developed for each function that incorporate the variables that contribute to that function, and that weight the included variables according to their relative significance. Calculated values for the functions also fall between 0 and 1.0. Values closer to 0 indicate a high degree of disturbance and low levels of wetland function, and values closer to 1.0 indicate greater conformity with reference standard, or less disturbed and more highly functional, conditions. Refer to Appendix B, HGM Methodology, for more details.

Vegetation Surveys

The recovery of the characteristic plant communities associated with the created wetlands is critical for successful mitigation. As described in the above section, HGM captures some plant community metrics. DMEC proposes to expand the plant community metrics surveyed in order to enhance the level of monitoring of the vegetation associated with each wetland type on the mitigation site. In addition, the restored grassland will be monitored to determine the general characteristics of the vegetation there. Refer to Appendix C, Mitigation Monitoring Forms, including the Floristic Assessment Form and the Grassland Assessment Form. The additional metrics are described below:

Floristic Assessment

This metric is based on an inventory of all the plant species present in the assessment area (AA) and the surrounding vegetated wetland buffer. The total number of species present, the number and percent of native species present, the total percent vegetative cover, the percent cover by native species, percent cover by nonnative species, and percent bare ground will be determined. Refer to Appendix C, Mitigation Monitoring Forms, for the Floristic Assessment Form.

Characteristic Native Wetland Species

This metric is derived from the floristic assessment by identifying the native plant species characteristic of the wetland type present in the AA and the surrounding vegetated wetland buffer. The number of characteristic native species present, the percent cover for each species, and their combined percent cover will be determined.

Restored Grassland

This metric is based on an inventory of the co-dominant native plant species (>10% vegetative cover) present in the upland areas of the mitigation site that are outside of the wetland AAs and their surrounding buffers. The number of co-dominant species present, the percent cover for each, the total percent co-dominant species cover, the percentage of native co-dominant species, and the percent cover of native co-dominant species will be determined. In addition, the overall percent vegetative cover for all species, including those that are not co-dominant, will be estimated. Refer to Appendix C, Mitigation Monitoring Forms, for the Grassland Assessment Form.

Baseline Conditions

For the purpose of this report, a general office-level baseline condition assessment was conducted to estimate current conditions onsite and to estimate general mitigation success criteria. Data for the general North Vineyard Specific Plan Area and North Vineyard Greens project site, summarized as Appendix C, Baseline Floristic Data, provide the floristic information from onsite and the region to aid in estimating baseline floristic data. However, more accurate baseline conditions will be determined for each of the wetland types currently on the project site with HGM functional assessments and vegetation surveys onsite prior to project implementation. Table 12 (above) lists the type and acreages for each of the existing wetlands onsite. It is proposed that all three vernal pools (a small isolated complex), the seasonal marsh, and the seasonal swale be surveyed, and that representative examples of the eleven seasonal wetlands be selected for the baseline survey. An initial assessment on the newly created wetlands will be conducted after their hydrology has been evaluated and any design and grading adjustments have been made, but prior to site revegetation.

Mitigation Success Criteria

Based on the HGM functional assessments and vegetation surveys the mitigation site will be measured against interim minimum success thresholds for each of the five years of monitoring as a percentage of the baseline conditions, with minimum required success thresholds at the end of the five-year monitoring period. The preliminary minimum thresholds for mitigation success are summarized in Table 18, Mitigation Success Criteria for NVG Vernal Pools, Table 19, Mitigation Success Criteria for NVG Seasonal Wetlands and Swales, and Table 20, Mitigation Success Criteria for NVG Seasonal Marsh. Appendix C provides the plant species by habitat type at the NVG project site, which helped to estimate the baseline floristic data provided in Tables 18, 19, and 20. The target values for the metrics to be met each year are preliminary and some of these percentages may change once field assessments are underway. DMEC suggests that adjusting thresholds based on actual site conditions is a more effective approach than strictly adhering to these preliminary guidelines.

Thresholds of success for each metric itemized in Tables 18, 19, and 20 must be generally met after five (5) years. Parameters that have values less than the established annual thresholds will require remediation and additional monitoring until the mitigation site conditions are brought up to satisfactory levels. Refer to Appendix D, Mitigation Monitoring Forms, for the General Progress, Observations, and Recommendations Forms.

Table 18. Mitigation Success Criteria for NVG Vernal Pools

Vernal Pool Assessment Area		Baseline (Existing)[27]	Initial	Year 1	Year 2	Year 3	Year 4	Year 5
HGM Functional Score	*1. Surface/Shallow Subsurface Water Storage/ Exchange*	0.72	0.25	0.25	0.50	0.65	0.75	0.95
	2. Landscape Hydrologic Connections	0.65	0.25	0.40	0.50	0.65	0.75	1.00
	3. Element and Compound Cycling	0.76	0.25	0.25	0.50	0.65	0.75	0.96
	4. Organic Carbon Export	0.71	0.01	0.25	0.50	0.65	0.75	0.98
	5. Plant Community	0.51	0.01	0.25	0.35	0.50	0.65	0.78
	6. Faunal Habitat	0.76	0.01	0.25	0.35	0.50	0.75	0.96
	7. Faunal Habitat Interspersion and Connectivity	0.39	0.01	0.15	0.25	0.35	0.50	0.62
	8. Invertebrate Assemblage[28]	-	-	-	-	-	-	-
	9. Vertebrate Assemblage	-	-	-	-	-	-	-
Floristic Assessment	*Total # Species*	25	0	8	12	14	18	20
	Total # Natives	17	0	5	8	11	14	17
	% Native Species	68%	0%	63%	66%	75%	78%	85%
	Total % Cover	50%	0%	10%	20%	30%	40%	50%
	% Cover by Native Species	40%	0%	5%	15%	25%	35%	45%
	% Cover by Nonnative Species	10%	0%	5%	5%	5%	5%	5%
	% Bare Ground	50%	0%	90%	80%	70%	60%	50%
Characteristic Native Species	*# Species*	7	0	2	3	5	7	9
	% Cover	30%	0%	5%	10%	20%	25%	30%
Vernal Pool Buffer		**Baseline (Existing)**	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Floristic Assessment	*Total # Species*	21	0	8	12	14	18	20
	Total # Natives	4	0	5	8	11	14	17
	% Native Species	19%	0%	63%	66%	75%	78%	85%
	Total % Cover	70%	0%	15%	30%	45%	60%	70%
	% Cover by Native Species	20%	0%	10%	20%	35%	50%	60%
	% Cover by Nonnative Species	50%	0%	5%	10%	10%	10%	10%
	% Bare Ground	30%	0%	85%	70%	55%	40%	30%
Characteristic Native Species	*# Species*	4	0	2	3	5	7	9
	% Cover	5%	0%	5%	10%	20%	25%	30%

27 Baseline data presented are estimates of existing conditions, as well as for post-mitigation conditions after 5 years.

28 For functions 8 and 9, the *Draft Guidebook* (L.C. Lee et al. 1997) states that the presence of invertebrates and vertebrates should be reported by direct assessment of the monitoring biologist. The number and species of wildlife directly and indirectly observed inhabiting and frequenting the assessment area should be recorded and reported.

Table 19. Mitigation Success Criteria for NVG Seasonal Wetlands and Swales

Seasonal Wetlands and Swales Assessment Area		Baseline (Existing)[29]	Initial	Year 1	Year 2	Year 3	Year 4	Year 5
HGM Functional Score	*1. Surface/Shallow Subsurface Water Storage/ Exchange*	0.72	0.25	0.25	0.50	0.65	0.75	0.95
	2. Landscape Hydrologic Connections	0.65	0.25	0.40	0.50	0.65	0.75	1.00
	3. Element and Compound Cycling	0.76	0.25	0.25	0.50	0.65	0.75	0.96
	4. Organic Carbon Export	0.71	0.01	0.25	0.50	0.65	0.75	0.98
	5. Plant Community	0.51	0.01	0.25	0.35	0.50	0.65	0.78
	6. Faunal Habitat	0.76	0.01	0.25	0.35	0.50	0.75	0.96
	7. Faunal Habitat Interspersion and Connectivity	0.39	0.01	0.15	0.25	0.35	0.50	0.62
	8. Invertebrate Assemblage[30]	-	-	-	-	-	-	-
	9. Vertebrate Assemblage	-	-	-	-	-	-	-
Floristic Assessment	*Total # Species*	26	0	5	8	10	113	15
	Total # Natives	15	0	3	6	8	11	13
	% Native Species	58%	0%	60%	75%	80%	85%	85%
	Total % Cover	75%	0%	20%	35%	50%	65%	75%
	% Cover by Native Species	50%	0%	10%	25%	40%	50%	60%
	% Cover by Nonnative Species	25%	0%	10%	10%	10%	15%	15%
	% Bare Ground	25%	0%	80%	65%	50%	35%	25%
Characteristic Native Species	*# Species*	5	0	2	3	5	6	7
	% Cover	15%	0%	8%	15%	25%	35%	40%
Seasonal Wetlands and Swales Buffer		**Baseline (Existing)**	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Floristic Assessment	*Total # Species*	23	0	5	8	10	113	15
	Total # Natives	5	0	3	6	8	11	13
	% Native Species	22%	0%	60%	75%	80%	85%	85%
	Total % Cover	75%	0%	20%	35%	50%	65%	75%
	% Cover by Native Species	15%	0%	10%	25%	40%	50%	60%
	% Cover by Nonnative Species	60%	0%	10%	10%	10%	15%	15%
	% Bare Ground	25%	0%	80%	65%	50%	35%	25%
Characteristic Native Species	*# Species*	5	0	2	3	5	6	7
	% Cover	5%	0%	8%	15%	25%	35%	40%

29 Baseline data presented are estimates of existing conditions, as well as for post-mitigation conditions after 5 years.

30 For functions 8 and 9, the *Draft Guidebook* (L.C. Lee et al. 1997) states that the presence of invertebrates and vertebrates should be reported by direct assessment of the monitoring biologist. The number and species of wildlife directly and indirectly observed inhabiting and frequenting the assessment area should be recorded and reported.

Table 20. Mitigation Success Criteria for NVG Seasonal Marsh

Seasonal Marsh Assessment Area		Baseline (Existing)[31]	Initial	Year 1	Year 2	Year 3	Year 4	Year 5
HGM Functional Scores	*1. Surface/Shallow Subsurface Water Storage/ Exchange*	0.72	0.25	0.25	0.50	0.65	0.75	0.95
	2. Landscape Hydrologic Connections	0.65	0.25	0.40	0.50	0.65	0.75	1.00
	3. Element and Compound Cycling	0.76	0.25	0.25	0.50	0.65	0.75	0.96
	4. Organic Carbon Export	0.71	0.01	0.25	0.50	0.65	0.75	0.98
	5. Plant Community	0.51	0.01	0.25	0.35	0.50	0.65	0.78
	6. Faunal Habitat	0.76	0.01	0.25	0.35	0.50	0.75	0.96
	7. Faunal Habitat Interspersion and Connectivity	0.39	0.01	0.15	0.25	0.35	0.50	0.62
	8. Invertebrate Assemblage[32]	-	-	-	-	-	-	-
	9. Vertebrate Assemblage	-	-	-	-	-	-	-
Floristic Assessment	*Total # Species*	17	0	4	7	9	12	14
	Total # Natives	11	0	2	5	7	10	12
	% Native Species	65%	0%	50%	70%	78%	83%	85%
	Total % Cover	50%	0%	10%	20%	30%	40%	50%
	% Cover by Native Species	40%	0%	5%	15%	25%	35%	45%
	% Cover by Nonnative Species	10%	0%	5%	5%	5%	5%	5%
	% Bare Ground	50%	0%	90%	80%	70%	60%	50%
Characteristic Native Species	*# Species*	6	0	2	3	5	6	7
	% Cover	25%	0%	5%	10%	15%	25%	30%
Seasonal Marsh Buffer		**Baseline (Existing)**	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Floristic Assessment	*Total # Species*	24	0	4	7	9	12	14
	Total # Natives	5	0	2	5	7	10	12
	% Native Species	21%	0%	50%	70%	78%	83%	85%
	Total % Cover	50%	0%	10%	20%	30%	40%	50%
	% Cover by Native Species	10%	0%	5%	15%	20%	25%	40%
	% Cover by Nonnative Species	40%	0%	5%	5%	10%	10%	10%
	% Bare Ground	50%	0%	90%	80%	70%	60%	50%
Characteristic Native Species	*# Species*	4	0	2	3	5	6	7
	% Cover	10%	0%	5%	10%	15%	25%	30%

31 Baseline data presented are estimates of existing conditions, as well as for post-mitigation conditions after 5 years.

32 For functions 8 and 9, the *Draft Guidebook* (L.C. Lee et al. 1997) states that the presence of invertebrates and vertebrates should be reported by direct assessment of the monitoring biologist. The number and species of wildlife directly and indirectly observed inhabiting and frequenting the assessment area should be recorded and reported.

CONTINGENCY MEASURES

DMEC fully anticipates the possibility that the site may not satisfy some or all of the stated project criteria. If project standards are not being met at any time during the monitoring period, immediate steps will be taken to develop and implement appropriate contingency measures to restore wetland ecosystem functions to a level of compliance with project requirements.

Specific contingency measures are not outlined herein since approaches must be case specific. For example, excessive plant mortality could occur for a variety of reasons: inappropriate planting location, drought or flood damage, browsing damage, disease, or physical disturbance, to name a few. Clearly, merely replanting the same species in the same locations is not always the appropriate solution. Thus, contingency measures must be based on a detailed analysis of the events or site conditions responsible for any failures.

Finally, the general approach of this mitigation plan is to utilize naturally occurring physical and biological attributes and processes to support and guide the restoration of wetland ecosystem functions onsite. Thus, it is possible that an initial appearance of deviation from the originally stated objectives actually could be natural processes altering the course of the mitigation to one that is slightly different but equally functional. In this regard, this monitoring plan must remain flexible enough to allow the incorporation of changing objectives (Weinstein et al. 1997).

SECTION 6. ACKNOWLEDGEMENTS

This mitigation plan was written by Stephen Hoskinson and Cher Batchelor. David Magney managed this project, and reviewed and edited this report. William Abbott and Mr. Magney prepared graphics for this report. Mr. Magney conducted the site visits and assisted with the revised wetland delineation.

Joel Butterworth, Valley Environmental Consulting, provided technical assistance with an analysis of onsite soil conditions, and suitability of wetland habitat creation within the proposed mitigation site. Matt Gause, formerly of Wildlands, Inc., provided general site evaluation and suitability advise. Craig Hiatt, ECORP, provided background information about the project site wetlands, environmental review, and special-status species present onsite. Diana Rains provided coordination support and background information for this effort.

Andrea Jones, U.S. Army Corps of Engineers, provided guidance throughout the development of this mitigation and monitoring plan. Mary Butterwick, U.S. Environmental Protection Agency, provided DMEC with a copy of the Borden Ranch HGM model guidebook, and provided guidance related to applicability of HGM for this project.

SECTION 7. CITATIONS

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PERSONAL COMMUNICATIONS

Andrea Jones, Regulatory Project Manager, U.S. Army Corps of Engineers, Sacramento, California; Meeting in Sacramento on 27 February 2007 regarding the North Vineyard Greens Section 404 Individual Permit Application.

APPENDICES

APPENDIX A.
PROJECT SITE PHOTOGRAPHS

APPENDIX B.
HGM METHODOLOGY

APPENDIX C.
BASELINE FLORISTIC DATA

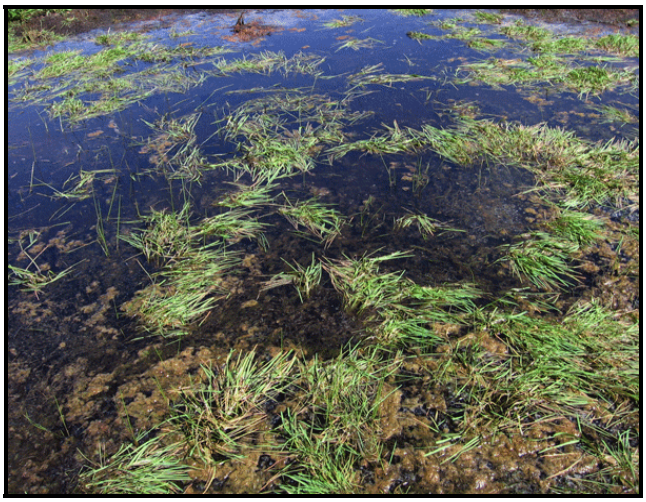
APPENDIX D.
MITIGATION MONITORING FORMS

APPENDIX A.
PROJECT SITE PHOTOGRAPHS


Left: Man-made stock/fish pond. Right: Ruderal Grassland. (22 September 2006)


Left: Stock pond. Right: Grassland. (15 March 2007)


Left: Vernal pool. Right: wet swale along railroad tracks, adjacent to and connected to vernal pools (15 March 2007)

*Left: Curly Dock (*Rumex crispus*). Right: Seasonal wetland with Waxy Mannagrass (*Glyceria declinata*). (15 March 2007)*


Left: Ranunculus *sp. with* Glyceria declinata *in seasonal wetland. Right: a aquatic buttercup (*Ranunculus *sp.). (15 March 2007)*


*Left & Right: Water Pygmy-weed (*Crassula tillaea*). (15 March 2007)*


*Left: Cocklebur (*Xanthium strumarium*) with ruderal species.*
*Right: Dove Weed (*Eremocarpus setigerus*) in seasonal wetland habitat. (22 September 2006)*


*Left: Vinegarweed (*Trichostema lanceolatum*). Right: Fitch's Tarweed (*Hemizonia fitchii*). (22 September 2006)*


*Left: Harest Brodiaea (*Brodiaea coronaria*). Right: Hawkbit (*Leontodon taraxacoides*). (11 May 2007)*


*Left: Swamp Grass (*Crypsis schoenoides*). Right: Bird nest in grassland. (22 September 2006)*


Left: Mallards in seasonal wetland. (15 March 2007) Right: Pacific Tree Frog. (11 May 2007).


Left: Crayfish remains. Right: Freshwater snail shells. (22 September 2006)



Above: Preparing soil pits for sampling. (11 May 2007)


Left & Right: Sampling soil pits. (11 May 2007)


Left: Soil sample showing oxidized rhizospheres. Right: Claypan/duripan layer. (11 May 2007)

APPENDIX B.
HGM METHODOLOGY

A Guidebook for Assessment of the Functions of Waters of the United States Including Wetlands, on the Borden Ranch, Sacramento and San Joaquin Counties, California

Developed For

Wetlands Regulatory Office (WTR-8)
United States Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105-3901

By

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September 15, 1997

Disclaimer

This draft guidebook was developed at the request of the U.S. Environmental Protection Agency, Region IX, San Francisco, California. It was created specifically for the application of a hydrogeomorphic approach (HGM) to assessment of the functions of waters of the U. S., including wetlands within the boundaries of the Borden Ranch, Sacramento and San Joaquin Counties, California. It provides a synthesis of information and data for the application of HGM functional assessments for the following three classes of waters/wetlands found on Borden Ranch:

1) Hydrologically isolated/closed and surface and shallow sub-surface flow-through depressions and their associated slope waters/wetlands,
2) Slope waters/wetlands at the headward extent of riverine waters/wetlands, and
3) First to Third order riverine waters/wetlands.

This guidebook is a draft document. It was developed, in part, with the benefit of information provided to the authors by (1) the U.S. Environmental Protection Agency, Region IX, (2) the owners of Borden Ranch, and (3) the public domain. Due to time and budget constraints associated with the Borden Ranch project, this guidebook has yet to go through all the developmental steps and peer review processes recommended by the Federal Interagency Hydrogeomorphic Implementation Team (NHIT) (Federal Register, 8/16/96 and 6/20/97).

This guidebook was developed for application of an HGM functional assessment approach within the Borden Ranch Property **only**. The reference systems, subclass profiles, and assessment models in this guidebook are developed from reference data collected on Borden Ranch. Consequently, the draft HGM models presented herein are not applicable at regional scales (*i.e.,* outside the Borden Ranch property boundaries).

The following steps must be taken prior to the utilization of this guidebook at regional scales:

1. An A-Team of regional experts on depressional, slope, and riverine waters/wetlands in the Central Valley of California must be identified.

2. Additional reference sites outside the Borden Ranch property must be sampled. The additional data then must be incorporated into the draft reference systems offered in this guidebook.

2. The "A" Team must complete all of the developmental and peer review steps outlined in the NHIT protocol for development and implementation of an HGM regional guidebook (Federal Register 8/16/96 and 6/20/97).

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This report to be cited as follows:
Lee, L.C., M. L. Butterwick, J. L. Cassin, R. A. Leidy, J. A. Mason, M.C. Rains, L.E. Shaw, E. G. White. 1997. *A Draft Guidebook for Assessment of the Functions of Waters of the U.S., Including Wetlands on the Borden Ranch, Sacramento and San Joaquin Counties, California.* Seattle, WA.

II. Scope of the Draft Guidebook

A. HGM Classes, Subclasses and the Established Reference Domain

As discussed in Section I above, this draft Guidebook was developed to assist the EPA/LALC team in the application of an HGM approach to functional assessments for depressional, slpe, and riverine waters/wetlands on the Borden Ranch. Specifically, the Guidebook addresses five subclasses of Borden Ranch waters/wetlands. These are defined in Table 4 and illustrated in Figures 12.

Table 4. HGM Classes and Subclasses of Waters/Wetlands that Occur on Borden Ranch and which are Addressed by this Draft Guidebook

HGM Class	HGM Subclasses	Addressed by Guidebook
Depressions	Closed and/or hydrologically isolated (perched) depressions	Yes
	Surface and/or shallow sub-surface flow-through depressions	Yes
	Discharge depressions with or without outlet	No
Slopes	Slopes that are at the headward extent of riverine waters/wetlands	Yes
	Slopes that form inter-connections between or among depressions	Yes
Riverine	First, Second and Third Order (Strahler 1952, 1:24,000) riverine waters/wetlands	Yes

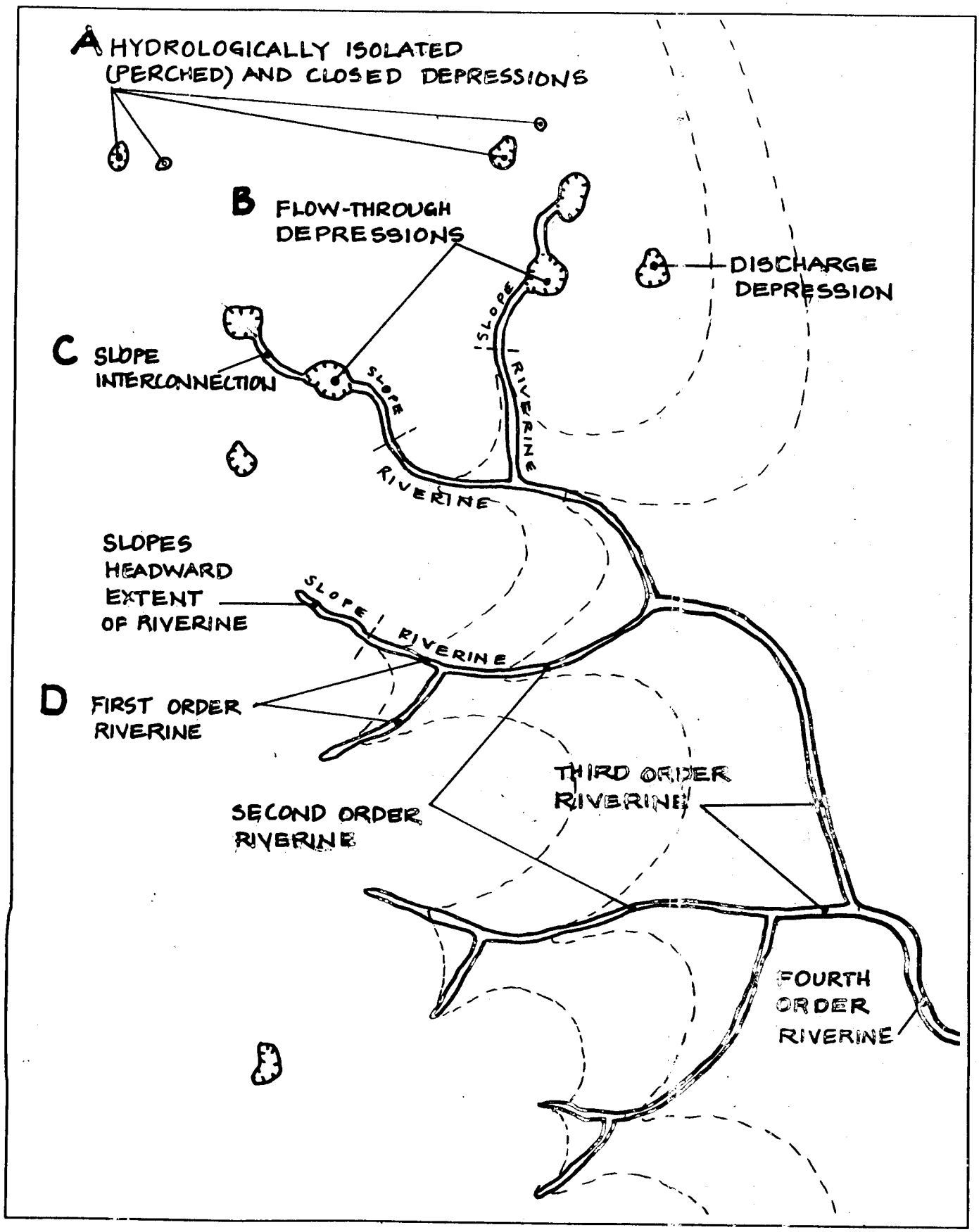
The reference "domains" addressed in this draft Guidebook (Table 1) therefore, consist of the waters/wetlands defined in Table 4 that can be identified within the property boundaries of the Borden Ranch (Figure 12). The draft HGM models included in this draft Guidebook were developed based on the best professional judgment of the EPA/LCLA team and data collected from a total of 90 reference sites: 30 depressions, 30 slopes, and 30 riverine waters/wetlands. Viewed as a group of samples, these 90 sites represent the established reference domains for the HGM models offered in the draft Guidebook.

B. Applicability of the Draft Guidebook at a Regional Scale

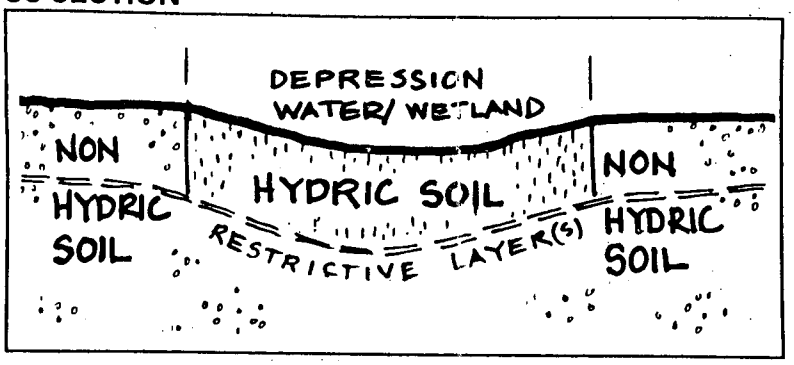
As discussed above, this draft Guidebook was developed exclusively for use on the Borden Ranch. Thus, the established reference domains for the draft HGM models offered in this draft Guidebook are restricted to the waters/wetlands classes and subclasses defined in Table 4 and described in detail in the subclass profiles offered in Section IV below. Similar waters/wetlands in an expanded geographic region (*e.g.* the Central Valley) represent the "potential reference domain" for a more regional HGM guidebook (Figure 13).

As has occurred in other areas of the U. S. (NWSTC 1996a, b, c; 1997) the Borden Ranch draft Guidebook could potentially serve as a generic template from which more regional HGM models could be developed. However, development of a more regional guidebook would require significant effort by regional experts. Specifically, while the structure of the models outlined in this draft (*i.e.*, the functions, variables, and indices of function) may apply to waters/wetlands in

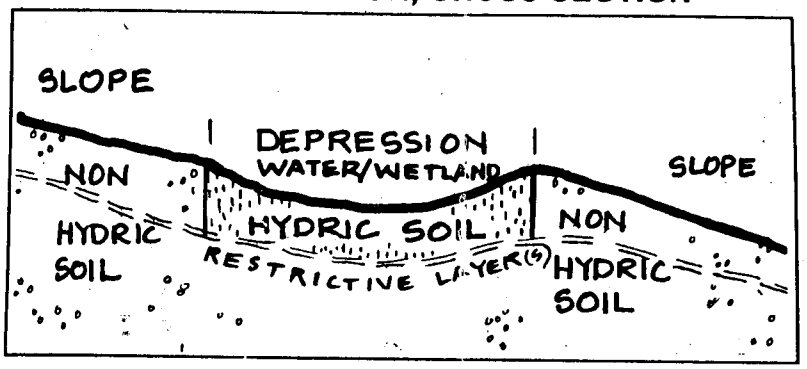
Figure 12. Classes and Subclasses of Waters/Wetlands on the Forden Ranch, Sacramento and



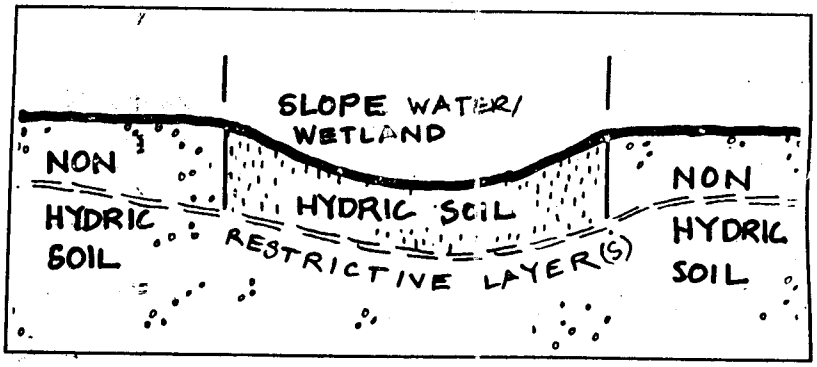
A. HYDROLOGICALLY ISOLATED (PERCHED) AND CLOSED DEPRESSION, CROSS SECTION



B. FLOW-THROUGH DEPRESSION, CROSS SECTION



C. SLOPE WETLAND, CROSS SECTION



D. RIVERINE WETLAND, CROSS SECTION

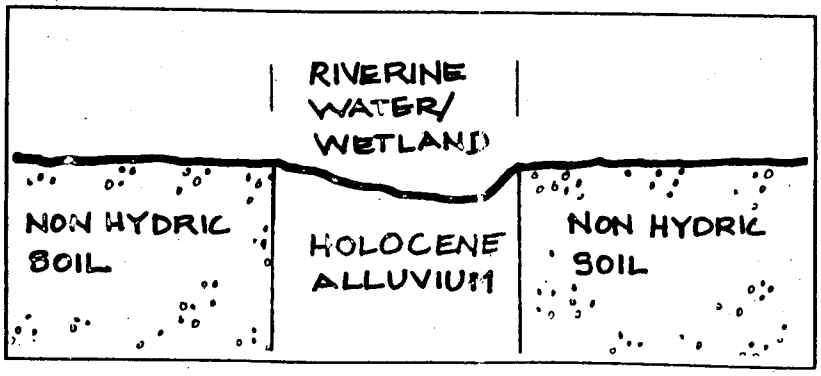
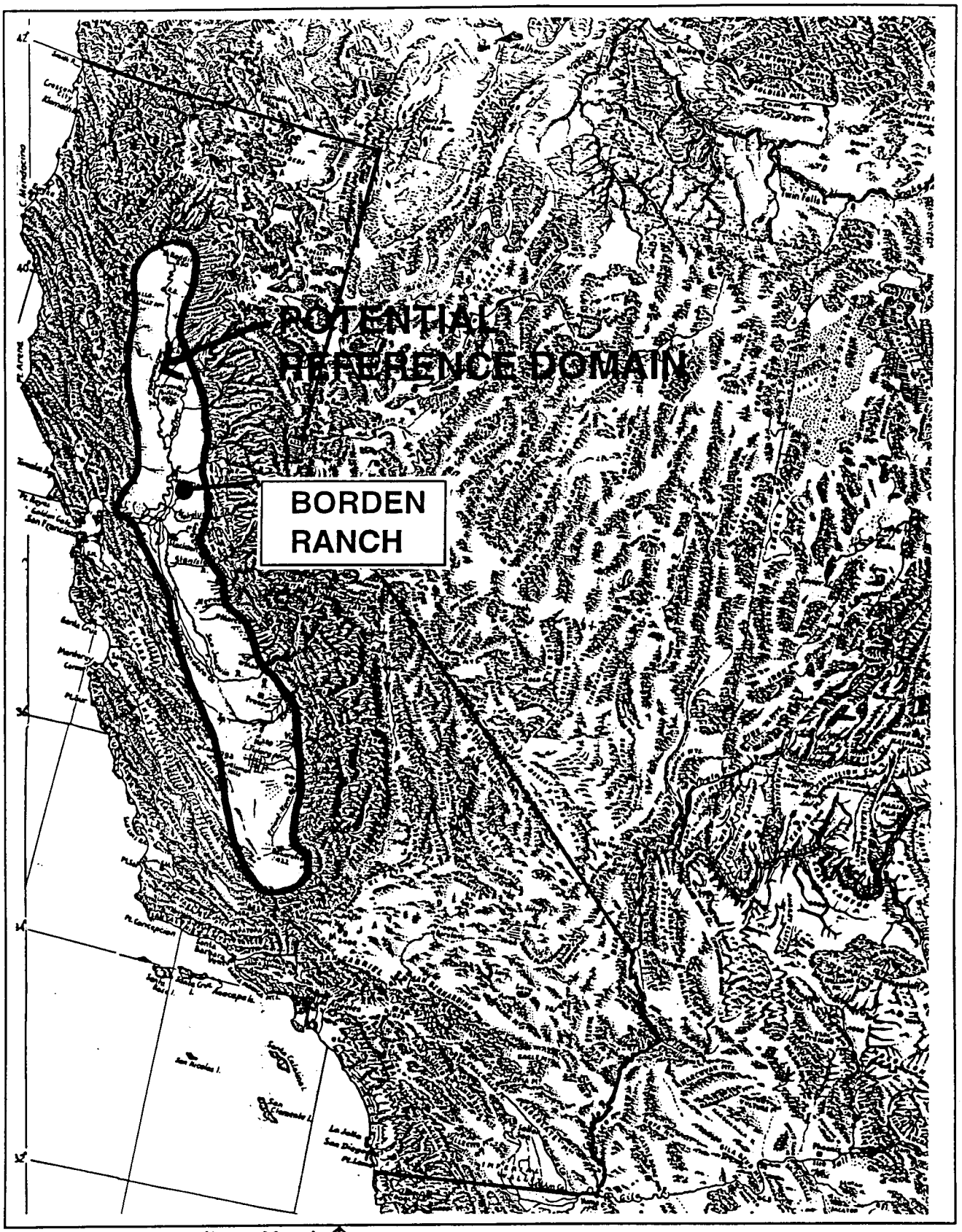


Figure 13. Potential Reference Domain



Scale 1" = 400 miles North ↑

the potential reference domain, proper application of an HGM approach requires that the draft models not be used outside their established domains until they are calibrated with appropriate reference systems. That is, until reference data are collected in other areas of the Central Valley of California and the draft models presented herein are calibrated by regional experts (*e.g.*, a regional interdisciplinary A-Team), the draft Borden Ranch models cannot be used outside of the established reference domain as defined above. Additional reference data is necessary in order to establish the link between this HGM draft Guidebook and specific ecosystem functions for similar classes and subclasses of waters/wetlands that exist outside the defined reference domain (*i.e.*, the Borden Ranch). Without additional reference sites, there are no tangible and accessible benchmarks that can be used to calibrate the functions of waters/wetlands, or to relate model scaling to reference standards that represent the highest level of functioning in the class(es) or subclass(es) in the Central Valley of California.

III. Methods

A. Identification of HGM Classes and Subclasses and Candidate Reference Sites

1. Identification of HGM Classes and Subclasses

As outlined in the introductory sections of this Guidebook, the EPA/LCLA technical team initiated field reconnaissance of the Borden Ranch site on April 10, 1997. In preparation for field reconnaissance efforts, supporting documentation was gathered and examined by team members in an attempt to develop detailed knowledge of the types and geographic distribution of waters/wetland ecosystems on the ranch. The sources and types of information examined included but was not limited to the Brinson (1993) HGM classification document, the jurisdictional delineation maps and report by Sugnet & Associates (Sugnet 1993), aerial photographs at several different scales and from several different years, U.S. Geological Survey (USGS) maps at several scales, USGS geologic survey reports, parcel ownership maps and records, NRCS soil surveys, etc. In addition, the EPA/LCLA team (1) initiated a literature search on Central Valley and California depression, slope and riverine waters/wetlands, and (2) conducted several interviews and field visits with Borden Ranch owners and their consultants.

During the reconnaissance efforts, the EPA/LCLA technical team made note of (1) typical geomorphic surfaces and (2) the geographic extent and type of land-use treatments that are present on the Borden Ranch. These treatments are summarized in Table 5. Team efforts were concentrated in both Sacramento and San Joaquin Counties, and particularly (1) in the study area identified in the AO, and (2) in areas where land preparation activities (*e.g.,* ripping, discing, irrigation system construction, etc.) were on-going since October, 1996.

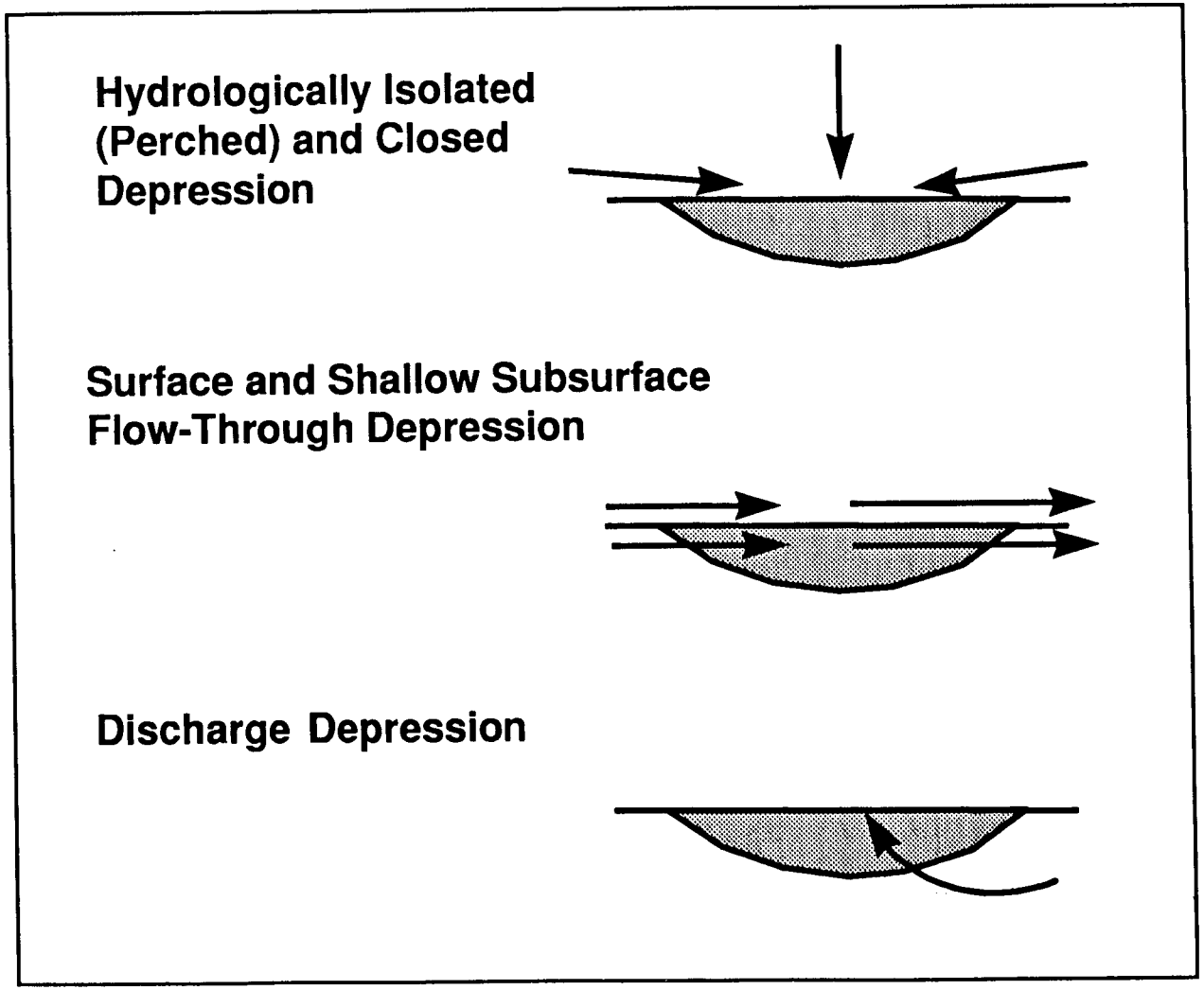
Table 5. Chronological Summary of Land Treatments Observed on the Borden Ranch Property, Sacramento and San Joaquin Counties, California.

Land Use Condition	Activity	Photograph
Grazed/Preserve	Moderate to Heavy Grazing/Preserve	7
Site in Preparation	Ripped One-way	8
	Ripped Two-ways	9
	Ripped Two-ways Plowed and/or Disced	10
	Ripped Two-ways, Plowed and/or Disced and Rolled; Soil Amendments	11
	Ripped, Plowed and/or Disced, Rolled and Irrigation System Installed	12
	Ripped, Plowed and/or Disced, Rolled and Irrigation and Planted	13-14
Vineyard/Orchard	1 Year Old Vineyard/Orchard Plowed and/or Disced	13-14
	2 Year Old Vineyard/Orchard Plowed and/or Disced	
	3 Year Old Vineyard/Orchard	
	4 Year Old Vineyard/Orchard	

It became clear to the EPA/LCLA team that at least three distinct classes and potentially seven subclasses of waters/wetlands were present on the property. These are named and defined in

Figure 14.

HGM Subclasses of Depressional Waters/Wetlands at Borden Ranch, Sacramento and San Joaquin Counties, California



NWSTC/L.C.Lee & Associates, Inc.

Table 4. Figure 12 provides a generalized summary of the Borden Ranch HGM classes and subclasses, and Figures 12 & 14 provide details on the types of depressional and riverine waters/wetlands that are common on the ranch. The technical team also noted the following conditions with respect to the waters/wetland subclasses in the field:

a. The number of waters/wetlands per unit area (density) and pattern of distribution of the HGM subclasses changed at site specific and landscape scales in response to (1) geomorphic surface, (2) land use practices, (4) slope steepness, and (4) soil types.

b. The descriptions of geomorphic surfaces and correlations between geomorphic surface(s) and soil type(s) provided in the NRCS (Soil Conservation Service) Soil Surveys for Sacramento and San Joaquin Counties (Tugel 1993; McElhiney 1992) were particularly informative in setting the stage for closer examination of the subclasses of waters/wetlands that occurred in the study area at both site specific and landscape scales. Figures 15, 16, and17 and photographs 1,2,3, and 4 provide generalized summaries of the common geomorphic surfaces on the Borden Ranch. They are (1) high terrace, (2) dissected terrace face, (3) infrequently flooded Holocene terrace, and (4) frequently flooded Holocene floodways.

c. On Borden Ranch, it is important to recognize the scale at which waters/wetlands features occur on the landscape and to understand the relationship of scale to several very practical issues concerning application of an HGM assessment protocol. The slope subclasses are a case in point. (Table 4, Figure 12) The Sugnet & Associates map scale (1" = 400') often did not account for small, jurisdictional waters/wetlands that existed as slope interconnections between mapped pools. Further, definition of assessment area boundaries in these small slope areas would have required extremely detailed mapping. Costs and time investments would have been prohibitive, given the AO schedule and project budget to identify assessment area boundaries. Separation of the slopes that form the headward extent of riverine networks is relatively easy to accomplish in the field. On the other hand, separation of the slopes that form the interconnections among vernal pool depressions from the vernal pool depressions themselves is often very difficult. In any given area of the Borden Ranch, these slope interconnections can vary in size from a few feet in length and/or width to >50 feet. As discussed above, some of the interconnections among pools are jurisdictional waters/wetlands, many are not. Maintenance of the integrity of the slope interconnections is important to the functioning of flow-through depressions for several reasons (detailed in the subclass profiles below). Therefore, it was the best professional judgment of the EPA/LCLA technical team that the Borden Ranch HGM model should be responsive to scale and to the practical issues related to rapid functional assessments. Therefore, the team decided to subsume (bound) the slope interconnection subclass into the assessment area and logic for the flow-through depression models. This issue will be explained in detail in the HGM model section of this draft Guidebook.

d. On a similar note, four types of riverine waters/wetlands exist on the Borden Ranch. At a scale of 1:24,000, Borden Ranch riverine waters/wetlands exist as first, second, third and fourth order systems (Strahler 1952). For the purposes of this functional assessment study, first, second, and third order riverine ecosystems were lumped.

Figure 15. Generalized Cross-Section View of the Major Geomorphic Surfaces on the Borden Ranch, Sacramento and San Joaquin Counties, California

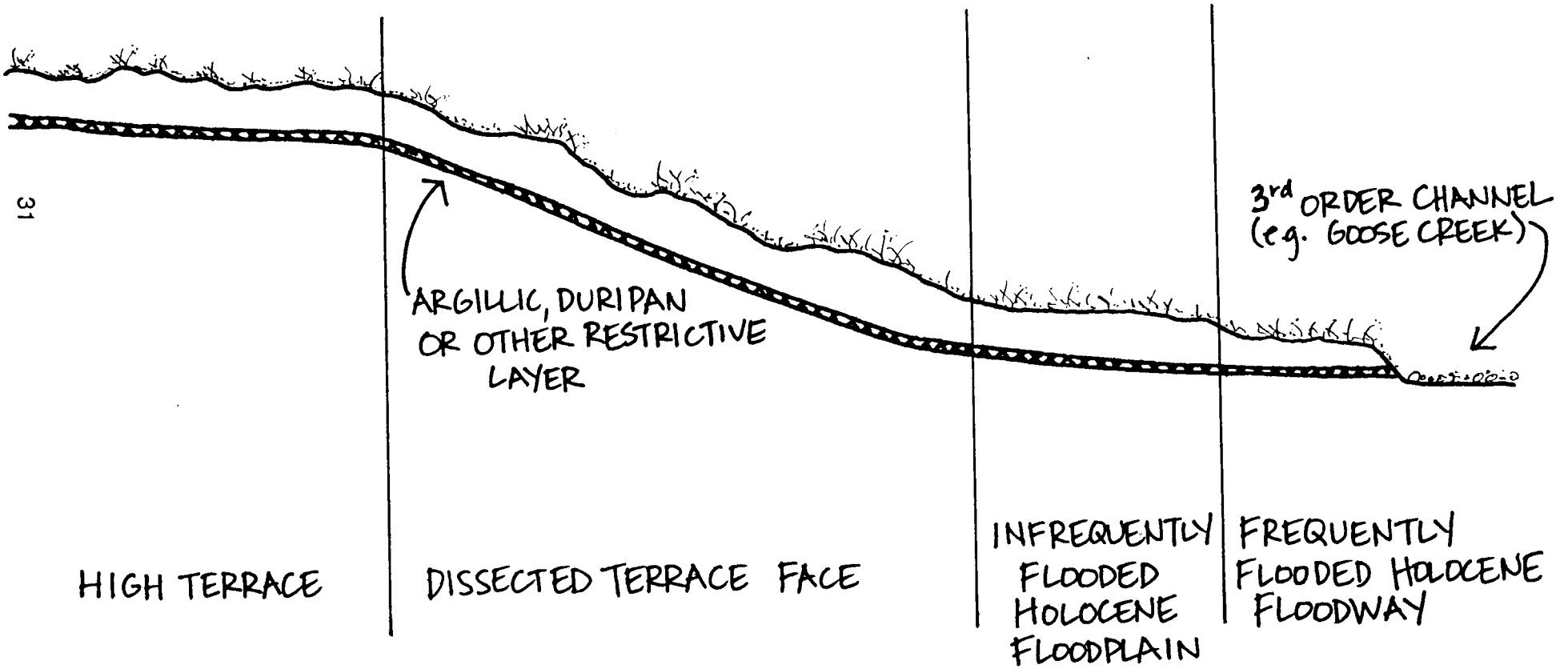


Figure 16. Geomorphic Surfaces Occurring on the Borden Ranch Property, Sacramento and San Joaquin Counties, California

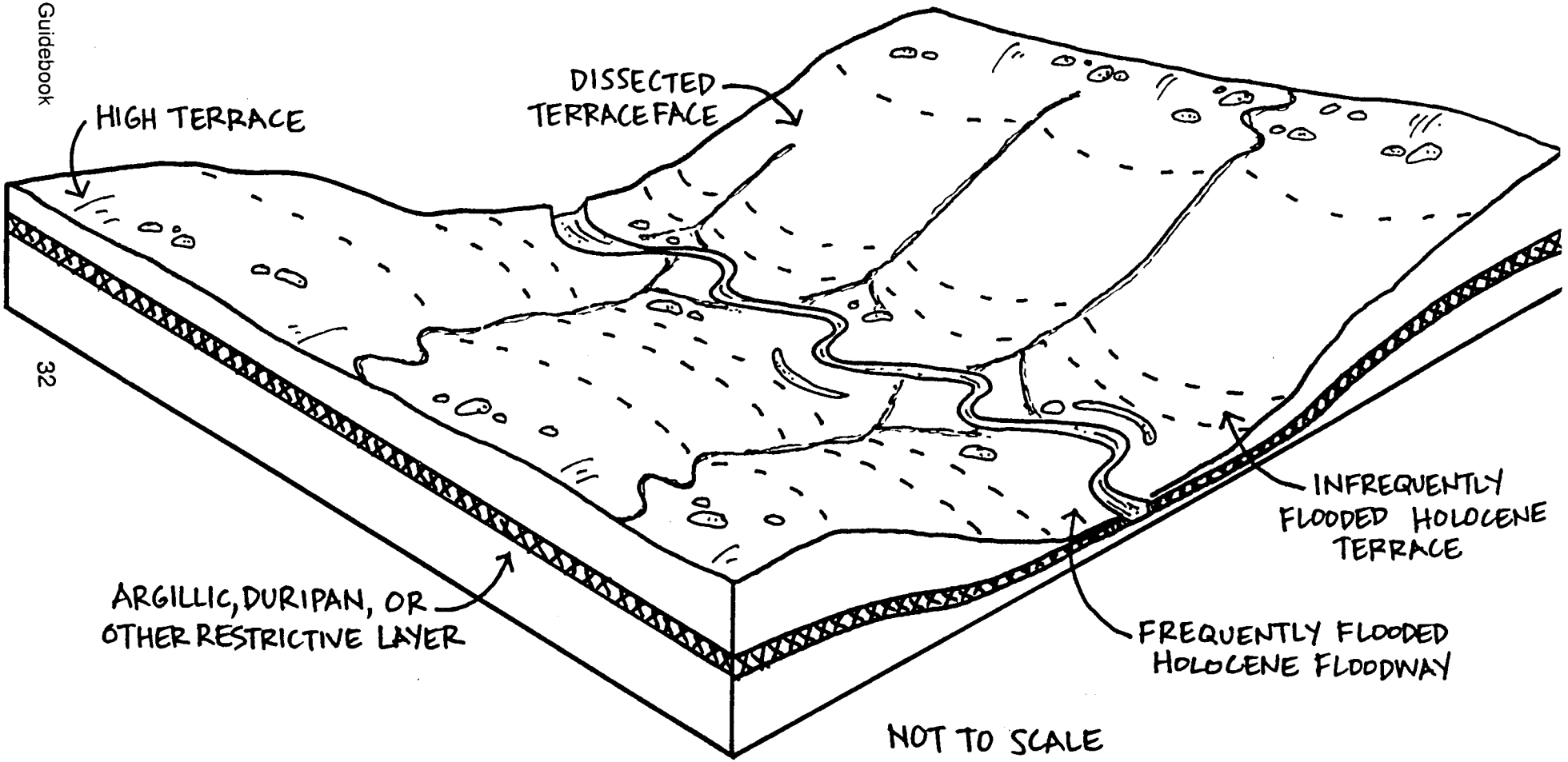
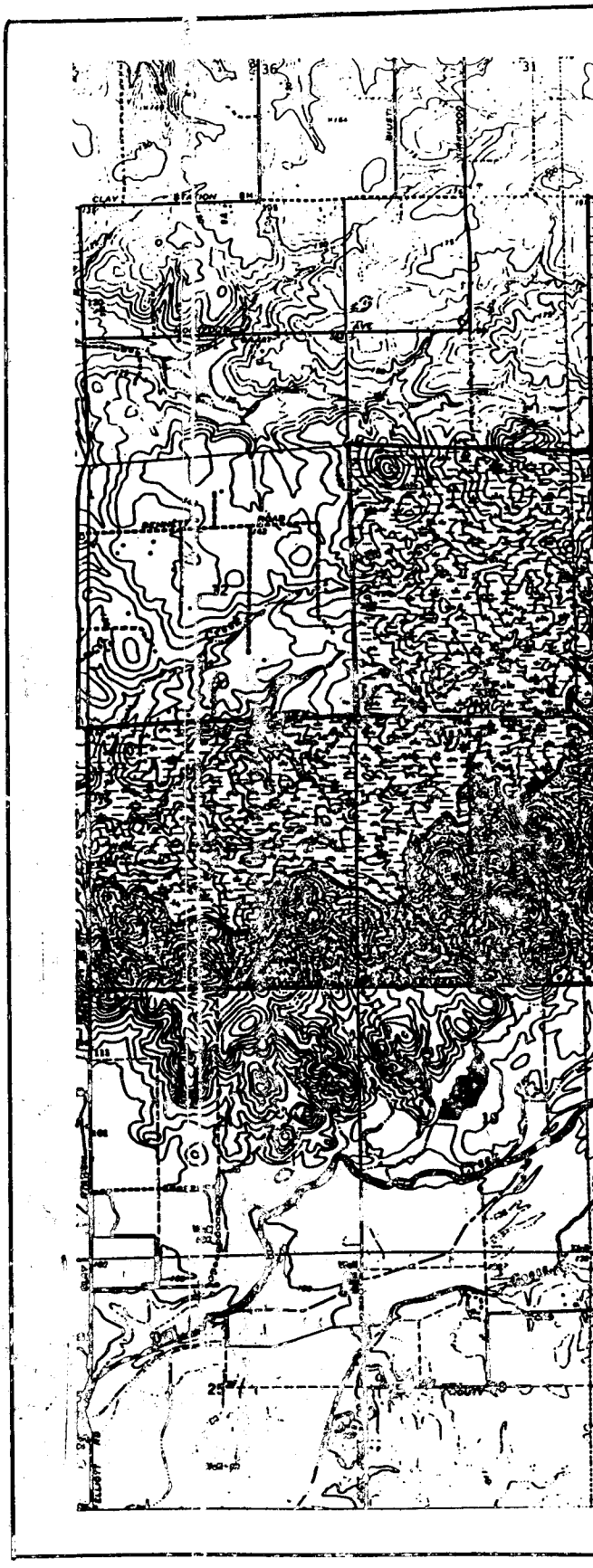


Figure 17. Geomorphic Surfaces Occurring Thre
Sacramento and San Joa



High Terrace

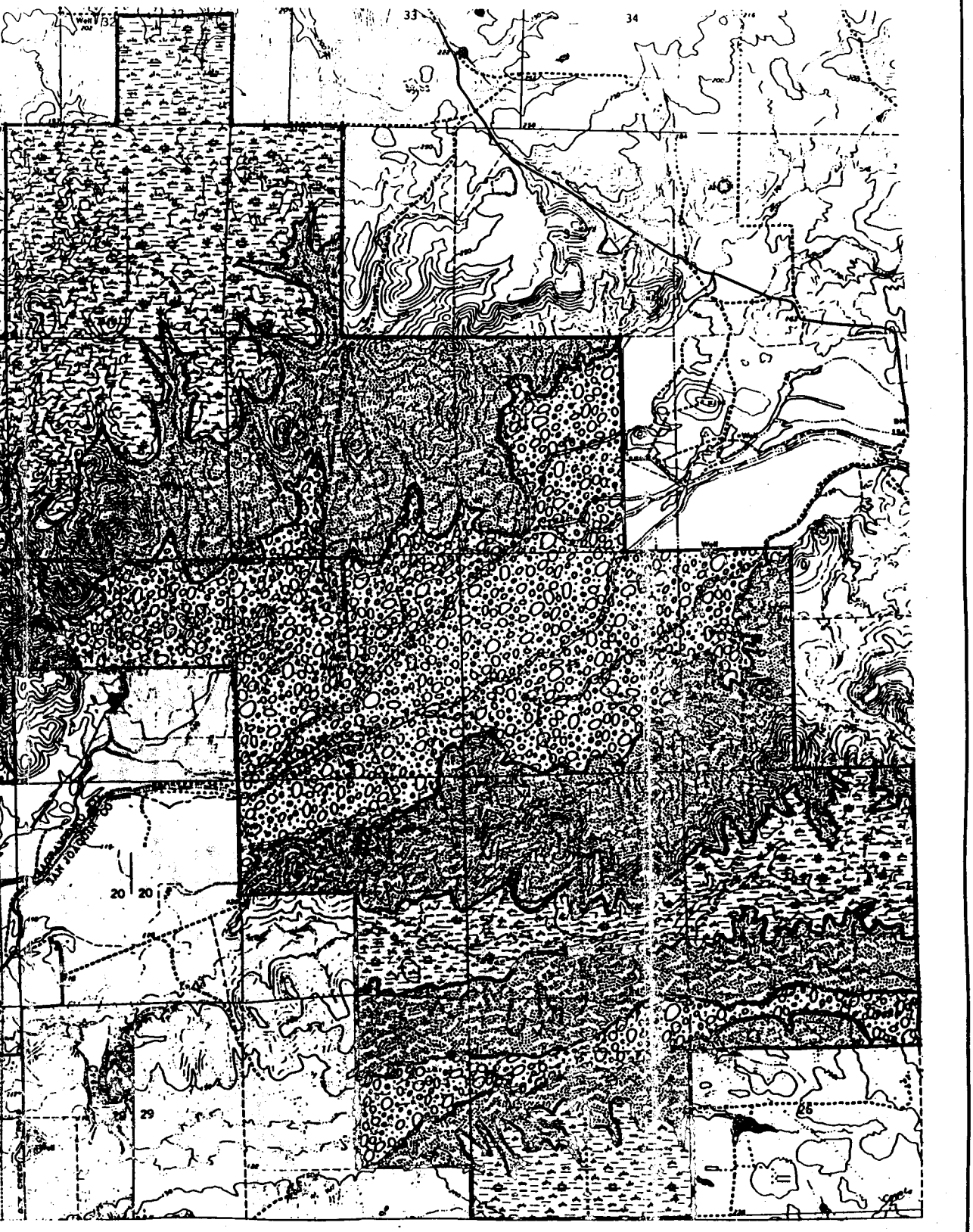
Dissected Terrace Face

Holocene Terrace and Floodplain

North

1 Mile

oughout the Borden Ranch Property
quin Counties, California



Fourth order ecosystems (*e.g.,* Dry Creek) were outside of the study area directly impacted by vineyard and/or orchard conversion operations.

e. As discussed above, there are basically three subclasses of depressions that occur on the Borden Ranch: hydrologically isolated (perched) and closed (Photograph 5), surface and shallow subsurface flow through (Photograph 6), and discharge (Table 4, Figures 12 and 14). By far, the most common types of depressions are closed/isolated and surface and shallow subsurface flow through (Photograph 6). Discharge depressions are very rare and unique on Borden Ranch. Because of their unique status on the landscape, discharge depressions were not included in the sampling or logic for the draft HGM models presented herein.

2. Chronological Sequence of Land-Use Treatments

A chronological sequence of land-use treatments that runs the gamut from moderately to heavily grazed pasture to vineyards in their 4th full growing season occurs (Photographs 7,8,9,10,11,12,13, and 14) on the Borden Ranch. Table 5 provides a summary of major land use conditions that the EPA/LCLA team found on the ranch. The EPA/LCLA team quickly developed familiarity with the common land-use practices and landscape positions on the Borden Ranch. With this background, team members found it relatively easy to distinguish among the various stages of development associated with conversion of pastures to vineyards. Thus, through field observations and with the assistance of information provided by Borden Ranch management staff, the chronological sequence of conversion activities was noted for each reference site.

B. Field Methods for Reference Sampling

Appendix A consists of the field data sheets used by the EPA/LCLA team to sample reference depressions, slopes, and riverine waters/wetlands on Borden Ranch. These data sheets were developed specifically for the Borden Ranch project, and reflect the EPA/LCLA team's best effort to capture field data that would be adequate to (1) build a first approximation reference system for each subclass of waters/wetland, and (2) support quantitative and qualitative scaling of the variables that are combined to estimated functions in the draft HGM models. The discussions of methods that follow are keyed to the data sheets in Appendix A.

1. Hydrology

a. Depressional Waters/Wetlands

(1) Identification Of Subclass and Geomorphic Setting

Each of the 30 depressional waters/wetlands reference sites was classified as either a hydrologically isolated (perched) and closed depression or a flow-through depression in the field. On Borden Ranch, closed contour and hydrologically isolated (perched) and closed depressions (Photograph 5) can occur on any geomorphic surface. They tend to occur most frequently in topographic lows with closed contours. They are frequently associated with low-permeability deposits. If, because of subtle microtopography or recent perturbation, any team members had doubts as to whether a particular depression had an outlet, then the EPA/LCLA

team convention was to use a David White Auto Laser 500 Model AEL-500 Laser level to determine elevations of closed contours and/or outlet locations.
Hydrodynamics in the closed/isolated depressions are dominantly vertical. The dominant hydrologic inputs are precipitation and surface and shallow subsurface flow from adjacent non-wetlands. The dominant hydrologic output is evapotranspiration.

Flow-through depressions (Photograph 6) occur in topographic lows with closed contours and low-permeability deposits, but inlets and outlets are present that allow water to flow into and out of the depression during periods of high water. The dominant hydrodynamics are vertical, although unidirectional flows can exist during high water events. The dominant hydrologic inputs are precipitation, surface and shallow subsurface flow from adjacent non-wetlands, and surface and shallow subsurface flow from up-gradient swale features. The dominant hydrologic outputs are evapotranspiration and surface and shallow subsurface flow through down-gradient swale features.

During the reference site sampling effort, geomorphic setting was determined by consulting topographic maps and the appropriate soil survey. Additionally, surface and shallow subsurface features of the assessment site and the immediately surrounding area were noted. Terminology and definitions used for descriptions of topographic settings, geomorphic surfaces, etc. are consistent with guidance provided by the Natural Resource Conservation Service (NRCS).

At each reference site, the shape of the depression was described as either concave or complex (Figure 18). Depressions were classified as concave if the depression bottom was relatively smooth. Depressions were classified as complex if the depression bottom undulated and contained non-wetland islands.

Abney and/or laser levels were used to measure depression slope(s) and a Silva Ranger compass was used to measure the true azimuth of the topographic fall line. Because depressional waters/wetlands on the Borden Ranch primarily occur in relatively level landscape positions (*e.g.*, high terraces), slope and azimuth measurements generally were not applicable or particularly informative.

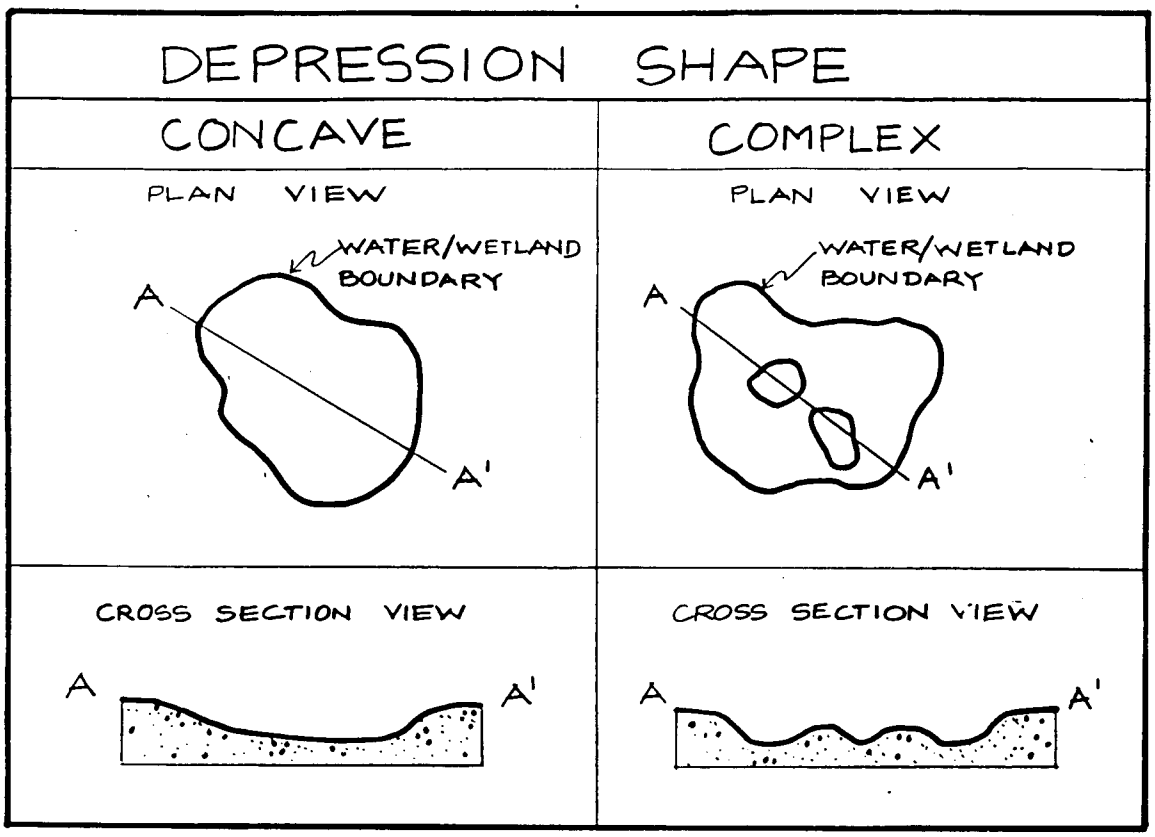
(2) Depression Dimensions

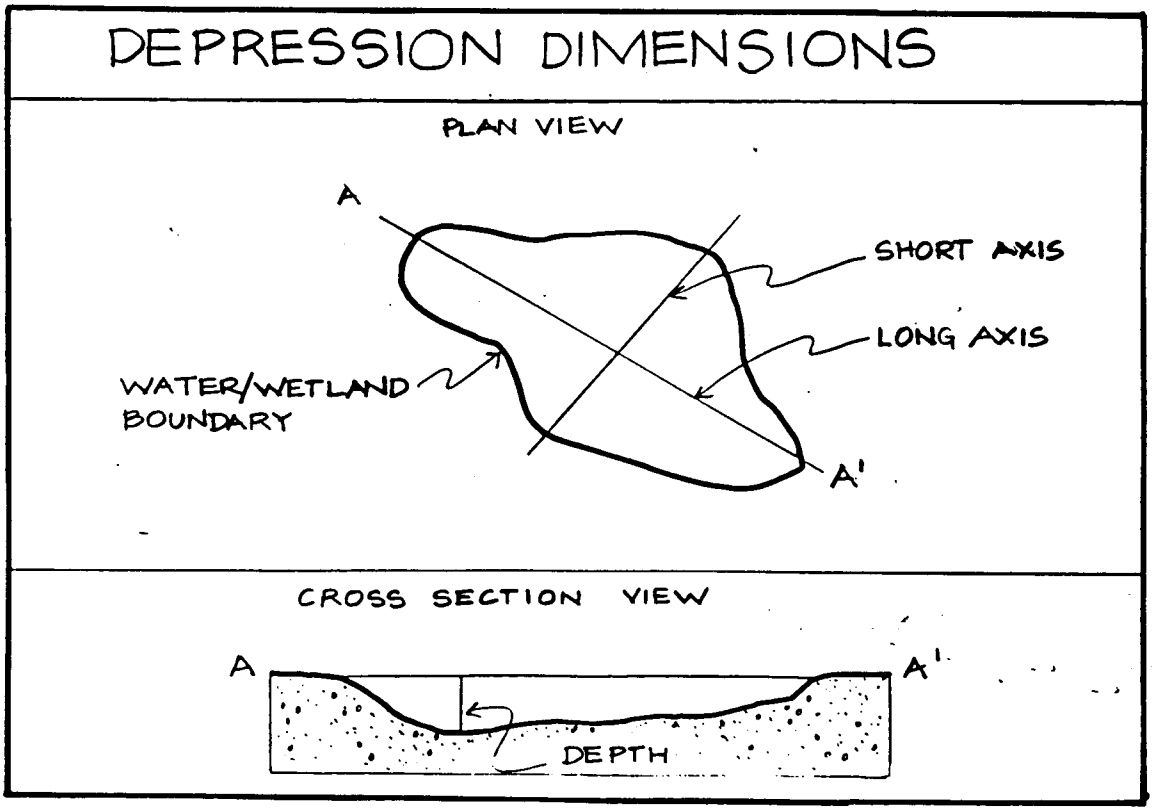
Long-axis and short-axis lengths of depressions were taken by measuring the planar distances between the waters/wetlands boundaries (Figure 18). Maximum depth was determined by measuring the maximum depth below the plane formed during the long-axis and short-axis measurements (Figure 18). Area and volume of the depression were calculated by assuming that depressions are (1) ellipses in plan view and (2) one half of an ellipsoid feature cut lengthwise when viewed in three dimensions.

(3) Depression Inlet and Outlet

Inlets and outlets were defined as swale features that connected the assessment site to other waters/wetlands. The team noted whether swale features were waters/wetlands or non-waters/wetlands. The relationship of the outlet elevation to the wetland jurisdictional boundary was determined by surveying several elevations along the waters/wetlands boundary, determining a mean elevation of the boundary, and surveying the relative elevation of the crest in the outlet swale feature. If necessary, the laser level was used.

Figure 18. Methods for Determining Depression Shape and Measuring Long and Short Axis Depression Dimensions





(4) Depression Water/Wetland Land Use, Buffer, and Contributing Area Characteristics

(a) Water/Wetland Land Use

The predominant land use and condition of the water/wetland was scored according to a disturbance scale that was described on the data sheet.

(b) Depression Buffer

Buffer widths were defined as 20 feet or to the top of the contributing area, whichever was the lesser distance (Figure 19). Buffer continuity is expressed as a percentage determined by dividing (a) the distance around the water/wetland edge that is bounded by a buffer divided by (b) the total distance around the water/wetland edge. In order for it to exist, the buffer must (1) be greater than one foot wide, (2) be grassland, (3) show no evidence of increased extent and/or rate of sediment deposition, and (4) have unfractured restrictive layers (*e.g.* argillic or durapan layers). The distance to disturbance was determined by measuring from the water/wetland boundary to the nearest disturbance within the buffer. This was performed at several points for each depressional water/wetland and a mean distance to disturbance was reported. The percent of disturbed buffer was calculated by dividing the mean distance from the waters/wetlands boundary to disturbance by the mean buffer width and subtracting that number from 100 (percent). The height of the forbs, graminoids, ferns, and fern allies in the buffer was measured in tenths of feet at a number of points and the mean height was reported. Percent cover of the forbs, graminoids, ferns and fern allies was visually estimated. Finally, the predominant land use and condition of the buffer was scored according to a disturbance scale that was included as a footnote on the data sheet.

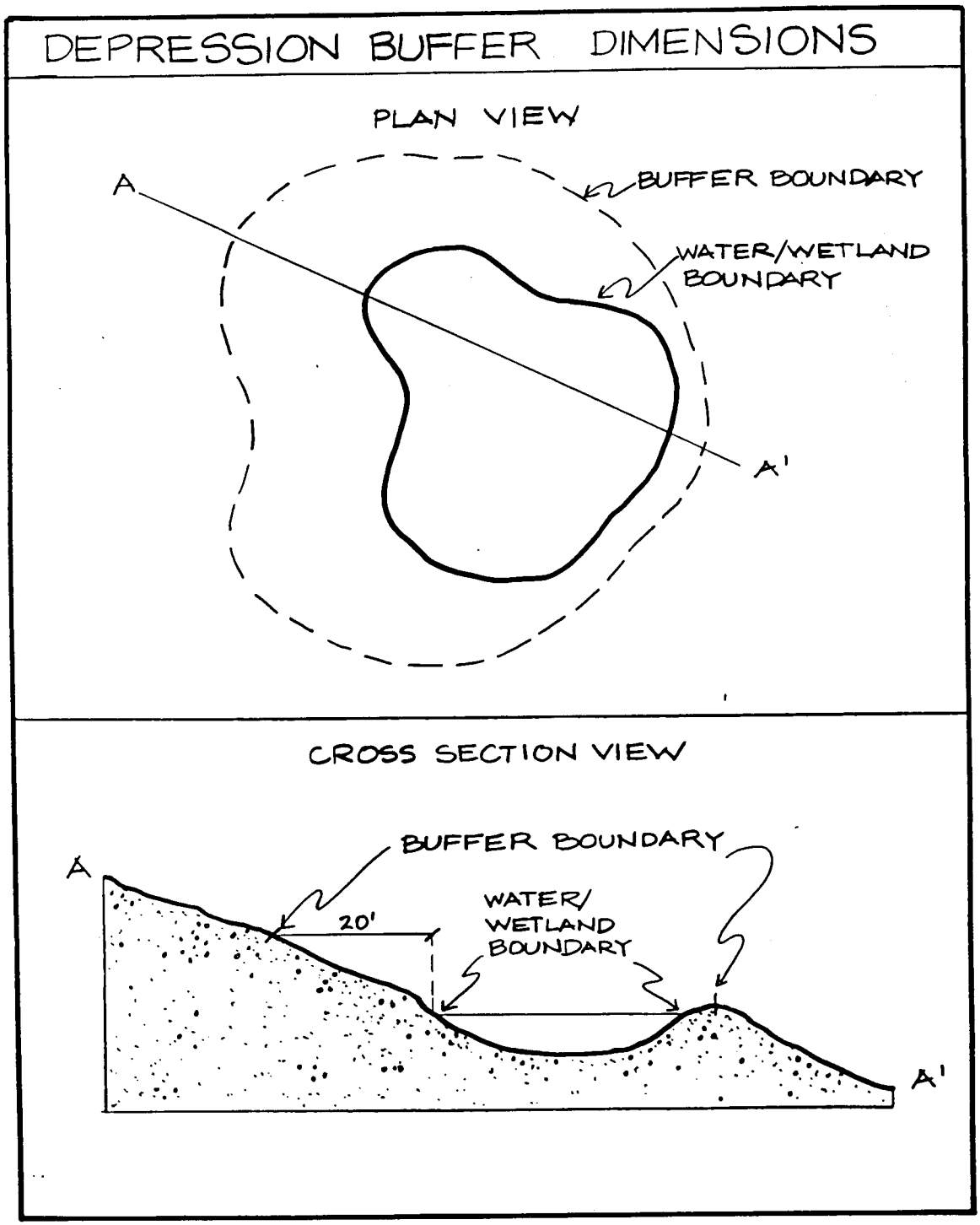
(c) Depression Contributing Area

The (hydrologic) contributing area was defined as that area that collects water and drains via surface and shallow subsurface flow to the depressional water/wetland. The predominant land use and condition of the contributing area was scored according to a disturbance scale that was included as a footnote on the data sheet (Appendix A). If the predominant land use in the contributing area potentially could have altered the hydroperiod, then these potential alterations were briefly described.

(5) Hydrologic Connections of Depressions to Down-Gradient Waters/Wetlands

Flow-through depressions often are connected to down-gradient waters/wetlands through swale features that are either waters/wetlands or non-waters/wetlands (Photograph 6). Hydrologic connections to down-gradient waters/wetlands were assessed by reviewing the Sugnet & Associates delineation maps and by making field observations. The subclass(es) of waters/wetlands that were located down-gradient were described, and the predominant use and condition of the hydrologic connection was scored according to a disturbance scale that was included as a footnote on the data sheet.

Figure 19. Methods for Measuring Depression Buffer Dimensions



(6) Depression Microtopography

Microtopographic characteristics of depressions (Photographs 5 and 7) were measured by surveying changes in ground surface elevation with a laser level. Microtopography transects were established along the long axis, the short axis, and as a typical cross-section of the swale outlet feature if applicable (Figure 20). Microtopography was surveyed at intervals that allowed accurate description of the ground surface. No fixed intervals were specified.

(7) Identification of Depression Boundaries

Where there were distinct and observable changes in landscape form from depression to riverine class, the EPA/LCLA team described and measured the riverine waters/wetlands features. See B.7. below for a description of criteria that commonly indicated a change in wetland class.

b. Slope Waters/Wetlands

(1) Slope Geomorphic Setting

The geomorphic setting of slope waters/wetlands was determined in a manner similar to that for the depressional waters/wetlands described above. The EPA/LCLA team regularly referred to pertinent topographic maps and soil surveys. Additionally, surface and shallow subsurface features of the assessment site and the immediately surrounding area were noted. Terminology and definitions are consistent with guidance provided by the Natural Resource Conservation Service (NRCS).

(2) Slope Contributing Area

The contributing area for slope waters/wetlands is defined as the area that collects water and drains via surface and shallow subsurface flow to the slope water/wetland. The predominant land use and condition of the contributing area was scored according to a disturbance scale that was included as a footnote on the slope data sheet (Appendix A). If the predominant land use and condition of the contributing area potentially could have altered the hydroperiod, then these potential alterations were briefly described.

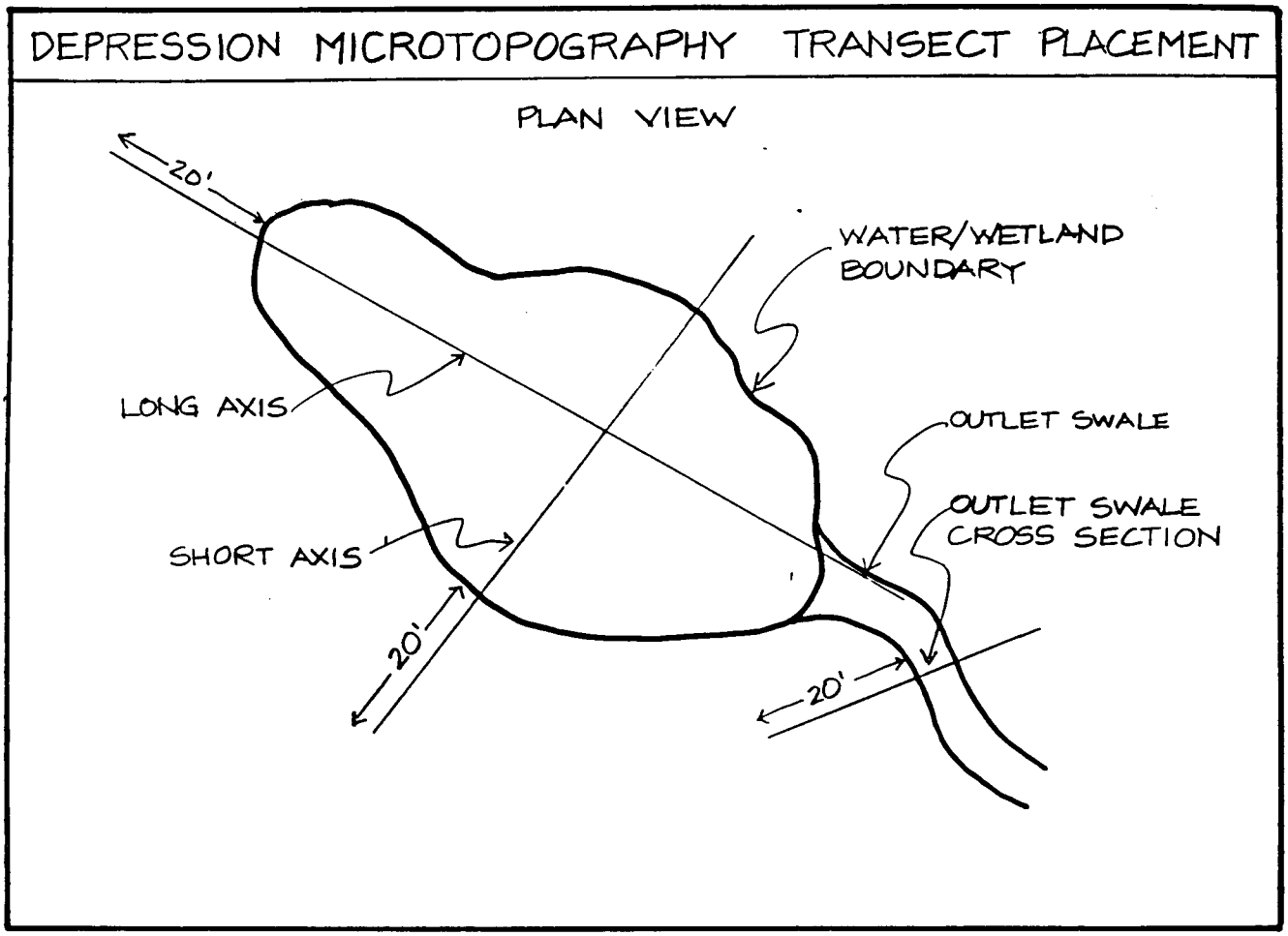
(3) Hydrologic Connections of Slope Waters/Wetlands to Down-Gradient Waters/Wetlands

Slope waters/wetlands often are connected to down-gradient waters/wetlands through swale features that are either waters/wetlands or non-waters/wetlands (Photograph 15). Hydrologic connections to down-gradient waters/wetlands were assessed by reviewing delineation maps and making field observations. The subclass(es) of waters/wetlands that were located down-gradient were described, and the predominant land use and condition of the connection was scored according to a disturbance scale that was included as a footnote on the data sheet.

(4) Slope Buffer Characteristics

Slope buffer widths were defined by the EPA/LCLA technical team as 20 feet or to the top of the contributing area, whichever was the shorter distance. Slope buffer continuity is defined as the

Figure 20. Methods for Measuring Depression Microtopography



distance around the water/wetland edge that is bounded by a buffer divided by the total distance around the water/wetland edge (expressed as a percentage). The buffer must (1) be greater than one foot wide, (2) be grassland, (3) show no evidence of increased extent and/or rate of sediment deposition, and (4) have an unfractured restrictive layer(s) (*e.g.,* unfractured argillic or durapan layers). The distance to disturbance was determined by measuring from the water/wetland boundary to the nearest disturbance within the buffer. This was performed at four points and a mean distance to disturbance was reported.

The percent of the buffer that was disturbed was calculated by multiplying the distance to the disturbance (at the four observation points) by the length of the assessment area (100feet for the slope subclass). These measurements capture the area of buffer that remains undisturbed. This undisturbed buffer area was subtracted from 4000/ft^2, the total possible buffer area for the slope assessment reach (i.e., the total possible buffer area is 20 feet wide (the buffer width by definition) multiplied by 100 feet long (the length of the assessment area for the slope class) multiplied by 2 (each side of the water/wetland). This number was then divided by 4000ft^2 and multiplied by 100 in order to report the percentage of the total buffer that was disturbed.

The height of the forbs, graminoids, ferns, and fern allies in the buffer was measured in tenths of feet at a number of points and the mean height was reported. Percent cover of the forbs, graminoids, ferns, and fern allies was visually estimated. Finally, the predominant use and condition of the buffer was scored according to a disturbance scale that was included as a footnote on the data sheet (Appendix A).

(5) Slope Microtopography

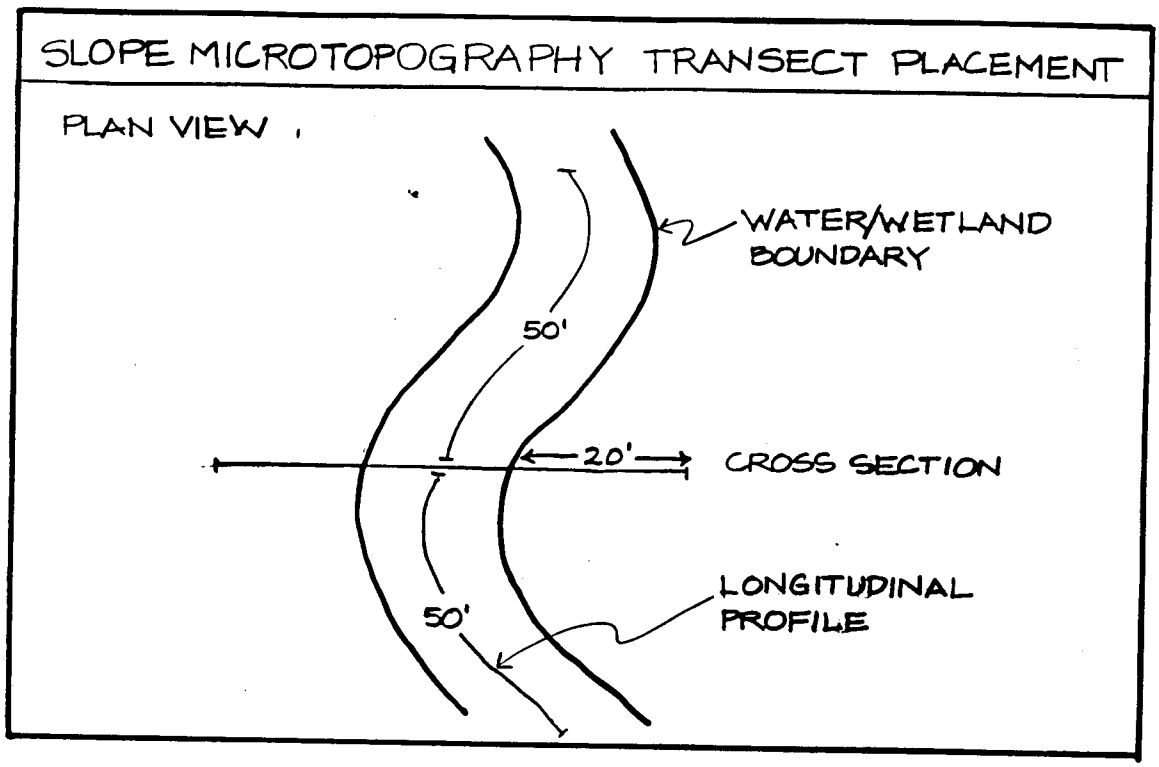
Microtopography of slope waters/wetlands was measured by surveying changes in ground surface elevation with a laser level. Microtopography transects were established as typical cross-sections and typical longitudinal profiles (Figure 21). Stations were surveyed at intervals that allowed accurate description of the ground surface. No fixed intervals were specified. Cross-sectional transects encompassed the width of the water/wetland and 20 foot buffers on each side. The default distance for the longitudinal profile transects was 100 feet.

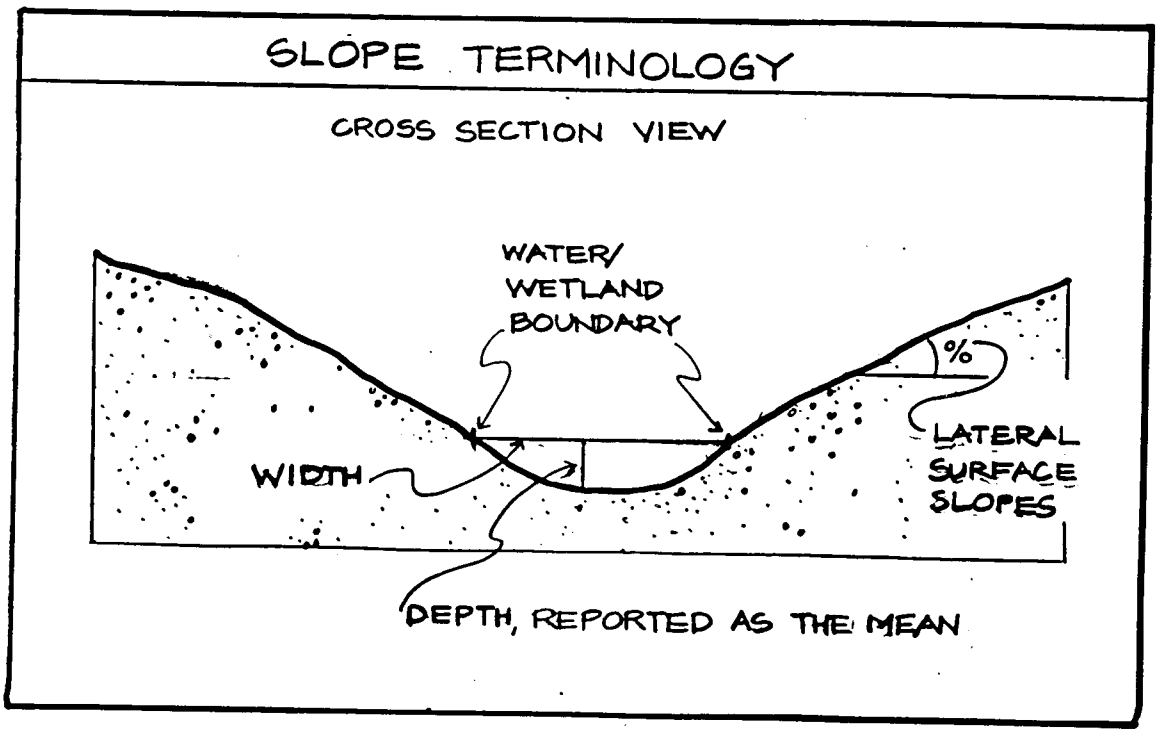
(6) Slope Water/Wetland Characteristics

The predominant use and condition of the water/wetland was scored according to a disturbance scale that was included as a footnote on the data sheet (Appendix A). It was noted if the assessment site was potentially a sediment source, as well as if there was a change in subclass from slope water/wetland to riverine water/wetland due to formation and maintenance of bed and bank features. However, the assessment site was assessed as a slope water/wetland as long as the change to riverine water/wetland (*i.e.*, the formation and maintenance of bed and bank features) was apparently caused by land use activities.

Additional data were calculated from surveyed measurements of slope waters/wetlands. Mean water/wetland width was determined by measuring the planar distance between the waters/wetlands boundaries, while mean water/wetland depth was determined by taking multiple measurements of depths below the plane formed during the width measurement. Mean lateral surface slopes were measured using an Abney level. Mean longitudinal surface slope was calculated from the longitudinal profile transect.

Figure 21. Methods for Assessing Slope Microtopography and Morphometry





(7) Identification of the Riverine Water/Wetland Subclass

The EPA/LCLA technical team recognized, described, and measured riverine water/wetland features where there were distinct and observable changes in landscape form and position from either depression(s) to riverine or slope(s) to riverine subclasses. The most obvious field criteria that triggered recognition of a change in subclass was (1) expression of riverine sediment dynamics (*e.g.*, import, transport, storage and export) and other fluvial processes (*e.g.*, flowing water), and (2) formation and maintenance of channel bed and bank features. Riverine features were described as discontinuous or continuous, and the length of the features was measured in the field. All other measurements reported in the riverine water/wetland characteristics section of the data sheet were performed as described for riverine waters/wetlands (Section IC, below).

c. Riverine Waters/Wetlands

(1) Riverine Geomorphic Setting

The geomorphic setting associated with the riverine subclass on the Borden Ranch was determined by field observations of landscape position and through referral to topographic maps and soil surveys. Additionally, surface and shallow subsurface features of the assessment area and immediately surrounding areas were noted. As with depressions and slopes, terminology and definitions are consistent with guidance provided by the NRCS.

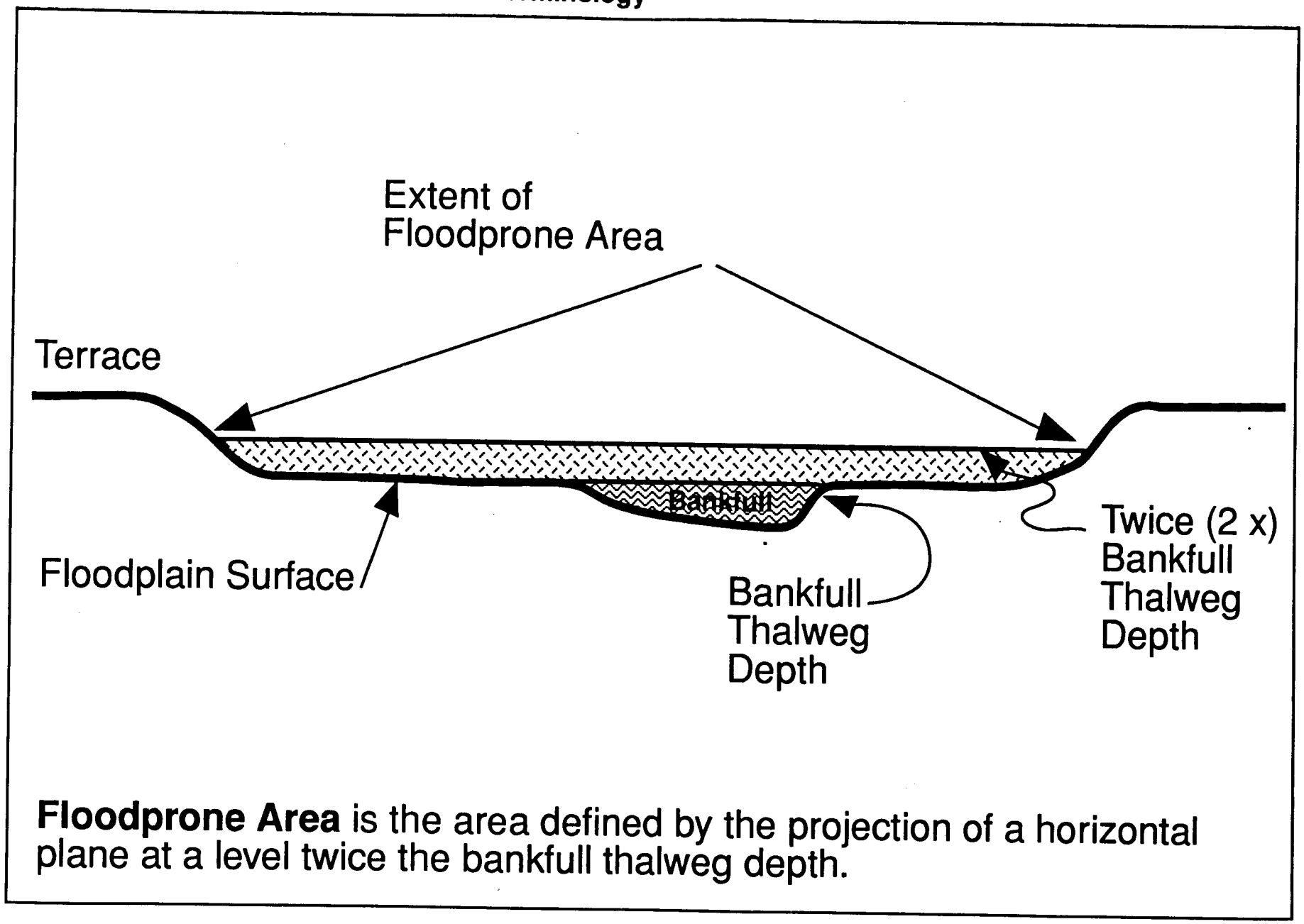
(2) Riverine Cross-Section Measurements

Riverine cross sections were calculated from field survey measurements. Water/wetland width was determined by measuring the planar distance between the waters/wetlands boundaries at regular intervals and finding the mean. Mean water/wetland depth was determined by taking multiple measurements of depths below the plane formed during the width measurement. Floodplains were defined as flat depositional surfaces that tend to occur near the ordinary high water mark. Extensive floodplains are uncommon in the riverine waters/wetlands of the Borden Ranch, but the widths of the floodplains were measured when they were observed. The floodprone area was defined by projecting a horizontal plane at twice the maximum ordinary high water (thalweg) depth. This is the area that has been empirically shown to flood at relatively regular intervals in a variety of hydrophysiographic provinces (Dunne and Leopold 1978; Rosgen 1994). Figure 22 offers a summary of metrics used in characterizing the cross sectional geometry of the riverine subclass on Borden Ranch.

Most of the rivers on the Borden Ranch are erosional rather than depositional (Photograph 16). Consequently, bank tops were defined as the pre-erosional surface. Bank heights were measured as the depth from the pre-erosional surface to the deepest point in the channel. Bank slopes were measured from the break in slope at the top of the bank to the break in slope at the bottom of the bank. Lateral surface slopes were measured using either Abney or laser levels.

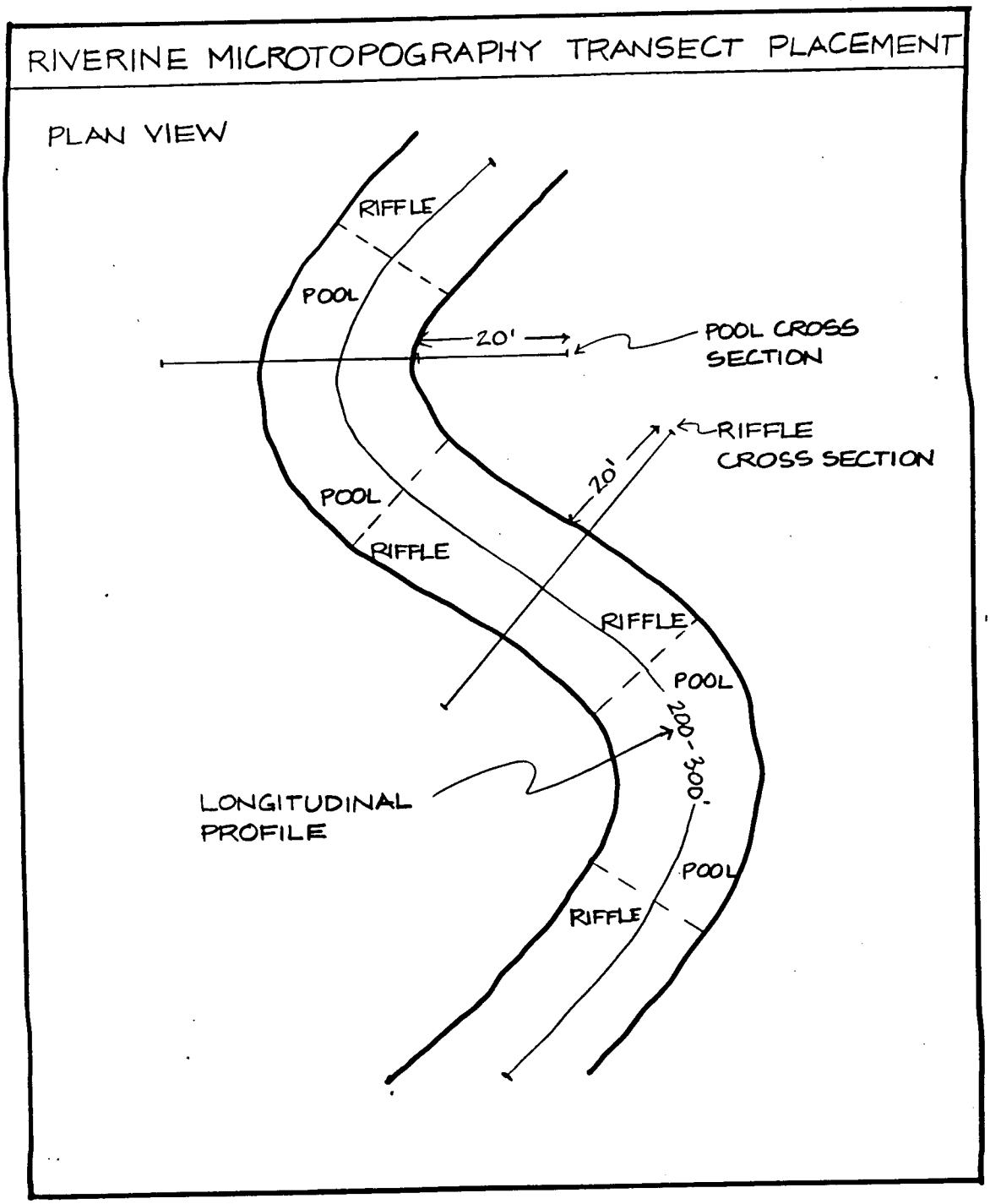
Measurements reported in the longitudinal profile section of the data sheet also were calculated from surveyed measurements (Figure 23). Reach length was measured in the field and was

Figure 22. Riverine Waters/Wetlands Terminology



Floodprone Area is the area defined by the projection of a horizontal plane at a level twice the bankfull thalweg depth.

Figure 23. Methods for Measuring Riverine Microtopography



used to bound the longitudinal length of the assessment site. Pool and riffle lengths were measured at the same time. Longitudinal surface slope was calculated from the longitudinal profile transect.

(3) Riverine Drainage Area/Contributing Area Characteristics

The drainage area/contributing area for the riverine subclass at Borden Ranch is defined as that area that collects water and drains via surface and shallow subsurface flow to the riverine water/wetland. Simply, it is the watershed area that contributes runoff to the riverine system in question. The predominant use and condition of the contributing area was scored according to a disturbance scale that was included as a footnote on the riverine data sheet (Appendix A). If the predominant use and condition of the contributing area potentially altered the hydroperiod, then these potential alterations were briefly described. Additionally, the spatial relationship and orientation of furrows and/or ripped areas to the water/wetland was noted.

(4) Riverine Assessment Site Characteristics

The predominant use and condition of the water/wetland was scored according to a disturbance scale that was included as a footnote on the data sheet (Appendix A). The presence or absence of a terminal or "dead" furrow that could disconnect the riverine water/wetland from surface and shallow subsurface drainage from the contributing area was noted, and the rate of sediment delivery to the water/wetland was scored according to a scale provided on the data sheet.

(5) Riverine Buffer Characteristics

Buffer widths for the riverine subclass were defined as a 20 feet or to the top of the contributing area, whichever was the shorter distance. Buffer continuity is defined as the distance around the water/wetland edge that is bounded by a buffer divided by the total distance around the water/wetland edge (expressed as a percentage). The buffer must (1) be greater than one foot wide, (2) be grassland, (3) not have evidence of increased extent and/or rate of sediment deposition, and (4) have an unfractured restrictive layer (*e.g.*, unfractured argillic and/or durapan layers). The distance to disturbance was determined by measuring from the water/wetland boundary to the nearest disturbance within the buffer. This was performed at four points and a mean distance to disturbance was reported.

The percent of the buffer that was disturbed was calculated by dividing the area of the disturbance (at the four observation points) by the total area. These measurements capture the area of buffer that remains undisturbed. This undisturbed buffer area was subtracted from 8000 ft^2, the total possible buffer area for the riverine assessment reach (i.e., the total possible buffer area is 20 feet wide (the buffer width by definition) multiplied by 200 feet long (the length of the assessment area for the riverine class) multiplied by 2 (each side of the water/wetland). This number was then divided by 8000 ft^2 and multiplied by 100 in order to report the percentage of the total buffer that was disturbed.

The height of the forbs, graminoids, ferns, and fern allies in the buffer was measured in tenths of feet at a number of points and the mean height was reported. Percent cover of the forbs,

graminoids, ferns, and fern allies was visually estimated. Finally, the predominant use and condition of the buffer was scored according to a disturbance scale that was included as a footnote on the data sheet.

(6) Hydrologic Connections of Riverine Waters/Wetlands to Down-Gradient Waters/Wetlands

Hydrologic connections from riverine reference sites to down-gradient waters/wetlands were assessed by reviewing delineation maps, air photos, and through direct field observations. The predominant use and condition of the connection was scored according to a disturbance scale that was included as a footnote on the data sheet (Appendix A), and disruption(s) to the connection were noted and described.

(7) Riverine Microtopography

Microtopographic characteristics for the riverine subclass were measured by surveying changes in ground surface elevation with a laser level. Microtopography transects were established as typical cross-sections in pools and riffles and typical longitudinal profiles (Figure 23). Microtopography was surveyed at intervals that allowed accurate description of the ground surface. No fixed intervals were specified. Cross-sectional transects encompassed the width of the water/wetland and 20 foot buffers on each side. The default distance for the longitudinal profile transects was 100 feet.

(8) Pebble Count

The channel particle size distribution was determined by performing a pebble count. The pebble count procedure entails walking down the channel in a random or zig-zag pattern. Samples were collected by reaching down to a point in front of the toe with eyes closed or averted and touching the channel substrate with an extended finger. The first particle that was touched was picked up and measured in millimeters along its intermediate axis (*i.e.*, neither the longest nor shortest axis). The measurement was recorded as the lower limit of the size class into which the rock falls.

2. Soils

a. Depression, Slope, and Riverine Waters/Wetlands

The general methods and data sheets used in the collection of soils information were consistent between depressional, slope, and riverine waters/wetlands (Appendix A). The exact soil sampling protocols varied slightly among subclasses of waters/wetlands and when perturbations to systèms associated with soil ripping, discing, and cultivation required alternative methods. In general, the goals of the soils investigations were to characterize modal soil conditions at each sample site and to place observed conditions in the soils in the context of the surrounding landscape, geomorphic surface(s), and land-use practices.

At each sample site, a main soil pit was excavated by hand to the depths possible in the dry season using shovels, augers, and standard excavation tools. If possible, adjacent cut faces or other landscape features that would allow a deeper look into the soil profile were examined, and conditions were noted. In addition to the main pit, several ancillary pits were excavated or

probed in an attempt to characterize the condition of restrictive layers and/or to confirm observations taken at the main pit. Landscape position and land-use practices were carefully noted.

(1) Soil Survey And Taxonomy

The Sacramento and San Joaquin County Soil Surveys (Tugel 1993, McElhiney 1992) and the arrays showing SCS soil types provided on the Sugnet and Associates delineations maps were used throughout this project. All reference sites were located on the appropriate soil survey maps and the mapped NRCS soil type was noted. The mapped NRCS soil type was confirmed or rejected for the assessment site following the soil pit excavation and description. Acceptance or rejection of the NRCS mapped soil was accomplished by comparing the field data to the soil type description published in the soil survey. Hydric soils were identified using standard criteria provided in the U.S. Army Corps of Engineers Wetland Delineation Manual (Corps 1987) and more recent guidance and technical documentation (*e.g.,* Hurt *et al.* 1996).

The Keys To Soil Taxonomy (USDA, NRCS 1996) served as the guide to all soil taxonomic decisions and nomenclature. In addition, Dr. Lee met with the NRCS Soil Survey Staff in Davis, California, and with technical staff of the NRCS Wetland Institute, Laurel, Maryland to clarify technical issues regarding (1) approaches for description of ripped soils, (2) definition and characterization of truncated soil profiles, and (3) field recognition and characterization of argillic and duripan layers characteristic to the Borden Ranch landscape.

(2) Geomorphic Setting

Geomorphic setting was determined in the field by consulting topographic maps and soil surveys. Additionally, surface and shallow subsurface features of the assessment site and the immediately surrounding area were noted. Terminology and definitions were consistent with guidance provided by the NRCS.

(3) Evidence of Flooding, Ponding and Saturation

Evidence of the occurrence of flooding, ponding and saturation and an estimate of the duration of each were noted in the field. Evidence of flooding, ponding, or saturation occurrence and duration included, but were not limited to, direct observations, presence or absence of hydric soils, presence of algal mats on soil surfaces, water-stained organic material, drift lines, erosion features, and sediment deposits.

(4) Organic Matter

Throughout this study, organic matter was defined to include all non-living and/or senescent vegetative material accumulated on the soil surface. This definition included algal crusts common in areas where water ponded for long duration. The percent cover of the organic mat was estimated visually in an area immediately surrounding the main soil pit. The thickness of the organic mat was measured and the predominant source of the organic material was noted at the main soil pit.

(5) Restrictive Layer

The presence or absence of a restrictive layer was noted (Photograph 17). For the purposes of this study, the term "restrictive layer" was defined to include (1) argillic and duripan layers in truncated soil profiles, and (2) abrupt soil textural changes that would perch water. At each site the team estimated the degree to which the restrictive layer was fractured in the water/wetland and in the buffer following the excavation of a series of small pits and or probe holes. Often, and especially because of the dry soil conditions experienced in the field for the duration of the study, it was impossible to distinguish between argillic, duripan, and/or lithic contact at depth. When these circumstances occurred, it was standard practice of the EPA./LCLA team to note the presence or absence of a restrictive layer and to estimate its condition, regardless of its exact composition.

(6) Approximate Area and Volume of Fill in the Reference Sites

The approximate area and volume of sediment input and/or "fill" was determined by field measurements. Approximate areas of fill were determined through measurements of aerial coverage. The approximate depths of fill were measured by probing or with small soil pits in a few areas, and a mean depth of fill was calculated. Approximate volumes of fill or sediment were determined by multiplying the aerial coverage of fill by the mean depth of fill.

(7) Soil Profile Characterization

Given the dry soil conditions that existed throughout this study, soil pits were excavated by hand to practicable depths. This usually resulted in pits to the depth of the restrictive layer. Identification and nomenclature of the soil horizons were consistent with NRCS guidance (Tugel 1993; McElhiney 1992; USDA, NRCS 1996). Soil colors were determined from moist samples using Munsell soil color charts (Munsell 1994).

3. Flora and Fauna

a. Depression, Slope, and Riverine Waters/Wetlands

As with soils methods detailed above, the field sampling approaches and data sheets used in the collection of information concerning flora and fauna were consistent among depression, slope, and riverine waters/wetlands subclasses (Appendix A). The principal objective of the sampling efforts for vegetation was to characterize the abundance, structure, and species composition of the dry phase plant communities at each reference site. All plant taxonomic nomenclature and species identifications for this study follow the Jepson Manual (Hickman 1993).

With respect to the faunal community, sampling focused on observation of direct evidence of use of the sample site by faunal species (*e.g.,* direct observation of an animal in the waters/wetland). In the absence of direct observation, sign, scat, tracks, beds, kills, browse, and other types of indirect evidence of use of the water/wetlands was recorded. No trapping efforts, incubations, or formal observation intervals were possible in the context of the AO schedule.

(1) Vegetation Presence and Abundance

Because both plant abundance and species composition change across the stages of the hydrologic cycles characteristic to all subclasses of waters/wetlands on the Borden Ranch, two approaches were used to characterize vegetation presence and abundance. To assess abundance, only those individuals that were living (*i.e.*, actively photosynthesizing and/or reproducing) were measured. No attempt was made to measure the abundance of non-living plant materials. The height of the forbs, graminoids, ferns, and fern allies in the water/wetland was measured in tenths of feet at a number of points and the mean height was reported. Percent cover of forbs, graminoids, ferns and fern allies, algal crust, and bare ground was visually estimated at a number of points, and the mean percent cover was reported. Percent cover estimates of bare ground included areas that were covered with non-living plant materials.

To assess species composition, a list of dominant taxa was made at each site. Living plants were identified to species whenever possible; if identifications could not be made on-site, vouchers were collected and identifications verified later. Plants were identified to the lowest taxonomic category possible, given the condition of the vegetation. Senescent or non-living individuals were therefore occasionally identified only to family or genus level.

(2) Habitat Components and Faunal Evidence

Each reference site was scanned for habitat components (*e.g.,* vegetation structure and composition) and evidence of use by faunal species. For example, in addition to direct observations of animals, indirect evidence such as tracks, scat, beds, browse and the presence of chitonous exoskeletons was considered sufficient proof that the sample site was used by vertebrates or invertebrates. Most observations were limited to waters/wetlands, however, some observations of species use were made and recorded in buffers.

(3) Land Use and Condition

The predominant land use and condition in a circle with a 3000-foot radius centered at the sample site was scored according to a disturbance scale that was included as a footnote on the data sheet (Appendix A). A 3000-foot radius was used because regional experts have suggested that it is reasonable to assume that 3000 feet is the approximate distance that wide-ranging amphibians and/or avifauna might travel to access waters/wetlands.

(4) Contiguity

Habitat contiguity was determined in each of eight "sectors" of a circle with a 3000-foot radius centered at the sample site. Specifically, the 3000-foot radius circle was separated into eight sectors, each with an interior angle of 45°. Within each sector, the predominant land use and condition was observed and recorded. If the predominant land use and condition was moderate to heavy grazing, then discontinuities such as fences, roads, or vineyards were noted and distances to these discontinuities were measured or estimated. Discontinuity in areas of relatively intact waters/wetlands habitats (*i.e.,* grazed areas) will affect the movement of animals across the landscape. (Hanson *et al.* 1995)

C. Data Analyses and Profile/Model Development

Following the field components of the reference sampling effort, all data were quality assured and quality controlled (QA/QC) by the EPA/LCLA team. All data were then entered into electronic format and QA/QC was performed on the electronic data matrices. When possible, descriptive data were converted to numeric ranges. Other descriptive data were used to characterize sites. Data analyses and syntheses were completed using a range of standard analytical techniques. These included, but were not limited to, standard parametric statistical test, non-parametric analyses, and multivariate analyses (*e.g.*, detrended correspondence analysis). The statistical analyses were conducted on the quantitative data (and the converted descriptive data) with the overall objective of determining (1) measured attributes with the greatest influence on the structure and functioning of the subclass, and (2) similarity/dissimilarity among sampled sites (Hill 1979, Gauch and Hill 1982, ter Braak 1987, Jongman *et al.* 1987). Quantitative data were also analyzed graphically (*e.g.*, bar graphs) and statistically to determine trends. In this effort, simple and standard statistical analyses were used to find ranges of values, averages, standard deviations, etc. (Zar 1984).

The graphic displays of the reference data were sorted according to the following land-use conditions: (1) preserve, (2) sites that were ripped, disced and rolled, but not planted, (3) vineyards with vegetation between rows, and (4) vineyards without vegetation between rows. The results of this sorting and analyses of the sorted data were used to numerically describe several reference conditions , including the influences of anthropogenic disturbances on ecosystem functions. All of the data analyses described above were used to develop and refine the second approximation draft HGM models for the Borden Ranch. In particular, it is important to emphasize that the reference data collected during the course of this study were used to support the scaling of variables in the draft HGM models.

D. Field Testing/Revision of Second Approximation HGM Assessment Models

Once preliminary data analyses were complete and the second approximation HGM models were drafted, the EPA/LCLA team conducted a series of field tests on the draft models. Field testing was accomplished during the interval August 19 - 21, 1997. In this effort, the EPA/LCLA team visited several sites within each subclass on the Borden Ranch. A range of land-use conditions was tested for each subclass (*e.g.*, preserve areas, recently ripped and disced sites, 1, 2, and 3 year old vineyards, etc.). Based on the results of the field tests, the second approximation models were revised and edited, and the third approximation models presented in this Guidebook were developed.

B. *Draft HGM Model for Closed and Flow-Through Depression Waters/Wetlands and Associated Slope Waters/Wetlands on Borden Ranch, Sacramento and San Joaquin Counties, California*

1. Definitions of Functions

a. Hydrologic Functions

1) Surface and Shallow Subsurface Water Storage and Exchange (Closed and Flow-Through)

This function refers to the capacity of a water/wetland (1) to collect and detain surface and shallow subsurface water as static water above the soil surface, pore water in the saturated zone, and soil moisture in the unsaturated zone, and (2) to allow for the exchange of water between surface and shallow subsurface compartments. The land use and condition of the contributing area and the buffer affect the timing, duration, and amount of surface and shallow subsurface water flowing into the water/wetland. The presence or absence and elevation of an outlet affect the amount of surface and shallow subsurface water a water/wetland can detain. An intact soil profile is critical to this function since (1) perching above the restrictive layer is the primary mechanism of surface and shallow subsurface water storage, and (2) exchange of water occurs between surface and shallow subsurface compartments (*i.e.*, between the pool and the upper part of the soil). Fine root turnover maintains soil pore space for shallow subsurface water storage and maintains soil permeability to allow for the exchange of water between surface and shallow subsurface compartments. Sediment input changes the soil pore space characteristics and, therefore, alters the way in which shallow subsurface water is stored and exchanged.

2) Landscape Hydrologic Connections (Flow-Through)

This functions refers to the hydrologic connectivity of contributing areas to flow-through depressions and slope waters/wetlands, and to other downgradient waters/wetlands. Flow-through depression and slope waters/wetlands have land-dominated hydrographs so the timing, duration, and amount of water delivered to the channel is dependent upon the condition of the watershed and the buffer. The high-order seasonal and perennial streams depend upon intact connections from the upper portions of the watershed to maintain flow and sediment transport characteristics.

b. Biogeochemical Functions

1) Element and Compound Cycling (Closed and Flow-Through)

Element and compound cycling includes the abiotic and biotic processes that convert compounds from one form to another. These are primarily recycling processes wherein elements and compounds are cycled between atmosphere, water, soil and vegetation. Additionally, elements and compounds are temporarily removed from cycling processes through retention/detention in soils and sediments. The critical attributes and processes are in the soil and vegetation. The water/wetland buffer filters incoming surface and shallow subsurface

water. Soil provides habitat for soil microorganisms that mediate the cycling processes, and also provides space where elements and compounds can be stored. Vegetation takes up, transforms, and temporarily stores elements and compounds and also provides oxygen to the rooting zone.

2) Organic Carbon Export (Flow-Through)

Organic carbon is exported from waters/wetlands in dissolved and particulate forms. Mechanisms of organic carbon export include leaching, displacement, and erosion. Sources of organic carbon include herbaceous vegetation both in the water/wetland and in the buffer, as well as organic matter incorporated in to the soil profile. Export of organic carbon from the flow-through depression and associated slope waters/wetlands is dependent upon the status/condition of the hydrologic connection to downgradient waters/wetlands.

c. Plant Community/Habitat Functions

1) Plant Community (Closed and Flow-Through)

Attributes of plant community include species composition and physical characteristics of the living plant biomass. The emphasis is on the composition and structure of the plant community. Species composition is influenced by physical processes that maintain the characteristic hydrologic functions of ephemeral depressional wetlands (*e.g.*, soil structure and hydraulic conductivity) and biological processes (*e.g.*, presence of viable populations of native pollinators). In addition, because ephemeral depressional waters/wetlands are habitat islands, the condition, areal extent and distribution of depressional wetlands habitat in the surrounding landscape (*i.e.*, surrounding land use and density of wetlands), which provides a regional source of colonists (propagules) to balance local extinctions within single pools, is critical to maintaining viable plant communities. Physical structure and attributes of the vegetation are also components of this function, including characteristic aerial cover, vertical and horizontal spatial distributions, and accumulation of organic matter.

2) Faunal Habitat (Closed and Flow-Through)

This function refers to the capacity of a water/wetland to support animal populations and guilds by providing heterogeneous habitats that provide food, cover, and reproductive opportunities. The emphasis is on species that require depressional waters/wetlands as an essential component for some or all parts of their life history.

3) Faunal Habitat Interspersion and Connectivity (Closed and Flow-Through)

Faunal habitat interspersion and connectivity is the capacity of a water/wetland to permit vertebrate and invertebrate aquatic organisms to enter or leave via surface or shallow subsurface connections, as well as the capacity of a water/wetland to permit access by terrestrial invertebrates and vertebrates to contiguous areas of food, cover, and reproductive opportunities.

4) Invertebrate Assemblage (Closed and Flow-Through)

This function refers to the population of terrestrial and/or aquatic invertebrates supported by the water/wetland.

5) Vertebrate Assemblage (Closed and Flow-Through)

This function refers to the population of terrestrial and/or aquatic vertebrates supported by the water/wetland.

2. Function Equations

Surface and Shallow Subsurface Water Storage and Exchange (Closed and Flow-Through)

Closed:

$$\text{Function} = (V_{OUT} \times (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{VEGABUND})/5)^{1/2}$$

Flow-Through:

$$\text{Function} = (V_{OUT} \times (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{SOILINT} + V_{SED} + V_{VEGABUND} + V_{LONGCON})/7)^{1/2}$$

Landscape Hydrologic Connections (Flow-Through)

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{LONGCON})/4$$

Element and Compound Cycling (Closed and Flow-Through)

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/7$$

Organic Carbon Export (Flow-Through)

$$\text{Function} = ((V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + (V_{SOILINT} + V_{OM} + V_{VEGABUND})/3 + V_{OUT} + V_{LONGCON})/4$$

Plant Community (Closed and Flow-Through)

$$\text{Function} = (V_{OM} + V_{SOILINT} + V_{VEGABUND} + V_{PRATIO} + V_{DSINDSP} + (V_{WETDEN} + V_{LANDCOND})/2)/6$$

Faunal Habitat (Closed and Flow-Through)

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/7$$

Faunal Habitat Interspersion and Connectivity (Closed and Flow-Through)

Closed:

$$\text{Function} = (V_{LANDCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{WETDEN})/3$$

Flow-Through:

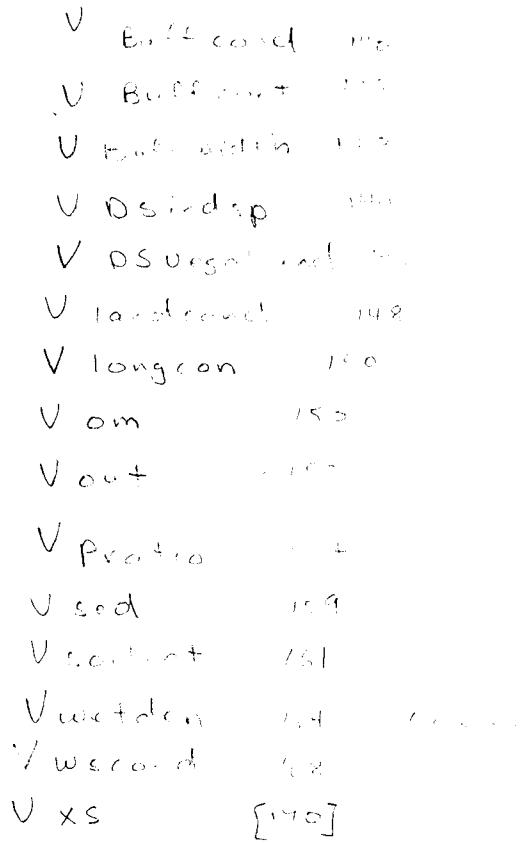
$$\text{Function} = (V_{LANDCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{LONGCON} + V_{WETDEN})/5$$

Invertebrate Assemblage (Closed and Flow-Through)

Direct Assessment

Vertebrate Assemblage (Closed and Flow-Through)

Direct Assessment



3. Variables

Variable: BUFFER CONDITION

Definition: Predominant land use or condition of the area 20 feet, perpendicular to and outward from the water/wetland edge or to the top of the contributing area divide whichever is less.

Measurement Protocol: Make a visual assessment of the predominant (*i.e.*, >50%) land use and/or condition of the water/wetland buffer in the assessment area. Compare to all the descriptions provided in the scaling for the $V_{BUFFCOND}$ variable and choose the lowest score that appropriately describes the predominant land use and/or condition of the buffer.

Scaling: The predominant use and condition of the buffer was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

$V_{BUFFCOND}$: Buffer Condition

Measurement or Condition	Index
Land condition is light or no grazing and management has explicit intent to: a) reduce the abundance of non-native and/or invasive plant species, b) increase the abundance of native plant species, c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land use is characterized by moderate to heavy grazing. There is no management intended explicitly to: a) reduce the abundance of non-native and/or invasive plant species, b) increase the abundance of native plant species, c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
CONDITION 1: The buffer is characterized by a) maintenance plowing, disking, harrowing, or raking, **and** b) an unfractured restrictive layer. **OR** **CONDITION 2:** The buffer is characterized by a) accelerated rates of sediment deposition **and** b) an unfractured restrictive layer.	0.5
The buffer is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) cultivated crops (*e.g.*, vineyards or orchards), d) no maintenance plowing, disking, harrowing, or raking between rows, **and** e) abundant herbaceous vegetation growing between rows.	0.25
CONDITION 1: The buffer is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) cultivated crops (*e.g.*, vineyards or orchards), d) maintenance plowing, disking, harrowing, or raking between rows, **and** e) little to no herbaceous vegetation growing between rows. **OR** **CONDITION 2:** The buffer is characterized by a) a ripped soil profile, b) a fractured restrictive layer, **and** c) no cultivated crops (*e.g.*, vineyards and orchards).	0.1
The buffer is characterized by anthropogenic impervious surfaces (*e.g.*, roads, parking lots, buildings).	0.0

Variable: BUFFER CONTINUITY

Definition: Continuity of the buffer (20 feet perpendicular to and outward from the water/wetland edge or to the top of the contributing area divide, whichever is less) around the water/wetland edge. Continuity is defined as the distance around the water/wetland edge that is bounded by an intact buffer divided by the total distance around the water/wetland edge. The buffer must (1) greater than or equal to one foot wide, (2) be vegetated with herbaceous species, (3) have no evidence of increased area and/or rate of sediment deposition, and (4) have an unfractured restrictive layer.

Measurement Protocol: Within the assessment area, measure the distance around the water/wetland edge that is bounded by an intact buffer. Divide this measurement by the total distance around the water/wetland edge in the assessment area to reach the percent continuity of the water/wetland buffer. Compare the percent continuity for the buffer to all the descriptions provided in the scaling for the $V_{BUFFCONT}$ variable and choose the lowest score that appropriately describes the continuity of the buffer and/or the recoverability of the buffer continuity. Note that the buffer must (1) be greater than one foot wide, (2) be dominated by herbs, (3) have no evidence of increased area and/or rate of sediment deposition, and (4) have an unfractured restrictive layer.

Scaling: Buffer continuity was defined as the distance around the water/wetland edge that was bounded by an intact buffer divided by the total distance around the water/wetland edge (expressed as a percentage). The buffer had to (1) be greater than one foot wide, (2) be vegetated with herbaceous species, (3) have no evidence of increased sediment deposition, and (4) have an unfractured restrictive layer.

The data are bimodal. Buffer continuity tended to be 100 percent or 0 percent. The bimodal nature of the data did not allow for the determination of whether relationships between buffer continuity and ecosystem attributes and processes (*e.g.*, sediment accretion) were linear or curvilinear. Thus, the relationship was assumed to be linear.

Confidence: Medium.

$V_{BUFFCONT}$: Buffer Continuity

Measurement or Condition	Index
100% of the water/wetland edge is bounded by an intact buffer.	1.0
75% to <100% of the water/wetland edge is bounded by an intact buffer.	0.75
50% to <75% of the water/wetland edge is bounded by an intact buffer.	0.5
25% to <50% of the water/wetland edge is bounded by an intact buffer.	0.25
0% to <25% of the water/wetland edge is bounded by an intact buffer. Variable is recoverable and sustainable through natural processes and under current conditions.	0.1
0% to <25% of the water/wetland edge is bounded by an intact buffer. Variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: BUFFER WIDTH

Definition: Mean width of the buffer (20 feet perpendicular to and outward from the water/wetland edge or to the top of the contributing area divide whichever is less). The buffer must (1) be vegetated with herbaceous species, (2) not have evidence of increased area and/or rate of sediment deposition, and (3) have an unfractured restrictive layer.

Measurement Protocol: Within the assessment area, measure the mean width of the water/wetland buffer. A minimum of four measurements should be made to calculate the mean width. Measurements are made perpendicular to the water/wetland edge a maximum distance of 20 feet (20 feet is the maximum width of the buffer, by definition). Compare the mean buffer width to all the descriptions provided in the scaling for the $V_{BUFFWIDTH}$ variable and choose the lowest score that appropriately describes the mean width of the buffer and/or the recoverability of the width of the buffer.

Scaling: Buffer widths were defined as 20 feet or to the top of the contributing area, whichever was the lesser distance. The buffer must (1) be greater than one foot wide, (2) be vegetated with herbaceous species, (3) have no evidence of increased sediment deposition, and (4) have an unfractured restrictive layer. The distance to disturbance was determined by measuring from the water/wetland boundary to the nearest disturbance within the buffer. This was performed at multiple points and a mean distance to disturbance was reported.

The data are bimodal. Buffer widths tended to be greater than or equal to 20 feet or 0 feet. The bimodal nature of the data did not allow a determination whether relationships between buffer widths and ecosystem attributes and processes (*e.g.*, sediment accretion) were linear or curvilinear. Thus, the relationship was assumed to be linear.

Confidence: Medium.

$V_{BUFFWIDTH}$: Buffer Width

Measurement or Condition	Index
Mean buffer width is greater than or equal to 20 feet **or** to top of contributing area.	1.0
Mean buffer width is between 15 and 20 feet **or** to top of contributing area.	0.75
Mean buffer width is between 10 and 15 feet **or** to top of contributing area.	0.5
Mean buffer width is between 0 and 15 feet **or** to top of contributing area.	0.25
Mean buffer width is between 0 and 5 feet **or** to the top of contributing area. Variable is recoverable and sustainable through natural processes and under current conditions.	0.1
Mean buffer width is between 0 and 5 feet **or**. Variable is not recoverable and sustainable through natural processes and under current conditions or to top of contributing area.	0.0

Variable: DEPRESSION/SLOPE INDICATOR SPECIES

Definition: The presence of plant taxa that are restricted to, or indicative, characteristic or typical of, depression and slope waters/wetlands in the Sacramento Region of the Central Valley of California.

Measurement Protocol: A list of the dominant taxa (*i.e.*, all taxa that make up > 50% of the total vegetative cover, plus taxa that make up > 20% total cover) is made from visual inspection of 1 square meter plots in the assessment area. At least 10 plots should be made at random points within the assessment area. Dominant taxa are compared with lists of restricted or associated plants compiled from the literature, and the percent of taxa that is restricted or associated is calculated by dividing restricted/associated taxa by total taxa and multiplying by 100. Compare the percent indicators to all the descriptions provided in the scaling for the $V_{DSINDSP}$ or the V_{RINDSP} variable and choose the lowest score that appropriately describes the condition. This variable can be assessed when vegetation is senescent if taxa can be identified.

Scaling: The presence of indicator species was assessed by listing the dominant taxa within the assessment area and checking these taxa against lists of taxa restricted to, or typically associated with ephemeral depression or slope wetlands in the Central Valley of California. The lists were compiled from (1) data collected in depression and slope waters/wetlands on Borden Ranch and (2) the literature on the vegetation of vernal pools in the Central Valley. The variable was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

Note: Confidence in this variable is medium because $V_{DSINDSP}$ was scored during the dry stage when vegetation is senescent, due to constraints of time. Because plant identifications are more difficult at this time, some taxa could only be identified to genera. The scoring of this variable is conservative, however, because taxa that could be identified only to genus level were classified as restricted or associated if any members of that genus are restricted or associated in California.

$V_{DSINDSP}$: Depression/Slope Indicator Species

Measurement or Condition	Index
> 90% of the dominant taxa present are restricted to ephemeral depression/slope wetlands in California (see attached lists),	1.0
> 50% to 90% of the taxa present are restricted to ephemeral depression/slope wetlands in California or are frequently or typically associated with depression and slope waters/wetlands in California (see attached lists).	0.75
a) at least 50% of the dominant taxa present are restricted to, or are frequently or typically associated with, depression and slope waters/wetlands in California; **and** b) other taxa present are from the surrounding annual grasslands (*e.g.*, *Lolium*, *Hordeum*, *Briza*, *Juncus bufonius*).	0.5
a) 25% to 50% of the dominant taxa present are restricted to, or are frequently or typically associated with, depression and slope waters/wetlands in California; **and** b) > 50% of the dominant taxa are typical of more permanently wet soils (*e.g.*, *Typha*, *Salix*, *Cyperus*, *Cynodon*, *Erodium*, *Echinochloa*, *Juncus*) or adventive annuals from more open, disturbed habitats (*e.g.*, *Atriplex*, *Rumex*, Chenopodiaceae, *Matricaria*, *Lolium*, *Polypogon*, *Malva*)	0.25
CONDITION 1: a) < 25% of the taxa present are restricted to, or are frequently or typically associated with, depression and slope waters/wetlands in California; **and** b) > 50% of the taxa are typical of more permanently wet soils (see list above) or open, disturbed habitats (see list). **OR** **CONDITION 2:** No vegetative cover, but variable is recoverable and sustainable through natural processes and under current conditions.	0.1
No vegetative cover; variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: DEPRESSION/SLOPE VEGETATION ABUNDANCE

Definition: Characteristics of vegetation abundance and structure in the waters/wetland (including height, cover, stem density, spatial distribution, and phenological sequence).

Measurement Protocol: Measurement of this variable is keyed to the different stages in the wet-to-dry cycle that characterizes depression, slope and riverine wetlands on Borden Ranch. Depending on the time of year when the assessment is conducted, choose one of the three stages in the cycle, either wetting/wet, drying, dry (see Glossary for definitions of stages) and use the descriptions for that stage. Vegetative cover is visually estimated by assessing the percent cover of actively photosynthesizing vegetation within 1 square meter plots. At least 10 plots should be made at random points within the assessment area and an average of these 10 observations should be calculated. The vegetation within the water/wetland is visually inspected (*i.e.*, physiognomy, spatial distribution of species, and species composition) to determine if vegetation within the assessment area can be distinguished from the vegetation outside the assessment area. Compare percent cover, distinctness of the vegetation within the assessment area, and species composition to all descriptions provided in the scaling for the $V_{DSVEGABUND}$ variable and choose the lowest score that appropriately describes the condition.

Scaling: Vegetation abundance was assessed by measuring the percent cover and species composition of the dominant taxa, as well as describing the nature of the boundary between the vegetation of the assessment area and vegetation of the surrounding areas. This variable was scaled separately for the wetting wet, drying and dry stages of the seasonal wet-to-dry cycle, because vegetation abundance and species composition both change over time. The $V_{VEGABUND}$ variable was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

$V_{DSVEGABUND}$: Depression/Slope Vegetation Abundance

Measurement or Condition	Index
Drying Stage: a) dominants are low growing (<1') native, annual forbs; **and** b) form concentric rings of different species along gradient from depression center to margin (may be one 'ring' in slopes); **and** c) boundaries between depression/slope vegetation and surrounding grassland vegetation are distinct and clear; **and** d) cover of vegetation in waters/wetlands lower (*i.e.*, 63% to 85%) than in surrounding grasslands (*i.e.*,·90% to 100%).	1.0
Dry Stage: a) vegetative cover is <5% **and;** b) boundaries of the plant community are clear and distinct either as a water-filled depression, or as dry, open ground with a cover of senescent *Eryngium*; **and** c) no invasion by species from the surrounding annual grasslands.	
Wetting/Wet Stage: Data not collected.	

Measurement or Condition	Index
Drying Stage: a) dominants are low growing, annual forbs; **and** b) form concentric rings along gradient from depression center to margin; **and** c) boundaries between depression vegetation and grassland are clear and distinct, but margins may contain increased cover from surrounding grassland plants; **and** d) cover of vegetation in the margins >85% where grassland species have invaded. **Dry Stage**: a) vegetative cover is <5%; **and** b) boundaries of plant community are clearly visible either as water-filled depression, or as dry open ground which contains mostly senescent *Eryngium*; **and** c) may contain some species from the surrounding annual grasslands. **Wetting/Wet Stage: Data not collected.**	0.75
No standard for this score.	0.5
All Stages: a) cover of spring/summer vegetation is >85% and >50% of dominants area non-native plants typical of more permanently wet soils (*e.g.*, *Echinochloa*, *Typha*, *Salix*, *Cyperus*, *Rumex*, *Lolium*), or adventives (*e.g. Chenopodium, Taraxacum, Atriplex,*); **and** b) cover/height of vegetation remains unchanged during time of year when depressions/slopes are normally dry (*i.e.*, summer); **and** c) no distinct boundary is recognizable between vegetation in depressions/slopes and surrounding area; **and** d) no clear wetting/wet stage (*i.e.*, standing water), although vegetation may be senescent during late fall/winter months.	0.25
All Stages: a) vegetative cover is <5% at all times; **and** b) during late fall/winter boundaries of original plant community may be visible with some ponding of water; **and** c) variable is recoverable and sustainable through natural processes and under current conditions.	0.1
All Stages: a) vegetative cover is <5 at all times; **and** b) boundaries of original plant community are not visible; **and** c) no short (>7 days) or very short (i.e. >1 day) ponding of water occurs during or after winter rains; **and** d) variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: LAND USE OR CONDITION

Definition: *Predominant land use or condition within a 3000-foot radius of the centroid of the assessment site.*

Measurement Protocol: This variable is assessed through visual observations during site review and/or by using other available information (*e.g.*, aerial photos, maps etc.). Recent aerial photographs can facilitate the identification of land uses within the 3,000-foot radius. Compare to all the descriptions provided in the scaling for the $V_{LANDCOND}$ variable and choose the lowest score that appropriately describes the predominant (*i.e.*, >50%) land use within a 3,000-foot radius of the centroid of the assessment area.

Scaling: The predominant use and condition of the area within a circle with a 3000-foot radius centered on the centroid of the assessment site was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

$V_{LANDCOND}$: Land Use or Condition

Measurement or Condition	Index
Land is subject to a management plan that includes either light grazing or no grazing with a fire management component. The plan has the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land is subject to a management plan that includes either moderate to heavy grazing or no grazing and no fire management. The plan does not have the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
No standard for this score.	0.5
The area is characterized by a) a ripped soil profile, **and** b) a fractured restrictive layer, **and** c) cultivated crops that have been in place for 2 or more years (*e.g.*, vineyards or orchards).	0.25
CONDITION 1: The area is characterized by a) a ripped soil profile, **and** b) a fractured restrictive layer, **and** c) cultivated crops that have been in place for 2 or more years (*e.g.*, vineyards or orchards). **OR** **CONDITION 2:** The area is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) no cultivated crops (*e.g.*, vineyards or orchards), d) no disking or rolling in preparation for planting, and e) some vegetation and/or microtopographic variation exists.	0.1
The area is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) no cultivated crops (*e.g.*, vineyards or orchards), d) disking or disking and rolling in preparation for planting, and e) little to no vegetation and/or microtopographic variation exists.	0.0

Variable: LONGITUDINAL CONNECTIONS TO DOWN-GRADIENT WATERS/WETLANDS

Definition: Land use or condition of the longitudinal connections to down-gradient waters/wetlands within 500 feet of the assessment area or to the next water/wetland (measurement from top of assessment area to 500' down-gradient). Flow-through depression waters/wetlands often form the headward extent of slope waters/wetlands, and slope waters/wetlands often form the headward extent of riverine waters/wetlands. The connections provide pathways for surface and shallow subsurface water flow, particulate transport, organic carbon export, and flora and fauna movement.

Measurement Protocol: Make a visual assessment of the predominant (*i.e.*, >50%) land use and/or condition of the longitudinal hydrologic connection(s) to down-gradient waters/wetlands within 500 feet of the assessment area. Compare to all the descriptions provided in the scaling for the $V_{LONGCON}$ variable and choose the lowest score that appropriately describes the predominant land use or condition of the longitudinal hydrologic connection(s) to down-gradient waters/wetlands.

Scaling: The predominant use and condition of the longitudinal connections to down-gradient waters/wetlands was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

$V_{LONGCON}$: Longitudinal Connections to Downgradient Waters/Wetlands

Measurement or Condition	Index
Land is subject to a management plan that includes either light grazing or no grazing with a fire management component. The plan has the explicit intent to a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land is subject to a management plan that includes either moderate to heavy grazing or no grazing and no fire management. The plan does not have the explicit intent to a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
CONDITION 1: The longitudinal connection is characterized by a) maintenance plowing, disking, harrowing, or raking **and** b) an unfractured restrictive layer. **OR** **CONDITION 2:** The longitudinal connection is characterized by a) accelerated rates of sediment deposition **and** b) an unfractured restrictive layer. **OR** **CONDITION 3:** The longitudinal connection is characterized by a) discontinuous disruptions to surface and/or shallow subsurface water flow (*e.g.*, road crossings, buried pipelines, and small ripped areas), **and** b) an unfractured restrictive layer.	0.5
The longitudinal connection is characterized by a) a ripped soil profile, **and** b) a fractured restrictive layer, **and** c) cultivated crops (*e.g.*, vineyards or orchards), **and** d) no maintenance plowing, disking, harrowing, or raking between rows, **and** e) abundant herbaceous vegetation growing between rows.	0.25

Measurement or Condition	Index
CONDITION 1: The longitudinal connection is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer; **and** c) cultivated crops (*e.g.*, vineyards or orchards); **and** d) maintenance plowing, disking, harrowing, or raking between rows; **and** e) little to no herbaceous vegetation growing between rows. OR **CONDITION 2:** The longitudinal connection is characterized by a) a ripped soil profile, b) a fractured restrictive layer, and c) no cultivated crops (*e.g.*, vineyards and orchards).	0.1
Longitudinal connections disconnected by anthropogenic activities and no longer exist (*e.g.*, channel bed cannot be identified).	0.0

Variable: PERCENT COVER OF ORGANIC MATERIAL IN THE WATER/WETLAND

Definition: Percent cover of the organic detrital material on the soil surface. The organic detrital material is composed of algal mats and/or accumulated plant litter from forbs, graminoids, ferns, and fern allies.

Measurement Protocol: Make a visual assessment using 1 square meter plots of the percent cover of organic material within the assessment area. At least 10 plots should be made at random points within the assessment area and an average of these 10 observations should be calculated. Compare the average percent cover of organic material in the assessment area to all the descriptions provided in the scaling for the V_{OM} variable and choose the lowest score that appropriately describes the percent cover of organic material.

Scaling: The percent cover from organic matter in the assessment area was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: High

V_{OM}: Organic Material

Measurement or Condition	Index
Depression and Slope: Cover of organic material (OM) is > 75%. **Riverine:** Cover of OM is > 50% to 70%; OM can be composed of algal and/or plant material accumulating where the kinetic energy of surface water is low.	1.0
Depression and Slope: Cover of OM is > 50% to 75%. **Riverine:** Cover of OM is > 30% to 50%; OM can be composed of algal and/or plant material accumulating where the kinetic energy of surface water is low.	0.75
Depression and Slope: Cover of OM is > 25% to 50%. **Riverine:** Cover of OM is > 20% to 30%,	0.5
Depression and Slope: Cover of OM is > 10% to 25%. **Riverine:** Cover of OM is > 5% to 20%.	0.25
Depression and Slope: **CONDITION 1:** Cover of OM is < 10%. **OR** **CONDITION 2:** Cover is high (> 90% locally) in response to irrigation return flow or in areas where irrigation has caused algal blooms in areas of ponding on the surface. **Riverine**: **CONDITION 1:** Cover of OM is <5%. **OR** **CONDITION 2:** Cover is high (> 60% locally) in response to irrigation return flow or in areas where irrigation has caused algal blooms in areas of ponding on the surface.	0.1
Depression, Slope, and Riverine: No OM. Variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: OUTLET

Definition: Presence or absence and elevation of a natural or constructed surface and shallow subsurface water outlet.

Measurement Protocol: Determine the presence or absence of a hydrologic outlet in the depressional wetland and thus if the depressional water/wetland is an isolated or flow-through depression. If an outlet is absent, the depression is thus isolated and scores a 1.0 on the variable scaling. If an outlet is present, determine if the outlet has been altered (*i.e.*, raised or lowered). If the outlet has been artificially raised it scores a 0.75 on the variable scaling. If the outlet has been lowered from its original elevation (*i.e.*, excavated), measure the relative elevation of the excavated outlet. Compare the elevation of the excavated outlet to the elevation of the maximum depth of the depression. Compare to all the descriptions provided in the scaling for the V_{OUT} variable and choose the lowest score that appropriately describes the elevation of the excavated outlet.

Scaling: Outlets were defined as swale features that connected the assessment site to other waters/wetlands. The swale features were waters/wetlands or non-waters/wetlands. The outlet elevation relative to the jurisdictional boundary was determined by surveying relative elevations of the waters/wetlands boundary, determining a mean relative elevation of the boundary, and surveying the relative elevation of the crest in the outlet swale feature. Data were plotted and assessed in the context of field notes and photographs.

Confidence: Medium.

V_{OUT}: Outlet

Measurement or Condition	Index
Closed: No outlet present. Flow-Through: Outlet present. Elevation of the outlet not modified by anthropogenic activities.	1.0
Closed: No score for this scale. Flow-Through: Outlet present. Outlet elevation raised resulting in surface water impoundment.	0.75
Closed and Flow-Through: Outlet present. Outlet excavated to a depth of up to 50% of the depression depth.	0.5
Closed and Flow-Through: Outlet present. Outlet excavated to a depth of up to 75% of the depression depth.	0.25
Closed and Flow-Through: Outlet present. Outlet excavated to a depth of up to 90% of the depression depth.	0.1
Closed and Flow-Through: Outlet excavated to the maximum depth of the depression. Depression drains and does not store surface water.	0.0

Variable: PERCENT OF NATIVE PLANT SPECIES

Definition: The percent of the dominant plant taxa present in the waters/wetlands that are native to California.

Measurement Protocol: A list of the dominant taxa (*i.e.*, all taxa that make up > 50% of the total vegetative cover plus taxa that make up > 20% total cover) is made from visual inspection of 1 square meter plots in the assessment area. At least 10 plots should be made at random points within the assessment area. Dominant taxa are recorded as either natives or non-natives using the Jepson Manual. The percent of native taxa is calculated by dividing the number of native taxa by total taxa. Compare the percent native taxa to all the descriptions provided in the scaling for the V_{PRATIO} variable and choose the lowest score that appropriately describes the condition. This variable can be assessed when senescent vegetation is present if taxa can be identified.

Scaling: The percent of native species was assessed by listing the dominant taxa within the assessment area and checking these taxa against the Jepson Manual to determine native/non-native status in California. The variable was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium

Note: Confidence in this variable is medium because V_{PRATIO} was scored during the dry stage when vegetation is senescent, due to constraints of time. Because plant identifications are more difficult at this time, some taxa could only be identified to genera. The scoring of this variable is conservative, however, because taxa that could be identified only to genus level were classified as native if any members of that genus are native to California.

V_{PRATIO}: Percent of Native Plant Species

Measurement or Condition	Index
Depression, Slope, and Riverine: > 90% of the taxa are native.	1.0
Depression and Slope: a) >70% to 90% native taxa; **and** b) individuals from surrounding non-native annual grasslands may be present. **Riverine**: 90 a) >50% to 75% of the taxa are natives; **and** b) individuals from surrounding non-native annual grasslands may be present.	0.75
Depression and Slope: a) >50% to 70% native taxa; **and** b) non-native taxa are from the surrounding annual grasslands (*e.g.*, *Lolium*, *Briza*, *Aira*, *Hordeum*, *etc.*). **Riverine**: a) >25% to 50% native taxa; **and** b) non-native taxa from surrounding annual grasslands (*e.g.*, *Lolium*, *Hordeum*, *Briza*, *Aira*), or non-native adventives (*e.g.*, *Taraxacum*, *Atriplex*, *Salsola*, *Rumex*) are present.	0.5

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Percent of Native Plant Species cont.

Measurement or Condition	Index
Depression and Slope: a) >20% to 50% are natives; **and** b) >50%of taxa are either non-natives typical of more permanently wet habitats (*e.g.*, *Echinochloa*, *Erodium*, *Ranunculus*, *Cyperus*), or taxa typical of open, disturbed habitats (*e.g.*, *Chenopodium*, *Rumex*, *Salsola*, *Taraxacum*). **Riverine**: a) >5% to 25% native taxa; **and** b) >75% are non-native taxa typical of more permanently wet habitats (*e.g.*, *Echinochloa*, *Cynodon*, *Erodium*, *Ranunculus*, *Cyperus*) or taxa typical of open, disturbed habitats (*e.g.*, *Chenopodium*, *Rumex*, *Salsola*, *Taraxacum*).	0.25
Depression and Slope: CONDITION 1: <20% native taxa. **OR** CONDITION 2: No vegetation present. Variable is recoverable and sustainable through natural processes and under current conditions. **Riverine**: CONDITION 1: <5% native taxa. **OR** CONDITION 2: No vegetation present. Variable is recoverable and sustainable through natural processes and under current conditions	0.1
Depression, Slope, and Riverine: There is no vegetation present. Variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: SEDIMENT DEPOSITION

Definition: Area and/or rate of sediment deposition in the water/wetland.

Measurement Protocol: Make a visual assessment of the area and/or rate of sediment delivery to the water/wetland within the assessment area. Compare to all the descriptions provided in the scaling for the V_{SED} variable and choose the lowest score that appropriately describes the condition/status of sediment delivery to the water/wetland within the assessment area.

Scaling: The approximate area and volume of fill in the assessment site was determined by field measurements. Approximate areas of fill were determined through measurements of aerial coverage. The approximate depths of fill were measured in a few areas, and a mean depth of fill was calculated. The approximate volumes were determined by multiplying the aerial coverage of fill by the mean depth of fill.

This scaling for this variable was based upon the V_{SED} variable from the *Operational Draft Guidebook to HGM Functional Assessments in Temporary and Seasonal Depressional Waters/Wetlands in the Northern Prairie Pothole Region* (*The Northern Prairie Depressional HGM Guidebook*)(Lee *et al.* 1997). *The Northern Prairie Depressional HGM Guidebook* has been through peer review and is one of the most mature HGM guidebooks in the nation. The scaling was modified by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: High.

V_{SED}: Sediment Deposition

Measurement or Condition	Index
No evidence of increased area or rate of sediment deposition in the water/wetland from anthropogenic sources.	1.0
Historical evidence suggests that the area and/or rate of sediment deposition in the water/wetland increased in the past. a) Evidence may include, but is not limited to, stabilized fans and/or sediment layering on the soil surface; **and** b) The current condition is stable as evidenced by intact plant communities and/or the development of distinct soil structural and morphological features in the sediment layers.	0.75
The area and/or rate of sediment deposition in the water/wetland has slightly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, discontinuous bank shear, a veneer of fine sediment located where kinetic energy of surface water is low (*e.g.*, small pits), and/or sediment staining on detritus and/or plant materials; **and**. b) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.5
The area and/or rate of sediment deposition in the water/wetland has greatly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, recently developed and/or developing fans and sediment layering on the soil surface; **and** b) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.25
The area and/or rate of sediment deposition in the water/wetland has greatly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, recently ripped soil profiles; **and** b) 100% of the assessment site ***area*** is filled; **and** c) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.1
The area and/or rate of sediment deposition in the water/wetland has greatly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, recently ripped, disked, and rolled soil profiles; **and**. b) 100% of the assessment site ***volume*** is filled **and** c) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.0

Variable: SOIL PROFILE INTEGRITY

Definition: Presence and condition of the soil profile in the assessment area.

Measurement Protocol: Excavate a representative soil pit in the assessment area. Characterize the soil pit consistent with NRCS protocols (USDA 1993). Compare to all the descriptions provided in the scaling for the $V_{SOILINT}$ variable and choose the lowest score that appropriately describes the predominant (*i.e.*, >50%) soil condition of the water/wetland within the assessment area.

Scaling: Soil pits were excavated to practicable depths, usually to the depth of the restrictive layer. Identification and nomenclature of the soil horizons were consistent with NRCS guidance. Colors were determined from wet samples and were reported as Munsell Soil Colors. The $V_{SOILINT}$ variable was scaled by the interdisciplinary team and is based upon the soil pit data and best professional judgment.

Confidence: High.

$V_{SOILINT}$: Soil Profile Integrity

Measurement or Condition	Index
Depression and Slope: a) Soil profile is intact and undisturbed. Typically, the soil profile has a thin O horizon over well-developed A (and/or E), B, and C horizons. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. **Riverine:** a) Soil profile is intact and undisturbed. Typically, the soil profile consists of Entisols that are fluvial in origin. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured.	1.0
Depression and Slope: a) Soil profile is truncated due to compaction by domestic livestock. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. **Riverine:** **CONDITION 1:** a) Soil profile is truncated due to compaction by domestic livestock. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. ***CONDITION 2:*** a) Soil profile consists of Entisols that are fluvial in origin. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured; **and** c) A veneer of fine sediment is present. Typically, the veneer of fine sediment is located where kinetic energy of surface water is low (*e.g.*, small pits).	*0.75*
Depression and Slope: a) Soil profile has an Ap horizon due to plowing, disking, harrowing, or raking. Restrictive layers, where present, occur in the B and/or C horizon(s) **and** b) Restrictive layers, where present, are unfractured. **Riverine:** a) Soil profile consists of Entisols that are fluvial in origin. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured; **and** c) Soil profile altered by discontinuous disruptions (*e.g.*, road crossings and/or small ripped areas).	0.5
Depression and Slope: a) Soil profile has not been ripped, but it is buried under recently deposited sediment (*e.g.*, silt, sand, gravel, and/or cobble). Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. **Riverine:** a) Soil profile plowed, disked, harrowed, or raked. An Ap horizon may be present.. Restrictive layer(s), where present, occur in the B and/or C horizons; **and** b) Restrictive layer(s), where present, are unfractured.	0.25

Measurement or Condition	Index
Depression, Slope, and Riverine: a) Soil profile has been ripped and, possibly, disked, rolled, or excavated. C horizons dominate throughout the soil profile.; **and** b) Restrictive layers, where present, are fractured.	0.1
Depression, Slope, and Riverine: The substrate is anthropogenically-derived impervious surface (*e.g.*, roads, parking lots, buildings).	0.0

Variable: WETLAND DENSITY

Definition: The percent of the total area that is occupied by depressional, slope, and riverine waters/wetlands within a 3000-foot radius of the centroid of the assessment site.

Measurement Protocol: First determine which geomorphic surface the assessment area is located on (*e.g.*, high terrace, dissected terrace face, Holocene terrace and floodplain, etc.). This will determine which set of variable scaling scores to use for the assessment area water/wetland. Next determine the density of waters/wetlands through visual observations during site review and/or by using other available information (*e.g.*, aerial photos, maps, etc.). Recent aerial photographs can facilitate the identification of wetland types within the 3,000-foot radius. Compare the density to all the descriptions provided in the scaling for the V_{WETDEN} variable and choose the lowest score that appropriately describes the density of waters/wetlands within a 3,000-foot radius of the centroid of the assessment area.

Scaling: The percent of the total area within a 3000-foot radius of the assessment area was determined by measuring the area covered by depressions, slopes, riverine waters/wetlands from 1:6000 scale aerial photographs taken of the Borden Ranch site at the time of the assessment in August 1997. The variable was scaled separately for each geomorphic surface because densities of the different waters/wetland classes differ among high terrace, dissected terrace face and Holocene terrace and floodplain. The variable was scored according to the disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: High

V_{WETDEN}: Wetland Density

Measurement or Condition	Index
High Terrace: Depressional waters/wetlands: >50% to 75% of the total area, with large depressions/complexes of depressions present; Slope waters/wetlands: >50% to 75% of the total area; with large complexes of slopes/depressions Riverine waters/wetlands: >5% to 10% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: >15% to 25% of the total area, with depressions smaller than on high terrace, often isolated; Slope waters/wetlands: >30% to 50% of the total area Riverine waters/wetlands: >10% to 20% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: >20% to 30% of the total area Slope waters/wetlands: >40% to 60% of the total area Riverine waters/wetlands: >40% to 50% of the total area **AND** No fragmentation due to anthropogenic activities	1.0
High Terrace: Depressional waters/wetlands: >40% to 50% of the total area Slope waters/wetlands: >40% to 50% of the total area Riverine waters/wetlands: >5% to 10% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: >10% to 15% of the total area Slope waters/wetlands: >20% to 30% of the total area Riverine waters/wetlands: >5% to 10% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: >10% to 20% of the total area Slope waters/wetlands: >30% to 40% of the total area Riverine waters/wetlands: >30% to 40% of the total area **AND** Fragmentation by fencing, roads and activities associated with moderate to heaving grazing.	0.75

V_{WETDEN}: **Wetland Density** (cont)

Measurement or Condition	Index
High Terrace: Depressional waters/wetlands: >20% to 40% of the total area, with few large, connected complexes Slope waters/wetlands: >20% to 40% of the total area Riverine waters/wetlands: >1% to 5% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: >5% to 10% of the total area Slope waters/wetlands: >10% to 20% of the total area Riverine waters/wetlands: > 1% to 5% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: >5% to 10% of the total area Slope waters/wetlands: >20% to 30% of the total area Riverine waters/wetlands: >20% to 30% of the total area **AND** Fragmentation due to large areas with fractured restrictive layers (*e.g.* ripped and disked or ripped, disked and cultivated)	0.5
High Terrace: Depressional waters/wetlands: >10% to 20% of the total area, with no large connected complexes Slope waters/wetlands: >10 to 20% of the total area Rverine waters/wetlands: <1% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: > 1% to 5% of the total area Slope waters/wetlands: >5 to 10% of the total area Riverine waters/wetlands: <1% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: <5% of the total area Slope waters/wetlands: >10% to 20% of the total area Riverine waters/wetlands: >10% to 20% of the total area **AND** Fragmentation due to large areas with fractured restrictive layers (e.g. ripped and disked or ripped, disked and cultivated)	0.25

V_{WETDEN}: **Wetland Density** (cont)

Measurement or Condition	Index
High Terrace: Depressional waters/wetlands: >5% to 10% total area Slope waters/wetlands: > 5% to 10% total area Riverine waters/wetlands: < 1% total area **Dissected Terrace Face**: Depressional waters/wetlands: < 1% total area Slope waters/wetlands: < 5% total area Riverine waters/wetlands: < 1% total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: > 1% to 5% total area Slope waters/wetlands: > 5% to 10% total area Riverine waters/wetlands: > 5% to 10% total area **AND** Fragmentation due to large areas with fractured restrictive layers (*e.g.*, ripped and disked or ripped, disked and cultivated)	0.1
High Terrace: Depressional waters/wetlands: < 5% Slope waters/wetlands: < 5% Riverine waters/wetlands: none present **Dissected Terrace Face**: Depressional waters/wetlands: none present Slope waters/wetlands: none present Riverine waters/wetlands: none present **Holocene Terrace and Floodplain**: Depressional waters/wetlands: none present Slope waters/wetlands: none present Riverine waters/wetlands: none present	0.0

Variable: WATERSHED CONDITION

Definition: Predominant land use or condition of the contributing area.

Measurement Protocol: Make a visual assessment of the predominant (*i.e.*, >50%) land use and/or condition of the watershed/contributing area. Compare to all the descriptions provided in the scaling for the V_{WSCOND} variable and choose the lowest score that appropriately describes the predominant land use or condition of the watershed/contributing area.

Scaling: The predominant use and condition of the contributing area was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

V_{WSCOND}: Watershed Condition

Measurement or Condition	Index
Land is subject to a management plan that includes either light grazing or no grazing with a fire management. The plan has the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species; **and** b) increase the abundance of native plant species; **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land is subject to a management plan that includes either moderate to heavy grazing or no grazing and no fire management. The plan does not have the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species; **and** b) increase the abundance of native plant species; **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
The watershed is characterized by a) maintenance plowing, disking, harrowing, or raking **and** b) an unfractured restrictive layer.	0.5
The watershed is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer; **and** c) cultivated crops (*e.g.*, vineyards or orchards); **and** d) no maintenance plowing, disking, harrowing, or raking between rows, **and** e) abundant herbaceous vegetation growing between rows.	0.25
CONDITION 1: The watershed is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer; **and** c) cultivated crops (*e.g.*, vineyards or orchards); **and** d) maintenance plowing, disking, harrowing, or raking between rows, **and** e) little to no herbaceous vegetation growing between rows. **OR** **CONDITION 2:** The watershed is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer, **and** c) no cultivated crops (*e.g.*, vineyards and orchards).	0.1
The watershed is characterized by anthropogenic impervious surfaces (*e.g.*, roads, parking lots, buildings).	0.0

Variable: SWALE OR CHANNEL CROSS-SECTION

Definition: Condition of the swale or channel cross-section in terms of widths, depths, cross-sectional areas, and width:depth ratios. NOTE: This variable should not be used to assess isolated depressions; for use in slope, riverine or flow-through depressions.

Measurement Protocol: Make a visual assessment of the channel cross-section/outlet swale. Compare to all the descriptions provided in the scaling for the V_{XS} variable and choose the lowest score that appropriately describes the predominant (*i.e.*, >50%) land use and/or condition of the channel cross-section/outlet swale.

Scaling: Microtopography was measured by surveying changes in ground surface elevation with a laser level. Microtopography transects were established as typical cross-sections in pools and riffles and typical longitudinal profiles. Stations were surveyed at intervals that allowed accurate description of the ground surface. There were no fixed intervals specified. Cross-sectional transects encompassed the width of the water/wetland and 20 foot buffers on each side. Data were plotted and assessed in the context of field notes and photographs.

Confidence: High.

V_{XS}: Swale or Channel Cross-Section

Measurement or Condition	Index
Swale or channel cross-section unaltered as evidenced by intact soil profiles and plant communities.	1.0
Swale or channel cross-section altered by portions of the swale margin/channel bank that have been pushed or pulled in by ripping and/or disking operations and/or cattle grazing (*e.g.*, bank trampling, shear).	0.75
Swale or channel cross-section altered by discontinuous entrenchment (*i.e.*, small areas that are incipient headcuts).	0.5
CONDITION 1: Swale or channel cross-section altered by continuous entrenchment. **OR** **CONDITION 2:** Swale or channel cross-section altered by discontinuous surface disruptions to surface and/or shallow subsurface water flow (*e.g.*, road crossings and small ripped areas).	0.25
a) Swale or channel cross-section altered by continuous surface disruptions to surface and/or shallow subsurface water flow (*e.g.*, entirely ripped and/or disked); **and/or** b) Discontinuous areas with poorly-developed channel cross-sections occur; **and** c) May include areas with infrequent or no maintenance cultivation (*i.e.*, disking, mowing, etc.)	0.1
Swale or channel cross-section altered by continuous surface disruptions to surface and/or shallow subsurface water flow (*e.g.*, entirely ripped and/or disked). No areas with channel cross-sections can be identified.	0.0

VI. Application and Use of HGM Guidebooks and Models

A. Overview

As discussed in the introductory sections of this draft Guidebook, the HGM approach to assessing the functions of waters/wetlands can be used as the basis for (1) impact assessment, (2) restoration design, and (3) development of monitoring protocols and contingency measures (Brinson 1993, Brinson *et al.* 1995, NWSTC 1996). It was the best professional judgment of the EPA/LCLA technical team that use of an HGM approach in performing the rapid assessments of waters/wetland functions required in the AO was appropriate because an HGM approach is consistent with (1) current federal guidance and (2) use of the best current scientific methods. For example, the Clinton Administration has recognized that (1) "...all wetlands are not the same...," (2) a fair, flexible approach should be encouraged that allows restoration of wetland functions, and (3) an HGM approach should be used to measure wetland functions (Clinton Administration Wetland Policy 1993). It is the current administration's goal to encourage development of HGM approaches in hopes that policies regarding "no-net-loss of wetland area and/or functions" can be more consistently and effectively implemented. As detailed in the Federal Register (Federal Register 8/16/96, 6/20/97), HGM is in the process of being developed in several areas of the U.S. and thus adopted by several federal and state agencies.

With particular respect to Borden Ranch, application of the draft HGM approach offered in this guidebook should be accomplished consistent with draft model logic and with conventions for field observations and measurements that are necessary to complete an assessment. This section of the draft Guidebook provides guidance on how to use the draft Guidebook to run HGM models in Borden Ranch waters/wetlands.

B. Recommended Steps for Performing HGM Functional Assessments on Borden Ranch

1. When Not To Use The Draft HGM Models/How To Score Zero

In perturbed landscapes, situations are often encountered where waters/wetlands are entirely eliminated through filling and other activities. Similarly, situations can exist where waters/wetlands are so highly altered that they no longer can be classified within the same HGM class and/or subclass. That is, perturbations can cause a change of state (*i.e.,* from a slope to a riverine waters/wetland). In either of these cases (*i.e.,* elimination or change of state) it is inappropriate to apply the HGM models offered in this draft Guidebook. Therefore, consistent with the draft guidance for use of reference systems in the HGM approach (NWSTC - in Prep), the answers to questions concerning functioning of either former (eliminated) or "state- changed" waters/wetlands is "0." The rationale for this logic is easy. First, waters/wetlands that do not exist cannot perform waters/wetland functions. Second, waters/wetlands that have undergone a change of

state from one class or subclass to another cannot perform functions associated with the initial (reference) state.

2. Recommended Steps and Procedures

Table 9 summarizes the steps for performing an HGM assessment. Steps must be taken in three broad areas: office preparation for field work, field work itself, and preparation of an assessment report. The paragraphs offered below offer rationale and explanations for each step.

Table 9. Recommended Steps and Procedures for Performing HGM Functional Assessments

Office Preparation for the Field

1. Collect and review information relevant to the site.

Field Work

1. Assemble Field Equipment and Field Data Sheets.
2. Identify the HGM Class and Subclass.
3. Bound the assessment area(s).
   a. Determine the geographic extent of any other subclasses that may be present.
   b. Determine the geographic extent of each subclass within the project area.
   c. Determine the geographic extent of each pertinent fire and/or anthropogenic disturbance regime.
4. Score the variables.
   a. Score the variables using standards for that variable listed in the Guidebook HGM models.
5. Calculate the indices of function.
   a. Always calculate the indices of function in the field.
   b. Review functional index scores in the field to ensure accuracy.

Preparation of an Assessment Report

The following outline represents recommended minimum submittals for HGM assessment reports:

1. Introduction to the project and assessment objectives
2. Background of the assessment team members, their expertise and training, including training in HGM
3. A written and graphic documentation of the assumptions used by the assessment team to locate, classify, and bound the assessment area
4. Citations to the guidebook and models used to conduct the assessment
5. A detailed description of the study and assessment areas. Include maps, aerial photos, site photos, soils maps and data, hydrologic data, etc.
6. A detailed discussion of field reconnaissance and sampling protocols
7. A list of all written, cartographic and/or photographic materials used to conduct the assessment and a description of how each piece of information was used.
8. All field data sheets that show variable scores and the rationale used to select a score for each variable
9. All variable scores and calculations of functional capacity indices
10. Any calculations of functional capacity units and their basis.
11. A synthesis and interpretation of assessment results
12. Appendices with data, substantiating information, etc.

Office Preparation for the Field

HGM functional assessments cannot be performed without a thorough review of the assessment area and its context in the field. While the HGM context can be used to structure discussion of ecosystem functions, an HGM functional assessment is not completed until a site review is performed. This is due to the fact that many of the variables require field measurement, and remote techniques lack the precision and accuracy that is required for useful data. The exception to the rule about making a field assessment only occurs in review of designs for development projects and for enhancement, restoration, and creation projects. In these situations, HGM functional assessments can be performed on data collected or synthesized from design documents.

Step 1. Collect and Review Information that is Relevant to the Site

Any field effort requires advance preparation. Prior to performing a field or design document review, it is important to collect information that is relevant to the assessment site. Aerial photographs, topographic maps, geologic maps, soil surveys, NWI maps, jurisdictional delineation documents, and other relevant information should be compiled and reviewed to provide a firm base of knowledge. During this review, particular attention should be paid to the geomorphic setting of the assessment area. Understanding the geomorphic setting will facilitate the functional assessment by providing geomorphic boundaries to the assessment area(s). For instance, data may be compiled that suggest the existence of depression and riverine waters/wetlands in a given area, and these subclasses will need to be assessed separately (see below). Also, attention should be focused on the land-use history and landscape context of the assessment area, as these factors may affect the boundaries of the assessment area(s) or on variable scores. For example, on Borden Ranch a proposed assessment area may be 0.5 acres in size. A portion of it may be moderately to heavily grazed grassland, and 200 acres of it could be recently ripped or converted to vineyards. Such conditions will have bearing on HGM assessment model results and they should be carefully noted. If necessary, separate assessment areas will need to be defined.

Field Work

Step 1. Assemble Field Equipment and Field Data Sheets

The following equipment is a minimum list for use of this draft Guidebook in the field. A more complete list of equipment is provided in Appendix G

a. Field sampling gear required to measure variables
b. Copies of the field forms provided in Appendix G
c. Calculator or computer for calculation of functional scores
d. Supporting documentation (*e.g.*, flora, soil surveys, maps, photos, hydrologic information, etc.)

Step 2. Identify the HGM Class and Subclass Correctly

The draft HGM models presented here are intended for application only within the specified classes and subclasses of waters/wetlands defined for the Borden Ranch. The

subclass profiles presented in Section IV of this draft Guidebook provide detailed profiles of key physical and biological attributes of the depressions, slopes and riverine waters/wetlands on Borden Ranch. In addition, Table 10 is a "Key to Classes and Subclasses of Waters/Wetlands on Borden Ranch." Use of the Key is fundamental to proper application of the draft HGM models. Specifically, draft Guidebook users should run through the key to correctly identify which class and subclass of waters/wetlands on Borden Ranch they intend to assess. This basic classification step will allow Guidebook users to quickly identify the correct draft HGM models for the assessment.

Table 10. Key to Classes and Subclasses of Waters/Wetlands on Borden Ranch, Sacramento and San Joaquin Counties, California.

1a. The water/wetland consists of a depression with or without an outlet. It has an intact restrictive layer and no evidence of very long duration ponding and/or saturation of soils as a result of groundwater upwelling or discharge. - **2**

2a. The water/wetland is a closed depression without an outlet.

3a. Water/wetland has an intact restrictive layer and no evidence of very long duration ponding and/or saturation of soils as a result of groundwater upwelling or discharge through fractures in the restrictive layer - **Depression, Closed and hydrologically isolated (perched).**

3b. Water/wetland has a relatively intact restrictive layer and clear evidence of ponding and/or saturation of soils as result of groundwater upwelling or discharge - **Depression, Closed and discharge (not a subclass addressed by the draft HGM models in this report).**

2b. The water/wetland is a depression with an outlet. The outlet is a jurisdictional water/wetland or non-jurisdictional slope feature that can convey surface and/or shallow subsurface water from the depression down-gradient during periods of high water. Depression may or may not exhibit very long duration ponding and/or saturation of soils as a result of groundwater upwelling - **4**

4a. Depression receives virtually all of its hydrologic inputs from precipitation and from surface and shallow subsurface flow. It does not exhibit plant community or hydric soil characteristics that would indicate very long duration ponding and/or saturation of soils as a result of groundwater upwelling.--- **Depression, surface and shallow subsurface flow-through.**

4b. Depression exhibits very long duration ponding and/or saturation of soils as a result of groundwater upwelling. - **Depression, flow-through, discharge (not a subclass addressed by the draft HGM models in this report).**

1b. The waters/wetland has a generally linear shape. Its slope is nearly level (<1%) to moderate (>2% - <10%). It may or may not have bed and bank channel features and evidence of sediment import, storage and transport - **5**

5a. The water/wetland forms the headward most extent of a drainage network. Its contributing area is relatively small. Its slope is nearly level (<1%) to moderate (>2% and <10%). No channel features (*e.g.,* bed and bank) and no significant sediment import, storage and transport processes are evident. - **Slope, Headward extent of riverine waters/wetlands.**

5b. The water/wetland exists as part of an ephemeral or intermittent drainage network. It is not a perennial stream. Its contributing area is relatively large. Its slope is nearly level (<1%) to moderate (>2% - 10%) or (rarely) steep (>10%). Continuous channel features (*e.g.,* bed and bank) are evident in relatively pristine and in grazed conditions. Sediment import, storage and transport processes are clearly evident. - **Riverine First, Second or Third Order.**

Step 3. Define and Bound the Assessment Area(s)

After classification, the next task in the field is to bound or delimit the assessment area(s). In order to complete bounding, conduct a reconnaissance of the entire study area. Walk completely around the site. Draw a map of the assessment area boundaries and its landscape context. Make sure to observe (1) the range of variation of variable conditions that exist on the site, and (2) landscape context and condition. Note the watershed boundaries and waters/wetlands boundaries. All these areas should be reviewed carefully, particularly those that appear to be distinct from each other during office preparation. It is critical that the assessment area(s) be bounded correctly for three reasons:

First, if the project site includes uplands and wetlands, then the assessment area must be bounded such that only the portion that is part of the waters/wetland subclasses treated by this Guidebook is included in the assessment (Figures 73 and 74). In the case of this draft Guidebook, only depression, slope and riverine waters/ wetlands should be included. Recall, however, that sites that are not currently functioning as waters/wetlands due to natural or anthropogenic disturbance should not be assessed or they should be assigned a score of "0."

Second, if different subclasses exist on the same project site, then separate models must be used in the functional assessments of these areas. For example, where depressional waters/wetlands occur adjacent to riverine waters/wetlands (*e.g.,* active channels and floodplains), each subclass should be assessed using the appropriate model for its subclass.

Third, if different stages of development and/or different disturbance regimes exist on the same project site, then separate functional assessments may need to be performed for each area (Figure 75). For example, consider a project site that contains waters/wetlands within a single subclass (*e.g.*, a third order riverine waters/wetland). If a portion (*e.g.*, the upper one-half) of this waters/wetland is undisturbed, while the lower one-half has been impacted by human disturbance, these areas may need to be separated into two assessment areas.

Step 4. Score the Model Variables

a. Number of Assessments Required and Field Forms

The HGM models in this draft Guidebook are composed of several variables that are combined in a variety of ways in the calculation of the indices of function. Most of the variables are used in several indices. In order to streamline the functional assessment for a particular waters/wetland in a given condition (*e.g.,* current condition), each of the variables called by an individual model should be scored once and tabulated on a field assessment form (Appendix G). If future conditions (*e.g.,* absence of cattle grazing or some proposed restoration activity) need to be assessed, each of the variables called by the model will need to be scored again.

b. Complete Field Measurements of Variable Conditions

In Appendix G, the variables are arranged in alphabetical order. To perform an HGM assessment, each of these variables must be scored according to the measurement protocols detailed in the models.

Do not estimate variable conditions if measurements are required. This will result in significant errors.

Record the measurement result, the associated variable score, and the team's rationale in selecting the variable score on the field data sheet. Please note that the field data sheets include space for recording rationale or making comments on the decision. The authors intent here is to provide model users with an opportunity to make notes on each variable score and to facilitate meaningful discussions at a later date.

Groups of variables require different ranges or scales of observation within the assessment area. For example, the variable "Soil Profile Integrity" ("$V_{soilint}$") requires observations of soil conditions within the waters/wetland; the variable "Watershed Condition" (V_{wscond}) requires observation of the predominant land use or condition of the contributing area. The variable "Wetland Density" (V_{WDEN}) requires observations within 3,000 feet of the centroid of the assessment area. Figures 76 and 77 summarize the scale at which each variable should be observed.

Step 5. Calculate Indices of Function

In order to streamline the functional assessment, functions for depressions, slopes and riverine waters/wetlands and their corresponding indices of function are condensed into field data sheets (Appendix G). The indices of function should be calculated in the field.

Preliminary assessment results should be reviewed by the assessment team members in the field, not in the office.

Again, the field data sheets include space for recording rationale or making comments on the decision with the intent of facilitating meaningful discussions on later dates.

Preparation of an HGM Assessment Report

Consistent with the guidance offered in Table 10, a written report of all HGM assessment results should be prepared by the assessment team. Table 10 lists minimum submittals for such a report.

Figure 73. HGM Assessment Bounding

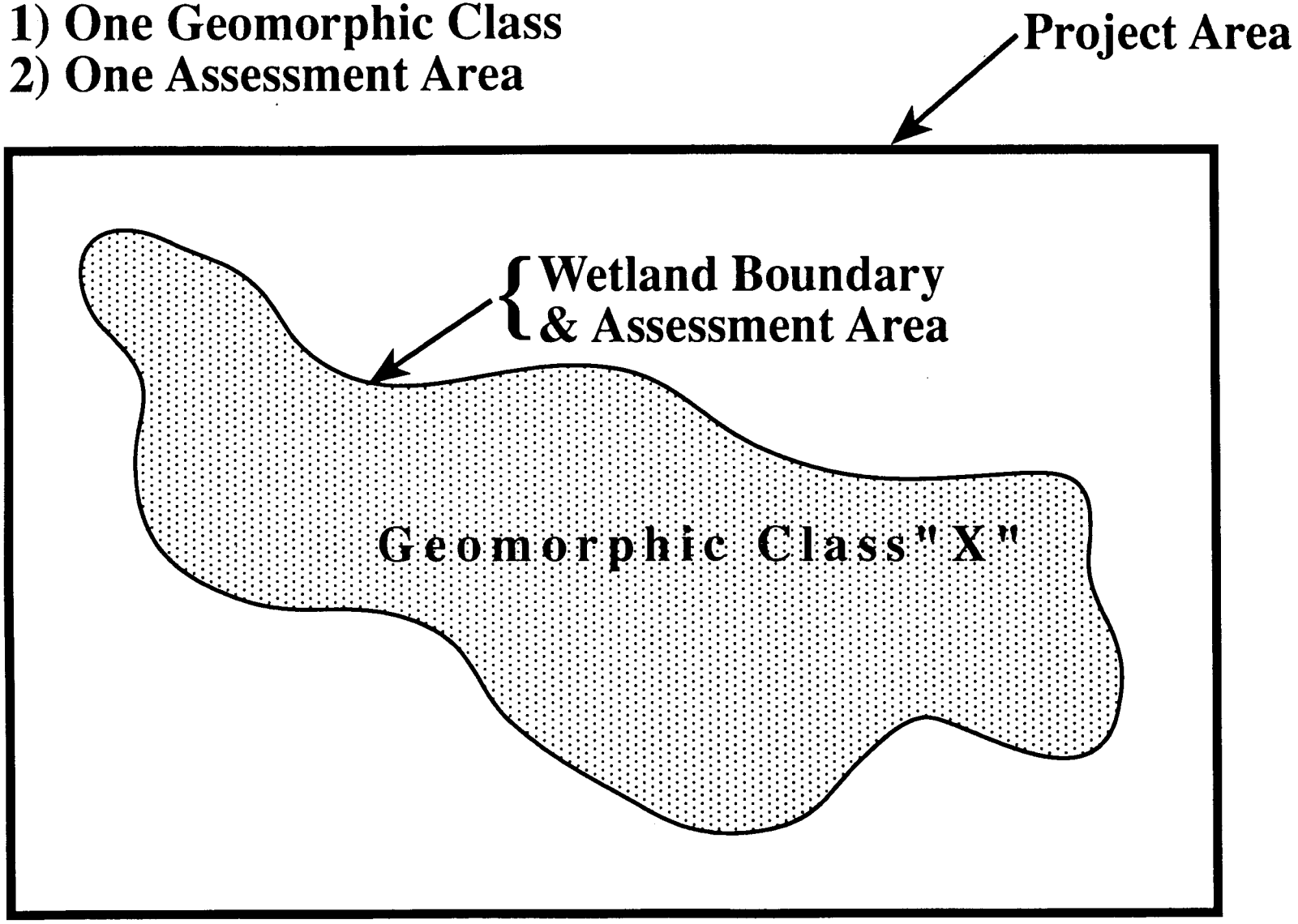


Figure 74. HGM Assessment Bounding

1) One Geomorphic Class
2) One On Site Assessment Area (Project Area) &

Separate Off Site &/or Cumulative Effects Assessment

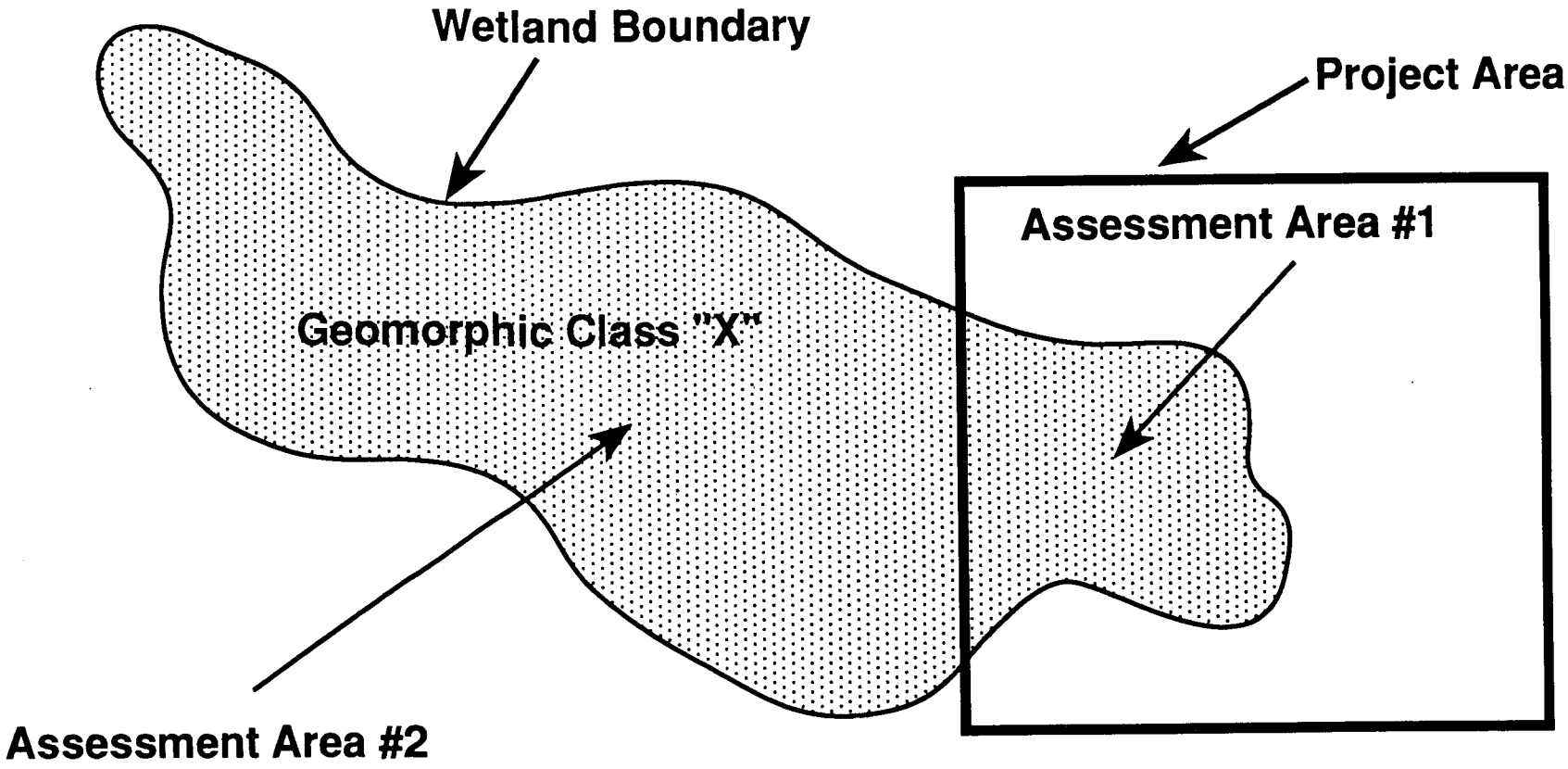


Figure 75. HGM Assessment Bounding

1) One Geomorphic Class
2) Two Assessment Areas

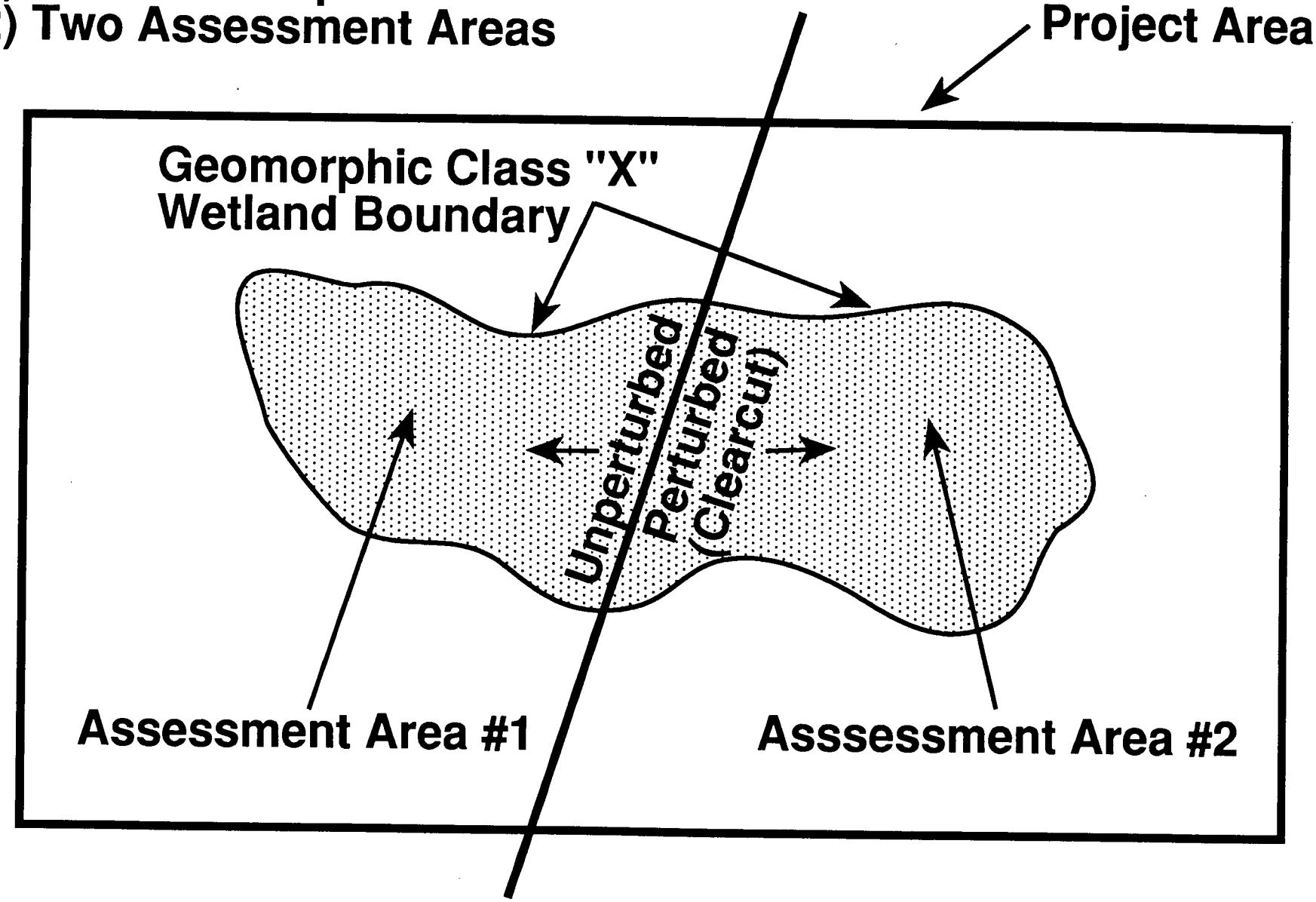
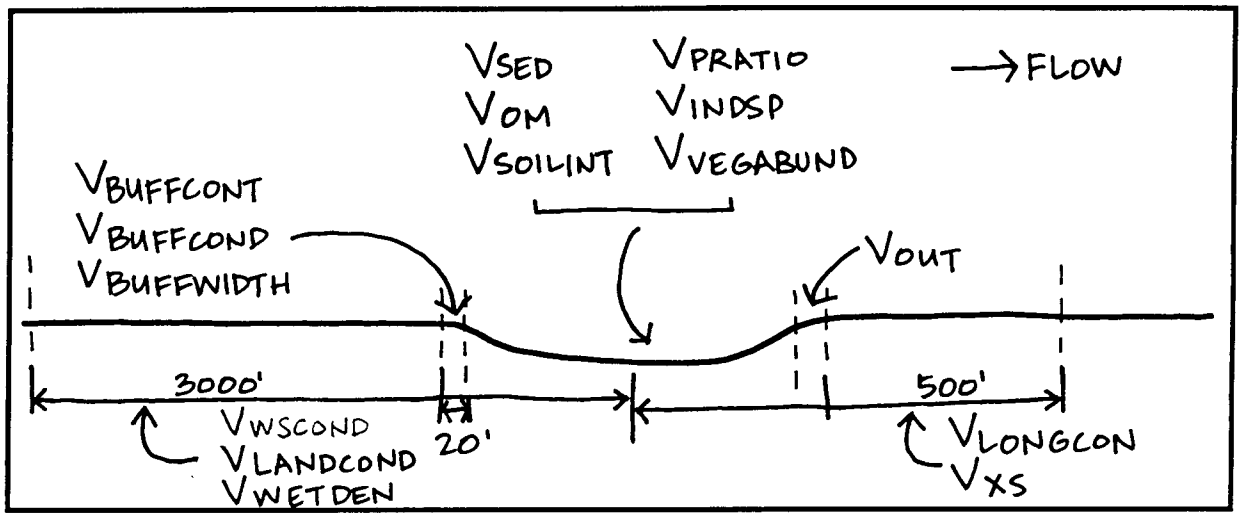
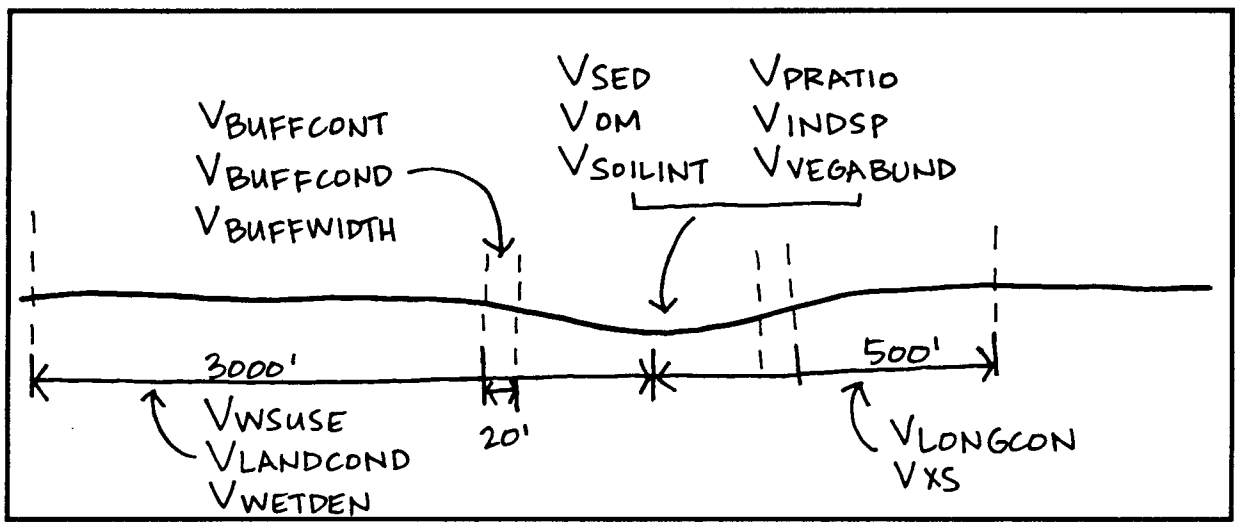


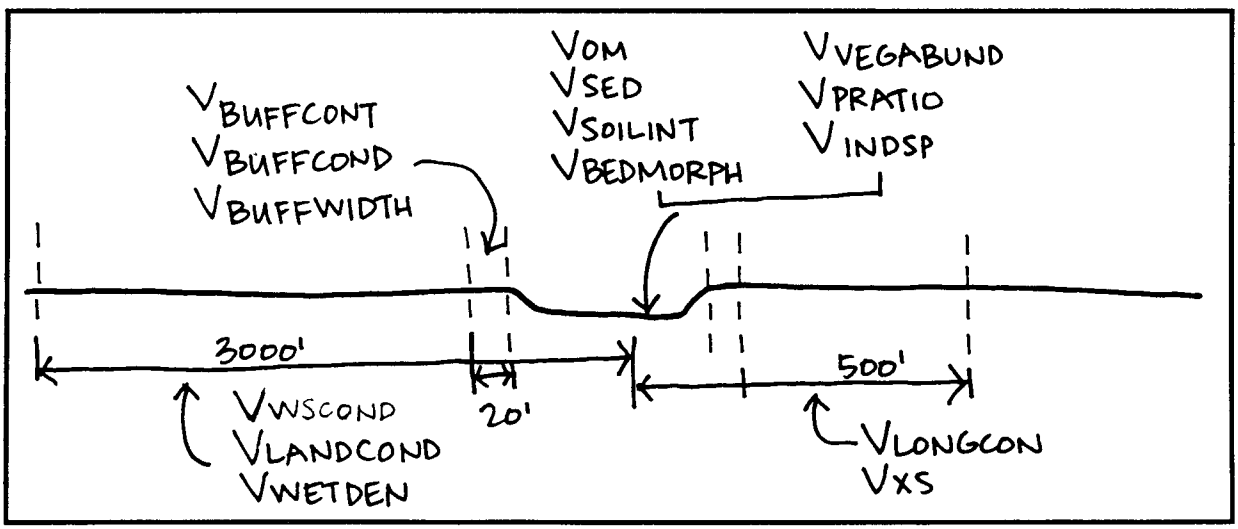
Figure 76. Cross-Sections Locating Areas In Which To Focus the Assessment of Variables in Wetlands on the Borden Ranch Property



Depression



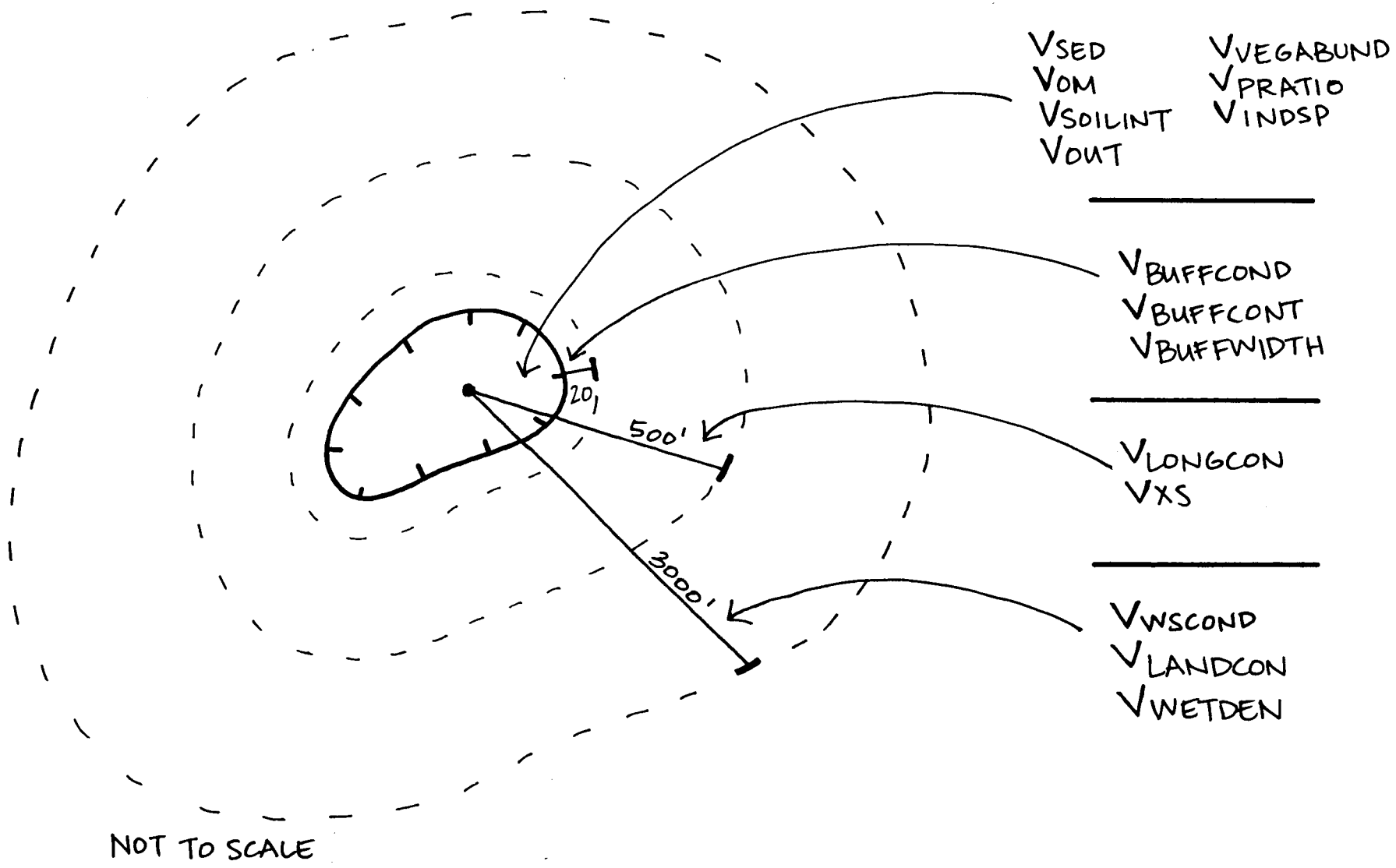
Slope



Riverine

NOT TO SCALE

Figure 77. Plan View Locating Areas In Which To Focus the Assessment of Variables in Depression Wetlands on the Borden Ranch Property



APPENDIX G

FIELD ASSESSMENT FORMS FOR

APPLICATION OF THE HGM MODELS

Borden Ranch

Complete Gear List For Running Draft HGM Functional Assessment Models

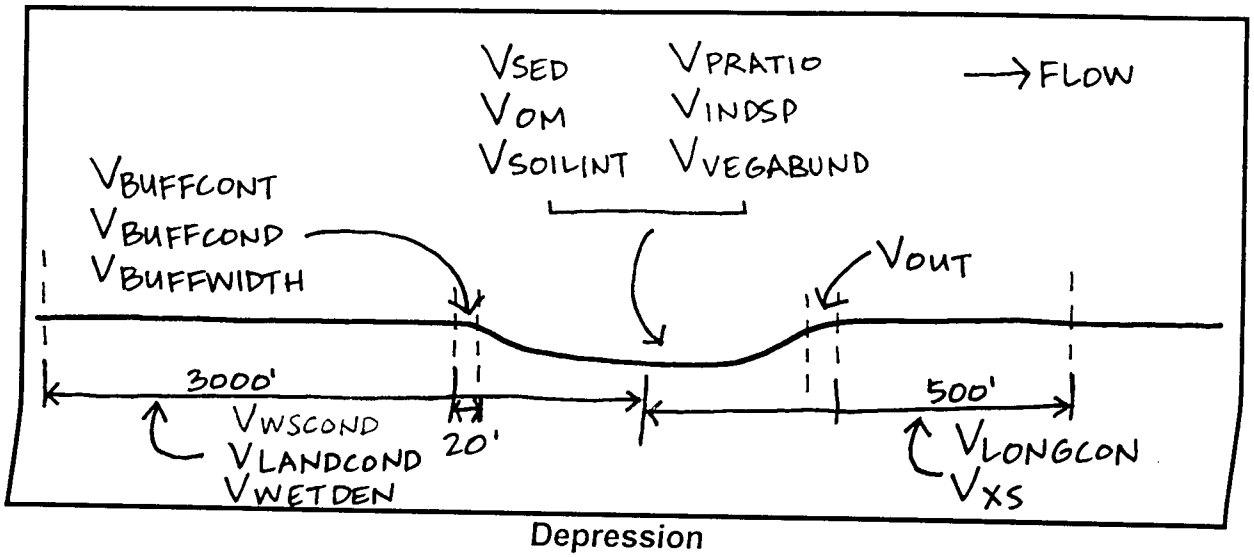
I. Essential Gear

A. Sacramento and San Joaquin County Soil Surveys
B. Aerial Photos
C. Shovel(s) and soil probes
D. 300+ foot measuring tape(s)
E. 100 Fooot spences tape(s)
F. Abney level &/or clinometer
G. Clipboard
H. Ruler(s) (metric and English)
I. Engineer's Rule
J. Camera & film'
K. Water
L. Jepson Manual
M. Plastic bags

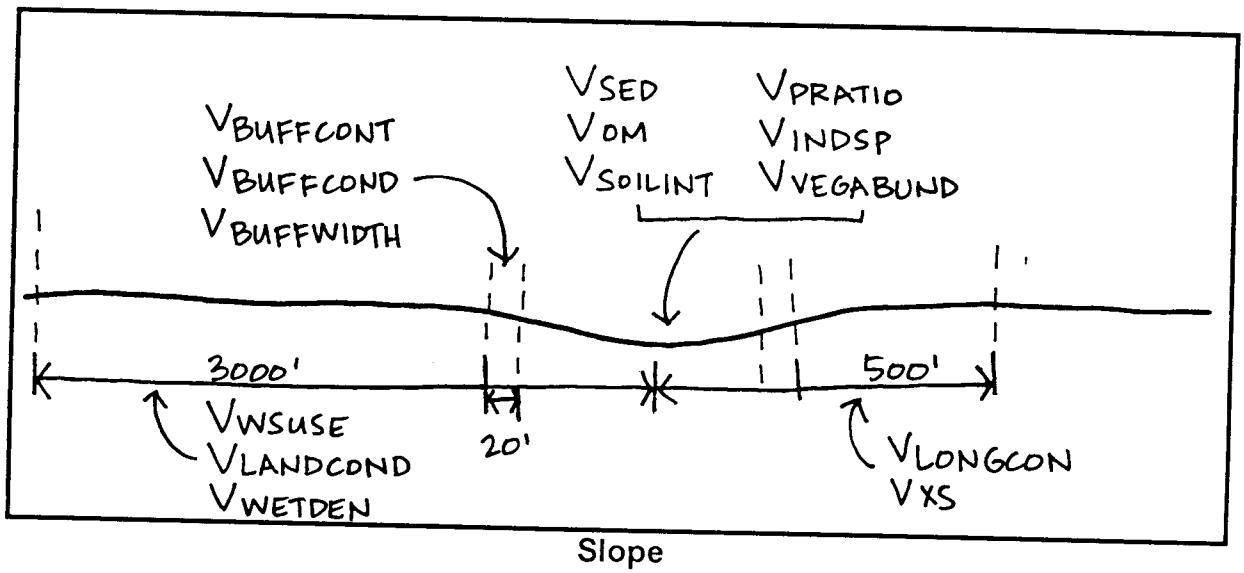
II. Desireable Gear

A. GPS
B. Laser level, tripod, rod, target

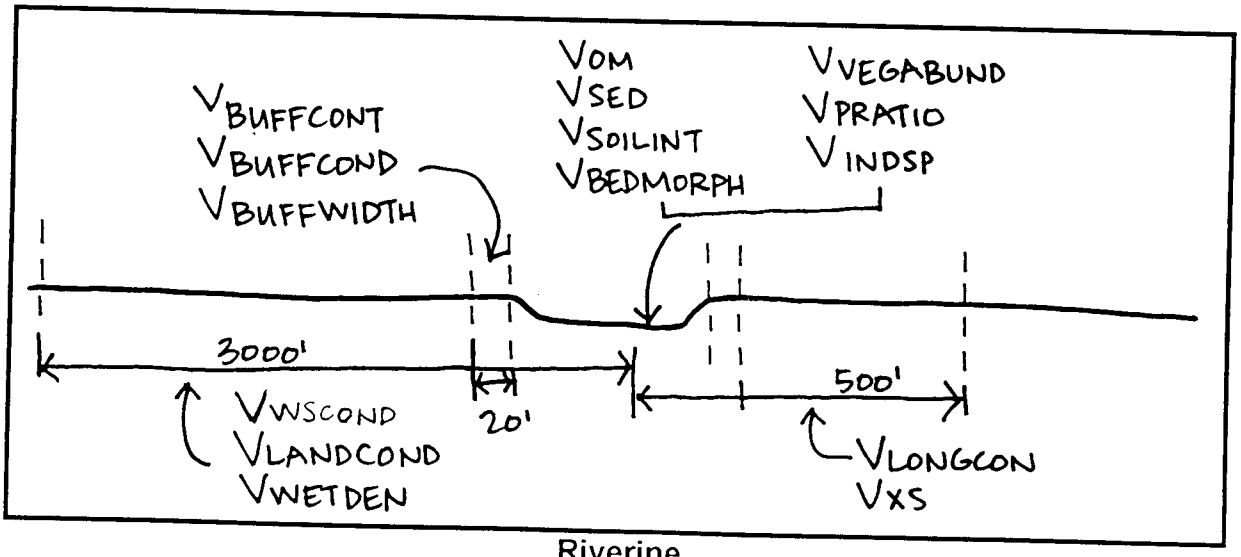
Figure 76. Cross-Sections Locating Areas In Which To Focus the Assessment of Variables in Wetlands on the Borden Ranch Property



Depression



Slope



Riverine

NOT TO SCALE

Figure 77. Plan View Locating Areas In Which To Focus the Assessment of Variables in Depression Wetlands on the Borden Ranch Property

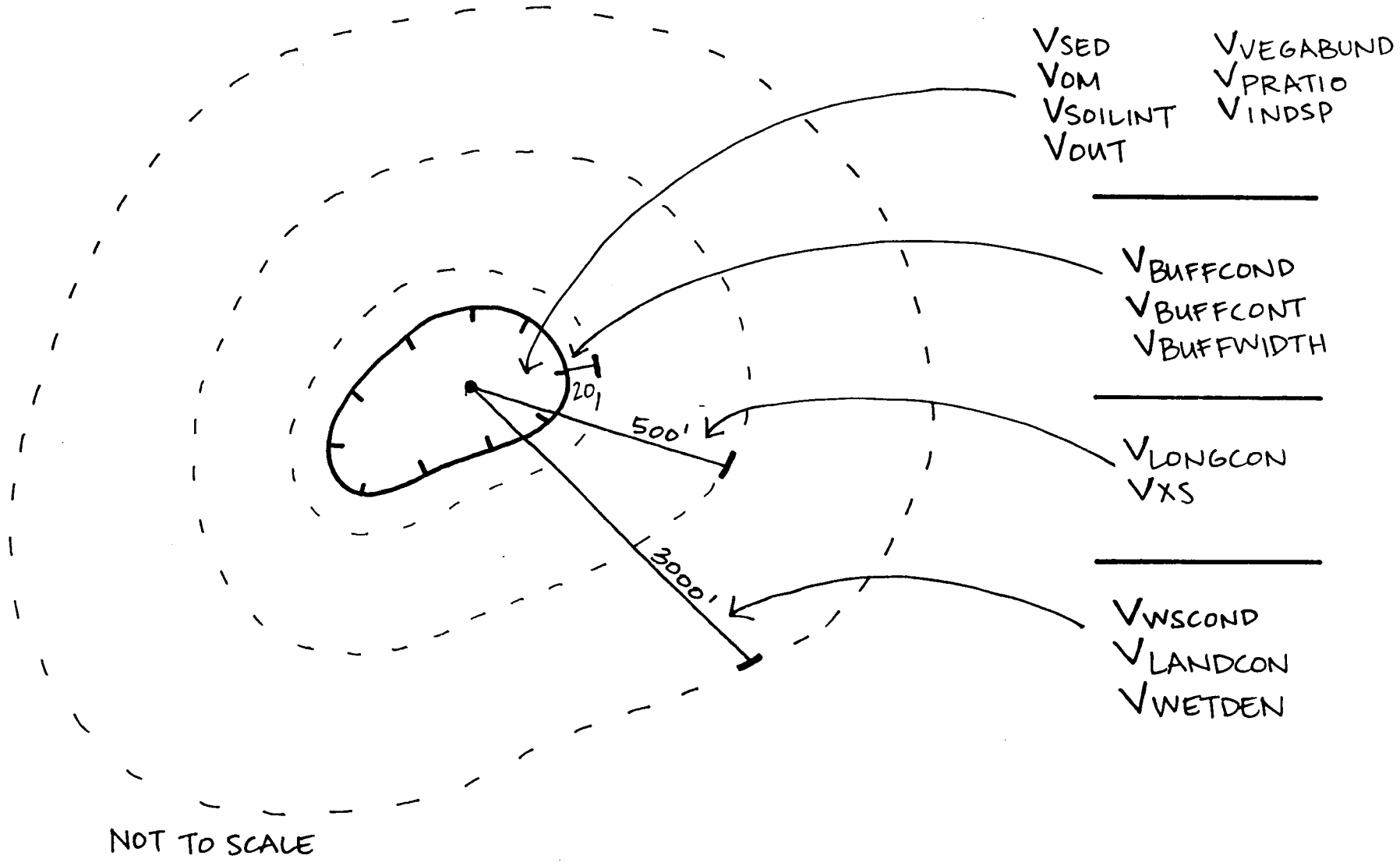


Table G-1. Variable Score Field Form

Variable		Indicator Measurement Result (e.g. stems/acre; canopy coverage, etc.)	Method/ Approach used to estimate Indicator Measurement	Variable Score from HGM Model	Discussion / Rationale
$V_{BEDMORPH}$:	Channel Bed Morphology				
$V_{BUFFCOND}$:	Buffer Condition				
$V_{BCONTINUITY}$:	Buffer Continuity				
V_{BWIDTH}:	Buffer Width				
$V_{DSINDSP}$:	Depression/Slope Indicator Species				
$V_{DSVEGABUND}$:	Depression/Slope Vegetation Abundance				
$V_{LANDCON}$:	Land Use or Condition				
$V_{LONGCON}$:	Longitudinal Connections to Down-Gradient Waters/Wetlands				
V_{OM}:	Organic Material				
V_{OUT}:	Outlet				
V_{PRATIO}:	Percent of Native Plant Species				
V_{RINDSP}:	Riverine Indicator Species				
$V_{RVEGABUND}$:	Riverine Vegetation Abundance				
V_{SED}:	Sediment Deposition				
$V_{SOILINT}$:	Soil Profile Integrity				
V_{WETDEN}:	Wetland Density				
V_{WSCOND}:	Watershed Condition				
V_{XS}:	Swale of Channel Cross-Section				

Table G-2. Function Score Field Form for Depressional Waters/Wetlands on Borden Ranch

FUNCTION	INDEX	Functional Index Score	Rationale/ Comments
Surface and Shallow Subsurface Water Storage and Exchange (Closed and Flow-Through)	Closed: $(V_{OUT} \times (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{VEGABUND})/5)^{1/2}$ Flow-Through: $(V_{OUT} \times (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{SOILINT} + V_{SED} + V_{VEGABUND} + V_{LONGCON})/7)^{1/2}$		
Landscape Hydrologic Connections (Flow-Through	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{LONGCON})/4$		
Element and Compound Cycling (Closed and Flow-Through)	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/7$		
Organic Carbon Export (Flow-Through)	$((V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + (V_{SOILINT} + V_{OM} + V_{VEGABUND})/3 + V_{OUT} + V_{LONGCON})/4$		
Plant Community (Closed and Flow-Through)	$(V_{OM} + V_{SOILINT} + V_{VEGABUND} + V_{PRATIO} + V_{DSINDSP} + (V_{WETDEN} + V_{LANDCOND})/2)/6$		
Faunal Habitat (Closed and Flow-Through)	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/7$		
Faunal Habitat Interspersion and Connectivity (Closed and Flow-Through	Closed: $V_{LANDCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{WETDEN})/3$ Flow-Through: $(V_{LANDCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{OUT} + V_{LONGCON} + V_{WETDEN})/5$		
Invertebrate Assemblage (Closed and Flow-Through)	Direct Assessment		
Vertebrate Assemblage (Closed and Flow-Through)	Direct Assessment		

Function Score Field Form for Slope Waters/Wetlands on Borden Ranch

FUNCTION	INDEX	Functional Index Score	Rationale/ Comments
Surface and Shallow Subsurface Water Storage and Exchange	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{SOILINT} + V_{SED} + V_{VEGABUND} + V_{LONGCON})/7$		
Sediment Retention	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{SOILINT} + V_{SED} + V_{VEGABUND})/6$		
Landscape Hydrologic Connections	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{LONGCON})/3$		
Element and Compound Cycling	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/6$		
Organic Carbon Export	$((V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + (V_{SOILINT} + V_{OM} + V_{VEGABUND})/3 + V_{LONGCON})/3$		
Plant Community	$(V_{OM} + V_{SOILINT} + V_{VEGABUND} + V_{PRATIO} + V_{DSINDSP} + (V_{WETDEN} + V_{LANDCOND})/2/6$		
Faunal Habitat	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/6$		
Faunal Habitat Interspersion and Connectivity	$(V_{LANDCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{LONGCON} + V_{WETDEN})/4$		
Invertebrate Assemblage	Direct Assessment		
Vertebrate Assemblage	Direct Assessment		

Function Score Field Form for Riverine Waters/Wetlands on Borden Ranch

FUNCTION	INDEX	Functional Index Score	Rationale/ Comments
Surface and Shallow Subsurface Water Storage and Exchange	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{BEDMORPH} + V_{SOILINT} + V_{SED} + V_{VEGABUND} + V_{LONGCON})/8$		
Sediment Mobilization, Transport and Deposition	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{BEDMORPH} + V_{SOILINT} + V_{SED} + V_{VEGABUND})/7$		
Energy Dissipation	$(V_{XS} + V_{BEDMORPH} + V_{SED} + V_{VEGABUND})/4$		
Landscape Hydrologic Connections	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{LONGCON})/3$		
Element and Compound Cycling	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/6$		
Organic Carbon Export	$((V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + (V_{SOILINT} + V_{OM} + V_{VEGABUND})3 + V_{LONGCON})/3$		
Plant Community	$(V_{OM} + V_{SOILINT} + V_{VEGABUND} + V_{PRATIO} + V_{RINDSP} + (V_{WETDEN} + V_{LANDCOND})/2)/6$		
Faunal Habitat	$(V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/6$		
Faunal Habitat Interspersion and Connectivity	$(V_{LANDCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{LONGCON} + V_{WETDEN})/4$		
Invertebrate Assemblage	Direct Assessment		
Vertebrate Assemblage	Direct Assessment		

C. *Draft HGM Model for Slope Waters/Wetlands at the Headward Extent of Riverine Waters/Wetlands on Borden Ranch, Sacramento and San Joaquin Counties, California*

1. Definitions of Functions

a. Hydrologic Functions

1) Surface and Shallow Subsurface Water Flow and Storage

The focus of this function is on the ability of a slope water/wetland to moderate the rate of surface and shallow subsurface water flow as water moves into, through, and out of the assessment site. Increases in flows and/or flow velocities are not increases in functional capacity. Intact slope waters/wetlands dissipate hydrologic energy and moderate rates of surface and shallow subsurface water flow. Moderate rates of surface and shallow subsurface water flow maintain soil moisture in the assessment site and maintain baseflows in down-gradient riverine waters/wetlands. Slope waters/wetlands have land-dominated hydrographs so the timing, duration, and amount of water delivered to the swale is dependent upon the condition of the watershed and the buffer. Surface and shallow subsurface water flow and storage characteristics are further modified by swale dimension, transmissivity in the upper part of the soil profile, and roughness characteristics (*e.g.*, herbaceous cover and fine root biomass).

2) Sediment Retention

Intact slope waters/wetlands are characterized by very low rates of sediment mobilization. It is these low rates of sediment mobilization that limit the development of riverine morphological features such as channel beds and banks. Low rates of sediment mobilization are the result of surface and shallow subsurface water flow moderation. Slope waters/wetlands have land-dominated hydrographs so the timing, duration, and amount of water delivered to the swale is dependent upon the condition of the watershed and the buffer. Thus, the kinetic energy of the water as it flows into, through, and out of the slope water/wetland is affected by the condition of the contributing area and the buffer. The upper parts of the profile are mobilized, transported, and deposited when slope waters/wetlands become sediment sources. Thus, intact soil profiles and a lack of sediment deposition are indicative of sediment retention. Sediments are retained, in part, due to the energy dissipation and fine root biomass provided by vegetation.

3) Landscape Hydrologic Connections

This function refers to the hydrologic connectivity of contributing areas to slope waters/wetlands, and to other downgradient waters/wetlands. Slope waters/wetlands have land-dominated hydrographs so the timing, duration, and amount of water delivered to the swale is dependent upon the condition of the watershed and the buffer. The high-order seasonal and perennial streams depend upon intact connections from the upper portions of the watershed to maintain flow and sediment transport characteristics.

b. Biogeochemical Functions

1) Element and Compound Cycling

Element and compound cycling includes the abiotic and biotic processes that convert compounds from one form to another. These are primarily recycling processes wherein elements and compounds are cycled between atmosphere, water, soil and vegetation. Additionally, elements and compounds are temporarily removed from cycling processes through retention/detention in soils and sediments. The critical attributes and processes are in soil and vegetation. The buffer filters incoming surface and shallow subsurface water. Soil provides habitat for soil microorganisms that mediate the cycling processes, and also provides space where elements and compounds can be stored. Vegetation takes up, transforms, and temporarily stores elements and compounds and also provides oxygen to the rooting zone.

2) Organic Carbon Export

Organic carbon is exported from waters/wetlands in dissolved and particulate forms. Mechanisms of organic carbon export include leaching, displacement, and erosion. Sources of organic carbon include herbaceous vegetation both in the water/wetland and in the buffer, as well as organic matter incorporated into the soil profile. Export of organic carbon from the riverine water/wetland is dependent upon the condition of the hydrologic connection to down-gradient waters/wetlands.

c. Plant Community/Habitat Functions

1) Plant Community

Attributes of plant community include the species composition and physical characteristics of the living plant biomass. The emphasis is on the composition and structure of the plant community. Species composition is influenced by physical processes that maintain the characteristic hydrologic functions of slope wetlands (*e.g.*, soil structure and hydraulic conductivity) and biological processes (*e.g.*, presence of viable populations of native pollinators). In addition, because slope wetlands occur as fragmented habitat islands, the condition, areal extent and distribution of depressional/slope waters/wetlands habitat in the surrounding landscape (*i.e.*, surrounding land use and density of wetlands), which provides a regional source of colonists (propagules) to balance local extinctions within single pools, is critical to maintaining viable plant communities. Physical structure and attributes of the vegetation are also components of this function, including characteristic aerial cover, vertical and horizontal spatial distributions, and accumulation of organic matter.

2) Faunal Habitat

This function referes to the capacity of a water/wetland to support animal populations and guilds by providing heterogeneous habitats that provide food, cover, and

reproductive opportunities. The emphasis is on species that require slope waters/wetlands as an essential component for some or all parts of their life history.

3) Faunal Habitat Interspersion and Connectivity

Faunal habitat interspersion and connectivity is the capacity of a water/wetland to permit vertebrate and invertebrate aquatic organisms to enter or leave via surface or shallow subsurface connections as well as the capacity of a water/wetland to permit access of terrestrial invertebrates and vertebrates to access contiguous areas of food, cover, and reproductive opportunities.

4) Invertebrate Assemblage

This function referes to the population of terrestrial and/or aquatic invertebrates supported by the water/wetland.

5) Vertebrate Assemblage

This function refers to the population of terrestrial and/or aquatic vertebrates supported by the water/wetland.

2. Function Equations

Surface and Shallow Subsurface Water Flow and Storage

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{SOILINT} + V_{SED} + V_{VEGABUND} + V_{LONGCON})/7$$

Sediment Retention

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{XS} + V_{SOILINT} + V_{SED} + V_{VEGABUND})/6$$

Landscape Hydrologic Connections

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{LONGCON})/3$$

Element and Compound Cycling

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/6$$

Organic Carbon Export

$$\text{Function} = ((V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + (V_{SOILINT} + V_{OM} + V_{VEGABUND})/3 + V_{LONGCON})/3$$

Plant Community

$$\text{Function} = (V_{OM} + V_{SOILINT} + V_{VEGABUND} + V_{PRATIO} + V_{DSINDSP} + (V_{WETDEN} + V_{LANDCOND})/2/6$$

Faunal Habitat

$$\text{Function} = (V_{WSCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{SOILINT} + V_{SED} + V_{OM} + V_{VEGABUND})/6$$

Faunal Habitat Interspersion and Connectivity

$$\text{Function} = (V_{LANDCOND} + (V_{BUFFCOND} + V_{BUFFCONT} + V_{BUFFWIDTH})/3 + V_{LONGCON} + V_{WETDEN})/4$$

Invertebrate Assemblage

Direct Assessment

Vertebrate Assemblage

Direct Assessment

3. Variables

Variable: BUFFCOND

Definition: Predominant land use or condition of the area 20 feet out from the water/wetland edge or to the top of the contributing area divide whichever is less.

Measurement Protocol: Make a visual assessment of the predominant (*i.e.*, >50%) land use and/or condition of the water/wetland buffer in the assessment area. Compare to all the descriptions provided in the scaling for the $V_{BUFFCOND}$ variable and choose the lowest score that appropriately describes the predominant land use and/or condition of the buffer.

Scaling: The predominant use and condition of the buffer was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

$V_{BUFFCOND}$: Buffer Condition

Measurement or Condition	Index
Land condition is light or no grazing and management has explicit intent to: a) reduce the abundance of non-native and/or invasive plant species, b) increase the abundance of native plant species, c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land use is characterized by moderate to heavy grazing. There is no management intended explicitly to: a) reduce the abundance of non-native and/or invasive plant species, b) increase the abundance of native plant species, c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
CONDITION 1: The buffer is characterized by a) maintenance plowing, disking, harrowing, or raking, **and** b) an unfractured restrictive layer. **OR** **CONDITION 2:** The buffer is characterized by a) accelerated rates of sediment deposition **and** b) an unfractured restrictive layer.	0.5
The buffer is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) cultivated crops (*e.g.*, vineyards or orchards), d) no maintenance plowing, disking, harrowing, or raking between rows, **and** e) abundant herbaceous vegetation growing between rows.	0.25
CONDITION 1: The buffer is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) cultivated crops (*e.g.*, vineyards or orchards), d) maintenance plowing, disking, harrowing, or raking between rows, **and** e) little to no herbaceous vegetation growing between rows. **OR** **CONDITION 2:** The buffer is characterized by a) a ripped soil profile, b) a fractured restrictive layer, **and** c) no cultivated crops (*e.g.*, vineyards and orchards).	0.1
The buffer is characterized by anthropogenic impervious surfaces (*e.g.*, roads, parking lots, buildings).	0.0

Variable: BUFFER CONTINUITY

Definition: Continuity of the buffer (20 feet out from the water/wetland edge or to the top of the contributing area divide whichever is less) around the water/wetland edge. Continuity is defined as the distance around the water/wetland edge that is bounded by a buffer divided by the total distance around the water/wetland edge times 100=%. The buffer must 1) $\geq$ one foot wide, 2) be vegetated with herbaceous species, 3) not have evidence of increased area and/or rate of sediment deposition, and 4) have an unfractured restrictive layer.

Measurement Protocol: Within the assessment area, measure the distance around the water/wetland edge that is bounded by a buffer[1]. Divide this measurement by the total distance around the water/wetland edge in the assessment area. Multiply this number by 100 to generate the percent continuity of the water/wetland buffer. Compare the percent continuity for the buffer to all the descriptions provided in the scaling for the $V_{BUFFCONT}$ variable and choose the lowest score that appropriately describes the continuity of the buffer and/or the recoverability of the buffer continuity. [1]Note: the buffer must be 1) greater than one foot wide, 2) be dominated by herbs, 3) not have evidence of increased area and/or rate of sediment deposition, and 4) have an unfractured restrictive layer.

Scaling: Buffer continuity was defined as the distance around the water/wetland edge that was bounded by a buffer divided by the total distance around the water/wetland edge (expressed as a percentage). The buffer had to 1) be greater than one foot wide, 2) be vegetated with herbaceous species, 3) not have evidence of increased sediment deposition, and 4) have an unfractured restrictive layer.

The data are bimodal. Buffer continuity tended to be 100 percent or 0 percent. The bimodal nature of the data did not allow for the determination of whether relationships between buffer continuity and ecosystem attributes and processes (*e.g.*, sediment accretion) were linear or curvilinear. Thus, the relationship was assumed to be linear.

Confidence: Medium.

$V_{BUFFCONT}$: Buffer Continuity

Measurement or Condition	Index
100% of the water/wetland edge is bounded by an intact buffer.	1.0
75% to <100% of the water/wetland edge is bounded by an intact buffer.	0.75
50% to <75% of the water/wetland edge is bounded by an intact buffer.	0.5
25% to <50% of the water/wetland edge is bounded by an intact buffer.	0.25
0% to <25% of the water/wetland edge is bounded by an intact buffer. Variable is recoverable and sustainable through natural processes and under current conditions.	0.1
0% to <25% of the water/wetland edge is bounded by an intact buffer. Variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: BUFFER WIDTH

Definition: Mean width of the buffer (20 feet out from the water/wetland edge or to the top of the contributing area divide whichever is less). The buffer must 1) be vegetated with herbaceous species, 2) not have evidence of increased area and/or rate of sediment deposition, and 3) have an unfractured restrictive layer.

Measurement Protocol: Within the assessment area, measure the mean width of the water/wetland buffer. A minimum of four measurements should be made to calculate the mean width. Measurements are made perpendicular from the water/wetland edge to a maximum distance of 20 feet (20 feet is the maximum width of the buffer by definition). Compare the mean buffer width to all the descriptions provided in the scaling for the $V_{BUFFWIDTH}$ variable and choose the lowest score that appropriately describes the mean width of the buffer and/or the recoverability of the width of the buffer.

Scaling: Buffer widths were defined as a 20 feet or to the top of the contributing area, whichever was the lesser distance. The buffer had to 1) be greater than one foot wide, 2) be vegetated with herbaceous species, 3) not have evidence of increased sediment deposition, and 4) have an unfractured restrictive layer. The distance to disturbance was determined by measuring from the water/wetland boundary to the nearest disturbance within the buffer. This was performed at multiple points and a mean distance to disturbance was reported.

The data are bimodal. Buffer widths tended to be greater than or equal to 20 feet or 0 feet. The bimodal nature of the data did not allow for the determination of whether relationships between buffer widths and ecosystem attributes and processes (*e.g.*, sediment accretion) were linear or curvilinear. Thus, the relationship was assumed to be linear.

Confidence: Medium.

$V_{BUFFWIDTH}$: Buffer Width

Measurement or Condition	Index
Mean buffer width is greater than or equal to 20 feet **or** to top of contributing area.	1.0
Mean buffer width is between 15 and 20 feet **or** to top of contributing area.	0.75
Mean buffer width is between 10 and 15 feet **or** to top of contributing area.	0.5
Mean buffer width is between 0 and 15 feet **or** to top of contributing area.	0.25
Mean buffer width is between 0 and 5 feet **or** to the top of contributing area. Variable is recoverable and sustainable through natural processes and under current conditions.	0.1
Mean buffer width is between 0 and 5 feet **or**. Variable is not recoverable and sustainable through natural processes and under current conditions or to top of contributing area.	0.0

Variable: DEPRESSION/SLOPE INDICATOR SPECIES

Definition: The presence of plant taxa that are restricted to; indicative, characteristic or typical of; depression and slope waters/wetlands in the Sacramento Region of the Central Valley of California.

Measurement Protocol: A list of the dominant taxa (i.e. all taxa that make up > 50% of the total vegetative cover, plus taxa that make up > 20% total cover) is made from visual inspection of 1 square meter plots in the assessment area. At least 10 plots should be made at random points within the assessment area. Dominant taxa are compared with lists of restricted or associated plants compiled from the literature and the percent of taxa that are restricted or associated is calculated by dividing restricted/associated taxa by total taxa and multiplying by 100. Compare the percent indicators to all the descriptions provided in the scaling for the $V_{DSINDSP}$ or the V_{RINDSP} variable and choose the lowest score that appropriately describes the condition. This variable can be assessed when vegetation is senescent if taxa can be identified.

Scaling: The presence of indicator species was assessed by listing the dominant taxa within the assessment area and checking these taxa against lists of taxa restricted to, or typically associated with ephemeral depression or slope wetlands in the Central Valley of California. The lists were compiled from data collected in depression/slope waters/wetlands on Borden Ranch and the literature on the vegetation of vernal pools in the Central Valley. The variable was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

Note: Confidence in this variable is medium because due to constraints of time, $V_{DSINDSP}$ was scored during the dry stage when vegetation is senescent. Because plant identifications are more difficult at this time, some taxa could only be identified to genera. The scoring of this variable is conservative however, because taxa that could be identified only to genus level were classified as restricted or associated if any members of that genus are restricted or associated in California.

$V_{DSINDSP}$: Depression/Slope Indicator Species

Measurement or Condition	Index
> 90% of the dominant taxa present are restricted to ephemeral depression/slope wetlands in California (see attached lists).	1.0
> 50% to 90% of the taxa present are restricted to ephemeral depression/slope wetlands in California or are frequently or typically associated with depression and slope waters/wetlands in California (see attached lists).	0.75
a) at least 50% of the dominant taxa present are restricted to, or are frequently or typically associated with, depression and slope waters/wetlands in California; **and** b) other taxa present are from the surrounding annual grasslands (*e.g.*, *Lolium*, *Hordeum*, *Briza*, *Juncus bufonius*).	0.5
a) >25% to 50% of the dominant taxa present are restricted to, or are frequently or typically associated with, depression and slope waters/wetlands in California; **and** b) > 50% of the dominant taxa are typical of more permanently wet soils (*e.g.*, *Typha*, *Salix*, *Cyperus*, *Cynodon*, *Erodium*, *Echinochloa*, *Juncus*) or adventive annuals from more open, disturbed habitats (*e.g.*, *Atriplex*, *Rumex*, Chenopodiaceae, *Matricaria*, *Lolium*, *Polypogon*, *Malva*)	0.25
CONDITION 1: a) < 25% of the taxa present are restricted to, or are frequently or typically associated with, depression and slope waters/wetlands in California; **and** b) > 50% of the taxa are typical of more permanently wet soils (see list above) or open, disturbed habitats (see list). **OR** **CONDITION 2:** No vegetative cover, but variable is recoverable and sustainable through natural processes and under current conditions.	0.1
No vegetative cover; variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: DEPRESSION/SLOPE VEGETATION ABUNDANCE

Definition: Characteristics of vegetation abundance and structure in the waters/wetland (including height, cover, stem density, spatial distribution, and phenological sequence).

Measurement Protocol: Measurement of this variable is keyed to the different stages in the wet to dry cycle that characterizes depression, slope and riverine wetlands on Borden Ranch. Depending on the time of year the assessment is conducted, choose one of the two stages in the cycle, either Drying or Wetting/Dry (see Glossary for definitions of stages) and use the descriptions for that stage . Vegetative cover is visually estimated by assessing the percent cover of actively photosynthesizing vegetation within 1 square meter plots. At least 10 plots should be made at random points within the assessment area and an average of these 10 observations should be calculated. The vegetation within the waters/wetland is visually inspected (i.e. physiognomy, spatial distribution of species, and species composition) to determine if vegetation within the assessment area can be distinguished from the vegetation outside the assessment area. Compare percent cover, distinctness of the vegetation within the assessment area, and species composition to all descriptions provided in the scaling for the $V_{VEGABUND}$ variable and choose the lowest score that appropriately describes the condition.

Scaling: Vegetation Abundance was assessed by measuring the percent cover and species composition of the dominant taxa, as well as describing the nature of the boundary between the vegetation of the assessment area and vegetation of the surrounding areas. This variable was scaled separately for the wet/dry and the drying stages of the seasonal wet to dry cycle, because vegetation abundance and species composition both change over time. The $V_{VEGABUND}$ variable was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium

$V_{DSVEGABUND}$: Depression/Slope Vegetation Abundance

Measurement or Condition	Index
Drying Stage: a) dominants are low growing (<1') native, annual forbs; **and** b) form concentric rings of different species along gradient from depression center to margin (may be one 'ring' in slopes); **and** c) boundaries between depression/slope vegetation and surrounding grassland vegetation are distinct and clear; **and** d) cover of vegetation in waters/wetlands lower (*i.e.*, 63% to 85%) than in surrounding grasslands (*i.e.*, 90% to 100%). **Dry Stage**: a) vegetative cover is <5% **and;** b) boundaries of the plant community are clear and distinct either as a water-filled depression, or as dry, open ground with a cover of senescent *Eryngium*; **and** c) no invasion by species from the surrounding annual grasslands. **Wetting/Wet Stage: Data not collected.**	1.0
Drying Stage: a) dominants are low growing, annual forbs; **and** b) form concentric rings along gradient from depression center to margin; **and** c) boundaries between depression vegetation and grassland are clear and distinct, but margins may contain increased cover from surrounding grassland plants; **and** d) cover of vegetation in the margins >85% where grassland species have invaded. **Dry Stage**: a) vegetative cover is <5%; **and** b) boundaries of plant community are clearly visible either as water-filled depression, or as dry open ground which contains mostly senescent *Eryngium*; **and** c) may contain some species from the surrounding annual grasslands. **Wetting/Wet Stage: Data not collected.**	0.75
No standard for this score.	0.5
All Stages: a) cover of spring/summer vegetation is >85% and >50% of dominants area non-native plants typical of more permanently wet soils (*e.g.*, *Echinochloa*, *Typha*, *Salix*, *Cyperus*, *Rumex*, *Lolium*), or adventives (*e.g. Chenopodium, Taraxacum, Atriplex,*); **and** b) cover/height of vegetation remains unchanged during time of year when depressions/slopes are normally dry (*i.e.*, summer); **and** c) no distinct boundary is recognizable between vegetation in depressions/slopes and surrounding area; **and** d) no clear wetting/wet stage (*i.e.*, standing water), although vegetation may be senescent during late fall/winter months.	0.25
All Stages: a) vegetative cover is <5% at all times; **and** b) during late fall/winter boundaries of original plant community may be visible with some ponding of water; **and** c) variable is recoverable and sustainable through natural processes and under current conditions.	0.1

Depression/Slope Vegetation Abundance cont.

Measurement or Condition	Index
All Stages: a) vegetative cover is <5 at all times; **and** b) boundaries of original plant community are not visible; **and** c) no short (>7 days) or very short (i.e. >1 day) ponding of water occurs during or after winter rains; **and** d) variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: LAND USE OR CONDITION

Definition: Predominant land use or condition within a 3000 foot radius of the centroid of the assessment site.

Measurement Protocol: Assess through visual observations during site review and/or by using other available information (e.g., aerial photos, maps etc.). Recent aerial photographs can facilitate the identification of land uses within the 3,000 foot radius. Compare to all the descriptions provided in the scaling for the $V_{LANDCOND}$ variable and choose the lowest score that appropriately describes the predominant (*i.e.*, >50%) land use within a 3,000 foot radius of the centroid of the assessment area.

Scaling: The predominant use and condition of the area within a circle with a 3000 foot radius centered on the centroid of the assessment site was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

$V_{LANDCOND}$: Land Use or Condition

Measurement or Condition	Index
Land is subject to a management plan that includes either light grazing or no grazing with a fire management component. The plan has the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land is subject to a management plan that includes either moderate to heavy grazing or no grazing and no fire management. The plan does not have the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
No standard for this score.	0.5
The area is characterized by a) a ripped soil profile, **and** b) a fractured restrictive layer, **and** c) cultivated crops that have been in place for 2 or more years (*e.g.*, vineyards or orchards).	0.25
CONDITION 1: The area is characterized by a) a ripped soil profile, **and** b) a fractured restrictive layer, **and** c) cultivated crops that have been in place for 2 or more years (*e.g.*, vineyards or orchards). OR **CONDITION 2:** The area is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) no cultivated crops (*e.g.*, vineyards or orchards), d) no disking or rolling in preparation for planting, and e) some vegetation and/or microtopographic variation exists.	0.1
The area is characterized by a) a ripped soil profile, b) a fractured restrictive layer, c) no cultivated crops (*e.g.*, vineyards or orchards), d) disking or disking and rolling in preparation for planting, and e) little to no vegetation and/or microtopographic variation exists.	0.0

Variable: LONGITUDINAL CONNECTIONS TO DOWNGRADIENT WATERS/WETLANDS

Definition: Land use or condition of the longitudinal connections to down-gradient waters/wetlands within 500 feet of the assessment area or to the next water/wetland (measurement from top of assessment are to 500' down-gradient). Flow-through depression waters/wetlands often form the headward extent of slope waters/wetlands, and slope waters/wetlands often form the headward extent of riverine waters/wetlands. The connections provide pathways for surface and shallow subsurface water flow, particulate transport, organic carbon export, and flora and fauna movement.

Measurement Protocol: Make a visual assessment of the predominant (*i.e.*, >50%) land use and/or condition of the longitudinal hydrologic connection(s) to down gradient waters/wetlands within 500 ft of the assessment area. Compare to all the descriptions provided in the scaling for the $V_{LONGCON}$ variable and choose the lowest score that appropriately describes the predominant land use or condition of the longitudinal hydrologic connection(s) to down gradient waters/wetlands.

Scaling: The predominant use and condition of the longitudinal connections to down-gradient waters/wetlands was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

$V_{LONGCON}$: Longitudinal Connections to Down-Gradient Waters/Wetlands

Measurement or Condition	Index
Land is subject to a management plan that includes either light grazing or no grazing with a fire management component. The plan has the explicit intent to a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land is subject to a management plan that includes either moderate to heavy grazing or no grazing and no fire management. The plan does not have the explicit intent to a) reduce the abundance of non-native and/or invasive plant species, **and** b) increase the abundance of native plant species, **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
CONDITION 1: The longitudinal connection is characterized by a) maintenance plowing, disking, harrowing, or raking **and** b) an unfractured restrictive layer. **OR** **CONDITION 2:** The longitudinal connection is characterized by a) accelerated rates of sediment deposition **and** b) an unfractured restrictive layer. **OR** **CONDITION 3:** The longitudinal connection is characterized by a) discontinuous disruptions to surface and/or shallow subsurface water flow (*e.g.*, road crossings, buried pipelines, and small ripped areas), **and** b) an unfractured restrictive layer.	0.5
The longitudinal connection is characterized by a) a ripped soil profile, **and** b) a fractured restrictive layer, **and** c) cultivated crops (*e.g.*, vineyards or orchards), **and** d) no maintenance plowing, disking, harrowing, or raking between rows, **and** e) abundant herbaceous vegetation growing between rows.	0.25

Longitudinal Connections to Down-Gradient Waters/Wetlands cont.

Measurement or Condition	Index
CONDITION 1: The longitudinal connection is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer; **and** c) cultivated crops (*e.g.*, vineyards or orchards); **and** d) maintenance plowing, disking, harrowing, or raking between rows; **and** e) little to no herbaceous vegetation growing between rows. OR **CONDITION 2:** The longitudinal connection is characterized by a) a ripped soil profile, b) a fractured restrictive layer, and c) no cultivated crops (*e.g.*, vineyards and orchards).	0.1
Longitudinal connections disconnected by anthropogenic activities and no longer exist (*e.g.*, channel bed cannot be identified).	0.0

Variable: PERCENT COVER OF ORGANIC MATERIAL IN THE WATER/WETLAND

Definition: Percent cover of the organic detrital material on the soil surface. The organic detrital material is composed of algal mats, and/or accumulated plant litter from forbs, graminoids, ferns, and fern allies.

Measurement Protocol: Make a visual assessment using 1 square meter plots of the percent cover of organic material within the assessment area. At least 10 plots should be made at random points within the assessment area and an average of these 10 observations should be calculated. Compare the average percent cover of organic material in the assessment area to all the descriptions provided in the scaling for the V_{OM} variable and choose the lowest score that appropriately describes the percent cover of organic material.

Scaling: The percent cover from organic matter in the assessment area was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: High

V_{OM}: Organic Material

Measurement or Condition	Index
Depression and Slope: Cover of organic material (OM) is > 75%. **Riverine:** Cover of OM is > 50% to 70%; OM can be composed of algal and/or plant material accumulating where the kinetic energy of surface water is low.	1.0
Depression and Slope: Cover of OM is > 50% to 75%. **Riverine:** Cover of OM is > 30% to 50%; OM can be composed of algal and/or plant material accumulating where the kinetic energy of surface water is low.	0.75
Depression and Slope: Cover of OM is > 25% to 50%. **Riverine:** Cover of OM is > 20% to 30%,	0.5
Depression and Slope: Cover of OM is > 10% to 25%. **Riverine:** Cover of OM is > 5% to 20%.	0.25
Depression and Slope: **CONDITION 1:** Cover of OM is < 10%. **OR** **CONDITION 2:** Cover is high (> 90% locally) in response to irrigation return flow or in areas where irrigation has caused algal blooms in areas of ponding on the surface. **Riverine**: **CONDITION 1:** Cover of OM is <5%. **OR** **CONDITION 2:** Cover is high (> 60% locally) in response to irrigation return flow or in areas where irrigation has caused algal blooms in areas of ponding on the surface.	0.1
Depression, Slope, and Riverine: No OM. Variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: PERCENT OF NATIVE PLANT SPECIES

Definition: The percent of the dominant plant taxa present in the waters/wetlands that are native to California.

Measurement Protocol: A list of the dominant taxa (i.e. all taxa that make up > 50% of the total vegetative cover, plus taxa that make up > 20% total cover) is made from visual inspection of 1 square meter plots in the assessment area. At least 10 plots should be made at random points within the assessment area. Dominant taxa are recorded as either natives or non-natives using the Jepson Manual. The percent of native taxa is calculated by dividing native taxa by total taxa and multiplying by 100. Compare the percent native taxa to all the descriptions provided in the scaling for the V_{PRATIO} variable and choose the lowest score that appropriately describes the condition. This variable can be assessed when senescent vegetation is present if taxa can be identified.

Scaling: The percent of native species was assessed by listing the dominant taxa within the assessment area and checking these taxa against the Jepson Manual to determine native/non-native status in California. The variable was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium

Note: Confidence in this variable is medium because due to constraints of time, V_{PRATIO} was scored during the dry stage when vegetation is senescent. Because plant identifications are more difficult at this time, some taxa could only be identified to genera. The scoring of this variable is conservative however, because taxa that could be identified only to genus level were classified as native if any members of that genus are native to California.

V_{PRATIO}: Percent of Native Plant Species

Measurement or Condition	Index
Depression, Slope, and Riverine: > 90% of the taxa are native.	1.0
Depression and Slope: a) >70% to 90% native taxa; **and** b) individuals from surrounding non-native annual grasslands may be present. **Riverine**: a) >50% to 75% of the taxa are natives; **and** b) individuals from surrounding non-native annual grasslands may be present.	0.75
Depression and Slope: a) >50% to 70% native taxa; **and** b) non-native taxa are from the surrounding annual grasslands (*e.g., Lolium, Briza, Aira, Hordeum, etc.*). **Riverine**: a) >25% to 50% native taxa; **and** b) non-native taxa from surrounding annual grasslands (*e.g., Lolium, Hordeum, Briza, Aira*), or non-native adventives (*e.g., Taraxacum, Atriplex, Salsola, Rumex*) are present.	0.5
Depression and Slope: a) >20% to 50% are natives; **and** b) >50%of taxa are either non-natives typical of more permanently wet habitats (*e.g., Echinochloa, Erodium, Ranunculus, Cyperus*), or taxa typical of open, disturbed habitats (*e.g., Chenopodium, Rumex, Salsola, Taraxacum*). **Riverine**: a) >5% to 25% native taxa; **and** b) >75% are non-native taxa typical of more permanently wet habitats (*e.g., Echinochloa, Cynodon, Erodium, Ranunculus, Cyperus*) or taxa typical of open, disturbed habitats (*e.g., Chenopodium, Rumex, Salsola, Taraxacum*).	0.25
Depression and Slope: CONDITION 1: <20% native taxa. **OR** CONDITION 2: No vegetation present. Variable is recoverable and sustainable through natural processes and under current conditions. **Riverine**: CONDITION 1: <5% native taxa. **OR** CONDITION 2: No vegetation present. Variable is recoverable and sustainable through natural processes and under current conditions	0.1

Percent Cover of Native Plant Species cont.

Measurement or Condition	Index
Depression, Slope, and Riverine: There is no vegetation present. Variable is not recoverable and sustainable through natural processes and under current conditions.	0.0

Variable: SEDIMENT DEPOSITION

Definition: Area and/or rate of sediment deposition in the water/wetland.

Measurement Protocol: Make a visual assessment of the area and/or rate of sediment delivery to the water/wetland within the assessment area. Compare to all the descriptions provided in the scaling for the V_{SED} variable and choose the lowest score that appropriately describes the condition/status of sediment delivery to the water/wetland within the assessment area.

Scaling: The approximate area and volume of fill in the assessment site was determined by field measurements. Approximate areas of fill were determined through measurements of aerial coverage. The approximate depths of fill were measured in a few areas, and a mean depth of fill was calculated. The approximate volumes were determined by multiplying the aerial coverage of fill by the mean depth of fill.

This scaling for this variable was based upon the V_{SED} variable from the *Operational Draft Guidebook to HGM Functional Assessments in Temporary and Seasonal Depressional Waters/Wetlands in the Northern Prairie Pothole Region* (*The Northern Prairie Depressional HGM Guidebook*)(Lee *et al.* 1997). *The Northern Prairie Depressional HGM Guidebook* has been through peer review, and is one of the most mature HGM guidebooks in the nation. The scaling was modified by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: High.

V_{SED}: Sediment Deposition

Measurement or Condition	Index
No evidence of increased area or rate of sediment deposition in the water/wetland from anthropogenic sources.	1.0
Historical evidence suggests that the area and/or rate of sediment deposition in the water/wetland increased in the past. a) Evidence may include, but is not limited to, stabilized fans and/or sediment layering on the soil surface; **and** b) The current condition is stable as evidenced by intact plant communities and/or the development of distinct soil structural and morphological features in the sediment layers.	0.75
The area and/or rate of sediment deposition in the water/wetland has slightly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, discontinuous bank shear, a veneer of fine sediment located where kinetic energy of surface water is low (*e.g.*, small pits), and/or sediment staining on detritus and/or plant materials; **and**. b) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.5
The area and/or rate of sediment deposition in the water/wetland has greatly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, recently developed and/or developing fans and sediment layering on the soil surface; **and** b) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.25
The area and/or rate of sediment deposition in the water/wetland has greatly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, recently ripped soil profiles; **and** b) 100% of the assessment site ***area*** is filled; **and** c) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.1
The area and/or rate of sediment deposition in the water/wetland has greatly increased due to current anthropogenic activities. a) Evidence may include, but is not limited to, recently ripped, disked, and rolled soil profiles; **and**. b) 100% of the assessment site ***volume*** is filled **and** c) Current conditions are not stable as evidenced by perturbed plant communities and/or the lack of development of distinct soil structural and morphological features in the sediment layers.	0.0

Variable: SOIL PROFILE INTEGRITY

Definition: Presence and condition of the soil profile in the assessment area.

Measurement Protocol: Excavate a representative soil pit in the assessment area. Characterize the soil pit consistent with NRCS protocols (USDA 1993). Compare to all the descriptions provided in the scaling for the $V_{SOILINT}$ variable and choose the lowest score that appropriately describes the predominant (*i.e.*, >50%) soil condition of the water/wetland within the assessment area.

Scaling: Soil pits were excavated to practicable depths, usually to the depth of the restrictive layer. Identification and nomenclature of the soil horizons were consistent with NRCS guidance. Colors were determined from wet samples and were reported as Munsell Soil Colors. The $V_{SOILINT}$ variable was scaled by the interdisciplinary team and is based upon the soil pit data and best professional judgment.

Confidence: High.

$V_{SOILINT}$: Soil Profile Integrity

Measurement or Condition	Index
Depression and Slope: a) Soil profile is intact and undisturbed. Typically, the soil profile has a thin O horizon over well-developed A (and/or E), B, and C horizons. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. **Riverine:** a) Soil profile is intact and undisturbed. Typically, the soil profile consists of Entisols that are fluvial in origin. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured.	1.0
Depression and Slope: a) Soil profile is truncated due to compaction by domestic livestock. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. **Riverine:** **CONDITION 1:** a) Soil profile is truncated due to compaction by domestic livestock. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. **CONDITION 2:** a) Soil profile consists of Entisols that are fluvial in origin. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured; **and** c) A veneer of fine sediment is present. Typically, the veneer of fine sediment is located where kinetic energy of surface water is low (*e.g.*, small pits).	0.75
Depression and Slope: a) Soil profile has an Ap horizon due to plowing, disking, harrowing, or raking. Restrictive layers, where present, occur in the B and/or C horizon(s) **and** b) Restrictive layers, where present, are unfractured. **Riverine:** a) Soil profile consists of Entisols that are fluvial in origin. Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured; **and** c) Soil profile altered by discontinuous disruptions (*e.g.*, road crossings and/or small ripped areas).	0.5
Depression and Slope: a) Soil profile has not been ripped, but it is buried under recently deposited sediment (*e.g.*, silt, sand, gravel, and/or cobble). Restrictive layers, where present, occur in the B and/or C horizon(s); **and** b) Restrictive layers, where present, are unfractured. **Riverine:** a) Soil profile plowed, disked, harrowed, or raked. An Ap horizon may be present.. Restrictive layer(s), where present, occur in the B and/or C horizons; **and** b) Restrictive layer(s), where present, are unfractured.	0.25

Soil Profile Integrity cont.

Measurement or Condition	Index
Depression, Slope, and Riverine: a) Soil profile has been ripped and, possibly, disked, rolled, or excavated. C horizons dominate throughout the soil profile.; **and** b) Restrictive layers, where present, are fractured.	0.1
Depression, Slope, and Riverine: The substrate is anthropogenically-derived impervious surface (*e.g.*, roads, parking lots, buildings).	0.0

Variable: WETLAND DENSITY

Definition: The percent of the total area that is occupied by depressional, slope, and riverine waters/wetlands within a 3000 foot radius of the centroid of the assessment site.

Measurement Protocol: Measurement Protocol - First determine which geomorphic surface the assessment area is located on (*e.g.,* High Terrace, Terrace Dissection, Holocene Alluvium etc.). This will determine which set of variable scaling scores to use for the assessment area water/wetland. Next determine the density of waters/wetlands through visual observations during site review and/or by using other available information (e.g., aerial photos, maps etc.). Recent aerial photographs can facilitate the identification of wetland types within the 3,000 foot radius. Compare the density to all the descriptions provided in the scaling for the V_{WETDEN} variable and choose the lowest score that appropriately describes the density of waters/wetlands within a 3,000 foot radius of the centroid of the assessment area.

Scaling: The percent of the total area within a 3000 foot radius of the assessment area was determined by measuring the area covered by depressions/slopes/riverine waters/wetlands from 1:6000 scale aerial photographs taken of the Borden Ranch site at the time of the assessment, in August 1997. The variable was scaled separately for each geomorphic surface because densities of the different waters/wetland classes differ among High Terrace, Dissected Terrace Face and Holocene Terrace and Floodplain. The variable was scored according to the disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: High

V_{WETDEN}: Wetland Density

Measurement or Condition	Index
High Terrace: Depressional waters/wetlands: >50% to 75% of the total area, with large depressions/complexes of depressions present; Slope waters/wetlands: >50% to 75% of the total area; with large complexes of slopes/depressions Riverine waters/wetlands: >5% to 10% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: >15% to 25% of the total area, with depressions smaller than on high terrace, often isolated; Slope waters/wetlands: >30% to 50% of the total area Riverine waters/wetlands: >10% to 20% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: >20% to 30% of the total area Slope waters/wetlands: >40% to 60% of the total area Riverine waters/wetlands: >40% to 50% of the total area **AND** No fragmentation due to anthropogenic activities	1.0
High Terrace: Depressional waters/wetlands: >40% to 50% of the total area Slope waters/wetlands: >40% to 50% of the total area Riverine waters/wetlands: >5% to 10% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: >10% to 15% of the total area Slope waters/wetlands: >20% to 30% of the total area Riverine waters/wetlands: >5% to 10% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: >10% to 20% of the total area Slope waters/wetlands: >30% to 40% of the total area Riverine waters/wetlands: >30% to 40% of the total area **AND** Fragmentation by fencing, roads and activities associated with moderate to heaving grazing.	0.75

V_{WETDEN}: **Wetland Density** cont.

Measurement or Condition	Index
High Terrace: Depressional waters/wetlands: >20% to 40% of the total area, with few large, connected complexes Slope waters/wetlands: >20% to 40% of the total area Riverine waters/wetlands: >1% to 5% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: >5% to 10% of the total area Slope waters/wetlands: >10% to 20% of the total area Riverine waters/wetlands: > 1% to 5% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: >5% to 10% of the total area Slope waters/wetlands: >20% to 30% of the total area Riverine waters/wetlands: >20% to 30% of the total area **AND** Fragmentation due to large areas with fractured restrictive layers (*e.g.* ripped and disked or ripped, disked and cultivated)	0.5
High Terrace: Depressional waters/wetlands: >10% to 20% of the total area, with no large connected complexes Slope waters/wetlands: >10 to 20% of the total area Riverine waters/wetlands: <1% of the total area **Dissected Terrace Face**: Depressional waters/wetlands: > 1% to 5% of the total area Slope waters/wetlands: >5 to 10% of the total area Riverine waters/wetlands: <1% of the total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: <5% of the total area Slope waters/wetlands: >10% to 20% of the total area Riverine waters/wetlands: >10% to 20% of the total area **AND** Fragmentation due to large areas with fractured restrictive layers (e.g. ripped and disked or ripped, disked and cultivated)	0.25

V_{WETDEN}: Wetland Density (cont)

Measurement or Condition	Index
High Terrace: Depressional waters/wetlands: >5% to 10% total area Slope waters/wetlands: > 5% to 10% total area Riverine waters/wetlands: < 1% total area **Dissected Terrace Face**: Depressional waters/wetlands: < 1% total area Slope waters/wetlands: < 5% total area Riverine waters/wetlands: < 1% total area **Holocene Terrace and Floodplain**: Depressional waters/wetlands: > 1% to 5% total area Slope waters/wetlands: > 5% to 10% total area Riverine waters/wetlands: > 5% to 10% total area **AND** Fragmentation due to large areas with fractured restrictive layers (*e.g.,* ripped and disked or ripped, disked and cultivated)	0.1
High Terrace: Depressional waters/wetlands: < 5% Slope waters/wetlands: < 5% Riverine waters/wetlands: none present **Dissected Terrace Face**: Depressional waters/wetlands: none present Slope waters/wetlands: none present Riverine waters/wetlands: none present **Holocene Terrace and Floodplain**: Depressional waters/wetlands: none present Slope waters/wetlands: none present Riverine waters/wetlands: none present	0.0

Variable: WATERSHED CONDITION

Definition: Predominant land use or condition of the contributing area.

Measurement Protocol: Make a visual assessment of the predominant (*i.e.*, >50%) land use and/or condition of the watershed/contributing area. Compare to all the descriptions provided in the scaling for the V_{WSCOND} variable and choose the lowest score that appropriately describes the predominant land use or condition of the watershed/contributing area.

Scaling: The predominant use and condition of the contributing area was scored according to a disturbance scale. The disturbance scale was developed by the interdisciplinary team and is based upon field observations and best professional judgment.

Confidence: Medium.

V_{WSCOND}: Watershed Condition

Measurement or Condition	Index
Land is subject to a management plan that includes either light grazing or no grazing with a fire management. The plan has the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species; **and** b) increase the abundance of native plant species; **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	1.0
Land is subject to a management plan that includes either moderate to heavy grazing or no grazing and no fire management. The plan does not have the explicit intent to: a) reduce the abundance of non-native and/or invasive plant species; **and** b) increase the abundance of native plant species; **and** c) protect sensitive plant species, **and** d) manage fire fuel loads.	0.75
The watershed is characterized by a) maintenance plowing, disking, harrowing, or raking **and** b) an unfractured restrictive layer.	0.5
The watershed is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer; **and** c) cultivated crops (*e.g.*, vineyards or orchards); **and** d) no maintenance plowing, disking, harrowing, or raking between rows, **and** e) abundant herbaceous vegetation growing between rows.	0.25
CONDITION 1: The watershed is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer; **and** c) cultivated crops (*e.g.*, vineyards or orchards); **and** d) maintenance plowing, disking, harrowing, or raking between rows, **and** e) little to no herbaceous vegetation growing between rows. **OR** **CONDITION 2:** The watershed is characterized by a) a ripped soil profile; **and** b) a fractured restrictive layer, **and** c) no cultivated crops (*e.g.*, vineyards and orchards).	0.1
The watershed is characterized by anthropogenic impervious surfaces (*e.g.*, roads, parking lots, buildings).	0.0

Variable: SWALE OR CHANNEL CROSS-SECTION

Definition: Condition of the swale or channel cross-section in terms of widths, depths, cross-sectional areas, and width:depth ratios. NOTE: This variable should not be used to assess isolated depressions; for use in slope, riverine, or flow through depressions.

Measurement Protocol: Make a visual assessment of the channel cross-section/outlet swale. Compare to all the descriptions provided in the scaling for the V_{XS} variable and choose the lowest score that appropriately describes the predominant (*i.e.*, >50%) land use and/or condition of the channel cross-section/outlet swale.

Scaling: Microtopography was measured by surveying changes in ground surface elevation with a laser level. Microtopography transects were established as typical cross-sections in pools and riffles and typical longitudinal profiles. Stations were surveyed at intervals that allowed accurate description of the ground surface. There were no fixed intervals specified. Cross-sectional transects encompassed the width of the water/wetland and 20 foot buffers on each side. Data were plotted and assessed in the context of field notes and photographs.

Confidence: High.

V_{XS}: Swale or Channel Cross-Section

Measurement or Condition	Index
Swale or channel cross-section unaltered as evidenced by intact soil profiles and plant communities.	1.0
Swale or channel cross-section altered by portions of the swale margin/channel bank that have been pushed or pulled in by ripping and/or disking operations and/or cattle grazing (*e.g.*, bank trampling, shear).	0.75
Swale or channel cross-section altered by discontinuous entrenchment (*i.e.*, small areas that are incipient headcuts).	0.5
CONDITION 1: Swale or channel cross-section altered by continuous entrenchment. **OR** **CONDITION 2:** Swale or channel cross-section altered by discontinuous surface disruptions to surface and/or shallow subsurface water flow (*e.g.*, road crossings and small ripped areas).	0.25
a) Swale or channel cross-section altered by continuous surface disruptions to surface and/or shallow subsurface water flow (*e.g.*, entirely ripped and/or disked); **and/or** b) Discontinuous areas with poorly-developed channel cross-sections occur; **and** c) May include areas with infrequent or no maintenance cultivation (*i.e.*, disking, mowing, etc.)	0.1
Swale or channel cross-section altered by continuous surface disruptions to surface and/or shallow subsurface water flow (*e.g.*, entirely ripped and/or disked). No areas with channel cross-sections can be identified.	0.0

APPENDIX C.
FLORISTIC BASELINE DATA

(Baseline Floristic Data for Tables 18, 19, and 20 in the Mitigation Success Criteria Section)

Appendix C. Plant Species by Habitat Type at the NVG Project Site

Scientific Name[33]	Common Name	Habit[34]	WIS[35]	Family
Vernal Pool (25 total, 17 native, 8 nonnative)				
*Anagallis arvensis**	Scarlet Pimpernel	AH	FAC	Primulaceae
*Briza minor**	Little Quakinggrass	AG	FACW-	Poaceae
Callitriche marginata+	Winged Water-starwort	AH	OBL	Callitrichaceae
*Chamomilla suaveolens**	Pineapple Weed	AH	FACU	Asteraceae
Castilleja campestris ssp. *campestris*	Field Owl's Clover	AH	OBL*	Orobanchaceae
Deschampsia danthonioides	Annual Hairgrass	AG	FACW	Poaceae
Eleocharis macrostachya	Creeping or Pale Spikerush	PG	OBL	Cyperaceae
Epilobium ciliatum	Northern Willow-herb	PH	FACW	Onagraceae
Epilobium densiflorum	Dense-flowered Willow-herb	AH	OBL	Onagraceae
Eremocarpus setigerus	Dove Weed	AH	-	Euphorbiaceae
Gratiola ebracteata	Bractless Hedgehyssop	AH	OBL	Scrophulariaceae
Hordeum marinum ssp. *gussoneanum**	Mediterranean Barley	AG	FAC	Poaceae
Juncus bufonius	Common Toad Rush	AG	OBL	Juncaceae
Lasthenia fremontii	Fremont's Goldfields	A/PH	OBL	Asteraceae
Lasthenia glaberrima+	Smooth Goldfields	AH	OBL	Asteraceae
*Lolium multiflorum**	Italian Ryegrass	AG	FAC*	Poaceae
*Lythrum hyssopifolium**	Hyssop Loosestrife	AH	FACW	Lythraceae
Navarretia leucocephala+	Whitehead Navarretia	AH	OBL	Polemoniaceae
Plagiobothrys stipitatus+	Stalked Popcornflower	AH	OBL	Boraginaceae
*Poa annua**	Annual Bluegrass	AG	FACW-	Poaceae
*Pseudognaphalium luteoalbum**	Everlasting Cudweed	AH	FACW-	Asteraceae
Psilocarphus brevissimus+	Dwarf Woollyheads	AH	OBL	Asteraceae
Ranunculus bonariensis+	Carter's Buttercup	AH	OBL	Ranunculaceae
Triteleia hyacinthina	White Brodiaea	PH	FACW*	Liliaceae
Veronica peregrina	Neckweed	AH	OBL	Veronicaceae
Vernal Pool Buffer (21 total, 4 native, 17 nonnative)				
*Anagallis arvensis**	Scarlet Pimpernel	AH	FAC	Primulaceae

[33] * = Introduced plant species that have become naturalized. + = Native species characteristic of the habitat. Scientific names of the plant species follow Hickman (1993) and Flora of North America Committee (2001-2007). Brackets [ ] indicate updated nomenclature.

[34] Habit definitions: AG = annual graminoid; AH = annual herb; AV = annual vine; F = Fern; PG = perennial graminoid; PH = perennial herb; PV = perennial vine; S = shrub; T = tree.

[35] WIS = Wetland Indicator Status. The following code definitions are according to Reed (1988):
OBL = obligate wetland species, occurs almost always in wetlands (>99% probability).
FACW = facultative wetland species, usually found in wetlands (67-99% probability).
FAC = facultative species, equally likely to occur in wetlands or nonwetlands (34-66% probability).
FACU = facultative upland species, usually found in nonwetlands (67-99% probability).
UPL = obligate upland species in this region (99% probability), occurs in wetlands in another region
NI = no indicator status has been assigned due to a lack of information.
+ or - symbols are modifiers that indicate greater or lesser affinity for wetland habitats.
* = tentative assignment to that indicator status by Reed (1988).
( ) Parentheses indicate a wetland status suggested by David L. Magney based on extensive field observations.

Scientific Name[33]	Common Name	Habit[34]	WIS[35]	Family
*Avena barbata**	Slender Wild Oat	A/PG	-	Poaceae
*Brassica rapa**	Field Mustard	AH	-	Brassicaceae
*Briza minor**	Little Quakinggrass	AG	FACW-	Poaceae
*Bromus diandrus**	Ripgut Brome	AG	(FACU)	Poaceae
*Bromus hordeaceus**	Soft Brome	AG	FACU-	Poaceae
Bromus madritensis ssp. *rubens**	Red Brome	AG	NI	Poaceae
Centaurium muhlenbergii	Monterey Centaury	AH	FAC	Gentianaceae
*Chamomilla suaveolens**	Pineapple Weed	AH	FACU	Asteraceae
Deschampsia danthonioides	Annual Hairgrass	AG	FACW	Poaceae
Hordeum marinum ssp. *gussoneanum**	Mediterranean Barley	AG	FAC	Poaceae
*Hordeum murinum**	Summer Barley	AG	NI	Poaceae
*Juncus capitatus**	Leafybract Dwarf Rush	AG	FACU	Juncaceae
*Leontodon taraxacoides**	Hawkbit	A/B/PH	FACU	Asteraceae
Lepidium nitidum	Common Peppergrass	AH	-	Brassicaceae
*Lolium multiflorum**	Italian Ryegrass	AG	FAC*	Poaceae
*Lythrum hyssopifolium**	Hyssop Loosestrife	AH	FACW	Lythraceae
Plantago erecta	California Plantain	AH	-	Plantaginaceae
*Poa annua**	Annual Bluegrass	AG	FACW-	Poaceae
*Pseudognaphalium luteoalbum**	Everlasting Cudweed	AH	FACW-	Asteraceae
*Vulpia bromoides**	Brome Fescue	AG	FACW	Poaceae
Seasonal Wetlands and Swales (26 total, 15 native, 11 nonnative)				
*Alisma lanceolatum**	Lanceleaf Water Plantain	PH	OBL	Alismataceae
Azolla filiculoides	Pacific Mosquitofern	F	OBL	Azollaceae
*Crypsis schoenoides**	Swamp Grass	AG	OBL	Poaceae
Cyperus eragrostis+	Umbrella-sedge	PG	FACW	Cyperaceae
Deschampsia danthonioides	Annual Hairgrass	AG	FACW	Poaceae
Epilobium ciliatum+	Northern Willow-herb	PH	FACW	Onagraceae
Epilobium densiflorum	Dense-flowered Willow-herb	AH	OBL	Onagraceae
Epilobium pygmaeum	Smooth Spike-primrose	AH	OBL	Onagraceae
*Glyceria declinata**	Waxy Mannagrass	PG	-	Poaceae
Gnaphalium palustre+	Lowland Cudweed	AH	FACW	Asteraceae
Hordeum marinum ssp. *gussoneanum**	Mediterranean Barley	AG	FAC	Poaceae
Juncus balticus+	Baltic Rush	PG	OBL	Juncaceae
Juncus bufonius	Common Toad Rush	AG	OBL	Juncaceae
Juncus effusus	Common Rush	PG	OBL	Juncaceae
Juncus xiphioides	Iris-leaved Rush	PG	OBL	Juncaceae
*Lolium multiflorum**	Italian Ryegrass	AG	FAC*	Poaceae
*Mentha pulegium**	Pennyroyal	PH	OBL	Lamiaceae
Phyla nodiflora	Turkey Tangle Fogfruit	PH	FACW	Verbenaceae
Plagiobothrys stipitatus+	Stalked Popcornflower	AH	OBL	Boraginaceae
*Polypogon monspeliensis**	Rabbitsfoot Grass	AG	FACW+	Poaceae

Scientific Name[33]	Common Name	Habit[34]	WIS[35]	Family
*Rumex acetosella**	Common Sheep Sorrel	PH	FAC-	Polygonaceae
*Rumex crispus**	Curly Dock	PH	FACW-	Polygonaceae
*Rumex pulcher**	Fiddle Dock	PH	FAC+	Polygonaceae
Triteleia hyacinthina	White Brodiaea	PH	FACW*	Liliaceae
*Veronica anagallis-aquatica**	Water Speedwell	PH	OBL	Veronicaceae
Veronica peregrina	Neckweed	AH	OBL	Veronicaceae
Seasonal Wetlands and Swales Buffer (23 total, 5 native, 18 nonnative)				
Amaranthus retroflexus+	Redroot Amaranth	AH	FACU	Amaranthaceae
*Anthemis cotula**	Mayweed	AH	FACU	Asteraceae
Asclepias fascicularis+	Narrowleaf Milkweed	PH	FAC	Apocynaceae
*Bromus diandrus**	Ripgut Brome	AG	(FACU)	Poaceae
*Bromus hordeaceus**	Soft Brome	AG	FACU-	Poaceae
Bromus madritensis ssp. *rubens**	Red Brome	AG	NI	Poaceae
*Chamomilla suaveolens**	Pineapple Weed	AH	FACU	Asteraceae
*Chenopodium album**	Lambsquarters	AH	FAC	Chenopodiaceae
*Festuca arundinacea**	Tall Fescue	PG	FAC-	Poaceae
Hordeum marinum ssp. *gussoneanum**	Mediterranean Barley	AG	FAC	Poaceae
*Lactuca serriola**	Prickly Wild Lettuce	AH	FAC	Asteraceae
Lepidium nitidum+	Common Peppergrass	AH	-	Brassicaceae
*Lolium multiflorum**	Italian Ryegrass	AG	FAC*	Poaceae
*Lotus corniculatus**	Birdsfoot Trefoil	PH	FAC	Fabaceae
*Lythrum hyssopifolium**	Hyssop Loosestrife	AH	FACW	Lythraceae
*Picris echioides**	Bristly Ox-tongue	AH	(FAC)	Asteraceae
Plantago erecta+	California Plantain	AH	-	Plantaginaceae
*Plantago lanceolata**	English Plantain	PH	FAC-	Plantaginaceae
*Polygonum arenastrum**	*Common Knotweed*	AH	FAC	Polygonaceae
*Pseudognaphalium luteoalbum**	Everlasting Cudweed	AH	FACW-	Asteraceae
*Ranunculus muricatus**	Spinyfruit Buttercup	A/B/PH	FACW+	Ranunculaceae
*Rumex crispus**	Curly Dock	PH	FACW-	Polygonaceae
Xanthium strumarium+	Cocklebur	AH	FAC+	Asteraceae
Seasonal Marsh (17 total, 11 native, 6 nonnative)				
*Alisma lanceolatum**	Lanceleaf Water Plantain	PH	OBL	Alismataceae
Azolla filiculoides	Pacific Mosquitofern	F	OBL	Azollaceae
*Crypsis schoenoides**	Swamp Grass	AG	OBL	Poaceae
Epilobium pygmaeum	Smooth Spike-primrose	AH	OBL	Onagraceae
*Glyceria declinata**	Waxy Mannagrass	PG	-	Poaceae
Juncus effuses+	Common Rush	PG	OBL	Juncaceae
Juncus xiphioides+	Iris-leaved Rush	PG	OBL	Juncaceae
Lemna minuscula	Least Duckweed	PH	OBL	Lemnaceae
Ludwigia peploides	Floating Water-primrose	PH	OBL	Onagraceae
*Mentha pulegium**	Pennyroyal	PH	OBL	Lamiaceae

Scientific Name[33]	Common Name	Habit[34]	WIS[35]	Family
Polygonum hydropiperoides	Swamp Smartweed	PH	OBL	Polygonaceae
Polygonum punctatum	Dotted Smartweed	A/PH	OBL	Polygonaceae
*Polypogon monspeliensis**	Rabbitsfoot Grass	AG	FACW+	Poaceae
*Ranunculus muricatus**	Spinyfruit Buttercup	A/B/PH	FACW+	Ranunculaceae
Schoenoplectus [*Scirpus*] *acutus*+	Hardstem Bulrush	PH	OBL	Cyperaceae
Typha latifolia+	Cattail	PH	OBL	Typhaceae
Xanthium strumarium	Cocklebur	AH	FAC+	Asteraceae
Seasonal Marsh Buffer (24 total, 5 native, 19 nonnative)				
*Anagallis arvensis**	Scarlet Pimpernel	AH	FAC	Primulaceae
*Bromus diandrus**	Ripgut Brome	AG	(FACU)	Poaceae
*Bromus hordeaceus**	Soft Brome	AG	FACU-	Poaceae
Bromus madritensis ssp. *rubens**	Red Brome	AG	NI	Poaceae
*Chamomilla suaveolens**	Pineapple Weed	AH	FACU	Asteraceae
*Chenopodium album**	Lambsquarters	AH	FAC	Chenopodiaceae
Epilobium ciliatum+	Northern Willow-herb	PH	FACW	Onagraceae
Eryngium vaseyi+	Coyotethistle	PH	FACW	Apiaceae
*Festuca arundinacea**	Tall Fescue	PG	FAC-	Poaceae
*Lactuca serriola**	Prickly Wild Lettuce	AH	FAC	Asteraceae
Lepidium nitidum+	Common Peppergrass	AH	-	Brassicaceae
*Lolium multiflorum**	Italian Ryegrass	AG	FAC*	Poaceae
*Lotus corniculatus**	Birdsfoot Trefoil	PH	FAC	Fabaceae
*Lythrum hyssopifolium**	Hyssop Loosestrife	AH	FACW	Lythraceae
*Picris echioides**	Bristly Ox-tongue	AH	(FAC)	Asteraceae
Plantago erecta	California Plantain	AH	-	Plantaginaceae
*Plantago lanceolata**	English Plantain	PH	FAC-	Plantaginaceae
*Polygonum arenastrum**	*Common Knotweed*	AH	FAC	Polygonaceae
*Polypogon monspeliensis**	Rabbitsfoot Grass	AG	FACW+	Poaceae
*Pseudognaphalium luteoalbum**	Everlasting Cudweed	AH	FACW-	Asteraceae
*Rumex acetosella**	Common Sheep Sorrel	PH	FAC-	Polygonaceae
*Rumex crispus**	Curly Dock	PH	FACW-	Polygonaceae
*Rumex pulcher**	Fiddle Dock	PH	FAC+	Polygonaceae
Xanthium strumarium+	Cocklebur	AH	FAC+	Asteraceae
Upland Grassland (79 total, 18 native, 61 nonnative)				
*Aegilops triuncialis**	Barbed Goatgrass	AG	-	Poaceae
*Aira caryophyllea**	Silver Hairgrass	AG	-	Poaceae
Amsinckia menziesii	Rancher's Fire	AH	-	Boraginaceae
Asclepias fascicularis	Narrowleaf Milkweed	PH	FAC	Apocynaceae
*Avena barbata**	Slender Wild Oat	A/PG	-	Poaceae
*Avena fatua**	Wild Oat	AG	-	Poaceae
*Brachypodium distachyon**	Purple False Brome	A/PG	-	Poaceae
*Brassica nigra**	Black Mustard	AH	-	Brassicaceae

Scientific Name[33]	Common Name	Habit[34]	WIS[35]	Family
*Brassica rapa**	Field Mustard	AH	-	Brassicaceae
*Briza minor**	Little Quakinggrass	AG	FACW-	Poaceae
Brodiaea coronaria	Harvest Brodiaea	PH	(FAC)	Liliaceae
Bromus carinatus	California Brome	AG	-	Poaceae
*Bromus diandrus**	Ripgut Brome	AG	(FACU)	Poaceae
*Bromus hordeaceus**	Soft Brome	AG	FACU-	Poaceae
Bromus madritensis ssp. *rubens**	Red Brome	AG	NI	Poaceae
*Carduus pycnocephalus**	Italian Thistle	AH	-	Asteraceae
Castilleja attenuata	Valley Tassels	AH	-	Orobanchaceae
*Centaurea solstitialis**	Yellow Star-thistle	AH	-	Asteraceae
*Cerastium glomeratum**	Mouse-ear Chickweed	AH	FACU	Caryophyllaceae
*Chamomilla suaveolens**	Pineapple Weed	AH	FACU	Asteraceae
*Cichorium intybus**	Chicory	PH	-	Asteraceae
*Cirsium vulgare**	Bull Thistle	PH	FACU	Asteraceae
*Convolvulus arvensis**	Bind Weed	PV	-	Convolvulaceae
*Crassula tillaea**	Water Pygmy-weed	AH	NI*	Crassulaceae
*Cynodon dactylon**	Bermuda Grass	PG	FAC	Poaceae
*Daucus carota**	Queen Anne's Lace	PH	-	Apiaceae
Epilobium brachycarpum	Tall Annual Willow-herb	AH	UPL	Onagraceae
Eremocarpus setigerus	Dove Weed	AH	-	Euphorbiaceae
*Erodium botrys**	Broadleaf Filaree	AH	-	Geraniaceae
*Erodium moschatum**	Whitestem Filaree	AH	-	Geraniaceae
Euphorbia spathulata	Warty Spurge	AH	-	Euphorbiaceae
Galium aparine	Goose Grass	AH	FACU	Rubiaceae
*Geranium dissectum**	Cut-leaved Geranium	AH	-	Geraniaceae
Grindelia camporum	Great Valley Gumplant	PH	FACU	Asteraceae
Hemizonia fitchii	Fitch's Tarweed	AH	-	Asteraceae
*Hirschfeldia incana**	Summer Mustard	PH	-	Brassicaceae
Holocarpha virgata	Yellowflower Tarweed	AH	-	Asteraceae
Hordeum marinum ssp. *gussoneanum**	Mediterranean Barley	AG	FAC	Poaceae
*Hordeum murinum**	Summer Barley	AG	NI	Poaceae
*Hypochaeris glabra**	Smooth Cat's-ear	AH	-	Asteraceae
*Kickxia elatine**	Arrowleaf Fluvellin	AH	NI*	Veronicaceae
*Lactuca serriola**	Prickly Wild Lettuce	AH	FAC	Asteraceae
*Lathyrus angulatus**	Angled Pea	AV	-	Fabaceae
Lepidium nitidum	Common Peppergrass	AH	-	Brassicaceae
*Lolium multiflorum**	Italian Ryegrass	AG	FAC*	Poaceae
*Lotus corniculatus**	Birdsfoot Trefoil	PH	FAC	Fabaceae
Lotus purshianus	Spanish Clover	AH	UPL	Fabaceae
*Malva parviflora**	Cheeseweed	AH	-	Malvaceae
*Medicago polymorpha**	Burclover	AH	-	Fabaceae

Scientific Name[33]	Common Name	Habit[34]	WIS[35]	Family
*Paspalum dilatatum**	Dallisgrass	PG	FAC	Poaceae
*Phalaris aquatica**	Bulbous Canarygrass	PG	FAC+	Poaceae
*Phytolacca americana**	American Pokeweed	PH	NI	Phytolaccaceae
*Picris echioides**	Bristly Ox-tongue	AH	(FAC)	Asteraceae
Plantago erecta	California Plantain	AH	-	Plantaginaceae
*Plantago lanceolata**	English Plantain	PH	FAC-	Plantaginaceae
*Poa annua**	Annual Bluegrass	AG	FACW-	Poaceae
*Polygonum arenastrum**	*Common Knotweed*	AH	FAC	Polygonaceae
*Raphanus raphanistrum**	Wild Radish	A/PH	-	Brassicaceae
*Raphanus sativus**	Radish	A/BH	-	Brassicaceae
*Rumex acetosella**	Common Sheep Sorrel	PH	FAC-	Polygonaceae
*Rumex pulcher**	Fiddle Dock	PH	FAC+	Polygonaceae
*Silene gallica**	Windmill Pink	AH	-	Caryophyllaceae
*Silybum marianum**	Milk Thistle	AH	-	Asteraceae
*Sonchus oleraceus**	Common Sow-thistle	AH	NI*	Asteraceae
*Sorghum halepense**	Johnsongrass	PG	FACU	Poaceae
*Spergularia rubra**	Purple (Red) Sandspurrey	A/PH	FAC-	Caryophyllaceae
*Stellaria media**	Common Chickweed	AH	FACU	Caryophyllaceae
*Taeniatherum caput-medusae**	Medusahead	AG	-	Poaceae
*Tanacetum parthenium**	Feverfew	PH	-	Asteraceae
*Taraxacum officinale**	Dandelion	PH	FACU	Asteraceae
Trichostema lanceolatum	Vinegarweed	AH	-	Lamiaceae
*Trifolium dubium**	Suckling Clover	AH	FACU*	Fabaceae
*Trifolium hirtum**	Rose Clover	AH	-	Fabaceae
*Trifolium repens**	White Clover	PH	FACU+	Fabaceae
Triteleia laxa	Ithuriel's Spear	PG	-	Liliaceae
*Vicia sativa**	Common Vetch	AH	FACU	Fabaceae
*Vicia villosa**	Hairy Vetch	AH	-	Fabaceae
*Vulpia bromoides**	Brome Fescue	AG	FACW	Poaceae
Wyethia angustifolia	California Compassplant	PH	FACU-	Asteraceae

APPENDIX D.
MITIGATION MONITORING FORMS

FLORISTIC ASSESSMENT FORM

PROJECT NAME: North Vineyard Greens Project, Sacramento County, California

CORPS REGULATORY NUMBER: 200600428 Survey Date: ______________ **Page**____ **of**____

Wetland ID: ________________________ **Monitor(s):** ______________________________________

Wetland AA ____ **Buffer** ____ **Existing** **Initial** **Year:** 1 2 3 4 5

Botanical Name	Common Name	Native	% Cover	Characteristic Native Species

Total # Species	#Non-native Species	#Native Species	%Native Species
Total % Cover	%Native Cover	#Characteristic Species	Characteristic %Cover

GRASSLAND ASSESSMENT FORM

PROJECT NAME: North Vineyard Greens Project, Sacramento County, California

CORPS REGULATORY NUMBER: 200600428 **Page____ of____**

Survey Date: ________________________ **Monitor(s):** ______________________________________

Co-dominant Species (>10% cover) **Existing** **Initial** **Year:** 1 2 3 4 5

Botanical Name	Common Name	Native	% Cover

#Co-dominant Species	#Native Co-dominant Species	%Native Co-dominant Species
%Co-dominant Cover	%Native Co-dominant Cover	Total %Cover for All Species

GENERAL PROGRESS, OBSERVATIONS, AND RECOMMENDATIONS

PROJECT NAME: North Vineyard Greens Project, Sacramento County, California

CORPS REGULATORY NUMBER: 200600428

Survey Date: _____ **Monitor(s):** _____

Wetland ID: _____ **Existing Initial Year:** 1 2 3 4 5

PURPOSE OF THIS MONITORING/OBSERVATION: Periodic report to assess the progress of mitigation site plantings, including species diversity, vegetative cover, and the presence of non-native species; condition of irrigation system (if applicable); and wetland hydrology.

GENERAL PROGRESS OF THE MITIGATION PLANTINGS:

_____

_____

_____

_____

OVERALL OBSERVATIONS, CORRECTIVE MEASURES, AND RECOMMENDATIONS:

Plantings: _____

_____

_____

_____

Irrigation: _____

_____

_____

_____

Wetland Hydrology: _____

_____

_____

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PHOTOGRAPHIC DATA

Photo	View	Notes	Photo	View	Notes
1			9		
2			10		
3			11		
4			12		
5			13		
6			14		
7			15		
8			16		