WETLANDS MITIGATION AND MONITORING PLAN
DUTRA HAYSTACK LANDING WETLAND MITIGATION PROJECT
PETALUMA, SONOMA COUNTY, CALIFORNIA
(U.S. Army Corps of Engineers File No. 28104N)

Prepared for:

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1.0 INTRODUCTION

The Dutra Group is proposing to establish an asphalt plant facility and associated conveying system on the approximately 35-acre[1] Haystack Landing project site, located at 3355 Petaluma Boulevard South bordering Petaluma in Sonoma County, California. The facility will take delivery of aggregate and sand from the existing Landing Way barge offload facility and process some aggregate into the finished asphalt product and sell the remainder of the aggregate directly to the public in Sonoma County. The offloading will occur at the existing Landing Way barge off-loading facility (owned by Shamrock Materials, Inc.) located at 210 Landing Way in Petaluma, and will be transferred by an enclosed electric conveyor on the Landing Way property, over the Barton property to the south and cross over the SMART (Sonoma Marin Area Rail Transit) right-of-way to the Haystack property to the southwest. At the Haystack site, the material will be deposited into stockpiles at the proposed asphalt facility. The locations of the proposed asphalt plant and conveyor belt, and the existing offloading facility are illustrated on Figure 1.

Construction of the proposed asphalt plant will result in the filling of approximately 1.37 acre of seasonal wetland subject to U.S. Army Corps of Engineers (Corps) jurisdiction pursuant to Section 404 of the Clean Water Act. In addition, transferring aggregate materials from the barges via the electronic conveyor will require the decommissioning of an existing mitigation wetland that covers approximately 0.47 acre. This report details the proposed mitigation program that provides a total of 10.93 acres of enhanced and created wetland habitat designed to mitigate for the wetlands impacted by the proposed asphalt plant and impacts to the Landing Way mitigation area. In addition, a section of coastal brackish marsh fronting the Petaluma River on Parcel B (Barton Property) will be restored since approximately 0.02 acre in this area was filled in 2005. Restoration of this area will include removing fill from the wetland area and planting the disturbed and adjacent zones with native brackish marsh plants.

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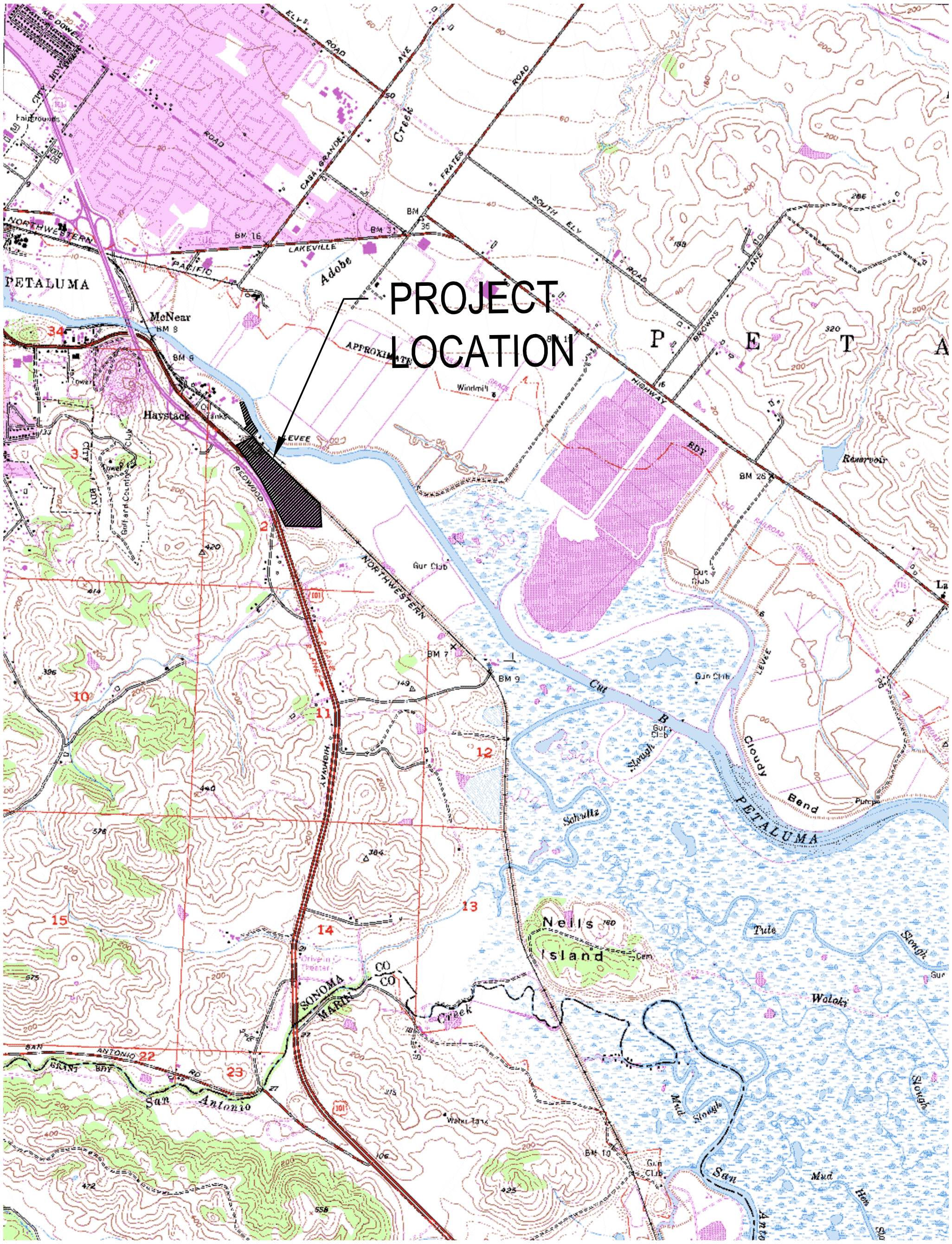
[1] Since the 2006 submittal of the original mitigation plan for this project, the existing acreage at the project site has been reduced by approximately 2.29 acres with the Marin-Sonoma Narrows (MSN) Caltrans improvement project. The improvements within the Caltrans right of way impacted approximately 0.26 acres of existing wetlands within the Haystack Landing property, leaving Haystack Landing (including Barton property) with approximately 12.17 acres of existing wetlands (see Plate 1).



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DUTRA HAYSTACK ASPHALT FACILITY
USGS MAP
OVERALL SITE PLAN

SONOMA FIGURE 1 CALIFORNIA

To complement the wetland creation and enhancement projects, an additional 2.54 acres within the wetland mitigation area on the 35-acre parcel will be planted with native trees and shrubs to provide wildlife habitat and to serve as a natural buffer to the proposed asphalt industrial facility. Another 0.29 acre of upland buffer will be planted with native trees and shrubs on the Landing Way site. This buffer will be on the east side of the Landing Way property along an existing earthen berm that will provide a buffer between the loading facility and the coastal brackish marsh associated with the Petaluma River.

With the exception of the restored section of marsh fronting the Petaluma River and the Landing Way buffer enhancement, the proposed wetland mitigation project will occur on approximately 17 acres on the southern portion of the 35-acre Haystack site. Of these 17 acres, approximately 9 acres are jurisdictional seasonally inundated wetlands (Plate 1). The reasons this portion of the site was selected as the optimal location for the mitigation preserve are as follows:

1) To locate the asphalt facilities on primarily upland habitats north of this area thereby avoiding over 90 percent of the wetland habitats on the 35-acre site, and
2) To create new seasonally inundated wetland habitat and enhance degraded wetland habitat as a bay-fringe mosaic in an area adjacent to tidal sloughs and wetlands associated with the Petaluma River corridor (see Plate 2).
3) To "restore" an area that was historically coastal brackish marsh but filled in the 1960s for construction of quarry silt ponds to a higher quality seasonally inundated wetland environment.

The proposed mitigation project would include the following:

- creation of 2.66 acres seasonally inundated wetland
- enhancement of 8.27 acres seasonally inundated wetland
- restoration of 0.02 acres of brackish marsh fronting the Petaluma River
- preservation of 0.90 acre seasonally inundated wetland
- enhancement of 3.29 upland buffer zone

In total, the proposed mitigation would compensate for wetlands-related impacts resulting from construction of the operating plant at greater than a 3:1 replacement ratio[2] with the goal of creating improved wetlands functions and values on the project site.

[2] The replacement ratio was calculated assuming full credit for the creation of 2.66 acres of seasonally inundated wetland habitat and 50% credit for the enhancement of 8.27 acres of existing wetland habitat

2.0 RESPONSIBLE PARTIES

2.1 Applicant/Permittee

Mr. Ross Campbell of the Dutra Group, 1000 Point San Pedro Road, San Rafael, California 94901-8312 is the designated agent(s) for the proposed project. Phone number 415-258-6873.

2.2 Applicant's Designated Agent

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3.0 PROJECT REQUIRING MITIGATION

3.1 Environmental Setting

The Haystack Landing project site consists of three assessor parcels on the Petaluma River USGS quadrangle in the middle portion of Section 2 in Sonoma County, California. Two of these parcels (APN 019-320-023 and APN 019-320-022) form an approximately 35-acre trapezoidal parcel bound to the east by the Sonoma Marin Area Rail Transit (SMART) tracks and to the west by Highway 101 (hereafter jointly referred to as Parcel A in this report). The third parcel (APN 019-220-001) occurs east of the railroad tracks and fronts the Petaluma River (also known as the Barton Parcel, hereafter referred to as Parcel B in this report). Finally, a portion of the Landing Way Facility (approximately 0.47 acre) would be impacted to construct an electric conveyor that would transport materials off-loaded at the Shamrock Materials, Inc. Landing Way facility to the 35-acre parcel where the asphalt plant will be constructed. These parcels are described in greater detail in Section 3.3.

3.2 Description of Asphalt Plant, Recycling Plant, and Off-loading Facility

The proposed project will consist of a new asphalt plant and associated stockpiles of rock and sand used to produce finished products. These stockpiles will include recycled asphalt and concrete which are integral components for manufacturing recycled asphaltic concrete (AC).

The new asphalt plant, which will be located on the northern portion of Parcel A, will consist of a 6-product cold feed bin assembly, a 400 ton per hour counter flow drum mix assembly, twin oil storage tanks, four 100 ton storage silo assemblies, a heating oil plant, and a truck scale installation. An operator's compartment and electrical motor control will also be incorporated into the plant. This facility will be designed and constructed to meet seismic standards, as well as blue smoke and related emission requirements.

In support of the asphalt plant, Dutra will use the current Shamrock Material, Inc. Landing Way off-loading facility to import material. A conveying system will be erected to transport materials from the off-load facility to the plant site on the 35-acre parcel to the southwest.

The barge offloading equipment includes an existing "e-crane" which is operated from the shore and reaches onto the barge to collect the aggregate. The aggregate is placed into a hopper by the e-crane. From the hopper, the aggregate is transferred to the conveyor which carries the material approximately 670 feet towards the SMART right-of-way. The next leg is approximately 120 feet long and rises to a height of 24' to cross the railroad tracks. This height is necessary to allow standard trains to pass underneath the conveyor. After crossing the railroad, the conveyor system will take the material 390' in a southeasterly direction roughly parallel to the railroad. This conveyor will sit on top on the hill and remain approximately level until it crosses over the current access road, which will remain in place. At the end of this conveyor, the stockpile distribution system will separate the material into the appropriate stockpiles. This will allow the most efficient storage of material on the site.

A small office complex, consisting of a reception and weigh-master area, an operations office, and a conference room area will also support the facility.

3.3 Site Characteristics

3.3.1 Background

The project site consists of three properties as referenced in the original wetlands assessment conducted for the project: Parcel A covers approximately 35 acres east of Petaluma Boulevard South and Parcel B covers approximately 0.8 acres east of Parcel A and fronts the Petaluma River. A portion of the Landing Way facility, just north of Parcel B, is also included in the project.

Prior to construction of the Northwestern Pacific railroad tracks in the late 1800's and early 1900's, much of the 35-acre site was coastal brackish marsh habitat associated with the Petaluma River corridor. With construction of the railroad, normal hydrologic flows to Parcel A were impeded by the railroad bed, reducing the functions and values of the wetland areas. Parcel A was then used as a dairy farm until 1968 when the site was purchased by American Rock and later the Dutra Group. The northern 25 acres of the site were leased back to the dairy rancher at that time and the remaining 10 acres located in the southern portion of the site were used for the disposal of quarry wash water transferred from a quarry located on the west side of Highway 101 just north of the project site. Since 1968, various dikes and siltation ponds were constructed on the 35-acresite; eventually five siltation ponds were constructed for settling quarry wash water (Figure 2). In 1976, the northernmost siltation pond was filled with earthen material excavated from an adjacent hill. The remaining ponds, including the one originally constructed in 1968 at the southernmost portion of the site, were actively used by the quarry for the disposal of quarry wash water until the mid-1970s. Two of the ponds located on the southwestern portion of the site were in continuous use until at least 1990[3]. According to the current property owners, none of the siltation ponds have been actively used for quarry or other operations since 1990. An historic farmhouse occupied the northern 4 acres of the project site until it burned down in 2004. Several barns and outbuildings used to store miscellaneous materials located south of the house were demolished in 2004 as permitted by a County demolition permit.

Parcel B fronts the Petaluma River and covers approximately 0.8 acre of relatively flat land. Historically this site had a small residence on it and was primarily vegetated with non-native grasses and various shrubs including coyote bush.

A description of current conditions at the project site is provided below.

Parcel A

The northern portion of Parcel A covers approximately 4 acres directly adjacent to Petaluma Boulevard South. Two small dirt roads provide access to this area that is vacant and primarily dominated by ruderal grasses and herbs. The southern portion of Parcel A covers approximately 33 acres east of Highway 101 and is comprised of the abandoned siltation ponds referenced above.

Portions of the ponds that are higher in elevation have developed upland characteristics while lower elevations have developed primarily seasonal wetland characteristics. Various drainage ditches, at least one of which is tidally influenced, traverse portions of the site.

In September 2005 approximately 10 acres of the northern portion of Parcel A were grubbed and cleared of vegetation. Since that time, this portion of the site was hydroseeded as part of an erosion control program and has revegetated with herbaceous vegetation.

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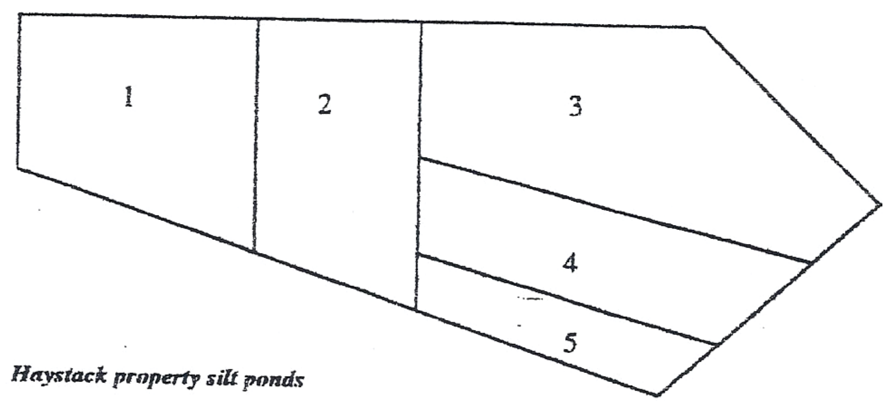
[3] LSA Associates, Inc. 1995. *Determination of Corps Jurisdictional Area, Haystack Landing, Petaluma*.



Siltation Ponds
Haystack Landing Project Site
Petaluma, California

Figure 2
(Source: LSA Associates, Inc. 1995)

Parcel B

Parcel B fronts the Petaluma River and covers approximately 0.80 acre. A small band of coastal brackish marsh associated with the Petaluma River forms the eastern property boundary of this parcel. A remnant slough bisects a portion this parcel for a distance of approximately 110 linear feet, averaging approximately 7 feet wide, and is connected to the Petaluma River.

In early 2005 the house on this parcel was demolished as authorized by a County of Sonoma demolition permit. In September 2005, the parcel was cleared of vegetation and a layer of drain rock applied to the majority of the site (excluding the small tidal slough). The purpose of installing the drain rock was to provide a foundation for storing equipment associated with the future asphalt plant. By the end of 2005 the equipment was removed and since that time most of the area disturbed has revegetated with ruderal weedy species.

Landing Way Off-loading Facility

A portion of the Landing Way off-loading facility will be used to off-load materials and transfer them by an electric conveyor to Parcel A for use in creating asphalt. The existing Landing Way facility fronts the Petaluma River and is immediately north of Parcel B. The area to be impacted by construction of the conveyor belt woud impact 0.47 acre of seasonal wetland mitigation area supporting primarily non-native wetland grasses. This area is proposed to be decommissioned as part of the proposed project.

3.3.2 Existing Wetland Habitats

3.3.2.1 Parcel A

On November 7, 2003 the San Francisco District of the U.S. Army Corps of Engineers conducted a jurisdictional determination on Parcel A and again on October 18, 2008 to also include Parcel B and the portion of the property just west of the NWP tracks. In total, approximately 12.62 acres of jurisdictional wetlands and waters of the U.S. were identified on these two parcels. Since the 2006 submittal of the original mitigation plan for this project, the existing acreage at the project site has been reduced by approximately 2.29 acres with the Marin-Sonoma Narrows (MSN) Caltrans improvement project. The improvements within the Caltrans right of way impacted approximately 0.26 acres of existing wetlands within the Haystack Landing property, leaving Haystack Landing (including Barton property) with approximately 12.17 acres of existing wetlands (see Plate 1). Wetland areas are described below and delineated on Plate 1. A request for an updated approved jurisdictional determination has been submitted to the Corps for verification of current conditions; once this verification is obtained, copies will be provided to the RWQCB as well.

Drainage Ditches

Several drainage ditches occur on the project site. Most of these ditches support shallow pools of standing water and two of the drainage ditches appear to be tidally influenced. Illustrated on Plate 1 as drainage ditch DD1 and drainage ditch DD2 in the central portion of the property, these areas drain into a larger drainage ditch along the railroad tracks that parallels the eastern property boundary. The drainage ditch within the railroad easement is outside the project area and therefore is not mapped on the project site. Aerial photograph review indicates that the railroad ditch drains to the Petaluma River via a tidally-influenced slough.

Drainage ditch DD 1 looking north

Drainage Ditch DD 2 looking east towards Petaluma River

A smaller drainage ditch, delineated as drainage ditch DD3, parallels the southern property line for approximately 500 feet and is approximately 3 feet wide as shown on Plate 1. Saturated soils were observed in March 2003 in the eastern portion of the ditch where it connects to a pond located east of the property. This area also appears to be marginally tidally influenced.

The remaining ditches (drainage ditches DD4 and DD5) are probably brackish given the composition of cattail and pickleweed. However, it appears that the most northern of the ditches (drainage DD6) may convey and contain freshwater as there is no evidence of a direct hydrologic connection to any of the other tidally influenced ditches on the project site and the vegetation growing in drainage ditch DD6 consists of cattails

In total, the ditches on Parcel A cover approximately 1.53 acres subject to Corps jurisdiction.

Seasonally Inundated Wetlands

A total of nine seasonally inundated wetland areas were identified on Parcel A ranging in size from 0.07-acre to 4.0 acres as illustrated on Plate 1. All of these areas occur within the former siltation ponds.

Wetland A is located in the middle of the site and covers approximately 1.09 acres. This wetland area appears to occasionally support standing water for a significant period of time during the growing season, as evidenced by the presence of algal matting in the western and northern edges of the wetland. Soils in this area are moist clay loam, with some gleying observed at approximately 16 inches. Hydrophytes (wetland plants) including alkali heath (*Frankenia salina*), rye grass (*Lolium multiflorum*), bird's-foot trefoil (*Lotus corniculatus*), and bristly ox tongue (*Picris echioides*) were the dominant plant species observed growing in this area. As a result of the grubbing activity that occurred on the northern portion of Parcel A in 2005, approximately 0.53 acre of Wetland A was grubbed and cleared of vegetation. This area has since reestablished with vegetation.

Other wetlands on the site include a small seasonal wetland (Wetland I) covering 0.03-acre and wetlands B, C, and D that occur on the southern portion of the site. Wetland B is the largest of these areas (measuring 4.0 acres) and during the rainy season supports standing water in the eastern portion where it connects to a small ditch that drains to the ditch adjacent to the railroad tracks east of the project site. Obligate wetland plants including cattail (*Typha domenigensis*) and pickleweed (*Salicornia virginica*) grow in this area. Significant algal matting in the lower portions of this area and evidence of debris at the outlet of the drainage ditch connecting to Wetland B were observed in March 2003 which indicates that this area ponds water during the wetter months.

Soil texture, color, and structure are greatly varied throughout the soil profile within the Wetland B area. This is mostly attributed to the fact that the soils in this area are an accumulation of sediments from quarry wash water deposited in these ponds in the 1970's and 1980's. Gleying and mottling observed throughout the soil profile suggests that soils in this area are saturated for extended periods of time.

View of Wetland B looking southeast

Wetlands C and D (covering 0.08 and 0.39-acre respectively) are located north of Wetland B and are dominated primarily by facultative plant species including bristly ox-tongue and bird's-foot trefoil, and facultative-wet species, most notably peppergrass (*Lepidium latifolium*). Occasional bulrush (*Schoenoplectus maritimus*), formerly known as *Scirpus maritimus*) and cattail also grow in this wetland, though these species are sparse. Soils in these areas are less varied in composition than those observed in Wetland B and exhibit significant mottling, especially in the surface soils. Algal matting is also present. The upland areas adjacent to these wetland areas are primarily dominated by Italian thistle (*Carduus pycnocephalus*), vulpia (*Vulpia bromoides*), and geranium (*Geranium dissectum*).

Wetlands E through H occur on the southern portion of the site just east of Highway 101. These areas range in size from 0.07 to 3.51 acres as shown on Plate 1. Soil texture, structure, and color vary significantly because this portion of the site was also used for quarry siltation ponds. Mottling, oxidized rhizospheres, and algal matting provide hydrology indicators that suggest prolonged inundation in these wetland areas. Vegetation in these areas was comprised mostly of obligate- and facultative-wet plant species, including pickleweed, toad rush (*Juncus bufonius*), salt grass (*Distichlis spicata*), and sand spurrey (*Spergularia marina*). Patches of bare ground were also observed within these wetland areas, perhaps because the salt content of the soils is too high for some species to tolerate or that prolonged inundation has resulted in vegetation suppression.

View of Wetland H looking southwest towards Highway 101

A small pond that supports several feet of standing water is located at the northwestern edge of Wetland H and is connected to drainage ditch DD2 (which is tidally influenced) via a small culvert that passes under a levee road. Wetland I supported standing water (up to 2 inches) in March 2003 and saturated soils in several lower depressions in the northern portion of the wetland. Plant species composition is similar to that of Wetlands E-H; however, more obligate species including cattail and bulrush occur, particularly in the areas with standing water. Wetlands A through I cover a total area of 10.06 acres subject to Corps jurisdiction.

In total, 12.42 acres of jurisdictional wetland areas were identified on Parcel A (Plate 1).

3.3.2.2 Parcel B

A jurisdictional wetland delineation was conducted on Parcel B on January 21, 2004 after this parcel was included as part of the proposed project. One remnant slough occurs on this parcel and measures approximately 110 feet in length and approximately 6-8 feet in width, covering a total area of approximately 0.02 acre potentially subject to Corps jurisdiction. In addition, approximately 200 linear feet of coastal brackish marsh averaging about 20 feet wide occur on the eastern boundary of this parcel. In January 2004 it was determined that the coastal brackish marsh habitat covered about 0.10 acre potentially subject to Corps jurisdiction.

As a result of the grubbing activities and the installation of drain rock across the majority of this parcel in 2005, it was determined that approximately 0.02 acre of the coastal marsh habitat on this parcel was filled.

3.3.2.3 Portion of Landing Way

A portion of the Landing Way off-loading facility, approximately 0.47 acre, will be used to off-load materials and transfer them by an electric conveyor to Parcel A for use in creating asphalt. The existing Landing Way facility fronts the Petaluma River and is immediately north of Parcel B. The area to be impacted by construction of the conveyor belt is a seasonal wetland mitigation area supporting primarily non-native wetland grasses. The San Francisco Corps confirmed on December 14, 2010 that this mitigation area covered 0.47 acre subject to Corps jurisdiction.

3.3.3 Aquatic Functions of Wetland Habitats on Site

The seasonal wetland areas on the project site provide flood retention and sediment storage, serving to filter sediments that otherwise may flow directly to the drainages on and adjacent to the project site and provide groundwater recharge functions.

3.3.4 Wildlife Habitat Functions of Wetland Habitats on Site

The seasonal wetlands provide habitat for birds, especially waterfowl, during the winter and spring months when wetland areas pond water for extended periods of time. The seasonal wetlands also provide habitat and forage opportunities for small mammals. A variety of terrestrial wildlife uses the seasonal wetlands and adjacent uplands onsite as well. Wildlife species commonly associated with open grasslands and seasonal wetland habitats such as those found on the project site include western meadowlark (*Sturnella neglecta*), savannah sparrow (*Passerculus sandwichensis*), northern harrier (*Circus cyaneus*), killdeer (*Charadrius vociferus*), western terrestrial garter snake (*Thamnophis elegans*), pacific chorus frog (*Pseudacris regilla*), red-tailed hawk (*Buteo jamaicensis*), white-tailed kite (*Elanus leucurus*), and black-tailed jackrabbit (*Lepus californicus*). Species associated with coastal marsh and estuarine habitats include great egret (*Ardea alba*), green heron (*Butorides virescens*), great blue heron (*Ardea herodias*), sora (rail) (*Porzana carolina*), and American coot (*Fulica americana*).

Animal species observed on the project site during field surveys conducted in January, September, and October 2004 include mute swan (*Cygnus olo*r), mallard (*Anas platyrhynchos*), black-necked stilt (*Himantopus mexicanus*), song sparrow (*Melospiza melodia*), acorn woodpecker (*Melanerpes formicivorus*), mourning dove (*Zenaida macroura*), killdeer, black-tailed hare, opossum (*Didelphis virginiana*) tracks, cinnamon teal (*Anas cyanoptera*), blue-winged teal (*Anas discors*), northern harrier, Canada goose (*Branta canadensis*), western harvest mouse (*Reithrodontomys megalotis*), California meadow vole (*Microtus californicus*), and the non-native house mouse (*Mus musculus*).

3.3.5 Climate

The project site has climate characteristics similar to other locations on the lowlands surrounding the northwest corner of San Pablo Bay. In general, the site is located in the Mediterranean climate zone typical of central coastal California. This climate zone is characterized by cool, wet winters and hot, dry summers tempered, in this case, by proximity to San Pablo Bay and by the occurrence of occasional coastal fog, especially in late spring and summer. The windiest months are May and June, when turbidities in the Bay and Petaluma River can frequently persist at levels of 200 to 500 nephelometric turbidity units (NTUs).

Situated in the ‘rain shadow’ of coastal mountains, the project site receives a mean annual precipitation of approximately 22 inches (Rantz, 1971). The average rainfall value is the statistical mean of rainfall totals that show a wide range of values strongly influenced by global weather patterns, such as the El Nino Southern Oscillation and prolonged periods of drought. The location of the site north and east of Bolinas and Big Rock Ridges, Mount Burdell and Chileno Valley hills, and west of the Sonoma Mountains strongly influences event totals.

Reference evapotranspiration at Petaluma averages 44 inches per year[4]. Reference evapotranspiration is the evapotranspiration of a well-watered 4- to 6-inch tall cool-season grass; evapotranspiration from small seasonally inundated or emergent wetland vegetation can be 10 to 15 percent higher.

3.3.6 Hydrography

The project site is situated in the upper reaches of the tidally-influenced portion of the Petaluma River, in a zone of transition between freshwater runoff and saline water of the San Pablo Bay. It is on the western flank of the valley, on lowlands adjacent to shallow 400- to 500-foot hills having roughly 30-percent slopes, in an area characteristic for tidal-fringe habitats. A mile upstream, the Town of Petaluma is a classic 'bridge point' town, founded at the head of tidewater, at another transition from fresher headwater habitats to downstream salt-marsh habitats. Hence, the site affords an opportunity to restore much of the same types of landward-edge-of-tidewater wetlands upon which much of downtown Petaluma has been established, and which has disproportionately been filled or affected – both in the Petaluma River system, and throughout the San Francisco Bay region.

In the vicinity of the project site, river salinity seasonally fluctuates down to about 7 parts per thousand (ppt) during wet-season runoff and increases to about 25 ppt during dry-season baseflow (see hydrologic report in Appendix C). Tidal water circulates onto the project site through a 20-foot wide slough east of the SMART tracks, and beneath the tracks through a new 36" RCP culvert installed by SMART in 2014. West of the tracks, tidal waters flow in the ditch along the tracks and onto the project site via drainage ditches DD1, DD2 and DD3. Tidal action reaches an off-site diked pond of about 8 to 10 acre-feet in size located to the southeast of Parcel A.

On Parcel A, tidal circulation is limited to the drainage ditches, and only during the highest, primarily winter tides does water spill from drainage ditch DD2 to Wetland H. The ditches on-site drain somewhat poorly relative to the off-site railroad-track ditch and slough downstream, and always have water below 2.6-foot elevation, owing to the nearly level channel slope, accumulated sediment and wetland vegetation above the confluences. Mean High Water (MHW) is 3.0-foot elevation, and Mean Higher High Water (MHHW) is 3.4 foot elevation. These elevations are optimal for pickleweed colonization (see Appendix C).

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[4] California Irrigation Management Information System (CIMIS) station 144; http://wwwcimis.water.ca.gov/cimis/frontStationDetailInfo.do?stationId=144&src=info; Station averages: Jan 0.98, Feb 1.65, Mar 2.81, Apr 4.25, May 5.61, Jun, 6.26, Jul 6.47, Aug 5.86, Sep 4.49, Oct 3.05, Nov 1.54, Dec 0.98, Annual 43.95 inches.

On-site runoff during the wet season collects in the seasonally inundated wetland areas and/or sheet flows to the drainage ditches. Wetlands A and H overflow to drainage ditch DD2, and Wetland B drains to the railroad track ditch. Other wetlands, such as Wetland E, do not generate runoff except during the most extreme events. During the dry season, all of the wetlands desiccate. Only drainage ditches DD1, DD2 and DD3 receive tidal water. Tidal waters extend in these ditches as far upstream as the onsite access road and not beyond. Off-site runoff from the upland slopes to the west enters the site from four locations (Figure 3): 1) three at the southwest corner of Parcel A from a watershed area of 18.26 acres; and 2) one at the northwest corner of Parcel A from an area of 30.31 acres. Regional runoff averages about 6 inches per year (Rantz, 1974).

The highest values of specific conductance (a surrogate for salinity) are commonly found in the tidally influenced waters, in drainage ditches DD1 and DD2, particularly in the dry-season when freshwater inflows in the Petaluma River recede and saline bay water extends further upstream. Regardless of the tidal waters, specific conductance of surface waters and near-surface ground waters on site vary greatly, and are influenced largely by high soil salinities at the south portion of the parcel resulting from a combination of effects including evapo-concentration, poor drainage locally, and possibly wicking up of displaced porewaters of underlying compacted bay mud (see Appendix C for details). Wetlands B and H largely receive runoff from this southern portion of the parcel, and both have moderately high specific conductance when ponded but lower specific conductance than tidal waters. Lowest conductivities (salinities) were measured in smaller seasonally inundated wetlands such as Wetlands C, D, E and I that collect rainfall.

3.3.7 Soils/Substrate

The Haystack Landing site is located within the Coast Range Geomorphic Province of California, where slopes developed on older bedrock meet the geologically-recent deposits of San Pablo Bay. The regional bedrock geology in the vicinity of the project site primarily consists of complexly folded, faulted, sheared, and altered sedimentary, igneous, and metamorphic rock of the Juarrasic- and Cretaceous-age Franciscan Complex. Tolay Volcanics of Miocene age outcrop in the region – most notably Burdell Mountain – and are found just northwest of the site in the area of the Dutra quarry Petaluma from which the source rock was extracted for aggregate processing (mapped by Blake and others, 1974). South of this Tolay Volcanics outcrop, Franciscan bedrock form the shallow hills immediately west of the site. Quaternary alluvium (Bay Mud marsh deposits) largely overlies bedrock within the Petaluma River valley lowlands, and at the site, the artificial fill and wash deposits (deposited from quarry operations) overlie Bay Mud.

Natural soils developed in place before quarry fines were deposited and consisted of Reyes silty clay underlying much of the site, and Goulding cobbly clay loam along the western boundary of the site, rising from the lowlands to Highway 101 and beyond (Sonoma County Soil Survey, USDA, by Miller, 1972). Reyes silty clay developed on Bay Mud and low-gradient stream alluvium. Poorly drained, it is common in saline and brackish marshes surrounding the Bay. In contrast, Goulding soils are well drained and are found on hilly volcanic (andesite or basalt) bedrock west and south of the site. Goulding soils also extend from the site about a mile to the northwest, to the quarry from which the source rock was extracted for aggregate processing. Other soils further west of the site, on the low hills draining to the site from west of Highway 101 are also well drained. They consist of Diablo clay and Los Osos clay loam, which both commonly form on weathered Franciscan sandstone and shale. Table 1 lists the recharge and water-holding properties of the on-site and off-site soils.

The quarry fines on site consist of silts and clays washed from the material processed at the quarry, primarily composed of Tolay Volcanics with some outcrops of typical Franciscan bedrock. A geotechnical investigation of the tailings on the southern portion of the site designated for the proposed wetlands mitigation project was conducted by Miller Pacific Engineering Group (2004). A copy of this report is attached as Appendix A. Subsurface exploration was performed on May 21, 2004 and consisted of drilling 6 soil borings utilizing truck-mounted drilling equipment with 6-inch hollow-stem continuous flight augers.

The subsurface conditions encountered were consistent with the mapped geology and soils. Miller Pacific staff found 6.5 to 11.0 feet of variable artificial fill/wash sediments. The fill materials encountered consisted of soft to very stiff, high to low plasticity sandy and silty clays and dense clayey sands. Soft, highly compressible Bay Mud varying in thickness from 8.0 to 13.5-feet underlies the fill. Older alluvial deposits underlie the Bay Mud. These deposits consist of very dense sandy clays and stiff, medium to highly plastic, sandy silts and clays. Bay Mud thickness contours (appearing in Figure 2 of Appendix B) are consistent with the soils survey, which shows Bay Mud 'pinching out' along the western portion of the site.

The lowest ground-water levels (during late summer and fall) are expected to be near the Bay Mud surface or slightly higher (Miller Pacific Engineering Group, 2004). Ground-water conditions in winter can be variable, depending on amount of and the elapsed time since significant rainfall. To minimize these effects, we measured conditions three weeks into a typical mid-winter drought. Wet-season ground-water levels, as well as subsurface specific conductance (salinity) and temperature levels, were evaluated on February 4, 2005 by Balance Hydrologics, following this 3-week mid-winter dry spell after a 2-week period of heavy rainfall during early January (see Appendix C for details). Within the tailings basins on the southern portion of the site, depth to water was 2 to 3 feet below ground surface in areas furthest from inundated wetland, and transitioning to approaching the ground surface at the wetlands.

3.3.8 Plant Communities on Site

Botanical surveys were conducted on Parcel A of the Haystack Landing site on March 31 and June 6 and 11, 2003, and on Parcel B on April 30, 2004. Descriptions of the vegetative communities identified are provided below.

3.3.8.1 Parcel A

A total of 119 species of vascular plants were observed on Parcel A. Of these, 31 species are native to the site, and 86 species are non-native. For two species, it could not be determined whether or not the species is native to the site. One of these species (*Atriplex* sp.) could only be identified to genus at the time the survey was conducted and could be either a native species or a non-native species. Since there are no known rare *Atriplex* species in Sonoma County, a late-summer visit of the site was not made to positively identify the species. In accordance with CDFW's survey protocol, this plant was identified at the level necessary to determine its rarity status (that is, to the genus level). The other species, Pacific madrone (*Arbutus menziesii*), is native to the region, but may have been planted on this site.

Table 1. Recharge and water-holding properties of surficial soils
Haystack Landing, Sonoma County, California

Map Symbol	Soil Series [1]	Parent Material	Taxonomy	Hydrologic Soil Group [2]	Project Area Coverage	Off-Site Watershed Coverage		Depth Zone	USCS[3]	Atterberg Limits		Permeability	Available Water Capacity[4]		Reaction	Remarks
			(order, subgroup, family)		(% estimated)	from SW	from NW	(inches)		Liquid	Plastic	(inches/hour)	Per Inch *(in./in. of soil)*	Profile *(total, in)*	(pH)	
Qaf	Artificial fill (aggregate processing wash tailing)	Sonoma Volcanics and some Franciscan bedrock.	-- -- --	C	100%	0%	0%	0 to 100	SM, SC, SW, CL, ML	43-56	7-28	0.06 to 0.2	0.1	10.0	6	Onsite area for wetlands restoration; mostly overlying RmA; depths and Attenberg Limits after MPEG 2004, other properties estimated
													Total	*10.0*		
RmA	Reyes silty clay, < 2% slopes	Bay Mud and river alluvium	Inceptisols Fluventic Haplaquepts Fine, mixed, sulfurous, acid, thermic	D	0%	0%	0%	0 to 63	MH, OH	60-70	10-30	0.06 to 0.2	0.14 to 0.16	9.5	4.0-4.5	Poorly-drained silty clay marshland soils underlying on-site artificial fill; soils compacted altering properties since survey.
													Total	*9.5*		
GID	Goulding cobbly clay loam, 5% to 15% slopes	Metamorphosed basic igneous and weathered andesitic basalt of old volcanic formation.	Inceptisols Lithic Xerochrepts Loamy-skeletal, mixed, mesic	D	0%	19%	23%	0 to 15	CL	30-40	15-30	0.63 to 2.0	0.15 to 0.17	2.4	5.6-6.5	Underlying the northern-most portion of the site and the southwest corner, along the west boundary, and west off-site; runoff is medium and the erosion hazard is moderate.
								11 to 30	GC	30-40	15-30	0.63 to 2.0	0.09 to 0.11	1.5	6.1-6.5	
													Total	*3.9*		
GIF2	Goulding cobbly clay loam, 30% to 50% slopes	Metamorphosed basic igneous and weathered andesitic basalt of old volcanic formation.	Inceptisols Lithic Xerochrepts Loamy-skeletal, mixed, mesic	D	0%	0%	7%	0 to 11	CL	30-40	15-30	0.63 to 2.0	0.15 to 0.17	1.8	5.6-6.5	On steeper slopes off-site to the northwest; runoff is rapid and the erosion hazard is high.
								11 to 22	GC	30-40	15-30	0.63 to 2.0	0.09 to 0.11	1.1	6.1-6.5	
													Total	*2.9*		

Map Symbol	Soil Series [1]	Parent Material	Taxonomy	Hydrologic Soil Group [2]	Project Area Coverage	Off-Site Watershed Coverage		Depth Zone	USCS[3]	Atterberg Limits		Permeability	Available Water Capacity[4]		Reaction	Remarks
			(order, subgroup, family)		(% estimated)	from SW	from NW	(inches)		Liquid	Plastic	(inches/hour)	Per Inch *(in./in. of soil)*	Profile *(total, in)*	(pH)	
LoD, LoE	Los Osos clay loam, 2% to 30% slopes	Weathered, fractured sandstone and shale	Mollisols	C	0%	55%	0%	0 to 16	CL or ML	35-45	10-20	0.2 to 0.63	0.19 to 0.21	3.0	5.6 to 6.0	Runoff contributing areas off-site to the west; runoff is medium to rapid and the erosion hazard is medium to high.
			Typic Argixerolls					16 to 34	CL or ML	35-50	10-25	0.06 to 0.2	0.14 to 0.16	2.5	6.6 to 7.3	
			Fine, montmorillonic, thermic										*Total*	*5.6*		
LoF2	Los Osos clay loam, 30% to 50% slopes, eroded	Weathered, fractured sandstone and shale	Mollisols	C	0%	18%	26%	0 to 12	CL or ML	35-45	10-20	0.2 to 0.63	0.19 to 0.21	2.3	5.6 to 6.0	Runoff contributing areas off-site to the west; runoff is medium to rapid and the erosion hazard is medium to high.
			Typic Argixerolls					12 to 28	CL or ML	35-50	10-25	0.06 to 0.2	0.14 to 0.16	2.2	6.6 to 7.3	
			Fine, montmorillonic, thermic										*Total*	*4.5*		
DbE	Diablo clay, 15% to 30% percent slopes	Interbedded calcareous fine-grained sandstone, clayey shale, weathered	Vertisols	D	0%	8%	44%	0 to 45	CH or MH	50-65	20-35	0.06 to 0.2	0.14 to 0.16	6.0	6.1 to 8.4	Runoff contributing areas off-site to the west; runoff is medium to rapid and the erosion hazard is medium to high.
			Chromic Pelloxererts													
			Fine, montmorillonic, thermic										*Total*	*6.0*		

Notes:

1) Information taken from the most-recent USDA soil survey for the area (1972), and/or Soil Survey Laboratory Data for Some Soils of California (Soil Survey Investigations Report No. 24), 1973. This soil survey generally does not distinguish areas smaller.

2) Hydrologic Soil Groups: A = High infiltration; B = Moderate infiltration; C = Slow infiltration; D = very slow infiltration.

3) USCS = Unified Soils Classification System, commonly used in geotechnical or soil-foundation investigations, and in routine engineering geologic logging.

4) Available Water Capacity = Held water available for use by most plants, usually defined as the difference between the amount of soil water at field capacity (one day of drainage after a rain or recharge event) and the amount at the wilting point.

Although recognition of habitat types on these parcels is somewhat arbitrary due to their highly disturbed nature, the following five habitat types were recognized: settling ponds, levees, drainage ditches, pond/seasonal wetland, and developed/ruderal. The first three of these habitat types encompasses the settling pond complex in the southern portion of the site. The developed/ruderal habitat type encompasses most of the remainder of the site. The pond habitat type characterizes the two small ponds near the western site boundary. With the partial exception of the pond habitat type, none of these habitat types could be considered “natural”; all have been created and/or maintained by intensive disturbance and large-scale alteration of the site, and they mostly do not resemble native vegetation types, although the drainage ditches habitat type is dominated by native species.

Brief descriptions of each habitat type are presented below.

Settling ponds. The beds that have developed on the settling ponds are gently sloping or somewhat undulating, so that some areas receive more seasonal inundation than others. The vegetation on the pond bottoms is a heterogeneous assemblage of native and non-native species, with both cover and species composition varying considerably over short distances. Much of this variation is clearly correlated with the exact elevation of particular portions of the pond bottom and the degree of seasonal inundation. The northern settling pond, which probably receives relatively little seasonal inundation, is densely vegetated (cover 100 percent or nearly so), primarily with non-native grasses and herbs. Characteristic species include Italian rye grass (*Lolium multiflorum*), bird’s-foot trefoil (*Lotus corniculatus*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), curly dock (*Rumex crispus*), bristly ox-tongue (*Picris echioides*), soft chess (*Bromus hordeaceus*), black mustard (*Brassica nigra*), yellow star thistle (*Centaurea solstitialis*), winter vetch (*Vicia villosa* ssp. *varia*), and, in the lowest areas, annual beard grass (*Polypogon monspeliensis*). Scattered individuals of the native shrub coyote brush (*Baccharis pilularis*) occur in this settling pond. One large clump (perhaps a single clone) of arroyo willow (*Salix lasiolepis*) occurs in the northeast portion of this settling pond.

In the southwestern settling pond, which receives more seasonal inundation than the northern settling pond, the higher areas are largely dominated by Italian rye grass, and the associates are mostly non-native, with a species composition similar to that of the northern settling pond. The non-native thistle Italian thistle (*Carduus pycnocephalus*) occurs in scattered dense patches in this area. There is considerable yellow star thistle at the south end, and the escaped ornamental species sweet pea (*Lathyrus odoratus*) is locally abundant in the northeast corner. Lower-lying areas in this settling pond are dominated by the native pickleweed (*Salicornia virginica*), the native perennial grass saltgrass (*Distichlis spicata*), and the non-native species annual beard grass and brass buttons (*Cotula coronopifolia*).

The southeastern settling pond is probably similar to the southwestern settling pond in the degree of seasonal inundation, although the lowest-lying portion on the east side apparently has standing water for a longer period than any other portion of the settling ponds. The higher portions of this settling pond are largely dominated by weedy non-native grasses, including ripgut grass (*Bromus diandrus*), six-weeks fescue (*Vulpia bromoides*), soft chess, slender wild oat (*Avena barbata*), Mediterranean barley, and Italian rye grass, with considerable bird's-foot trefoil and Italian thistle; cut-leaved geranium (*Geranium dissectum*) is also locally abundant. Somewhat lower-lying areas are dominated by bird's-foot trefoil, annual beard grass, and pickleweed, with considerable bare ground, or by annual beard grass and bristly ox-tongue. The lowest-lying area is overwhelmingly dominated by annual beard grass, with sour clover (*Melilotus indica*) and pickleweed the only abundant associates. A small amount of narrow-leaved cattail (*Typha angustifolia*), a species generally indicating prolonged inundation, occurs in the southeast corner.

Levees. The levees are elevated linear features that separate the settling ponds from each other and from bordering areas. These levees could have been included in the developed/ruderal habitat type, but, because they form a distinct part of the settling pond complex, they are treated separately. Dense clumps of coyote brush occur locally on the levees, and a dense patch of the invasive non-native shrub French broom (*Genista monspessulana*) occurs at one location on the levee between the northern and southwestern settling ponds. The levees are otherwise largely vegetated by weedy non-native herbs and grasses, including fuller's teasel (*Dipsacus fullonum*), poison-hemlock (*Conium maculatum*), purple vetch (*Vicia benghalensis*), Italian rye grass, Mediterranean barley, and yellow star thistle. Sweet pea is locally abundant on the levees bordering the southwestern and southeastern settling ponds.

Drainage ditches. Drainage ditches occur adjacent to some of the levees. These ditches are artificially excavated and hold standing water permanently or for varying periods during the season. Where vegetated, the species composition of the drainage ditches consists mostly of native moisture-loving species, principally cosmopolitan bulrush, narrow-leaved cattail, pickleweed, cord grass (*Spartina* sp.), and saltgrass.

Pond. The two small ponds located near the western boundary of the site apparently hold water for all, or at least most, of the season. Narrow-leaved cattail and annual beard grass are relatively abundant, especially around the margins of these ponds, with brass buttons also relatively abundant around the southern pond. Several individuals of arroyo willow occur around the margins of the northern pond.

Developed/ruderal. The developed/ruderal habitat type includes the entire site north of the northern settling pond and its associated levee and ditch, as well as a narrow strip of land between the settling ponds and the Highway 101 right-of-way. The northern, most elevated portion of the site supports an assemblage of species that is quite heterogeneous in both species composition and physiognomy, but that consists primarily of weedy species. Some areas have been repeatedly mowed; these areas are vegetated with a low, rather sparse cover. Where not mowed, the vegetation is tall and generally dense. Numerous large, planted trees of the non-native species English elm (*Ulmus procera*), Northern California black walnut (*Juglans californica* var. *hindsii*, native to Northern California but not indigenous to this site), and non-native blue gum (*Eucalyptus globulus*) were scattered in this area. The first of these is reproducing by suckers, while the latter two species have reproduced from seed. Two large valley oak (*Quercus lobata*) trees, a native species, were located on the north side of the abandoned house. Several dense clumps of the tall, robust non-native grass giant reed (*Arundo donax*) occur near the border of Parcel A. As of spring 2014 all of the existing trees on the northern portion of Parcel A have been removed by Caltrans as part of the MSN B-2 project.

The north central portion of Parcel A is largely unvegetated; the margins and several adjacent dirt piles are sparsely to moderately densely vegetated by weedy species. Between this parking lot and the northern settling pond is a level area with hard-packed soil, probably graded in the past, with a low to tall, sparse to locally dense vegetation, mostly of weedy species. There are a number of small Pacific madrone trees (*Arbutus menziesii*) in this area, perhaps planted, as well as one small individual of the native tree species coast live oak (*Quercus agrifolia*). The strip of ruderal habitat between the settling ponds and Highway 101, which is interrupted by the two small ponds, is vegetated with a mostly dense cover of weedy species.

3.3.8.2 Parcel B

A botanical survey was conducted on Parcel B on April 30, 2004. In 2004, this parcel was primarily dominated by ruderal grasses and herbs with scattered individuals of the native coyote bush. The narrow and discontinuous strip of land bordering the river (which is evidently brackish in this area due to tidal flow) is occupied by a coastal brackish marsh habitat type. Within the study area, this habitat type is not well-developed and contains few species, due to its relatively small area and to the frequent flooding and scouring from the river, but it is dominated by native species, particularly three species of tule or bulrush: cosmopolitan bulrush, viscid tule (*Schoenoplectus acutus*), and three-square (*Schoenoplectus americanus*). Associates include the rhizomatous, perennial saltgrass and the succulent pickleweed.

Landing Way Mitigation Area

One seasonal wetland covering a total area of 0.47 acre occurs on the area to be decommissioned as part of the proposed project. The majority of the wetland area is dominated by non-native grasses and herbs including rip-gut brome (*Bromus diandrus*), soft-chess brome (*Bromus hordeaceus*), oat (*Avena barbata*), bristly ox tongue (*Picris echiodes*), poison hemlock (*Conium maculatum*), and Italian rye grass (*Lolium multiflorum*). "Wetter" portions of the wetland area are dominated by facultative and facultative wetland species including fox-tail barley (*Hordeum murinum* ssp. *gussoneanum*), and rabbit's foot grass (*Polypogon monspeliensis*).

3.3.9 Special-status Plant and Animal Species

3.3.9.1 Special-status Plants

In order to identify special-status plant species and sensitive habitat types with potential to occur in the study area, various sources were consulted and include occurrence records for the project vicinity from the California Natural Diversity Data Base (CNDDB); county occurrence records and USGS quadrangle occurrence records for the Petaluma River quadrangle and the eight quadrangles surrounding it in the CNPS *Inventory of Rare and Endangered Vascular Plants of California*. From the above sources, a target list of special-status plants with potential to occur in the project vicinity was developed.

Thirty-six different special-status plant species were identified for the target list of special-status plants with potential to occur in the project vicinity.

Field surveys were conducted on Parcel A on March 31 and June 6 and 11, 2003 and on Parcel B on April 30, 2004. These survey dates were chosen to be within the period when most of the special-status plant species with potential to occur in the survey area would have been identifiable. The survey was conducted on foot. All vascular plant species in identifiable condition at the times the surveys were conducted, regardless of regulatory status, were identified to species or infraspecific taxon using keys and descriptions in standard floras. All habitat types occurring on the site were characterized, and data on physiognomy, dominant and characteristic species, topographic position, slope, aspect, substrate conditions, hydrologic regime, and evident disturbance for each habitat type were recorded.

No special-status plant species indigenous to the parcels were observed during the spring 2003 and 2004 surveys and none are expected to occur given the highly disturbed condition of the site. One species present but not indigenous on Parcel A is northern California black walnut which is a special-status species. Northern California black walnut is on List 1B (Plants Rare and Endangered in California and elsewhere) of the CNPS *Inventory* (Tibor 2001; CNPS 2003). However, the species is clearly introduced from planted trees and not native to this site. Because this species is not native to the site, no mitigation would be required for any future impacts to the black walnut trees on this site.

Botanical surveys were conducted by a qualified botanist (Ecosystems West Consulting Group, 2003) on the Landing Way site (including the portion proposed for the electric conveyor) on May 12, 2003 and September 10, 2003. No special-status plant species were observed on the project site during these surveys and none are expected to occur on the site due to its increasingly disturbed nature since construction of the Landing Way facility.

Two species of bird's beak, Point Reyes bird's beak (*Cordylanthus maritimus* ssp. *palustris*) and soft bird's beak (*Cordylanthus mollis* spp. *mollis*) occur in tidal salt marsh habitats and thus would have some potential to occur in the coastal marsh habitat on Parcel B. This area will be surveyed by a qualified botanist in April and June prior to restoration to determine if special-status species (primarily *Cordylanthus* spp.) occur in this area.

Sensitive Plant Communities

Coastal brackish marsh was formerly recognized as a "high priority" habitat type by the CNDDB (Holland 1986). Although coastal brackish marsh *per se* is not currently recognized as a CNDDB "high priority" habitat type, the small band of coastal brackish marsh on the eastern boundary of Parcel B appears to have a close affinity to the Alkali Bulrush/Pickleweed association, which is currently recognized as a CNDDB "high priority" habitat type (California Department of Fish and Wildlife 2003).

3.3.9.2 Special-status Wildlife

The California Department of Fish and Wildlife's Natural Diversity Data Base (CNDDB, 2003 and 2011) was reviewed to identify special-status wildlife species potentially occurring on or within the vicinity of the project site. State and Federal resource agency personnel and other environmental consultants familiar with the project area were also contacted regarding the potential occurrence of special-status species within the project area.

Eleven special-status animal species were listed on the Petaluma River CNDDB quadrangle. Based on the habitat characteristics of the site and given that a portion of the Petaluma River is included in the project boundary, it was determined that seven of these species have the potential to occur on or within the vicinity of the project site. These include three special-status birds, the California clapper rail (*Rallus longirostris obsoletus*), California black rail (*Laterallus jamaicensis coturniculus*), and Salt-marsh common yellowthroat (*Geothlypis trichas sinuosa*), and steelhead (*Oncorhynchus mykiss irideus*). In addition, Chinook salmon was included since it is a known resident of San Francisco Bay. The salt marsh harvest mouse (*Reithrodontomys raviventris halicoetes*) (SMHM) was also included given that it is known to occur in the San Francisco Bay salt marshes. The Pacific pond turtle (*Actinemys marmorata marmorata*) was included because it may have the potential to occur within the vicinity of the project site. Finally, nesting raptors including white-tailed kite (*Elanus leucurus*) and northern harrier (*Circus cyaneus*), and nesting egrets (*Egretta thula*, *Ardea alba*) were also identified as having the potential to occur on or within the vicinity of the site. All of these species and their habitat preferences are described below.

Fish

Two fish species potentially occurring in the Petaluma River and estuary adjacent to Parcel B have special-status listing as federally threatened or endangered species or as anadromous species targeted for enhancement under CDFW policies. These species include steelhead trout and Chinook salmon (Macmillan et al, 2003).

Chinook Salmon

There are four main races of chinook salmon in streams draining to San Francisco Bay and include:

- Sacramento River winter-run chinook salmon,
- Central Valley spring run chinook salmon,
- Central Valley fall run chinook salmon, and
- Central Valley late fall run chinook salmon

The Sacramento River winter-run Chinook salmon was listed as a federally threatened species in 1994. Critical habitat for Sacramento winter-run Chinook salmon was designated on June 16, 1993. Sacramento winter-run Chinook were re-classified as an endangered species on January 4, 1994. The status applies to all Sacramento River winter-run Chinook salmon, wherever found. Historically, winter-run Chinook salmon inhabited the Upper Sacramento River and its tributaries the McCloud, Pit, and Little Sacramento. Adult winter-run Chinook salmon migrate up the Sacramento River to spawn from December through May and peak spawning occurs from May to June. Winter-run chinook juveniles emigrate from the upper Sacramento River as smolts from January through May. Peak migration of smolts through the Delta is primarily from January through March.

The Central Valley spring run Chinook salmon was listed as a federally threatened species in 1999 and State Threatened in 1998. Adult spring run Chinook salmon historically migrated up the larger tributaries of the Sacramento, San Joaquin, Klamath and Eel Rivers (Moyle 2002) and remained in deep pools before spawning in early fall. Juveniles reared in the streams for 3 months to over one year, depending on flow. This run was once as abundant as fall run chinook but because the majority of historic spawning areas have been dammed, especially tributaries to the San Joaquin River, their numbers are very depressed.

Central Valley fall run Chinook salmon are being considered as a candidate for Threatened status by NOAA Fisheries. NOAA Fisheries believes that the late-fall run is part of the fall-run, whereas CDFW believes that separate management is necessary and lists them as Species of Special Concern. Historically these runs may have been the most abundant run in California (Moyle 2002). Fall-run Chinook tend to spawn in the lower reaches of large rivers and their tributaries and move up from the ocean in late summer and early fall. Spawning takes place almost immediately. Fry emerge from the gravel in spring and juveniles move down to mainstream rivers or estuaries in summer. This run is unique in that they have a greater propensity to stray from their natal streams and can thus colonize newer areas if hydrologic and geomorphic conditions are more favorable.

Chinook salmon have been observed in many of the tributaries to San Francisco Bay although many if not all of these may be strays of hatchery origin. Historical population levels in the Petaluma River are unknown, but they are now generally low. Chinook salmon have been captured and spawned at the Casa Grande hatchery on Adobe Creek in recent years. However, it is unlikely that these fish are of the endangered Sacramento winter-run as that run is dependent solely on habitats and releases within the upper reaches of the Sacramento River.

Steelhead

Steelhead in the Petaluma River are part of the Central California Coast ESU (evolutionarily significant unit); this species now is federally listed as threatened. Historically, reproducing populations of steelhead were found in most of the tributary and headwater areas of the Petaluma River drainage. Currently, their abundance is reduced. Some juvenile steelhead may spend varying amounts of time in the lower Petaluma River as they move from upstream rearing areas to San Francisco Bay and the ocean. Peak movement occurs during winter and early spring. Estuarine areas can provide important transitional habitat for steelhead juveniles that are undergoing physiological adaptation to seawater. These fish may be found in inshore, slough, and open waters of the estuary where they feed on terrestrial and aquatic insects, amphipods, other small crustaceans, and small fish. Steelhead juveniles may also benefit. Steelhead, both adults and fry, have been recorded in Adobe Creek by the United Anglers of Casa Grande, a rigorous high school program aimed at restoring the creek and its salmonid resources. CDFW has observed steelhead juveniles in Lynch Creek, approximately 4½ miles upstream of the site (Cox per. comm. 2003). CDFW also stated that steelhead are likely in Willow Brook and Lichau creeks, both of which are over 7½ miles upstream of the site; however, detailed spawning and habitat surveys have not been conducted in these two water bodies.

Reptiles

Pacific Pond Turtle

The Pacific pond turtle (*Actinemys marmorata* (previously *Clemmys marmorata*) is considered a federal candidate threatened by U. S. Fish and Wildlife Service (USFWS) and a species of special concern by CDFW.

Pacific pond turtles have declined over much of their range in the past 75 years. Over grazing, introduced predators, loss of habitat from agriculture, disease, and over-hunting have all been implicated in their decline. The Pacific pond turtle is a habitat generalist, inhabiting a wide range of fresh and brackish, permanent and intermittent water bodies from sea level to about 4,500 feet above sea level (USFWS, 1992).

While there are recorded occurrences for the Pacific pond turtle in the upper reaches of the Petaluma River in quiet backwater channels where basking sites are suitable, the Petaluma River in the vicinity of the project site undergoes periods of heavy flow in the winter and spring and therefore is probably not suitable habitat. Parts of Shollenberger Park and Adobe Creek, which are north and east of the project site respectively, may offer better habitat for this species.

Birds

Special-status bird species having the potential to occur within the vicinity of the project site include the California clapper rail, California black rail, the salt-marsh yellowthroat and two raptor species, the northern harrier and white-tailed kite. In addition, an egret rookery was identified on the project site in 2003. These various species are discussed below.

California Clapper Rail

The California clapper rail is both a state- and federally-listed endangered species. The clapper rail is a locally common resident in coastal wetlands and brackish areas around San Francisco, Monterey, and Morro bays. In the San Francisco Bay area, the clapper rail breeds mid-March through July, nesting in saline emergent wetlands, mostly in the lower zones, where cordgrass is abundant and tidal sloughs are nearby. In brackish water, the clapper rail builds its nest in dense cattail or bulrush (Zeiner *et al*. 1990). There are recent records for this species at Shollenberger Park east of Parcel B across the Petaluma River. The small band of coastal marsh habitat that borders the project site is unlikely to provide nesting habitat for California clapper rail because the marsh is relatively small (0.02 acre) and is adjacent to areas that are currently used for industrial purposes.

California Black Rail

The California black rail is a federal species of concern and state listed as threatened. The Black Rail is a rarely seen, scarce resident of saline, brackish, and freshwater emergent wetlands in the San Francisco Bay area, Sacramento-San Joaquin Delta, coastal southern California at Morro Bay and a few other locations. The black rail nests in dense vegetation, often pickleweed, near the upper limits of tidal flooding. Nesting has been recorded to occur from mid-March to early June (Zeiner *et al*. 1990).

The coastal brackish marsh adjacent to the proposed off-loading facility parcel can be accessed during low tide and provides potential foraging habitat for this species; however, breeding in this area is very unlikely. The wetlands across the river from the project site (located on the eastern side of the river), which provide denser and more extensive cover, provide potential nesting habitat for this species. Black rail have been recorded in Shollenberger Park to the east of the site as well.

Saltmarsh Common Yellowthroat

The saltmarsh common yellowthroat is described as known from only the marshes surrounding San Francisco and Suisun Bays and is considered to be a species of special concern by CDFW. It occurs in *Spartina* and *Salicornia* dominated habitats with the added use of upland, freshwater marshes, and grasslands bordering brackish marshes (Hobson *et al.*1986). There also appears to be a preference by this species for channels in marsh habitats (Nur 1997). Its population in the bay area is not well known, but there are historical records north and south of the project site along the Petaluma River (Hobson *et al.* 1986).

The coastal brackish marsh habitat located along the shoreline of Parcel B provides marginal potential nesting and foraging habitat for this species.

Nesting Raptors

Raptor species that could be expected to nest on or within the vicinity of the project site include the white-tailed kite (*Elaneus leucurus*) and northern harrier (*Circus cyaneus*). White-tailed kite is a state “fully protected” species and northern harrier is considered a species of special concern by CDFW. These species frequent meadows, grasslands, open ranges, and fresh and saltwater emergent wetland areas (Zeiner et al, 1990). The open grassland areas on the project site provide potential foraging habitat for these species. Harriers are likely to nest in the project site’s grasslands, while white-tailed kites have potential to nest in trees and large shrubs such as coyote brush adjacent to open foraging areas.

Nesting Egrets

Rookeries (colonial breeding sites) of the great egret (*Ardea alba*) and snowy egret (*Egretta thula*) are considered sensitive by the California Department of Forestry. A small rookery with nesting pairs of both species was observed in August of 2003 in the eucalyptus grove located immediately north of the old farmhouse that occurred until recently on Parcel A. At least 5 nests were observed in this grove on April 14, 2004; 4 were great egret and 1 was snowy egret. At least 3 nests and egrets were also observed on March 8, 2005. Since 2005, it appears the number of egrets observed has declined and the egrets probably have relocated elsewhere. This is even more likely since the birds abandoned the colony in 2012 and the trees were removed by Caltrans in 2013.

Mammals

Salt Marsh Harvest Mouse

The salt marsh harvest mouse (*Reithrodontomys raviventris*) is federally and state listed as endangered and is a California fully protected species. The salt marsh harvest mouse is endemic to the tidal and diked marshes of the San Francisco Estuary, including the San Francisco, San Pablo, and Suisun bays, of northern California. The northern subspecies (*Reithrodontomys raviventris halicoetes*) is found on the Marin Peninsula, through Petaluma, Napa, and Suisun Bay marshes and in northern Contra Costa County (Zeiner *et al.* 1990). This species prefers saline emergent wetland habitats dominated by pickleweed; grasslands adjacent to pickleweed marsh are also used, but only when new grass provides adequate cover in the spring and summer (Zeiner *et al*. 1990). *R. r. halicoetes* breeds from May to November, with litters averaging four young.

Parcel A was studied by Monk & Associates wildlife biologists to determine if portions of the site provide suitable habitat for the salt marsh harvest mouse. Results of the site analysis were submitted to the USFWS in conjunction with a request for technical assistance to determine if trapping studies would be required on the site. USFWS requested trapping studies be conducted on the site to definitively determine if salt marsh harvest mice inhabit the site. A trapping plan was submitted to the USFWS and CDFW and Monk & Associates received authorization to initiate the trapping study in the Fall of 2004. The 5,584 trap-night study was conducted from September 26 through September 30, and October 4 through October 8, 2004. No salt marsh harvest mice were captured. Results of the trapping study were presented in a written report submitted to the USFWS and CDFW (Monk & Associates 2004). On January 13, 2005, the USFWS sent a letter to Monk & Associates stating that based on the trapping study results they have determined that development of the project site is "not likely to result in take of the salt marsh harvest mouse." Hence, no further action regarding this species on the project site will be required (Appendix E).

4.0 MITIGATION DESIGN

The proposed mitigation program for the Haystack site calls for creating and enhancing wetland communities typical of the inner edge of the tidal/freshwater ecotones that were once widespread around the Bay. The proposed design is based on (a) identifying areas in which sufficient fresh waters can be sustained during most or nearly all years for a portion of the year, (b) locations and depths providing sufficient hydrology for seasonally inundated wetlands (freshwater and brackish) and (c) to provide a slightly-sloping edge to several wetlands, allowing them to expand and contract with fluctuations in weather or in adjustment to watershed change. A number of hydrologic studies were conducted at various seasons to quantify factors needed to meet these guidelines.

4.1 Work Conducted

Balance Hydrologics and CSW/Stuber-Stroeh have conducted preliminary hydrologic evaluations of the southern portion of the site (approximately 17 acres) proposed for mitigation. The evaluation included the following as detailed in Appendices B, C, D and E of this report:

- Tidal elevation and salinity levels were monitored and findings used to estimate tidal height-duration relationships, tidal peaks and percentage of inundation. Three tidal monitoring stations were installed: one station within the boundaries of the Haystack Landing project site in drainage ditch DD2; one station in the off-site railroad drainage ditch at the upstream end of the culvert crossing the tracks; and third, a station at the mouth of the slough where it meets the Petaluma River. At each station water levels, water temperature and specific conductance (a surrogate for salinity) were monitored through two complete 28-day tidal cycles and the highest tides of the dry season. This baseline data documents the nature of the tidal circulation on site and in the tidal channel network connecting the site with the Petaluma River.

- Mid-winter surface ponding, shallow ground-water levels and specific-conductance were assessed at the end of a three-week dry spell that followed a couple of weeks of wet weather, including several major winter storms (Appendix C). The baseline data document ground-water levels and salinities prior to the proposed re-grading of the site and the proposed direction of additional flows into the cattail and seasonal wetlands on portions of the site. The data were established under typical conditions likely to occur in future years, facilitating comparisons between years. From this, it was found that the greatest depth to water and highest salinities were concentrated in the southern portion of the site, where soils have a higher sand content.

- Summarized in Appendix D, potential soil and water salinities levels in the proposed enhanced wetland area were estimated using baseline monitoring and spot measurements of water levels and specific conductance (refer to Appendices C and D for these data). The salinity ranges were used to propose success criteria for the proposed enhanced wetland areas (Section 5).

4.2 Mitigation Approach

- The site is located in the historic fringe of tidal water circulation, upland runoff and seasonally inundated wetland habitats. Regionally, the 'Bay Fringe' landscape has generally been transformed by human settlement of the region during the past 200 years. Its present size is both limited in extent and often modified from its natural state. The mitigation approach for the proposed project aims to restore a mosaic of wetland habitats and related biologic diversity commonly found in 'Bay Fringe' landscapes by re-grading the site to enhance hydrologic conditions for seasonally inundated wetland as well as segments of upland buffer.

4.2.1 Hydrologic Considerations

A. Project upland areas

Onsite, runoff from the proposed 5.82-acre asphalt plant is divided into two components. The eastern portion will enter a sand filter and be discharged into DD1. The remaining 3.52 acres will flow through a sand filter and into DD5 before continuing through a culvert under the driveway and into DD6 along a contoured to flow to the mitigation area. The drainage from the storage area flows southwest and is directed to a sand filter that then outlets into DD2. Drainage ditch DD5 continues south and flows over a broad weir at elevation 3.5+/-, and into existing Wetland H in the existing levee. The swale behind the future Fire Training Station flows through a culvert under the proposed access road to the residences on the east side of the railroad and into Wetland WJ which also feeds into DD1 and DD2. As noted above DD6 on the west side of Parcel A will be connected to drainage ditch DD5 through a culvert under the project entrance which flows into DD5 and ultimately to the mitigation area. DD1 and DD2 have a 12,000 +/- ft3 approximate storage volume (or 0.3 acre feet).B.

B. Seasonal runoff from west of Highway 101

Off-site runoff from the hill west of the site collects in the road and highway ditches west of Highway 101 and enters the site at four locations:

- At the north part of the site, runoff from 30.31 acres flows through the new drainage system being installed with the Caltrans MSN B-2 project and discharges onto the frontage road ditch, moving along the frontage road through DD6 and DD5 into Wetland H. To be conservative, potential runoff from this area was not included to size the seasonally inundated wetlands, only onsite runoff.

- At the south part of the site, runoff from the highway discharges at three distinct locations along the mitigation area. The most northerly watershed discharges from a bio filter at the end of 18" and 24" pipes draining 2.96 acres. The central watershed discharges from a bio filter at the end of an 18" pipe draining 0.58 acres and the southerly watershed drains from a 30" pipe which collects water from the west side of the highway and drains 14.72 acres. These 18 acres generate sufficient inflow, together with direct rainfall, that it becomes feasible to enhance and/or create seasonal wetlands with a salinity gradient increasing eastward from fresh to brackish. We are proposing removing portions of the berm between the southwestern and southeastern settling ponds to realize the potential of this gradient, as very few restoration sites in the Bay Area have this potential.

Figures 3, 4 and 5 graphically depict existing and proposed watersheds.

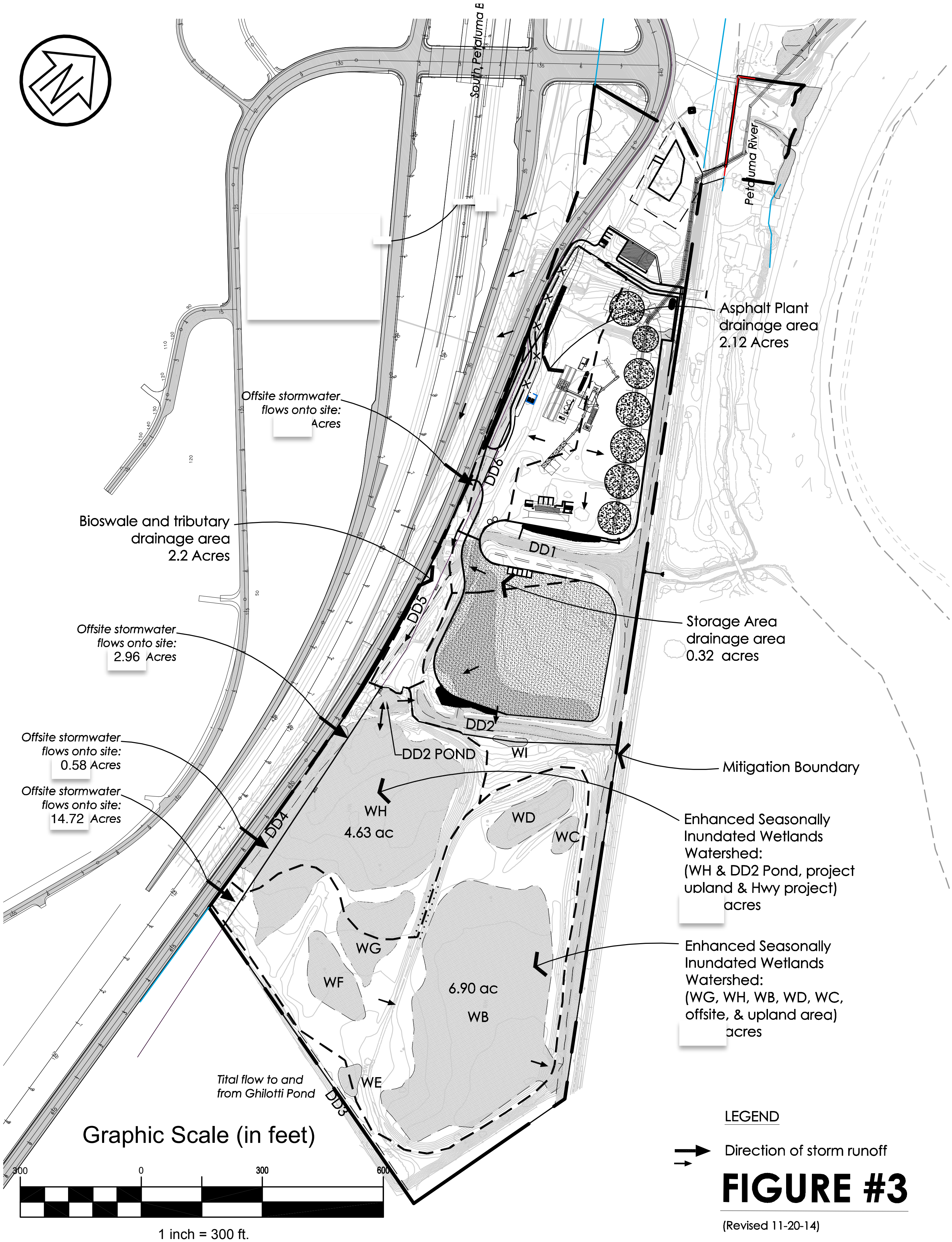
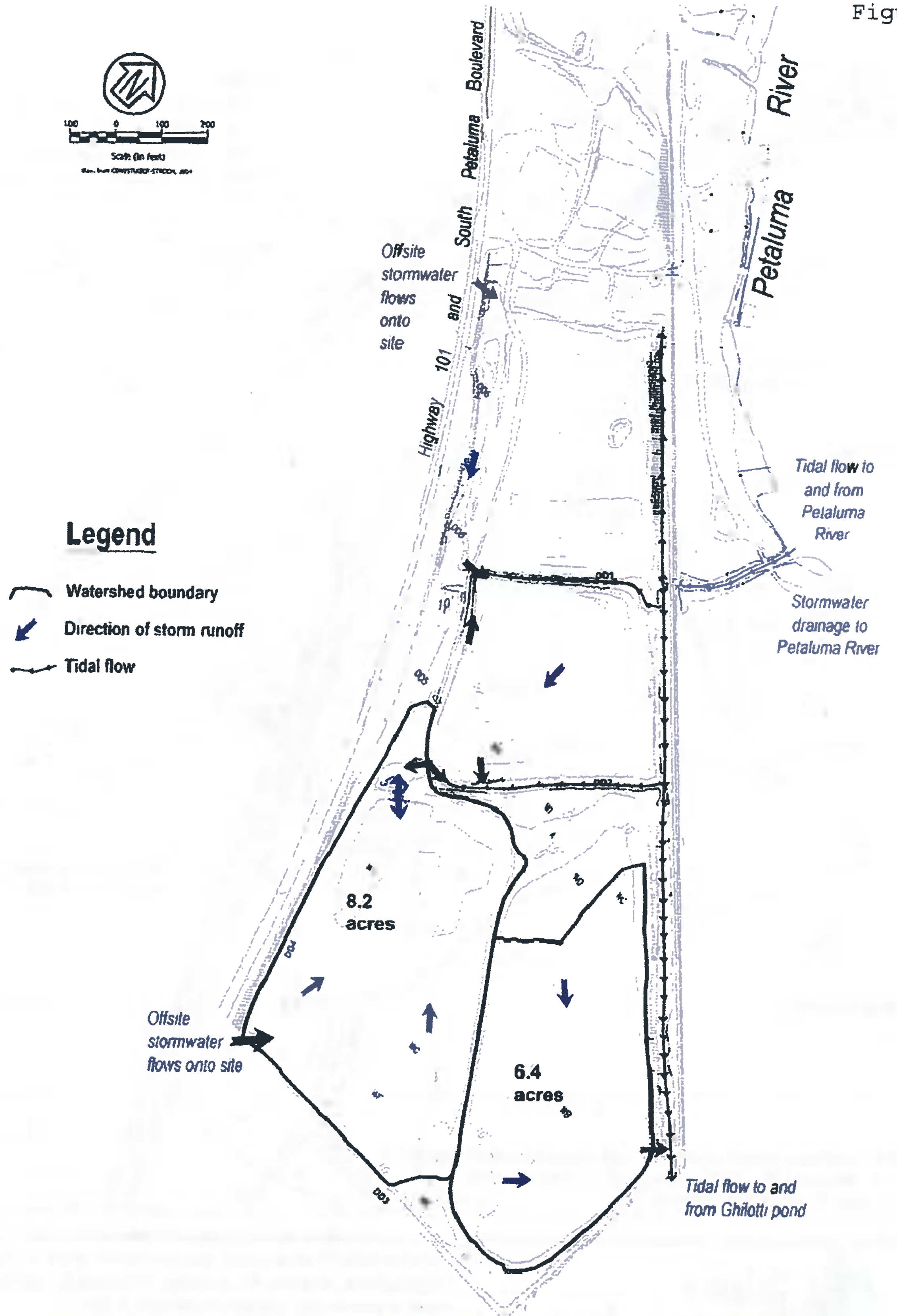


FIGURE #3

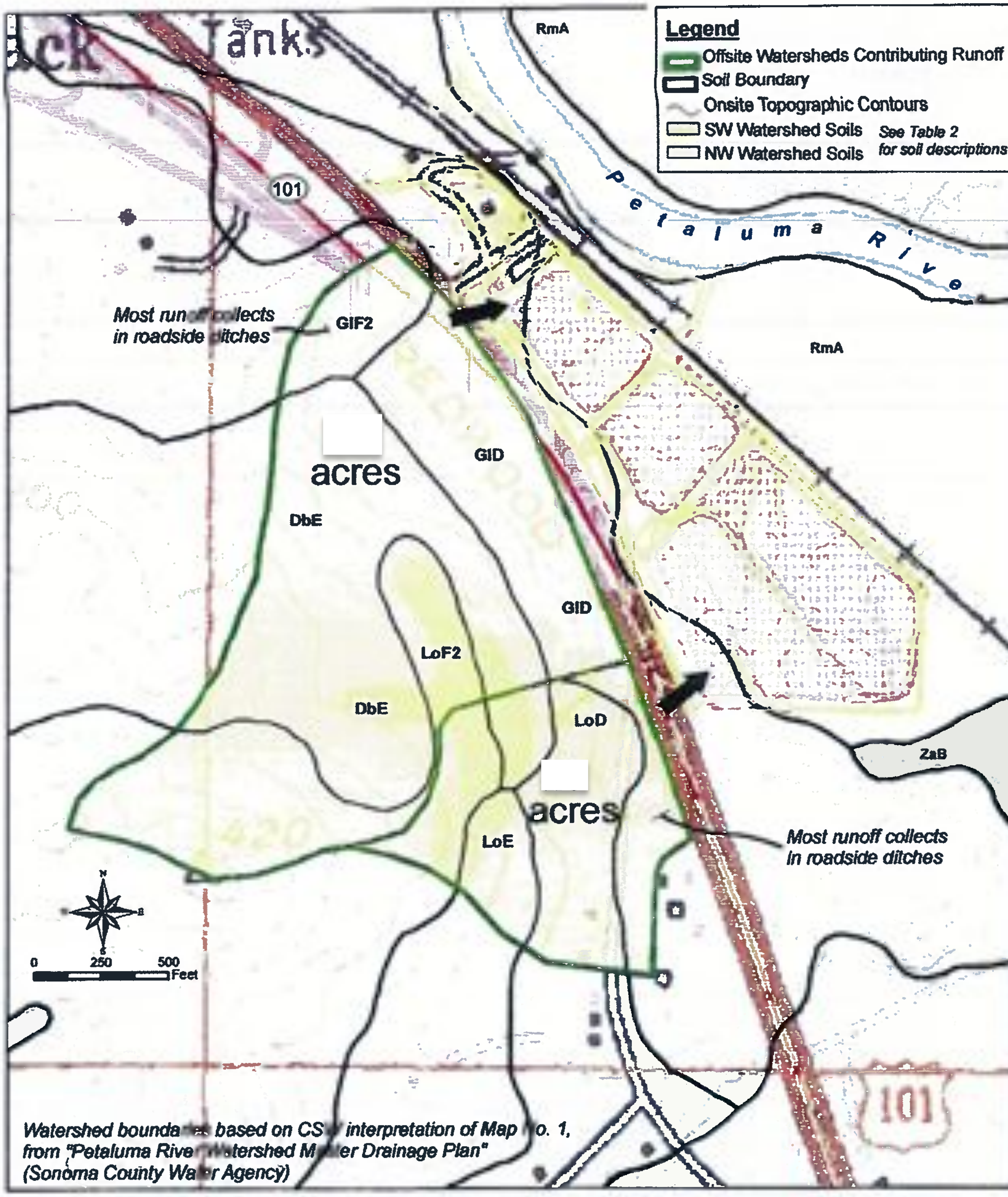
(Revised 11-20-14)

Figure 4



Balance Hydrologics, Inc.

Figure 4 **Existing watersheds and direction of surface flow of areas enhanced for wetland restoration, Haystack Landing, Sonoma County, California**



Balance Hydrologics, Inc.

Offsite runoff areas and natural soils prior to tailings deposition, Haystack Landing, Petaluma, California

Source: Air photo courtesy of the USGS, captured June 10, 1993
U.S. Department of Agriculture, Natural Resources Conservation Service, 2003, Soil Survey Geographic (SSURGO) [redacted] for Sonoma County, California (Based on U.S. [redacted] of Agriculture, Soil Conservation Service, 1972, Soil Survey of Sonoma County, California).

W:\Projects\204012\204012_soils_map2.mxd

4.2.2 Wildlife Considerations

A major factor influencing development of the mitigation plan was consideration of existing wildlife species that may be temporarily displaced by construction associated with implementation of the plan as well as consideration for creating habitats that would provide potential foraging and nesting habitat for terrestrial and avian species. A primary concern of preliminary mitigation planning was to determine if the site currently provides habitat for the federally-listed salt marsh harvest mouse so as to avoid "take" of this species during project implementation. As described in Section 3.3.9.2, a USFWS-authorized trapping program determined that the site does not support this species. One of the goals of the project is to design wetland habitat that will support dense covers of pickleweed that in turn may encourage future salt marsh harvest mouse colonization. In addition, creation of deeper seasonally inundated wetland habitat is proposed to provide foraging and roosting habitat for migrating waterfowl and other wading bird species.

4.2.3 Other Considerations

4.2.3.1 Importance of the landward bay fringe

The Haystack wetlands, once restored, will be a mosaic of more densely vegetated seasonally inundated wetlands that once typified much of the landward bay fringe. Once prevalent throughout the North Bay, this fringe has been widely filled, diked or otherwise altered. Few remnants of this mosaic remain, most notably at China Beach State Park and at several locations between Petaluma and Las Gallinas. There are very few remaining opportunities to restore the landward bay fringe with the types of wetlands that once characterized the edge of the Bay. Because of the higher salt content of soil in the southern portion of the site, much of the enhanced or created wetland will likely trend towards salt-tolerant species such as pickleweed.

4.2.3.2 Opportunity for highway spill containment

The completed Caltrans highway project incorporated provisions for highway spill containment in its design, recognizing that the project proposes to enhance a significant wetland area. On the Dutra Haystack project side, the wetlands to be enhanced have been sized to retain and store the contents of a typical 8600-gallon (equivalent to 1,140 cubic feet) tanker or industrial carrier to protect the Petaluma Marsh and the San Pablo Bay from the most acute effects of a possible spill.

Table 2 – Estimated decrease in tide levels west of the SMART tracks (not applicable, tidal areas no longer considered part of the Wetlands Mitigation Plan).

In the event that a spill during a storm, the seasonally inundated wetland areas could easily be closed off at their outlets, and other points both upstream and downstream from the outlets could also be closed. Storage and attenuation of many contaminants is an intrinsic function of wetlands; at this site, adjacent to the freeway, it is a responsible approach to incorporate spill containment into the wetland design.

4.3 Criteria for Design

The distribution of wetland plant species is largely controlled by vertical elevation and water salinity levels. The range of elevations within each wetland area will govern the depth, duration, and extent of inundation, while the water and soil salinities within each marsh area will select for freshwater and brackish plant species. The proposed criteria to be created and enhanced are provided below.

With the exception of the tidally influenced drainages on the site, the existing wetlands on the project site are primarily seasonal and located in topographic depressions and shallow swales. Depressional wetlands accumulate rainfall during the wet season and later this water recedes during the dry season. Some depressional wetlands, especially those occurring on silty substrate such as those at the Haystack site, often allow infiltration, enhancing ground-water recharge.

Opportunities for enhancing and expanding the seasonal wetlands on site are found on the southern portion of the site. This area is divided by a bermed access road and smaller berms remnant from construction of the historic siltation ponds. The west portion of the proposed mitigation area is gently sloping and principally drains to the north towards Wetland H, but because of the presence of small shallow flats and poorly drained conditions it also supports seasonal wetlands in the upper portion of the swale. The east portion is gently sloping and drains to the east, to Wetland B. There is also some off-site runoff, from the hill west of the site that flows through culverts beneath the freeway, and collects in the ditches along the southwest corner of the site. The mitigation area in general has some of the higher elevations on site and (in its eastern portions) some of the highest soil and shallow ground-water salinity on site as well (Appendix D).

The hydrologic design criteria for enhancing and expanding the seasonally inundated wetlands include:

- Re-contouring the divide between wetlands B and H to enlarge the watershed for Wetland B and diminish the watershed for Wetland H;
- Establishing a divide elevation at elevation +8.0 between watersheds for wetlands B and H, directing all of the flow from the off-site culvert located on the southernmost portion of the site away from Wetland H and toward the existing brackish marsh.

- Contouring a broad, shallow swale to: (a) draw water from the southwest corner of the site towards Wetland B; (b) lower base elevations to elevate wetness broadly across the swale; and (c) over the long term, lower salinity levels by flushing salts during the runoff-generating large storms.

Existing Avoided Wetlands

Wetland ID	Annual Watershed Volume	Maximum Storage Volume
WC (avoided)	0.43 ac-ft*	0.14 ac-ft*
WD (avoided)	1.65 ac-ft*	0.32 ac-ft*
WE (avoided)	0.40 ac-ft*	0.14 ac-ft*

*Annual watershed volume and maximum storage volume remains unchanged in the existing and proposed conditions

Existing Sloughs

Slough ID	Annual Watershed Volume	Maximum Storage Volume
DD1 (avoided portion)	5.52 ac-ft	0.90 ac-ft*
DD2 (avoided portion)	6.90 ac-ft	0.90 ac-ft*
DD3 (avoided portion)	0.40 ac-ft*	0.2 ac-ft*
WJ (avoided portion)	7.90 ac-ft	1.7 ac-ft*

*Annual watershed volume and maximum storage volume remains unchanged in the existing and proposed conditions

Created / Enhanced Wetlands

Onsite watersheds only

Wetland ID	Watershed Volume	Maximum Storage Volume
Regraded WB	11.08 ac-ft	1.6 ac-ft
Regraded WF	5.51 ac-ft	0.9 ac-ft
Regraded WH and WG	8.36 ac-ft	12.6 ac-ft
Regraded DD5 and DD6	6.70 ac-ft	1.1 ac-ft

Watersheds from Highway 101 and hills west of highway only

Wetland ID	Watershed Volume	Maximum Storage Volume
Regraded WB	0.0 ac-ft	1.6 ac-ft
Regraded WF	0.0 ac-ft	0.9 ac-ft
Regraded WH and WG	31.40 ac-ft	12.6 ac-ft
Regraded DD5 and DD6	52.13 ac-ft	1.1 ac-ft

Totals

Wetland ID	Watershed Volume	Maximum Storage Volume
Regraded WB	11.08 ac-ft	1.6 ac-ft
Regraded WF	5.51 ac-ft	0.9 ac-ft
Regraded WH and WG	39.76 ac-ft	12.6 ac-ft
Regraded DD5 and DD6	58.83 ac-ft	1.1 ac-ft

Table 4 - Dry season depth (not applicable – refer to Appendix B)

5.0 Design

5.1 Hydrology

Opportunities for enhancing and creating seasonally inundated wetlands are found on the southern portion of the site. These areas will be re-graded such that the maximum depth across the wetland areas would be approximately 2 feet. This depth reflects existing changes in elevation throughout portions of the existing wetland areas. The on-site watershed area for Wetland B will increase from the existing 6.4 acres to 7.4 acres, and additional off-site water collecting in the ditches at the southwest corner of the site may potentially spill on site during storm peaks further enhancing these habitats (Table 3).

A detailed water budget analysis was conducted to determine if there would be adequate water supply to the wetlands to be created, enhanced, and avoided. This balance demonstrated that there would be sufficient water supply during a normal rainfall year for the wetland habitats. Refer to Appendix B.

5.2 Target Vegetation

The seasonally inundated wetland habitat will be designed to support a dominance of herbaceous wetland species that are adapted to grow in environments that remain inundated or saturated throughout much of the early growing season, but become dry by summer. Plants found in the seasonally inundated wetlands will include a variety brackish and salt-tolerant species due to the presence of saline pockets in the underlying substrate.

Table 5 – Watershed Areas to the proposed wetland restoration areas (not applicable, see Table 3)

6.0 Planting Plan

The purpose of the plant revegetation plan is to create and enhance the wetland community typical of the inner edge of the brackish/freshwater ecosystems of the bay and adjacent upland chaparral habitat. The proposed revegetation plan consists of seeding the wetland area with native fresh and brackish water wetland plant species and installing plugs of individual nursery plants using the same plant species palette of grasses, graminoids, and forbs. The upland chaparral habitat will be planted with individual container plants of woody species, and seeded with native grass mixture for erosion control.

The planting zones outlined on Plate 4 accurately depict the boundary of the maximum area that will receive plantings and the number of plants proposed for installation in each zone. No individual plant or vegetation mat locations are shown. The final planting design will be developed in the field by a professional qualified in ecological restoration. Individual plant and vegetation mat locations shall be marked in the field with a color-coded (to species) surveyor flag. Flags shall remain at each location after plant installation to aid in plant identification and survival monitoring.

6.1 Wetland Seeding

Brackish/fresh water wetland seed mixture shall be hydro-seeded immediately following the completion of wetland construction and grading and once rainfall is likely to occur within one week following the application of the hydro-seed. The hydro-seed slurry shall consist of: hydro-mulch, a small amount of compost (to aid in moisture retention) and the wetland seed mixture. Prior to hydro-seeding, the soil shall be tested for available Nitrogen, Phosphorous, and Potassium (NPK). If soils are found to be low in available nutrients (NPK) then either an organic fertilizer or a slow release inorganic fertilizer shall be used and application rates shall be kept low. A two-pass seeding method is recommended to assist with vegetation cover and the reducing recolonization of invasive non-native plant species. The first pass of hydro-seed shall include fast germinating, fast growing native grass and graminoids species (see Plate 4). The first pass may occur earlier in the season (November/December) depending on rainfall and ground water inundation. The second pass of wetland seed mixture shall include slower growing graminoids and forb plant species to increase plant species diversity and assist with barren areas not colonized by the first pass hydro-seed. The second pass shall be broadcast no later than two to four weeks after the first pass. Special consideration should be given to weather conditions after broadcast seeding is complete. Brackish/fresh water wetland species' seeds are generally smaller when compared to upland plant species and prone to drying out if proper moisture is not maintained during early stages of establishment. All seed shall be purchased on a pure-live-seed (PLS) basis. The selected wetland seed mixture should provide seed densities ranging from 160 to 210 seeds per square foot applied at the specified rate of 20 to 30 PLS lbs. per acre.

6.2 Wetland Plant Installation

Live wetland plants grown in plugs (2" by 2") shall be planted clustered into groups of 5-6 plants on one foot spacing around the perimeter of a five-foot diameter circle, (see Plate 4). Clusters shall be installed evenly throughout the zone. Pre-vegetated mats or blankets may be used as a plant installation method in lieu of or in addition to the traditional plug and cluster method. Pre-vegetated mats are ideal for situations where birds may pull out newly planted seedlings or a flood event may dislodge seedling plugs. Pre-vegetated products need to be pre-grown to ensure that the seedlings get established before installing the mats.

6.3 Upland Chaparral Seeding

The upland chaparral planting zones will be hand broadcast seeded and covered by straw mulch. Seeding and mulch will occur at the same time as the first pass of wetland hydro-seeding to limit disturbance, reduce invasive non-native plant species colonization, and control for erosion during heavy rains. The upland chaparral native grass seed mixture shall be applied at the specified rate of 30 PLS lbs. per acre.

6.4 Upland Chaparral Plant Installation and Maintenance

The upland chaparral revegetation planting will be installed during the winter months, once rainfall has moistened the soil to a depth of 10 inches or greater. All upland chaparral plant installation shall consist primarily of woody plant species and shall be completed by March 31, dependent on weather and nursery stock availability.

Individual woody plants will receive protective hardware and surrounded by nine square feet of weed control fabric. Plant protection hardware shall consist of "collar and screen" or Tubex and Propex weed control fabric, (see Planting Details). Protective hardware will be installed to protect the newly planted seedlings from damaging herbivory associated with deer and other mammals in the area.

Plants in all zones will either be hand watered, installed with two dri-water tube and gel packs, or placed on an above ground temporary drip irrigation system. Hand watering and dri-water gel replacements will commence in April of the year following plant installation and through November of that same year. The drip irrigation system will be operational by April 15th. The plantings will require frequent irrigation during the first dry season after planting. During each irrigation visit, approximately one to two gallons of water will be applied immediately adjacent to the outside of the planting collar. Watering frequency during the first dry season will be in 10-20 days increments, depending on weather conditions. During the second dry season plants will be irrigated once every 3-4 weeks.

The plantings will be maintained for five years following plant installation. Each plant will have weeds removed from inside the planting collar and surrounding weed mat three times each year for five years following installation. Weed removal will be performed at least once in February, April and December each year.

Protective screens shall be opened during the later portion of the first growing season to allow the plant to grow beyond the confines of the screen enclosure. Open screens will appear as an open cylinder to provide continued browse protection to the lower portion of the plant. Screens, collars and weed control fabric will remain in place for five years following plant installation.

6.5 Restoration of Coastal Brackish Marsh

Approximately 0.02 acre of coastal brackish marsh fronting the Petaluma River on Parcel B will be restored through the removal of fill material that was deposited in this area in 2005. The restored section of marsh and adjacent areas covering a total of 0.18 acre will support a dominance of pickleweed and other native salt marsh and brackish species, such as alkali heath (*Frankenia salina*), fat hen (*Atriplex triangularis*), fleshy jaumea (*Jaumea carnosa*), alkali bulrush (*Schoenoplectus robustus*), and California sea-blite *(Suaeda californica*). A limited access zone for this area will be established within 50 feet of the High Tide Line and within 10 feet of the top of bank of the slough. In addition, a fence will be installed along the perimeter of the habitat enhancement area to separate the sensitive habitat from industrial uses. The fence will consist of permanent 4-foot high wildlife friendly fencing that reads “Sensitive Marsh Habitat/No Disturbance Zone”.

6.6 Coastal Brackish Marsh Plant Installation

Live wetland plants grown in plugs (2” by 2”) shall be planted clustered into groups of 5-6 plants on one foot spacing around the perimeter of a five-foot diameter circle, (see Planting Details). Clusters shall be installed evenly throughout the zone. Pre-vegetated mats or blankets may be used as a plant installation method in lieu of or in addition to the traditional plug and cluster method. Pre-vegetated mats are ideal for situations where birds may pull out newly planted seedlings or a flood event may dislodge seedling plugs. Pre-vegetated products need to be pre-grown to ensure that the seedlings get established before installing the mats.

7.0 Annual Native Plant Monitoring

The following monitoring for the wetlands, upland chapparral, and restored coastal brackish marsh are proposed:

7.1 Wetland Habitat - Sampling Methodology

1) Methodology for measuring aerial coverage within the plot:

The monitor will use the point intercept method for sampling wetland vegetation change over time. The point intercept data shall be collected annually in conjunction with the one-dimensional transect method. A point frame quadrat (1m x 1m) will be used to measure vegetation or abiotic ground cover that intersects at each cross-point. The formula to calculate the proportion (percent cover) of hits on each cross-point for a species of vegetation type or abiotic ground cover is: *Cover of Species A = (# of hits of Species A/total # of hits possible) x 100).* The species of vegetation will be a 'hit' if either the basal or foliar section of the plant is identified at the cross-point.

2) Methodology for selecting random plot locations:

Plot sampling shall be distributed throughout the two wetland zones. The point intercept data shall be collected annually using the random one-dimensional transect method. Each transect run and quadrat points collected along the transect shall be noted using a handheld GPS unit and mapped using GIS software. During the annual monitoring, the monitor shall establish at random two – north to south transects and three – east to west transects, in each of the two wetland zones, for a total of ten transects. Transects shall be parallel to one another by following a compass bearing. The starting point for the first transect shall be selected using a computer-based random number generator (1 to 120 for north to south transects and 1 to 215 for east to west transects). After the initial drawing, subsequent transects shall be spaced approximately 25-50 meters apart. Subsequent transects will be selected to move either north/south or east/west in the wetland zone by flipping a coin in the field. Point intercept data shall be collected at 20-meter intervals along the north to south transects and 10-meter intervals along the east to west transects, for a total of 43-50 sampling points distributed throughout the wetland zone (20-25 points along north to transects and 20-25 points along the east to west transects).

3) Method to determine sample size adequacy:

Limits of Standard Deviation of the mean shall be 15%. To determine sample size, the margin of error is set at 15%. Using the formula for calculating sample size: ME = (z) x (the square root of (p(1-p)/n)), where ME = 15%, z = 1.96, p = 0.5 and n = sample size, the sample size is calculated at 43. With a sample size of 43 and a p value of 0.5 the Standard Error is calculated at 8%

4) Statistical methods that will be used to determine changes in vegetation cover:

Percent cover of the vegetation will be analyzed using repeated measures ANOVA of power-transformed data (factors: transect direction, species).

5) Target Percent Areal Cover of Wetland Indicator Species:

After installation and during the growth of wetland plants, tiered success criteria shall be adopted to evaluate wetland performance during the 5-year monitoring and maintenance program. The wetland zones shave have a native plant vegetative cover of 80% or greater to meet success criteria at the end of the five year monitoring period.

Tiered Success Criteria Scale:

1. Year 1 – 10 percent
2. Year 2 – 20 percent
3. Year 3 – 40 percent
4. Year 4 – 60 percent
5. Year 5 – 80 percent

7.2 Upland Chaparral Habitat – Sampling Methodology

All plantings will have a minimum of 80% survival at the end of five years. The monitoring program for the upland chaparral plantings will commence the summer after planting is implemented. Monitoring of all the plantings will occur annually for a period of five years. If the annual survival of plants falls below 80%, then the permit holder will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, and any other practices, to achieve these requirements. Replacement plants shall be monitored with the same survival and growth requirements specified in this plan for five years after planting.

Annual monitoring reports will include the individual survival and overall vigor of both tree and shrub species. The number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters shall also be included. Photos from designated photo locations will also be included. Reports will be submitted to the resource agencies after each of the five years of monitoring.

A qualified biologist or ecologist with appropriate credentials and experience in native habitat restoration will perform monitoring. The project monitor will provide oversight of maintenance operations to ensure high quality project maintenance and to address immediately any unanticipated problems.

When the project has been deemed complete and documented in the final reports, any of the agencies may require a site visit to confirm completion of the project.

7.3 Restored Coastal Brackish Marsh – Sampling Methodology

After installation and during the growth of wetland plants, tiered success criteria shall be adopted to evaluate wetland performance during the 5-year monitoring and maintenance program. The newly restored marsh area should have a native plant vegetative cover of 80% or greater to meet success criteria at the end of the five year monitoring period.

Tiered Success Criteria Scale:

1. Year 1 – 10 percent
2. Year 2 – 20 percent
3. Year 3 – 40 percent
4. Year 4 – 60 percent
5. Year 5 – 80 percent

7.4 Hydrologic Monitoring of Seasonally Inundated Wetlands

Hydrologic observations will be conducted at least once a month during the months of December, February, April, June, August, and September (six monitoring visits per year). During each site visit, the percent of the mitigation wetland/marsh areas that is dry, saturated, or inundated will be assessed visually. The total area of the mitigation wetlands that is dry, saturated, and inundated will be expressed as a percent of the total graded area (initial wetland areas will be reported in an As-built Report). The aerial extent of open water relative to the extent of herbaceous vegetation will be assessed during each monitoring visit.

A more extensive hydrologic mapping of the surface water and shallow ground water will be conducted twice a year: (a) during September, and (b) during a mid-winter dry spell, preferably two to three weeks following significant rainfall and runoff. Methods will be similar to those described in Appendix D. Eight points to be located on the boundary of the existing wetlands (by GPS) will be used to assess whether water levels are higher than those observed during pre-project conditions.

7.5 Wildlife Monitoring Methods

All wildlife using the mitigation wetlands and adjacent uplands will be noted during hydrology and vegetation monitoring efforts. At the end of each monitoring period a complete list of wildlife species that were recorded using the wetland areas will be prepared and included in annual monitoring reports.

7.6 Soil Organic Matter Monitoring Methods

A core sample will be taken in each of the random plots, placed in a zip-lock bag, and submitted to a lab for processing the level of organic matter in the soil. This will be compared to the level of organic matter in the preserved wetlands and a suitable reference site for comparison purposes.

7.7 Photographic Documentation of Wetland Habitats

Once all wetland habitats have been created/enhanced/restored, permanent photo stations will be established at each wetland community. During each hydrology and vegetation monitoring visit, photographs will be taken at the permanently established stations to document the establishment of vegetation over time.

8.0 Invasive Species Control

8.1 Invasive Species

Invasive species control across the 17-acre mitigation area, the upland habitats on the asphalt plant site, the restored section of coastal brackish marsh and adjacent uplands will occur annually as specified here and in the management plan prepared for the project site (Appendix F)

Invasive species control will be necessary prior to project implementation. Invasive control will be planned ahead of time and will be started prior to anticipated initial planting. Invasive species are defined as those listed by the California Invasive Species Council (Cal-IPC) with a rating of high, or any Tier 1 invasive species listed in the Water Board's Fact Sheet for Wetland projects (RWQCB, 2009). Invasive plant species common to the Haystack Landing project site include, but are not limited to: yellow star thistle (*Centaurea solstitialis*), pepperweed (*Lepidium latifolium)*, and non-native Spartina (e.g. *Spartina alterniflora*).

Below several strategies are described that address invasive species at the project site, both before initial planting as well as during the monitoring phase. A 10 percent cover of any invasive plant species will be the trigger level for implementing adaptive management. In many cases, multiple strategies combined will be most effective in eliminating specific unwanted species from the project site, and in all cases monitoring and adaptive management will be key to long-term success of the restored habitats and elimination of invasive species. Once the native target species are established, it is anticipated that they will out-compete the invasive species. After the general strategies discussion below for invasive control, individual invasive species known to occur at the project site are addressed in the context of which strategy(s) will be considered for feasible elimination of that species.

8.2 Invasive Species Control Methodology

Mechanical Removal

The advantages of hand pulling invasive species include low ecological impact, minimal damage to neighboring plants, and low cost for equipment or supplies. Hand removal is extremely labor intensive, however, and is effective only for relatively small areas, even when abundant labor and resources are available. Weed wrenches and other tools can be used to remove large sapling and shrubs that are too big to be pulled by hand. To minimize soil disturbance, soil will be replaced to disturbed areas. Trampled and disturbed areas can provide optimal germination sites for additional weeds, and replanting and use of seed mixes and/or erosion control mix is important.

Where grazing (or fire) is not practical, mowing is sometimes used as a surrogate method of maintaining open grassland structure. Green machines and mowers can be used on a routine basis to weed around the riparian plantings, woodland, and wetland mitigation site, as needed. The weed management will be done in late summer until plants are established. Stakes and mulch collars will help to keep the weeds and mowers away from the plants. Machinery will not be used at the site during wet conditions. Mowing is difficult on steep, rough, and varied terrain. Height and timing of mowing will be planned to avoid impacts to sensitive species.

Cultural

There is growing interest in the potential of carefully controlled livestock grazing to manage invasive plants on pastures, rangelands, and forests. Scientific studies and on-the-ground experiences have clearly demonstrated that livestock are a promising tool in the battle against weeds. Prescribed grazing is an effective technique, rivaling traditional chemical and mechanical control methods, for the management of deleterious invasive plants. Grazing is viewed by many as an ‘environmentally friendly’ alternative to traditional methods because it leaves no chemical residue, can be removed whenever necessary, and often improves land health and biodiversity. Prescribed grazing can be integrated with herbicides, mechanical removal, and biological control methods to increase the efficacy and longevity of the invasive species management plan.

Chemical

Use of pesticides (including insecticides, herbicides/weed-killers, fungicides, rodenticides) will be employed as part of an integrated management plan in concert with all applicable non-chemical options. All pesticides will be used in a manner consistent with limitations described on the label certified by the California Department of Pesticide Regulation and United States Environmental Protection Agency. All strategies discussed will be utilized as initial procedures to knock down the dominant invasive plants in advance of planting, relying on a pre-emergent herbicide to be used at time of planting to address the seed bank stored in the soil that will regenerate. As well, subsequent applications of herbicides and/or strategies discussed below will be employed as part of an adaptive management strategy.

8.3 Treatments for Individual Plant Species

Yellow star-thistle (*Centaurea solstitialis*):

Yellow star-thistle is a simple to bushy winter annual, occasionally biennial, with spiny yellow-flowered heads and stiff wiry stems to 6 ft. tall. Plants form a basal rosette of leaves until mid-spring. Stem leaves are alternate and mature foliage is grayish-to bluish-green, densely covered with fine white cottony hairs. Its leaf bases form wings along the stems. Rosette leaves typically wither by flowering time. The taproot can extend deep into the soil (> 6 ft.) allowing plants to utilize deep soil moisture not available to other annual species, particularly grasses. The flower heads are solitary on stem tips, and consist of numerous yellow disk flowers. The phyllaries are densely to sparsely covered with cottony hairs or with patches of hairs at the bases of the spines. The central spine of the main phyllaries is 10 to 25 mm long, stiff, yellowish to straw-colored throughout. Yellow star-thistle reproduces only by seed and develops two types of achenes. The outer ring of achenes is a dull dark brown, often speckled with tan, lacking pappus bristles, and often remaining in heads. The inner achenes are glossy, gray or tan to mottled cream-colored and tan, with slender white pappus bristles 2 to 5 mm long. Most seeds fall near the parent plant. Some seed is viable 8 days after flower initiation. Large flushes of seeds typically germinate after the first fall rains, but smaller germination flushes can occur during winter and early spring. Seeds can survive for up to about 10 years in the field under certain environmental conditions, but it appears that few seeds survive beyond 4 years.

Yellow star-thistle is found in open disturbed sites, open hillsides, grassland, rangeland, open woodlands, fields, pastures, roadsides, waste places. It may also inhabit cultivated fields and does not tolerate low light areas or shading. It was accidentally introduced as a seed contaminant in alfalfa. It has spread rapidly since its introduction into California in the mid-1800s. Plants are highly competitive and typically develop dense, impenetrable stands that displace desirable vegetation in natural areas, rangelands, roadsides and other places. Yellow star-thistle is considered one of the most serious rangeland weeds in the western U.S. Yellow star-thistle is sometimes problematic in grain fields, where the seeds can contaminate the grain harvest and lower its quality and value.

To prevent large-scale infestations, it is important to control new invasions. Spot eradication is the least expensive and most effective method of preventing establishment of yellow star-thistle. In established stands, a successful control strategy must result in dramatic reduction or, preferably, elimination of new seed production, multiple years of management, and follow-up treatment(s) to prevent rapid reestablishment. Effective control using any of the available techniques depends on proper timing. Combinations of techniques may prove more effective than any single technique. For example, prescribed burning followed by spot application of post-emergence herbicides to surviving plants can prevent the rapid re-infestation of the treated area. Similarly, combining mowing and grazing, revegetation and mowing, or herbicides and biological control may provide better control than any of these strategies used alone. Effective combinations may depend on location or on the objectives and restrictions imposed on land managers.

Mechanical - (pulling, cutting, disking). Hand removal, mowing, or cultivation, when used to prevent seed production over 2 to 3 years or more (the soil life of the seeds), can reduce or eliminate an infestation. Manual removal of yellow star-thistle is most effective with small patches or in maintenance programs where plants are sporadically located in the grassland system. This usually occurs with a new infestation or in the third year or later in a long-term management program. These methods can also be important in steep or uneven terrain where other mechanical tools (e.g., mowing) are impossible to use. To ensure that plants do not recover it is important to detach all above-ground stem material. Leaving even a 2-inch piece of the stem can result in recovery if leaves and buds are still attached to the base of the plant. The best timing for manual removal is after plants have bolted but before they produce viable seed (i.e. early flowering). At this time, plants are easy to recognize, and some or most of the lower leaves have senesced. If hand removal is conducted after plants begin to produce seeds, it may be necessary to put pulled plants in bags and remove them from the site. Hand removal is particularly easy in areas with competing vegetation. Under this condition, yellow star-thistle will develop a more erect slender stem with few basal leaves. These plants are relatively brittle and easy to remove. In addition, they usually lack leaves at the base and, consequently, rarely recover even when a portion of the stem is left intact. Hand removal options for yellow star-thistle typically include hand pulling, hoeing, or string trimming. Systematic surveys and repeated removal will be conducted every 2 to 4 weeks throughout the growing season.

Mowing is most effective when 2 to 5% of the total population of seed-heads is in bloom. Mowing too early can result in higher seed production. Plants should be cut below the height of the lowest branches. It will require multiple years of continuous mowing to successfully manage yellow star-thistle. Mowing is best used in an integrated approach. Since it is a late season management tool, it is best employed in the later years of a long-term management program or in a lightly infested area. Mowing is not feasible in many locations due to rocks and steep terrain. Mowing is not always successful and can decrease the reproductive efforts of insect biocontrol agents, injure late growing native forb species, and reduce fall and winter forage for wildlife and livestock. The success of mowing depends on proper timing and the growth form of the plant. Mowing too early (before seed-heads reach spiny stage) or too late (after seed set) will usually increase the yellow star-thistle problem. Mowing too early in the season can remove competitive grass cover and promote vigorous yellow star-thistle regrowth. If done too late, mowing scatters yellow star-thistle seed. Best results were obtained by mowing once at the early flowering stage, and again 4 to 6 weeks later to cut regrowth during the floral bud stage. A dense spring canopy of desirable vegetation optimizes yellow star-thistle control. Yellow star-thistle plants with an erect, high-branching growth form are effectively controlled by a single mowing at the early flowering stage, while sprawling low-branching plants cannot be controlled even with repeated mowing. Despite its limitations, mowing conducted at the early flowering stage, before viable seed production, can be very effective for yellow star-thistle control.

Anecdotal information also indicates that mowing the standing skeletons in fall, before the first rains, can form a mulch that blocks light and suppresses subsequent germination of yellow star-thistle. A flail mower is considered best. The yellow star-thistle litter layer may be less suppressive to grass germination, as it is not as light dependent as yellow star-thistle.

Tillage is effective, and is occasionally used on roadsides. It is also often used in agricultural lands, which is probably why yellow star-thistle is not a significant cropland weed. In wildlands and rangelands, tillage is usually not appropriate because it can damage important desirable species, increase erosion, alter soil structure, and expose the soil for rapid re-infestation if subsequent rainfall occurs. Any tillage operation that severs the roots below the soil surface can effectively control yellow star-thistle. Early summer tillage, before viable seeds are set, and repeated tillage following rainfall/germination events will rapidly deplete the yellow star-thistle seed bank, but may also have the same effect on the seed bank of desirable species.

Cultural. High-intensity short-duration grazing by sheep, goats, or cattle should be implemented during the period when yellow star-thistle plants have bolted to just before they produce spiny heads. Cattle and sheep avoid yellow star-thistle once the buds produce spines, whereas goats continue to browse plants even in the flowering stage. For this reason, goats have become a more popular method for controlling yellow star-thistle in relatively small infestations.

Grazing the weed during the bolting stage can provide palatable high protein forage (8 to 14%). This can be particularly useful in late spring and early summer when other annual species have senesced. Grazing alone will not provide long-term management or eradication of yellow star-thistle, but can be a valuable tool in an integrated management program. This prescription must be continued for at least 3 years in a severe infestation to reduce the yellow star-thistle seed bank.

Prescribed burns can provide control if conducted at the proper timing. Burning should be timed to coincide with the very early yellow star-thistle flowering stage. At this time yellow star-thistle has yet to produce viable seed, whereas seeds of most desirable species have dispersed and grasses have dried to provide adequate fuel. Fire has little if any impact on seeds in the soil. Burning at other times may enhance yellow star-thistle survival by removing the thatch and encouraging seed germination in fall.

The ability to use repeated burning depends on climatic and environmental conditions. In areas where resources are ample and total plant biomass is abundant, 2 or 3 consecutive years of burning may be practical. However, in other situations, fuel loads may not be sufficient to allow multiple year burns. Consequently, prescribed burning may be more appropriate as part of an integrated approach. Air quality issues can be significant when burns are conducted adjacent to urban areas. A major risk of prescribed burning is the potential of fire escapes. This risk is greatest when burns are conducted during the summer months. In some areas, burning can lead to rapid invasion by other undesirable species with wind-dispersed seeds, particularly members of the sunflower family.

In addition to summer burning, yellow star-thistle seedlings have been controlled using winter or early spring flaming. This technique is somewhat nonselective, and control of yellow star-thistle is inconsistent. When spring drought follows a flaming treatment, control of yellow star-thistle can be excellent. In contrast, a wet spring can lead to complete failure and increased yellow star-thistle infestation, particularly since competing species may be dramatically suppressed.

Biological. Six insects have become established for the control of yellow star-thistle in the western United States. These include three species of weevils (seed-head weevil [*Bangasternus orientalis*], flower weevil [*Larinus curtus*], and the hairy weevil [*Eustenopus villosus*]), and three species of flies (seed-head fly [*Urophora sirunaseva*], peacock fly [*Chaetorellia australis*], and the false peacock fly [*Chaetorellia succinea*]). All six insects attack the flower heads of yellow star-thistle and produce larvae that develop and feed within the seed-head. Of these, only four have become well established. Of these, only two, *Eustenopus villosus* and *Chaetorellia succinea*, have any significant impact on reproduction. The combination of these two insects reduces seed production by 43 to 76%. Although this level of suppression is not sufficient to provide long-term yellow star-thistle management, the use of biological control agents can be an important component of an integrated management approach. A more successful biological control program will likely require the introduction of plant pathogens or other insects which attack roots, stems, or foliage.

A new potential biological control agent is a root-feeding weevil, *Ceratapion basicorne*, that has shown promise under greenhouse conditions. It has yet to be approved, but is expected to be released in the next couple of years. The most widely studied pathogen for yellow star-thistle control is the Mediterranean rust fungus *Puccinia jaceae*. It can attack the leaves and stem of yellow star-thistle, causing enough stress to reduce flower-head and seed production. Although it has been released it does not seem to have much impact on yellow star-thistle populations.

Chemical. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

MODE OF ACTION	CHEMICAL NAME
Growth Regulators	2,4-D; Aminopyralid; Clopyralid; Dicamba
Aromatic Amino Acid Inhibitors	Glyphosate
Branched-Chain Amino Acid Inhibitors	Chlorsulfuron; Imazapyr; Sulfometuron
Photosynthetic Inhibitors	Hexazinone

Conclusion and Recommendation: The most effective means of yellow-star thistle control will likely be a combination of hand pulling and or mowing and chemical control. Based on conditions at the site, the applicant will use the most effective means or combination of means to control the species. Any techniques not described herein that may in the future prove successful at eliminating yellow-star thistle will require the review and approval of the Regional Board and Corps prior to implementation.

Perennial Pepperweed (*Lepidium latifolium)*:

Perennial pepperweed is found in all western states, except North and South Dakota, in many different areas and habitats, including wetlands, riparian areas, meadows, vernal pools, salt marshes, flood plains, sand dunes, roadsides, irrigation ditches, ornamental plantings, and agronomic crops, including alfalfa, orchards, vineyards, and irrigated pastures. Most typically found on moist or seasonally wet sites in the west, and most problematic in riparian or wetland areas, and will tolerate saline and alkaline conditions. Perennial pepperweed can rapidly form large, dense stands that displace desirable vegetation and wildlife. Populations easily spread along waterways and can infest entire stream corridors, riparian areas, or irrigation structures. Roots do not hold soil together well, allowing erosion of river, stream, or ditch banks. Flooded streams often wash away roots growing along the streambank, and new infestations develop downstream. Once established, perennial pepperweed is persistent and difficult to control in crops, natural areas, and ornamental plantings. Perennial pepperweed reduces forage quality in hay and pasture. Perennial pepperweed plants extract salts from deep soil and deposit them on the soil surface, inhibiting the germination and growth of other species that are sensitive to salinity.

Perennial pepperweed is an erect perennial to 6 ft. tall. The crown and lower stems are weakly woody. The foliage lacks hairs and is green to gray-green, often dusted with powdery white caused by a rust fungus. The basal leaves are larger and wider than stem leaves, to 1 ft. long and 4 inches wide, with serrate margins. The aboveground parts typically die in late fall and winter, leaving dead stems and thatch which can persist for several years. The roots are long, thick, minimally branched, and vigorously creeping. Most grow in the top 2 ft. of soil, but some can penetrate to a depth of 10 ft. or more. The inflorescences are rounded to pyramidal and consist of numerous small white flowers. The flowers
have four petals, producing small pods (about 2 mm long) with tiny reddish-brown seeds (about 1 mm long). Perennial pepperweed is a prolific seed producer. Laboratory tests suggest seeds germinate readily with fluctuating temperatures and adequate moisture; however, seeds do not appear to remain viable in the soil for extended periods. As a result, perennial pepperweed reproduces primarily vegetatively from roots and root fragments. Large root fragments can survive desiccation on the soil surface for extended periods, and fragments as small as 0.5 to 1 inch long and 2 to 8 mm in diameter can develop into new plants. Root fragments and seeds disperse with flooding, soil movement, and human and animal activities.

Mechanical - (pulling, cutting, disking). Seedlings are easily controlled by hand-pulling or tillage, but these techniques do not control established plants because shoots quickly resprout from vast root reserves. In addition, seedlings are not often encountered. Root segments as small as 1 inch are capable of producing new shoots. Cultivation and tillage typically increase infestations by dispersing root fragments. Clean equipment after tillage to prevent spreading root fragments. Mowing stimulates perennial pepperweed plants to resprout and produce new growth, but mowing is helpful for removing accumulated thatch. Mowing breaks old stems into small fragments and helps prevent shading of favorable species. Combining mowing with herbicides has been shown to be an effective control strategy. For best results, mow plants at the bolting or flower bud stage and apply herbicides to resprouting shoots once they have reached the flower bud stage (refer to Chemical section following).

Cultural. Cattle, sheep, and goats will graze perennial pepperweed, especially rosettes in early spring. When stands are dense it becomes difficult for most animals to graze. Goats appear to tolerate heavy consumption of fresh plants. Sheep and goats permanently maintained in a pasture suppress growth of perennial pepperweed. However, once livestock are removed, plants quickly resprout. Burning is not effective at reducing perennial pepperweed stands, but it is helpful at removing accumulated thatch. Perennial pepperweed thatch burns best in winter or spring under dry conditions before initiation of spring growth. Seasonal flooding for an extended period during the growing season can significantly reduce populations. It is not known how long perennial roots can survive flooded conditions, but anecdotal information indicates that 6 months of submergence are required. Establishing desirable vegetation in disturbed areas can suppress perennial pepperweed and slow reinvasion after control. Because perennial pepperweed is very competitive, seed or transplant desirable vegetation after dense perennial pepperweed stands are controlled. Choose vigorous, fast-growing plant species that are adapted to the site. Perennial grasses are a good choice for natural areas and pastures. Grasses are tolerant of broadleaf-selective herbicides, and over time grasses form a thick sod that prevents future weed establishment. In pastures, promote grass expansion and vigor with fertilization and grazing management.

Biological. Biological control agents are being evaluated for use on perennial pepperweed in the United States, but currently no organisms are available

Chemical. A combination of hand control and the use of herbicide is most successful in fighting Lepidium invasion and therefore will be the primary means of control of Lepidium on site. Herbicide application for pepperweed works most effectively when applied using a backpack application system or hand held applicator to avoid overspray of adjacent plants. Herbicide application timing is critical for pepperweed and works best at the flower bud stage and worst at the rosette or early bolting stage. Because plant phenology differs between location and year, it will be important to regularly observe infested areas in the spring and begin applying herbicides when flower buds appear. If herbicide cannot be applied at the flower bud stage, mow plants and apply the herbicide to any regrowth. With seedlings, apply herbicides as soon as possible to prevent plants from producing new lateral shoots from the root. On the edges of Lepidium colonies, care should be taken to spray Lepidium plants only, and not other species that are growing in the fringe habitat. If herbicide is over-applied, other less resilient plants may not recover enabling Lepidium to reinvade at a later date. Herbicide choice depends on label restrictions, land use objectives, and cost[4]. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically.

The order of herbicide listing is not reflective of the order of efficacy or preference.

MODE OF ACTION	CHEMICAL NAME
Growth Regulators	2, 4-D
Aromatic Amino Acid Inhibitors	Glyphosate
Branched-Chain Amino Acid Inhibitors	Chlorosulfuron; Imazapyr; Propoxycarbazone-sodium

Conclusion and Recommendation: The most effective means of Lepidium control will likely be a combination of mechanical and chemical control. Based on conditions at the site, the applicant will use the most effective means or combination of means to control the species. Any techniques not described herein that may in the future prove successful at eliminating Lepidium will require the review and approval of the Regional Board and Corps prior to implementation.

Invasive Spartina (*Spartina alterniflora* et al)

Non-native cordgrass (invasive *Spartina* spp.) is a common invasive species in San Francisco Bay marshlands and estuaries and could potentially colonize on portions of the site adjacent to the Petaluma River and along the tidally influenced ditches on the 35-acre site. The most agressive of the Spartina is the hybrid of Atlantic smooth cordgrass (*Spartina alterniflora*) and the native cordgrass (*Spartina foliosa*). *Spartina alterniflora* is a perennial deciduous grass found in intertidal wetlands, most commonly

[4] http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74121.html

estuarine salt marshes. A native to the Atlantic coast, *Spartina alternifora* was introduced to San Francisco Bay marshlands in the 1970s as part of marshland restoration projects. It grows 3-5 feet tall and has smooth, hollow stems which typically have leaves from ½ foot to 2 feet long and ½ inch wide at their base. Pollen production, higher fertility, greater tolerance for both inundation and drought, and increased timeframe for flowering enable hybrids to outcompete the native strain.[5]

Mechanical - (hand pulling). Cordgrass can be pulled or dug before it produces flowers and seeds. This will probably be the most effective mechanical means on the site since the drainage ditches are relatively narrow and easily accessible by foot.

Cultural. Grazing can be used as a means of control but is not recommended for this site due to the wetness of the drainages.

Biological. Leafhopper bugs (*Prokelisia marginata*) have been used to control invasive Spartina in Washington State.

Chemical. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

MODE OF ACTION	CHEMICAL NAME
Aromatic Amino Acid Inhibitors	Glyphosate
Branched-Chain Amino Acid Inhibitors	Impazapyr, Sulfometuron

Conclusion and Recommendation: The most effective means of Spartina control will likely be a hand pulling and possibly chemical control. Based on conditions at the site, the applicant will use the most effective means or combination of means to control the species. Any techniques not described herein that may in the future prove successful at eliminating Spartina will require the review and approval of the Regional Board and Corps prior to implementation.

9.0 Project Construction and Implementation

9.1 Grading and Clearing

5 Kerr, Drew. 2015. *Aquatic Pesticide Application Plan for the San Francisco Estuary Invasive Spartina Project*. Prepared for the State Coastal Conservancy. March.

Prior to grading the site for construction of the asphalt plant and storage area all wetland areas to remain as part of the project will be fenced with orange construction fencing to avoid accidental intrusion. The asphalt plant and storage area will then be cleared and grubbed of vegetation. In order to construct the wetland mitigation project, approximately 24,000 cubic yards of soil from the mitigation area will be removed using standard earthmoving equipment including scrapers, bulldozers, hydraulic excavators, trucks and other construction equipment.

Grading for the asphalt plant and storage area, and the wetland mitigation project includes additional earth movement of approximately 12,000 cubic yards of soil in the northern portion of the site. Between the excavation and re-contouring of the mitigation area and the excavation and fill for the proposed asphalt and recycling plant, the soil will be balanced on-site and no import or off-haul of soil will be required.

9.2 Avoidance Measures

9.2.1 Wetlands

Wetland areas that are to remain within and adjacent to construction zones will be fenced with high visibility orange construction fencing to prevent accidental intrusion into these areas during construction.

9.2.2 Special-status Species

Based on the habitat characteristics of the site and given that a portion of the Petaluma River is included in the project boundary, it was determined that seven special-status species have the potential to occur on or within the vicinity of the project site. These include three special-status birds, the California clapper rail, California black rail, and salt-marsh common yellowthroat, and three special-status fish species, Chinook, steelhead, and Sacramento splittail. The Pacific pond turtle was also included because it may also have the potential to occur within the vicinity of the project site. Finally, nesting raptors including white-tailed kite (*Elaneus leucurus*) and northern harrier (*Circus cyaneus*), and nesting egrets were also identified as having the potential to occur on or within the vicinity of the site.

Mitigation measures designed to reduce direct and/or indirect impacts to the above referenced special-status species are as follows:

1) For the California clapper rail, the California black rail and the salt-marsh common yellowthroat, construction on the project site may be restricted during these species nesting periods, which occur between February 1st and August 31st. Prior to construction, specific construction schedules would be determined in consultation with the U.S. Fish and Wildlife Service (USFWS) and the California

Department of Fish and Wildlife (CDFW) through the Clean Water Act Section 404 permit process.

2) If earth-moving/grading activity or construction-related disturbance will occur on the project site during the raptor nesting season (March15 to August 15), a pre-construction raptor nesting survey should be conducted by a qualified biologist to determine if construction activities could disturb nesting raptors. If nesting raptors are identified on the project site, a non-disturbance buffer (determined in coordination with CDFW) should be established around the nest tree. This buffer should be fenced with orange construction fencing. A qualified raptor biologist would need to periodically monitor the nest site(s) to determine if construction activity occurring outside the buffer zone disturbs the birds, and whether the buffer zone should be increased to prevent nest abandonment. No disturbance should occur within the minimum 500-foot buffer zone until a qualified raptor biologist has determined that the young have fledged (left the nest), and are flying well enough to avoid project construction zones, typically by August 1st. Once the young have successfully fledged, no further mitigation would be required.

9.3 Construction Monitoring

9.3.1 Equipment Use

Equipment, vehicles, debris, building materials, and excess soil associated with project construction shall not be stored or parked within 15 feet of the coastal marsh habitat and any wetland habitats to remain after project construction. Wetland areas that are to remain within and adjacent to construction zones will be fenced with high visibility orange construction fencing to prevent accidental intrusion into these areas.

9.3.2 Clearing of Mitigation Areas

Non-native plant species occurring in the proposed mitigation areas will be eradicated by hand or mechanical clearing. Cleared vegetation and waste materials and debris generated during project construction will be removed from the proposed mitigation area.

9.3.3 Grading Mitigation Areas

The grading of the mitigation areas will be done with the equipment described in Section 7.1 above. The operation will be completed simultaneously with the grading for the asphalt plant and recycle areas.

9.3.4 Soil Disposal

The project site will include soil movement of approximately 36,000 cubic yards. All of the soil movement is expected to be balanced on site and no import or export is expected.

9.4 Construction Schedule

Construction of the mitigation area will occur in the summer and fall of 2015. Preparation of the asphalt and recycling plant site can begin prior to that time weather permitting. The grading operation will take approximately six weeks. Installing the site utilities associated with the asphalt and recycling plant will also require approximately 6 weeks to complete. Following the site preparation work, an additional 8 weeks will be required to install the plant and equipment.

10.0 MAINTENANCE

Wetlands habitats on the site will likely require (a) initial adjustments for up to 3 years, and/or (b) ongoing maintenance. Initial grading adjustments may be required because of the substantial change of the land surface that will occur with transforming the man-made watersheds of the site that have little relationship to the proposed restored functions and ecological units. Nonetheless, the existing seasonal wetlands and emergent marsh on the site have developed seed banks and vegetation which, although sub-optimal, provide some value and therefore should be disturbed as little as possible. While the proposed mitigation plan minimizes initial grading of these two units, it is possible that subsequent grading work may be needed to make adjustments to localized areas, some of which may be large enough to require the use of small-scale mechanized equipment. For example, the enhanced seasonal wetland in the southern portion of the site may locally incise preventing water from spreading to adjacent areas as anticipated, a situation which may be addressed with minor grading that does not disrupt the seed bank[5].

Maintenance measures specific to each habitat type are described below.

---

[5] Because the substrate is completely artificial, it is better to plan to configure the ultimate equilibrium profile of the channel with an initial estimate followed by adjustment (‘adaptive management’)

10.1 Seasonal wetlands

10.1.1 Adjustments maintenance

Conduct minor spot grading or reconfiguration, to maximize the area of wetlands that can be sustained. Work will be done in late summer, in a manner that will minimize disturbance of the seed bank or existing vegetation.

10.1.2 On-going maintenance

Clear trash or rubbish. Make minor adjustments in channel and sill elevations using hand equipment. Clear obstructions as needed from the mouth of the culvert beneath Highway 101.

10.2 Treatment train

10.2.1 Adjustments maintenance

Remove sediment introduced during the initial rains from uplands, from adjustment of the channel, or from areas west of the highway. Replant vegetation dislodged during the initial years' establishment period. Adjust sill elevations or drainage facilities as needed.

10.2.2 Ongoing maintenance

Clear trash and rubbish. Trim or prune shrubby vegetation which may limit the performance of the BMPs. Check culverts and sills annually to remove obstructions. Perform other maintenance as needed, generally using hand labor.

11.0 SUBMITTAL OF MONITORING REPORTS

11.1 As-built Report and Plans

As-built plans will be prepared depicting finished grades of the various wetland habitats created and enhanced. Methods of construction as well as any problems or unexpected conditions encountered during construction will also be recorded. Permanent photo-points will also be established and recorded on the as-built plans as described in previous sections of this report. Baseline information will be incorporated into a written report describing the as-built status of the project. This report will be submitted with the as-built plans to the Corps and Regional Water Quality Control Board within six weeks of completion of construction activities.

11.2 Annual Mitigation Monitoring Reports

Annual monitoring reports will be submitted by the applicant to the Corps and Regional Water Quality Control Board by October 31 of the year following the first growing season after planting, and yearly thereafter or as specified by the Corps and the Regional Board.

At the end of each monitoring year (years one through five), a detailed annual monitoring report will be prepared. At a minimum each monitoring report shall contain:

A) Hydrology data summaries;

B) Plant community sampling data and summaries;

C) Photographic documentation of hydrologic functions of the mitigation wetlands.

The monitoring reports will also include analyses of all quantitative monitoring data, prints of monitoring photographs, and maps identifying transect locations and permanent photo points. A qualitative assessment of the success of the upland buffer zone and associated plantings will also be provided. Overall success of the mitigation program will be discussed, and any remedial measures taken during the course of the monitoring period will be described.

12.0 CONTINGENCY MEASURES

If the annual performance criteria are not met for all or any portion of the mitigation program in any year, or if the final success criteria are not met, the applicant, or its assignee, will prepare an analysis of the cause(s) of failure, and, if determined necessary by the Corps and Regional Board, propose remedial measures for approval. Such remedial measures may include further corrective measures to be implemented on the mitigation site, or, if conditions are such that goals for the site may not be met, implementation of mitigation measures in other areas of Sonoma County and/or in the Petaluma River watershed.

If the mitigation site has not met the performance criteria, the applicant's maintenance and monitoring obligations may continue, as deemed necessary by the Corps and Regional Board, until the Corps and Regional Board have given final confirmation.

13.0 COMPLETION OF MITIGATION RESPONSIBILITIES

At the end of the fifth year following project implementation, a report will be submitted to the Corps evaluating the success of the mitigation project and determining whether all the goals of the mitigation plan have been met. If the goals have been met, the report will document completion of the project.

When the project has been deemed complete and documented in a final report, the Corps may require a site visit to confirm completion of the project. The Corps will be the agency responsible for determining whether the final success criteria have been met and will notify the applicant of its determination in writing.

14.0 FISCAL RESPONSIBILITIES AND OTHER ADMINISTRATIVE COMPONENTS

The project applicant, or a legal assignee, shall be solely liable for financing all work associated with mitigation plan implementation, monitoring, remedial actions, and contingency plans as specified in this mitigation plan as detailed in the attached management plan. Assignee shall mean any affiliate, heirs, successors, joint venture partners, or an assessment district, or other vehicle duly formed to implement this wetland mitigation plan. Fiscal responsibility for these tasks shall remain the sole obligation of the applicant or the assignee until mitigation is considered successful pursuant to success criteria by the resource agencies.

15.0 LONG-TERM PROTECTION AND MANAGEMENT

The applicant proposes to deed the approximately 17-acre mitigation area to a conservation organization such as the Sonoma County Land Trust or another organization dedicated to preserving open space areas. If dedication of the property to a non-profit organization is not practicable, the applicant will retain the property and execute a conservation easement on the project site to protect the mitigation area. Management of the project area will occur as specified in the maintenance section of this report and the management plan prepared for the project.

REFERENCES

Atwater, B.F. and C.W. Hedel. 1976. Distribution of seed plants with respect to tide levels and water salinity in the natural tidal marshes of the northern San Francisco Bay estuary, California. United States Department of the Interior Geological Survey.

Best, C., J. T. Howell, W. Knight, I. Knight, and M. Wells. 1996. A flora of Sonoma County. California Native Plant Society, Sacramento, CA. 347 pp.

California Native Plant Society. 2003. California Native Plant Society's electronic inventory of rare and endangered vascular plants of California. Computer program. Version 1.5.1.

California Native Plant Society, 2001. Inventory of Rare and Endangered Plants of California. August.

CNDDB, 2011 and 2003. California Natural Diversity Data Base (Petaluma River quadrangle) March.

Coulombe, H.N. 1970. The Role of Succulent Halophytes in the Water Balance of Salt Marsh Rodents. Oecologia Vol 4.

DiTomaso, J.M., G.B. Kyser et al. 2013. Weed Control in Natural Areas in the Western United States.
Weed Research and Information Center, University of California.

Environmental Laboratory, 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87. Hickman, J. C. (ed.). 1993. The Jepson manual: higher plants of California. University of California Press, Berkeley, CA.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, Calif/S.F. Bay Regional Water Quality Control Board, Oakland, Calif.

Goals Project. 2000. Baylands ecosystem species and community profiles: Life histories and environmental requirements of key plants, fish and wildlife. Prepared by the San Francisco Bay Area wetlands ecosystem goals project. P.R. Olofson, editor. S.F. Bay Regional Water Quality Control Board, Oakland, Calif.

Hickman, J. C. (ed.). 1993. The Jepson manual: higher plants of California. University of California Press, Berkeley, CA.

Hobson, K., P. Perrine, E.B. Roberts, M.L. Foster, and P. Woodin. 1985. A breeding season survey of salt marsh yellowthroats (Geothlypis trichas sinuosa) in the San Francisco Bay Region. U. S. Fish and Wildl. Serv. Contract Rept. 84-57. Sacramento, CA. 92 pp.

Kingma, Hope. 2003. Identifying habitat parameters for salt marsh harvest mouse habitat restoration. Unpublished thesis, California State University, Hayward.

Macmillan, L., R. Buck, N. Kawamoto, and J. Winter, 2003. *Biological Constraints Analysis, Landing Way Project Site, Shamrock Materials, Inc., Petaluma, California*. November. 30 pp.

Mall, R.E. 1969. Soil-water-salt relationships of waterfowl food plants in the Suisun Marsh of California. California Department of Fish and Game, Wildlife Bulletin No. 1

Miller Pacific Engineering Group, 2004. Geotechnical Investigation, Haystack Landing Wetlands Restoration, Petaluma, California. October 1, 2004.

Mitsch, William J. and James G. Gosselink, 1986. Wetlands. Van Nostrand Reinhold. New York.

Monk & Associates. 2004. Salt marsh harvest mouse trapping study. Haystack Landing. Petaluma, California. Prepared for the U.S. Fish and Wildlife Service on behalf of Ms. Lucy Macmillan, Wetland Scientist. November 17, 2004. 9 pps. plus datasheets.

Moyle, P. 2002. Inland Fishes of California. Revised and Expanded. University of California Press. Berkeley.

Munz, P. A. and D. D. Keck. 1973. A California flora and supplement. University of California Press, Berkeley, CA.

Reed, P.B. Jr. 1997. Revision of the national list of plant species that occur in wetlands. Department of the Interior, U.S. Fish and Wildlife Service, Washington, DC. 253 pps.

Shellhammer, H.S., R. Jackson, W. Davilla, A. M. Gilroy, H.T. Harvey, and L. Simons. 1982. Habitat preferences of salt marsh harvest mice (*Reithrodontomys raviventris*). The Wasmann Journal of Biology 40(1-2), 1982. pp. 102-114.

Skinner, M. W. and B. M. Pavlik (eds.). 1994. Inventory of rare and endangered vascular plants of California. Calif. Native Plant Soc. Spec. Publ. No.1./ Fifth Edition. Sacramento, CA.

Tibor, D. P. (ed.). 2001. Inventory of rare and endangered vascular plants of California. California Native Plant Society Special Publication No. 1 [6th edition].

Ungar, I.A. 2000. Ecophysiology of vascular halophytes. CRC Press, Boca Raton, FL.

U.S. Army Corps of Engineers, 2006. Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region.

U.S. Fish & Wildlife Service, 2011. Sacramento Fish & Wildlife Office
Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Petaluma River (484A) U.S.G.S. 7 1/2 Minute Quad. Database last updated: April 29, 2010. Report Date: March 10, 2011

U.S. Army Corps of Engineers. 1987. Corps of Engineers wetlands delineation manual. Environmental Laboratory. Department of the Army. Waterways Experiment Station. Wetlands Research Program. Technical Report Y-87-1. Vicksburg, Mississippi. 100 pp. plus Appendices.

U.S.D.A. 1992. Hydric Soil Lists. Field Office Official List of Hydric Soil Map Units for Sonoma County, California.

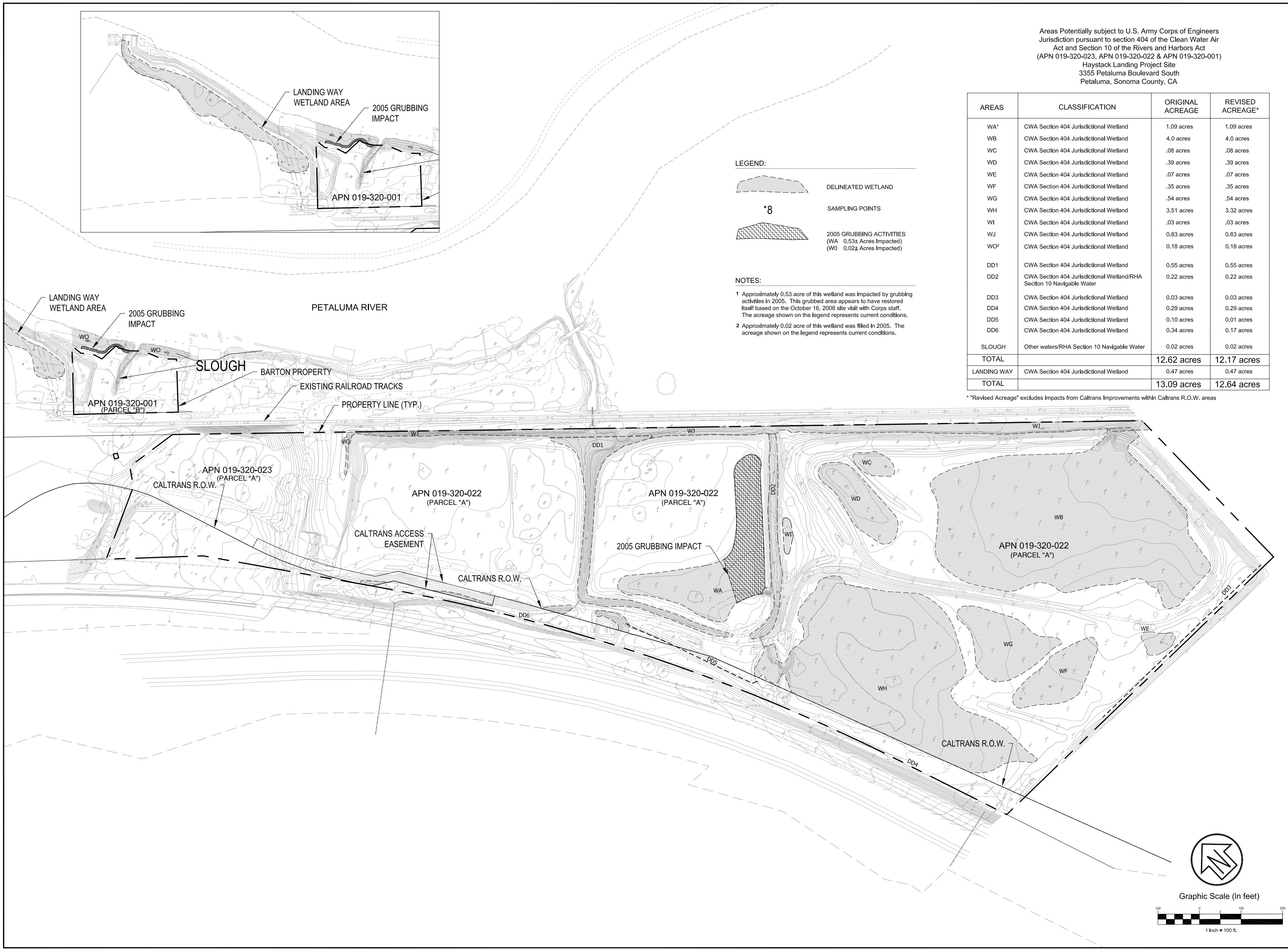
U.S.D.A. 1990. Soil Survey. Sonoma County California.

U.S.D.A. 1991. Hydric Soils of the United States. Soil Conservation Service. Miscellaneous Publication Number 1491. 3rd Edition.

Woyshner, M.R., Porras, G., Mallory, B., and Hecht, B. 2004. Preliminary Hydrologic Evaluation of Wetland Restoration Feasibility at Haystack Landing, Petaluma, California. Balance Hydrologics, Inc. report prepared for Lucy Macmillan.

Zeiner, David C., William F Laudenslayer, Jr., Kenneth E. Mayer, and Marshall White. 1990. California’s Wildlife, Volume II, Birds. California Statewide Habitat Relationships System.

Plate 1 – Clean Water Act Section 404 Potential Jurisdictional Wetlands Determination Map



Areas Potentially subject to U.S. Army Corps of Engineers
Jurisdiction pursuant to section 404 of the Clean Water Air
Act and Section 10 of the Rivers and Harbors Act
(APN 019-320-023, APN 019-320-022 & APN 019-320-001)
Haystack Landing Project Site
3355 Petaluma Boulevard South
Petaluma, Sonoma County, CA

AREAS	CLASSIFICATION	ORIGINAL ACREAGE	REVISED ACREAGE*
WA[1]	CWA Section 404 Jurisdictional Wetland	1.09 acres	1.09 acres
WB	CWA Section 404 Jurisdictional Wetland	4.0 acres	4.0 acres
WC	CWA Section 404 Jurisdictional Wetland	.08 acres	.08 acres
WD	CWA Section 404 Jurisdictional Wetland	.39 acres	.39 acres
WE	CWA Section 404 Jurisdictional Wetland	.07 acres	.07 acres
WF	CWA Section 404 Jurisdictional Wetland	.35 acres	.35 acres
WG	CWA Section 404 Jurisdictional Wetland	.54 acres	.54 acres
WH	CWA Section 404 Jurisdictional Wetland	3.51 acres	3.32 acres
WI	CWA Section 404 Jurisdictional Wetland	.03 acres	.03 acres
WJ	CWA Section 404 Jurisdictional Wetland	0.83 acres	0.83 acres
WO[2]	CWA Section 404 Jurisdictional Wetland	0.18 acres	0.18 acres
DD1	CWA Section 404 Jurisdictional Wetland	0.55 acres	0.55 acres
DD2	CWA Section 404 Jurisdictional Wetland/RHA Section 10 Navigable Water	0.22 acres	0.22 acres
DD3	CWA Section 404 Jurisdictional Wetland	0.03 acres	0.03 acres
DD4	CWA Section 404 Jurisdictional Wetland	0.29 acres	0.29 acres
DD5	CWA Section 404 Jurisdictional Wetland	0.10 acres	0.01 acres
DD6	CWA Section 404 Jurisdictional Wetland	0.34 acres	0.17 acres
SLOUGH	Other waters/RHA Section 10 Navigable Water	0.02 acres	0.02 acres
TOTAL		12.62 acres	12.17 acres
LANDING WAY	CWA Section 404 Jurisdictional Wetland	0.47 acres	0.47 acres
TOTAL		13.09 acres	12.64 acres

* "Revised Acreage" excludes impacts from Caltrans Improvements within Caltrans R.O.W. areas

LEGEND:

DELINEATED WETLAND

•8 SAMPLING POINTS

2005 GRUBBING ACTIVITIES
(WA 0.53± Acres Impacted)
(W0 0.02± Acres Impacted)

NOTES:

1 Approximately 0.53 acre of this wetland was impacted by grubbing activities in 2005. This grubbed area appears to have restored itself based on the October 16, 2008 site visit with Corps staff. The acreage shown on the legend represents current conditions.

2 Approximately 0.02 acre of this wetland was filled in 2005. The acreage shown on the legend represents current conditions.

CSW | ST2
CSW/Stuber-Stroeh
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Land Planning
Construction Management
Landscape Architecture

Rev	Date	Description	Designed	Drawn	Checked
-	04-29-15	CALTRANS IMPACTS REMOVED	RSW	RSW	AGC
-	10-23-08	WETLAND DELINEATION MAP	RSW	RSW	AGC

DUTRA HAYSTACK LANDING
POTENTIAL JURISDICTIONAL WETLANDS
DUTRA GROUP

City Of

County Of
Sonoma

State Of
California

Prepared Under the Direction of:

Sheet
EXH9

Scale:	1" = 100'
Date:	10-23-08
File:	591302-C3D
Plan File:	D-4862

P:\05\591302\DWG_2012\Exhibit\EX9 Wetland Verification 042015.dwg, 4/29/2015 - 01:51 PM, sperj, 1:1

PLATE 1

Plate 2 – Haystack Landing Wetlands Mitigation Plan Design

MIT ALT 11A 2014-09-22

CREATED WETLAND HABITAT

ACRES	SYMBOL	DESCRIPTION
2.66		CREATED SEASONALLY INUNDATED WETLAND
2.66		TOTAL CREATED WETLAND HABITAT

ENHANCED WETLAND HABITAT

8.27		ENHANCED EX. SEASONALLY INUNDATED WETLAND
8.27		TOTAL ENHANCED WETLANDS

BRACKISH MARSH ENHANCED WITH PLANTINGS (WO2)

0.16		EX. BRACKISH MARSH WETLAND - ENHANCED (BARTON PROPERTY)
.016		TOTAL PLANTING ENHANCEMENT

RESTORED COASTAL BRACKISH MARSH HABITAT (WO2)

0.02		EX. SEASONAL WETLAND-RESTORED (BARTON PROPERTY)
.02		TOTAL RESTORED WETLANDS
10.95		TOTAL CREATED, RESTORED, & ENHANCED WETLAND HABITAT

3.29		PROPOSED UPLAND ENHANCEMENT/ BUFFER ZONE (INCLUDING LANDING WAY)
		LIMITS OF CORPS JURISDICTIONAL WETLANDS.
0.90		PRESERVED EXISTING WETLANDS
17.0		MITIGATION BOUNDARY (AFTER CALTRANS IMPROVEMENTS, 19.0 ACRES PRIOR TO IMPROVEMENTS)

MITIGATION AREA

WETLAND	EX. ACRES	ENHANCED ACRES
WB	4.00	4.0
WC	0.08	0
WD	0.39	0
WF	0.35	0.35
WG	0.54	0.54
WH	3.51	3.38
TOTAL	8.87	8.27
WO2	0.18	0
TOTAL	9.05	8.27

Rev	Date	Description	Checked
-			

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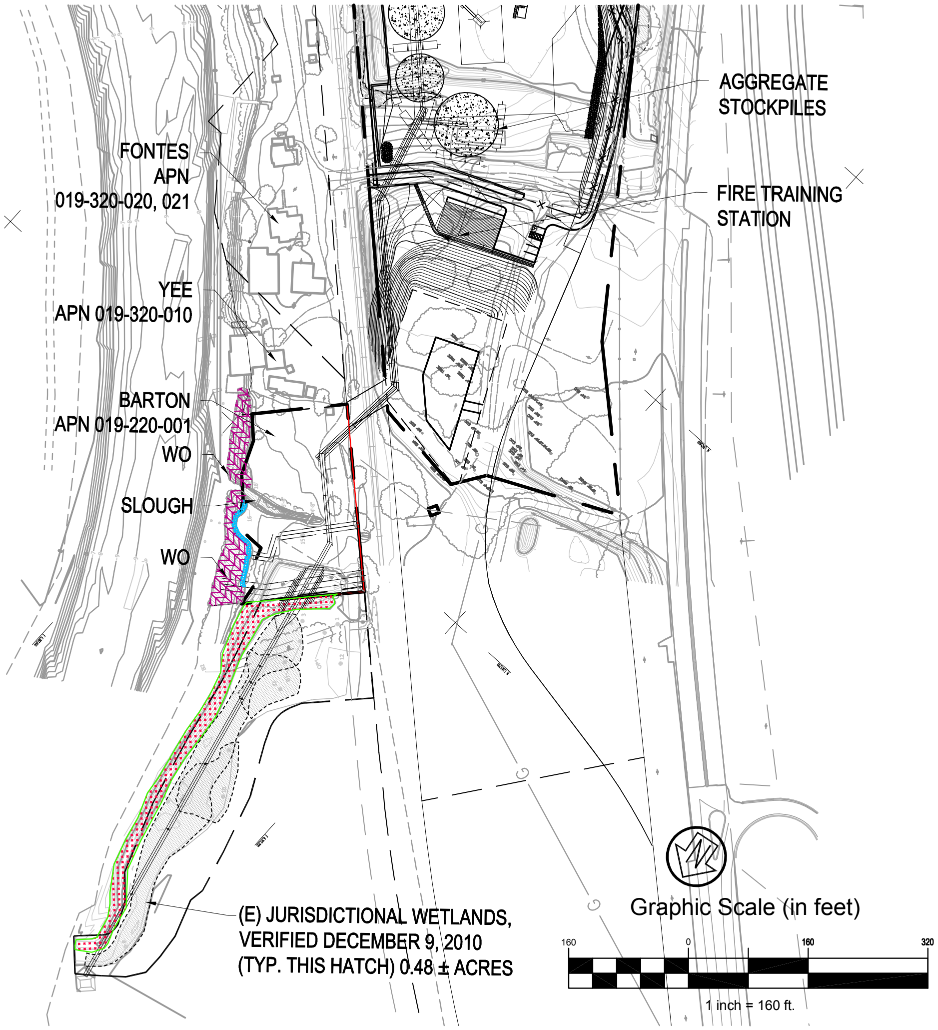
Prepared Under the Direction of:

Job No. 591302
Date: 04/13/2011
Revision: 11/11/2014
Scale: 1"=160'

DUTRA HAYSTACK ASPHALT FACILITY
WETLANDS MITIGATION PLAN DESIGN
PLATE 2
SONOMA CALIFORNIA



MIT ALT 11A 2014-09-22

CREATED WETLAND HABITAT

ACRES	SYMBOL	DESCRIPTION
2.66		CREATED SEASONALLY INUNDATED WETLAND
2.66		TOTAL CREATED WETLAND HABITAT

ENHANCED WETLAND HABITAT

8.27		ENHANCED EX. SEASONALLY INUNDATED WETLAND
8.27		TOTAL ENHANCED WETLANDS

BRACKISH MARSH ENHANCED WITH PLANTINGS (WO2)

0.16		EX. BRACKISH MARSH WETLAND - ENHANCED (BARTON PROPERTY)
.016		TOTAL PLANTING ENHANCEMENT

RESTORED COASTAL BRACKISH MARSH HABITAT (WO2)

0.02		EX. SEASONAL WETLAND-RESTORED (BARTON PROPERTY)
.02		TOTAL RESTORED WETLANDS

10.95	TOTAL CREATED, RESTORED, & ENHANCED WETLAND HABITAT

3.29		PROPOSED UPLAND ENHANCEMENT/ BUFFER ZONE (INCLUDING LANDING WAY)
		LIMITS OF CORPS JURISDICTIONAL WETLANDS.
0.90		PRESERVED EXISTING WETLANDS
17.0		MITIGATION BOUNDARY (AFTER CALTRANS IMPROVEMENTS, 19.0 ACRES PRIOR TO IMPROVEMENTS)

MITIGATION AREA

WETLAND	EX. ACRES	ENHANCED ACRES
WB	4.00	4.0
WC	0.08	0
WD	0.39	0
WF	0.35	0.35
WG	0.54	0.54
WH	3.51	3.38
TOTAL	8.87	8.27
WO2	0.18	0
TOTAL	9.05	8.27

Rev	Date	Description	Checked
-			

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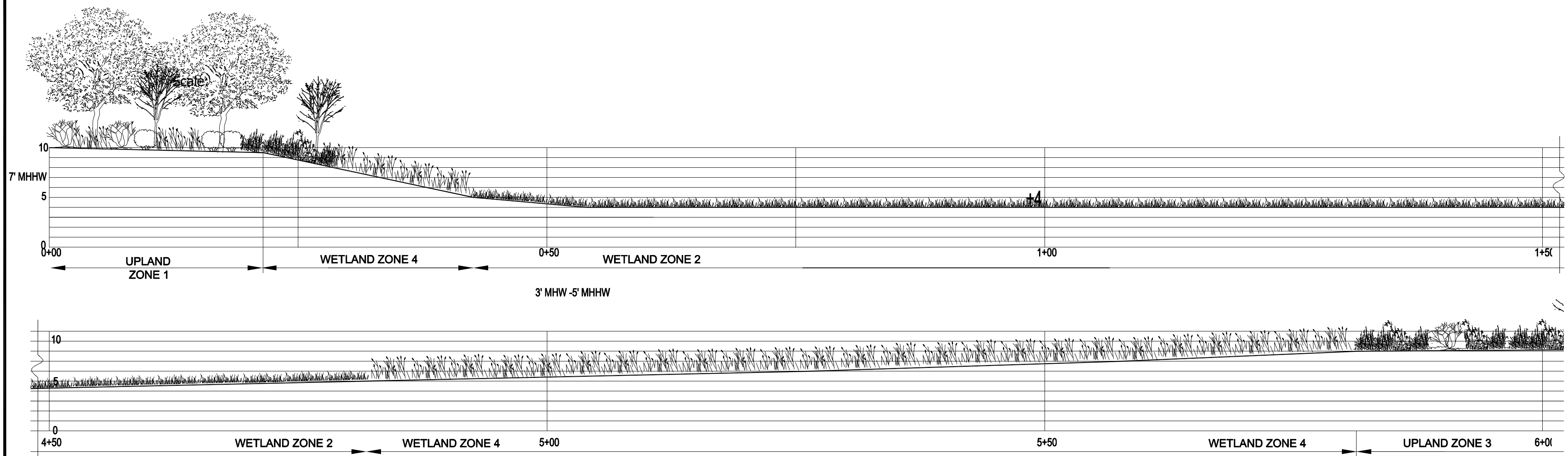
Prepared Under the Direction of:

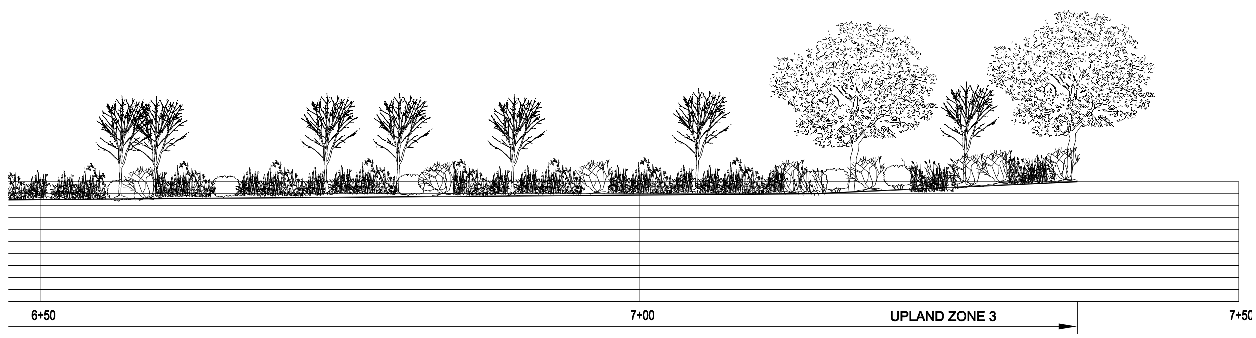
Job No. 591302
Revision: 11/11/2014
Date: 04/13/2011
Scale: 1"=160'

DUTRA HAYSTACK ASPHALT FACILITY
WETLANDS MITIGATION PLAN DESIGN
PLATE 2a

SONOMA CALIFORNIA

Plate 3 – Cross section

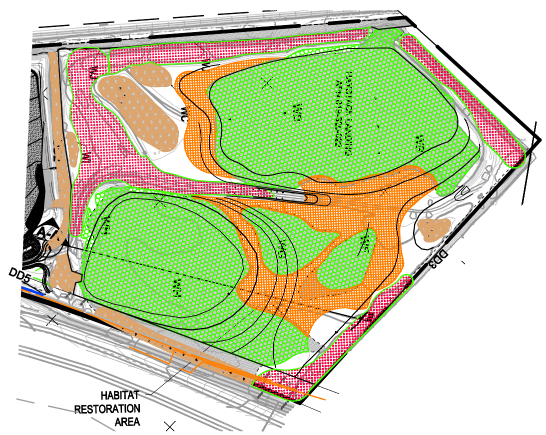




A-A TYPICAL CROSS SECTION SEASONALLY INUNDATED WETLAND
1"=10'

NOTE:
MHHW-MEAN HIGHER HIGH WATER
MHW-MEAN HIGH WATER

SEE PLATE 4A-4D FOR REVEGETATION PLAN AND PLANT SELECTION IN EACH ZONE



Rev	Date	Description	Checked
-			

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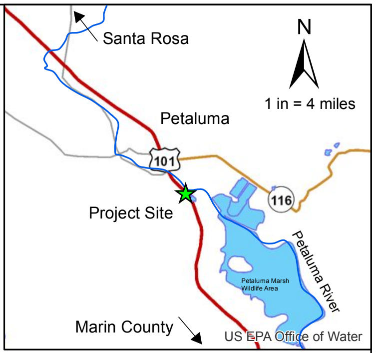
Prepared Under the Direction of:

Job No. 591302
Date: 04/13/2011
Revision: 05/15/2015
Scale: 1"=160'

DUTRA HAYSTACK ASPHALT FACILITY
CROSS SECTION OF MITIGATION AREA
PLATE 3
SONOMA CALIFORNIA

P:\05\591302\DWG_2012\Archive\Submittals\2015-04-24 RWQCB Corps- Resubmittal\RWQCB\2015-05 WMMP Report\PLATE 3 CROSS SECTION OF MITIGATION.dwg, 5/19/2015 - 10:25 AM, sperj, 1:1

Plates 4a-d – Wetland Mitigation Planting Plan and Details



1 inch = 183 feet

0 125 250 500

Feet

- Upland Chapparal Revegetation Zones
- Transitional Wetland Revegetation Zones
- Seasonal Wetland Revegetation Zones

The Center for Social and Environmental Stewardship

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Santa Rosa, CA 95401
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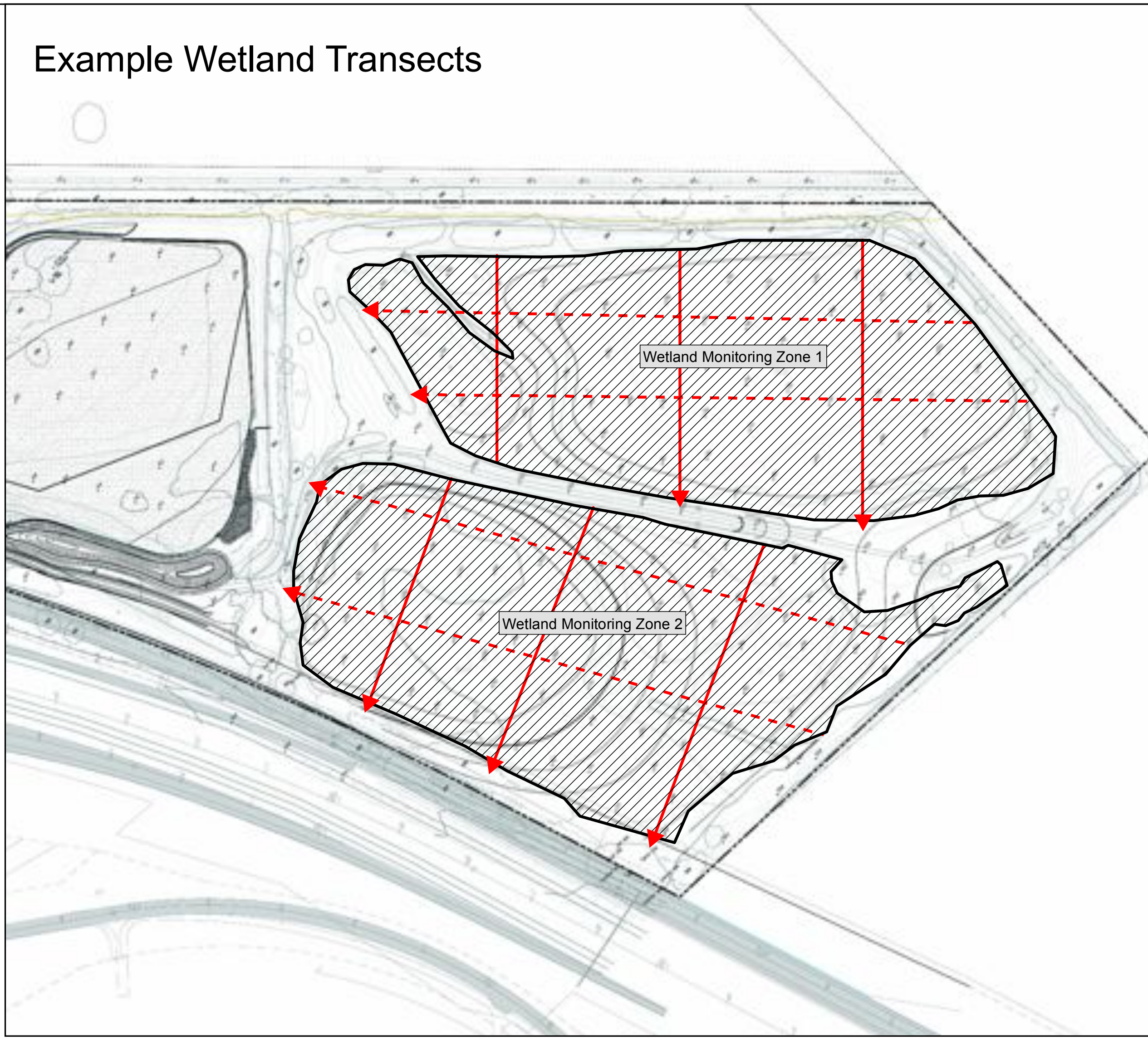
		REVISION	DATE	BY
DESIGN:	Anya Perron-Burdick			
DRAWN:	Kesley Setliff			
SCALE:	see above			
DATE:	5/14/15			
FILE:	Dutra_Haystack_5.14.15			

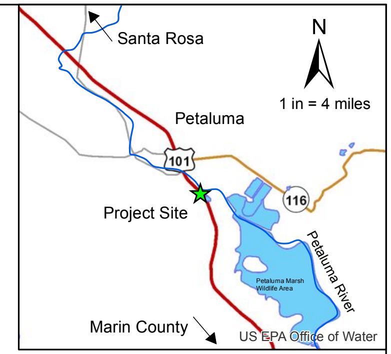
PRODUCED FOR:
Dutra Haystack Asphalt Plant Project
3355 Petaluma Boulevard South
Petaluma, CA

Seasonal Wetland and Upland Chaparral Revegetation Plan
Petaluma, Sonoma County, California

1 OF 4 SHEETS

Example Wetland Transects





North/South Transect

East/West Transect

1 inch = 183 feet

0 125 250 500

Feet

Wetland Monitoring Zones

The Center
for Social and Environmental Stewardship

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DESIGN:	Anya Perron-Burdick	REVISION	DATE	BY
DRAWN:	Kesley Setliff			
SCALE:	see above			
DATE:	5/14/15			
FILE:	Dutra_Haystack_5.14.15			

PRODUCED FOR:
Dutra Haystack Asphalt Plant Project
3355 Petaluma Boulevard South
Petaluma, CA

Seasonal Wetland and Upland Chaparral Revegetation Plan
Petaluma, Sonoma County, California

2
OF 4 SHEETS

NOTES:

The purpose of the Dutra Haystack Asphalt Plant Revegetation and Invasive Species Eradication Plan is to offset biotic impacts of the proposed Dutra Haystack Asphalt Plant Project (Joint Aquatic Resources Permit Application; Corps File No. 28104N) located along the Napa River on the Haystack Landing project site, 3355 Petaluma Boulevard South, Petaluma, Sonoma County, California. The construction of the proposed asphalt plant will result in the filling of approximately 1.37 acres of seasonal wetland and an existing mitigation wetland covering 0.47 acres. The proposed revegetation plan will include native plant installation and an invasive plant species control plan for a total of 10.95 acres of seasonal wetland and 3.13 acres of upland chaparral habitat. The purpose of the plant revegetation plan is to create and enhance the wetland community typical of the inner edge of the brackish/freshwater ecosystems of the bay and adjacent upland chaparral habitat. The proposed revegetation plan consists of seeding the wetland area with native fresh and brackish water wetland plant species and installing plugs of individual nursery plants using the same plant species palette of grasses, graminoids, and forbs. The upland chaparral habitat will be planted with individual container plants of woody species, and seeded with native grass mixture for erosion control.

__Revegetation Planting Plan:__

The planting zones outlined on Sheet 1 accurately depicts the boundary of the maximum area that will receive plantings and the number of plants proposed for installation in each zone. The Brackish Wetland Zones are not depicted Sheet 1. No individual plant or vegetation mat locations are shown. The final planting design will be developed in the field by a professional qualified in ecological restoration. Individual plant and vegetation mat locations shall be marked in the field with a color coded (to species) surveyor flag. Flags shall remain at each location after plant installation to aid in plant identification and survival monitoring.

__Seasonal Wetland Habitat Enhancement and Brackish Marsh Restoration Plan:__

__Wetland Seeding:__ Seasonal fresh water and brackish wetland seed mixture shall be hydro-seeded immediately following the completion of wetland construction and grading and once rainfall is likely to occur within one week following the application of the hydro-seed. The hydro-seed slurry shall consist of: hydro-mulch, a small amount of compost (to aid in moisture retention) and the wetland seed mixture. Prior to hydro-seeding, the soil shall be tested for available Nitrogen, Phosphorous, and Potassium (NPK). If soils are found to be low in available nutrients (NPK) than either an organic fertilizer or a slow release inorganic fertilizer shall be used and rates shall be kept low. A two-pass seeding method is recommended to assist with vegetation cover and the reducing recolonization of invasive non-native plant species. The first pass of hydro-seed shall include fast germinating, fast growing native grass and graminoids species (see Plant Species Table). The first pass may occur earlier in the season (November/December) depending on rainfall and ground water inundation from the Petaluma River's tidal flow. The second pass of wetland seed mixture shall include slower growing graminoids and forb plant species to increase plant species diversity and assist with barren areas not colonized by the first pass hydro-seed. The second pass shall be broadcast no later than two to four weeks after the first pass. Special consideration should be given to weather conditions after broadcast seeding is complete. Brackish/fresh water wetland species' seeds are generally smaller when compared to upland plant species and prone to drying out if proper moisture is not maintained during early stages of establishment. All seed shall be purchased on a pure-live-seed (PLS) basis. The selected wetland seed mixture should provide seed densities ranging from 160 to 210 seeds per square foot applied at the specified rate of 20 to 30 PLS lbs. per acre.
__Wetland Plant Installation:__ Live wetland plants grown in plugs (2" by 2") shall be planted clustered into groups of 5-6 plants on one foot spacing around the perimeter of a five foot diameter circle, (see Planting Details). Clusters shall be installed evenly throughout the zone. Pre-vegetated mats or blankets may be used as a plant installation method in lieu of or in addition to the traditional plug and cluster method. Pre-vegetated mats are ideal for situations where birds may pull out newly planted seedlings or a flood event dislodge seedling plugs. Pre-vegetated products need to be pre-grown to ensure that the seedlings get established before installing the mats.

__Upland Chaparral Habitat Enhancement Plan:__

__Upland Chaparral Seeding:__ The upland chaparral planting zones will be hand broadcast seeded and covered by straw mulch. Seeding and mulch will occur at the same time as the first pass of wetland hydro-seeding to limit disturbance, reduce invasive non-native plant species colonization, and control for erosion during heavy rains. The upland chaparral native grass seed mixture shall be applied at the specified rate of 30 PLS lbs. per acre.

__Upland Chaparral Plant Installation:__ The upland chaparral revegetation planting will be installed during the winter months, once rainfall has moistened the soil to a depth of 10 inches or greater. All upland chaparral plant installation shall consist primarily of woody plant species and shall be completed by March 31, dependent on weather and nursery stock availability.

Individual woody plants will receive protective hardware and surrounded by nine square feet of weed control fabric. Plant protection hardware shall consist of "collar and screen" or Tubex and Propex weed control fabric, (see Planting Details). Protective hardware will be installed to protect the newly planted seedlings from damaging herbivory associated with deer and other mammals in the area.

Plants in all zones will either be hand watered, installed with two dri-water tube and gel packs, or placed on an above ground temporary drip irrigation system. Hand watering and dri-water gel replacements will commence in April of the year following plant installation and through November of that same year. The drip irrigation system will be operational by April 15th. The plantings will require frequent irrigation during the first dry season after planting. During each irrigation visit, approximately one to two gallons of water will be applied immediately adjacent to the outside of the planting collar. Watering frequency during the first dry season will be in 10-20 days increments, depending on weather conditions. During the second dry season plants will be irrigated once every 3-4 weeks.

The plantings will be maintained for five years following plant installation. Each plant will have weeds removed from inside the planting collar and surrounding weed mat three times each year for five years following installation. Weed removal will be performed at least once in February, April and December each year.

Protective screens shall be opened during the later portion of the first growing season to allow the plant to grow beyond the confines of the screen enclosure. Open screens will appear as an open cylinder to provide continued browse protection to the lower portion of the plant. Screens, collars and weed control fabric will remain in place for five years following plant installation.

__Invasive Species Control Plan:__

An invasive plant species control program shall be implemented immediately following the completion of grading. Invasive species monitoring will be conducted at a minimum of three times annually, to be timed with common invasive plant species growth patterns: early winter or four weeks after the first substantial rainfall, early spring March or April to identify flowering heads, and late spring May or June to prevent seeds from spreading. During each monitoring event the monitor will walk the site in concentric circles. Invasive non-native plants will be identified and marked with a surveyor's flag/ tape or with a handheld GPS unit. The marking method chosen, flag or GPS, will be utilized based on whichever is most practical given site conditions, abundance, and distribution of the invasive non-native plant species. If the handheld GPS method is selected, then the data will be downloaded and recorded using a GIS computer software to create a map for field orientation.

Invasive non-native plants shall be controlled/eradicated by mechanically removing the plant by hand, brushcutting flowering-heads of annual non-native plant species, or using an herbicide approved for aquatic use, such as Glyphosate or Imazapyr, with the R-11 spreader activator nonionic surfactant.

If the invasive plant species population increases (beyond a quantity determined by a Botanist or Restoration Ecologist) in species diversity, distribution and/or abundance to be effectively monitored with a site 'walk-through', then during each of the three monitoring visits 50 one-meter square plots will be selected at random to assess changing invasive species vegetation cover. Adaptive management techniques will be adopted and implemented annually based on monitoring the abundance and distribution of previously treated invasive non-native plants and/or the identification of new species. Common adaptive management techniques utilized for seasonal wetland and upland chaparral habitat include: 1) targeting specific invasive non-native species for aggressiveness, invasiveness, ability to outcompete, or alter hydrologic conditions; or 2) focus on specific habitat locations (i.e. wetlands, or buffer ecotone regions), depending on the distribution and/or specific species of invasive non-native plant or native plant diversity goal for that habitat.

Invasive plant species common to the Haystack Landing project site include, but are not limited to: rye grass (*Lolium multiflorum*), bird's-foot trefoil (*Lotus corniculatus*), bristly ox-tongue (*Picris echioides*), Mediterranean barley (*Hordeum marinum* ssp. *Gussoneanum*), curly dock (Rumex crispus), black mustard (*Brassica nigra*), yellow star thistle (*Centaurea solstitialis*), winter vetch (*Cicia villosa* ssp. *Varia*) and pepperweed (*Lepidium latifolium)*, Italian thistle (*Carduus pycnocephalus*), vulpia (*Vulpia bromoides*), and geranium (*Geranium dissectum*).

__Annual Native Plant Monitoring:__

__Wetland Habitat - Sampling Methodology:__
1) Methodology for measuring aerial coverage within the plot:
The monitor will use the point intercept method for sampling wetland vegetation change over time. The point intercept data shall be collected annually in conjunction with the one-dimensional transect method. A point frame quadrat (1m x 1m) will be used to measure vegetation or abiotic ground cover that intersects at each cross-point. The formula to calculate the proportion (percent cover) of hits on each cross-point for a species of vegetation type or abiotic ground cover is: *Cover of Species A = (# of hits of Species A/total # of hits possible) x 100).* The species of vegetation will be a 'hit' if either the basal or foliar section of the plant is identified at the cross-point.

1) Methodology for selecting random plot locations:
Plot sampling shall be distributed throughout the two wetland zones. The point intercept data shall be collected annually using the random one-dimensional transect method. Each transect run and quadrat points collected along the transect shall be noted using a handheld GPS unit and mapped using GIS software. During the annual monitoring, the monitor shall establish at random two – north to south transects and three – east to west transects, in each of the two wetland zones, for a total of ten transects. Transects shall be parallel to one another by following a compass bearing. The starting point for the first transect shall be selected using a computer-based random number generator (1 to 120 for north to south transects and 1 to 215 for east to west transects). After the initial drawing, subsequent transects shall be spaced approximately 25-50 meters apart. Subsequent transects will be selected to move either north/south or east/west in the wetland zone by flipping a coin in the field. Point intercept data shall be collected at 20-meter intervals along the north to south transects and 10-meter intervals along the east to west transects, for a total of 43-50 sampling points distributed throughout the wetland zone (20-25 points along north to transects and 20-25 points along the east to west transects).

2) Method to determine sample size adequacy:
Limits of Standard Deviation of the mean shall be 15%. To determine sample size, the margin of error is set at 15%. Using the formula for calculating sample size: ME = (z) x (the square root of (p(1-p)/n)), where ME = 15%, z = 1.96, p = 0.5 and n = sample size, the sample size is calculated at 43. With a sample size of 43 and a p value of 0.5 the Standard Error is calculated at 8%.

3) Statistical methods that will be used to determine changes in vegetation cover:
Percent cover of the vegetation will be analyzed using repeated measures ANOVA of power-transformed data (factors: transect direction, species).

4) Target Percent Areal Cover of Wetland Indicator Species:
After installation and during the growth of wetland plants, tiered success criteria shall be adopted to evaluate wetland performance during the 5 year monitoring and maintenance program. The wetland zones shave have a native plant vegetative cover of 80% or greater to meet success criteria at the end of the five year monitoring period.

Tiered Success Criteria Scale:

1. Year 1 – 10 percent
2. Year 2 – 20 percent
3. Year 3 – 40 percent
4. Year 4 – 60 percent
5. Year 5 – 80 percent

__Upland Chaparral Habitat:__ All plantings will have a minimum of 80% survival at the end of five years. The monitoring program for the upland chaparral plantings will commence the summer after planting is implemented. Monitoring of all the plantings will occur annually for a period of five years. If the annual survival of plants falls below 80%, then the permit holder will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, and any other practices, to achieve these requirements. Replacement plants shall be monitored with the same survival and growth requirements specified in this plan for five years after planting.

Annual monitoring reports will include the individual survival and overall vigor of both tree and shrub species. The number by species of plants replaced, an overview of the revegetation effort, and the method used to assess these parameters shall also be included. Photos from designated photo locations will also be included. Reports will be submitted to Lucy Macmillan by December 31 after each of the five

The Center
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		REVISION	DATE	BY
DESIGN:	Anya Perron-Burdick			
DRAWN:	Kesley Setliff			
SCALE:	see above			
DATE:	5/14/15			
FILE:	Dutra_Haystack_5.14.15			

PRODUCED FOR:
Dutra Haystack Asphalt Plant Project
3355 Petaluma Boulevard South
Petaluma, CA

Seasonal Wetland and Upland Chaparral Revegetation Plan
Petaluma, Sonoma County, California

Plant Table - Dutra Haystack Wetland and Upland Chapparal Revegetation Plan

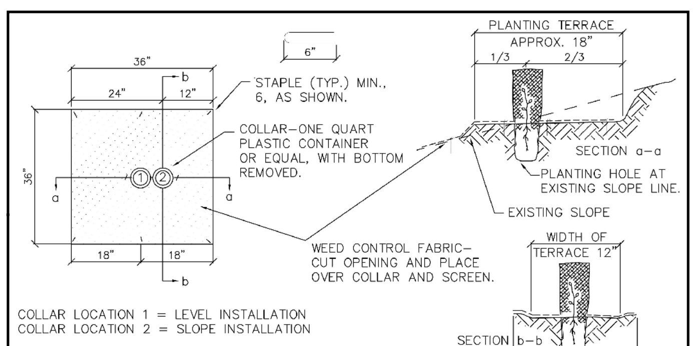
Scientific Name	Common Name	Number of Plants/Vegetated Mats									TOTAL	Container Size	Spacing (F.O.C.)
		UPLAND ZONES			WETLAND ZONES								
	Zones	Zone 1	Zone 2	Zone 3	Zone 1a	Zone 1b	Zone 2	Zone 3a	Zone 3b	Zone 4			
	Zones Sq. Ft.	92,160	18,580	15,650	178,110	10,125	190,200	59,010	7,112	43,575	**614,522**		
SHRUBS													
Arbutus mensiesii	pacific madrone	160	40	30							**230**	DP	10'
Baccharis pilularis	coyote bush	425	75	65							**565**	TB	10'
Grindelia stricta		225	40	35							**300**	DP	10'
Heteromeles arbutifolia	toyon	110	30	25							**165**	TB	10'
Rhamnus californica	coffeeberry	110	30	25							**165**	TB	10'
Rosa californica	California rose	410	75	65							**550**	TB	10'
	TOTAL SHRUBS:	**1,440**	**290**	**245**							**1,975**		
WETLAND PLUGS													
Upland Seasonal Wetland													
Aster chilensis	California aster							900	300	700	**1,900**	PL	1'
Deschampsia elongata	slender hairgrass							1,100	400	900	**2,400**	PL	1'
Euthamia occidentalis	goldenrod							1,200	120	700	**2,020**	PL	1'
Hordeum brachyantherum	California meadow-barley							1,200	200	900	**2,300**	PL	1'
Leymus glaucus	blue wild-rye							1,500	600	1,400	**3,500**	PL	1'
Leymus triticoides	creeping wild-rye							1,500	600	1,400	**3,500**	PL	1'
Emergent Wetland Seed													
Carex praegracilis	slender sedge				2,300	300	2,650				**5,250**	PL	1'
Cyperus eragrostis	nutsedge				2,500	400	3,000				**5,900**	PL	1'
Distichlis spicata	saltgrass				1,400	120	1,600				**3,120**	PL	1'
Eleocharis macrostachya	spike rush				2,300	200	2,700				**5,200**	PL	1'
Juncus balticus	baltic rush				2,450	200	2,400				**5,050**	PL	1'
Juncus patens	spreading rush				2,450	200	2,400				**5,050**	PL	1'
Salicornia virginca	pickleweed				1,400	120	1,400				**2,920**	PL	1'
	TOTAL PLUGS				**14,800**	**1,540**	**16,150**	**7,400**	**2,220**	**6,000**	**48,110**		
EMERGENT VEGETATED MATS*													
Emergent Wetland Vegetated Mats					840		904				**1,744**	mats	6'-8'
	TOTAL MATS:										**1,744**		
SEED MIX													
Upland Chapparal													
Bromus carinatus	California brome	8	3	2							**13**	lb/acre	
Euthamia occidentalis	goldenrod	8	3	2							**13**	lb/acre	
Festuca ruba	red fescue	13	3	3							**19**	lb/acre	
Hordeum brachyantherum	California meadow-barley	15	2	2							**19**	lb/acre	
Leymus glaucus	blue wild-rye	19	5	4							**28**	lb/acre	
Upland Seasonal Wetland													
Aster chilensis	California aster							5	1	5	**11**	lb/acre	
Deschampsia elongata	slender hairgrass							8	1	6	**15**	lb/acre	
Euthamia occidentalis	goldenrod							4	1	3	**8**	lb/acre	
Hordeum brachyantherum	California meadow-barley							7	1	5	**13**	lb/acre	
Leymus glaucus	blue wild-rye							8	1	5	**14**	lb/acre	
Leymus triticoides	creeping wild-rye							8	1	5	**14**	lb/acre	
Emergent Wetland Seed													
Carex praegracilis	slender sedge				18	1.3	20				**39**	lb/acre	
Cyperus eragrostis	nutsedge				26	1.5	25				**52**	lb/acre	
Distichlis spicata	saltgrass				12	1.0	13				**26**	lb/acre	
Eleocharis macrostachya	spike rush				22	1.5	24				**48**	lb/acre	
Juncus balticus	baltic rush				21	1.5	23				**46**	lb/acre	
Juncus patens	spreading rush				21	1.3	23				**45**	lb/acre	
Salicornia virginca	pickleweed				12	1.0	13				**26**	lb/acre	
	TOTAL LBS/ACRE:	**63**	**16**	**13**	**133**	**9**	**141**	**41**	**5**	**29**	**449**		

*Vegetated Mats are comprised of the same specis as Emergent Wetland plugs and seed

Plant Table - Dutra Haystack Brackish Wetland Revegetation Plan

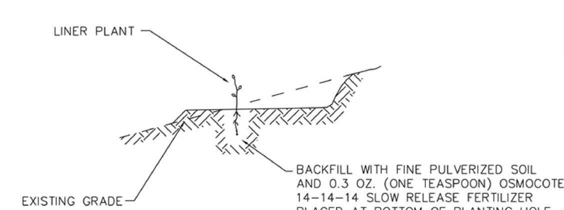
Scientific Name	Common Name	Number of Plants/Vegetated Mats		TOTAL	Container Size	Spacing (F.O.C.)
		BRACKISH WETLAND ZONES				
	Zones	Zone 1	Zone 2			
	Zones Sq. Ft.	436	436	**872**		
WETLAND PLUGS						
Emergent Wetland Seed						
Distichlis spicata	saltgrass	15	15	**30**	PL	1'
Frankenia salina	alkali heath	10	10	**20**	PL	1'
Jaumea carnosa	marsh jaumea	15	10	**25**	PL	1'
Salicornia pacifica	perennial pickleweed	10	15	**25**	PL	1'
Scirpus martimus	alkali bulrush	15	15	**30**	PL	1'
	TOTAL PLUGS	**65**	**65**	**100**		
EMERGENT VEGETATED MATS*						
Emergent Wetland Vegetated Mats		9	9	**18**	mats	6'-8'
	TOTAL MATS:	**9**	**9**	**18**		
SEED MIX						
Emergent Wetland Seed						
Distichlis spicata	saltgrass	0.1	0.1	**0.2**	lb/acre	
Frankenia salina	alkali heath	0.1	0.1	**0.2**	lb/acre	
Jaumea carnosa	marsh jaumea	0.1	0.1	**0.2**	lb/acre	
Salicornia pacifica	perennial pickleweed	0.1	0.1	**0.2**	lb/acre	
Scirpus martimus	alkali bulrush	0.1	0.1	**0.2**	lb/acre	
	TOTAL LBS/ACRE:	**1**	**1**	**1**		

*Vegetated Mats are comprised of the same specis as Emergent Wetland plugs and seed



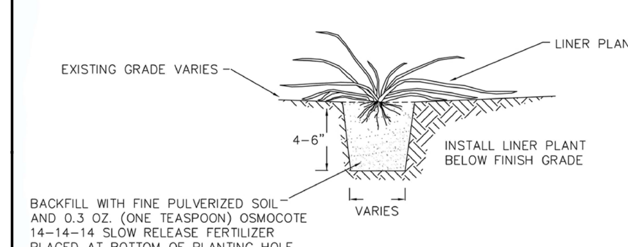
PLANTING INSTALLATION DETAIL

NOT TO SCALE



NO HARDWARE INSTALLATION DETAIL

NOT TO SCALE



GRASS LINER INSTALLATION DETAIL

NOT TO SCALE

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DESIGN:	Anya Perron-Burdick	REVISION	DATE	BY
DRAWN:	Kesley Setliff			
SCALE:	see above			
DATE:	5/14/15			
FILE:	Dutra_Haystack_5.14.15			

PRODUCED FOR:
Dutra Haystack Asphalt Plant Project
3355 Petaluma Boulevard South
Petaluma, CA

Seasonal Wetland and Upland Chaparral Revegetation Plan
Petaluma, Sonoma County, California

Appendix A - Geotechnical Investigation Haystack Landing Wetlands Restoration, Petaluma, California

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GEOTECHNICAL INVESTIGATION
HAYSTACK LANDING WETLANDS RESTORATION
PETALUMA, CALIFORNIA

October 1, 2004

Project 1139.01

Prepared For:
Ms. Lucy Macmillan
28 Bernard Street, Suite 4
Mill Valley, California 94941

CERTIFICATION

This document is an instrument of service, prepared by or under the direction of the undersigned professionals, in accordance with the current ordinary standard of care. The service specifically excludes the investigation of radon, asbestos or other hazardous materials. The document is for the sole use of the client and consultants on this project. No other use is authorized. If the project changes, or more than two years have passed since issuance of this report, the findings and recommendations must be reviewed by the undersigned.

MILLER PACIFIC ENGINEERING GROUP
(a California corporation)

REVIEWED BY:

Mike Morisoli
Geotechnical Engineer No. 2541
(Expires 12/31/04)

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GEOTECHNICAL INVESTIGATION
HAYSTACK LANDING WETLANDS RESTORATION
PETALUMA, CALIFORNIA

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GEOTECHNICAL INVESTIGATION
HAYSTACK LANDING WETLANDS RESTORATION
PETALUMA, CALIFORNIA

I. INTRODUCTION

This report presents the results of our geotechnical investigation for the planned restoration of wetlands on the southern portion of the Haystack property located in Petaluma, California. The project site location is shown on Figure 1. The wetlands restoration will include excavation of sediments that overlay the Bay Mud found at the site.

This report represents the completion of our Phase 1 services for the wetlands restoration as described in our proposal dated March 5, 2004. The scope of our Phase 1 services includes the following geotechnical services:

- Perform a subsurface exploration with soil borings;
- Laboratory testing to evaluate the engineering properties of the sediments;
- Evaluate settlement potential from placement of new fill loads;
- Develop criteria for site grading,
- Preparation of this geotechnical investigation report

Additional geotechnical services for the wetlands restoration project may include supplemental consultation as project planning moves forward. This consultation will be provided as part of our Phase 2 services on the project.

This report is intended for the exclusive use of Lucy Macmillan and the project design team for this project and site. No other use is authorized without the written consent of Miller Pacific Engineering Group.

II. PROJECT DESCRIPTION

The proposed wetlands restoration will occur on approximately 11 acres in the southern portion of the 37-acre Haystack site. Based on discussions with others on the project team, we understand the 11 acres that will be restored were filled with wash sediments between 1968 and 1990 when the nearby quarry was washing aggregates. The clays, silts and sands deposited as part of the washing operation will be excavated and, as appropriate, topsoil from the excavated areas may be stockpiled for use in the wetland restoration project.

The Owner of the project site is Pagliaio Ventures, L.L.C.

III. SITE CONDITIONS

A. Regional Geology

The site is located within the Coast Range Geomorphic Province of California. The regional bedrock geology consists of complexly folded, faulted, sheared, and altered sedimentary, igneous, and metamorphic rock of the Jurassic-Cretaceous age (65-190 million years ago) Franciscan Complex.

Northwest-southeast trending mountain ridges and intervening valleys that were formed from tectonic activity between the North American Plate and the Pacific Plate characterize the regional topography. Extensive faulting during the Pliocene Age (1.8-7 million years ago) formed the uneven depression that is now the San Francisco Bay. More recent tectonic activity is concentrated along the San Andreas Fault zone, a complex group of generally parallel faults.

For the last 15,000 years, the sea level has continually risen (due to melting of glaciers from the Wisconsin glaciation) and flooded the lower topography. For the last 8,000 years, silt and clay particles carried in suspension in floodwater have been deposited in the San Francisco Bay to form the highly compressible "Bay Mud." This process continues today.

Regional geologic mapping by Huffman and Armstrong indicates that the project site is located on an alluvial deposit (Qal). Alluvial materials are deposited by rivers and generally consist layers of varying thickness and of any combination of sands, silts, and clays. Young Bay Mud (Qbm) is mapped adjacent to the site. Bay Mud is a soft, highly compressible marine deposit with fine intermittent silt seams. Intermittent lenses of eolian (wind deposited) sands and organics are also found within Young Bay Mud deposits.

B. Surface Conditions

The northern half (+/-) of the 37-acre project site is used as an aggregate processing area. Currently, the site is lightly vegetated with brush and shrubs. A small natural hill with a peak elevation of about +32.0-feet is located on the northern most portion of the property. The existing structures atop of the hill are to be removed or relocated. The remainder of the site gently slopes to the south from an elevation of +15.0-feet to about +5.0-feet.

The 11-acres at the southern end of the property, which are the focus of the wetlands restoration project, slope gently to the southeast. Embankment fill berms, up to about 8-feet in height, separate the area into "detention basins". Topography and the "basins" are shown on Figure 2.

C. Field Exploration and Laboratory Testing

Our subsurface exploration was performed on May 21, 2004 and consisted of drilling 6 soil borings utilizing truck-mounted drilling equipment with 6-inch hollow stem continuous flight augers. Borings 1 though 6 were drilled for the wetland restoration phase of the project. The locations of our borings are shown on Figure 2.

The soils encountered were logged and select samples were obtained for laboratory testing. The subsurface exploration program is discussed in more detail in Appendix A. A Soil Classification Chart and Rock Classification Chart are shown on Figures A-1 and A-2, respectively. The boring logs are presented on Figures A-3 through A-10 of Appendix A.

Laboratory testing of relatively "undisturbed" samples from the exploratory borings included moisture content, dry density, plasticity, compaction and sieve analysis. The results of the moisture content and dry density tests are presented on the boring logs. The results of the plasticity testing are presented on Figure A-11 and the compaction test results are presented on Figure A-12. The sieve analysis test results are presented on Figure A-13. The laboratory testing program is discussed in more detail in Appendix A. We also performed salinity testing on bulk samples that were provided by Lucy Macmillan. The salinity test results are included in Appendix B.

The purpose of the exploration and laboratory testing was to determine the approximate depths of the wash sediments/fill soils over the bay mud to determine the approximate depth of material that would need to be excavated for the restoration project.

D. Subsurface Conditions and Groundwater

The subsurface conditions are consistent with the mapped geology. The southern portion of the site, where the wetlands restoration will occur, consists primarily of seasonal wetland marsh areas. Subsurface conditions consist of a 6.5 to 11.0-feet of variable artificial fill/wash sediments. The fill materials encountered consisted of soft to very stiff, high to low plasticity sandy and silty clays and dense clayey sands. Soft, highly compressible Bay Mud varying in thickness from 8.0 to 13.5-feet underlies the fill. Old alluvial deposits underlie the Bay Mud. These deposits consist of very dense sandy clays and stiff, medium to highly plastic, sandy silts and clays.

Utilizing the data from our subsurface exploration and a late 1800's topographic survey of the adjacent marshes to the Petaluma River in the vicinity of the project site, we interpolated a contour map indicating the varying thickness of Bay Mud. The Bay Mud thickness contours are shown on Figure 2.

The lowest groundwater levels (late summer and fall) are expected to be near the bay mud surface elevation or slightly higher.

IV. GEOLOGIC HAZARDS

A. General

This section identifies potential geologic hazards at the property site, their significant adverse impacts, and recommended mitigation measures. The significant geologic hazards at the project site as they relate to the wetlands restoration are judged to be erosion, expansive soils and slope stability. Other geologic hazards, such as seismicity, settlement, seismic induced ground settlement, lurching and ground cracking and seiche and tsunami are not considered significant for the project A brief description of geologic hazards and mitigation measures is listed in the following sections.

B. Erosion

Sandy soils on moderate slopes or clayey soils on steep slopes are susceptible to erosion when exposed to concentrated surface water flow. The potential for erosion is increased when established vegetation is disturbed or removed. The site is relatively level with little relief thus the potential for significant erosion at the site is minimal.

Erosion Mitigation Measures - The project Civil Engineer, in coordination with project hydrologists, should design the site drainage to collect surface water into a storm drain system (if appropriate) and discharge water at an appropriate location. A revegetation plan for the reclaimed wetlands and surrounding areas will be developed by team members to achieve restoration goals as they are developed. Re-establishing vegetation on disturbed upland areas will also be required to minimize erosion. Erosion control measures during and after construction should conform to the most recent version of the Erosion and Sediment Control Field Manual (California Regional Water Quality Control Board, 2002).

C. Expansive Soil

During our site reconnaissance, we did not observe indications, such as ground cracking, that the surface soils are highly expansive. Plasticity testing of the wash sediments include liquid limits ranging from 43 to 56 and plasticity indices ranging from 7 to 28, suggesting low to moderate expansive potential. The Bay Mud that underlies the fill has a moderate to high expansion potential. Expansive silts and clays, are typically weaker and therefore can be more susceptible to slope instability. Expansive soils can also be detrimental to structures and flatwork during periods of fluctuating soil moisture content, although we do not anticipate "hard" surfacing such as concrete slabs-on-grade will be part of the restoration work.

D. Slope Stability

The project site consists of nearly flat slopes and traditional slope stability is not a geologic hazard. However, due to the presence of soft compressible Bay Mud, placement of heavy stockpile loads could result in deep rotational failures within the Bay Mud.

Mitigation will not be required for placing a few feet of fill excavated from the wetland restoration area. Cut and fill slopes within the restoration area should be designed as discussed in Section V of this report.

V. DISCUSSION AND RECOMMENDATIONS

A. General

Based on the results of our site investigation and laboratory testing, we conclude excavation of the wash sediments and restoration of the wetlands is feasible from a geotechnical perspective. The sediments will be variable in nature and will be sandier in some areas and more clayey in others.

The primary geotechnical issues with the wetlands restoration will likely be potentially saturated/wet soils that may limit the use of rubber-tired excavation equipment and stability of cut slopes associated with the excavation.

B. Settlement

Settlement, for the purpose of the wetlands restoration, could result in adverse drainage patterns or water ponding if the surfaces of new fills are not sloped adequately to drain. We recommend sloping any new fill surfaces (that are sensitive to standing water) at a minimum of 2% in the direction of deepening Bay Mud as shown on Figure 2. Therefore, the surface of the fill should slope so that surface drainage is directed toward the east. As settlement occurs, the 2% slope should theoretically increase, but variations in the Bay Mud thickness and compressibility could result in differential settlements. Gravity-flow pipes, such as sewers or storm drains (if they are needed/incorporated into the wetlands restoration) should also be sloped to anticipate the effects of long-term settlement.

Areas where Bay Mud is not present will experience minor to no settlements. Likewise, "unloading" the Bay Mud by removing the wash sediments will not result in settlements of the excavated surface. Differential settlements can be expected in transition areas where fill is placed between Bay Mud and stiff ground areas.

C. Slope Stability

Slope stability, as it relates to the wetlands reclamation, should be limited to design of new cut slopes, as we do not anticipate significant fill will be placed for the restoration work. These cut slopes are anticipated to be only a few feet in height, but could be subjected to tidal and small wave action, resulting in decreased performance. Recommendations for cut and fill slopes is included in the following section of this report.

D. Site Grading

1. Excavation. Site preparation should include scraping grass, weeds and their root crowns from the material to be excavated. The anticipated depth of this clearing is only a few inches, but deeper grubbing may be required where heavier brush is located or where organic materials have collected in deeper layers over the years. These strippings should be off-hauled or stockpiled for re-use in the wetlands restoration project as specified by team members

Excavation of the soft and loose sediments will be possible with conventional excavation equipment, i.e. excavators and scrapers, but depending on the time of year, soils may be wet and rubber-tired equipment could sink/become stuck. As the excavations approach the soft bay mud, rubber-tired equipment will have difficulty operating regardless of the season.

2. Fill Placement. Fills, if placed as part of the wetlands restoration, should typically be placed on a subgrade that is firm and unyielding and has been cleared of organic material. For "landscaping" type fills (where settlement is not an concern), soils should generally be moisture conditioned to near optimum and compacted to at least 85% relative compaction. Relative compaction, maximum dry density and optimum moisture content of fill materials should be determined in accordance with ASTM Test Method D 1557, "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using a 10-lb. Rammer and 18-in. Drop."

If fills will be placed on sloping ground of if fills deeper than about 5 feet are planned, we should be consulted regarding the stability and settlement issues that could impact the project.

3. Cut and Fill Slope Construction. Cut slopes will occur for the wetlands restoration and will likely be constructed into relatively soft and/or loose sediments. These cuts will be relatively shallow and should therefore perform reasonably well at steeper inclinations. Slopes of 2:1 (horizontal:vertical) will likely perform adequately, but the risk of erosion and minor sloughing is increased in the soft soils. We instead recommend flattening the slopes to 3:1 and revegetating to reduce the risk of erosion of surficial sloughing.

Where small fill slopes are planned, horizontal benching into firm materials will be required. For small fills (i.e. less than 4 feet high), subdrainage will probably not be required, but we should review the location and details of the fill areas to verify that subdrainage is not required. The keyway depths, benching and need for and location of subdrains should be verified during construction by the project Geotechnical Engineer. Maximum inclination of fill slopes should be 2:1 (horizontal:vertical). For small fills that could potentially be placed as part of the restoration, we anticipate the fill may be placed directly on a subgrade that has been stripped of organic material and compacted as previously described.

E. Drying Wet Soils

Depending on when construction occurs, excavated sediments may be well above optimum moisture content and may not be suitable for placement as structural fill. Drying and/or dewatering of these soils may therefore be required. The drying could be as simple as scarifying or disking the surface layer and allowing natural air-drying to occur. Wet soils could also be blended with dryer soils to reduce moisture contents. Sandy soils will be easier to dewater and dry than clayey soils.

Soils could also be lime- or cement-treated to reduce moisture contents and to decrease the expansive potential of clayey soils. Lime would be the preferred additive in clayey soils and cement would be preferred in sandier soils. The amount of lime or cement required to dry the soils would be relatively small and would be determined when the beginning moisture contents are known.

VI. ADDITIONAL GEOTECHNICAL SERVICES

We will be available during the design and permitting process to respond the geotechnical issues and provide supplemental consultation. As the construction plans near completion, we can review them, if requested, to verify that the intent of our geotechnical recommendations has been incorporated.

During construction, we need to observe placement of structural fill materials, but this will most likely be performed as part of our services for the recycling/asphalt plant.

LIST OF REFERENCES

American Society for Testing and Materials, "2000 Annual book of ASTM Standards, Section 4, Construction, Volume 4.08, Soil and Rock; Dimension Stone; Geosynthetics," ASTM, Philadelphia, 2000.

Bonaparte, M. and Mitchell, J.K. (1979), "The Properties of San Francisco Bay mud at Hamilton Air Force Base, California," Department of Civil Engineering Institute of Transportation and Traffic Engineering, University of California, Berkeley, April 1979.

California Building Code (2001 Ed.), California Building Standards Commission, Sacramento, California, California Code of Regulations, Title 24, Part 2, Volume 2, Chapter 16.

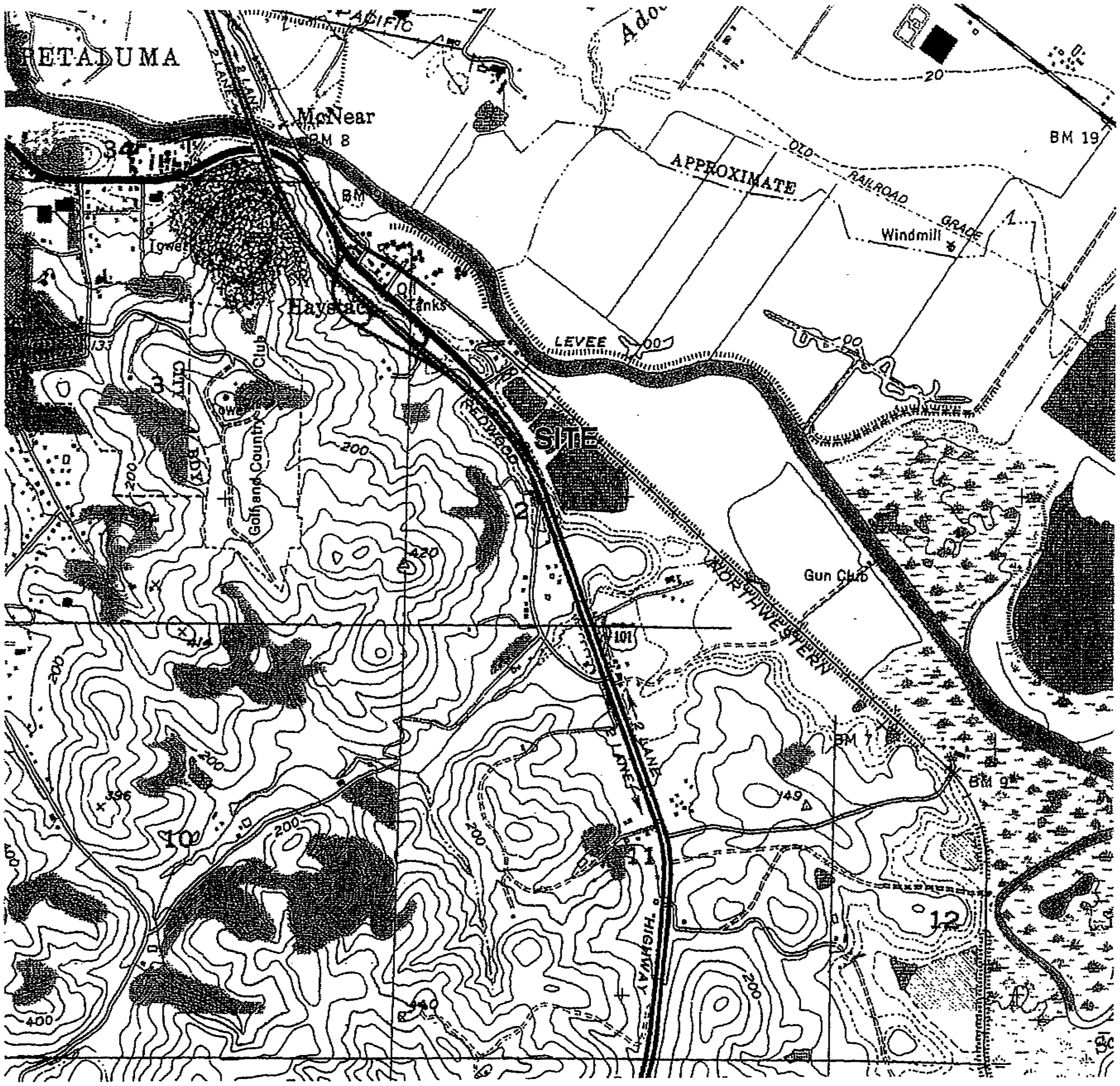
California Department of Conservation, Division of Mines and Geology, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada to be Used with the 1997 Uniform Building Code, International Conference of Building Officials, Whittier, California, February 1998.

California Department of Conservation, Division of Mines and Geology, "Geology for Planning: in Sonoma County, California," Special Report 120, 1980 (reprinted 2000).

California Department of Transportation (Caltrans), Standard Specifications, 2000.

Uniform Building Code, 1997 Edition, International Conference of Building Officials, Whittier, California.

U.S. Geological Survey web site. 04/02/2004. http://neic.usgs.gov/neis/epic/epic_circ.html.



SITE LOCATION

SCALE

0 1000 2000 4000 FEET

0 500 1000 METERS

NORTH

REFERENCE: DeLorme 3D TopoQuads, 1999

FILE: Site Map.dwg

Miller Pacific
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SITE LOCATION MAP
Haystack Landing Wetlands Restoration
Petaluma, California

Project No.	1139.01	Date	8/12/04	Approved By:	[signature]	Figure 1

APPENDIX A
SUBSURFACE EXPLORATION AND LABORATORY TESTING

1.0 Subsurface Exploration

We explored the subsurface conditions by drilling 6 soil borings utilizing a truck mounted drilling equipment with 6-inch hollow stem continuous flight augers on May 21, 2004. The locations of our borings are shown on Figure 2.

The soils encountered were logged and identified in general accordance with ASTM Standard D 2487, "Field Identification and Description of Soils (Visual-Manual Procedure)." This standard is briefly explained on Figures A-1 and A-2, Soil Classification Chart and Rock Classification Chart, respectively. The exploratory boring logs are presented on Figures A-3 to A-10.

We obtained “undisturbed” samples using a 3-inch diameter, split-barrel California sampler with 2.5 by 6-inch brass tube liners. The 2-inch Standard Penetration Test (SPT) split-barrel sampler was intermittently used to aid in soil property indexing and identification. The samplers were driven with a mechanical trip hammer. The number of blows required to drive the samplers 18 inches was recorded and is reported on the boring logs as blows per foot for the last 12 inches of driving. We also utilized a Shelby tube sampler to obtain less disturbed samples of Bay Mud. Shelby tubes are thin walled brass tubes 2.5-inches in diameter and 18-inches long that are slowly pressed into the Bay Mud under the hydraulic pressure of the drill rig. The samples obtained were examined in the field, sealed to prevent moisture loss, and transported to our laboratory.

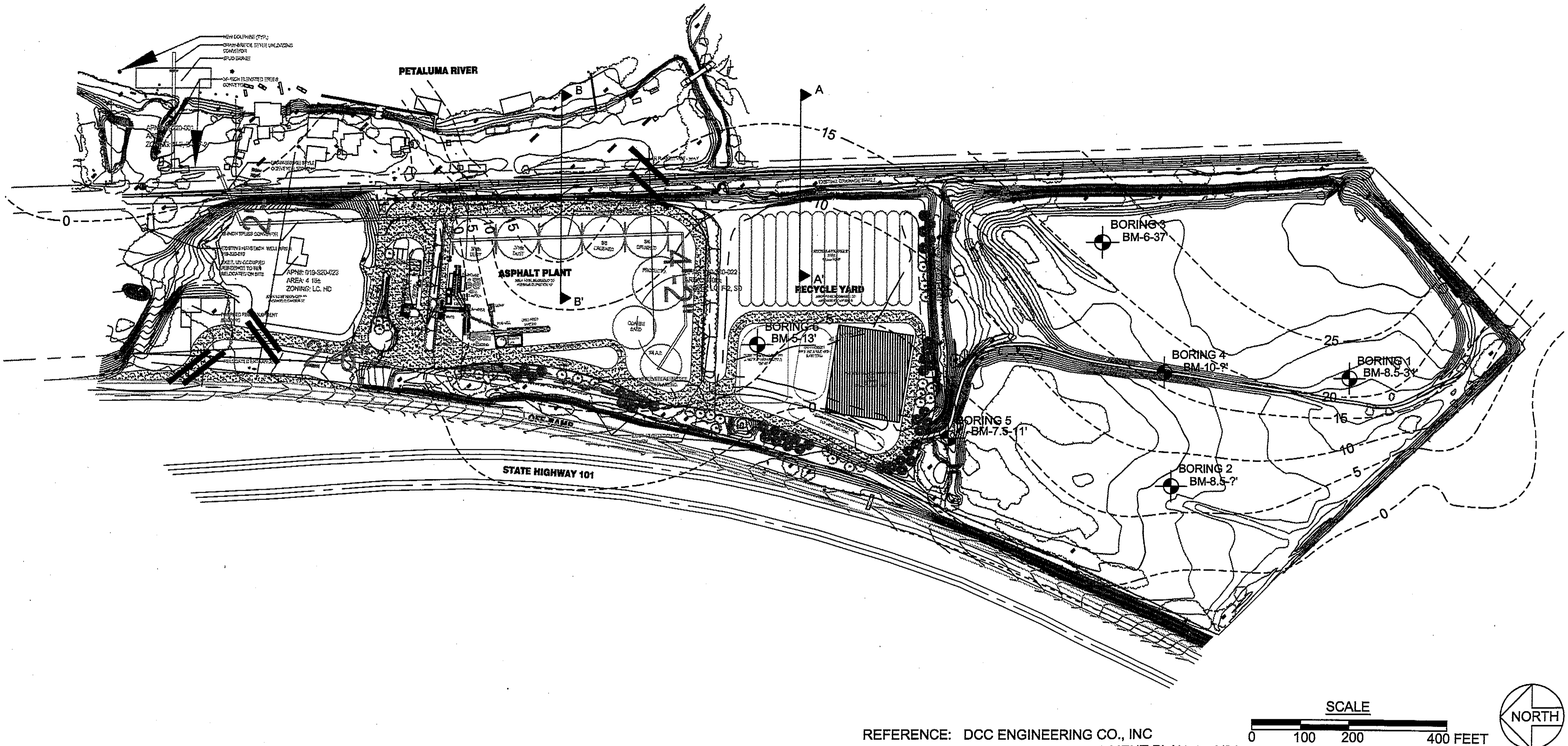
2.0 Laboratory Testing

We conducted laboratory tests on selected intact samples to verify field identifications and to evaluate engineering properties. The following laboratory tests were conducted in accordance with the ASTM standard test method cited:

- Laboratory Compaction Characteristics of Soil Using Modified Effort, ASTM D-1557;
- Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D 4318.
- Particle-Size Analysis of Soils, ASTM D 422; and
- Laboratory Determination of Water (Moisture Content) of Soil, Rock, and Soil-Aggregate Mixtures, ASTM D 2216;
- Density of Soil in Place by the Drive-Cylinder Method, ASTM D 2937; and

The moisture content and dry density test results are shown on the exploratory boring logs, Figures A-2 and A-10. The results of our plasticity testing are summarized on Figure A-11 and the compaction test results are on Figure A-12. Particle size (sieve) test results are summarized on Figure A-13.

The boring logs, description of soils encountered and the laboratory test data reflect conditions only at the location of the boring explorations and soil borings at the time they were excavated or retrieved. Conditions may differ at other locations and may change with the passage of time due to a variety of causes including natural weathering, climate and changes in surface and subsurface drainage.



REFERENCE: DCC ENGINEERING CO., INC
PROPOSED DEVELOPMENT PLAN, 2/20/04

FILE: 1139.01SP.dwg

LEGEND

- BORING PERFORMED BY MPEG
- BAY MUD THICKNESS CONTOUR

Miller Pacific
ENGINEERING GROUP

SITE PLAN
Haystack Landing Wetlands Restoration
Petaluma, California

Figure 2

Project No. 1139.01 | Date 8/18/04 | Approved By: [signature]

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS		SYMBOL	DESCRIPTION
COARSE GRAINED SOILS over 50% sand and gravel	CLEAN GRAVEL	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
	GRAVEL with fines	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	CLEAN SAND	SW	Well-graded sands or gravely sands, little or no fines
		SP	Poorly-graded sands or gravely sands, little or no fines
	SAND with fines	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS over 50% silt and clay	SILT AND CLAY liquid limit <50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	SILT AND CLAY liquid limit >50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT	Peat, muck, and other highly organic soils
ROCK			Undifferentiated as to type or composition

KEY TO BORING AND TEST PIT SYMBOLS

CLASSIFICATION TESTS

AL	ATTERBERG LIMITS TEST
SA	SIEVE ANALYSIS
HYD	HYDROMETER ANALYSIS
P200	PERCENT PASSING NO. 200 SIEVE
P4	PERCENT PASSING NO. 4 SIEVE

STRENGTH TESTS

TV	FIELD TORVANE (UNDRAINED SHEAR)
UC	LABORATORY UNCONFINED COMPRESSION
TXCU	CONSOLIDATED UNDRAINED TRIAXIAL
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL
	UC, CU, UU = 1/2 Deviator Stress

SAMPLER TYPE

UNDISTURBED CORE SAMPLE: MODIFIED CALIFORNIA OR HYDRAULIC PISTON SAMPLE

STANDARD PENETRATION TEST SAMPLE

X DISTURBED OR BULK SAMPLE

ROCK OR CORE SAMPLE

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the location and time of exploration. Subsurface rock, soil and water conditions may differ in locations and with the passage of time. Lines defining interface between differing soil or rock description are approximate and may indicate a gradual transition.

FILE: 1139.01SE.dwg

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SOIL CLASSIFICATION CHART
Haystack Landing Wetlands Restoration
Petaluma, California

A-1

Project No. 1139.01 | Date 8/18/04 | Approved By: [signature] | Figure

FRACTURING AND BEDDING

Fracture Classification	Spacing	Bedding Classification
Crushed	less than 3/4 inch	Laminated
Intensely fractured	3/4 to 2-1/2 inches	Very thinly bedded
Closely fractured	2-1/2 to 8 inches	Thinly bedded
Moderately fractured	8 to 24 inches	Medium bedded
Widely fractured	2 to 6 feet	Thickly bedded
Very widely fractured	greater than 6 feet	Very thickly bedded

HARDNESS

Low	Carved or gouged with a knife
Moderate	Easily scratched with a knife, friable
Hard	Difficult to scratch, knife scratch leaves dust trace
Very hard	Rock scratches metal

STRENGTH

Friable	Crumbles by rubbing with fingers
Weak	Crumbles under light hammer blows
Moderate	Indentations <1/8 inch with moderate blow with pick end of rock hammer
Strong	Withstands few heavy hammer blows, yields large fragments
Very strong	Withstands many heavy hammer blows, yields dust, small fragments

WEATHERING

Complete	Minerals decomposed to soil, but fabric and structure preserved
High	Rock decomposition, thorough discoloration, all fractures are extensively coated with clay, oxides or carbonates
Moderate	Fracture surfaces coated with weathering minerals, moderate or localized discoloration
Slight	A few stained fractures, slight discoloration, no mineral decomposition, no affect on cementation
Fresh	Rock unaffected by weathering, no change with depth, rings under hammer impact

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the location and time of exploration. Subsurface rock, soil and water conditions may differ in other locations and with the passage of time.

FILE: 11399.01SE.dwg

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ROCK CLASSIFICATION CHART
Haystack Landing Wetlands Restoration
Petaluma, California

A-2

Project No. 1139.01 Date 8/18/04 Approved By: [signature] Figure

BORING 1

EQUIPMENT: Mobile B-53 truck mounted drill rig with 6-inch hollow stem augers

DATE: May 21, 2004

ELEVATION: 21 feet

*REFERENCE: PCC Engineering

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0 – 0			SILTY SAND (SM) light brown, moist, medium dense, with occasional rootlets and coarse-grained sand lenses
		19	14.5	77				
					– 1			grades wet and loose
		5	18.9		5			
		4			– 2			grades red-brown, wet, with approx. 5 % bay mud mixed in with sand
		2/22"						
								BAY MUD (MH) blue-green-gray, wet, soft, high plasticity
					– 3 / 10			
					– 4			
					15			pushed rods to 31ft.
					– 5			
					– 6 / 20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

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BORING LOG
Haystack Landing Wetlands Restoration
Petaluma, California

A-3

Project No. 1139.01 | Date 08/12/04 | Approved By: [signature] | Figure

BORING 1 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
						20			BAY MUD (MH) blue-green-gray, wet, soft, high plasticity
					7				
						25			pushed rods to 31ft.
					8				
					9				
						30			
		50/3"	15.8				⊠		CLAYEY SAND (SC) (ALLUVIUM) tan-brown, wet, very dense, with approx. 5% subrounded gravels (up to 0.5" in dimension)
					10				Bottom of boring at 31.5 ft. No groundwater reading taken due to boring cave-in
						35			
					11				
					12				
						40			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

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BORING LOG
Haystack Landing Wetlands Restoration
Petaluma , California

A-4

Project No. 1139.01 Date 08/12/04 Approved By: [signature] Figure

BORING 2

EQUIPMENT: Mobile B-53 truck mounted drill rig with 6-inch hollow stem augers

DATE: May 21, 2004

ELEVATION: 7 feet

*REFERENCE: PCC Engineering

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	DESCRIPTION
					0	0	**SANDY CLAY (CL)** medium brown, moist, very stiff, low plasticity, with well graded sand and gravel (up to 1" in dimension)
		33					
		19	10.6	93	1		**CLAYEY SAND (SC) with GRAVEL** medium brown, wet, dense
		10	45.3	84		5	**SANDY CLAY (CL)** dark brown, very moist, medium stiff, medium plasticity, with approx. 30 % medium to coarse-grained sand
		14			2		dark red-brown, grades to wet, stiff, with approx. 20% gravel (up to 0.5" in dimension)
		9					
							BAY MUD (MH) gray with black inclusions, medium stiff, wet, high plasticity, with organic odor
					3	10	Bottom of boring at 9.5ft. No groundwater encountered during drilling
					4		
						15	
					5		
					6	20	

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

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BORING LOG
Haystack Landing Wetlands Restoration
Petaluma, California

A-5

Project No. 1139.01 Date 08/12/04 Approved By: [signature] Figure

BORING 3

EQUIPMENT: Mobile B-53 truck mounted drill rig with 6-inch hollow stem augers

DATE: May 21, 2004

ELEVATION: 21 feet

*REFERENCE: PCC Engineering

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0 / 0			WELL GRADED SAND (SW) red-brown, moist, loose, with silt
		8	52	66				
		4	73.2	54	1			
								SAND & CLAY (SW & CL/CH) dark brown and gray, wet, loose/soft, high plasticity clay, finely layered
					5 (ft)			
		7	69.4	58				
					2			BAY MUD (MH) blue-green-gray, wet, soft, high plasticity
					3 / 10			
					4			
					15 (ft)			pushed rods to 37ft.
					5			
					6 / 20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

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BORING LOG
Haystack Landing Wetlands Restoration
Petaluma, California

A-6

Project No. 1139.01 | Date 08/12/04 | Approved By: [signature] | Figure

BORING 3 (CONTINUED)

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
						20			BAY MUD (MH) blue-green-gray, wet, soft, high plasticity
					7				
						25			
					8				pushed rods to 37ft.
					9	30			
					10				
						35			
					11				
		50/3"	21.1				☒		SANDY CLAY (CL) gray and red-brown, wet, very stiff, low to medium plasticity, with pockets of gray clayey sand
					12				Bottom of boring at 37.5 ft. No groundwater encountered during drilling
						40			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

Miller Pacific ENGINEERING GROUP

BORING LOG
Haystack Landing Wetlands Restoration
Petaluma , California

A-7

Project No. 1139.01 Date 08/12/04 Approved By: [signature]

Figure

BORING 4

EQUIPMENT: Mobile B-53 truck mounted drill rig with 6-inch hollow stem augers

DATE: May 21, 2004

ELEVATION: 16 feet

*REFERENCE: PCC Engineering

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0 – 0			GRAVELLY CLAY (CL) with sand red-brown, black, white, moist, very stiff, low plasticity, with angular rock fragments (up to 1.5" in dimension)
		67	12.3	108				
					1			grades with less rock fragments
		30	18	85				
					5			grades mottled brown, stiff with sandstone rock fragments (>2.5" in dimension)
		17	11.9	106				
					2			grades dark brown, medium stiff, wet
		14						
		8			3 / 10			SANDY CLAY (CH) gray, wet, soft, high plasticity
								Bottom of boring at 10.5ft. No groundwater encountered during drilling
					4			
					15			
					5			
					6 / 20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

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BORING LOG
Haystack Landing Wetlands Restoration
Petaluma, California

A-8

Project No. 1139.01 Date 08/12/04 Approved By: [signature]

Figure

BORING 5

EQUIPMENT: Mobile B-53 truck mounted drill rig with 6-inch hollow stem augers

DATE: May 21, 2004

ELEVATION: 3 feet

*REFERENCE: PCC Engineering

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)
		29	17.8	90
		39	13.3	119
		36	17.7	101
		16	39.2	78
		36	29.2	
		22		
		19		

DEPTH: meters 0 – 1 – 2 – 3 – 4 – 5 – 6; feet 0 – 5 – 10 – 15 – 20

SAMPLE / SYMBOL (3)

SANDY CLAY (CL)
red-brown, moist, stiff, low plasticity, with approx. 20% subrounded to subangular rock fragments (up to 0.5" in dimension)

grades green-brown

BAY MUD (MH)
gray and black, very moist, high plasticity, stiff, with organic odor

SANDY CLAY (CL) (ALLUVIUM)
light brown, moist, very stiff, low plasticity

WEATH. ROCK (CLAYSTONE) / RESIDUAL SOIL?
medium plasticity with relict rock texture

Bottom of boring at 17.5ft.
No groundwater encountered during drilling

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

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BORING LOG
Haystack Landing Wetlands Restoration
Petaluma, California

A-9

Project No. 1139.01 Date 08/12/04 Approved By: [signature]

Figure

BORING 6

EQUIPMENT: Mobile B-53 truck mounted drill rig with 6-inch hollow stem augers

DATE: May 21, 2004

ELEVATION: 6 feet

*REFERENCE: PCC Engineering

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	DESCRIPTION
					0	0			SANDY SILT (ML) medium brown, very moist, soft, low plasticity, with approx. 20% fine to medium-grained sand
		5	54.8	60			■		
		3	73.2	42	1		■		SILTY SAND (SM) red-brown, very moist, loose
						5			BAY MUD (MH) gray and black, wet, soft, high plasticity
		1	140.8	35	2		■		
					3	10			
					4				SANDY CLAY (CL) gray and brown, moist, very stiff, medium plasticity, with subrounded sand (up to 1/8" in dimension)
						15			
		40			5		■		
									Bottom of boring at 16.5ft. No groundwater encountered during drilling
					6	20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlogs(1-6).dwg

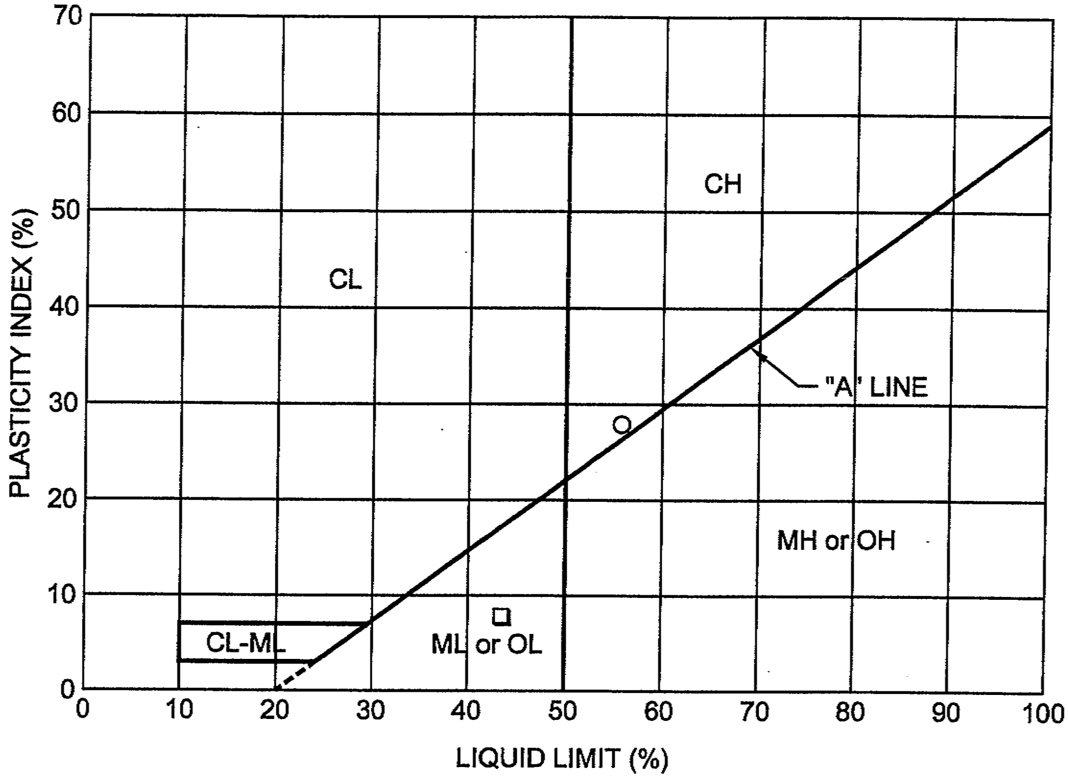
Miller Pacific
ENGINEERING GROUP

BORING LOG
Haystack Landing Wetlands Restoration
Petaluma, California

A-10

Project No. 1139.01 Date 08/12/04 Approved By: [signature]

Figure



SYMBOL	SAMPLE SOURCE	CLASSIFICATION	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)
□	Borings 2 & 3 composite of 0 to 3 Feet	SANDY SILT (ML) light brown	43	36	7
○	Boring 4 composite of 2 & 4 Feet	CLAYEY SAND (CH) greenish-yellow	56	28	28

REFERENCE: Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D 4318

FILE: Plasticity Index.dwg

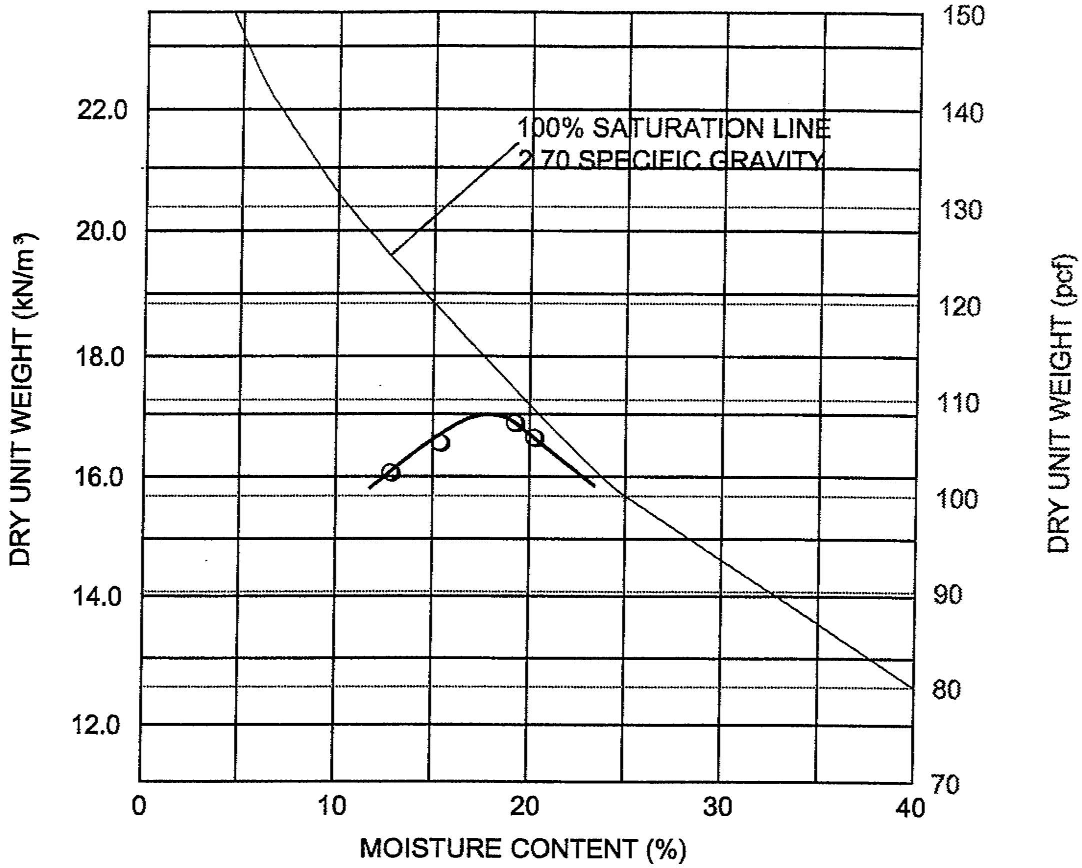
Miller Pacific
ENGINEERING GROUP

PLASTICITY CHART
Haystack Landing Wetlands Restoration
Petaluma, California

A-11

Project No. 1139.01 Date 8/12/04 Approved By: [signature]

Figure



NOTE: pcf x 0.157 = kN/m^3 (rounded to 3 significant figures)

SYMBOL	SAMPLE SOURCE	CLASSIFICATION	OPTIMUM MOISTURE CONT. (%)	MAXIMUM DRY UNIT WEIGHT (kN/m³)	(pcf)
O	BORINGS 2 & 3	SILTY SAND (SM) light brown	18	17.1	109

REFERENCE: ASTM D-1557

Miller Pacific ENGINEERING GROUP

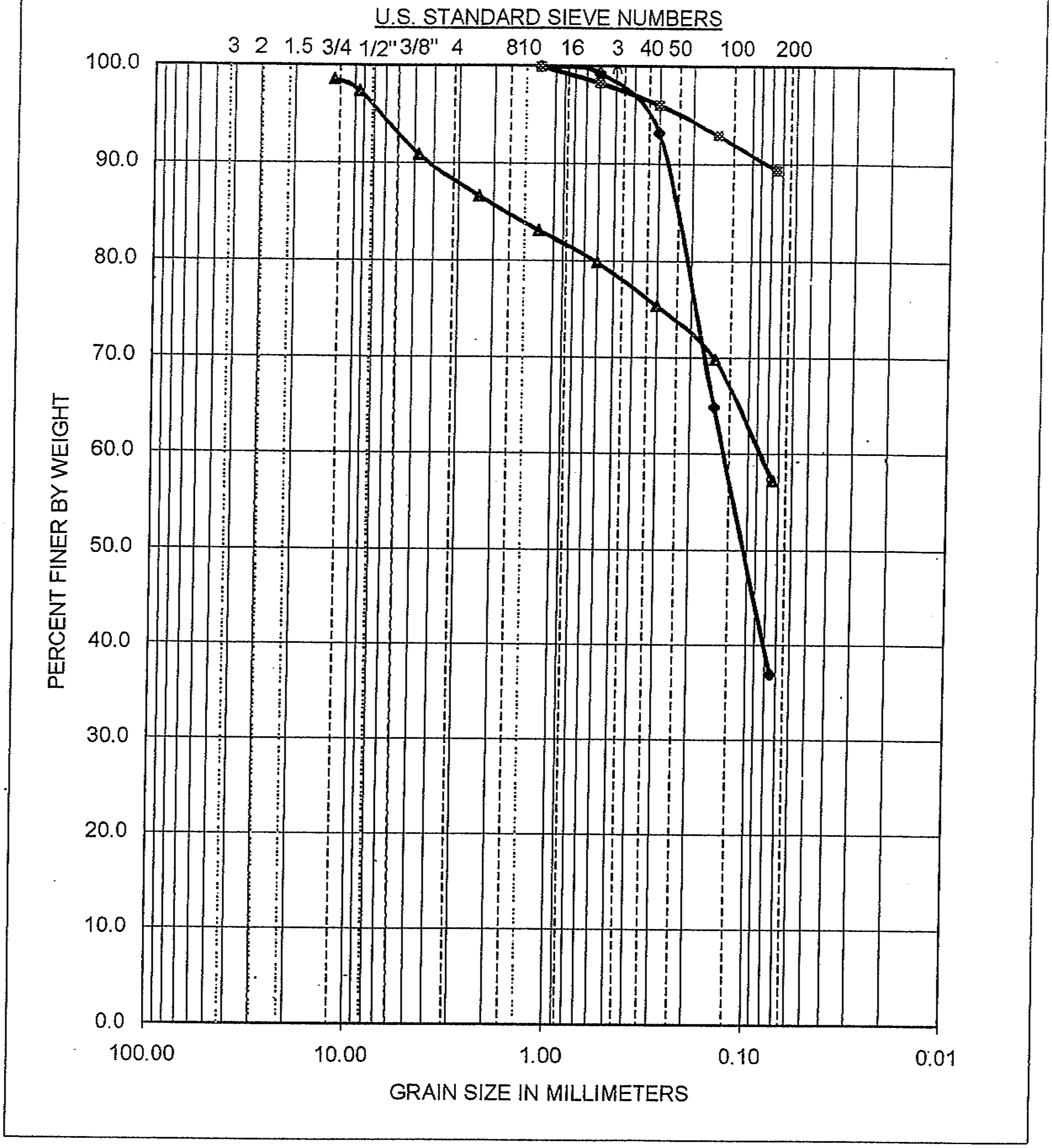
COMPACTION TEST
Haystack Landing Wetlands Restoration
Petaluma, California

A-12

Project No. 1139.01 Date 08/12/04 Approved By: [signature]

Figure

PARTICLE SIZE ANALYSIS CHART



SYMBOL	SAMPLE SOURCE	CLASSIFICATION
◆	B1 @ 2'	(SM) Brown Silty Sand
■	B6 @ 1.5'	(ML) Brown sandy silt
▲	Bulk of B2 & B3--0-3'	(SM) Brown gravelly sandy silt

Test: ASTM D-422

FILE: Sieve.dwg

Miller Pacific
ENGINEERING GROUP

SIEVE ANALYSIS
Haystack Landing Wetlands Restoration
Petaluma, California

A-13

Project No. 1139.01 | Date 9/30/04 | Approved By: [signature]

Figure

APPENDIX B
SALINITY TEST RESULTS

Three surface soil samples were taken in areas where pickleweed (*Salicornia* sp.) grows in the existing seasonal wetlands located on the southern portion of the project site. These samples were analyzed for leachable sodium, leachable conductivity and leachable chloride. The purpose of the analysis was to determine salinity levels in surface soils where pickleweed occurs on the project site as this information may be useful in establishing substrate criteria for the wetland restoration phase of the proposed project.

Analytical Sciences

July 30, 2004

Mike Morisoli
Miller Pacific Engineering Group
165 North Redwood Drive, Suite 120
San Rafael, CA 94903

Dear Mike,

Enclosed you will find Analytical Sciences' revised report 4061403 for your Dutra Haystack project. An invoice for this additional work is enclosed.

Should you or your client have any questions regarding this report please contact me at your convenience. We appreciate you selecting Analytical Sciences for this work and look forward to serving your analytical chemistry needs on projects in the future.

Sincerely,

Analytical Sciences

Mark

Mark A. Valentini

PO Box 750336
Petaluma, CA 94975-0336
Telephone: (707) 769-3128

110 Liberty Street
Petaluma, CA 94952
Fax: (707) 769-8093

Analytical Sciences

Report Date: July 30, 2004

Mike Morisoli
Miller Pacific Engineering Group
165 North Redwood Drive, Suite 120
San Rafael, CA 94903

LABORATORY REPORT

Project Name: **Dutra Haystack** **1139.01**

Lab Project Number: **4061403**

This 4 page report of analytical data has been reviewed and approved for release.

Mark A. Valentini, Ph.D.
Laboratory Director

PO Box 750336
Petaluma, CA 94975-0336
Telephone: (707) 769-3128

110 Liberty Street
Petaluma, CA 94952
Fax: (707) 769-8093

Leachable Sodium

Lab #	Sample ID	Analysis	Result (mg/kg)	RDL (mg/kg)
22900	**Haystack #1**	**Sodium** (Na)	**2,700** (1)	100

Date Sampled:	06/11/04	Date Analyzed:	07/01/04	QC Batch #:	4558
Date Received:	06/14/04	Method:	EPA 3050/6010		

Lab #	Sample ID	Analysis	Result (mg/kg)	RDL (mg/kg)
22901	**Haystack #2**	**Sodium** (Na)	**2,600** (1)	100

Date Sampled:	06/11/04	Date Analyzed:	07/01/04	QC Batch #:	4558
Date Received:	06/14/04	Method:	EPA 3050/6010		

Lab #	Sample ID	Analysis	Result (mg/kg)	RDL (mg/kg)
22902	**Haystack #3**	**Sodium** (Na)	**2,800** (1)	100

Date Sampled:	06/11/04	Date Analyzed:	07/01/04	QC Batch #:	4558
Date Received:	06/14/04	Method:	EPA 3050/6010		

(1) Milligrams of leachable sodium per kilogram of soil.

Leachable Conductivity

Lab #	Sample ID	Analysis	Result (µMho/cm)	RDL (µMho/cm)
22900	**Haystack #1**	**Leachable Conductivity**	**5,000**	5.0

Date Sampled: 06/11/04
Date Received: 06/14/04
Date Analyzed: 07/01/04
Method: EPA 3050/6010
QC Batch #: 4558

Lab #	Sample ID	Analysis	Result (µMho/cm)	RDL (µMho/cm)
22901	**Haystack #2**	**Leachable Conductivity**	**3,600**	5.0

Date Sampled: 06/11/04
Date Received: 06/14/04
Date Analyzed: 07/01/04
Method: EPA 3050/6010
QC Batch #: 4558

Lab #	Sample ID	Analysis	Result (µMho/cm)	RDL (µMho/cm)
22902	**Haystack #3**	**Leachable Conductivity**	**6,200**	5.0

Date Sampled: 06/11/04
Date Received: 06/14/04
Date Analyzed: 07/01/04
Method: EPA 3050/6010
QC Batch #: 4558

Leachable Chloride

Lab #	Sample ID	Analysis	Result (mg/kg)	RDL (mg/kg)
22900	**Haystack #1**	**Chloride** (Cl)	**1,900** (2)	100

Date Sampled:	06/11/04	Date Analyzed:	06/25/04	QC Batch #:	4621
Date Received:	06/14/04	Methods:	EPA 300 (IC)		

Lab #	Sample ID	Analysis	Result (mg/kg)	RDL (mg/kg)
22901	**Haystack #2**	**Chloride** (Cl)	**840** (2)	50

Date Sampled:	06/11/04	Date Analyzed:	06/25/04	QC Batch #:	4621
Date Received:	06/14/04	Methods:	EPA 300 (IC)		

Lab #	Sample ID	Analysis	Result (mg/kg)	RDL (mg/kg)
22902	**Haystack #3**	**Chloride** (Cl)	**1,400** (2)	50

Date Sampled:	06/11/04	Date Analyzed:	06/25/04	QC Batch #:	4621
Date Received:	06/14/04	Methods:	EPA 300 (IC)		

(2) Milligrams of leachable chloride per kilogram of soil.

Analytical Sciences
.O. Box 750336, Petaluma, CA 94975-0336
110 Liberty Street, Petaluma, CA 94952
(707) 769-3128
Fax (707) 769-8093

CHAIN OF CUSTODY

LAB PROJECT NUMBER: 4061403
CLIENT'S PROJECT NAME: DUTRA Haystack
CLIENT'S PROJECT NUMBER: 1139.01

CLIENT INFORMATION

COMPANY NAME: Miller Pacific Engineers
ADDRESS: 165 N. Redwood Drive Suite 120
San Rafael, CA. 94903
CONTACT: Mike Morisoli
PHONE#: (415) 491-1338
FAX #: (415) 491-1831

TURNAROUND TIME (check one)

MOBILE LAB ____
SAME DAY ____ 24 HOURS ____
48 HOURS ____ 72 HOURS ____
5 DAYS ____ NORMAL X

GEOTRACKER EDF: ____ Y X N
GLOBAL ID: ____

COOLER TEMPERATURE Cool/RT °C
COC
PAGE 1 OF 1

ANALYSIS

ITEM	CLIENT SAMPLE I.D.	DATE SAMPLED	TIME	MATRIX	# CONT.	PRESV. YES/NO	Leachable Na+Cl-	TOTAL Cl + Sodium	COMMENTS	LAB SAMPLE #
1	Haystack #1	6/11/04		S	1	N	X	X		
2	Haystack #2	6/11/04		S	1	N	X	X		22900
3	Haystack #3	6/11/04		S	1	N	X	X		22901
4										22902
5										
6										
7										
8										
9										
10										
11										

SIGNATURES

SAMPLED BY: ____

RELINQUISHED BY: [signature]
SIGNATURE
6-14-04 1:20 pm
DATE TIME

RECEIVED BY LABORATORY: Mark A. Valentini
SIGNATURE
6/14/04 1:20 pm

Appendix B – Water Budget Analysis

TABLE OF CONTENTS

Existing site conditions include a hillside to the north, tidally influenced ditches on the east, seasonal wetlands, primarily in the south portion of the site, and uplands that remain dry throughout most of the year. An undulating topography resulting from diked silt ponds creates the low-lying seasonal wetlands which vary in elevation from 3 to 8 NGVD. A proposed system of weirs and culverts will help to manage storage volumes within the wetlands below elevation 7.00. The existing volume stored below elevation 7.00 is 16.11 ac-ft.

Existing Wetlands to be avoided

Existing wetlands WC, WD, WE, levees A through D, and adjacent uplands will be avoided in accordance with the avoidance standard.

Existing Sloughs to be avoided

Existing sloughs DD1 through DD3, slough in area "A", and the majority of WJ will be avoided in accordance with the avoidance standard.

Created and enhanced wetlands

Proposed grading operations remove some of the existing hillside to the north and fill in a portion of existing wetlands WA, DD4, and WJ in order provide level pads for the proposed fire training station, asphalt production area, and temporary storage area as well as roads for access. The proposed grading operations will regrade portions of existing wetlands WB, WF, WG, WH, DD5, and DD6 on the south portion of the site. Impacted wetlands will be mitigated per the conditions of approval and resource agency regulations. Further design

Project Water Balance Summary

Existing Site

Runoff received (onsite only): 61.92 ac-ft
Maximum Storage Volume: 16.11 ac-ft

Proposed Site

Remaining existing avoided wetlands (WC, WD, WE)
Runoff received (onsite only): 2.08 ac-ft
Maximum storage volume: 1.3 ac-ft

Remaining existing sloughs (DD1 through 3, remaining WJ)
Runoff received (onsite only): 20.71 ac-ft
Maximum storage volume: 3.0 ac-ft

Created and improved wetlands (WB, WF, WG, WH, DD5, and DD6 (regraded))
Runoff received (onsite only): 31.63 ac-ft
Runoff received (from Highway 101and western watersheds): 83.54 ac-ft
Runoff received (total): 115.17 ac-ft

Further descriptions and assumptions are discussed in the conclusions section.

Grading Earthwork Balance
Grading operations are designed to balance the site's earthwork quantities and provide a zero net fill for the overall site.

Net Zero Balance in Special Flood Hazard Area
Wetland mitigation meets and exceeds the zero net fill in special flood hazard area.

The following sections describe the parameters, assumptions and sources used to develop the water balance analysis.

2. HYDROLOGIC CONSIDERATIONS

2.1 Precipitation

Total Precipitation (inches) is based on the CIMIS online database for station "Petaluma East – North Coast Valleys – Station 144" from dates August 1999 through February 2015.

Seasonal Runoff from Highway 101 and the Existing Hillside West of the Highway
The runoff coefficients for the existing/future Highway 101 and existing hillside west of the highway are tabulated in the drainage report entitled "U.S. 101 Marin-Sonoma Narrows Segment B2 Project, Sonoma County, California, Drainage Report" dated April 2012. Typical C values used were C=0.60 (typ) for existing

ground cover, C=1.0 (typ) for impervious surfaces, and C=composite value for areas with mixed impervious and pervious surfaces.

Proposed Grading
Since the developed area of the site will be paved or compacted dirt, a high C-value can be used, C = 0.90 minimum, typically.

Proposed Wetlands
Precipitation onto a wetland completely contained within the wetland has zero runoff and is all available to provide water for the wetland. Therefore, a high C-value can be used, C=1.00.

2.2 Evapotranspiration

Total Evapotranspiration (inches) is based on the CIMIS online database for station "Petaluma East – North Coast Valleys – Station 144" from dates August 1999 through February 2015.

2.3 Tidal influences

Tidal influences are expected to periodically inundate the wetlands. However, the inundation would be infrequent and only occurs a few times per year under extreme tides or a combination of high tides and severe weather. Normal tidal cycles will continue to provide twice daily brackish water to the slough and ditch system that is not impacted by the project and subject of the wetlands permit. For purposes of this water balance, tidal influences are not relied upon to support the new seasonal wetlands.

2.4 Seasonal runoff from Highway 101 and the hillside west of the highway

Seasonal runoff from Highway 101 and from the hillside west of the highway is tabulated in the drainage report entitled "U.S. 101 Marin-Sonoma Narrows Segment B2 Project, Sonoma County, California, Drainage Report" dated April 2012. Watershed Maps and Drainage Plans indicate there will be seasonal runoff that discharges into wetlands DD5, WH, and WF. This impact was accounted for in the permit obtained by Caltrans to support the RWQCB certification of the B2 project. Seasonal runoff onto the site is provided in Appendix 6.3.

3. SITE DESIGN

3.1 Proposed Grading

The proposed ditch system along the frontage road was designed to transport runoff into wetlands via gravity flow. Runoff is either transported via sheet flows, shallow concentrated flows, or channelized flow until it reaches a wetland.

3.2 Proposed Storm Drain Network

The proposed storm drain network was designed to transport runoff into a wetland via a network of inlets, underground storm drain lines, sand filters, weirs, and culverts.

3.3 Proposed Wetlands

Proposed wetland areas and the re-graded existing wetland areas were created to mitigate wetlands lost due to the project configuration. Impacted wetlands were mitigated per requirements of the conditions of approval and resource agency regulations.

4. WATER BALANCE

4.1 Water Balance Boundary

The Water Balance was performed within the watershed boundary.

4.2 Period of Analysis

Recent records of water use reflect current trends in precipitation and evapotranspiration. As such, recent information is based on the CIMIS online database for station "Petaluma East – North Coast Valleys – Station 144" from dates August 1999 through February 2015.

The period of analysis extends from September 1 to August 31 during those years, and represents a period beginning and ending during low runoff conditions, where a typical rainy season can be analyzed.

4.3 Tidal Influences

Tides are expected to temporarily inundate the wetlands, providing periodic influxes and effluxes of brackish water. While this influx and efflux is more apparent in shorter timeframes, larger time frames should see a balanced condition, where influx approximately equals efflux. For this reason, tidal influences have been neglected in this analysis

4.4 Water Balance Equation

The Water Balance equation used is:

$$\text{Wetland Storage Remaining} = \text{inflow} + \text{storage} - \text{depletions} - \text{withdrawals}$$

Where:
Water storage remaining = water storage in wetland
Inflow = precipitation
Storage = storage in wetland from previous month
Depletions = evapotranspiration
Withdrawals = assume no withdrawals from wetlands (assume withdrawals = 0)

4.5 Results of Water Balance Analysis

Using the Runoff Coefficients and watershed areas, the seasonal runoff entering each system was calculated. All seasonal wetlands will see water coverage more than the required 30 days each year. Water coverage is expected to last the majority of the rainy season. As summer progresses, water coverage is expected to diminish. A monthly summary of seasonal runoff, wetland storage volumes, and wetland depths is further discussed in the appendices.

5. CONCLUSIONS

5.1 Wetlands Net Zero Fill

The wetland mitigation resulted in an increased flood storage volume below elevation 7.00. Flood Storage Volumes below elevation 7.00 as follows:

Existing flood storage volume below elevation 7.00:
16.11ac-ft

Proposed flood storage volume below elevation 7.00:
20.52 ac-ft
(after project grading and wetland mitigation plan has been implemented)

5.2 Storage Volumes

Existing Avoided wetlands

Existing avoided wetlands WC, WD, and WE should expect to see no change in water storage compared with existing conditions. At the beginning of the rain year, around September, runoff begins to enter the system and wetlands should expect to see water storage. As the rain year continues into wetter months, October through

April, wetlands should expect to receive runoff from rain events and to store water within each wetland. When rainfall tapers off in late Spring/early Summer, around May, water lost through evapotranspiration begins to outweigh incoming precipitation and water storage begins to diminish until eventually drying out by late Summer/early Autumn months.

Existing Avoided Sloughs

Existing avoided sloughs DD1 through DD3, WJ, and slough in area "A" should continue to function tidally with twice daily tidal cycles. The water surface will riseover the normal tides during storm periods. During extreme tide conditions, brackish water is expected to temporarily flood the sloughs.

Created and Enhanced wetlands

Created and enhanced wetlands WB, WF, WG and WH (regraded), DD5, and DD6 (regraded) should expect to see water storage within the wetlands at the beginning of the rain year, around September, as runoff begins to enter the system. As the rain year continues into wetter months, October through April, wetlands should continue to receive runoff from rain events and to develop water storage within each wetland. When rainfall tapers off in late Spring/early Summer, around May, water lost through evapotranspiration begins to outweigh incoming precipitation and water storage begins to diminish until eventually drying out by late Summer/early Autumn months. By late August, only seasonal wetlands DD5 and WH should expect to have water remaining from the previous rain year.

The proposed Wetland enhancement area uses water from upstream watersheds that is being delivered by the Caltrans Project and will be further directed as a part of the Haystack project.

However, all existing remaining sloughs will continue to see daily tidal flows that have been enhanced by the new 36" culvert which replaced the partially collapsed wood box culvert. In addition, during storm events, additional fresh water flows will reach DD5, DD1, DD2 wetlands. WJ will receive flows from the sand filter at the north portion of the plant and the hillside above the fire storage building. DD1 will continue to receive flows from the south part of the asphalt plant through the sand filter which collects runoff from the southerly portion of the site. In addition, a 15 inch culvert from the remnants of DD6 will connect the main drainage channel along the frontage road to DD1. DD2 will receive flow from the sand filter which will drain the gravel storage area as well as a 15 inch culvert from the remnants of DD6 which will connect the main drainage channel along the frontage road to DD2.

5.3 Storage Volumes Tables

The following table indicates the gross watershed runoff volume expected in a typical rain year versus the maximum storage volume:

Existing Avoided Wetlands

Wetland ID	Annual Watershed Volume	Maximum Storage Volume
WC (avoided)	0.43 ac-ft*	0.14 ac-ft*
WD (avoided)	1.65 ac-ft*	0.32 ac-ft*
WE (avoided)	0.40 ac-ft*	0.14 ac-ft*

*Annual watershed volume and maximum storage volume remains unchanged in the existing and proposed conditions

Existing Sloughs

Slough ID	Annual Watershed Volume	Maximum Storage Volume
DD1 (avoided portion)	5.52 ac-ft	0.90 ac-ft*
DD2 (avoided portion)	6.90 ac-ft	0.90 ac-ft*
DD3 (avoided portion)	0.40 ac-ft*	0.2 ac-ft*
WJ (avoided portion)	7.90 ac-ft	1.7 ac-ft*

*Annual watershed volume and maximum storage volume remains unchanged in the existing and proposed conditions

Created / Enhanced Wetlands

Onsite watersheds only

Wetland ID	Watershed Volume	Maximum Storage Volume
Regraded WB	11.08 ac-ft	1.6 ac-ft
Regraded WF	5.51 ac-ft	0.9 ac-ft
Regraded WH and WG	8.36 ac-ft	12.6 ac-ft
Regraded DD5 and DD6	6.70 ac-ft	1.1 ac-ft

Watersheds from Highway 101 and hills west of highway only

Wetland ID	Watershed Volume	Maximum Storage Volume
Regraded WB	0.0 ac-ft	1.6 ac-ft
Regraded WF	0.0 ac-ft	0.9 ac-ft
Regraded WH and WG	31.40 ac-ft	12.6 ac-ft
Regraded DD5 and DD6	52.13 ac-ft	1.1 ac-ft

Totals

Wetland ID	Watershed Volume	Maximum Storage Volume
Regraded WB	11.08 ac-ft	1.6 ac-ft
Regraded WF	5.51 ac-ft	0.9 ac-ft
Regraded WH and WG	39.76 ac-ft	12.6 ac-ft
Regraded DD5 and DD6	58.83 ac-ft	1.1 ac-ft

APPENDIX 6.1

Storage Volumes

Depths

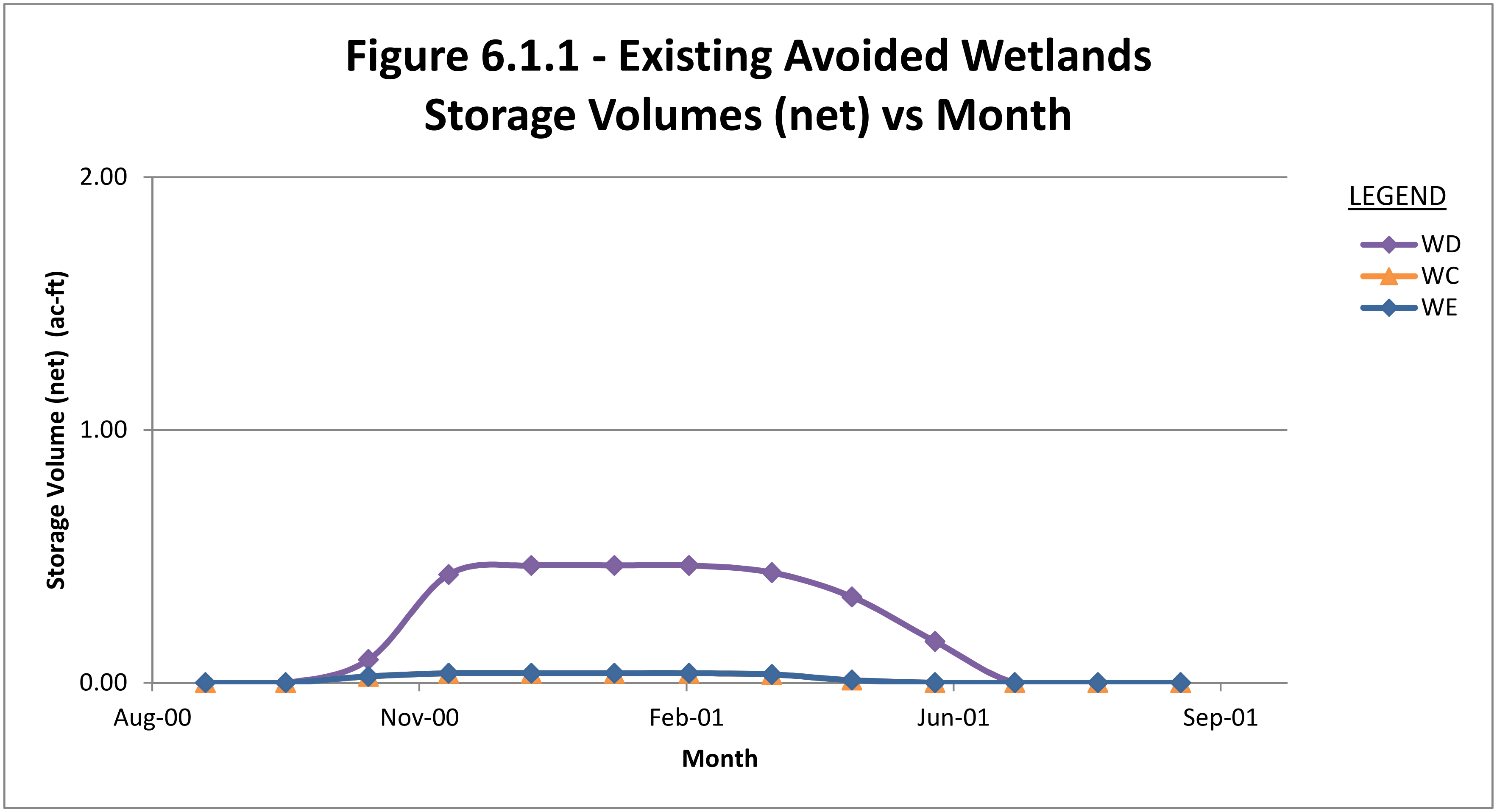


Figure 6.1.1 - Existing Avoided Wetlands
Storage Volumes (net) vs Month
2.00
1.00
0.00
Storage Volume (net) (ac-ft)
Aug-00
Nov-00
Feb-01
Jun-01
Sep-01
Month
LEGEND
WD
WC
WE

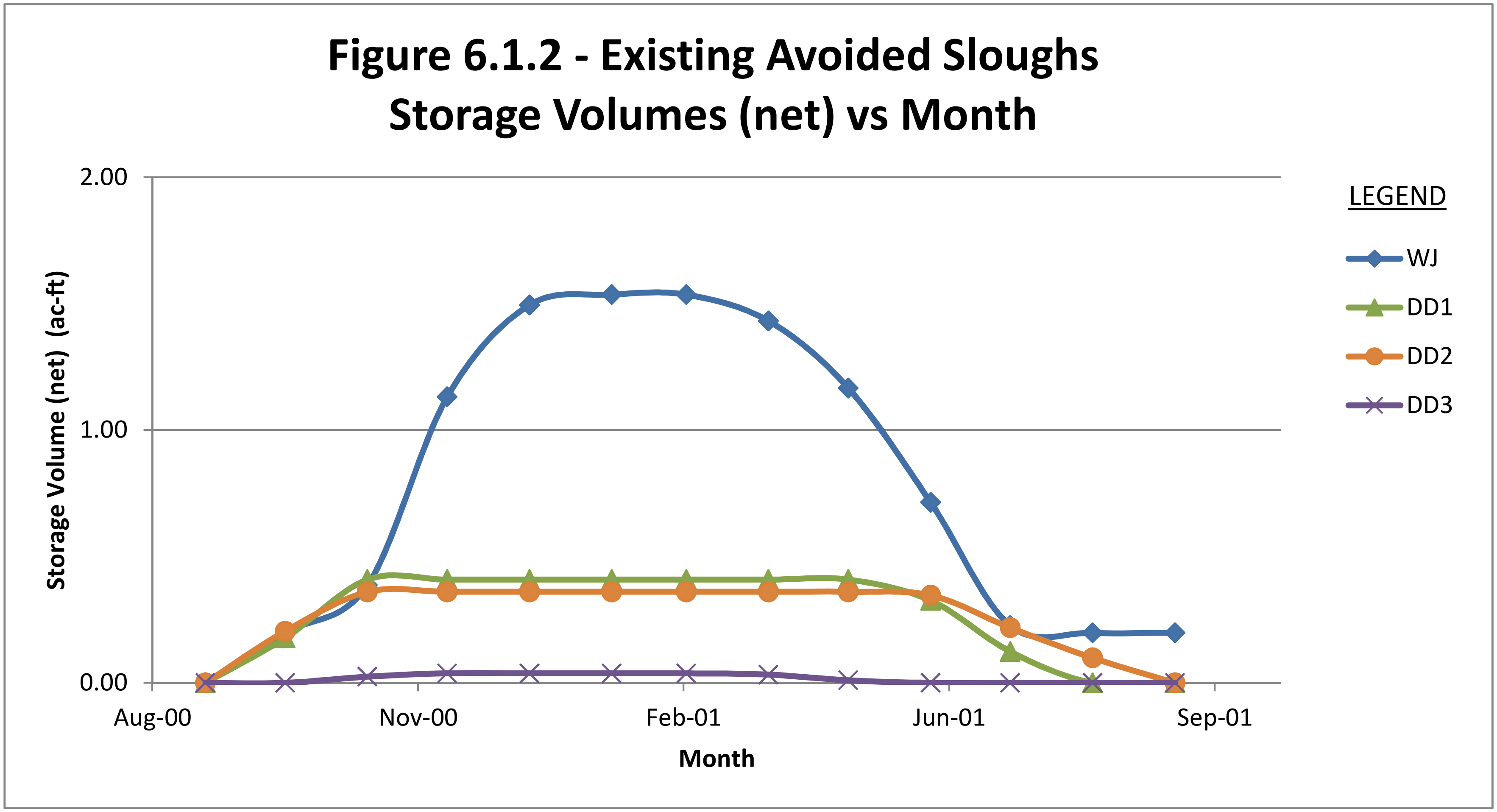


Figure 6.1.2 - Existing Avoided Sloughs
Storage Volumes (net) vs Month
2.00
1.00
0.00
Storage Volume (net) (ac-ft)
Aug-00
Nov-00
Feb-01
Jun-01
Sep-01
Month
LEGEND
WJ
DD1
DD2
DD3

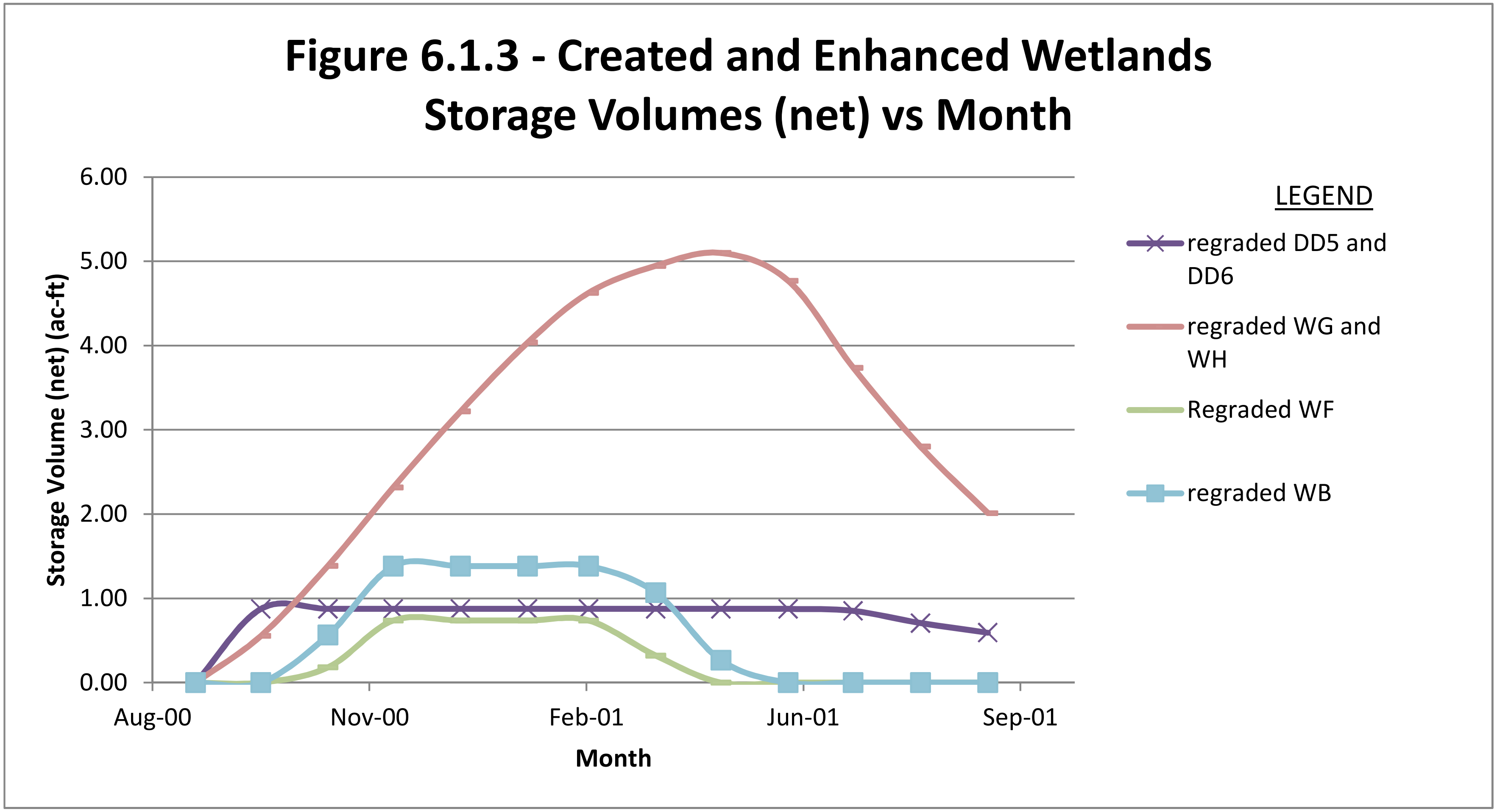


Figure 6.1.3 - Created and Enhanced Wetlands
Storage Volumes (net) vs Month
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Storage Volume (net) (ac-ft)
Aug-00
Nov-00
Feb-01
Jun-01
Sep-01
Month
LEGEND
regraded DD5 and DD6
regraded WG and WH
Regraded WF
regraded WB

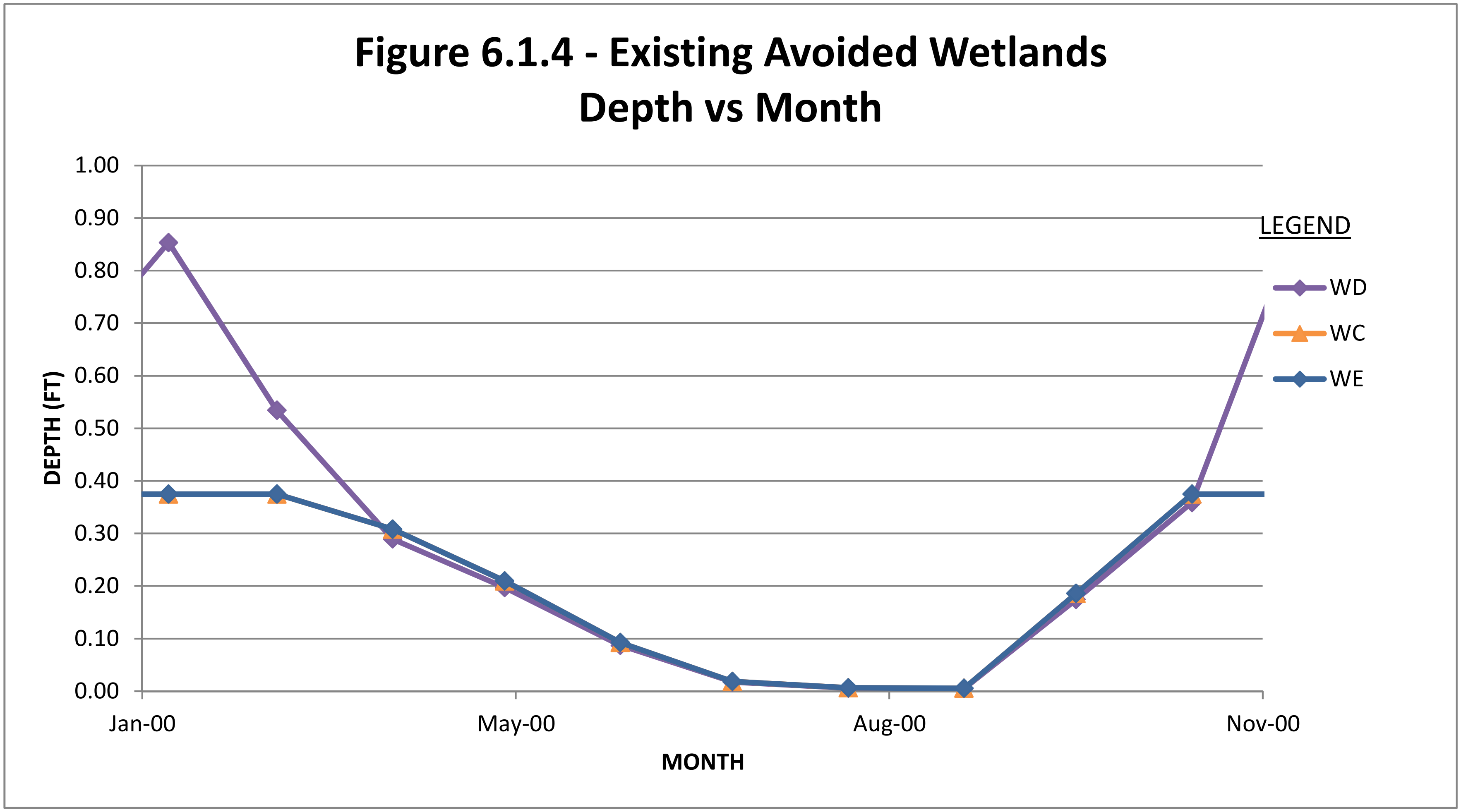


Figure 6.1.4 - Existing Avoided Wetlands
Depth vs Month
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
DEPTH (FT)
Jan-00
May-00
Aug-00
Nov-00
MONTH
LEGEND
WD
WC
WE

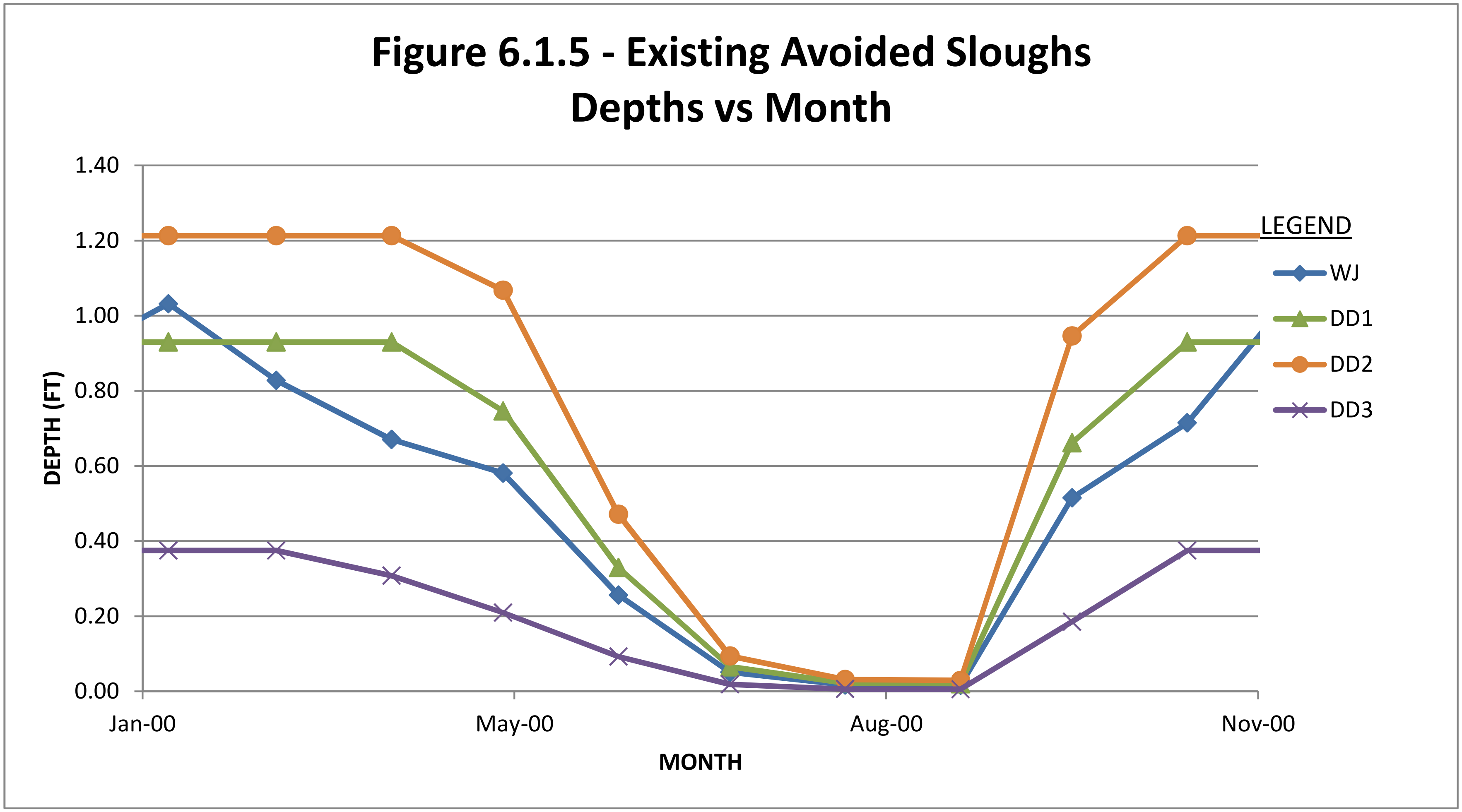


Figure 6.1.5 - Existing Avoided Sloughs
Depths vs Month
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
DEPTH (FT)
Jan-00
May-00
Aug-00
Nov-00
MONTH
LEGEND
WJ
DD1
DD2
DD3

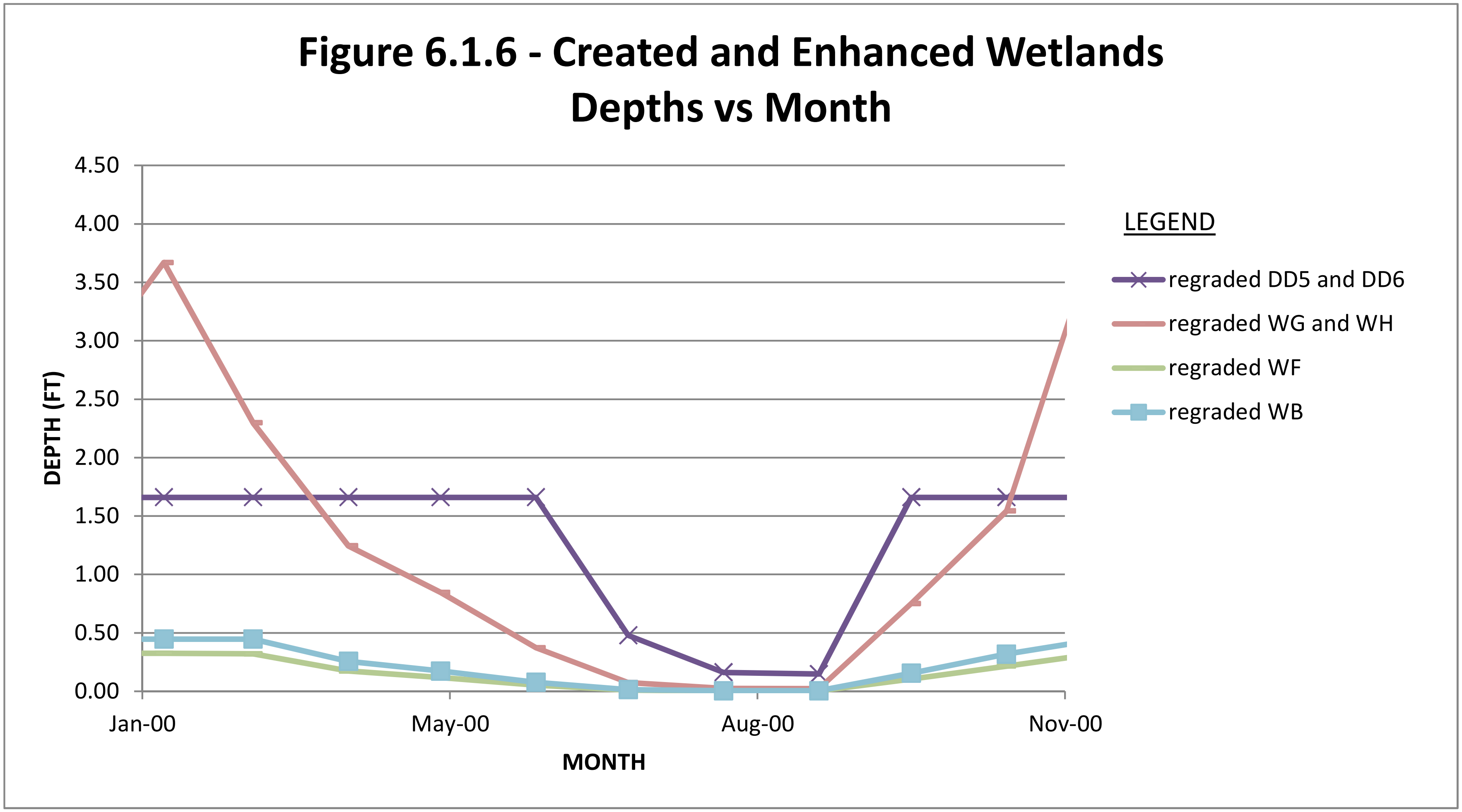


Figure 6.1.6 - Created and Enhanced Wetlands
Depths vs Month
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
DEPTH (FT)
Jan-00
May-00
Aug-00
Nov-00
MONTH
LEGEND
regraded DD5 and DD6
regraded WG and WH
regraded WF
regraded WB

APPENDIX 6.2

Precipitation and Evapotranspiration, CIMIS Monthly Averages

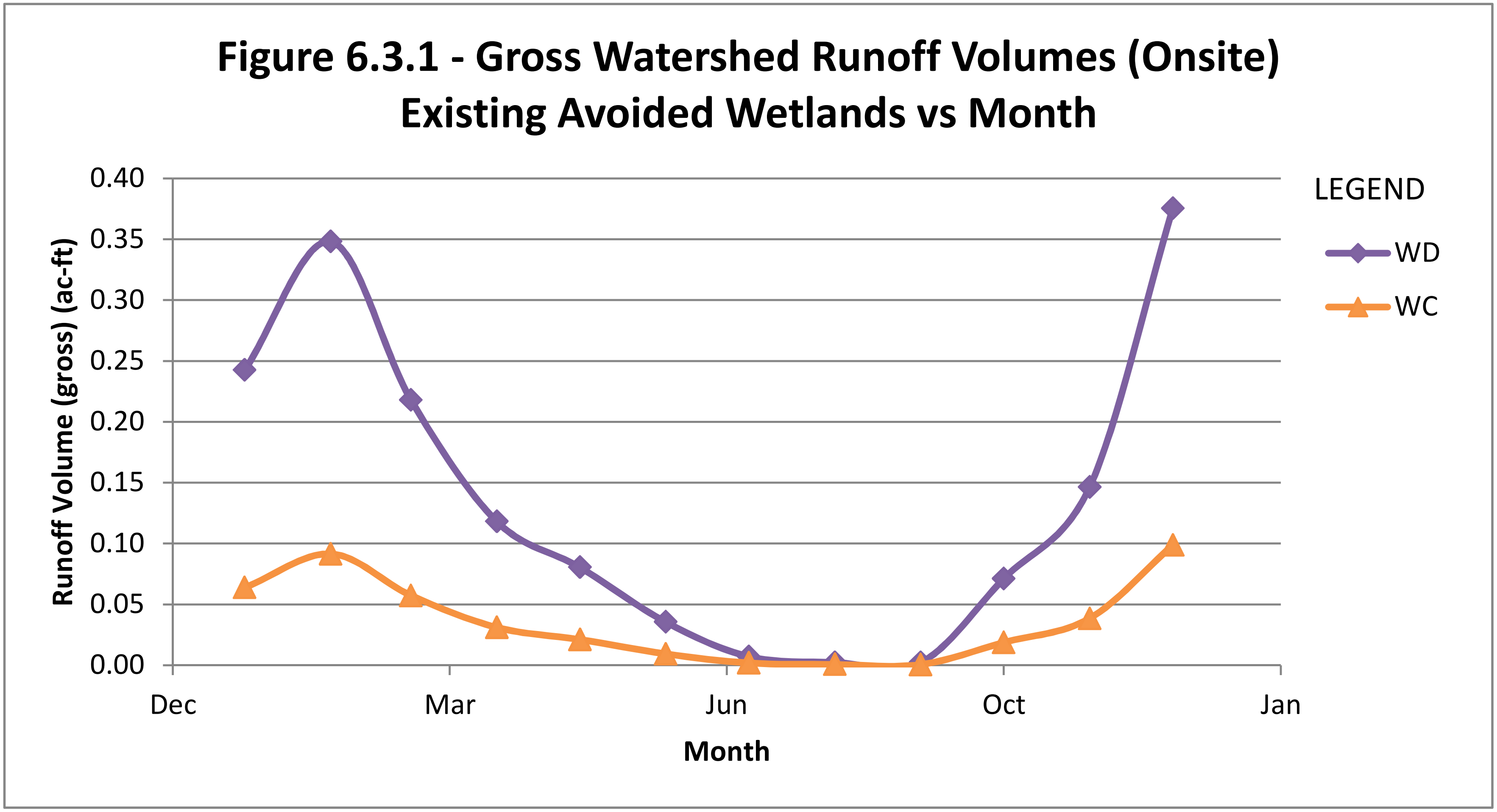


Figure 6.3.1 - Gross Watershed Runoff Volumes (Onsite)
Existing Avoided Wetlands vs Month
Runoff Volume (gross) (ac-ft)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Dec
Mar
Jun
Oct
Jan
Month
LEGEND
WD
WC

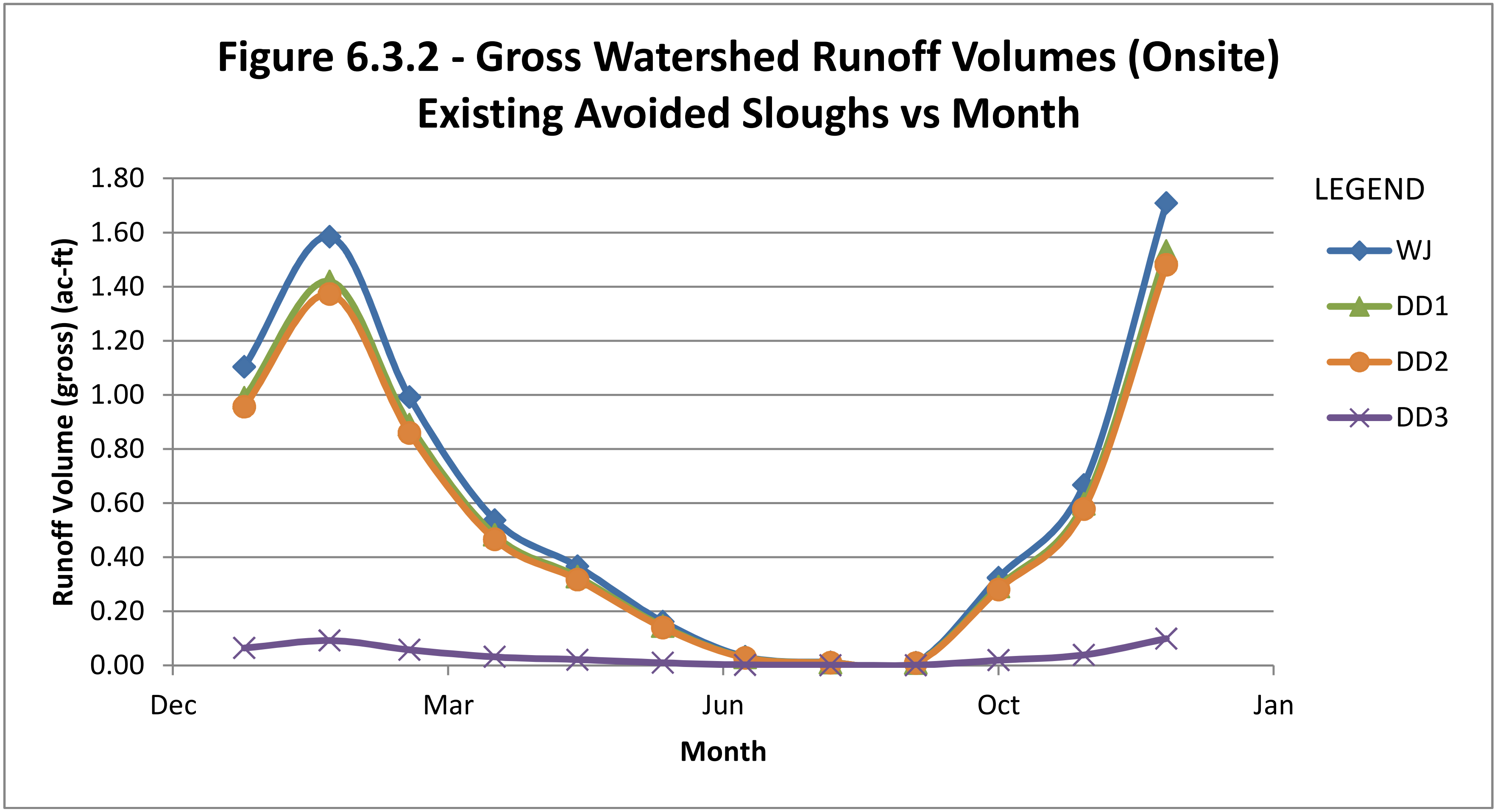


Figure 6.3.2 - Gross Watershed Runoff Volumes (Onsite)
Existing Avoided Sloughs vs Month
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Runoff Volume (gross) (ac-ft)
Dec
Mar
Jun
Oct
Jan
Month
LEGEND
WJ
DD1
DD2
DD3

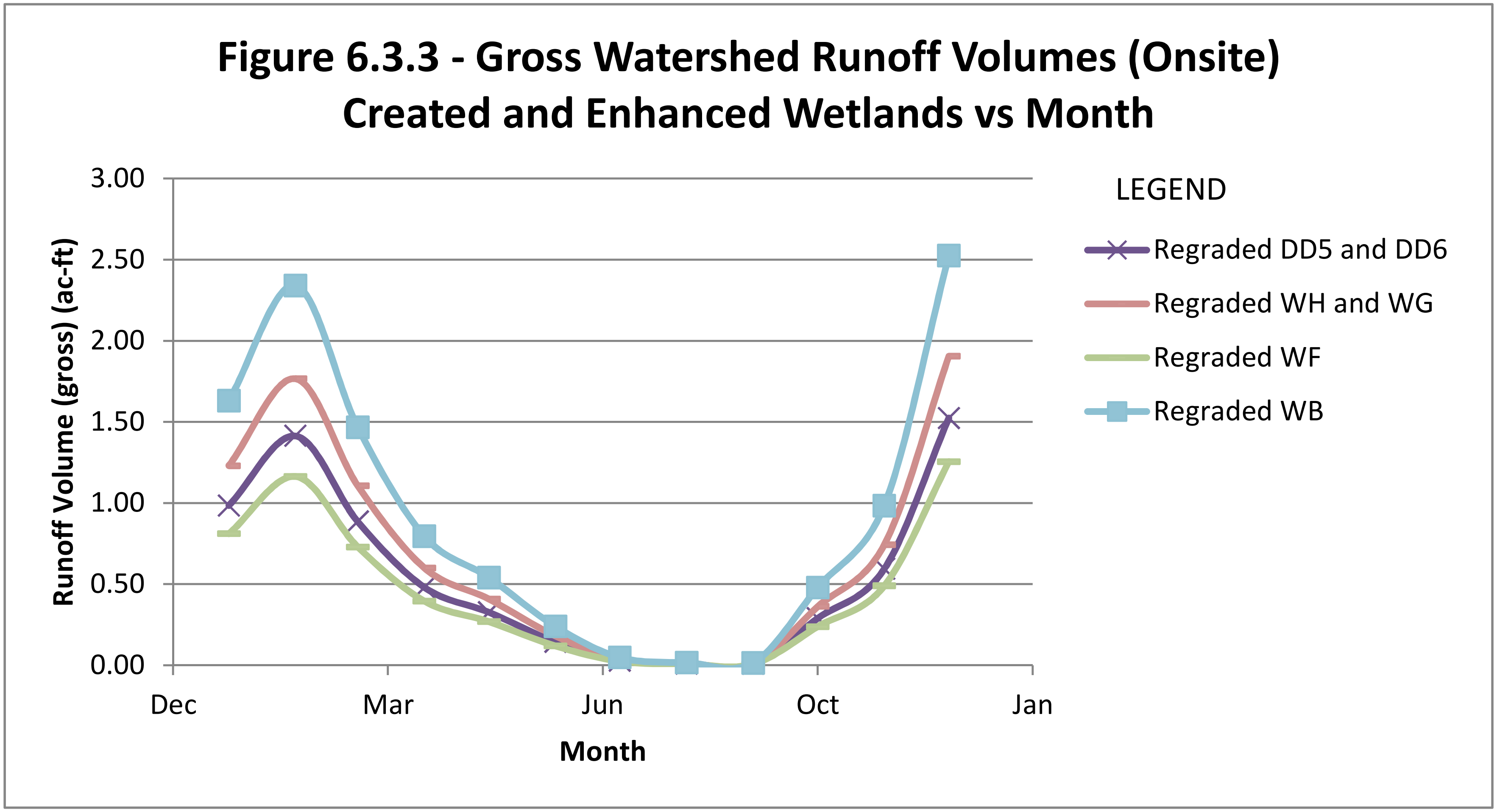


Figure 6.3.3 - Gross Watershed Runoff Volumes (Onsite)
Created and Enhanced Wetlands vs Month
Runoff Volume (gross) (ac-ft)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Dec
Mar
Jun
Oct
Jan
Month
LEGEND
Regraded DD5 and DD6
Regraded WH and WG
Regraded WF
Regraded WB

APPENDIX 6.4

Gross Watershed Runoff Volumes - from Highway 101 and the hillside west of the highway

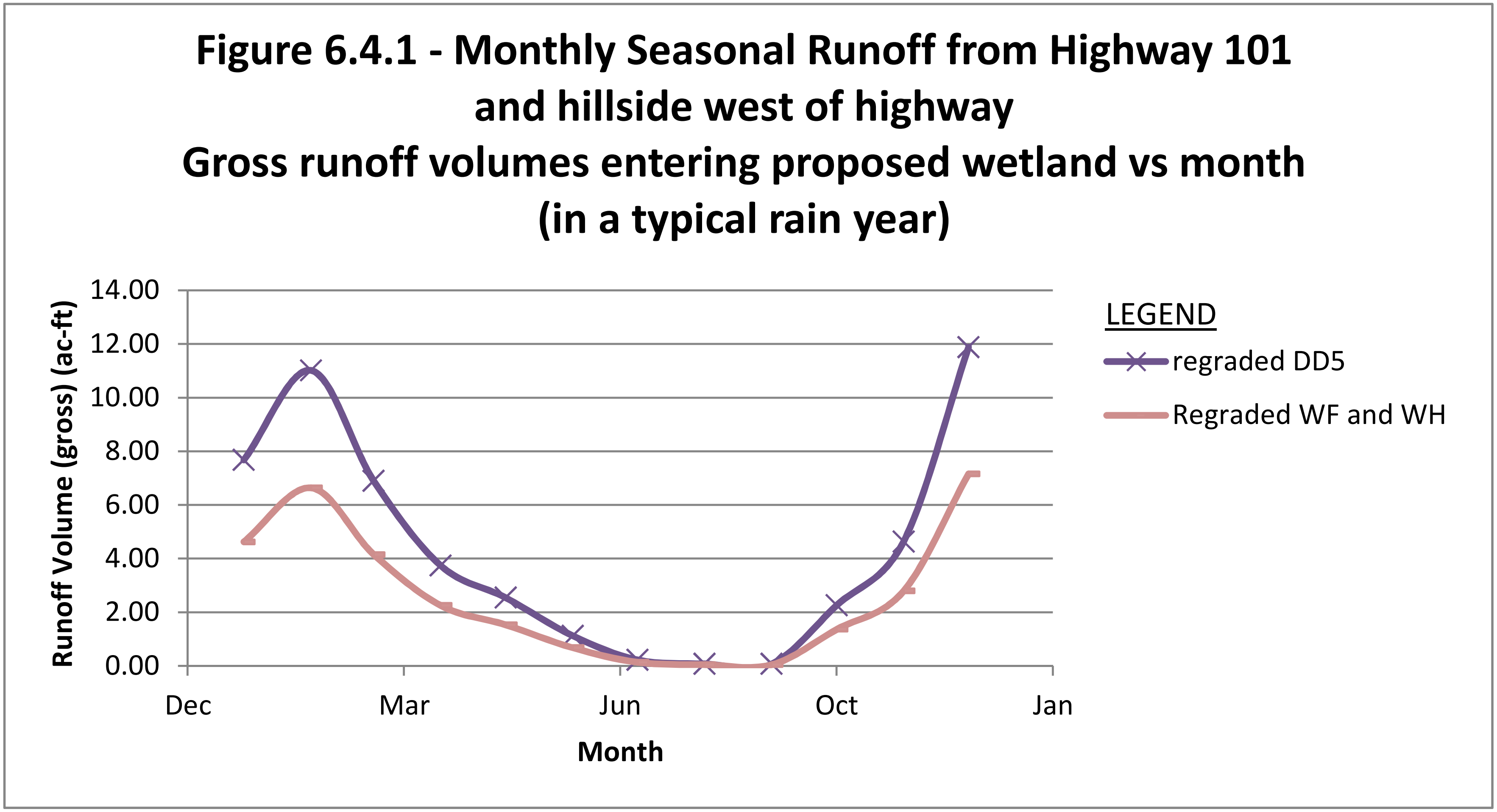


Figure 6.4.1 - Monthly Seasonal Runoff from Highway 101
and hillside west of highway
Gross runoff volumes entering proposed wetland vs month
(in a typical rain year)
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Runoff Volume (gross) (ac-ft)
Dec
Mar
Jun
Oct
Jan
Month
LEGEND
regraded DD5
Regraded WF and WH

APPENDIX 6.5

Offsite Watershed Maps

Appendix C – Establishment of winter ground-water baseline, Haystack Landing Wetland Restoration (Note that the tidal wetland portion of this report is no longer applicable. This is for salinity reference only).

Preliminary Hydrologic Evaluation of Wetland Restoration Feasibility at Haystack Landing, Petaluma, California

Prepared for:

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October 2004

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Preliminary Hydrologic Evaluation of Wetland Restoration Potential at Haystack Landing, Petaluma, California

Balance Project Assignment 204012

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1. INTRODUCTION

1.1 Background and Purpose

This study presents the results of our preliminary evaluation for restoration of brackish (oligohaline) marsh habitat at the former quarry fines disposal site in the southern part of the Haystack Landing parcel in the City of Petaluma, Sonoma County, California (Figure 1).

The project proponent wishes to restore approximately 11 acres of tidal wetlands, plus fringe buffers of brackish and freshwater wetlands at locations where water enters from adjoining uplands. Target habitat types include pickleweed (*Salicornia virginica*) dominated communities and upland refuge areas for the salt marsh harvest mouse. If feasible, restoration of a more diverse marsh which also includes stands of Pacific cordgrass (*Spartina foliosa*) and low marsh habitat suited for clapper-rail foraging will be pursued. Restoration of these habitat types and their long-term sustainability is dependent on the presence and/or creation of specific tidal and salinity regimes.

This evaluation is intended to identify the nature of existing tidal circulation at the site such that more specific restoration opportunities and constraints can be evaluated during a later phase of the project. It presents the results of field monitoring and related hydrologic analyses, and literature review to generate the necessary background data. Recommendations on how to proceed with the proposed tidal wetland restoration project are put forth in Section 3.0 of this report.

1.2 Location and Description

Haystack Landing is located at 3355 Petaluma Boulevard South in the southeast corner of the City of Petaluma (Figure 1). The 37-acre site is about 5 times longer than it is wide and extends southeast to northwest, bordered by Highway 101 on the southwest and the Northwestern Pacific Railroad (NWPRR) on the northwest, both of which extend the full length of the project site. Beyond the tracks to the east are private parcels fronting a tidal and brackish reach of the Petaluma River. Agricultural , rangeland and open space abut the southern portion of the site and wrap around the east and west sides, interrupted by Highway 101 and the railroad tracks.

Land use history at Haystack Landing is described in the Wetland Delineation report (Macmillan, 2003). The site supported a dairy operation until 1968, when it was purchased for use as a sediment collection and disposal area for aggregate wash water from the quarry located west of Highway 101. Various dikes and siltation ponds were constructed on the site for this purpose, which continued until about 1990. During this period, drainage activities and deposition of fine-grained material altered the hydrology of the site.

Wetland restoration is currently proposed on the southern portion of the site. A number of outbuildings and storage facilities formerly occupied the 4-acre northern section of the site but have recently been demolished or removed. The 33-acre southern section where tidal marsh restoration is planned will remain as open space.

1.3 Existing Wetlands

The deposition of quarry fines on former historic histosols and likely wetlands appears to have raised topographic elevations and hydrologic controls for the existing tidal channel network. Approximately 11.69 acres of jurisdictional wetlands have been delineated on the project site as confirmed by the U.S. Army Corps of Engineers on November 7, 2003 (Corps file No. 28104N). Many of these wetlands are located within the former siltation ponds and drainage ditches that were constructed as part of the industrial operations. Some of the existing wetlands (notably DD1 and DD2, see Figure 2) are part of the tidal channel network[1]. Water levels in these wetlands rise and fall in response to tidal fluctuations. During the wet season, salinities in these wetlands are likely lower from lower salinities in the Petaluma River, from local rainfall and runoff to the wetlands from upland areas, and temporary flow exchange with other on-site wetlands. Hydrologic conditions of non-tidal wetlands on-site appear to function directly by rainfall and/or stormwater runoff from non-tidal uplands.

1.4 Local Climate Characteristics

The Haystack Landing project site has climate characteristics similar to other locations on the plains surrounding the northwest corner of San Pablo Bay. In general, the site is located in the Mediterranean climate zone typical of coastal, central California. This climate zone is characterized by cool, wet winters and hot, dry summers tempered, in this case by proximity to San Pablo Bay and by the occurrence of occasional coastal fog, especially in late spring and summer. The windiest months are May and June, when turbidities in the Bay and Petaluma Creek can frequently persist at levels of 200 to 500 nephelometric turbidity units (NTUs).

---

[1] Wetland DD3 drains to an off-site pond located to the southeast of the project site (Macmillan, 2003). The main slough that accesses DD1 and DD2 via the channel southwest along the railroad tracks also flows to this off-site pond.

Situated in the 'rain shadow' of coastal mountains, the project site receives a mean annual precipitation of approximately 22 inches (Rantz, 1971). The average rainfall value is the statistical mean of rainfall totals that show a wide range of values strongly influenced by global weather patterns, such as the El Nino Southern Oscillation and prolonged periods of drought. The location of the site north and east of Bolinas and Big Rock Ridges, Mount Burdell and Chileno Valley hills, and west of the Sonoma Mountains strongly influences event totals.

1.5 Work Conducted and Methods

Staff from Balance Hydrologics, Inc. (Balance) initially walked the site on January 21, 2004 with Lucy Macmillan (independent wetlands consultant) and Sarah Lynch (Monk & Associates). About eleven inches of rain had fallen for the season and surface water had ponded on the site at several locations beyond the dry-season tidal circulation observed later that year. Sites with water that had dried later in the season included "Drainage Ditch #6" (DD6) and "Seasonal Wetlands B and I" (WB and WI), both delineated as jurisdictional wetlands under Clean Water Act (CWA) Section 404 (Macmillan, 2003). DD6 drains to DD1; WI drains to DD2 and then to the channel along the NWPRR tracks (also jurisdictional wetlands but off site); and WB drains to the NWPRR tracks channel beyond the confluence of DD2 (see Figure 2). From its mouth at the Petaluma River, tides convey flow through a short slough and a culvert under the NWPRR tracks to the project site in DD1 and DD2. Field observations indicate that the culvert is the only means through which tidal flows can access the project site, as well as drain storm flows. We measured specific conductance (a proxy for salinity) and temperature across the site with a field meter. Specific conductance ranged from 4 mmhos per centimeter at 25 degrees Celsius (mmhos/cm @ 25ºC) at WB, to 15 mmhos/cm @ 25ºC at WI.[2] All measurements and observations from this and subsequent visits are tabulated by date and time in the 'observers log' (Appendix A).

On May 7, 2004, following review of previous reports (LSA Associates, Inc., 1990), the project wetland delineation (Macmillan, 2003), and topographic mapping, we visited the site to select and install monitoring stations. During the site visit, we focused on hydrologic characteristics of existing wetlands, identification of tidal connections, flow response to tidal fluctuations in on- and off-site sloughs, and high water marks from recent high tides. Three monitoring stations at which to install continuous-monitoring equipment were selected based on their respective locations within the tidal network (Figure 2).

[2] For comparison, the specific conductance of sea water is usually given as approximately 53 mmhos/cm@25ºC, equal to 53,000 µmhos/cm@25ºC (c.f., Hem, 1985).

- **Station #1** is located beneath a privately owned bridge at the mouth of the main slough through which tidal waters flow onto and off the Haystack Landing wetland restoration site (Figure 10). The mouth of the slough is located on the right bank of the Petaluma River approximately 10 miles upstream of San Pablo Bay, Highway 37 and Black Point (Figure 1).

- **Station #2** is located on the main slough about 250 feet upstream of Station #1 at the upstream end of the culvert beneath the NWPRR tracks (Figure 11). It is at the confluence of three channels: channel DD1 which accesses the project site, and channels to the east and west along the railroad tracks. The channel extending to the east along the tracks is longer and drains jurisdictional areas DD2 and WB, and drains most of the wetland restoration area. It also conveys water to and from an off-site pond east of WB.

- **Station #3** is located on-site approximately 730 feet upstream of Station #2 in channel DD2 (Figure 12).

At each station, we installed a Campbell Scientific CR10X datalogger equipped with probes to monitor the water level (stage), specific conductance and temperature at 6-minute intervals. We installed a staff plate at each station to manually measure the stage and calibrate the continuous record downloaded from the datalogger. During a subsequent site visit we surveyed the staff plates to a benchmark elevation (NGVD [3]) identified on the site topographic map. We also calibrated the specific conductance and temperature records to field measurements conducted with a portable meter that was previously calibrated to laboratory standards.

Water levels, specific conductance and temperature were recorded by the dataloggers from May 7 to July 26, 2004. During this time period we visited the gages several times to download data and take manual readings for calibrating the continuous record. Wet-season ponding progressively diminished into the summer, leaving only DD1 and DD2 with tidally inundated water. Two complete 28-day tidal cycles were monitored, including the highest tides of the dry season. On July 26, 2004, we removed the monitoring equipment but left the staff plates in place in the event that additional monitoring is warranted. We processed the raw datalogger data and converted the stage record to elevations based on survey data. Based on errors inherent in calibrating wind-blown water data and in conducting the surveys, we estimate that the accuracy of the water-surface elevation values presented in this report are within +/- 0.05 feet.

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[3] All elevations cited in this report are given in the National Geodetic Vertical Datum of 1929 (NGVD) unless otherwise noted.

Data were further reduced to present statistical elevations of key tidal metrics -- mean higher high water (MHHW) and mean high water (MHW) -- calculated over a representative 28-day cycle during the monitoring period, June 10 through July 7, 2004, as well as the frequency of inundation at these target elevations. A frequency of inundation from 18 and 5 percent at MHW and MHHW elevations, respectively, are standard criteria to support pickleweed habitat.

1.6 Existing Gages on the Petaluma River

The locations of gages used in planning the Haystack Landing wetland restoration on the Petaluma River are shown on Figure 1. The closest active gage is the Petaluma River at D Street Bridge (Station PTB), maintained by the City of Petaluma and California Department of Water Resources. We used the record for this long-term station to compare to water levels monitored on site. Water level monitoring at the three National Ocean Service tidal stations[4] shown in Figure 1 have been discontinued, and datum elevations are maintained using correlations to San Francisco Golden Gate gage.

[4] A division of National Oceanic and Atmospheric Administration.

2. HYDROLOGIC FINDINGS

Results of our monitoring program are presented graphically in Figures 3 through 9. Table 1 presents statistical elevations of tidal crests and other key metrics at each monitoring station, and Table 2 presents the frequency of inundation. Field measurements and observations are included in Appendix A.

2.1 Tidal Elevations at Haystack Landing and Petaluma River

Water-level elevations at the three monitoring stations on Haystack Landing wetlands restoration site and in the Petaluma River are presented in Figure 3, 4 and 5. Figure 3 shows the tidal record for the three stations during the entire monitoring period, from May 7 to July 26, 2004, and Figure 4 shows the tidal record during the same period at the Petaluma River at the D Street Bridge station, located approximately two miles up river. We selected the consecutive 28-day period with the highest seasonal tidal peaks – from June 10 through July 7 – to calculate the Mean High Water (MHW) and Mean Higher High Water (MHHW), and percent time of tidal inundation. The tidal elevation statistics are presented for each station in Table 1.

The tidal peaks are more muted at Stations #2 and #3 on-site (showing lower peaks) than at Station #1 at the mouth of the slough (Figure 3). This difference is detailed in the 48-hour plot of the highest tides of the season, July 2 to 4 (Figure 5) – illustrating muted and delayed peaks at Stations #2 and #3. We attribute this response to clogging of the old wooden box culvert beneath NWPRR tracks by sediment, aquatic growth and floating debris. During a site visit at low tide when the channel was nearly drained, we observed accumulated mud in the lower portion of the culvert and considerable growth of barnacle-like marine life on the insides the culvert (see photo Figure 11). The growth also appears to obstruct floating debris. The rising tide clearly backed up downstream of the culvert and drained upstream water at the latter portion of the downstream receding tide.

The lower low water (LLW) elevation of each day are not present on site because the channel elevations are higher than the elevation of the tidal low water, and appear truncated in the water level record. For example, at the lowest tides of each day, the bed is exposed at the mouth of the slough immediately downstream of Station #1 with only a trickle flowing out to the Petaluma River, which is at an even lower level. In the record at Station #1 the LLW elevations are at the same level each day (Figure 3), as they also are at Station #2, as would be expected. At Station #3 in DD2, both low tide elevations (the lower low water and the low water) are truncated. Truncation for Station #3 is at a much higher elevation because the bed elevation is higher, well above the low tides. The truncated record from the Petaluma River D Street gage seems to be due to instrumentation placement rather than bed elevation; the sensor appears not to be placed at bed level.

2.2 Height-Duration Relationships

Exceedance plots are used to evaluate the hydrologic performance of sloughs and tidal marshes. These curves show the percent of time that a given water elevation is equaled or exceeded, and demonstrate tidal heights and circulation patters. The success and long-term sustainability of tidal marsh plant and animal communities are strongly influenced by tidal elevations, thus, mitigation plans typically prescribe the percent of time at which particular elevations should be inundated, depending on habitat goals. As an example, optimal elevations for pickleweed colonization range between MHW and MHHW. To create a diverse tidal marsh community with upland refuge zones and deeper water, one might grade the portions of site such that there is a range of elevations. In such a system, given current conditions, the area planned for pickleweed habitat would be at an elevation ranging between MHW and MHHW. Based on the data we collected at stations #2 and #3, we would expect these elevations to be inundated about 18 to 6 percent of the time.

Table 2 and Figure 6 show the duration of inundation at all four stations during the seasonal high-tide monitoring index period of June 10 through July 7, 2004. At Stations #2 and #3, the range of elevations between MHW and MHHW is inundated 18 to 6 percent of the time. In contrast, the MHW to MHHW elevation range at Station #1 is inundated only 13 to 5 percent of the time. After repairing the flow-constraining culvert, inundation frequencies on site should resemble Station #1. These statistics describing existing conditions – or existing conditions with only culvert repair -- will be especially useful during development of more detailed plans and grading specifications.

2.3 Specific Conductance

We measured specific conductance (a proxy for salinity) across the site on our January 21, 2004 initial site visit, and field values ranged from 4 mmhos per centimeter at 25 degrees Celsius (mmhos/cm @ 25C) at WB, to 15 mmhos/cm @ 25C at WI (see Appendix A for details). Tidally influenced wetland DD1 was 5.6 mmhos/cm @ 25C, and DD2 was 6.9 mmhos/cm @ 25C. As the dry season progressed, specific conductance of the tidal waters entering the site from the Petaluma River increased as increasing proportions of sea water advanced upstream from San Pablo Bay. Specific conductance increased at Station #1 (at the mouth of the slough) from about

18 mmhos/cm @ 25C in early June to about 37 mmhos/cm @ 25C by late July (Figure 7). A similar trend was observed on site at Station #2 and #3 (Figures 8 and 9).

3. CONCLUSIONS AND RECOMMENDATIONS

All tidal drainage at Haystack Landing appears to flow through a single slough system. Balance staff established two monitoring stations in this channel network within the boundaries of the Haystack Landing project site, as well as one station immediately off-site, at the mouth of the tidal slough. At each station we monitored water level, water temperature and specific conductance (a proxy for salinity) during a nearly three-month observation period (from May 7 through July 26, 2004) including two complete 28-day tidal cycles and the highest tides of the dry season. Tidal circulation on the project site is muted by the partially blocked culvert under the Northwestern Pacific Railroad that forms the project's eastern border. Replacement of the partially blocked culvert would allow sufficient tidal flows to enter the site, thus creating one of the essential conditions necessary to restore tidal wetlands. We recommend culvert replacement as part of the mitigation plan.

The site shows excellent hydrologic potential to support a diverse tidal marsh community with long-term sustainability. The timing, capacity and logistics related to replacement of the NWPRR culvert may guide restoration decisions, and should precede development of grading plans for wetland restoration and creation. Similarly, assessment of water quality and the physical and chemical properties of the deposited sediment – to be considered in a subsequent phase -- will also shape the feasibility of restoration. We look forward to discussing with the ecological team the attributes which enhance the distribution of pickleweed or other tidal wetland types.

4. LIMITATIONS

This report was prepared in general accordance with the accepted standard of practice for initial evaluation of such sites in northern California for projects of similar scale at the time the investigations were performed. No other warranties, expressed or implied, are made.

As is customary, we note that readers should recognize that the interpretation and evaluation of factors affecting the hydrologic context of any site is a difficult and inexact art. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the conditions present. More extensive or extended studies can reduce the inherent uncertainties, but may delay implementation of the project.

We have used standard environmental information -- such as wetland and topographic mapping -- in our analyses and approaches without verification or modification, in conformance with local custom. New information or changes in regulatory guidance could influence the plans or recommendations, perhaps fundamentally. As updated information becomes available, the interpretations and recommendations contained in this report may warrant change. Further assessment of the properties of sediments at the site will also be needed.

Concepts, findings, interpretations and recommendations contained in this report are intended for the exclusive use of our client under the conditions presently prevailing at Haystack Landing. Their use beyond the boundaries of the site could lead to environmental or structural damage, and/or to noncompliance with water-quality policies, regulations or permits.

Finally, we ask once again that readers who have additional pertinent information, who observed changed conditions, or who may note material errors should contact us with their findings or concerns at the earliest possible date, so that timely changes may be made.

5. REFERENCES

Baye, P.R., Faber, P.M., Grewell, B., 2000, Tidal marsh plants of the San Francisco Estuary: in Goals--Project 2000, Baylands ecosystem species and community profiles: Life histories and environmental requirements of key plants, fish and wildlife, prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project, Olofson, P.R. (Ed.), San Francisco Bay Regional Water Quality Control Board, Oakland California, p. 9-33.

Hem, J.D.,1985, Study and interpretation of the chemical characteristics of natural water: U.S. Geol. Survey Water-Supply Paper 2254, 3rd ed. , 264 p.

LSA Associates, Inc., 1995, Determination of Corps jurisdictional area, Haystack Landing, Petaluma: Consulting report prepared for Haystack Landing Associates (included as appendix to Macmillan, 2003), 13 p. + appendices.

Macmillan, L., 2003, Clean Water Act jurisdictional wetlands assessment, Haystack Landing project site, Petaluma, Sonoma County, California: Consulting report prepared for Pagliaio Ventures, LLC, submitted to U.S. Army Corps of Engineers, 10 p. + appendices.

Pacific Aerial Surveys, Marsh 1, 1958, black and white aerial photo of site, scale 1:2400

Rantz, S.E., 1971, Precipitation depth-duration frequency relations for the San Francisco Bay region, California. Menlo Park: U.S. Geological Survey Map MF-613 plus 24 p. pamphlet.

Steven J. Lafranchi & Associates, March 9, 2004, Site constraints exhibit: Topographic survey map prepared for Dutra-Haystack Landing asphalt and recycling facility, Petaluma Boulevard South, APN 019-320-022, 023, Petaluma, California, sheet 1, scale 1″=140′

TABLES

Table 1. Tidal elevation statistics at Haystack Landing wetland restoration site and Petaluma River, Petaluma, CA

	Petaluma River at D Street Bridge [1] *(feet, NGVD)*	Haystack Station #1: Mouth of slough at bridge *(feet, NGVD)*	Haystack Station #2: Slough above train tracks *(feet, NGVD)*	Haystack Station #3: Jurisdictional area DD2 *(feet, NGVD)*
Mean Higher High Water (MHHW)	5.11	4.16	3.47	3.41
Mean High Water (MHW)	4.44	3.49	3.06	---
Mean Low Water (MLW)	---	-1.86	-1.16	---
Mean Lower Low Water (MLLW)	---	---	---	---

Notes:

1. California Department of Water Resources Petaluma River At D Street Bridge (PTB) station is operated by the City of Petaluma. The data are reported in feet above the 1929 National Geodetic Vertical Datum (NGVD) and recorded at variable intervals. Some high water levels conceivably may have occurred between long time-interval readings.

2. Haystack Landing statistics were based on a continuous water-level monitoring record from June 10 through July 7, 2004.

3. Tidal statistics were not calculated where channel elevations were above tide levels. For example, the elevation of the lower low water (LLW) trough for each day was not recorded at the monitoring stations because the channel elevations were higher than the LLW elevations which truncated the record.

Table 2. Tidal peaks and percent of time exceeded at Haystack Landing wetland restoration site, Petaluma, CA

Station Location	Elevation range from MHW to MHHW[1] *(feet, NGVD)*	Percent of time exceeded
Petaluma River at D Street Bridge[2]	4.44 to 5.11	9 to 4%
Haystack Landing[3]		
Mouth of slough at bridge	3.49 to 4.16	13 to 5%
Slough above train tracks culvert	3.06 to 3.47	18 to 7%
Jurisdictional area DD2[4]	3.41	6%

Notes:

1. Elevation range of interest for pickleweed is Mean High Water (MHW) to Mean Higher High Water (MHHW) having a inudation range from 18 to 5 percent.
2. California Department of Water Resources Petaluma River At D Street Bridge (PTB) station is operated by the City of Petaluma. The data are reported in feet above the 1929 National Geodetic Vertical Datum (NGVD) and recorded at variable intervals. Some high water levels conceivably may have occurred between long time-interval readings.
3. Haystack Landing statistics were based on a continuous water-level monitoring record from June 10 through July 7, 2004.
4. Channel elevation of jurisdictional area DD2 is above the Mean High Water (MHW) tide and thus cannot be calculated.

FIGURES

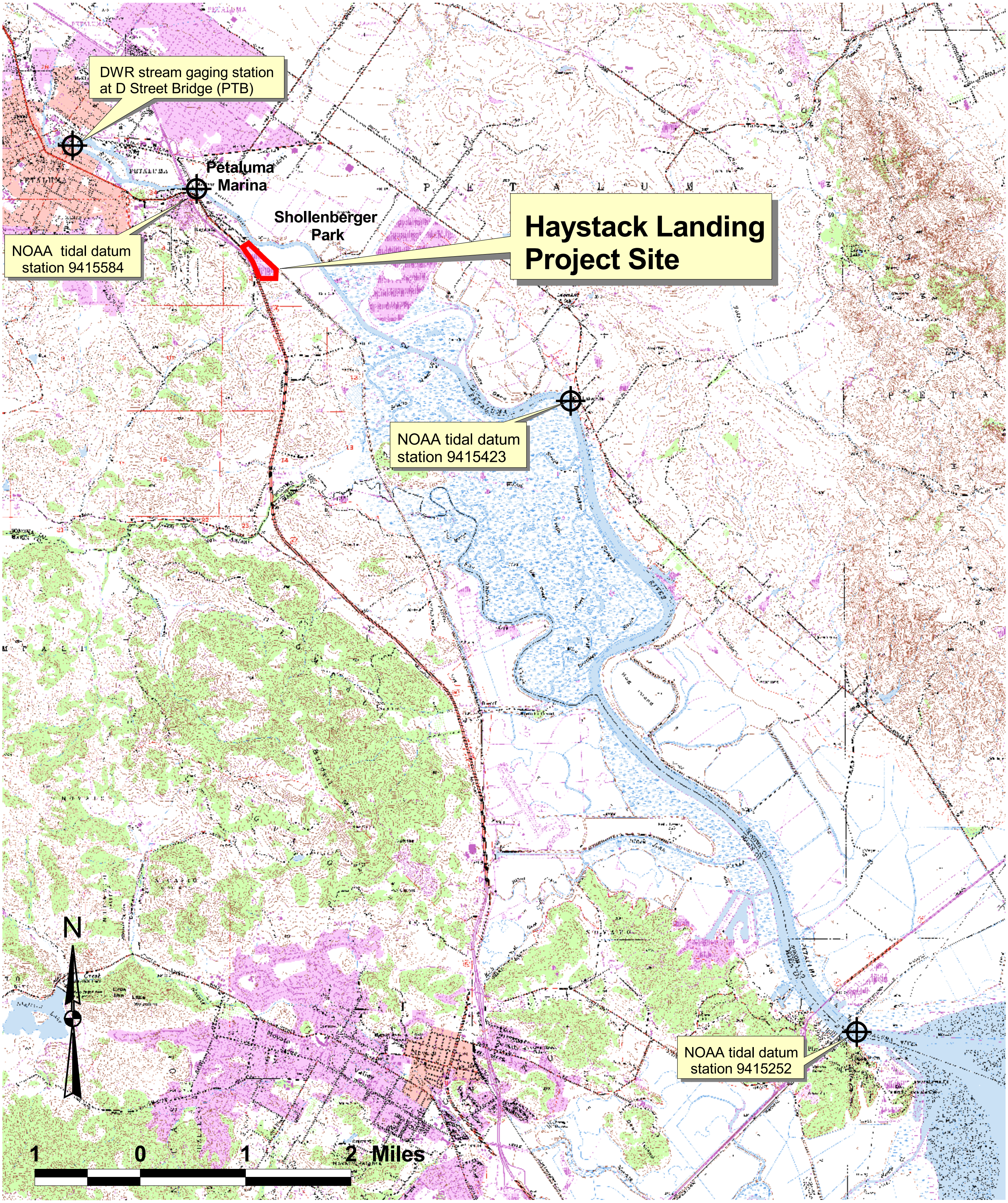

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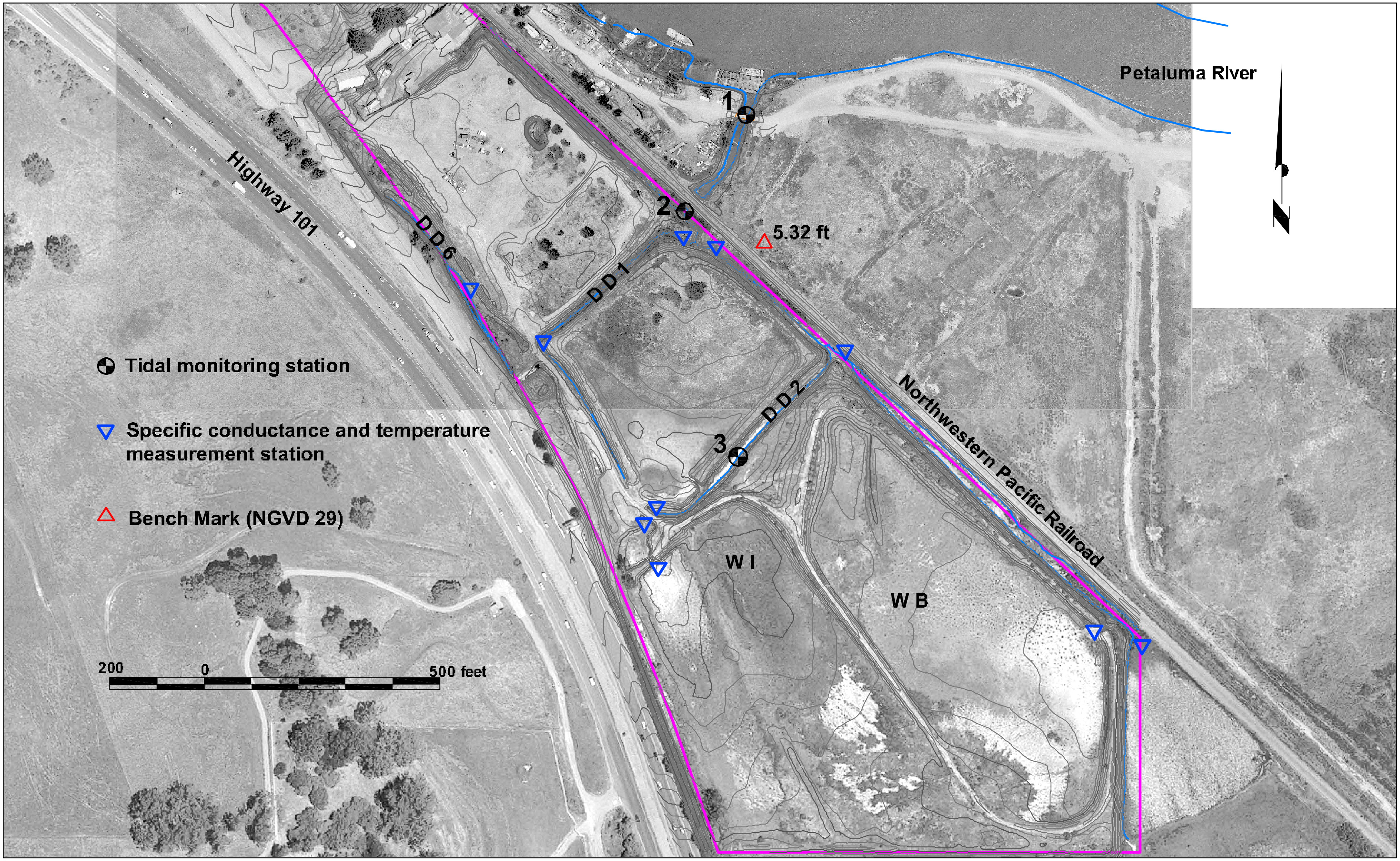
Figure 1. **Location map of Haystack Landing project site, tidal datum and stream gaging stations, Sonoma County, California**

204012 haystack.apr

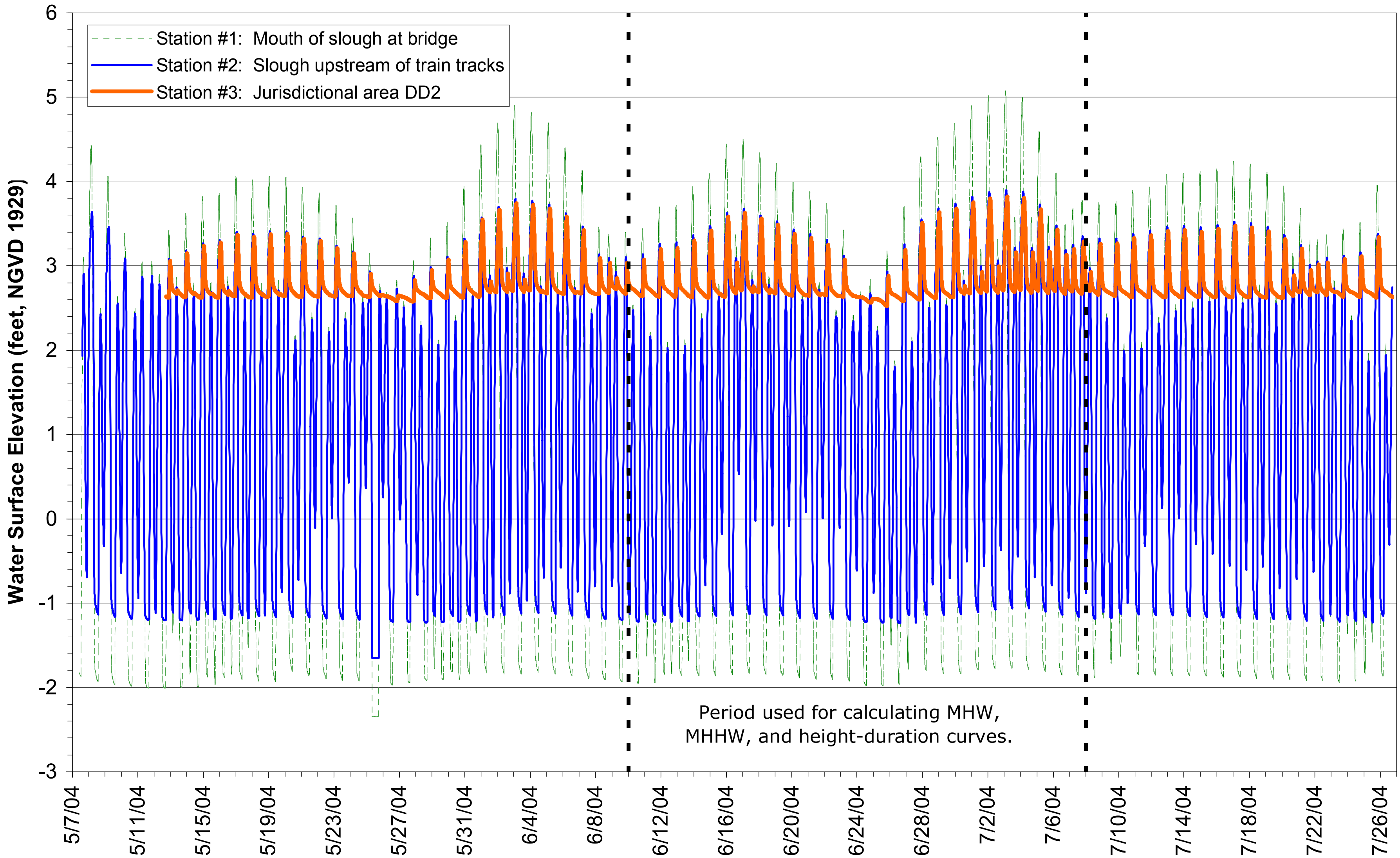


Source of map and aerial photo: Steven J. Lafranchi & Associates, Inc. Civil Engineers-Land Surveyors, Petaluma California

Figure 2. Existing site plan and locations of monitoring stations, Haystack Landing, Petaluma, California.

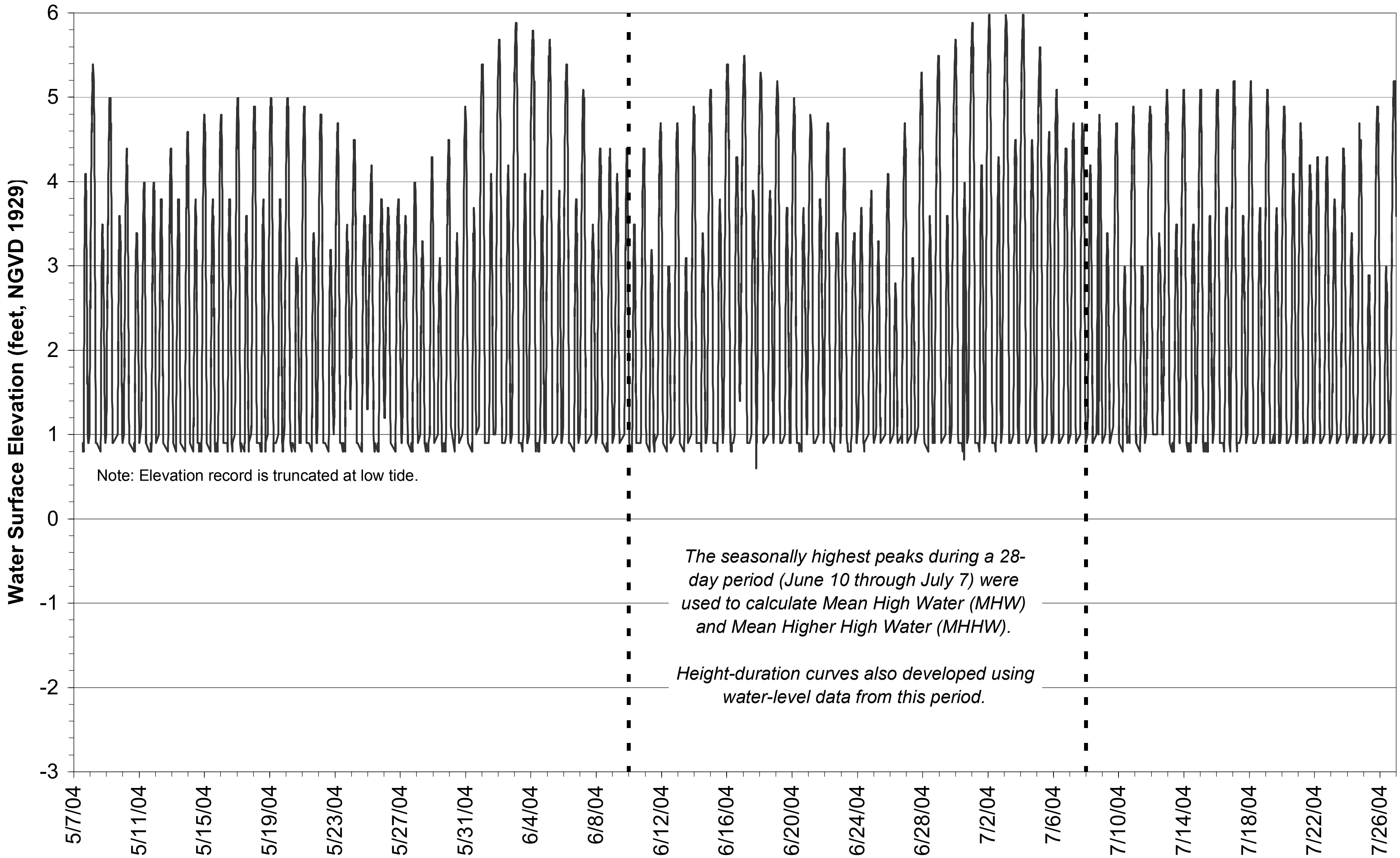
Balance Hydrologics, Inc.

204012 Loc Map.dwg



Balance Hydrologics, Inc.

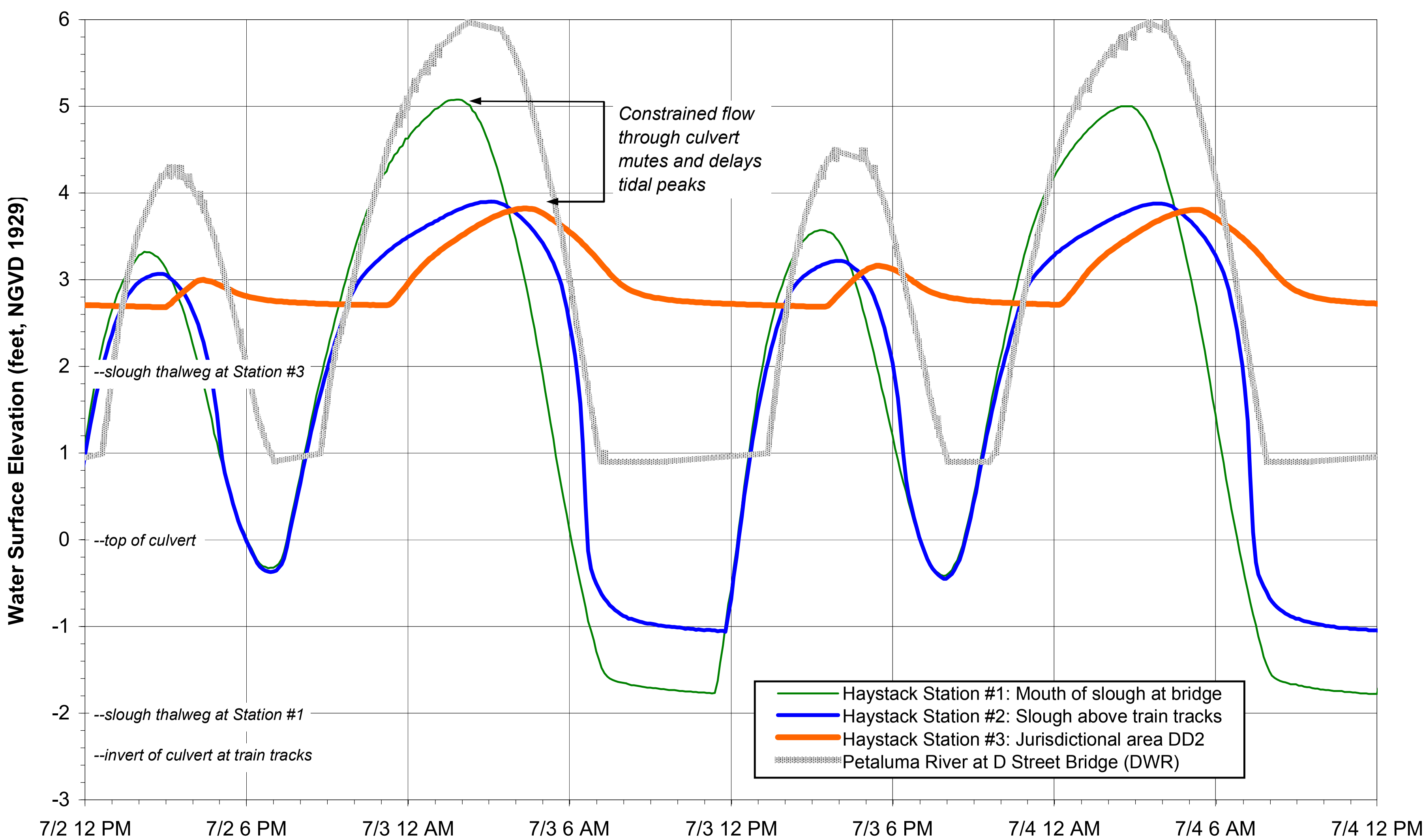
Figure 3. Water surface elevations at tidal monitoring stations installed on the Haystack Landing wetland restoration site, May 7 to July 26, 2004, Petaluma, CA.
Mean High Water (MHW) and Mean Higher High Water (MHHW) elevations were calculated for each station using the seasonally highest peaks during a 28 day period (June 10 through July 7).



Balance Hydrologics, Inc.

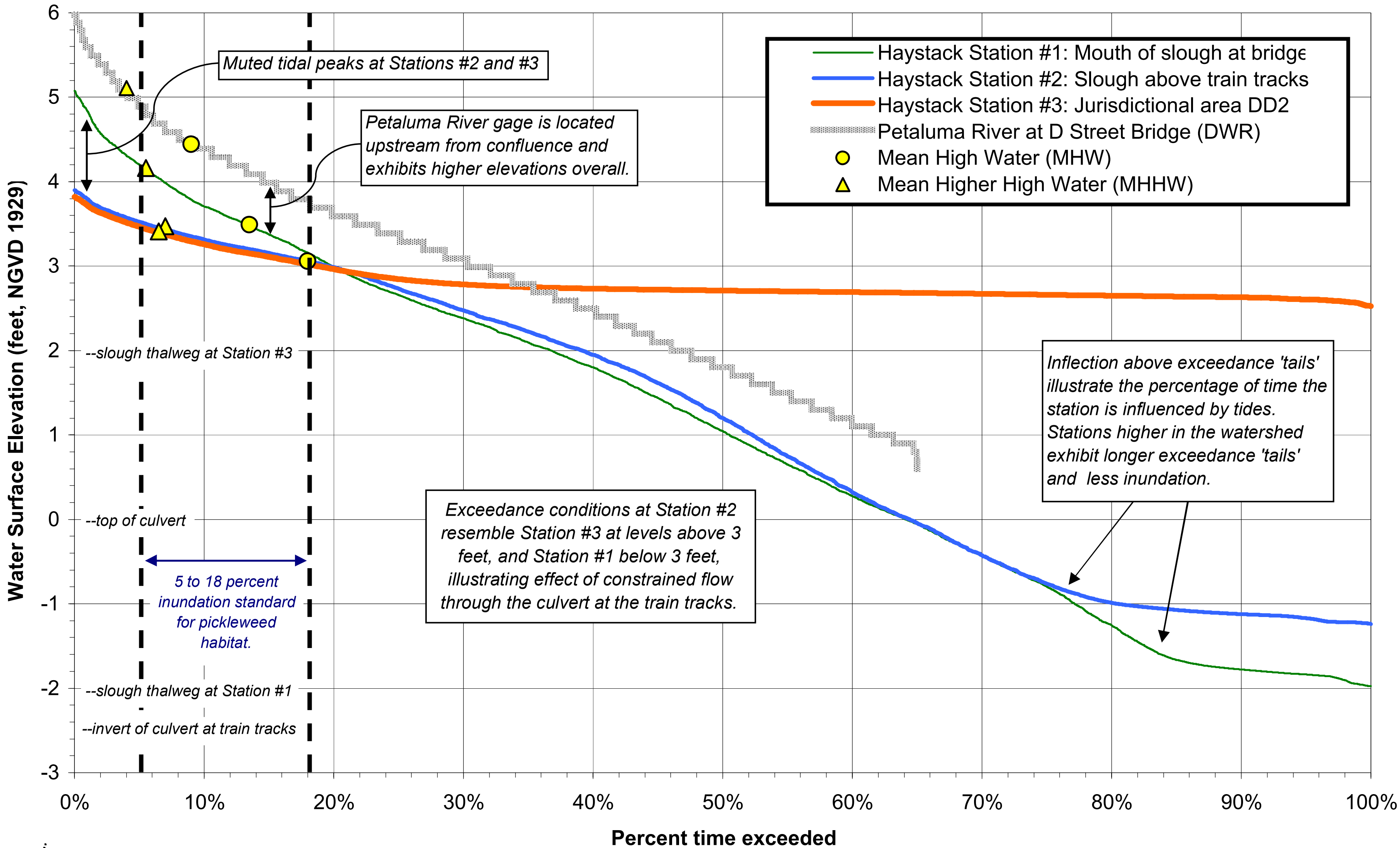
Figure 4. Petaluma River water surface elevations at the D Street Bridge gaging station during tidal monitoring on the Haystack Landing wetland restoration site, May 7 to July 26, 2004, Petaluma, CA.

Data source: California Department of Water Resources gaging station PTB.



Balance Hydrologics, Inc.

Figure 5. Elevation of the Petaluma River and tidal drainages at Haystack Landing wetland restoration site during the highest seasonal tides, July 2 to 4, 2004, Petaluma, CA. The clogged culvert beneath the train tracks constrains tidal circulation onto the restoration site west of the tracks, as evidenced by the broad lower peaks at Stations #2 and #3, delaying filling and draining.



Balance Hydrologics, Inc.

Figure 6. Height-duration curves for the Petaluma River and gaging stations on Haystack Landing wetland restoration site, June 10 to July 7, 2004, Petaluma, CA.
Mean tidal peaks (MHW and MHHW elevations) are plotted on each station curve to illustrate exceedance ranges and characterize hydrologic conditions for each channel.

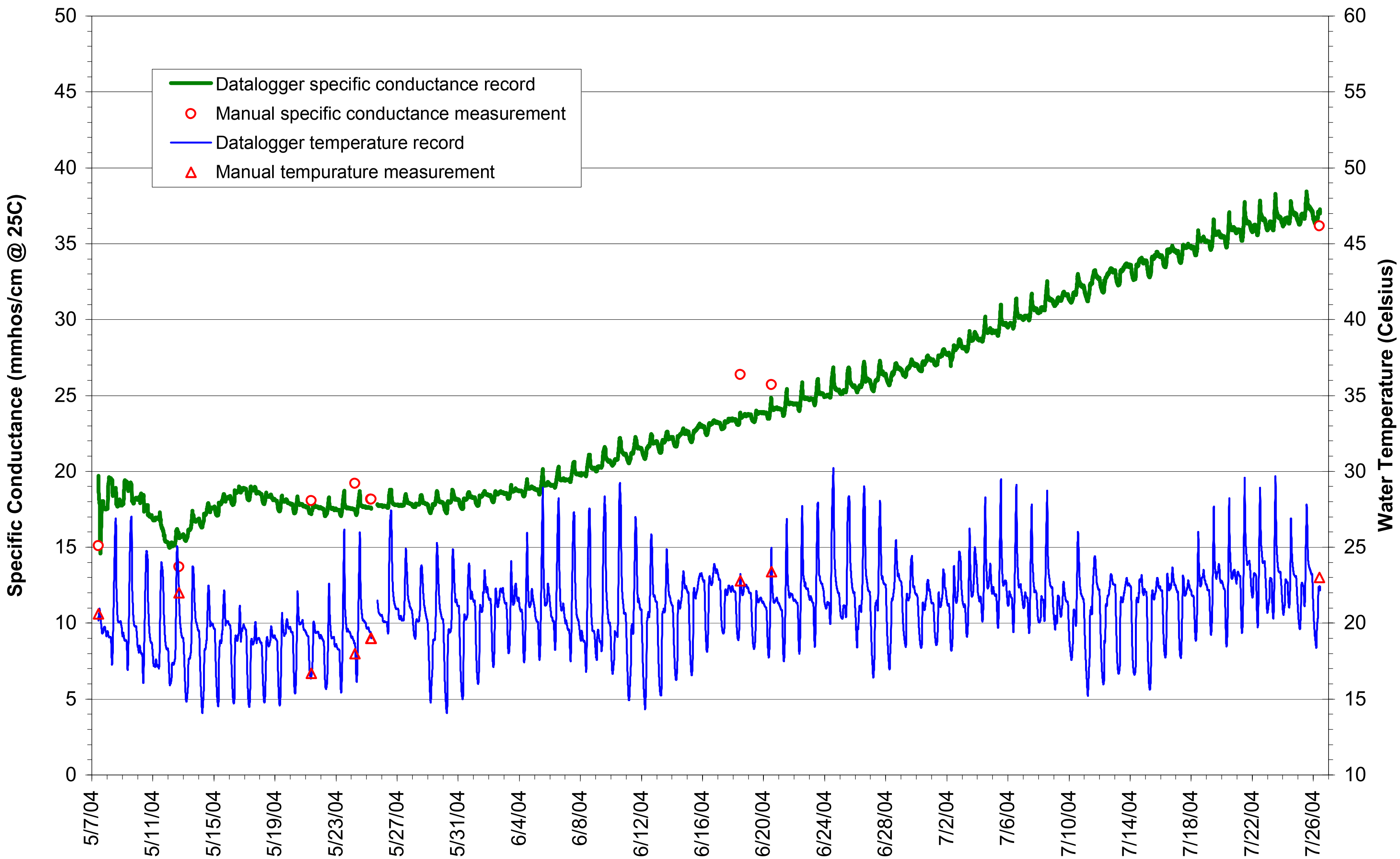


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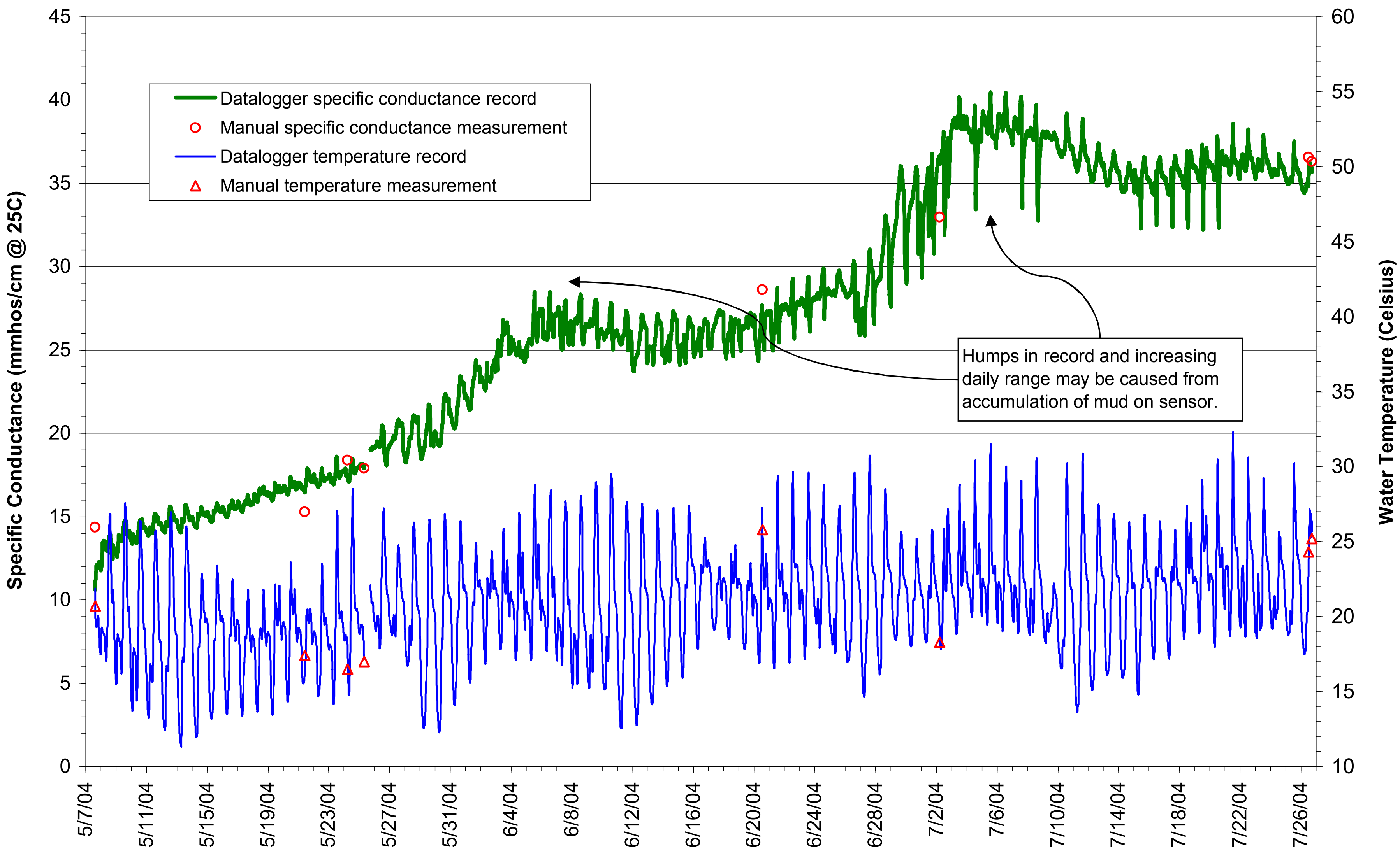
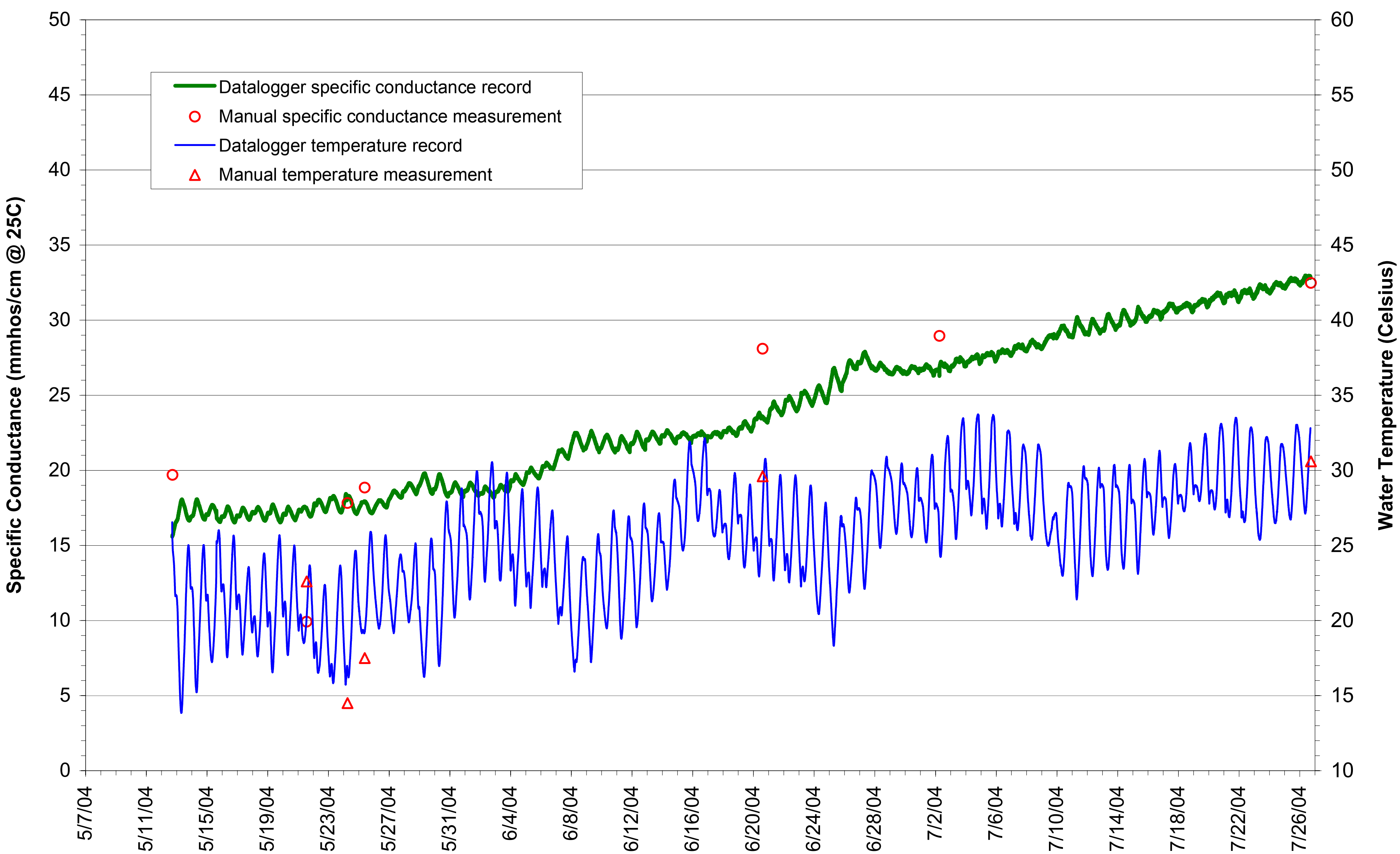
Figure 7. Specific conductance and water temperature at monitoring station #1, mouth of slough connecting Haystack Landing wetland restoration site with Petaluma River, May 7 to July 26, 2004, Petaluma, CA. Specific conductance is responding to receding streamflow in the Petaluma River and seasonally increasing proportions of sea water advancing upstream from San Pablo Bay.

204012 Haystack 1 datalogger record.xls, Figure 7, 10/10/2004



Balance Hydrologics, Inc.

Figure 8. Specific conductance and water temperature at monitoring station #2, upstream of culvert beneath train tracks on slough connecting Haystack Landing wetland restoration site with Petaluma River, May 7 to July 26, 2004, Petaluma, CA. Specific conductance is responding to receding streamflow in the Petaluma River and seasonally increasing proportions of sea water advancing upstream from San Pablo Bay.



Balance Hydrologics, Inc.

Figure 9. Specific conductance and water temperature at monitoring station #3, jurisdictional area DD2 on Haystack Landing wetland restoration site, May 7 to July 26, 2004, Petaluma, CA. Specific conductance is responding to receding streamflow in the Petaluma River and seasonally increasing proportions of sea water advancing upstream from San Pablo Bay.

← View of the channel upstream of Station #1 located at the bridge in the distance. *Photo taken at train tracks looking downstream towards the Petaluma River.*

Gaging Station #1 →

Balance Hydrologics, Inc.

Figure 10. Photos of gaging Station #1 located at the mouth of the slough connecting Haystack Landing wetland restoration site with Petaluma River, Petaluma, CA.

High tide, train tracks seen in distance ↑

Culvert seen at low tide →

Balance Hydrologics, Inc.

Figure 11. Photos of gaging Station #2 located upstream of the culvert beneath the train tracks on the slough connecting Haystack Landing wetland restoration site with Petaluma River , Petaluma, CA.

Balance Hydrologics, Inc.

Figure 12. Photos of gaging Station #3 located in jurisdictional wetland DD2 on Haystack Landing wetland restoration site, Petaluma, CA.

APPENDICES

APPENDIX A

Station Observer Log 2004: Haystack Landing Wetland Restoration Site, Petaluma, California

Appendix A. Station observer log 2004: Haystack Landing wetland restoration, Petaluma, California.

Site Conditions						Datalogger Readings				High-Water Marks	Water Quality Measurments			Remarks
Observer Date Time (DST)	Datalogger Date Time (PST)	Observer	Stage	Stage NGVD29 Elevation	Hydrograph	Pressure Transducer #1	Pressure Transducer #2	Field Specific Conductance	Water Tempurature	Estimated stage at staff plate	Water Temperature	Field Specific Conductance	Adjusted Specific Conductance	
(mm/dd/yr hh:mm)	*(mm/dd/yr hh:mm)*		*(feet)*	*(feet)*	*(R/F/S/B)*	*(feet)*	*(feet)*	*(µmhos/cm)*	*(oC)*	*(feet)*	*(oC)*	*(µmhos/cm)*	*(at 25 oC)*	
GAGING STATION #1: Mouth of slough at bridge														
5/7/04 11:30	5/7/04 10:30	gp, bm, mw	0.53	-1.81	F	0.422	0.335	14230	20.5		20.6	13830	15090	installed datalogger; set at standard time; GPS N38 13.225, W122 36.095, 14 ft accuracy
5/7/04 12:40	5/7/04 11:40	gp, bm, mw	0.50	-1.84		0.395	0.307	13537	20.7					
5/12/04 18:24	5/12/04 17:24	mw	0.90	-1.44	R	0.919	0.834	12100	21.6		22.0	13000	*13719*	downloaded data
5/21/04 9:56	5/21/04 8:59	gp, mw	0.53	-1.81	F	0.410	0.324	11813	16.6		16.7	15210	*18070*	downloaded data; level survey; 0 on staff plate = -2.34 feet elev
5/21/04 12:18	5/21/04 11:21	gp, mw	0.52	-1.82	F	0.409	0.323	12420	18.0					width of water surface = 3.15 feet
5/24/04 5:45	5/24/04 4:45	mw	5.34	3.00	F	5.295	5.226	12570	18.8					
5/24/04 5:50	5/24/04 4:50	mw	5.32	2.98	F	5.211	5.142	12580	18.8					
5/24/04 6:43	5/24/04 5:43	mw	4.25	1.91	F	4.105	4.032	12577	18.8		18.0	16500	*19195*	downloaded data
5/25/04 7:52	5/25/04 6:52	gp, mw	3.41	1.07	F	3.269	3.194	12813	19.4		19.0	16000	*18153*	downloaded data; resurveyed staff plate
5/25/04 8:36	5/25/04 7:36	gp, mw	2.55	0.21	F	2.472	2.394	12700	19.2		19.0	16000	*18153*	downloaded data; resurveyed staff plate
6/18/04 12:52	6/18/04 11:49	gp	2.65	0.31	F	2.592	2.514	18188	23.0		22.8	25280	*26370*	Did not download data
6/20/04 13:42	6/20/04 12:39	gp	2.00	-0.34	R	1.950	1.869	19055	24.0		23.4	24890	25700	
7/2/04 6:10	7/2/04 5:07	gp	2.38	0.04	F	2.281	2.198	19377	19.8					
7/2/04 7:19	7/2/04 6:16	gp	0.88	-1.46	F	0.762	0.676	18753	18.6					
7/26/04 11:02	7/26/04 9:59	gp	3.49	1.15	R	3.475	3.399	27348	22.5		23.0	34750	*36150*	
GAGING STATION #2: Main branch of slough above train tracks culvert														
5/7/04 15:49	5/7/04 14:49	gp, bm, mw	3.86	2.02	R	3.741	3.727	12177	20.9		20.7	13150	14370	installed datalogger; set at standard time; GPS N38 13.193, W122 36.120, 13 ft accuracy
5/7/04 15:55	5/7/04 14:55	gp, bm, mw	3.99	2.15	R	3.834	3.819	12160	20.6					
5/12/04 17:52	5/12/04 16:52	mw	0.66	-1.18	F	0.457	0.446	16620	24.7					half of wood box culvert exposed showing barnacle-like growth blockage; downloaded data
5/21/04 10:59	5/21/04 10:03	gp, mw	0.71	-1.14	F	0.524	0.511	15280	17.0	3.75, 5.20	17.4	13050	15270	downloaded data; level survey; 0 on staff plate = -1.84 feet elev
5/21/04 13:08	5/21/04 12:12	gp	0.68	-1.16	R	0.495	0.484	16460	19.4					
5/24/04 5:54	5/24/04 4:58	mw	4.90	3.06	F	4.734	4.717	16630	19.1					
5/24/04 6:23	5/24/04 5:27	mw	4.71	2.87	F	4.513	4.496	16465	18.7					
5/24/04 6:24	5/24/04 5:28	mw	4.70	2.86	F	4.502	4.485	16460	18.7		16.5	15200	*18372*	downloaded data
5/24/04 6:27	5/24/04 5:31	mw	4.68	2.84	F	4.468	4.450	16445	18.7					
5/25/04 9:00	5/25/04 8:00	gp, mw	1.66	-0.18	F	1.485	1.470	16520	17.9		17.0	15000	*17899*	downloaded data
6/20/04 14:14	6/20/04 13:12	gp	2.40	0.56	F	2.207	2.192	26280	25.6		25.8	29030	28600	
7/2/04 6:34	7/2/04 5:32	gp	2.95	1.11	F	2.777	2.759	30520	19.4		18.3	28720	32970	
7/26/04 11:23	7/26/04 10:21	gp	2.71	0.87	R	2.577	2.557	30485	20.8					
7/26/04 12:49	7/26/04 11:47	gp	2.03	0.19	R	1.854	1.834	32243	23.0		24.3	36180	*36560*	
7/26/04 18:19	7/26/04 17:17	gp	4.47	2.63	R	4.374	4.353	34497	25.6		25.2	36490	*36320*	

Site Conditions						Datalogger Readings				High-Water Marks	Water Quality Measurments			Remarks
Observer Date Time (DST)	Datalogger Date Time (PST)	Observer	Stage	Stage NGVD29 Elevation	Hydrograph	Pressure Transducer #1	Pressure Transducer #2	Field Specific Conductance	Water Tempurature	Estimated stage at staff plate	Water Temperature	Field Specific Conductance	Adjusted Specific Conductance	
(mm/dd/yr hh:mm)	(mm/dd/yr hh:mm)		(feet)	(feet)	(R/F/S/B)	(feet)	(feet)	(µmhos/cm)	(oC)	(feet)	(oC)	(µmhos/cm)	(at 25 oC)	
Lower jurisdictional area DD1														
5/7/04 14:15		gp, bm, mw			F						18.4	11300	12930	
Upper jurisdictional area DD1														
1/21/04 0:00		lm, bh, mw									15.0	4500	*5655*	
		mm, ns, mw									12.0	4600	*6258*	
5/7/04 13:10		gp, bm, mw			-									damp
Jurisdictional area DD6														
		mm, ns, mw									12.0	3400	*4626*	above culvert to DD1
5/7/04 13:00		gp, bm, mw			-						17.1	1473	1733	isolated pool; depth about 12";
Petaluma Blvd. box culvert														
5/7/04 13:00		gp, bm, mw												culvert is dry
Main branch slough above DD1 confluence														
5/7/04 14:03		gp, bm, mw			F						21.1	15170	16370	
GAGING STATION #3: Jurisdictional area DD2														
5/7/04 16:57		gp, bm, mw	5.14	2.67	R									installed staff plate; GPS N38 13.105, W122 36.097, 15 ft accuracy
5/12/04 17:30	5/12/04 17:30	mw	5.11	2.64	F	0.715	0.942	18250	22.5	5.54	30.0	22000	*19700*	installed datalogger; set at daylight-savings time
5/21/04 12:33	5/21/04 12:33	gp, mw	5.16	2.69	F	0.772	0.947	16745	18.1					width of water surface = 11.1 feet
5/21/04 13:30	5/21/04 13:30	gp, mw	5.15	2.68	F	0.763	0.940	16890	18.3		22.6	9450	9920	level survey; 0 on staff plate = -2.47 feet elev
5/24/04 5:59	5/24/04 5:59	mw	5.59	3.12	F	1.221	1.372	16490	17.1					
5/24/04 6:07	5/24/04 6:07	mw	5.57	3.10	F	1.198	1.378	16407	17.1		14.5	14000	*17825*	downloaded data
5/24/04 6:12	5/24/04 6:12	mw	5.56	3.09	F	1.196	1.380	16290	17.1					
5/25/04 9:24	5/25/04 9:24	gp, mw	5.20	2.73	F	0.820	0.991	17080	18.1		17.5	16000	*18850*	downloaded data
6/20/04 14:39	6/20/04 14:39	gp	5.16	2.69	F	0.766	0.965	25250	21.1		29.6	30800	28100	
7/2/04 6:21	7/2/04 6:21	gp	5.60	3.13	F	1.233	1.416	28270	21.0		19.3	25770	28950	
7/26/04 11:15	7/26/04 11:15	gp	5.14	2.67	R	0.752	0.955	34980	21.5					
7/26/04 17:41	7/26/04 17:41	gp	5.10	2.63	F	0.709	0.937	37850	23.6		30.6	6640	*5940*	
Jurisdictional area DD2 below culvert to WI														
1/21/04 0:00		lm, bh, mw									15.0	5500	*6912*	
5/7/04 13:13		gp, bm, mw									18.4	13600	15600	
North arm of jurisdictional area WI														
1/21/04 0:00		lm, bh, mw									15.0	7500	*9425*	
		mm, ns, mw									11.0	4800	*6708*	
5/7/04 13:15		gp, bm, mw									18.0	4920	5670	culvert to DD2 does not appear to have tidal circulation; south portion dry

Site Conditions						Datalogger Readings				High-Water Marks	Water Quality Measurments			Remarks
Observer Date Time (DST)	Datalogger Date Time (PST)	Observer	Stage	Stage NGVD29 Elevation	Hydrograph	Pressure Transducer #1	Pressure Transducer #2	Field Specific Conductance	Water Tempurature	Estimated stage at staff plate	Water Temperature	Field Specific Conductance	Adjusted Specific Conductance	
(mm/dd/yr hh:mm)	*(mm/dd/yr hh:mm)*		*(feet)*	*(feet)*	*(R/F/S/B)*	*(feet)*	*(feet)*	*(µmhos/cm)*	*(oC)*	*(feet)*	*(oC)*	*(µmhos/cm)*	*(at 25 oC)*	
Jurisdictional area WI														
1/21/04 0:00		lm, bh, mw									15.0	12000	*15080*	
5/7/04 13:15		gp, bm, mw												dry
Main branch slough above DD2 confluence														
1/21/04 0:00		lm, bh, mw									13.0	4300	*5696*	
Jurisdictional area WB														
1/21/04 0:00		lm, bh, mw									13.0	3000	*3974*	spilling to slough
		mm, ns, mw									14.0	2900	*3741*	
5/7/04 13:20		gp, bm, mw												dry
Pond on adjacent parcel														
1/21/04 0:00		lm, bh, mw									13.0	7000	*9273*	

Notes:

Observer Key: Gustavo Porras (gp), Bonnie Mallory (bm); Mark Woyshner (mw); Lucy MacMillan (lm), Barry Hecht (bh)

Stage: Water level observed at outside staff plate

Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), or baseflow (B)

Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance

Additional Sampling: Qbed = Bedload, Qss = Suspended sediment, Nutr = nutrients; other symbols as appropriate

Appendix D – Estimated salinities in mitigation wetland area, Haystack Landing, Petaluma, California

Appendix D Estimated salinities in the restored wetland area, Haystack Landing, Sonoma County.

Enhanced Wetland Area	Soil Salinity ppt	Water Salinity ppt	Remarks
Tidal	0.2 to 5	7 to 25	higher in the summer
Seasonally inundated	2 to 6	2 to 5	locally higher
Emergent	0.2 to 4	0.2 to 2	initially higher until flushed and at the southerly portion

Notes:
Salinity values were based on a qualitative degree of flushing for each wetland area, and measurements made during the preliminary hydrologic evaluation (Woyshner and others, 2004), a subsequent water quality survey on February 4, 2005 during winter baseflow conditions, and during the geotechnical investigation by Miller Pacific (2004).

Appendix E – Letter from U.S. Fish and Wildlife Service to Monk & Associates, January 13, 2005

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:
1-1-05-TA-0185

JAN 13 2005

Ms. Sarah Lynch
Senior Associate Biologist
Monk & Associates
1136 Saranap Avenue, Suite Q
Walnut Creek, California 94595

Subject: Request for No Take Determination for the Haystack Landing Project Site, City of Petaluma, Sonoma County, California

Dear Ms. Lynch:

This letter is in response to your November 17, 2004, request that the U.S. Fish and Wildlife Service (Service) determine that development of the Haystack Landing Project site in Petaluma, California, is not likely to result in take of the salt marsh harvest mouse (*Reithrodontomys raviventris*) in accordance with the requirements of the Endangered Species Act of 1973, as amended (16U.S.C. 1531 *et seq.*)(Act). Your letter was received in our office on November 18, 2004.

The proposed 37-acre Haystack Landing Project site is located at 3355 Petaluma Boulevard South on the southern edge of the City of Petaluma. The project site is an irregularly shaped rectangle located on the east side of Highway 101 and is composed of two parcels. The site is bordered by commercially zoned lots and commercial buildings to the north, Petaluma Boulevard South and Highway 101 to the west, and the Northwestern Pacific Railroad tracks, commercial buildings, and agricultural fields to the east. The Petaluma River lies east of the commercial buildings and agricultural fields bordering the east side of the project site.

The project proponent is proposing to establish an asphalt plant and related operations on the northern portion of the Haystack Landing Project site. About 1.76 acres of wetland habitats would be filled to accommodate the facility. The southern portion of the project site would be used to create and enhance wetland habitats to offset the proposed filling of 1.76 acres of wetlands. The project site has been used previously as a dairy farm and for the disposal of quarry wash water as part of a gravel and asphalt quarry operation. As a result of these land uses, most pickleweed (*Salicornia virginica*) dominated wetlands that probably historically occurred on the project site have been eliminated and the quality of the remaining wetlands have been greatly diminished. Presently, pickleweed cover on the project site is minimal and patchy, and overall vegetation cover is low.

Ms. Sarah Lynch

To determine the presence or absence of salt marsh harvest mice on the project site, Monk & Associates conducted trapping surveys approved by the Service prior to their implementation. These surveys were extensive and designed specifically to determine the presence/absence of salt marsh harvest mice on the project site. A total of 698 Sherman live-traps were set each night over an eight-night period from September 26 through October 8, 2004. Trap lines and trapping grids were established in wetland areas and adjacent uplands that appeared to have the greatest potential for supporting salt marsh harvest mice. A total of 5,584 trap-nights were completed under the purview of Recovery Permit TE776608-4 issued by the Service and a Memorandum of Understanding with the California Department of Fish and Game. No salt marsh harvest mice were trapped during the surveys. A total of 761 house mice *(Mus musculus)*, 210 western harvest mice (*Reithrodontomys megalotis*), and three California meadow voles (*Microtus californicus*) were trapped during the surveys.

The Service has determined that development of the Haystack Landing Project site is not likely to result in take of the salt marsh harvest mouse. We base this determination on the following: (1) the project site is fairly isolated, (2) substantial barriers and distance exist between the project site and other suitable harvest mouse habitat, (3) habitat conditions for salt marsh harvest mice on the project site are highly degraded, (4) the presence of non-native rodents which could preclude salt marsh harvest mice from inhabiting the wetland, and (5) your extensive surveys did not detect the presence of salt marsh harvest mice in the wetland. This determination is made solely for the Haystack Landing Project site and has no implications for any other project site within the range of the salt marsh harvest mouse. Therefore, unless new information reveals effects of the project that may affect federally listed species or critical habitat in a manner not identified to date, or if a new species is listed or critical habitat is designated that may be affected by the proposed development, no further action pursuant to the Act is necessary.

Please contact Jim Browning of my staff at (916) 414-6625, if you have questions regarding this response on the Haystack Landing Project.

Sincerely,

Cliff Nogard

fn Catrina Martin
Deputy Assistant Field Supervisor

Appendix F – Management Plan Dutra Haystack Wetlands Mitigation Project

MANAGEMENT PLAN
HAYSTACK WETLANDS MITIGATION PROJECT
PETALUMA, SONOMA COUNTY, CALIFORNIA
USACE File No. 28104N

Prepared for:

The Dutra Group
1000 Point San Pedro Road
San Rafael, California 94901-8312
Mr. Ross Campbell

Submitted to:

U.S. Army Corps of Engineers, San Francisco District
Regulatory Branch, 8th Floor
1455 Market Street 16th Floor
San Francisco, California 94103-1398
Attention: Mr. Bryan Matsumoto
(415) 503-5786

Prepared by:

Ms. Lucy Macmillan
Environmental Scientist
108 Rising Road
Mill Valley, CA 94941
(415) 389-9199

OCTOBER 2015

I Introduction

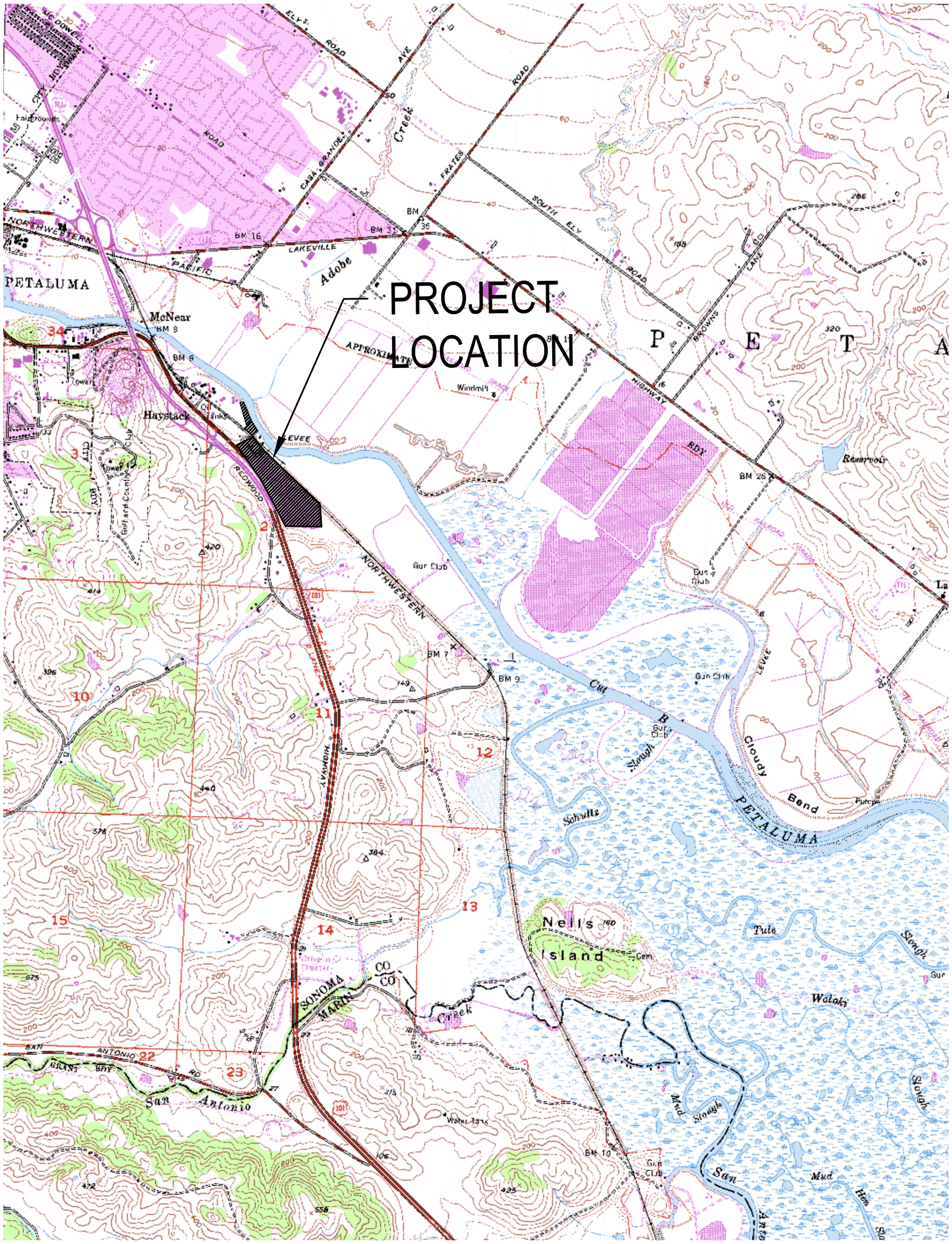
A Purpose of Project

This report presents the interim and long-term management plan for the proposed Dutra Haystack Wetland Mitigation Project (project) to be developed on approximately 17 acres of the proposed Dutra Haystack Asphalt Plant located at 3355 Petaluma Boulevard South bordering Petaluma in Sonoma County, California (Figure 1). The Dutra Group is proposing to establish an asphalt plant facility and associated conveying system to the approximately 35-acre Haystack Landing project site. The facility will take delivery of aggregate and sand from the Landing Way barge offload facility and process some aggregate into the finished asphalt product and sell the remainder of the aggregate directly to the public. The offloading will occur at the Landing Way barge off-loading facility (owned by Shamrock Materials, Inc.) located at 210 Landing Way in Petaluma, and will be transferred by an enclosed electric conveyor on the Landing Way property, over the Barton property to the south and cross over the Northern Pacific Railroad Tracks to the Haystack property to the southwest. At the Haystack site, the material will be deposited into stockpiles at the proposed asphalt facility.

Construction of the proposed asphalt plant will result in the filling of approximately 1.37 acre of seasonally inundated wetland subject to U.S. Army Corps of Engineers (USACE) jurisdiction pursuant to Section 404 of the Clean Water Act. In addition, transferring aggregate materials from the barges via the electronic conveyor will require the decommissioning of an existing mitigation wetland that covers approximately 0.47 acre. This management plan proposes short and long-term management strategies for the wetland mitigation area in perpetuity.

The proposed mitigation project would include the following:

- creation of 2.66 acres seasonally inundated wetland
- enhancement of 8.27 acres seasonally inundated wetland
- restoration of 0.02 acre of brackish marsh fronting the Petaluma River
- preservation of 0.90 acre seasonal wetland
- enhancement of 3.29 upland buffer zone



C S W | S T 2
CSW/Stuber-Stroeh Engineering Group, Inc.
Civil & Structural Engineers | Surveying & Mapping | Environmental Planning
Land Planning | Construction Management | Landscape Architecture
45 Leveroni Court
Novato, CA 94949
tel: 415.883.9850
fax: 415.883.9835

Rev. 2015-08-25	Date: 04-14-11
Job No. 591302	Scale: nts

DUTRA HAYSTACK ASPHALT FACILITY
USGS MAP
OVERALL SITE PLAN

SONOMA FIGURE 1 CALIFORNIA

The approving agencies for this project include the U.S. Army Corps of Engineers (USACE) and San Francisco Bay Regional Water Quality Control Board (SFRWQCB).

B Purpose of this Management Plan

The purpose of the Management Plan is to establish tasks to monitor the various wetland habitats within the mitigation area. This Management Plan is considered the interim and long-term management plan and is a binding and enforceable instrument to be implemented by the Land Manager.

C Land Manager

The Land Manager for the property will be a natural resource management organization approved by the USACE and SFRWQCB. If no land manager can be found, the applicant will retain ownership of the property and its associated management responsibilities. The Land Manager will be responsible for mitigation monitoring and cooperatively working with the agencies to manage the property in perpetuity.

II Property Description

A Project Setting

The Haystack Landing project site consists of three assessor parcels on the Petaluma River USGS quadrangle in the middle portion of Section 2 in Sonoma County, California. Two of these parcels (APN 019-320-023 and APN 019-320-022) form an approximately 35-acre trapezoidal parcel bound to the east by the Sonoma Marin Area Rail Transit tracks and to the west by Highway 101 (hereafter jointly referred to as Parcel A). The third parcel (APN 019-220-001) occurs east of the railroad tracks and fronts the Petaluma River (also known as the Barton Parcel, hereafter referred to as Parcel B). Finally, a portion of the Landing Way Facility (approximately 0.47 acre) would be used to construct an electric conveyor that would transport materials off-loaded at the Shamrock Materials, Inc. Landing Way facility to the 35-acre parcel where the asphalt plant will be constructed.

B History and Land Use

Historically, Parcel A was used as a dairy farm until 1968 when the site was purchased by American Rock and later the Dutra Group. The northern 27 acres of the site were leased back to the dairy rancher at that time and the remaining 10+- acres located in the southern portion of the site were used for the disposal of quarry wash water transferred from a quarry located on the west side of Highway 101 just north of the project site. Since 1968, various dikes and siltation ponds were constructed on the Haystack site; eventually five siltation ponds were constructed for settling quarry wash water. In 1976, the northernmost siltation pond was filled with earthen material excavated from an adjacent hill. The remaining ponds, including the one originally constructed in 1968 at the southernmost portion of the site, were actively used by the quarry for the disposal of quarry wash water until the mid-1970s. Two of the ponds located on the southwestern portion of the site were in continuous use until at least 1990[1]. According to the current property owners, none of the siltation ponds have been actively used for quarry or other operations since 1990. An historic farmhouse occurred on the northern 4 acres of the project site until it burned down in 2004. Several barns and outbuildings used to store miscellaneous materials located south of the house were demolished in 2004 as permitted by a County demolition permit as well.

Parcel B fronts the Petaluma River and covers approximately 0.8 acre of relatively flat land. Historically this site had a small residence on it and was primarily vegetated with non-native grasses and various shrubs including coyote bush.

The Landing Way property was historically a dredge disposal area until the Landing Way Operational Facility (an aggregate distribution facility) was constructed in 2005.

C Geology, Soils, Climate, and Hydrology

The project site has climate characteristics similar to other locations on the lowlands surrounding the northwest corner of San Pablo Bay. In general, the site is located in the Mediterranean climate zone typical of central coastal California. This climate zone is characterized by cool, wet winters and hot, dry summers tempered, in this case, by proximity to San Pablo Bay and by the occurrence of occasional coastal fog, especially in late spring and summer. The windiest months are May and June, when turbidities in the Bay and Petaluma River can frequently persist at levels of 200 to 500 nephelometric turbidity units (NTUs).

Situated in the 'rain shadow' of coastal mountains, the project site receives a mean annual precipitation of approximately 22 inches. The average rainfall value is the statistical mean of rainfall totals that show a wide range of values strongly influenced by global weather patterns, such as the El Nino Southern Oscillation and prolonged periods of drought. The location of the site north and east of Bolinas and Big Rock Ridges, Mount Burdell and Chileno Valley hills, and west of the Sonoma Mountains strongly influences event totals.

Reference evapotranspiration at Petaluma averages 44 inches per year.[2] Reference evapotranspiration is the evapotranspiration of a well-watered 4- to 6-inch tall cool-season grass; evapotranspiration from small seasonally inundated or emergent wetland vegetation can be 10 to 15 percent higher.

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1 LSA Associates, Inc. 1995. *Determination of Corps Jurisdictional Area, Haystack Landing, Petaluma*.

2 California Irrigation Management Information System (CIMIS) station 144; http://wwwcimis.water.ca.gov/cimis/frontStationDetailInfo.do?stationId=144&src=info; Station averages: Jan 0.98, Feb 1.65, Mar 2.81, Apr 4.25, May 5.61, Jun, 6.26, Jul 6.47, Aug 5.86, Sep 4.49, Oct 3.05, Nov 1.54, Dec 0.98, Annual 43.95 inches.

The project site is situated in the upper reaches of the tidally-influenced portion of the Petaluma River, in a zone of transition between freshwater runoff and saline water of the San Pablo Bay. It is on the western flank of the valley, on lowlands adjacent to shallow 400- to 500-foot hills having roughly 30-percent slopes, in an area characteristic for tidal-fringe habitats. A mile upstream, the Town of Petaluma is a classic 'bridge point' town, founded at the head of tidewater, at another transition from fresher headwater habitats to downstream salt-marsh habitats. Hence, the site affords an opportunity to restore much of the same types of landward-edge-of-tidewater wetlands upon which much of downtown Petaluma has been established, and which has disproportionately been filled or affected – both in the Petaluma River system, and throughout the San Francisco Bay region.

In the vicinity of the project site, river salinity seasonally fluctuates down to about 7 parts per thousand (ppt) during wet-season runoff and increases to about 25 ppt during dry-season baseflow. Tidal water circulates onto the project site through a 20-foot wide slough east of the Sonoma Marin Area Rail Transit (NWPRR) tracks, and beneath the tracks through a 2-foot by 2-foot old wooden box culvert. Flow through the culvert is constrained by sediment, aquatic growth and floating debris. West of the tracks, tidal waters flow in the ditch along the tracks and onto the project site via various drainage ditches. Tidal action reaches an off-site diked pond of about 8 to 10 acre-feet in size located to the southeast of Parcel A.

On Parcel A, tidal circulation is limited to the drainage ditches, and only during the highest, primarily winter tides does water spill from drainage ditch DD2 to Wetland H. The ditches on-site drain poorly relative to the off-site railroad-track ditch and slough downstream, and always have water below 2.6-foot elevation, owing to the nearly level channel slope, accumulated sediment and wetland vegetation above the confluences. Mean High Water (MHW) is 3.0-foot elevation, and Mean Higher High Water (MHHW) is 3.4 foot elevation. These elevations are optimal for pickleweed colonization.

On-site runoff during the wet season collects in the seasonally inundated wetland areas and/or sheet flows to the drainage ditches. Wetlands A and H overflow to drainage ditch DD2, and Wetland B drains to the railroad track ditch. Other wetlands, such as Wetland E, do not generate runoff except during the most extreme events. During the dry season, all of the wetlands desiccate. Only drainage ditches DD1 and DD2 receive tidal water. Tidal waters extend in these ditches as far upstream as the onsite access road and not beyond. Off-site runoff from the upland slopes to the west enters the site from two locations: 1) at the southwest corner of Parcel A from a watershed area of 53 acres; and 2) at the northwest corner of Parcel A from an area of 20 acres. Regional runoff averages about 6 inches per year.

The Haystack Landing site is located within the Coast Range Geomorphic Province of California, where slopes developed on older bedrock meet the geologically-recent deposits of San Pablo Bay. The regional bedrock geology in the vicinity of the project site primarily consists of complexly folded, faulted, sheared, and altered sedimentary, igneous, and metamorphic rock of the Juarrasic- and Cretaceous-age Franciscan Complex. Tolay Volcanics of Miocene age outcrop in the region – most notably Burdell Mountain – and are found just northwest of the site in the area of the Dutra quarry Petaluma from which the source rock was extracted for aggregate processing (mapped by Blake and others, 1974). South of this Tolay Volcanics outcrop, Franciscan bedrock form the shallow hills immediately west of the site. Quaternary alluvium

(Bay Mud marsh deposits) largely overlies bedrock within the Petaluma River valley lowlands, and soil types are underlain by valley alluvium and have clay hard pans. at the site, the artificial fill and wash deposits (deposited from quarry operations) overlie Bay Mud.

Natural soils developed in place before quarry fines were deposited and consisted of Reyes silty clay underlying much of the site, and Goulding cobbly clay loam along the western boundary of the site, rising from the lowlands to Highway 101 and beyond (Sonoma County Soil Survey, USDA, by Miller, 1972). Reyes silty clay developed on Bay Mud and low-gradient stream alluvium. Poorly drained, it is common in saline and brackish marshes surrounding the Bay. In contrast, Goulding soils are well drained and are found on hilly volcanic (andesite or basalt) bedrock west and south of the site. Goulding soils also extend from the site about a mile to the northwest, to the quarry from which the source rock was extracted for aggregate processing. Other soils further west of the site, on the low hills draining to the site from west of Highway 101 are also well drained. They consist of Diablo clay and Los Osos clay loam, which both commonly form on weathered Franciscan sandstone and shale.

The quarry fines on site consist of silts and clays washed from the material processed at the quarry, primarily composed of Tolay Volcanics with some outcrops of typical Franciscan bedrock. A geotechnical investigation of the tailings on the southern portion of the site designated for the proposed wetlands mitigation project was conducted by Miller Pacific Engineering Group (2004). Subsurface exploration was performed on May 21, 2004 and consisted of drilling 6 soil borings utilizing truck-mounted drilling equipment with 6-inch hollow-stem continuous flight augers.

The subsurface conditions encountered were consistent with the mapped geology and soils. Miller Pacific staff found 6.5 to 11.0 feet of variable artificial fill/wash sediments. The fill materials encountered consisted of soft to very stiff, high to low plasticity sandy and silty clays and dense clayey sands. Soft, highly compressible Bay Mud varying in thickness from 8.0 to 13.5-feet underlies the fill. Older alluvial deposits underlie the Bay Mud. These deposits consist of very dense sandy clays and stiff, medium to highly plastic, sandy silts and clays. Bay Mud thickness contours are consistent with the soils survey, which shows Bay Mud 'pinching out' along the western portion of the site.

The lowest ground-water levels (during late summer and fall) are expected to be near the Bay Mud surface or slightly higher (Miller Pacific Engineering Group, 2004). Ground-water conditions in winter can be variable, depending on amount of and the elapsed time since significant rainfall. To minimize these effects, we measured conditions three weeks into a typical mid-winter drought. Wet-season ground-water levels, as well as subsurface specific conductance (salinity) and temperature levels, were evaluated on February 4, 2005 by Balance Hydrologics, following this 3-week mid-winter dry spell after a 2-week period of heavy rainfall during early January. Within the tailings basins on the southern portion of the site, depth to water was 2 to 3 feet below ground surface in areas furthest from inundated wetland, and transitioning to approaching the ground surface at the wetlands.

III Habitat and Species Descriptions

A Plant Communities, Habitats, and Species

Botanical surveys were conducted on Parcel A of the Haystack Landing site on March 31 and June 6 and 11, 2003, and on Parcel B on April 30, 2004. Descriptions of the vegetative communities identified are provided below.

Parcel A

A total of 119 species of vascular plants were observed on Parcel A. Of these, 31 species are native to the site, and 86 species are non-native. For two species, it could not be determined whether or not the species is native to the site. One of these species (*Atriplex* sp.) could only be identified to genus at the time the survey was conducted and could be either a native species or a non-native species. Since there are no known rare *Atriplex* species in Sonoma County, a late-summer visit of the site was not made to positively identify the species. In accordance with CDFW's survey protocol, this plant was identified at the level necessary to determine its rarity status (that is, to the genus level). The other species, Pacific madrone (*Arbutus menziesii*), is native to the region, but may have been planted on this site.

Although recognition of habitat types on these parcels is somewhat arbitrary due to their highly disturbed nature, the following five habitat types were recognized: settling ponds, levees, drainage ditches, pond/seasonal wetland, and developed/ruderal. The first three of these habitat types encompasses the settling pond complex in the southern portion of the site. The developed/ruderal habitat type encompasses most of the remainder of the site. The pond habitat type characterizes the two small ponds near the western site boundary. With the partial exception of the pond habitat type, none of these habitat types could be considered "natural"; all have been created and/or maintained by intensive disturbance and large-scale alteration of the site, and they mostly do not resemble native vegetation types, although the drainage ditches habitat type is dominated by native species.

Brief descriptions of each habitat type are presented below.

Settling ponds. The beds that have developed on the settling ponds are gently sloping or somewhat undulating, so that some areas receive more seasonal inundation than others. The vegetation on the pond bottoms is a heterogeneous assemblage of native and non-native species, with both cover and species composition varying considerably over short distances. Much of this variation is clearly correlated with the exact elevation of particular portions of the pond bottom and the degree of seasonal inundation. The northern settling pond, which probably receives relatively little seasonal inundation, is densely vegetated (cover 100 percent or nearly so), primarily with non-native grasses and herbs. Characteristic species include Italian rye grass (*Lolium multiflorum*), bird's-foot trefoil (*Lotus corniculatus*), Mediterranean barley

(*Hordeum marinum* ssp. *gussoneanum*), curly dock (*Rumex crispus*), bristly ox-tongue (*Picris echioides*), soft chess (*Bromus hordeaceus*), black mustard (*Brassica nigra*), yellow star thistle (*Centaurea solstitialis*), winter vetch (*Vicia villosa* ssp. *varia*), and, in the lowest areas, annual beard grass (*Polypogon monspeliensis*). Scattered individuals of the native shrub coyote brush (*Baccharis pilularis*) occur in this settling pond. One large clump (perhaps a single clone) of arroyo willow (*Salix lasiolepis*) occurs in the northeast portion of this settling pond.

In the southwestern settling pond, which receives more seasonal inundation than the northern settling pond, the higher areas are largely dominated by Italian rye grass, and the associates are mostly non-native, with a species composition similar to that of the northern settling pond. The non-native thistle Italian thistle (*Carduus pycnocephalus*) occurs in scattered dense patches in this area. There is considerable yellow star thistle at the south end, and the escaped ornamental species sweet pea (*Lathyrus odoratus*) is locally abundant in the northeast corner. Lower-lying areas in this settling pond are dominated by the native pickleweed (*Salicornia virginica*), the native perennial grass saltgrass (*Distichlis spicata*), and the non-native species annual beard grass and brass buttons (*Cotula coronopifolia*).

The southeastern settling pond is probably similar to the southwestern settling pond in the degree of seasonal inundation, although the lowest-lying portion on the east side apparently has standing water for a longer period than any other portion of the settling ponds. The higher portions of this settling pond are largely dominated by weedy non-native grasses, including ripgut grass (*Bromus diandrus*), six-weeks fescue (*Vulpia bromoides*), soft chess, slender wild oat (*Avena barbata*), Mediterranean barley, and Italian rye grass, with considerable bird's-foot trefoil and Italian thistle; cut-leaved geranium (*Geranium dissectum*) is also locally abundant. Somewhat lower-lying areas are dominated by bird's-foot trefoil, annual beard grass, and pickleweed, with considerable bare ground, or by annual beard grass and bristly ox-tongue. The lowest-lying area is overwhelmingly dominated by annual beard grass, with sour clover (*Melilotus indica*) and pickleweed the only abundant associates. A small amount of narrow-leaved cattail (*Typha angustifolia*), a species generally indicating prolonged inundation, occurs in the southeast corner.

Levees. The levees are elevated linear features that separate the settling ponds from each other and from bordering areas. These levees could have been included in the developed/ruderal habitat type, but, because they form a distinct part of the settling pond complex, they are treated separately. Dense clumps of coyote brush occur locally on the levees, and a dense patch of the invasive non-native shrub French broom (*Genista monspessulana*) occurs at one location on the levee between the northern and southwestern settling ponds. The levees are otherwise largely vegetated by weedy non-native herbs and grasses, including fuller's teasel (*Dipsacus fullonum*), poison-hemlock (*Conium maculatum*), purple vetch (*Vicia benghalensis*), Italian rye grass, Mediterranean barley, and yellow star thistle. Sweet pea is locally abundant on the levees bordering the southwestern and southeastern settling ponds.

Drainage ditches. Drainage ditches occur adjacent to some of the levees. These ditches are artificially excavated and hold standing water permanently or for varying periods during the season. Where vegetated, the species composition of the drainage ditches consists mostly of native moisture-loving species, principally cosmopolitan bulrush, narrow-leaved cattail, pickleweed, cord grass (*Spartina* sp.), and saltgrass.

Pond. The two small ponds located near the western boundary of the site apparently hold water for all, or at least most, of the season. Narrow-leaved cattail and annual beard grass are relatively abundant, especially around the margins of these ponds, with brass buttons also relatively abundant around the southern pond. Several individuals of arroyo willow occur around the margins of the northern pond.

Developed/ruderal. The developed/ruderal habitat type includes the entire site north of the northern settling pond and its associated levee and ditch, as well as a narrow strip of land between the settling ponds and the Highway 101 right-of-way. The northern, most elevated portion of the site supports an assemblage of species that is quite heterogeneous in both species composition and physiognomy, but that consists primarily of weedy species. Some areas have been repeatedly mowed; these areas are vegetated with a low, rather sparse cover. Where not mowed, the vegetation is tall and generally dense. Numerous large, planted trees of the non-native species English elm (*Ulmus procera*), Northern California black walnut (*Juglans californica* var. *hindsii*, native to Northern California but not indigenous to this site), and non-native blue gum (*Eucalyptus globulus*) are scattered in this area. The first of these is reproducing by suckers, while the latter two species have reproduced from seed. Two large valley oak (*Quercus lobata*) trees, a native species, are located on the north side of the abandoned house. Several dense clumps of the tall, robust non-native grass giant reed (*Arundo donax*) occur near the border of Parcel A.

The north central portion of Parcel A is largely unvegetated; the margins and several adjacent dirt piles are sparsely to moderately densely vegetated by weedy species. Between this parking lot and the northern settling pond is a level area with hard-packed soil, probably graded in the past, with a low to tall, sparse to locally dense vegetation, mostly of weedy species. There are a number of small Pacific madrone trees (*Arbutus menziesii*) in this area, perhaps planted, as well as one small individual of the native tree species coast live oak (*Quercus agrifolia*). The strip of ruderal habitat between the settling ponds and Highway 101, which is interrupted by the two small ponds, is vegetated with a mostly dense cover of weedy species.

Parcel B

A botanical survey was conducted on Parcel B on April 30, 2004. In 2004, this parcel was primarily dominated by ruderal grasses and herbs with scattered individuals of the native coyote bush. The narrow and discontinuous strip of land bordering the river (which is evidently brackish in this area due to tidal flow) is occupied by a coastal brackish marsh habitat type. Within the study area, this habitat type is not well-developed and contains few species, due to its relatively small area and to the frequent flooding and scouring from the river, but it is dominated by native species, particularly three species of tule or bulrush: cosmopolitan bulrush, viscid tule (*Schoenoplectus acutus*), and three-square (*Schoenoplectus americanus*). Associates include the rhizomatous, perennial saltgrass and the succulent pickleweed.

Landing Way Mitigation Area

One seasonal wetland covering a total area of 0.47 acre occurs on the area to be decommissioned as part of the proposed project. The majority of the wetland area is dominated by non-native grasses and herbs including rip-gut brome (*Bromus diandrus*), soft-chess brome (*Bromus hordeaceus*), oat (*Avena barbata*), bristly ox tongue (*Picris echiodes*), poison hemlock (*Conium maculatum*), and Italian rye grass (*Lolium multiflorum*). "Wetter" portions of the wetland area are dominated by facultative and facultative wetland species including fox-tail barley (*Hordeum murinum* ssp. *gussoneanum*), and rabbit's foot grass (*Polypogon monspeliensis*).

Special-status Plant and Animal Species

No special-status species plant or animal species are known to occur on the project site but some do occur in the vicinity, including California clapper rail[3], California black rail, and salt marsh common yellowthroat.

IV Monitoring and Management

The overall goal of implementing the tasks specified in this plan will be to monitor the wetland habitats in a manner that will foster the long-term viability of these resources and the wildlife habitat functions and values they provide.

A Implementation Management

The land manager will install three-strand barbed wire fencing along the perimeter of the property following completion of construction. One access gate will be installed at the western portion of the mitigation area adjacent to the asphalt plant for the purpose of easy access by land managers and monitors. In addition, this access gate would provide vehicular access for mowing and other management activities. Emergency vehicles could also access the site through this gate if needed.

B Interim and Long-term Monitoring and Management

Both interim and long-term monitoring and management activities will include fence maintenance and repair, weed control, fire management, trash collection, and other tasks as described in this plan. Long-term monitoring and management responsibilities assumed by the designated land manager (payee) will be funded by the endowment dedicated to the trustee for this project.

C Biological Resources

The primary goal of the management program is to preserve wetland habitats. The wetland habitats will be qualitatively monitored on an annual basis to assess general conditions and trends as specified in the mitigation plan for the project. The primary aspects that will be monitored and may require management actions are erosion, invasion by exotic species, water quality, vegetation management, and fire hazard.

Toward the long-term protection of the site's biological resources, the following are specific measures to be implemented during the initial and long-term management of the site:

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[3] This species is now referred to as Ridgway's rail.

Element 1- Invasive Species

Invasive species control will be necessary prior to project implementation. Invasive control will be planned ahead of time and will be started prior to anticipated initial planting. Invasive species are defined as those listed by the California Invasive Species Council (Cal-IPC) with a rating of high, or any Tier 1 invasive species listed in the Water Board's Fact Sheet for Wetland projects (RWQCB, 2009). Invasive plant species common to the Haystack Landing project site include, but are not limited to: yellow star thistle (*Centaurea solstitialis*), pepperweed (*Lepidium latifolium)*, and non-native Spartina (e.g. *Spartina alterniflora*).

Below several strategies are described that address invasive species at the project site, both before initial planting as well as during the monitoring phase. A 10 percent cover of any invasive plant species will be the trigger level for implementing adaptive management. In many cases, multiple strategies combined will be most effective in eliminating specific unwanted species from the project site, and in all cases monitoring and adaptive management will be key to long-term success of the restored habitats and elimination of invasive species. Once the native target species are established, it is anticipated that they will out-compete the invasive species. After the general strategies discussion below for invasive control, individual invasive species known to occur at the project site are addressed in the context of which strategy(s) will be considered for feasible elimination of that species.

INVASIVE SPECIES CONTROL METHODOLOGY

Mechanical Removal

The advantages of hand pulling invasive species include low ecological impact, minimal damage to neighboring plants, and low cost for equipment or supplies. Hand removal is extremely labor intensive, however, and is effective only for relatively small areas, even when abundant labor and resources are available. Weed wrenches and other tools can be used to remove large sapling and shrubs that are too big to be pulled by hand. To minimize soil disturbance, soil will be replaced to disturbed areas. Trampled and disturbed areas can provide optimal germination sites for additional weeds, and replanting and use of seed mixes and/or erosion control mix is important.

Where grazing (or fire) is not practical, mowing is sometimes used as a surrogate method of maintaining open grassland structure. Green machines and mowers can be used on a routine basis to weed around the riparian plantings, woodland, and wetland mitigation site, as needed. The weed management will be done in late summer until plants are established. Stakes and mulch collars will help to keep the weeds and mowers away from the plants. Machinery will not be used at the site during wet conditions. Mowing is difficult on steep, rough, and varied terrain. Height and timing of mowing will be planned to avoid impacts to sensitive species.

Cultural

There is growing interest in the potential of carefully controlled livestock grazing to manage invasive plants on pastures, rangelands, and forests. Scientific studies and on-the-ground experiences have clearly demonstrated that livestock are a promising tool in the battle against weeds. Prescribed grazing is an effective technique, rivaling traditional chemical and mechanical control methods, for the management of deleterious invasive plants. Grazing is viewed by many as an 'environmentally friendly' alternative to traditional methods because it leaves no chemical residue, can be removed whenever necessary, and often improves land health and biodiversity. Prescribed grazing can be integrated with herbicides, mechanical removal, and biological control methods to increase the efficacy and longevity of the invasive species management plan.

Chemical

Use of pesticides (including insecticides, herbicides/weed-killers, fungicides, rodenticides) will be employed as part of an integrated management plan in concert with all applicable non-chemical options. All pesticides will be used in a manner consistent with limitations described on the label certified by the California Department of Pesticide Regulation and United States Environmental Protection Agency. All strategies discussed will be utilized as initial procedures to knock down the dominant invasive plants in advance of planting, relying on a pre-emergent herbicide to be used at time of planting to address the seed bank stored in the soil that will regenerate. As well, subsequent applications of herbicides and/or strategies discussed below will be employed as part of an adaptive management strategy.

TREATMENTS FOR INDIVIDUAL PLANT SPECIES

Yellow star-thistle (*Centaurea solstitialis*):

Yellow star-thistle is a simple to bushy winter annual, occasionally biennial, with spiny yellow-flowered heads and stiff wiry stems to 6 ft. tall. Plants form a basal rosette of leaves until mid-spring. Stem leaves are alternate and mature foliage is grayish-to bluish-green, densely covered with fine white cottony hairs. Its leaf bases form wings along the stems. Rosette leaves typically wither by flowering time. The taproot can extend deep into the soil (> 6 ft.) allowing plants to utilize deep soil moisture not available to other annual species, particularly grasses. The flower heads are solitary on stem tips, and consist of numerous yellow disk flowers. The phyllaries are densely to sparsely covered with cottony hairs or with patches of hairs at the bases of the spines. The central spine of the main phyllaries is 10 to 25 mm long, stiff, yellowish to straw-colored throughout. Yellow star-thistle reproduces only by seed and develops two types of achenes. The outer ring of achenes is a dull dark brown, often speckled with tan, lacking pappus bristles, and often remaining in heads. The inner achenes are glossy, gray or tan to mottled cream-colored and tan, with slender white pappus bristles 2 to 5 mm long. Most seeds fall near the parent plant. Some seed is viable 8 days after flower initiation. Large flushes of seeds typically germinate after the first fall rains, but smaller germination flushes can occur during winter and early spring. Seeds can survive for up to about 10 years in the field under certain environmental conditions, but it appears that few seeds survive beyond 4 years.

Yellow star-thistle is found in open disturbed sites, open hillsides, grassland, rangeland, open woodlands, fields, pastures, roadsides, waste places. It may also inhabit cultivated fields and does not tolerate low light areas or shading. It was accidentally introduced as a seed contaminant in alfalfa. It has spread rapidly since its introduction into California in the mid-1800s. Plants are highly competitive and typically develop dense, impenetrable stands that displace desirable vegetation in natural areas, rangelands, roadsides and other places. Yellow star-thistle is considered one of the most serious rangeland weeds in the western U.S. Yellow star-thistle is sometimes problematic in grain fields, where the seeds can contaminate the grain harvest and lower its quality and value.

To prevent large-scale infestations, it is important to control new invasions. Spot eradication is the least expensive and most effective method of preventing establishment of yellow star-thistle. In established stands, a successful control strategy must result in dramatic reduction or, preferably, elimination of new seed production, multiple years of management, and follow-up treatment(s) to prevent rapid reestablishment. Effective control using any of the available techniques depends on proper timing. Combinations of techniques may prove more effective than any single technique. For example, prescribed burning followed by spot application of post-emergence herbicides to surviving plants can prevent the rapid re-infestation of the treated area. Similarly, combining mowing and grazing, revegetation and mowing, or herbicides and biological control may provide better control than any of these strategies used alone. Effective combinations may depend on location or on the objectives and restrictions imposed on land managers.

Mechanical - (pulling, cutting, disking). Hand removal, mowing, or cultivation, when used to prevent seed production over 2 to 3 years or more (the soil life of the seeds), can reduce or eliminate an infestation. Manual removal of yellow star-thistle is most effective with small patches or in maintenance programs where plants are sporadically located in the grassland system. This usually occurs with a new infestation or in the third year or later in a long-term management program. These methods can also be important in steep or uneven terrain where other mechanical tools (e.g., mowing) are impossible to use. To ensure that plants do not recover it is important to detach all above-ground stem material. Leaving even a 2-inch piece of the stem can result in recovery if leaves and buds are still attached to the base of the plant. The best timing for manual removal is after plants have bolted but before they produce viable seed (i.e. early flowering). At this time, plants are easy to recognize, and some or most of the lower leaves have senesced. If hand removal is conducted after plants begin to produce seeds, it may be necessary to put pulled plants in bags and remove them from the site. Hand removal is particularly easy in areas with competing vegetation. Under this condition, yellow star-thistle will develop a more erect slender stem with few basal leaves. These plants are relatively brittle and easy to remove. In addition, they usually lack leaves at the base and, consequently, rarely recover even when a portion of the stem is left intact. Hand removal options for yellow star-thistle typically include hand pulling, hoeing, or string trimming. Systematic surveys and repeated removal will be conducted every 2 to 4 weeks throughout the growing season.

Mowing is most effective when 2 to 5% of the total population of seed-heads is in bloom. Mowing too early can result in higher seed production. Plants should be cut below the height of the lowest branches. It will require multiple years of continuous mowing to successfully manage yellow star-thistle. Mowing is best used in an integrated approach. Since it is a late season management tool, it is best employed in the later years of a long-term management program or in a lightly infested area. Mowing is not feasible in many locations due to rocks and steep terrain. Mowing is not always successful and can decrease the reproductive efforts of insect biocontrol agents, injure late growing native forb species, and reduce fall and winter forage for wildlife and livestock. The success of mowing depends on proper timing and the growth form of the plant. Mowing too early (before seed-heads reach spiny stage) or too late (after seed set) will usually increase the yellow star-thistle problem. Mowing too early in the season can remove competitive grass cover and promote vigorous yellow star-thistle regrowth. If done too late, mowing scatters yellow star-thistle seed. Best results were obtained by mowing once at the early flowering stage, and again 4 to 6 weeks later to cut regrowth during the floral bud stage. A dense spring canopy of desirable vegetation optimizes yellow star-thistle control. Yellow star-thistle plants with an erect, high-branching growth form are effectively controlled by a single mowing at the early flowering stage, while sprawling low-branching plants cannot be controlled even with repeated mowing. Despite its limitations, mowing conducted at the early flowering stage, before viable seed production, can be very effective for yellow star-thistle control.

Anecdotal information also indicates that mowing the standing skeletons in fall, before the first rains, can form a mulch that blocks light and suppresses subsequent germination of yellow star-thistle. A flail mower is considered best. The yellow star-thistle litter layer may be less suppressive to grass germination, as it is not as light dependent as yellow star-thistle.

Tillage is effective, and is occasionally used on roadsides. It is also often used in agricultural lands, which is probably why yellow star-thistle is not a significant cropland weed. In wildlands and rangelands, tillage is usually not appropriate because it can damage important desirable species, increase erosion, alter soil structure, and expose the soil for rapid re-infestation if subsequent rainfall occurs. Any tillage operation that severs the roots below the soil surface can effectively control yellow star-thistle. Early summer tillage, before viable seeds are set, and repeated tillage following rainfall/germination events will rapidly deplete the yellow star-thistle seed bank, but may also have the same effect on the seed bank of desirable species.

Cultural. High-intensity short-duration grazing by sheep, goats, or cattle should be implemented during the period when yellow star-thistle plants have bolted to just before they produce spiny heads. Cattle and sheep avoid yellow star-thistle once the buds produce spines, whereas goats continue to browse plants even in the flowering stage. For this reason, goats have become a more popular method for controlling yellow star-thistle in relatively small infestations.

Grazing the weed during the bolting stage can provide palatable high protein forage (8 to 14%). This can be particularly useful in late spring and early summer when other annual species have senesced. Grazing alone will not provide long-term management or eradication of yellow star-thistle, but can be a valuable tool in an integrated management program. This prescription must be continued for at least 3 years in a severe infestation to reduce the yellow star-thistle seed bank.

Prescribed burns can provide control if conducted at the proper timing. Burning should be timed to coincide with the very early yellow star-thistle flowering stage. At this time yellow star-thistle has yet to produce viable seed, whereas seeds of most desirable species have dispersed and grasses have dried to provide adequate fuel. Fire has little if any impact on seeds in the soil. Burning at other times may enhance yellow star-thistle survival by removing the thatch and encouraging seed germination in fall.

The ability to use repeated burning depends on climatic and environmental conditions. In areas where resources are ample and total plant biomass is abundant, 2 or 3 consecutive years of burning may be practical. However, in other situations, fuel loads may not be sufficient to allow multiple year burns. Consequently, prescribed burning may be more appropriate as part of an integrated approach. Air quality issues can be significant when burns are conducted adjacent to urban areas. A major risk of prescribed burning is the potential of fire escapes. This risk is greatest when burns are conducted during the summer months. In some areas, burning can lead to rapid invasion by other undesirable species with wind-dispersed seeds, particularly members of the sunflower family.

In addition to summer burning, yellow star-thistle seedlings have been controlled using winter or early spring flaming. This technique is somewhat nonselective, and control of yellow star-thistle is inconsistent. When spring drought follows a flaming treatment, control of yellow star-thistle can be excellent. In contrast, a wet spring can lead to complete failure and increased yellow star-thistle infestation, particularly since competing species may be dramatically suppressed.

Biological. Six insects have become established for the control of yellow star-thistle in the western United States. These include three species of weevils (seed-head weevil [*Bangasternus orientalis*], flower weevil [*Larinus curtus*], and the hairy weevil [*Eustenopus villosus*]), and three species of flies (seed-head fly [*Urophora sirunaseva*], peacock fly [*Chaetorellia australis*], and the false peacock fly [*Chaetorellia succinea*]). All six insects attack the flower heads of yellow star-thistle and produce larvae that develop and feed within the seed-head. Of these, only four have become well established. Of these, only two, *Eustenopus villosus* and *Chaetorellia succinea*, have any significant impact on reproduction. The combination of these two insects reduces seed production by 43 to 76%. Although this level of suppression is not sufficient to provide long-term yellow star-thistle management, the use of biological control agents can be an important component of an integrated management approach. A more successful biological control program will likely require the introduction of plant pathogens or other insects which attack roots, stems, or foliage.

A new potential biological control agent is a root-feeding weevil, *Ceratapion basicorne*, that has shown promise under greenhouse conditions. It has yet to be approved, but is expected to be released in the next couple of years. The most widely studied pathogen for yellow star-thistle control is the Mediterranean rust fungus *Puccinia jaceae*. It can attack the leaves and stem of yellow star-thistle, causing enough stress to reduce flower-head and seed production. Although it has been released it does not seem to have much impact on yellow star-thistle populations.

Chemical. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

MODE OF ACTION	CHEMICAL NAME
Growth Regulators	2,4-D; Aminopyralid; Clopyralid; Dicamba
Aromatic Amino Acid Inhibitors	Glyphosate
Branched-Chain Amino Acid Inhibitors	Chlorsulfuron; Imazapyr; Sulfometuron
Photosynthetic Inhibitors	Hexazinone

Conclusion and Recommendation: The most effective means of yellow-star thistle control will likely be a combination of hand pulling and or mowing and chemical control. Based on conditions at the site, the applicant will use the most effective means or combination of means to control the species. Any techniques not described herein that may in the future prove successful at eliminating yellow-star thistle will require the review and approval of the Regional Board and Corps prior to implementation.

Perennial Pepperweed (*Lepidium latifolium*):

Perennial pepperweed is found in all western states, except North and South Dakota, in many different areas and habitats, including wetlands, riparian areas, meadows, vernal pools, salt marshes, flood plains, sand dunes, roadsides, irrigation ditches, ornamental plantings, and agronomic crops, including alfalfa, orchards, vineyards, and irrigated pastures. Most typically found on moist or seasonally wet sites in the west, and most problematic in riparian or wetland areas, and will tolerate saline and alkaline conditions. Perennial pepperweed can rapidly form large, dense stands that displace desirable vegetation and wildlife. Populations easily spread along waterways and can infest entire stream corridors, riparian areas, or irrigation structures. Roots do not hold soil together well, allowing erosion of river, stream, or ditch banks. Flooded streams often wash away roots growing along the streambank, and new infestations develop downstream. Once established, perennial pepperweed is persistent and difficult to control in crops, natural areas, and ornamental plantings. Perennial pepperweed reduces forage quality in hay and pasture. Perennial pepperweed plants extract salts from deep soil and deposit them on the soil surface, inhibiting the germination and growth of other species that are sensitive to salinity.

Perennial pepperweed is an erect perennial to 6 ft. tall. The crown and lower stems are weakly woody. The foliage lacks hairs and is green to gray-green, often dusted with powdery white caused by a rust fungus. The basal leaves are larger and wider than stem leaves, to 1 ft. long and 4 inches wide, with serrate margins. The aboveground parts typically die in late fall and winter, leaving dead stems and thatch which can persist for several years. The roots are long, thick, minimally branched, and vigorously creeping. Most grow in the top 2 ft. of soil, but some can penetrate to a depth of 10 ft. or more.
The inflorescences are rounded to pyramidal and consist of numerous small white flowers. The flowers

have four petals, producing small pods (about 2 mm long) with tiny reddish-brown seeds (about 1 mm long). Perennial pepperweed is a prolific seed producer. Laboratory tests suggest seeds germinate readily with fluctuating temperatures and adequate moisture; however, seeds do not appear to remain viable in the soil for extended periods. As a result, perennial pepperweed reproduces primarily vegetatively from roots and root fragments. Large root fragments can survive desiccation on the soil surface for extended periods, and fragments as small as 0.5 to 1 inch long and 2 to 8 mm in diameter can develop into new plants. Root fragments and seeds disperse with flooding, soil movement, and human and animal activities.

Mechanical - (pulling, cutting, disking). Seedlings are easily controlled by hand-pulling or tillage, but these techniques do not control established plants because shoots quickly resprout from vast root reserves. In addition, seedlings are not often encountered. Root segments as small as 1 inch are capable of producing new shoots. Cultivation and tillage typically increase infestations by dispersing root fragments. Clean equipment after tillage to prevent spreading root fragments. Mowing stimulates perennial pepperweed plants to resprout and produce new growth, but mowing is helpful for removing accumulated thatch. Mowing breaks old stems into small fragments and helps prevent shading of favorable species. Combining mowing with herbicides has been shown to be an effective control strategy. For best results, mow plants at the bolting or flower bud stage and apply herbicides to resprouting shoots once they have reached the flower bud stage (refer to Chemical section following).

Cultural. Cattle, sheep, and goats will graze perennial pepperweed, especially rosettes in early spring. When stands are dense it becomes difficult for most animals to graze. Goats appear to tolerate heavy consumption of fresh plants. Sheep and goats permanently maintained in a pasture suppress growth of perennial pepperweed. However, once livestock are removed, plants quickly resprout. Burning is not effective at reducing perennial pepperweed stands, but it is helpful at removing accumulated thatch. Perennial pepperweed thatch burns best in winter or spring under dry conditions before initiation of spring growth. Seasonal flooding for an extended period during the growing season can significantly reduce populations. It is not known how long perennial roots can survive flooded conditions, but anecdotal information indicates that 6 months of submergence are required. Establishing desirable vegetation in disturbed areas can suppress perennial pepperweed and slow reinvasion after control. Because perennial pepperweed is very competitive, seed or transplant desirable vegetation after dense perennial pepperweed stands are controlled. Choose vigorous, fast-growing plant species that are adapted to the site. Perennial grasses are a good choice for natural areas and pastures. Grasses are tolerant of broadleaf-selective herbicides, and over time grasses form a thick sod that prevents future weed establishment. In pastures, promote grass expansion and vigor with fertilization and grazing management.

Biological. Biological control agents are being evaluated for use on perennial pepperweed in the United States, but currently no organisms are available

Chemical. A combination of hand control and the use of herbicide is most successful in fighting Lepidium invasion and therefore will be the primary means of control of Lepidium on site. Herbicide application for pepperweed works most effectively when applied using a backpack application system or hand held applicator to avoid overspray of adjacent plants. Herbicide application timing is critical for pepperweed and works best at the flower bud stage and worst at the rosette or early bolting stage. Because plant phenology differs between location and year, it will be important to regularly observe infested areas in the spring and begin applying herbicides when flower buds appear. If herbicide cannot be applied at the flower bud stage, mow plants and apply the herbicide to any regrowth. With seedlings, apply herbicides as soon as possible to prevent plants from producing new lateral shoots from the root. On the edges of Lepidium colonies, care should be taken to spray Lepidium plants only, and not other species that are growing in the fringe habitat. If herbicide is over-applied, other less resilient plants may not recover enabling Lepidium to reinvade at a later date. Herbicide choice depends on label restrictions, land use objectives, and cost[4]. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically.

The order of herbicide listing is not reflective of the order of efficacy or preference.

MODE OF ACTION	CHEMICAL NAME
Growth Regulators	2, 4-D
Aromatic Amino Acid Inhibitors	Glyphosate
Branched-Chain Amino Acid Inhibitors	Chlorosulfuron; Imazapyr; Propoxycarbazone-sodium

Conclusion and Recommendation: The most effective means of Lepidium control will likely be a combination of mechanical and chemical control. Based on conditions at the site, the applicant will use the most effective means or combination of means to control the species. Any techniques not described herein that may in the future prove successful at eliminating Lepidium will require the review and approval of the Regional Board and Corps prior to implementation.

Invasive Spartina (*Spartina alterniflora* et al)

Non-native cordgrass (invasive *Spartina* spp.) is a common invasive species in San Francisco Bay marshlands and estuaries and could potentially colonize on portions of the site adjacent to the Petaluma River and along the tidally influenced ditches on the 35-acre site. The most agressive of the Spartina is the hybrid of Atlantic smooth cordgrass (*Spartina alterniflora*) and the native cordgrass (*Spartina foliosa*). *Spartina alterniflora* is a perennial deciduous grass found in intertidal wetlands, most commonly estuarine salt marshes. A native to the Atlantic coast, *Spartina alternifora* was introduced to San Francisco Bay marshlands in the 1970s as part of marshland restoration projects. It grows 3-5 feet tall and has smooth, hollow stems which typically have leaves from ½ foot to 2 feet long and ½ inch wide at their base. Pollen production, higher fertility, greater tolerance for both inundation and drought, and increased timeframe for flowering enable hybrids to outcompete the native strain.[5]

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4 http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74121.html

5 Kerr, Drew. 2015. *Aquatic Pesticide Application Plan for the San Francisco Estuary Invasive Spartina Project*. Prepared for the State Coastal Conservancy. March.

Mechanical - (hand pulling). Cordgrass can be pulled or dug before it produces flowers and seeds. This will probably be the most effective mechanical means on the site since the drainage ditches are relatively narrow and easily accessible by foot.

Cultural. Grazing can be used as a means of control but is not recommended for this site due to the wetness of the drainages.

Biological. Leafhopper bugs (*Prokelisia marginata*) have been used to control invasive Spartina in Washington State.

Chemical. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

MODE OF ACTION	CHEMICAL NAME
Aromatic Amino Acid Inhibitors	Glyphosate
Branched-Chain Amino Acid Inhibitors	Impazapyr, Sulfometuron

Conclusion and Recommendation: The most effective means of Spartina control will likely be a hand pulling and possibly chemical control. Based on conditions at the site, the applicant will use the most effective means or combination of means to control the species. Any techniques not described herein that may in the future prove successful at eliminating Spartina will require the review and approval of the Regional Board and Corps prior to implementation

Element 2 - Vegetation and Fire Management

Goal: Maintain vegetation height and composition similar to the targeted habitat types. In addition, maintain site as required for fire control but limiting impacts on site biological values. Target species to be controlled include sweet fennel, poison hemlock, Italian thistle, star thistle, pampas grass, French broom, Scotch broom, eucalyptus (with the exception of the eucalyptus that historically supported egrets), stinkwort, giant reed, non-native cordgrass, pepperweed, acacia and other common exotics. Suppress weedy species to maintain higher quality habitat.

Task: Conduct 3 annual visits (early spring, summer and early fall) to monitor weeds. Implement any methods that are allowed and cost effective that have the least impacts to site biological resources. Preferred methods for removal would be hand removal or targeted use of herbicides designed for use in sensitive wetland areas. Small mowers or weed whackers may be used on adjacent buffer zones dominated by upland grasses as long as plantings are not affected. Disking is not to be used for fire control. Keep track of any trends in particular invasive species and target those most aggressive. Include observations in annual report.

D Security, Safety, and Public Involvement

The site will have no general public access or any regular public or private use. Fencing around the perimeter of the site is the most vulnerable portion of the site to potential trespass.

Potential mosquito issues associated with wetland habitats will be addressed through the provision of access to the Marin-Sonoma Mosquito and Vector Control District staff and through management of the wetlands for minimal mosquito production.

Potential wildfire fuel (dry grass) will be reduced as needed by mowing in areas where appropriate as specified in Element 2 above.

Element 3 - Trash removal and trespass

Goal: Monitor sources of trash and trespass 3 times a year.
Collect and remove trash, repair vandalized structures, and rectify trespass impacts.

Task: Collect and remove trash and repair and rectify vandalism and trespass impacts.

E Infrastructure and Facilities

Fence and gate maintenance and repair frequency will be dependent on trespass and access control issues.

Element 4 - Fence Repair and Replacement

Goal: Monitor condition of fences. Maintain fences to prevent casual trespass, allow necessary access, and facilitate management.

Task A: During each site visit, record condition of fences. Record location, type, and recommendations to implement fence repair or replacement.

Task B: Maintain fences as necessary by replacing posts, wire, etc.

Element 5 – Gate Repair and Replacement

<u>Goal:</u> Monitor condition of gate. Maintain gate to prevent casual trespass, allow necessary access, and facilitate management.

Task A: During each site visit, record condition of gate. Record location, type, and recommendations to implement gate repair or replacement.

Task B: Maintain gate and replace as necessary.

F Habitat Assessment

Site and habitat conditions should be evaluated with the goal of maintaining biological resource values on the site. Elements of site and habitat conditions that should be evaluated include drainage of wetland areas to wetlands on adjacent properties. Maintenance of the culvert under the Sonoma Marin Area Rail Transit tracks will be conducted by railroad employees during their regular maintenance and operation activities and is not the responsibility of the land manager.

<u>Element 6 – Habitat inspection and site evaluation</u>

<u>Goal:</u> Maintain and potentially enhance habitat quality over time.

Task A: Walk project site and evaluate wetland habitats. Record observations and general assessment of habitat conditions, particularly those habitats adjacent to access roads and wetland habitats on adjacent properties. Note condition of access road and potential erosion or sedimentation problems and provide written recommendations regarding remedial measures as appropriate.

G Reporting and Administration

Element 7 – Annual Report

Goal: Provide annual report on activities conducted and general site conditions to USACE and SFRWQCB.

Task A: Prepare annual report summarizing results of monitoring and maintenance and any key problems or issues. Remedies for problems should be provided. Complete and circulate to agencies and other parties by February 15 of each year for review and approval of proposed actions.

Task B: Make recommendations with regard to (1) any habitat enhancement measures deemed to be warranted, (2) any problems that need near term attention (e.g., weed removal, fence repair, erosion control), and/or (3) any changes in the monitoring or management program that appear to be warranted based on monitoring results to date.

V Transfer, Replacement, Amendments, and Notices

A Transfer

The conservation easement and associated management responsibilities specified in this plan will remain in effect should the property be transferred to another party. The property cannot be transferred with trustee concurrence and the new owner must agree to follow the terms of the conservation easement for the site.

B Amendments

Amendments to this plan designed to better meet management goals and preserve the habitat and conservation values of the property will only be allowed with the approval of the trustee in cooperation with the land manager. Any amendments must be approved in writing by the trustee. Any amendments to the plan shall be implemented without any additional cost to the land manager.

VI Funding

Based on the tasks specified in this plan, there will be costs associated with the long-term management for the site. These include estimates to conduct weed and fire abatement, trash removal, fence repair, and funding needed to fully replace the fences. Estimated costs for long-term maintenance will be provided in the form of an endowment matrix prior to groundbreaking. This funding estimate will require approval by the permitting agencies for the project.

REFERENCES

Atwater, B.F. and C.W. Hedel. 1976. Distribution of seed plants with respect to tide levels and water salinity in the natural tidal marshes of the northern San Francisco Bay estuary, California. United States Department of the Interior Geological Survey.

Best, C., J. T. Howell, W. Knight, I. Knight, and M. Wells. 1996. A flora of Sonoma County. California Native Plant Society, Sacramento, CA. 347 pp.

Coulombe, H.N. 1970. The Role of Succulent Halophytes in the Water Balance of Salt Marsh Rodents. Oecologia Vol 4.

DiTomaso, J.M., G.B. Kyser et al. 2013. Weed Control in Natural Areas in the Western United States.
Weed Research and Information Center, University of California.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, Calif/S.F. Bay Regional Water Quality Control Board, Oakland, Calif.

Goals Project. 2000. Baylands ecosystem species and community profiles: Life histories and environmental requirements of key plants, fish and wildlife. Prepared by the San Francisco Bay Area wetlands ecosystem goals project. P.R. Olofson, editor. S.F. Bay Regional Water Quality Control Board, Oakland, Calif.

Hickman, J. C. (ed.). 1993. The Jepson manual: higher plants of California. University of California Press, Berkeley, CA.

Hobson, K., P. Perrine, E.B. Roberts, M.L. Foster, and P. Woodin. 1985. A breeding season survey of salt marsh yellowthroats (Geothlypis trichas sinuosa) in the San Francisco Bay Region. U. S. Fish and Wildl. Serv. Contract Rept. 84-57. Sacramento, CA. 92 pp.

Kingma, Hope. 2003. Identifying habitat parameters for salt marsh harvest mouse habitat restoration. Unpublished thesis, California State University, Hayward.

Macmillan, L., R. Buck, N. Kawamoto, and J. Winter, 2003. *Biological Constraints Analysis, Landing Way Project Site, Shamrock Materials, Inc., Petaluma, California*. November. 30 pp.

Mall, R.E. 1969. Soil-water-salt relationships of waterfowl food plants in the Suisun Marsh of California. California Department of Fish and Wildlife, Wildlife Bulletin No. 1

Miller Pacific Engineering Group, 2004. Geotechnical Investigation, Haystack Landing Wetlands Restoration, Petaluma, California. October 1, 2004.

Monk & Associates. 2004. Salt marsh harvest mouse trapping study. Haystack Landing. Petaluma, California. Prepared for the U.S. Fish and Wildlife Service on behalf of Ms. Lucy Macmillan, Wetland Scientist. November 17, 2004. 9 pps. plus datasheets.

Munz, P. A. and D. D. Keck. 1973. A California flora and supplement. University of California Press, Berkeley, CA.

Shellhammer, H.S., R. Jackson, W. Davilla, A. M. Gilroy, H.T. Harvey, and L. Simons. 1982. Habitat preferences of salt marsh harvest mice (*Reithrodontomys raviventris*). The Wasmann Journal of Biology 40(1-2), 1982. pp. 102-114.

Skinner, M. W. and B. M. Pavlik (eds.). 1994. Inventory of rare and endangered vascular plants of California. Calif. Native Plant Soc. Spec. Publ. No.1./ Fifth Edition. Sacramento, CA.

Tibor, D. P. (ed.). 2001. Inventory of rare and endangered vascular plants of California. California Native Plant Society Special Publication No. 1 [6th edition].

Ungar, I.A. 2000. Ecophysiology of vascular halophytes. CRC Press, Boca Raton, FL.

U.S. Fish & Wildlife Service, 2011. Sacramento Fish & Wildlife Office
Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Petaluma River (484A) U.S.G.S. 7 1/2 Minute Quad. Database last updated: April 29, 2010. Report Date: March 10, 2011

U.S.D.A. 1990. Soil Survey. Sonoma County California.

U.S.D.A. 1991. Hydric Soils of the United States. Soil Conservation Service. Miscellaneous Publication Number 1491. 3rd Edition.

Woyshner, M.R., Porras, G., Mallory, B., and Hecht, B. 2004. Preliminary Hydrologic Evaluation of Wetland Restoration Feasibility at Haystack Landing, Petaluma, California. Balance Hydrologics, Inc. report prepared for Lucy Macmillan.

Zeiner, David C., William F Laudenslayer, Jr., Kenneth E. Mayer, and Marshall White. 1990. California's Wildlife, Volume II, Birds. California Statewide Habitat Relationships System.