Mad River Floodplain and Public Access Enhancement Project

McKinleyville Community Services District

Appendices

Appendix A: Project Designs

A1: Basis of Engineer Design

A2: Habitat Design

A3: Public Access Design

Appendix A1: Basis of Engineering Design

Basis of Engineering Designs

Mad River Estuary Restoration: Off-channel Habitat Design
CDFW Fisheries Restoration Grant Program No. P1410511 and SCC Grant No. 14-067

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April 2017

Basis of Engineering Designs

Mad River Estuary Restoration: Off-channel Habitat Design
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CALIFORNIA TROUT

California Trout, Inc.

McKINLEYVILLE COMMUNITY SERVICES DISTRICT

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LIST OF ACRONYMS

AET	Apparent effects threshold
CalTrout	California Trout, Inc.
CDFW	California Department of Fish and Wildlife
cfs	Cubic feet per second
D50	Median grain size
EDL	Estimated detection limit
ERL	Effects range low
ERM	Effects range median
FRGP	Fisheries Restoration Grants Program
ft	Feet
LC10	Lethal concentration to 10 percent of sample population
LC50	Lethal concentration to 50 percent of sample population
LiDAR	Light Detection and Ranging
MCSD	McKinleyville Community Services District
MDL	Method detection limit
mg/kg	Milligrams per kilogram
mm	Millimeter
MRFZ	Mad River Fault Zone
mS/cm	MilliSiemens per centimeter
MW	Groundwater monitoring well
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
ND	Non-detect
NHE	Northern Hydrology & Engineering
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PELs	Probable effects levels
pg/g	Picograms per gram
ppt	Parts per thousand (or trillion?)
RWQCB	Regional Water Quality Control Board
SCC	State Coastal Conservancy
SHN	SHN Consulting Engineers & Geologists, Inc.
SQuirt	Screening quick reference table
TELs	Threshold effects levels
USGS	United State Geological Survey
WDRs	Waste Discharge Requirements
WWTF	Wastewater Treatment Facility
WY	Water year
μg/kg	Micrograms per kilogram

1. INTRODUCTION

1.1 Project Background

California Trout, Inc. (CalTrout) received a grant from the California Department of Fish and Wildlife (CDFW) Fisheries Restoration Grants Program (FRGP), Agreement No. P1410511, to prepare engineering designs to reconnect lower Mad River to approximately 4.25 acres of leveed percolation ponds (historical active floodplain) to provide critical juvenile salmonid rearing habitat and off-channel refugia for coho salmon (*Oncorhynchus kisutch*). The State Coastal Conservancy provided necessary supplementary funding for the off-channel habitat enhancement project (Grant No. 14-067) and expanded the project scope to improve public access to the river and implement a biofiltration study on the adjacent floodplain. The project area is owned by the McKinleyville Community Services District (MCSD) and is located along the east bank of the lower Mad River (Figure 1). MCSD has provided in-kind labor and equipment.

CalTrout employed Northern Hydrology & Engineering (NHE) to develop engineering designs to decommission the existing MCSD Wastewater Treatment Facility's (WWTF) percolation ponds and reconnect the river to its historical active floodplain, enhancing off-channel habitat for salmonids. A geologic investigation was performed by SHN Consulting Engineers & Geologists, Inc. (SHN) to install groundwater wells, characterize the floodplain subsurface soils, and evaluate the physical and engineering properties of the pond levees for potential material reuse. Toxicity screening of pond soils was performed at TestAmerica Laboratories, Inc.

1.2 Project Purpose

The Mad River coho salmon population is recognized to have a high extinction risk, with key limiting stresses of altered sediment supply, lack of floodplain and channel structure, impaired water quality, and impaired estuary/mainstem function (NMFS 2014). The Mad River is listed under Section 303(d) in the Clean Water Act to be impaired with sediment, turbidity, and temperature, stressors to salmonid productivity and survival. The highest priority coho salmon recovery actions include the construction of off-channel and backwater ponds and alcoves. Protected and slow flowing side channels that fill during high flows provide some of the best over-wintering habitat in coho salmon streams (CDFW 2004). In increase in juvenile coho salmon rearing in the estuary and lower Mad River could result in increased survival and productivity of the population that spawns and rears in the river's tributaries (NMFS 2014). The proposed project is to design low velocity juvenile salmon habitat off the mainstem river directly related to the recovery of the Mad River coho salmon population.

1.3 MCSD Waste Water Treatment Facility

The McKinleyville Community Services District (MCSD) is an independent, special district formed in 1970. MCSD maintains and operates a Wastewater Treatment Facility (WWTF) that serves the community of McKinleyville. The WWTF discharges directly to the surface waters of the Mad River at the Hammond Bridge during a permitted "discharge period", through a National Pollutant Discharge Elimination System (NPDES) permit governed by the California Regional Water Quality Control Board (RWQCB) that includes Waste Discharge Requirements (WDRs) for effluent treatment, discharge, and reclamation. The river discharge prohibition period is May 15 through September 30, when effluent is discharged to the percolation ponds and/or to land for reclamation. The percolation ponds were constructed on the active floodplain in 1983 and include two separate ponds that are annually alternated in use (Figure 2). Although the use of the percolation ponds for effluent disposal is allowed under the current permit, the RWQCB has indicated that future discharge permits may limit this use.

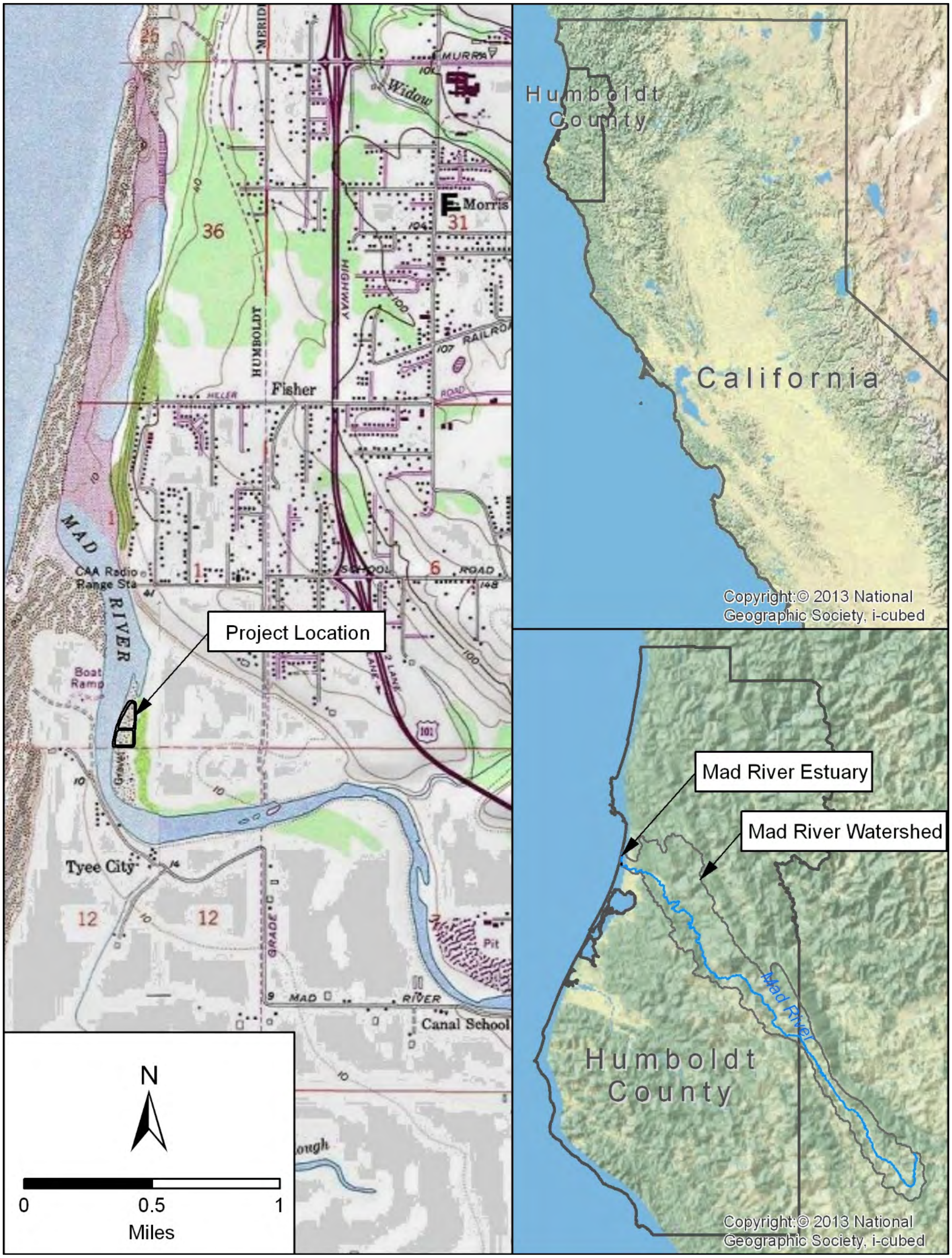


Figure 1. Location Map

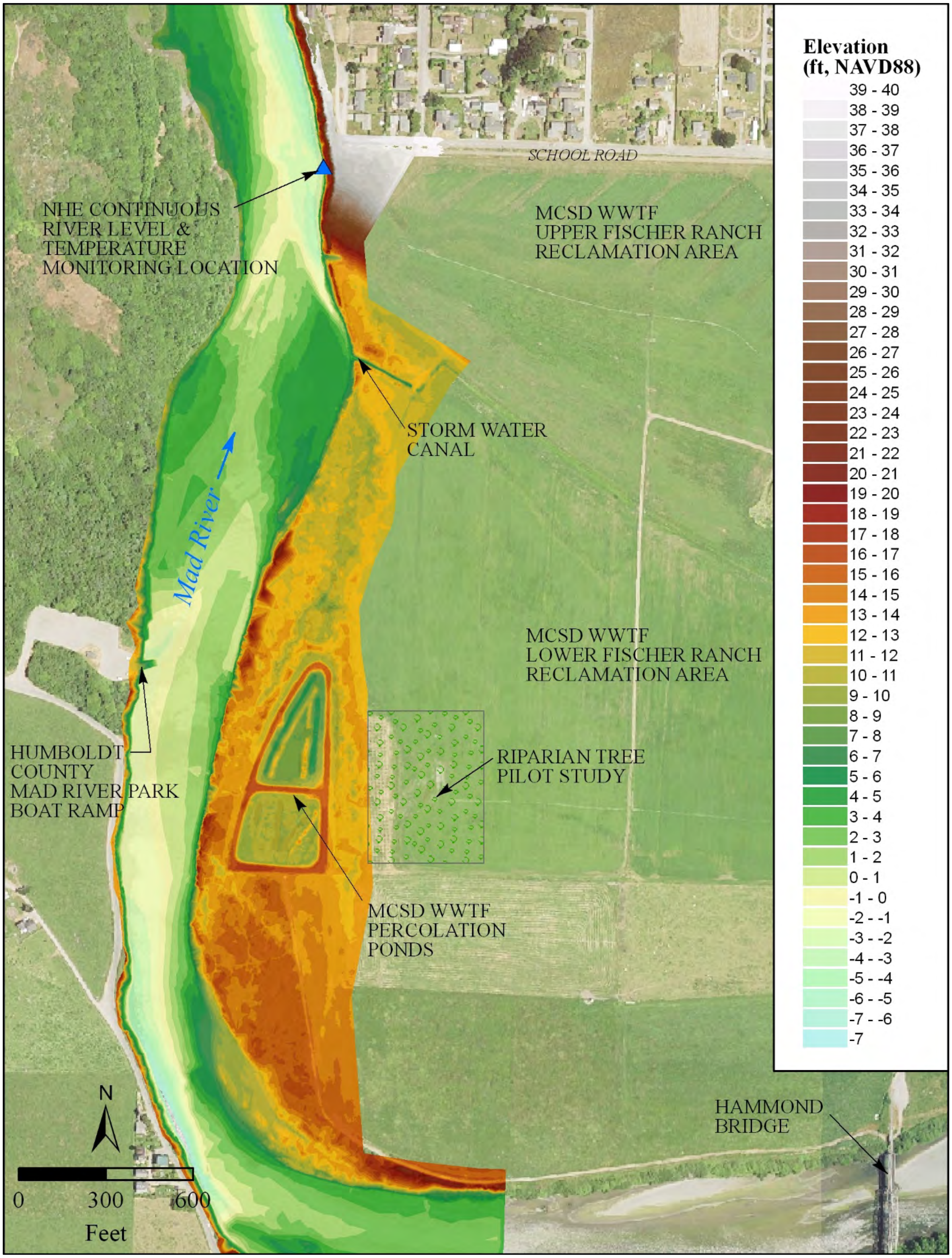


Figure 2. Project Site Map

About 7 years ago, MCSD began pursuing efforts to decommission the percolation ponds to restore the area back into active floodplain for salmonid habitat. MCSD recognized the opportunity and initiated a study to increase the available land reclamation area's capacity to off-set the percolation pond discharge allocation. A pilot project was conceived to test the assumption that changing the pasture-based crop cover to a riparian forest on the large floodplain used for reclamation could increase the land's capacity to uptake nutrients and water. In 2012, a small grant from the Arbor Day Foundation funded an acre plot of reclamation pasture to be planted with black cottonwoods. As part of the expanded portion of the off-channel habitat design project funded by the State Coastal Conservancy, the pilot project has been increased to include three more acres of red alder, a mixed riparian forest, and a pasture control area. In addition, groundwater wells were installed to monitor water levels and collect water quality samples. Implementation of the pasture crop conversion pilot project is intended to provide MCSD with data to make changes to future NPDES permits and for percolation pond decommissioning.

1.4 Site Description

The project site is located on the eastern floodplain of the Mad River at the inside of a meander bend (Figure 2). A mature, intact riparian forest has developed on the active floodplain, lee side of a long riffle downstream of the Mad River County Park Boat Ramp. A historical backwater channel remains as a depression in the forest floor and is inundated during high flows. The project area focal point is a pair of constructed percolation ponds that are leveed from the river's floods and ringed with cyclone fencing to prohibit access. The ponds maintain inundated water levels when in use for treated wastewater discharge and drain into emergent wetlands when they are unfilled. The southern pond is generally 10 feet in elevation with a single linear ridge that is over 13 feet high. The northern pond ranges from around 5.5 feet in dredged areas to 13 feet on elevated ridges that serve as islands when the pond is in use. Isolated willows provide habitat diversity within the ponds, particularly up on the elevated ridges. The levees range from 15 feet on the northern end to above 17 feet on the southern end. Adjacent floodplain areas range from around 10 feet in historic depressions and existing backwater areas to 14 feet elevation. When the river banks overtop, water backwaters through a system of human-made footpaths back to a historical backwater area, which stays ponded for a period as flow waters recede and standing waters infiltrate and evaporate.

The habitat restoration project area is bound to the north by an existing storm water canal that drains the floodplain to the east through a canal gate that remains open through the winter season and is closed when MCSD is applying treated wastewater to their fields. The project is limited to the south by a neighboring property and to the east by the floodplain used for MCSD's treated wastewater reclamation.

1.5 Design Approach

The design approach was to synthesize existing and collected data to better understand existing conditions, including river and site topography, local geology, surface and groundwater hydrology, biology, ocean tides, pertinent water and soils data. These data were used to develop a suite of design options, included in three conceptual design alternatives. A single alternative was chosen for further hydraulic analysis. An existing conditions one-dimensional hydraulic model will be used to estimate hydraulic parameters. A two-dimensional hydrodynamic model of the river and project area will be used evaluate individual design elements. Low flow conditions will be simulated to evaluate design elements when river levels were influenced by the flood and ebb of ocean tides. High flow conditions will be simulated to evaluate the design elements when the river levels were dominated by the flood and recession of storm event discharge.

2. EXISTING CONDITIONS

2.1 Topography

Base map topography was a compilation of existing data sets, including: 2010/2011 Coastal LiDAR (NOAA 2012), and 2008 channel cross-sections surveyed as part of the Mad River bluff restoration project implemented by Humboldt County by Points West Surveying in 2008, and 2011 river bathymetry along the toe of the Mad River bluff restoration project collect by Graham Matthews & Associates in 2013. Project surveying control was established by Points West Surveying. Additional topography and bathymetry was collected by NHE. Project topography is reported in US survey feet and is referenced to the North American Datum of 1983 (NAD83), California State Plane Zone 1, 2007 Epoch. Elevations are reported in feet, referenced to the North American Vertical Datum of 1988 (NAVD88).

2.2 Geomorphic Setting

The project site is located on the active floodplain at the downstream-most meander bend of the Mad River. To the south, the river "bottoms," or wide alluvium and soil floodplain, transitions into Humboldt Bay. West of the river are large foredunes built up between the Pacific Ocean and a thick riparian forest. From the project site, the river flows 3 miles north to the Pacific Ocean between a long sand spit and marine terraces. The river mouth is transient along the sand spit; therefore, this distance is relative to when the mouth was located just south of Vista Point on Highway 101.

The Mad River Fault Zone (MRFZ) has been described in detail and mapped in geologic reports. The principal faults of the MRFZ are designated as the Fickle Hill, Mad River, McKinleyville, Blue Lake, and Trinidad faults (Carver 1985). The multi-strand Mad River fault offsets marine terraces along the coastline north of the project (Carver 1992). The remnant terrace that defines the southernmost lower plate of the Mad River fault is buried beneath the greater river floodplain associated with the project site (McCrory 1996, Carver et al. 1986).

2.3 Fish Surveys

On February 17, 2015, the Humboldt State University (HSU) Biology of Pacific Salmon class, led by professor Darren Ward surveyed fish species abundance in the storm water canal, downstream of the project site, the flood ditch for the pastures east of the canal and the river backwater channel that drains the canal. Species collected included coho salmon (age 1+), young of the year Chinook salmon, tidewater goby, western mosquitofish, *Cottus spp.*, and three-spined stickleback. A report of this survey is included in Appendix A.

On January 8, 2016, Bob Pagliuco surveyed the storm water canal and upstream flood ditch and found a 95 mm coho salmon in the flood ditch, as well as prickly sculpin and three-spined stickleback. A report of this survey is included in Appendix A.

On February 17, 2016, the HSU class repeated the surveys and found Chinook salmon, *Cottus spp*., and three-spined stickleback. The class surveyed the canal again on February 14, 2017 and found a juvenile coho. No reports from these past two surveys are in circulation.

2.4 Mad River Hydrology

2.4.1 River Level Monitoring

A pressure transducer with a temperature sensor was installed in the Mad River in a pool immediately downstream of the project site to monitor continuous water depths and temperature from November 24, 2015 to July 15, 2016 and from August 2, 2016 to December 6, 2016. Water depths were converted to water surface elevations, which displayed tidal fluctuations and waters rising and falling during storm events. Water levels were compared to the stream discharge hydrograph reported approximately 5.5 miles upstream at the US Geological Survey (USGS) gaging station No. 11481000, Mad River near Arcata CA (Figure 3).

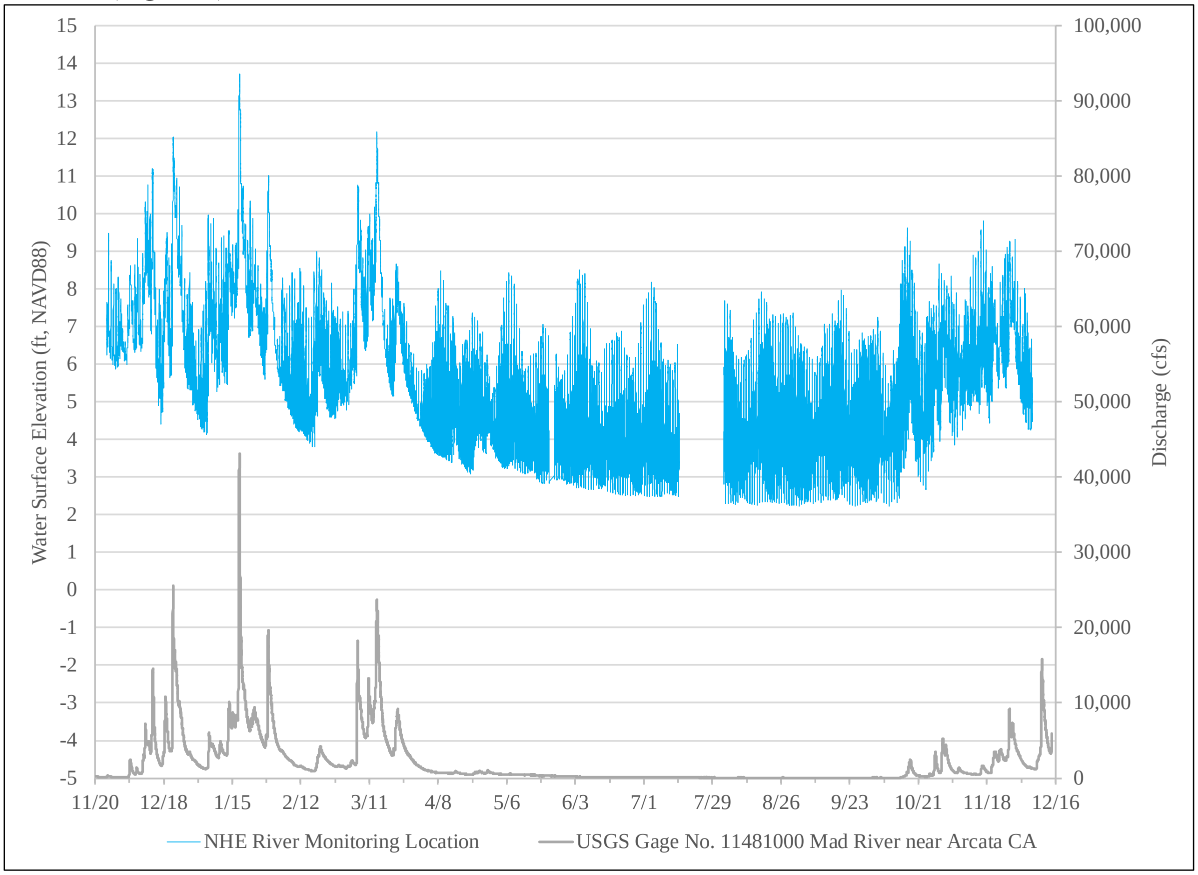


Figure 3. River levels near the project site and stream flow at USGS Gage Station No. 11481000

2.4.2 Mad River Discharge

The USGS gaged the Mad River near Arcata, CA (Station No. 11481000) from October 1, 1910 to September 30, 1913 (water years [WY] 1911 to 1913) and from October 1, 1950 to the present day (WY 1951 to 2017). During the project monitoring record, high flow events occurred several times during the winter, including a 5-year recurrence interval event that peaked on January 17, 2016.

Annual peak flow data is available through WY 2015. During the 68-year period of record, annual peak discharge events ranged from 3,360 cubic feet per second (cfs) on March 7, 1977 to 81,000 cfs on December 22, 1964. The USGS flood frequency software PeakFQ was used to estimate flood recurrence intervals, including the 1.5-, 2-, 10-, 50- and 100-year flood events (Table 1). Figure 4 illustrates the annual peak flood flow frequency analysis results as exceedence probabilities, including a 95% confidence interval.

Table 1. Peak Flow Estimates for Recurrence Intervals at USGS Gaging Station No. 11481000

Recurrence Interval	PeakFQ Bulletin 17B Estimated Peak Discharge (cfs)
1.5-year	20,550
2-year	26,410
5-year	41,560
10-year	51,670
25-year	64,280
50-year	73,460
100-year	82,420

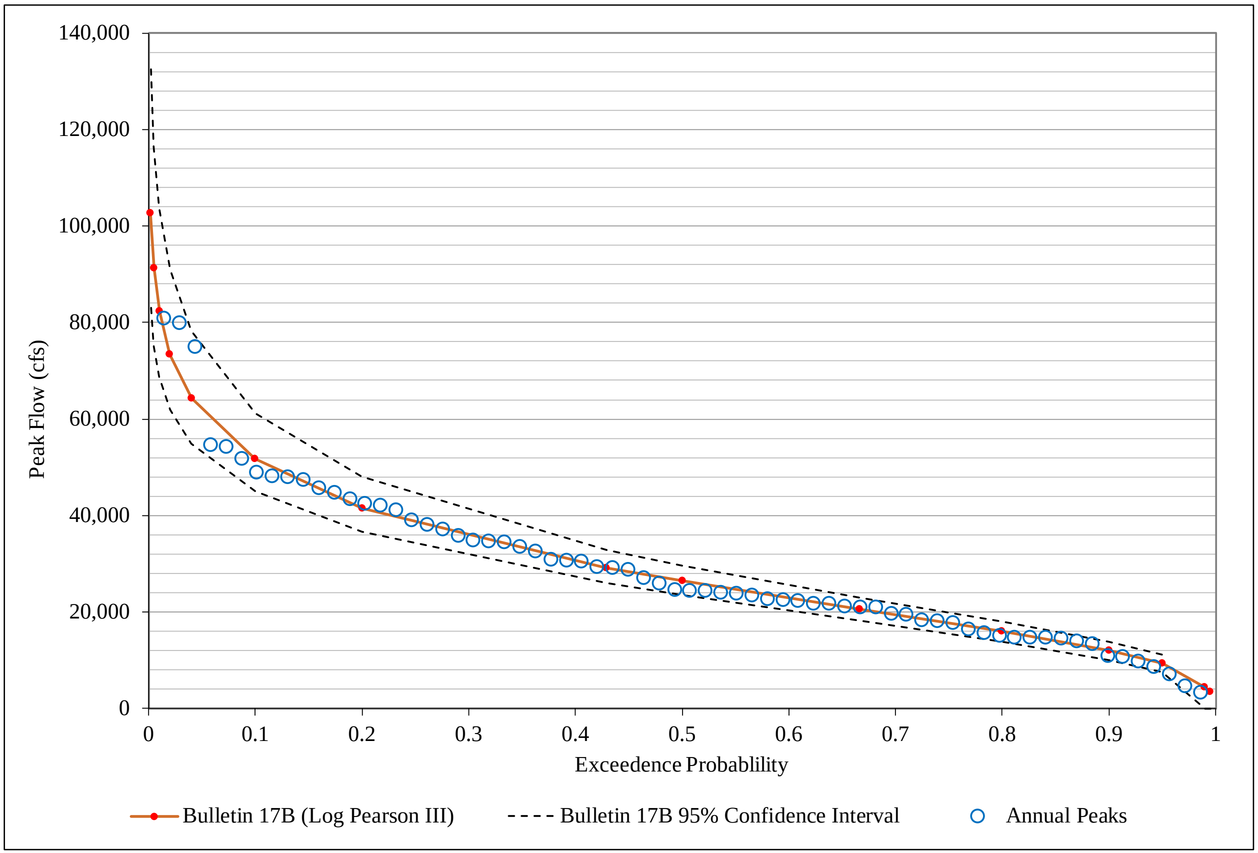


Figure 4. Annual peak flood flow exceedence probabilities for the USGS Gaging Station No. 11481000

2.4.3 Tides

Monitored river levels were compared to local tidal data at the NOAA Station ID 9418767 (North Spit) and Station ID 9419750 (Crescent City). In general, the Mad River tides were in sync with the North Spit tidal gage. Project reach river levels were controlled by the bed elevations at the river mouth, which periodically scours the bed during winter storms to form a sand bar in the ocean. The monitoring data displayed a transition in the river level control before and after the first storm events, when the river forms a sand bar offshore of the mouth (Figure 3).

2.5 Mad River Water Quality

2.5.1 Temperature

Continuous stream temperature was monitored at the NHE river monitoring location, downstream of the project site. Figure 5 displays the diurnal and seasonal fluctuation in the stream temperature.

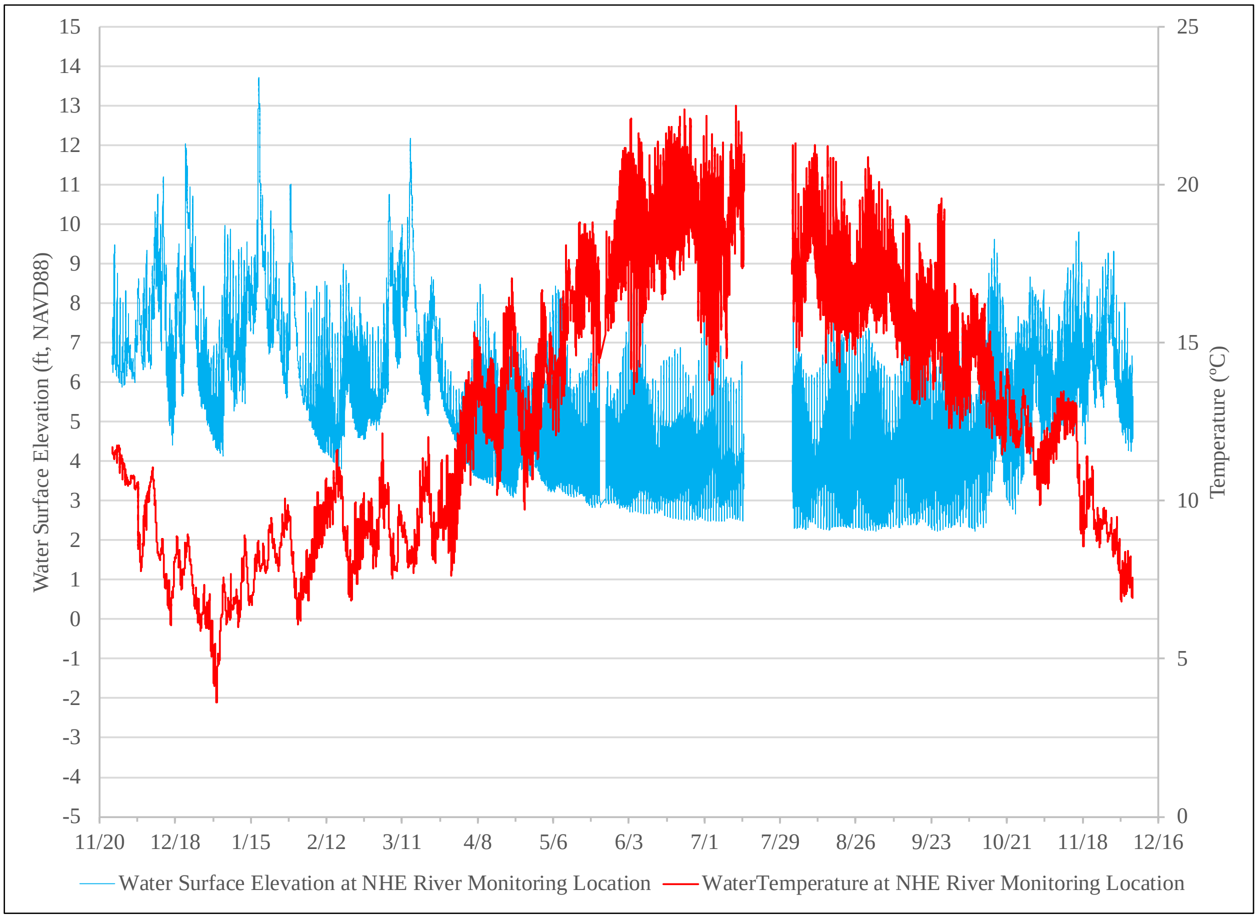


Figure 5. River Levels and Temperature near the Project Site

2.5.2 Salinity

On August 2, 2016 at 12:50 PM, at high tide and low flow (approximately 50 cfs), a salinity profile was measured at the NHE river monitoring location (Table 2).

Table 2. Salinity profile at the NHE river monitoring location August 2, 2016 at 12:50 PM

Water Depth	Temperature (°C)	Salinity (ppt)	Conductivity (mS/cm)
Surface to 5 feet	19.7	14.1	23.25
5 to river bed	18.4	19.6	31.1

On August 3, 2016 at 7:15 AM, at low tide and low flow (approximately 50 cfs), a salinity profile was measured at the NHE river monitoring location (Table 3).

Table 3. Salinity profile at the NHE river monitoring location August 3, 2016 at 7:15 AM

Water Depth	Temperature (ºC)	Salinity (ppt)	Conductivity (mS/cm)
Surface to 3 feet	18.6	3.6	6.45
3 to 4 feet	18.3	14.8	24.8
4 to 6 feet	16.7	27.2	42.17
6 feet to river bed	16.4	29.5	45.4

High salinity levels were expected to be present during high tide; however, salinity stratification differences between the two samples were likely due to mixing during the mid-day high tide sample.

On August 7, 2016 at 4:45 PM during high tide, salinity was measured to be 15.0 ppt in the storm water canal, downstream of the project area. Water temperature was 20.4 ºC and conductivity was 24.3 mS/cm.

2.5.3 Suspended Sediment Grain Size

The USGS collected and analyzed water quality data at the gaging station No. 11481000, including grain size distribution of suspended sediment samples from the gaging station for WY 1966 to 1974. Figure 6 displays the range in the results. In general, all suspended sediment was less than 2 mm, indicative of sands and finer. The median grain size, or D50 ranged from 0.004 mm (very fine silt) to 0.067 mm (very fine sand).

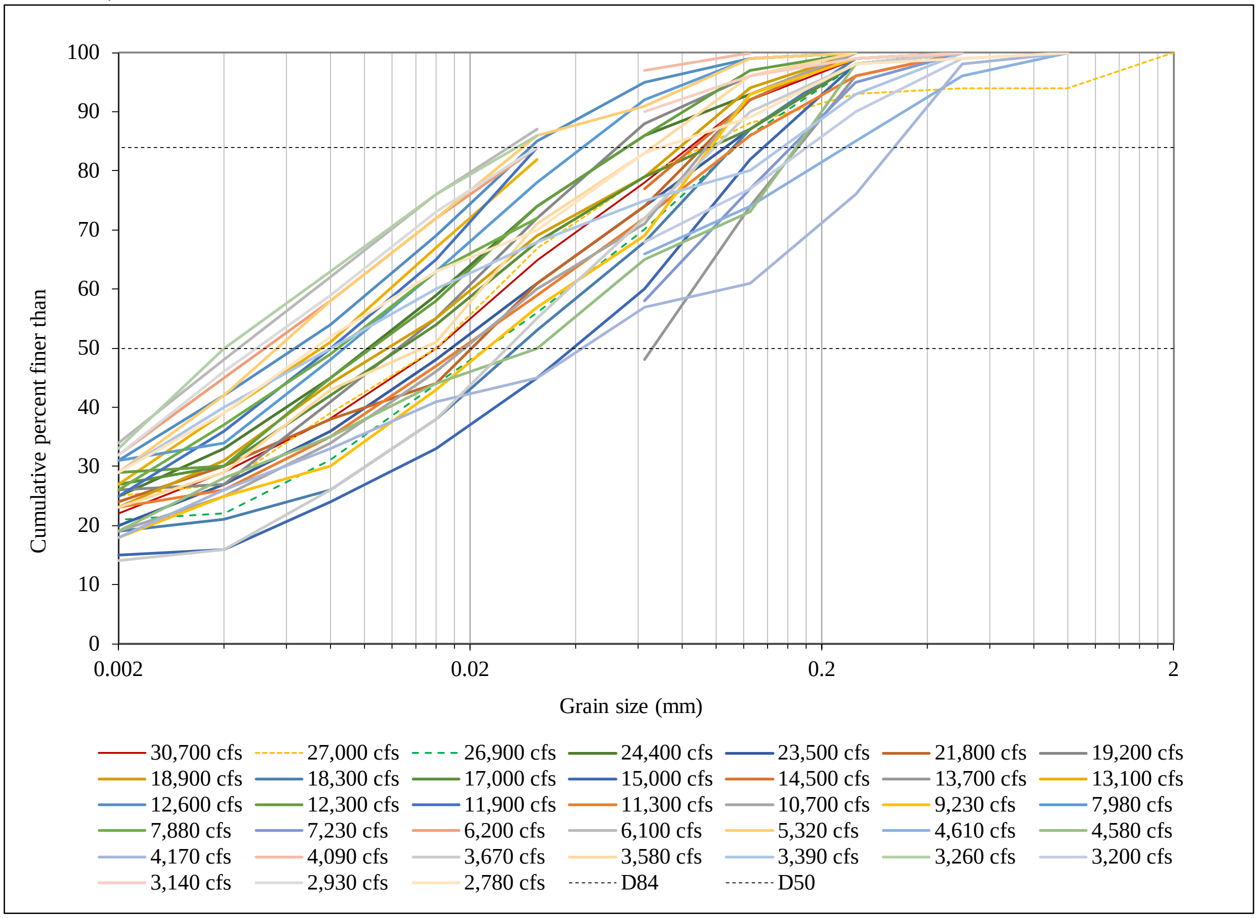


Figure 6. Mad River Suspended Sediment Grain Size Distribution, WY 1966-1974

2.6 Groundwater Levels and Temperature Monitoring

Six 1.5-inch diameter groundwater wells were drilled on the Mad River floodplain, recorded as MW-23, MW-24, MW-25, MW-26, MW-27, and MW-28 (Figure 7). Nearby MW-21 and 22 were previously installed by MCSD. Well logs shown in Appendix B illustrate the soil profiles at each of the project wells. The four groundwater wells installed within MCSD's treated wastewater reclamation area were paired groundwater wells, and located north and south of the tree planting plots for the biofiltration study. These paired wells consisted of a shallow well (10 feet below ground surface) and a deep well (20 feet below ground surface). The two wells on the active floodplain adjacent to the percolation ponds were located outside of the pond levee and were 10 feet deep.

Pressure transducers with temperature sensors were installed in the wells to monitor continuous water depths and temperature (Figure 8). Water depths were converted to water surface elevations. Groundwater levels were compared to river levels at the NHE river monitoring location.

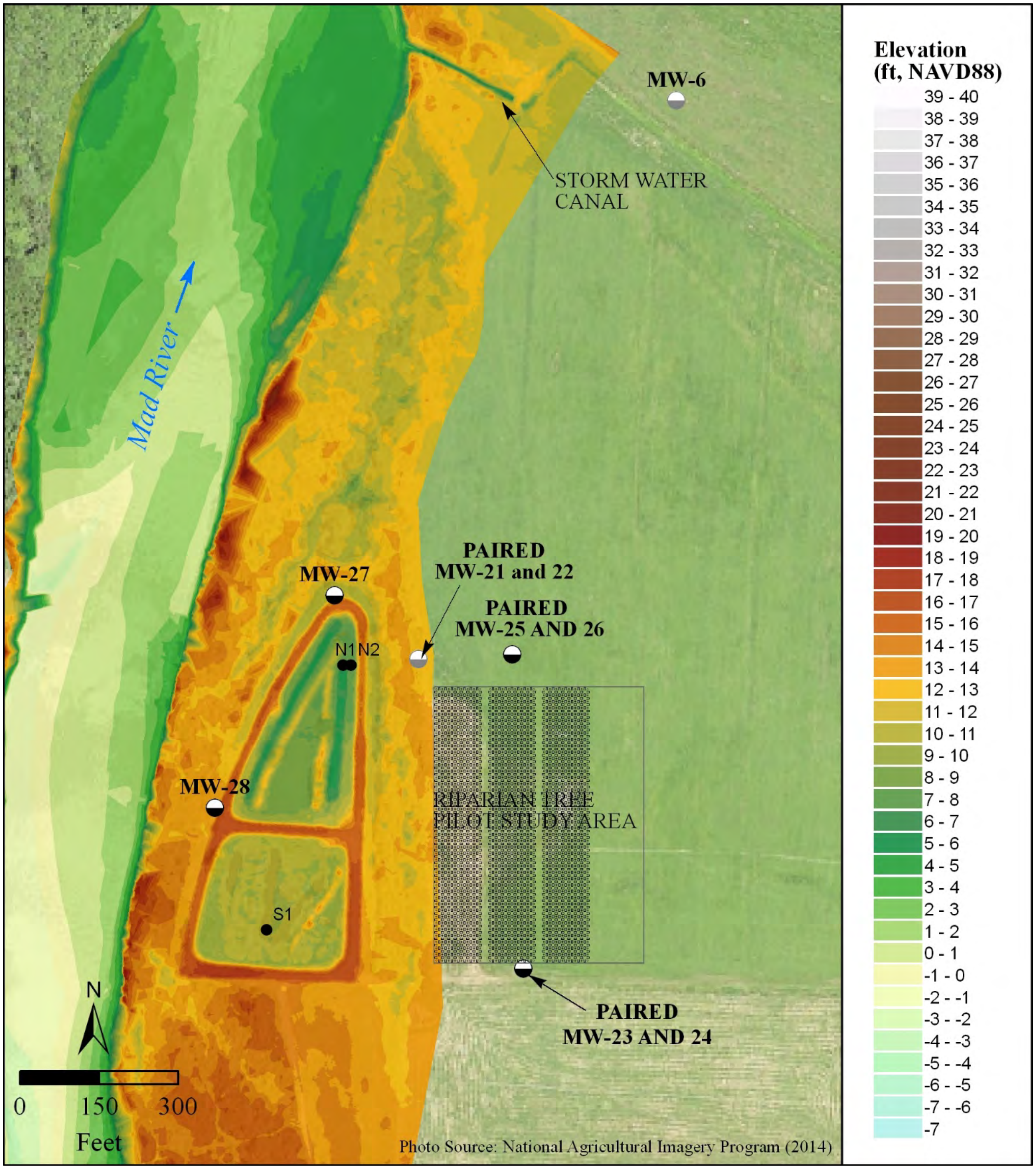


Figure 7. Groundwater Well and Soil Sampling Site Map

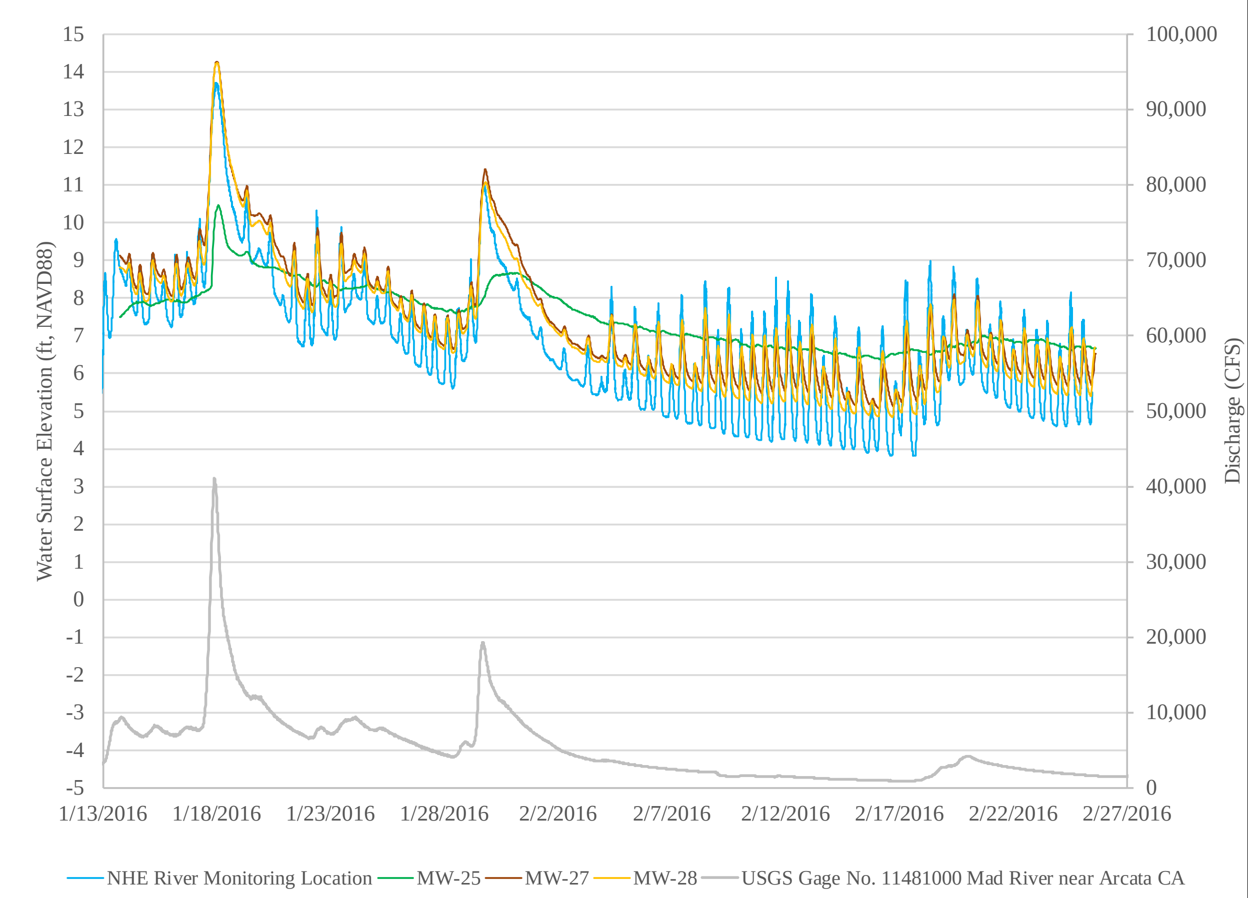


Figure 8. Ground Water Levels at Project Monitoring Wells

Tidal fluctuations were observed in the two wells near the percolation ponds and responses to high flow events were observed in all wells at varying degrees.

2.7 Percolation Pond Soils

2.7.1 Lithology

SHN logged soil lithology when the groundwater wells were installed and collected representational soil samples for analysis (Appendix B). At MW-27, north of the ponds and levee, a thin layer of sandy organic soil covers approximately 3.5 feet of silty sand that overlays 15.5 feet of well graded sand with gravel. Lean clay was observed 19 feet below ground surface, which was approximately 10.5 feet elevation. At MW-28, west of the ponds and levee, a thin layer of organic soil and sand covers approximately 7.5 feet of layered silty sand, silty sand with gravel, and well graded sand with silt that overlays at least 12.5 feet of well graded gravel with sand. The ground elevation at MW-28 is approximately 13.5 feet

2.7.2 Soil Quality

Soil samples were collected from the percolation ponds on May 12, 2016, prior to the start of annual use for treated wastewater discharge. The north and south ponds received treated wastewater during the discharge prohibition periods of 2014 and 2015, respectively. Treated wastewater was pumped into the ponds from pipes located at the eastern corners of the ponds at the central levee. Soil quality in the ponds was analyzed for elevated levels of constituents of concern, providing initial data for the feasibility of material reuse to be incorporated into the project design surface.

Three soil samples were collected from the two ponds, of which two were collected from the north pond (N1 and N2) and one was collected from the south pond (S1; Figure 7). Sample locations were based on site reconnaissance and professional judgement. Stratification of organic matter was observed in the ponds: submerged, lower elevation areas maintained a higher composition of fine organic matter and mid-elevation vegetated areas were underlain with a mix of coarser material mixed with organic matter.

The north pond was mostly dry with small patch of water remaining from winter rains. Two samples were collected, within 10 feet of each other. Sample N1 was collected from the recently dried bottom of the pond in an unvegetated, low elevation area. Sample N2 was collected below the root level of a well vegetated, mid-elevation plain. The south pond sample, S1, was collected in an area that was representative of the south pond, on a semi-vegetated plain. Single samples were collected (versus sample composites) because the treated wastewater ponding, subsequent precipitation, and varying elevation plains created a distinct stratification layers of corresponding sample types, based on fine sediment organic matter. Sample N1 represents aged pond soil quality at the lowest pond elevation and highest accumulation of fine sediments with high organic content and no vegetation. Sample N2 represents aged pond soil quality on a vegetated plain. Sample S1 represents pond soil quality of recently applied treated wastewater.

All samples were collected with a trenching shovel with a goal sample volume from a hole of 8 inches deep and 8 inches wide. Soil samples were packed on ice in a cooler and sent overnight to TestAmerica Laboratories in Sacramento. The laboratory homogenized and randomly subsampled each submitted sample prior to analysis. Results are included in Appendix C. Table 4 summarizes the analytes, methods used, reporting limits, results, and method detection limits for results of non-detect.

Table 4. Pond Soil Chemical Analyses

Chemical Analyte	Method	Units	Reporting Limit (dry weight)	Soil Analysis Results		
				N1	N2	S1
General Chemistry						
Total Kjeldahl Nitrogen	USEPA 351.2	mg/kg	180	2100	1100	1200
Diesel Range Organics						
Diesel Range Organics	USEPA 3550 B	mg/kg	90	210	31	37
Motor Oil Range Organics		mg/kg	450	950	110	140
Metals						
Silver	USEPA 6010 B	mg/kg	0.49-0.91	0.35 J[1]	ND[2] (<MDL[3] = 0.089)	ND (<MDL = 0.092)
Arsenic		mg/kg	2.0-3.6	2.7 J	1.3 J	1.7 J
Barium		mg/kg	0.99-1.8	95	67	57
Beryllium		mg/kg	0.20-0.36	0.51	0.42	0.36
Cadmium		mg/kg	0.20-0.36	0.14 J	ND (<MDL = 0.030)	ND (<MDL = 0.031)
Cobalt		mg/kg	0.49-0.91	16	8.3	5.9
Chromium		mg/kg	0.49-0.91	80	60	42
Copper		mg/kg	1.5-2.7	100	30	23
Molybdenum		mg/kg	2.0-3.6	ND (<MDL = 1.4)	ND (<MDL = 0.74)	ND (<MDL = 0.77)
Nickel		mg/kg	0.99-1.8	110	70	46
Lead		mg/kg	0.99-1.8	10	6.3	5
Selenium		mg/kg	2.0-3.6	ND (<MDL = 2.5)	ND (<MDL = 1.4)	ND (<MDL = 1.4)
Antimony		mg/kg	2.0-3.6	ND (<MDL = 1.7)	ND (<MDL = 0.93)	ND (<MDL = 0.96)
Thallium		mg/kg	2.0-3.6	ND (<MDL = 1.5)	ND (<MDL = 0.83)	ND (<MDL = 0.86)
Vanadium		mg/kg	0.49-0.91	47	40	37
Zinc		mg/kg	2.0-3.6	130	63	50
Total Mercury	USEPA 7471 A	mg/kg	0.024-0.044	0.10	0.046	0.029

Chemical Analyte	Method	Units	Reporting Limit (dry weight)	Soil Analysis Results		
				N1	**N2**	**S1**
PCBs						
PCB 1016	USEPA 8082	µg/kg	33-590	ND (<MDL = 60)	ND (<MDL = 3.4)	ND (<MDL = 3.5)
PCB 1221		µg/kg	33-590	ND (<MDL = 92)	ND (<MDL = 5.3)	ND (<MDL = 5.4)
PCB 1232		µg/kg	33-590	ND (<MDL = 110)	ND (<MDL = 6.5)	ND (<MDL = 6.6)
PCB 1242		µg/kg	33-590	ND (<MDL = 130)	ND (<MDL = 7.5)	ND (<MDL = 7.6)
PCB 1248		µg/kg	33-590	ND (<MDL = 100)	ND (<MDL = 5.8)	ND (<MDL = 5.9)
PCB 1254		µg/kg	33-590	ND (<MDL = 48)	ND (<MDL = 2.7)	ND (<MDL = 2.8)
PCB 1260		µg/kg	33-590	ND (<MDL = 52)	ND (<MDL = 2.9)	ND (<MDL = 3.0)
Organotins						
Monobutyltin	Organotins (TestAmerica Method)	µg/kg	2.6-4.8	ND (<MDL = 1.2)	ND (<MDL = 0.68)	ND (<MDL = 0.66)
Dibutyltin		µg/kg	4.3-7.8	ND (<MDL = 1.8)	ND (<MDL = 1.0)	ND (<MDL = 1.0)
Tributyltin		µg/kg	2.3-4.2	ND (<MDL = 0.92)	ND (<MDL = 0.52)	ND (<MDL = 0.51)
Tetra-n-butytin		µg/kg	13-24	ND (<MDL = 6.9)	ND (<MDL = 3.9)	ND (<MDL = 3.8)
Semi-volatile Organic Compounds						
Acenaphthene	USEPA 8270 C SIM	µg/kg	48-90	ND (<MDL = 8.5)	ND (<MDL = 4.8)	ND (<MDL = 4.6)
Acenapthylene		µg/kg	48-90	ND (<MDL = 5.9)	ND (<MDL = 3.4)	ND (<MDL = 3.2)
Anthracene		µg/kg	48-90	ND (<MDL = 7.1)	ND (<MDL = 4.0)	ND (<MDL = 3.8)
Benzo(a)anthracene		µg/kg	48-90	ND (<MDL = 5.5)	ND (<MDL = 3.1)	ND (<MDL = 2.9)

Chemical Analyte	Method	Units	Reporting Limit (dry weight)	Soil Analysis Results		
				N1	**N2**	**S1**
Semi-volatile Organic Compounds (continued)						
Benzo(a)pyrene	USEPA 8270 C SIM	µg/kg	48-90	ND (<MDL = 7.2)	ND (<MDL = 4.1)	ND (<MDL = 3.9)
Benzo(b)fluoranthene		µg/kg	48-90	25 J	11 J	4.9 J
Benzo(g,h,i)perylene		µg/kg	48-90	ND (<MDL = 18)	ND (<MDL = 10)	ND (<MDL = 9.7)
Benzo(k)fluoranthene		µg/kg	48-90	ND (<MDL = 14)	ND (<MDL = 7.7)	ND (<MDL = 7.4)
Chrysene		µg/kg	48-90	28 J	12 J	4.7 J
Dibenz(a,h)anthracene		µg/kg	48-90	ND (<MDL = 22)	ND (<MDL = 12)	ND (<MDL = 12)
Fluoranthene		µg/kg	48-90	14 J	5.4 J	3.5 J
Fluorene		µg/kg	48-90	41 J	11 J	5.0 J
Indeno(1,2,3-cd)pyrene		µg/kg	48-90	8.8 J	ND (<MDL = 4.9)	ND (<MDL = 4.6)
Naphthalene		µg/kg	48-90	36 J	11 J	4.9 J
Phenanthrene		µg/kg	48-90	120	47 J	22 J
Pyrene		µg/kg	48-90	24 J	8.9 J	4.8 J
Pentachlorophenol		µg/kg	66-120	110 J	43 J	42 J
Organochlorine Pesticides						
2,4’-DDD	USEPA 8081 B	µg/kg	34-60	ND (<MDL = 12)	ND (<MDL = 6.8)	ND (<MDL = 6.9)
4,4’-DDD		µg/kg	17-30	ND (<MDL = 4.6)	ND (<MDL = 2.6)	ND (<MDL = 2.7)
2,4’-DDE		µg/kg	34-60	ND (<MDL = 12)	ND (<MDL = 6.8)	ND (<MDL = 6.9)
4,4’-DDE		µg/kg	17-30	ND (<MDL = 3.9)	ND (<MDL = 2.2)	ND (<MDL = 2.3)
2,4’-DDT		µg/kg	34-60	ND (<MDL = 12)	ND (<MDL = 6.8)	ND (<MDL = 6.9)
4,4’-DDT		µg/kg	17-30	ND (<MDL = 7.1)	ND (<MDL = 4.1)	ND (<MDL = 4.1)
Aldrin		µg/kg	17-30	ND (<MDL = 3.7)	ND (<MDL = 2.1)	ND (<MDL = 2.2)

Chemical Analyte	Method	Units	Reporting Limit (dry weight)	Soil Analysis Results		
				N1	**N2**	**S1**
Organochlorine Pesticides (continued)						
Alpha-BHC	USEPA 8081 B	µg/kg	17-30	ND (<MDL = 3.9)	ND (<MDL = 2.2)	ND (<MDL = 2.3)
Alpha-Chlordane		µg/kg	17-30	ND (<MDL = 3.6)	ND (<MDL = 2.0)	ND (<MDL = 2.1)
Beta-BHC		µg/kg	17-30	ND (<MDL =5.9)	ND (<MDL = 3.3)	ND (<MDL = 3.4)
Delta-BHC		µg/kg	17-30	ND (<MDL = 2.8)	ND (<MDL = 1.6)	ND (<MDL = 1.7)
Dieldrin		µg/kg	17-30	6.4 J	ND (<MDL = 0.92)	ND (<MDL = 0.94)
Endosulfan-I		µg/kg	17-30	ND (<MDL = 0.92)	ND (<MDL = 0.53)	ND (<MDL = 0.54)
Endosulfan-II		µg/kg	17-30	ND (<MDL = 1.8)	ND (<MDL = 1.0)	ND (<MDL = 1.0)
Endosulfan sulfate		µg/kg	17-30	4.0 J	ND (<MDL = 0.93)	ND (<MDL = 0.95)
Endrin		µg/kg	17-30	ND (<MDL = 2.0)	ND (<MDL = 1.1)	ND (<MDL = 1.1)
Endrin aldehyde		µg/kg	17-30	ND (<MDL = 2.0)	ND (<MDL = 1.1)	ND (<MDL = 1.1)
Endrin ketone		µg/kg	17-30	ND (<MDL = 6.0)	ND (<MDL = 3.4)	ND (<MDL = 3.5)
Gamma-BHC (Lindane)		µg/kg	17-30	ND (<MDL = 3.0)	ND (<MDL = 1.7)	ND (<MDL = 1.8)
Gamma-Chlordane		µg/kg	17-30	ND (<MDL = 0.94)	2.8 J	1.1 J
Heptochlor		µg/kg	17-30	ND (<MDL = 3.4)	ND (<MDL = 1.9)	ND (<MDL = 2.0)
Heptochlor epoxide		µg/kg	17-30	ND (<MDL = 2.1)	ND (<MDL = 1.2)	ND (<MDL = 1.2)
Methoxychlor		µg/kg	34-60	ND (<MDL = 23)	ND (<MDL = 13)	ND (<MDL = 13)
Toxaphene		µg/kg	680-1200	ND (<MDL = 360)	ND (<MDL = 200)	ND (<MDL = 210)

Chemical Analyte	Method	Units	Reporting Limit (dry weight)	Soil Analysis Results		
				N1	N2	S1
Dioxins and Furans						
2,3,7,8-TCDD TEQ	WHO 2005/ OEHHA Public Health Goal	pg/g	N/A	0.42	0.092	0.032
2,3,7,8-TCDD	USEPA 1613 B	pg/g	1-1.8	ND (<EDL[4] = 0.23)	ND (<EDL = 0.10)	ND (<EDL = 0.072)
2,3,7,8-TCDF		pg/g	1.8	ND (<EDL = 0.54)	ND (<EDL = 0.25)	ND (<EDL = 0.22)
1,2,3,7,8-PeCDD		pg/g	5.0-9.1	ND (<EDL = 1.3)	ND (<EDL = 0.48)	ND (<EDL = 0.38)
1,2,3,7,8-PeCDF		pg/g	5.0-9.1	ND (<EDL = 0.13)	ND (<EDL = 0.054)	ND (<EDL = 0.041)
2,3,4,7,8-PeCDF		pg/g	5.0-9.1	0.16 J	ND (<EDL = 0.057)	ND (<EDL = 0.043)
1,2,3,4,7,8-HxCDD		pg/g	5.0-9.1	0.40 J	0.097 J	ND (<EDL = 0.052)
1,2,3,6,7,8-HxCDD		pg/g	5.0-9.1	0.53 J	0.14 J	0.12 J
1,2,3,7,8,9-HxCDD		pg/g	5.0-9.1	0.86 J	ND (<EDL = 0.048)	ND (<EDL = 0.043)
1,2,3,4,7,8-HxCDF		pg/g	5.0-9.1	ND (<EDL = 0.090)	0.088 J	ND (<EDL = 0.029)
1,2,3,6,7,8-HxCDF		pg/g	5.0-9.1	0.21 J	0.091 J	ND (<EDL = 0.026)
1,2,3,7,8,9-HxCDF		pg/g	5.0-9.1	ND (<EDL = 0.074)	ND (<EDL = 0.030)	ND (<EDL = 0.022)
2,3,4,6,7,8-HxCDF		pg/g	5.0-9.1	0.29 J	0.082 J	ND (<EDL = 0.022)
1,2,3,4,6,7,8-HpCDD		pg/g	5.0-9.1	10	2.9 J	1.7 J
1,2,3,4,6,7,8-HpCDF		pg/g	5.0-9.1	2.2 J	0.74 J	ND (<EDL = 0.49)
1,2,3,4,7,8,9-HpCDF		pg/g	5.0-9.1	ND (<EDL = 2.4)	ND (<EDL = 0.72)	ND (<EDL = 0.72)
OCDD		pg/g	10-18	55	17	8.7 J
OCDF		pg/g	10-18	2.6 J	0.87 J	0.46 J

1. J: Approximate concentration when the reporting limit > result ≥ method detection limit
2. ND: Non-detect
3. MDL: Method detection limit
4. EDL: Estimated detection limit

Figure 9 - Figure 11 shows the laboratory analysis results for metals and semi-volatile organics relative to available toxicity screening thresholds for marine sediment, listed in the National Oceanic and Atmospheric Administration (NOAA) screening quick reference tables (SQuirTs; NOAA 2016). Due to the range between the data and toxicity screening thresholds, a logarithmic scale of the concentrations was used. Non-detects were not estimated at any limit and therefore have a value of zero; however, method detection limits are tabulated in Table 4.

T20 and T50: Chemical concentrations corresponding to 20 and 50 percent probability of observing toxicity calculated from individual chemical logistic regression models based on 10-day survival results from marine amphipod tests (*Ampelisca a. and Rhepoxynius a.*).

Threshold Effects Levels (TELs) and Probable Effects Levels (PELs): Geometric mean of a database of synoptic contaminant concentrations and sediment toxicity bioassays or benthic community metrics. Different from the ERLs/ERMs, these benchmarks use the entire database, including non-toxic data results.

Effects Range Low (ERLs) and Effects Range Median (ERMs): 10th and 50th percentiles from samples categorized as toxic for a given analyte, of a database primarily of synoptic marine sediment chemistry and sediment toxicity bioassay data. As such, these benchmarks are not analogous to LC10s or LC50s (lethal concentrations to 10 or 50 percent of the sample population).

Apparent Effect Thresholds (AET): Benchmark based upon empirical relationships between sediment concentrations and observed toxicity bioassay results or observed benthic community impacts. For each analyte, paired observations are ranked in increasing concentrations. The highest concentration associated with a non-toxic sample, such that only toxic samples are observed at higher concentrations.

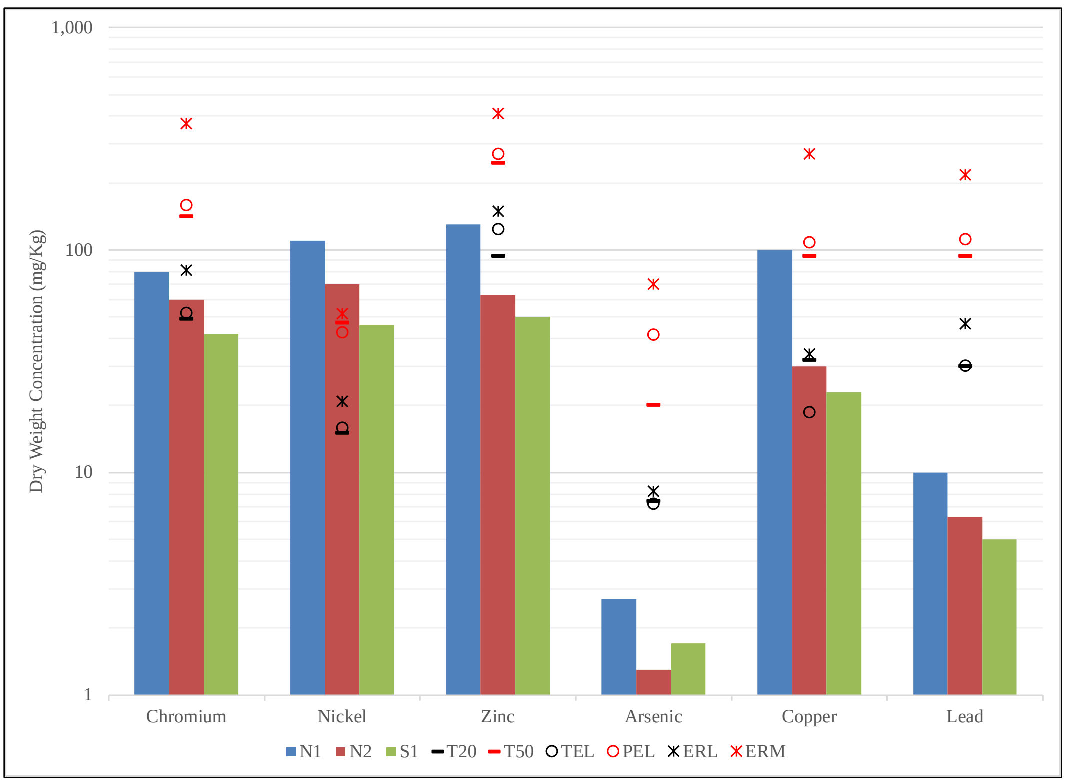


Figure 9. Metals Results (Cr, Ni, Zn, Ar, Cu, Pb) and Marine Sediment Toxicity Screening Thresholds

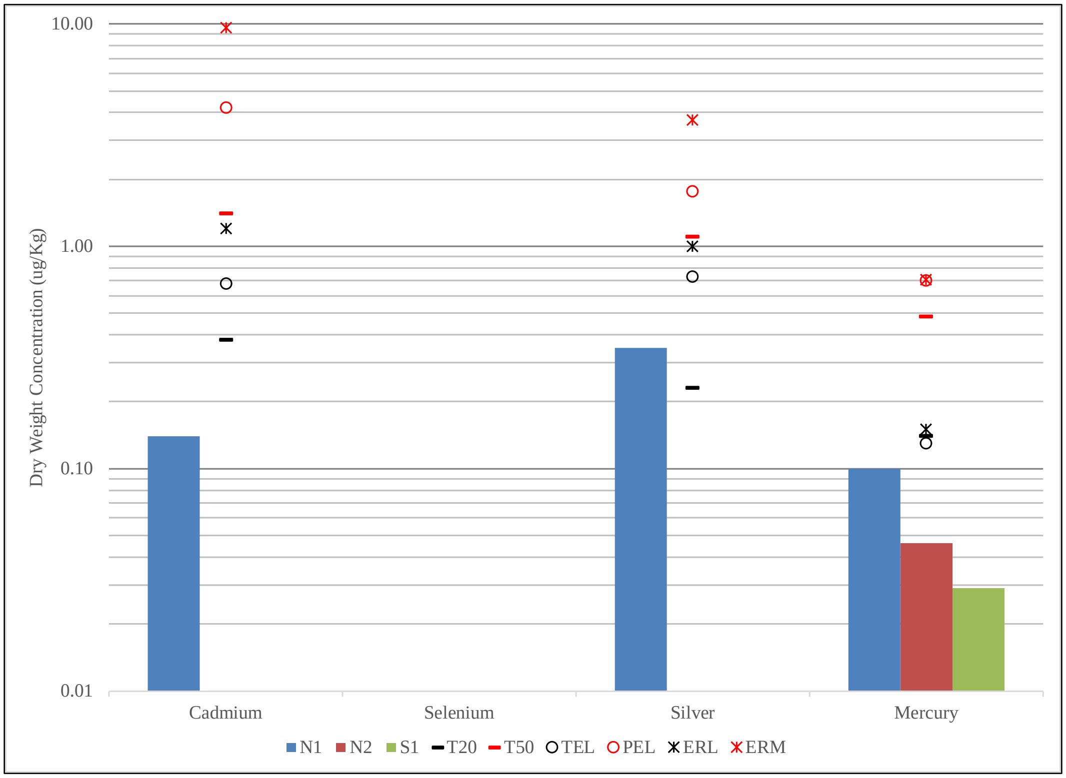


Figure 10. Metals Results (Cd, Se, Ag, Hg) and Marine Sediment Toxicity Screening Thresholds

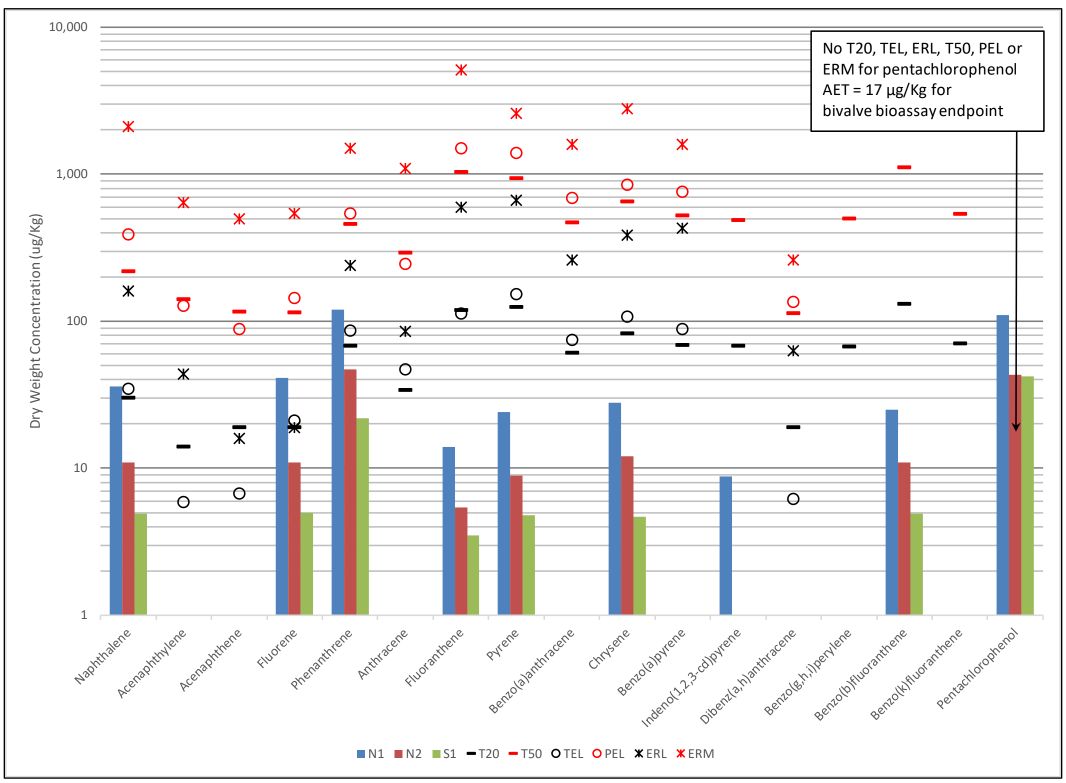


Figure 11. Semi-volatile Organics Results and Marine Sediment Toxicity Screening Thresholds

Levels of nickel and pentachlorophenol exceeded the marine sediment toxicity screening thresholds. The pentachlorophenol results were estimated (J flagged) and therefore not conclusive. Without sampling "background" conditions, it is assumed that all constituents are sourced from the treated wastewater. It is prudent to assume that all fine material will be removed from the project site within the pond area and placed at a permitted facility. MCSD is currently working with the RWQCB to permit their reclamation areas to the east of the project site to receive fine sediment from the ponds. It is anticipated that construction will require the separation of coarse material from fine material and that all coarse material will remain.

3. PROJECT OBJECTIVES, CRITERIA, AND CONSTRAINTS

3.1 Project Objectives

When implemented, the project will try to achieve specific habitat benefits:

- **Juvenile rearing:** Expand the floodplain through the project area to provide off-channel refugia with shallower depths and lower velocities to the main channel. Offer juvenile salmon protection from predation and slow moving water enabling the conservation of energy in preparation for outmigration.
- **Increased productivity:** Create off-channel areas to provide an abundance of terrestrial and aquatic food sources. Through restoration of riparian vegetation with hydrological connectivity to the river, facilitate nutrient and organic material exchange between and land and water and increase habitat complexity by way of food subsidies and debris. Increase riparian habitat to benefit species such as aquatic insects and beaver that in turn, are important elements to salmon ecology.
- **Floodplain/channel structure and estuary function:** Expand the riparian floodplain by removing levees and infrastructure. Improve the hydrologic connection between the river and floodplain, and if feasible provide tidal inundation and estuarine habitat.

3.2 Project Criteria

3.2.1 Fish Passage

NOAA Fisheries provides hydraulic criteria for juvenile salmonid passage that will be considered (NOAA 2001):

- Minimum water depth is 0.5 feet
- Maximum average water velocity is 1 ft/s
- Maximum water surface drop heights are 0.5 feet.

3.2.2 Pool Depths

Pool depths should range from a minimum in shallow areas to a minimum of 3 feet in areas intended for open water to inhibit emergent vegetation from colonizing. Target deep water areas should be 5-6 feet. Hydrological connectivity between the project area groundwater and the river was observed below fine sediment deposits.

3.2.3 Water Quality

Coho salmon can survive in water temperatures that range from 0 to 25.6 ºC, but prefer water temperatures ranging from 11.7 to 14.4 ºC (Bell 1990). Growth rate and food conversion efficiency of juvenile salmon is optimum at dissolved oxygen (DO) concentrations above 5 mg/l (Brett and Blackburn

1981), but have been found thriving in Strawberry Creek and Lawrence Creek in at DO concentrations as low at 3 mg/l, provided that water temperatures were below 18 ºC (Bob Pagliuco, pers. comm.)

3.3 Project Constraints

The project is constrained by the site's existing conditions, including, but not limited to:

- Target fish and other aquatic species
- Wildlife use
- Geomorphology
- Geology; landforms and tectonics
- Surface hydrology; seasonal instream flow variation
- Ocean tides; sea level rise
- Hydraulics
- Water quality (temperature and dissolved oxygen)
- Suspended sediment concentrations
- Bedload
- Debris
- Invasive species
- Pond soil quality: whether to leave on-site or remove existing material
- Land ownership/property boundaries
- NPDES permit restriction to adjacent land reclamation areas
- Access and constructability

4. OPTIONS ANALYSIS

An options analysis for decommissioning the MCSD WWTF percolation ponds and improving fish off-channel habitat to the river's active floodplain was prepared as part of the initial planning for the project designs. Specific design options were included in three conceptual design alternatives, which were presented and discussed in the project agency review meeting on April 25, 2016. These alternatives were revised based on input from the agencies and presented to the public at an MCSD Board meeting on May 4, 2016.

4.1 Alternative 1: Restore Existing Conditions Active Floodplain

The intent of Alternative 1 is to restore the percolation ponds to existing active floodplain conditions that can be backwatered through human use footpaths that serve as high flow channels during bankfull flood events (Figure 12). Alternative 1 considers the following actions:

1. Completely remove pond levees and grade ponds to the adjacent active floodplain elevation, leaving a wetland depression.
2. Revegetate the restored area with native wetland and riparian plants.

4.1.1 Benefits

By removing the levees around the percolation ponds, the Mad River will potentially gain approximately 4.25 acres of high flow-refugia during overbank storm events, similar in character and quality to the active floodplain areas adjacent to the existing ponds. The conversion of the percolation ponds to active floodplain with an emergent wetland depression would provide ecological connectivity currently bisected by the large levees and chain link fence that ring the ponds.

4.1.2 Impacts

Short-term impacts to wildlife use of the area are expected from demolition of the levees and wastewater infrastructure. By decommissioning the percolation ponds, there will be a net loss of open water habitat currently used by terrestrial and avian wildlife.

4.1.3 Limitations and Constraints

Project site inundation would be limited to the occurrence of river connectivity by backwatering during a high flow floodplain overtopping flood event. Backwater flooding enters the floodplain along foot pathways created by human recreational use. Removal of the levees will allow floodwaters and river settled out suspended sediment to build up the area over time and could convert areas of emergent wetland into riparian forest, similar to adjacent floodplain areas. Long term sustainability of the proposed design features would be limited to the site's hydrology necessary to sustain an emergent wetland and the floodplain topography that could be built up by river suspended sediment loads during flood events and reconfigured by human use.

Excess levee material would need to be relocated outside of the active floodplain. All demolished infrastructure materials would need to be removed to an off-site location.

4.1.4 Conclusions

Active floodplain flooding events typically occur every 1-2 years, and the area would be expected to backwater and then drain completely as river levels decrease. Although the existing condition of the active floodplain could provide limited high flow refugia habitat for salmonids, the active floodplain area drains as flood waters recede and fish stranding may be a concern if this alternative was implemented. Emergent wetlands could provide a good food source to the river's fisheries if these areas were hydrologically connected by surface water.

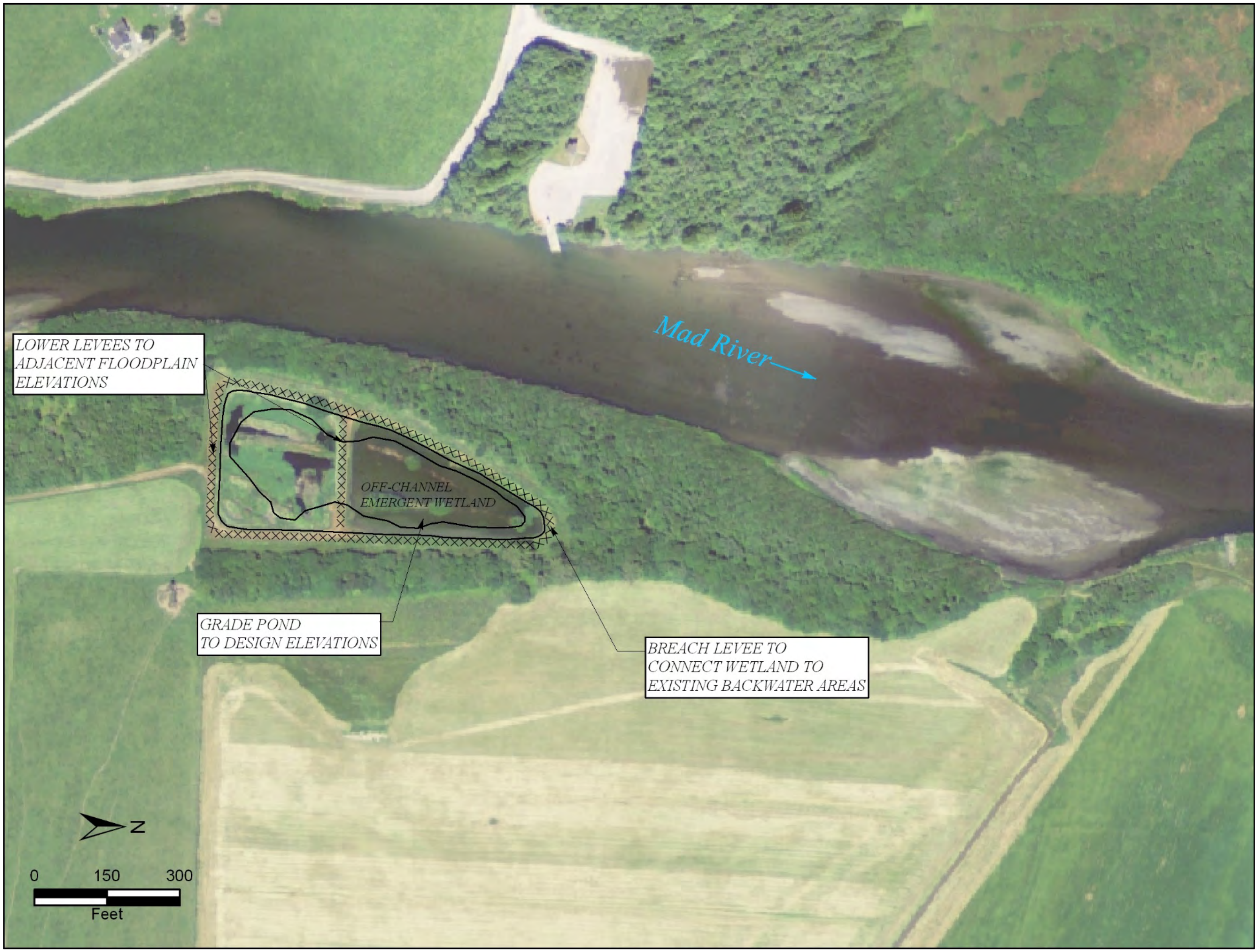


Figure 12. Alternative 1 Concept Design

4.2 Alternative 2: Create Backwater Channel and Off-Channel Backwater Pond

The intent of Alternative 2 is to create a channel that is tidally inundated during the river's low-flow period that backwaters during high flow periods into an off-channel pond (Figure 13). Alternative 2 considers the following actions:

1. Remove the river-side and interior levees and leave the landward levee.
2. Construct an approximately 1200-foot backwater channel to directly connect the storm water canal to an off-channel pond.
3. Excavate ponds to create a single, large and deep off-channel pond.

4.2.1 Benefits

By removing the river-side levees and fences around the percolation ponds, the Mad River will potentially gain approximately 4.25 acres of high flow-refugia during overbank storm events, with relatively higher quality than the active floodplain areas adjacent to the existing ponds. When floodwaters recede, the excavated pond is intended to provide deep water off-channel habitat and the constructed channel is intended to provide access back to the river. If the channel maintains an open water connection to the storm water canal, the channel would ideally exchange water between the river and pond during a tidal cycle.

4.2.2 Impacts

Short-term impacts to wildlife use of the area are expected from demolition of the levees and wastewater infrastructure, and by excavating a deep pond. Construction of the channel will require removing riparian trees from the floodplain, and removing floodplain fill material.

4.2.3 Limitations and Constraints

Backwater flooding will enter the floodplain from the constructed channel and will not be controlled or inhibited by the river-side levees. Uncertainty of the sustainability of the design inundation features are due to the impacts from river suspended sediment settling out within the channel and pond. If the channel fills to a level that tidally driven waters cannot inundate upstream design features, there are chances of seasonal to long-term stranding from hydrological disconnection between the pond and the river. Over time, the pond could fill with settled out suspended sediment from high flow events in the river.

4.2.4 Conclusions

Tidally driven flows into the channel will occur diurnally. If sediment fills the channel, the frequency of tidal inundation will be reduced. Initially, the channel will convey surface water during a flood tide from the river back to the pond and drain the channel back to the river during an ebb tide. The site has valuable backwatering conditions, which in turn present low energy areas to settle suspended sediment. Removal of the levees will reconnect the site to the active floodplain during high flow events to provide high flow refugia habitat for salmonids. Backwater features should incorporate emergent wetlands along banks and pond edges to promote sedimentation in targeted areas. Emergent wetlands could provide a good food source to the river's fisheries if these areas were hydrologically connected by surface water.

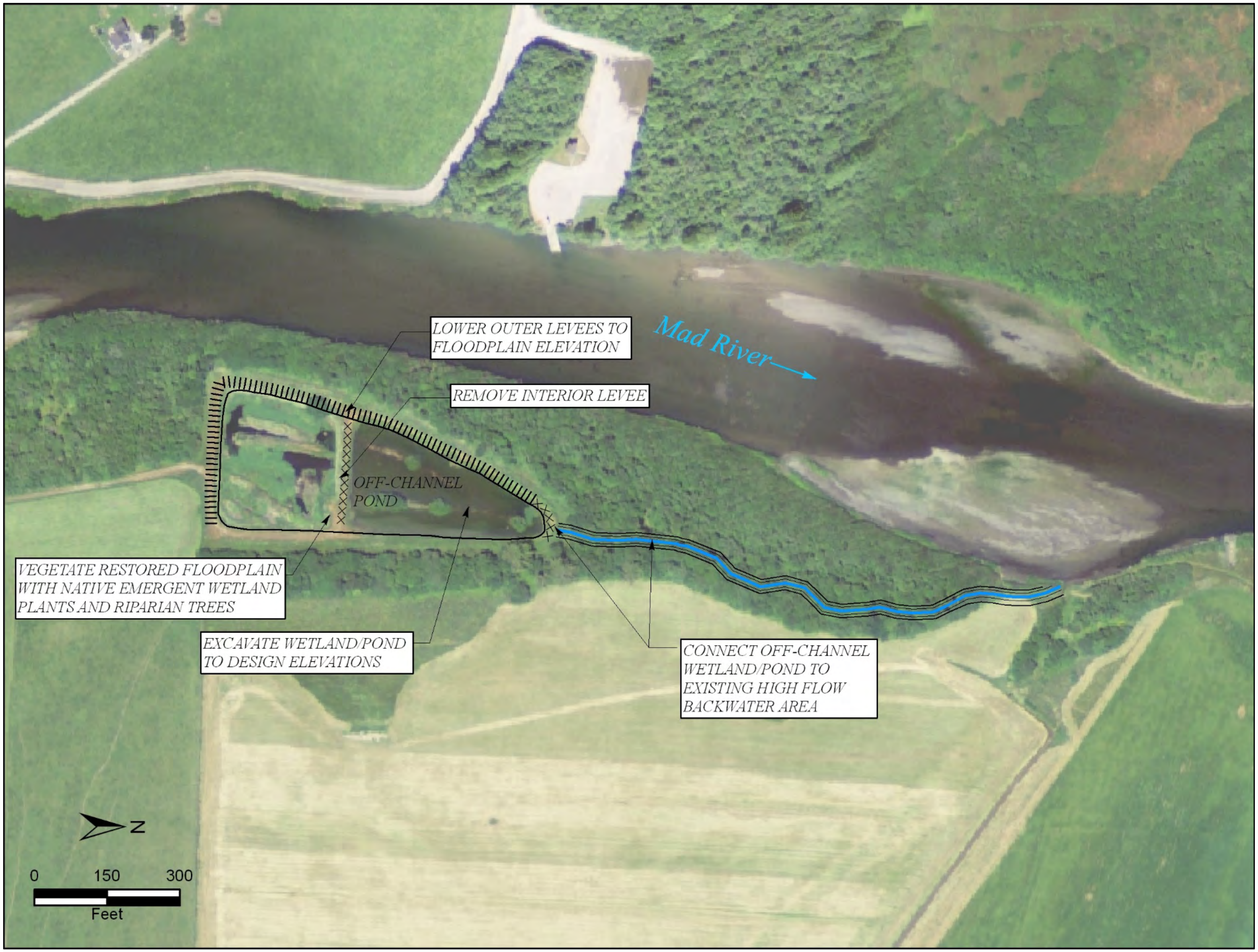


Figure 13. Alternative 2 Concept Design

4.3 Alternative 3: Create Backwater Channel and Off-Channel Backwater Pond with Emergent Wetlands and Swale for High Flow Through and Sediment Trapping

The intent of Alternative 3 is to create a backwater channel that is tidally inundated during the river's low-flow period and backwaters during high flow periods into the off-channel pond. The upstream swale is to provide flow-through from overtopping river events. The southern emergent wetland is expected to accumulate sediment at a faster rate than downstream design elements, extending the longevity of the downstream ponds. (Figure 14). Alternative 3 considers the following actions:

1. Remove the river-side and interior levees and leave the landward levee to remain.
2. Construct an approximately 1200-foot backwater channel to directly connect the storm water canal to an off-channel pond.
3. Excavate the northern (downstream) pond to create a deep off-channel pond with interior islands.
4. Leave the southern (upstream) pond and fill the southeastern edge to create a riparian bench.
5. Lower the floodplain, riverside of the southern pond to create a swale that connects to the river during high flows.
6. Revegetate the southern pond densely with emergent wetland plants and the benched areas and islands with riparian trees.

4.3.1 Benefits

By removing the river-side levees and fences around the percolation ponds, the Mad River will potentially gain approximately 4.25 acres of high flow-refugia during overbank storm events, with relatively higher quality than the active floodplain areas adjacent to the existing ponds. When floodwaters recede, the excavated pond is intended to provide deep water off-channel habitat and the constructed channel is intended to provide migration access back to the river. If the channel maintains an open water connection to the storm water canal (the channel does not clog with settled suspended sediment during storm flows), the channel could convey surface water during a flood tide and maintain the off-channel pond and its connection to the river all year. The upstream swale and emergent wetlands are intended to provide overtopping flows to settle suspended sediments and provide energy to scour sand from the backwater channel.

4.3.2 Impacts

Short-term impacts to wildlife use of the area are expected from demolition of the levees and wastewater infrastructure, and by excavating a deep pond. Construction of the swale and channel will require removing riparian trees from the floodplain, and removing floodplain fill material, which could impact wildlife use; however, the riparian forest is mature and continuous throughout the site.

4.3.3 Limitations and Constraints

Backwater flooding will primarily enter the floodplain from the constructed channel and will not be controlled or inhibited by the river-side levees. During high flow events, the swale is intended to overtop

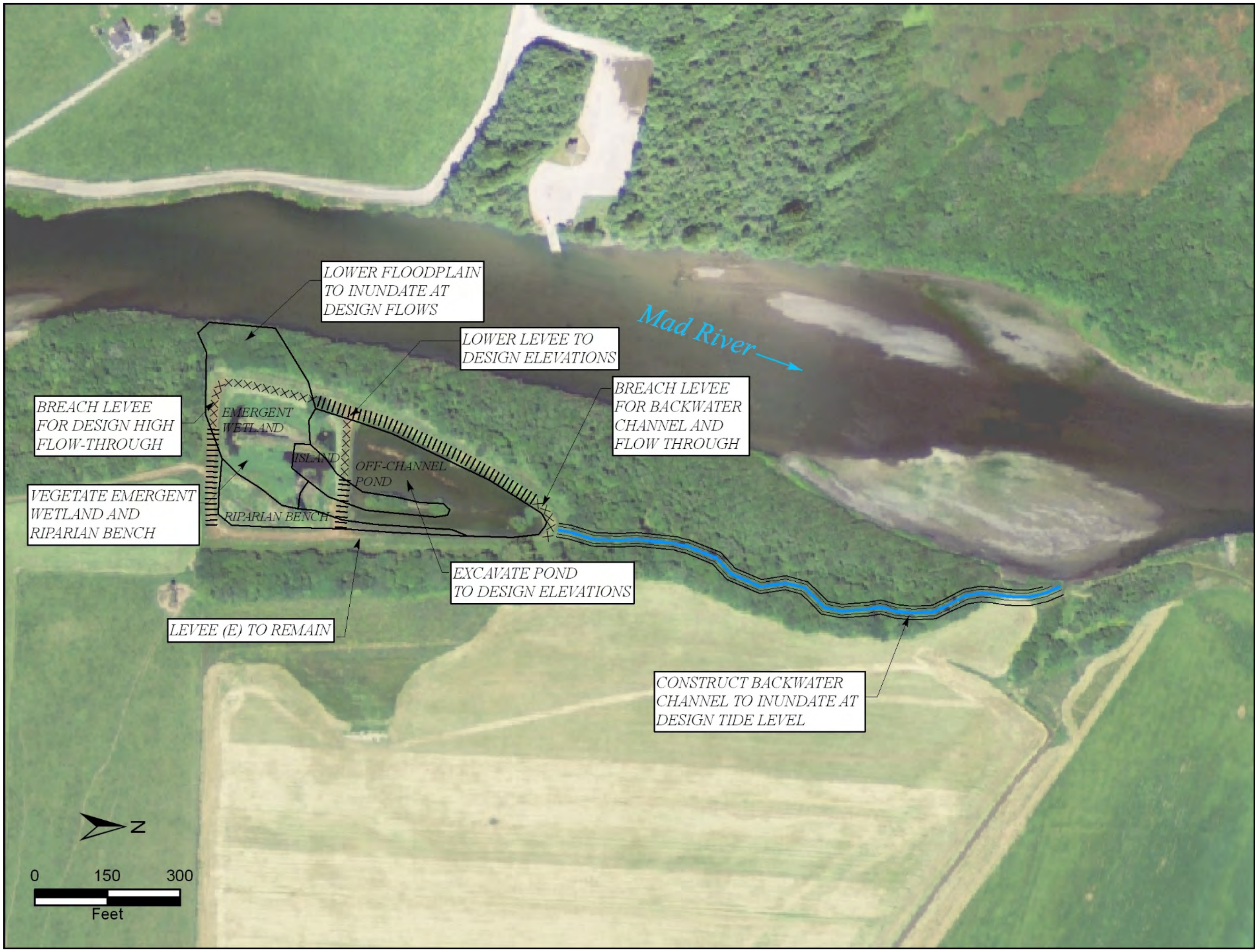


Figure 14. Alternative 3 Concept Design

and carry river water into the upstream emergent wetland, providing energy to the backwater channel to as flows recede. Uncertainty of the sustainability of the design inundation features are due to the impacts from river suspended sediment settling out within the channel and pond. If the channel fills to a level that tidally driven waters cannot inundate upstream design features, there are chances of seasonal to long-term stranding from hydrological disconnection between the pond and the river. Over time, the pond could fill with settled out suspended sediment from high flow events in the river. The location of the swale is not ideal and would be better suited in a location further upstream that could gain more hydraulic head before entering the site; however, the project is limited by landownership and must be kept within the boundaries of MCSD's property.

4.3.4 Conclusions

Tidally driven flows into the channel will occur diurnally. If sediment fills the channel, the frequency of tidal inundation will be reduced. Initially, the channel will convey surface water during a flood tide from the river back to the pond and drain the channel back to the river during an ebb tide. The site has valuable backwatering conditions, which in turn present low energy areas to settle suspended sediment. Removal of the levees will reconnect the site to the active floodplain during high flow events to provide high flow refugia habitat for salmonids. Backwater features incorporate emergent wetlands at an upstream swale to allow flood waters to settle sediment and promote scour in the backwater channel as surface water recedes. Emergent wetlands provide a good food source to the pond and potentially to the river if they maintain a hydrological connection by surface water.

Alternative 3 conceptual design was chosen for hydraulic analysis because it was the most complex of the three alternatives and will ultimately test assumptions of the site's hydraulics and design options for all three alternatives. A preferred design alternative will be based on the results of the hydraulic analysis.

5. PROPOSED DESIGN ELEMENTS

Figure 15 illustrates the initial draft design planform map and channel longitudinal profile. Key design features are annotated. The alignment is stationed from the existing river backwater channel, upstream through the proposed backwater channel, continuing up through the two converted percolation ponds and returning to the river through a swale.

5.1 Backwater Channel

The project's backwater channel is located within the active floodplain, continuing upstream from an existing river backwater channel, located at the eastside of a large riffle and gravel bar (Figure 15). The mouth of the project's backwater channel will empty at and through an existing storm water canal that drains the high pasture floodplain to the east through a canal gate. The downstream elevation of the backwater channel is controlled by the topography of the storm water canal, which is currently at approximately 3.5 to 4 feet elevation, and an existing river backwater channel that the storm water canal drains into which grades down to approximately -4 feet elevation near the County's culvert outlet. The channel grades up from approximately 3 feet elevation to approximately 6.2 feet elevation over a slope of 0.25% for 1250 feet. The channel flattens to a slope of 0.11% through the north pond reach for 325 feet and then steepens to a 2% slope up to the emergent wetland.

5.2 Off-Channel Pond

An off-channel pond is proposed approximately 1200 feet upstream of the backwater channel confluence with the storm water canal. The pond will be excavated to 0 feet elevation with a 20-foot width and 100-foot length. The pond is located off-set from the backwater channel, to reduce sediment loading. Minimum depths of approximately 6 feet are to inhibit emergent vegetation from colonizing.

5.3 Wetland Flats and Islands

The area between the off-channel pond and the backwater channel is intended to provide wetland flats at an elevation of 7 to 8 feet and elevated topography as isolated islands vegetated with riparian trees at a peak of 11 to 13 feet elevation. The wetlands will likely be emergent freshwater wetlands; however, there is a possibility that salt-tolerant, brackish vegetation could colonize.

5.4 Upstream Swale and Emergent Wetland/Sedimentation Basin

South of the off-channel pond is a proposed overflow system where the river can overtop a swale and spread inflowing water through an emergent wetland/sedimentation basin prior to draining into the backwater channel. It is assumed that flow direction will reverse when the swale overtops. The swale will grade from 11 feet down towards the sedimentation pond at 10 feet elevation over a slope of 0.55%. The wetland maintains a slight slope of 0.01% towards the backwater channel, but is a large flat feature.

5.5 Riparian Bench

A bench at 13 to 14 feet elevation is proposed for riparian trees along the east side of the emergent wetland to increase habitat complexity and direct overtopping flow-through towards the emergent wetland and backwater channel.

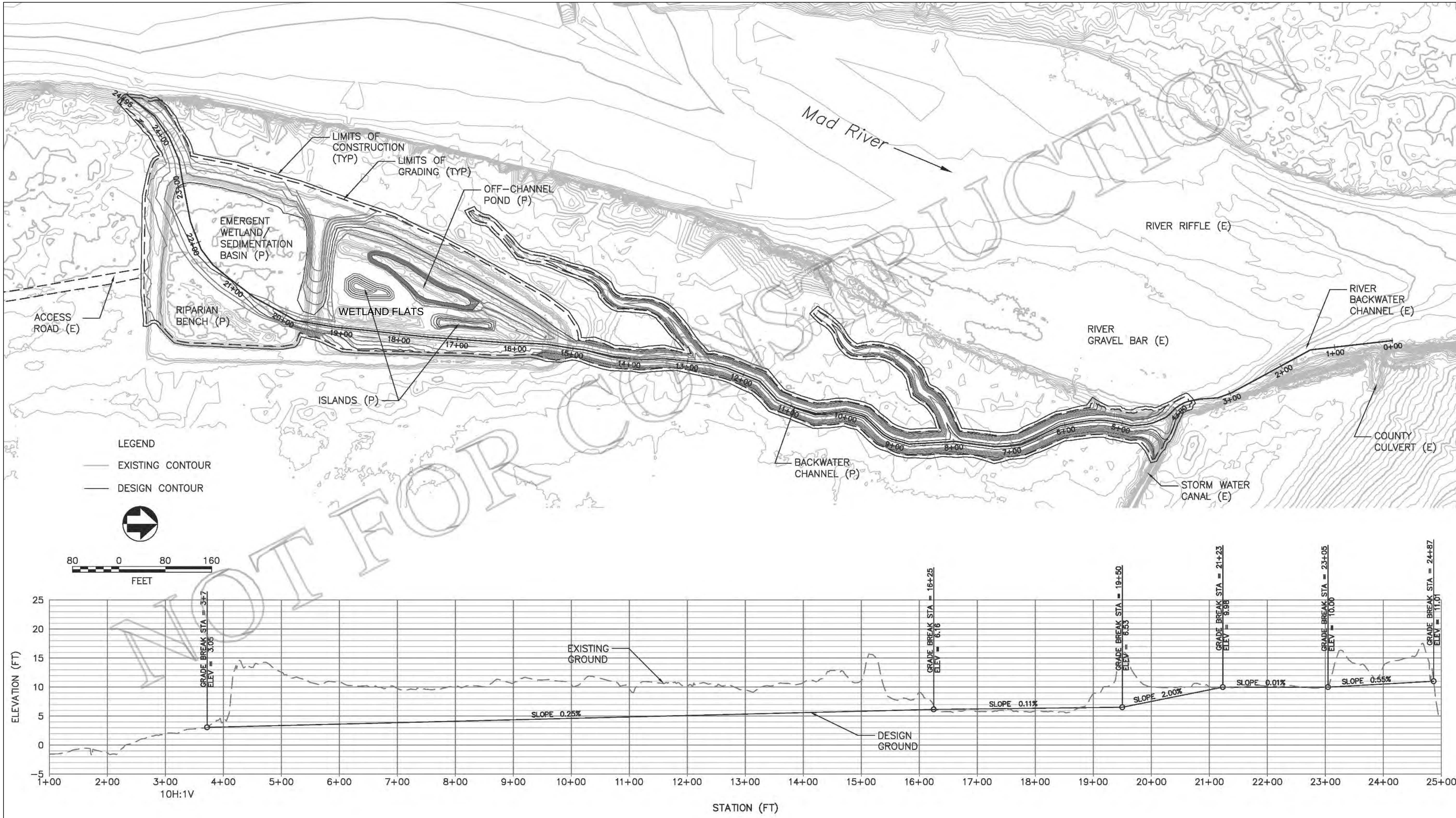


Figure 15. Alternative 3 Project Design Planform and Profile

6. REFERENCES

Bell, M.C.. 1990. *Fisheries handbook of engineering requirements and biological criteria*. Fish Passage Development and Evaluation Program. U.S. Army Corps of Engineers.

Brett, J. R., and J.M. Blackburn. 1981. *Oxygen requirements for growth of young coho (Oncorhynchus kisutch) and sockeye (O. nerka) salmon at 15°C*. Can. J. Fish. Aquat. Sci. 38:399-404

California Department of Fish and Wildlife. 2004. *Recovery strategy for California coho salmon*. Report to the California Fish and Game Commission. Sacramento, CA:CDFW.

---. 2009. Chapter XII of the *California Salmonid Stream Habitat Restoration Manual*. Sacramento, CA:CDFW.

Carver, G.A. 1985. *Quaternary tectonics north of the Mendocino triple junctions*, in Kelsey, H.M., et al. eds. Redwood Country guidebook. Arcata, CA. American Geomorphological Field Group. 1985 Field Trip, p. 155-167.

---. 1992. *Late Cenozoic tectonics of coastal northern California*, in Carver, G.A., and Aalto, K.R., eds., Field guide to the late Cenozoic subduction tectonics and sedimentation of northern coastal California: American Association of Petroleum Geologists, v. GB-71, p. 1-9.

Carver, G.A., Burke, R.M., and Kelsey, H.M., 1986, *Quaternary deformation in the region of the Mendocino triple junction: Technical report to U.S. Geological Survey*. Reston, Virginia, under Contract 14-08-001-22009, 25 p.

California Geological Society. 1999. Fault number 13, *Mad River fault zone, in Quaternary fault and fold database of the United States*. Accessed 12/05/2016. NR:CGS. https://earthquakes.usgs.gov/hazards/qfaults.

McCrory, P.A., 1996, *Evaluation of fault hazards, northern coastal California: U.S. Geological Survey Open-File Report* 96-656, 87 p., 2 pls.

National Oceanic and Atmospheric Administration. 2001. *National Marine Fisheries Service Guidelines for Salmonid Passage at Stream Crossings*. NR:NOAA.

---. 2012. *2009-2011 CA Coastal Conservancy Coastal Lidar Project*. Office for Coastal Management National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce; California Coastal Conservancy, Ocean Protection Council, Scripps Institution of Oceanography; and the Joint Airborne Lidar Bathymetry Technical Center of Expertise. Charleston, SC: NOAA.

---. 2016. *Screening Quick Reference Tables (SQuiRTs)*. Accessed on June 5, 2016. NR:NOAA. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html.

National Marine Fisheries Service. 2014. *Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon* (*Oncorhynchus kisutch*). National Marine Fisheries Service. Arcata, CA:NMFS.

APPENDIX A: FISH SURVEY REPORTS

Mad River fish community composition in the drainage channel on the School Road trail

Multiple fish species of conservation concern in the Mad River watershed- including Chinook salmon, coho salmon, and tidewater goby- use off-channel habitats in the lower basin and estuary as feeding areas and refuge from high winter flows. Currently, the small channel providing winter drainage from the pasture on the east side of the Mad River at School Road in Mckinleyville is one of the few places potentially providing such habitat in the tidal portion of the lower Mad River. Projects in the planning phase, particularly the proposed decommissioning and floodplain reconnection of a nearby infiltration pond owned and operated by Mckinleyville Community Services district, could greatly expand the area of off-channel habitat in this area and provide a conservation benefit to fish.

To provide more information about the species currently using off-channel habitats in the lower Mad River, the Biology of Pacific Salmon class from Humboldt State University sampled the winter drainage channel at School Road on 17 February 2015. Seventeen students used seines and minnow traps to sample the channel from the confluence with the Mad River to the culvert and flow control device at the edge of the pasture (ca. 70 m), two pools and a reach of the ditch above the culvert (30 m) as well as adjacent areas in the Mad River side channel near the confluence (Figure 1). Six species were collected, including juvenile Chinook salmon and coho salmon (Table 1). Most species were collected in the pool immediately below the culvert. A goby collected was field-identified as a tidewater goby and photographed, but the photographs were not adequate for confirmation of the field identification (Figure 2). Molly Schmelzle and Andrew Kinziger are planning a follow-up analysis of environmental DNA in water samples to confirm the presence of tidewater goby.

Table 1. Catch data for each sampling technique and location. Refer to Figure 1 for the location of sample sites.

Site number	Site description	Technique	Species	Catch
1	Downstream of confluence in side-channel; ca. 100 m by 5 m of habitat sampled; max. depth > 1 m.	Seine	Chinook salmon (young of the year)	5
			Cottus spp.†	6
			Three-spined stickleback	5
		Minnow trap	Cottus spp.†	3
2	Side channel at confluence; ca. 10 m by 20 m of habitat sampled; 0.8 m max depth.	Seine	Chinook salmon (young of the year)	7
			Cottus spp.†	7
			Three-spined stickleback	2
		Minnow trap	--	0
3	Lower ditch channel from confluence up; 20 m by 1 m of habitat sampled; < 10 cm max depth.	Seine	--	0
4	Pool immediately below culvert; 3 m by 6 m of habitat sampled; 0.7 m max depth.	Seine	Coho salmon (age 1+)	2
			Cottus spp.†	1
			Three-spined stickleback	150
			Tidewater goby*	1
			Western mosquitofish	1
		Minnow trap	Cottus spp.†	9
			Three-spined stickleback	26
5	Pool immediately above culvert; ca. 3 m by 3 m of habitat sampled; max depth 0.7 m.	Seine	Three-spined stickleback	150
5		Minnow trap	Three-spined stickleback	7
6	Channel above culvert; ca. 25 m by 1 m of habitat sampled; max. depth 0.5 m.	Seine	Three-spined stickleback	12
6		Minnow trap	--	0
†Species not distinguished, potentially includes prickly sculpin and coast range sculpin.				
*Field identification as tidewater goby, awaiting eDNA confirmation				

Figure 1. Approximate location of sample sites. Google Earth imagery dated 23 August 2012.

Figure 2. Purported tidewater goby.

Report submitted by Darren Ward and the Spring 2015 Biology of Pacific Salmon class: Justin Alvarez, Timothy Ash, Nick Easterbrook, Naomi Gair, Molly Gorman, Jon Hollis, Joe Jackson, Kyle Johnson, Dylan Keel, Dan Marsant, Kaitlyn O'Brien, Brad Padilla, Bernie Rolf, James Schwartz, Angela Shaver, Libby Tonning, Woody Vernard.

Sampling the McKinleyville Community Service District's Drainage Channel in the Mad River Estuary

January 8, 2016

Prepared by Bob Pagliuco

Background

Funding has become available through the Fisheries Restoration Grant Program to develop restoration design alternatives at the McKinleyville Community Service District's (MCSD) Mad River Estuary ponds at the bottom of School Road. Caltrout has been working with MCSD and Rose Patenaude from Northern Hydrology to develop wells and conduct topographic surveys to inform design development.

On February 17, 2015, Darren Ward took his "Biology of Pacific Salmon" class out to sample the winter drainage channel that drains the hay pasture and assess the fish assemblages with seins and minnow traps. The Mad River was approximately 1500 cfs. They found several species below the tidegate structure including juvenile Chinook, coho, tidewater goby, stickleback, mosquitofish and sculpin. Only stickleback were found above the tidegate structure.

On January 8, 2016 Rose Patenaude and I revisited this site and deployed minnow traps to see if fish were utilizing this channel for off channel habitat and had made it above the tidegate structure. The Mad River was approximately 2700 cfs and there was a significant gradient and velocity through the tidegate structure and channel downstream of the tidegate structure. Six minnow traps were deployed throughout the reach, baited with frozen steelhead roe and soaked for 45minutes to 1 hour (See Figure 1 and 2). In addition to stickleback and sculpin, a coho was found above the tidegate structure.

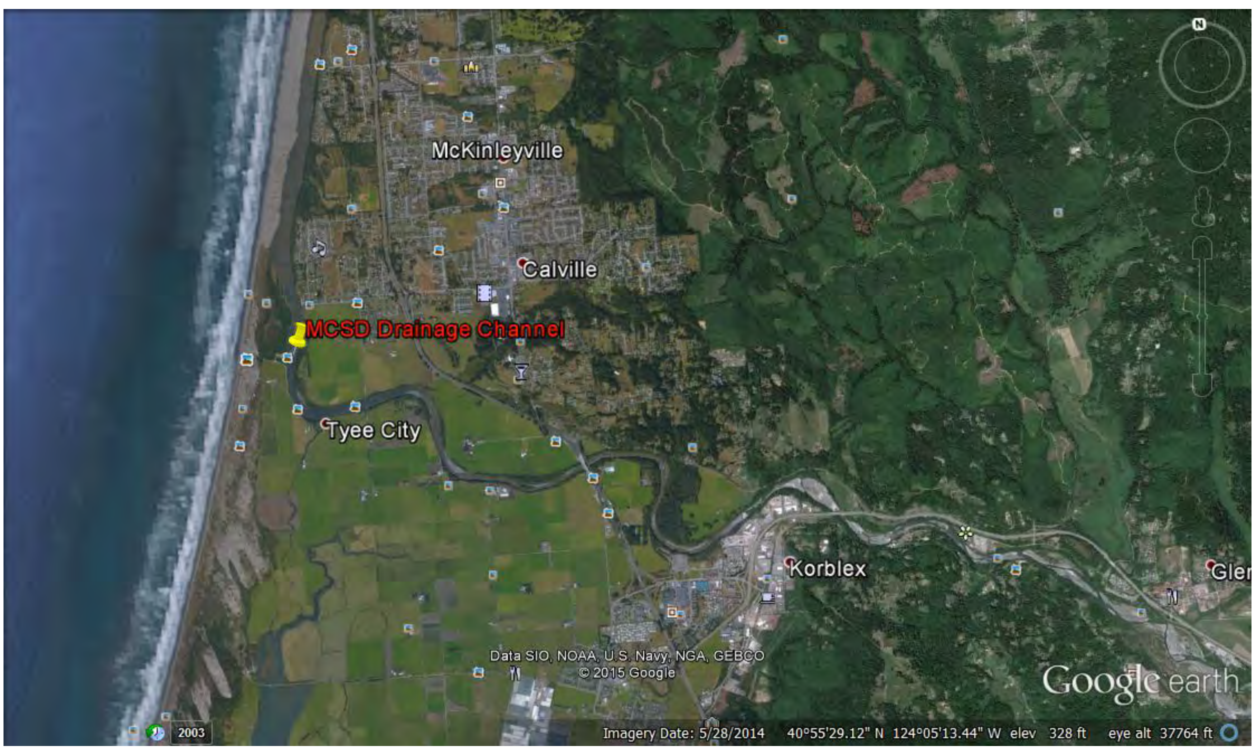


Figure 1 – Overview of MCSD Sampling Area

Figure 2 – Specific Sampling sites

Results

Site Number	Site Description	Temperature ©	Dissolved Oxygen (mg/l)	Species	Catch
1	Mad River at channel confluence	8.6	11.1	Stickleback	1
2	Ten feet above footbridge in drainage channel	9.5	8.1	No Fish	0
3	Pool below tidegate	9.3	6.7	Stickleback	1
4	Pool above tidegate	9.2	6.5	No Fish	0
5	Slow water habitat at 90 degree turn in pasture channel	9.2	6.5	Coho (95mm)	1
5	Slow water habitat at 90 degree turn in pasture channel	9.2	6.5	Prickly Sculpin	1
6	Pasture Channel	9.3	6.4	Stickleback	2

APPENDIX B: SHN FILL REUSE REPORT

SHN CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash • Eureka, CA 95501-2138 • 707-441-8855 • FAX: 707-441-8877 •shninfo@shn-engr.com

Reference: 015169

June 28, 2016

Ms. Mary Burke
California Trout, Inc.
615 - 11th Street
Arcata, CA 95521

Subject: Fieldwork Summary, Suitability of Levee Material for Reuse as Fill for McKinleyville Community Services District Ponds, Mad River, McKinleyville, California

Introduction

This letter presents the results of SHN Engineers & Geologists summary of fieldwork and qualitative assessment for the potential reuse of pond levee soils as select engineered and/or general fill material. The scope of work included the following:

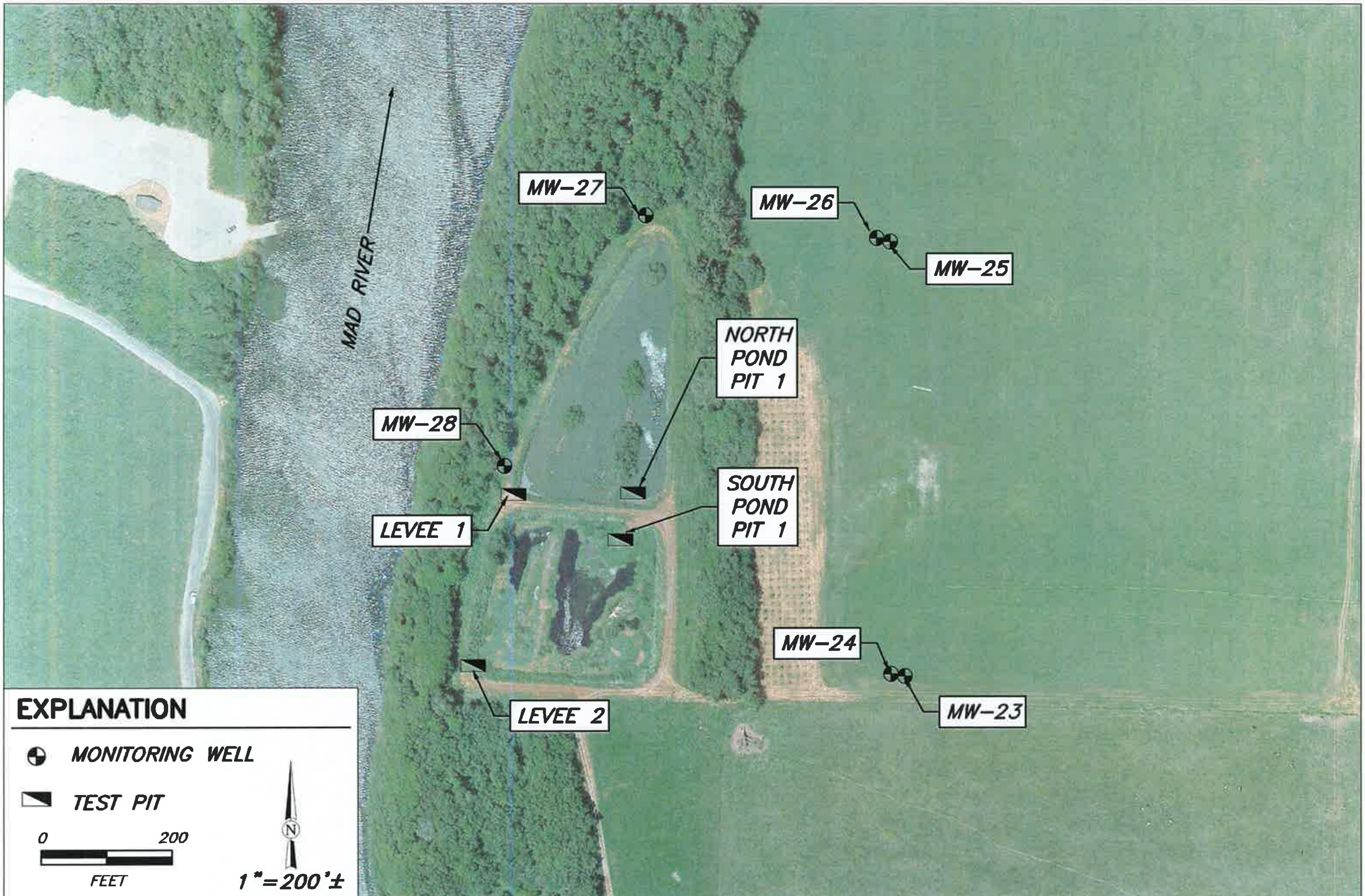
- Installing six groundwater monitoring wells
- Installing four backhoe test pits
- Laboratory analysis of select soil samples
- Submittal of this work summary

SHN's characterization of the levee material is based on our observations of subsurface conditions conducted during the excavation of backhoe test pits into the levee slopes and pond edges. As part of this investigation, SHN conducted laboratory testing of bulk soil samples collected from the test pits. The laboratory testing program included sieve analyses and a determination of the materials plasticity.

Soil profile logs for excavations and monitoring wells are included as Attachment 1. Laboratory test data is included as Attachment 2. Notes and forms describing procedures and observations made during field work to install monitoring wells and excavations are included in Attachment 3. A site map presenting approximate locations of monitoring wells and test pits installed during field efforts is presented as Figure 1.

Reuse of Levee Material as Select Engineered Fill

In general, select fill used for construction purposes including road and trail building, and foundation support typically consists of non-plastic and non-expansive granular soil that is free of organic materials and contains less than 30% fines (silt and clay combined). The sieve analysis and plastic index test results indicate that the upper 3 feet of the levee fill may meet the minimum



NOTE: ALL LOCATIONS ARE APPROXIMATE; BASEMAP FROM GOOGLE EARTH (2014)

SHN Consulting Engineers & Geologists, Inc.

California Trout, Inc. MCSD Ponds Fischer Ranch, McKinleyville, California		Site Map SHN 015169
June 2016	Figure1_SIteMap	Figure 1

criteria to be considered as select engineered fill. This material consists of rounded, fine to coarse gravel and sand used to armor the levee slope faces. Provided this gravelly material is segregated during levee removal it has the potential to be reused as select engineered fill. The material appears well suited for use as sub-base for any future roads and/or trails at the project site provided the sub-base is properly compacted and armored with a layer of crushed aggregate base rock.

The soil test pit logs indicate that the levee materials grade finer with depth and are comprised largely of silt and fine sand with low plasticity fines. On this basis, we expect that the majority of the levee materials will not meet the minimum criteria to be considered as select fill. It is also expected that the levee materials will be extremely heterogeneous, which will likely be difficult to compact. Therefore, it is recommended that levee material below a depth of about 3 feet not be used as select structural fill to support concrete foundations, retaining walls, roadways, or any other type of structure that will rely on compacted fill for bearing support.

Reuse of Levee Material as General Fill

Soil obtained from the core of the levees and pond bottoms may be suitable for use as general fill, provided the materials are free of debris and organic matter. General fill may be used for raising site grades on grazing land and pastures, infilling drainage swales and ditches, or as landscaping fill. Proper compaction of general fill, if required, will depend on the moisture content at the time of compaction. It is expected that the moisture content of the levee materials will generally exceed optimum moisture levels for compaction immediately after levee removal. Levee material to be reused as general fill will require aeration prior to reuse.

Because the levee soils to be used as general fill is likely to be heterogeneous, mixing, blending, and moisture conditioning will be required to create a material that can be placed and adequately compacted. All fill stockpiles should be scarified, plowed, disked, and/or bladed until the material is uniform in consistency and free of large, unbroken clods of soil. Clods of soil or rock particles larger than 4 inches in greatest dimension either should be broken down by heavy earthmoving equipment or removed from the fill during placement.

The placement of levee material as general fill during the wet season could be problematic due the fine-grained nature of the material and its high moisture holding capacity. Over-optimum moisture conditions will greatly influence the time and effort required to achieve minimum compaction requirements. Wet or over-saturated plastic soils will also be difficult to spread with heavy equipment.

Please call me at 707-441-8855 if you have any questions.

Sincerely,

SHN Engineers & Geologists

Giovanni A. Vadurro
Engineering Geologist

PROFESSIONAL GEOLOGIST
GIOVANNI ANTHONY VADURRO
7/6/16
No. 2554
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

GAV:lms

Attachments:
1. Test Pit and Monitoring Well Logs
2. Laboratory Test Data
3. Field Notes and Forms

1

Test Pit and Monitoring Well Logs

SHN Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 — ph. (707) 441-8855 — fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 — ph. (530) 221-5424 — fax. (530) 221-0135

EXCAVATION ID

Levee 1

- **PROJ. NAME:** CALTrout-MCSD
- **PROJ. NUMBER:** 015169
- **OPERATOR:** MCSD
- **EXCAVATION METHOD:** Backhoe
- **SAMPLER TYPE:** Grab
- **LOGGED BY:** J. Wellik
- **LOCATION:** Fischer Ranch, McKinleyville , CA
- **GROUND ELEV.:** 21 feet NAVD88
- **DEPTH OF EXCAVATION:** 7 feet
- **INITIAL WATER LEVEL:** NA
- **STABILIZED WATER LEVEL:** NA
- **DATE:** 4/25/2016

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	SOIL DESCRIPTION	REMARKS
21	0				SM	SILTY SAND WITH GRAVEL, yellowish brown, moist, loose, fine sand, fine to coarse rounded gravel, silt.	
20	-1						
19	-2						
18	-3						
			100		ML/ SM	SANDY SILT, olive, soft, moist, silt, fine sand, occasional roots, low plasticity.	
17	-4						
16	-5						
15	-6				SM	SILTY SAND, bluish gray, moist, loose to medium dense, fine sand, silt.	
14	-7						
13	-8						

FIELD LOG

Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CALTrout-MCSD
PROJ. NUMBER: 015169
OPERATOR: MCSD
EXCAVATION METHOD: Backhoe
SAMPLER TYPE: Grab
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville , CA
GROUND ELEV.: 21 feet NAVD88
DEPTH OF EXCAVATION: 10 feet
INITIAL WATER LEVEL: NA
STABILIZED WATER LEVEL: NA
DATE: 4/25/2016

EXCAVATION ID
Levee 2

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS
21	0				SM		SILTY SAND WITH GRAVEL, yellowish brown, moist, loose, fine sand, fine to coarse rounded gravel, silt.	
20	-1							
19	-2							
18	-3				ML/ SM		SANDY SILT, olive, soft, moist, silt, fine sand, low plasticity.	
17	-4							
16	-5		100					
15	-6							
14	-7							
13	-8				SM		POORLY GRADED SAND WITH SILT, grayish brown, moist, loose to medium dense, fine sand, silt.	
12	-9							
11	-10							
10	-11							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time

FIELD LOG

Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CALTrout-MCSD
PROJ. NUMBER: 015169
OPERATOR: MCSD
EXCAVATION METHOD: Backhoe
SAMPLER TYPE: NA
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville , CA
GROUND ELEV.: 11 feet NAVD88
DEPTH OF EXCAVATION: 4.5 feet
INITIAL WATER LEVEL: 4.5 feet
STABILIZED WATER LEVEL: NA
DATE: 4/25/2016

EXCAVATION ID
North Pond Pit 1

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS
11	0		100		SM/ML		SILTY SAND, olive, loose, moist, fine sand, silt, trace fine rounded gravel, sulfur odor present.	
10	-1							
9	-2							
8	-3				ML		SILT WITH SAND, olive, soft, moist, silt, fine sand, low plasticity.	
					PT		PEAT, dark reddish brown, moist, fiberous texture, roots, wood, fine sand, silt.	
7	-4				ML		SILT WITH SAND, olive, soft, moist, silt, fine sand, low plasticity.	
		▽			SM/SP		POORLY GRADED SAND WITH SILT, gray with salt and pepper sand grains, loose, wet, fine to medium sand, silt, sulfur odor present.	sidewall failure occuring due to poorly cohesive soils that comprise the sidewalls and presence of the water table
6	-5							
5	-6							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CALTrout-MCSD
PROJ. NUMBER: 015169
OPERATOR: MCSD
EXCAVATION METHOD: Backhoe
SAMPLER TYPE: NA
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville , CA
GROUND ELEV.: 11 feet NAVD88
DEPTH OF EXCAVATION: 5 feet
INITIAL WATER LEVEL: 4.75 feet
STABILIZED WATER LEVEL: NA
DATE: 4/25/2016

EXCAVATION ID
South Pond Pit 1

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS
11	0		100		SM/ ML		SILTY SAND, olive, loose, moist, fine sand, silt, trace fine rounded gravel, sulfur odor present.	
10	-1							
9	-2							
8	-3							
7	-4							
		▽			SM/ SP		POORLY GRADED SAND WITH SILT, gray with salt and pepper sand grains, loose, wet, fine to medium sand, silt, sulfur odor present.	sidewall failure occuring due to poorly cohesive soils that comprise the sidewalls and presence of the water table
6	-5							
5	-6							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location Subsurface conditions may differ at other locations and with the passage of time

FIELD LOG

SHN

Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~16 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: NA
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

MONITORING WELL ID

MW-23

ELEVATION (ft) / DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS
16 / 0		75	ML	SANDY SILT, olive to grayish brown, soft, moist, silt, fine sand, roots in top 6 inches of return, no plasticity.	
11.5 / -4.5		70	ML	SILT WITH SAND, olive to grayish brown, soft, moist, silt/clay, fine sand, low plasticity.	mottling present above 8 feet
8 / -8		85	CL/ ML	LEAN CLAY, gray, soft, moist, clay, silt, fine sand, moderate plasticity.	Soil Sample Collected
		100			minor manganese precipitation below 15 feet BGS
-1.5 / -17.5			ML	SANDY SILT, gray, soft, moist, silt, fine sand, low plasticity.	Soil Sample Collected
-2 / -18		100	ML/ CL	LEAN CLAY, gray, soft, moist, clay, silt, fine sand, low plasticity.	
-3 / -19			ML/ PT	INTERBEDDED PEAT AND LEAN CLAY, peat is brown to black, soft, moist, 100 percent organic detritus; clay is gray, soft, moist, and comprises clay, silt, fine sand, low plasticity.	Halt at 20 feet BGS in same

MONITORING WELL CONSTRUCTION

- 1.5-inch diameter Blank PVC casing
- cement slurry seal
- hydrated bentonite seal
- #8 sand filter pack
- 1.5-inch diameter 0.010 slot PVC screen

WELL LOG

SHN Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

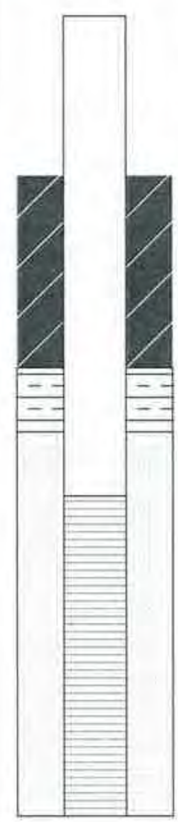
LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~16 Feet NAVD88
DEPTH OF BORING/WELL: 10/10 feet
INITIAL WATER LEVEL: NA
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

MONITORING WELL ID

MW-24

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS
19	3					
18	2					
17	1					
16	0			ML	SANDY SILT, olive to grayish brown, soft, moist, silt, fine sand, roots in top 6 inches of return, no plasticity.	
15	-1					
14	-2		85			
13	-3					
12	-4					mottling present above 8 feet
11	-5			ML	SILT WITH SAND, olive to grayish brown, soft, moist, silt/clay, fine sand, low plasticity.	
10	-6		85			
9	-7					
8	-8			CL/ML	LEAN CLAY, gray, soft, moist, clay, silt, fine sand, moderate plasticity.	
7	-9		100			
6	-10					Halt at 10 feet BGS in same
5	-11					

MONITORING WELL CONSTRUCTION



1.5-inch diameter Blank PVC casing

cement slurry seal

hydrated bentonite seal

#8 sand filter pack

1.5-inch diameter 0.010 slot PVC screen

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location Subsurface conditions may differ at other locations and with the passage of time.

WELL LOG

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PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: 16 feet BGS
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

MONITORING WELL ID

MW-25

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS	MONITORING WELL CONSTRUCTION
15	3						
14	2						1.5-inch diameter Blank PVC casing
13	1						
12	0			SM			
11	-1				SILTY SAND, olive to grayish brown, loose, moist, fine sand, silt, clay, roots/organics at ground surface, non-plastic.	iron mottling present between 0 and 7 feet BGS	cement slurry seal
10	-2		90				
9	-3			ML			
8	-4				SANDY SILT, grayish brown, soft, moist, silt, fine sand, low plasticity.		
7	-5			ML/ CL			
6	-6		80		SILT WITH SAND, olive with iron mottling present, soft, moist, silt, fine sand, low plasticity.		
5	-7			CL/ PT			
4	-8				LEAN CLAY, gray with yellowish brown streaks, soft, moist, clay, fine sand, moderate plasticity, organic content high at thin peat layers.	Soil Sample Collected	
3	-9					Interbedded Clay and Peat layers are present from approximately 7 to 14 feet BGS; Peat layer thicknesses vary between 0.5 inch to 5 inches.	
2	-10		75				
1	-11			PT/ SM	PEAT, brown to reddish brown, organic detritus, moist, interbedded with silty sand		
0	-12						
-1	-13			CL/ PT			hydrated bentonite seal
-2	-14		80		LEAN CLAY, gray, soft, moist, clay, fine sand, moderate plasticity, interbedded with peat		
-3	-15						#8 sand filter pack
-4	-16	▽		SM/ PT	SILTY SAND, gray, loose, wet, fine sand, silt, clay, non-plastic, interbedded with peat.		
-5	-17					Soil Sample Collected	
-6	-18		100	PT	PEAT, brown to reddish brown, organic detritus, moist.	Interbedded Silty Sand and Peat layers are present from approximately 16 to 17 feet BGS; Peat layer thicknesses vary between 1 inch to 2 inches.	1.5-inch diameter 0.010 slot PVC screen
-7	-19						
-8	-20						
-9	-21						
-10	-22						
-11	-23						
-12	-24					Halt at 20 feet BGS in same	
-13	-25						

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time

WELL LOG

Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 10/10 feet
INITIAL WATER LEVEL:5 feet BGS
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

MONITORING WELL ID

MW-26

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS	MONITORING WELL CONSTRUCTION
15	3								
14	2								1.5-inch diameter Blank PVC casing
13	1								
12	0				SM		SILTY SAND, olive, loose, moist to wet from 5 to 6 feet BGS, fine sand, silt, clay, low plasticity, roots in top 4 inches.		
11	-1							Iron mottling present to 6.5 feet BGS	cement slurry seal
10	-2		75						
9	-3							clay fraction increases	hydrated bentonite seal
8	-4								
7	-5	▽							#8 sand filter pack
6	-6		80						
5	-7				ML/ CL		SILT WITH SAND, gray, soft, moist, silt, clay, fine sand, low plasticity.		
4	-8								1.5-inch diameter 0.010 slot PVC screen
3	-9		100						
2	-10								
1	-11								

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time

WELL LOG

SHN Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: 1 foot BGS
STABILIZED WATER LEVEL: NA
DATE: 11/24/2015

MONITORING WELL ID

MW-27

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS	MONITORING WELL CONSTRUCTION
15	3						
14	2						1.5-inch diameter Blank PVC casing
13	1						
12	0			ML	SANDY ORGANIC SOIL, brown, soft, moist, silt, clay, fine sand, low plasticity, roots.		
11	-1	▼		SM			cement slurry seal
10	-2		50				
9	-3				SILTY SAND, olive gray, loose, wet, fine sand, silt, non-plastic.		
8	-4			SW/GP			
7	-5				WELL GRADED SAND WITH GRAVEL, gray, loose, wet, well graded sand, fine rounded to subrounded gravel, trace silt, non-plastic.		
6	-6		40				
5	-7						
4	-8						
3	-9						hydrated bentonite seal
2	-10		40				
1	-11						
0	-12					soil sample collected	#8 sand filter pack
-1	-13						
-2	-14		10				
-3	-15						
-4	-16						
-5	-17						
-6	-18		60				1.5-inch diameter 0.010 slot PVC screen
-7	-19			CL	LEAN CLAY, gray, firm, moist, clay, silt, fine sand, medium plasticity.		
-8	-20					Halt at 20 feet BGS in same.	
-9	-21						
-10	-22						
-11	-23						
-12	-24						
-13	-25						

WELL LOG

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PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: 7 feet BGS
STABILIZED WATER LEVEL: NA
DATE: 11/24/2015

MONITORING WELL ID

MW-28

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS	MONITORING WELL CONSTRUCTION
15	3						
14	2						1.5-inch diameter Blank PVC casing
13	1						
12	0			OL SM	ORGANIC SOIL WITH SAND, brown, soft, moist, organic detritus/roots, silt, fine sand, non-plastic.		
11	-1						cement slurry seal
10	-2		50				
9	-3			SM/ GM	SILTY SAND, yellowish brown, loose, moist grading to dry at 0.5 feet BGS, fine sand, silt, non-plastic.		
8	-4						
7	-5			SW/ SM	SILTY SAND WITH GRAVEL, yellowish brown, loose, dry, well graded sand, well graded rounded to subrounded gravel, silt, non-plastic.		
6	-6		50				
5	-7	▼					
4	-8			GW	WELL GRADED SAND WITH SILT, gray, loose, dry grading to wet at 7 feet BGS, well graded sand, silt, trace coarse subrounded to rounded gravel, non-plastic.		
3	-9						hydrated bentonite seal
2	-10		60				
1	-11						
0	-12					soil sample collected	#8 sand filter pack
-1	-13				WELL GRADED GRAVEL WITH SAND, gray, loose, wet, well graded subrounded to rounded gravel, well graded sand, trace silt, non-plastic.		
-2	-14		60				
-3	-15						
-4	-16						
-5	-17						
-6	-18		0				1.5-inch diameter 0.010 slot PVC screen
-7	-19						
-8	-20					Halt at 20 feet BGS in same.	
-9	-21						
-10	-22						
-11	-23						
-12	-24						
-13	-25						

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location Subsurface conditions may differ at other locations and with the passage of time

WELL LOG

2

Laboratory Test Data

SHN
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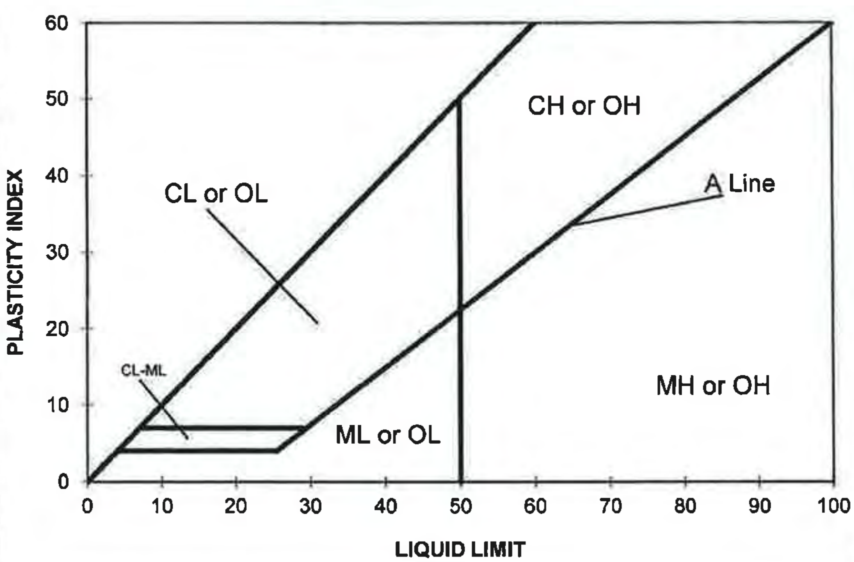
LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

JOB NAME:	Trout MCSD	JOB #:	015169	LAB SAMPLE #:	16-445
SAMPLE ID:	Levee 1 0-12"	PERFORMED BY:	JMA	DATE:	4/28/2016
PROJECT MANGER:	RR	CHECKED BY:	[signature]	DATE:	5/3/16

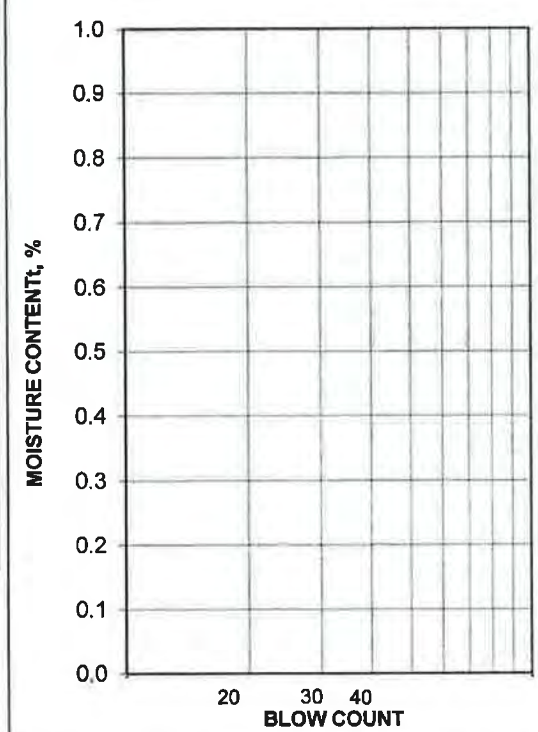
LINE NO.		TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 3
A	PAN #	15	16	4	5	6
B	PAN WT. (g)	20.590	21.000	29.310	28.790	29.600
C	WT. WET SOIL & PAN (g)					
D	WT. DRY SOIL & PAN (g)					
E	WT. WATER (C-D)					
F	WT. DRY SOIL (D-B)					
G	BLOW COUNT	--	--			
H	MOISTURE CONTENT (E/F*100)	NP	NP	NP	NP	NP

LIQUID LIMIT	PLASTIC INDEX	PLASTIC LIMIT
	Non Plastic	

PLASTICITY CHART



LIQUID LIMIT DETERMINATION



Revised 1/03

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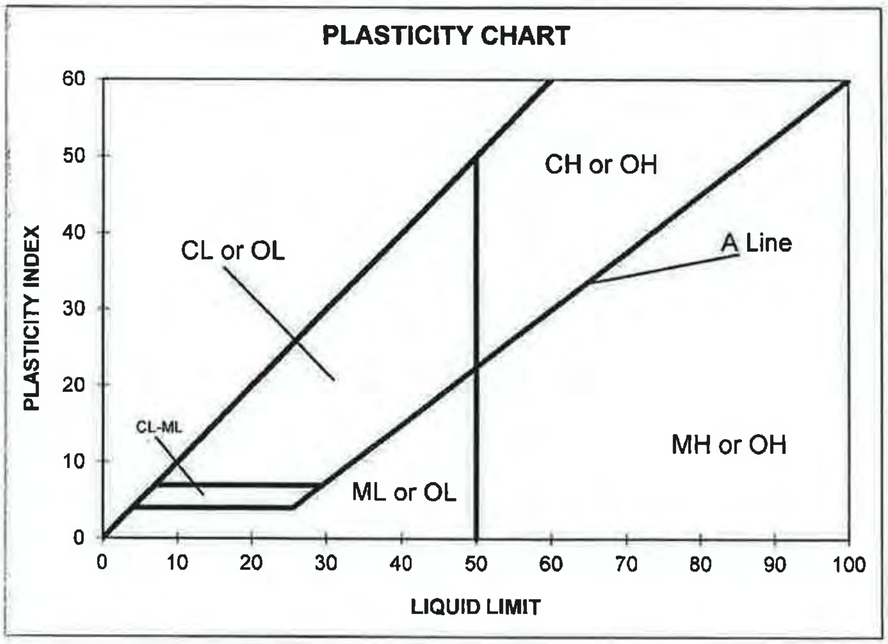
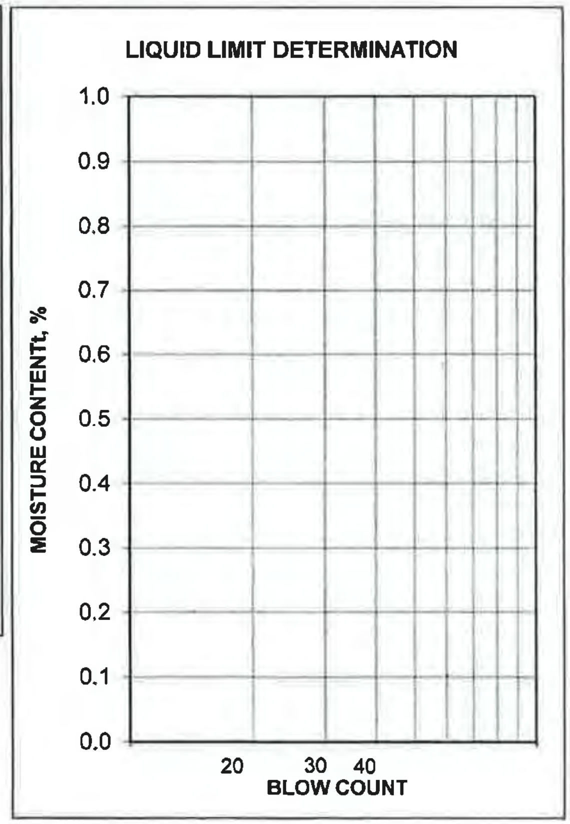
LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

JOB NAME:	Trout MCSD	JOB #:	015169	LAB SAMPLE #:	16-446
SAMPLE ID:	Levee 2 0-12"	PERFORMED BY:	JMA	DATE:	4/28/2016
PROJECT MANGER:	RR	CHECKED BY:	Dh	DATE:	5/3/16

LINE NO.		TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 3
A	PAN #	17	18	1	2	3
B	PAN WT. (g)	20.440	20.220	29.860	29.220	29.240
C	WT. WET SOIL & PAN (g)					
D	WT. DRY SOIL & PAN (g)					
E	WT. WATER (C-D)					
F	WT. DRY SOIL (D-B)					
G	BLOW COUNT	--	--			
H	MOISTURE CONTENT (E/F*100)	NP	NP	NP	NP	NP

LIQUID LIMIT	PLASTIC INDEX	PLASTIC LIMIT
	Non Plastic	





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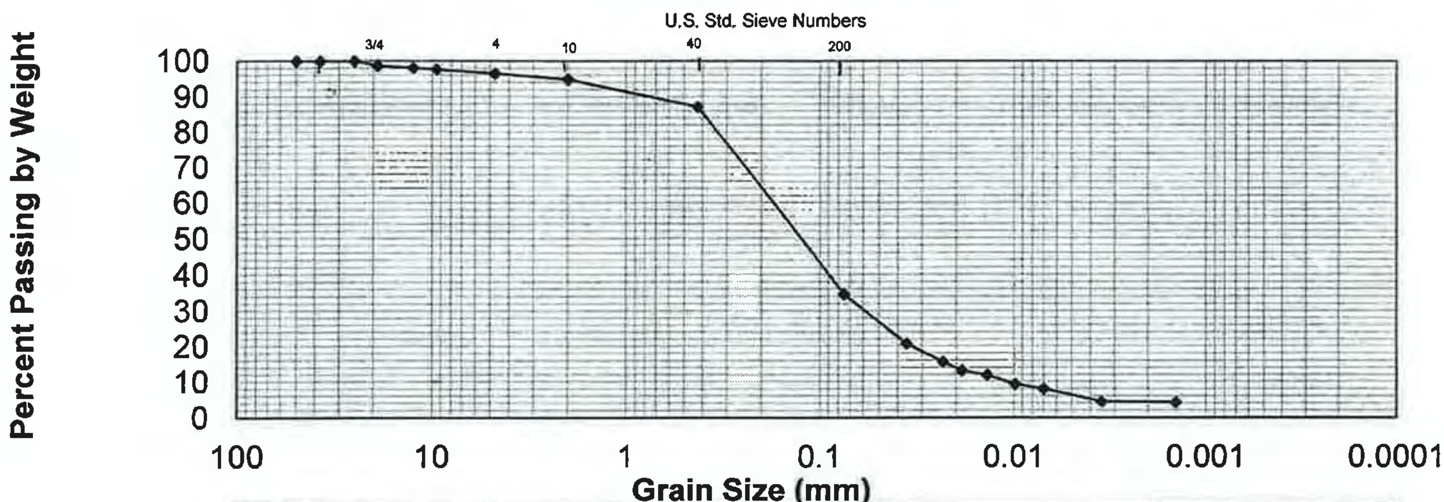
Project Name:	Trout MCSD	Project Number:	015169
Boring ID:	--	Lab # :	16-446
Sample Depth:	0-12"	Checked By:	Dh
Sample Number:	Levee 2	Date :	5/3/16

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0361	0.0234	0.0188	0.0138	0.0099	0.0070	0.0035	0.0014
PERCENT PASSING	100	100	100	98.8	98.2	97.8	96.6	95.0	87.3	34.7	20.8	15.8	13.2	12.0	9.5	8.1	4.5	4.3

Gradation Test Results



GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

% Gravel 3.4 **% Sand 61.9** **% Silt 30.3** **% Clay 4.4**

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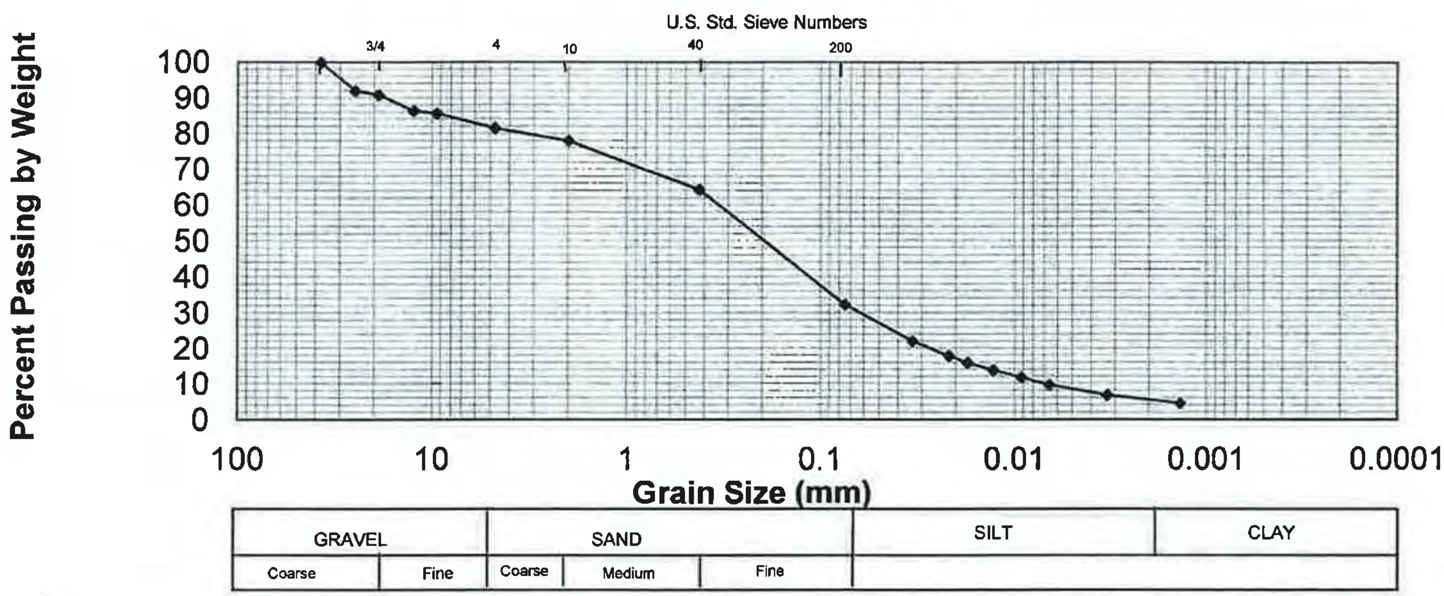
Project Name:	Trout MCSD	Project Number:	015169
Boring ID:	--	Lab # :	16-445
Sample Depth:	0-12"	Checked By:	Dh
Sample Number:	Levee 1	Date :	5/3/16

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0335	0.0218	0.0175	0.0129	0.0092	0.0066	0.0033	0.0014
PERCENT PASSING		100	92.0	91.0	86.4	85.7	81.6	78.2	64.3	32.3	22.1	18.0	15.9	13.9	11.8	9.6	6.8	4.5

Gradation Test Results



% Gravel 18.4 | % Sand 49.3 | % Silt 26.8 | % Clay 5.5

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Reference: 015169

April 21, 2016

Caltrout - MCSD

SOIL PERCOLATION SUITABILITY / TEXTURAL ANALYSIS RESULTS

Job Name: Caltrout - MCSD
Date Sampled: 11/23/15
Date Received: 4/12/16
Sampled By: JMW
Date Tested: 4/21/16
AP Number: --

Sample ID	Depth	% Sand	% Clay	% Silt	% Coarse Fragments by Volume	Zone	Bulk Density
MW-23	16-18'	9.3	36.3	54.4	0.0	4	*
	Material:	**Silty Clay Loam**					
MW-24	7-9'	9.2	28.6	62.2	0.0	4	*
	Material:	**Silty Clay Loam**					
MW-25	16-18'	79.7	6.9	13.4	0.0	2	*
	Material:	**Loamy Sand**					
MW-26	7-10'	16.1	28.1	55.8	0.0	4	*
	Material:	**Silty Clay Loam**					

* = no peds provided

Regional Water Quality Control Board Zone Descriptions:

Zone 1 - Soils in this zone are very high in sand content. They readily accept effluent, but because of their low silt and clay content they provide minimal filtration. These soils demand greater separation distances from groundwater.

Zone 2 - Soils in this zone provide adequate percolation rates and filtration of effluent. They are suitable for use of a conventional system without further testing.

Zone 3 - Soils in this zone are expected to provide good filtration of effluent, but their ability to accept effluentat at a suitable rate is questionable. These soils require wet-weather percolation tests to verify their suitability for effluent disposal by conventional leachfield methods.

Zone 4 - Soils in this zone are unsuitable for a conventional leachfield because of their severe limitations for accepting effluent.

3

Field Notes and Forms

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Daily Field Report

Job No. 015169	Page 1 of 1	
Project Name: CALTROUT-MCSD	Client/Owner: MCSD	Weather: PARTLY CLOUDY, COOL
General Location of Work: FISCHER RANCH	Project Manager: R. RUEBER	Date: 11/3/15 — Day of Week: TUESDAY
Type of Work: USA MARKINGS		Field Personnel: JMW

1600	ARRIVE ONSITE, PLACE USA MARKS ON FISCHER RD., CONTACT MCSD PERSONNEL AT PUMP STATION AND INFORM THEM OF NEED TO ACCESS WORKSITE. FOR USA PURPOSES, REQUEST IS MADE THAT I DO NOT DRIVE DOWN WET ROADWAY IN FIELDS
1615	PARK AT HAY BARN AND WALK TO WORK AREA WITH STAKES/FLAGGING, + SLEDGE HAMMER. SET MARKERS AT WELL LOCATIONS BASED OFF OF WORKPLAN MAP, MARK SOIL SAMPLING LOCATIONS ON POND BERMS.
1730	OFFSITE, END OF DAY.

Copy given to:

Reported By: JMW

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Daily Field Report

		Job No. 015169
		Page 1 of 1
Project Name: MCSD - CAL TROUT	Client/Owner: MCSD - CAL TROUT	Weather: CLOUDY, COOL
General Location of Work: FISCHER RANCH	Project Manager: R. RUEBER	Date: 11/23/15 — Day of Week: MONDAY
Type of Work: WELL INSTALLATION		Field Personnel: JMW

0915	ARRIVE ONSITE, FISCH DRILLING ONSITE, ROSE P. ONSITE, LOAD WELL SUPPLIES ON TRUCK, MOB TO DRILL LOCATION
0945	WALK DRILL LOCATIONS WITH RICK AND NATE, WALK POND LOCATIONS FOR RIG ACCESS; SHOULD WORK OUT OK.
1030	SET UP ON SOUTHERN WELL PAIR AND CONT. CORE TO DEPTH. OF 20', CURRENTLY ID'ED AS MW-SOUTH
1100	AT 20' WITH CONT. CORE, LOG CORES, CONSTRUCT 20' DEEP WELL 1.5" DIAM PVC 0.010 SLOT SCREEN FROM 20-15', #8 SAND 20-14' BENTONITE TO 13', CEMENT TO GRADE
1130	STEP OVER TO SET SHALLOW WELL WITH SCREEN INTERVAL FROM 5 TO 10' MW-SOUTH SHALLOW, #8 SAND 10-4', BENTONITE TO 3', CEMENT TO GRADE.
1145	ROSE CHECKS IN, DISCUSSES SCREEN DEPTH RELATIVE TO CLAY LAYER AND JMW DESCRIBES OBSERVED STRATIGRAPHY + COLLECTION OF SOIL SAMPLES FROM WITHIN THE SCREENED INTERVALS OF BOTH WELLS, ROSE ASKS ABOUT WELL HEAD PROTECTION AND WELLS BEING SET IN A PAD, JMW NOTES OUTSIDE OF WORKSCOPE, NOT INCLUDED IN WORK PLAN, JMW & ROSE AGREE MCSD CAN PLACE AT A LATER DATE.
1200	ROSE OFFSITE, MOB TO MW-NORTH LOCATION.
1215	BREAK FOR LUNCH
1245	REPEAT CORING AND WELL CONSTRUCTION AT NORTHERN LOCATION.
1330	AT DEPTH (~20') AT MW-NORTH LOCATION, SI = 20-15, #8 SAND 20-14 BENTONITE 14-13', CEMENT TO GRADE. ~2.5' OF BLANK ABOVE GRADE.
1355	STEP OVER AND CORE + CONSTRUCT MW-NORTH SHALLOW, MOVE ~1' WEST. SHALLOW WELL = SI = 5-10', SAND (#8) 10-4', BENTONITE CHIPS 4-3' CEMENT TO GRADE, MOBE OFFSITE
1515	JMW + RICK SCOUT PATHWAY AND CHECK GATES TO POND LOCATIONS
1545	END OF DAY.

Copy given to:

Reported By: JMW

SHN ENGINEERS & GEOLOGISTS
812 W. Wabash Ave.
Eureka, CA 95501-2138
Tel. 707 / 441-8855
Fax: 707 / 441-8877

JOB 015101
SHEET NO. 1 OF
CALCULATED BY DATE 11/23/15
CHECKED BY DATE
SCALE

HEALTH & SAFETY MTG., NO TOXICS, PPE, PINCH POINTS

JOHN WELLIK SHN

Nathan Ohlsson Fisch

Rick Bertolino Fisch-Drill

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Daily Field Report

Project Name: MCSD - CAL TROUT	Client/Owner:	Job No. 015169 / Page 1 of 1 / Weather: RAIN
General Location of Work: PERC PONDS	Project Manager: R. RUEBER	Date: 11/24/15 / Day of Week: TUESDAY
Type of Work: WELL INSTALLATION		Field Personnel: JMW.

750	ONSITE WITH FISCH AT HAMMOND BRIDGE, MOBE TO DRILLING LOCATION AT PERC PONDS
0840	INITIATE CORING ~~AT~~ MW-POND-NORTH, COARSE SAND AND GRAVEL TO 12', WILL CORE TO 20' AND CONSTRUCT WELL, BOTTOM 1' HAS ML/CL (19-20'), BUILD MW-POND-N WITH 10' OF SCREEN FROM 10-20', SAND TO 9', BENTONITE TO 8', CEMENT TO GRADE, ELEVATED WATER TABLE INCREASES DIFFICULTY OF ADDING SAND TO WELL SCREEN
0915	CONSTRUCT WELL, SOIL SAMPLE COLLECTED FROM UPPER PORTION OF SI @ 12-14'
0945	MOBE TO GW-POND-WEST LOCATION NEAR BERM BI-SECTING PONDS
1000	BEGIN CONTINUOUS CORING ~~@~~ JMW 11/24/15 AT GW-POND-WEST
1030	CONSTRUCT WELL SAME AS GW-POND-NORTH, SOIL SAMPLE COLLECTED AT 12-14' DEPTH RANGE.

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Daily Field Report

Project Name: CALTROUT	Client/Owner: MCSO - CAL TROUT	Job No. 015169 · Page 1 of 1 · Weather: SUNNY, WINDY, COOL
General Location of Work: INFILTRATION PONDS	Project Engineer:	Date: 4/25/16 · Day of Week: MONDAY
Type of Work: EXCAVATION + GEOTECH SOIL SAMPLING	Supervisor: R.R.	Technician: JMW

0845	JMW ONSITE IN FIELDS - MOB TO PONDS WITH SAMPLING GEAR + FIELD SUPPLIES
0900	MCSD JAMES NOTES THAT OPERATOR ERIC WILL BE ~20 MIN LATE JMW TAKES PHOTOS OF PONDS
0925	ERIC MCSD ONSITE - CONDUCT TAILBOARD + DISCUSS WORK SCOPE
0930	INSTALL SOUTH POND PIT @ BASE OF RAMP, CHOSE HIGHER PORTION BECAUSE OF SHALLOW WATER, WATER @ ~5' FROM TOP OF GROUND., PIT ID SPPIT1
0950	LOGGED SOILS IN SO. POND - BACKFILL PIT; MOB TO NP PIT1 LOCATION. AND POT HOLE.
1010	CLOSE NP PIT 1, MOBE TO LEVEE 1
1030	LEVEE1 TRENCH EXCAVATED ~ 15' INTO LEVEE OF NORTH POND @ SW CORNER TOTAL DEPTH ~ 7'
1055	SET UP ON LEVEE 2 TRENCH, SW CORNER OF SO. POND. LEVEE 2 TRENCH EXCAVATED ~20' INTO LEVEE DEPOSITS SIMILAR TO LEVEE 1 OBSERVATIONS - ~2' VENEER OF GRAVELLY ROAD BASE, ~6-8' SILTY SAND/SANDY SILT, BLUE GRAY SP/SM AT BASE OF EXCAVATION, COLLECTED 5 GAL BUCKET OF MATERIAL FOR LAB. BACKFILL AND COMPACT LEVEE 2 EXCAVATION, JMW MOBS GEAR TO VEHICLE.
1230	VEHICLE STUCK IN SOFT SEDS OFF OF ROAD BASE, MCSD ASSISTS WITH EXTRACTION.
1245	OFFSITE. MOB TO SHN EUREKA.

Note: All purge and decon water was transported to SHN's P.W.S.T. located at 812 W. Wabash Ave. Eureka, Ca. gallons total.

	Copy given to:	Reported By: JMW

HAZARDOUS MATERIALS SITE OPERATIONS
SITE SAFETY MEETING ATTENDANCE
SHN CONSULTING ENGINEERS & GEOLOGISTS

JOB NAME: MCSD CAL TROUT **ACTIVITY:** EXCAVATION **JOB #:** 015169

GIVEN BY: JMW **SIGNATURE:** [signature] **DATE:** 4/25/16 **TIME:**

Company/Agency	Name	Operation/ Function	Signature	Read SSP	29CFR1910.120(e) 40 hr	24 hr
SHN	JOHN WELLIK	GEOLOGIST	[signature]	Y / N	(Y) / N	Y / N
MCSD	Erik Jones	Leadman	[signature]	Y / N	(Y) / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N

APPENDIX C: LABORARY ANALYSIS RESULTS

Client Sample ID: PERC POND-NORTH N1

Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-1
Matrix: Solid
Percent Solids: 55.1

Method: 8270C SIM - Semivolatile Organic Compounds (GC/MS SIM)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acenaphthene	ND		90	8.5	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Acenaphthylene	ND		90	5.9	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Anthracene	ND		90	7.1	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Benzo[a]anthracene	ND		90	5.5	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Pentachlorophenol	**110**	**J F1**	120	31	ug/Kg	☼	05/26/16 13:29	05/27/16 20:00	10
Benzo[a]pyrene	ND		90	7.2	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Benzo[b]fluoranthene	**25**	**J**	90	9.1	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Benzo[g,h,i]perylene	ND		90	18	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Benzo[k]fluoranthene	ND		90	14	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Chrysene	**28**	**J**	90	6.2	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Dibenz(a,h)anthracene	ND		90	22	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Fluoranthene	**14**	**J**	90	5.3	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Fluorene	**41**	**J**	90	8.8	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Indeno[1,2,3-cd]pyrene	**8.8**	**J**	90	8.6	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Naphthalene	**36**	**J**	90	5.5	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Phenanthrene	**120**		90	6.3	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10
Pyrene	**24**	**J**	90	6.3	ug/Kg	☼	05/24/16 13:40	05/31/16 14:54	10

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Terphenyl-d14	*33*	*X*	*42 - 151*	*05/26/16 13:29*	*05/27/16 20:00*	*10*
2,4,6-Tribromophenol	*24*	*X*	*28 - 143*	*05/26/16 13:29*	*05/27/16 20:00*	*10*
Nitrobenzene-d5	*57*		*53 - 113*	*05/24/16 13:40*	*05/31/16 14:54*	*10*
Terphenyl-d14	*82*		*70 - 144*	*05/24/16 13:40*	*05/31/16 14:54*	*10*
2-Fluorobiphenyl (Surr)	*77*		*53 - 113*	*05/24/16 13:40*	*05/31/16 14:54*	*10*

Method: Organotins - Organotins, PSEP (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dibutyltin	ND		7.8	1.8	ug/Kg	☼	05/25/16 10:28	06/01/16 13:16	1
Monobutyltin	ND		4.8	1.2	ug/Kg	☼	05/25/16 10:28	06/01/16 13:16	1
Tetra-n-butyltin	ND		24	6.9	ug/Kg	☼	05/25/16 10:28	06/01/16 13:16	1
Tributyltin	ND		4.2	0.92	ug/Kg	☼	05/25/16 10:28	06/01/16 13:16	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Tripentyltin	*71*		*20 - 151*	*05/25/16 10:28*	*06/01/16 13:16*	*1*

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	**210**		90	45	mg/Kg	☼	05/25/16 11:00	05/27/16 10:03	50
Motor Oil Range Organics [C28-C40]	**950**		450	340	mg/Kg	☼	05/25/16 11:00	05/27/16 10:03	50

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl (Surr)	*111*		*63 - 141*	*05/25/16 11:00*	*05/27/16 10:03*	*50*

Method: 8081B - Organochlorine Pesticides (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aldrin	ND		30	3.7	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
alpha-BHC	ND		30	3.9	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
beta-BHC	ND		30	5.9	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
gamma-BHC (Lindane)	ND		30	3.0	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
delta-BHC	ND		30	2.8	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Client Sample ID: PERC POND-NORTH N1
Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-1
Matrix: Solid
Percent Solids: 55.1

Method: 8081B - Organochlorine Pesticides (GC) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
alpha-Chlordane	ND		30	3.6	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
gamma-Chlordane	ND		30	0.94	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
4,4'-DDD	ND		30	4.6	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
4,4'-DDE	ND		30	3.9	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
4,4'-DDT	ND		30	7.1	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Dieldrin	**6.4**	**J**	30	1.6	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Endosulfan I	ND		30	0.92	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Endosulfan II	ND		30	1.8	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Endosulfan sulfate	**4.0**	**J p**	30	1.6	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Endrin	ND		30	2.0	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Endrin aldehyde	ND		30	2.0	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Endrin ketone	ND		30	6.0	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Heptachlor	ND		30	3.4	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Heptachlor epoxide	ND		30	2.1	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Methoxychlor	ND		60	23	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
Toxaphene	ND		1200	360	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
2,4'-DDD	ND		60	12	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
2,4'-DDE	ND		60	12	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1
2,4'-DDT	ND		60	12	ug/Kg	☼	05/24/16 10:53	06/05/16 17:43	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl	*94*		*49 - 119*	*05/24/16 10:53*	*06/05/16 17:43*	*1*
DCB Decachlorobiphenyl	*109*		*49 - 119*	*05/24/16 10:53*	*06/05/16 17:43*	*1*
Tetrachloro-m-xylene	*92*		*58 - 111*	*05/24/16 10:53*	*06/05/16 17:43*	*1*
Tetrachloro-m-xylene	*88*		*58 - 111*	*05/24/16 10:53*	*06/05/16 17:43*	*1*

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		590	60	ug/Kg	☼	05/24/16 12:07	06/07/16 13:36	1
PCB-1221	ND		590	92	ug/Kg	☼	05/24/16 12:07	06/07/16 13:36	1
PCB-1232	ND		590	110	ug/Kg	☼	05/24/16 12:07	06/07/16 13:36	1
PCB-1242	ND		590	130	ug/Kg	☼	05/24/16 12:07	06/07/16 13:36	1
PCB-1248	ND		590	100	ug/Kg	☼	05/24/16 12:07	06/07/16 13:36	1
PCB-1254	ND		590	48	ug/Kg	☼	05/24/16 12:07	06/07/16 13:36	1
PCB-1260	ND		590	52	ug/Kg	☼	05/24/16 12:07	06/07/16 13:36	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl	*173*	*X*	*77 - 123*	*05/24/16 12:07*	*06/07/16 13:36*	*1*

Method: 1613B - Dioxins and Furans (HRGC/HRMS)

Analyte	Result	Qualifier	RL	EDL	Unit	D	Prepared	Analyzed	Dil Fac
2,3,7,8-TCDD	ND		1.8	0.23	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,7,8-PeCDD	ND		9.1	1.3	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,7,8-PeCDF	ND		9.1	0.13	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
2,3,4,7,8-PeCDF	**0.16**	**J q**	9.1	0.15	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,4,7,8-HxCDD	**0.40**	**J q**	9.1	0.15	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,6,7,8-HxCDD	**0.53**	**J q**	9.1	0.15	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,7,8,9-HxCDD	**0.86**	**J**	9.1	0.12	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,4,7,8-HxCDF	ND		9.1	0.090	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,6,7,8-HxCDF	**0.21**	**J q**	9.1	0.081	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1

Client Sample ID: PERC POND-NORTH N1
Lab Sample ID: 320-18842-1
Date Collected: 05/12/16 12:00
Matrix: Solid
Date Received: 05/13/16 09:35
Percent Solids: 55.1

Method: 1613B - Dioxins and Furans (HRGC/HRMS) (Continued)

Analyte	Result	Qualifier	RL	EDL	Unit	D	Prepared	Analyzed	Dil Fac
1,2,3,7,8,9-HxCDF	ND		9.1	0.074	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
2,3,4,6,7,8-HxCDF	**0.29**	**J**	9.1	0.068	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,4,6,7,8-HpCDD	**10**		9.1	0.33	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,4,6,7,8-HpCDF	**2.2**	**J q B**	9.1	2.0	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
1,2,3,4,7,8,9-HpCDF	ND		9.1	2.4	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
OCDD	**55**	**B**	18	0.27	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1
OCDF	**2.6**	**J B**	18	0.11	pg/g	☼	05/24/16 13:07	05/25/16 17:57	1

Isotope Dilution	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C-2,3,7,8-TCDD	*59*		*25 - 164*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,7,8-PeCDD	*54*		*25 - 181*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,7,8-PeCDF	*56*		*24 - 185*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-2,3,4,7,8-PeCDF	*56*		*21 - 178*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,4,7,8-HxCDD	*57*		*32 - 141*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,6,7,8-HxCDD	*67*		*28 - 130*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,4,7,8-HxCDF	*60*		*26 - 152*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,6,7,8-HxCDF	*66*		*26 - 123*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-2,3,4,6,7,8-HxCDF	*62*		*28 - 136*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,7,8,9-HxCDF	*57*		*29 - 147*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,4,6,7,8-HpCDD	*62*		*23 - 140*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,4,6,7,8-HpCDF	*60*		*28 - 143*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-1,2,3,4,7,8,9-HpCDF	*62*		*26 - 138*	*05/24/16 13:07*	*05/25/16 17:57*	*1*
13C-OCDD	*62*		*17 - 157*	*05/24/16 13:07*	*05/25/16 17:57*	*1*

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
37Cl4-2,3,7,8-TCDD	*103*		*35 - 197*	*05/24/16 13:07*	*05/25/16 17:57*	*1*

Method: 1613B - Dioxins and Furans (HRGC/HRMS) - RA

Analyte	Result	Qualifier	RL	EDL	Unit	D	Prepared	Analyzed	Dil Fac
2,3,7,8-TCDF	ND		1.8	0.54	pg/g	☼	05/24/16 13:07	05/25/16 18:21	1

Isotope Dilution	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C-2,3,7,8-TCDF	*57*		*24 - 169*	*05/24/16 13:07*	*05/25/16 18:21*	*1*

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
37Cl4-2,3,7,8-TCDD	*94*		*35 - 197*	*05/24/16 13:07*	*05/25/16 18:21*	*1*

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Silver	**0.35**	**J**	0.91	0.16	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Arsenic	**2.7**	**J**	3.6	2.4	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Barium	**95**	**F1**	1.8	0.22	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Beryllium	**0.51**		0.36	0.054	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Cadmium	**0.14**	**J**	0.36	0.054	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Cobalt	**16**		0.91	0.45	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Chromium	**80**	**F2**	0.91	0.25	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Copper	**100**	**F2**	2.7	0.40	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Molybdenum	ND		3.6	1.4	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Nickel	**110**	**F1**	1.8	0.43	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Lead	**10**		1.8	0.47	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Selenium	ND		3.6	2.5	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Antimony	ND	F1 F2	3.6	1.7	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2

Client Sample ID: PERC POND-NORTH N1

Lab Sample ID: 320-18842-1

Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Matrix: Solid
Percent Solids: 55.1

Method: 6010B - Metals (ICP) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Thallium	ND		3.6	1.5	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Vanadium	**47**	**F1**	0.91	0.34	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2
Zinc	**130**	**F1 F2**	3.6	0.34	mg/Kg	☼	05/26/16 07:00	05/31/16 17:24	2

Method: 7471A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.10**		0.044	0.0094	mg/Kg	☼	05/27/16 08:28	05/27/16 13:46	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	**2100**	**F1**	180	140	mg/Kg	☼	05/24/16 17:22	05/25/16 19:35	2

Client Sample ID: PERC POND-SOUTH S1

Lab Sample ID: 320-18842-2

Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Matrix: Solid
Percent Solids: 98.7

Method: 8270C SIM - Semivolatile Organic Compounds (GC/MS SIM)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acenaphthene	ND		48	4.6	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Acenaphthylene	ND		48	3.2	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Anthracene	ND		48	3.8	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Benzo[a]anthracene	ND		48	2.9	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Pentachlorophenol	**42**	**J**	66	17	ug/Kg	☼	05/26/16 13:29	05/27/16 21:07	10
Benzo[a]pyrene	ND		48	3.9	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Benzo[b]fluoranthene	**4.9**	**J**	48	4.9	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Benzo[g,h,i]perylene	ND		48	9.7	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Benzo[k]fluoranthene	ND		48	7.4	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Chrysene	**4.7**	**J**	48	3.4	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Dibenz(a,h)anthracene	ND		48	12	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Fluoranthene	**3.5**	**J**	48	2.8	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Fluorene	**5.0**	**J**	48	4.8	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Indeno[1,2,3-cd]pyrene	ND		48	4.6	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Naphthalene	**4.9**	**J**	48	3.0	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Phenanthrene	**22**	**J**	48	3.4	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10
Pyrene	**4.8**	**J**	48	3.4	ug/Kg	☼	05/20/16 10:56	05/24/16 16:46	10

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Terphenyl-d14	*89*		*42 - 151*	*05/26/16 13:29*	*05/27/16 21:07*	*10*
2,4,6-Tribromophenol	*87*		*28 - 143*	*05/26/16 13:29*	*05/27/16 21:07*	*10*
Nitrobenzene-d5	*77*		*53 - 113*	*05/20/16 10:56*	*05/24/16 16:46*	*10*
Terphenyl-d14	*79*		*70 - 144*	*05/20/16 10:56*	*05/24/16 16:46*	*10*
2-Fluorobiphenyl (Surr)	*76*		*53 - 113*	*05/20/16 10:56*	*05/24/16 16:46*	*10*

Method: Organotins - Organotins, PSEP (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dibutyltin	ND		4.3	1.0	ug/Kg	☼	05/25/16 10:28	06/01/16 13:39	1
Monobutyltin	ND		2.6	0.66	ug/Kg	☼	05/25/16 10:28	06/01/16 13:39	1
Tetra-n-butyltin	ND		13	3.8	ug/Kg	☼	05/25/16 10:28	06/01/16 13:39	1
Tributyltin	ND		2.3	0.51	ug/Kg	☼	05/25/16 10:28	06/01/16 13:39	1

Client Sample Results

Client: Northern Hydrology & Engineering
Project/Site: Mad River Ponds

TestAmerica Job ID: 320-18842-1

Client Sample ID: PERC POND-SOUTH S1

Lab Sample ID: 320-18842-2

Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Matrix: Solid
Percent Solids: 98.7

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Tripentyltin	*50*		*20 - 151*	*05/25/16 10:28*	*06/01/16 13:39*	*1*

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	**37**		10	5.2	mg/Kg	☼	05/25/16 11:00	05/27/16 10:32	10
Motor Oil Range Organics [C28-C40]	**140**		52	39	mg/Kg	☼	05/25/16 11:00	05/27/16 10:32	10

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl (Surr)	*106*		*63 - 141*	*05/25/16 11:00*	*05/27/16 10:32*	*10*

Method: 8081B - Organochlorine Pesticides (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aldrin	ND		18	2.2	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
alpha-BHC	ND		18	2.3	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
beta-BHC	ND		18	3.4	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
gamma-BHC (Lindane)	ND		18	1.8	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
delta-BHC	ND		18	1.7	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
alpha-Chlordane	ND		18	2.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
gamma-Chlordane	**1.1**	**J**	18	0.55	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
4,4'-DDD	ND		18	2.7	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
4,4'-DDE	ND		18	2.3	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
4,4'-DDT	ND		18	4.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Dieldrin	ND		18	0.94	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Endosulfan I	ND		18	0.54	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Endosulfan II	ND		18	1.0	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Endosulfan sulfate	ND		18	0.95	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Endrin	ND		18	1.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Endrin aldehyde	ND		18	1.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Endrin ketone	ND		18	3.5	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Heptachlor	ND		18	2.0	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Heptachlor epoxide	ND		18	1.2	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Methoxychlor	ND		35	13	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
Toxaphene	ND		690	210	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
2,4'-DDD	ND		35	6.9	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
2,4'-DDE	ND		35	6.9	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1
2,4'-DDT	ND		35	6.9	ug/Kg	☼	05/20/16 11:18	06/05/16 16:23	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl	*104*		*49 - 119*	*05/20/16 11:18*	*06/05/16 16:23*	*1*
DCB Decachlorobiphenyl	*108*		*49 - 119*	*05/20/16 11:18*	*06/05/16 16:23*	*1*
Tetrachloro-m-xylene	*99*		*58 - 111*	*05/20/16 11:18*	*06/05/16 16:23*	*1*
Tetrachloro-m-xylene	*103*		*58 - 111*	*05/20/16 11:18*	*06/05/16 16:23*	*1*

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		34	3.5	ug/Kg	☼	05/20/16 11:31	05/25/16 16:38	1
PCB-1221	ND		34	5.4	ug/Kg	☼	05/20/16 11:31	05/25/16 16:38	1
PCB-1232	ND		34	6.6	ug/Kg	☼	05/20/16 11:31	05/25/16 16:38	1
PCB-1242	ND		34	7.6	ug/Kg	☼	05/20/16 11:31	05/25/16 16:38	1
PCB-1248	ND		34	5.9	ug/Kg	☼	05/20/16 11:31	05/25/16 16:38	1

Client Sample Results

Client Sample ID: PERC POND-SOUTH S1

Lab Sample ID: 320-18842-2

Date Collected: 05/12/16 12:00

Matrix: Solid

Date Received: 05/13/16 09:35

Percent Solids: 98.7

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1254	ND		34	2.8	ug/Kg	☼	05/20/16 11:31	05/25/16 16:38	1
PCB-1260	ND		34	3.0	ug/Kg	☼	05/20/16 11:31	05/25/16 16:38	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl	*16*	*X*	*77 - 123*	*05/20/16 11:31*	*05/25/16 16:38*	*1*

Method: 1613B - Dioxins and Furans (HRGC/HRMS)

Analyte	Result	Qualifier	RL	EDL	Unit	D	Prepared	Analyzed	Dil Fac
2,3,7,8-TCDD	ND		1.0	0.072	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,7,8-PeCDD	ND		5.0	0.38	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,7,8-PeCDF	ND		5.0	0.041	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
2,3,4,7,8-PeCDF	ND		5.0	0.043	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,4,7,8-HxCDD	ND		5.0	0.052	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,6,7,8-HxCDD	**0.12**	**J**	5.0	0.053	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,7,8,9-HxCDD	ND		5.0	0.043	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,4,7,8-HxCDF	ND		5.0	0.029	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,6,7,8-HxCDF	ND		5.0	0.026	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,7,8,9-HxCDF	ND		5.0	0.022	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
2,3,4,6,7,8-HxCDF	ND		5.0	0.022	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,4,6,7,8-HpCDD	**1.7**	**J**	5.0	0.066	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,4,6,7,8-HpCDF	ND		5.0	0.49	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
1,2,3,4,7,8,9-HpCDF	ND		5.0	0.72	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
OCDD	**8.7**	**J B**	10	0.055	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1
OCDF	**0.46**	**J B**	10	0.036	pg/g	☼	05/24/16 13:07	05/25/16 18:43	1

Isotope Dilution	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C-2,3,7,8-TCDD	*75*		*25 - 164*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,7,8-PeCDD	*71*		*25 - 181*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,7,8-PeCDF	*72*		*24 - 185*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-2,3,4,7,8-PeCDF	*72*		*21 - 178*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,4,7,8-HxCDD	*76*		*32 - 141*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,6,7,8-HxCDD	*84*		*28 - 130*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,4,7,8-HxCDF	*78*		*26 - 152*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,6,7,8-HxCDF	*83*		*26 - 123*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-2,3,4,6,7,8-HxCDF	*81*		*28 - 136*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,7,8,9-HxCDF	*75*		*29 - 147*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,4,6,7,8-HpCDD	*80*		*23 - 140*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,4,6,7,8-HpCDF	*86*		*28 - 143*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-1,2,3,4,7,8,9-HpCDF	*82*		*26 - 138*	*05/24/16 13:07*	*05/25/16 18:43*	*1*
13C-OCDD	*80*		*17 - 157*	*05/24/16 13:07*	*05/25/16 18:43*	*1*

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
37Cl4-2,3,7,8-TCDD	*98*		*35 - 197*	*05/24/16 13:07*	*05/25/16 18:43*	*1*

Method: 1613B - Dioxins and Furans (HRGC/HRMS) - RA

Analyte	Result	Qualifier	RL	EDL	Unit	D	Prepared	Analyzed	Dil Fac
2,3,7,8-TCDF	ND		1.0	0.22	pg/g	☼	05/24/16 13:07	05/25/16 19:06	1

Isotope Dilution	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C-2,3,7,8-TCDF	*70*		*24 - 169*	*05/24/16 13:07*	*05/25/16 19:06*	*1*

Client Sample ID: PERC POND-SOUTH S1
Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-2
Matrix: Solid
Percent Solids: 98.7

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
37Cl4-2,3,7,8-TCDD	92		35 - 197	05/24/16 13:07	05/25/16 19:06	1

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Silver	ND		0.51	0.092	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Arsenic	**1.7**	**J**	2.1	1.3	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Barium	**57**		1.0	0.12	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Beryllium	**0.36**		0.21	0.031	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Cadmium	ND		0.21	0.031	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Cobalt	**5.9**		0.51	0.26	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Chromium	**42**		0.51	0.14	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Copper	**23**		1.5	0.23	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Molybdenum	ND		2.1	0.77	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Nickel	**46**		1.0	0.25	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Lead	**5.0**		1.0	0.27	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Selenium	ND		2.1	1.4	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Antimony	ND		2.1	0.96	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Thallium	ND		2.1	0.86	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Vanadium	**37**		0.51	0.19	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2
Zinc	**50**		2.1	0.19	mg/Kg	☼	05/26/16 07:00	05/31/16 17:48	2

Method: 7471A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.029**		0.024	0.0052	mg/Kg	☼	05/27/16 08:28	05/27/16 13:48	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	**1200**		100	76	mg/Kg	☼	05/24/16 17:22	05/25/16 19:35	2

Client Sample ID: PERC POND N2
Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-3
Matrix: Solid
Percent Solids: 99.1

Method: 8270C SIM - Semivolatile Organic Compounds (GC/MS SIM)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acenaphthene	ND		51	4.8	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Acenaphthylene	ND		51	3.4	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Anthracene	ND		51	4.0	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Benzo[a]anthracene	ND		51	3.1	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Pentachlorophenol	**43**	**J**	68	17	ug/Kg	☼	05/26/16 13:29	05/27/16 21:30	10
Benzo[a]pyrene	ND		51	4.1	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Benzo[b]fluoranthene	**11**	**J**	51	5.1	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Benzo[g,h,i]perylene	ND		51	10	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Benzo[k]fluoranthene	ND		51	7.7	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Chrysene	**12**	**J**	51	3.5	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Dibenz(a,h)anthracene	ND		51	12	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Fluoranthene	**5.4**	**J**	51	3.0	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Fluorene	**11**	**J**	51	5.0	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Indeno[1,2,3-cd]pyrene	ND		51	4.9	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Naphthalene	**11**	**J**	51	3.1	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10
Phenanthrene	**47**	**J**	51	3.6	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Client Sample ID: PERC POND N2
Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-3
Matrix: Solid
Percent Solids: 99.1

Method: 8270C SIM - Semivolatile Organic Compounds (GC/MS SIM) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Pyrene	**8.9**	**J**	51	3.6	ug/Kg	☼	05/20/16 10:56	05/24/16 17:16	10

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Terphenyl-d14	*82*		*42 - 151*	*05/26/16 13:29*	*05/27/16 21:30*	*10*
2,4,6-Tribromophenol	*79*		*28 - 143*	*05/26/16 13:29*	*05/27/16 21:30*	*10*
Nitrobenzene-d5	*54*		*53 - 113*	*05/20/16 10:56*	*05/24/16 17:16*	*10*
Terphenyl-d14	*73*		*70 - 144*	*05/20/16 10:56*	*05/24/16 17:16*	*10*
2-Fluorobiphenyl (Surr)	*60*		*53 - 113*	*05/20/16 10:56*	*05/24/16 17:16*	*10*

Method: Organotins - Organotins, PSEP (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Dibutyltin	ND		4.4	1.0	ug/Kg	☼	05/25/16 10:28	06/01/16 14:02	1
Monobutyltin	ND		2.7	0.68	ug/Kg	☼	05/25/16 10:28	06/01/16 14:02	1
Tetra-n-butyltin	ND		14	3.9	ug/Kg	☼	05/25/16 10:28	06/01/16 14:02	1
Tributyltin	ND		2.4	0.52	ug/Kg	☼	05/25/16 10:28	06/01/16 14:02	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Tripentyltin	*37*		*20 - 151*	*05/25/16 10:28*	*06/01/16 14:02*	*1*

Method: 8015B - Diesel Range Organics (DRO) (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	**31**		10	5.0	mg/Kg	☼	05/25/16 11:00	05/27/16 11:01	10
Motor Oil Range Organics [C28-C40]	**110**		50	38	mg/Kg	☼	05/25/16 11:00	05/27/16 11:01	10

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
o-Terphenyl (Surr)	*105*		*63 - 141*	*05/25/16 11:00*	*05/27/16 11:01*	*10*

Method: 8081B - Organochlorine Pesticides (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Aldrin	ND		17	2.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
alpha-BHC	ND		17	2.2	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
beta-BHC	ND		17	3.3	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
gamma-BHC (Lindane)	ND		17	1.7	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
delta-BHC	ND		17	1.6	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
alpha-Chlordane	ND		17	2.0	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
gamma-Chlordane	**2.8**	**J p**	17	0.54	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
4,4'-DDD	ND		17	2.6	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
4,4'-DDE	ND		17	2.2	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
4,4'-DDT	ND		17	4.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Dieldrin	ND		17	0.92	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Endosulfan I	ND		17	0.53	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Endosulfan II	ND		17	1.0	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Endosulfan sulfate	ND		17	0.93	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Endrin	ND		17	1.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Endrin aldehyde	ND		17	1.1	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Endrin ketone	ND		17	3.4	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Heptachlor	ND		17	1.9	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Heptachlor epoxide	ND		17	1.2	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Methoxychlor	ND		34	13	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
Toxaphene	ND		680	200	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1

Client Sample ID: PERC POND N2

Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-3
Matrix: Solid
Percent Solids: 99.1

Method: 8081B - Organochlorine Pesticides (GC) (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
2,4'-DDD	ND		34	6.8	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
2,4'-DDE	ND		34	6.8	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1
2,4'-DDT	ND		34	6.8	ug/Kg	☼	05/20/16 11:18	06/05/16 16:39	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl	*96*		*49 - 119*	*05/20/16 11:18*	*06/05/16 16:39*	*1*
DCB Decachlorobiphenyl	*101*		*49 - 119*	*05/20/16 11:18*	*06/05/16 16:39*	*1*
Tetrachloro-m-xylene	*89*		*58 - 111*	*05/20/16 11:18*	*06/05/16 16:39*	*1*
Tetrachloro-m-xylene	*93*		*58 - 111*	*05/20/16 11:18*	*06/05/16 16:39*	*1*

Method: 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		33	3.4	ug/Kg	☼	05/20/16 11:31	05/25/16 16:58	1
PCB-1221	ND		33	5.3	ug/Kg	☼	05/20/16 11:31	05/25/16 16:58	1
PCB-1232	ND		33	6.5	ug/Kg	☼	05/20/16 11:31	05/25/16 16:58	1
PCB-1242	ND		33	7.5	ug/Kg	☼	05/20/16 11:31	05/25/16 16:58	1
PCB-1248	ND		33	5.8	ug/Kg	☼	05/20/16 11:31	05/25/16 16:58	1
PCB-1254	ND		33	2.7	ug/Kg	☼	05/20/16 11:31	05/25/16 16:58	1
PCB-1260	ND		33	2.9	ug/Kg	☼	05/20/16 11:31	05/25/16 16:58	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl	*18*	*X*	*77 - 123*	*05/20/16 11:31*	*05/25/16 16:58*	*1*

Method: 1613B - Dioxins and Furans (HRGC/HRMS)

Analyte	Result	Qualifier	RL	EDL	Unit	D	Prepared	Analyzed	Dil Fac
2,3,7,8-TCDD	ND		1.0	0.10	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,7,8-PeCDD	ND		5.0	0.48	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,7,8-PeCDF	ND		5.0	0.054	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
2,3,4,7,8-PeCDF	ND		5.0	0.057	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,4,7,8-HxCDD	**0.097**	**J q**	5.0	0.059	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,6,7,8-HxCDD	**0.14**	**J q**	5.0	0.058	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,7,8,9-HxCDD	ND		5.0	0.048	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,4,7,8-HxCDF	**0.088**	**J**	5.0	0.037	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,6,7,8-HxCDF	**0.091**	**J**	5.0	0.033	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,7,8,9-HxCDF	ND		5.0	0.030	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
2,3,4,6,7,8-HxCDF	**0.082**	**J q**	5.0	0.028	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,4,6,7,8-HpCDD	**2.9**	**J**	5.0	0.087	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,4,6,7,8-HpCDF	**0.74**	**J B q**	5.0	0.53	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
1,2,3,4,7,8,9-HpCDF	ND		5.0	0.72	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
OCDD	**17**	**B**	10	0.092	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1
OCDF	**0.87**	**J B**	10	0.048	pg/g	☼	05/24/16 13:07	05/25/16 19:28	1

Isotope Dilution	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C-2,3,7,8-TCDD	*57*		*25 - 164*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,7,8-PeCDD	*53*		*25 - 181*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,7,8-PeCDF	*55*		*24 - 185*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-2,3,4,7,8-PeCDF	*56*		*21 - 178*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,4,7,8-HxCDD	*55*		*32 - 141*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,6,7,8-HxCDD	*63*		*28 - 130*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,4,7,8-HxCDF	*56*		*26 - 152*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,6,7,8-HxCDF	*61*		*26 - 123*	*05/24/16 13:07*	*05/25/16 19:28*	*1*

Client Sample ID: PERC POND N2
Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-3
Matrix: Solid
Percent Solids: 99.1

Method: 1613B - Dioxins and Furans (HRGC/HRMS) (Continued)

Isotope Dilution	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C-2,3,4,6,7,8-HxCDF	*59*		*28 - 136*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,7,8,9-HxCDF	*54*		*29 - 147*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,4,6,7,8-HpCDD	*59*		*23 - 140*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,4,6,7,8-HpCDF	*62*		*28 - 143*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-1,2,3,4,7,8,9-HpCDF	*61*		*26 - 138*	*05/24/16 13:07*	*05/25/16 19:28*	*1*
13C-OCDD	*59*		*17 - 157*	*05/24/16 13:07*	*05/25/16 19:28*	*1*

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
37Cl4-2,3,7,8-TCDD	*108*		*35 - 197*	*05/24/16 13:07*	*05/25/16 19:28*	*1*

Method: 1613B - Dioxins and Furans (HRGC/HRMS) - RA

Analyte	Result	Qualifier	RL	EDL	Unit	D	Prepared	Analyzed	Dil Fac
2,3,7,8-TCDF	ND		1.0	0.25	pg/g	☼	05/24/16 13:07	05/25/16 19:48	1

Isotope Dilution	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
13C-2,3,7,8-TCDF	*53*		*24 - 169*	*05/24/16 13:07*	*05/25/16 19:48*	*1*

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
37Cl4-2,3,7,8-TCDD	*96*		*35 - 197*	*05/24/16 13:07*	*05/25/16 19:48*	*1*

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Silver	ND		0.49	0.089	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Arsenic	**1.3**	**J**	2.0	1.3	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Barium	**67**		0.99	0.12	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Beryllium	**0.42**		0.20	0.030	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Cadmium	ND		0.20	0.030	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Cobalt	**8.3**		0.49	0.25	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Chromium	**60**		0.49	0.14	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Copper	**30**		1.5	0.22	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Molybdenum	ND		2.0	0.74	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Nickel	**70**		0.99	0.24	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Lead	**6.3**		0.99	0.26	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Selenium	ND		2.0	1.4	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Antimony	ND		2.0	0.93	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Thallium	ND		2.0	0.83	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Vanadium	**40**		0.49	0.19	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2
Zinc	**63**		2.0	0.19	mg/Kg	☼	05/26/16 07:00	05/31/16 17:51	2

Method: 7471A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	**0.046**		0.024	0.0052	mg/Kg	☼	05/27/16 08:28	05/27/16 13:50	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	**1100**		100	75	mg/Kg	☼	05/24/16 17:22	05/25/16 19:38	2

Client Sample ID: PERC POND-NORTH N1 　Lab Sample ID: 320-18842-1

Analyte	Result	Qualifier	NONE	NONE	Unit	WHO 2005 ND = 0 TEF	WHO 2005 ND = 0 TEQ	Method
Total Dioxin/Furan TEQ					pg/g		0.42	TEQ
Total TEQ					pg/g		0.42	TEQ

Analyte	Result	Qualifier	RL	EDL	Unit	WHO 2005 ND = 0 TEF	WHO 2005 ND = 0 TEQ	Method
2,3,7,8-TCDD	ND		1.8	0.23	pg/g	1	0.00	1613B
1,2,3,7,8-PeCDD	ND		9.1	1.3	pg/g	1	0.00	1613B
1,2,3,7,8-PeCDF	ND		9.1	0.13	pg/g	0.03	0.00	1613B
2,3,4,7,8-PeCDF	**0.16**	**J q**	9.1	0.15	pg/g	0.3	**0.048**	1613B
1,2,3,4,7,8-HxCDD	**0.40**	**J q**	9.1	0.15	pg/g	0.1	**0.040**	1613B
1,2,3,6,7,8-HxCDD	**0.53**	**J q**	9.1	0.15	pg/g	0.1	**0.053**	1613B
1,2,3,7,8,9-HxCDD	**0.86**	**J**	9.1	0.12	pg/g	0.1	**0.086**	1613B
1,2,3,4,7,8-HxCDF	ND		9.1	0.090	pg/g	0.1	0.00	1613B
1,2,3,6,7,8-HxCDF	**0.21**	**J q**	9.1	0.081	pg/g	0.1	**0.021**	1613B
1,2,3,7,8,9-HxCDF	ND		9.1	0.074	pg/g	0.1	0.00	1613B
2,3,4,6,7,8-HxCDF	**0.29**	**J**	9.1	0.068	pg/g	0.1	**0.029**	1613B
1,2,3,4,6,7,8-HpCDD	**10**		9.1	0.33	pg/g	0.01	**0.10**	1613B
1,2,3,4,6,7,8-HpCDF	**2.2**	**J q B**	9.1	2.0	pg/g	0.01	**0.022**	1613B
1,2,3,4,7,8,9-HpCDF	ND		9.1	2.4	pg/g	0.01	0.00	1613B
OCDD	**55**	**B**	18	0.27	pg/g	0.0003	**0.017**	1613B
OCDF	**2.6**	**J B**	18	0.11	pg/g	0.0003	**0.00078**	1613B
2,3,7,8-TCDF - RA	ND		1.8	0.54	pg/g	0.1	0.00	1613B

Client Sample ID: PERC POND-SOUTH S1 　Lab Sample ID: 320-18842-2

Analyte	Result	Qualifier	NONE	NONE	Unit	WHO 2005 ND = 0 TEF	WHO 2005 ND = 0 TEQ	Method
Total Dioxin/Furan TEQ					pg/g		0.032	TEQ
Total TEQ					pg/g		0.032	TEQ

Analyte	Result	Qualifier	RL	EDL	Unit	WHO 2005 ND = 0 TEF	WHO 2005 ND = 0 TEQ	Method
2,3,7,8-TCDD	ND		1.0	0.072	pg/g	1	0.00	1613B
1,2,3,7,8-PeCDD	ND		5.0	0.38	pg/g	1	0.00	1613B
1,2,3,7,8-PeCDF	ND		5.0	0.041	pg/g	0.03	0.00	1613B
2,3,4,7,8-PeCDF	ND		5.0	0.043	pg/g	0.3	0.00	1613B
1,2,3,4,7,8-HxCDD	ND		5.0	0.052	pg/g	0.1	0.00	1613B
1,2,3,6,7,8-HxCDD	**0.12**	**J**	5.0	0.053	pg/g	0.1	**0.012**	1613B
1,2,3,7,8,9-HxCDD	ND		5.0	0.043	pg/g	0.1	0.00	1613B
1,2,3,4,7,8-HxCDF	ND		5.0	0.029	pg/g	0.1	0.00	1613B
1,2,3,6,7,8-HxCDF	ND		5.0	0.026	pg/g	0.1	0.00	1613B
1,2,3,7,8,9-HxCDF	ND		5.0	0.022	pg/g	0.1	0.00	1613B
2,3,4,6,7,8-HxCDF	ND		5.0	0.022	pg/g	0.1	0.00	1613B

TEF Reference:
WHO 2005 = World Health Organization (WHO) 2005 TEF, Dioxins, Furans and PCB Congeners

Client Sample ID: PERC POND-SOUTH S1 (Continued)

Lab Sample ID: 320-18842-2

						WHO 2005 ND = 0		
Analyte	Result	Qualifier	RL	EDL	Unit	TEF	TEQ	Method
1,2,3,4,6,7,8-HpCDD	**1.7**	**J**	5.0	0.066	pg/g	0.01	**0.017**	1613B
1,2,3,4,6,7,8-HpCDF	ND		5.0	0.49	pg/g	0.01	0.00	1613B
1,2,3,4,7,8,9-HpCDF	ND		5.0	0.72	pg/g	0.01	0.00	1613B
OCDD	**8.7**	**J B**	10	0.055	pg/g	0.0003	**0.0026**	1613B
OCDF	**0.46**	**J B**	10	0.036	pg/g	0.0003	**0.00014**	1613B
2,3,7,8-TCDF - RA	ND		1.0	0.22	pg/g	0.1	0.00	1613B

Client Sample ID: PERC POND N2

Lab Sample ID: 320-18842-3

						WHO 2005 ND = 0		
Analyte	Result	Qualifier	NONE	NONE	Unit	TEF	TEQ	Method
Total Dioxin/Furan TEQ					pg/g		0.092	TEQ
Total TEQ					pg/g		0.092	TEQ

						WHO 2005 ND = 0		
Analyte	Result	Qualifier	RL	EDL	Unit	TEF	TEQ	Method
2,3,7,8-TCDD	ND		1.0	0.10	pg/g	1	0.00	1613B
1,2,3,7,8-PeCDD	ND		5.0	0.48	pg/g	1	0.00	1613B
1,2,3,7,8-PeCDF	ND		5.0	0.054	pg/g	0.03	0.00	1613B
2,3,4,7,8-PeCDF	ND		5.0	0.057	pg/g	0.3	0.00	1613B
1,2,3,4,7,8-HxCDD	**0.097**	**J q**	5.0	0.059	pg/g	0.1	**0.0097**	1613B
1,2,3,6,7,8-HxCDD	**0.14**	**J q**	5.0	0.058	pg/g	0.1	**0.014**	1613B
1,2,3,7,8,9-HxCDD	ND		5.0	0.048	pg/g	0.1	0.00	1613B
1,2,3,4,7,8-HxCDF	**0.088**	**J**	5.0	0.037	pg/g	0.1	**0.0088**	1613B
1,2,3,6,7,8-HxCDF	**0.091**	**J**	5.0	0.033	pg/g	0.1	**0.0091**	1613B
1,2,3,7,8,9-HxCDF	ND		5.0	0.030	pg/g	0.1	0.00	1613B
2,3,4,6,7,8-HxCDF	**0.082**	**J q**	5.0	0.028	pg/g	0.1	**0.0082**	1613B
1,2,3,4,6,7,8-HpCDD	**2.9**	**J**	5.0	0.087	pg/g	0.01	**0.029**	1613B
1,2,3,4,6,7,8-HpCDF	**0.74**	**J B q**	5.0	0.53	pg/g	0.01	**0.0074**	1613B
1,2,3,4,7,8,9-HpCDF	ND		5.0	0.72	pg/g	0.01	0.00	1613B
OCDD	**17**	**B**	10	0.092	pg/g	0.0003	**0.0051**	1613B
OCDF	**0.87**	**J B**	10	0.048	pg/g	0.0003	**0.00026**	1613B
2,3,7,8-TCDF - RA	ND		1.0	0.25	pg/g	0.1	0.00	1613B

TEF Reference:

WHO 2005 = World Health Organization (WHO) 2005 TEF, Dioxins, Furans and PCB Congeners

Client Sample ID: PERC POND-NORTH N1

Lab Sample ID: 320-18842-1
Date Collected: 05/12/16 12:00
Matrix: Solid
Date Received: 05/13/16 09:35

Method: D422 - Grain Size

Analyte	Result	Qualifier	NONE	NONE	Unit	D	Prepared	Analyzed	Dil Fac
Gravel	0.3				%			06/27/16 11:58	1
Coarse Sand	2.6				%			06/27/16 11:58	1
Medium Sand	11.0				%			06/27/16 11:58	1
Fine Sand	12.8				%			06/27/16 11:58	1
Silt	57.6				%			06/27/16 11:58	1
Clay	15.7				%			06/27/16 11:58	1
Sieve Size 3 inch	0.0				%			06/27/16 11:58	1
Sieve Size 2 inch	0.0				%			06/27/16 11:58	1
Sieve Size 1.5 inch	0.0				%			06/27/16 11:58	1
Sieve Size 1 inch	0.0				%			06/27/16 11:58	1
Sieve Size 0.75 inch	0.0				%			06/27/16 11:58	1
Sieve Size 0.375 inch	0.0				%			06/27/16 11:58	1
Sieve Size #4	0.3				%			06/27/16 11:58	1
Sieve Size #10	2.6				%			06/27/16 11:58	1
Sieve Size #20	7.5				%			06/27/16 11:58	1
Sieve Size #40	3.6				%			06/27/16 11:58	1
Sieve Size #60	2.8				%			06/27/16 11:58	1
Sieve Size #140	6.1				%			06/27/16 11:58	1
Sieve Size #200	0.0				%			06/27/16 11:58	1
Sieve Size #230	4.0				%			06/27/16 11:58	1
Sand	26.4				%			06/27/16 11:58	1

Client Sample ID: PERC POND-SOUTH S1

Lab Sample ID: 320-18842-2
Date Collected: 05/12/16 12:00
Matrix: Solid
Date Received: 05/13/16 09:35

Method: D422 - Grain Size

Analyte	Result	Qualifier	NONE	NONE	Unit	D	Prepared	Analyzed	Dil Fac
Gravel	20.9				%			06/27/16 11:58	1
Coarse Sand	11.3				%			06/27/16 11:58	1
Medium Sand	35.6				%			06/27/16 11:58	1
Fine Sand	22.8				%			06/27/16 11:58	1
Silt	6.2				%			06/27/16 11:58	1
Clay	3.3				%			06/27/16 11:58	1
Sieve Size 3 inch	0.0				%			06/27/16 11:58	1
Sieve Size 2 inch	0.0				%			06/27/16 11:58	1
Sieve Size 1.5 inch	0.0				%			06/27/16 11:58	1
Sieve Size 1 inch	0.0				%			06/27/16 11:58	1
Sieve Size 0.75 inch	0.0				%			06/27/16 11:58	1
Sieve Size 0.375 inch	0.0				%			06/27/16 11:58	1
Sieve Size #4	20.9				%			06/27/16 11:58	1
Sieve Size #10	11.3				%			06/27/16 11:58	1
Sieve Size #20	14.1				%			06/27/16 11:58	1
Sieve Size #40	21.5				%			06/27/16 11:58	1
Sieve Size #60	14.5				%			06/27/16 11:58	1
Sieve Size #140	6.8				%			06/27/16 11:58	1
Sieve Size #200	0.0				%			06/27/16 11:58	1
Sieve Size #230	1.5				%			06/27/16 11:58	1
Sand	69.7				%			06/27/16 11:58	1

Client Sample ID: PERC POND N2

Date Collected: 05/12/16 12:00
Date Received: 05/13/16 09:35

Lab Sample ID: 320-18842-3

Matrix: Solid

Method: D422 - Grain Size

Analyte	Result	Qualifier	NONE	NONE	Unit	D	Prepared	Analyzed	Dil Fac
Gravel	10.9				%			06/27/16 11:58	1
Coarse Sand	4.4				%			06/27/16 11:58	1
Medium Sand	19.5				%			06/27/16 11:58	1
Fine Sand	27.0				%			06/27/16 11:58	1
Silt	25.3				%			06/27/16 11:58	1
Clay	13.0				%			06/27/16 11:58	1
Sieve Size 3 inch	0.0				%			06/27/16 11:58	1
Sieve Size 2 inch	0.0				%			06/27/16 11:58	1
Sieve Size 1.5 inch	0.0				%			06/27/16 11:58	1
Sieve Size 1 inch	0.0				%			06/27/16 11:58	1
Sieve Size 0.75 inch	0.0				%			06/27/16 11:58	1
Sieve Size 0.375 inch	0.0				%			06/27/16 11:58	1
Sieve Size #4	10.9				%			06/27/16 11:58	1
Sieve Size #10	4.4				%			06/27/16 11:58	1
Sieve Size #20	6.4				%			06/27/16 11:58	1
Sieve Size #40	13.1				%			06/27/16 11:58	1
Sieve Size #60	11.8				%			06/27/16 11:58	1
Sieve Size #140	11.4				%			06/27/16 11:58	1
Sieve Size #200	0.0				%			06/27/16 11:58	1
Sieve Size #230	3.8				%			06/27/16 11:58	1
Sand	50.9				%			06/27/16 11:58	1

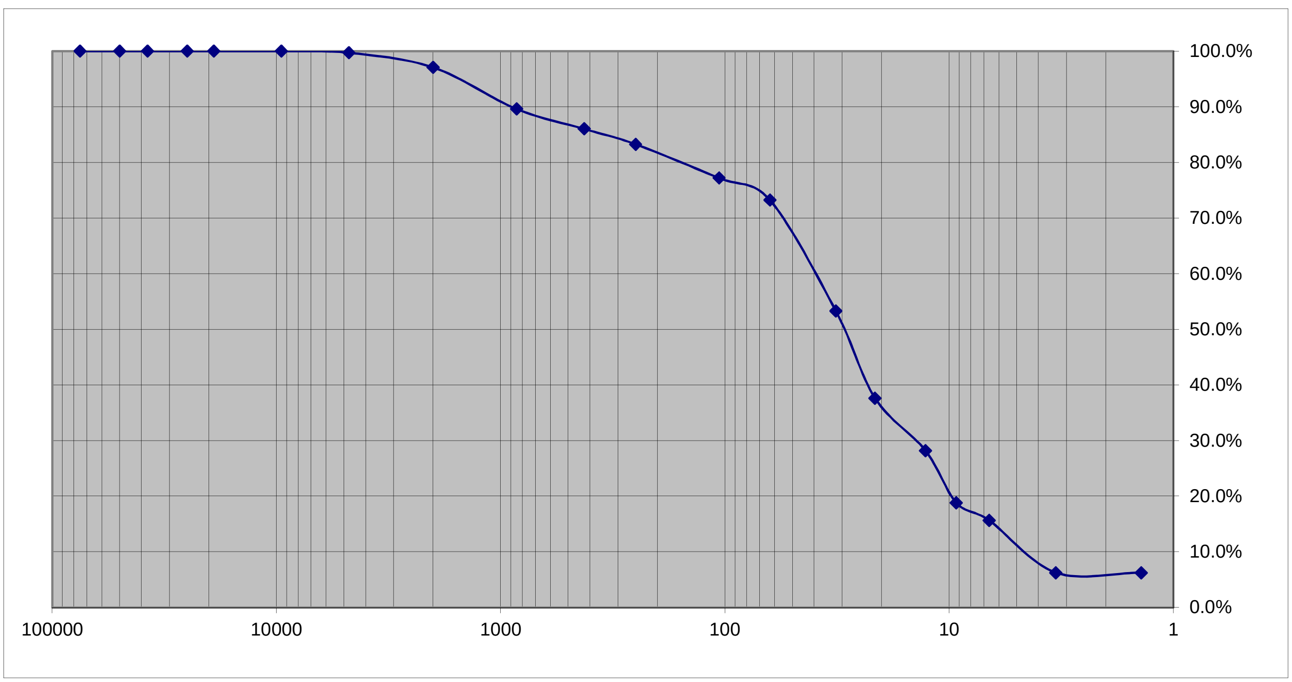
Grain Size ASTM D422

320-18842-C-1

Largest Partical Size #4

Partical Size	Partical Size	Percent Finer	Incremental Percent
3 inch	75000	100.0%	0.0%
2 inch	50000	100.0%	0.0%
1.5 inch	37500	100.0%	0.0%
1 inch	25000	100.0%	0.0%
3/4 inch	19000	100.0%	0.0%
3/8 inch	9500	100.0%	0.0%
#4	4750	99.7%	0.3%
#10	2000	97.1%	2.6%
#20	850	89.6%	7.5%
#40	425	86.0%	3.6%
#60	250	83.3%	2.8%
#140	106	77.2%	6.1%
#230	63	73.2%	4.0%
Hydrometer	32	53.3%	19.9%
Hydrometer	21	37.6%	15.7%
Hydrometer	13	28.2%	9.4%
Hydrometer	9	18.8%	9.4%
Hydrometer	7	15.7%	3.1%
Hydrometer	3	6.3%	9.4%
Hydrometer	1	6.3%	0.0%

Soil Clasification Percent	320-18842-C-1
Gravel	0.3%
Sand	26.5%
Corse Sand	2.6%
Medium Sand	11.0%
Fine Sand	12.8%
Silt	57.6%
Clay	15.7%



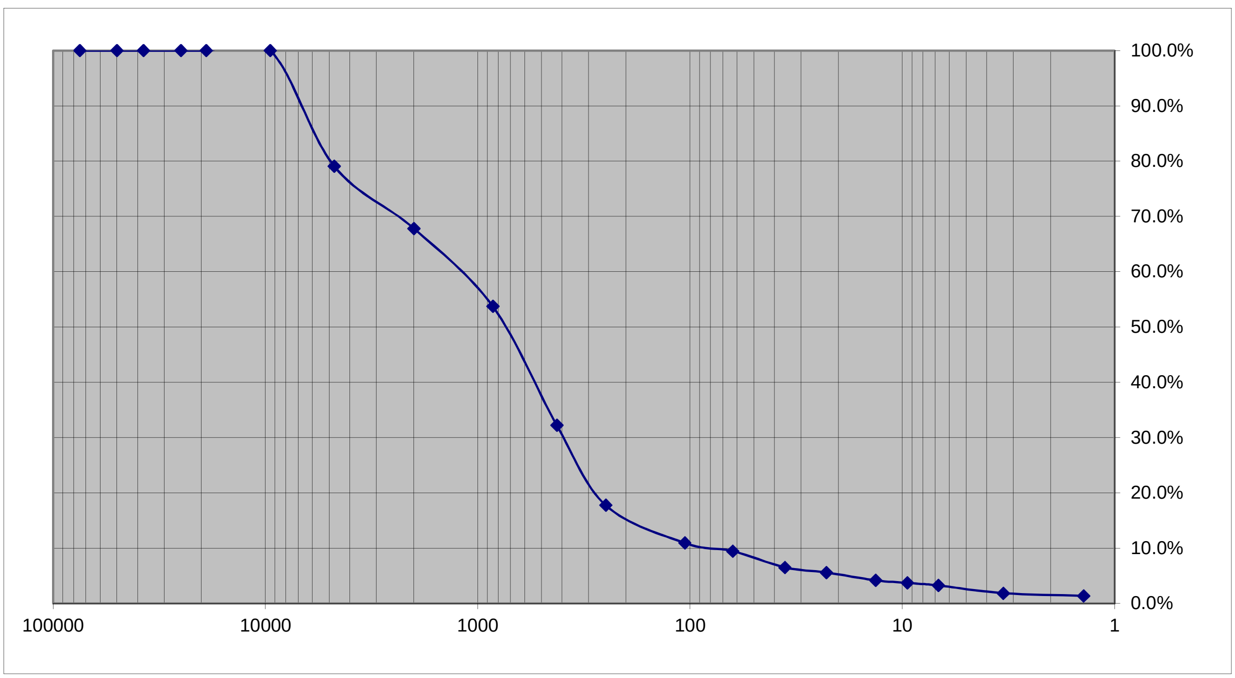
Grain Size ASTM D422

320-18842-C-2

Largest Partical Size #4

Partical size	Partical Size	Percent Finer	Incremental Percent
3 inch	75000	100.0%	0.0%
2 inch	50000	100.0%	0.0%
1.5 inch	37500	100.0%	0.0%
1 inch	25000	100.0%	0.0%
3/4 inch	19000	100.0%	0.0%
3/8 inch	9500	100.0%	0.0%
#4	4750	79.1%	20.9%
#10	2000	67.8%	11.3%
#20	850	53.8%	14.1%
#40	425	32.3%	21.5%
#60	250	17.8%	14.5%
#140	106	11.0%	6.8%
#230	63	9.5%	1.5%
Hydrometer	36	6.5%	2.9%
Hydrometer	23	5.6%	0.9%
Hydrometer	13	4.2%	1.4%
Hydrometer	9	3.7%	0.5%
Hydrometer	7	3.3%	0.5%
Hydrometer	3	1.9%	1.4%
Hydrometer	1	1.4%	0.5%

Soil Clasification Percent	320-18842-C-2
Gravel	20.9%
Sand	69.6%
Corse Sand	11.3%
Medium Sand	35.6%
Fine Sand	22.8%
Silt	6.2%
Clay	3.3%



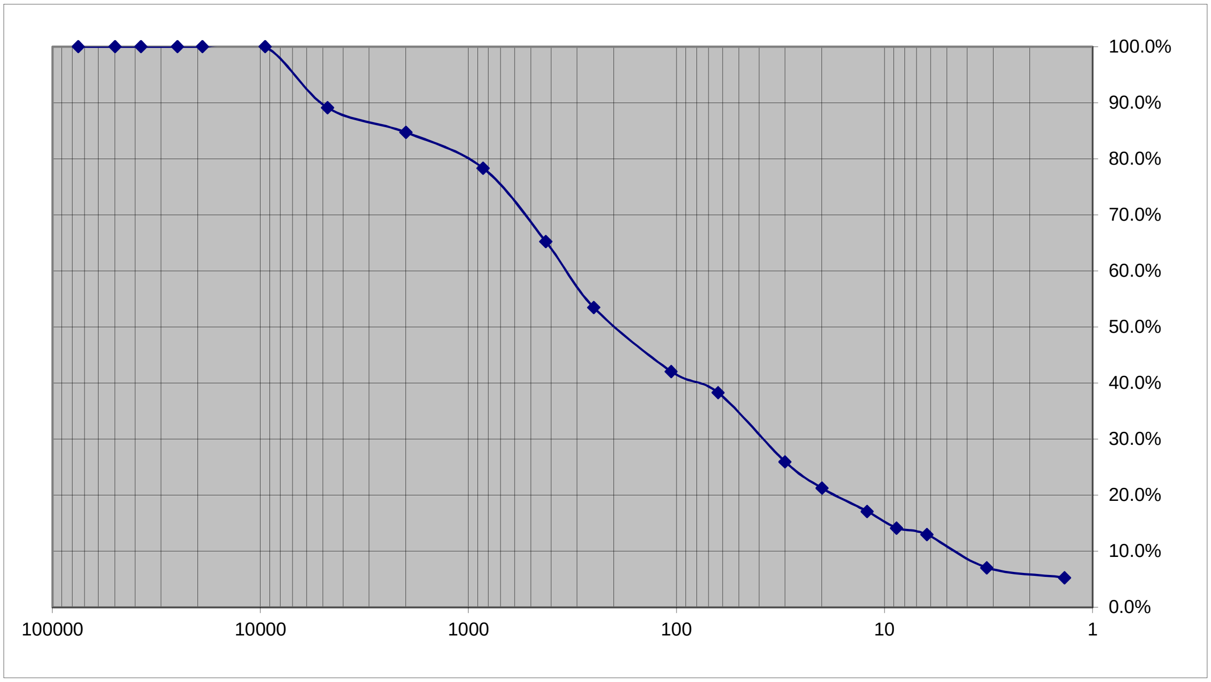
Grain Size ASTM D422

320-18842-C-3

Largest Partical Size #4

Partical size	Partical Size	Percent Finer	Incremental Percent
3 inch	75000	100.0%	0.0%
2 inch	50000	100.0%	0.0%
1.5 inch	37500	100.0%	0.0%
1 inch	25000	100.0%	0.0%
3/4 inch	19000	100.0%	0.0%
3/8 inch	9500	100.0%	0.0%
#4	4750	89.1%	10.9%
#10	2000	84.7%	4.4%
#20	850	78.3%	6.4%
#40	425	65.3%	13.1%
#60	250	53.5%	11.8%
#140	106	42.1%	11.4%
#230	63	38.3%	3.8%
Hydrometer	30	26.0%	12.3%
Hydrometer	20	21.3%	4.7%
Hydrometer	12	17.1%	4.1%
Hydrometer	9	14.2%	3.0%
Hydrometer	6	13.0%	1.2%
Hydrometer	3	7.1%	5.9%
Hydrometer	1	5.3%	1.8%

Soil Clasification Percent	320-18842-C-3
Gravel	10.9%
Sand	50.8%
Corse Sand	4.4%
Medium Sand	19.5%
Fine Sand	27.0%
Silt	25.3%
Clay	13.0%



Appendix A2: Habitat Design

Northern Hydrology and Engineering
P.O. Box 2515, McKinleyville, CA 95519
Telephone: (707) 839-2195; email: nhe@northernhydrology.com
Engineering – Hydrology – Stream Restoration – Water Resources

Date: 12 March 2018

Mary Burke, North Coast Region Program Coordinator
California Trout, Inc.
PO Box 715
Arcata, CA 95518

Re: Final Design Submittal for the Mad River Estuary Restoration Off-channel Habitat Designs

Dear Ms. Burke:

Northern Hydrology & Engineering has greatly enjoyed working with you and CalTrout's staff to complete the engineering designs for the Mad River Estuary Restoration: Off-channel Habitat. Enclosed are final designs, technical specifications, and the engineer's opinion of probable construction costs. Technical specifications include provisions for site clearing, earth moving and large wood placement. Not included are procurement and general specifications, which should be prepared as part of the bid documents. After the environmental compliance documents have been prepared and approved, these technical specifications will need to be updated for concurrence. Some unknowns remain in these designs, that need to be resolved during the next phase of the project, prior to preparing bid documents and hiring a contractor. Primarily, on-site cut volumes exceed fill volumes within the project (Table 1).

Table 1. Construction Area and Composition Cut and Fill Volumes

Construction Area	Estimated Material Type	On-site Cut (CY)	Fill Location	On-site Fill (CY)
Pond	Levee	4,100	Future Trail Base	900
			Pond Revegetation Areas	1,000
			To Be Hauled Off-site	2,200
	Topsoil	4,800	Pasture Stockpile Area	4,800
	Silt, Sand and Gravel	2,400	Road Surface	2,400
	Gravel with Sand	4,800	To be Hauled Off-site	4,800
Channel	Topsoil	3,200	Pond Revegetation Areas	1,700
			To be Hauled Off-site	1,500
	Subsoil (Unknown)	4,400	To be Hauled Off-site	4,400
Total		**23,700**		**23,700**

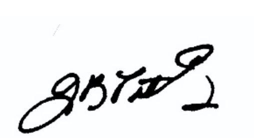
As shown in Table 1 and included in the engineer's opinion of costs, 900 CY of levee material has been earmarked for a future trail base to be placed on the outer edge and east of the existing riparian forest, which has not been confirmed nor included in these final plans. The design team has discussed with the McKinleyville Community Services District (MCSD) the option to spoil this material inside the fenced treated wastewater reclamation area to build up a surface that is currently used for an access road at the perimeter of the field with the intent of using the material to construct a trail in the future. Additional cost savings by placing other material at or near the project site include:

1. Sand and silt from the pond and channel subsoil could potentially be screened and spoiled in MCSD's reclamation areas. In the pond construction area, this could account for up to 2,200 CY. Subsoil composition in the channel area is unknown.
2. Based on two soil cores collected during the installation of monitoring wells located west and north of the existing percolation ponds, a layer of well-graded gravel underlies the subsoil in the pond, located at a depth of approximately 7.5 to 20 FT below ground surface. The soil core was collected near the proposed deep pond excavation. This data suggests that approximately 4,800 CY of well-graded gravel will be excavated as part of this project and could potentially be spoiled on the large gravel bar located along the right bank of the Mad River, upstream of the stormwater canal at the proposed backwater channel confluence.
3. Channel construction area topsoil could potentially be spoiled in MCSD's reclamation areas, which would account for 1,500 CY.

It is also conceivable that a contractor may view some of the material excavated from the project area as a valuable resource that they could potentially reused elsewhere and hauling costs would account for a discounted cost. Materials testing prior to or during construction (as different layers of material are excavated) could characterize the value and reuse potential. A long-term spoiling area has not yet been identified; however, Humboldt County maintains a storage yard off of Highway 299 that may be an option.

I look forward to the next phases of the project. Please contact me with any questions.

Sincerely,



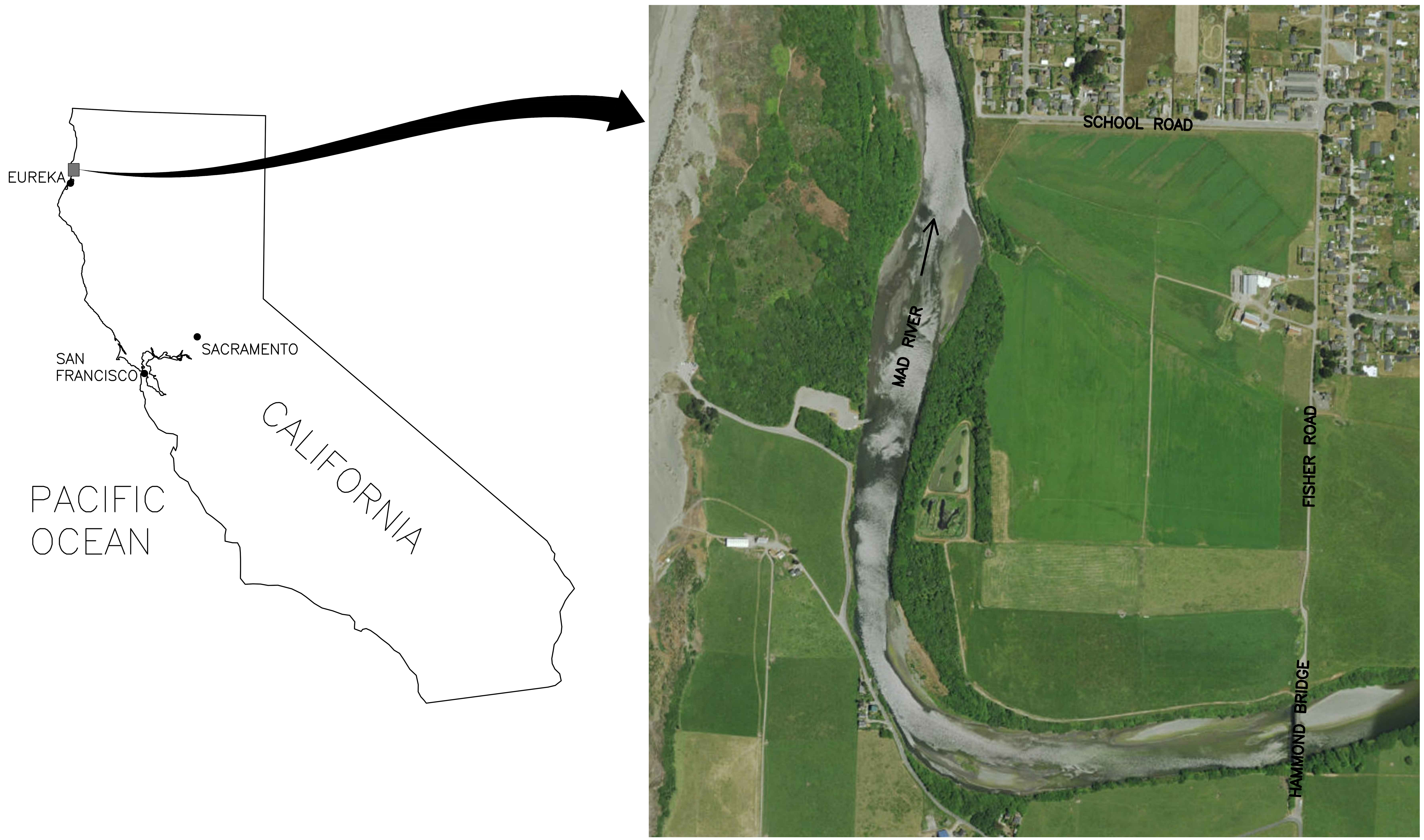
J. Rose Patenaude, PE
Water Resources Engineer

JRP:jka

Enclosures: Final Engineering Design Plans
Technical Specifications
Engineer's Opinion of Probable Costs

Cc: Greg Orsini, MCSD
Chris Ramsey, CDFW
Mark Smelser, CDFW
Michael Bowen, SCC
Bob Pagliuco, NOAA NMFS

MAD RIVER ESTUARY RESTORATION: OFF-CHANNEL HABITAT DESIGNS
HUMBOLDT COUNTY, CALIFORNIA



SHEET INDEX

REGISTERED PROFESSIONAL ENGINEER
JUSTIN ROSE PATENAUDE
No. 65963
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA

Northern Hydrology & Engineering
Engineering - Hydrology - Geomorphology - Water Resources
PO BOX 2515, MCKINLEYVILLE, CA 95519 (707) 839-2195

DESIGNED:	JRP
DRAFTED:	CEP, CP
TECH. REVIEW:	JRP, JKA
DATE:	2/15/2018

SUB SHEET NO. G1

COVER

MAD RIVER FLOODPLAIN RESTORATION
CALTROUT, MCSD, CDFW, SCC

SHEET 1 OF 8

GENERAL NOTES

1. THE LAND OWNER IS THE MCKINLEYVILLE COMMUNITY SERVICES DISTRICT. LAND OWNER CONTACT INFORMATION:

   GREG ORSINI, GENERAL MANAGER
   MCKINLEYVILLE COMMUNITY SERVICES DISTRICT
   P.O. BOX 2037
   MCKINLEYVILLE, CA 95519
   (707) 839-3251

2. THE PROJECT ENGINEER INFORMATION:

   J. ROSE PATENAUDE, P.E.
   NORTHERN HYDROLOGY & ENGINEERING
   P.O. BOX 2515
   MCKINLEYVILLE, CA 95519
   707-839-2195

3. THESE PLANS REPRESENT THE WORK TO BE PERFORMED FOR THE MAD RIVER ESTUARY RESTORATION & OFF-CHANNEL HABITAT PROJECT.

4. ALL IMPROVEMENTS SHALL BE ACCOMPLISHED UNDER THE APPROVAL, INSPECTION AND TO THE SATISFACTION OF THE OWNER OR OWNER'S REPRESENTATIVE, AND PROJECT ENGINEER. ALL OF THE CONSTRUCTION IMPROVEMENTS SHALL COMPLY WITH THESE PLANS, SPECIFICATIONS AND NOTES.

5. SHOULD IT APPEAR THAT THE WORK TO BE DONE, OR ANY MATTER RELATIVE THERETO, IS NOT SUFFICIENTLY DETAILED OR EXPLAINED ON THESE PLANS, THE CONTRACTOR SHALL CONTACT THE PROJECT ENGINEER RESPONSIBLE FOR THE PLAN PREPARATION BEFORE CONDUCTING WORK ON THAT PORTION OF THE PROJECT.

6. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY UNDERGROUND SEARCH ALERT (USA) PRIOR TO THE COMMENCEMENT OF WORK TO VERIFY THE LOCATION OF UNDERGROUND UTILITIES WITHIN THE PROJECT AREA.

7. THE LOCATION OF ANY UTILITIES SHOWN ON THESE PLANS IS APPROXIMATE AND FOR INFORMATION ONLY. THE LOCATION, TYPE, SIZE AND/OR DEPTH INDICATED WERE OBTAINED FROM SOURCES OF VARYING RELIABILITY. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE ACTUAL LOCATION, TYPE, SIZE AND/OR DEPTH PRIOR TO PERFORMING ANY EXCAVATION OR OTHER WORK CLOSE TO ANY UNDERGROUND PIPELINE, CONDUIT, DUCTS, WIRE, STRUCTURE OR OTHER UTILITIES SUBJECT TO CONCERNS FOR SAFETY, DISPLACEMENT, AND/OR DAMAGE BY REASONS OF THEIR OPERATIONS.

8. CONSTRUCTION HOURS SHALL BE MONDAY THROUGH SATURDAY BETWEEN 7:00 A.M. AND 7:00 P.M. UNLESS PRIOR APPROVAL IS RECEIVED FROM THE CONSULTANT TEAM.

9. THE CONTRACTOR SHALL AGREE TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY, AND FURTHER AGREES THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS IN ACCORDANCE WITH THE PROVISIONS OUTLINED BY THE PROJECT CONTRACT.

10. IT IS THE RESPONSIBILITY OF THE CONTRACTOR AND HIS/HER SUBCONTRACTOR(S) TO EXAMINE THE PROJECT SITE PRIOR TO THE COMMENCEMENT OF WORK. THE CONTRACTOR SHALL BECOME FAMILIAR WITH THE CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED, SUCH AS THE NATURE AND LOCATION OF THE WORK AND THE GENERAL AND LOCAL CONDITIONS, PARTICULARLY THOSE AFFECTING THE AVAILABILITY OF TRANSPORTATION, ACCESS TO AND FROM THE SITE, THE DISPOSAL, HANDLING, AND STORAGE OF MATERIALS, AVAILABILITY OF LABOR, WATER, ELECTRICITY, ROADS, THE UNCERTAINTIES OF WEATHER, THE CONDITIONS OF THE GROUND, SURFACE AND SUBSURFACE MATERIALS, THE EQUIPMENT AND FACILITIES NEEDED PRIMARILY FOR AND DURING THE PERFORMANCE OF THE WORK, AND THE COSTS THEREOF. ANY FAILURE BY THE CONTRACTOR AND SUBCONTRACTOR(S) TO ACQUAINT HIMSELF WITH ALL THE AVAILABLE INFORMATION WILL NOT RELIEVE HIM FROM RESPONSIBILITY FOR PROPERLY ESTIMATING THE DIFFICULTY AND COST OF SUCCESSFULLY PERFORMING THE WORK.

11. THE CONTRACTOR SHALL MAINTAIN A SET OF PLANS ON THE JOB SHOWING "AS-CONSTRUCTED" CHANGES MADE TO DATE. UPON COMPLETION OF THE PROJECT, THE CONTRACTOR SHALL SUPPLY TO THE OWNER, OWNER'S REPRESENTATIVE, OR PROJECT ENGINEER A SET OF PLANS, MARKED UP TO THE SATISFACTION OF THE CONSULTANT TEAM, REFLECTING THE AS-CONSTRUCTED MODIFICATIONS.

12. ALL REVISIONS TO THESE PLANS MUST BE MADE BY THE PROJECT ENGINEER RESPONSIBLE FOR THE PLAN PREPARATION, AND SHALL ACCURATELY BE SHOWN ON REVISED PLANS.

13. COPIES OF ALL ENVIRONMENTAL PERMITS WILL BE PROVIDED TO THE CONTRACTOR, AND MUST BE KEPT ON-SITE AT ALL TIMES DURING CONSTRUCTION. THE CONTRACTOR SHALL OBTAIN AT HIS/HER OWN EXPENSE ALL PERMITS, LICENSES, INSURANCE POLICIES, ETC., NOT ALREADY OBTAINED BY THE CONSULTANT TEAM, AS MAY BE NECESSARY TO COMPLY WITH STATE AND LOCAL LAWS ASSOCIATED WITH THE PERFORMANCE OF THE WORK. CONTRACTOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS.

14. UNLESS NOTED OTHERWISE ON THE PLANS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL EXISTING SURVEY MONUMENTS AND OTHER SURVEY MARKERS IDENTIFIED IN THESE PLANS.

15. THE CONTRACTOR SHALL PROVIDE, PLACE, AND MAINTAIN ALL LIGHTS, SIGNS, BARRICADES, FLAG PERSONS, PILOT CAR, OR OTHER DEVICES NECESSARY TO CONTROL TRAFFIC THROUGH THE CONSTRUCTION AREA AND FOR PUBLIC SAFETY IN ACCORDANCE WITH THESE PLANS, THE STANDARD SPECIFICATIONS AND CHAPTER 5 OF THE STATE TRAFFIC MANUAL, "MANUAL OF TRAFFIC CONTROLS."

16. THE CONTRACTOR SHALL USE ONLY DESIGNATED SPECIFIC SITES FOR STORAGE OF EQUIPMENT AND MATERIALS AS SHOWN ON THESE PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SECURITY OF ALL EQUIPMENT AND MATERIALS.

17. AT NO TIME SHALL THE CONTRACTOR UNDERTAKE TO CLOSE OFF ANY EXISTING UTILITY LINES OR OPEN VALVES OR TAKE ANY OTHER ACTION WHICH WOULD AFFECT THE OPERATION OF EXISTING WATER OR UTILITY SYSTEMS WITHOUT PRIOR APPROVAL FROM THE OWNER OR OWNER'S REPRESENTATIVE. APPROVAL SHALL BE REQUESTED AT LEAST 48 HOURS IN ADVANCE OF THE TIME THAT THE INTERRUPTION OF THE EXISTING SYSTEM IS REQUIRED. ANY INTERRUPTION OF SERVICE TO UTILITY SERVICES, WHETHER INTENTIONAL OR NOT, MUST BE KEPT TO A MINIMUM TIME PERIOD.

18. THE OWNER, OWNER'S REPRESENTATIVE, OR PROJECT ENGINEER WILL FURNISH THE CONSTRUCTION STAKING TO THE CONTRACTOR.

19. ALL CONTROL STATIONING AND DATA DIMENSIONING ARE REFERENCED TO THE CENTERLINE OF THE DESIGN CHANNEL SHOWN UNLESS OTHERWISE NOTED.

20. THE CONTRACTOR SHALL PRESERVE AND PROTECT ALL EXISTING UTILITIES AND IMPROVEMENTS WITHIN AND OUTSIDE THE LIMITS OF THE PROJECT AREA.

21. EQUIPMENT EXCLUSION AREAS SHALL BE CLEARLY FLAGGED BY THE OWNER OR OWNER'S REPRESENTATIVE PRIOR TO CONSTRUCTION TO SERVE AS A BUFFER FOR SENSITIVE SPECIES AND RESOURCES.

22. NO TREES OR WETLAND VEGETATION SHALL BE REMOVED UNLESS THEY ARE SHOWN AND NOTED TO BE REMOVED ON THE PLANS, OR AS DIRECTLY SPECIFIED ON-SITE BY THE OWNER OR OWNER'S REPRESENTATIVE.

23. IF, DURING CONSTRUCTION, ARCHAEOLOGICAL REMAINS ARE ENCOUNTERED, CONSTRUCTION IN THE VICINITY SHALL BE HALTED, AND THE OWNER, OWNER'S REPRESENTATIVE, OR PROJECT ENGINEER SHALL BE NOTIFIED IMMEDIATELY.

24. THE CONTRACTOR SHALL COORDINATE THE WORK WITH OTHERS AT THE LIMITS OF THE CONSTRUCTION LINES SHOWN IN THESE PLANS.

25. EROSION CONTROL STRUCTURES SHALL CONTAIN AND CONTROL EROSION AND PROVIDE FOR THE SAFE DISCHARGE OF SILT-FREE RUNOFF FROM THE PROJECT SITE INTO RECEIVING WATER BODIES. SUITABLE SUPPLIES FOR MITIGATING SEDIMENT IMPACTS TO ONSITE WATERWAYS SHALL BE MAINTAINED AT THE PROJECT SITE BY THE CONTRACTOR DURING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING ALL TEMPORARY EROSION CONTROL MEASURES. THE EROSION CONTROL MEASURES SHALL BE IN ACCORDANCE WITH THESE PLANS, THE STANDARD SPECIFICATIONS, LOCAL, COUNTY AND STATE ORDINANCES, AND APPLICABLE PERMIT REQUIREMENTS. THE CONTRACTOR SHALL CONTACT THE OWNER, OWNER'S REPRESENTATIVE, OR PROJECT ENGINEER PRIOR TO THE COMMENCEMENT OF WORK FOR A PRE-GRADING INSPECTION OF THE INSTALLED TEMPORARY EROSION CONTROL FACILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE AND PERFORMANCE OF THE TEMPORARY EROSION CONTROL MEASURES THROUGHOUT THE DURATION OF THE PROJECT.

26. THE CONTRACTOR SHALL KEEP ALL AREAS GENERATING DUST WELL WATERED DURING THE TERM OF THIS CONTRACT. THIS INCLUDES, BUT IS NOT LIMITED TO ACCESS RAMPS, ROADS, FILL AREAS AND ANY OTHER AREAS THAT MAY GENERATE DUST AS A RESULT OF THE CONTRACTOR'S OPERATIONS.

27. NONE OF THE NOTES, OR CONSTRUCTION DRAWINGS SHALL PRECLUDE THE CONTRACTOR FROM SUBSTITUTION OF MATERIALS OR PRACTICES NECESSARY TO COMPLETE THE PROJECT IN A TIMELY AND ECONOMICAL MANNER. ANY SUBSTITUTION OR FORGONE INSPECTIONS WITHOUT THE EXPLICIT CONSENT OF THE OWNER, OWNER'S REPRESENTATIVE, OR PROJECT ENGINEER BECOME THE RESPONSIBILITY OF THE CONTRACTOR. WHERE THE SPECIFICATIONS, NOTES, OR CONSTRUCTION DRAWINGS ARE NOT CONSISTENT WITH LOCAL REGULATIONS, AN EXPLICIT RECONSIDERATION OF PLANS AND SPECIFICATIONS BY THE CONSULTANT TEAM IS REQUIRED PRIOR TO ENACTMENT OF ANY CHANGES.

DISCLAIMERS

1. THE PROJECT ENGINEER RESPONSIBLE FOR PREPARATION OF THESE PLANS AND SPECIFICATIONS WILL NOT BE RESPONSIBLE FOR, OR LIABLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PROJECT ENGINEER RESPONSIBLE FOR PREPARATION OF THESE PLANS.

TOPOGRAPHY NOTES

1. BEARINGS, DISTANCES AND COORDINATES FOR THESE PLANS ARE BASED ON THE CALIFORNIA STATE PLANE ZONE 1 NORTH AMERICAN DATUM OF 1983 (NAD83), US FOOT.
2. VERTICAL DISTANCE FOR THESE PLANS IS BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1988 (NAVD88), US FOOT.
3. TOPOGRAPHY FOR THESE PLANS WAS A COMBINATION OF:
   * 2010/2011 COASTAL LIDAR (NOAA 2012)
   * 2008 CHANNEL CROSS-SECTIONS SURVEYED BY POINTS WEST SURVEYING AS PART OF THE HUMBOLDT COUNTY MAD RIVER BLUFF RESTORATION PROJECT
   * 2013 RIVER BATHYMETRY MEASURED BY GRAHAM MATTHEWS & ASSOCIATES AFTER THE MAD RIVER BLUFF RESTORATION PROJECT WAS IMPLEMENTED
   * ADDITIONAL TOPOGRAPHY WAS COLLECTED BY NHE WITH A SURVEYING TOTAL STATION UNDER THE SUPERVISION OF THE PROJECT ENGINEER
4. ALL CONTOURS ILLUSTRATED IN THESE PLANS ARE AT AN INTERVAL OF 1.0 FEET.

PROJECT TOTAL CUT/FILL VOLUMES AND AREAS

LOCATION	GRADING AREA (AC)	CUT (CY)	FILL (CY)
POND TOP SOIL REMOVAL (TO BE SCREENED AND STOCKPILED)	2.87	4,800	4,800
LEVEE REMOVAL, POND (BELOW TOP SOIL), AND WETLANDS	3.92	11,100	2,700
NORTH AND SOUTH ROAD SURFACES	1.74	0	2,400
BACKWATER CHANNELS	1.28	7,700	0
TO BE HAULED OFF-SITE	N/A	0	13,700
PROJECT TOTAL	**6.95**	**23,600**	**23,600**

REGISTERED PROFESSIONAL ENGINEER
JUSTICE ROSE PATENAUDE
No. 65963
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA

Northern Hydrology & Engineering

DESIGNED: JRP
DRAFTED: CEP, CP
TECH. REVIEW: JRP, JKA
DATE: 2/15/2018

SUB SHEET NO. G2

NOTES

MAD RIVER FLOODPLAIN RESTORATION
CALTROUT, MCSD, CDFW, SCC

LEGEND

- EXISTING CONTOUR (2 FT)
- GRADING BOUNDARY
- CONSTRUCTION BOUNDARY
- ACCESS ROAD
- MONITORING WELL (MW)
- CONTROL POINT (CP#)

SURVEY NOTES

SURVEY BY POINTS WEST SURVEYING CO., JANUARY, 2016. CORRECTED APRIL, 2016. BASIS OF COORDINATES AND ELEVATIONS:

1. HORIZONTAL DATUM IN NAD83, CALIFORNIA STATE PLANE ZONE 1 (FEET), 2007.0 EPOCH, BASED ON GPS TIES TO THE HPGN CA 0109 AT VISTA POINT.
2. VERTICAL DATUM IS NAVD88 (FEET) BASED ON THE VISTA POINT HPGN NOTED IN (1), HELD AT AN ELEVATION OF 118.21 FEET AS DETERMINED BY THE "CITY OF EUREKA AND HUMBOLDT COMMUNITY SERVICES DISTRICT 2000 GPS CONTROL SURVEYS FOR GIS" BY MCGEE SURVEYING CONSULTING AND OSCAR LARSON AND ASSOCIATES.
3. THIS IS NOT A BOUNDARY SURVEY. PARCEL LINES ARE NOT SHOWN. NO EASEMENTS HAVE BEEN LOCATED OR VERIFIED FROM ANY RECORD SOURCES.
4. THE FOLLOWING CONTROL POINTS WERE ESTABLISHED:

CP#	NORTHING	EASTING	ELEVATION	DESCRIPTION
CP1	2230618.231	5974191.543	38.76	CP_MAG_TRAIL
CP2	2230450.93	5974067.244	35.06	CP_SCRIBE_X_#1060
CP3	2230382.895	5973904.094	24.35	CP_SCRIBE_X_#1062
CP4	2228840.942	5973877.931	15.33	CP_RBR_PP_#151229117
CP5	2228451.658	5973641.958	16.69	CP_RBR_PP_#151229146
CP6	2228121.576	5973741.306	14.08	CP_ALCAP_TOP_NOID_#151229149

150 0 150 300
SCALE OF FEET

REGISTERED PROFESSIONAL ENGINEER
JUSTICE ROSE PATENAUDE
No. 65963
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA

Northern Hydrology & Engineering

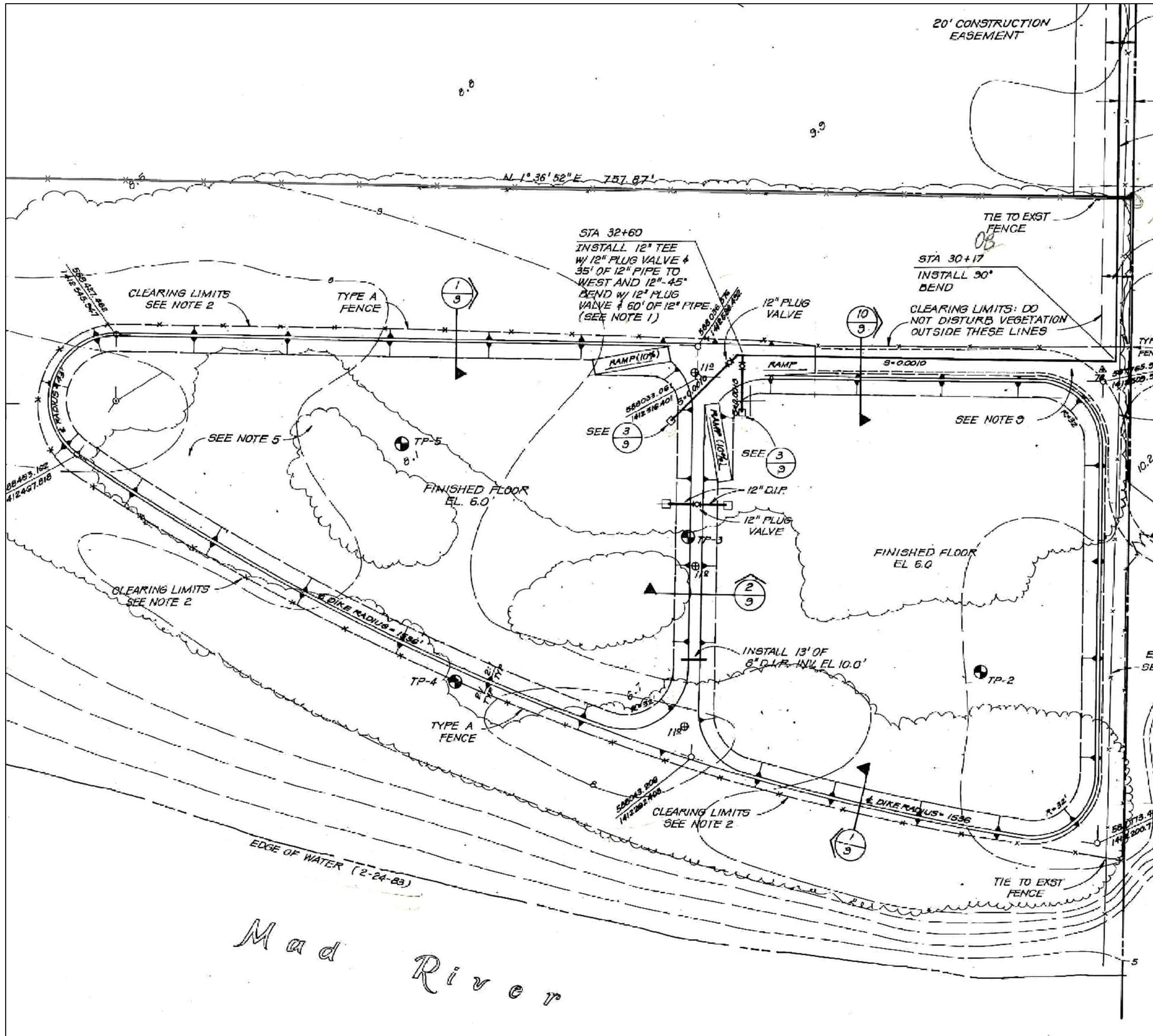
DESIGNED:	JRP
DRAFTED:	CEP, CP
TECH. REVIEW:	JRP, JKA
DATE:	2/6/2018

SUB SHEET NO. C1

SITE PLAN
OVERVIEW
MAD RIVER FLOODPLAIN RESTORATION

CALTROUT, MCSD, CDFW, SCC

SHEET 3 OF 8

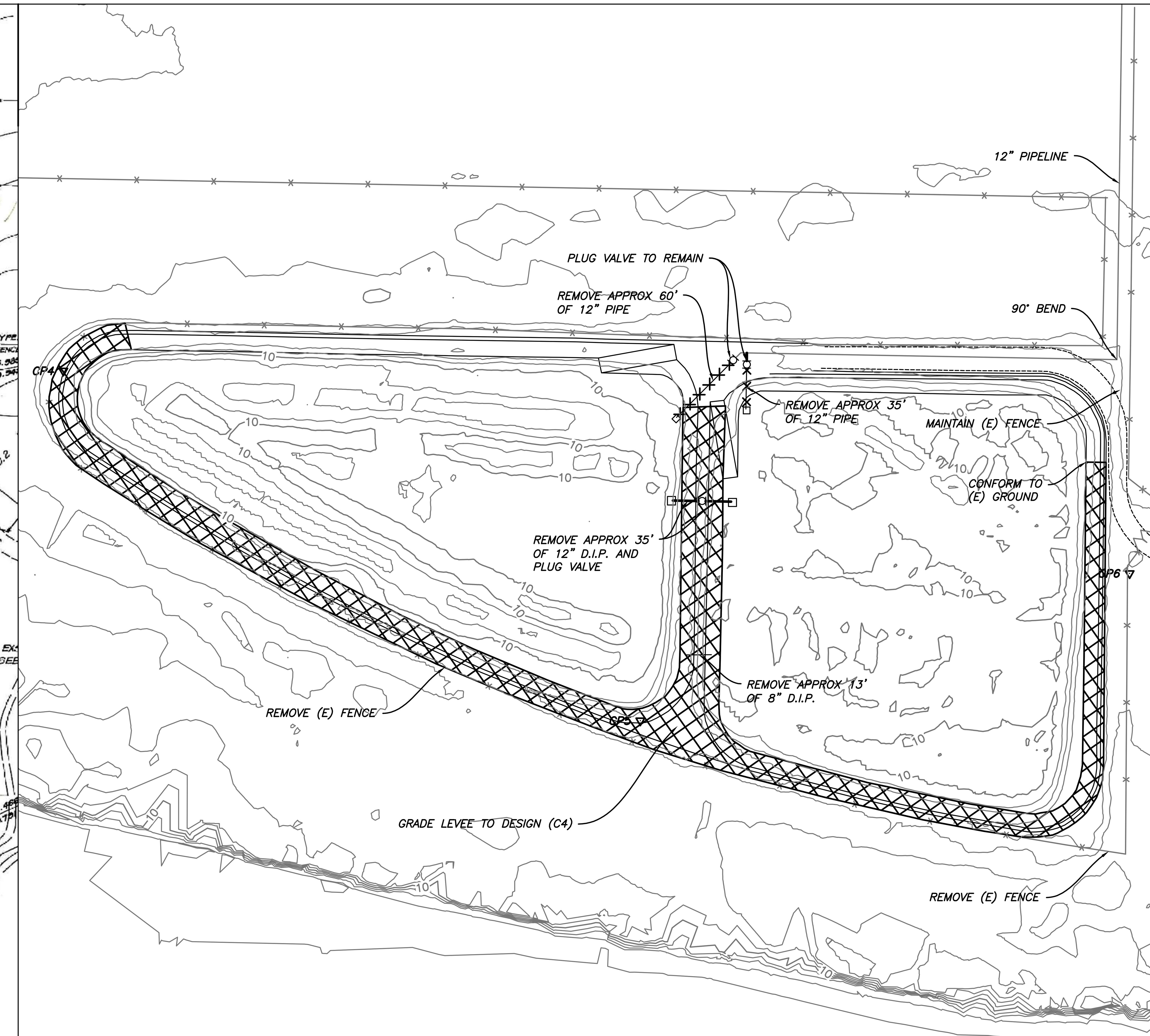


PERCOLATION PONDS DESIGN

WINZLER & KELLY, 3/8/83

NOTE:

ELEVATIONS ASSUMED TO BE REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929.



LEGEND

EXISTING CONTOUR (2 FT)

50 0 50 100

SCALE OF FEET

REGISTERED PROFESSIONAL ENGINEER
JUSTICE ROSE PATENAUDE
No. 65963
Exp. 6/30/18
CIVIL
STATE OF CALIFORNIA

Northern Hydrology & Engineering	DESIGNED: JRP DRAFTED: CEP, CP, BD TECH. REVIEW: JRP, JKA DATE: 2/15/2018	SUB SHEET NO. C2	DEMOLITION PLAN OVERVIEW MAD RIVER FLOODPLAIN RESTORATION CALTROUT, MCSD, CDFW, SCC	SHEET 4 OF 8

LONGITUDINAL PROFILE
5H:1V

40 0 40 80
FEET

REGISTERED PROFESSIONAL ENGINEER JUSTICE ROSE PATENAUDE No. 65963 Exp. 6/30/18 CIVIL STATE OF CALIFORNIA

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DATE: 2/6/2018

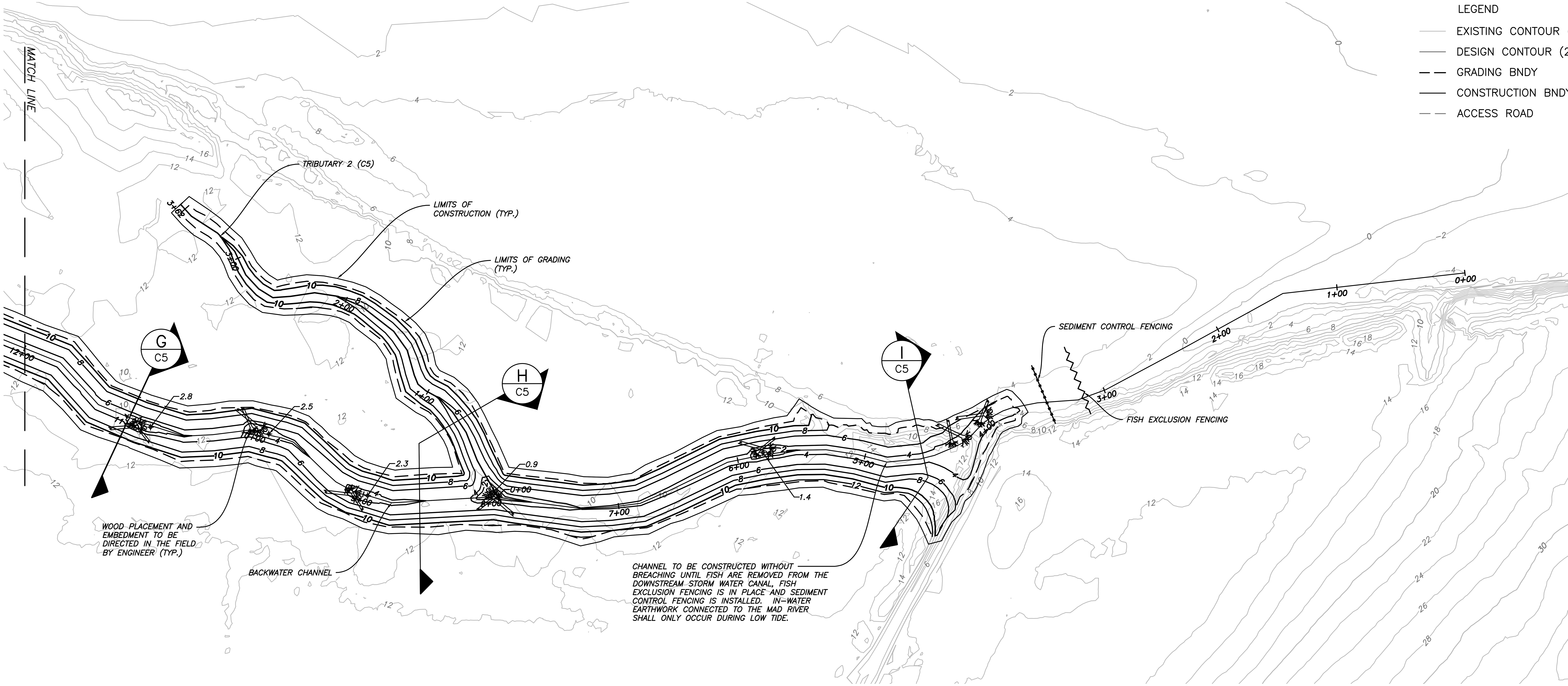
SUB SHEET NO. C3

GRADING PLAN AND PROFILE
STATIONS 12+00 TO 24+00
MAD RIVER FLOODPLAIN RESTORATION
CALTROUT, MCSD, CDFW, SCC

SHEET 5 OF 8

LEGEND

- EXISTING CONTOUR (2 FT)
- DESIGN CONTOUR (2 FT)
- GRADING BNDY
- CONSTRUCTION BNDY
- ACCESS ROAD



LONGITUDINAL PROFILE

5H:1V

40 0 40 80

FEET

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STATE OF CALIFORNIA

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TECH. REVIEW: JRP, JKA

DATE: 2/6/2018

SUB SHEET NO. C4

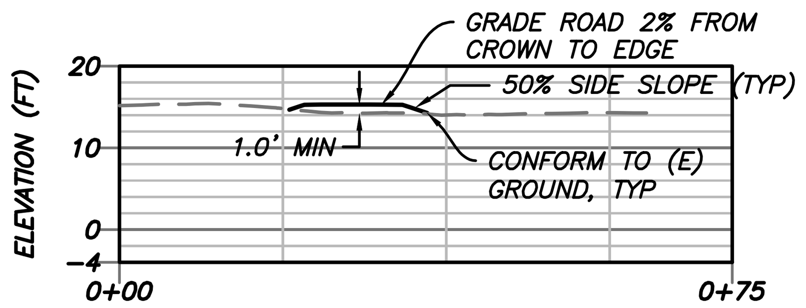
GRADING PLAN AND PROFILE

STATIONS 0+00 TO 12+00

MAD RIVER FLOODPLAIN RESTORATION

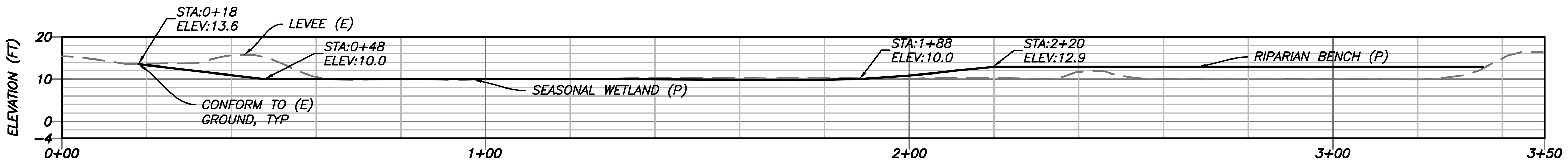
CALTROUT, MCSD, CDFW, SCC

SHEET 6 OF 8

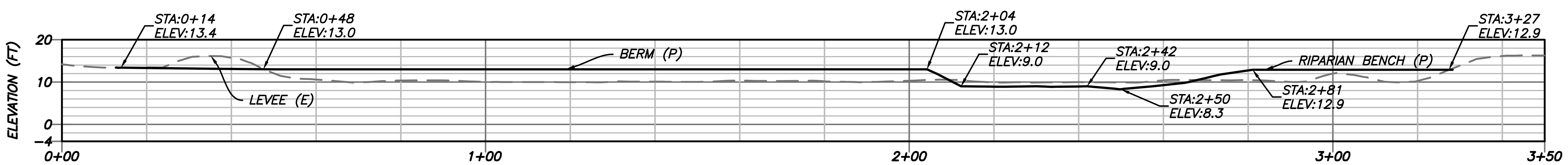


SECTION A C3
(TYPICAL ROAD CROSS-SECTION)

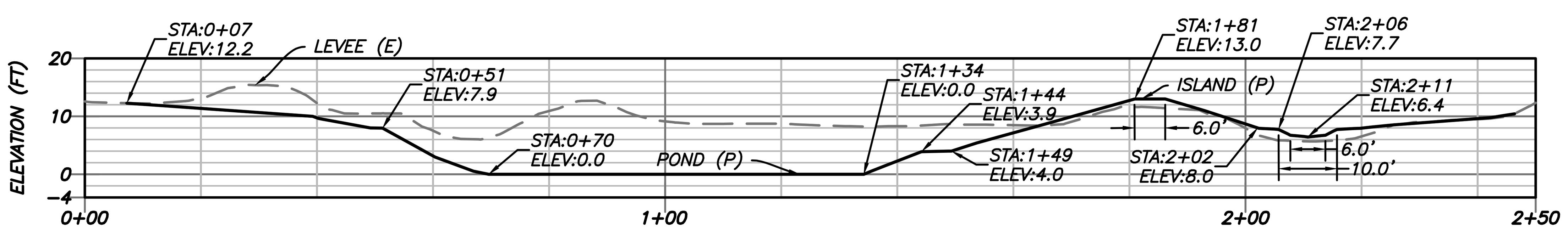
NOTE:
1. ROAD CONSTRUCTION DETAILS AND COMPACTION SPECIFICATIONS TO BE DESIGNED BY OTHERS.



SECTION B C3
(STATION 21+80)

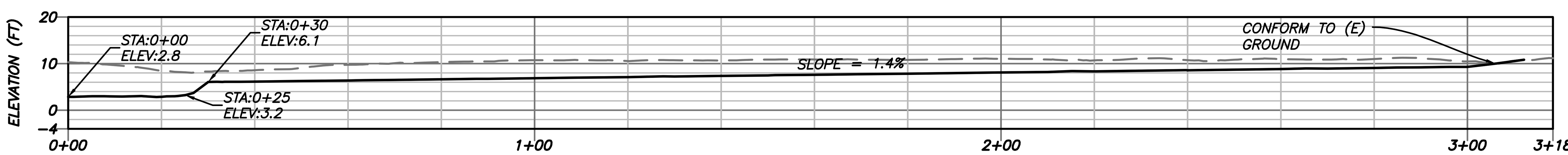


SECTION C C3
(STATION 20+40)

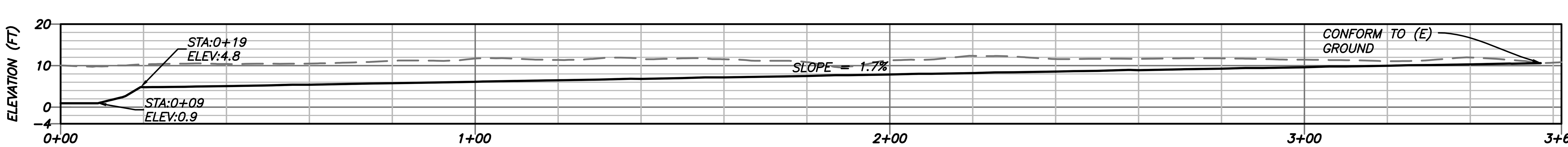


SECTION D C3
(STATION 18+61)

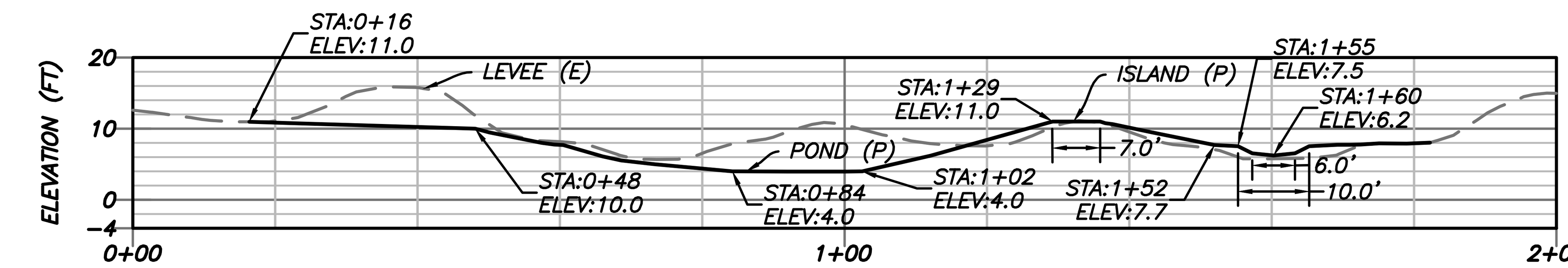
NOTES:
1. CHANNEL BOTTOM GRADES TOWARDS CHANNEL CENTER AT 10% SLOPES (TYP).
2. CHANNEL BANKS GRADE AT 50% SLOPES.



TRIBUTARY PROFILE 1 C3
(CONFLUENCE AT BACKWATER CHANNEL STATION 12+50)

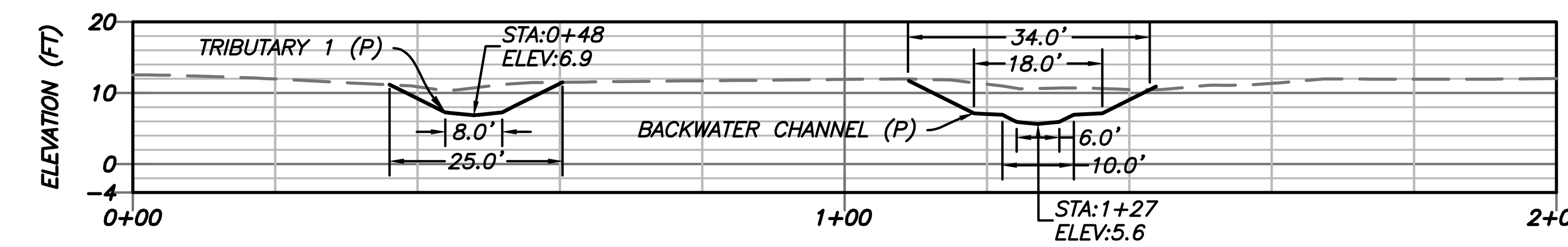


TRIBUTARY PROFILE 2 C4
(CONFLUENCE AT BACKWATER CHANNEL STATION 8+00)



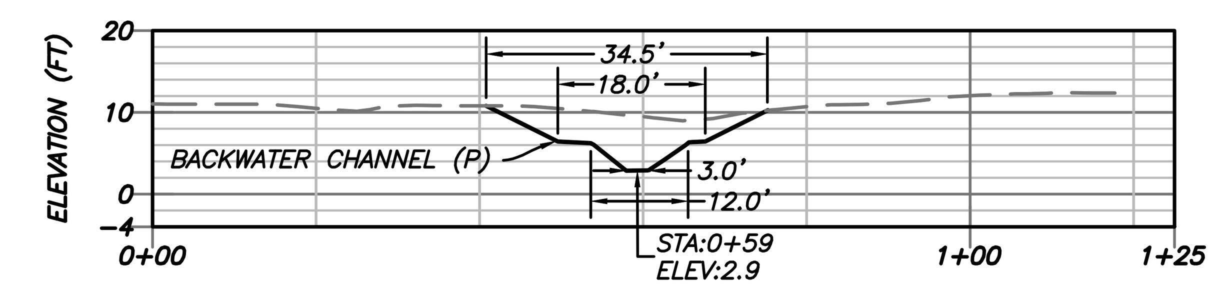
SECTION E C3
(STATION 17+00)

NOTES:
1. CHANNEL BOTTOMS AND BENCHES GRADE TOWARDS CHANNEL CENTER AT 10% SLOPES (TYP).
2. CHANNEL BANKS GRADE AT 50% SLOPES.



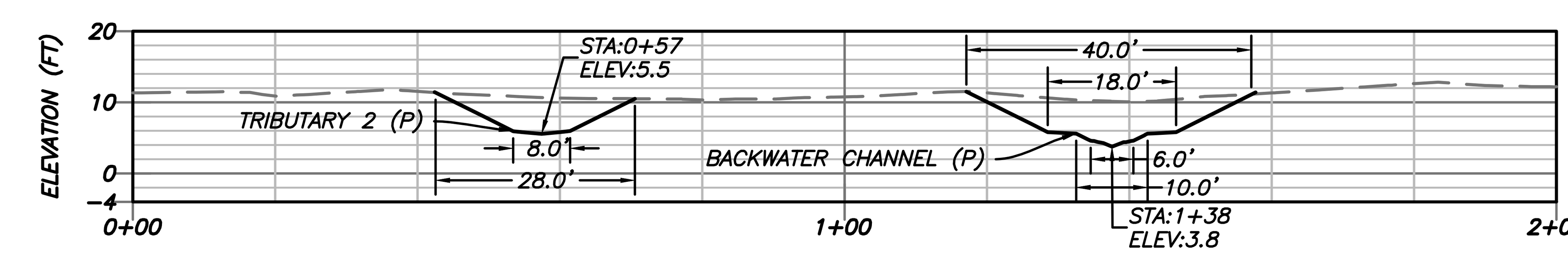
SECTION F C3
(STATION 13+58)

NOTES:
1. CHANNEL BOTTOMS AND BENCHES GRADE TOWARDS CHANNEL CENTER AT 10% SLOPES (TYP).
2. CHANNEL BANKS GRADE AT 50% SLOPES.



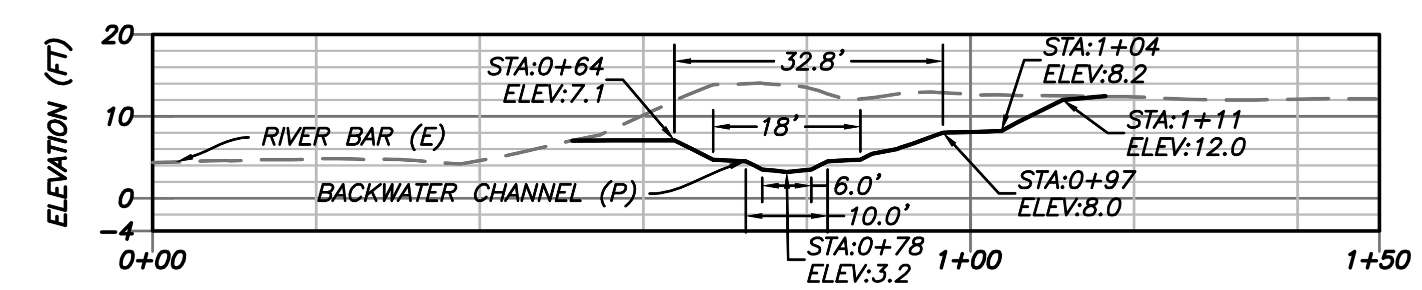
SECTION G C4
(STATION 11+00)

NOTES:
1. CHANNEL POOL BOTTOMS ARE FLAT ACROSS SECTIONS.
2. CHANNEL BENCHES GRADE TOWARDS CHANNEL CENTER AT 10% SLOPES (TYP).
3. CHANNEL BANKS GRADE AT 50% SLOPES.



SECTION H C4
(STATION 8+56)

NOTES:
1. CHANNEL BOTTOMS AND BENCHES GRADE TOWARDS CHANNEL CENTER AT 10% SLOPES (TYP).
2. CROSS-SECTION H SHOWS BACKWATER CHANNEL CROSSING POOL TAILOUT.
3. CHANNEL BANKS GRADE AT 50% SLOPES.



SECTION I C4
(STATION 4+53)

NOTES:
1. CHANNEL BOTTOMS AND BENCHES GRADE TOWARDS CHANNEL CENTER AT 10% SLOPES (TYP).
2. CHANNEL BANKS GRADE AT 50% SLOPES.

LEGEND
— — EXISTING GROUND
—— DESIGN GROUND

20 0 20 40
FEET

1H:1V

REGISTERED PROFESSIONAL ENGINEER
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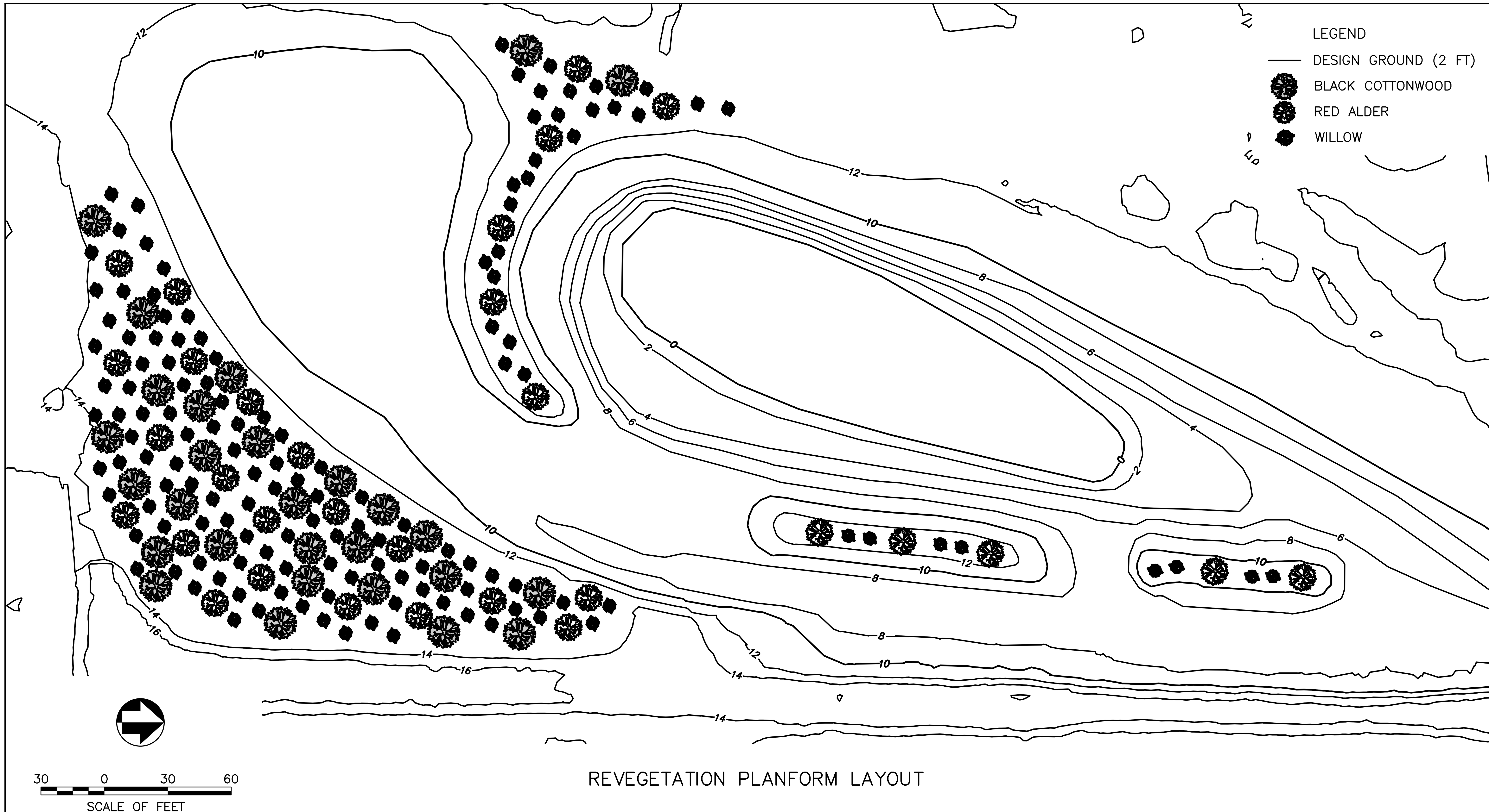
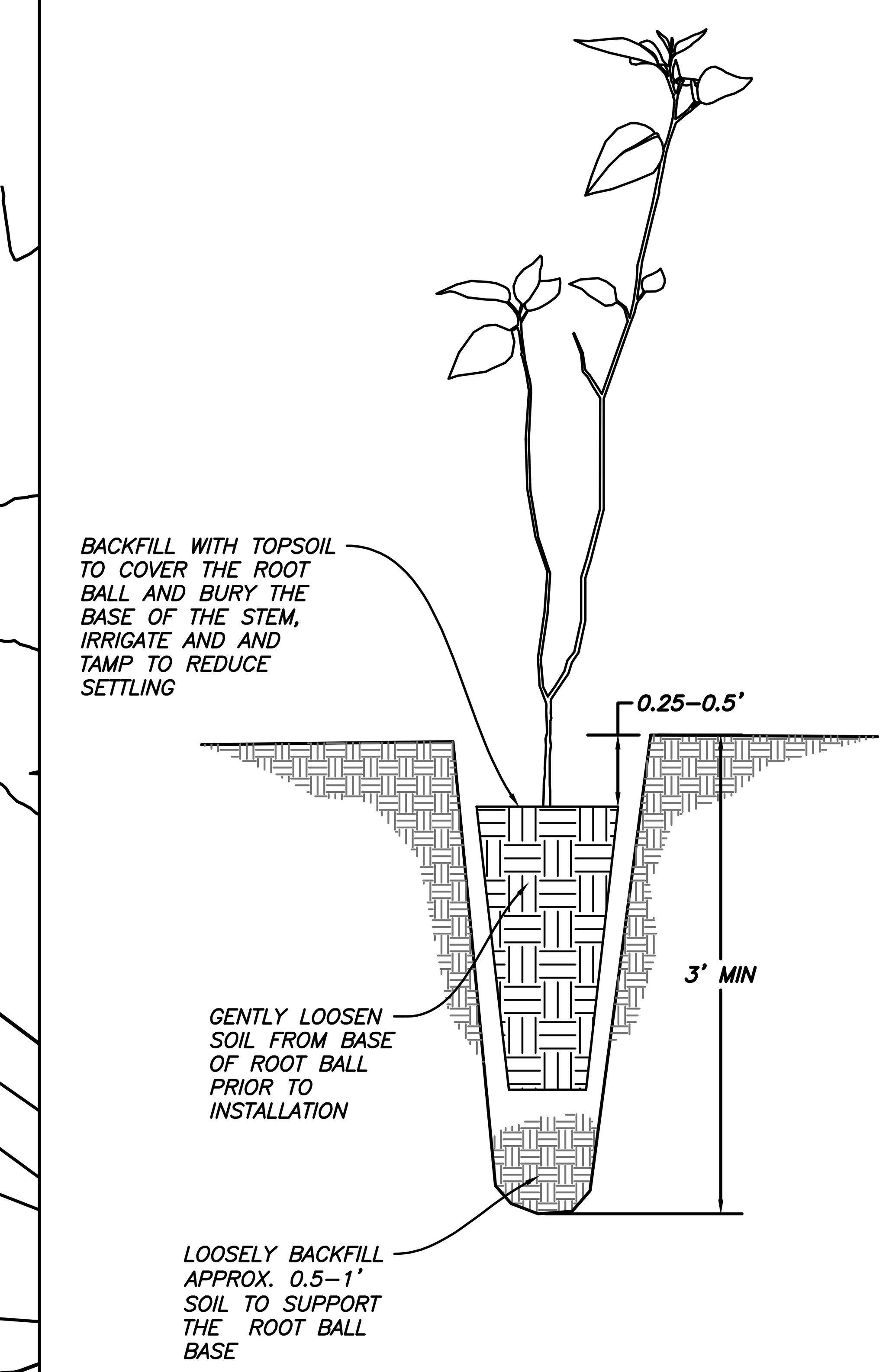
CIVIL
STATE OF CALIFORNIA

Northern Hydrology & Engineering

DESIGNED: JRP	SUB SHEET NO.	PROFILES	SHEET
DRAFTED: CEP, CP	C5	CROSS-SECTIONS AND TRIBUTARIES	7
TECH. REVIEW: JRP, JKA		MAD RIVER FLOODPLAIN RESTORATION	OF
DATE: 2/15/2018		CALTROUT, MCSD, CDFW, SCC	8



REVEGETATION PLANFORM LAYOUT



TYPICAL TREE PLANTING DETAIL
NTS

REGISTERED PROFESSIONAL ENGINEER
JUSTICE ROSE PATENAUDE
No. 65963
EXP______
CIVIL
STATE OF CALIFORNIA

Northern Hydrology & Engineering

DESIGNED: JRP DRAFTED: CEP, CP TECH. REVIEW: JRP, JKA DATE: 6/21/2017	SUB SHEET NO. C6	DESIGN DETAILS MAD RIVER FLOODPLAIN RESTORATION CALTROUT, MCSD, CDFW, SCC	SHEET 8 OF 8

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Clearing and grubbing
   2. Large tree harvesting for reuse
   3. Removal of trash and debris

1.2 LIMITATIONS

A. Environmental compliance permit requirements shall supersede these Specifications.

1.3 PROJECT CONDITIONS

A. Pond and Channel Construction Areas

   1. These Specifications designate pond and channel construction areas, which are delineated by the outside edge of the northern boundary of the existing levee, roughly at the backwater channel alignment Station 15+00.

1.4 SEQUENCING AND SCHEDULING

A. Prior to site clearing and grubbing, provide at least 48 HR advanced notice for Engineer or their representative to flag trees to be harvested for reuse.

B. Prior to site clearing and grubbing the channel construction area, stake out the backwater channel alignment and the extents of channel grading and provide at least 48 HR advanced notice for Engineer or their representative to review and approve.

C. Clearing and grubbing within the pond construction area may occur at a different time in the construction sequence as clearing and grubbing within the channel construction area. See Section 312000 – Earth Moving for recommended construction sequencing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Trees Harvested for Reuse

   1. Trees to be reused shall be flagged in the field by the engineer or their representative.
   2. Trees to be reused shall be 12 IN diameter or greater.

B. Other Woody Debris and Vegetation

C. Trash and Debris

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing Save Trees and their roots as specified or flagged on the ground. Provide fencing and necessary protections to avoid impacts.

B. Protect existing trees and other vegetation designated to remain against damage (Save Trees):

1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
2. Avoid foot or vehicular traffic or parking of vehicles within drip line.

C. Repair or replace trees and vegetation designated for protection but damaged by construction operations:

1. Repair to be performed by a qualified arborist.
2. Remove trees which cannot be repaired and restored to full-growth status.
3. Replace with new trees with a minimum 3 IN diameter.
4. Additional mitigation requirements by outside agencies, such as required for removal of protected species, will be at the cost of the Contractor, and no cost shall be accrued by Owner.

D. As feasible, protect existing trees and their roots that are not identified as Save Trees during Earthwork adjacent to the construction area by avoidance or trimming.

E. Protect existing surface and subsurface features on-site and adjacent to site as follows:

1. Protect and maintain surveying benchmarks, monuments or other established reference points and property corners. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agencies.
2. Verify location of utilities. Omission or inclusion of utility items does not constitute non-existence or definite location. Secure and examine local utility records for location data. It is the responsibility of the Contractor to notify Underground Search Alert (USA) prior to the commencement of Work to verify the location of underground utilities within the project area.
   a. Review location of wastewater transmission lines with Owner prior to Work.
   b. Take necessary precautions to protect existing utilities from damage due to any construction activity.
   c. Repair damages to utility items at Contractor’s expense.
   d. In case of damage, notify Owner immediately so required protective measures may be taken.
3. Maintain free of damage any facilities not indicated to be removed. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition. All repairs to be made and paid for by Contractor.
4. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.

F. Salvageable items: carefully remove items to be salvaged, and store on Owner's premises at designated stockpiling locations unless otherwise directed.

G. Dispose of waste materials, legally, off site. Burning as a means of waste disposal is not permitted, unless specified and will require permission from Owner and permits from governing agencies. Burning permits shall be submitted to Owner.

H. Prior to Work within the area that drains into the stormwater canal, temporary fish removal from the stormwater canal will be required and Contractor shall install fish exclusion fencing.

I. Prior to Prior to Work within the area that drains into the stormwater canal, sediment control fencing shall be installed on the upstream,Work-side of the fish exclusion fencing.

J. Sediment control barriers shall be installed in accordance with the current *California Stormwater Best Management Practices Handbook for Construction* and manufacturer's recommendations in the areas of Clearing and Grubbing within drainage to the Mad River or the stormwater canal prior to starting those activities. The sediment control barriers shall be maintained until the soils are stabilized and Work is complete.

K. While conducting Work within the area of the Mad River stormwater canal, Best Management Practices will be employed to minimize erosion of sediment into the stormwater canal. All material eroded into the canal during construction will be removed prior to the removal of either the sediment control or fish exclusion fencing.

L. Contractor shall employ erosion control measures, as described in these Specifications and as required to comply with project permits.

3.2 CLEARING AND GRUBBING

A. Do not disturb Save Trees, which will be flagged on-site, prior to Work.

B. Grub (remove) whole trees marked to harvest for reuse.
    1. Stockpile whole trees with root balls in-tact for reuse. Root systems shall be cleared of soil debris prior to stockpiling for reuse. Tree crowns and branches shall be removed and stockpiled with other woody debris.
    2. No trees will be harvested outside of the construction area.
    3. See Section 353219 – Large Wood Placement for detailed specifications describing the installation of wood habitat structures into the constructed backwater channel and pond.

C. Clear from within limits of construction other woody debris and vegetation not marked to remain.
    1. Other woody debris and vegetation includes trees that remain, shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and other organic debris.
    2. Other woody debris and vegetation that are not designated for protection or reuse within the construction footprint shall be removed and stockpiled in a designated area.
    3. Separately stockpile woody debris from other vegetation if grinding or burning will be used to dispose of the material.
    4. Separately stockpile non-woody organic material removed from pond surfaces.
    5. Separately stockpile invasive species, including but not limited to reed canarygrass and Himalaya blackberry.

6. Woody debris stockpiles shall be disposed of by burning, grinding or hauling off-site, as permitted by the governing agencies and Owner.

D. Grub from within limits of construction all stumps, roots, root mats, logs and debris encountered that are not designated to remain.
   1. Stockpile separately with other woody debris.

E. For erosion control purposes, clearing and grubbing shall not occur more than 15 days in advance of planned construction operations, within 25 feet of the Mad River stormwater canal, unless, specifically approved by the Engineer.

F. Do not bury organic matter on site, unless specifically approved in each case by the Engineer.

3.3 REMOVAL AND DISPOSAL OF TRASH AND DEBRIS

A. Remove and properly dispose of trash and other debris off-site.
   1. "Trash and debris" shall mean asphalt, concrete, pipes, tires, fencing, scrap metals, plastic, and other manmade refuse.
   2. Remove all trash and debris located within the construction limits as delineated on the Drawings.

B. Do not burn combustible materials on site.

C. Asphalt and concrete may be recycled at several local aggregate plants.

3.4 CLEANING

A. Immediately clear, sweep, clean and/or flush existing access roadways and public roadways of any spilled debris and material. Road closures shall not be permitted.

3.5 ACCEPTANCE

A. To ensure compliance with these Specifications and regulatory requirements, obtain Engineer's acceptance of the extent of clearing and grubbing upon completion of the site clearing.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Grading
2. Excavation
3. Fill and Backfill

1.2 LIMITATIONS

A. Environmental compliance permit requirements shall supersede these Specifications.

1.3 QUALITY ASSURANCE AND REFERENCES

A. *Standard Specifications* (State of California Department of Transportation, 2015).

B. *Report on the Suitability of Levee Material for Reuse as Fill* (SHN Consulting Engineers & Geologists, Inc., June 28, 2016).

1.4 PROJECT CONDITIONS

A. Wet Weather Conditions and River Levels

1. Excavating, filling, backfilling, and grading shall not be performed during wet weather conditions that might damage or be detrimental to the condition of existing ground, in-progress work, or completed work. When Work is interrupted by rain, freezing weather, or other conditions deemed unsuitable by the Owner, Engineer or their representative, excavating, filling, backfilling, and grading work shall not resume until the site and soil conditions (moisture content) are suitable for compaction. Compaction requirements necessary for road construction shall be designed by others.
2. The river levels are tidal and can affect the groundwater depths within the work site. Fluctuations in the groundwater levels as the tides change should be expected. Typical dry weather groundwater levels were recorded and may fluctuate between approximately 3.75 and 5 FT elevation. A storm may elevate groundwater levels as the river levels rise. Contractor shall schedule excavations and grading to account for these conditions.

B. Pond and Channel Construction Areas

1. These Specifications designate pond and channel construction areas, which are delineated by the outside edge of the northern boundary of the existing levee, roughly at the backwater channel alignment Station 15+00.
2. Drawings may indicate both existing grade and finished grade required for construction of Project.

1.5 SEQUENCING AND SCHEDULING

A. Excavation within the pond construction area is the deepest and in closest proximity to the Mad River. Groundwater depths are affected by river levels and early season storms may deepen the groundwater, making it more challenging to perform excavation. To minimize seasonal impacts due to weather, it is recommended that the pond excavation be performed as early as possible in the construction schedule.

B. The sequencing and scheduling of construction is the responsibility of Contractor. A recommend construction sequence is:

1. Clearing and grubbing shall be performed in the pond construction area per the requirements of Section 311000 - Site Clearing.
2. Pond topsoil shall be excavated, dried as necessary, screened and stockpiled in the area designated on the Drawings.
3. Levees shall be excavated and infrastructure demolished.
4. Deep pond shall be excavated prior to first rains.
5. Clearing and grubbing shall be performed in the channel construction area per the requirements of Section 311000 - Site Clearing.
6. Channel excavation and grading shall be performed.
7. Large wood placements shall be installed in the channel per the requirements of Section 353219 – Large Wood Placements.
8. Pond grading and backfilling shall be performed.
9. Large wood placements shall be installed in the pond per the requirements of Section 353219 – Large Wood Placements.
10. Road surfaces shall be constructed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. On-Site Cut

1. Material cut on-site to achieve final grades shown on the Drawings will be used to accommodate all fill materials (versus imported topsoil and other fill materials) for construction and to fill in holes in the landscape, except for pond topsoil.
2. On-site cut includes, but is not limited to:
   a. Levee material for use as engineered fill and general fill
   b. Pond topsoil
   c. Pond subsurface materials
   d. Channel topsoil
   e. Channel subsurface materials
3. On-site cut used for general fill shall meet the following criteria:
   a. Material will likely to be heterogeneous and will require mixing, blending, and moisture conditioning to create a material that can be placed and adequately compacted.
   b. Material will likely require aeration prior to reuse.
   c. Stockpiles shall be mixed or blended until the material is uniform in consistency and free of large, unbroken clods of soil.
   d. Clods of soil or rock particles larger than 6 IN diameter should be broken down with heavy equipment or removed during fill placement.

4. Pond topsoil shall be permanently stockpiled within the area designated on the Drawings.
5. Excess cut material can be stored at stockpiling locations, and then hauled off-site.

B. Levee Material for Reuse as Engineered Fill and General Fill

1. Levee material reuse potential was tested and documented by SHN Consulting Engineers & Geologists, Inc. SHN's report supersedes these Specifications.
2. The top 3 FT of levee material may meet the minimum criteria to be considered as select engineered fill.
3. The top 3 FT of levee material consists of rounded, fine to coarse gravel and sand used to armor the levee slope faces.
4. Levee material below the top 3 FT grades finer than the surface material and is not suitable to be used as engineered fill and may be used as general fill.

C. Pond Topsoil

1. Pond topsoil refers to the top layer of soil material within the existing pond levees, not including island surfaces.
2. Pond topsoil primarily consists of silt and sand and may have high concentrations of organic material.
3. Depth and volume of pond topsoil to be removed, screened, and placed at the designated stockpiling area shown on the Drawings will be directed in the field by Engineer or their representative.
4. Prior to stockpiling, pond topsoil material shall be screened to remove all debris, gravel and granular material greater than ½ IN diameter.

D. Pond Subsurface Materials

1. Pond subsurface materials refers all material within the pond construction area remaining after the levee material and pond topsoil have been excavated and removed.
2. To estimate subsurface soil characterization, soil logs documented in SHN's report provide subsurface soil descriptions and depths adjacent to the pond construction area.
3. Pond subsurface material may be used for road fill and general fill within the pond construction area.

E. Channel Topsoil

1. Channel topsoil refers to the top layer of soil material within the channel constructions area that may be rich in organic soil.
2. Depth of channel topsoil is estimated to be 12 IN below the existing ground surface.
3. Channel topsoil shall be cleaned of woody debris and stockpiled within the pond construction area for reuse in the pond revegetation areas.

F. Channel Subsurface Materials

1. Channel subsurface materials refers to all material within the channel construction area remaining after the channel topsoil has been excavated and removed.
2. Channel subsurface materials are undocumented and may consist of silt, sand, gravel, or clay of unknown composition quantities.
3. Excess material shall be stockpiled prior to hauling.

G. Road Fill

1. Road fill refers to material to be used to add to an existing South Access Road and North Access Road.
2. Road material 12 IN below the finished design grade at the center of the road will be composed of existing road material.
3. Road fill added to the existing road surface shall be compacted in 4 to 6 IN lifts.
4. Crown of road shall be composed of levee material for use as engineered fill or pond subsurface material from 12 IN below finished grade to finished grade.
   a. Crown of road shall be finished at design surface elevation.

H. Revegetation Areas Subsurface Fill
   1. Revegetation areas shall be constructed with general fill derived from on-site cut.

I. Revegetation Areas Topsoil Fill
   1. Revegetation topsoil fill material refers to soil material placed from 6 IN feet below finished grade to finished grade, unless otherwise specified.
   2. Revegetation topsoil fill material shall consist of channel topsoil.
   3. Topsoil material is to be ripped 12 IN into the rough graded material creating a 50/50 topsoil/fill material mix.

PART 3 - EXECUTION

3.1 PROTECTION

A. Erosion prevention: protect stockpiles, ditches, stream banks, embankments, filled, backfilled, and graded areas to prevent erosion until such time as permanent drainage and erosion control measures have been installed.

B. Protect graded areas:
   1. Protect Work areas from erosion, foot traffic by workers, equipment, stockpiling or any actions which would compact even minor areas of the surface.
   2. Reshape and re-compact fills subjected to vehicular traffic, if grades change beyond accepted tolerances.
   3. Protect graded areas against action of elements prior to acceptance of work. Reestablish grades where settlement or erosion occurs.

C. Protect finished grade:
   1. During construction, shape and drain embankment and excavations. Maintain ditches and drains to provide drainage at all times. Where necessary, drain towards temporary sediment basins or rock filters.
   2. Repair and re-establish grades to specified tolerances at locations where completed or partially completed surfaces have become eroded, rutted, or settled due to subsequent construction operations or weather conditions.
   3. Rip and backfill areas that get over-compacted during construction by equipment and trucks to native soil conditions.

D. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

E. Contractor shall ensure that all instream construction activities comply with all regulatory and permitting conditions.

3.2 TOLERANCES

A. Roadway Crown: construct finished vertical grades within 0.2 FT of elevations indicated on Drawings.

B. Channel Bottom Alignment: construct finished vertical grades within 0.1 FT of elevations indicated on Drawings.

C. Slopes and Other Graded Surfaces: construct finished vertical grades within 0.2 FT of elevations indicated on Drawings. Construct horizontal grades within 1 FT of locations indicated on Drawings.

3.3 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.4 QUALITY CONTROL

A. Stabilize subgrade with well graded granular materials. Obtain approval from Engineer or their representative with regard to suitability of soils for general fill prior to subsequent operations.

B. Specifications for road construction, including treatments for the existing base materials shall be provided by others.

C. Levee materials and subsurface materials shall be field, or laboratory tested to determine optimal moisture density requirements for compaction, as needed.

3.5 COMPACTION REQUIREMENTS

A. Filled areas within the pond and channel construction areas shall be constructed in 6 IN lifts.

B. Filled areas within the pond and channel construction areas shall be driven over twice by tracked equipment to set in place and hold grade. Filled areas are intended to be revegetated and not compacted to a density greater than 80%.

C. Compaction requirements necessary for road construction shall be designed by others.

3.6 EXCAVATING

A. Excavate to lines and grades required for construction of the Work as indicated on Drawings.

B. Do not excavate or remove any material from the Work area which is not within the designated excavation limits, grade lines, or levels.

C. Excavation shall be conducted in a manner to allow materials to be segregated for reuse. The Contractor shall segregate topsoil, subsurface soil, whole trees, and woody debris from the excavation into stockpiles for reuse, as necessary.

D. Materials identified for disposal shall be kept segregated during excavation and transported away from materials that are remaining on-site.

E. Correct areas over-excavated in accordance with Filling and Backfilling in this Section.

F. Except as otherwise indicated, preserve the material below and beyond the lines of excavations. Where excavation is carried below the indicated grade, backfill to the indicated grade as herein specified using materials specified in these Specifications, or if not specified, directed by the Engineer or their representative.

G. Contractor is responsible for retaining enough excavated material for reuse prior to hauling excess material off-site.

H. Excavation and its restoration, when conducted for convenience of the Contractor, shall be at no additional expense to the Owner.

I. Prevent displacement or loose material from falling into excavation, maintain soil stability.

J. Notify Engineer within the same day of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

3.7 FILLING AND BACKFILLING

A. Borrow on-site cut for fill and backfill.

B. All areas to receive fill or backfill shall be inspected by Engineer or their representative prior to fill or backfill placement. Engineer shall be notified at least 24 HR prior to the beginning of backfill operations.

C. Prepare ground surface for banks: before fill is started, scarify to a minimum depth of 6 inches. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.

D. Place backfill in horizontal layers of loose material and compact each layer before the next layer is placed.

E. Systematically backfill to allow maximum time for natural settlement.

F. Employ a placement method that does not disturb or damage other Work.

G. Fill areas to lines and grades indicated on Drawings.

H. Make grade changes gradual. Blend slopes into level areas.

I. Scarify subgrade surfaces of areas to be filled to a depth of 6 IN. All clods shall be broken and all rocks, hard ribs, and earth lumps over 6 IN in greatest dimension, and other unsuitable materials such as roots shall be removed and disposed.

J. Leave fill material stockpile areas free of excess fill materials.

K. Overbuild roadway slopes and machine trim to firm, compacted soil. Compaction requirements necessary for road construction will be designed by others.

L. Machine trim roadway slopes to grades indicated on Drawings. After trimming, the roadway slopes should have a hard, smooth appearance with no ridges or gouges that may encourage erosion of the slope.

3.8 SITE-SPECIFIC EXCAVATION, FILL AND GRADING

A. Construct roadways as required by the Contract Drawings:

1. Construct roadway fill at locations and to lines of grade indicated. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.

2. Ensure fill material is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN. Ensure that stones larger than 6 IN are not placed in upper 6 IN of fill or embankment, unless otherwise stated in Drawings. Do not place material in layers greater than 6 IN loose thickness. Place layers horizontally and compact each layer prior to placing additional fill.

B. Construct Pond Area as required by Drawings:

1. Excavate pond topsoil and stockpile at designated stockpile area. The depth of pond topsoil excavation is estimated and will require on-site approval by the Engineer or their representative. Depth of excavation will be achieved when the surface of the ground is predominately sand and gravel, and all fine-grained material has been removed from the Work area.
2. Excavate and remove levees and percolation pond infrastructure as shown on the Drawings, maintaining the eastern levee.
3. Excavate pond to the lines and grades shown on the Drawings. Dry season groundwater levels are estimated, and not guaranteed, to range between 3.75 and 5 FT elevation. Contractor shall dewater per permit requirements.

C. Construct Channel Area as required by Drawings:

1. Excavate channel topsoil to 12 IN depth and stockpile within pond construction area.
2. Construct channels to the lines and grades shown on the Drawings. Groundwater may be encountered, and Contractor shall dewater per these Specifications and governing agency requirements.

D. Install Embedded Whole Trees for Large Wood Placements

1. Wood shall be embedded below finished grade into channel and pond banks.
2. Location and alignment of large wood shall be determined on the ground and approved by the Engineer. Notify Engineer 24 HR prior to installation of large wood placements.
3. Wood installation provisions are described in Section 353219 – Large Wood Placements.

3.9 DEWATERING

A. The pond excavation will likely maintain groundwater levels that deepen during high tides. Water collected in the pond can be used by Contractor, as needed.

B. Contractor shall be required to develop a dewatering plan that complies with regulatory requirements. The following instructions for dewatering are suggested:

1. Contractor shall divert groundwater seepage by constructing temporary earthen berms or straw bale barriers in Work areas. Any berms or straw bales shall be removed, and ground shall be graded to final design topography before completing construction.

2. Dewatering may be required to remove groundwater seepage in excavation areas. Contractor shall employ Best Management Practices for dewatering operations described in the current *California Stormwater Best Management Practices Handbook for Construction*. Water shall be discharged away from areas of standing water on to open ground. Outlet protection may be required to prevent erosion. Allow water to infiltrate into the ground. Discharged water shall not be allowed to flow into the Mad River, drainage ditches, any water conveyance facilities, or into disturbed areas.
3. Pumps used for dewatering shall be placed on top of absorbent pads on dry stable ground.

3.10 STOCKPILING

A. Stockpile at designated areas, unless directed by Engineer.
   1. Pond topsoil shall be stockpiled in the area designated on the Drawings.
   2. Pond subsurface material to be reused as road fill may be stockpiled prior to reuse. Pond gravel may be stockpiled prior to being hauled for reuse elsewhere.
   3. The top 3 FT of levee material (approx., per SHN's report) identified as potential as engineered fill shall be separated from the remaining levee material and may be stockpiled prior to being hauled for reused on-site or elsewhere.
   4. Levee material below the top 3 FT (approx., per SHN's report) may be stockpiled for reuse as general fill in the pond construction area. Excess material may be stockpiled prior to being hauled away.
   5. Channel topsoil shall be stockpiled within the pond construction area prior to reuse.
   6. Channel subsurface material that will be reused in the pond construction area shall be stockpiled within the pond construction area. Excess may be stockpiled prior to being hauled away.

3.11 SPECIAL REQUIREMENTS

A. To protect fish and water quality, Work area will be disconnected from the Mad River stormwater canal until the backwater channel excavation and grading is completed.

B. As needed, temporary sediment plugs shall be installed within the constructed backwater channel to pool groundwater seepage for dewatering. Temporary sediment plugs will be removed from upstream to downstream with the downstreammost plug removed during a rising tide. Engineer or their representative shall be notified 24 HR in advance of the removal of any sediment plugs.

C. Prior to breaching the backwater channel into the stormwater canal and completing excavation and grading at the confluence, temporary fish removal from the stormwater canal will be required and Contractor shall install fish exclusion fencing.

D. Prior to breaching the backwater channel into the stormwater canal and completing excavation and grading at the confluence, sediment control fencing shall be installed on the upstream,Work-side of the fish exclusion fencing.

E. Sediment control barriers shall be installed in accordance with the current *California Stormwater Best Management Practices Handbook for Construction* and manufacturer's recommendations in the areas of Earthwork within drainage to the Mad River or the stormwater canal prior to starting those activities. The sediment control barriers shall be maintained until the soils are stabilized and Work is complete.

F. While conducting Work within the area of the backwater channel confluence, Best Management Practices will be employed to minimize erosion of sediment into the stormwater canal. All material eroded into the canal during construction will be removed prior to the removal of either the sediment control or fish exclusion fencing.

G. Contractor shall employ erosion control measures, as described in these Specifications and as required to comply with project permits.

H. All graded slopes will be seeded with native grass species prior to completion of Work.

END OF SECTION

SECTION 35 32 19

LARGE WOOD PLACEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Placement of whole trees by embedment into the constructed backwater channel and pond.

1.2 PROJECT CONDITIONS

A. Pond and Channel Construction Areas

   1. These Specifications designate pond and channel construction areas, which are delineated by the outside edge of the northern boundary of the existing levee, roughly at the backwater channel alignment Station 15+00.

1.3 PROJECT SEQUENCING AND SCHEDULING

A. Wood placement by embedment in the channel shall commence once the backwater channel is constructed. This Work should occur prior to the breaching and constructing of the backwater channel confluence with the Mad River stormwater canal.

B. Prior to installing the large wood, provide at least 24 HR advanced notice for Engineer or their representative to review and approve location and alignment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Large wood placement trees

   1. Large wood placement trees refer to trees harvested from the channel construction area during Site Clearing to be reused.
   2. Wood placement trees shall be 12 IN diameter or greater.
   3. Contractor shall have harvested trees for reuse whole, with their roots in-tact and their tree crowns and branches removed per Section 311000 – Site Clearing. Root systems shall be cleared of soil debris prior to installation in the backwater channel and pond.

PART 3 - EXECUTION

3.1 PROTECTION

A. Whole trees shall be moved and placed in a manner to minimize cracking or breaking off portions of the tree during installation. If a tree is cracked or broken during installation, another tree shall be used for replacement, as available.

3.2 LARGE WOOD PLACEMENT INSTALLATION

A. At least one tree shall be embedded into channel and pond banks at each wood placement location. Embedded trees may be used to pin other large wood down.

B. Embedment shall require narrow slots to be excavated a minimum of 3 FT below finished ground in channel banks to accommodate the placement and burial of minimum of 10 FT or 50% of the tree stem.

C. After large wood is installed, stem slots shall be backfilled per Specification Section 312000 – Earth Moving.

D. Channel Wood Placement:

1. Embedded wood shall be aligned with the root ball at or near the center of the channel pool, resting on or embedded in the channel surface.

E. Pond Wood Placement:

1. A minimum of four wood placements shall include wood embedded into the pond banks.
2. Embedded wood shall be aligned with the root ball within the pond, below the top of the pond bank.

F. After channel wood placement is completed and four embedded wood placements are installed in the pond banks, all remaining trees harvested for reuse shall be placed in the pond or on the pond banks for habitat.

3.3 ACCEPTANCE

A. Obtain Engineer's acceptance of the location and alignment of the wood placements prior to installation.

END OF SECTION

Mad River Estuary Off-Channel Habitat Restoration
Engineer's Opinion of Probable Construction Cost
Prepared for CalTrout, MCSD, CDFW, and SCC

Item No.	Item Description	Units	Quantity	Cost	Total Cost
	Phase 1: Pond Topsoil Removal				
1	Mobilization/Demobilization	LS	1	$ 15,000	$ 15,000
2	Pond Topsoil Excavation, Screening and Stockpiling	CY	4,800	$ 15.00	$ 72,000
3	Tilling Topsoil into Reclamation Areas (To be Implemented by MCSD's Reclamation Area Leasee)	LS	1	$ 4,000	$ 4,000
	Phase 2: Off-channel Restoration				
4	Construction Survey and Staking	LS	1	$ 10,000	$ 10,000
5	Site Clearing, Including Harvesting Whole Trees for Reuse	LS	1	$ 40,000	$ 40,000
6	Infrastructure Demolition and Debris Removal	LS	1	$ 12,000	$ 12,000
7	Levee Excavation (1,900 CY Reused On-site in Pond or Roads and for Future Trail Base)	CY	4,100	$ 10.00	$ 41,000
8	Excess Levee Material to be Hauled	CY	2,200	$ 10.00	$ 22,000
9	Pond and Wetlands Excavation (2,400 CY Placed On-Site and Compacted in Pond or Roads and for Future Trail Base)	CY	7,200	$ 10.00	$ 72,000
10	Excess Pond Gravel to be Hauled	CY	4,800	$ 10.00	$ 48,000
11	Backwater Channel Excavation (1,700 CY Topsoil Placed On-site in Pond)	CY	7,600	$ 10.00	$ 76,000
12	Excess Channel Material to be Hauled	CY	5,900	$ 10.00	$ 59,000
13	Large Wood Placements	EA	12	$ 2,000	$ 24,000
14	Field Wire Fence Material and Installation	LF	2,000	$ 15.00	$ 30,000
15	Revegetation (Plants and Installation)	AC	1.50	$ 5,000	$ 7,500
16	Environmental Compliance	LS	1	$ 10,000	$ 10,000
17	As-built Survey	LS	1	$ 5,000	$ 5,000
	CONTRACTOR TOTAL COST				**$ 547,500**
18	Construction Management (10% of Contractor Total Cost)	LS	1	$ 54,750	$ 54,750
19	Engineering Oversight (2% of Contractor Total Cost)	LS	1	$ 10,950	$ 10,950
20	Monitoring and Reporting (Photo point documentation, biological and sedimentation monitoring)	YR	3	$ 6,500	$ 19,500
	PROJECT TOTAL COST				**$ 632,700**

Appendix A3: Public Access Design

MCKINLEYVILLE COMMUNITY SERVICES DISTRICT

MAD RIVER PUBLIC ACCESS

MCKINLEYVILLE, CALIFORNIA

PREPARED BY:

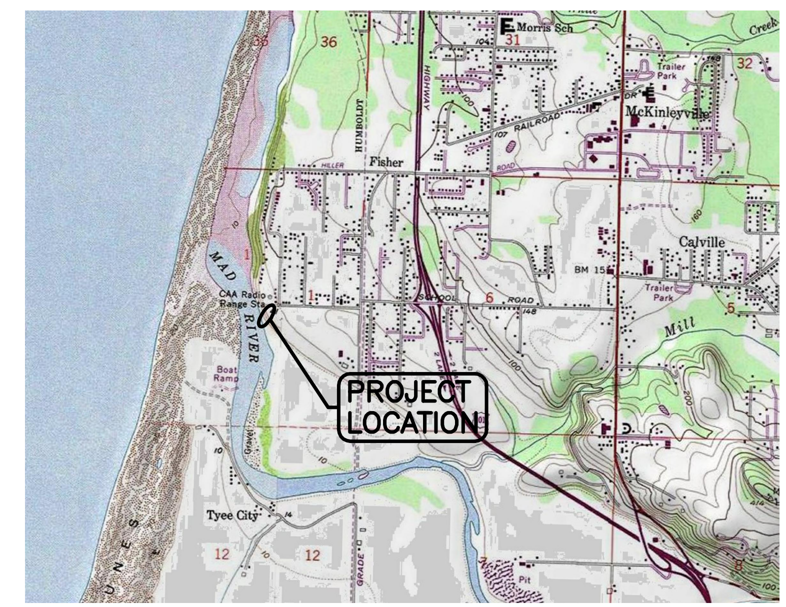
SHN

MAY 2019

LOCATION MAP
NTS

INDEX OF SHEETS

SEQ	SHEET	TITLE
1	G–1	COVER
2	G–2	STANDARD ABBREVIATIONS AND LEGENDS
3	G–3	PROJECT NOTES & SPECIFICATIONS
4	G–4	DEMOLITION AND EROSION CONTROL PLAN
5	C–1	SITE PLAN
6	C–2	GRADING PLAN
7	C–3	DETAILS
8	C–4	DETAILS



VICINITY MAP
NTS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SHN
812 W. WABASH AVE.
EUREKA, CA. 95501
WWW.SHN-ENGR.COM
707-441-8855

NO.	REVISION	DATE	BY

DSGN CJL
DR CDN
CHK JSO
APVD

MCKINLEYVILLE COMMUNITY SERVICES DISTRICT
MAD RIVER PUBLIC ACCESS
MCKINLEYVILLE, CALIFORNIA

COVER

SHEET G–1
SEQ
DATE 05/2019
PROJ. NO. 019025.200

PRELIMINARY

SAVED: 4/23/2019 2:40 PM CNEWELL, PLOTTED: 5/31/2019 4:07 PM CHRIS D. NEWELL
\\eureka\projects\2019\019025-Mad-River-Pub-Access\200-Civil-Design\Dwgs\019025-200-COVER.dwg

ABBREVIATIONS

A
ABN — ABANDON
ABS — ACRYLONITRILE–BUTADIENE–STYRENE
AB — ANCHOR BOLT, AGGREGATE BASE
AC — ASPHALTIC CONCRETE
ACP — ASBESTOS CEMENT PIPE
ACI — AMERICAN CONCRETE INSTITUTE
ADJ — ADJUSTABLE
AGGR — AGGREGATE
AISC — AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AL — ALUMINUM
ALT — ALTERNATE
AP — ANGLE POINT
APPROX — APPROXIMATELY
ARCH — ARCHITECTURAL
ASTM — AMERICAN SOCIETY FOR TESTING & MATERIALS
AUTO — AUTOMATIC
AUX — AUXILIARY
@ — AT

B
BC — BEGIN CURVE
BCR — BEGIN CURB RETURN
BD — BOARD
BF — BLIND FLANGE
BFV — BUTTERFLY VALVE
BK — BOOK OR BACK
BLDG — BUILDING
BM — BENCH MARK, BEAM
BMP — BEST MANAGEMENT PRACTICE
BO — BLOW OFF
BOT — BOTTOM
BRG — BEARING
BTWN — BETWEEN
BV — BALL VALVE
BVC — BEGINNING OF VERTICAL CURVE
BW — BACK OF WALK
BWV — BACKWATER VALVE

C
C — CHANNEL (STRUCTURAL SHAPE)
CARV — COMBINATION AIR AND VACUUM RELEASE VALVE
CATV — CABLE TELEVISION
CB — CATCH BASIN
CEIL — CEILING
CFM — CUBIC FEET PER MINUTE
CFS — CUBIC FEET PER SECOND
CHEM — CHEMICAL
CI — CAST IRON
CIP — CAST IRON PIPE
C.I.P. — CAST IN PLACE
CJ — CONSTRUCTION JOINT
CLR — CLEAR
℄ — CENTERLINE
CMP — CORRUGATED METAL PIPE
CMU — CONCRETE MASONRY UNIT
CTSK — COUNTERSINK
CO — CLEANOUT
COL — COLUMN
CONC — CONCRETE
CONT — CONTINUOUS OR CONTINUED
COORD — COORDINATE
CPLG — COUPLING
CRS — COLD ROLLED STEEL
CTR — CENTER
CTS — COPPER TUBE SIZE
CU — CUBIC
CU FT — CUBIC FEET
CV — CHECK VALVE
CW — COLD WATER
CY — CUBIC YARD

D
° — DEGREE (ANGLE)
d — PENNY (NAIL SIZE)
D — STORM DRAIN
DB — DISTRIBUTION BOX
DBL — DOUBLE
DF — DOUGLAS FIR
DI — DROP INLET OR DUCTILE IRON
DIA — DIAMETER
DIAG — DIAGONAL
DIM — DIMENSION
DIMJ — DUCTILE IRON MECHANICAL JOINT
DIP — DUCTILE IRON PIPE
DET — DETAIL
DWG — DRAWING
DW — DRIVEWAY

E
(E) — EXISTING
E — EASTING OR EAST
EA — EACH
EC — END CURVE
ECR — END CURB RETURN
EF — EACH FACE
EFL — EFFLUENT
EG — EXISTING GRADE/GROUND
EL — ELBOW
ELEC — ELECTRIC OR ELECTRICAL
ELEV — ELEVATION
ENGR — ENGINEER
EP — EDGE OF PAVING
EQ — EQUAL
EQUIP — EQUIPMENT
ER — EDGE OF ROAD
EVC — END OF VERTICAL CURVE
EW — EACH WAY
EWEF — EACH WAY, EACH FACE
EXC — EXCAVATE
EXP — EXPOSED OR EXPANSION
EXP JT — EXPANSION JOINT
EXST — EXISTING
EXT — EXTERIOR

F
F — FLANGE
FC — FLEXIBLE COUPLING OR FACE OF CURB
FCA — FLANGED COUPLING ADAPTER
FD — FLOOR DRAIN
FDC — FIRE DEPARTMENT CONNECTION
FDN — FOUNDATION
FF — FINISH FLOOR
FG — FINISHED GRADE
FH — FIRE HYDRANT
FIG — FIGURE
FIN — FINISH
FIP — FEMALE IRON PIPE
FL — FLOW LINE
FLG — FLANGE
FLR — FLOOR
FLTR — FILTER
FO — FIBER OPTIC
FOC — FACE OF CONCRETE
FT — FOOT OR FEET
FT^2 — SQUARE FEET
FT^3 — CUBIC FEET
FTG — FOOTING
FUT — FUTURE

G
G — GAS
GA — GAGE
GALV — GALVANIZED
GIP — GALVANIZED IRON PIPE
GM — GAS METER
GPD — GALLONS PER DAY
GPH — GALLONS PER HOUR
GPM — GALLONS PER MINUTE
GRD — GRADE OR GROUND
GSP — GALVANIZED STEEL PIPE
GV — GATE VALVE
GYP — GYPSUM

H
HB — HOSE BIBB
HDPE — HIGH DENSITY POLYETHYLENE
HDR — HEADER
HDW — HARDWARE
HMA — HOT MIX ASPHALT
HOR — HORIZONTAL
HP — HORSEPOWER, HIGH POINT
HR — HOUR
HT — HEIGHT
HW — HOT WATER
HWR — HOT WATER RETURN
HWS — HOT WATER SUPPLY

I
ID — INSIDE DIAMETER
IN — INCH
INFL — INFLUENT
INSUL — INSULATE OR INSULATION
INT — INTERIOR
INV — INVERT
IPS — IRON PIPE SIZE

J
JT — JOINT
JP — JOINT POLE

K
KIP — THOUSAND POUNDS
KW — KILOWATT

L
∠ — ANGLE (DEGREES)
L — ANGLE (STRUCTURAL SHAPE)
LAT — LATERAL
LB — POUND
LF — LINEAR FEET
LG — LONG
LH — LEFT HAND
LONG — LONGITUDINAL
LP — LOW POINT
LPG — LIQUIFIED PETROLEUM GAS
LRP — LEGALLY RESPONSIBLE PARTY
LR — LONG RADIUS
LT — LEFT
LVC — LENGTH OF VERTICAL CURVE

M
MATL — MATERIAL
MAX — MAXIMUM
MECH — MECHANICAL
MF — MEGA–FLANGE PIPE JOINT
MFR — MANUFACTURER
MGD — MILLION GALLONS PER DAY
MH — MANHOLE
MIN — MINIMUM OR MINUTE
MIP — MALE IRON PIPE
MISC — MISCELLANEOUS
MJ — MECHANICAL JOINT
MNPT — MALE NATIONAL PIPE THREAD
MTL — METAL
MWS — MAXIMUM WATER SURFACE

N
(N) — NEW
N — NORTHING OR NORTH
NC — NORMALLY CLOSED
NIC — NOT IN CONTRACT
NF — NON–FREEZE
NO — NUMBER OR NORMALLY OPEN
NOM — NOMINAL
NP — NEW PAVEMENT
NPT — NATIONAL PIPE THREAD
NTS — NOT TO SCALE
— NUMBER

O
OC — ON CENTER
OD — OUTSIDE DIAMETER
OG — ORIGINAL GROUND
OVFL — OVERFLOW
OZ — OUNCE
OH — OVERHEAD

P
PC — POINT OF CURVE
PCC — PORTLAND CEMENT CONCRETE
PCF — POUNDS PER CUBIC FOOT
PE — PLAIN END
PERF — PERFORATED
PEP — POLYETHELENE PIPE
PI — POINT OF INTERSECTION
PL — PLATE
℄ — PROPERTY LINE
PLCS — PLACES
PLYWD — PLYWOOD
PMP — PERFORATED METAL PIPE
POC — POINT ON CURVE
POT — POINT OF TANGENT
PP — POWER POLE
PRC — POINT OF REVERSE CURVE
PREFAB — PREFABRICATED
PRELIM — PRELIMINARY
PRESS — PRESSURE
PROP — PROPERTY
PSF — POUNDS PER SQUARE FOOT
PSI — POUNDS PER SQUARE INCH
PSIG — POUNDS PER SQUARE INCH, GAUGE
PT — POINT OF TANGENCY, POINT
PUE — PUBLIC UTILITY EASEMENT
PV — PLUG VALVE
PVC — POLYVINYL CHLORIDE PLASTIC
PVI — POINT OF VERTICAL INTERSECTION
PVMT — PAVEMENT

Q
QTY — QUANTITY

R
R — RADIUS
RC — RELATIVE COMPACTION
RCP — REINFORCED CONCRETE PIPE
RD — ROAD
RDCR — REDUCER
RWD — REDWOOD
REF — REFER OR REFERENCE
REINF — REINFORCED, REINFORCING OR REINFORCE
REQD — REQUIRED
RET — RETURN
RH — RIGHT HAND
RM — ROOM
RO — ROUGH OPENING
RSP — ROCK SLOPE PROTECTION
RT — RIGHT OR RING TIGHT
R/W — RIGHT OF WAY
RWL — RAIN WATER LEADER

S
S — SEWER
SL — SLOPE
SCHED — SCHEDULE
SCSD — SCOTIA COMMUNITY SERVICES DISTRICT
SD — STORM DRAIN
SDMH — STORM DRAIN MANHOLE
SECT — SECTION
SF — SQUARE FOOT/FEET
SHT — SHEET
SIM — SIMILAR
SP — SPACE OR SPACES
SPEC — SPECIFICATIONS
SQ — SQUARE
SQ FT — SQUARE FOOT
SQ IN — SQUARE INCH
SS — SANITARY SEWER
SSCO — SANITARY SEWER CLEAN OUT
SSMH — SANITARY SEWER MANHOLE
SST — STAINLESS STEEL
STA — STATION
STD — STANDARD
STL — STEEL
STR — STRUCTURAL
STRUCT — STRUCTURE
SUSP — SUSPENDED
SW — SIDEWALK
SWPPP — STORM WATER POLLUTION PREVENTION PLAN
SYMM — SYMMETRICAL

T
TAN — TANGENT
T&B — TOP AND BOTTOM
T&G — TONGUE AND GROOVE
TBC — TOP BACK CURB
TBM — TEMPORARY BENCH MARK
TBW — TOP BACK WALK
TC — TOP OF CURB
TCE — TEMPORARY CONSTRUCTION EASEMENT
TEL — TELEPHONE
TELEM — TELEMETRY
TEMP — TEMPERATURE OR TEMPORARY
TFC — TOP FACE CURB
THD — THREAD
TOC — TOP OF CONCRETE
TOG — TOP OF GRATE
TOS — TOWN OF SCOTIA
TOW — TOP OF WALL
TP — TURNING POINT, TOP OF PAVEMENT OR TELEPHONE POLE
TRANSV — TRANSVERSE
TS — TUBE, STRUCTURAL
TYP — TYPICAL

U
UBC — UNIFORM BUILDING CODE
UOS — UNLESS OTHERWISE SPECIFIED
UG — UNDERGROUND
UTIL — UTILITY

V
V — VOLT
VAC — VACUUM
VAR — VARIES
VC — VERTICAL CURVE
VCP — VITRIFIED CLAY PIPE
VERT — VERTICAL
VG — VALLEY GUTTER
VPI — VERTICAL POINT OF INTERSECTION

W
W — WATER OR WIDE FLANGE
W/ — WITH
W/O — WITHOUT
WM — WATER METER
WP — WORK POINT
WS — WATER SURFACE, WATER STOP
WWF — WELDED WIRE FABRIC

X
XFMR — TRANSFORMER

Y
YD — YARD
YD^2 — SQUARE YARD
YD^3 — CUBIC YARD

CURVE DATA

R (RADIUS)
L (LENGTH)
△ (DELTA)
T (TANGENT)

UTILITIES LEGEND

PROPOSED	EXISTING	
		GATE VALVE
	PV	PLUG VALVE
	BV	BALL VALVE
	BFV	BUTTERFLY VALVE
		AUTOMATICALLY OPERATED VALVE (P= PNEUMATIC, E= ELECTRIC, S= SOLENOID, H= HYDRAULIC, D= DIAPHRAGM ACTUATOR)
		3–WAY VALVE
		GLOBE VALVE
		ANGLE VALVE
		PRESSURE REGULATING VALVE
		PRESSURE RELIEF VALVE
		CHECK VALVE
		AIR OR VACUUM RELEASE VALVE
AV	AV	AIR AND VACUUM VALVE
CA	CA	COMBINATION AIR VALVE
		FLOW METER
	NF	HOSE BIBB (NF= NON–FREEZE)
		REDUCER
		FIRE HYDRANT
		DROP INLET
		MANHOLE
		SEWER CLEAN OUT OR SEWER LATERAL
E	E	UNDERGROUND ELECTRICAL
OH E	OH E	OVERHEAD ELECTRICAL
FO	FO	FIBER OPTIC LINE
TV	TV	CABLE TELEVISION
J	J	JOINT UTILITIES
TM	TM	UNDERGROUND TELEMETRY LINE
OH TM	OH TM	OVERHEAD TELEMETRY LINE
T	T	UNDERGROUND TELEPHONE LINE
OH T	OH T	OVERHEAD TELEPHONE LINE
FW	FW	FIRE WATER LINE
ST	ST	STEAM LINE
W	W	WATER LINE
SS	SS	SANITARY SEWER LINE
SD	SD	STORM DRAIN LINE
G	G	GAS LINE
FM	FM	FORCE MAIN AND DIRECTION OF FLOW
		CULVERT
		POLE MOUNTED ROADWAY LUMINAIRE
	NOT USED	ITEM TO BE REMOVED
		ITEM TO BE ABANDONED IN PLACE
		WATER SERVICE– WM–1= SINGLE, WM–2= DUAL
3	PB	PULL BOX AND DESIGNATION
R4–4		SIGN AND DESIGNATION

SIZE AND MATERIAL OF EXISTING PIPING MAY BE SHOWN WHEN KNOWN.

SIZE AND MATERIAL OF NEW PIPING MAY BE SHOWN ON PLAN OR IN PROFILE.

NOTES

1. CONTACT THE ENGINEER FOR SYMBOLS NOT LISTED.
2. THIS IS A STANDARD SHEET, THEREFORE, SOME SYMBOLS OR ABBREVIATIONS MAY APPEAR ON THIS SHEET WHICH DO NOT APPEAR ON THE PLANS.
3. SITE AND UTILITY SYMBOLS SHOWN ON THIS SHEET ARE NOT INTENDED TO REPRESENT THE PHYSICAL SCALE OR SHAPE OF ANY ITEMS. WHERE LARGE–SCALE PLANS ARE PRESENTED, THE SYMBOLS SHOWN HEREON MAY BE REPLACED BY DETAILS MORE SUITED TO THE DRAWING SCALE.

TOPOGRAPHIC LEGEND

PROPOSED	EXISTING	
		P.I. (POINT OF INTERSECTION)
NOT USED		TEMPORARY BENCH MARK
47.55	NOT USED	FINISH GRADE ELEVATON
NOT USED	42.6	ELEVATION OF ORIGINAL GROUND
		RADIAL POINT
		FLOW LINE AND DIRECTION
		TOP OF CUT
		TOP OF FILL
		TOE OF CUT OR FILL
200	180	CONTOUR LINE
		CONCRETE (IN PLAN)
		CONCRETE (IN SECTION)
		PAVEMENT
NOT USED		ROCKS
NOT USED		STUMPS
		TREES
		ROADS
	TP	UTILITY POLE (PP=POWER POLE, TP= TEL POLE, JP=JOINT POLE)
		GUY WIRE
		FENCE
		BOUNDARY LIMITS, W/DESIGNATION
		CENTERLINE
NOT USED		MARSH
		WETLAND
NOT USED		SPRING
TP–4	TP–4	TEST PIT AND DESIGNATION
		EXPLORATION BORE HOLE
		PROPERTY CORNER
		SURVEY MONUMENT
		CONTROL POINT
		DRIVEWAY

DETAIL AND SECTION DESIGNATION

SECTION (LETTER) OR DETAIL (NUMERAL) DESIGNATION — A

INDICATES SECTION OR DETAIL TAKEN AND SHOWN ON SAME SHEET — C–5

ON DRAWING WHERE SECTION OR DETAIL IS TAKEN: SHEET NUMBER WHERE SHOWN

ON DRAWING WHERE SECTION OR DETAIL IS SHOWN: SHEET NUMBER WHERE TAKEN

STANDARD DETAIL NUMBER (DETAIL MAY BE SHOWN ON ANY SHEET WITHIN THE DRAWING SET) — 006

PRELIMINARY

VERIFY SCALES

BAR IS ONE INCH ON ORIGINAL DRAWING

0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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NO.	REVISION	DATE	BY

DSGN CJL
DR CDN
CHK JSO
APVD

MCKINLEYVILLE COMMUNITY SERVICES DISTRICT
MAD RIVER PUBLIC ACCESS
MCKINLEYVILLE, CALIFORNIA

STANDARD ABBREVIATIONS AND LEGENDS

SHEET G-2

SEQ

DATE 05/2019

PROJ. NO. 019025.200

SAVED: 4/23/2019 2:39 PM CNEWELL, PLOTTED: 5/31/2019 4:07 PM CHRIS D. NEWELL
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GENERAL NOTES:

1. ALL WORK SHALL CONFORM TO CURRENT CALIFORNIA BUILDING CODE.
2. THE WORKING DRAWINGS ARE GENERALLY DIAGRAMMATIC. THEY DO NOT SHOW EVERY OFFSET, BEND OR ELBOW REQUIRED FOR INSTALLATION IN THE SPACE PROVIDED. THEY DO NOT SHOW EVERY DIMENSION, COMPONENT PIECE, SECTION, JOINT OR FITTING REQUIRED TO COMPLETE THE PROJECT. ALL LOCATIONS FOR WORK SHALL BE CHECKED AND COORDINATED WITH EXISTING CONDITIONS IN THE FIELD BEFORE BEGINNING CONSTRUCTION. EXISTING UNDERGROUND UTILITIES WITHIN THE LIMITS OF EXCAVATION SHALL BE VERIFIED AS TO CONDITION, SIZE AND LOCATION BY UNCOVERING, PROVIDED SUCH IS PERMITTED BY LOCAL PUBLIC AUTHORITIES WITH JURISDICTION, BEFORE BEGINNING CONSTRUCTION. CONTRACTOR SHALL NOTIFY ENGINEER OF ANY DISCREPANCIES.
3. THE CONTRACTOR SHALL SECURE ALL NECESSARY PERMITS PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.
4. THE CONTRACTOR SHALL PROVIDE A COPY OF THE TRENCH PERMIT FROM THE CALIFORNIA DIVISION OF INDUSTRIAL SAFETY PRIOR TO THE EXCAVATION OF ANY TRENCH OVER FIVE FEET IN DEPTH.
5. CONTRACTOR SHALL PERFORM TRENCH WORK IN CONFORMANCE WITH THE CALIFORNIA DIVISION OF INDUSTRIAL SAFETY REQUIREMENTS AND SHALL CONFORM TO ALL APPLICABLE OCCUPATIONAL SAFETY AND HEALTH STANDARDS, RULES, REGULATIONS AND ORDERS ESTABLISHED BY THE STATE OF CALIFORNIA AND OTHER APPLICABLE AGENCIES.
6. CONTRACTOR AGREES THAT IN ACCORDANCE WITH GENERALLY ACCEPTED CONSTRUCTION PRACTICES, GENERAL CONTRACTOR WILL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY. ALL WORK AND EQUIPMENT SHALL COMPLY WITH THE CALIFORNIA DIVISION OF INDUSTRIAL SAFETY REQUIREMENTS. THIS REQUIREMENT SHALL BE MADE TO APPLY CONTINUOUSLY, AND NOT BE LIMITED TO NORMAL WORKING HOURS. CONTRACTOR FURTHER AGREES TO HOLD HARMLESS, INDEMNIFY AND DEFEND THE OWNER, THE ENGINEER AND HIS/HER CONSULTANTS.
7. THE CONTRACTOR SHALL INDEPENDENTLY REVIEW GROUND, TOPOGRAPHY AND TREE CONDITIONS THROUGHOUT THE SITE, AND ASSUME THE RISK OF COMPLETING THE WORK SET OUT ON THESE PLANS, REGARDLESS OF ROCK, WATER TABLE OR OTHER CONDITIONS WHICH MAY BE ENCOUNTERED IN THE COURSE OF THE WORK.
8. ANY DISCREPANCY DISCOVERED BY THE CONTRACTOR IN THESE PLANS, OR ANY FIELD CONDITIONS DISCOVERED BY THE CONTRACTOR THAT MAY DELAY OR OBSTRUCT THE PROPER COMPLETION OF THE WORK SHOWN HEREIN SHALL BE BROUGHT TO THE ATTENTION OF THE OWNER AND THE ENGINEER IMMEDIATELY UPON DISCOVERY. SAID NOTIFICATION SHALL BE IN WRITING.
9. ALL UNDERGROUND IMPROVEMENTS SHALL BE INSTALLED TESTED AND APPROVED PRIOR TO PAVING.
10. THE CONTRACTOR SHALL NOT BEGIN EXCAVATING UNTIL ALL EXISTING UTILITIES HAVE BEEN MARKED IN THE FIELD. THE CONTRACTOR SHALL NOTIFY EACH APPLICABLE ENTITY AT LEAST 48 HOURS PRIOR TO COMMENCING WORK. CALL UNDERGROUND SERVICE ALERT (USA) TWO WORKING DAYS BEFORE DIGGING AT (800) 227-2600 FOR LOCATES.
11. GRADING AND CONSTRUCTION CONTRACTORS SHALL STOP WORK AND NOTIFY THE OWNER AND THE ENGINEER IF CULTURAL RESOURCES ARE DISCOVERED DURING CONSTRUCTION.
13. THE CONTRACTOR SHALL GIVE THE INSPECTOR 48 HOURS ADVANCE NOTICE OF ANY CONSTRUCTION OR REQUIRED TESTING.
14. SHOULD THE CONTRACTOR OR ANY OF HIS AGENTS OR EMPLOYEES ENCOUNTER OR DISCOVER MATERIALS WHICH APPEAR TO BE HAZARDOUS DURING THE PERFORMANCE OF THE WORK, THE CONTRACTOR SHALL INFORM THE ENGINEER IMMEDIATELY AND SUSPEND WORK IN THE AFFECTED AREA UNTIL THE ENGINEER HAS INSPECTED THE LOCATION AND MATERIALS IN QUESTION. SHOULD IT BE NECESSARY TO UNDERTAKE REMEDIATION, THE ENGINEER WILL GIVE WRITTEN NOTICE TO SUSPEND WORK IN THE AFFECTED AREA UNTIL THE PROPER COURSE OF ACTION HAS BEEN DETERMINED. OPERATIONS IN THE AFFECTED AREA SHALL BE RESUMED ONLY UPON WRITTEN NOTICE BY THE ENGINEER.
15. ALL SITE GRADING WILL BE INSPECTED BY THE ENGINEER. COMPACTION TESTING WILL BE CONDUCTED AFTER SUFFICIENT DENSITIES HAVE BEEN ACHIEVED IN THE CONTRACTOR'S OPINION. THE CONTRACTOR SHALL MAKE ALL REQUESTS FOR MATERIALS TESTING AT LEAST 48 HOURS IN ADVANCE. ANY SOILS THAT FAIL TO MEET THE REQUIRED COMPACTION LEVELS SHALL BE REMOVED, AND RECOMPACTED. ALL COSTS ASSOCIATED WITH ACHIEVING COMPACTION STANDARDS SHALL BE INCLUDED IN THE CONTRACTOR'S ORIGINAL BID.
16. THE TOPSOIL SHALL BE REMOVED FROM CUT AND FILL AREAS AND SHALL NOT BE USED FOR ENGINEERED FILL. TOPSOIL SHALL BE STOCKPILED SEPARATELY AND REPLACED OVER AREAS OF EXPOSED SUBGRADE TO A MINIMUM DEPTH OF 6 INCHES.
17. NO CHANGES OR MODIFICATIONS SHALL BE MADE TO THESE PLANS WITHOUT WRITTEN APPROVAL BY THE ENGINEER.

SURVEY NOTES:

THERE WAS NO SURVEY CONDUCTED FOR THE DESIGN OF THIS PROJECT. HORIZONTAL AND VERTICAL LOCATIONS OF ALL IMPROVEMENTS SHALL BE DETERMINED BY THE OWNER OR OWNER'S REPRESENTATIVE WITH THE CONTRACTOR PRIOR TO WORK BEGINNING.

LIDAR DATA DOWNLOADED FROM THE NOAA CALIFORNIA COSTAL LIDAR DATASET AS A DIGITAL ELEVATION MODEL (DEM).
CONTOURS WERE GENERATED IN ARCGIS.

AERIAL IMAGE DOWNLOADED BY ARCGIS USING THE CLARITY IMAGE SERVICE. DATE DOWNLOADED: 5/14/2019

EROSION CONTROL NOTES:

1. BMPs SHALL BE INSTALLED PRIOR TO ANY SITE DISTURBANCE AND MAINTAINED SUCH THAT NO VISIBLE SEDIMENT LEAVES THE SITE.
2. TRACKING CONTROLS: ENTRANCE/EXIT BMP.
3. PAVED AREAS AT THE ACCESS POINTS SHALL BE SWEPT OR VACUUMED AS OFTEN AS EACH DAY TO ELIMINATE TRACKING SOIL AND DEBRIS BEYOND THE LIMITS OF THE PROJECT SITE. ANY SOILS AND/OR DEBRIS, ROCK, GRAVEL, ETC. TRACKED BEYOND THE LIMITS OF THE PROJECT SITE AS A RESULT OF THIS PROJECT SHALL BE REMOVED IMMEDIATELY.
4. DISTURBED AREAS PROTECTED TO EXTENT PRACTICAL DURING CONSTRUCTION.
5. STOCKPILE MANAGEMENT TO BE IMPLEMENTED.
6. DISTURBED AREA STABILIZED AS SOON AS POSSIBLE.
7. SEE SHEET C-4 FOR MORE EROSION CONTROL NOTES.
8. THE CONTRACTOR SHALL NOT ALLOW ANY CONSTRUCTION DEBRIS TO ENTER THE STORM DRAIN OR SANITARY SEWER SYSTEMS. THE CONTRACTOR SHALL INSTALL APPROVED PHYSICAL BARRIERS TO ENSURE THAT ALL DEBRIS IS CAPTURED AND REMOVED FROM SURFACE RUNOFF PRIOR TO RELEASING SITE RUNOFF.

PROJECT SPECIFICATIONS:

GENERAL COMPACTION

1. REFER TO THE PRELIMINARY ENGINEERING GEOLOGIC REPORT PREPARED BY SHN, DATED MARCH 2019 FOR DETAILED GUIDELINES ON SITE PREPARATION, EXCAVATION, ENGINEERED FILL, AND OTHER GENERAL RECOMMENDATIONS.
2. COMPACTION REQUIREMENTS AS SPECIFIED WILL BE BY PERCENT OF THE MAXIMUM DRY DENSITY AND AS DETERMINED PER ASTM D 1557.
3. PLACE BACKFILL AND FILL SOIL MATERIAL IN LOOSE LIFTS OF NOT MORE THAN 8 INCHES FOR MATERIAL COMPACTED BY HEAVY EQUIPMENT, AND NOT MORE THAN 6 INCHES FOR MATERIAL COMPACTED BY HAND-OPERATED TAMPERS.
4. THE GROUND SURFACE IN AREAS TO RECEIVE FILL SHALL BE PREPARED AS FOLLOWS:
   - 4.1. ALL ORGANIC MATERIAL AND TOPSOIL SHALL BE REMOVED.
   - 4.2. ON SLOPES GREATER THAN 1V:4H, HORIZONTAL BENCHES SHALL BE CUT INTO THE SOIL TO PROVIDE A LEVEL BEARING SURFACE FOR THE FILL MATERIAL. THE MINIMUM WIDTH OF THE BENCHES SHALL BE FOUR FEET.
5. ALL IMPROVEMENTS SHALL BE GRADED TO DRAIN TO THE APPROVED DRAINAGE COURSE AT A UNIFORM SLOPE OF 2% MINIMUM UNLESS OTHERWISE NOTED.
6. THE CONTRACTOR SHALL BE RESPONSIBLE TO CONFIRM THE GROUND ELEVATIONS AND OVERALL TOPOGRAPHY OF THE SITE PRIOR TO THE START OF CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY SHN CONSULTING ENGINEERS AT 707-441-8855 IMMEDIATELY, AND PROVIDE WRITTEN DESCRIPTION OF ANY DIFFERENCES IN TOPOGRAPHY FROM THAT SHOWN ON THESE PLANS WHICH MAY REQUIRE CHANGES IN DESIGN AND/OR AFFECT EARTHWORK QUANTITY.
7. NO CUT OR FILL SLOPES SHALL EXCEED THE SLOPE RATIO OF 2H:1V, UNLESS OTHERWISE NOTED.
8. TOPSOIL SHALL BE REMOVED FROM ALL CUT AND FILL AREAS AND SHALL NOT BE USED FOR ENGINEERED FILL.
9. FILL MATERIALS SHALL COMPLY WITH THE REQUIREMENTS OF THE SOILS REPORT UNLESS OTHERWISE NOTED ON THESE PLANS. NO ADDITIONAL COMPENSATION WILL BE MADE FOR COMPLYING WITH THE FILL MATERIAL REQUIREMENTS OF THE SOILS REPORT.
10. COMPACTION IN TRENCHES SHALL BE TESTED EVERY 50-75 FEET WITH A MINIMUM OF TWO TESTS PER ANY LENGTH OF TRENCHING. THE ENGINEER WILL BE PERMITTED TO COMPLETE TESTING AT ANY BACKFILL ELEVATION DURING THE BACKFILL PROCESS. THE CONTRACTOR SHALL PROVIDE EQUIPMENT AND AN OPERATOR, FREE OF CHARGE TO FACILITATE THE TESTING REQUIRED BY THE ENGINEER.
11. FILL MATERIALS SHALL BE MECHANICALLY COMPACTED. JETTING WILL NOT BE ALLOWED.
12. CARE SHALL BE TAKEN NOT TO CRUSH THE PIPE OR OTHER COMPONENTS WITH COMPACTION EQUIPMENT.
13. GEOTECHNICAL ENGINEER SHALL INSPECT AND APPROVE FOOTING EXCAVATIONS PRIOR TO PLACEMENT OF FORMS AND REBAR.

TESTING AND INSPECTION

1. ALL SITE GRADING, SUBGRADE, AND BACKFILLING WILL BE INSPECTED BY THE OWNER OR OWNER'S REPRESENTATIVE. CONTRACTOR TO PROVIDE 48 HOUR NOTICE IN ADVANCE OF REQUIRED INSPECTION. FAILURE TO GIVE ADEQUATE NOTICE MAY RESULT IN TESTING DELAYS WHICH WILL BE THE RESPONSIBILITY OF THE CONTRACTOR.
2. THE OWNER'S REPRESENTATIVE WILL MAKE ALL COMPACTION TESTS WHEN ADVISED BY THE CONTRACTOR THAT IN THE OPINION OF THE CONTRACTOR, SUFFICIENT DENSITIES HAVE BEEN ACHIEVED. THE CONTRACTOR SHALL FURNISH A BACKHOE AND OPERATOR UPON REQUEST AT NO COST TO OWNER.
3. THE CONTRACTOR SHALL MAKE ALL NECESSARY EXCAVATIONS FOR COMPACTION TESTS. COSTS OF EXCAVATION, BACKFILLING, AND COMPACTING IN CONNECTION WITH COMPACTION TESTING SHALL BE BORNE BY THE CONTRACTOR. A FAILING COMPACTION TEST INDICATES THAT THE REQUIRED COMPACTION STANDARDS HAVE NOT BEEN ACHIEVED. ANY FILL MATERIAL OR PORTION OF FILL MATERIAL THAT DOES NOT MEET THE SPECIFIED REQUIREMENTS SHALL BE REMOVED AND RECOMPACTED UNTIL THE REQUIREMENTS ARE SATISFIED AT NO ADDITIONAL COST TO THE OWNER. COSTS ASSOCIATED WITH RETESTING PREVIOUSLY FAILED AREAS SHALL BE PAID BY OWNER AND BACK-CHARGED TO THE CONTRACTOR.
4. EXCAVATIONS FOR COMPACTION TESTS SHALL BE BACKFILLED WITH MATERIAL SIMILAR TO THAT EXCAVATED, AND BE COMPACTED TO THE SPECIFIED DENSITY.
5. ALL COSTS ASSOCIATED WITH ACHIEVING COMPACTION STANDARDS SHALL BE INCLUDED IN THE BID PRICES PAID FOR THE BID ITEM INVOLVED AND THEREFORE NO ADDITIONAL COMPENSATION SHALL BE MADE.

PAVING

1. ALL ASPHALT CONCRETE SHALL BE IN ACCORDANCE WITH CALTRANS STANDARD SPECIFICATIONS SECTION 39.
2. ASPHALT MATERIAL SHALL BE HMA TYPE A WITH ½ INCH AGGREGATE GRADATION. ASPHALT BINDER SHALL BE PG64-16.
3. ASPHALT CONCRETE SHALL BE INSTALLED AND TESTED ACCORDING TO THE "STANDARD PROCESS" SPECIFIED IN SECTION 39. ACCEPTANCE CRITERIA PER CALTRANS TEST 309.
4. WHERE NEW PAVING MEETS EXISTING PAVEMENT, EXISTING PAVEMENT SHALL BE SAWCUT.
5. APPLY TACK COAT TO CONTACT SURFACES OF CURBS, GUTTERS AND EXISTING PAVEMENT.
6. PLACE ASPHALT CONCRETE WITHIN 24 HOURS OF APPLYING PRIMER OR TACK COAT.
7. TACK COAT SHALL BE TYPE SS-1.
8. COMPACT PAVEMENT BY ROLLING TO A MINIMUM OF 95% OF MAXIMUM DENSITY. DO NOT DISPLACE OR EXTRUDE PAVEMENT FROM POSITION. HAND COMPACT IN AREAS INACCESSIBLE TO MECHANICAL ROLLING EQUIPMENT.
9. PERFORM ROLLING WITH CONSECUTIVE PASSES TO ACHIEVE SMOOTH FINISH WITHOUT ROLLER MARKS.
10. AGGREGATE BASE SHALL BE CALTRANS CLASS 2, COMPACTED TO 95% RELATIVE COMPACTION PER ASTM D1557/D6938.
11. IN AREAS TO BE PAVED, MINIMUM TOP 6 INCHES OF SUITABLE NATIVE SOIL SHALL BE SCARIFIED AND RECOMPACTED TO 90% RELATIVE COMPACTION PER ASTM D1557/D6938.
12. UNLESS OTHERWISE SHOWN ON THESE PLANS, NEW ASPHALT CONCRETE SURFACES AND NEW FINISH GRADE SURFACES SHALL BE INSTALLED SO AS TO MAINTAIN EXISTING SURFACE DRAINAGE PATTERNS.

PROJECT SPECIFICATIONS (CONT):

SITE WORK CONCRETE

1. SEE STRUCTURAL SHEETS FOR CONCRETE WITHIN THE BUILDING FOOTPRINT.
2. ALL CONCRETE CONSTRUCTION SHALL CONFORM WITH CHAPTER 19A OF THE CBC AND WITH THE PROVISIONS OF ACI 318. MIX DESIGNS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO CONCRETE PLACEMENT.
3. UNLESS OTHERWISE STATED, CONCRETE SHALL BE HARDROCK CONCRETE AND SHALL MEET THE FOLLOWING DESIGN CRITERIA:
   - A. MINIMUM 28-DAY COMPRESSIVE STRENGTH = 3,000 PSI
   - B. MINIMUM CEMENT CONTENT = 5 SACKS/CUYD
   - C. MAXIMUM AGGREGATE SIZE = 3/4"
   - D. SLUMP = 4"±1"
4. CONCRETE SHALL BE MIXED, PLACED, AND CURED IN ACCORDANCE WITH ACI 318.
5. REINFORCING SHALL BE PLACED IN ACCORDANCE WITH THE CONCRETE REINFORCING STEEL INSTITUTE (CRSI) "MANUAL OF STANDARD PRACTICE."
6. SURFACE OF ALL CONCRETE FLATWORK SHALL BE IN ACCORDANCE WITH CBC REQUIREMENTS FOR ACCESSIBLE ROUTES.
7. ALL ITEMS TO BE CAST IN CONCRETE SUCH AS REINFORCING DOWELS, BOLTS, ANCHORS, PIPES AND SLEEVES SHALL BE SECURELY POSITIONED IN FORMS BEFORE PLACEMENT OF CONCRETE.
8. WALKWAYS SHALL MEET THE ACCESSIBILITY REQUIREMENTS PROVIDED IN THE CALIFORNIA BUILDING CODE. LONGITUDINAL SLOPES OF WALKWAYS SHALL NOT EXCEED 5%. CROSS SLOPES OF WALKWAYS SHALL NOT EXCEED 2%. LANDINGS SHALL NOT EXCEED 2% SLOPE IN ANY DIRECTION.

PRELIMINARY

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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EUREKA, CA. 95501
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707-441-8855

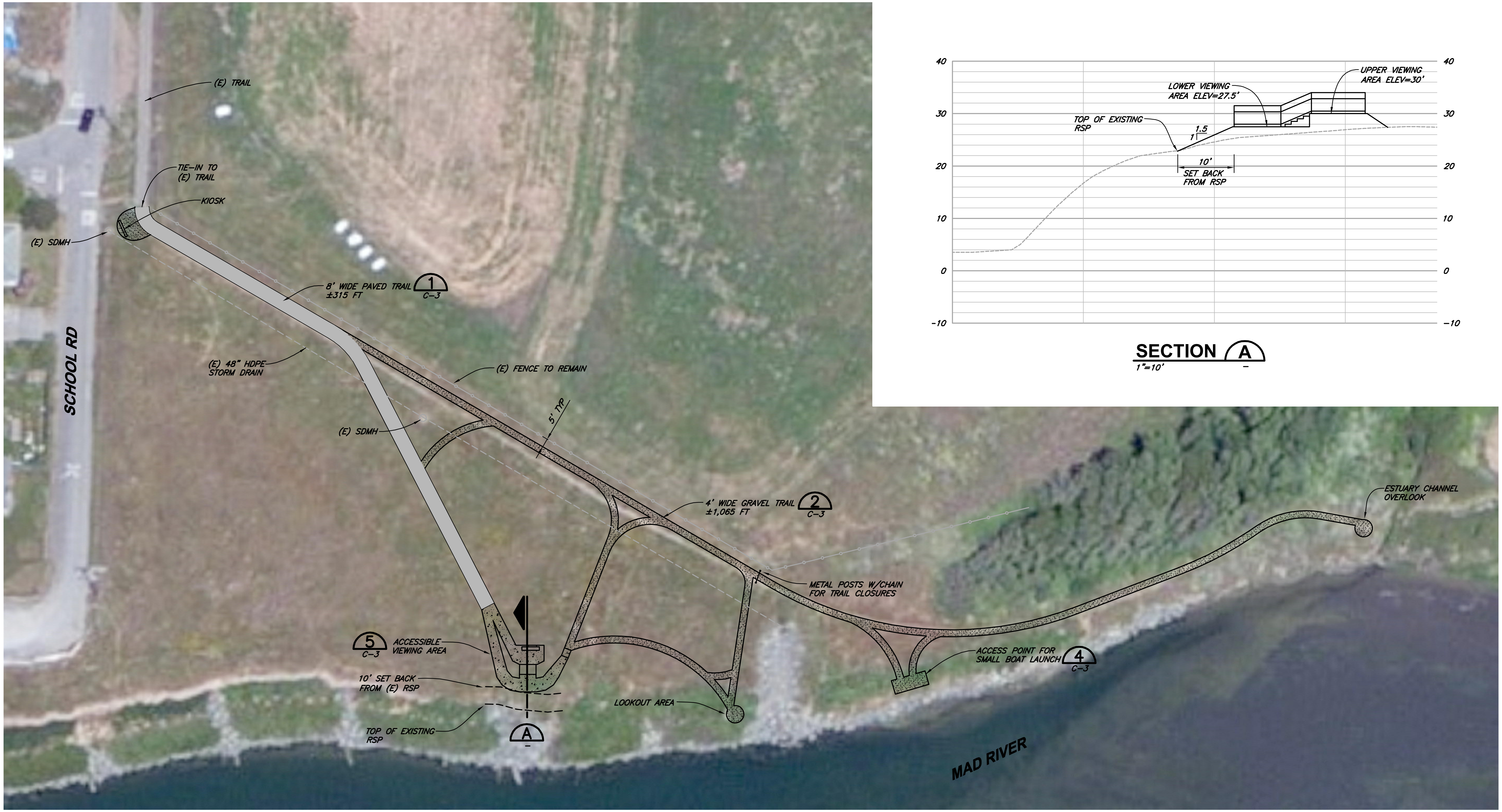
NO.	DATE	REVISION	BY

DSGN	CJL
DR	CDN
CHK	JSO
APVD	

MCKINLEYVILLE COMMUNITY SERVICES DISTRICT
MAD RIVER PUBLIC ACCESS
MCKINLEYVILLE, CALIFORNIA

PROJECT NOTES AND SPECIFICATIONS

SHEET G-3
SEQ
DATE 05/2019
PROJ. NO. 019025.200



SECTION A
1"=10'

PLAN
1"=30'

NOTE:

LOCATIONS ARE GENERALLY DIAGRAMMATIC. CONTRACTOR SHALL VERIFY LOCATIONS OF ALL IMPROVEMENTS WITH OWNER PRIOR TO STARTING ANY CLEARING OR EARTHWORK ACTIVITIES.

LEGEND

- AC PAVING
- CONC PAVING
- GRAVEL PATH

PRELIMINARY

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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CHK JSO
APVD

MCKINLEYVILLE COMMUNITY SERVICES DISTRICT
MAD RIVER PUBLIC ACCESS
MCKINLEYVILLE, CALIFORNIA

SITE PLAN

SHEET C-1
SEQ
DATE 05/2019
PROJ. NO. 019025.200

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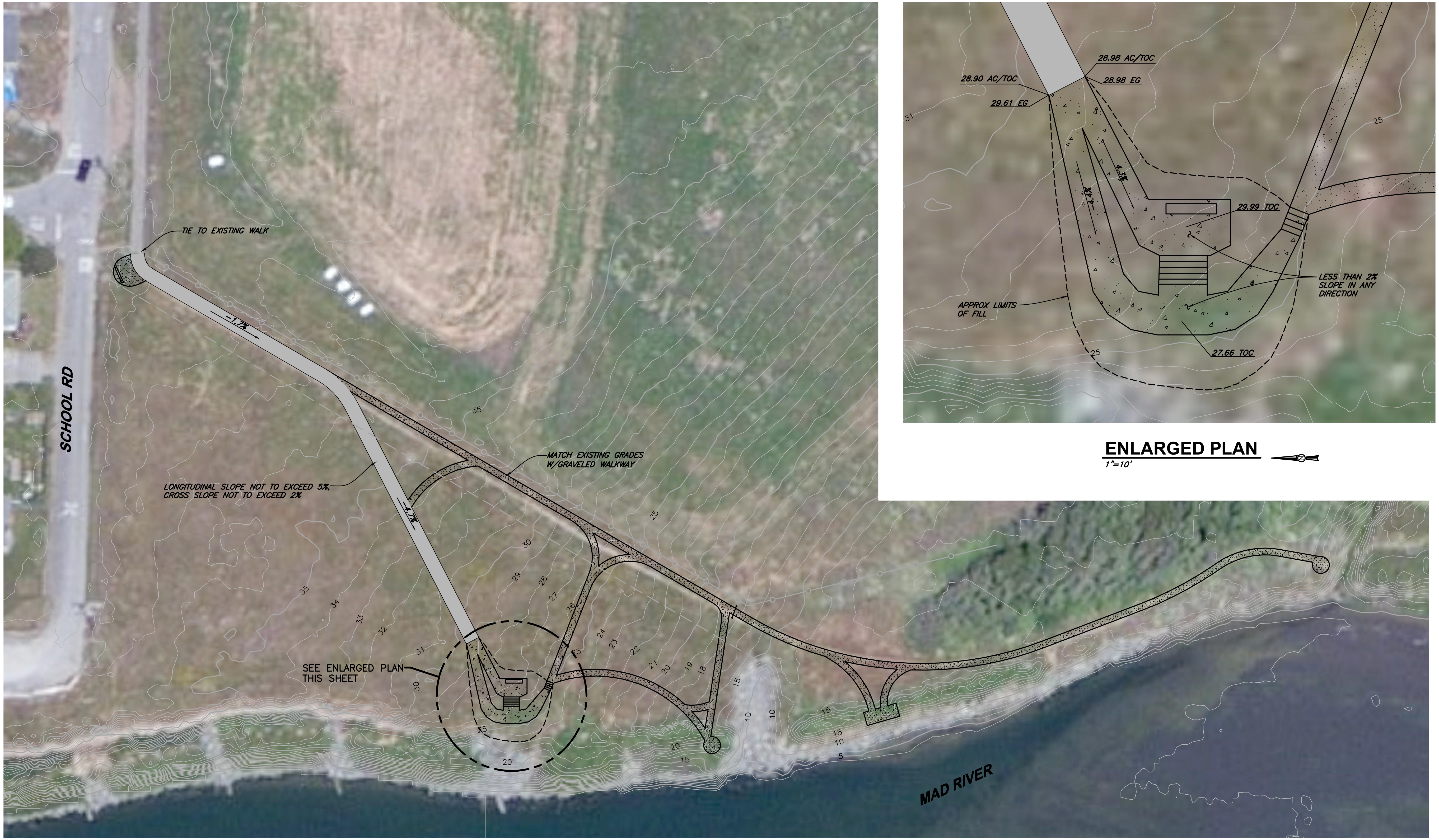

ENLARGED PLAN
1"=10'

PLAN
1"=30'

NOTE:

ALL ELEVATIONS SHOWN SHALL BE VERIFIED PRIOR TO STARTING ANY EXCAVATION ACTIVITIES. CONTRACTOR IS TO VERIFY THAT ALL MINIMUM AND MAXIMUM SLOPES CAN BE ACHIEVED PRIOR TO CONSTRUCTION START. IF THERE IS A CONFLICT NOTIFY OWNER IMMEDIATELY.

PRELIMINARY

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VERIFY SCALES
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0 1"
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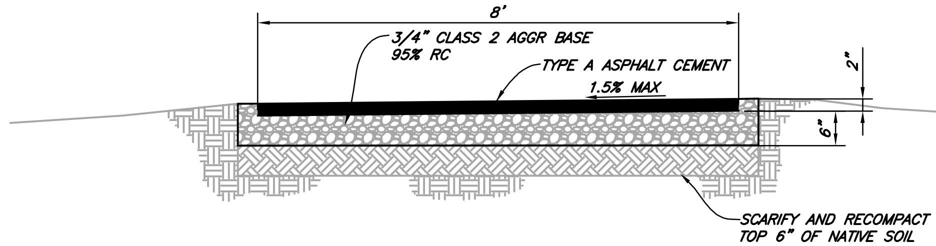
NO.	DATE	REVISION	BY

DSGN	CJL
DR	CDN
CHK	JSO
APVD	

MCKINLEYVILLE COMMUNITY SERVICES DISTRICT
MAD RIVER PUBLIC ACCESS
MCKINLEYVILLE, CALIFORNIA

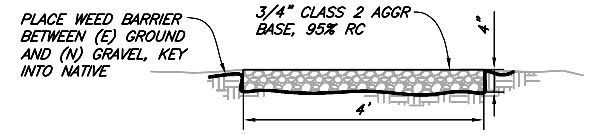
GRADING PLAN

SHEET C-2
SEQ
DATE 05/2019
PROJ. NO. 019025.200



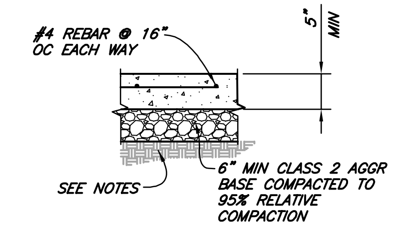
DETAIL 1 NTS C-1

(8' PAVED TRAIL SECTION)



DETAIL 2 NTS C-1

(4' GRAVEL TRAIL SECTION)

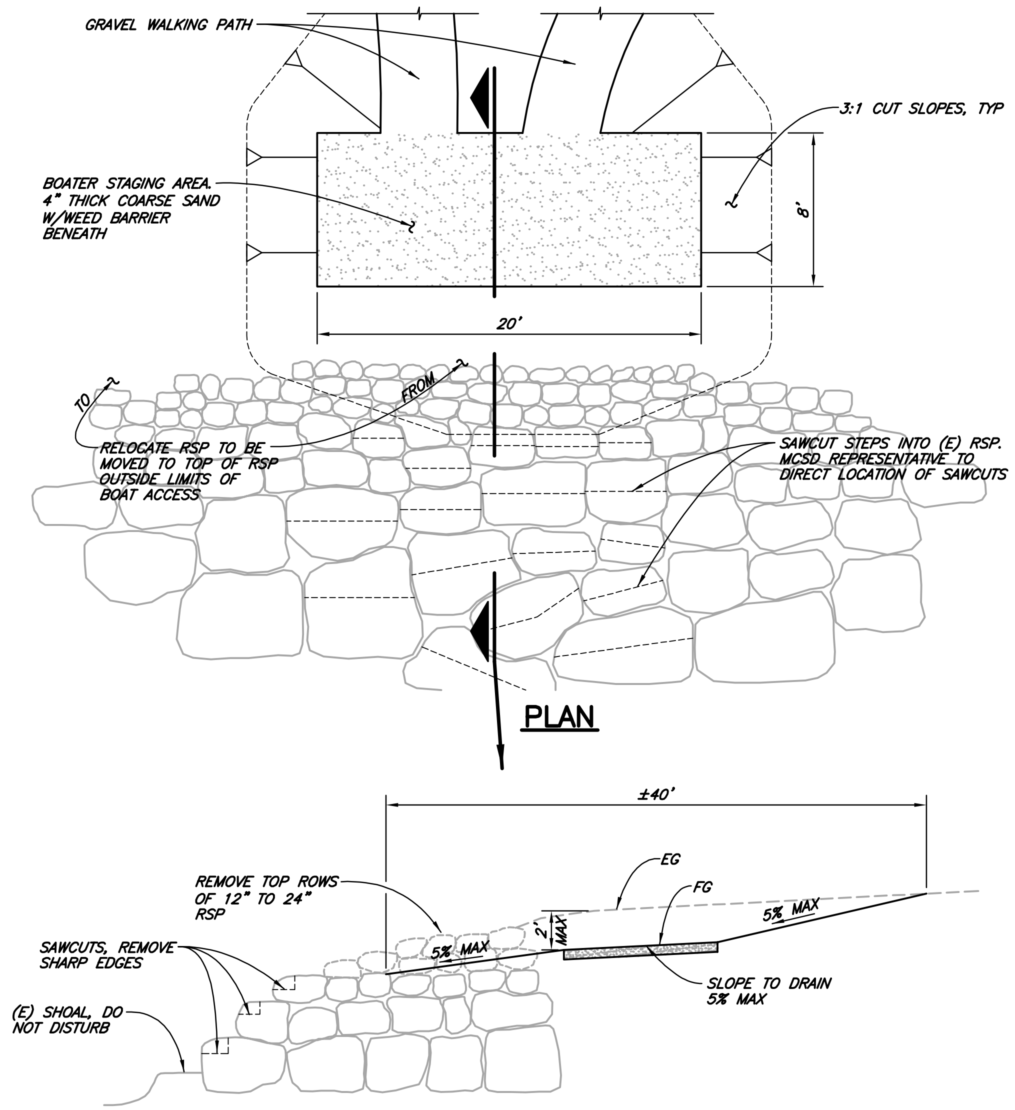


NOTES:

1. FOR EXISTING NATIVE SOIL, SCARIFY AND COMPACT TO 90% RELATIVE COMPACTION.
2. FOR NEW ENGINEERED FILL COMPACT TO 90% RELATIVE COMPACTION.

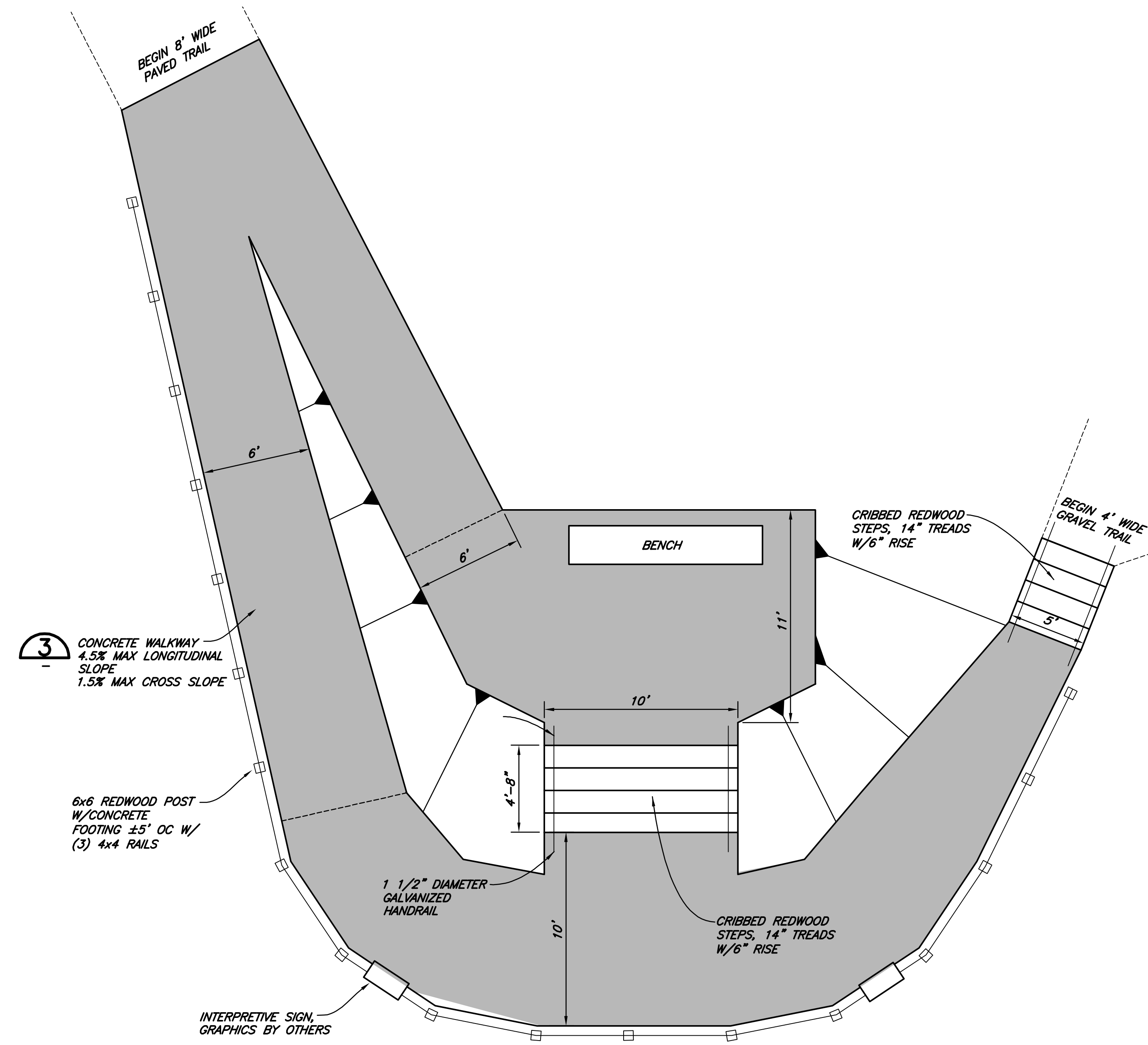
DETAIL 3 NTS –

(CONCRETE WALKWAY SECTION)



DETAIL 4 NTS C-1

(BOAT ACCESS)



DETAIL 5 NTS C-1

(ACCESSIBLE VIEWING AREA)

PRELIMINARY

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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NO.	DATE	REVISION	BY

DSGN CJL
DR CDN
CHK JSO
APVD

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MAD RIVER PUBLIC ACCESS
MCKINLEYVILLE, CALIFORNIA

DETAILS

SHEET C-3
SEQ
DATE 05/2019
PROJ. NO. 019025.200

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EROSION CONTROL PLAN NOTES:

1. CONSTRUCTION OF ALL EROSION CONTROL MEASURES AND BEST MANAGEMENT PRACTICES (BMP'S) SHALL BE IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2. THE IMPLEMENTATION OF THE EROSION CONTROL PLAN (ECP) AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT AND UPGRADING OF THESE BMP'S IS THE RESPONSIBILITY OF THE APPLICANT/CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND PERMANENT VEGETATION/LANDSCAPING IS ESTABLISHED.
3. THE BMP'S SHOWN ON THESE PLANS MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES AND IN SUCH A MANNER AS TO INSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT ENTER THE DRAINAGE SYSTEM, ROADWAYS, OR VIOLATE APPLICABLE WATER STANDARDS.
4. CONTRACTOR TO SCHEDULE AN IN-FIELD PRE-CONSTRUCTION MEETING WITH THE DESIGN ENGINEER BEFORE COMMENCING WORK TO DISCUSS THE INTENT OF THE EROSION CONTROL PLAN.
5. USE NATIVE GRASS SEED TO RESEED DISTURBED AREAS AND MATCH EXISTING VEGETATION TO THE EXTENT POSSIBLE. SEEDED AREAS SHALL BE COVERED WITH STRAW, RICE, OR COIR MULCH AND KEPT MOIST UNTIL GRASSES ESTABLISH.
6. STREET CLEANING MUST BE DONE BY VACUUM SWEEPER, STREET WASHING IS NOT ALLOWED. CONTRACTOR TO PERFORM STREET CLEANING ON PAVED STREETS AFTER CONSTRUCTION IS COMPLETE AND AS DEEMED NECESSARY DURING CONSTRUCTION.
7. INLET PROTECTION TO BE INSTALLED PRIOR TO DEMOLITION AND TO REMAIN IN PLACE UNTIL SURFACING IS COMPLETED, STOCKPILES ARE REMOVED, AND VEGETATION IS RE-ESTABLISHED.
8. SEDIMENT BARRIER TO BE INSTALLED PRIOR TO DEMOLITION AND TO REMAIN IN PLACE UNTIL SURFACING IS COMPLETED, STOCKPILES ARE REMOVED, AND VEGETATION IS RE-ESTABLISHED.

MAINTENANCE AND INSPECTION:

9. MAINTENANCE AND INSPECTION OF BMP'S, AT A MINIMUM, SHALL BE CONDUCTED ACCORDING TO THE FOLLOWING SCHEDULE:
   - BMP'S SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING.
   - BMP'S AT INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH, PRIOR TO A FORECAST STORM, AND WITHIN 24 HOURS FOLLOWING A STORM EVENT.

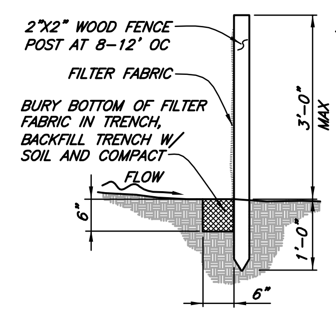
EROSION CONTROL PLAN NOTES (CONTINUED):

STOCKPILES:

10. EXCAVATED SOILS MAY BE PLACED ADJACENT TO THE TOP OF THE TRENCH IF THE STOCKPILED SOIL THICKNESSES ARE 2 FEET OR LESS. IF SOILS ARE PLACED IN MOUNDED STOCKPILES, THEN EXCAVATED SOILS SHOULD BE PLACED NO CLOSER THAN 10 FEET FROM THE TOP OF THE TRENCH EXCAVATION.
11. SOIL STOCKPILES SHALL BE COVERED, STABILIZED, OR PROTECTED WITH SOIL STABILIZATION MEASURES AND A PERIMETER SEDIMENT BARRIER AT ALL TIMES DURING THE RAINY SEASON, AND PRIOR TO THE ONSET OF RAIN DURING THE NON-RAINY SEASON.
12. STOCKPILES OF CONTAMINATED SOIL SHALL BE MANAGED IN ACCORDANCE WITH CALTRANS BMP FOR "CONTAMINATED SOIL MANAGEMENT"

DEWATERING:

13. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE PROPER DESIGN INSTALLATION, OPERATION, AND DESTRUCTION OF DEWATERING FACILITIES NEEDED DURING CONSTRUCTION.
14. CONTRACTOR SHALL ESTABLISH AND MAINTAIN DEWATERING FACILITIES TO ALLOW FOR THE EXCAVATION, AND SUBSEQUENT PLACEMENT AND RECOMPACTION OF TRENCH MATERIAL WITHIN THE EXCAVATED AREA.
15. HANDLING OF WATER FROM THE EXCAVATION AND DISPOSAL OF SAME FROM THE PROJECT SITE SHALL BE PERFORMED IN ACCORDANCE WITH BMP'S TO AVOID SEDIMENT TRANSPORT AND OTHER IMPACTS TO RECEIVING WATERS AS OUTLINED IN THE APPROVED SWPPP FOR THIS PROJECT.
16. SEDIMENT BASINS SHALL BE LOCATED A MINIMUM OF 100 FEET FROM A WATERCOURSE.
17. WATER FROM THE SEDIMENT BASINS SHOULD NOT BE DISCHARGED AS CONCENTRATED FLOW DIRECTLY INTO SLOUGHS, CUTOFF SLOUGHS, STREAMS, OR ANY DITCH THAT DISCHARGES TO ONE OF THESE FEATURES.

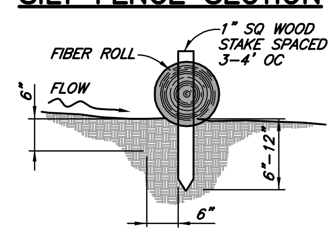


SILT FENCE SECTION

NOTES FOR SILT FENCE:
THE FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST, WITH A MINIMUM 6-INCH OVERLAP, AND BOTH ENDS SECURELY FASTENED TO THE POST.

THE FILTER FABRIC SHALL HAVE A MINIMUM VERTICAL BURIAL OF 6 INCHES.
STANDARD OR HEAVY DUTY FILTER FABRIC FENCE SHALL HAVE MANUFACTURED STITCHED LOOPS FOR 2 INCH X 2 INCH POST INSTALLATIONS.
STITCHED LOOPS SHALL BE INSTALLED ON THE UP HILL SIDE OF THE SLOPED AREA.

WHEN NO LONGER REQUIRED, FILTER FABRIC FENCES SHALL BE REMOVED AND PROPERLY DISPOSED OF.



FIBER ROLL SECTION

NOTES FOR FIBER ROLL:
THE FIBER ROLL SHALL BE PURCHASED IN A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FIBER ROLL SHALL BE SPLICED TOGETHER , WITH A MINIMUM 6-INCH OVERLAP, AND BOTH ENDS SECURELY STAKED.

FIBER ROLLS SHALL BE SEATED IN A TRENCH 2-3 INCHES DEEP TO ENSURE DIRECT CONTACT OF THE FIBER ROLL WITH THE SOIL.

STAKES SHALL BE NO MORE THAN 6" FROM ENDS OF FIBER ROLL

WHEN NO LONGER REQUIRED, SLIT FIBER ROLLS DOWN THE LENGTH OF THE NETTING, AND BROADCAST THE STRAW. GATHER NETTING AND PROPERLY DISPOSE OF.

GENERAL NOTES:

1. THE FILTER FABRIC FENCE SHALL BE INSTALLED TO FOLLOW THE CONTOURS WHERE FEASIBLE.
2. ALL EXCAVATED MATERIAL FROM FILTER FABRIC FENCE INSTALLATION SHALL BE BACK FILLED AND COMPACTED, ALONG THE ENTIRE DISTURBED AREA.
3. BARRIERS SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFUL PURPOSE, BUT NOT BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY PROTECTED AND STABILIZED.
4. SEDIMENT SHALL BE REMOVED WHEN IT BUILDS UP TO 1/3 OF THE BARRIER HEIGHT.

SEDIMENT BARRIER 225
NTS

PRELIMINARY

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SHN
812 W. WABASH AVE.
EUREKA, CA. 95501
WWW.SHN-ENGR.COM
707-441-8855

NO.	DATE	REVISION	BY

DSGN CJL
DR CDN
CHK JSO
APVD

MCKINLEYVILLE COMMUNITY SERVICES DISTRICT
MAD RIVER PUBLIC ACCESS
MCKINLEYVILLE, CALIFORNIA

DETAILS

SHEET C-4
SEQ
DATE 05/2019
PROJ. NO. 019025.200

SAVED: 5/31/2019 4:05 PM CNEWELL, PLOTTED: 5/31/2019 4:08 PM CHRIS D. NEWELL
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Appendix B: Preliminary Engineering

Geologic Report

Preliminary Engineering Geologic Report

Proposed Mad River Public Access Project
McKinleyville, California
APN: 508-021-007

Prepared for:

McKinleyville Community Services District

March 2019

019025.100

812 W. Wabash Avenue, Eureka, CA 95501-2138 707-441-8855
Civil Engineering, Environmental Services, Geosciences, Planning & Permitting, Surveying

Reference: 019025.100

March 6, 2019

Mr. Greg Orsini, General Manager
McKinleyville Community Services District
PO Box 2037
McKinleyville, CA 95519

Subject: Preliminary Engineering Geologic Report, Mad River Public Access Project, McKinleyville, California; APN: 508-021-007

Dear Mr. Orsini:

As requested, SHN is providing this preliminary engineering geologic report for the proposed public access improvements at the west end of School Road in McKinleyville, California. It is our understanding that the project is in the early stages of design, and our investigation was based on schematic drawings provided to us. The enclosed report presents our findings, conclusions, and recommendations to assist you and your design consultants with project planning and final design of the proposed project elements.

This report concludes our work on this phase of the project in accordance with our current agreement. If you have any questions, please call me at 707-441-8855.

Sincerely,

SHN

Jason P. Buck, CEG 2641
Senior Engineering Geologist

JPB:lms

Enclosure: Report

Reference: 019025.100

Preliminary Engineering Geologic Report

Proposed Mad River Public Access Project
McKinleyville, California
APN: 508-021-007

Prepared for:
McKinleyville Community Services District

JASON PAUL BUCK
No. 2641
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Jason P. Buck, CEG 2641
Senior Engineering Geologist

Prepared by:

SHN
812 W. Wabash Ave.
Eureka, CA 95501-2138
707-441-8855

March 2019

QA/QC:JHD

\\Eureka\Projects\2019\019025-Mad-River-Pub-Access\100-R2SoilsReport\PUBS\Rpts\20190306-MadRiverLookoutSoilsRpt.doc

Table of Contents

List of Illustrations

Abbreviations and Acronyms

mm	millimeters
pcf	pounds per cubic foot
µm	micrometers
$(N_1)_{60}$	soil density/blow count
AAPG	American Association of Petroleum Geologists
APN	Assessor's parcel number
ASCE	American Society of Civil Engineers
ASTM	ASTM-International
BGS	below ground surface
CBC	California Building Code
CDMG	California Division of Mines and Geology
CGS	California Geological Survey
HA	boring-number
H:V	horizontal to vertical
M#	magnitude number
MCSD	McKinleyville Community Services District
NR	no reference
OSHA	U.S. Occupational Safety and Health Administration
OSHPD	California Office of Statewide Health Planning and Development
PVC	polyvinyl chloride
SEAOC	Structural Engineers Association of California
SPT	standard penetration test
TP-#	test pit-number
USGS	U.S. Geological Survey

1.0 Introduction

1.1 General

This soils report presents the results of a field and laboratory investigation conducted by SHN to support the design development of the proposed public access improvements along the right bank of the Mad River near the west end of School Road in McKinleyville, California (Figure 1). The project is located on Assessor's parcel number (APN) 508-021-007. The latitude and longitude of the site are 40.933199°N and -124.127550°W, respectively. This report was prepared for the sole use of the McKinleyville Community Services District (MCSD) and its design consultants. The report is intended to satisfy the R-2 soils report requirements set forth by the Humboldt County Building Department.

The conclusions and recommendations presented in this report are provided to assist the project design consultants in the planning, design development, and construction of the proposed improvements. This report is based on our understanding of the proposed project, a review of published geologic literature and mapping in the vicinity of the project site, the data obtained from our field investigation, and the results of laboratory testing performed on samples obtained from the exploratory hand borings excavated during our field investigation.

1.2 Project Description

We understand that the project will consist of the development of a network of public access trails and lookouts along the right bank of the Mad River (Figure 2). The trails will effectively be an extension of the existing pedestrian trail along the south side of School Road. A schematic design prepared by Garrett McSorley, dated November 3, 2017, was provided to us for review. We understand that the project elements and their configurations are preliminary and subject to change during the design phase.

The specific project elements, as shown on the schematic drawings, include a network of pedestrian access trails (paved and gravel), two small overlook/viewing areas, a small boat access, and a main accessible viewing area constructed on a raised fill pad. In Fall 2008, the right bank of the Mad River underwent a major stabilization project. The stabilization was in response to significant erosion of the bluff slopes during the 2005/2006 winter season, and included a combination of large rock and bio-stabilization structures. The as-built designs for the stabilization project were reviewed as part of our assessment of the proposed project.

2.0 Scope of Work

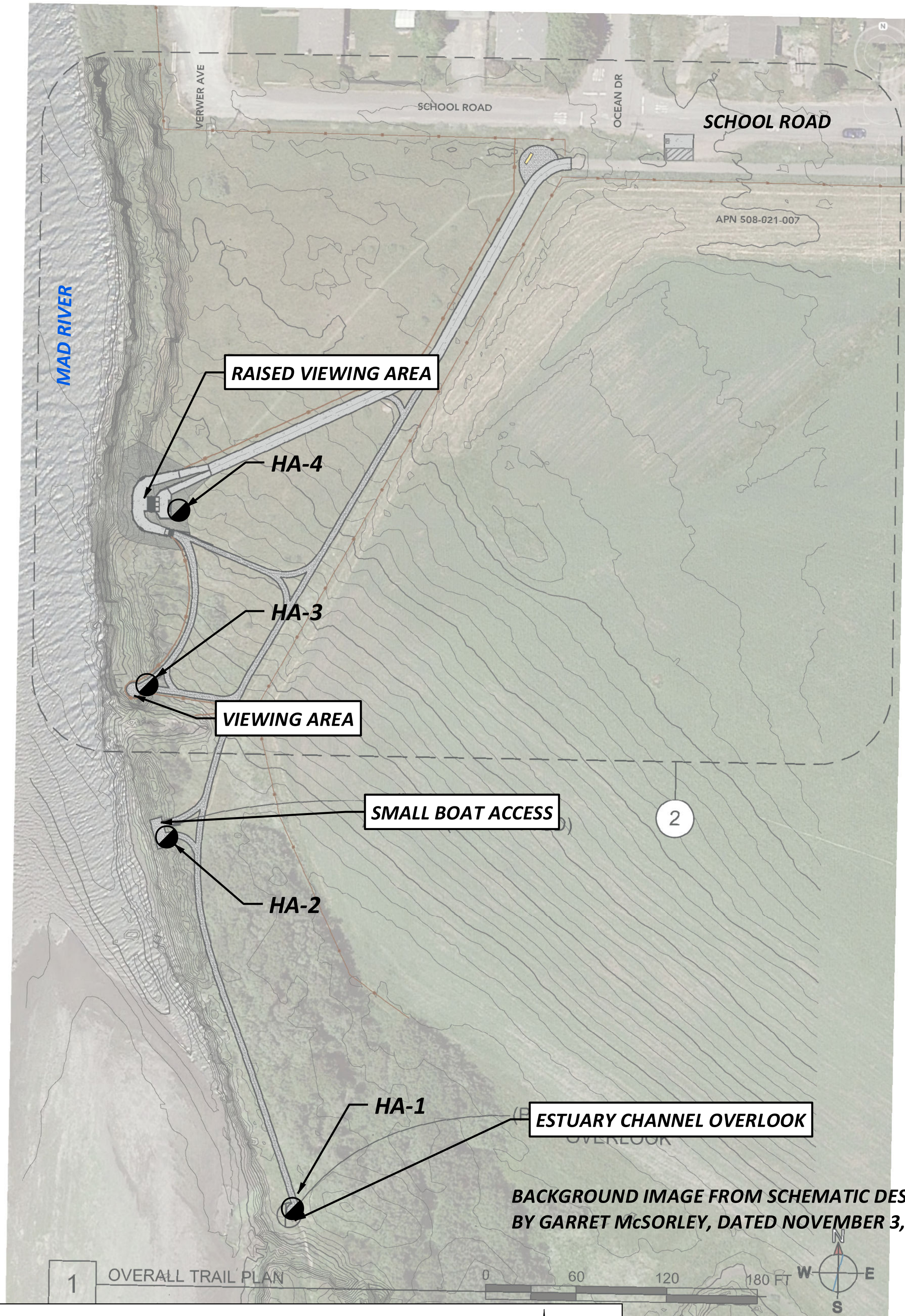
The scope of SHN's services included reviewing available geologic and subsurface information; the excavation of four shallow hand-augered borings; performing laboratory tests on selected soil samples; and providing general recommendations to aid in project planning, design, and construction.

Specifically, the following information, recommendations, and design criteria are presented in this report:

- Description of site terrain and local geology
- Description of soil and groundwater conditions, interpreted based on our field exploration, laboratory testing, and review of existing information

Path: \\EUREKASVRNEW\Projects\2019\019025-Mad-River-Pub-Access\GIS\PROJ_MXD\Figure1ProjectLocation.mxd User Name: hhummel

McKinleyville Community Services District Mad River Public Access Project School Road McKinleyville, CA		Project Location Map SHN 019025.100
March 2019	Figure1ProjectLocation	Figure 1



EXPLANATION

◐ *HAND AUGERED BORING LOCATION AND DESIGNATION*

0 100 ±

1"=100'±

N

McKinleyville Community Services District
Mad River Public Access Project
School Road McKinleyville, CA

Schematic Design w/Boring Locations

SHN 019025.100

March 2019 | Figure2ScheDesignBoringLocat | Figure 2

- Logs of the hand-augered borings (Appendix 1) and results of laboratory tests conducted for this investigation (Appendix 2)
- Assessment of potential earthquake-related geologic/geotechnical hazards (for example, strong earthquake ground shaking, surface fault rupture, liquefaction, slope instability)
- Seismic design parameters in accordance with the applicable portions of the 2016 California Building Code (CBC) and American Society of Civil Engineers (ASCE) 7-10 Standard, including site soil classification, seismic design category, and spectral response accelerations
- General recommendations for new site improvements, including site and subgrade preparation, fill material, and placement and compaction requirements
- Recommendations for observation of subgrade preparation, materials testing and inspection, and other construction considerations.

3.0 Field Investigation and Laboratory Testing

The field exploration and laboratory testing programs performed for this investigation are summarized below.

3.1 Field Exploration Program

On February 22, 2019, a project geologist from SHN logged and sampled four shallow hand-augered borings at the project site. The borings (Figure 2) were excavated to a maximum depth of 5 feet below existing ground surface (BGS). Borings were located at each of the four project elements along the margin of the river. Approximate locations of the borings are shown on Figure 2.

The soils encountered in the borings were logged and field classified in general accordance with the Manual-Visual Classification Method (ASTM-International [ASTM] D 2488). During excavation, the project geologist evaluated the in situ soil consistency based on equipment performance and level of effort required to advance the borings. Final logs, presented in Appendix 1, were prepared based on the field logs, examination of samples in the laboratory, and laboratory test results.

3.2 Laboratory Testing

Selected soil samples were tested in SHN's certified soils-testing laboratory in Eureka, California to determine selected index properties of the subsurface materials. Samples were tested for in-place moisture content and dry density. Results of the tests are provided at the corresponding sample locations on the test pit logs (Appendix 1) and included as Appendix 2.

4.0 Site Conditions

The following sections describe the geologic setting of the site, the site surface conditions, and subsurface soil and groundwater conditions encountered at the time of our field exploration.

4.1 Geologic Setting

Basement rock underlying the project site is composed of late Jurassic- to late Cretaceous-age mélange of the Franciscan Complex (McLaughlin and others, 2000; Clarke, 1992). The Franciscan basement rock is overlain by a variety of late Cenozoic age sedimentary rocks, which in coastal northern Humboldt County, includes the Falor formation and a series of late Pleistocene-age marine terraces (Carver et al., 1984). McKinleyville is located on a particularly well-developed flight of marine terraces that extends from the modern coastline to the hills along the eastern margin of town. These terraces typically consist of an abrasion platform cut across bedrock, covered by sediments typically consisting of near-shore marine deposits and terrestrial alluvial, colluvial, and eolian deposits.

The project site is situated within the Mad River fault zone. The Mad River fault zone is characterized by northwest-trending folds and parallel northeast-dipping thrust faults that have deformed Pleistocene deposits (Manning and Ogle, 1950). The thrust faults and folds are the central part of the on-land portion of the southern end of the Cascadia Subduction zone fold and thrust belt. The geomorphic features associated with thrust faults are difficult to locate precisely.

> *The thrust faults do not generate a well-defined linear scarp; they tend to be represented at the surface as a series of faults following a zone, with individual traces dying out along strike; and as they propagate upwards through the thick sequences of terrace deposits, displacement is taken up along multiple faults and associated fractures and folds so that offset at the ground surface becomes diffused* (Rust, 1982).

Carver, Stephens and Young (1982) suggest that multiple scarps are common (in the thrust fault zone) across zones of up to 500 meters (~1,640 feet) wide.

4.2 Site Description

The project site is situated at an approximate elevation ranging from 10 to 30 feet (Figure 2) relative to mean sea level, on a generally flat surface, southwest of School Road in McKinleyville, California. A fault scarp associated with a splay of the Mad River fault crosses through the subject parcel forming a prominent topographic step. The raised viewing area is situated on the upper surface (~ 25 foot to 30 foot elevation), the small viewing area is located near the base of the topographic step (~15 foot elevation), and the two southern features (boat access and estuary overlook) are on the lower surface (~10 foot to 15 foot elevation). The surface, particularly in the northern portions of the project area has been slightly modified by construction activities associated with the 2008 bluff stabilization project, but otherwise is in a generally natural condition. At the time of our investigation, the project area was vegetated with grasses and small trees/shrubs.

The river bank has been stabilized with a mixture of large rock and bio-engineered structures, generally consisting of alternating layers of fill material and willow branches separated by biodegradable geotextile material. Within the northern portion of the project where the surface elevation rises to approximately 30 feet or more, the stabilization structures do not extend all the way to the top of the bluff surface, leaving a near vertical cut in the exposed native soil anywhere from 5 to 10 feet high.

4.3 Subsurface Soil and Groundwater Conditions

The results of our subsurface investigation and review of exposures in the bluff face indicate that the site is underlain by a mixture of silts and fine sands overlying sandy/silty gravel. The near surface silts and fine sands are interpreted to be river flood deposits and/or aeolian deposits, and extend to depths of 4.5 feet or more. The surface soils on the upper surface are generally older than those on the lower surface. The lower surface is within the flood zone and sediment accumulation continues today, whereas the upper surface is high enough to be out of the influence of the flood events.

Most of the improvements (trails, small viewing areas, boat access) are shallow features and are anticipated to be developed, or founded, on the near-surface silty fine sands. Based on our field observations we characterize these materials as medium dense to medium stiff. Laboratory testing of these materials indicates that they have dry densities ranging from 78 to 89 pounds per square foot (pcf) with moisture contents ranging from 23 to 31 percent.

The footprint of the raised viewing area at the north end of the project, as shown on the schematic drawing, is located at the head of a large rock groin constructed of large rip rap. It appears that the rip rap feature coincides with the location where riverside access was provided for heavy equipment during the 2008 bank stabilization project. The soil profile in this location is anticipated to consist of native sandy/gravelly soils overlain by a fill prism that thins to the east. The specific materials used in the fill prism at this location is not detailed in the as-built drawings, but is anticipated to consist of a wedge of granular backfill overlain by a thick sequence of rip rap.

Groundwater was encountered within the southernmost boring (HA-1) at a depth of 4.5 feet below grade. Groundwater was not observed in the upper 5 feet of each of the other borings, and was not observed within the cutslope along the river. Groundwater levels fluctuate seasonally, and the levels observed during our investigation are anticipated to represent seasonal high levels. We do not anticipate groundwater to be encountered during the construction of the proposed improvements, particularly if the work is conducted during the dry season.

4.4 Geologic Hazards

Potential geologic/geotechnical hazards common to the local area include seismic ground shaking, surface fault rupture, seismically induced ground deformation (liquefaction and seismic compaction), and slope instability. Our assessment of these potential hazards is presented below.

4.4.1 Seismic Ground Shaking

The entire North Coast region is a seismically active area where strong seismic shaking presents a significant hazard. The project site is transected by a fault scarp associated with a splay of the Mad River fault zone. Faults considered active by the State of California are within close proximity to the project site including the Mad River and McKinleyville faults to the northeast and the Fickle Hill fault to the southwest. The Cascadia Subduction zone is located about 40 miles southwest of the project site, offshore. Cascadia earthquakes occur roughly every 300 to 500 years, and may have magnitudes ranging from magnitude M8.5 to M9.0. A rupture event originating on any one of these nearby faults would generate very strong shaking at the site.

4.4.2 Surface Rupture

The project site is transected by a splay of the Mad River fault, which is expressed as a northwest-southeast trending topographic step (fault scarp). This fault splay is not designated as “active” by the State of California and is, therefore, not located within an Earthquake Fault Zone (CGS, 2018). The nearest active fault is the Mad River fault, located approximately 4,000 feet east-northeast of the project.

4.4.3 Liquefaction

Liquefaction is the sudden loss of soil shear strength due to a rapid increase of soil pore water pressure caused by cyclic loading from a seismic event.

Generally, in order for liquefaction to occur, the following soil conditions are needed:

- Non-plastic granular soils (sand, silty sand, sandy silt, and some gravels)
- A shallow depth to groundwater (less than 50 feet BGS)
- Low relative density soil (standard penetration test [SPT] blow count $[N_1]_{60}$ less than 30, usually associated with materials of young geologic age)

The adverse effects of liquefaction include localized ground settlement, ground cracking and expulsion of water and sand (sand boils), the partial or complete loss of bearing and confining forces used to support loads, amplification of seismic shaking, and lateral spreading.

Susceptibility to liquefaction decreases with increasing geologic age, due to the effects of weathering, and the degree of densification, compaction, and/or cementation. Based on the published results of geotechnical testing and post-earthquake studies, the susceptibility of sediments to liquefaction can be directly correlated to the type, origin, and age of the deposits. Geologic materials most susceptible to liquefaction are geologically recent (that is, late Holocene age) sand- and silt-rich deposits, located adjacent to streams, rivers, bays, or ocean shorelines. It should be noted that these “most susceptible” conditions do not exist in the late Pleistocene marine terrace deposits at the site. Youd and Hoose (1978) estimated liquefaction susceptibility of Pleistocene-age terraces as “low.”

Based on our subsurface investigation, we interpret the northern portion of the site to be underlain by medium dense to dense, late Pleistocene-age marine terrace deposits, which we conclude to have a low potential for seismically induced liquefaction to occur. The southern, low elevation portions of the project are interpreted to be underlain by geologically young sediments associated with fluvial processes (active channel migration, floods) and, therefore, have a moderate to high potential for seismically induced liquefaction to occur.

4.4.4 Slope Instability

The proposed developments are primarily situated on flat to gently sloping ground. The right bank of the river presents the greatest slope instability hazard. As part of the stabilization effort carried out in 2008, a continuous buttress of large rock and bioengineering structures has armored the bluff face from erosion throughout the project area. Based on our review of the as-built documents, site photos, and video collected during the construction, we conclude that the bluff slope has been effectively stabilized; however, the bluff slope free face that extends above the armored section remains subject to erosion and potential slope failure. Provided our recommendations are adhered to, we conclude that the potential for slope instability to affect the development is low.

5.0 Conclusions and Recommendations

Based on the results of our current field and laboratory investigation, it is our opinion that the project is feasible from a geotechnical standpoint, provided that our recommendations are implemented during design and construction. The geotechnical considerations for development of the proposed improvements include the potential for strong seismic shaking, and the presence of variable subgrade materials including native silts, sands and fine gravel, and fill materials (gravel, bioengineered materials, rip rap) associated with the 2008 bluff stabilization project. In general the project elements consist of low-risk features relative to public safety (that is, no buildings or structures).

The most significant feature proposed is the raised accessible viewing area, which is currently proposed to be constructed on an existing rip rap slope in close proximity to the river's edge. Final configuration and design will be important to maintain stability of the existing bluff and promote long-term performance of the viewing platform. The primary geologic/geotechnical considerations in design and construction of the proposed project elements include suitable subgrade preparation, fill placement, and protection from fluvial erosion along the low elevation areas. Poor long-term stability of paved surfaces and settlement of improvements represent the greatest risks to the project. Our recommendations to mitigate these risks are provided below.

5.1 Seismic Design Criteria

Based on the subsurface conditions encountered at our exploration locations, laboratory test results, and our interpretation of soil conditions within 100 feet of the ground surface, we classify the site as a Site Class D consisting of a "stiff soil profile" in accordance with Chapter 20 of ASCE 7-10. On this basis, the mapped and design spectral response accelerations were determined using the Structural Engineers Association of California (SEAOC) and California's Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps (Accessed March 5, 2019) website in conjunction with the site class and the site coordinates (40.933199°N, -124.127550°W). Calculated values for ASCE 7-10 are presented in Table 1.

Table 1. ASCE 7-10 Standard Seismic Design Parameters
Mad River Public Access Project
McKinleyville, California

Parameter	Calculated Value
S_S	2.558
S_1	1.042
F_a	1.0
F_v	1.5
S_{MS}	2.558
S_{M1}	1.563
S_{DS}	1.705
S_{D1}	1.042
Risk Category	II
Seismic Design Category	E

5.2 General Site Preparation and Grading

- As appropriate, notify Underground Service Alert prior to commencing site work, and use this location service and other methods to avoid injury or risk to life, and to avoid damaging underground and/or overhead utilities.
- The following earthwork recommendations assume the work described herein will be completed during dry season conditions. Additional construction costs are likely to be incurred if the owner or contractor chooses to conduct the work during or immediately following the wet season. If grading commences in the winter or spring, or after a period of excessive rainfall, the surficial soils will become saturated due to the presence of fine-grained material. Wet or saturated soil may cause difficulties in access with grading and trenching equipment and difficulties in loading, spreading, and compaction of fill material.

- The contractor should be made aware that earthwork that is partially completed prior to the rainy season, but not fully completed, may need to be re-done and re-tested to achieve the compaction requirements specified in this report. Aerating of exposed subgrades in areas requiring over-excavation and replacement with engineered fill will likely be required.
- Site preparation for the construction of pathways and other shallow surficial improvements should include the stripping of the vegetation and upper weak, compressible topsoil and/or soft/loose fill. Prior to placement of the subgrade section (for paved paths or slabs) or gravel (for unpaved paths), the excavated subgrade should be scarified to a depth of 6 inches, moisture conditioned or aerated, and recompacted to 90 percent relative compaction[1]. A qualified representative of SHN should observe and approve the subgrade preparation and placement of fill. The excavated area can then be brought to planned grades with engineered fill compacted to a minimum of 90 percent relative compaction.
- Where soft, loose or otherwise unsuitable subgrade materials are encountered, overexcavation and backfill may be necessary to rebuild a suitable subgrade. The use of geotextile fabric or other stabilization techniques may be appropriate based on the nature and extent of the unsuitable materials.
- All active or inactive utility lines within the construction areas should be relocated, abandoned, or fully protected during new construction.
    - Pipelines to be abandoned in place should be filled with a two-sack cement slurry mix.
    - Excavations resulting from removal of buried utilities should be backfilled with properly compacted engineered fill.

5.3 Engineered Fill Placement and Compaction

Fill placed in areas to support pavement or other flatwork should meet the requirements for select engineered fill. Engineered fill should have less than 2 percent by dry weight of vegetation and deleterious material and should meet the gradation requirements presented in Table 2.

Table 2. Fill Gradation Criteria
Mad River Public Access Project
McKinleyville, California

Sieve Designation	Percent Passing by Dry Weight
3-inch (50 mm)[1]	100
1½-inch (37.5 mm)	90 minimum
¾-inch (19 mm)	70 minimum
No. 4 (4.75 mm)	60 minimum
No. 200 (75 µm)[2]	5 minimum; 30 maximum
1. mm: millimeters 2. µm: micrometers	

- Fine-grained soil with a liquid limit greater than 40 and a plasticity index greater than 15 should not be used as engineered fill. If clayey soils do not meet the plasticity requirements, mixing of the clayey soils with sandier soils may be required. Crushing and/or removal of rock particles greater than 3 inches in size will be required.

1 Relative compaction refers to the in-place dry density of a soil expressed as a percentage of the maximum dry density of the same soil, as determined by the ASTM D1557-12 Test Method. Optimum moisture content is the water content (percentage by dry weight) corresponding to the maximum dry density.

- Debris-rich fills at the site are unlikely to meet the criteria for engineered fills.
- All imported fill materials should be observed, tested, and approved by SHN prior to transportation to the site.
- Engineered fill should be placed in loose lifts not exceeding 8 inches in thickness and compacted to a minimum of 90 percent relative compaction.
- A qualified field technician should be present to observe fill placement and perform field density tests in accordance with ASTM D 6938 at random locations throughout each lift to verify the specified compaction is being achieved.

5.4 Raised Accessible Viewing Area

The raised viewing area is schematically shown on the top of a large rip rap feature interpreted to be the backfilled access ramp used during the 2008 bluff stabilization project. The specific backfill materials, thicknesses, and placement techniques used to construct the feature are not documented in the as-built drawings. We assume, for the purposes of this preliminary report, that they are consistent with the adjacent project elements that were documented, and that the fill prism forms a stable surface on which to build. We recommend contacting the contractor that did the stabilization work to see if any additional information is available. If any additional information becomes available or field conditions during construction suggest otherwise, we should be consulted to review the potential impacts to our recommendations.

The footprint of the proposed fill prism to support the viewing platform is underlain by both the rip rap fill and adjacent native ground. The transitions between native and rock fill should be designed to minimize the potential for differential settlement, particularly where flatwork directly overlies the transition. This can be accomplished by using stepped transitions and/or interlayered fill with geotextile fabric or geogrids. Sharp transitions between materials of distinctly different densities should be avoided.

Subgrade preparation on a surface that consists of existing rip rap should include the placement of coarse to progressively finer rock to fill the void space and create a relatively flat surface. Geotextile or other separation medium may be necessary to minimize the future development of void spaces beneath flatwork areas.

Where the footprint of the fill prism intersects the steep native cut slope on either side of the rip rap feature, the native subgrade should be stepped as necessary to achieve an overall slope transition no steeper than 1.5:1 H:V (horizontal:vertical).

The face of the fill prism should be sited appropriately to minimize the potential for impact to the existing rip rap feature and maintain long-term stability of the proposed viewing platform. Preliminarily, we recommend maintaining a setback of 10 feet from the top of the existing 1:1 H:V section of the rip rap and designing the new slope at a 1.5:1 H:V. The final design and configuration of the gravity wall as shown on the schematic drawings will be an important consideration in the appropriate positioning and configuration of the overall viewing area.

6.0 Construction Considerations

The following construction considerations are presented to aid in project planning. They are not intended to be comprehensive.

Groundwater is not anticipated to be encountered during the construction of the proposed project, provided the work is performed during the dry months. However, groundwater levels can fluctuate during the wet season due to prolonged periods of precipitation and other factors resulting in groundwater levels higher than observed during our investigation. It is important to note that even small quantities of persistent seepage can substantially complicate construction operations (such as, due to infiltration of surface runoff, or when foundation excavations are extended near the groundwater surface).

Excavations may be subject to sidewall instability (sloughing, running, or sudden collapse). The contractor is responsible for planning, scheduling, and implementing construction activities and associated construction site safety issues. OSHA Excavation and Trench Safety Standards, and applicable local, state, and federal regulations should be acknowledged and followed.

7.0 Additional Services

We suggest communications be maintained during the design phase between the design team and SHN to optimize compatibility between the design and soil conditions. We also recommend that SHN be retained during the construction phase to verify the implementation of our recommendations related to earthwork.

7.1 Plan and Specification Review

We have assumed, in preparing our recommendations, that SHN will be retained to review those portions of the plans and specifications that pertain to earthwork and foundations, if prepared by others. The purpose of this review is to confirm that our earthwork and foundation recommendations have been properly interpreted and implemented during design. If we are not provided this opportunity for review of the plans and specifications, our recommendations could be misinterpreted.

7.2 Construction-Phase Monitoring

In order to assess construction conformance with the intent of our recommendations, it is important that a representative of SHN perform the following tasks:

1. Review subgrade preparation.
2. Observe excavation, site preparation, and grading for earth wall construction.
3. Observe and test placement of structural fill and backfill.
4. Observe placement and compaction of subgrade and aggregate base in asphalt-paved areas.

This construction-phase monitoring is important, because it provides the stakeholders and SHN the opportunity to verify anticipated site conditions and recommend appropriate changes in design or construction procedures if site conditions encountered during construction vary from those described in this report. It also allows SHN to recommend appropriate changes in design or construction procedures if construction methods adversely affect the competence of onsite soils to support the structural improvements.

8.0 Limitations

The geotechnical conclusions and recommendations presented in this report are intended for planning and design of the proposed improvements at the project site as described in this report. These conclusions and recommendations may not apply if:

- changes are made to the proposed construction,
- the report is used for a different site,
- the recommendations given in this report are not followed, or
- any other change is made that materially alters the proposed project.

The analyses and recommendations presented in this report are based upon interpretation of data obtained from the exploration locations located approximately, as shown on Figure 2 and on general field observations made during the site investigation. Subsurface exploration of any site is necessarily confined to selected locations and subsurface conditions may, and usually do, vary between and around these locations. Any person associated with this project who observes conditions or features of the site or its surrounding areas that are different from those described in the report should report them immediately to SHN for evaluation. If varied conditions come to light during project development, SHN should be given the opportunity to evaluate the need for additional exploration, testing, or analysis.

The proposed project has only been schematically designed and it's important to note that the recommendations and design criteria given in this report are correspondingly general in nature. Final design development will require review of existing conditions and recommendations that are specific to the final location, design details, and any special requirements of the new construction. For this reason, we recommend SHN be given the opportunity to review the geotechnical elements of project grading, subgrade preparation, and specifications to check that the intent of our recommendations have been incorporated into these project documents. If SHN does not review the geotechnical elements of the plans and specifications, the reviewing geotechnical engineer should thoroughly review this report and should agree with its conclusions and recommendations or otherwise provide alternative recommendations. Furthermore, if another geotechnical consultant is retained for follow-up service to this report, SHN will at that time cease to be the Geotechnical Engineer-of-Record. SHN cannot assume responsibility or liability for the adequacy of our geotechnical recommendations unless SHN is retained to observe the soil-related portions of the construction.

This report was prepared in accordance with the generally accepted standards of geotechnical engineering practice in Humboldt County at the time this report was written. No other warranty, express or implied, is made. It is the owner's responsibility to see that all parties to the project, including the designers, contractors, and subcontractors, are made aware of this report in its entirety.

9.0 References

American Society of Civil Engineers. (2010). "ASCE 7-10: Minimum Design Loads for Buildings and Other Structures." Reston, VA:ASCE.

California Geologic Survey. (2018). "Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California," Special Publication 42, Revised 2018. Sacramento, CA:CGS.

California Building Standards Commission. (July 1, 2016). 2016 California Building Standards Code (Cal. Code Regs., Title 24). Based on International Building Code (2015) by the International Code Council. Sacramento, CA:California Building Standards Commission.

Carver, G. A., Stephens, T. A., and Young, J. C. (1982). Quaternary Faults-Mad River Fault Zone. Friends of the Pleistocene, 1982 Pacific Cell Field Trip, Late Cenozoic History and Forest Geomorphology of Humboldt County, California. 7.5 Minute Quad Maps. p 93-99

Carver, G. A., T. A. Stephens, and J. C. Young. (1984). “Quaternary Geologic Map of the Mad River Fault Zone, Arcata North 7.5’ quadrangle.” Unpublished preliminary map for the California Division of Mines and Geology State Map Project, scale 1:24,000. Sacramento, CA:CDMG.

Clarke, S.H., Jr. (1992). “Geology of the Eel River Basin and Adjacent Region: Implications for Late Cenozoic Tectonics of the Southern Cascadia Subduction Zone and Mendocino Triple Junction,” *AAPG Bulletin, v. 76, no. 2*, p. 199-224. Tulsa, OK:AAPG.

Manning, G. A. and Ogle, B. A. (1950). Geology of the Blue Lake Quadrangle: California Department of Natural Resources, Divisions of Mines, Bulletin 148.

McLaughlin, R.J., and 7 others. (2000). “Geology of the Cape Mendocino, Eureka, Garberville, and Southwestern part of the Hayfork 30 x 60 Minute Quadrangles and Adjacent Offshore Area, Northern California,” *U.S. Geological Survey Miscellaneous Field Studies MF-2336*. NR:USGS.

Rust, D. (1982). Late Quaternary Coastal Erosion, Faulting and Marine Terraces in the Trinidad Area, Humboldt County, Northern California. Friends of the Pleistocene, 1982 Pacific Cell Field Trip, Late Cenozoic History and Forest Geomorphology of Humboldt County, California. p. 107-129

Structural Engineers Association of California’s (SEAOC) and California’s Office of Statewide Health Planning and Development (OSHPD). (2019). Seismic Design Maps. Accessed 1/10/2019. https://seismicmaps.org/

Youd, T.L., and S.N. Hoose. (1978). *Historic Ground Failures in Northern California Triggered by Earthquakes: Geological Survey Professional Paper Number 993*. Washington, D.C.:United States Government Printing Office.

Subsurface Exploration Logs 1

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Mad River Public Access
LOCATION: Estuary Channel Overlook
GROUND SURFACE ELEVATION: ~12'
EXCAVATION METHOD: Hand Auger
LOGGED BY: A.Call

JOB NUMBER: 019025.100
DATE DRILLED: 2/22/19
TOTAL DEPTH OF BORING: 5.0 Feet BGS
SAMPLER TYPE: 2.5" O.D. brass shelby tube; hand hammer drive

BORING NUMBER HA-1

DEPTH (FT)	BULK SAMPLES	SHELBY TUBE	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	U.C. (psf) by P.P.	% Passing 200	REMARKS
0.0				SM		SILTY SAND, grayish brown, loose to medium dense, moist, very fine sand.						
-1.0		Sample	3				23.3	88				
						Becomes less silty, brownish gray.						
-2.0				ML		SILT WITH SAND, brownish gray, soft, moist, very fine sand.						
-3.0						Alternating layers of very fine sandy silt and silty very fine sand. Becomes wet, with fine common reddish brown mottles.						
-4.0												
▽ (water)												
-5.0												
-6.0						Bottom of boring at 5 feet BGS. Free water encountered at 4.5 feet BGS.						
-7.0												
-8.0												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Mad River Public Access
LOCATION: Small Boat Access
GROUND SURFACE ELEVATION: ~12'
EXCAVATION METHOD: Hand Auger
LOGGED BY: A.Call

JOB NUMBER: 019025.100
DATE DRILLED: 2/22/19
TOTAL DEPTH OF BORING: 5.0 Feet BGS
SAMPLER TYPE: 2.5" O.D. brass shelby tube; hand hammer drive

BORING NUMBER HA-2

DEPTH (FT)	BULK SAMPLES	SHELBY TUBE	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	U.C. (psf) by P.P.	% Passing 200	REMARKS
0.0 – -1.75				SM		SILTY SAND, grayish brown, loose to medium dense, moist, very fine sand.						
-1.75 – -3.75		-2.0 – -2.5	5	ML		SILT WITH SAND, brownish gray, soft, moist, very fine sand.	28.5	89				
-3.75 – -5.0				ML/SM		SILTY SAND/SANDY SILT WITH GRAVEL, dark brown, medium stiff/ medium dense, damp to moist, fine roots, fine rounded gravel.						
-5.0 – -8.0						Bottom of boring at 5 feet BGS. No free water observed.						

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

PROJECT: Mad River Public Access
LOCATION: Viewing Area
GROUND SURFACE ELEVATION: ~15'
EXCAVATION METHOD: Hand Auger
LOGGED BY: A.Call

JOB NUMBER: 019025.100
DATE DRILLED: 2/22/19
TOTAL DEPTH OF BORING: 5.0 Feet BGS
SAMPLER TYPE: 2.5" O.D. brass shelby tube; hand hammer drive

BORING NUMBER HA-3

DEPTH (FT)	BULK SAMPLES	SHELBY TUBE	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	U.C. (psf) by P.P.	% Passing 200	REMARKS
0.0				ML/SM		SILTY SAND/SANDY SILT WITH GRAVEL, dark brown, medium stiff/medium dense, damp to moist, fine roots, fine rounded gravel.						
		■	6				27.1	84				
-1.0												
-2.0						Grades to less dark brown, increased sand content.						
-3.0				SM		SILTY SAND, brown, medium dense, damp						
		■	4				30.0	82				
-4.0												
		■	4	SP/SM		SAND WITH SILT, yellowish brown, medium dense, moist.	27.7	85				
-5.0												
-6.0						Bottom of boring at 5 feet BGS. No free water observed.						
-7.0												
-8.0												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

SHN Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877

BORING NUMBER HA-4

PROJECT: Mad River Public Access

LOCATION: Raised Viewing Area

GROUND SURFACE ELEVATION: ~27'

EXCAVATION METHOD: Hand Auger

LOGGED BY: A.Call

JOB NUMBER: 019025.100

DATE DRILLED: 2/22/19

TOTAL DEPTH OF BORING: 5.0 Feet BGS

SAMPLER TYPE: 2.5" O.D. brass shelby tube; hand hammer drive

DEPTH (FT)	BULK SAMPLES	SHELBY TUBE	BLOWS PER 0.5'	USCS	PROFILE	DESCRIPTION	% Moisture	Dry Density (pcf)	Unc. Com. (psf)	U.C. (psf) by P.P.	% Passing 200	REMARKS
0.0						FILL: GRAVELLY SANDY SILT, dark brown, medium stiff, damp to moist.						
-1.0				ML/ SM		SILTY SAND/SANDY SILT WITH GRAVEL, dark brown, medium stiff/ medium dense, damp to moist, fine roots, fine rounded gravel.						Fill thickness anticipated to increase towards the west.
-2.0												
			11			Grades to less dark brown, increased sand content.	31.1	78				
-3.0												
-4.0				SM		SILTY SAND, yellowish brown, medium dense, damp						
			10				26.3	82				
-5.0												
-6.0						Bottom of boring at 5 feet BGS. No free water observed.						
-7.0												
-8.0												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

Laboratory Test Results 2

SHN CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash Eureka, CA 95501-2138 Tel: 707/441-8855 FAX: 707/441-8877 E-mail: shninfo@shn-engr.com

DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

Project Name:	**Mad River Bluff**	**Project Number:**	**019025.100**
Performed By:	**JMA**	**Date:**	**2/27/2019**
Checked By:	**NAN**	**Date:**	**2/28/2019**
Project Manager:	**JPB**		

Lab Sample Number	19-159	19-160	19-161	19-162	19-163
Boring Label	HA1	HA2	HA3	HA3	HA3
Sample Depth (ft)	.75-1.25	2-2.5	.5-1.0	3.75-4.25	4.5-5.0
Diameter of Cylinder, in	2.38	2.38	2.38	2.38	2.38
Total Length of Cylinder, in.	7.85	8.00	7.83	6.50	13.45
Length of Empty Cylinder A, in.	0.00	0.00	0.00	0.00	0.00
Length of Empty Cylinder B, in.	1.89	1.90	1.77	1.70	9.10
Length of Cylinder Filled, in	5.96	6.10	6.06	4.80	4.35
Volume of Sample, in^3	26.51	27.14	26.96	21.35	19.35
Volume of Sample, cc.	434.50	444.71	441.79	349.93	317.13

Pan #	s29	s25	s27	s19	s17
Weight of Wet Soil and Pan	903.9	960.3	910.0	819.7	783.0
Weight of Dry Soil and Pan	761.2	779.8	748.3	682.3	663.4
Weight of Water	142.7	180.5	161.7	137.4	119.6
Weight of Pan	147.5	145.4	152.4	224.7	231.7
Weight of Dry Soil	613.7	634.4	595.9	457.6	431.7
Percent Moisture	23.3	28.5	27.1	30.0	27.7
Dry Density, g/cc	1.41	1.43	1.35	1.31	1.36
Dry Density, lb/ft^3	88.2	89.1	84.2	81.6	85.0

SHN CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash Eureka, CA 95501-2138 Tel: 707/441-8855 FAX: 707/441-8877 E-mail: shninfo@shn-engr.com

DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

Project Name:	**Mad River Bluff**	**Project Number:**	**019025.100**
Performed By:	**JMA**	**Date:**	**2/27/2019**
Checked By:	**NAN**	**Date:**	**2/28/2019**
Project Manager:	**JPB**		

Lab Sample Number	19-164	19-165			
Boring Label	HA4	HA4			
Sample Depth (ft)	2-2.5	4.5-5			
Diameter of Cylinder, in	2.38	2.38			
Total Length of Cylinder, in.	13.45	13.50			
Length of Empty Cylinder A, in.	6.70	0.00			
Length of Empty Cylinder B, in.	0.45	4.50			
Length of Cylinder Filled, in	6.30	9.00			
Volume of Sample, in^3	28.03	40.04			
Volume of Sample, cc.	459.29	656.12			

Pan #	s18	s20			
Weight of Wet Soil and Pan	969.9	1307.6			
Weight of Dry Soil and Pan	792.4	1081.8			
Weight of Water	177.5	225.8			
Weight of Pan	221.8	221.7			
Weight of Dry Soil	570.6	860.1			
Percent Moisture	31.1	26.3			
Dry Density, g/cc	1.24	1.31			
Dry Density, lb/ft^3	77.6	81.8			

Eureka, CA | Arcata, CA | Redding, CA | Willits, CA | Coos Bay, OR | Klamath Falls, OR

www.shn-engr.com

Appendix C: Soil Testing Results

SHN CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash • Eureka, CA 95501-2138 • 707-441-8855 • FAX: 707-441-8877 •shninfo@shn-engr.com

Reference: 015169

June 28, 2016

Ms. Mary Burke
California Trout, Inc.
615 - 11th Street
Arcata, CA 95521

Subject: **Fieldwork Summary, Suitability of Levee Material for Reuse as Fill for McKinleyville Community Services District Ponds, Mad River, McKinleyville, California**

Introduction

This letter presents the results of SHN Engineers & Geologists summary of fieldwork and qualitative assessment for the potential reuse of pond levee soils as select engineered and/or general fill material. The scope of work included the following:

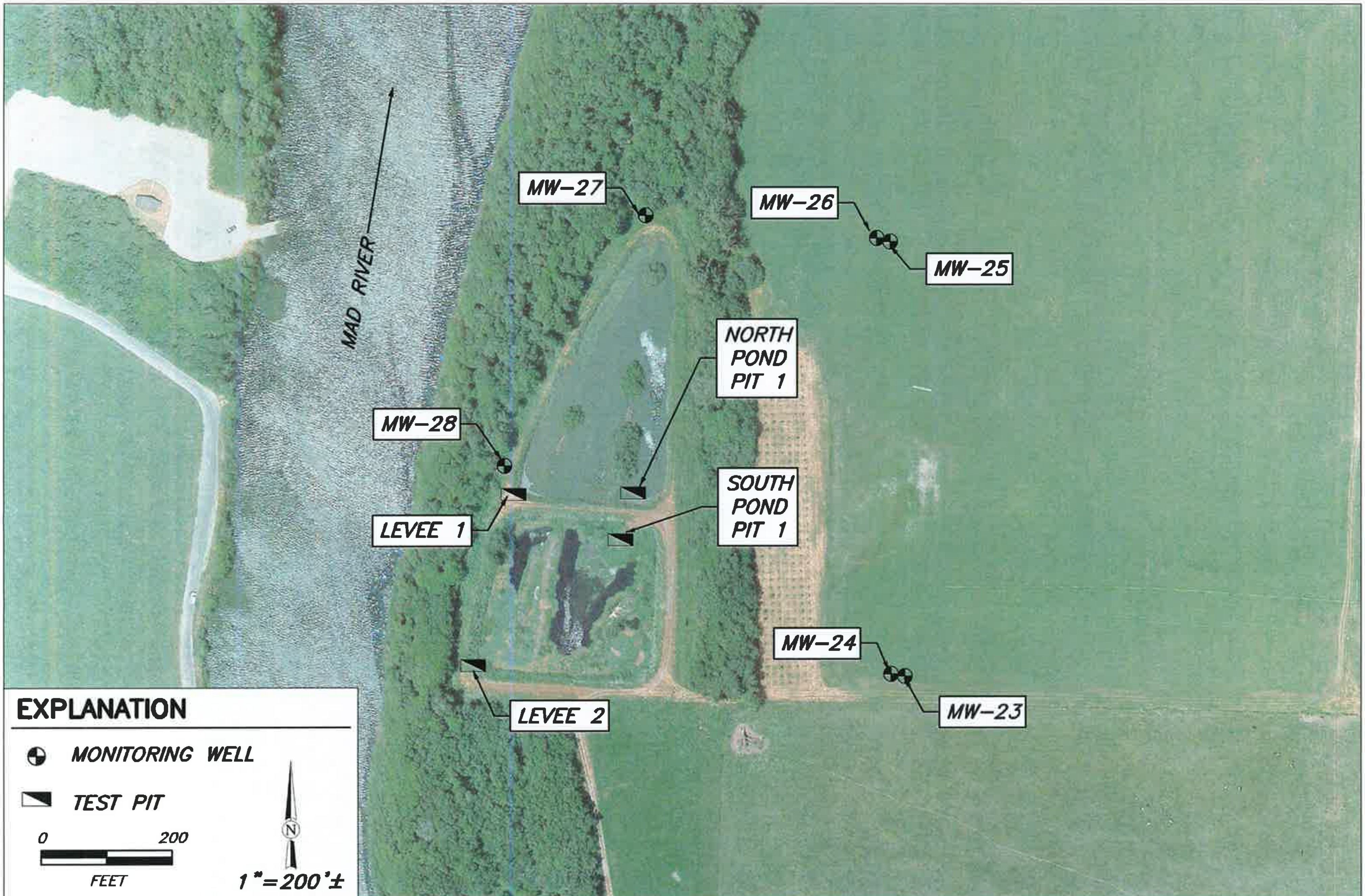
- Installing six groundwater monitoring wells
- Installing four backhoe test pits
- Laboratory analysis of select soil samples
- Submittal of this work summary

SHN's characterization of the levee material is based on our observations of subsurface conditions conducted during the excavation of backhoe test pits into the levee slopes and pond edges. As part of this investigation, SHN conducted laboratory testing of bulk soil samples collected from the test pits. The laboratory testing program included sieve analyses and a determination of the materials plasticity.

Soil profile logs for excavations and monitoring wells are included as Attachment 1. Laboratory test data is included as Attachment 2. Notes and forms describing procedures and observations made during field work to install monitoring wells and excavations are included in Attachment 3. A site map presenting approximate locations of monitoring wells and test pits installed during field efforts is presented as Figure 1.

Reuse of Levee Material as Select Engineered Fill

In general, select fill used for construction purposes including road and trail building, and foundation support typically consists of non-plastic and non-expansive granular soil that is free of organic materials and contains less than 30% fines (silt and clay combined). The sieve analysis and plastic index test results indicate that the upper 3 feet of the levee fill may meet the minimum



NOTE: ALL LOCATIONS ARE APPROXIMATE; BASEMAP FROM GOOGLE EARTH (2014)

SHN Consulting Engineers & Geologists, Inc.

California Trout, Inc.
MCSD Ponds
Fischer Ranch, McKinleyville, California

June 2016 | Figure1_SIteMap

Site Map
SHN 015169

Figure 1

criteria to be considered as select engineered fill. This material consists of rounded, fine to coarse gravel and sand used to armor the levee slope faces. Provided this gravelly material is segregated during levee removal it has the potential to be reused as select engineered fill. The material appears well suited for use as sub-base for any future roads and/or trails at the project site provided the sub-base is properly compacted and armored with a layer of crushed aggregate base rock.

The soil test pit logs indicate that the levee materials grade finer with depth and are comprised largely of silt and fine sand with low plasticity fines. On this basis, we expect that the majority of the levee materials will not meet the minimum criteria to be considered as select fill. It is also expected that the levee materials will be extremely heterogeneous, which will likely be difficult to compact. Therefore, it is recommended that levee material below a depth of about 3 feet not be used as select structural fill to support concrete foundations, retaining walls, roadways, or any other type of structure that will rely on compacted fill for bearing support.

Reuse of Levee Material as General Fill

Soil obtained from the core of the levees and pond bottoms may be suitable for use as general fill, provided the materials are free of debris and organic matter. General fill may be used for raising site grades on grazing land and pastures, infilling drainage swales and ditches, or as landscaping fill. Proper compaction of general fill, if required, will depend on the moisture content at the time of compaction. It is expected that the moisture content of the levee materials will generally exceed optimum moisture levels for compaction immediately after levee removal. Levee material to be reused as general fill will require aeration prior to reuse.

Because the levee soils to be used as general fill is likely to be heterogeneous, mixing, blending, and moisture conditioning will be required to create a material that can be placed and adequately compacted. All fill stockpiles should be scarified, plowed, disked, and/or bladed until the material is uniform in consistency and free of large, unbroken clods of soil. Clods of soil or rock particles larger than 4 inches in greatest dimension either should be broken down by heavy earthmoving equipment or removed from the fill during placement.

The placement of levee material as general fill during the wet season could be problematic due the fine-grained nature of the material and its high moisture holding capacity. Over-optimum moisture conditions will greatly influence the time and effort required to achieve minimum compaction requirements. Wet or over-saturated plastic soils will also be difficult to spread with heavy equipment.

Please call me at 707-441-8855 if you have any questions.

Sincerely,

SHN Engineers & Geologists

PROFESSIONAL GEOLOGIST
GIOVANNI ANTHONY VADURRO
7/6/16
No. 2554
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Giovanni A. Vadurro
Engineering Geologist

GAV:lms

Attachments:
1. Test Pit and Monitoring Well Logs
2. Laboratory Test Data
3. Field Notes and Forms

1

Test Pit and Monitoring Well Logs

SHN Consulting Engineers & Geologists, Inc.
812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CALTrout-MCSD
PROJ. NUMBER: 015169
OPERATOR: MCSD
EXCAVATION METHOD: Backhoe
SAMPLER TYPE: Grab
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville , CA
GROUND ELEV.: 21 feet NAVD88
DEPTH OF EXCAVATION: 7 feet
INITIAL WATER LEVEL: NA
STABILIZED WATER LEVEL: NA
DATE: 4/25/2016

EXCAVATION ID
Levee 1

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS
21	0				SM		SILTY SAND WITH GRAVEL, yellowish brown, moist, loose, fine sand, fine to coarse rounded gravel, silt.	
20	-1							
19	-2							
18	-3		100		ML/ SM		SANDY SILT, olive, soft, moist, silt, fine sand, occasional roots, low plasticity.	
17	-4							
16	-5							
15	-6				SM		SILTY SAND, bluish gray, moist, loose to medium dense, fine sand, silt.	
14	-7							
13	-8							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CALTrout-MCSD
PROJ. NUMBER: 015169
OPERATOR: MCSD
EXCAVATION METHOD: Backhoe
SAMPLER TYPE: Grab
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville , CA
GROUND ELEV.: 21 feet NAVD88
DEPTH OF EXCAVATION: 10 feet
INITIAL WATER LEVEL: NA
STABILIZED WATER LEVEL: NA
DATE: 4/25/2016

EXCAVATION ID
Levee 2

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS
21	0				SM		SILTY SAND WITH GRAVEL, yellowish brown, moist, loose, fine sand, fine to coarse rounded gravel, silt.	
20	-1							
19	-2							
18	-3				ML/ SM		SANDY SILT, olive, soft, moist, silt, fine sand, low plasticity.	
17	-4							
16	-5		100					
15	-6							
14	-7							
13	-8				SM		POORLY GRADED SAND WITH SILT, grayish brown, moist, loose to medium dense, fine sand, silt.	
12	-9							
11	-10							
10	-11							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

SHN Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CALTrout-MCSD
PROJ. NUMBER: 015169
OPERATOR: MCSD
EXCAVATION METHOD: Backhoe
SAMPLER TYPE: NA
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville , CA
GROUND ELEV.: 11 feet NAVD88
DEPTH OF EXCAVATION: 4.5 feet
INITIAL WATER LEVEL: 4.5 feet
STABILIZED WATER LEVEL: NA
DATE: 4/25/2016

EXCAVATION ID

North Pond Pit 1

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	SOIL DESCRIPTION	REMARKS
11	0		100		SM/ ML	SILTY SAND, olive, loose, moist, fine sand, silt, trace fine rounded gravel, sulfur odor present.	
10	-1						
9	-2						
8	-3				ML	SILT WITH SAND, olive, soft, moist, silt, fine sand, low plasticity.	
					PT	PEAT, dark reddish brown, moist, fiberous texture, roots, wood, fine sand, silt.	
7	-4				ML	SILT WITH SAND, olive, soft, moist, silt, fine sand, low plasticity.	
		▽			SM/ SP	POORLY GRADED SAND WITH SILT, gray with salt and pepper sand grains, loose, wet, fine to medium sand, silt, sulfur odor present.	sidewall failure occuring due to poorly cohesive soils that comprise the sidewalls and presence of the water table
6	-5						
5	-6						

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

FIELD LOG

Consulting Engineers & Geologists, Inc.

812 West Wabash, Eureka, CA 95501 ph. (707) 441-8855 fax. (707) 441-8877
350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CALTrout-MCSD
PROJ. NUMBER: 015169
OPERATOR: MCSD
EXCAVATION METHOD: Backhoe
SAMPLER TYPE: NA
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville , CA
GROUND ELEV.: 11 feet NAVD88
DEPTH OF EXCAVATION: 5 feet
INITIAL WATER LEVEL: 4.75 feet
STABILIZED WATER LEVEL: NA
DATE: 4/25/2016

EXCAVATION ID
South Pond Pit 1

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS
11	0		100		SM/ML		SILTY SAND, olive, loose, moist, fine sand, silt, trace fine rounded gravel, sulfur odor present.	
10	-1							
9	-2							
8	-3							
7	-4	▽			SM/SP		POORLY GRADED SAND WITH SILT, gray with salt and pepper sand grains, loose, wet, fine to medium sand, silt, sulfur odor present.	sidewall failure occuring due to poorly cohesive soils that comprise the sidewalls and presence of the water table
6	-5							
5	-6							

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FIELD LOG

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350 Hartnell Ave. St B, Redding, CA 96002 ph. (530) 221-5424 fax. (530) 221-0135

PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~16 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: NA
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

MONITORING WELL ID

MW-23

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS
19	3					
18	2					
17	1					
16	0			ML	SANDY SILT, olive to grayish brown, soft, moist, silt, fine sand, roots in top 6 inches of return, no plasticity.	
15	-1					
14	-2		75			
13	-3					
12	-4					mottling present above 8 feet
11	-5			ML	SILT WITH SAND, olive to grayish brown, soft, moist, silt/clay, fine sand, low plasticity.	
10	-6		70			
9	-7					
8	-8			CL/ ML	LEAN CLAY, gray, soft, moist, clay, silt, fine sand, moderate plasticity.	Soil Sample Collected
7	-9					
6	-10		85			
5	-11					
4	-12					
3	-13					
2	-14		100			
1	-15					minor manganese precipitation below 15 feet BGS
0	-16					
-1	-17			ML	SANDY SILT, gray, soft, moist, silt, fine sand, low plasticity.	Soil Sample Collected
-2	-18		100	ML/ CL	LEAN CLAY, gray, soft, moist, clay, silt, fine sand, low plasticity.	
-3	-19			ML/ PT	INTERBEDDED PEAT AND LEAN CLAY, peat is brown to black, soft, moist, 100 percent organic detritus; clay is gray, soft, moist, and comprises clay, silt, fine sand, low plasticity.	Halt at 20 feet BGS in same
-4	-20					
-5	-21					
-6	-22					
-7	-23					
-8	-24					
-9	-25					

MONITORING WELL CONSTRUCTION

- 1.5-inch diameter Blank PVC casing
- cement slurry seal
- hydrated bentonite seal
- #8 sand filter pack
- 1.5-inch diameter 0.010 slot PVC screen

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WELL LOG

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PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~16 Feet NAVD88
DEPTH OF BORING/WELL: 10/10 feet
INITIAL WATER LEVEL: NA
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

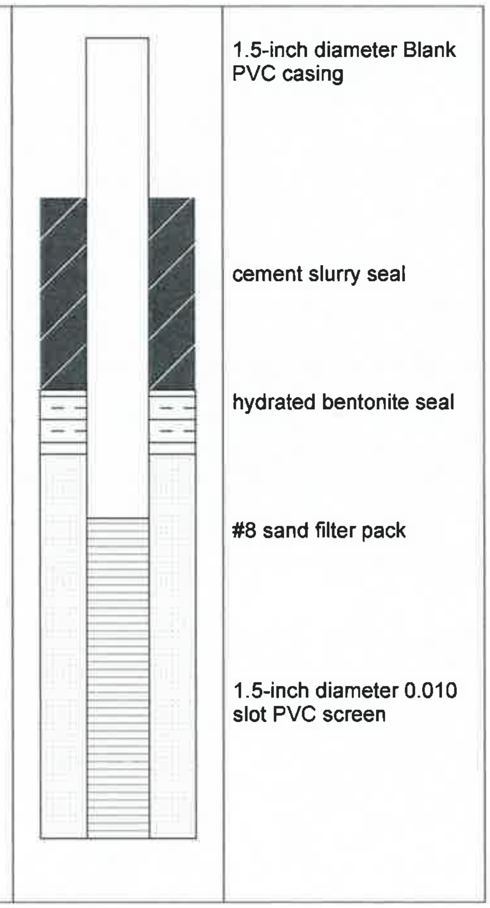
MONITORING WELL ID

MW-24

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS
16 to 11.5	0 to -4.5		85		ML		SANDY SILT, olive to grayish brown, soft, moist, silt, fine sand, roots in top 6 inches of return, no plasticity.	
11.5 to 8	-4.5 to -8		85		ML		SILT WITH SAND, olive to grayish brown, soft, moist, silt/clay, fine sand, low plasticity.	mottling present above 8 feet
8 to 6	-8 to -10		100		CL/ ML		LEAN CLAY, gray, soft, moist, clay, silt, fine sand, moderate plasticity.	Halt at 10 feet BGS in same

Elevation scale (ft): 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5
Depth scale (ft.): 3, 2, 1, 0, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11

MONITORING WELL CONSTRUCTION



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WELL LOG

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PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: 16 feet BGS
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

MONITORING WELL ID

MW-25

ELEVATION (ft)	DEPTH (FT.)
15	3
14	2
13	1
12	0
11	-1
10	-2
9	-3
8	-4
7	-5
6	-6
5	-7
4	-8
3	-9
2	-10
1	-11
0	-12
-1	-13
-2	-14
-3	-15
-4	-16
-5	-17
-6	-18
-7	-19
-8	-20
-9	-21
-10	-22
-11	-23
-12	-24
-13	-25

WATER LEVEL: ∇ at -16

SAMPLE % RECOVERY: 90, 80, 75, 80, 100

USCS	SOIL DESCRIPTION	REMARKS
SM	SILTY SAND, olive to grayish brown, loose, moist, fine sand, silt, clay, roots/organics at ground surface, non-plastic.	iron mottling present between 0 and 7 feet BGS
ML	SANDY SILT, grayish brown, soft, moist, silt, fine sand, low plasticity.	
ML/ CL	SILT WITH SAND, olive with iron mottling present, soft, moist, silt, fine sand, low plasticity.	
CL/ PT	LEAN CLAY, gray with yellowish brown streaks, soft, moist, clay, fine sand, moderate plasticity, organic content high at thin peat layers.	Soil Sample Collected Interbedded Clay and Peat layers are present from approximately 7 to 14 feet BGS; Peat layer thicknesses vary between 0.5 inch to 5 inches.
PT/ SM	PEAT, brown to reddish brown, organic detritus, moist, interbedded with silty sand	
CL/ PT	LEAN CLAY, gray, soft, moist, clay, fine sand, moderate plasticity, interbedded with peat	
SM/ PT	SILTY SAND, gray, loose, wet, fine sand, silt, clay, non-plastic, interbedded with peat.	Soil Sample Collected
PT	PEAT, brown to reddish brown, organic detritus, moist.	Interbedded Silty Sand and Peat layers are present from approximately 16 to 17 feet BGS; Peat layer thicknesses vary between 1 inch to 2 inches. Halt at 20 feet BGS in same

MONITORING WELL CONSTRUCTION

- 1.5-inch diameter Blank PVC casing
- cement slurry seal
- hydrated bentonite seal
- #8 sand filter pack
- 1.5-inch diameter 0.010 slot PVC screen

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WELL LOG

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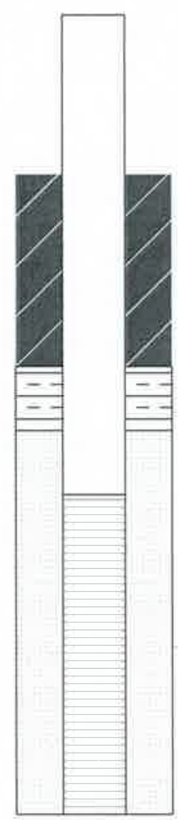
PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 10/10 feet
INITIAL WATER LEVEL: 5 feet BGS
STABILIZED WATER LEVEL: NA
DATE: 11/23/2015

MONITORING WELL ID

MW-26

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS	MONITORING WELL CONSTRUCTION
15	3						
14	2						1.5-inch diameter Blank PVC casing
13	1						
12	0			SM	SILTY SAND, olive, loose, moist to wet from 5 to 6 feet BGS, fine sand, silt, clay, low plasticity, roots in top 4 inches.		
11	-1					Iron mottling present to 6.5 feet BGS	cement slurry seal
10	-2		75				
9	-3					clay fraction increases	hydrated bentonite seal
8	-4						
7	-5	▽					#8 sand filter pack
6	-6		80				
5	-7			ML/CL	SILT WITH SAND, gray, soft, moist, silt, clay, fine sand, low plasticity.		
4	-8						1.5-inch diameter 0.010 slot PVC screen
3	-9		100				
2	-10						
1	-11						



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WELL LOG

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PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: 1 foot BGS
STABILIZED WATER LEVEL: NA
DATE: 11/24/2015

MONITORING WELL ID

MW-27

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	USCS	SOIL DESCRIPTION	REMARKS	MONITORING WELL CONSTRUCTION
15	3						
14	2						1.5-inch diameter Blank PVC casing
13	1						
12	0			ML	SANDY ORGANIC SOIL, brown, soft, moist, silt, clay, fine sand, low plasticity, roots.		
11	-1	▼		SM			cement slurry seal
10	-2		50				
9	-3				SILTY SAND, olive gray, loose, wet, fine sand, silt, non-plastic.		
8	-4			SW/GP			
7	-5				WELL GRADED SAND WITH GRAVEL, gray, loose, wet, well graded sand, fine rounded to subrounded gravel, trace silt, non-plastic.		
6	-6		40				
5	-7						
4	-8						
3	-9						hydrated bentonite seal
2	-10		40				
1	-11						
0	-12					soil sample collected	#8 sand filter pack
-1	-13						
-2	-14		10				
-3	-15						
-4	-16						
-5	-17						
-6	-18		60				1.5-inch diameter 0.010 slot PVC screen
-7	-19				LEAN CLAY, gray, firm, moist, clay, silt, fine sand, medium plasticity.		
-8	-20			CL		Halt at 20 feet BGS in same.	
-9	-21						
-10	-22						
-11	-23						
-12	-24						
-13	-25						

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PROJ. NAME: CalTrout-MCSD
PROJ. NUMBER: 015169
DRILLER: Fisch Environmental
DRILLING METHOD: GeoProbe
SAMPLER TYPE: Dual-Tube
LOGGED BY: J. Wellik

LOCATION: Fischer Ranch, McKinleyville, CA
GROUND ELEV.: ~12 Feet NAVD88
DEPTH OF BORING/WELL: 20/20 feet
INITIAL WATER LEVEL: 7 feet BGS
STABILIZED WATER LEVEL: NA
DATE: 11/24/2015

MONITORING WELL ID

MW-28

ELEVATION (ft)	DEPTH (FT.)	WATER LEVEL	SAMPLE % RECOVERY	SAMPLE INTERVAL	USCS	LITHOLOGY	SOIL DESCRIPTION	REMARKS	MONITORING WELL CONSTRUCTION
15	3								
14	2								1.5-inch diameter Blank PVC casing
13	1								
12	0				OL SM		ORGANIC SOIL WITH SAND, brown, soft, moist, organic detritus/roots, silt, fine sand, non-plastic.		
11	-1								cement slurry seal
10	-2		50		SM/ GM				
9	-3						SILTY SAND, yellowish brown, loose, moist grading to dry at 0.5 feet BGS, fine sand, silt, non-plastic.		
8	-4								
7	-5				SW/ SM				
6	-6		50				SILTY SAND WITH GRAVEL, yellowish brown, loose, dry, well graded sand, well graded rounded to subrounded gravel, silt, non-plastic.		
5	-7	▼							
4	-8				GW				
3	-9						WELL GRADED SAND WITH SILT, gray, loose, dry grading to wet at 7 feet BGS, well graded sand, silt, trace coarse subrounded to rounded gravel, non-plastic.		hydrated bentonite seal
2	-10		60						
1	-11								
0	-12							soil sample collected	#8 sand filter pack
-1	-13						WELL GRADED GRAVEL WITH SAND, gray, loose, wet, well graded subrounded to rounded gravel, well graded sand, trace silt, non-plastic.		
-2	-14		60						
-3	-15								
-4	-16								
-5	-17								
-6	-18		0						1.5-inch diameter 0.010 slot PVC screen
-7	-19								
-8	-20							Halt at 20 feet BGS in same.	
-9	-21								
-10	-22								
-11	-23								
-12	-24								
-13	-25								

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WELL LOG

2

Laboratory Test Data

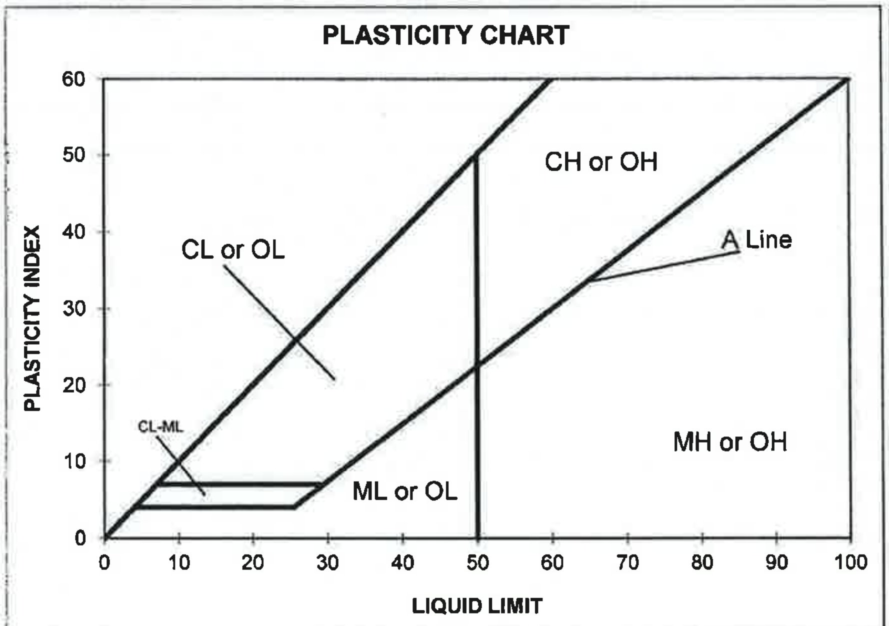
SHN
CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash Eureka, CA 95501-2138 Tel: 707/441-8855 FAX: 707/441-8877 E-mail: shninfo@shn-engr.com

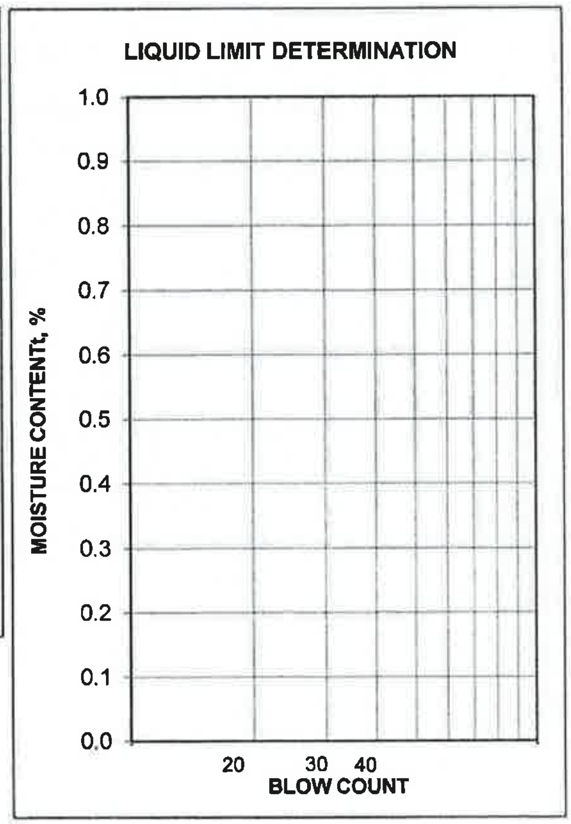
LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

JOB NAME:	Trout MCSD	JOB #:	015169	LAB SAMPLE #:	16-445
SAMPLE ID:	Levee 1 0-12"	PERFORMED BY:	JMA	DATE:	4/28/2016
PROJECT MANGER:	RR	CHECKED BY:	[signature]	DATE:	5/3/16

LINE NO.		TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 3
A	PAN #	15	16	4	5	6
B	PAN WT. (g)	20.590	21.000	29.310	28.790	29.600
C	WT. WET SOIL & PAN (g)					
D	WT. DRY SOIL & PAN (g)					
E	WT. WATER (C-D)					
F	WT. DRY SOIL (D-B)					
G	BLOW COUNT	--	--			
H	MOISTURE CONTENT (E/F*100)	NP	NP	NP	NP	NP

LIQUID LIMIT	PLASTIC INDEX	PLASTIC LIMIT
	Non Plastic	





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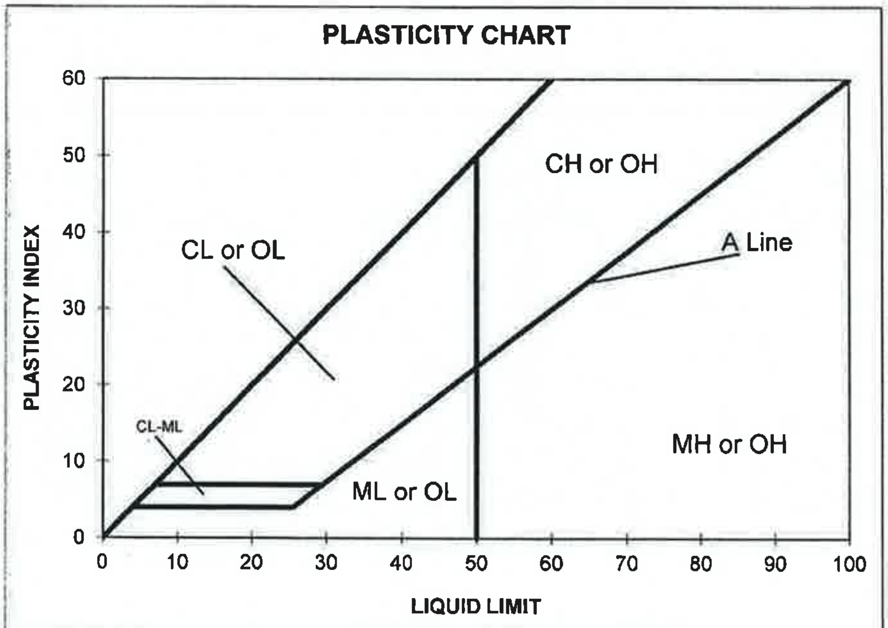
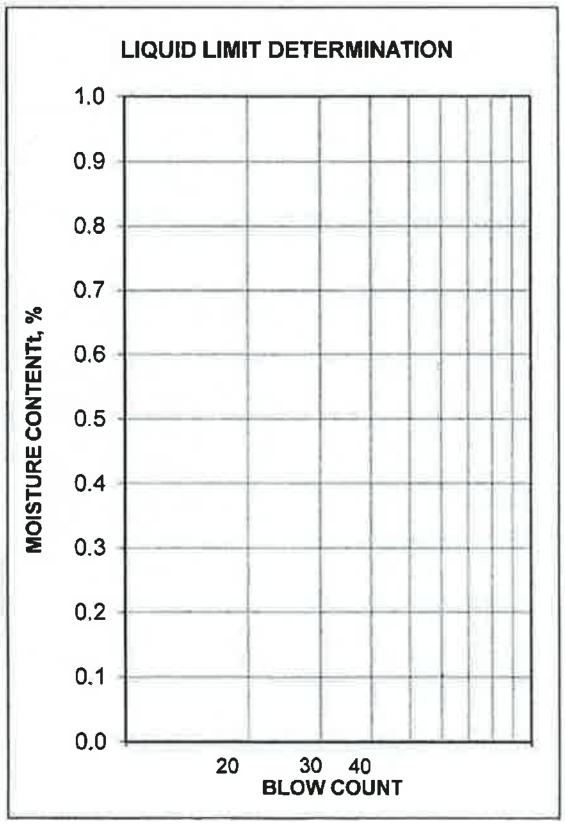
LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

JOB NAME:	Trout MCSD	JOB #:	015169	LAB SAMPLE #:	16-446
SAMPLE ID:	Levee 2 0-12"	PERFORMED BY:	JMA	DATE:	4/28/2016
PROJECT MANGER:	RR	CHECKED BY:	[signature]	DATE:	5/3/16

LINE NO.		TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 1	TRIAL NO. 2	TRIAL NO. 3
A	PAN #	17	18	1	2	3
B	PAN WT. (g)	20.440	20.220	29.860	29.220	29.240
C	WT. WET SOIL & PAN (g)					
D	WT. DRY SOIL & PAN (g)					
E	WT. WATER (C-D)					
F	WT. DRY SOIL (D-B)					
G	BLOW COUNT	--	--			
H	MOISTURE CONTENT (E/F*100)	NP	NP	NP	NP	NP

LIQUID LIMIT	PLASTIC INDEX	PLASTIC LIMIT
	Non Plastic	





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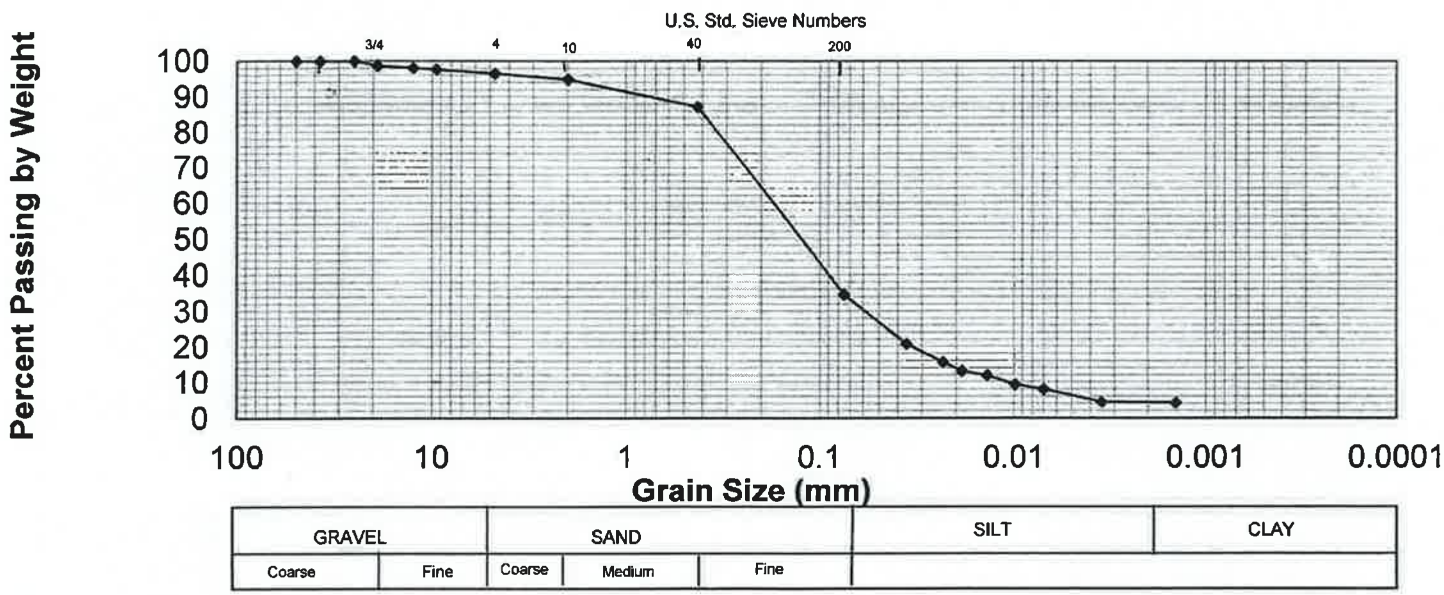
Project Name:	Trout MCSD	Project Number:	015169
Boring ID:	--	Lab # :	16-446
Sample Depth:	0-12"	Checked By:	Dh
Sample Number:	Levee 2	Date :	5/3/16

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0361	0.0234	0.0188	0.0138	0.0099	0.0070	0.0035	0.0014
PERCENT PASSING	100	100	100	98.8	98.2	97.8	96.6	95.0	87.3	34.7	20.8	15.8	13.2	12.0	9.5	8.1	4.5	4.3

Gradation Test Results



% Gravel 3.4 **% Sand 61.9** **% Silt 30.3** **% Clay 4.4**

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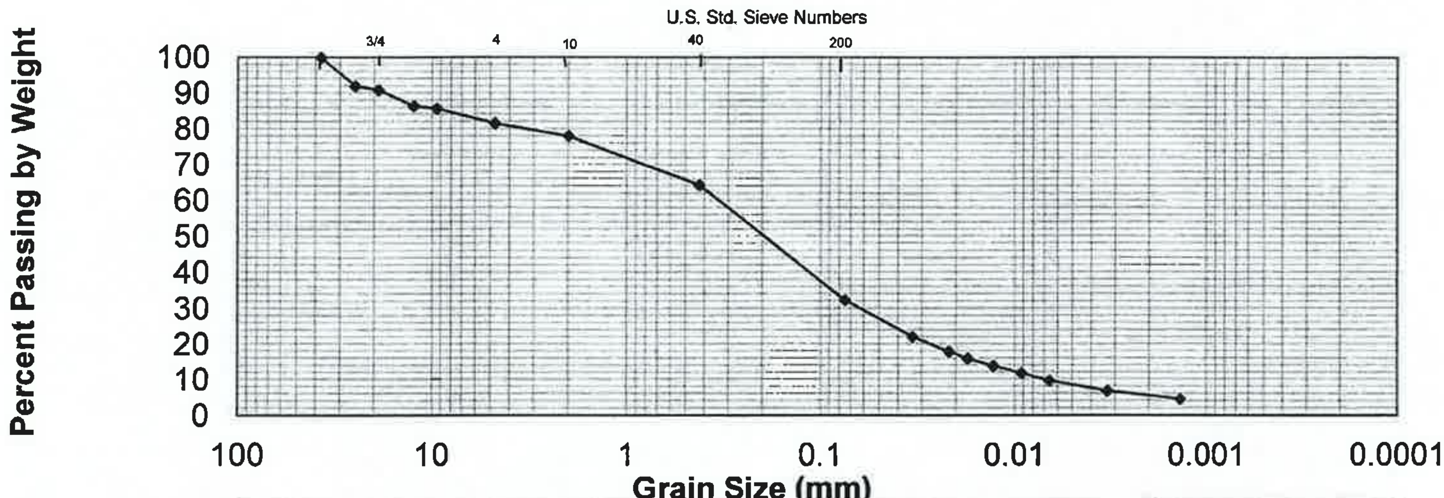
812 W. Wabash Eureka, CA 95501-2138 Tel: 707/441-8855 FAX: 707/441-8877 E-mail: shninfo@shn-engr.com

Project Name:	Trout MCSD	Project Number:	015169
Boring ID:	--	Lab # :	16-445
Sample Depth:	0-12"	Checked By:	
Sample Number:	Levee 1	Date :	5/3/16

SIEVE	2"	1.5"	1"	0.75"	0.5"	0.375"	#4	#10	#40	#200								
SIEVE SIZE (mm)	50	37.50	25	19.00	12.5	9.5	4.75	2.00	0.425	0.075	0.0335	0.0218	0.0175	0.0129	0.0092	0.0066	0.0033	0.0014
PERCENT PASSING		100	92.0	91.0	86.4	85.7	81.6	78.2	64.3	32.3	22.1	18.0	15.9	13.9	11.8	9.6	6.8	4.5

Gradation Test Results



GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

% Gravel 18.4 **% Sand 49.3** **% Silt 26.8** **% Clay 5.5**

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Reference: 015169

April 21, 2016

Caltrout - MCSD

SOIL PERCOLATION SUITABILITY / TEXTURAL ANALYSIS RESULTS

Job Name: Caltrout - MCSD
Date Sampled: 11/23/15
Date Received: 4/12/16
Sampled By: JMW
Date Tested: 4/21/16
AP Number: --

Sample ID	Depth	% Sand	% Clay	% Silt	% Coarse Fragments by Volume	Zone	Bulk Density
MW-23	16-18'	9.3	36.3	54.4	0.0	4	*
	Material:	**Silty Clay Loam**					
MW-24	7-9'	9.2	28.6	62.2	0.0	4	*
	Material:	**Silty Clay Loam**					
MW-25	16-18'	79.7	6.9	13.4	0.0	2	*
	Material:	**Loamy Sand**					
MW-26	7-10'	16.1	28.1	55.8	0.0	4	*
	Material:	**Silty Clay Loam**					

* = no peds provided

Regional Water Quality Control Board Zone Descriptions:

Zone 1 - Soils in this zone are very high in sand content. They readily accept effluent, but because of their low silt and clay content they provide minimal filtration. These soils demand greater separation distances from groundwater.

Zone 2 - Soils in this zone provide adequate percolation rates and filtration of effluent. They are suitable for use of a conventional system without further testing.

Zone 3 - Soils in this zone are expected to provide good filtration of effluent, but their ability to accept effluentat at a suitable rate is questionable. These soils require wet-weather percolation tests to verify their suitability for effluent disposal by conventional leachfield methods.

Zone 4 - Soils in this zone are unsuitable for a conventional leachfield because of their severe limitations for accepting effluent.

3

Field Notes and Forms

SHN CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash • Eureka, CA 95501-2138 • 707/441-8855 • FAX: 707/441-8877 •shninfo@shn-engr.com

Daily Field Report

Project Name	Client/Owner	Job No. 015169	
		Page 1 of 1	
CALTROUT-MCSD	MCSD	Weather: PARTLY CLOUDY, COOL	
General Location of Work: FISCHER RANCH	Project Manager: R. RUEBER	Date: 11/3/15	Day of Week: TUESDAY
Type of Work: USA MARKINGS		Field Personnel: JMW	

1600	ARRIVE ONSITE, PLACE USA MARKS ON FISCHER RD., CONTACT MCSD PERSONNEL AT PUMP STATION AND INFORM THEM OF NEED TO ACCESS WORKSITE. FOR USA PURPOSES, REQUEST IS MADE THAT I DO NOT DRIVE DOWN WET ROADWAY IN FIELDS
1615	PARK AT HAY BARN AND WALK TO WORK AREA WITH STAKES / FLAGGING, + SLEDGE HAMMER. SET MARKERS AT WELL LOCATIONS BASED OFF OF WORKPLAN MAP, MARK SOIL SAMPLING LOCATIONS ON POND BERMS.
1730	OFFSITE, END OF DAY.

[signature]

Copy given to:

Reported By: JMW

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Daily Field Report

Daily Field Report		Job No. 015169 Page 1 of 1
Project Name: MCSD - CAL TROUT	Client/Owner: MCSD - CAL TROUT	Weather: CLOUDY, COOL
General Location of Work: FISCHER RANCH	Project Manager: R. RUEBER	Date: 11/23/15 — Day of Week: MONDAY
Type of Work: WELL INSTALLATION		Field Personnel: JMW

0915	ARRIVE ONSITE, FISCH DRILLING ONSITE, ROSE P. ONSITE, LOAD WELL SUPPLIES ON TRUCK, MOB TO DRILL LOCATION
0945	WALK DRILL LOCATIONS WITH RICK AND NATE, WALK POND LOCATIONS FOR RIG ACCESS; SHOULD WORK OUT OK.
1030	SET UP ON SOUTHERN WELL PAIR AND CONT. CORE TO DEPTH. OF 20', CURRENTLY ID'ED AS MW-SOUTH
1100	AT 20' WITH CONT. CORE, LOG CORES, CONSTRUCT 20' DEEP WELL 1.5" DIAM PVC, 0.010 SLOT SCREEN FROM 20-15', #8 SAND 20-14' BENTONITE TO 13', CEMENT TO GRADE
1130	STEP OVER TO SET SHALLOW WELL WITH SCREEN INTERVAL FROM 5 TO 10' MW-SOUTH SHALLOW, #8 SAND 10-4', BENTONITE TO 3', CEMENT TO GRADE.
1145	ROSE CHECKS IN, DISCUSSES SCREEN DEPTH RELATIVE TO CLAY LAYER AND JMW DESCRIBES OBSERVED STRATIGRAPHY + COLLECTION OF SOIL SAMPLES FROM WITHIN THE SCREENED INTERVALS OF BOTH WELLS, ROSE ASKS ABOUT WELL HEAD PROTECTION AND WELLS BEING SET IN A PAD, JMW NOTES OUTSIDE OF WORKSCOPE, NOT INCLUDED IN WORK PLAN, JMW & ROSE AGREE MCSD CAN PLACE AT A LATER DATE.
1200	ROSE OFFSITE, MOB TO MW-NORTH LOCATION.
1215	BREAK FOR LUNCH
1245	REPEAT CORING AND WELL CONSTRUCTION AT NORTHERN LOCATION.
1330	AT DEPTH (~20') AT MW-NORTH LOCATION, SI = 20-15, #8 SAND 20-14 BENTONITE 14-13', CEMENT TO GRADE. ~2.5' OF BLANK ABOVE GRADE.
1355	STEP OVER AND CORE + CONSTRUCT MW-NORTH SHALLOW, MOVE ~1' WEST. SHALLOW WELL = SI = 5-10', SAND (#8) 10-4', BENTONITE CHIPS 4-3' CEMENT TO GRADE, MOBE OFFSITE
1515	JMW + RICK SCOUT PATHWAY AND CHECK GATES TO POND LOCATIONS
1545	END OF DAY.

Copy given to:

Reported By: JMW

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Eureka, CA 95501-2138
Tel. 707 / 441-8855
Fax: 707 / 441-8877

JOB 015101
SHEET NO. 1 OF
CALCULATED BY DATE 11/23/15
CHECKED BY DATE
SCALE

HEALTH & SAFETY MTG., NO TOXICS, PPE, PINCH POINTS

JOHN WELLIK SHN [signature]

Nathan Ohlsson Fisch [signature]

Rick Bertolino Fisch Drilling [signature]

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Daily Field Report

Project Name: MCSD - CAL TROUT	Client/Owner:	Job No. 015169	Page 1 of 1
General Location of Work: PERC PONDS	Project Manager: R. RUEBER	Weather: RAIN	
Type of Work: WELL INSTALLATION		Date: 11/24/15	Day of Week: TUESDAY
		Field Personnel: JMW.	

750	ONSITE WITH FISCH AT HAMMOND BRIDGE, MOBE TO DRILLING LOCATION AT PERC PONDS
0840	INITIATE CORING ~~AT~~ AT MW-POND-NORTH, COARSE SAND AND GRAVEL TO 12', WILL CORE TO 20' AND CONSTRUCT WELL, BOTTOM 1' HAS ML/CL (19-20'), BUILD MW-POND-N WITH 10' OF SCREEN FROM 10-20', SAND TO 9', BENTONITE TO 8', CEMENT TO GRADE, ELEVATED WATER TABLE INCREASES DIFFICULTY ~~OF~~ ~~ADDING~~ SAND TO WELL SCREEN
0915	CONSTRUCT WELL, SOIL SAMPLE COLLECTED FROM UPPER PORTION OF SE @ 12-14'
0945	MOBE TO GW-POND-WEST LOCATION NEAR BERM BI-SECTING PONDS
1000	BEGIN CONTINUOUS CORING ~~@~~ JMW 11/24/15 AT GW-POND-WEST
1030	CONSTRUCT WELL SAME AS GW-POND-NORTH, SOIL SAMPLE COLLECTED AT 12-14' DEPTH RANGE.

	Copy given to:	Reported By:

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Daily Field Report

Job No. 015169	Page 1 of 1	
Project Name: CALTROUT	Client/Owner: MCSD - CAL TROUT	Weather: SUNNY, WINDY, COOL
General Location of Work: INFILTRATION PONDS	Project Engineer:	Date: 4/25/16 — Day of Week: MONDAY
Type of Work: EXCAVATION + GEOTECH SOIL SAMPLING	Supervisor: R.R.	Technician: JMW

0845	JMW ONSITE IN FIELDS - MOB TO PONDS WITH SAMPLING GEAR + FIELD SUPPLIES
0900	MCSD JAMES NOTES THAT OPERATOR ERIC WILL BE ~20 MIN LATE
	JMW TAKES PHOTOS OF PONDS
0925	ERIC MCSD ONSITE - CONDUCT TAILBOARD + DISCUSS WORK SCOPE
0930	INSTALL SOUTH POND PIT @ BASE OF RAMP, CHOSE HIGHER PORTION BECAUSE OF SHALLOW WATER, WATER @ ~5' FROM TOP OF GROUND., PIT ID SPPIT1
0950	LOGGED SOILS IN SO. POND - BACKFILL PIT; MOB TO NP PIT 1 LOCATION. AND POT HOLE.
1010	CLOSE NP PIT 1, MOBE TO LEVEE 1
1030	LEVEE 1 TRENCH EXCAVATED ~ 15' INTO LEVEE OF NORTH POND @ SW CORNER TOTAL DEPTH ~ 7'
1055	SET UP ON LEVEE 2 TRENCH, SW CORNER OF SO. POND. LEVEE 2 TRENCH EXCAVATED ~ 20' INTO LEVEE DEPOSITS SIMILAR TO LEVEE 1 OBSERVATIONS - ~2' VENEER OF GRAVELLY ROAD BASE, ~ 6-8' SILTY SAND/SANDY SILT, BLUE GRAY SP/SM AT BASE OF EXCAVATION, COLLECTED 5 GAL BUCKET OF MATERIAL FOR LAB. BACKFILL AND COMPACT LEVEE 2 EXCAVATION, JMW MOBS GEAR TO VEHICLE.
1230	VEHICLE STUCK IN SOFT SEDS OFF OF ROAD BASE, MCSD ASSISTS WITH EXTRACTION,
1245	OFFSITE. MOB TO SHN EUREKA.

Note: All purge and decon water was transported to SHN's P.W.S.T. located at 812 W. Wabash Ave. Eureka, Ca. gallons total.

	Copy given to:	Reported By: JMW

HAZARDOUS MATERIALS SITE OPERATIONS
SITE SAFETY MEETING ATTENDANCE
SHN CONSULTING ENGINEERS & GEOLOGISTS

JOB NAME: MCSD CAL TROUT **ACTIVITY:** EXCAVATION **JOB #:** 015169

GIVEN BY: JMW **SIGNATURE:** [signature] **DATE:** 4/25/16 **TIME:**

Company/Agency	Name	Operation/ Function	Signature	Read SSP	29CFR1910.120(e) 40 hr	24 hr
SHN	JOHN WELLIK	GEOLOGIST	[signature]	Y / N	Y / N (Y circled)	Y / N
MCSD	Erik Jones	Leadman	[signature]	Y / N	Y / N (Y circled)	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N
				Y / N	Y / N	Y / N

Appendix D: Hydraulic Analysis Report

Hydraulic Analysis Report

Mad River Estuary Restoration: Off-channel Habitat Design
CDFW Fisheries Restoration Grant Program No. P1410511 and SCC Grant No. 14-067

Prepared for

California Trout, Inc.
615 11th Street
Arcata, CA 95521

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June 2017

Hydraulic Analysis Report

Mad River Estuary Restoration: Off-channel Habitat Design
CDFW Fisheries Restoration Grant Program No. P1410511and SCC Grant No. 14-067

Prepared for

CALIFORNIA TROUT
FISH · WATER · PEOPLE

California Trout, Inc.

McKINLEYVILLE COMMUNITY SERVICES DISTRICT

McKinleyville Community Services District

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

California Department of Fish and Wildlife

State Coastal Conservancy

Prepared by

REGISTERED PROFESSIONAL ENGINEER
JUSTICE ROSE PAGNAUDE
No. 65963
EXP 6/30/20
CIVIL
STATE OF CALIFORNIA

Northern Hydrology & Engineering

June 2017

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Acronyms and Abbreviations

1-D	One-dimensional
2-D	Two-dimensional
Approx.	Approximate
CalTrout	California Trout, Inc.
CDFW	California Department of Fish and Wildlife
cfs	Cubic feet per second
D50	Median grain size
D84	84th percentile grain size
(E)	Existing
ELEV	Elevation
Esp.	Especially
FRGP	Fisheries Restoration Grants Program
ft	Feet
HEC-RAS	Hydrologic Engineering Center River Analysis System
Hrs	hours
ID	Identification
LiDAR	Light Detection and Ranging
MCSD	McKinleyville Community Services District
mg/L	Milligrams per liter
mm	Millimeter
MW	Groundwater monitoring well
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NHE	Northern Hydrology & Engineering
NOAA	National Oceanic and Atmospheric Administration
N/m^2	Newton per meter squared (equal to Pascal)
(P)	Proposed
Pa	Pascal (equal to a N/m^2)
Poss.	Possibly
RM	River Mile
SCC	State Coastal Conservancy
SHN	SHN Consulting Engineers & Geologists, Inc.
STA	Station
t	Time step
TSC	Technical Service Center
(TYP.)	Typical
USACE	United State Army Corps of Engineers
USBOR	United States Bureau of Reclamation
USGS	United State Geological Survey
VEG	Vegetated
WSE	Water surface elevation
WY	Water year

1. INTRODUCTION

1.1 Project Background

California Trout, Inc. (CalTrout) received a grant from the California Department of Fish and Wildlife (CDFW) Fisheries Restoration Grants Program (FRGP), Agreement No. P1410511, to prepare engineering designs to reconnect lower Mad River to approximately 4.25 acres of leveed percolation ponds (historical active floodplain) to provide critical juvenile salmonid rearing habitat and off-channel refugia for coho salmon (*Oncorhynchus kisutch*). The State Coastal Conservancy (SCC) provided necessary supplementary funding for the off-channel habitat enhancement project (Grant No. 14-067) and expanded the project scope to improve public access to the river and implement a biofiltration study on the adjacent floodplain. CalTrout employed Northern Hydrology & Engineering (NHE) to develop the project's engineering designs. The project area is owned by the McKinleyville Community Services District (MCSD) and is located along the east bank of the lower Mad River (Figure 1). MCSD has provided in-kind labor and equipment.

Specific design options were included in three conceptual design alternatives, which were presented and discussed in the project agency review meeting on April 25, 2016. These alternatives were revised based on input from the agencies and presented to the public at an MCSD Board meeting on May 4, 2016. A *Basis of Engineering Designs* report was prepared by NHE and submitted to the design review team on April 20, 2017, which included a summary of data collected and compiled to establish existing conditions, project objectives, criteria and constraints, and the options analysis. Alternative 3 was chosen for further hydraulic analysis to evaluate the most complex design conditions, including options considered in Alternatives 1 and 2. This report summarizes the hydraulic analyses used to evaluate the Alternative 3 design options and provides conclusions and recommendations to adjust the 30% design for the next design phase, 65% designs. Repetition of information between the reports is for the benefit of the reviewer, to provide a clear description on which the hydraulic analyses were built.

Points West Surveying established project surveying control from School Road to the percolation ponds. Project topography is reported in US survey feet and referenced to the North American Datum of 1983 (NAD83), California State Plane Zone 1, 2007 Epoch. Elevations are reported in feet (ft), referenced to the North American Vertical Datum of 1988 (NAVD88).

1.2 Geographic Setting

The Mad River drains approximately 497 square miles in northern California over a length of roughly 100 miles to the Pacific Ocean near the town of McKinleyville, north of Humboldt Bay (Figure 2). Watershed elevations range from 6,000 ft at the Coast Range headwaters in Trinity County to sea level at the mouth, approximately 6 miles north of Humboldt Bay. Matthews Dam impounds Ruth Lake at river mile (RM) 79, and a natural boulder falls barrier to anadromous salmonids is located on the mainstem river near Bug Creek at approximately RM 50. The project is located at approximately RM 2 within the Mad River estuary.

1.3 Site Description

The project site is located on the eastern floodplain of the Mad River at the inside of a meander bend (Figure 3). The northern, downstream end of the project site is within a mature, intact riparian forest developed on the active floodplain, lee side of a riffle located downstream of the Mad River County Park Boat Ramp. A historical backwater channel remains as a depression in the forest floor and is inundated during high flows. The project area focal point is a pair of constructed percolation ponds that are leveed

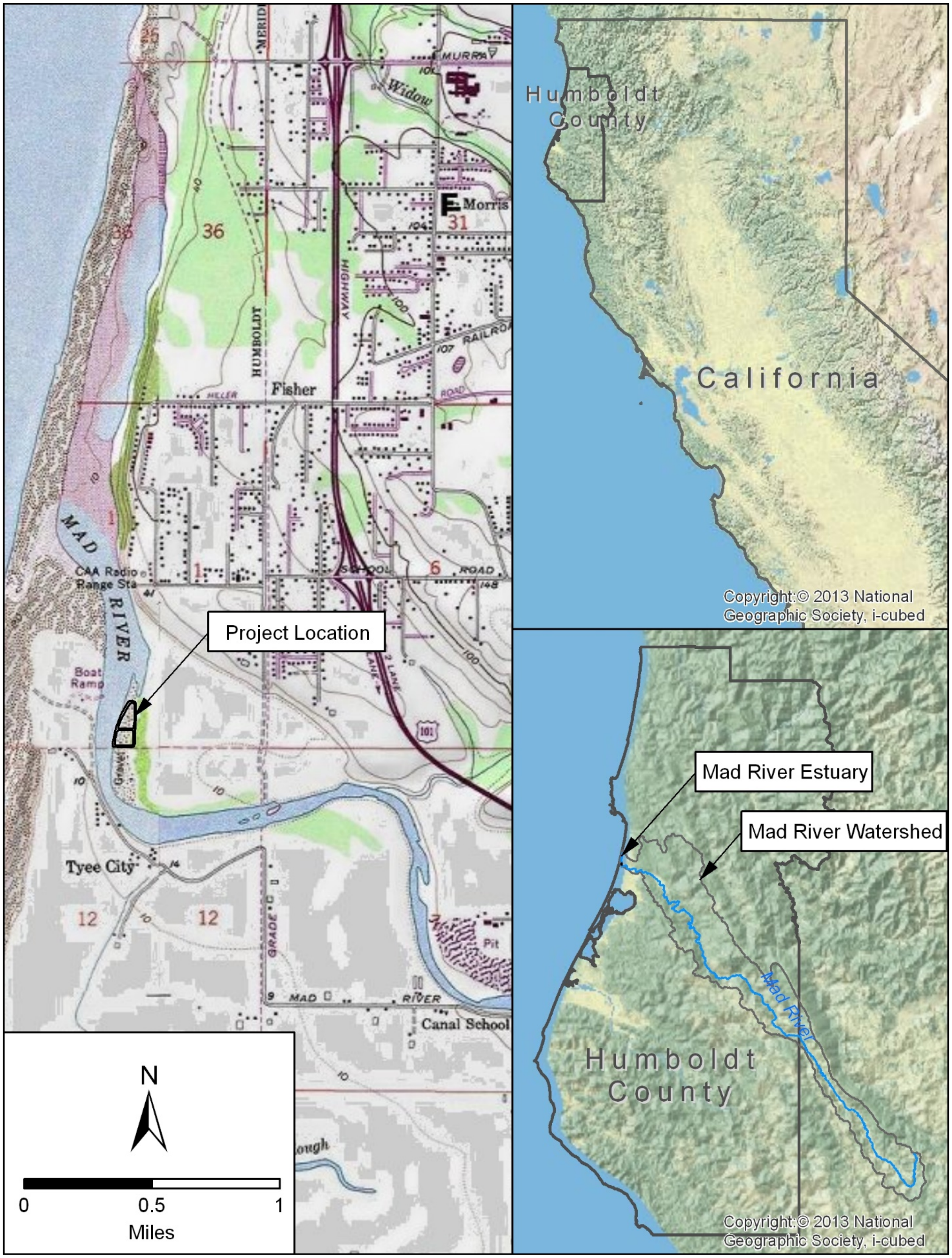

Figure 1. Location Map

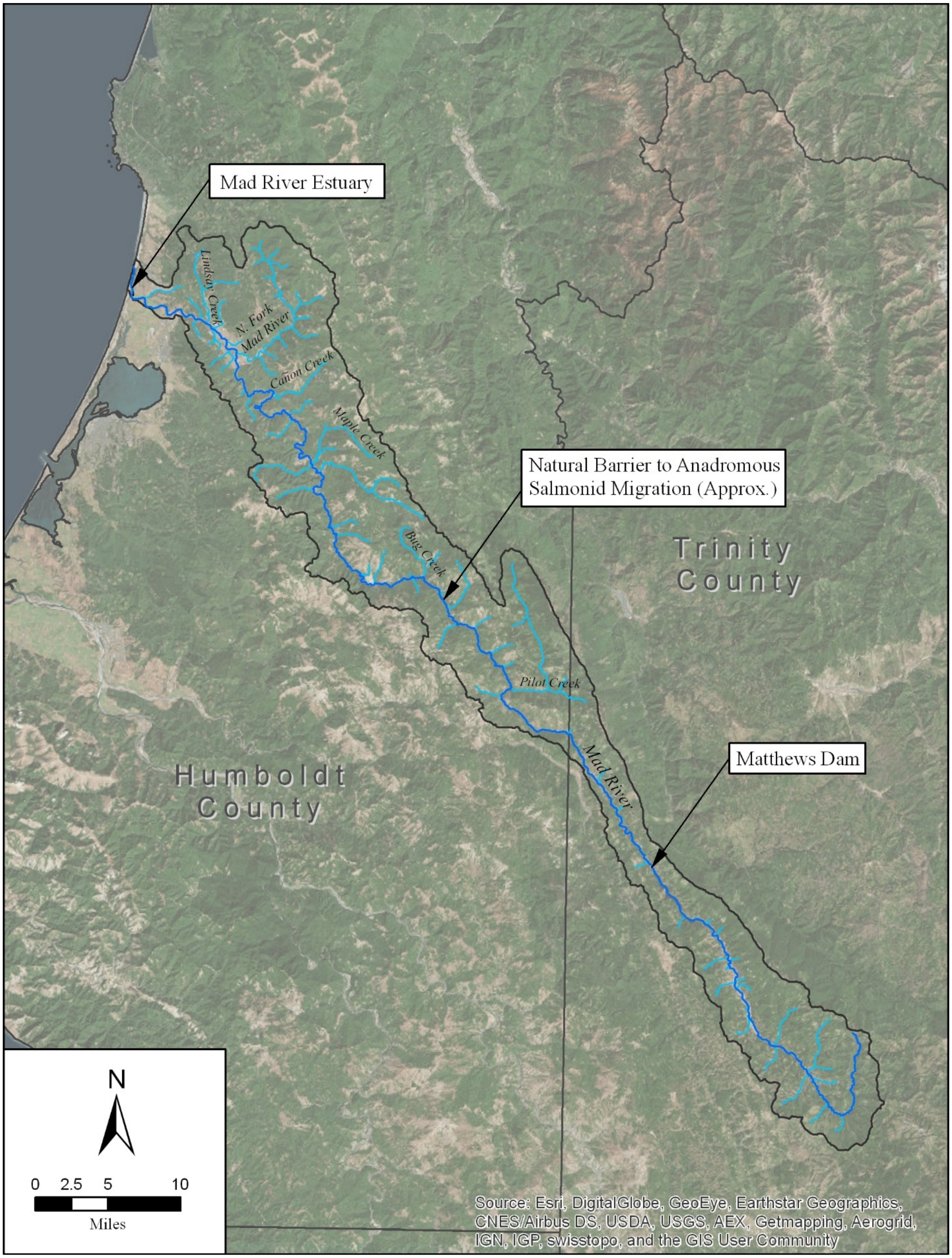

Figure 2. Watershed Map

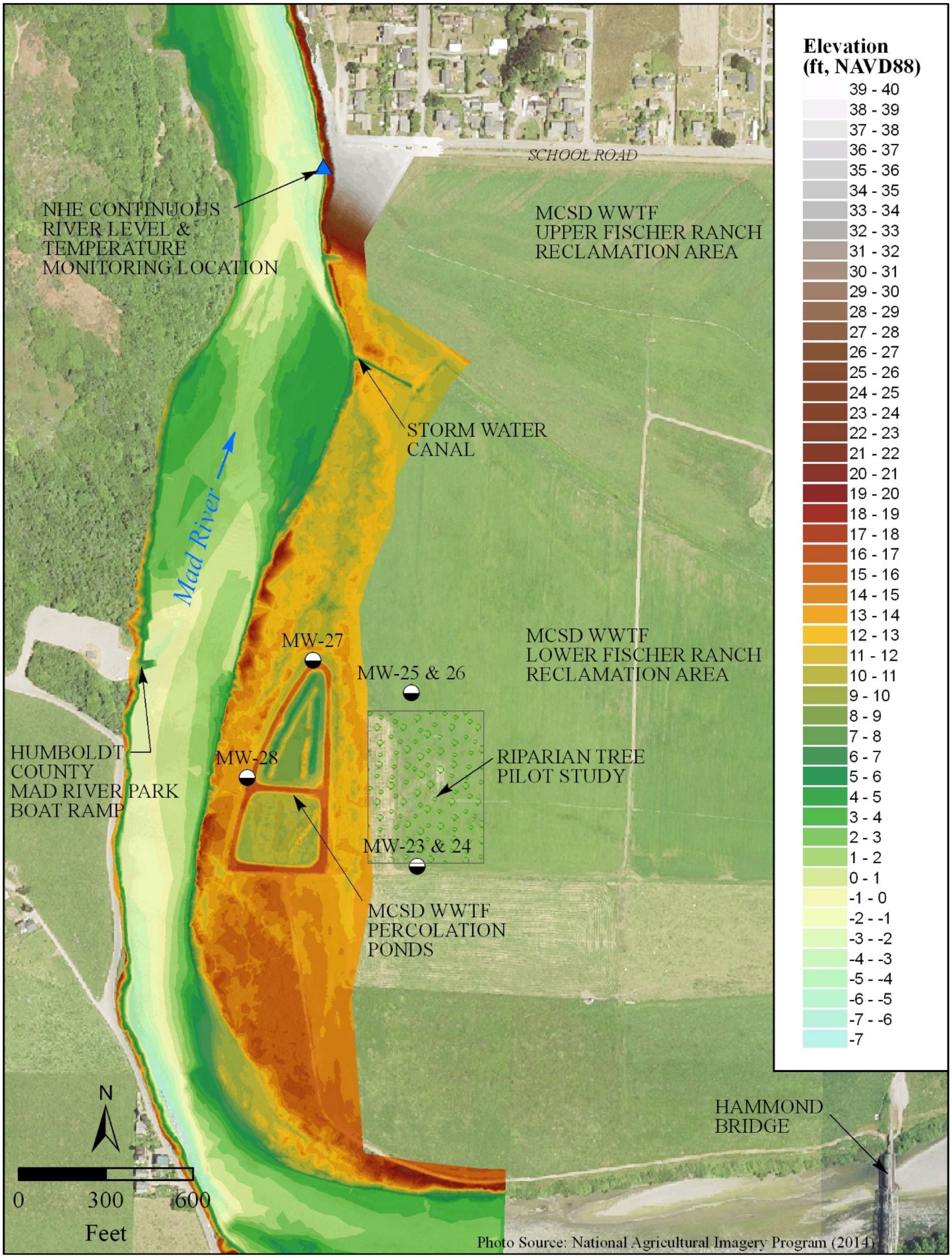

Figure 3. Project Site Map

from the river's floods and ringed with cyclone fencing to prohibit public access. The ponds maintain inundated water levels when in use for treated wastewater discharge and convert to emergent wetlands when they are unfilled. The southern pond is generally 10 ft elevation with a single linear ridge that is over 13 ft high. The northern pond ranges from around 5.5 ft elevation in dredged areas to 13 ft on elevated ridges that serve as islands when the pond is in use. Isolated willows provide habitat diversity within the ponds, particularly up on the elevated ridges. The levees range from 15 ft on the northern end to above 17 ft on the southern end. Adjacent floodplain areas range from around 10 ft in historic depressions and existing backwater areas to 14 ft elevation. When the river banks overtop, water backwaters through a system of human-made footpaths back to a historical backwater area, which stays ponded for a period as flow waters recede and standing waters infiltrate and evaporate. The habitat restoration project area is bound to the north by an existing storm water canal that drains the large, elevated floodplain to the east through a canal gate that remains open through the winter season and is closed when MCSD is applying treated wastewater to their fields. The project is limited to the south by a neighboring property and to the east by the large, elevated floodplain used seasonally for MCSD's treated wastewater reclamation.

1.4 Site Geology

The project site is mapped in the *Geology of the Cape Mendocino, Eureka, Garberville and Southwestern Part of the Hayfork 30 X 60 Minute Quadrangles and Adjacent Offshore Area, Northern California* (McLaughlin et al. 2000). The river and floodplain are mapped as "undeformed marine shoreline and aolian deposits (Holocene and late Pleistocene), consisting of gravel and sand deposited in marine terraces, on benches and on dunes along present shorelines". SHN Consulting Engineers and Geologists, Inc. prepared a *Final Foundation Report* for the Hammond Trail Pedestrian Bridge Replacement, which included a geologic cross-section interpretation of the river and floodplain subsurface in close proximity to the project site (SHN 2015). Subsurface data were collected from excavated machine borings to a depth of 80 ft on the floodplains and approximately 200 ft in the channel. Lithology was logged and geotechnical tests were performed on representative samples. Underlying the floodplain surface were Holocene alluvial deposits, measured to depths of approximately 75 ft. An approximately 40-foot thick defined silt/clay layer was mapped at a depth of approximately 30 ft below the floodplain surface on the north bank (SHN 2015). Holocene alluvium was underlain with late Pliocene to middle Pleistocene age Falor Formation sediments.

SHN logged soil lithology when the groundwater wells were installed (Figure 3). Soil logs were included as an appendix in the *Basis of Engineering Designs* report. MW-27 was installed north of the ponds and levee into the ground surface at an elevation of approximately 10.5 ft. Less than a foot of sandy organic soil covered approximately 3 ft of silty sand (down to elevation of 7 ft) that overlays 15.5 ft of well graded sand with gravel (from elevation 7 ft down to -8.5 ft). Lean clay was observed 19 ft below ground surface (at -8.5 ft elevation). MW-28 was installed west of the ponds and levee in the ground surface at an elevation of approximately 13.5 ft. A thin layer of organic soil and sand covers approximately 2 ft of silty sand (down to an elevation of 11.5 ft), layered over approximately 2.5 ft of silty sand with gravel (down to an elevation of 9 ft), and approximately 3 ft of well graded sand with silt (to an elevation of 6 ft). Below these layered deposits is at least 12.5 ft of well graded gravel with sand (observed from and elevation of 6 ft to -6.5 ft). The lithology logs from these two wells provides some information about the floodplain foundation and the potential composition of native soils of in areas of excavation. For example, the backwater channel base near MW 27 was proposed to daylight at an elevation of 6 ft. It can be expected that the material at the base of the channel near the ponds would be composed of well graded sand with gravel.

1.5 Climate

The climate at the project site was characterized by the National Oceanic & Atmospheric Administration (NOAA) cooperative weather gauge station, located in Eureka, CA at Woodley Island. The gauge recorded precipitation, temperature, and snowfall from January 1, 1906 to the present. Normal precipitation relative to the 1981-2010 epoch indicate that the average annual precipitation is 40 inches and the wet season is from October to May, when 95% of the rainfall occurs (NCDC 2017). Temperatures range from an average high of 64.3 °F in August to an average low of 55.0 °F in December (NCDC 2017).

2. HYDROLOGY

2.1 Mad River Discharge

The United States Geological Survey (USGS) gaged the Mad River near Arcata, CA (Station No. 11481000) from October 1, 1910 to September 30, 1913 (water years [WY] 1911 to 1913) and from October 1, 1950 to the present day (WY 1951 to 2017). Annual peak flow data was reported through WY 2015. During the 68-year period of record, annual peak discharge events ranged from 3,360 cubic feet per second (cfs) on March 7, 1977 to 81,000 cfs on December 22, 1964.

2.2 Flood Frequency Analysis

Flood frequency analysis using the USGS software PeakFQ, can be performed at USGS gauging sites with 10 or more years of annual peak flow records to estimate the design recurrence interval flood events. PeakFQ fits a hydrologic record of annual peak flow events to a flood frequency distribution, using the USGS Bulletin 17B Guidelines of the Hydrology Subcommittee (USGS, 1982). Specifically, PeakFQ uses a Pearson III frequency distribution to fit the logarithms of USGS gauging station instantaneous peak flow formatted records.

The USGS flood frequency software PeakFQ (version 5.2) was used to estimate flood recurrence intervals, including the 1.5-, 2-, 5-, 10-, 25-, 50- and 100-year flood events (Table 1).

Table 1. Peak Flow Estimates for Recurrence Intervals at USGS Gaging Station No. 11481000

Recurrence Interval	PeakFQ Bulletin 17B Estimated Peak Discharge (cfs)
1.5-year	20,550
2-year	26,410
5-year	41,560
10-year	51,670
25-year	64,280
50-year	73,460
100-year	82,420

During the project monitoring period, high flow events occurred several times during the winter, including a 5-year recurrence interval event (provisional report of 43,100 cfs at USGS gaging station No. 11481000) that peaked on January 17, 2016 (Figure 4).

2.3 River Level Monitoring

A pressure transducer monitored continuous water depths in the Mad River at a pool immediately downstream of the project site from November 24, 2015 to July 15, 2016 and from August 2, 2016 to December 6, 2016. Water depths were converted to water surface elevations, which displayed tidal fluctuations and waters rising and falling during storm events. Water levels were compared to the stream discharge hydrograph reported approximately 5.5 miles upstream at the USGS gaging station No. 11481000, Mad River near Arcata CA (Figure 4).

2.4 Tides

Monitored river levels were compared to local tidal data at the NOAA Station ID 9418767 (North Spit) and Station ID 9419750 (Crescent City). In general, the Mad River tides were in sync with the North Spit tidal gage. Project reach river levels were controlled by the bed elevations at the river mouth, which periodically scours the bed during winter storms to form a sand bar in the ocean. The monitoring data displayed a transition in the river level control before and after the first storm events, when the river formed a sand bar offshore of the mouth (Figure 4).

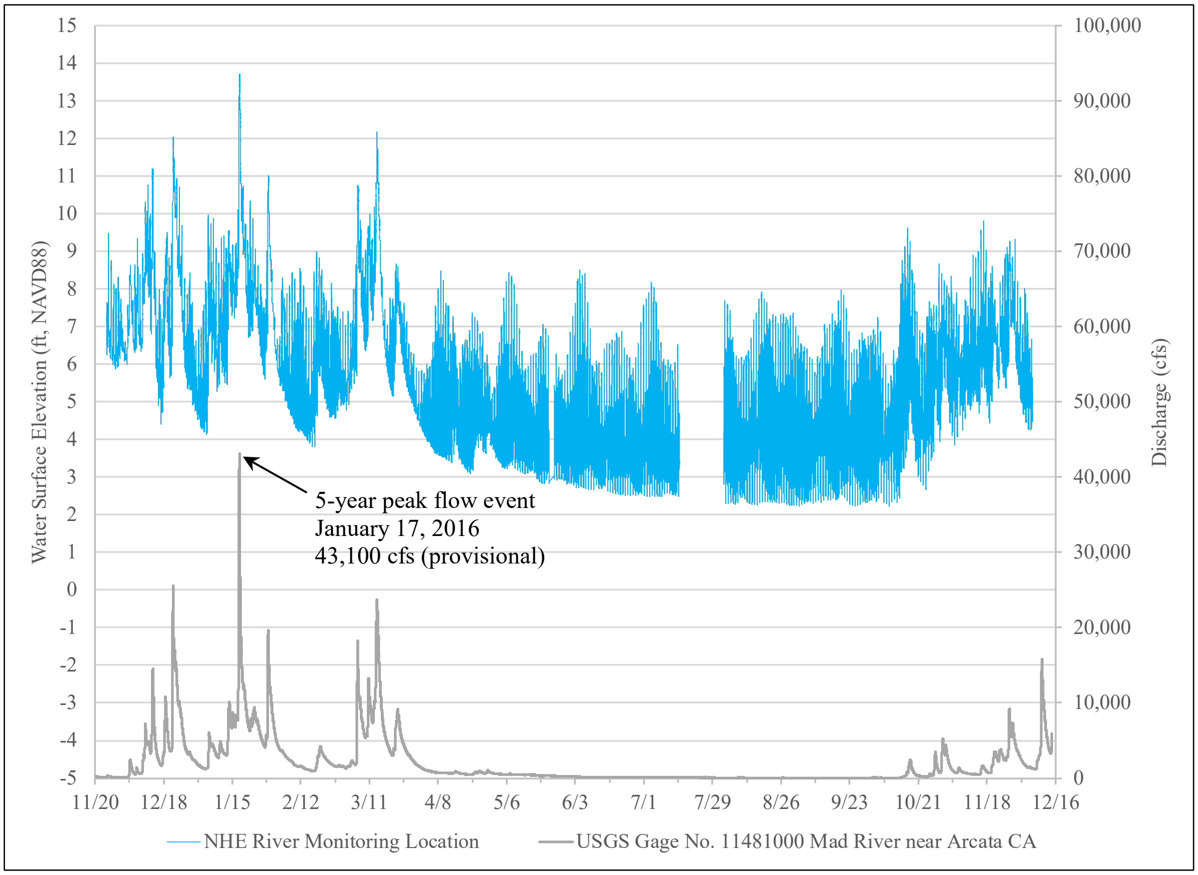

Figure 4. River Levels near the Project Site and Stream Flow at USGS Gage Station No. 11481000

3. HYDRAULIC ANALYSES

3.1 Topography and Bathymetry

A project base map was generated for the design from existing surveyed topography, including:

- 2010/2011 Coastal LiDAR (NOAA 2012).
- 2008 channel cross-sections surveyed by Points West Surveying as part of the Humboldt County Mad River bluff restoration project.
- 2013 river bathymetry measured by Graham Matthews & Associates after the Mad River bluff restoration project was implemented.
- Additional topography was collected by NHE with a surveying total station under the supervision of the project engineer.

The design project base map was combined with available data from the the 2013 *NOAA Coastal California TopoBathy Merge Project*, which included 2010/2011 Coastal LiDAR topography and 2009/2010 ocean bathymetry (NOAA 2013). The extended project map does not include the river bathymetry from the river mouth and ocean bottom upstream to the surveyed river bathymetry near the project reach. Channel slope and form were estimated from the available data by adjusting the channel mouth elevation to recreate measured tidal water surface elevations using the one-dimensional hydraulic model. The channel mouth was assumed to have fluctuated seasonally; lowering after the first storm events and then building back up as flows receded and the local littoral cell moved sands along the shore. This assumption was substantiated in the seasonally fluctuating tidal elevations observed at the project monitoring station. A channel alignment was defined in the Mad River through the project reach that captures grade control breaks, such as riffle crest elevations (Figure 5).

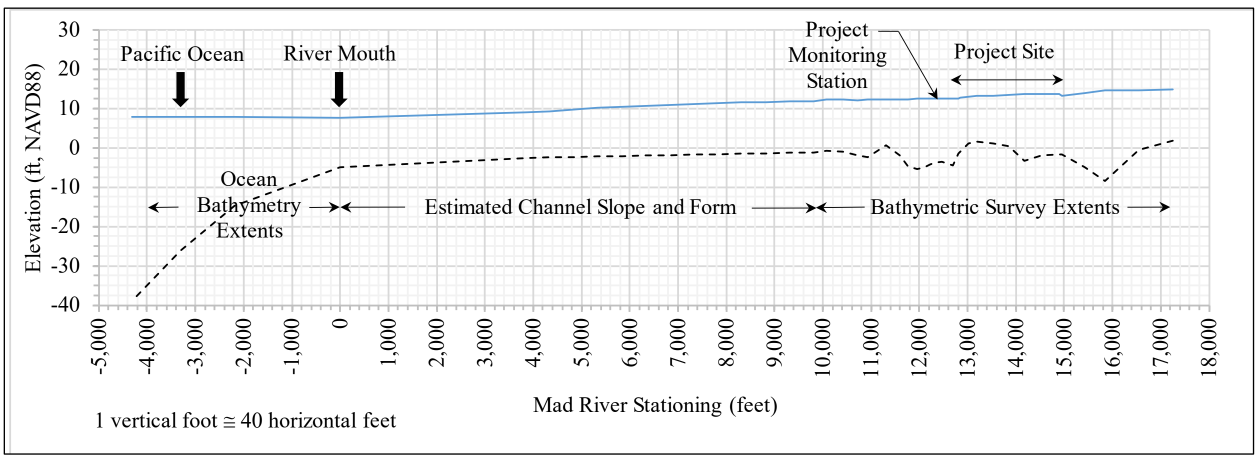

Figure 5. Longitudinal Profile of the Mad River

3.2 One-Dimensional Existing Conditions Open Channel Flow Model

Existing conditions were simulated in a steady-state, sub-critical, single-dimension US Army Corps of Engineers (USACE) Hydrologic Engineering Center River Analysis System (HEC-RAS) version 5.0.1 modeling software (USACE 2016). The HEC-RAS model was used to estimate existing condition water surface elevations through the project reach where channel bathymetry was well-defined and calibration data were collected. The purpose of the existing conditions one-dimensional model was to provide boundary conditions and “Manning’s n” roughness parameters to calculate the drag coefficients for a two-dimensional design conditions simulation model at the project site. The HEC-RAS model calculates one-dimensional water surface profiles and average channel velocities for both steady gradually varied flow and unsteady flow through a channel. For this analysis, steady flow modeling was used to predict water surface elevations within the project area and modeling reach for design flow conditions. Reference can be made to the HEC-RAS hydraulic manual for information specific to steady-state modeling.

3.2.1 HEC-RAS Model Extents

The upstream boundary of the hydraulic analyses was approximately 1,300 ft downstream of the Hammond Bridge. In-channel bathymetry surveys and LiDAR (NOAA 2012) were used to define the 2,100-foot project reach. Downstream of the surveyed bathymetry, the model reach extended another 12,850 ft to the channel mouth and 4,300 ft out into the Pacific Ocean. Ocean bathymetry the channel mouth from the banks landward were defined by combined bathymetry and topography LiDAR (NOAA 2013). The channel mouth bathymetry form and elevation were estimated from model results to simulate observed water surface elevations at the project monitoring station.

Channel surveys were combined with overbank and ocean bathymetry LiDAR to define 33 cross-sections and a streamline along the thalweg (Figure 6). The channel mouth migrates along its sand spit and periodically breaches during high flows; therefore, the channel mouth cross-section locations were based on the best topographic data available. Thalweg elevations and channel form for the two cross-sections at and directly upstream of the channel mouth were estimated to calibrate the water surface elevations observed at the NHE project monitoring station. Five additional cross-sections were interpolated between the area of surveyed bathymetry and the cross-section upstream of the channel mouth.

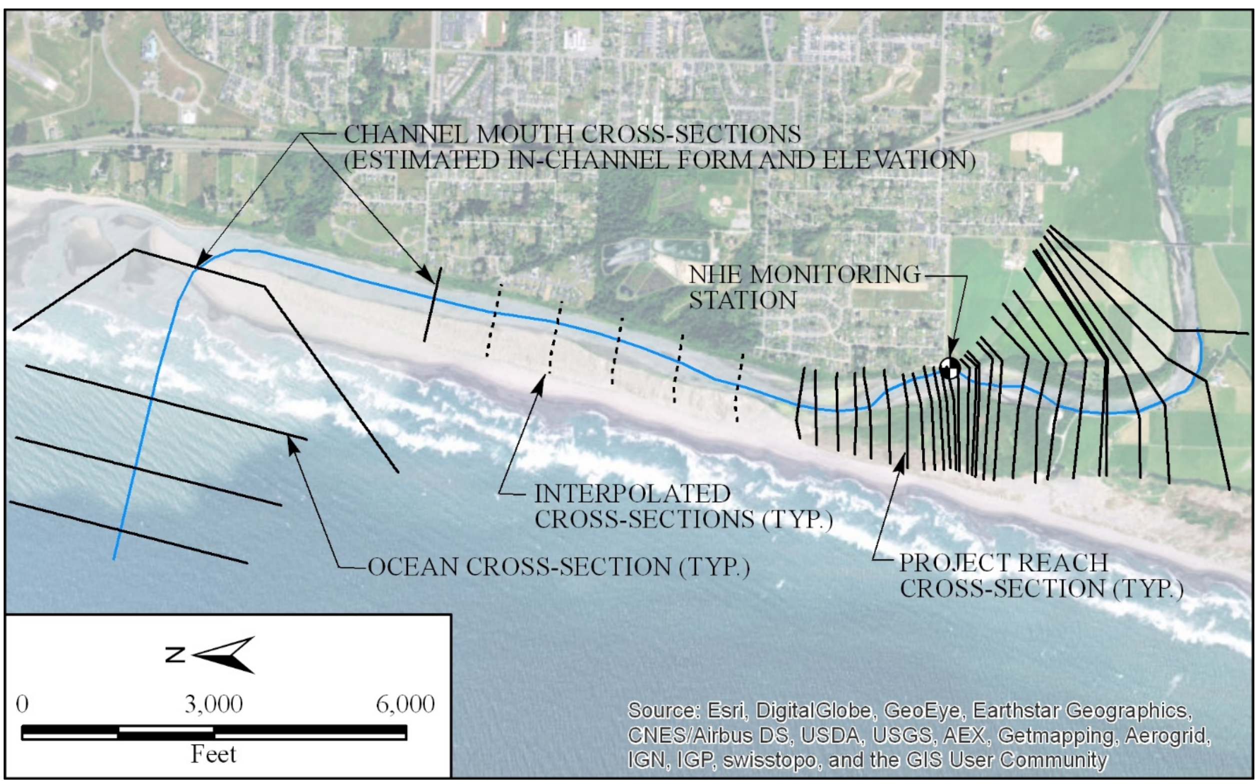

Figure 6. HEC-RAS Model Cross-section Layout

3.2.2 HEC-RAS Boundary Conditions

Downstream Water Surface Elevation Boundary

The downstream boundary for the model was a tidal elevation located approximately 4,000 ft off-shore bound laterally by ineffective flow areas. Bathymetry at the river mouth had not been surveyed and was seasonally dynamic; therefore, channel elevations at the mouth were synthetically recreated in the model to produce water levels observed in the river upstream. To accurately estimate the channel elevation at the mouth, the downstream tidal boundary of the one-dimensional model needed to initiate in the Pacific Ocean, where bathymetry and tidal elevations were better defined. Tidal conditions in the ocean were estimated based on the NOAA North Spit tidal station. Tidal peaks and lag time correlate well to the water levels observed at the NHE monitoring station, downstream of the project site. River mouth bathymetry was adjusted for the wet season, accounting for changes in the channel pre- and post-winter flows, to calibrate the model simulation of measured water surface elevations at the NHE monitoring station near the project site. In the summer, the low tide levels in the river were observed to be higher than ocean tides, due to the sand spit built up near the mouth. Once the high winter flows reconfigured the sand bar and deepened the mouth, ocean low tides continued to be muted in the river due the channel elevations over a riffle located downstream of the project site. Water levels didn't drop below 2.75 ft elevation for the 2016 period of record at the NHE monitoring station.

Upstream Flow Boundary

River discharge was estimated to be equal to the stream gage discharge reports from the USGS at the Mad River near Arcata Station No. 1481000. Stream discharge peaks were adjusted by lag time to the river stage peaks observed downstream at the NHE monitoring station for calibration (detailed in HEC-RAS model results Table 3).

Manning's n values and river mouth elevations were adjusted to best simulate observed conditions in the channel. Table 4 summarizes the calibration accuracy of the HEC-RAS model to reproduce observed water surface elevations. Results for a single model geometry at the channel mouth and Manning's n values are summarized, which best suit bankfull channel conditions (estimated to be the 2-year flow peak at 26,500 cfs).

During low flow, in-channel Manning's n values were increased to 0.0225-0.0265 to better predict observed conditions. During the monitoring period, measured river stage errors up to 0.5 ft were recorded due to wind waves. The model was not adjusted to better predict higher flow conditions because of uncertainty in the river mouth location and geometry. Model results indicated that the project site backwatered the adjacent riffle and that flows greater than bankfull were deeper, but did not create a side channel through with greater velocities or shear stresses.

3.2.3 HEC-RAS Model Calibration

Manning's Roughness Coefficient

The model considered variations in surface friction represented as the Manning's roughness coefficient, "n." Each cross-section was divided into sections with separate, distinct roughness values based on channel and overbank definition. Manning's n was estimated based on vegetation or land use type, which were identified from aerial photography and site reconnaissance. Manning's n values were varied to simulate water surface elevations at the NHE monitoring station and river stage observation points during several calibration discharge events. Table 2 summarizes the Manning's n values used to generate water surface elevations observed in the river during various stream discharge events.

Table 2. Manning's Roughness Coefficient Values

Land Use or Vegetation Type	Final (Calibrated) Manning's n
River	0.018 – 0.0185 (bankfull)/0.0225 – 0.0265 (low flow)
Riparian Trees	0.085
Riprap	0.055
Pasture	0.03
Bare Sand Dune	0.02
Vegetated Sand Dune	0.05
Brush	0.07
Emergent Wetlands/Pond	0.03 – 0.035
Houses and Developed Areas	0.03
Paved and Dirt Roads	0.02

The areas with specific Manning's roughness coefficients are delineated in Figure 7.

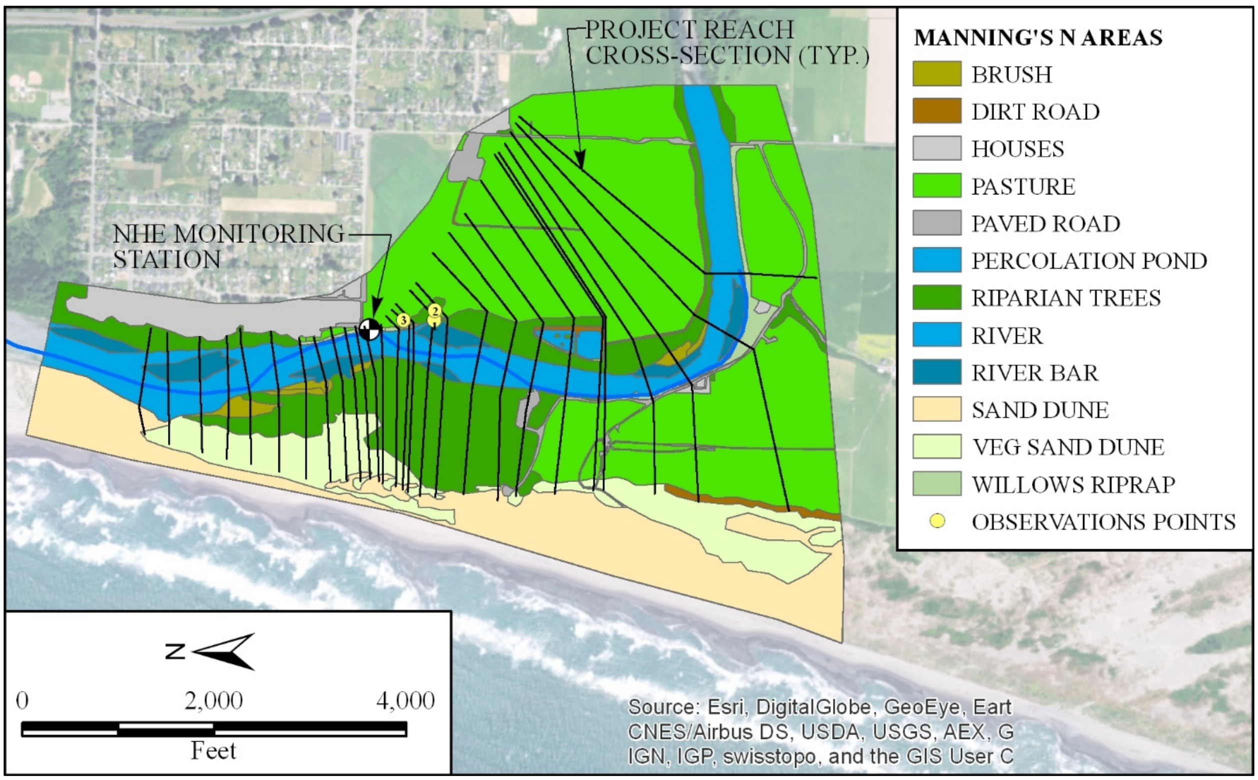

Figure 7. HEC-RAS Model Project Reach Manning's N Areas and River Stage Observation Points

Calibration Measurements

NHE collected river stage data during storm events in addition to the continuous stage data at the project monitoring station (Figure 7). Table 3 lists the river observation point details used for the HEC-RAS model calibration and evaluation.

Table 3. River Stage Observations

River Stage Observation Date and Time	River Stage Observation Location ID	River Stage Observation Location Description	Observed Water Surface Elevation (ft)	Estimated River Discharge (cfs)	NHE Monitoring Station Elevation (ft)	Estimated Tide Elevation (ft)
12/23/2015 8:59	1	Wooden fence post south of storm ditch	10.93	13,700	10.73	8.4
1/17/2016 17:18	2	Wooden corner post north of storm ditch	12.26	21,900	11.78	5.0
1/17/2016 22:30	3	Wooden fence post along field	14.39	43,100	13.58	3.1
1/18/2016 9:50	2	Wooden corner post north of storm ditch	12.19	22,700	11.45	5.0
2/9/2016 12:00	N/A	N/A	N/A	1760	8.26	7.9
2/9/2016 18:18	N/A	N/A	N/A	1730	4.35	-0.9
3/14/2016 3:00	N/A	N/A	N/A	23,700	12.18	7.9

3.2.4 HEC-RAS Model Results

Manning's n values and river mouth elevations were adjusted to best simulate observed conditions in the channel. Table 4 summarizes the calibration accuracy of the HEC-RAS model to reproduce observed water surface elevations. Results for a single model geometry at the channel mouth and Manning's n values is shown. These results best suit the bankfull conditions (estimated to be 26,500 cfs). In-channel Manning's n values were increased from 0.018/0.0185 to 0.0225-0.0265 to better predict winter base flow conditions. During the monitoring period, measured river stage errors up to 0.5 ft were observed in all types of weather conditions due to wind waves. The model was not calibrated to predict flows above bankfull because of the limitations of a one-dimensional model in an estuary.

Table 4. HEC-RAS Model Calibration Results

River Stage Observation Date and Time	Estimated River Discharge (cfs)	Estimated Tide Elevation (ft)	River Stage Observation Location	Observed Water Surface Elevation (ft)	Model Simulation Water Surface Elevation (ft)	Error (ft)	Error Explanation
12/23/2015 8:59	13,700	8.4	1	10.93	10.63	-0.30	Error could be due to waves. Approx. time of winter breach and sandbar set up at the mouth. Raising Manning's n values and elevations near the mouth may provide better predictions.
			NHE Monitoring Station	10.73	10.30	-0.40	
1/17/2016 17:18	21,900	5.0	2	12.26	12.27	+0.01	Storm's rising limb, bankfull. Acceptable error, poss. due to waves.
			NHE Monitoring Station	11.78	11.66	-0.12	
1/17/2016 22:30	43,100	3.1	3	14.39	15.71	+1.37	10-yr flow event. 1-D model cannot capture 2-D floodplain flow, esp. overbank backwater areas. Error may also be due to breaches in the spit and fluctuations in the channel mouth location and elevation.
			NHE Monitoring Station	13.58	15.44	+1.86	
1/18/2016 9:50	22,700	5.0	2	12.19	12.47	+0.28	Storm's receding limb following 10-year event. Bankfull and draining. Error poss. due to established overbank flow paths downstream, waves or fluctuations in the bed.
			NHE Monitoring Station	11.45	11.84	+0.39	
2/9/2016 12:00	1760	7.9	NHE Monitoring Station	8.26	7.98	-0.28	Acceptable error, poss. due to waves.
2/9/2016 18:18	1730	-0.9	NHE Monitoring Station	4.35	4.33	-0.02	Acceptable error.
3/14/2016 3:00	23,700	7.9	NHE Monitoring Station	12.18	12.10	-0.08	Acceptable error.

The analysis of existing conditions showed that there are governing forces dominating the project reach seasonally. Some of these are not predictable, such as the location and form of the river mouth and breaches in the sand spit; however, proposed design elements could be evaluated with the two-dimensional design model under the following conditions:

- Low flow, when the river is dominated by an unsteady downstream tidal boundary and upstream flows are steady-state.
- Bankfull flow, when the river is dominated by a steady or unsteady upstream flow boundary and the downstream base elevation is steady-state.

Measured river stages indicate that the river stage is dominated by the tides during low flows, fluctuating diurnally during the day. In contrast, storm discharges backwater the riffle adjacent to the project site, drowning the effect of the tides.

3.3 Two-Dimensional Design Conditions Open Channel Flow Model

Alternative 3 (Figure 8) was chosen for hydraulic analysis. The purpose of a two-dimensional model was to evaluate habitat design features under various flow conditions, including overbank flows. The United States Bureau of Reclamation (USBOR) Technical Service Center (TSC) two-dimensional hydraulic model SRH-2D (Version 2) was used to solve variables including water surface elevations, water depth, and depth-averaged velocity. In addition, bed shear stress was calculated. The approach uses the following assumptions:

1. the flow is steady (or at least does not vary appreciably over short time scales)
2. the flow is hydrostatic (vertical accelerations are neglected)
3. the turbulence can be treated adequately by relating Reynolds stresses to shear stresses using an isotropic eddy viscosity

3.3.1 SRH-2D Model Extents

The upstream boundary of the two-dimensional hydraulic model was approximately 1,300 ft downstream of the Hammond Bridge, the same as the one-dimensional model. The two-dimensional model extended downstream to the pool where the NHE monitoring data collect river stage. Design topography was incorporated into the existing conditions digital elevation model with AutoCAD Civil 3D for two-dimensional hydraulic analysis, including a backwater channel stemming upstream from the existing storm water canal, removal of the riverfront levee around the percolation ponds, recontouring the ponds and a swale to connect the ponds to the river upstream (Figure 8).

3.3.2 SRH-2D Boundary Conditions

SRH-2D was used to simulate both steady-state and unsteady flow and stage boundary conditions. As stated, the model does not vary flow appreciably over a short time scale; however, rising or falling limbs of the 2-year flow events were gradual enough for the model to converge. High flow conditions maintain very slowly changing downstream boundaries, unlike tidal conditions.

Downstream Water Surface Elevation Boundary

The downstream boundary for the two-dimensional model was located approximately 3,600 ft downstream of the NHE monitoring station and defined by design tidal boundaries. Low flow river stages at the boundary were unsteady, fluctuating with the tides. Bankfull river stages at the boundary were relatively steady varying gradually with the upstream flows.

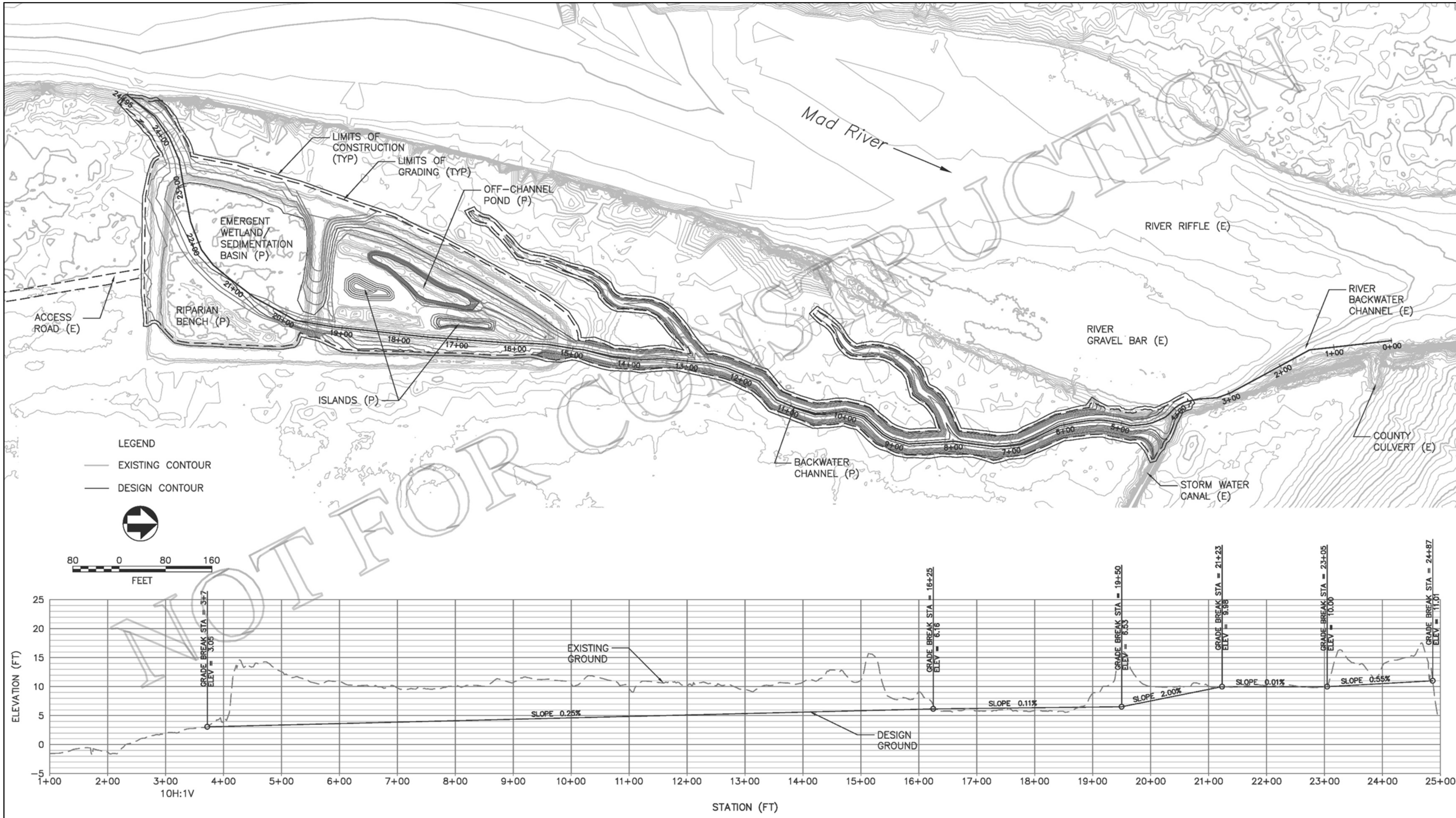

Figure 8. Alternative 3 Project Design Planform and Profile

Upstream Flow Boundary

Low flow design river discharge at the upstream boundary was estimated to be a steady 50 cfs to simulate summer conditions when the tides dominated the river stage. Bankfull design river discharge was estimated to peak at 26,500 cfs to represent a 2-year recurrence interval flow and evaluated for both steady and unsteady simulations.

Manning's Roughness Coefficient

The model considered variations in surface friction represented as Manning's n, as defined in Table 2. Figure 9 illustrates the model roughness areas, including project element areas.

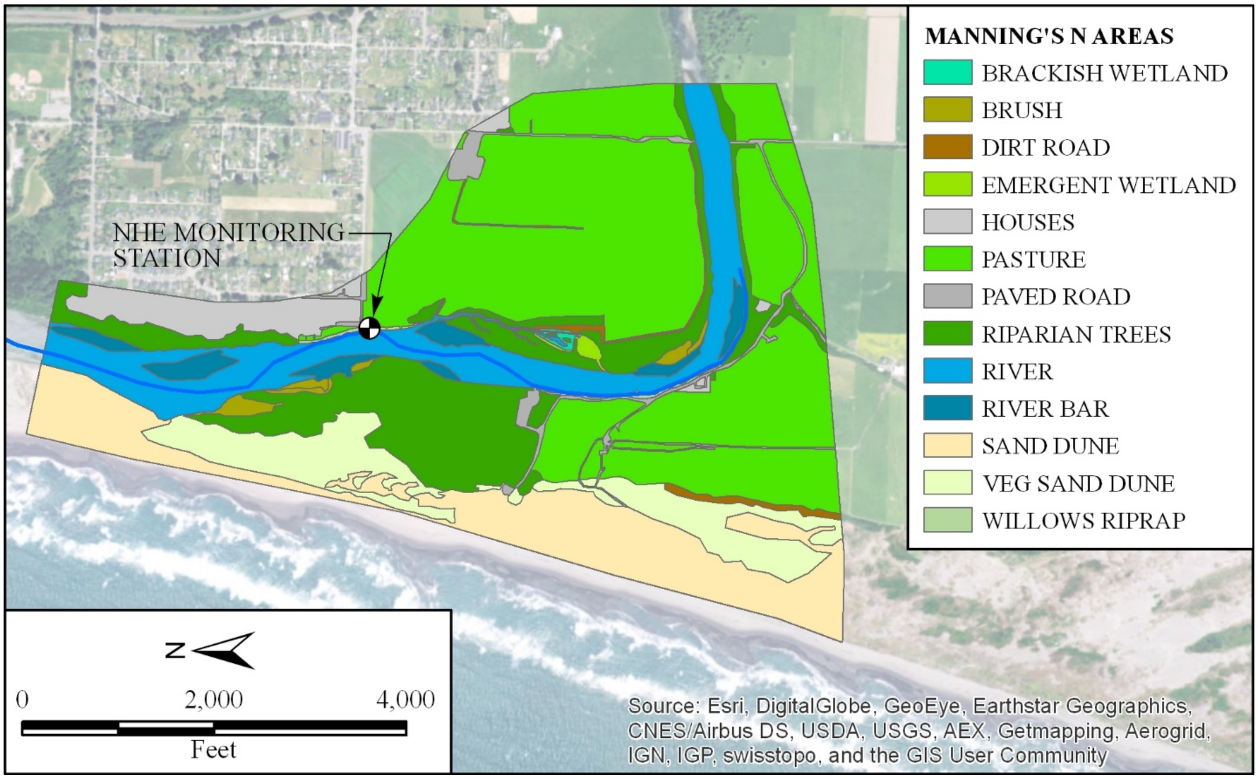

Figure 9. SRH-2D Model Manning's N Areas

The two-dimensional model results were verified by comparison with the one-dimensional model results for in-channel flows.

3.3.3 SRH-2D Model Results and Discussion

Design conditions were based on measured data, altered to simulate specific scenarios. For example, low flow conditions were coupled with a tidal peak that was not measured of 8.5 ft, but would be useful to evaluate for the design. Although a variety of scenarios were simulated, it would not be prudent to present every result; therefore, specific results at chosen time steps are presented for discussion. All profile illustrations of the results are along the channel alignment shown in Figure 8.

Steady-state Low Flow with an Unsteady Downstream Tidal Boundary

Steady-state low flow conditions were simulated with an unsteady downstream tidal boundary to evaluate the project when the river water levels are governed by ocean tides. Upstream low flow was estimated to remain constant at 50 cfs. The downstream boundary was a synthetic high to low tidal curve located near the NHE monitoring station, ranging from 8.5 ft to 2.75 ft over approximately 10 hours. Water surface elevations during the trough of the ebb tide cannot drop below 2.75 ft at the project site due to a riffle control in the river downstream. Figure 10 - Figure 12 illustrate the design backwater channel profile at the 2-hour time step when water surface elevations were approximately 6.7 ft and maximum velocities and bed shear stresses occurred where the off-channel pond drains into the backwater channel, downstream of backwater channel station 1,500 ft.

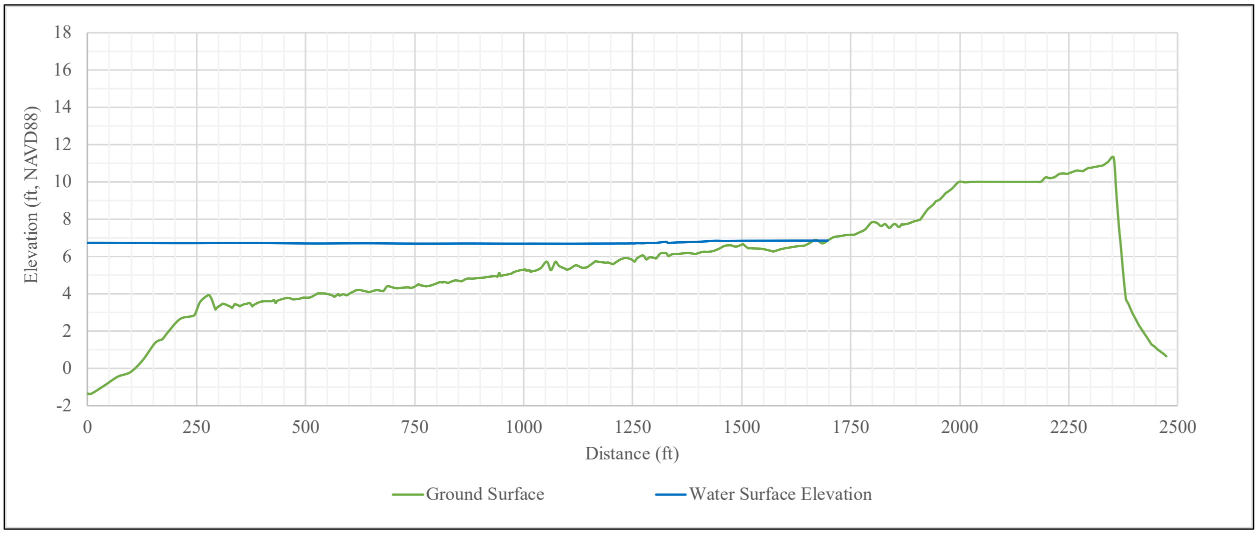

Figure 10. SRH-2D Low Flow Results (t=2 hrs): Water Surface Elevation Profile

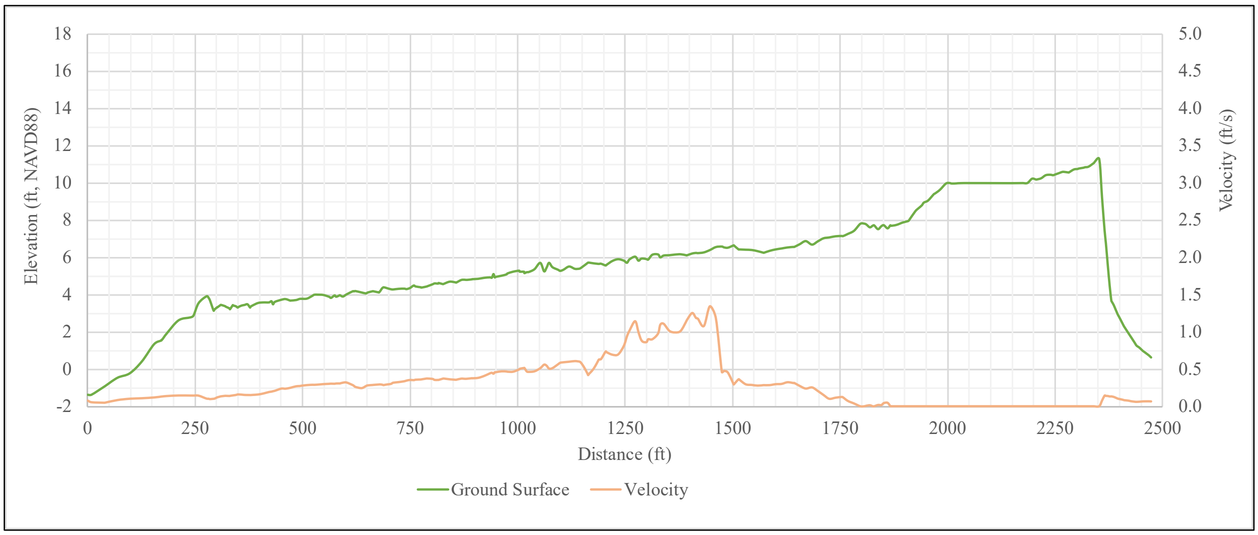

Figure 11. SRH-2D Low Flow Results (t=2 hrs): Depth-averaged Velocity Profile

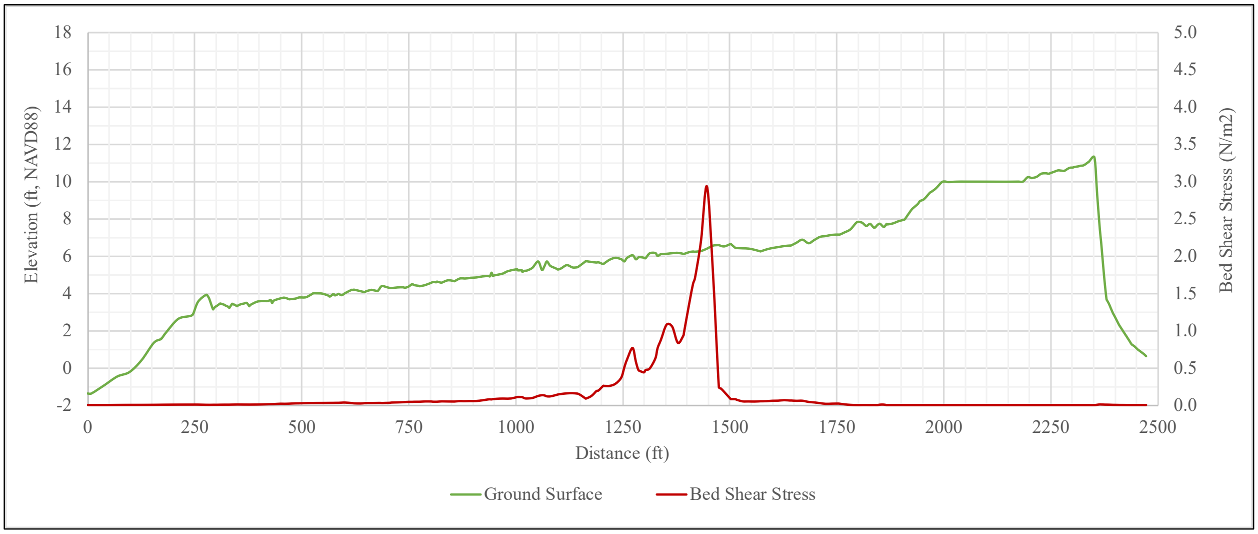

Figure 12. SRH-2D Low Flow Results (t=2 hrs): Bed Shear Stress Profile

Steady-state Bankfull Flow with a Downstream Receding Stage Boundary

A steady, design bankfull peak discharge of 26,500 cfs was used at the upstream boundary to recreate steady-state peak flood conditions. The downstream river stage boundary decreases from 12.6 ft to 11 ft over approximately 9 hours, corresponding to an ocean high tide ebbing to low tide during a steady-state river bankfull flow condition. Figure 13 -Figure 16 show the planform results for this scenario and Figure 17 - Figure 19 illustrate the design backwater channel profile at the 4-hour time step when water surface elevations were approximately 12.7 ft. Depth average velocities and bed shear stresses were consistently low through the design backwater features (around 0.2-0.4 ft/s and 0.05 N/m^2, respectively), due to the mild change in the downstream boundary over the model time. These downstream conditions were consistent with monitored data.

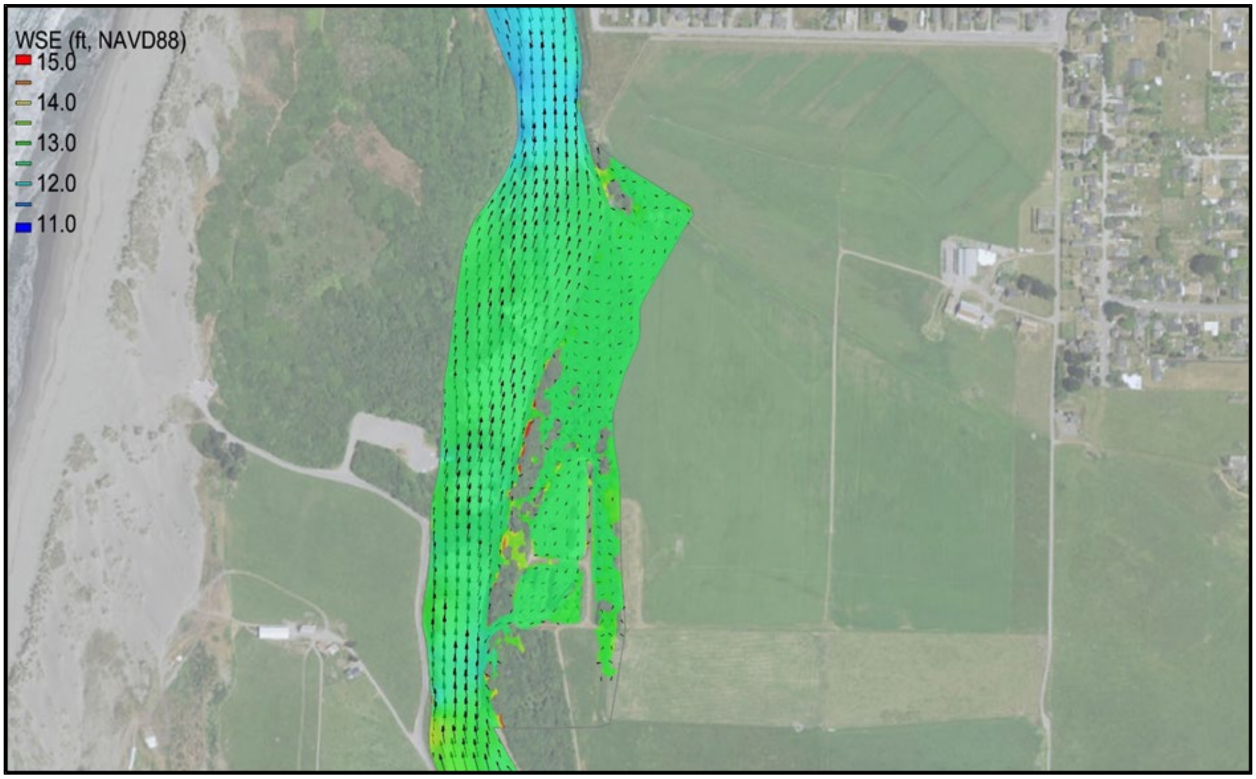

Figure 13. SRH-2D High Flow Results (t=4 hrs): Water Surface Elevations with Velocity Vectors

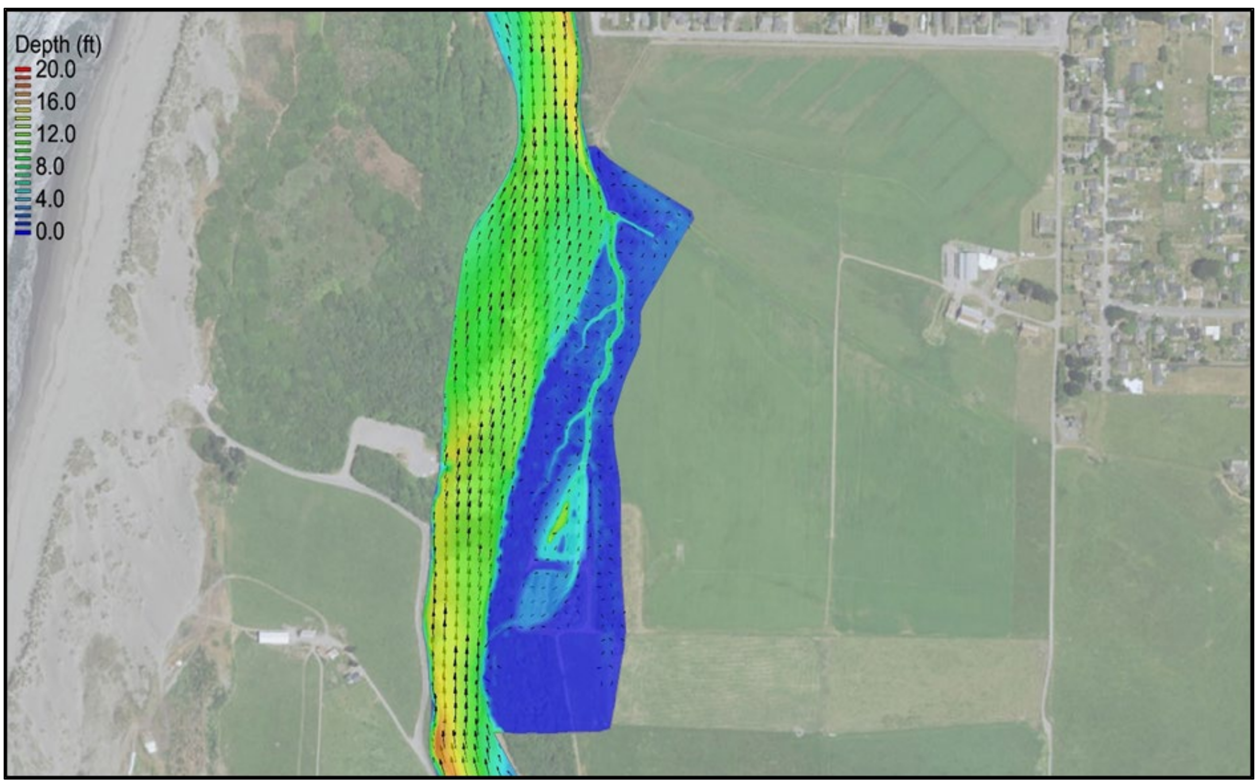

Figure 14. SRH-2D High Flow Results (t=4 hrs): Water Depths with Velocity Vectors

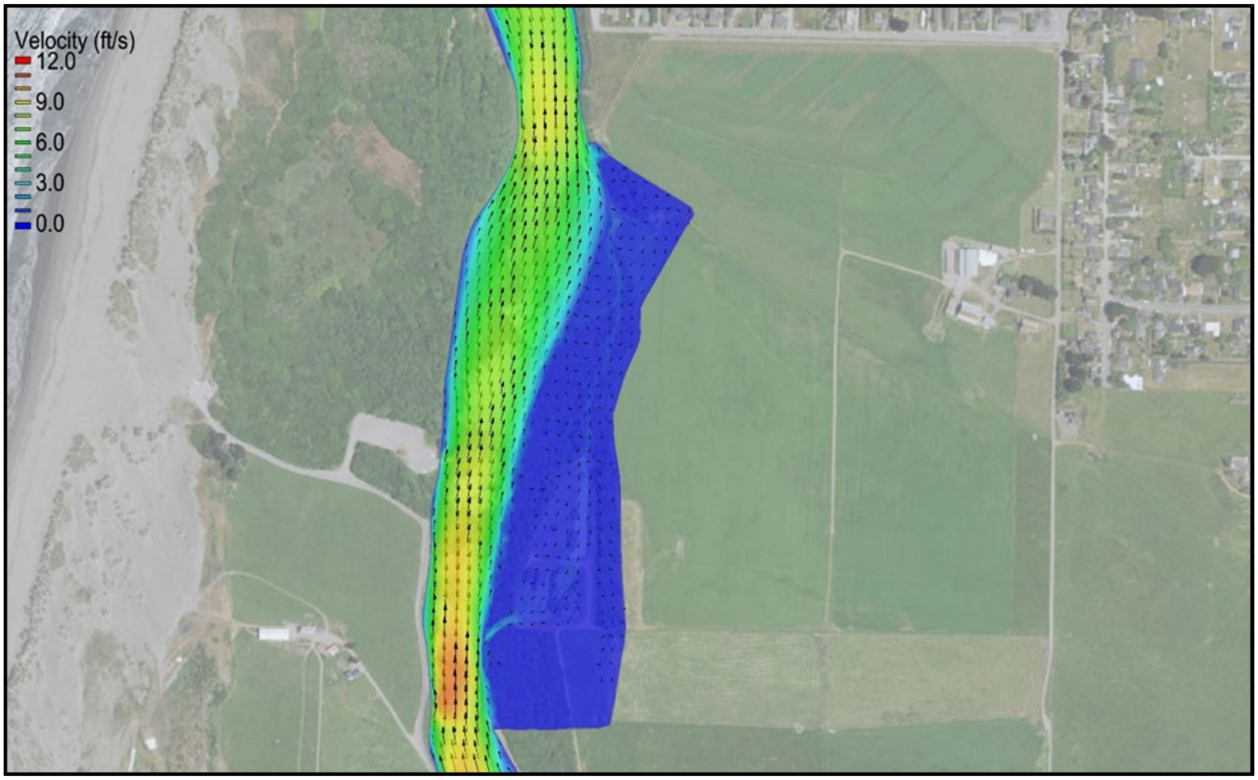

Figure 15. SRH-2D High Flow Results (t=4 hrs): Depth-averaged Velocity Magnitude and Vectors

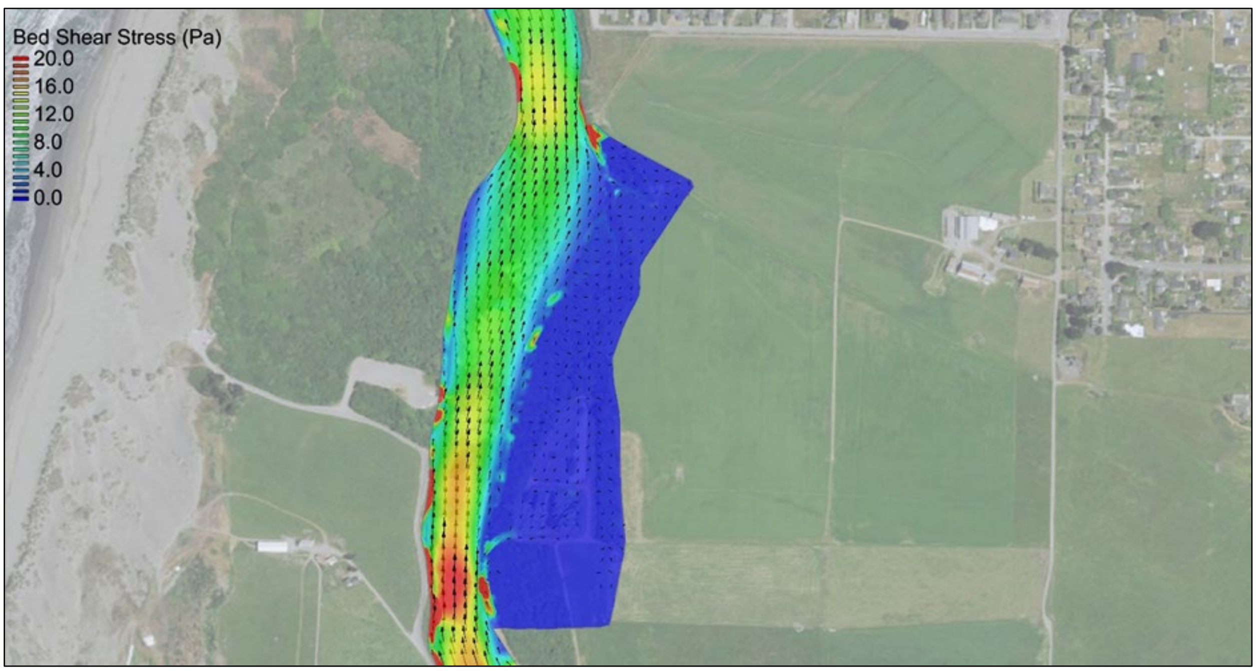

Figure 16. SRH-2D High Flow Results (t=4 hrs): Bed Shear Stress with Velocity Vectors

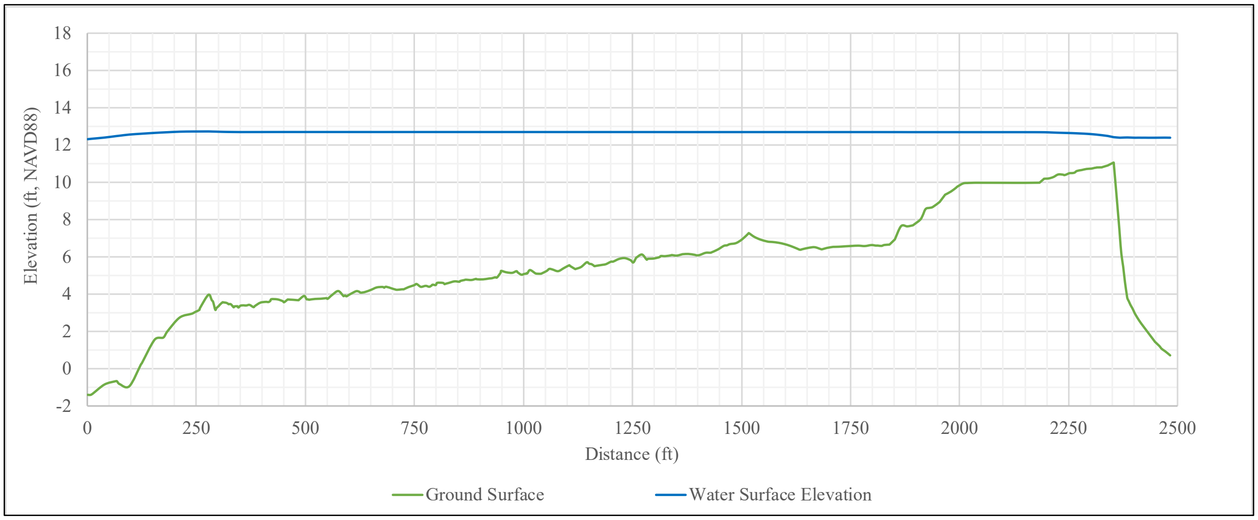

Figure 17. SRH-2D High Flow Results (t=4 hrs): Water Surface Elevation Profile

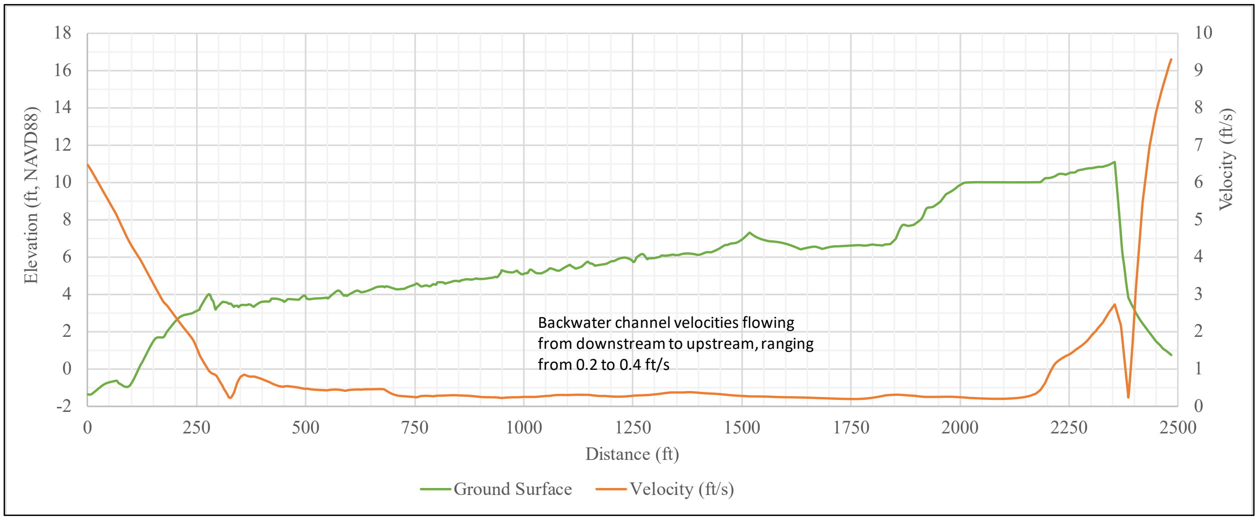

Figure 18. SRH-2D High Flow Results (t=4 hrs): Depth-averaged Velocity Profile

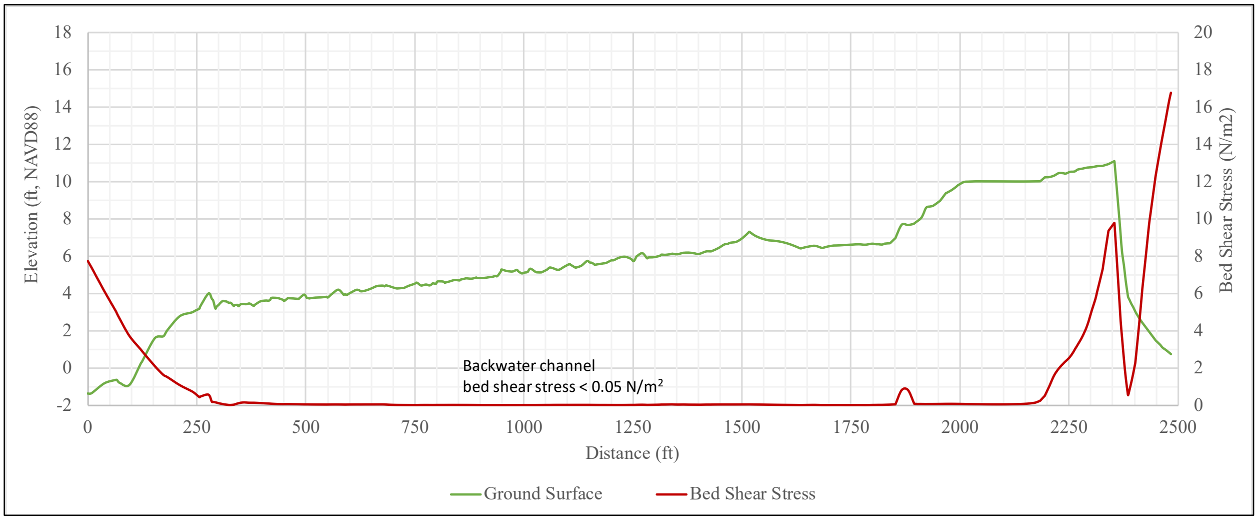

Figure 19. SRH-2D High Flow Results (t=4 hrs): Bed Shear Stress Profile

Water enters the project site through the constructed backwater channel and continues flowing in the upstream direction relative to the river as flood waters rise. Maximum floodplain velocities should occur in the constructed backwater channel. The model results indicate that the upstream overflow swale doesn't function as a flow-through side channel to the river under design high flows, rather it is the upper extent of the backwatering from the downstream channel. The site drains when river levels drop downstream, which requires for the river flow upstream to decrease.

3.4 Geomorphic Assessment

The project is located on an active floodplain and upstream of a backwater channel; therefore, sediment transported through the project site is assumed to be fine sediment carried in suspension. The USGS collected and analyzed water quality data at gaging station No. 11481000, including suspended sediment grain size distribution and concentration for WY 1966 to 1974. From WY 1972 to 1974, instantaneous flow measurements were collected at the same time as the suspended sediment data. Assuming that this data subset can be used to estimate existing conditions, it is discussed herein.

3.4.1 Suspended Sediment Composition

Grain size distributions were measured from a range of stream discharges from 980 to 40,500 cfs. All suspended sediment was less than 2 mm, indicative of coarse sands and finer. The median grain size for all samples ranged from 0.004 mm (very fine silt) to 0.04 mm (coarse silt), with an average value of 0.02 mm (medium silt). Median grain size (D50) and the 84th percentile grain size (D84) for sampled discharge events are shown in Figure 20.

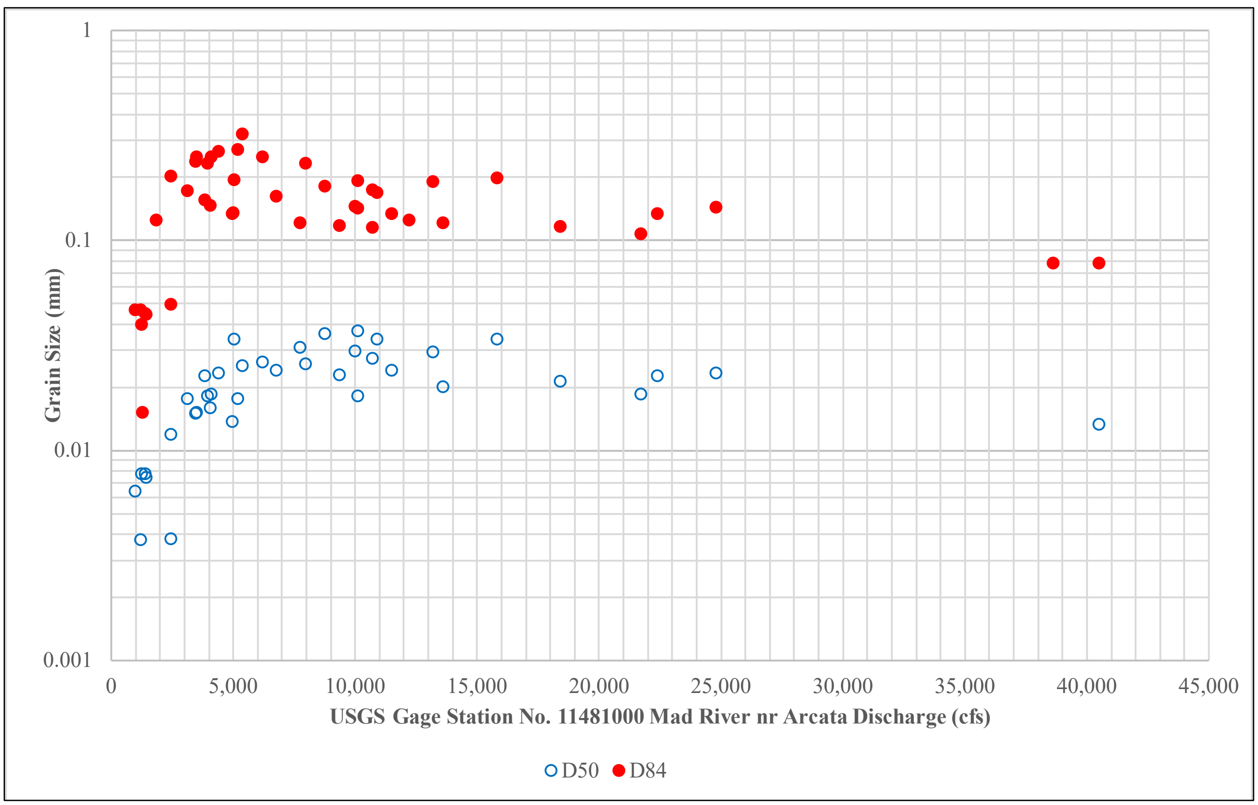

Figure 20. Median and 84th Percentile Grain Size Diameter vs Stream Discharge

Stream discharge from 980 to approximately 5,000 cfs showed a general rise in particle size as flow increased. Above 5,000 cfs, there was little variation in the particle size distribution. A slight decrease in particle size was observed as flows increased above bankfull discharge (estimated to be the 2-year flow at 26,500 cfs); however, too few samples were collected to be conclusive.

3.4.2 Suspended Sediment Concentration

Sampled suspended sediment concentrations ranged from 11 to 8,580 mg/L for stream discharges ranging from 53 to 40,500 cfs (Figure 21).

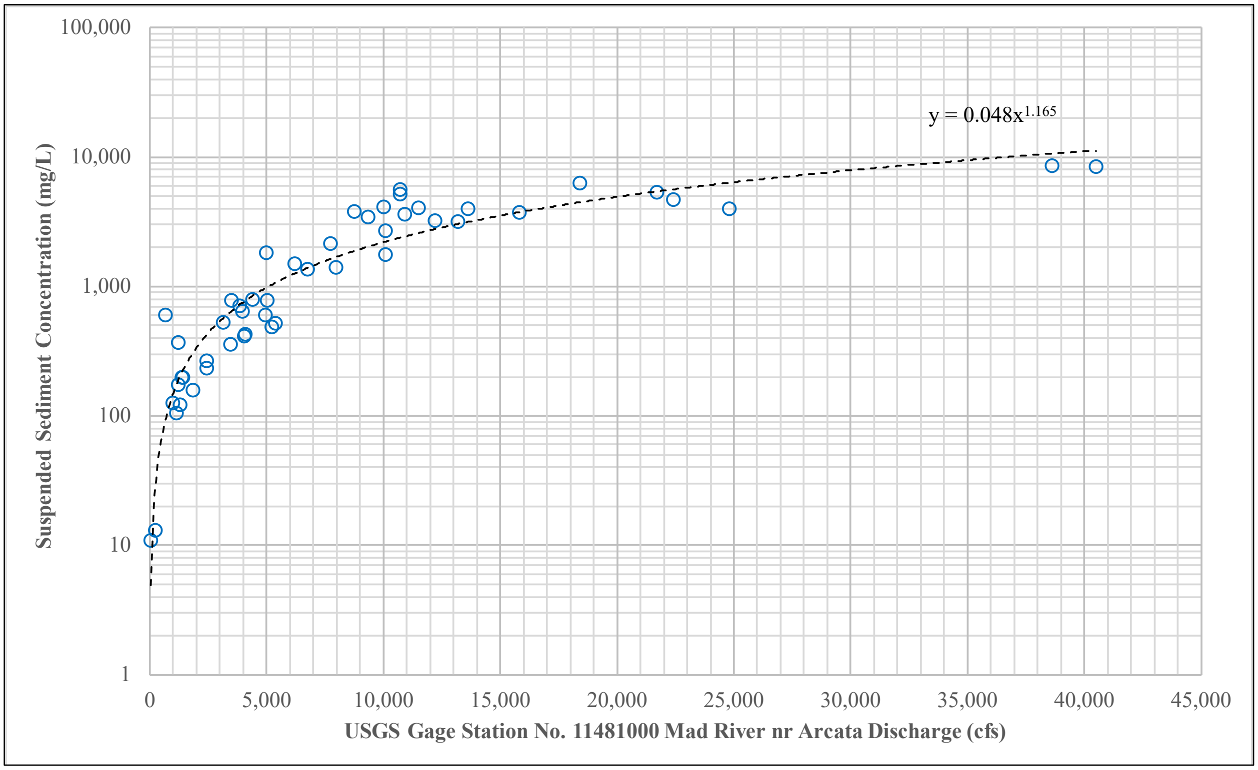

Figure 21. Suspended Sediment Concentration Related to Stream Discharge

A single regression line shows a relation between stream discharge and sampled suspended sediment concentration. An improved model would need more data and a a series of regression lines would likely improve the relation estimate.

3.4.3 Fine Sediment Mobility

Sediment mobility was evaluated by a stable particle analysis based on Shield's equation for incipient motion of a grain size (Julien, 1998; Julien 2002). Particle motion was evaluated for the maximum median grain size reported by the USGS of 0.04 mm. Specific gravity of the particles was assumed to be 2.65 (quartz). The settling velocity of a 0.04 mm particle is approximately 0.004 ft/s. Critical bed shear stress necessary for incipient motion of a 0.04 mm particle is on the order of 0.1 N/m^2.

4. CONCLUSIONS AND RECOMMENDATIONS FOR A PREFERRED DESIGN

4.1 Conclusions

The project area is located on the inside of a meander bend within an active floodplain, which is ideal for backwatering and is a typical area of sedimentation in a river; particularly fine sediment in an estuary reach. Due to the high sediment loading from the Mad River watershed, project features such as the backwater channel and off-channel pond have a likelihood of accruing fine sediments and aggrading over time. Based on the suspended sediment records from the USGS, larger storms tend to bring in greater quantities of fine sediment, as higher flows bring in a greater volume of water and a higher concentration of suspended sediment. It is probable that large magnitude flood events could fill in both backwater and floodplain features or that a series of small flood events could aggrade the project area over time. If the backwater channel aggrades, then summer tides will be disconnected from the river into the pond and may provide wetland habitat. If the pond aggrades, it will transition into emergent and seasonal wetlands. Regardless of aggradation, the area should continue to provide valuable high flow refugia from mainstem river velocities and shear stresses for salmonids. In addition, the project will produce rich food sources to the river and floodplain fauna.

4.2 Recommendations for a Preferred Design

Because it is inevitable that the project site will aggrade, the backwater channel will be designed as a distinct feature in the landscape so that initial conditions will concentrate velocity and shear stress along a single water pathway when flow waters come into the site and drain. Emergent wetland areas will be incorporated into the transition landscape between the channel and main off-channel pond area to promote sedimentation and increase the pool's longevity. These areas may cut off the pool from the channel for periods of time, but should continue to provide a rich food source.

The overflow swale and emergent wetlands/sedimentation area (south pond) do not appear to present additional value to the project design as originally intended (as a side channel during high flow events); therefore, the swale recommended for removal from the design and the south pond will remain as a high, seasonal wetland and suspended sediment settling area to add topographic diversity to the project.

The following recommendations are provided to proceed with a 65% Design:

1. Remove the upstream swale
2. Maintain the upstream (south) pond as a seasonal wetland
3. Broaden the deep-water portion of the off-channel pond
4. Add shallow benches for emergent wetlands along the pond edges
5. Relocate the upland islands to the existing upland island areas
6. Recontour the berm between the two ponds for a more natural transition between landscapes
7. Broaden the backwater channel mouth at the storm water canal confluence by an inset floodplain for sedimentation to the east (towards the pasture)*

* This recommendation was proposed by the DFW engineering geologist and discussed between the project engineer and the landowner. The option was not desirable to the landowner; therefore, it was not incorporated into the 65% designs.

5. REFERENCES

Julien, Pierre Y. 1998. *Erosion and Sedimentation*. Cambridge, U.K.: University of Cambridge Press.

---. 2002. *River Mechanics*. Cambridge, U.K.: University of Cambridge Press.

McLaughlin, R.J., Ellen, S.D., Blake, M.C., Jr., Jayko, A.S., Irwin, W.P., Aalto, K.R., Carver, G.A. and Clarke, S. H., Jr. 2000. *Geology of the Cape Mendocino, Eureka, Garberville and Southwestern Part of the Hayfork 30 X 60 Minute Quadrangles and Adjacent Offshore Area, Northern California*. U.S. Geological Survey Miscellaneous Field Studies, MF-2336.

NOAA National Climatic Data Center. (Accessed January 10, 2017). Eureka Weather Forecast Office Woodley Island, CA 1981-2010 Normals. Accessed at: http://www.ncdc.noaa.gov/cdo-web/datatools/normals. NCDC.

---. 2012. *2009-2011 CA Coastal Conservancy Coastal Lidar Project*. Office for Coastal Management National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce; California Coastal Conservancy, Ocean Protection Council, Scripps Institution of Oceanography; and the Joint Airborne Lidar Bathymetry Technical Center of Expertise. Charleston, SC: NOAA.

---. 2013. *2013 NOAA Coastal California TopoBathy Merge Project*. Office for Coastal Management National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. Charleston, SC: NOAA.

SHN Consulting Engineers & Geologists, Inc. 2015. *Final Foundation Report: Hammond Trail Pedestrian Bridge Replacement, Mad River Crossing, North of Arcata, Humboldt County, California.* Prepared for: Humboldt County Public Works Department. NR: SHN.

U.S. Army Corps of Engineers. 2016. *HEC-RAS River Analysis System Hydraulic Reference Manual*, Version 5.0 NR:ACOE.

U.S. Geological Survey. 1982. *Interagency Advisory Committee on Water Data, Guidelines for Determining Flood-Flow Frequency: Bulletin 17B*. 183 p. Reston, VA: USGS, Hydrology Subcommittee, Office of Water Data Coordination.

Appendix E: Documentation of Fish Observations

Mad River fish community composition in the drainage channel on the School Road trail

Multiple fish species of conservation concern in the Mad River watershed- including Chinook salmon, coho salmon, and tidewater goby- use off-channel habitats in the lower basin and estuary as feeding areas and refuge from high winter flows. Currently, the small channel providing winter drainage from the pasture on the east side of the Mad River at School Road in Mckinleyville is one of the few places potentially providing such habitat in the tidal portion of the lower Mad River. Projects in the planning phase, particularly the proposed decommissioning and floodplain reconnection of a nearby infiltration pond owned and operated by Mckinleyville Community Services district, could greatly expand the area of off-channel habitat in this area and provide a conservation benefit to fish.

To provide more information about the species currently using off-channel habitats in the lower Mad River, the Biology of Pacific Salmon class from Humboldt State University sampled the winter drainage channel at School Road on 17 February 2015. Seventeen students used seines and minnow traps to sample the channel from the confluence with the Mad River to the culvert and flow control device at the edge of the pasture (ca. 70 m), two pools and a reach of the ditch above the culvert (30 m) as well as adjacent areas in the Mad River side channel near the confluence (Figure 1). Six species were collected, including juvenile Chinook salmon and coho salmon (Table 1). Most species were collected in the pool immediately below the culvert. A goby collected was field-identified as a tidewater goby and photographed, but the photographs were not adequate for confirmation of the field identification (Figure 2). Molly Schmelzle and Andrew Kinziger are planning a follow-up analysis of environmental DNA in water samples to confirm the presence of tidewater goby.

Table 1. Catch data for each sampling technique and location. Refer to Figure 1 for the location of sample sites.

Site number	Site description	Technique	Species	Catch
1	Downstream of confluence in side-channel; ca. 100 m by 5 m of habitat sampled; max. depth > 1 m.	Seine	Chinook salmon (young of the year)	5
			Cottus spp.†	6
			Three-spined stickleback	5
		Minnow trap	Cottus spp.†	3
2	Side channel at confluence; ca. 10 m by 20 m of habitat sampled; 0.8 m max depth.	Seine	Chinook salmon (young of the year)	7
			Cottus spp.†	7
			Three-spined stickleback	2
		Minnow trap	--	0
3	Lower ditch channel from confluence up; 20 m by 1 m of habitat sampled; < 10 cm max depth.	Seine	--	0
4	Pool immediately below culvert; 3 m by 6 m of habitat sampled; 0.7 m max depth.	Seine	Coho salmon (age 1+)	2
			Cottus spp.†	1
			Three-spined stickleback	150
			Tidewater goby*	1
			Western mosquitofish	1
		Minnow trap	Cottus spp.†	9
			Three-spined stickleback	26
5	Pool immediately above culvert; ca. 3 m by 3 m of habitat sampled; max depth 0.7 m.	Seine	Three-spined stickleback	150
5		Minnow trap	Three-spined stickleback	7
6	Channel above culvert; ca. 25 m by 1 m of habitat sampled; max. depth 0.5 m.	Seine	Three-spined stickleback	12
6		Minnow trap	--	0
†Species not distinguished, potentially includes prickly sculpin and coast range sculpin.				
*Field identification as tidewater goby, awaiting eDNA confirmation				

Figure 1. Approximate location of sample sites. Google Earth imagery dated 23 August 2012.

Figure 2. Purported tidewater goby.

Report submitted by Darren Ward and the Spring 2015 Biology of Pacific Salmon class: Justin Alvarez, Timothy Ash, Nick Easterbrook, Naomi Gair, Molly Gorman, Jon Hollis, Joe Jackson, Kyle Johnson, Dylan Keel, Dan Marsant, Kaitlyn O'Brien, Brad Padilla, Bernie Rolf, James Schwartz, Angela Shaver, Libby Tonning, Woody Vernard.

Sampling the McKinleyville Community Service District's Drainage Channel in the Mad River Estuary

January 8, 2016

Prepared by Bob Pagliuco

Background

Funding has become available through the Fisheries Restoration Grant Program to develop restoration design alternatives at the McKinleyville Community Service District's (MCSD) Mad River Estuary ponds at the bottom of School Road. Caltrout has been working with MCSD and Rose Patenaude from Northern Hydrology to develop wells and conduct topographic surveys to inform design development.

On February 17, 2015, Darren Ward took his "Biology of Pacific Salmon" class out to sample the winter drainage channel that drains the hay pasture and assess the fish assemblages with seins and minnow traps. The Mad River was approximately 1500 cfs. They found several species below the tidegate structure including juvenile Chinook, coho, tidewater goby, stickleback, mosquitofish and sculpin. Only stickleback were found above the tidegate structure.

On January 8, 2016 Rose Patenaude and I revisited this site and deployed minnow traps to see if fish were utilizing this channel for off channel habitat and had made it above the tidegate structure. The Mad River was approximately 2700 cfs and there was a significant gradient and velocity through the tidegate structure and channel downstream of the tidegate structure. Six minnow traps were deployed throughout the reach, baited with frozen steelhead roe and soaked for 45minutes to 1 hour (See Figure 1 and 2). In addition to stickleback and sculpin, a coho was found above the tidegate structure.

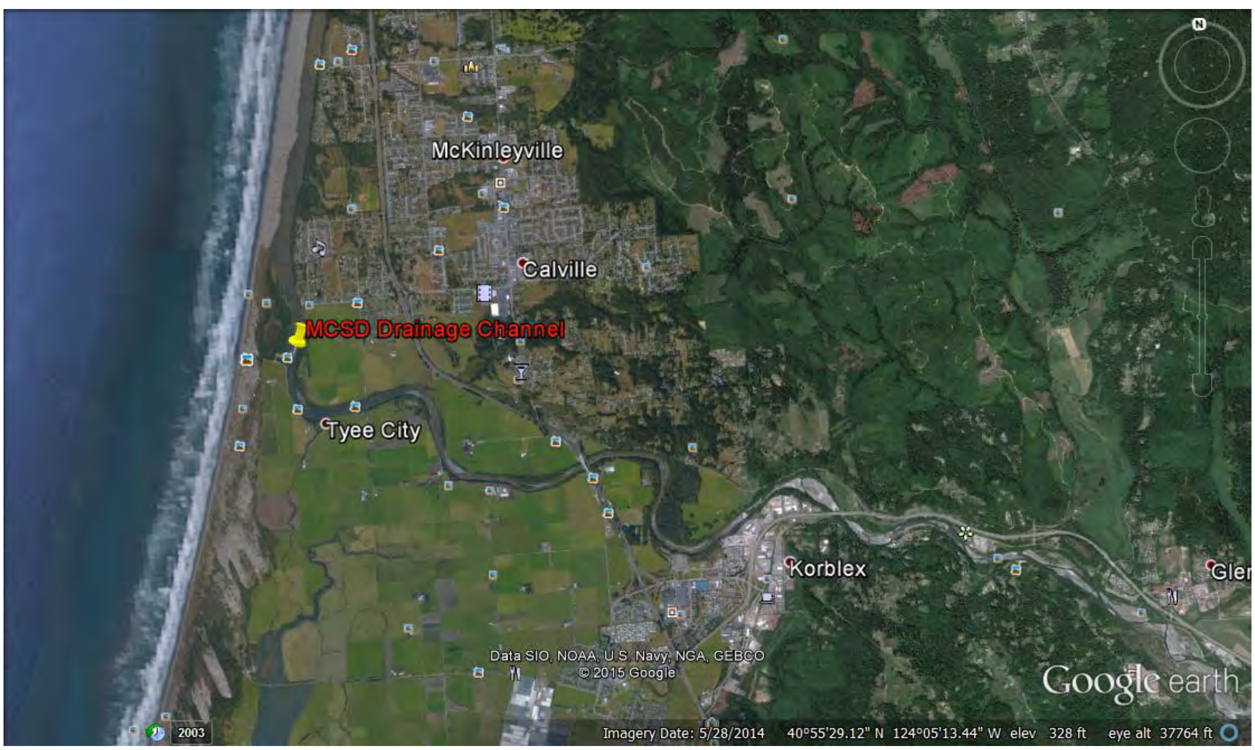

Figure 1 – Overview of MCSD Sampling Area

Figure 2 – Specific Sampling sites

Results

Site Number	Site Description	Temperature ©	Dissolved Oxygen (mg/l)	Species	Catch
1	Mad River at channel confluence	8.6	11.1	Stickleback	1
2	Ten feet above footbridge in drainage channel	9.5	8.1	No Fish	0
3	Pool below tidegate	9.3	6.7	Stickleback	1
4	Pool above tidegate	9.2	6.5	No Fish	0
5	Slow water habitat at 90 degree turn in pasture channel	9.2	6.5	Coho (95mm)	1
5	Slow water habitat at 90 degree turn in pasture channel	9.2	6.5	Prickly Sculpin	1
6	Pasture Channel	9.3	6.4	Stickleback	2

Appendix F: Vegetation Mapping

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VEGETATION MAPPING FOR THE MAD RIVER FLOODPLAIN ENHANCEMENT PROJECT

Prepared for: *California Trout*
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August 23, 2019

1 INTRODUCTION

California Trout (CalTrout) proposes to improve public access and enhance riparian and aquatic habitat within the floodplain on the right bank of the Mad River near the western end of School Road in McKinleyville, California (Figure 1). The property is owned by the McKinleyville Community Services District (MCSD). The project includes public access features, removal of levees surrounding percolation ponds, and construction of open water/ponds and a backwater side channel with alcoves to provide improved salmonid habitat (Figure 1). The project is in the design and environmental compliance phase. Vegetation in the project area was mapped to inform the project's impact analysis, post-implementation recovery, and post-implementation monitoring. Distinct vegetation cover types were mapped onto recent aerial photos and then grouped into wetland, riparian, and upland biological land cover types ("biohabitats"). The goal of the vegetation mapping was to distinguish between wetlands and uplands based on vegetation cover types and then estimate impacts to existing vegetation using the restoration design footprint boundary and proposed revegetation design concepts (NHE 2018).

The entire project boundary encompasses 96.1 acres, including well-developed riparian vegetation adjacent to the Mad River, constructed percolation ponds, and pastures used for wastewater reuse, spraying, and flood irrigation (Figure 1). Vegetation mapping focused on the 18.4 acres of riparian and grassland vegetation west of the pastures (Figure 2), where public access improvements and floodplain restoration improvements have been proposed. As of this analysis, the public access portions of the project were still under design. Therefore, the impact analyses presented here include only the 6.1-acre floodplain restoration boundary (Figure 2).

The objectives of this study are to:

- Map pre-implementation baseline vegetation on 18.4 acres adjacent to the Mad River, as defined by the mapping boundary provided by CalTrout (Figure 2). The additional area beyond the floodplain restoration boundary was included in the vegetation mapping to characterize nearby vegetation and potentially inform revegetation designs.
    - Map at a scale of 1"=150' to capture sufficient detail in cover types around the percolation ponds and transition area from bluff to floodplain;

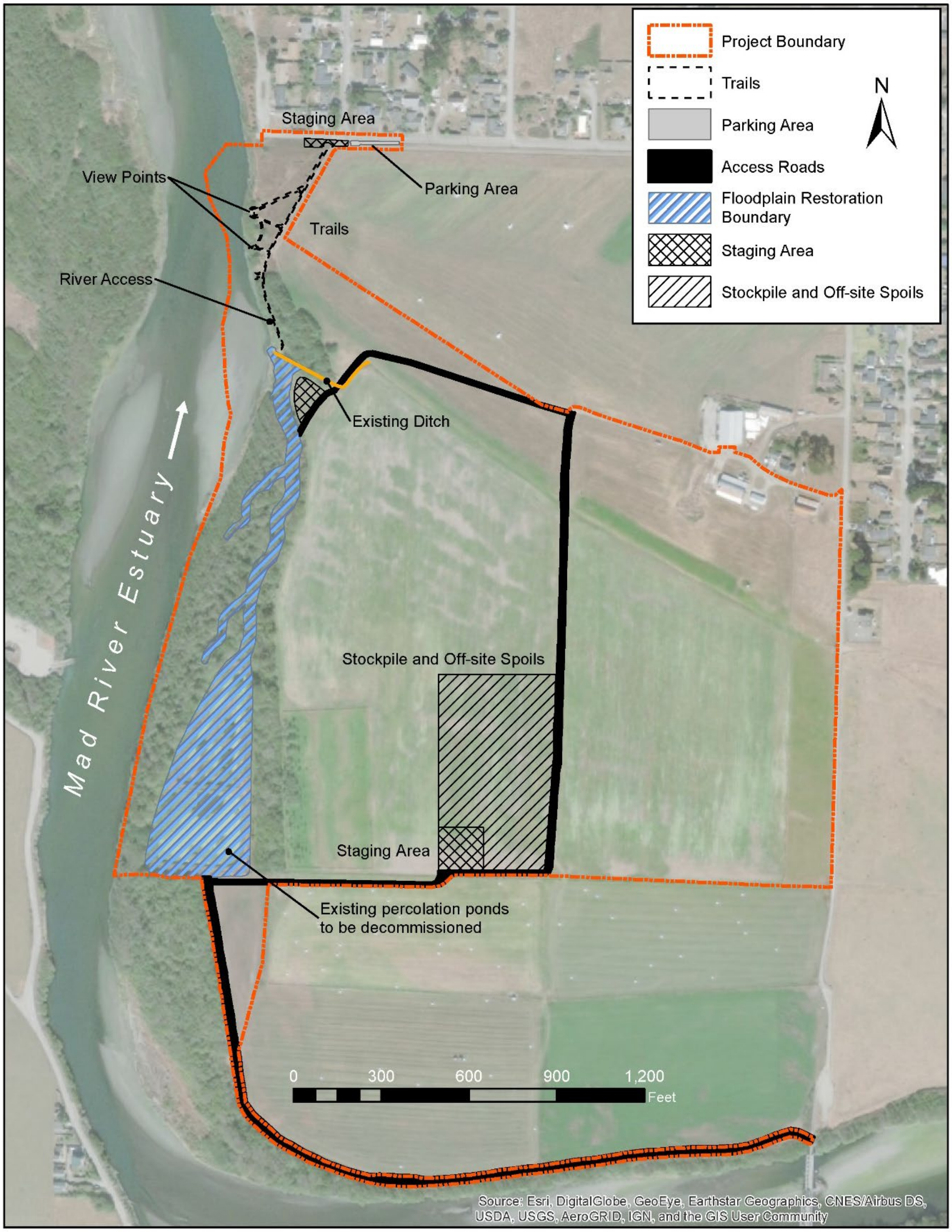

Figure 1. Mad River Floodplain Enhancement Project location and design overview. The project boundary (dated 5/2/2019) is shown in orange and the floodplain restoration boundary (dated 3/13/2019) is shown in blue hatching.

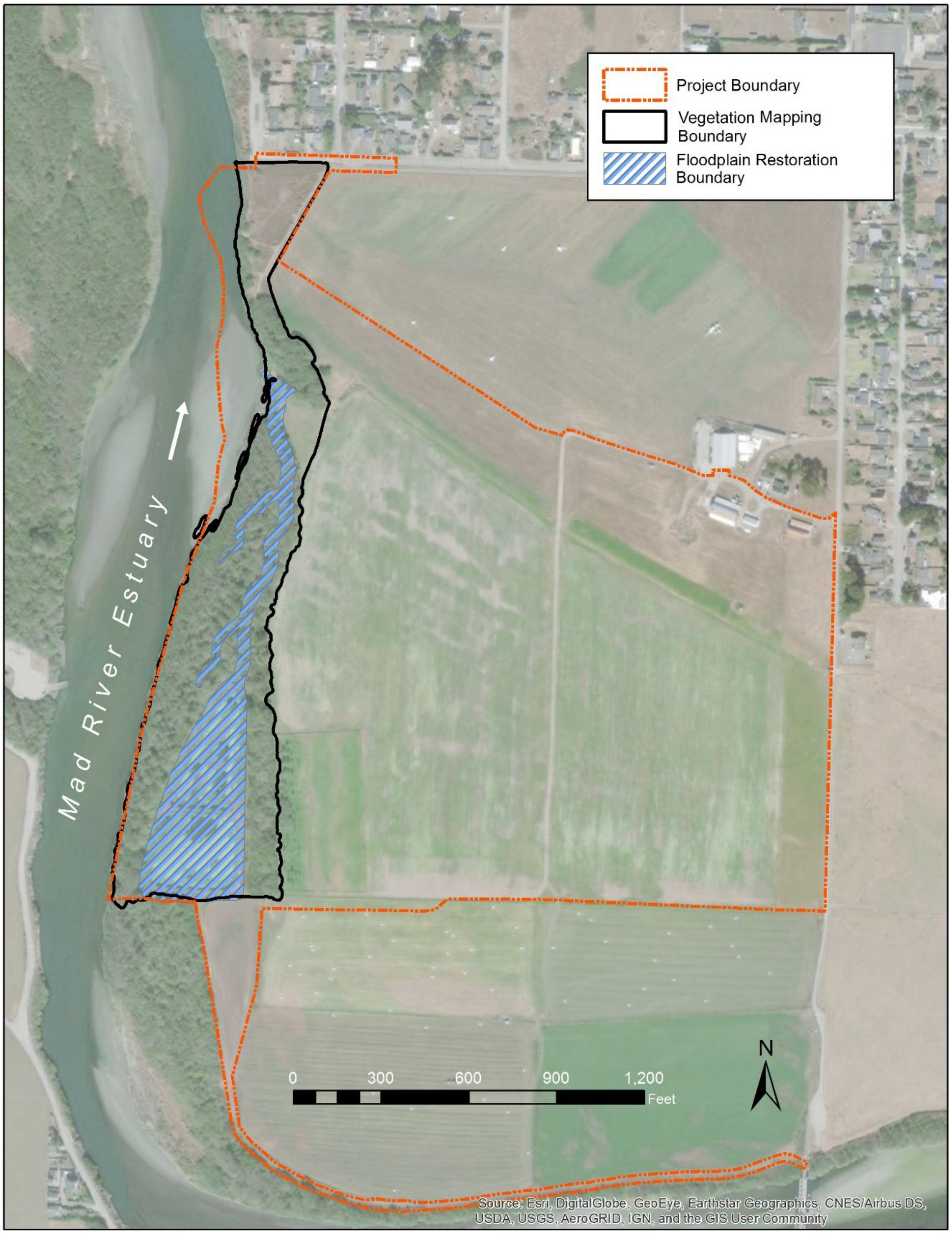

Figure 2. Mad River Floodplain Enhancement Project showing project boundary (dated 5/2/2019) in orange, riparian vegetation mapping boundary (dated 6/22/2018) in black, and floodplain restoration boundary (dated 3/13/2019) in blue hatching.

- Classify vegetation cover types into biohabitats to estimate the amount of wetland, riparian, and upland vegetation within the 18.4-acre vegetation mapping boundary and the 6.1-acre floodplain restoration boundary.
- Quantify the amount of "mature" riparian vegetation within the floodplain restoration boundary (backwater side channel and percolation ponds). Mature vegetation included riparian hardwood species greater than 12" diameter at breast height (dbh), as defined by consultation with the California Department of Fish and Wildlife (CDFW).

- Estimate acres of riparian vegetation likely to be impacted by proposed floodplain restoration, including impacts to mature riparian vegetation; and
- Locate and map invasive plant species, if any, within the vegetation mapping boundary.

2 METHODS

Vegetation includes all the plant species in a region, and usually appears as a mosaic of numerous, definable plant cover types (Sawyer et al. 2009). The dominant plant species in the canopy usually define the cover type, or class. Numerous vegetation classifications have been developed for California vegetation. Classifications can be broad or specific, depending on the reason for describing the vegetation. It can be useful to compare the same vegetation using different classification systems, as they each yield a unique understanding of the vegetation. For instance, Manual of California Vegetation (MCV; Sawyer et al. 2009) alliances are the most up-to-date and botanically rigorous classification in widespread use in California, although the naming system can be inaccessible to non-botanists (Table 1). Holland vegetation types (Holland 1986) tend to be broader and form the foundation upon which the more recent MCV descriptions are based, and the naming system is more user friendly. California Wildlife Habitat Relationships (WHR) specifically relate vegetation types to the habitats commonly occupied by the birds, mammals, reptiles, and amphibians of California (Mayer and Laudenslayer 1988). Since its publication in 1988, WHR has been updated to include a predictive model for terrestrial wildlife, resulting in additional habitat type descriptions (CDFW 2018a). However, because its primary purpose is to describe vegetation as it relates to wildlife, WHR does not include a comprehensive treatment of all California vegetation. A project-specific classification system of biological land cover types (hereafter "biohabitats") was developed based on overall growth form (woody/shrubby, herbaceous), water requirements, and land use (grazed, ungrazed). The National Wetland Plant List (Lichvar et al. 2016) was used to determine the wetland indicator status of the dominant plant species in each mapped cover type, which formed the basis for determining water requirements. A crosswalk of the mapped alliances and their corresponding Holland, WHR, and biohabitat classes can be found in Table 1.

Vegetation within the project reach was mapped on June 22, 2018, using the most recent MCV alliances. A botanist conducted the field survey by walking the project site and visiting each distinct cover type. The field-based vegetation survey ensured a highly detailed and accurate vegetation map. Polygon boundaries were hand-drawn onto October 2017 aerial photographs (DigitalGlobe 10/12/2017), scaled to 1 inch = 150 feet, around discrete cover types, and a cover attribute was assigned following the MCV alliances. Mapped vegetation units were no smaller than 100 ft^2. Unvegetated polygons were assigned a cover type based on visible substrate and level of human disturbance. Hand-drawn polygons were entered into a GIS in the office, and cover type acreages were calculated in GIS based on field vegetation mapping.

To estimate the potential impacts of the proposed floodplain restoration portion of the project on existing riparian vegetation, it was initially proposed to GPS all mature riparian trees greater than 12 inches dbh within the design footprint. However, due to the extremely high density of riparian hardwood trees meeting this definition, and due to the preliminary stage of project development (the proposed channel alignment could not be flagged due to high density of vegetation), it was determined in the field by CalTrout and McBain Associates to provide an acreage estimate of cover types based on MCV alliances within the design footprint, with emphasis on differentiating between mature cover types and younger cover types (see results for description). Consequently, mapping within the project area was conducted at finer detail (i.e., to the association level, which includes components of the sub-canopy or shrub layers) for the red alder alliance to capture differences in stand structure, age-class distribution, and species composition.

Impacts were estimated for the 6.1-acre floodplain restoration boundary. The floodplain restoration boundary (dated 3/13/2019 from NHE) was overlaid onto the vegetation cover types map (dated 6/22/2018 from MA), and acres of each cover type within the floodplain restoration boundary were estimated. Impacts from the proposed trail system were assumed to be negligible and were not included in this impact analysis.

During vegetation mapping, locations of three invasive plant species were mapped: periwinkle (*Vinca major*), reed canary grass (*Phalaris arundinacea*), and spartina (*Spartina densiflora*). Periwinkle is a moderately invasive non-native species that can grow rapidly in shady, moist soil and form dense patches to the exclusion of native species. Periwinkle spreads easily from stolons and root fragments, especially following earthwork and ground-clearing activities (Cal-IPC 2009). Reed canary grass is a California native species (Jepson Flora Project 2018) that also grows rapidly, especially in riparian areas, causing many land managers to treat it as invasive (Apfelbaum and Sams 1987). Due to long-term cultivation of non-native genotypes in North America, it is possible that current populations of reed canary grass may include non-native strains or hybrids between native and non-native strains (Waggy 2010). This species quickly forms dense monocultures, similar to cattails (*Typha* spp.), and often occurs on lower ground surfaces adjacent to streams. Spartina is a non-native salt marsh species that can spread rapidly and outcompete native salt marsh species like pickleweed (*Salicornia* spp.). Its seeds can disperse long distances over water and it tolerates high salinity conditions.

3 RESULTS AND DISCUSSION

3.1 Cover Types

Twenty-one cover types were mapped in the 18.4-acre vegetation mapping boundary (Table 1, Figure 3, Table 2). Red alder/mixed willow forest was the most abundant cover type (4.8 acres), followed by Hooker's willow (2.6 acres), velvet grass meadow (2.3 acres), and California blackberry (2.1 acres). All of the woody riparian vegetation in the project area had a strong Hooker's willow component. Differences in stand structure (i.e., shrub-dominated vs. tree-dominated) and species composition could be seen depending on the underlying geomorphic feature. For instance, the shrub-dominated Hooker's willow and short-tree-dominated red alder/Hooker's willow stands occurred on the steep streambank edges and bluff faces directly adjacent to the Mad River (Figure 3). When present in these stands, red alder tended to be 12–15 inches dbh. Together, these two cover types represented younger riparian vegetation in the project area. By contrast, the large-tree-dominated red alder/mixed willow stands occurred on floodplain surfaces and had a more diverse tree canopy, including Pacific willow, Sitka willow, arroyo willow, and Scouler's willow. Many of the red alder trees in this stand type were upwards of 2–3 ft dbh.

The percolation ponds provide seasonal standing water to support several wetland and aquatic cover types (Figure 3). Lyngbye's sedge was mapped along the immediate channel margin on the right bank of the Mad River. Lyngbye's sedge has a California rare plant rank of 2.2B, meaning it is rare in California but more common outside the state, and current California populations are moderately threatened. Lyngbye's sedge is protected under CEQA and any impacts due to project activities will likely require mitigation.

Table 1. Comparison (crosswalk) between cover types mapped in the vegetation mapping boundary and other vegetation classification systems. "Biohabitat" definitions are specific to this project. Cover types dominated by non-native species are shown in red.

Cover Type	MCV Alliance	Biohabitat	Holland Type	WHR Class
American bulrush	*Schoenoplectus americanus* Herbaceous Alliance	Brackish marsh	Coastal and valley freshwater marsh	Fresh emergent wetland
Beard grass	No corresponding type	Wet meadow	Coastal and valley freshwater marsh	Fresh emergent wetland
Black cottonwood	*Populus trichocarpa* Forest Alliance	Riparian forest	North coast black cottonwood forest	Valley foothill riparian
California blackberry	*Rubus (parviflorus, spectabilis, ursinus)* Shrubland Alliance	Coastal scrub	Northern (Franciscan) coastal bluff scrub	Coastal scrub
Cattail	*Typha (angustifolia, domingensis, latifolia)* Herbaceous Alliance	Freshwater marsh	Coastal and valley freshwater marsh	Fresh emergent wetland
Duckweed	*Lemna (minor)* and Relatives Provisional Herbaceous Alliance	Freshwater marsh	Coastal and valley freshwater marsh	Fresh emergent wetland
Floating pennywort	*Hydrocotyle (ranunculoides, umbellata)* Herbaceous Alliance	Freshwater marsh	Coastal and valley freshwater marsh	Fresh emergent wetland
Foxtail	*Alopecurus geniculatus* Provisional Herbaceous Alliance	Wet meadow	Freshwater seep	Wet meadow
Hooker's willow	*Salix hookeriana* Shrubland Alliance	Riparian scrub	North Coast riparian scrub	Fresh emergent wetland
Human disturbance	None	Human disturbance	N/A	Urban
Lupine	No corresponding type	Coastal scrub	Northern coastal bluff scrub	Coastal scrub
Lyngbye's sedge	No corresponding type	Brackish marsh	Coastal brackish marsh	Saline emergent wetland
Mixed willow	Several corresponding types	Riparian scrub	North Coast riparian scrub	Fresh emergent wetland
Pacific reed grass	*Calamagrostis nutkaensis* Herbaceous Alliance	Brackish marsh	Coastal terrace prairie	Perennial grassland
Red alder	*Alnus rubra* Forest Alliance	Riparian forest	Red alder riparian forest	Montane hardwood–conifer
Red alder/ Hooker's willow	No corresponding type	Riparian scrub	North Coast riparian scrub	Fresh emergent wetland
Red alder/ Mixed willow	No corresponding type	Riparian forest	North Coast riparian scrub	Fresh emergent wetland
Reed canary grass	*Phalaris arundinacea* Provisional Semi-Natural Herbaceous Stands	Wet meadow	Coastal and valley freshwater marsh	Fresh emergent wetland
Spartina	*Spartina* (*alternifolia, densiflora*) Semi-natural Herbaceous Stands	Brackish marsh	Northern coastal salt marsh	Saline emergent wetland
Velvet grass meadow	*Holcus lanatus–Anthoxanthum odoratum* Semi-Natural Herbaceous Stands	Coastal prairie	Coastal terrace prairie	Perennial grassland
Yarrow	No corresponding type	Coastal prairie	Coastal terrace prairie	Perennial grassland

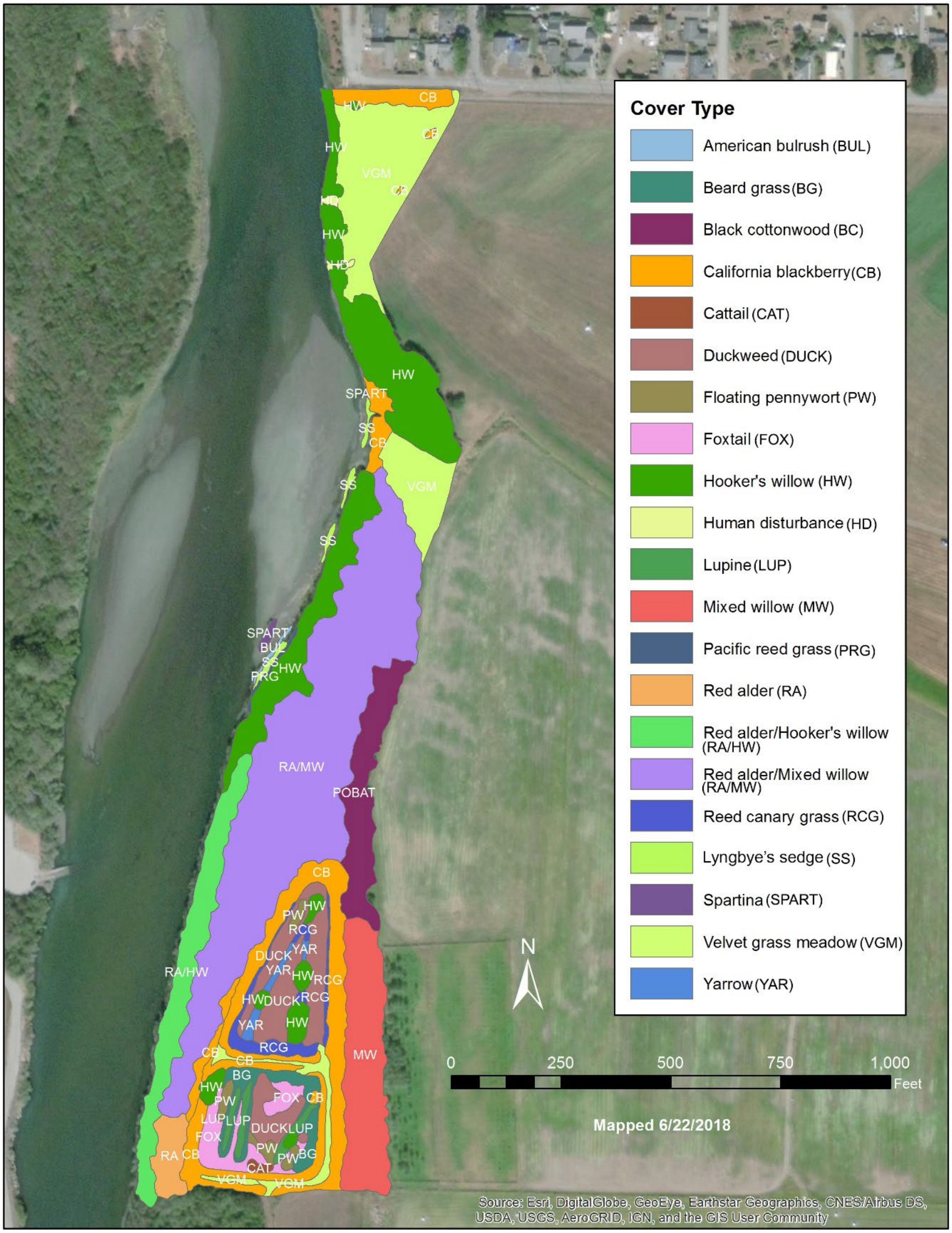

Figure 3. Vegetation cover types field-mapped on June 22, 2018, within the 18.4-acre vegetation mapping boundary.

Table 2. Eight biohabitats field-mapped in the vegetation mapping boundary on June 22, 2018.

Biohabitat	Cover Type	Acres	
Brackish marsh	American bulrush	0.0	0.2
	Pacific reed grass	0.0	
	Lyngbye's sedge	0.1	
	Spartina	0.0	
Coastal prairie	Velvet grass meadow	2.3	2.4
	Yarrow	0.1	
Coastal scrub	California blackberry	2.1	2.3
	Lupine	0.2	
Freshwater marsh	Cattail	0.0	1.2
	Duckweed	1.0	
	Floating pennywort	0.1	
Human disturbance	Human disturbance	0.0	0.0
Riparian forest	Black cottonwood	0.9	6.3
	Red alder	0.3	
	Red alder/Mixed willow	5.1	
Riparian scrub	Hooker's willow	2.6	5.0
	Mixed willow	1.3	
	Red alder/Hooker's willow	1.1	
Wet meadow	Beard grass	0.4	1.0
	Foxtail	0.4	
	Reed canary grass	0.3	
Total		**18.4**	**18.4**

3.1 Biohabitats

Cover types were grouped into eight biohabitats (Table 2, Figure 4). Riparian forest and riparian scrub together covered 11.3 acres of the 18.4 acres comprising the vegetation mapping boundary. Descriptions for the eight biohabitats developed for the Mad River Floodplain Enhancement and Restoration Project can be found below.

<u>Brackish Marsh Biohabitats</u>

Brackish marsh biohabitats were composed of herbaceous cover types located along the right bank of the Mad River at the downstream end of a large point bar/meander floodplain. Brackish marsh biohabitats were subject to tidal influence and were dominated by obligate wetland and facultative wetland species, and included American bulrush (*Schoenoplectus americanus*), Pacific reed grass (*Calamagrostis nutkaensis*), Lyngbye' sedge (*Carex lyngbyei*), and spartina (*Spartina densiflora*). Brackish marsh biohabitats covered only 0.2 acres and were not representative of most of the vegetation in the project area. They occurred directly on the right bank of the Mad River, where tidal influences created brackish conditions favoring their growth.

Coastal Prairie Biohabitats

Coastal prairie biohabitats consisted mostly of velvet grass meadow on the bluffs, with several small patches of yarrow (*Achillea millefolium*) growing on sediment islands within the percolation ponds. Velvet grass meadow was dominated by facultative and facultative upland species, especially velvet grass (*Holcus lanatus*) and sweet vernal grass (*Anthoxanthum odoratum*), with a variety of other non-native herbaceous species, such as Queen Anne's lace (*Daucus carota*), oxeye daisy (*Leucanthemum vulgaris*), sheep sorrel (*Rumex acetosella*), English plantain (*Plantago lanceolata*), and rattlesnake grass (*Briza maxima*).

Coastal Scrub Biohabitats

Coastal scrub biohabitats consisted largely of California blackberry (*Rubus ursinus*) patches and small areas dominated by riverbank lupine (*Lupinus rivularis*). Coastal scrub biohabitats tended to occur on drier sites and were dominated by facultative species. The California blackberry patches also contained the non-native Himalaya berry (*R. armeniacus*), salmonberry (*R. spectabilis*), cow parsnip (*Heracleum maximum*), and twinberry (*Lonicera involucrata*), though the native California blackberry was dominant. While blackberry species were a strong component of several cover types in the project area, true California blackberry patches occurred as isolated patches in coastal prairie and around the percolation ponds on the slopes of both sides of the levees. Lupine patches were only encountered on narrow linear islands within the percolation pond area.

Freshwater Marsh Biohabitats

Freshwater marsh biohabitats occurred exclusively in the percolation ponds and included cattails (*Typha latifolia*), duckweed (*Lemna* sp.), and floating pennywort (*Hydrocotyle ranunculoides*) cover types. All three species are obligate wetland plants and formed emergent or floating mats on the pond surfaces.

Riparian Forest Biohabitats

Riparian forest biohabitats in the project reach were well-developed, especially near the proposed backwater side channel on the floodplain. Riparian forest biohabitats were dominated by facultative wetland species. Red alder/mixed willow was the most common riparian forest cover type, with mature tree canopies over 50 ft tall and many trees between 2.5 and 3.5 ft dbh. Red alder (*Alnus rubra*) was always present in the canopy, with Hooker's willow (*Salix hookeriana*), Pacific willow (*S. lasiandra*), Sitka willow (*S. sitchensis*), arroyo willow (*S. lasiolepis*), and Scouler's willow (*S. scouleriana*) co-dominating the canopy. Other riparian forest biohabitats included black cottonwood (*Populus trichocarpa*), which occurred at the edge of the riparian vegetation where it meets grazed pasture. The understory of riparian forest biohabitats was generally dense with blackberries, elderberry (*Sambucus racemosa*), scouring rush (*Equisetum hyemale*), twinberry, and slough sedge (*Carex obnupta*).

Riparian Scrub

Riparian scrub consisted of mostly willow-dominated cover types adjacent to the river and were dominated by facultative wetland species. Patches of Hooker's willow and red alder/Hooker's willow occurred along the bluffs adjacent to the river. The primary difference between the riparian forest biohabitats (i.e., red alder/mixed willow) and the riparian scrub biohabitats (i.e., red alder/Hooker's willow) was the higher species diversity of tree willows in riparian forests and younger age (i.e., shorter, smaller dbh) of alders in the canopy of riparian scrub biohabitats.

Wet Meadow Biohabitats

The wet meadow biohabitats occurred exclusively along the water's edge in the percolation ponds. Beard grass (*Polypogon maritimus*), foxtail (*Alopecurus geniculatus*), and reed canary grass formed monotypic patches at the base of the levees. Beard grass and foxtail are obligate wetland species, and reed canary grass is a facultative wetland species.

Human Disturbance Biohabitats

The human disturbance biohabitat was associated with public access points along the bluffs, where benches overlook the Mad River.

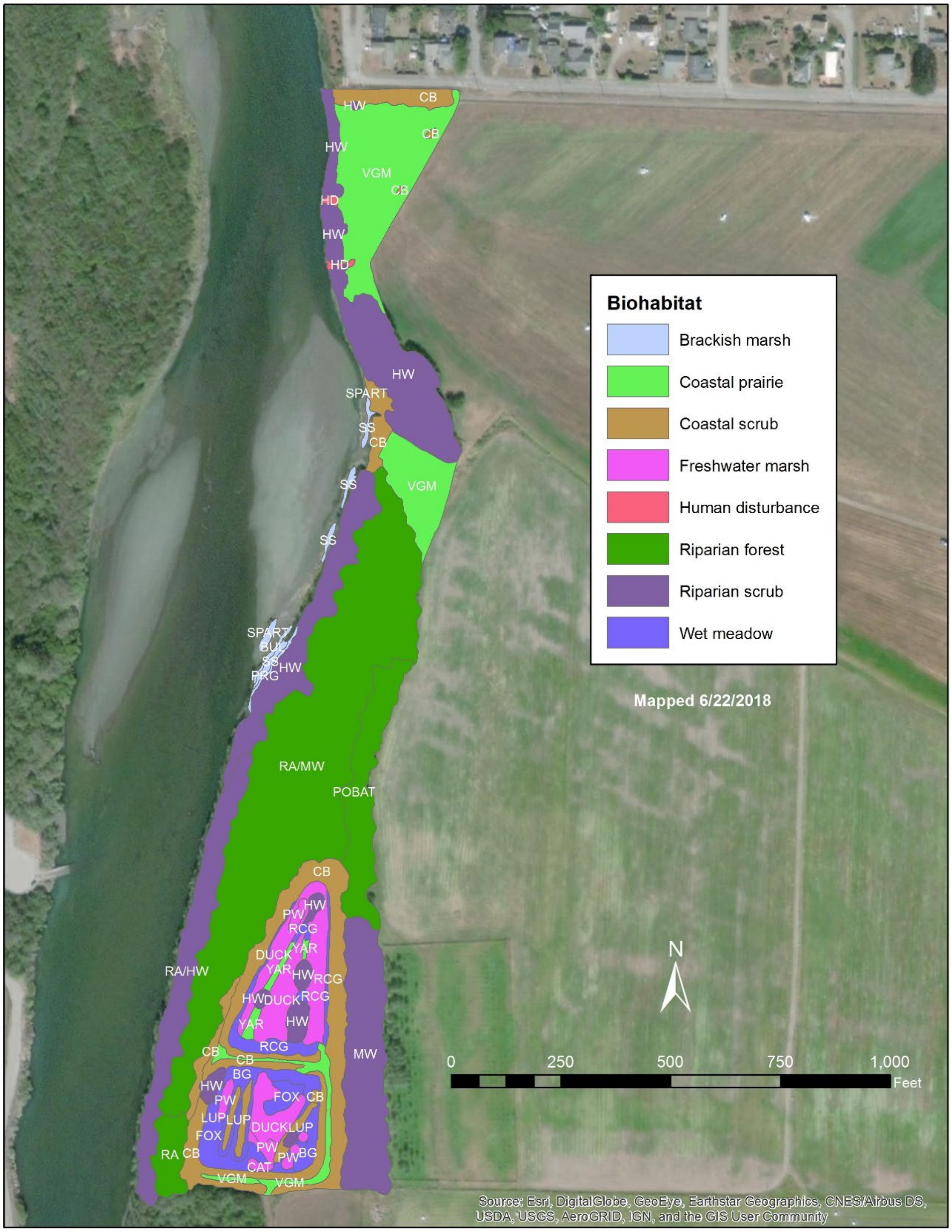

Figure 4. Biological land cover types (biohabitats) field mapped on June 22, 2018, in the vegetation mapping boundary.

3.2 Potential Project Impacts

Biohabitats were combined into impact analysis categories to be consistent with permitting documents, as follows: (1) "wetlands" were composed of brackish marsh, freshwater marsh, and wet meadow habitats; (2) "mature riparian forest" was composed of riparian forest; (3) "young riparian forest" was composed of riparian scrub; (4) "upland" was composed of coastal prairie and coastal scrub; and (5) "percolation ponds" was composed of all the cover types within the existing percolation ponds boundary as established in the permitting documents (Table 3). Approximately 5.1 acres of vegetation within the 6.1-acre floodplain restoration boundary are estimated to be impacted by proposed floodplain restoration (Table 3, Table 4).

Table 3. Cover types and their associated impact categories mapped within the floodplain restoration boundary, showing how cover types were grouped into the "Percolation Pond" impact category.

Cover Type	Young Riparian Forest	Mature Riparian Forest	Percolation Ponds	Wetland	Upland	Total Area (acres)
Beard grass	–	–	0.4	–	–	0.4
Black cottonwood	–	0.1	–	–	–	0.1
California blackberry	–	–	1.3	–	0.1	1.4
Cattail	–	–	<0.1	–	–	<0.1
Duckweed	–	–	1.0	–	–	1.0
Floating pennywort	–	–	0.1	–	–	0.1
Foxtail	–	–	0.4	–	–	0.4
Hooker's willow	0.1	–	0.3	–	–	0.4
Lupine	–	–	0.2	–	–	0.2
Red alder	–	–	0.1	–	–	0.1
Red alder/Mixed willow	–	1.3	<0.1	–	–	1.3
Reed canary grass	–	–	0.3	–	–	0.3
Lyngbye's sedge	–	–	–	0.01	–	0.01
Velvet grass meadow	–	–	0.3	–	0.1	0.3
Yarrow	–	–	0.1	–	–	0.1
Total	**0.1**	**1.4**	**4.4**	**0.01**	**0.2**	**6.1**

Lyngbye's sedge occurs at the downstream end of the floodplain restoration boundary, at the entrance to the backwater channel. Only 1% of the mapped total area of Lyngbye's sedge is estimated to be impacted by project activities in the floodplain restoration boundary. Additionally, construction of lower-elevation backwater channel margins will create new habitat for Lyngbye's sedge. Therefore, impacts to this rare plant species as a result of restoration activities are expected to be small. Including Lyngbye's sedge in the revegetation design, combined with careful excavation and replanting of existing plants, should mitigate impacts from construction.

Table 4. Estimated project impacts within the 6.1-acre floodplain restoration boundary. Approximately 5.1 acres are associated with the grading plan, where design elements will be implemented.

<table>
<tr><th>Impact Category</th><th>Pre-Construction Area (acres)</th><th>Estimated Impact Associated with Grading Plan (acres)</th><th>Post-Construction Area After Revegetation (acres)</th></tr>
<tr><td>Young riparian forest</td><td>0.1</td><td>0.1</td><td rowspan="2">2.1</td></tr>
<tr><td>Mature riparian forest</td><td>1.4</td><td>1.1</td></tr>
<tr><td>Percolation ponds</td><td>4.4</td><td>3.9</td><td>0.4</td></tr>
<tr><td>Wetland</td><td>0.01</td><td>0.01</td><td>2.0</td></tr>
<tr><td>Upland</td><td>0.2</td><td>0.0</td><td>0.2</td></tr>
<tr><td>Open water</td><td>–</td><td>–</td><td>1.4</td></tr>
<tr><td>Total</td><td>6.1</td><td>5.1</td><td>6.1</td></tr>
</table>

The proposed floodplain restoration will rehabilitate existing percolation ponds and construct a backwater channel to create off-channel winter rearing habitat for juvenile salmonids (Figure 5). Construction is proposed within the 5.1-acre grading plan (NHE 2018). The northern, western, and southern percolation pond levees will be lowered, the settled material in the percolation ponds will be excavated, and the area will be converted to pond and channel features that restore floodplain connectivity. Following construction, the area will be planted with native riparian and wetland species. Proposed revegetation is still conceptual as of this report, and a detailed revegetation design, including plant species, quantities, and locations, will be developed at a later time. The post-construction areas following revegetation shown in Figure 6are based on the conceptual revegetation designs.

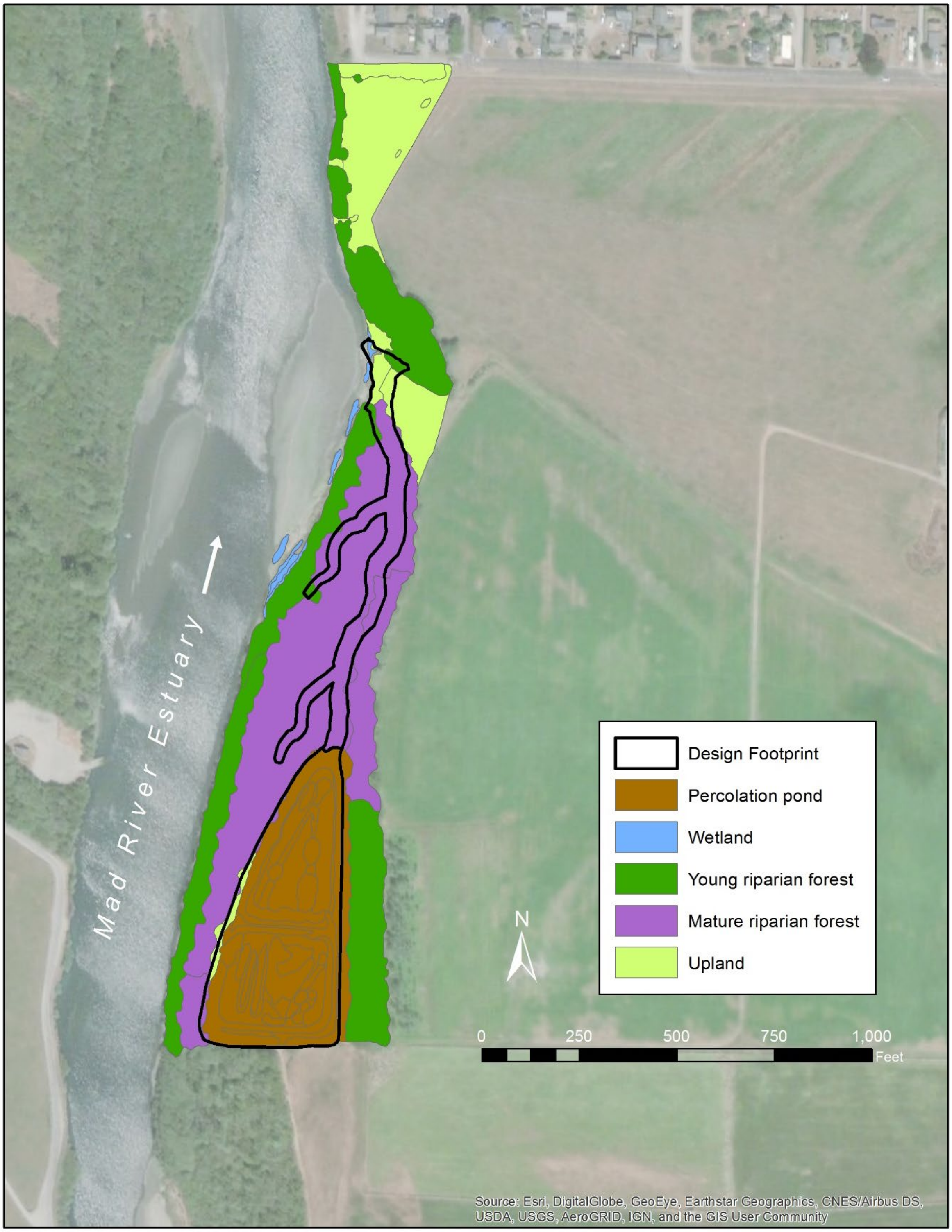

Figure 5. Riparian vegetation impact categories (as defined in Table 3) and the proposed project design footprint in the vegetation mapping boundary.

3.3 Invasive Species

Four locations of invasive plants were encountered during vegetation mapping (Figure 6). A single occurrence of periwinkle was found in a Hooker's willow patch. The occurrence was approximately 10 ft × 30 ft. Because the occurrence is small, it should be removed during channel restoration activities, even though it is not within the floodplain restoration boundary. Appropriate removal and disposal methods should be researched and employed to avoid spreading this species throughout the restoration area.

In addition to the reed canary grass cover types mapped within the percolation ponds (Figure 3), three discrete locations of reed canary grass were found. All occurrences were found in red alder stands. *Reed canary grass-1* occurred on the edge of a red alder adjacent to the grazed/mowed pasture, and the occurrence was approximately 10 ft × 10 ft in June 2018. The occurrence was revisited in August 2018 to obtain a waypoint, and had been mowed so that it appeared to cover less area. *Reed canary grass-2* and *Reed canary grass-3* both occurred along the access trail across the floodplain under a mature red alder canopy. *Reed canary grass-2* was approximately 80 ft × 20 ft, interspersed with scouring rushes and blackberry brambles. *Reed canary grass-3* was approximately round in shape with a 20-ft radius. In addition to the three discrete locations, scattered individuals of reed canary grass occurred throughout the project area in a variety of habitats. Because it was widespread throughout the site and due to its native status, it may not be possible or desirable to remove it completely from the site. However, the project may be more successful if reed canary grass is removed from the areas where channel restoration is proposed. Appropriate removal and disposal methods should be researched and employed to avoid widespread invasion.

Small amounts of spartina were mapped on the western edge of riparian vegetation occurring adjacent to the proposed floodplain restoration boundary. Each occurrence was within the active channel of the Mad River, and the downstream-most occurrence may have been scoured by high winter flows between the original field mapping in June 2018 and a subsequent field visit in June 2019. Individual plants not mapped as a separate cover type were growing between the two occurrences.

*Figure 6. Locations of periwinkle (*Vinca major*), reed canary grass (*Phalaris arundinacea*), and spartina (*Spartina densiflora*) encountered during June 2018 vegetation mapping at the Mad River Floodplain Enhancement Project.*

4 SUMMARY

Twenty-one cover types were mapped on 18.4 acres on the right bank of the Mad River near the end of School Road in McKinleyville, California. The cover types were grouped into eight biohabitats, which were further grouped into six impact categories. Although vegetation was mapped in 18.4 acres total, the impact analysis focused on the proposed floodplain restoration boundary, which includes 6.1 acres within the vegetation mapping boundary. One objective of vegetation mapping was to determine the potential impacts of the proposed project on "mature" riparian vegetation (defined for this project as vegetation composed of trees 12 inches in diameter or larger). Therefore, mapping focused on structural differences between stand types to define younger scrub-dominated types from older tree-dominated types. Black cottonwood, red alder/mixed willow, and red alder comprised mature riparian vegetation and covered approximately 1.4 acres within the restoration floodplain boundary (6.4 acres within the vegetation mapping boundary). Hooker's willow, mixed willow, and red alder/Hooker's willow comprised younger riparian vegetation, and covered approximately 0.1 acre within the floodplain restoration boundary (5.0 acres within the mapping area). Proposed activities within the floodplain restoration boundary are estimated to impact 1.1 acres of mature woody forest, and 0.1 acre of young riparian forest, for a total of 1.2 acres of impact to riparian vegetation.

Three invasive species were located during field mapping: periwinkle, reed canary grass, and spartina. The periwinkle occurrence is small and should be targeted for eradication during channel restoration activities. It is outside the floodplain restoration boundary but could be removed by hand to prevent its spread into the restoration area. It may be appropriate to limit the spread of reed canary grass in the new constructed channel to improve the ultimate success of the restoration project. Spartina occurs sporadically adjacent to the project. Because the proposed backwater channel will occur in brackish conditions, and due to the presence of spartina nearby, additional post-project monitoring and management may be necessary to reduce the abundance of spartina in constructed conditions.

5 REFERENCES

Apfelbaum, Stephen I., and Charles E. Sams. 1987. Ecology and control of reed canary grass (*Phalaris arundinacea* L.). Natural Areas Journal 7: 69–74.

Baldwin, B.G., Goldman, D.H.., Keil, D.J., Patterson, R., Rosatti, T.J., and D.H. Wilken (editors). 2012. The Jepson Manual: Vascular Plants of California. 2nd Edition. University of California Press, Berkeley, CA.

Buck-Diaz, J., Batiuk, S., and J.M. Evens. 2012. Vegetation Alliances and Associations of the Great Valley Ecoregion, California. California Native Plant Society, Vegetation Program. Sacramento, CA.

California Department of Fish and Wildlife. 2018a. California Wildlife Habitat Relationships System. https://www.wildlife.ca.gov/Data/CWHR/Wildlife-Habitats

California Department of Fish and Wildlife (CDFW). 2018b. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities. Available at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18959&inline

California Invasive Plant Council (Cal-IPC). 2009. California Invasive Plant Inventory. California Invasive Plant Council, Berkeley, CA. Available at: https://www.cal-ipc.org/plants/inventory/

Holland, R. 1986. Preliminary Descriptions of the Terrestrial Natural Communities of California. The Resources Agency, California Department of Fish and Game, Natural Heritage Division. Sacramento, CA

Jepson Flora Project (eds.) 2018. Jepson eFlora, http://ucjeps.berkeley.edu/eflora/ [accessed on Sept 25, 2018].

Mayer, K.E. and W.F. Laudenslayer, Jr. 1988. A Guide to Wildlife Habitats of California. The Resources Agency, California Department of Fish and Game, Sacramento, CA.

Northern Hydrology and Engineering. 2018. Final Design Submittal for the Mad River Estuary Restoration Off-channel Habitat Designs. Prepared for California Trout, North Coast Region. Arcata, CA.

Sawyer, J.O., T. Keeler-Wolf, and J. Evens. 2009. A Manual of California Vegetation. 2nd Edition. California Native Plant Society Press, Sacramento, CA.

Waggy, M. 2010. *Phalaris arundinacea.* In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Ft. Collins, CO. Available: https://www.fs.fed.us/database/feis/plants/graminoid/phaaru/all.html

Appendix G: Rare and Sensitive Plant Survey

Special Status Plant Survey Results

MAD RIVER FLOODPLAIN AND PUBLIC ACCESS ENHANCEMENT PROJECT

HUMBOLDT COUNTY, CA

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1.0 INTRODUCTION

This report presents the results of Special Status plant and natural community surveys conducted for the Mad River Floodplain and Public Access Enhancement Project on the Mad River in Humboldt County, California. The purpose of the surveys was to identify Special Status plants and natural communities that could be impacted by the project activities.

The goal of the proposed project is to restore floodplain habitat to benefit fish and wildlife and to improve public access, including a nature study trail and viewing areas.

One Special Status plant, Lyngbye's sedge (*Carex lyngbei*) was encountered along the riverbank. No other Special Status plants or natural communities were encountered within the project area.

2.0 SPECIAL STATUS PLANT AND NATURAL COMMUNITY DEFINITIONS

Special Status plants are rare, threatened or endangered species as defined by the Federal and California Endangered Species Acts, as well as non-listed species that require consideration under 14 Cal. Code Reg. §15380.

Special Status plants include species that meet one or more of the following criteria:

- Plants listed or proposed for listing as threatened or endangered under the federal Endangered Species Act or California Endangered Species Act.
- Plants on the California Rare Plant Ranking (CRPR) Lists 1A, 1B, and 2.

The primary sources for information on the status of Special Status plant species and natural communities are the California Native Plant Society and the California Natural Diversity Database (CNDDB). The California Native Plant Society (CNPS) *Inventory of Rare and Endangered Plants of California* is a comprehensive list with five categories that are summarized below:

Plants on lists 1A, 1B and 2 are considered Special Status species as described in the California Environmental Quality Act (14 Cal. Code Reg. §15380) and are therefore the focus of this report.

1A: Plants presumed extinct in California
1B: Plants rare, threatened, or endangered in California and elsewhere
2: Plants rare, threatened, or endangered in California but more common elsewhere
3: Plants about which we need more information - a review list
4: Plants of limited distribution – a watch list

A Threat Code extension follows the California Rare Plant Rank (e.g. 1B.1, 2.2 etc.) such that the lower the number, the higher the corresponding threat level:

.1 - Seriously endangered in California
.2 – Fairly endangered in California
.3 – Not very endangered in California

The California Department of Fish and Wildlife (CDFW) has a similar list of Special Vascular Plants, Bryophytes, and Lichens published by the California Natural Diversity Database (CNDDB). The Special Plants List includes the CNPS Inventory, as well as species considered sensitive by other governmental agencies (e.g., Bureau of Land Management, U.S. Fish and Wildlife Service, and U.S. Forest Service).

Special Status natural communities are communities with limited distribution that may be vulnerable to environmental impacts. The Global (G) and State (S) rarity rankings for currently recognized vegetation alliances are provided on the California Natural Diversity Database (CNDDB 2019).

3.0 ENVIRONMENTAL SETTING

3.1. Project Location

The project is located on the Arcata North USGS quadrangle in the Mad River watershed near School Road west of Highway 101 in McKinleyville, Humboldt County, California on land managed by the McKinleyville Community Services District. The elevation of the project site ranges from approximately 5 to 25 feet above mean sea level.

3.2. Vegetation

The project site includes the Mad River, its streambed and streambanks, access roads, and areas for stockpiling spoils. It is located primarily within a riparian area within a landscape dominated by non-native grasses. The forest canopy is dominated by willows and red alder. Dominant understory species include California blackberry (*Rubus ursinus*), Himalayan blackberry (*Rubus armeniacus*), and common scouring rush (*Equisetum hyemale* ssp*. affine*).

Vegetated areas of the riverbank are dominated by Lyngbye's sedge (*Carex lyngbyei*) and *Schoenoplectis pungens* var*. longispicatus* (common three-square bulrush). Areas designated for stockpiling spoils are managed livestock pastures and hayfields dominated by non-native grasses and clovers. Access roads that will be used for project activities traverse these pastures and hayfields. A vegetation assessment of the project area was conducted by McBain Associates and is included in a separate report (McBain Associates 2019).

4.0 METHODS

4.1. Scoping

In order to meet California Environmental Quality Act (CEQA) requirements, scoping for potential presence of Special Status plant species and natural communities was conducted to determine whether the proposed project would have significant negative impacts on such resources.

Prior to field surveys, a list of Special Status plants that could potentially occur in the project area was generated by consulting the *California Natural Diversity Database* (CDFW 2019) and the CNPS *Inventory of Rare and Endangered Plants* (CNPS 2019). The list also includes other species for which the site supports suitable habitat if the site is within or near the known range of the species (Table 1). The scoping list was used to determine seasonally-appropriate survey dates for floristic surveys.

The assessment area was defined as the USGS 7.5' quadrangle in which the project is located (Arcata North Quad), as well as the adjacent quadrangles (Crannell, Panther Creek, Arcata South, Eureka, Blue Lake, Korbel, Tyee City, and Trinidad). The most up-to-date CNDDB Quick Viewer (2019) and CNPS (2019) were used to query known occurrences of California Rare Plant Rank (CRPR) List 1 and 2 species within the assessment area. The CNPS Inventory was also queried for CRPR List 3 and 4 species known to occur within the county, although those species lists are not presented here. The queries yielded 42 Special Status plant species previously documented in the assessment area (Table 1). Four Special Status plant communities are documented from this assessment area (Table 2). Though suitable habitat for some of the species in the scoping list was not present within the project area, the complete scoping list is present in Table 1.

Table 1. Lower Mad River Assessment Area: Predicted Sensitive Plant Species and California Rare Plant Rankings.

Scientific Name	CRPR	Blooming Season
Abronia umbellata var. breviflora	1B.1	Jun-Oct
Astragalus pycnostachyus var. *pycnostachyus*	1B.2	(Apr)Jun-Oct
Astragalus umbraticus	2B.3	May-Aug
Cardamine angulata	2B.2	(Jan)Mar-Jul
Carex arcta	2B.2	Jun-Sep
Carex lenticularis var. *limnophila*	2B.2	Jun-Aug
Carex leptalea	2B.2	Mar-Jul
Carex lyngbyei	2B.2	Apr-Aug
Carex praticola	2B.2	May-Jul
Carex viridula ssp. *viridula*	2B.3	(Jun)Jul-Sep(Nov)
Castilleja ambigua var. *humboldtiensis*	1B.2	Apr-Aug
Castilleja litoralis	2B.2	Jun-Jul

Castilleja mendocinensis	1B.2	Apr-Aug
Chloropyron maritimum ssp. *palustre*	1B.2	Jun-Oct
Collinsia corymbosa	1B.2	Apr-Jun
Empetrum nigrum	2B.2	Apr-Jun
Erigeron bloomeri var. *nudatus*	2B.3	Jun-Jul
Erysimum menziesii	1B.1	Mar-Sep
Erythronium oregonum	2B.2	Mar-Jun(Jul)
Erythronium revolutum	2B.2	Mar-Jul(Aug)
Gilia capitata ssp. *pacifica*	1B.2	Apr-Aug
Gilia millefoliata	1B.2	Apr-Jul
Hesperevax sparsiflora var. *brevifolia*	1B.2	Mar-Jun
Juncus nevadensis var. *inventus*	2B.2	Jul-Nov
Lasthenia californica ssp. *macrantha*	1B.2	Jan-Nov
Lathyrus japonicus	2B.1	May-Aug
Lathyrus palustris	2B.2	Mar-Aug
Layia carnosa	1B.1	Mar-Jul
Lilium occidentale	1B.1	Jun-Jul
Lycopodiella inundata	2B.2	Jun-Sep
Monotropa uniflora	2B.2	Jun-Aug(Sep)
Montia howellii	2B.2	(Jan-Feb)Mar-May
Oenothera wolfii	1B.1	May-Oct
Packera bolanderi var. *bolanderi*	2B.2	(Jan-Apr)May-Jul(Aug)
Piperia candida	1B.2	(Mar)May-Sep
Polemonium carneum	2B.2	Apr-Sep
Romanzoffia tracyi	2B.3	Mar-May
Sidalcea malviflora ssp. *patula*	1B.2	(Apr)May-Aug
Sidalcea oregana ssp. *eximia*	1B.2	Jun-Aug
Silene scouleri ssp. *scouleri*	2B.2	(Mar-May)Jun-Aug(Sep)
Spergularia canadensis var. *occidentalis*	2B.1	Jun-Aug
Viola palustris	2B.2	Mar-Aug

Table 2. Lower Mad River Assessment Area: Special Status Plant Communities.

Northern Coastal Salt Marsh
Northern Foredune Grassland
Sitka Spruce Forest
Sphagnum Bog

4.2. Special Status Plant Surveys

In keeping with survey guidelines established by both CNPS (2001) and CDFW (2018), field surveys were floristic in nature. All plants encountered during the surveys were identified to the taxonomic level necessary to determine whether or not they are sensitive. Taxonomy follows the Jepson Manual (Baldwin et al. 2012).

Jennifer Kalt conducted the pre-field scoping, field surveys, and plant identification. Kalt is a professional botanist with a Bachelor of Science degree in Botany and a Master of Arts degree in Biology from Humboldt State University, with more than fifteen years of experience conducting sensitive plants surveys in northern California. Surveys were conducted on April 1, 2016; July 23, 2017; and July 17 and 30, 2019, with a total of 7 field-person hours spent surveying the project area. Survey route maps are provided in Appendix A.

5.0 RESULTS

5.1 Special Status Plants

One Special Status plant, Lyngbye's sedge (*Carex lyngbei*) was encountered along the riverbank. No other Special Status plants were encountered within the project area.

A list of all plant species encountered is provided in Appendix B. All plants encountered during the surveys were identified to the taxonomic level necessary to determine whether they are special status (Baldwin et al. 2012).

5.2 Special Status Natural Communities

No special status natural communities were encountered.

6.0 RECOMMENDATIONS

Lyngbye's sedge (*Carex lyngbyei*) is a sensitive plant species associated with brackish marshes and tidally influences sloughs and streambanks in the region, and is present within and adjacent to the project footprint along the right bank of the Mad River. The project may result in impacts to a small patch (approximately 0.01 acres) of Lyngbye's sedge (see Fig. 3 and Table 3 in McBain Associates 2019).

The project may enhance habitat for this species by expanding the floodplain and area of tidal influence. If temporary and/or permanent impacts to Lyngbye's sedge cannot be avoided, it is recommended that a mitigation and monitoring plan be developed with input from permitting and resource agencies as well as restoration consultants to ensure feasibility and success.

No other botanical surveys are recommended prior to project activities.

7.0 REFERENCES

Baldwin, B. C., D. H. Goldman, D. J. Keil, R. Patterson, and T.J. Rossetti. Eds. 2012. *The Jepson Manual, Vascular Plant of California, Second Edition*. University of California Press. Berkeley, CA.

California Department of Fish and Wildlife (CDFW). 2019. *California Natural Diversity Database* (CNDDB), Wildlife and Habitat Data Branch, Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2018. *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities.* California Department of Fish and Wildlife, Sacramento, CA.

California Native Plant Society (CNPS) 2019. *Inventory of Rare and Endangered Plants* (online edition). California Native Plant Society, Sacramento, CA.

McBain Associates. 2019. Vegetation Mapping for the Mad River Floodplain Enhancement Project. Prepared for California Trout, Arcata, CA.

Appendix A. Survey route map, Mad River Floodplain and Public Access Enhancement Project, Humboldt County, CA.

Appendix B. List of plant species present within the Mad River Floodplain and Public Access Enhancement Project, Humboldt County, CA.

Scientific Name	Common Name
Trees	
Alnus rubra	red alder
Picea sitchensis	Sitka spruce
Populus trichocarpa	black cottonwood
Salix hookeriana	Hooker's willow
Salix sp.	willow
Sequoia sempervirens	coast redwood
Shrubs	
Baccharis pilularis	coyote brush
Cytisus scoparius	Scotch broom
Fuchsia sp.	fuchsia
Lonicera involucrata	twinberry
Ribes menziesii	canyon gooseberry
Rosa sp.	rose
Rubus armeniacus	Himalayan blackberry
Rubus parviflorus	thimbleberry
Rubus spectabilis	salmonberry
Rubus ursinus	California blackberry
Sambucus racemosa	red elderberry
Solanum laciniatum	potato tree
Symphoricarpos albus var. *laevigatus*	common snowberry
Herbs	
Achillea millefolium	common yarrow
Agrostis oregonensis	Oregon redtop
Agrostis sp.	bent grass
Anthoxanthum odoratum	sweet vernal grass
Artemisia douglasiana	mugwort
Athyrium filix-femina	lady fern
Avena sp.	wild oat
Brassica rapa	field mustard
Bromus carinatus	California brome
Bromus hordeaceus	soft chess
Bromus sp.	brome grass
Cardamine oligosperma	western bittercress

Carduus pycnocephalus	Italian thistle	
Carex leptopoda	short-scaled sedge	
Carex lyngbyei	**Lyngbye's sedge**	***CRPR 2.B2***
Chamomilla suaveolens	pineapple weed	
Cirsium vulgare	bull thistle	
Convolvulus arvensis	field bindweed	
Crepis capillaris	hawksbeard	
Dactylis glomerata	orchard grass	
Daucus carota	wild carrot or Queen Anne’s lace	
Deschampsia caespitosa	tufted hairgrass	
Dipsacus sp.	teasel	
Distichlis spicata	salt grass	
Epilobium ciliatum	northern willowherb	
Equisetum hyemale ssp. *affine*	common scouring rush	
Equisetum telmateia ssp. *braunii*	giant horsetail	
Festuca arundinacea	tall fescue	
Festuca perennis	perennial ryegrass	
Fragaria chiloensis	beach strawberry	
Galium aparine	goose grass	
Geranium dissectum	cut-leaved geranium	
Helminthotheca echoides	bristly ox-tongue	
Heracleum maximum	cow parsnip	
Hirschfeldia incana	Mediterranean mustard	
Holcus lanatus	common velvet grass	
Hordeum jubatum	foxtail barley	
Hordeum marinum ssp. *gussoneanum*	Mediterranean barley	
Hydroctyle sp.	marsh pennywort	
Hypochaeris radicata	hairy cat’s-ear	
Iris douglasiana	Douglas iris	
Juncus bufonius	common toad rush	
Juncus effusus	common rush	
Juncus patens	spreading rush	
Lapsana communis	nipplewort	
Lathyrus sp.	wild pea	
Lemna sp.	duckweed	
Leucanthemum vulgare	ox-eye daisy	
Linum bienne	western blue flax	
Lotus corniculatus	birdfoot trefoil	
Malva nicaeensis	bull mallow	
Marah oreganus	coast man-root	

Melilotus alba	white sweetclover
Melilotus officinalis	yellow sweetclover
Mentha _piperita	peppermint
Mentha pulegium	pennyroyal
Parentucellia viscosa	yellow parentucellia
Phalaris arundinacea	reed canary grass
Phleum pratense	cultivated timothy grass
Plantago lanceolata	English plantain
Plantago major	common plantain
Poa annua	annual bluegrass
Polystichum munitum	sword fern
Potentilla anserina ssp. *pacifica*	Pacific silverweed
Ranunculus repens	creeping buttercup
Raphanus sativus	wild radish
Rumex acetosella	sheep sorrel
Rumex crispus	curly dock
Rumex sp.	dock
Schoenoplectis pungens var. *longispicatus*	common three-square bulrush
Scirpus microcarpus	small-flowered bulrush
Scrophularia californica	coast figwort
Senecio vulgaris	common butterweed
Solidago spathulata	coast goldenrod
Soliva sessilis	soliva
Sonchus sp.	sow thistle
Spartina densiflora	dense-flowered cordgrass
Stachys ajugoides var. *rigida*	hedge nettle
Symphyotrichum chilense	common California aster
Taraxacum officinale	dandelion
Tolmiea diplomenziesii	youth-on-age
Torreyochloa pallida var. *pauciflora*	weak mannagrass
Trifolium dubium	shamrock clover
Trifolium pratense	red clover
Trifolium repens	white clover
Typha latifolia	broadleaf cattail
Urtica dioica	stinging nettle
Veronica sp.	veronica
Vicia sativa	common vetch
Vinca major	greater periwinkle
Vulpia sp.	annual fescue

Appendix H: NOAA Fish Removal Guidelines and Requirements

Appendix H: Fish Relocation Guidelines and Requirements

Fish relocation efforts will follow the guidelines established by NMFS for habitat restoration projects in Northern California. General conditions for all fish capture and relocation activities are as follows:

- Fish relocation and dewatering activities shall only occur between June 15 and November 1 of each year.
- All seining, electrofishing, and relocation activities shall be performed by a qualified fisheries biologist. The qualified fisheries biologist shall capture and relocate listed salmonids prior to construction of the water diversion structures (*e.g.*, cofferdams). The qualified fisheries biologist shall note the number of salmonids observed in the affected area, the number and species of salmonids relocated, where they were relocated to, and the date and time of collection and relocation. The qualified fisheries biologist shall have a minimum of three years field experience in the identification and capture of salmonids, including juvenile salmonids, considered in this biological opinion. The qualified biologist will adhere to the following requirements for capture and transport of salmonids:
    - Determine the most efficient means for capturing fish (*i.e.*, seining, dip netting, trapping, electrofishing). Complex stream habitat generally requires the use of electrofishing equipment, whereas in outlet pools, fish may be concentrated by pumping-down the pool and then seining or dipnetting fish.
    - Notify NMFS one week prior to capture and relocation of salmonids to provide NMFS an opportunity to monitor.
    - Initial fish relocation efforts will be conducted several days prior to the start of construction. This provides the fisheries biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to construction. In many instances, additional fish will be captured that eluded the previous day's efforts.
    - In streams with high water temperature, perform relocation activities during morning periods.
- Prior to capturing fish, determine the most appropriate release location(s). Consider the following when selecting release site(s):
    - Similar water temperature as capture location.
    - Ample habitat for captured fish.
    - Low likelihood of fish reentering work site or becoming impinged on exclusion net or screen.
    - Fish must be released in a nearby location within the same HUC 8 watershed.
- Periodically measure air and water temperatures. Cease activities when measured water temperatures exceed 17.8 ºC. Temperatures will be measured at the head of riffle tail of pool interface.

The zone of exclusion will be established and maintained with upstream and downstream block nets.

Appendix I: Biological Resource Investigation

Mad River Floodplain Enhancement and Restoration Biological Assessment

November 11, 2019

Final

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Introduction

Slauson Wildlife performed a biological assessment for the proposed Mad River Floodplain Enhancement and Restoration Project sites (California Trout 2019). The following document is designed to assist in identifying biological resources of conservation concern that may occur in the proposed project area, provide recommendations for pre-construction surveys, and propose appropriate avoidance, minimization, and mitigation measures that may be necessary to avoid or reduce the potential for adverse impacts due to the activities of the proposed project. This report combines queries of state databases on the occurrence of species of conservation concern and a synthesis of pertinent literature and existing habitat conditions to identify the complete suite species of conservation concern that may occur in or near the proposed project areas.

Environmental Setting

The Mad River Floodplain Enhancement and Restoration Project is located in McKinleyville, in the lower section of the Mad River watershed in Humboldt County, California (Figure 1). The proposed project area occurs along the right bank of the main-stem of the Mad River, beginning just downstream of the Hammond Trail Bridge and 3 miles upstream from the mouth of the Mad River. The project location is on the McKinleyville Community Services District (MCSD) Fischer Ranch properties APN numbers 508-021-04 and 508-021-05. The Fischer Ranch properties provide service to the community as a permitted wastewater reuse and discharge location and as public coastal access location (Figure 1). The overall goal of the project is to restore floodplain habitat and improve public access amenities. Specifically, the floodplain restoration component addresses a major limiting factor for recovery of listed salmonids as detailed in Federal Recovery Plans by providing backwater pools, a State-defined desired condition for low gradient streams and rivers (NMFS 2016, NMFS 2014, NCRWQCB 2006). The public access amenity component is in alignment with local and state plans (Humboldt County Trails Master Plan; MCSD's Recreation Master Plan; County; SCC-coastal trail). The proposed project enhances fish and wildlife habitat and public access located in the lowest reach of the Mad River where there are limited opportunities for creating both backwater habitat and public access.

The proposed project consists of two distinct components: 1) habitat restoration to restore the existing percolation ponds to the native floodplain elevation and provide channels and ponds connected to the Mad River via a backwater channel to increase and improve aquatic habitat (Figure 1c) 2) improve public coastal access, including Americans with Disabilities Act (ADA) accessible trails with resting areas and interpretive features (Figure 1B; California Trout 2019). The proposed project occurs on 18.4 acres of MCSD's Fischer Ranch and an estimated 6.1 acres of vegetation may be impacted by proposed project activities (Loya 2018).

Figure 1. Mad River Floodplain Enhancement and Restoration Project location and project boundary (A. area within white polygon; California Trout 2019) and proposed 65% design project footprint, showing details of the public access features near School Road (B), and the proposed backwater side channel and removal of levees around the former wastewater treatment ponds (C).

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The habitat restoration component of the proposed project involves the following construction activities: 1) removal and regrading of the existing levees around the north, south, and west sides of the existing percolation ponds to restore them to current floodplain elevation 2) creation of a backwater channel by removing riparian vegetation and excavating soil to the desired elevation along the channel 3) creation of an 6 ft deep 20 x 100 ft off-channel pond by removing vegetation and soil to desired depth 4) creation of a wetland flat with island features between the off-channel pond and backwater channel by removing vegetation and excavating soil to the desired depth 5) creation of an upstream swale connecting the south end of the percolation ponds to the upstream portion of the Mad river to direct high river flow events through the backwater channel by removing vegetation and excavating the broad swale area to the desired elevation 6) creation of a riparian bench along the east side of the swale to direct high flow events through the backwater channel. Some planting of desired native riparian and wetland vegetation is included at specific locations of the restoration project.

The public access improvement component of the proposed project involves the following construction activities: 1) creation of a trail system with a hardened surface in existing and new trail locations by improving existing trails or removing vegetation and creating new hardened surfaces 3) creation of a bluff overlook platform 4) creation of river access points along the trail network to provide aquatic access to recreationists.

The proposed project activities would potentially affect wildlife species and/or habitat in the following ways: 1) removal of riparian vegetation for floodplain grading, backwater channel creation, pond creation, and creating/enhancing access roads to the pond and channel sites to support soil removal 2) loss of some areas of riparian vegetation 3) creation of aquatic features that could attract establishment of non-native invasive species 4) noise and visual disturbance due to the presence and activities of machinery during construction and sediment transportation activities 5) long-term increases in disturbance levels from human recreation activities in the project area.

Proposed construction activities in the project area will occur in phases. The first phase involves removal of vegetation prior to the onset of the avian nesting season in the winter of 2020 and/or 2021. The public access portion of the project may be constructed as soon as the spring of 2020 and/or 2021 prior to the avian nesting season. Most construction activities for the remainder of the project will occur after August 15 through October as the onset of rainy weather permits in 2020 and/or 2021. The proposed project activities impacting vegetation would occur primarily in riparian forest and scrub and secondarily in coastal scrub habitats and 2 human created freshwater marshes (Figures 1, 2).

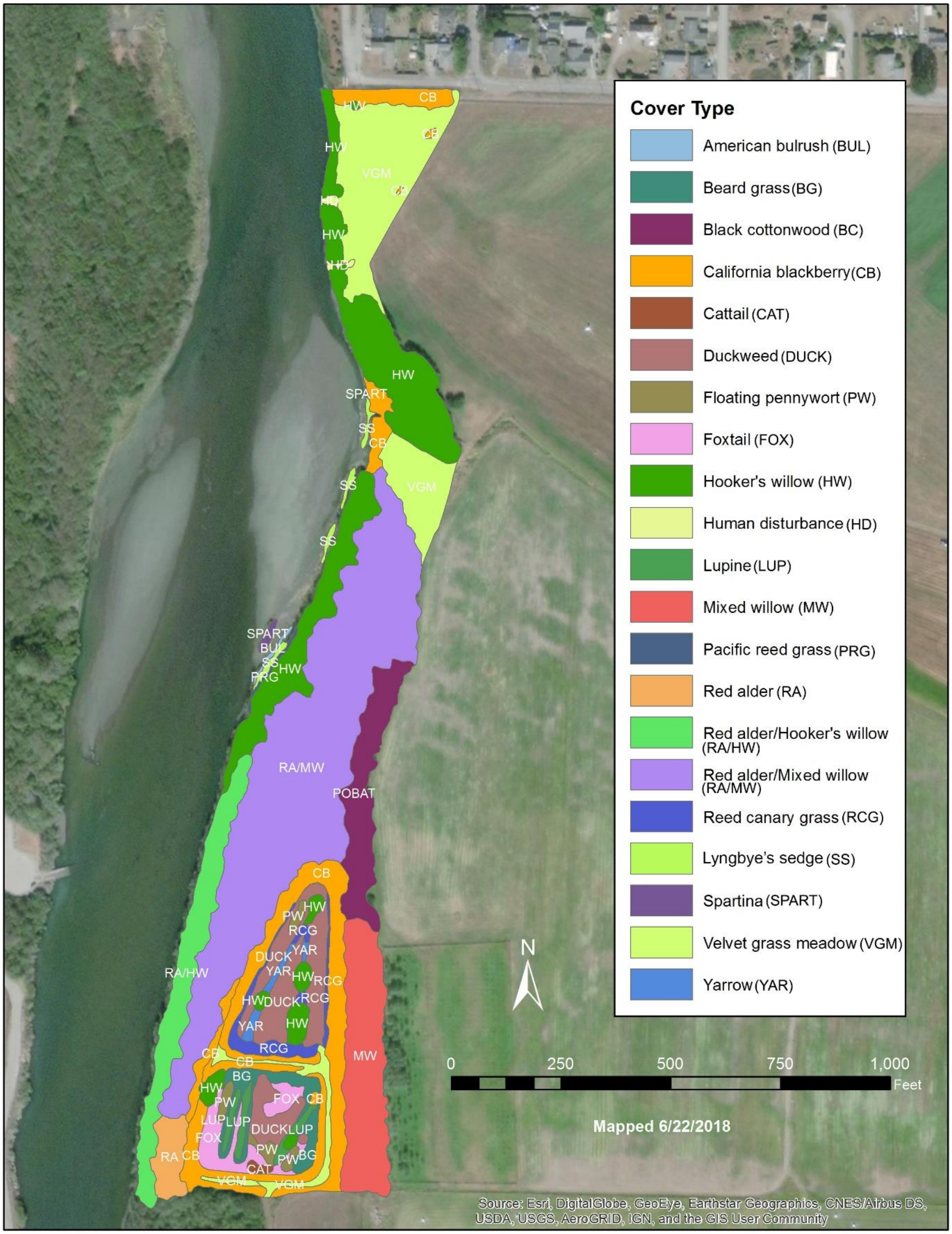

Figure 2. Biological land cover types field mapped on June 22, 2018, in the Mad River Floodplain Enhancement and Restoration Project area (Loya 2018).

Biological Assessment Methods

Species addressed in this assessment include all species legally protected pursuant to the California and Federal Endangered Species Acts (CESA and FESA, respectively), California's "Fully Protected Species" statutes (California Department of Fish and Game (CDFG) codes 3503.5, 3505, 3511, 4700, 5050 and 5515), and the California Environmental Quality Act (CEQA). This assessment utilizes three elements: 1) queries of state and federal agency databases for species occurrence in the proposed project region 2) an assessment of current habitat conditions to support species of conservation concern in the proposed project region and 3) a site visit to the proposed project areas to evaluate habitat conditions and detect species present during the site visit period. The California Natural Diversity Database (CNDDB), the Biogeographic Information Observation System (BIOS), and the northern spotted owl database (Gould 1997) for the project region were queried for the occurrence of species of conservation concern in the proposed project region. The proposed project region is defined as the 9-quadrangle area centered on the Fields Landing quadrangle and also includes: Arcata North, Tyee City, Blue Lake, Eureka, Arcata South, Korbel, Trinidad, Crannell and Panther Creek. The CNDDB and BIOS were queried in April of 2019, and a current official list of federally threatened, endangered, or candidate species for the proposed project region was obtained in April of 2019. Finally, this assessment also considered any other species listed on CDFW's special animals list (CDFW 2018) that are known to occur in the project region, based on additional literature and/or habitat conditions, that were not identified by during the database queries. All species of conservation concern identified in these queries, habitat assessments, and during site visits are included in Appendix 1. In addition, several site visits were conducted across the spring, summer and fall periods of 2018-2019 to detect additional species and potentially suitable habitat for species not identified in the previously described CNDDB query.

Species of Conservation Concern

A total of 91 species of conservation concern were identified in the CNDDB query and an additional 9 species, for a total of 100, were evaluated based on the presence of suitable habitat to support them in the proposed project area or detection of them during site visits (Appendix 1).

Amphibians and Reptiles

Five species of amphibians and one species of reptile of conservation concern were considered (Appendix 1): Pacific tailed frog, Northern red-legged frog, Foothill yellow-legged frog (FYLF), Southern torrent salamander (STSA), Del Norte salamander (DNSA), and Western pond turtle (WPTU). Of these species, all 5 amphibians and the Western pond turtle are known to occur or suitable habitat is known to be present in the Mad River and adjacent larger watersheds, however suitable breeding habitat in the proposed project area is suspected only for the Northern red-legged frog due to the salinity of the Mad River channel adjacent to the entire proposed project site (FYLF, WPTU) and lack of suitable habitat for more upland forest associated salamanders (STSA, DNSA). The section of the Mad River channel adjacent to the proposed project site routinely is contacted by salt water during daily high tide events when the river is at low summer and fall flows preventing occupancy by salt water intolerant amphibians and reptiles. The extent of the salt-water intrusion on the main channel of the Mad River is uncertain, but up-river tidal influences appears to extend up to and potentially beyond the Hammond Bridge, up river of the proposed project site. Several adult Northern red-legged frogs were detected in the riparian forest just west and north of the percolation ponds in the proposed project site. It is also possible that the percolation ponds may support breeding for this species. The Foothill yellow-legged frog is designated by CDFW as a "Candidate Threatened Species" and the remaining 4 amphibians and the one reptile are designated as "Species of Special Concern" pursuant to CEQA (Appendix 1).

Birds

Twenty-seven species of birds of conservation concern are considered (Appendix 1), including those with fully protected status by the CDFW. Fully protected species likely to occur in the proposed project region, all potentially occurring species in the family Ardeidae (herons and egrets) and birds of prey in the orders Falconiformes (diurnal raptors) and Strigiformes (owls) (CDFG codes 3503.5 and 3505). Of the species likely to occur in the proposed project region, 2 species are listed as either threatened or endangered under the Federal ESA (Northern spotted owl, Western snowy plover) and 3 under the California ESA (Northern spotted owl, Bank swallow, Little willow flycatcher), and 20 are designated "Species of Special Concern" pursuant to CEQA. With regard to federally listed species, critical habitat occurs within the project region for the Western snowy plover (re-designated June 12, 2012; USFWS 2012a) and Northern spotted owl (revised Dec 4, 2012b; USFWS 2008).

Of the species listed under the Federal or State ESAs, potentially suitable habitat only occurs in or near the proposed project area for the Little willow flycatcher. Two protocol surveys (Bombay et al. 2003) for this species were conducted during site visits in survey periods 2 (June 15-25th) and 3 (June 26th-Jult 15th) in 2018 with no detections. Several colony nesting waterbirds forage in or adjacent to the proposed project site but none nesting colonies have been detected in or near the proposed project site. Of the 10 raptors species considered, most have been detected foraging in or adjacent to the proposed project area, but nesting structures (large diameter riparian or conifer trees) are not present to support nesting for most species with the exception of the Cooper's hawk and Great horned owl (Appendix 1). Black-crowned night herons were detected roosting communally along the main channel in several locations in close proximity to the proposed project site during site visits in the non-nesting season. Three additional birds species of conservation concern nest in or near the proposed project site, the Yellow warbler, Yellow-breasted chat, and Black-capped chickadee and were all detected in the proposed project area during site visits during the nesting season (Appendix 1). Three pelagic species, Fork-tailed storm-petrel, Tufted puffin, and Rhinoceros auklet were identified in the CNDDB query but were not evaluated due to the lack of presence of pelagic habitats in or adjacent to the proposed project site.

Mammals

Seven species of mammals of conservation concern are considered (Appendix 1): Townsend's big-eared bat, Long-eared myotis, Sonoma tree vole, White-footed vole, Humboldt mountain beaver, North American porcupine, and Pacific fisher. Of these, none are listed as threatened or endangered pursuant to FESA or CESA, although 1 (Pacific fisher) is a candidate for both federal and state listing status. Five species are designated "Species of Special Concern" pursuant to CEQA and none are USFWS "Species of Concern". Of these seven mammal species considered, only the two bat species have the potential to occur in the project area and no suitable breeding season roosting or maternal colony structures are present in or immediately adjacent to the proposed project site (Appendix 1).

Invertebrates

Three species of insects and two species of mollusks were considered (Appendix 1): Sandy beach tiger beetle, Western bumblebee, Obscure bumblebee, Western pearshell, and California floater. Of these, only the two bumblebee species have the potential to occur in the proposed project area.

Fish

Nine species of fish of conservation concern were considered, (Appendix 1), including the Eulachon, Longfin smelt, Summer run steelhead trout, steelhead-Northern California DPS, Coho-California ESU, Coastal cutthroat trout, Tidewater goby, Pacific lamprey, and Green sturgeon. All these fish species were considered to be potentially present in the project area in the main channel of the Mad River but are not likely to be impacted by project activities if the avoidance and minimization measures are followed to avoid connecting constructed aquatic features to the main channel prior to the completion of construction activities. The project has the potential to benefit multiple species of fish by providing off-channel habitat in the lower Mad River estuary where there is currently little off-channel habitat.

Plants

Forty-six species of plants of conservation concern are considered, including 41 vascular and 5 non-vascular plants (Appendix 1). Of those only 8 species have potentially suitable habitat present in the proposed project site (Appendix 1).

Recommendations

The following avoidance, minimization, and mitigation measures are recommended in order to avoid potential adverse impacts to the species of conservation concern that are known to or may occur in or adjacent to the proposed project site:

Amphibians and Reptiles

- ❖ Best Management Practices (BMP's) should be implemented to control project generated storm-water runoff, avoid increased turbidity in wetlands, ponds, and the Mad River, and insure soil stabilization.

- ❖ Construction activities in freshwater wetland habitat located in the percolation ponds work should not occur during the breeding (January-May) and metamorphosis (June-August) periods for the Northern red-legged frog. Should the project proponent wish to avoid seasonal restrictions; clearance surveys for potentially breeding frogs should be conducted by a qualified biologist in suitable habitat prior to the initiation of in-pond work (see below). These surveys would need to be conducted within the proposed construction boundary no more than 2 weeks prior to the start of in-stream activities. If larvae or eggs are detected, the biologist will relocate them to a suitable location outside of the proposed construction boundary (Trinity River Restoration Program 2009). Alternatively, a dewatering plan (no additional discharge into the ponds during the breeding period (January-May) for the ponds may preclude development of suitable breeding conditions.

- ❖ Immediately prior (1-3 days) to initiation of construction activities all dewatered channels and adjacent habitat that will have vegetation removed or impacted by project activities should be surveyed by a qualified biologist to detect and re-locate any amphibians that have entered (dewatered ponds, channels) or reside (riparian vegetation) in these areas in the proposed construction boundary. All species observed should be moved to an appropriate, pre-determined relocation site, upstream from the footprint of the proposed construction area.

- Should construction activities cease for a period > 2 days during damp periods, when amphibians may be moving greater distances, the construction site should be surveyed by a qualified biologist to detect and move and amphibians to an appropriate, pre-determined relocation site, either upstream or downstream from the footprint of the proposed construction area.

- In the event that a Northern red-legged frog is observed within the construction boundary during construction activities, in-stream work should be temporarily halted until the frog has been moved to a safe location with suitable habitat outside of the construction area footprint (Trinity River Restoration Program 2009).

Birds

- No riparian or scrub habitats should be degraded or removed during the general breeding period (February 1st through August 15th) for bird species likely to nest in the proposed project area. Breeding Periods for individual species are presented in Appendix 1.

- No project activities resulting in noise disturbance should be conducted during the general breeding period for birds (February 1st through August 15th) that may potentially occur in or adjacent to the proposed project site. Noise disturbing activities are defined as those resulting in volumes significantly greater than current ambient levels.

- Should these seasonal restrictions to construction activities be unfeasible to the project proponent, clearance surveys for potentially nesting birds should be conducted by a qualified biologist to survey habitat that will be directly impacted by construction actives and within a 1000 foot radius of said activities.

- It is also recommended that should riparian vegetation removal be proposed to occur between August 15th and August 31st, a minimum of one visit by a qualified biologist should occur to detect any late-season active nesting birds immediately prior to vegetation removal activities. This recommendation is based on recent evidence from elsewhere in the proposed project region that native nesting birds, primarily residents (e.g., song sparrow) often double brood near the coast and may have active nests beyond August 15th.

- Willow flycatcher surveys, using the recommended survey protocol by CDFW (Bombay et al. 2003) during the June and June-July survey periods, should be conducted by a qualified biologist prior to the initiation of construction activities to identify occupied nesting habitat. Because Willow flycatchers are amongst the latest of the migratory species to arrive and initiate nesting activities in Humboldt County, there is the potential that nesting territories may remain active beyond August 15th. Should one or more occupied Willow flycatcher nesting territories be located during these surveys, consultation with CDFW will be necessary to evaluate appropriate mitigation measures to minimize degradation of each nesting territory from proposed project activities that may degrade or remove riparian habitat.

❖ To the extent possible, minimize removal of large-diameter (≥12 inch DBH) riparian trees and any trees with visible cavities capable of supporting breeding birds and roosting bats.

Mammals

❖ No avoidance, minimization, or mitigation measures are recommended for any mammal species considered.

Fish

❖ Avoid impacting all fish species present in the main Mad River channel by conducting all construction activities prior to connecting the northern channel of the project to the main river channel. If avoidance of aquatic connectivity of the main river channel until the completion of the construction of all features is not possible, utilize a fish screen approved by CDFW to block fish from entering the backwater channel during construction.

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Plants

❖ Conduct pre-construction botanical surveys to detect and avoid or minimize impacts by implementing suitable measures for impacting any special status plant species in the proposed project site. If avoidance or minimization is not possible, develop mitigation measures in cooperation with CDFW.

Habitat Loss Mitigation Measures

❖ Mitigate the permanent loss of young and mature riparian vegetation by restoring a riparian habitat along the eastern edge of the proposed project in accordance with permitting requirements. Replant the area with the mix of dominant tree (red alder, black cottonwood) and shrubs (hooker willow) present at or adjacent to the site.

Conclusions

The overall conclusion of this wildlife assessment is that the Mad River Floodplain Restoration Project is not expected to have any adverse effects to any special-status species, nor their habitat, considered herein as long as the mitigation measures identified above are attended to by the project proponents. This conclusion of no adverse effects includes all 4 species listed under the federal endangered species act and all 5 state endangered species act.

References

Adam, M.D. and Hayes, J.P., 2000. Use of bridges as night roosts by bats in the Oregon Coast Range. Journal of Mammalogy, 81(2), pp.402-407.

Anderson, J. M. 1977a. "Yellow Rail (*Coturnicops noveboracensis*)." In Management of migratory shore and upland game birds in North America., edited by G. C. Sanderson, 66-70. Washington, D.C: Internatl. Assoc. Fish and Wildlife Agencies.

Ashton, D. T., A. J. Lind, and K. E. Schlick. 1998. Foothill yellow-legged frog (*Rana boylii*) natural history. USDA Forest Service, Pacific Southwest Research Station, Arcata, CA. 18pp.

Bank Swallow Technical Advisory Committee (BANS-TAC). 2013. Bank Swallow (*Riparia riparia*) Conservation Strategy for the Sacramento River Watershed, California. Version 1.0. www.sacramentoriver.org/bans/

Bebler, J. L and F. W. King. 1979. The Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf. New York.

Bildstein, K. L. and K. Meyer. 2000. Sharp-shinned hawk (*Accipiter striatus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/482doi:10.2173/bna.482.

Bombay, H. L., T. M. Benson, B. E. Valentine, and R. A. Stefani. 2003. A willow flycatcher survey protocol for California. Unpublished report, https://www.wildlife.ca.gov/Conservation/Survye-Protocols#377281284-birds, accessed 1 June 2017.

Buehler, D. A. 2000. Bald Eagle (*Haliaeetus leucocephalus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/506doi:10.2173/bna.506.

Bull, E. L. and C. T. Collins. 1996. Nest site fidelity, breeding age, and adult longevity in the Vaux's Swift. N. Amer. Bird Bander no. 21:49-51.

Bull, Evelyn L. and Charles T. Collins. 2007. Vaux's Swift (*Chaetura vauxi*), version 2.0. In The Birds of North America (P. G. Rodewald, editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bna.77.

Butler, R. W. 1992. Great blue heron (*Ardea herodias*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/025doi:10.2173/bna.25.

California Natural Diversity Database (CNDDB). 2017. Rarefind, Version 3.1.1, updated July 4, 20017. Sacramento, California.

California Department of Fish and Wildlife, Natural Diversity Database. October 2018. Special Animals List. Periodic publication. 65 pp.

California Trout. 2019. Mad River Floodplain Enhancement and Restoration: project description. California Trout, Arcata, CA. 14 p.

Curtis, O. E., R. N. Rosenfield, and J. Bielefeldt. 2006. Cooper's hawk (*Accipiter cooperii*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online:

CWHR. 2000. Foothill yellow-legged frog. California's Wildlife Habitat Relationships System, California Department of Fish and Game, California Interagency Wildlife Task Group. January, 2000. Web 29 June, 2009. <nrm.dfg.ca.gov/FileHandler.ashx?DocumentVersionID=17711>.

Davis, Jr. W. E. 1993. Black-crowned night heron (*Nycticorax nycticorax*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/074doi:10.2173/bna.74.

Degroot, D. S. 1927. The California Clapper Rail: its nesting habits, enemies, and habitat. Condor no. 29:259-270.

Dunk, J. R. 1995. White-tailed kite (*Elanus leucurus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.cirds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species.178doi:10.2173/bna.

Dykstra, C. R., J. L. Hays, and S. T. Crocoll. 2008. Red-shouldered hawk (*Buteo lineatus*), The Birds of North America Online (A. Poole, Ed. Ithica: cornell Lab of Ornithology, retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bna/species/107doi:10.2173/bna.107.

Harvey, T. E. 1988. Breeding biology of the California Clapper Rail in south San Francisco Bay. Trans. West. Sect. Wildl. Soc. no. 24:98-104.

Garrison, B.A., Humphrey, J.M. and Laymon, S.A., 1987. Bank swallow distribution and nesting ecology on the Sacramento River, California. Western Birds, 18:71-76.

Garrison, Barrett A. (1999). Bank Swallow (*Riparia riparia*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/banswa DOI: 10.2173/bna.414

Gould. G. 1997. Spotted owl territories [ds97]. California Department of Fish and Game Biogeographic Information and Observation System (BIOS). Retrieved 2008 from https://bios.dfg.ca.gov.

Green, R. 2017. Reproductive parameters for the fisher (Pekania pennant in the Sierra Nevada. Dissertation, U. C. Davis.

Hammerson, G. & Welsh, H. 2004. *"Plethodon elongatus"*. *The IUCN Red List of Threatened Species*. *IUCN*. 2004: e.T59339A11920133. *doi*:*10.2305/IUCN.UK.2004.RLTS.T59339A11920133.en. Retrieved 14 January 2018*.

Hayes, J.P., 2003. Habitat ecology and conservation of bats in western coniferous forests. Mammal community dynamics: management and conservation in the coniferous forests of western North America. Cambridge University Press, United Kingdom, pp.81-119.

Harris, S. W. 2006. Northwestern California birds: a guide to the status, distribution, and habitats of the birds of Del Norte, Humboldt, Trinity, northern Mendocino, and western Siskiyou Counties, California. Living Gold Press, Klamath River, CA.

Hatch, J. J. and D. V. Weseloh. 1999. Double-crested cormorant (*Phalacrocorax auritus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/441doi:10.2173/bna.

Hickman, James C., Ed. 1993. The Jepson Manual: Higher Plants of California. University of California Press, Berkeley, CA.

Houston, C. S., D. G. Smith, and C. Rohner. 1998. Great horned owl (*Bubo virginianus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved form the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/372doi:10.2173/bna.372.

Hunter, J. E., D. Fix, G. A. Schmidt, and J. C. Power. 2005. Atlas of the breeding birds of Humboldt County, California. Redwood Region Audubon Society, Eureka, CA

Knopf, F. L. and J. R. Rupert. 1995. Habits and habitats of Mountain Plovers in California. Condor no. 97:743-751.

Lofroth, E.C., Raley, C.M., Higley, J.M., Truex, R.L., Yaeger, J.S., Lewis, J.C., Happe, P.J., Finley, L.L., Naney, R.H., Hale, L.J., Krause, A.L., Livingston, S.A., Myers, A.M., Brown, R.N., 2010. Conservation of fishers (Martes pennanti) in south-central British Columbia, Western Washington, Western Oregon, and California: Conservation Assessment, vol. 1. Bureau of Land Management, US Department of Interior, Denver, Colorado, USA.

Lowther, P. E., C. Celada, N. K. Klein, C. C. Rimmer and D. A. Spector. 1999. Yellow warbler (*Dendroica petechia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/454doi:10.2173/bna.454.

Loya, S. 2018. Vegetation Mapping near the Mad River Estuary, McKinleyville, CA. McBain Associates, Arcata, CA 95521, 11 p.

Marti, C. D., A. F. Poole and L. R. Bevier. 2005. Barn Owl (*Tyto alba*), The Birds of North America Online (A. Poole Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/001doi:10.2173/bna.1.

MacWhirter, R. B. and K. L. Bildstein. 1996. Northern harrier (*Circus cyaneus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bnaproxy.birds.cornell.edu/bna/species/210doi:10,2173/bna.210.

Mathis, R. L. 2000. Analysis of Long-billed Curlews (*Numenius americanus*) distributions at three special scales. Master's Thesis, Humboldt State Univ., Arcata, CA.

Mayer, K.E. and Laudenslayer, W.F., 1988. A guide to wildlife habitats of California. The California Department of Fish and Wildlife.

McCrimmon, Jr., D. A., J. C. Ogden, and F. T. Bancroft. 2001. Great egret (*Ardea alba*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/570doi:10.2173/bna.570.

Meiselman, N. and Doyle, A.T., 1996. Habitat and microhabitat use by the red tree vole (*Phenacomys longicaudus*). American Midland Naturalist, pp.33-42.

Morey, S. 2000. Foothill yellow-legged frog. California's Wildlife Habitat Relationships System, California Department of Fish and Game, California Interagency Wildlife Task Group. January, 2000. Web 22 August, 2009.

Naummann, R. 1999. *Lasionycteris noctivagans* (online), Animal Diversity Web. Accessed September 23, 2009: http://animaldiversity.ummz.umich.edu/site/accounts/information/Lasinonycteris_noctivagans.html.

National Marine Fisheries Service. 2014. Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon (*Oncorhynchus kisutch*). National Marine Fisheries Service. Arcata, CA.

National Marine Fisheries Service. 2016. Coastal Multispecies Recovery Plan. National Marine Fisheries Service, West Coast Region, Santa Rosa, California.

Page, G. W., J. S. Warriner, J. C. Warriner, and P. W. Paton. 1995. Snowy plover (*Charadrius alexandrinus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/154doi:10.2173/bna.154.

Parsons, K. C and T. L Master. 2000. Snowy egret (*Egretta thula*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/489doi:10.2173/bna.489.

Poole, A. F., R. O. Bierregaard, and M. S. Martell. 2002. Osprey (*Pandion haliaetus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/683doi:10.2173/bna.683.

Powell, R.A. 1993. The fisher: life history, ecology, and behavior, second edition. University of Minnesota Press, Minneapolis, Minnesota, USA.

Rush, Scott A., Karen F. Gaines, William R. Eddleman and Courtney J. Conway. 2012. Ridgway's Rail (*Rallus obsoletus*), version 2.0. In The Birds of North America (P. G. Rodewald, editor). Cornell Lab of Ornithology, Ithaca, New York, USA. Retrieved from the Birds of North America: http://birdsna.org/Species-Account/bna/species/ridrai1

Sedgwick, James A. 2000. Willow Flycatcher (*Empidonax traillii*), version 2.0. In The Birds of North America (P. G. Rodewald, editor). Cornell Lab of Ornithology, Ithaca, New York, USA. https://doi.org/10.2173/bna.533

Sherwin, R.E., Stricklan, D. and Rogers, D.S., 2000. Roosting affinities of Townsend's big-eared bat (*Corynorhinus townsendii*) in northern Utah. Journal of Mammalogy, 81(4), pp.939-947.

Slauson, K. 2017. Detection of Two New Bank Swallow (*Riparia riparia*) Nesting Colonies at the Hauck-Hansen Gravel Bars on the Van Duzen and Eel Rivers: Detection Summary and Species Report. Slauson Wildlife Special Report 17-01, 11 p.

Smith, S. M. 1993. Black-capped chickadee (*Poecile atricapillus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/039doi:10.2173/bna.39.

Solick, Donald I.; Barclay, Robert M. R. 2006. Morphological Differences among Western Long-Eared Myotis (Myotis evotis) Populations in Different Environments. Journal of Mammalogy. 87 (5): 1020–1026.

State of California. 2006. Desired Salmonid Freshwater Habitat conditions for Sediment-Related Indices. North Coast Regional Water Quality Control Board. Santa Rosa, CA.

Storm, R. M. 1960. Notes on the breeding biology of the red-legged frog (*Rana aurora aurora*) Herpetologica 16:251-259.

Tait, C. K. and L. Diller. 2006. Life history of the southern torrent salamander (*Rhyacotriton variegatus*) in coastal northern California. Journal of Herpetology 40(1):43-54.

Thompson, B. C. 1977a. Behavior of Vaux's Swifts nesting and roosting in a chimney. Murrelet no. 58:73-77.

Trinity River Restoration Program. 2009. Channel Rehabilitation and Sediment Management for Remaining Phase I and II Sites, Final Master Environmental Impact Report. 94 pp. and appendices.

USFWS. 1992. Protocol for surveying proposed management activities that may impact northern spotted owls. 16pp.

USFWS. 2012a. Designation of critical habitat for the Pacific coast population of the western snowy plover. Final Rule. Federal Register 77:36728.

USFWS. 2012b. Designation of revised critical habitat for northern spotted owl. Final rule. Federal Register 77(233):71876-72068. December 4, 2012.

Vrieze, J.M., 1980. Spatial patterning of red tree mouse, Arborimus longicaudus, nests.

Westover, M. L. 2010. Freshwater Mussel Distribution, Abundance and Habitat Use in the Middle Klamath River. Thesis, Whitman College, WA.

Whitaker, Jr., J. O., 1980. National Audubon Society Field Guide to North American Mammals. Alfred A. Knopf. New York.

White, C. M., N. J. Clum, T. J. Cade, and W. G. Hunt. 2002. Peregrine Falcon (*Falco Peregrinus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/660doi:10.2173/bna.660.

Wiggins, D. A., D. W. Holt, and S. M. Leasure. 2006. Shoret-eared owl (*Asio flammeus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology, Retrieved from the Birds of North America Online: http://bna.birds.cornell.bnaproxy.birds.cornell.edu/bna.species/062doi:10.2173/bna62.

Wunder, M. B. and F. L. Knopf. 2003. Imperial Valley agriculture is critical to wintering Mountain Plovers. J. Field Ornithol. no. 74:74-80.

Zeiner, D. C., W. F. Laudenslayer, Jr. K. E. Mayer, and M White, Eds. 1998-1990. California's Wildlife. Vol. I-III. California Department of Fish and Game, Sacramento, CA.

Appendix 1. List of species of conservation concern. Conservation status codes: F-E (Federally endangered), F-T (Federally threatened), F-CE (Federally candidate endangered), F-CT (Federally candidate threatened), C-E (State endangered), C-T (State threatened), C-CE (State candidate endangered), C-CT (State candidate threatened), C-SC (State species of special concern), C-FP (State fully protected), C-WL (State watch list), WBWG-X (Western bat working group H = High, M = Moderate, LM = Low-moderate), S-# (State conservation ranking highest to lowest 1-5, respectively).

Common Name (*Scientific Name*)	**Status**	**Habitat**	**Breeding Period**	**Potential to Occur**	**Potential Effect**
Amphibians					
Pacific tailed-frog (*Ascaphus truei*)	CA-SC	Occurs locally in montane hardwood-conifer, redwood and Douglas-fir habitats. Restricted to perennial streams. Tadpoles require water below 15 degrees C (CNDDB 2017).	Late fall, summer (Bebler and King 1979). Larvae require 2-3 years to metamorphose (Morey 2000).	Low: Species is unlikely to occur in the project area due to lack of suitable habitat.	Not likely to be adversely affected.
Northern red-legged frog (Rana aurora)	CA-SC	Occurs in humid forests, woodlands, grasslands and stream sides in northwestern California, usually near dense riparian cover. Generally near permanent water, but can be found far from water in damp woods and meadows during the non-breeding season (CNDDB 2017).	January to March (Bebler and King 1979). Metamorphosis is attained in June through July (Storm 1960).	Low. Suitable terrestrial habitat for adults occurs in the project area. No suitable breeding habitat present.	Not likely to be adversely affected.
Del Norte salamander (*Plethadon elongatus*)	CA-SC	Del Norte salamanders are found in closed-canopy coastal forests with mixed hardwood/conifer. Generally associated with moist talus and rocky substrates, often among moss covered rock rubble, or under bark or logs on the forest floor (Hammerson and Welsh 2004).	Late winter through summer.	Low: Species is unlikely to occur in the project area due to lack of suitable habitat.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Amphibians					
Foothill yellow-legged frog (*Rana boylii*)	CA-CT	Occupies partly-shaded, shallowstreams and riffles with a rockysubstrate in a variety of habitats.Requires at least some cobble-sizedsubstrates for egg-laying. Need at least15 weeks to attain metamorphosis(CNDDB 2017).	March-May (Bebler andKing 1979).Metamorphosisattained 3-4months afterhatching (June-September; Ashton et al.1998).	Low: river salinity likely unsuitable.	Not likely to be adversely affected.
Southern torrent salamander (*Rhyacotriton variegatus*)	CA-SC	Inhabits coastal redwood, Douglas-fir, mixed conifer, montane riparian and montane hardwood-conifer habitats. Associated with old-growth forest and cold, well-shaded, permanent streams and seepages, or areas within the splash zone or on moss-covered rock within trickling water (CNDDB 2017).	February through October. Prolonged larval period lasts 2-2.5 years (Tait and Diller 2006).	Moderate: sedimentation of headwall stream habitat from project activities possible.	Potential to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Reptiles					
Western pond turtle (*Emys marmorata*)	CA-SC	Associated with permanent or nearly permanent water in a variety of habitats. Requires basking sites. Nest sites may be found up to 0.5 km from water. Known to burrow in soil and fallen log debris (CNDDB 2017).	April to August (Bebler and King).	Low: Salinity of river channel likely unsuitable.	Not likely to be adversely affected.
Insects					
Western bumblebee (*Bombus occidentalis*)	CA-WL	Western bumblebees are generalist foragers. Because they do not depend on any one flower type, they are considered to be excellent pollinators.	A new colony typically starts in the early spring by a solitary queen.	Moderate: Species likely occurs in the project area.	Not likely to be adversely affected.
Obscure bumblebee (*Bombus caliginosus*)	CA-WL	The workers are most often seen on Fabaceae, the legume family, while queens are most often seen on Ericaceae, the heath family, and males have been noted most often on Asteraceae, the aster family. Common plants visited by the workers in a sample included ceanothus, thistles, sweet peas, lupines, rhododendrons, *Rubus*, willows, and clovers.	A new colony typically starts in the early spring by a solitary queen.	Moderate: Species likely occurs in the project area	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Insects					
Sandy Beach Tiger beetle (*Cicindela hirticollis gravida*)	CA-WL	Coastal dunes.	Spring.	Low: Species is unlikely to occur in the project area due to lack of suitable habitat.	Not likely to be adversely affected.
Mollusks					
Western pearlshell (*Margaritifera falcata*)	CA-WL	Preferentially inhabits boulder and gravel substrates; commonly occupied stable bank edges (Westover 2010).	Unknown	Low: Suitable habitat not likely present in project area.	Not likely to be adversely affected.
California floater (*Amdonta californiensis*)	CA-WL	Occur in lakes, slow rivers (Taylor 1981), and some reservoirs (Nedeau et al. 2009) with mud or sand substrates (Clarke 1981) and are typically found at low elevations (Frest and Johannes 1995). The distribution of freshwater mussels within a water body is probably dependent on the size and geology of the water body and patterns of host fish distribution during the mussel's reproductive period (Watters 1992).	Unknown	Low: Suitable habitat not likely present in project area.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Double-crested cormorant (*Phalacrocorax auritus*)	CA-WL	Colonial nester on coastal cliffs, offshore islands, and along lake margins in the interior of the state. Nests along the coast on sequestered islets, usually on ground with sloping surface, or in tall trees along lake margins (CNDDB 2017).	April through August (Hatch and Weseloh 1999).	High: main channel serves as foraging habitat. No nesting colonies nearby.	Not likely to be adversely affected.
Great egret (*Ardea alba*) *Rookery Sites	CA-FP	Colonial nesting species, nesting in larger trees. Rookery sites located near marshes, tide flats, irrigated pastures and margins of rivers and lakes (CNDDB 2017).	March through July (McCrimmon et al. 2001).	High: Species is known to use the project area for foraging. No known nesting colonies occur near the project site.	Not likely to be adversely affected.
Great blue heron (*Ardea herodias*) *Rookery Sites	CA-FP	Colonial nesting species in tall trees, cliff sides, and sequestered spots on marshes. Rookery sites in close proximity to foraging areas. Marshes, Lake margins, tide flats, rivers, streams, and wet meadows (CNDDB 2017).	March through August (Butler 1992).	High: Species is known to use the project area for foraging. No known nesting colonies occur near the project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Black-crowned night-heron (*Nycticorax nycticorax*)	CA-FP	Colonial nester, usually in trees, occasionally in tule patches. Rookery sites located adjacent to foraging areas: lake margins, mud-bordered bays, marshy spots (CNDDB 2017).	Mid-late November through August (Davis, Jr. 1993).	High: The project area is used as foraging and roosting habitat.	Not likely to be adversely affected.
Cooper's hawk (*Accipiter cooperii*)	CA-WL	Occurs in woodlands, primarily of the open, interrupted or marginal type. Nest sites are mainly in riparian growths of deciduous trees, as in canyon bottoms on river flood plains and in live oaks (CNDDB 2017).	Late March through July (Curtis el al. 2006).	Moderate: suitable habitat for foraging present. Potential for nesting.	Not likely to adversely affect with the incorporation of mitigation measures.
Northern harrier (*Circus cyaneus*)	CA-SC	Inhabits coastal salt and freshwater marshes. Forages in grasslands and nests on the ground in shrubby vegetation, usually at marsh edge. Nests are large mounds built of sticks in wet areas (CNDDB 2017).	April through September (MacWhirter and Bildstein 1996).	Low: only the open pasture portion of the project area has the potential to support foraging habitat.	Not likely to be adversely affected.
White-tailed kite (*Elanus leucurus*)	CA-FP	Inhabits rolling foothills and valley margins with scattered oaks and river bottomlands or marshes next to deciduous woodland. Foraging habitat: open grasslands, meadows or marshes close to isolated, dense-topped trees for nesting and perching (CNDDB 2017).	February through early August (Dunk 1995).	Moderate: open pastures adjacent of the project area are used for foraging. Local pairs nest east of project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Red-shouldered hawk (*buteo lineatus*)	CA-FP	Nests primarily in riparian oak woodland. During migration it is still associated with woodlands although often occurs in smaller woodland patches or more fragmented landscapes. It winters in lowland areas near water such as swamps, marshes and river valleys (Dykstra et al. 2008).	Late March through July (Dykstra and Hays 2008).	High: Species observed in the project area during site visit & exhibited territorial behavior. Suitable nesting, roosting, and foraging habitat present.	Not likely to adversely affect with the incorporation of mitigation measures.
Bald eagle (*Haliaeetus leucocephalus*)	F-Delisted CA-FP	Nests in large trees near rivers, lakes, marshes, etc. Winter near open water, which can attract sufficient food and evening roost sites (CNDDB 2017).	Late March through September (Buehler 2000).	Low: Species breeds in the project region, but only forages occasionally along lower Mad River adjacent to the project site.	Not likely to be adversely affected.
Osprey (*Pandion haliaetus*) *Nesting	CA-WL	Primarily along rivers, lakes, bays, and seacoasts. Nests in dead snags, living trees, utility poles, etc. usually near or above water (CNDDB 2017).	April through early September (Poole et al. 2002).	Low: Species nests east of the project site and forages frequently in the Mad River adjacent to the project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
American peregrine falcon (*Falco peregrinus anatum*)	CA-FP	Inhabits dry, open terrain. Breeding sites are located on cliffs. Forages far afield, even to marshland and ocean shores (CNDDB 2017).	February through August (White et al. 2002).	Low: Peregrines are resident in the project region and occasionally forage over the project site, but do not nest there.	Not likely to be adversely affected.
Yellow rail (*Coturnicops noveboracensis*)	CA-SC	In winter, Yellow Rails appear to prefer drier portions of Spartina stands in coastal marshes (Anderson 1977a). In Texas, wintering birds were primarily associated with dense, low undergrowth dominated by Distichlis stricta and Spartina spartina (Grace et al. 2005).	Species does not breed in Humboldt County.	Low: Suitable habitat is not present in the proposed project site.	Not likely to be adversely affected.
California Ridgway's rail (*Rallus obsoletus obsoletus*)	CA-E	Principal habitats are low portions of coastal wetlands dominated by cordgrass (Spartina sp.), and pickleweed (Salicornia spp.; Rush et al. 2012). Nesting habitat in San Francisco Bay, CA, characterized by presence of tidal sloughs; abundant invertebrate populations; pickleweed coverage with extensive cordgrass coverage in lower zone; and tall pickleweed, gum plant (Grindelia cuneifolia), and wrack in upper zone (Harvey 1988).	Nesting in San Francisco Bay, CA, begins in late Mar; peaks in late Apr–mid-May (Degroot 1927, Harvey 1988).	Low: Historical status in Humboldt Bay questionable. Suitable habitat is not present in the proposed project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Western snowy plover (*Charadrius alexandrinus nivosus*)	F-T CA-SC	Sandy beaches, salt pond levees, shores of large alkali lakes (CNDDB 2017) and gravel bars.	March through September (Page et al. 1995).	Low: No suitable habitat occurs in the project area.	Not likely to be adversely affected.
Mountain plover (*Charadrius montanus*)	CA-SC	Winter habitat: Most birds winter in California, where they spend about 75% of their time on tilled fields, but prefer heavily grazed annual grasslands or burned fields (Knopf and Rupert 1995). Little current use of California coastal plains (Wunder et al. 2003).	Species does not breed in Humboldt County.	Low: Species rarely winters in Humboldt County and suitable habitat does not occur in the proposed project site.	Not likely to be adversely affected.
Barn owl (*Tyto alba*)	CA-FP	Inhabits open habitats including grasslands, chaparral, riparian and other wetlands. Often associated with human communities (Zeiner et al. 1988-1990).	Year-round (Marti et al. 2005).	Moderate: Species forages in grassland habitats adjacent to the proposed project site.	Not likely to be adversely affected.
Great horned owl (*Bubo virginianus*)	CA-FP	Occurs in a variety of forest habitats with meadows and other openings including mixed coniferous forest. Commonly forages and breeds in riparian and coniferous habitats (Zeiner et al. 1988-1990).	May through September (Houston et al. 1998).	High: Species breeds in the project region, foraging, roosting, and potentially nesting habitat present.	Not likely to adversely affect with the incorporation of mitigation measures.

Appendix 1. Continued.

Common Name (***Scientific Name***)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Northern spotted owl (Strix occidentalis caurina)	F-T CA-T	Old-growth forests or mixed stands of old-growth and mature trees. Occasionally in younger forests with patches of big trees.	February through August (USFWS 1992).	Low: Nearest known activity center is >3 miles away and species unlikely to make significant use of habitat in the project area.	Not likely to adversely affect with the incorporation of mitigation measures.
Little willow flycatcher (*Empidonax traillii brewsteri*) (Nesting)	CA-E	Nesting habitat is deciduous thickets, especially willows and often near water. In Humboldt County nesting locations have occurred on the Eel, Elk, and Mad Rivers, and rarely in upland young regenerating forest (Hunter et al. 2005). Nesting habitat in riparian habitat adjacent to slow moving or stagnant water sources, such as off-channel pools (Eel and Mad Rivers) or human-created analogs such as stagnant ponds (Blue Lake Waste Water Treatment Plant) or channels (Mad River Fisher Hatchery).	Begins early to mid-Jun in Oregon and Colorado, mid- to late May farther south (s. California, s. Arizona;).	High: Suitable nesting habitat occurs in the proposed project site.	Not likely to adversely affect with the incorporation of mitigation measures.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Bank swallow (*Riparia riparia*) (Nesting)	CA-T	Bank swallows establish colonies along eroded, vertical banks within river systems with friable alluvial soils (Garrison et al. 1987). Dynamic river processes create these conditions as rivers meander and expose fresh soil most typically on the outside bends of meanders. The three known colonies along the lower Van Duzen and Eel rivers all occur in these types of locations where recent high-flow winter events have caused maintained vertical banks and exposed new soil via erosion. In coastal areas wave or wind action can erode banks or bluffs and create suitable colony locations. The Mad River overlook colony occurs in such a wind-eroded coastal bluff. Burrows are often destroyed by erosional processes from year to year, exposing fresh soil that the swallows will use to construct new burrows (BANS-TAC 2013).	The nesting season for Bank swallows in California is from 1 April through 31 August and includes the time of first arrival of individuals at colony sites, completion of egg laying and fledging of young, and ending with dispersal of juveniles from the nesting colony site (Garrison 1998)	Low: This species has been recently expanding its breeding range on the Eel River and Mad Rivers (Slauson 2017), however suitable nesting habitat is not present in the proposed project site. Species may forage in the vicnity of the project site.	Not likely to be adversely affected.
Black-capped chickadee (*Poecile atricapillus*)	CA-WL	Inhabits riparian woodlands in Humboldt County. Primarily found in deciduous tree types, especially willows and alders along large or small watercourses (CNDDB 2017).	April through July (Smith 1993).	High: Species was detected during site visit and nests and forages in the project site.	Not likely to adversely affected with incorporation of mitigation measures.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Yellow-breasted chat (*Icteria virens*) (Nesting)	CA-SC	Nesting habitat: In the arid West, largely confined to riparian and shrubby habitats; a generalist compared with other species in its use of available nesting habitat (Brown and Trosset 1989).	April-July (Hunter et al. 2005).	Moderate: Species nests in the project area and suitable habitat may occur in the proposed project site.	Not likely to adversely affect with the incorporation of mitigation measures.
Yellow warbler (*Setophaga petechia*)	CA-SC	Riparian species, occurring in willows, cottonwoods, aspens, sycamores, and alders for nesting and foraging. Also nests in montane shrubbery in open coniferous forests (CNDDB 2017).	May to early August (Lowther et al. 1999).	High: Suitable nesting and foraging habitat occurs in the proposed project site.	Not likely to adversely affect with the incorporation of mitigation measures.
Mammals					
Townsend's big-eared bat (*Corynorhinus townsendii*)	CA-SC	Species occurs throughout California, but complete details of its distribution are unclear, and it occurs in both forested and non-forested habitats (Hayes 2003). Appears to use bridges for night roosts less often than more common bat species in the Oregon coast range (Adam and Hayes 2000) and elsewhere (Sherwin et al. 2000).	April-August. Fertilization from stored sperm occurs in the spring. Gestation lasts from 50 to 60 days. As with other bat species, pups are born without the ability to fly.	Low: Suitable habitat is not present in the proposed project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Long-eared myotis (*Myotis evotis*)	WBWG-M	Species known to occur in semiarid shrublands, shortgrass prairie, and subalpine forests, with habitats ranging from sea level to 2,830 meters (Solick et al. 2006). They roost in a variety of places, including tree cavities, rock crevices, caves, and even abandoned buildings. They seem to prefer rock crevices	Likely June-August. Reproducing females generally roost in small, 2-centimeter wide crevices that are typically vertically oriented.	Moderate: Suitable habitat may occur the project region, but suitable roosting and colony sites are not liekly present in the proposed proejct site.	Not likely to be adversely affected.
Humboldt mountain beaver (*Aplodontia rufa humboldtiana*)	G5TNR SNR	In conifer forests and shrubby headland habitats in Humboldt County. In conifer forest often in moist headwater creek locations with ample herbaceous (e.g., sword fern) vegetation which is their primary food (K. Slauson pers. Obs).	The breeding season is between January and March, with two or three young born February to April.	Low: Suitable habitat occurs in the project region but does not occur in the proposed project site.	Not likely to be adversely affected.
North American Porcupine (*Erethizon dorsatum*)	G5 S3	Throughout it's range this species is commonly found in coniferous and mixed forested areas, however in Humboldt county the few contemporary records occur in shore pine and serpentine habitats (K. Slauson pers. Obs.)	Females give birth to a single young in spring and mating occurs in fall.	Low: Suitable habitat is not present in the proposed project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Sonoma tree vole (*Arborimus pomo*)	CA-SC	The species' habitat consists of mixed evergreen forests; optimum habitat appears to be wet and mesic old-growth Douglas-fir forest, but this species also occurs in younger forests (e.g., Douglas-fir 47 years old).	Nests in trees, 2-50 m above ground; uses old nests of birds, squirrels, or woodrats. Nests usually in Douglas-fir trees but sometimes in other conifers or in Pacific madrone (Meiselman, 1996, Vrieze, 1998).	Low: No suitable habitat occurs in or adjacent to the proposed project site.	Not likely to be adversely affected.
Pacific fisher (*Pekania pennanti pacifica*)	F-CT CA-CT	Forages in a variety of seral stages near the coast, but rests and dens in large-diameter live and dead woody structures (Lofroth et al. 2010).	March-October (Powell 1993, Green 2017)	Low: Species is known to occur in the project region but no suitable habitat occurs in the proposed project site.	Not likely to be adversely affected.
White-footed vole (*Arborimus albipes*)	S2	North coast coniferous forest, Redwood, Riparian forest	Spring-summer.	Low: Species not known to occur in saline-influenced riparian habitat.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	**Status**	**Habitat**	**Breeding Period**	**Potential to Occur**	**Potential Effect**
Fish					
Eulachon (*Thaleichthys pacificus*)	F-T	Aquatic, Klamath/North coast flowing waters	Winter-Spring.	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.
Longfin smelt (*Spirinchus thaleichthys*)	F-C CA-T	Aquatic, estuary.	Fall-spring?	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.
Summer-run steelhead trout (*Oncorhynchus mykiss irideus* pop. 36)	F-T	Aquatic, Klamath/North coast flowing waters, Sacramento/San Joaquin flowing waters.	Summer	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.
Steelhead Northcoast DPS (*Oncorhynchus mykiss irideus* pop. 16)	F-T CA-T	Aquatic, Klamath/North coast flowing waters, Sacramento/San Joaquin flowing waters	Fall-winter.	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.
Coho-California ESU (*Oncorhynchus kisutch* pop. 2)	F-T CA-T	Aquatic, Klamath/North coast flowing waters, Sacramento/San Joaquin flowing waters	Fall-winter.	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Breeding Period	Potential to Occur	Potential Effect
Fish					
Coast Cutthroat trout (*Oncorhynchus clarkii clarkii*)	S3	Aquatic, Klamath/North coast flowing waters	Fall-winter.	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.
Tidewater goby (*Eucyclogobius newberryi*)	F-E	Aquatic, Klamath/North coast flowing waters, Sacramento/San Joaquin flowing waters, South coast flowing waters	Spring?	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.
Pacific lamprey (*Entosphenus tridentatus*)	S4	Aquatic, Klamath/North coast flowing waters, Sacramento/San Joaquin flowing waters, South coast flowing waters.	Fall-winter.	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.
Green sturgeon (*Acipenser medirostris*)	F-T	Aquatic, Klamath/North coast flowing waters, Sacramento/San Joaquin flowing waters.	Fall-winter.	High: species likely to occur in main channel of the Mad River adjacent to the project site.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Potential to Occur	Potential Effect
Plants				
Northern clustered sedge (*Carex arcta*)	S1	Bog & fen, North coast coniferous forest, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Oregon goldthread (*Coptis laciniata*)	S3?	Meadow & seep, North coast coniferous forest, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Giant fawn lily (*Erythronium oregonum*)	S2	Cismontane woodland, Meadow & seep, Ultramafic	Low: suitable habitat not present.	Not likely to be adversely affected.
Coast fawn lily (*Erythronium revolutum*)	S3	Bog & fen, Broadleaved upland forest, North coast coniferous forest, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Running-pine (*Lycopodium clavatum*)	S3	Lower montane coniferous forest, Marsh & swamp, North coast coniferous forest, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Howell's montia (*Montia howellii*)	S2	Meadow & seep, North coast coniferous forest, Vernal pool, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Seacoast ragwort (*Packera bolanderi var. bolanderi*)	S2/3	Coastal scrub, North coast coniferous forest	Low: suitable habitat not present.	Not likely to be adversely affected.
White-flowered rain orchid (*Piperia candida*)	S3	Broadleaved upland forest, Lower montane coniferous forest, North coast coniferous forest, Ultramafic	Low: suitable habitat not present.	Not likely to be adversely affected.
Maple leaved checkerbloom (*Sidalcea malachroides*)	S3	Broadleaved upland forest, Coastal prairie, Coastal scrub, North coast coniferous forest, Riparian forest	Moderate: potentially suitable habitat present.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Potential to Occur	Potential Effect
Plants				
Siskiyou checerbloom (*Sidalcea malviflora ssp. Patula*)	S2	Coastal bluff scrub, Coastal prairie, North coast coniferous forest	Moderate: potentially suitable habitat present.	Not likely to be adversely affected.
Methusela's beard lichen (*Usnea longissima*)	S4	Broadleaved upland forest, North coast coniferous forest, Oldgrowth, Redwood	Low: suitable habitat not present.	Not likely to be adversely affected.
Pink sand verbena (*Abronia umbellata var. breviflora*)	S2	Coastal dunes.	Low: suitable habitat not present.	Not likely to be adversely affected.
Twisted horsehair lichen (*Bryoria spiralifera*)	S1/S2	North coast coniferous forest.	Low: suitable habitat not present.	Not likely to be adversely affected.
Lagoon sedge (Carex lenticularis var. limnophila)	S1	Bog & fen, Marsh & swamp, North coast coniferous forest	Low: suitable habitat not present.	Not likely to be adversely affected.
Bristle-stalked sedge (*Carex leptalea*)	S1	Bog & fen, Freshwater marsh, Marsh & swamp, Meadow & seep, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Lying bye's sedge (*Carex lyngbyei*)	S3	Marsh & swamp, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Northern meadow sedge (*Carex praticola*)	S2	Meadow & seep, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Potential to Occur	Potential Effect
Plants				
Green yellow sedge (*Carex viridula ssp. Viridula*)	S2	Bog & fen, Marsh & swamp, North coast coniferous forest, Wetland	Low: suitable habitat not present.	Not likely to be adversely affected.
Humboldt owl's clover (*Castilleja ambigua var. humboldtiensis*)	S2	Marsh & swamp, Salt marsh, Wetland.	Low: suitable habitat not present.	Not likely to be adversely affected.
Oregon coast paintbrush (*Castilleja litoralis*)	S3	Coastal bluff scrub, Coastal dunes, Coastal scrub.	Low: suitable habitat not present.	Not likely to be adversely affected.
Mendocino coast paintbrush (*Castilleja mendocinensis*)	S2	Closed-cone coniferous forest, Coastal bluff scrub, Coastal dunes, Coastal prairie, Coastal scrub.	Low: suitable habitat not present.	Not likely to be adversely affected.
Point Reyes salty birdsbeak (*Chloropyron maritimum ssp. Palustre*)	S2	Marsh & swamp, Salt marsh, Wetland.	Low: suitable habitat not present.	Not likely to be adversely affected.
Naked flag moss (*Discelium nudum*)	S1	Coastal bluff scrub.	Low: suitable habitat not present.	Not likely to be adversely affected.
Black crowberry (*Empetrum nigrum*)	S1?	Coastal bluff scrub, Coastal prairie.	Low: suitable habitat not present.	Not likely to be adversely affected.
Waldo daisy (*Erigeron bloomeri var. nudatus*)	S3	Lower montane coniferous forest, Ultramafic, Upper montane coniferous forest.	Low: suitable habitat not present.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Potential to Occur	Potential Effect
Plants				
Pacific gilia (*Gilia capitata ssp. Pacifica*)	S2	Chaparral, Coastal bluff scrub, Coastal prairie, Valley & foothill grassland.	Moderate: potentially suitable habitat present.	Not likely to be adversely affected if avoidance and minimization measures are followed.
Dark-eyed gilia (Gilia millefoliata)	S2	Coastal dunes.	Low: suitable habitat not present.	Not likely to be adversely affected.
California globe mallow (*Iliamna latibracteata*)	S2	Chaparral, Lower montane coniferous forest, North coast coniferous forest, Riparian scrub.	Moderate: potentially suitable habitat present.	Not likely to be adversely affected if avoidance and minimization measures are followed.
Sierra rush (*Juncus nevadensis var. inventus*)	S1	Bog & fen, Wetland.	Low: suitable habitat not present.	Not likely to be adversely affected.
Seaside pea (*Lathyrus japonicus*)	S2	Coastal dunes.	Low: suitable habitat not present.	Not likely to be adversely affected.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Potential to Occur	Potential Effect
Plants				
Western lilly (*Lilium occidentale*)	F-E CA-E	Bog & fen, Coastal bluff scrub, Coastal prairie, Coastal scrub, Freshwater marsh, Marsh & swamp, North coast coniferous forest, Wetland.	Moderate: potentially suitable habitat present.	Not likely to be adversely affected if avoidance and minimization measures are followed.
Inundated bog clubmoss (*Lycopodiella inundata*)	S1?	Bog & fen, Lower montane coniferous forest, Marsh & swamp, Wetland.	Low: suitable habitat not present.	Not likely to be adversely affected.
Leafy-stemmed mitrewort (*Mitellastra caulescens*)	S4	Broadleaved upland forest, Lower montane coniferous forest, Meadow & seep, North coast coniferous forest.	Low: suitable habitat not present.	Not likely to be adversely affected.
Ghost pipe (*Monotropa uniflora*)	S2	Broadleaved upland forest, North coast coniferous forest.	Low: suitable habitat not present.	Not likely to be adversely affected.
Wolf's evening primrose (*Oenothera wolfii*)	S1	Coastal bluff scrub, Coastal dunes, Coastal prairie	Moderate: potentially suitable habitat present.	Not likely to be adversely affected if avoidance and minimization measures are followed.

Appendix 1. Continued.

Common Name (*Scientific Name*)	Status	Habitat	Potential to Occur	Potential Effect
Plants				
Coast checkerbloom (*Sidalcea oregana ssp. Eximia*)	S1	Lower montane coniferous forest, Meadow & seep, North coast coniferous forest, Wetland.	Low: suitable habitat not present.	Not likely to be adversely affected.
Western sand-spurey (*Spergularia canadensis var. occidentalis*)	S1	Marsh & swamp, Wetland.	Low: suitable habitat not present.	Not likely to be adversely affected.
Cylindrical trichodon (*Trichodon cylindricus*)	S2	Broadleaved upland forest, Upper montane coniferous forest.	Low: suitable habitat not present.	Not likely to be adversely affected.
Alpine marsh violet (Viola palustris)	S1/S2	Bog & fen, Coastal scrub, Wetland	Moderate: potentially suitable habitat present.	Not likely to be adversely affected if avoidance and minimization measures are followed.
Seaside bittercress (Cardamine angulata)	S3	Lower montane coniferous forest, North coast coniferous forest, Wetland.	Low: suitable habitat not present.	Not likely to be adversely affected.
Scouler's catchfly (*Silene scouleri ssp. Scouleri*)	S2/S3	Coastal bluff scrub, Coastal prairie, Valley & foothill grassland.	Moderate: potentially suitable habitat present.	Not likely to be adversely affected if avoidance and minimization measures are followed.

Appendix 2. Proposed pre-construction surveys and during-construction monitoring dates and estimated time and cost for their completion. Total costs for recommended surveys is dependent on the level of use of pre-construction nesting bird surveys; minimum estimate would be $1,650 (amphibian and willow flycatcher surveys) and minimum for including 20 hours of nesting bird surveys would be $3,150.

Survey Type	Timing	Cost
Pre-construction Amphibian Surveys and Re-locations	Anytime as needed: 0-2 days prior to vegetation removal or channel excavation	$750 (estimated 10 hours)
Protocol Nesting Willow Flycatcher Surveys	June (1 survey) and July (1 survey) 2020	$900 (estimated 12 hours)
Pre-construction Nesting Bird Surveys for Construction Activities Impacting Vegetation between 1 February and 15 August	Anytime as needed: 0-3 days prior to vegetation removal or channel excavation	$1500 (estimated 20 hours)

Appendix J: Photo Documentation of Public Access Parking Area Aesthetics

Appendix J: Photo documentation of Public Access Parking Area Aesthetics

Figure 1: Parking area view west. Public access entrance at western terminus of paved trail, indicated by the white arrow.

Figure 2: Parking area view east. Photo point at the public access entrance.

Figure 3 – View of parking area from the north. Panorama shows the view southwest, south, and southeast.

Figure 4 – View of the parking area from the south. Panorama shows the view northwest, north, and northeast.

Appendix K: CalEEMod Table of Results

Mad River Floodplain and Public Access Enhancement Project

Humboldt County, Summer

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
	0.00	Dwelling Unit	0.00	0.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	103
Climate Zone	1			**Operational Year**	2021
Utility Company	Pacific Gas & Electric Company				
CO2 Intensity (lb/MWhr)	641.35	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use -

Construction Phase - Restoration Project of short duration, hence non-default values

Off-road Equipment - no concrete at site; 4 dump trucks identified as "other"

Grading - Stockpile area (existing) is 5.4-acres.

Trips and VMT - No paving, hence change of defaults

On-road Fugitive Dust - No painting nor architectural coating

Architectural Coating - No architectural coating

Road Dust - No paving

Area Coating - No VOC for arch coating

Energy Use -

Land Use Change - New wetland habitat created

Sequestration - Riparian consists of alder, willow and Sitka spruce

Area Mitigation -

Water Mitigation -

Table Name	Column Name	Default Value	New Value
tblArchitecturalCoating	EF_Nonresidential_Exterior	250.00	0.00
tblArchitecturalCoating	EF_Nonresidential_Interior	250.00	0.00
tblArchitecturalCoating	EF_Parking	250.00	0.00
tblArchitecturalCoating	EF_Residential_Exterior	250.00	0.00
tblArchitecturalCoating	EF_Residential_Interior	250.00	0.00
tblAreaCoating	Area_EF_Nonresidential_Exterior	250	0
tblAreaCoating	Area_EF_Nonresidential_Interior	250	0
tblAreaCoating	Area_EF_Parking	250	0
tblAreaCoating	Area_EF_Residential_Exterior	250	0
tblAreaCoating	Area_EF_Residential_Interior	250	0

tblAreaCoating	ReapplicationRatePercent	10	0
tblConstructionPhase	NumDays	0.00	33.00
tblConstructionPhase	NumDays	0.00	3.00
tblConstructionPhase	NumDays	0.00	22.00
tblConstructionPhase	NumDays	0.00	11.00
tblConstructionPhase	NumDays	0.00	22.00
tblConstructionPhase	PhaseEndDate	5/31/2020	8/30/2020
tblConstructionPhase	PhaseEndDate	5/31/2020	6/3/2020
tblConstructionPhase	PhaseEndDate	5/31/2020	7/14/2020
tblConstructionPhase	PhaseEndDate	5/31/2020	6/15/2020
tblConstructionPhase	PhaseStartDate	6/1/2020	7/15/2020
tblConstructionPhase	PhaseStartDate	6/1/2020	6/15/2020
tblGrading	AcresOfGrading	0.00	7.00
tblGrading	AcresOfGrading	5.50	1.00
tblGrading	AcresOfGrading	1.50	1.00
tblGrading	MaterialExported	0.00	13,700.00
tblLandUseChange	CO2peracre	0.00	4.31
tblOffRoadEquipment	HorsePower	172.00	16.00
tblOffRoadEquipment	LoadFactor	0.38	0.38
tblOffRoadEquipment	LoadFactor	0.42	0.38
tblOffRoadEquipment	OffRoadEquipmentType		Excavators
tblOffRoadEquipment	OffRoadEquipmentType		Other Construction Equipment
tblSequestration	NumberOfNewTrees	0.00	100.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00

tblTripsAndVMT	WorkerTripNumber	18.00	5.00
tblTripsAndVMT	WorkerTripNumber	10.00	30.00
tblTripsAndVMT	WorkerTripNumber	18.00	0.00

2.0 Emissions Summary

2.1 Overall Construction (Maximum Daily Emission)

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2020	2.3946	36.6951	16.9150	0.0742	2.5445	0.9627	3.4448	0.8297	0.8857	1.6773	0.0000	7,571.7524	7,571.7524	0.8517	0.0000	7,589.0578
Maximum	**2.3946**	**36.6951**	**16.9150**	**0.0742**	**2.5445**	**0.9627**	**3.4448**	**0.8297**	**0.8857**	**1.6773**	**0.0000**	**7,571.7524**	**7,571.7524**	**0.8517**	**0.0000**	**7,589.0578**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	lb/day										lb/day					
2020	2.3946	36.6951	16.9150	0.0742	2.5445	0.9627	3.4448	0.8297	0.8857	1.6773	0.0000	7,571.7524	7,571.7524	0.8517	0.0000	7,589.0578
Maximum	**2.3946**	**36.6951**	**16.9150**	**0.0742**	**2.5445**	**0.9627**	**3.4448**	**0.8297**	**0.8857**	**1.6773**	**0.0000**	**7,571.7524**	**7,571.7524**	**0.8517**	**0.0000**	**7,589.0578**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Area	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

	ROG	**NOx**	**CO**	**SO2**	**Fugitive PM10**	**Exhaust PM10**	**PM10 Total**	**Fugitive PM2.5**	**Exhaust PM2.5**	**PM2.5 Total**	**Bio- CO2**	**NBio-CO2**	**Total CO2**	**CH4**	**N20**	**CO2e**
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Staging	Site Preparation	6/1/2020	6/3/2020	5	3	Equipment Preparation and Staging
2	Paving	Paving	6/1/2020	5/31/2020	5	0	
3	Architectural Coating	Architectural Coating	6/1/2020	5/31/2020	5	0	
4	Site Preparation	Site Preparation	6/1/2020	6/15/2020	5	11	Clearing and Grubbing
5	Grading	Grading	6/15/2020	7/14/2020	5	22	Berm Removal and Hauling
6	Building Construction	Building Construction	7/15/2020	8/30/2020	5	33	Trail construction, etc.
7	Revegetation	Site Preparation	9/1/2020	9/30/2020	5	22	Revegetation and site clean up

Acres of Grading (Site Preparation Phase): 1

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Paving	Cement and Mortar Mixers	4	6.00	9	0.56
Revegetation	Graders	1	8.00	187	0.41
Grading	Concrete/Industrial Saws	1	8.00	81	0.73
Building Construction	Cranes	1	4.00	231	0.29
Building Construction	Forklifts	2	6.00	89	0.20
Site Preparation	Graders	1	8.00	187	0.41
Paving	Pavers	1	7.00	130	0.42
Paving	Rollers	1	7.00	80	0.38
Revegetation	Tractors/Loaders/Backhoes	1	8.00	97	0.37
Grading	Rubber Tired Dozers	1	1.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Staging	Tractors/Loaders/Backhoes	1	8.00	97	0.37
Grading	Tractors/Loaders/Backhoes	2	6.00	97	0.37
Paving	Tractors/Loaders/Backhoes	1	7.00	97	0.37
Site Preparation	Tractors/Loaders/Backhoes	1	8.00	97	0.37
Staging	Graders	1	8.00	187	0.41
Staging	Excavators	1	8.00	158	0.38
Staging	Other Construction Equipment	4	8.00	16	0.38

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Staging	7	5.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Site Preparation	2	5.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Grading	4	30.00	0.00	1,355.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Building Construction	5	0.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT
Paving	7	0.00	0.00	0.00	0.00	0.00	20.00	LD_Mix	HDT_Mix	HHDT
Architectural Coating	1	0.00	0.00	0.00	0.00	0.00	20.00	LD_Mix	HDT_Mix	HHDT
Revegetation	2	5.00	0.00	0.00	10.80	7.30	20.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

3.2 Staging - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3535	0.0000	0.3535	0.0382	0.0000	0.0382			0.0000			0.0000
Off-Road	1.3915	13.0156	9.6964	0.0173		0.6266	0.6266		0.5765	0.5765		1,672.567 2	1,672.567 2	0.5409		1,686.090 8
Total	**1.3915**	**13.0156**	**9.6964**	**0.0173**	**0.3535**	**0.6266**	**0.9801**	**0.0382**	**0.5765**	**0.6146**		**1,672.567 2**	**1,672.567 2**	**0.5409**		**1,686.090 8**

3.2 Staging - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0378	0.0341	0.2901	4.0000e-004	0.0411	4.0000e-004	0.0415	0.0109	3.7000e-004	0.0113		39.3022	39.3022	2.8100e-003		39.3724
Total	**0.0378**	**0.0341**	**0.2901**	**4.0000e-004**	**0.0411**	**4.0000e-004**	**0.0415**	**0.0109**	**3.7000e-004**	**0.0113**		**39.3022**	**39.3022**	**2.8100e-003**		**39.3724**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.3535	0.0000	0.3535	0.0382	0.0000	0.0382			0.0000			0.0000
Off-Road	1.3915	13.0156	9.6964	0.0173		0.6266	0.6266		0.5765	0.5765	0.0000	1,672.5672	1,672.5672	0.5409		1,686.0908
Total	**1.3915**	**13.0156**	**9.6964**	**0.0173**	**0.3535**	**0.6266**	**0.9801**	**0.0382**	**0.5765**	**0.6146**	**0.0000**	**1,672.5672**	**1,672.5672**	**0.5409**		**1,686.0908**

3.2 Staging - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0378	0.0341	0.2901	4.0000e-004	0.0411	4.0000e-004	0.0415	0.0109	3.7000e-004	0.0113		39.3022	39.3022	2.8100e-003		39.3724
Total	**0.0378**	**0.0341**	**0.2901**	**4.0000e-004**	**0.0411**	**4.0000e-004**	**0.0415**	**0.0109**	**3.7000e-004**	**0.0113**		**39.3022**	**39.3022**	**2.8100e-003**		**39.3724**

3.3 Paving - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Paving - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Paving	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.3 Paving - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Architectural Coating - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Architectural Coating - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Archit. Coating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.4 Architectural Coating - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Site Preparation - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.0964	0.0000	0.0964	0.0104	0.0000	0.0104			0.0000			0.0000
Off-Road	0.6853	8.4307	4.0942	9.7400e-003		0.3353	0.3353		0.3085	0.3085		943.4872	943.4872	0.3051		951.1158
Total	**0.6853**	**8.4307**	**4.0942**	**9.7400e-003**	**0.0964**	**0.3353**	**0.4318**	**0.0104**	**0.3085**	**0.3189**		**943.4872**	**943.4872**	**0.3051**		**951.1158**

3.5 Site Preparation - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0378	0.0341	0.2901	4.0000e-004	0.0411	4.0000e-004	0.0415	0.0109	3.7000e-004	0.0113		39.3022	39.3022	2.8100e-003		39.3724
Total	**0.0378**	**0.0341**	**0.2901**	**4.0000e-004**	**0.0411**	**4.0000e-004**	**0.0415**	**0.0109**	**3.7000e-004**	**0.0113**		**39.3022**	**39.3022**	**2.8100e-003**		**39.3724**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.0964	0.0000	0.0964	0.0104	0.0000	0.0104			0.0000			0.0000
Off-Road	0.6853	8.4307	4.0942	9.7400e-003		0.3353	0.3353		0.3085	0.3085	0.0000	943.4872	943.4872	0.3051		951.1158
Total	**0.6853**	**8.4307**	**4.0942**	**9.7400e-003**	**0.0964**	**0.3353**	**0.4318**	**0.0104**	**0.3085**	**0.3189**	**0.0000**	**943.4872**	**943.4872**	**0.3051**		**951.1158**

3.5 Site Preparation - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0378	0.0341	0.2901	4.0000e-004	0.0411	4.0000e-004	0.0415	0.0109	3.7000e-004	0.0113		39.3022	39.3022	2.8100e-003		39.3724
Total	**0.0378**	**0.0341**	**0.2901**	**4.0000e-004**	**0.0411**	**4.0000e-004**	**0.0415**	**0.0109**	**3.7000e-004**	**0.0113**		**39.3022**	**39.3022**	**2.8100e-003**		**39.3724**

3.6 Grading - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					1.0902	0.0000	1.0902	0.4502	0.0000	0.4502			0.0000			0.0000
Off-Road	0.8674	7.8729	7.6226	0.0120		0.4672	0.4672		0.4457	0.4457		1,147.2352	1,147.2352	0.2169		1,152.6578
Total	**0.8674**	**7.8729**	**7.6226**	**0.0120**	**1.0902**	**0.4672**	**1.5574**	**0.4502**	**0.4457**	**0.8959**		**1,147.2352**	**1,147.2352**	**0.2169**		**1,152.6578**

3.6 Grading - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.5772	20.1527	3.1678	0.0497	1.0704	0.0949	1.1653	0.2928	0.0908	0.3836		5,205.914 8	5,205.914 8	0.1505		5,209.677 6
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.2269	0.2048	1.7404	2.3800e-003	0.2464	2.3800e-003	0.2488	0.0654	2.2000e-003	0.0676		235.8131	235.8131	0.0169		236.2343
Total	**0.8041**	**20.3575**	**4.9082**	**0.0521**	**1.3169**	**0.0973**	**1.4142**	**0.3582**	**0.0930**	**0.4512**		**5,441.727 9**	**5,441.727 9**	**0.1674**		**5,445.911 8**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					1.0902	0.0000	1.0902	0.4502	0.0000	0.4502			0.0000			0.0000
Off-Road	0.8674	7.8729	7.6226	0.0120		0.4672	0.4672		0.4457	0.4457	0.0000	1,147.235 2	1,147.235 2	0.2169		1,152.657 8
Total	**0.8674**	**7.8729**	**7.6226**	**0.0120**	**1.0902**	**0.4672**	**1.5574**	**0.4502**	**0.4457**	**0.8959**	**0.0000**	**1,147.235 2**	**1,147.235 2**	**0.2169**		**1,152.657 8**

3.6 Grading - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.5772	20.1527	3.1678	0.0497	1.0704	0.0949	1.1653	0.2928	0.0908	0.3836		5,205.914 8	5,205.914 8	0.1505		5,209.677 6
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.2269	0.2048	1.7404	2.3800e-003	0.2464	2.3800e-003	0.2488	0.0654	2.2000e-003	0.0676		235.8131	235.8131	0.0169		236.2343
Total	**0.8041**	**20.3575**	**4.9082**	**0.0521**	**1.3169**	**0.0973**	**1.4142**	**0.3582**	**0.0930**	**0.4512**		**5,441.727 9**	**5,441.727 9**	**0.1674**		**5,445.911 8**

3.7 Building Construction - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8617	8.8523	7.3875	0.0114		0.5224	0.5224		0.4806	0.4806		1,102.978 1	1,102.978 1	0.3567		1,111.8962
Total	**0.8617**	**8.8523**	**7.3875**	**0.0114**		**0.5224**	**0.5224**		**0.4806**	**0.4806**		**1,102.978 1**	**1,102.978 1**	**0.3567**		**1,111.896 2**

3.7 Building Construction - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Off-Road	0.8617	8.8523	7.3875	0.0114		0.5224	0.5224		0.4806	0.4806	0.0000	1,102.978 1	1,102.978 1	0.3567		1,111.8962
Total	**0.8617**	**8.8523**	**7.3875**	**0.0114**		**0.5224**	**0.5224**		**0.4806**	**0.4806**	**0.0000**	**1,102.978 1**	**1,102.978 1**	**0.3567**		**1,111.896 2**

3.7 Building Construction - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

3.8 Revegetation - 2020

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.5303	0.0000	0.5303	0.0573	0.0000	0.0573			0.0000			0.0000
Off-Road	0.6853	8.4307	4.0942	9.7400e-003		0.3353	0.3353		0.3085	0.3085		943.4872	943.4872	0.3051		951.1158
Total	**0.6853**	**8.4307**	**4.0942**	**9.7400e-003**	**0.5303**	**0.3353**	**0.8656**	**0.0573**	**0.3085**	**0.3658**		**943.4872**	**943.4872**	**0.3051**		**951.1158**

3.8 Revegetation - 2020

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0378	0.0341	0.2901	4.0000e-004	0.0411	4.0000e-004	0.0415	0.0109	3.7000e-004	0.0113		39.3022	39.3022	2.8100e-003		39.3724
Total	**0.0378**	**0.0341**	**0.2901**	**4.0000e-004**	**0.0411**	**4.0000e-004**	**0.0415**	**0.0109**	**3.7000e-004**	**0.0113**		**39.3022**	**39.3022**	**2.8100e-003**		**39.3724**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Fugitive Dust					0.5303	0.0000	0.5303	0.0573	0.0000	0.0573			0.0000			0.0000
Off-Road	0.6853	8.4307	4.0942	9.7400e-003		0.3353	0.3353		0.3085	0.3085	0.0000	943.4872	943.4872	0.3051		951.1158
Total	**0.6853**	**8.4307**	**4.0942**	**9.7400e-003**	**0.5303**	**0.3353**	**0.8656**	**0.0573**	**0.3085**	**0.3658**	**0.0000**	**943.4872**	**943.4872**	**0.3051**		**951.1158**

3.8 Revegetation - 2020

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Worker	0.0378	0.0341	0.2901	4.0000e-004	0.0411	4.0000e-004	0.0415	0.0109	3.7000e-004	0.0113		39.3022	39.3022	2.8100e-003		39.3724
Total	**0.0378**	**0.0341**	**0.2901**	**4.0000e-004**	**0.0411**	**4.0000e-004**	**0.0415**	**0.0109**	**3.7000e-004**	**0.0113**		**39.3022**	**39.3022**	**2.8100e-003**		**39.3724**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
Total					

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by

4.4 Fleet Mix

Land Use	LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
	0.479770	0.048374	0.208987	0.137651	0.044565	0.007238	0.014792	0.045519	0.003292	0.001618	0.005746	0.001515	0.000933

5.0 Energy Detail

Historical Energy Use: Y

5.1 Mitigation Measures Energy

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	lb/day										lb/day					
Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	lb/day										lb/day					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Consumer Products	0.0000					0.0000	0.0000		0.0000	0.0000			0.0000			0.0000
Landscaping	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000		0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**		**0.0000**

7.0 Water Detail

7.1 Mitigation Measures Water

8.0 Waste Detail

8.1 Mitigation Measures Waste

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Stationary Equipment

Fire Pumps and Emergency Generators

Equipment Type	Number	Hours/Day	Hours/Year	Horse Power	Load Factor	Fuel Type

Boilers

Equipment Type	Number	Heat Input/Day	Heat Input/Year	Boiler Rating	Fuel Type

User Defined Equipment

Equipment Type	Number

11.0 Vegetation