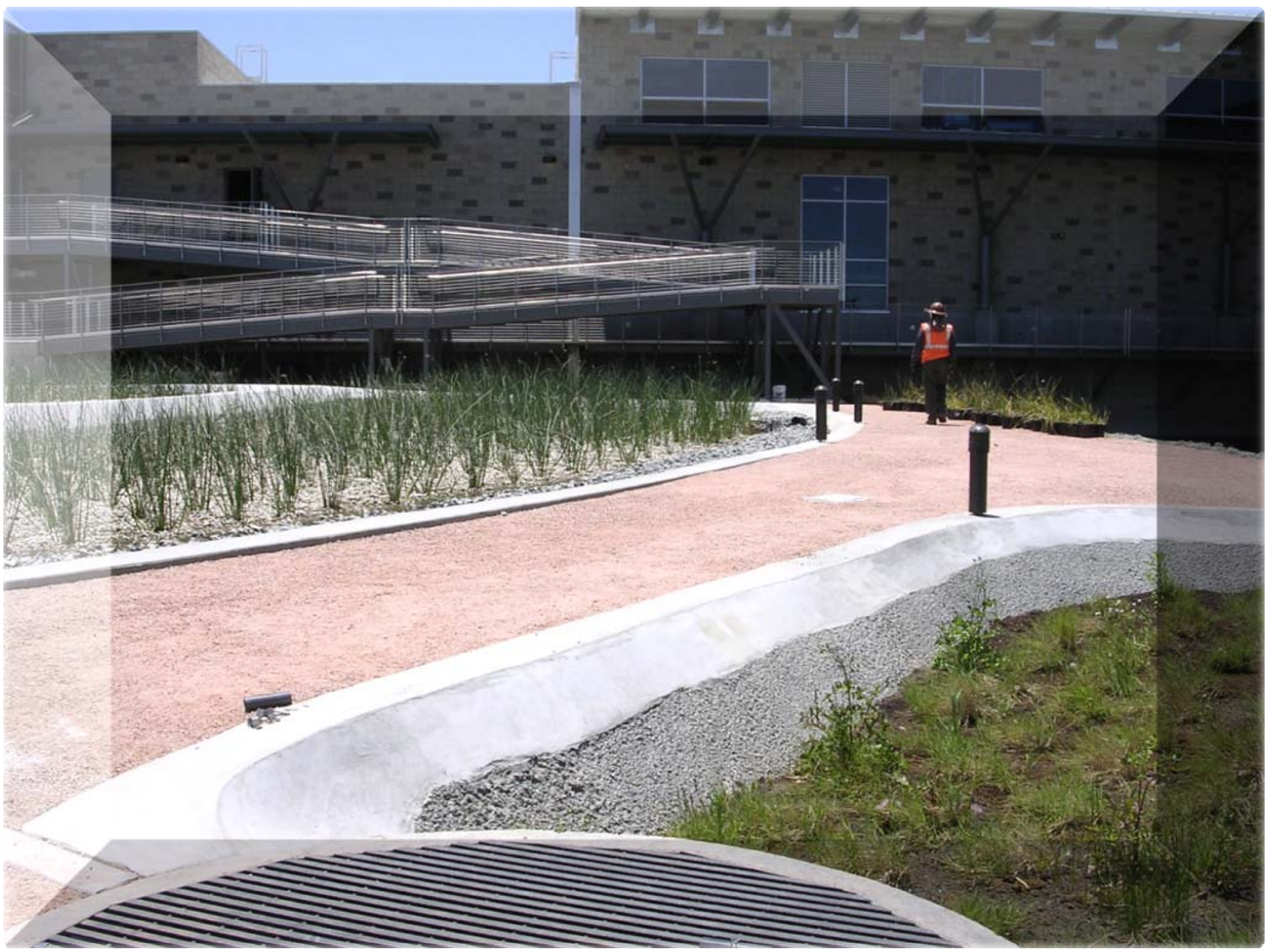
RECLAMATION
Managing Water in the West

Oxnard Saline Treatment Wetlands: Monitoring Plan, Baseline Monitoring Results, and Supplemental Research Topics

City of Oxnard, California



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Bureau of Reclamation

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Oxnard Saline Treatment Wetland Monitoring Plan, Baseline Results, and Supplemental Research Topics

City of Oxnard, California

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Acronyms and Abbreviations

As	arsenic
AWPF	advanced water purification facility
B	boron
BOD_5	biological oxygen demand
Ca	calcium
$CaCO_3$	calcium carbonate
CFU	colony forming unit
CSU	Colorado State University
Cu	copper
DO	dissolved oxygen
DOC	dissolved organic carbon
EC	electrical conductivity
Fe	iron
Hg	mercury
GREAT	Groundwater Recharge Extraction and Treatment
gpd	gallons per day
K	potassium
m^2	square meters
m^3/d	cubic meters per day
MBAS	methylene blue activated substances
MF	microfiltration
Mg	magnesium
Mn	manganese
N	nitrogen
Na	sodium
NH_4^+	ammonium
NO_2-N	nitrite nitrogen
NO_3-N	nitrate nitrogen
NTU	nephelometric turbidity unit
P	phosphorus
PCBs	polychlorinated biphenyls

Regional Board	Los Angeles Regional Water Quality Control Board
RO	reverse osmosis
S	sulfur
Se	selenium
SWPL	Soil, Water, and Plant Testing Laboratory
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
WET	whole effluent toxicity
Zn	zinc
ºC	degrees Celcius
%	percent
%OM	percent organic matter

Table of Contents

Page

Acronyms and Abbreviations iii
1.0 Introduction 1
 1.1 Saline Treatment Wetland 1
 1.2 Basin Plan Requirements 3
2.0 Wetland Monitoring Plan 5
 2.1 Baseline Monitoring 5
  2.1.1 Vegetation 6
  2.1.2 Soil and Sediment 7
  2.1.3 Water Quality 7
  2.1.4 Wetland Operation 8
 2.2 Long-Term Monitoring and Demonstration 8
  2.2.1 Daily Monitoring 9
  2.2.2 Weekly Monitoring 10
  2.2.3 Monthly Monitoring 11
  2.2.4 Quarterly, Semiannual, and Annual Monitoring 11
3.0 Baseline Monitoring Results 15
 3.1 Vegetation, Soils, and Sediments 15
  3.1.1 Vegetation Morphology 15
  3.1.2 Vegetation Uptake Analyses 16
  3.1.3 Soil and Sediment 18
 3.2 Water Quality 19
 3.3. Wetland Hydraulics 20
  3.3.1 Baseline Operating Conditions 20
  3.3.2 Wetland Water Volumes 20
  3.3.3 MF/RO System 21
4.0 Supplemental Wetland Research 23
5.0 References 25
Appendix A – Monitoring Schedule 27
Appendix B – Daily Monitoring Template 31
Appendix C – Weekly Monitoring Template 35
Appendix D – Monthly Monitoring Template 41
Appendix E – Quarterly, Semiannual, and Annual Monitoring Template 47

Tables

Page

Table 1 Regional Water Quality Objectives for Inland Surface Waters and Wetlands 3
Table 2 Wetland Sample Types and Locations for Performance Monitoring 5
Table 3 Water Quality Analyses for Baseline Sampling 7
Table 4 Weekly Monitoring Parameters 10

Table 5 Monthly Water Sample Monitoring Parameters 11
Table 6 Baseline vegetation data collected on June 26, 2012, from Oxnard's Concentrate Treatment Wetlands 16
Table 7 Monthly Water Sample Monitoring Parameters 17
Table 8 Methods provided and used by Colorado State University's Soil, Water and Plant Testing Laboratory 19
Table 9 Estimated Influent Water Quality from Oxnard's Annual Water Report 20
Table 10 Baseline Pictures and Observations of the Oxnard Wetland Stages.. 21

Figures

Page

Figure 1. AWPF Demonstration Wetlands three-stage configuration................... 1
Figure 2. Example of a potential AWPF completion plan provided by the city of Oxnard.. 2
Figure 3. AWPF Demonstration Wetland three-stage configuration inlets and outlets. 9

1.0 Introduction

The goal of the Oxnard Saline Treatment Wetlands project is to demonstrate the use of wetlands as a natural treatment technology for advanced water treatment concentrate waste streams. Wetlands have the potential for creating and/or restoring coastal saline wetlands habitat. Alternative strategies for concentrate management must be developed to serve the anticipated growth in use of membrane technologies and current need for concentrate disposal. The potential exists to remove contaminants from concentrate with engineered treatment wetlands and create or restore brackish or salt marsh wetlands with treated concentrate.

1.1 Saline Treatment Wetland

The city of Oxnard's Groundwater Recharge Extraction and Treatment (GREAT) program incorporated two desalting facilities that yield concentrate qualities of highly varying composition and strength. Building upon the findings of the original Wetland Pilot Study, Oxnard's Water Division and CH2M HILL routed a sidestream of up to 20,000 gallons per day (gpd) (76 cubic meters per day [m^3/d]) of advanced water purification facility (AWPF) concentrate to a series of wetlands modeled after the wetland technologies evaluated as a further demonstration of the ecological benefit of concentrate reuse in wetlands.

To address the high strength of the AWPF concentrate (total dissolved solids [TDS] greater than [>] 11,000 milligrams per liter [mg/L] and ammonium >140 mg/L), the AWPF Demonstration Wetlands are configured as a three-stage treatment process (see figure 1) with specific treatment objectives:

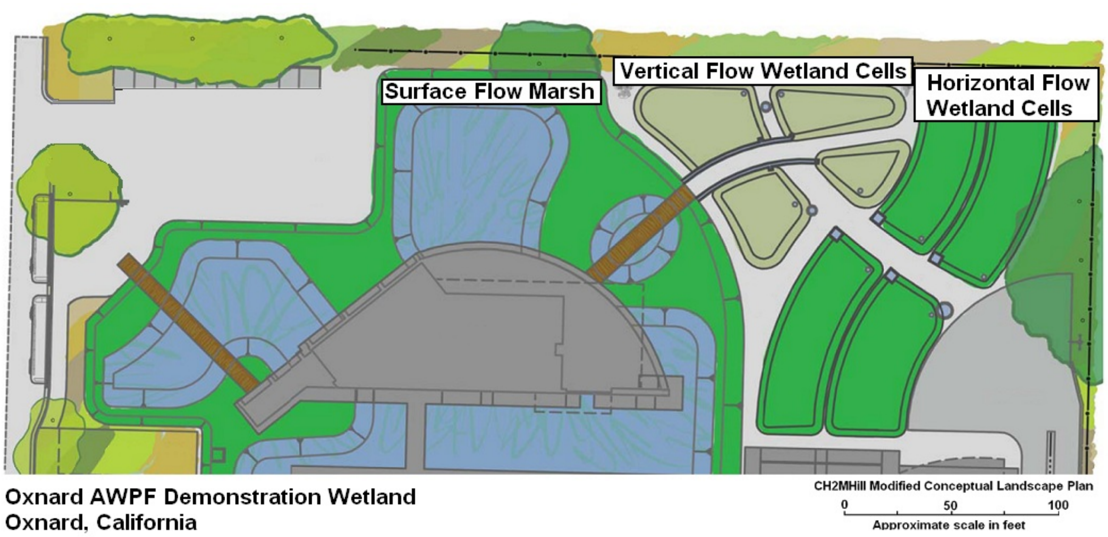


Figure 1. AWPF Demonstration Wetlands three-stage configuration

Stage 1: Horizontal Subsurface Flow Wetlands with supplemental aeration for nitrification of ammonia.

Stage 2: Vertical Subsurface Upflow Wetlands for denitrification of nitrate-nitrogen and anaerobic removal of selenium.

Stage 3: Surface Flow Marsh and Open Pond for final polishing and wetland habitat creation.

Wetland monitoring objectives focus on collecting information to address regional objectives for the demonstration wetland system and the potential for expanding the demonstration wetland into a full-scale facility. Oxnard's GREAT program provided a conceptual design for completion of the AWPF, which is provided as figure 2. The completed design has the potential to include both concentrate treatment wetlands and storm water management storage along with a variety of other water management aspects. Sufficient wetland monitoring of the concentrate treatment wetland demonstration, along with supplemental targeted research projects, will aid the city of Oxnard in attempts to develop a full-scale facility.

Figure 2. Example of a potential AWPF completion plan provided by the city of Oxnard.

This document is created for the city of Oxnard to provide guidance on monitoring the saline demonstration wetland, provide baseline results for initial samples taken from the system, and suggest supplemental topics that may be of future interest for Oxnard to explore through research collaborations.

1.2 Basin Plan Requirements

Wetland discharge requirements for a future full scalefacility will be based on the water quality objectives specified by the Los Angeles Regional Water Quality Control Board (Regional Board). These water quality objectives include the regional objectives for inland surface waters and the regional narrative objectives for wetlands. Facility permitting may not require monitoring of the full list of objectives and will be site dependent. Table 1 provides a summary of the water quality objectives, descriptions, and limits where provided.

Table 1. Regional Water Quality Objectives for Inland Surface Waters and Wetlands

Regional Objectives for Inland Surface Waters	
Ammonia	One-hour and four-day average concentrations of ammonia (un-ionized) and total ammonia depend on temperature, pH, and water designation (warm/cold).
Bacteria, coliform	In waters designated for non-water contact recreation (REC-2), fecal coliform concentration shall not exceed a log mean of 2,000/100 mL (based on a minimum of not less than four samples on any 30-day period), nor shall more than 10 percent (%) of samples collected during any 30-day period exceed 4,000/100 mL.
Bioaccumulation	Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels that are harmful to aquatic life or human health.
Biological oxygen demand (BOD5)	Waters shall be free of substances that result in increases in the BOD_5, which adversely affect beneficial uses.
Biostimulatory substances	Waters shall not contain biostimulatory substances (nutrients—nitrogen/phosphorus—and other compounds that stimulate aquatic growth) in concentrations that promote aquatic growth to the extent that such growth causes a nuisance or adversely affects beneficial uses.
Chemical constituents	Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use (refers to inorganic chemicals, but not maximum contaminant level concentrations).
Chlorine, total residual	Chlorine residual from wastewater disinfection shall not be present in surface water discharges at concentrations that exceed 0.1 mg/L and shall not persist in receiving waters at any concentration that impairs beneficial uses.
Color	Water shall be free of coloration that causes a nuisance or adversely affects beneficial uses.
Exotic vegetation	Exotic vegetation shall not be introduced around stream courses to the extent that such growth causes a nuisance or adversely affects beneficial uses.
Floating material	Waters shall not contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.
Methylene blue activated substances (MBAS)	The MBAS procedure tests for the presence of anionic surfactants (detergents) in water, which can disturb the surface tension affecting insects and can affect gills in aquatic life.

Table 1. Regional Water Quality Objectives for Inland Surface Waters and Wetlands (continued)

Regional Objectives for Inland Surface Waters	
Mineral quality	Numerical mineral quality objectives are dependent on individual inland surface waters and include TDS, sulfate, chloride, boron, nitrogen, and the sodium adsorption ratio.
Nitrogen (nitrate, nitrite)	Excess nitrogen in surface waters can cause health problems in humans and can lead to excess aquatic growth.
Oil and grease	Water shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause a nuisance, or that otherwise adversely affect beneficial uses.
Oxygen, dissolved (DO)	Dissolved oxygen requirements are dependent on the beneficial uses of the water body. At a minimum, the mean annual dissolved oxygen concentration of all waters shall be greater than 7 mg/L; and no single determination shall be less than 5.0 mg/L, except when natural conditions cause lesser concentrations.
Pesticides	No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.
pH	pH of inland surface waters shall not be depressed below 6.5 or raised above 8.5 as a result of waste discharges. Ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharge.
Polychlorinated biphenyls (PCBs)	The purposeful discharge of PCBs to waters of the region, or at locations where the waste can subsequently reach waters of the region is prohibited.
Radioactive substances	Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life or that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life.
Solid, suspended, or settleable materials	Waters shall not contain suspended or settleable material in concentrations that cause nuisance or adversely affect beneficial uses.
Taste and odor	Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible aquatic resources, cause nuisance, or adversely affect beneficial uses.
Temperature	The natural receiving water temperature of all regional waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Board that such alteration in temperature does not adversely affect beneficial uses.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in, human, plant, animal, or aquatic life. The use of bioassays (toxicity tests) is widely accepted as a valid approach to evaluating toxicity of waste and receiving waters.
Turbidity	Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.

2.0 Wetland Monitoring Plan

This monitoring plan was developed based on Regional Board requirements stated in the Basin Plan, suggestions provided by CH2M Hill, and similar wetland monitoring plans created by the Bureau of Reclamation (Reclamation) and United States Geological Survey (USGS). This section suggests monitoring guidance to aid in the collection of demonstration data and assess the health and performance of the wetland system, and is organized into baseline monitoring and long-term demonstration monitoring. General information is provided on parameter, monitoring location, and monitoring frequency. General monitoring locations in the wetland cells for baseline and long-term monitoring are suggested in table 2.

Table 2. Wetland Sample Types and Locations for Performance Monitoring

Plant Samples	Locations	Test Objectives
Whole plant	Select a plant from each of the four species from each wetland cell	Analyze nutrients, metals, and salts accumulated in the plant during growth in the wetland system
Density analysis	Measure plant density within a 0.0625 square meter (m^2) quadrat in each cell	Assess plant health and growth in the wetland cells
Soil Samples	**Locations**	**Test Objectives**
Scoop of soil	Select a soil sample from all four vertical flow cells and two samples from within the surface marsh cell	Analyze metals and salts accumulated in the soil during operation of the wetland system
Water Samples	**Locations**	**Test Objectives**
Grab sample	Sample influent and effluent water streams of each cell	Analyze nutrients, metals, and salts present in the water stream to determine treatment performance of each engineered cell

Note: Specific procedures and frequencies are provided in the following sections.

2.1 Baseline Monitoring

Baseline monitoring focuses on the identification of baseline plant, soil, and water conditions to generate a comparison dataset for wetland performance monitoring. Baseline sampling and collection should be repeated at any point in time where major modifications to the facility operation or wetland design occur, such as after the introduction of brine. Note, see section 3 for baseline monitoring results for vegetation, soil/sediment, and water quality.

2.1.1 Vegetation

At the time of plant installation, measure above ground and below ground plant biomass, stem density, stem diameters, and stem lengths of plants planted in the vertical and surface flow wetlands:

1. Before installation, select two representative plants per species: *Schoenoplectus californicus* (California bulrush), *S. tabernaemontani* (softstem bulrush), *Anemopsis californica* (yerba mansa) and *Distichlis spicata* (saltgrass).

2. Separate plants into above and below ground sections; be careful to rinse off all sediment and rocks, and place each section into separate labeled plastic bags.

3. Count the number of plants stems within each plant sample and record to determine initial plant density (number of stems per m^2) based on the design specifications of 2-foot plant centers.

4 Use calipers to measure the diameters and lengths of 10 respective stems and record. The stems should be measured at their base as they emerge from the gravel substrate.

5. Dry for 48 hours in a 38-degree Celsius (ºC) oven or until no further weight loss occurs; weigh each portion separately and record.

Also at the time of plant installation,

1. Separate two additional representative plants of each of the four species, into above and below ground sections; be careful to rinse off all sediment and rocks; place each section into separate labeled plastic bags; and keep cool

2. Send to an analytical laboratory for analysis of extractible N, P, K, Ca, Mg, Na, Fe, Mn, Cu, Zn, B, and NO_3-N content.[1]

Note: Other elements or contaminants could be added to this list if they are of concern to the project stakeholders or of interest to later research studies.

[1] N = nitrogen; P = phosphorus; K = potassium; Ca = calcium; Mg = magnesium; Na = sodium; Fe = iron; Mn = manganese; Cu = copper; Zn = zinc; B = boron; NO_3-N = nitrate nitrogen.

2.1.2 Soil and Sediment

At the time of plant installation, measure the baseline sediment surface layer:

1. Collect grab samples using latex gloves from each vertical flow cell and from two locations within the surface flow wetland. Place each sample into separate labeled plastic bags and keep cool.

2. Send to an analytical laboratory for analysis of pH, electrical conductivity (EC), lime, percent organic matter (%OM), NO_3-N, P, K, B, Zn, Fe, Mn, Cu, Ca, Mg, S, and Na content.[2]

Note: Other elements or contaminants could be added to this list if they are of concern to the project stakeholders or of interest to later research studies.

2.1.3 Water Quality

At the time of plant installation, measure the baseline or initial water quality entering the wetland system:

1. Collect three grab samples using sample bottles of the initial water supply at the location where the water enters the wetland complex.

2. Through the onsite laboratory or an external analytical laboratory, perform water analyses for the water quality parameters listed in table 3 using EPA or Standard Methods for the Examination of Water and Wastewater.

Table 3. Water Quality Analyses for Baseline Sampling

General Parameters	Specific Nutrients, Salts, and Metals		
Conductivity	Total organic carbon (TOC)	Alkalinity	Copper
Dissolved oxygen		Aluminum	Chromium
Biological oxygen demand (BOD_5)	Dissolved organic carbon (DOC)	Arsenic	Iron
Fecal coliform (colony forming unit [CFU] per 100 mL)	Nitrite (NO_2-N)	Barium	Fluoride
	Nitrate (NO_3-N)	Beryllium	Magnesium
pH	Total Kjeldahl nitrogen (TKN)	Boron	Potassium
Temperature		Bromide	Selenium
TDS	Ammonium (NH_4^+-N)	Cadmium	Strontium
Total suspended solids (TSS)	Orthophosphate	Calcium	Sulfate
Turbidity, in NTU	Oil and grease	Chloride	Zinc

Note: Other elements or contaminants could be added to this list if they are of concern to the project stakeholders or of interest to later research studies.

[2] %OM = percent organic matter; S = sulfur.

2.1.4 Wetland Operation

2.1.4.1 Wetland Water Volumes

Wetland baseline information should be collected regarding water volume balances for each stage/cell, pulsation, or frequency of flow release into Stage 1, Stage 1 aeration rates, time to equilibration of anoxic conditions in Stage 2, and general flow path information in Stage 3.

2.1.4.2 Baseline Operating Conditions

An accurate record should be kept of the timeline required to achieve baseline operation conditions, including the start of fresh water addition, duration of baseline testing and operation with freshwater, start of concentrate addition, volumetric loading of concentrate, and concentrate to fresh water ratio.

2.1.4.3 Microfiltration/Reverse Osmosis System

At the time that the membrane plant operation grab samples are collected from the reverse osmosis (RO) system feed, RO concentrate and RO product should be analyzed for the water quality parameters and constituents as given in the table 2 objectives. Information on the microfiltration (MF)/RO treatment system should be collected at the time of sampling and include process operation information, such as water recovery, water production, and operating pressures.

2.2 Long-Term Monitoring and Demonstration

This section focuses on the long-term study operation and monitoring of the system to demonstrate the treatment capabilities of the engineered wetland system. Sampling and monitoring are organized by frequency. The long-term monitoring schedule is provided as appendix A. Monitoring data templates are available in the appendices for data recording and are organized in the following manner:

- Appendix A: Monitoring Schedule
- Appendix B: Daily Monitoring Template
- Appendix C: Weekly Monitoring Template
- Appendix D: Monthly Monitoring Template
- Appendix E: Quarterly, Semiannual, and Annual Monitoring Template

Long-term monitoring mainly occurs at the inlet and outlet of each cell unless otherwise specified (see figure 3). The sampling frequency was developed based on the goal of generating sufficient data to evaluate the system performance, permitting requirements, and creating historical performance data to support further study and research at this facility.

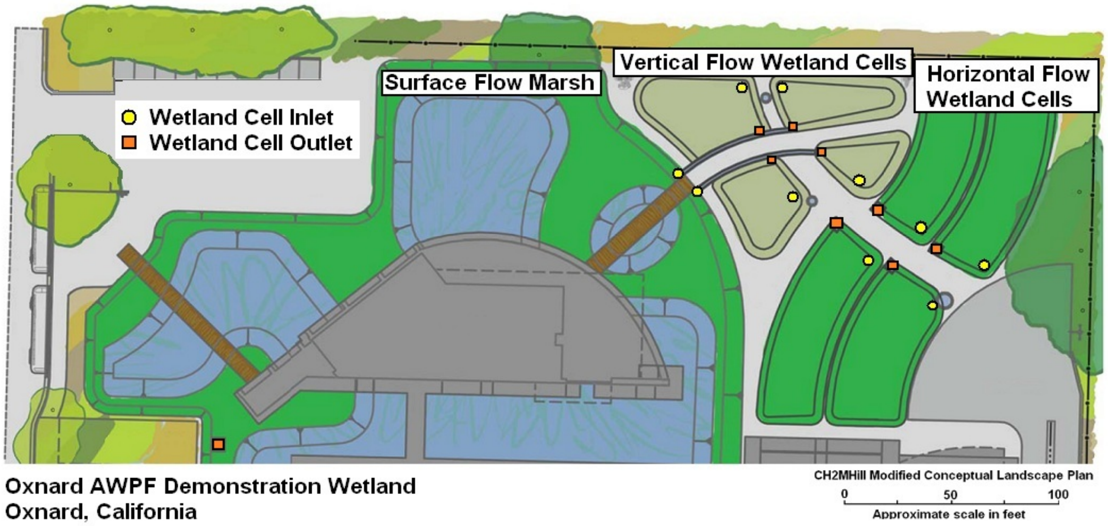


Figure 3. AWPF Demonstration Wetland three-stage configuration inlets and outlets.

2.2.1 Daily Monitoring

2.2.1.1 General Appearance

If the wetland site is used as an educational facility providing public tours and observance, then daily monitoring and cleanup of trash and waste products should be performed.

2.2.1.2 Vegetation

After plants are planted (installed) in the pilot cell, plant survival should be checked daily for the first 2 weeks, specifically:

1. Check to ensure water level is kept the same in all cells.
2. Inspect plants for damage by animals, insects, or disease,
3. Examine plants for general health (i.e., height, robustness, color, flowers, etc.).
4 If any problems are noted, deal with them as necessary.

2.2.1.3 Debris Accumulation

Inspect the wetland daily, particularly at the inflow and outflow areas for problem accumulations of detritus and debris. Inspect the wetland for evidence of internal clogging such as water ponding on the surface of the subsurface flow beds.

2.2.1.4 Water Levels

Monitor water levels and inflow rates to protect wetland vegetation, which also should include ensuring that piping and structures are maintained. Inspect inlet and outlet pumps and weir box daily to ensure that the pump is working properly.

2.2.1.5 Weather Conditions

If an interest develops for evaluating carbon sequestration or evapotranspiration at the facility, a weather station may be set up onsite to measure daily temperatures, wind intensity and direction, and precipitation.

2.2.2 Weekly Monitoring

2.2.2.1 Vegetation

Beginning 2 weeks after planting, the following should be performed weekly:

1. Check to ensure water level is kept the same in all cells, including the surface flow marsh cell.

2. Inspect plants for damage by animals, insects, or disease.

3. Examine plants for general health (i.e., height, robustness, color, flowers, etc.).

4. If any problems are noted, deal with them as necessary.

2.2.2.2 Water Depth

Inspect the water depth of each wetland bed weekly to ensure water is contained within the cell boundaries and water level is below the surface in the horizontal flow cell. Note that improper water depth is often the principal culprit for the failure of constructed wetland systems.

2.2.2.3 Water Flow and Quality

Perform in situ and sample monitoring of MF/RO concentrate, wetland influent, and staged cell influent/effluent general parameters. A list of parameters to monitor weekly is provided in table 4.

Table 4. Weekly Monitoring Parameters

Wetland Flow Volumes	Monitoring Locations
Influent concentrate mixture	Main inflow to wetland
Influent water flow rate	Main inflow to wetland
Water flow/weir levels	Inflow and outflow of each cell vertical flow cell and surface flow marsh
Water Samples	**Sampling Locations**
pH Temperature Dissolved oxygen (DO) Conductivity Turbidity, in nephelometric turbidity unit (NTU)	Grab samples taken from the inflow and outflow of each cell vertical flow cell and surface flow marsh

Note: Other elements or contaminants could be added to this list if they are of concern to the project stakeholders or of interest to later research studies.

2.2.3 Monthly Monitoring

2.2.3.1 Water Quality

Grab samples should be collected monthly and analyzed for the parameters in table 5. All samples should be collected monthly at the same time each day. Monthly sampling should continue for a minimum of 1 full year following concentrate addition.

Table 5. Monthly Water Sample Monitoring Parameters

Weekly Influent and Effluent Parameters	Monthly Wetland Stage Influent and Effluent Constituents
Conductivity	TDS/TSS
DO	TOC/DOC
pH	Fecal coliform (CFU/100 mL)†
Temperature	Alkalinity (calcium carbonate [$CaCO_3$])
Turbidity, in NTU	Biological oxygen demand (BOD_5)†

Monthly Wetland Stage Influent and Effluent Specific Constituents			
Aluminum	Calcium	Magnesium	Potassium
Arsenic	Chloride	Nitrite (NO_2-N)	Selenium
Beryllium	Copper	Nitrate (NO_3-N)	Strontium
Boron	Chromium	Total Kjeldahl nitrogen (TKN)	Sulfate
Bromide	Fluoride	Ammonium (NH_4^+-N)	Zinc
Cadmium	Iron	Orthophosphate	

Note: Sample collection at the wetland inflow, the inflow and outflow of each vertical flow cell, and the inflow and outflow of the surface marsh unless noted as †, then collection at the wetland inflow and outflow only.

2.2.3.3 Monitoring Database

A monitoring database should be created based on the monitoring plan parameters. The database should be updated monthly to include information from sample analyses, flow monitoring, record sampling events, and to document general observations. The creation and maintenance of a monitoring database will help to facilitate research onsite.

2.2.4 Quarterly, Semiannual, and Annual Monitoring

2.2.4.1 Vegetation

In the fourth month after planting (the establishment period):

1. Plants should be inspected to determine whether 80% of each plant species installed has survived.

2. If less than 80% of the installed plants have survived, notify the plant contractor so dead plants can be replaced, as specified in the pilot cell construction contract.

Quarterly, measure stem density, stem diameters and stem lengths:

1. Count the number of plants within two randomly placed 0.0625-m^2 quadrats in each of the species blocks and record.

2. Use calipers to measure the diameters and lengths of 10 representative stems within each of the quadrats. The stem diameters should be measured at their base as they emerge from the gravel substrate. Record all measurements.

Semiannually, estimate the areal vegetation coverage (every 6 months):

1. The same person should estimate the areal vegetation coverage to maintain consistency over the period of study.

2. Estimate the percent of area that each plant species covers within each pilot cell section; record the percent areal coverage.

3. Photograph each section with identifications (i.e., plant name, cell section, date, etc.), as a permanent record of plant coverage.

Annually, measure above and below ground plant biomass, stem density, stem diameters, and stem lengths of plants planted in the vertical and surface flow wetlands:

1. Select two representative plants per species (yerba mansa, salt grass, softstem bulrush, and California bulrush).

2. Separate plants into above and below ground sections; be careful to rinse off all sediment and rocks, and place each section into separate labeled plastic bags.

3. Count the number of plants within two randomly placed 0.0625-m^2 quadrats in each of the species blocks and record.

4. Use calipers to measure the diameters and lengths of 10 representative stems within each of the quadrats. The stem diameters should be measured at their base as they emerge from the gravel substrate. Record all measurements.

5. Dry for 48 hours in a 38-^{o}C oven or until no further weight loss occurs; weigh each portion separately and record.

Also annually,

1. Carefully remove two complete representative plants from each species blocks, separate into above and below ground sections; be

careful to rinse off all sediment and rocks; place each section into separate labeled plastic bags; and keep cool.

2. Send to an analytical laboratory for analysis of extractible N, P, K, Ca, Mg, Na, Fe, Mn, Cu, Zn, B, and NO_3-N content.

Note: Other elements or contaminants could be added to this list (e.g., pesticides, endocrine disruptors, pharmaceuticals, viruses, etc.) if they are of concern to the project stakeholders or of interest to later research studies.

Additionally, seasonal harvesting vegetation and removing the desired plant species may be performed to reduce the plant biomass and minimize detrital buildup within the system.

2.2.4.2 Soil and Sediment

Annually, measure the baseline sediment surface layer:

1. Using latex gloves, collect grab samples from each vertical flow cell and from two locations within the surface flow wetland. Place each sample into separate labeled plastic bags, and keep cool.

2. Send to an analytical laboratory for analysis of pH, EC, lime, %OM, NO_3-N, P, K, B, Zn, Fe, Mn, Cu, Ca, Mg, S, and Na content.

Note: Other elements or contaminants could be added to this list if they are of concern to the project stakeholders or of interest to later research studies.

2.2.4.3 Water Quality

In addition to the parameters and constituents identified in table 4, annual grab samples should be collected to address water quality monitoring for parameters such as pesticides, biostimulatory substances, MBAS, PCBs, radioactive substances, and whole effluent toxicity (WET) testing. These parameters are included in the Regional Board’s objectives or have been identified as constituents of concern in wastewater effluent. Annual measurements to ensure non-detect levels may mitigate the need for more frequent monitoring.

2.2.4.4 Wildlife

Due to the wetland location and its proximity to the designed free water surface habitat wetlands, wildlife—especially birds—will be attracted to it. If nests of bird species are produced on the wetland aggregate or among the desirable wetland vegetation, then particular care must be made to allow the eggs to hatch and fledglings to fly before cleaning out or otherwise maintaining the area as all active bird nests are "protected" under the Migratory Bird Treaty Act (MBTA).

If the wildlife or their activities are found to interfere with the proper operations of the wetland beds or to significantly impact the water quality of the water flowing through the wetlands, then care must be taken to discourage use of the area. Possible techniques for deterring bird or wildlife usage could include netting the area, using sound systems, trapping and removing, etc.

If mosquitoes become an issue, mosquito abatement should be performed on an as-needed basis, either through using mosquito fish and/or periodically applying biological larvicide to surface waters in the surface flow marsh cell.

2.2.4.5 Educational Material

Collection of educational material to support the exhibit such as time-lapse photographs, model plants or soils, and cross section views of horizontal/vertical flow systems should be collected monthly to document the growth and progression of the habitat and treatment system. Vegetation photography referenced in the biomonitoring section is an example of routine monitoring observations that also can be used as educational material.

3.0 Baseline Monitoring Results

Assessment of certain baseline conditions occurred during the June 26, 2012 project site visit by USGS and Reclamation employees. Results of the baseline monitoring performed are included in the following section.

3.1 Vegetation, Soils, and Sediments

Initial baseline plant and soil samples were taken during the site visit on June 26, 2012. These samples were analyzed by the Colorado State University (CSU) Soil, Water, and Plant Testing Laboratory (SWPL) in Fort Collins, Colorado.

3.1.1 Vegetation Morphology

Baseline vegetation monitoring was done on June 26, 2012, using the plant stock that was planted in the research cells the previous week to establish the initial size, weight, and density of the plants when they were planted. The initial conditions was recorded to evaluate how the plants respond to the saline wastewater once it is added to the system. Four 15-centimeter (cm) (6-inch) diameter pots of the species yerba mansa, salt grass, softstem bulrush, and California bulrush were sampled to represent the species planted in the pilot cells.

Vegetation coverage was not estimated for the baseline monitoring because planting had recently been done, and the vegetation was planted uniformly across the cells on either 61-cm (2-foot) or 46-cm (18-inch) centers. Areal coverage estimates will be used for determining total plant biomass within the wetland. These estimates will be used to evaluate treatment capabilities related to plant coverage (see Sartoris et al., 2000a; 2000b).

Above and below ground plant biomass, culm/stem density, diameters, and lengths from two of the pots per species were measured. Plant biomass was collected by destructive sampling (Daniels et al., 2010), removing the plants from the four random pots of each species and cutting the above ground vegetation (culms, stems and leaves) from the below ground vegetation (roots and rhizomes) using a ceramic knife and powder-free latex gloves.

All culms/stems were counted and recorded as the plant density per 15-cm pot. Ten representative culms/stems diameters and lengths from each plant were measured, then dried at 38 °C and weighed. Dry weight was recorded after no more weight loss occurred. Results of the baseline vegetation morphology are included in table 6.

The two plants from each species showed some variability between the samples with the biggest mean range occurring between the culm/stem density (number of culms/pot, range = 16.0) and the below ground biomass that averaged a 22.7-gram (g) difference compared to a 2.7-g difference between above ground biomass.

Table 6. Baseline vegetation data collected on June 26, 2012, from Oxnard's Saline Treatment Wetlands[1]

Species			**softstem bulrush**			**California bulrush**		
			Rep 1	Rep 2	**Avg.**	Rep 1	Rep 2	**Avg.**
Samples	# Culms	/plant	10	17	**13.5**	6	9	**7.5**
Mean	Diameters	mm	3.8	3.5	**3.6**	7.5	7.1	**7.3**
Mean	Lengths	cm	40.4	24.3	**32.4**	58.1	54.2	**56.2**
Dry wt.	Above ground	g	4.74	4.83	**4.79**	13.53	16.02	**14.78**
Dry wt.	Below ground	g	55.14	35.11	**45.13**	42.37	60.11	**51.24**
Planting	On center	cm	60.96	60.96	**60.96**	60.96	60.96	**60.96**
Number	Planted	#			**2,000**			**3,070**
Area	Planted	m^2			**583.6**			**896.0**
Plant	Density	$\#/m^2$			**3.43**			**3.43**
Species			**yerba mansa**			**saltgrass**		
			Rep 1	Rep 2	Avg.	Rep 1	Rep 2	Avg.
Samples	# Culms	/plant	1	1	**1**	46	100	**73**
Mean	Diameters	mm	5.2	4.5	**4.9**	0.8	0.8	**0.8**
Mean	Lengths	cm	15.8	13.8	**14.8**	22.6	21.1	**21.8**
Dry wt.	Above ground	g	7.95	11.79	**9.87**	9.24	13.50	**11.37**
Dry wt.	Below ground	g	67.43	40.63	**54.03**	11.18	37.48	**24.33**
Planting	On center	cm	45.72	45.72	**45.72**	60.96	60.96	**60.96**
Number	Planted	#			**714**			**1,192**
Area	Planted	m^2			**117.2**			**347.6**
Plant	Density	$\#/m^2$			**6.09**			**3.43**

[1] # = number; mm = millimeters; g = grams; $\#/m^2$ = grams per square meter; rep = replicate sample analyzed

Note: Plant samples were removed from their nursery pots, which were 15 centimeter (cm) in diameter (0.01824 square meters [m^2]) for measuring.

3.1.2 Vegetation Uptake Analyses

For nutrient and elemental analyses, two other plants of each species were cleaned and then cut into the above and below ground portions using a ceramic knife and powder-free latex gloves. Each portion was transported in separate labeled plastic Ziploc® bags to CSU's SWPL for analyses of extractable N, P, K, Ca, Mg, Na, Fe, Mn, Cu, Zn, B, NO_3-N, selenium (Se), mercury (Hg), and arsenic (As) content. Results of the baseline vegetation analyses are included in table 7.

Table 7. Vegetation Uptake Results[1]

	Sample	N	Ca	Mg	Na	K	P	S
					%			
Below Ground	Soft stem bulrush rep 1	0.76	0.82	0.23	0.06	0.48	0.09	0.001
	Soft stem bulrush rep 2	0.96	0.74	0.23	0.05	0.44	0.09	<0.01
	Salt grass rep 1	0.66	0.65	0.17	0.05	0.48	0.13	0.002
	Salt grass rep 2	0.85	0.73	0.23	0.08	0.44	0.10	<0.01
	California bullrush rep 1	0.74	0.93	0.37	0.09	0.41	0.08	<0.01
	California bullrush rep 2	0.93	0.80	0.21	0.06	0.46	0.12	<0.01
	Yerbo mansa rep 1	0.47	0.54	0.19	0.16	0.54	0.09	<0.01
	Yerbo mansa rep 2	0.50	0.55	0.25	0.19	0.63	0.13	<0.01
Above Ground	Soft stem bulrush rep 1	0.95	0.48	0.12	0.18	1.06	0.08	0.14
	Soft stem bulrush rep 2	0.99	0.72	0.16	0.20	1.03	0.07	0.20
	Salt grass rep 1	0.91	0.30	0.14	0.06	0.69	0.27	0.19
	Salt grass rep 2	1.03	0.29	0.13	0.07	0.67	0.21	0.15
	California bullrush rep 1	0.93	0.56	0.17	0.33	1.30	0.08	0.25
	California bullrush rep 2	1.02	0.52	0.16	0.21	1.60	0.12	0.22
	Yerbo mansa rep 1	1.15	1.33	0.37	0.97	1.26	0.17	0.21
	Yerbo mansa rep 2	1.38	1.13	0.32	1.11	0.83	0.17	0.22

	Sample	Fe	Mn	Cu	Zn	B	NO_3-N
				mg/kg			
Below Ground	Soft stem bulrush rep 1	4,151	151	15.9	145	5.68	38.9
	Soft stem bulrush rep 2	4,333	122	15.5	127	6.63	25.5
	Salt grass rep 1	3,927	198	14.4	133	7.32	10.9
	Salt grass rep 2	5,004	131	19.2	116	6.57	6.5
	California bullrush rep 1	10,710	173	20.5	92.1	10.2	7.3
	California bullrush rep 2	5,455	195	10.0	168	8.68	104
	Yerbo mansa rep 1	2,136	185	7.41	65.2	6.44	9.0
	Yerbo mansa rep 2	4,447	187	15.0	64.3	7.78	9.2
Above Ground	Soft stem bulrush rep 1	165	122	3.92	48.1	2.72	5.4
	Soft stem bulrush rep 2	150	114	8.72	75.3	2.46	7.1
	Salt grass rep 1	341	74.2	14.0	214	4.21	4.5
	Salt grass rep 2	188	85.2	15.0	168	2.70	5.2
	California bullrush rep 1	75.1	70.9	6.10	24.5	3.85	12.4
	California bullrush rep 2	65.8	62.4	5.01	41.9	3.82	7.3
	Yerbo mansa rep 1	116	29.6	6.76	34.5	27.5	18.2
	Yerbo mansa rep 2	116	55.4	8.06	35.3	35.3	5.7

[1] % = percent; mg = milligrams; kg = kilogram; rep = replicate sample analyzed

Table 7. Vegetation Uptake Results[1] (continued)

	Sample	Mo	Al	As	Se	Hg	Dry Matter
				mg/kg			%
Below Ground	Soft stem bulrush rep 1	8.68	3,677	3.406	5.658	0.009	28.0
	Soft stem bulrush rep 2	7.57	3,675	9.708	10.19	0.008	27.0
	Salt grass rep 1	13.1	5,416	10.50	7.361	0.005	24.2
	Salt grass rep 2	9.37	4,664	4.981	5.656	0.006	26.3
	California bullrush rep 1	18.0	7,048	17.59	7.361	0.009	28.8
	California bullrush rep 2	8.68	3,920	9.705	8.479	0.007	31.4
	Yerbo mansa rep 1	7.57	2,510	8.131	<0.005	0.008	31.5
	Yerbo mansa rep 2	10.5	3,967	12.59	11.31	0.007	33.3
Above Ground	Soft stem bulrush rep 1	2.15	117	7.344	11.32	0.003	17.8
	Soft stem bulrush rep 2	3.68	109	6.818	6.787	0.004	16.8
	Salt grass rep 1	1.87	371	4.195	<0.005	0.005	29.4
	Salt grass rep 2	<0.01	110	9.967	3.393	0.004	27.0
	California bullrush rep 1	3.40	35.5	0.521	<0.005	0.005	18.7
	California bullrush rep 2	0.34	33.1	12.06	8.472	0.005	17.4
	Yerbo mansa rep 1	<0.01	85.4	6.031	28.81	0.006	11.6
	Yerbo mansa rep 2	<0.01	94.2	3.934	<0.005	0.005	12.0

[1] % = percent; mg = milligrams; kg = kilogram; rep = replicate sample analyzed

As expected, there is a clear difference in element concentrations between the above and below ground plant materials. Additionally, yerba mansa contained more Na, but less Zn, than the other species in both above and below ground portions and more Ca in its stems and leaves; California and softstem bulrush contained more NO_3-N on average in their roots and rhizomes; and saltgrass stems and leaves contained the highest concentrations of Zn.

3.1.3 Soil and Sediment

Baseline samples of the surface sediment layer also were collected on June 26, 2012. Four surface soil samples were collected from the top 10 cm within each of the vertical flow cells, and two additional samples were collected from the surface flow marsh using powder-free latex gloves and placed in labeled plastic Ziploc® bags for transport to the CSU SWPL for analyses. Samples were kept cool during transit and then were analyzed for pH, EC, lime estimate, %OM, sediment organic carbon, NO_3-N, P, K, Zn, Fe, Mn, Cu, B, Ca, Mg, S, Na, As, Se, and Hg content.

The methods used by CSU’s SWPL are referred to in table 8. Soil and sediment samples are still being analyzed by CSU’s SWPL. The results of these analyses will be provided to Oxnard upon return from CSU’s SWPL.

Table 8. Methods provided and used by Colorado State University's Soil, Water and Plant Testing Laboratory

Paste pH	Method 8C1b in Soil Survey Laboratory Methods Manual, Soil Survey Investigations Report No. 42, Version 3.0, January, 1996. USDA, NRCS, National Soil Survey Center. p. 411.
Electrical Conductivity	Method 8A1a in *Soil Survey Laboratory Methods Manual* (see above). p. 669.
Lime Estimate	Lime Estimate (by effervescence) in Workman, S.M., P.N. Soltanpour, and R.H. Follet. 1988. *Soil Testing Methods Used at Colorado State University for the Evaluation of Fertility, Salinity, and Trace Element Toxicity. Technical Bulletin LTB88-2.* Agricultural Experiment Station. Department of Agronomy. Soil Testing Laboratory. Cooperative Extension.
Organic matter	(Modified Walkely-Black); see the reference by Workman, et al.
Nitrate-N	Extraction with ammonium bicarbonate-diethylene triamine pentaacetic acid [DTPA], analysis by flow injection analysis using cadmium reduction; see the reference by Workman, et al.
Phosphorus	Extraction with ammonium bicarbonate-DTPA, analysis by molybdate-blue method; see the reference by Workman, et al.
Potassium, Zn, Fe, Mn, Cu	Extraction with ammonium bicarbonate-DTPA, analysis by inductively coupled plasma using a TJA Solutions IRIS Advantage radial ICP); see the reference by Workman, et al.
Sand, Silt, Clay	By Hydrometer; in *Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods,* 2nd edition. A. Klute, Ed. American Society of Agronomy, Soil Science Society of America, Madison, Wisconsin. 1986. "Chapter 15. Particle Size Analysis." G.W. Gee and J.W. Bauder. Method 15-5 Hydrometer Method. p. 404.
Extractable arsenic and selenium	Extraction with ammonium bicarbonate-DTPA, analysis by ICP-hydride; see the reference by Workman, et al.

Note: Methods provided and used by James R. Self, Ph.D., Director Colorado State University's Soil, Water and Plant Testing Laboratory, Natural and Environmental Sciences Building – A319, Fort Collins, Colorado 80523-1120, Phone: 970-491-5061, Fax: 970-491-2930.

3.2 Water Quality

Water addition at the time of baseline sampling was the Oxnard public water for which general water quality information was provided based on the 2011 annual water quality report. The Oxnard water quality report was split into four districts. An estimated composite water quality is included in table 9, where constituents were calculated based on concentrations, and a weighted average was based on percent of supply.

Table 9. Estimated Influent Water Quality from Oxnard's Annual Water Report[1]

Bulk Monitoring Parameters		Inorganic Chemicals	
Turbidity (monthly) (NTU)	0.03	Aluminum (ppb)	78.5
Total Chlorine Residual (ppm)	1.90	Arsenic (ppb)	2.0
Alkalinity (ppm)	156.3	Barium (ppb)	ND
Hardness (total hardness) (ppm)	389.0	Boron (ppb)	310.3
		Calcium (ppm)	96.4
pH (pH Units)	8.20	Chloride (ppm)	65.0
Specific Conductance (umho/cm)	506.5	Fluoride (ppb)	0.71
		Iron (ppb)	ND
Total Dissolved Solids (ppm)	755.9	Magnesium (ppm)	34.11
Total Organic Carbon (ppm)	1.6	Manganese (ppm)	0.0
Radionuclides		Nitrate (as N) (ppm)	0.4
Gross Alpha Particle Activity (pCi/L)	1.8	Nitrate (as NO_3) (ppm)	20.6
		Potassium (ppm)	3.0
Gross Beta Particle Activity (pCi/L)	ND	Selenium (ppb)	2.4
		Sodium (ppm)	61.5
Radon (pCi/L)	96.2	Sulfate (ppm)	319.1
Uranium (pCi/L)	3.0	Vanadium (ppb)	2.9

[1] ppm = parts per million; ppb = parts per billion; ND = not determined; pCi/L = picocuries per liter.

3.3. Wetland Hydraulics

3.3.1 Baseline Operating Conditions

Oxnard has kept records of the operating timeline. Planting occurred onsite the week of June 17, 2012; and during the site visit, all the wetland cells had been planted. The plan is for Oxnard to add concentrate to the wetland in the next few months. A timeline of concentrate addition and concentrate mixture quality is important because the wetland moves into operating with the MF/RO concentrate.

3.3.2 Wetland Water Volumes

Baseline water volume information for the wetland cells included the following information configured in table 10.

Table 10. Baseline Pictures and Observations of the Oxnard Wetland Stages

Wetland Stage	Pictures of Wetland Stages
Stage 1: Horizontal Subsurface Flow Wetlands were saturated with water flowing within the gravel support layer along the plant roots. Aeration was not occurring in these stages at the time of the site visit, so aeration rates were not recorded.	
Stage 2: Vertical Subsurface Upflow Wetlands were saturated with effluent flow from the horizontal subsurface flow units moving vertically through these units and into collection weirs for the surface flow marsh. At the time of the site visit, dissolved oxygen was not measured in the vertical upflow units. These analyses should be taken in accordance with the weekly monitoring suggestions.	
Stage 3: Surface Flow Marsh and Open Pond Stage 3 recently had been emptied and contained water only in the deep pool areas. Due to the absence of flow in the surface flow marsh, no information on general flow paths was recorded.	

3.3.3 MF/RO System

At the time of sampling, the membrane plant was under construction and not in operation. Baseline samples should be collected upon plant operation and concentrate addition to the wetland system. Upon completion, grab samples should be collected from the RO system feed, RO concentrate, and RO product and analyzed for the water quality parameters and constituents in the Table 3. Additional operational data should be recorded regaurding water recovery, water production, and operating pressures at the time sampling occurs.

4.0 Supplemental Wetland Research

Wetland research topics are provided based on previous conversations with the technical group. These topics should be further defined to determine facility capability, monitoring needs, and potential research collaboration with universities. Wetland research ideas include, but are not limited to, the following topic areas:

- Water balance processes and optimization
- Hydraulic tracer testing (i.e., lithium fluoride)
- Concentrate balance and accumulation in the system
- Contaminant fate and cycling
- Treatment model rate calibration
- Nutrient fate and removal
- Metal speciation, particularly selenium speciation in media beds to develop a total Se budget
- Bioattenuation of emergent contaminants of concern
- Engineered wetland design modifications
- Anaerobic media organic source supplementation
- MF/RO post-treatment prior to wetland application
- Process and mechanism analysis for scale-up issues and permitting
- Carbon sequestration potential
- Animal community organization and colonization
- Wetland comparison to native brackish wetland communities (biologic, wildlife, biotic, etc.)
- Plant tissue analysis to look at accumulation in biota
- Bacterial community identification and degradation rates
- Wildlife – invertebrate communities
- Macroinvertebrates – taxonomic inventory
- Mosquito control and use of mosquito fish
- Emerging contaminant uptake studies of bioaccumulation
- Toxicity testing of brackish organisms

5.0 References

California Regional Water Quality Control Board. Los Angeles Region (4). 1994. *Water Quality Control Plan Los Angeles Region: Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties*. State of California. Water Quality Objectives.

Daniels, J.S. (Thullen), B.S. Cade, J.J. Sartoris. 2010. "Measuring bulrush culm relationships to estimate plant biomass within a southern California constructed wastewater surface-flow wetland" in *Wetlands* 30(2): 231–239.

Sartoris, J.J., J.S. Thullen, L.B. Barber, and D.E. Salas. 2000. "Investigation of nitrogen transformations in a southern California constructed wastewater treatment wetland" in *Ecological Engineering* 14(1–2): 49–65.

Sartoris, J.J., J.S. Thullen, and L.B. Barber. 2000. "Effect of hemi-marsh reconfiguration on nitrogen transformations in a southern California treatment wetland" in *7th International Conference on Wetland Systems for Water Pollution Control*, November 11–16, 2000, Lake Buena Vista, Florida, Volume I. London: IWA Pub. p. 359–364.

United States Environmental Protection Agency. *Analytical Methods Approved for Compliance Monitoring Under the Enhanced Surface Water Treatment Rule*. Accessed July 18, 2012, at http://www.epa.gov/safewater/methods/analyticalmethods_ogwdw.html.

Appendix A – Monitoring Schedule

Monitoring Schedule

Monitoring Tasks	1 Month	2 Month	3 Month	4 Month	5 Month	6 Month	7 Month	8 Month	9 Month	10 Month	11 Month	12 Month
1. General Appearance												
Trash and waste removal												
Debris removal to prevent clogging												
2. Water Levels												
Inspect pump and weir boxes												
Inspect water depths in VF, SFM												
Influent/effluent flow rates												
3. Water Quality												
In-situ water analysis												
Bulk water quality parameters												
Metals, non-metals, nutrients												
Topics of interest analyses												
4. Vegetation												
Plant Inspection - general												
Plant stem density and diameters												
Areal vegetation coverage												
Plant biomass measurements												
Plant uptake analyses												
5. Soil and Sediment												
VF and SFM sample collection												
Laboratory soil analysis												
6. Wildlife												
Mosquito abatement												
Invasive species												
7. Educational Material												
Time lapse photographs												
Specific wetland interests												

Note: Schedule based on time since major changes in brine addition or new planting

Appendix B – Daily Monitoring Template

Date ____________________
Time ____________________
Operator ____________________

Daily Monitoring Tasks

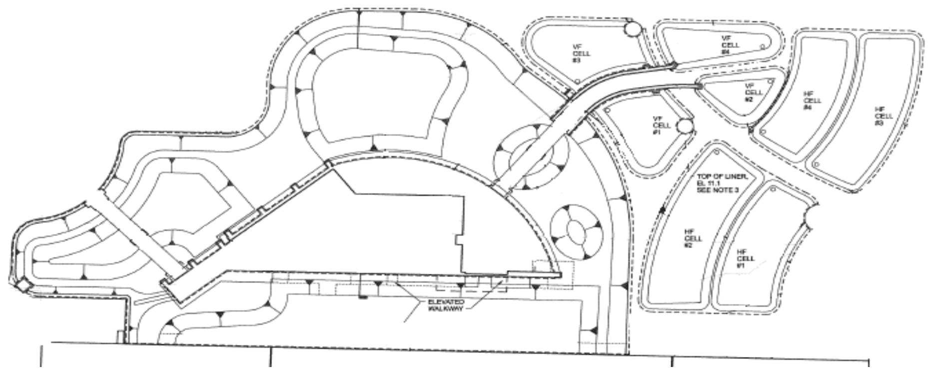
Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. General Appearance				
Cleanup of trash and waste products from the wetland area	☐	☐	☐	
2. Vegetation *				
Inspect plants for damage by animals, insects, or disease	☐	☐	☐	
Examine plants for general health (i.e., height, robustness, color, flowers, etc.)	☐	☐	☐	
If any problems are noted, deal with them as necessary	☐	☐	☐	
3. Debris Accumulation				
Inspect the inflow and outflow areas for problem accumulations of detritus and debris	☐	☐	☐	
Inspect for evidence of internal clogging (i.e. water ponding on the subsurface flow cells)	☐	☐	☐	
4. Water Levels				
Monitor water levels and inflow rates to protect wetland vegetation	☐	☐	☐	
Inspect inlet and outlet pumps and weir box ensure that the pump is working properly	☐	☐	☐	

* Only perform daily vegetation monitoring for the first two weeks after new plants are planted or for two weeks after a new brine mixture is added. After two week period refer to weekly schedule.

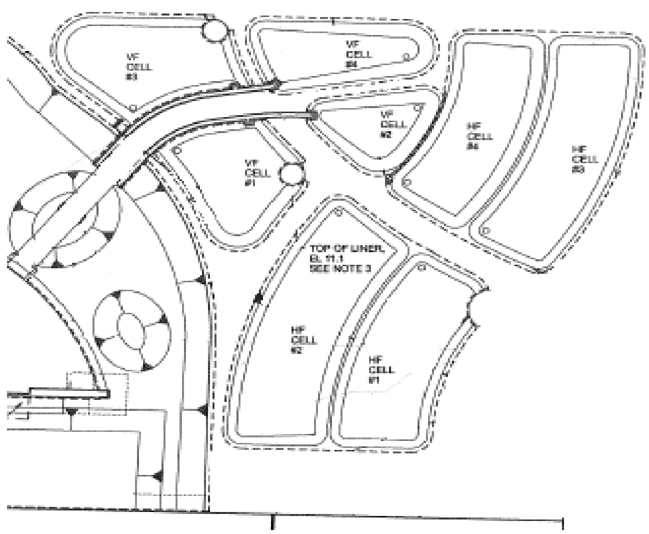
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Additional Monitoring Diagrams

1. Wetland System: Horizontal Flow (HF) Cells, Vertical Flow (VF) Cells, and Surface Flow Marsh (SFM)



2. First 2 Stages of Wetland System: Horizontal Flow (HF) Cells and Vertical Flow (VF) Cells



Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Appendix C – Weekly Monitoring Template

Date ______________________
Time ______________________
Operator ______________________

Weekly Monitoring Tasks

Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. Vegetation				
Inspect plants for damage by animals, insects, or disease	☐	☐	☐	______
Examine plants for general health (i.e., height, robustness, color, flowers, etc.)	☐	☐	☐	______
If any problems are noted, deal with them as necessary	☐	☐	☐	______
2. Water Levels				
Inspect the water depth of each wetland bed weekly	☐	☐	☐	______
3. Feed Water Mixture and Flow Rates				
Record general information on the influent/effluent wetland water mixture	☐	☐	☐	______

Influent mixture ________ % MF/RO Concentrate
Influent water flow rate _____ gpm
Effluent water flow rate _____ gpm

Water flow/weir levels: $HF1_{ef}$ _____ $HF2_{ef}$ _____ $HF3_{ef}$ _____ $HF4_{ef}$ _____ units _____
$VF1_{ef}$ _____ $VF2_{ef}$ _____ $VF3_{ef}$ _____ $VF4_{ef}$ _____ units _____

Monitoring Task and Description	Y	N	n/a	Notes:
4. Water Quality				
Perform in situ and sample monitoring of the specified locations and parameters	☐	☐	☐	______
Fill out data collection sheet on next page	☐	☐	☐	______

continues on next page

Note: HF: Horizontal Flow, VF: Vertical Flow, ef: effluent
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________
Time ____________________
Operator ____________________

Weekly Monitoring Tasks (continued)

Monitoring Task and Description

4. Water Quality

Sample Location	Temp. (° C)	pH	Cond. (mS/cm)	Turbidity (ntu)	DO (mg/L)
Wetland Feed	____	_____	_____	_____	_____
HF Cell 1 Effluent	____	_____	_____	_____	_____
HF Cell 2 Effluent	____	_____	_____	_____	_____
HF Cell 3 Effluent	____	_____	_____	_____	_____
HF Cell 4 Effluent	____	_____	_____	_____	_____
VF Cell 1 Effluent	____	_____	_____	_____	_____
VF Cell 2 Effluent	____	_____	_____	_____	_____
VF Cell 3 Effluent	____	_____	_____	_____	_____
VF Cell 4 Effluent	____	_____	_____	_____	_____
SFM1 Influent	____	_____	_____	_____	_____
SFM2 Influent	____	_____	_____	_____	_____
SFM Effluent	____	_____	_____	_____	_____

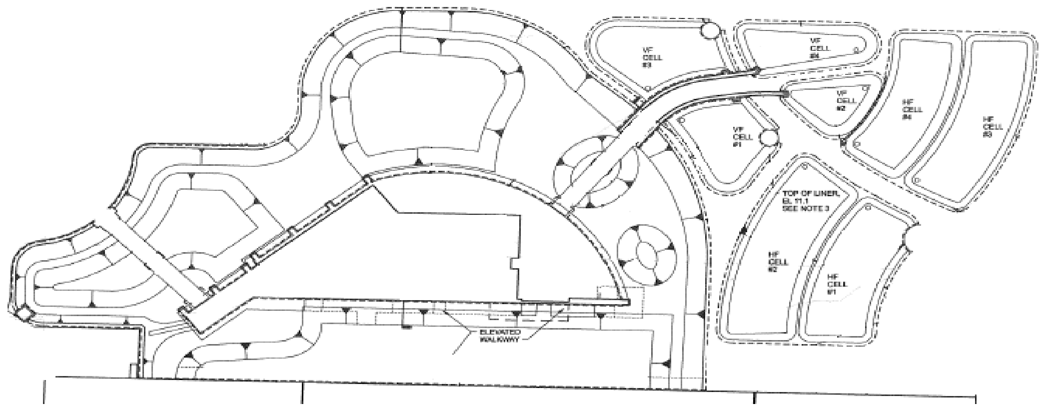
Note: HF: Horizontal Flow, VF: Vertical Flow, SFM: Surface Flow Marsh, mS/cm: microsiemens per centimeter, DO: Dissolved oxygen

* Only perform weekly vegetation monitoring only after two weeks of daily monitoring has been perform on new plants or after a new brine mixture is added.

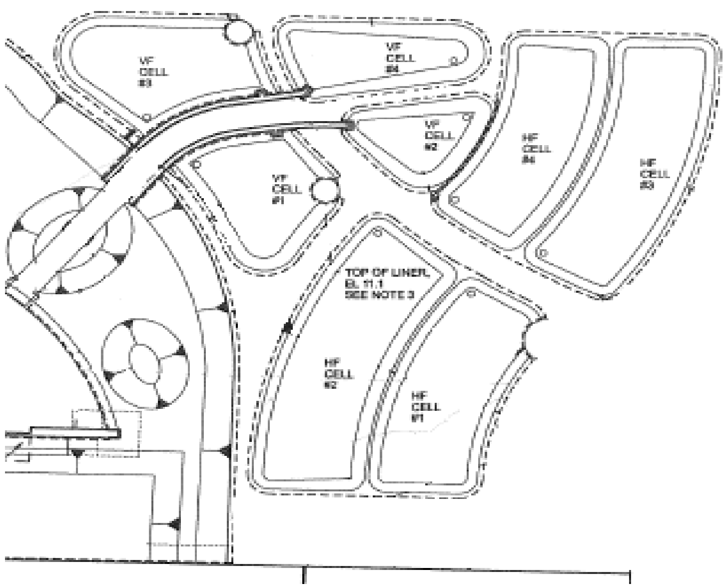
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Additional Monitoring Diagrams

1. Wetland System: Horizontal Flow (HF) Cells, Vertical Flow (VF) Cells, and Surface Flow Marsh (SFM)



2. First 2 Stages of Wetland System: Horizontal Flow (HF) Cells and Vertical Flow (VF) Cells



Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Appendix D – Monthly Monitoring Template

Date ____________________
Time ____________________
Operator ____________________

Monthly Monitoring Tasks

Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. Vegetation - 8 weeks after planting				
Plants should be inspected to determine whether 80% of each plant species survived	☐	☐	☐	____________
If < 80% survived, notify the plant contractor so dead plants can be replaced	☐	☐	☐	____________
2. Water Quality				
Grab samples collected and analyzed for specified parameters	☐	☐	☐	____________
Fill out sample collection information in the table below:	☐	☐	☐	____________

Parameter and Sample Location		
Wetland Influent (HF Influent)		
BOD_5	Sample ID: ____________	Laboratory: ____________
Fecal coliform	Sample ID: ____________	Laboratory: ____________
TDS/TSS	Sample ID: ____________	Laboratory: ____________
TOC/DOC	Sample ID: ____________	Laboratory: ____________
Alkalinity ($CaCO_3$)	Sample ID: ____________	Laboratory: ____________
Metals Sample	Sample ID: ____________	Laboratory: ____________
Non-Metals Sample	Sample ID: ____________	Laboratory: ____________
Nutrient Sample	Sample ID: ____________	Laboratory: ____________
Wetland Effluent (SFM Effluent)		
BOD_5	Sample ID: ____________	Laboratory: ____________
Fecal coliform	Sample ID: ____________	Laboratory: ____________
TDS	Sample ID: ____________	Laboratory: ____________
TSS	Sample ID: ____________	Laboratory: ____________
TOC and DOC	Sample ID: ____________	Laboratory: ____________
Alkalinity ($CaCO_3$)	Sample ID: ____________	Laboratory: ____________
Metals Sample	Sample ID: ____________	Laboratory: ____________
Non-Metals Sample	Sample ID: ____________	Laboratory: ____________
Nutrient Sample	Sample ID: ____________	Laboratory: ____________

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Note: HF: Horizontal Flow, SFM: Surface Flow Marsh
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________
Time ____________________
Operator ____________________

Monthly Monitoring Tasks (continued)

Monitoring Task and Description

HF 1 Effluent		
TDS and TSS	Sample ID: ____________	Laboratory: ____________
TOC and DOC	Sample ID: ____________	Laboratory: ____________
Alkalinity (CaCO3)	Sample ID: ____________	Laboratory: ____________
Metals Sample	Sample ID: ____________	Laboratory: ____________
Non-Metals Sample	Sample ID: ____________	Laboratory: ____________
Nutrient Sample	Sample ID: ____________	Laboratory: ____________
HF 2 Effluent		
TDS and TSS	Sample ID: ____________	Laboratory: ____________
TOC and DOC	Sample ID: ____________	Laboratory: ____________
Alkalinity (CaCO3)	Sample ID: ____________	Laboratory: ____________
Metals Sample	Sample ID: ____________	Laboratory: ____________
Non-Metals Sample	Sample ID: ____________	Laboratory: ____________
Nutrient Sample	Sample ID: ____________	Laboratory: ____________
HF 3 Effluent		
TDS and TSS	Sample ID: ____________	Laboratory: ____________
TOC and DOC	Sample ID: ____________	Laboratory: ____________
Alkalinity (CaCO3)	Sample ID: ____________	Laboratory: ____________
Metals Sample	Sample ID: ____________	Laboratory: ____________
Non-Metals Sample	Sample ID: ____________	Laboratory: ____________
Nutrient Sample	Sample ID: ____________	Laboratory: ____________
HF 4 Effluent		
TDS and TSS	Sample ID: ____________	Laboratory: ____________
TOC and DOC	Sample ID: ____________	Laboratory: ____________
Alkalinity (CaCO3)	Sample ID: ____________	Laboratory: ____________
Metals Sample	Sample ID: ____________	Laboratory: ____________
Non-Metals Sample	Sample ID: ____________	Laboratory: ____________
Nutrient Sample	Sample ID: ____________	Laboratory: ____________

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Note: HF: Horizontal Flow
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________
Time ____________________
Operator ____________________

Monthly Monitoring Tasks (continued)

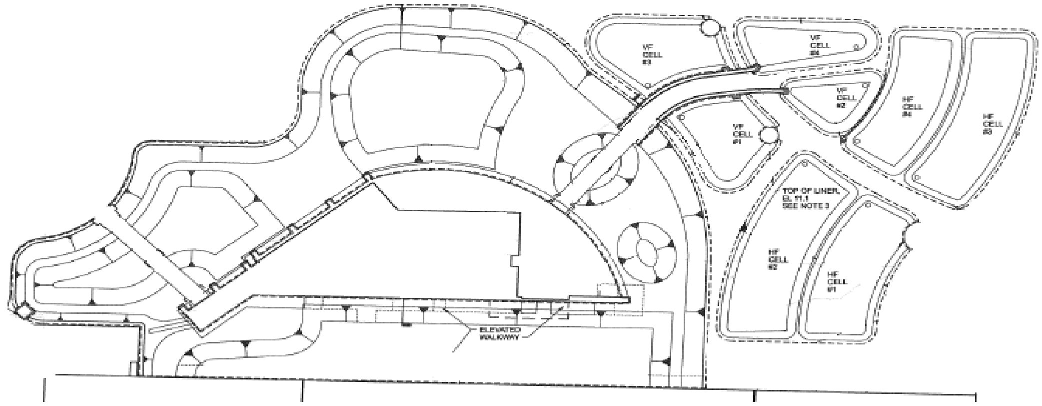
Monitoring Task and Description

VF 1 Effluent		
TDS and TSS	Sample ID: ______________	Laboratory: ______________
TOC and DOC	Sample ID: ______________	Laboratory: ______________
Alkalinity (CaCO3)	Sample ID: ______________	Laboratory: ______________
Metals Sample	Sample ID: ______________	Laboratory: ______________
Non-Metals Sample	Sample ID: ______________	Laboratory: ______________
Nutrient Sample	Sample ID: ______________	Laboratory: ______________
VF 2 Effluent		
TDS and TSS	Sample ID: ______________	Laboratory: ______________
TOC and DOC	Sample ID: ______________	Laboratory: ______________
Alkalinity (CaCO3)	Sample ID: ______________	Laboratory: ______________
Metals Sample	Sample ID: ______________	Laboratory: ______________
Non-Metals Sample	Sample ID: ______________	Laboratory: ______________
Nutrient Sample	Sample ID: ______________	Laboratory: ______________
VF 3 Effluent		
TDS and TSS	Sample ID: ______________	Laboratory: ______________
TOC and DOC	Sample ID: ______________	Laboratory: ______________
Alkalinity (CaCO3)	Sample ID: ______________	Laboratory: ______________
Metals Sample	Sample ID: ______________	Laboratory: ______________
Non-Metals Sample	Sample ID: ______________	Laboratory: ______________
Nutrient Sample	Sample ID: ______________	Laboratory: ______________
VF 4 Effluent		
TDS and TSS	Sample ID: ______________	Laboratory: ______________
TOC and DOC	Sample ID: ______________	Laboratory: ______________
Alkalinity (CaCO3)	Sample ID: ______________	Laboratory: ______________
Metals Sample	Sample ID: ______________	Laboratory: ______________
Non-Metals Sample	Sample ID: ______________	Laboratory: ______________
Nutrient Sample	Sample ID: ______________	Laboratory: ______________

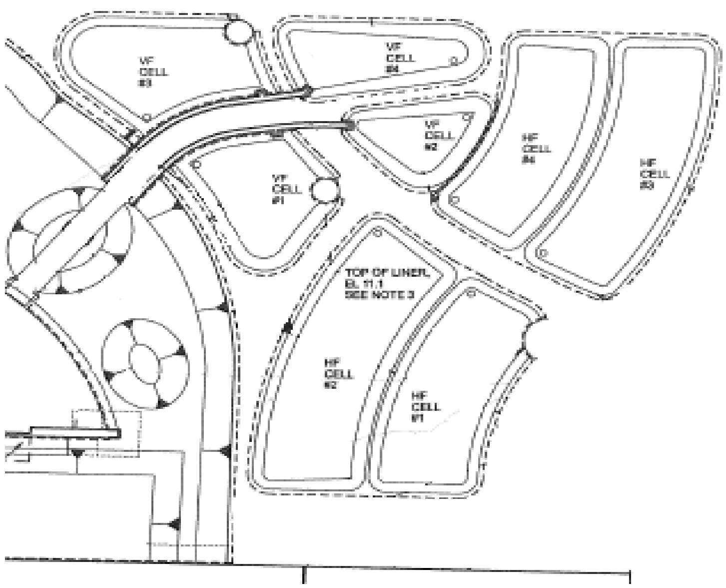
Note: VF: Vertical Flow
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Additional Monitoring Diagrams

1. Wetland System: Horizontal Flow (HF) Cells, Vertical Flow (VF) Cells, and Surface Flow Marsh (SFM)



2. First 2 Stages of Wetland System: Horizontal Flow (HF) Cells and Vertical Flow (VF) Cells



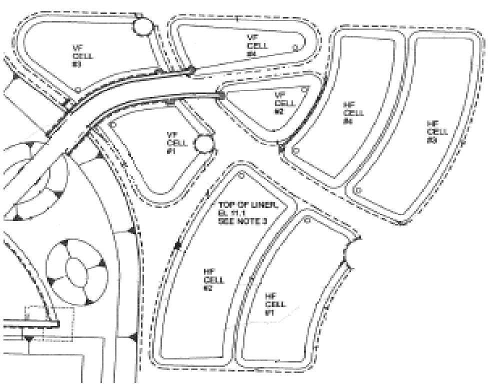
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Appendix E – Quarterly, Semiannual, and Annual Monitoring Template

Date ______________________
Time ______________________
Operator ______________________

Quarterly Monitoring Tasks

Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. Vegetatior				
Count the number of plants within two 0.0625-m^2 quadrats in each of the species block	☐	☐	☐	
Use calipers to measure the diameters of 10 stems within each of the quadrats	☐	☐	☐	
Fill out data collection sheets at the end of this page and on the following pages	☐	☐	☐	
2. Wildlife				
If mosquitoes become an issue, perform mosquito abatement as-needed	☐	☐	☐	
3. Educational Material				
Collection of educational material to support the exhibit such as time-lapse photographs	☐	☐	☐	
1. Vegetation (continued				
Identify Quadrat Locations on the Diagram	☐	☐	☐	



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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ________________________
Time ________________________
Operator ________________________

Quarterly Monitoring Tasks (continued)

Monitoring Task and Description

1. Vegetation (continued

	Quadrat 1 (species___________)	Quadrat 2 (species___________
HF1:	______________ # of plants	_______________ # of plant
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________
HF2:	______________ # of plants	_______________ # of plant
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________
HF3:	______________ # of plants	_______________ # of plant
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length

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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________________
Time ____________________________
Operator ____________________________

Quarterly Monitoring Tasks (continued)

Monitoring Task and Description

1. Vegetation (continued

	Quadrat 1 (species___________)	Quadrat 2 (species___________
HF4:	______________ # of plants	_______________ # of plant
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF1:	______________ # of plants	_______________ # of plant
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF1:	______________ # of plants	_______________ # of plant
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length

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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________
Time ____________________
Operator ____________________

Quarterly Monitoring Tasks (continued)

Monitoring Task and Description

1. Vegetation (continued

	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF2:	______________ # of plants	_______________ # of plant
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF2:	______________ # of plants	_______________ # of plant
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF3:	______________ # of plants	_______________ # of plant
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl

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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ___________________________
Time ___________________________
Operator ___________________________

Quarterly Monitoring Tasks (continued)

Monitoring Task and Description

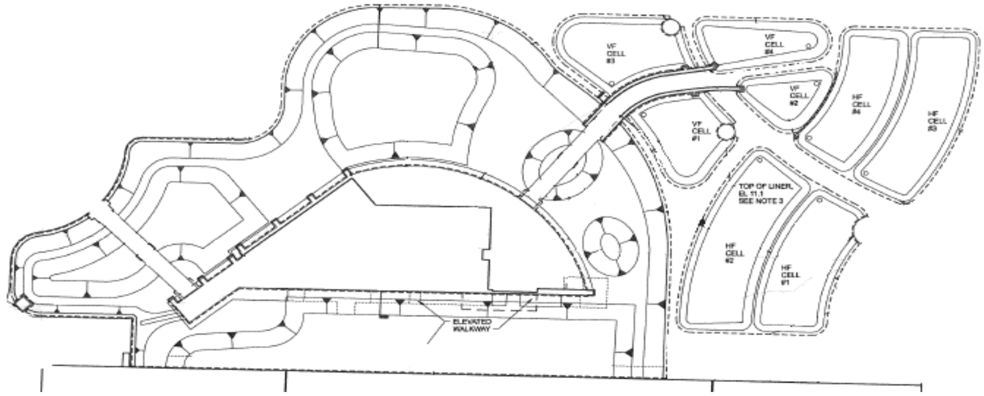
1. Vegetation (continued

	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF3:	_____________ # of plants	_______________ # of plant
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF4:	_____________ # of plants	_______________ # of plant
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
	Quadrat 1 (species___________)	Quadrat 2 (species___________
VF4:	_____________ # of plants	_______________ # of plant
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/lengtl

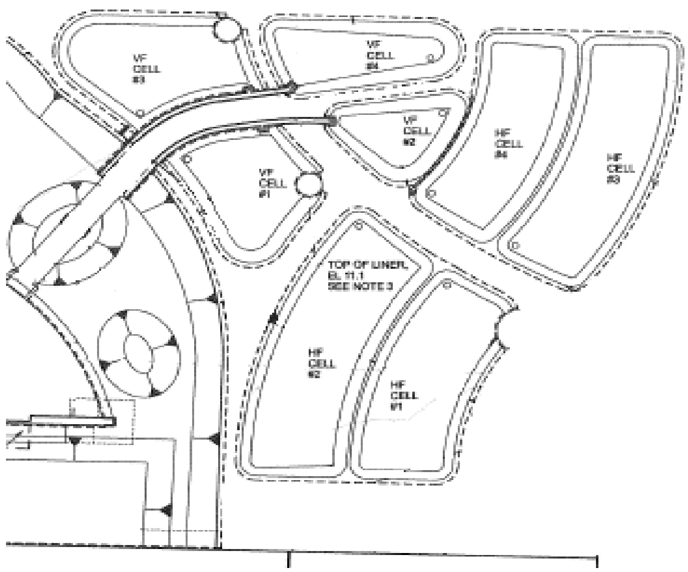
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Additional Monitoring Diagrams

1. Wetland System: Horizontal Flow (HF) Cells, Vertical Flow (VF) Cells, and Surface Flow Marsh (SFM)



2. First 2 Stages of Wetland System: Horizontal Flow (HF) Cells and Vertical Flow (VF) Cells



Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________
Time ____________________
Operator ____________________

Semiannual Monitoring Tasks

Monitoring Task and Description	Completed Y	Completed N	Completed n/a	Notes:
1. Vegetation Estimate the percent of area that each plant species covers within each pilot cell section	☐	☐	☐	____________________
Photograph each section with identifications (i.e., plant name, cell section, date, etc.)	☐	☐	☐	____________________

California bulrush

HF1 __________ % Area   HF2 __________ % Area

HF3 __________ % Area   HF4 __________ % Area

Yerba mansa

VF1 __________ % Area   VF2 __________ % Area

VF3 __________ % Area   VF4 __________ % Area

Saltgrass

VF1 __________ % Area   VF2 __________ % Area

VF3 __________ % Area   VF4 __________ % Area

Softstem bulrush

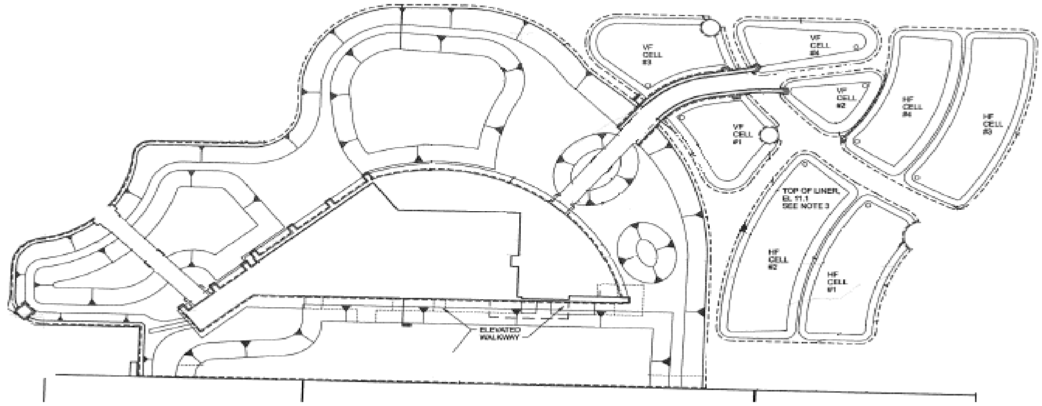
VF1 __________ % Area   VF2 __________ % Area

VF3 __________ % Area   VF4 __________ % Area

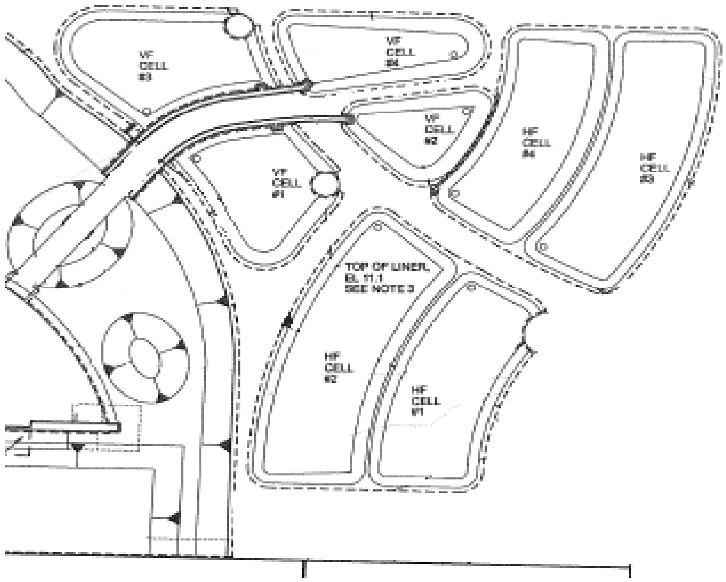
Note: HF: Horizontal Flow, VF: Vertical Flow
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Additional Monitoring Diagrams

1. Wetland System: Horizontal Flow (HF) Cells, Vertical Flow (VF) Cells, and Surface Flow Marsh (SFM)



2. First 2 Stages of Wetland System: Horizontal Flow (HF) Cells and Vertical Flow (VF) Cells

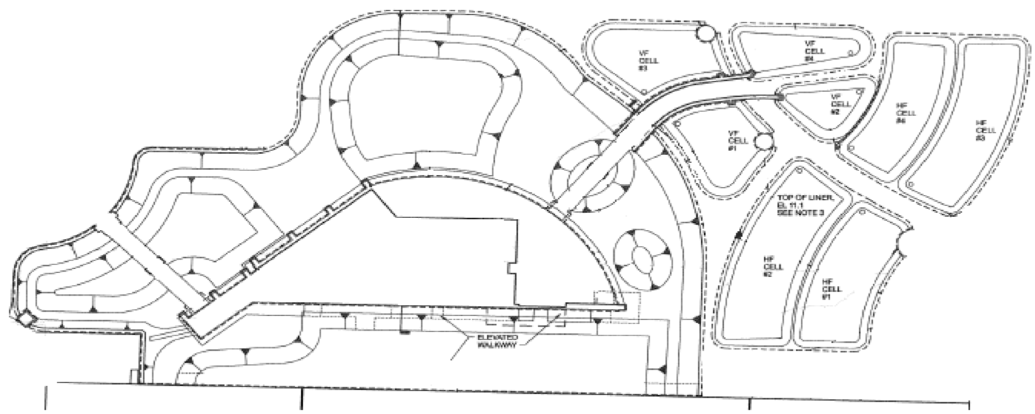


Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ______________________
Time ______________________
Operator ______________________

Annual Monitoring Tasks

Monitoring Task and Description	Completed Y	N	n/a	Notes:
1. Soil and Sediment				
Grab samples from each vertical flow cell and fron two locations in the surface flow wetland	☐	☐	☐	
Identify grab sample locations on diagram	☐	☐	☐	



Monitoring Task and Description	Completed Y	N	n/a	Notes:
Send to an analytical laboratory for soil and sediment analysis	☐	☐	☐	
2. Water Quality				
Collect additional wetland influent and effluent water samples for topics of interest (TBD):	☐	☐	☐	
Pesticides	☐	☐	☐	
PCBs	☐	☐	☐	
Radioactive Substances	☐	☐	☐	
Whole Effluent Toxicity	☐	☐	☐	
Other:____________________________	☐	☐	☐	

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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________
Time ____________________
Operator ____________________

Annual Monitoring Tasks (continued)

Monitoring Task and Description	Completed Y	N	n/a	Notes:
3. Vegetation				
Select four representative plants per species and remove from wetland cells	☐	☐	☐	
Send two samples/species to an analytical lab for uptake analyses	☐	☐	☐	
Separate the other two samples/species into above and below ground sections	☐	☐	☐	
Dry for 48 hours in a 38-°C oven, weigh each portion, and record below	☐	☐	☐	

California bulrush
Rep 1 __________ above ground weight   Rep 1 __________ below ground weight
Rep 2 __________ above ground weight   Rep 2 __________ below ground weight

Yerba mansa
Rep 1 __________ above ground weight   Rep 1 __________ below ground weight
Rep 2 __________ above ground weight   Rep 2 __________ below ground weight

Saltgrass
Rep 1 __________ above ground weight   Rep 1 __________ below ground weight
Rep 2 __________ above ground weight   Rep 2 __________ below ground weight

Softstem bulrush
Rep 1 __________ above ground weight   Rep 1 __________ below ground weight
Rep 2 __________ above ground weight   Rep 2 __________ below ground weight

Monitoring Task and Description	Y	N	n/a	Notes:
Count the number of plants within two 0.0625-m^2 quadrats in each of the species block	☐	☐	☐	
Use calipers to measure the diameters of 10 stems within each of the quadrats	☐	☐	☐	
Fill out data collection sheets at the end of this page and on the following pages	☐	☐	☐	

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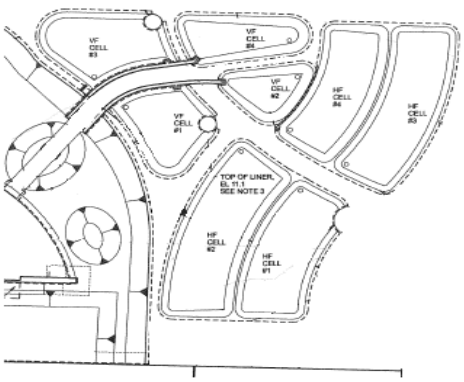
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________________
Time ____________________________
Operator ____________________________

Annual Monitoring Tasks (continued)

Monitoring Task and Description	Completed Y	N	n/a	Notes:
3. Vegetation (continued) Identify Quadrat Locations on the Diagram	☐	☐	☐	____________________________



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3. Vegetation (continued)

	Quadrat 1 (species___________)		Quadrat 2 (species___________)	
HF1:	______________	# of plants	______________	# of plants
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length
HF1:	_______/_______	stem diameter/length	_______/_______	stem diameter/length

Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________________
Time ____________________________
Operator ____________________________

Annual Monitoring Tasks (continued)

Monitoring Task and Description

3. Vegetation (continued)

	Quadrat 1 (species___________)	Quadrat 2 (species___________)
HF2:	_______________ # of plants	_______________ # of plants
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________)
HF3:	_______________ # of plants	_______________ # of plants
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________)
HF4:	_______________ # of plants	_______________ # of plants
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
HF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length

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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________________
Time ____________________________
Operator ____________________________

Annual Monitoring Tasks (continued)

Monitoring Task and Description

3. Vegetation (continued)

	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF1:	______________ # of plants	_______________ # of plants
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF1:	______________ # of plants	_______________ # of plants
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF1:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF2:	______________ # of plants	_______________ # of plants
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length

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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________________
Time ____________________________
Operator ____________________________

Annual Monitoring Tasks (continued)

Monitoring Task and Description

3. Vegetation (continued)

	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF2:	_______________ # of plants	________________ # of plants
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF2:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF3:	_______________ # of plants	________________ # of plants
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF3:	_______________ # of plants	________________ # of plants
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF3:	_______/_______ stem diameter/length	_______/_______ stem diameter/length

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Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Date ____________________

Time ____________________

Operator ____________________

Annual Monitoring Tasks (continued)

Monitoring Task and Description

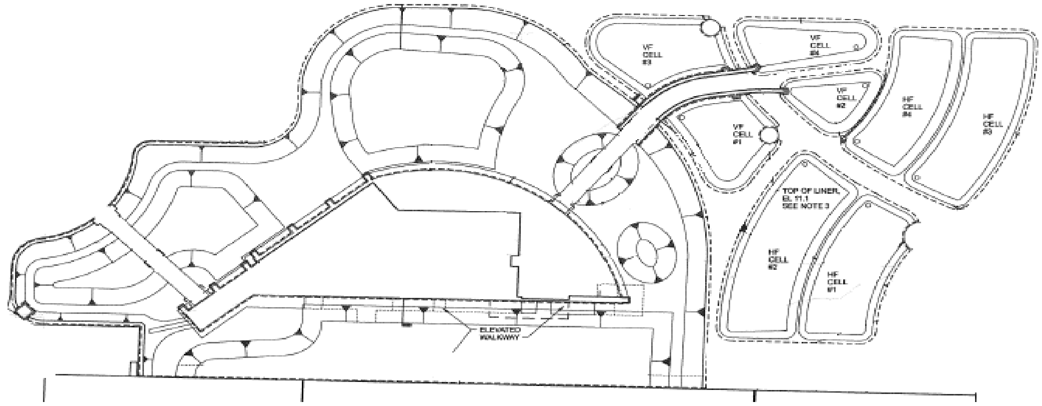
3. Vegetation (continued)

	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF4:	_______________ # of plants	_______________ # of plants
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
	Quadrat 1 (species___________)	Quadrat 2 (species___________)
VF4:	_______________ # of plants	_______________ # of plants
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length
VF4:	_______/_______ stem diameter/length	_______/_______ stem diameter/length

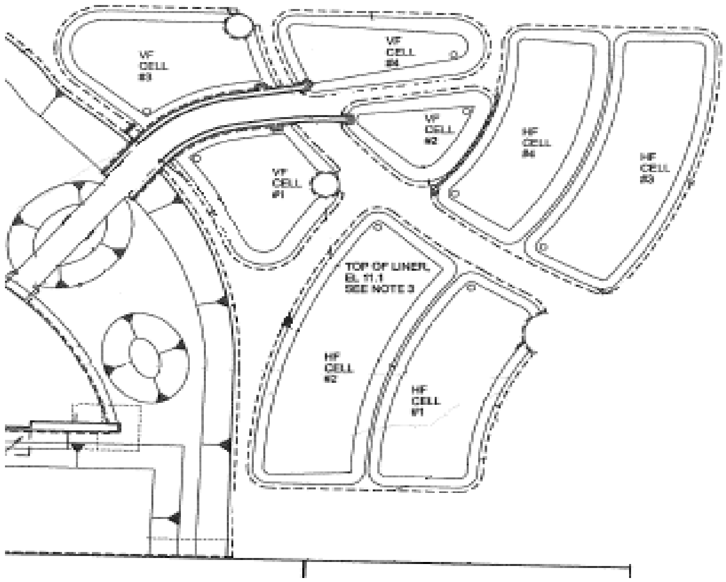
Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.

Additional Monitoring Diagrams

1. Wetland System: Horizontal Flow (HF) Cells, Vertical Flow (VF) Cells, and Surface Flow Marsh (SFM)



2. First 2 Stages of Wetland System: Horizontal Flow (HF) Cells and Vertical Flow (VF) Cells



Refer to the Oxnard Monitoring Plan for further details on monitoring methods and frequency.