# A Community Approach to Puddingstone Watershed Restoration

# Ultimate Goal

To make Puddingstone Reservoir and the Frank G. Bonelli Regional park a more inviting place to be for both the community and ecosystem while improving the overall health of the watershed.

# Agenda

- Team Introduction
- Site and Context
- Problem Statement
- Solutions
- Outcomes

# Introduction

# Project Team

Alex
Berk

Eduardo
Contreras

Jon
Del Rosario

Albert
Hong

Andrew
Novak

Cristopher
Rodriguez Paz

Alan
De Nova

Flora
Delgado

Francisco
Ponce

Ryan
Porras

Marifel
Retuta

Amanda
Saleeba

Anna
Shao

Jose
Talavera

Ernesto
Torres

Alex
Vasquez

# Advisors

Omar Mora, Ph.D, LSIT
Cal Poly Pomona

Monica Palomo, Ph.D., P.E., BCEE
Cal Poly Pomona

Kevin Grell, Ph.D
Cal Poly Pomona

Steve Steinberg, Ph.D, MPA, GISP
Los Angeles County GIS

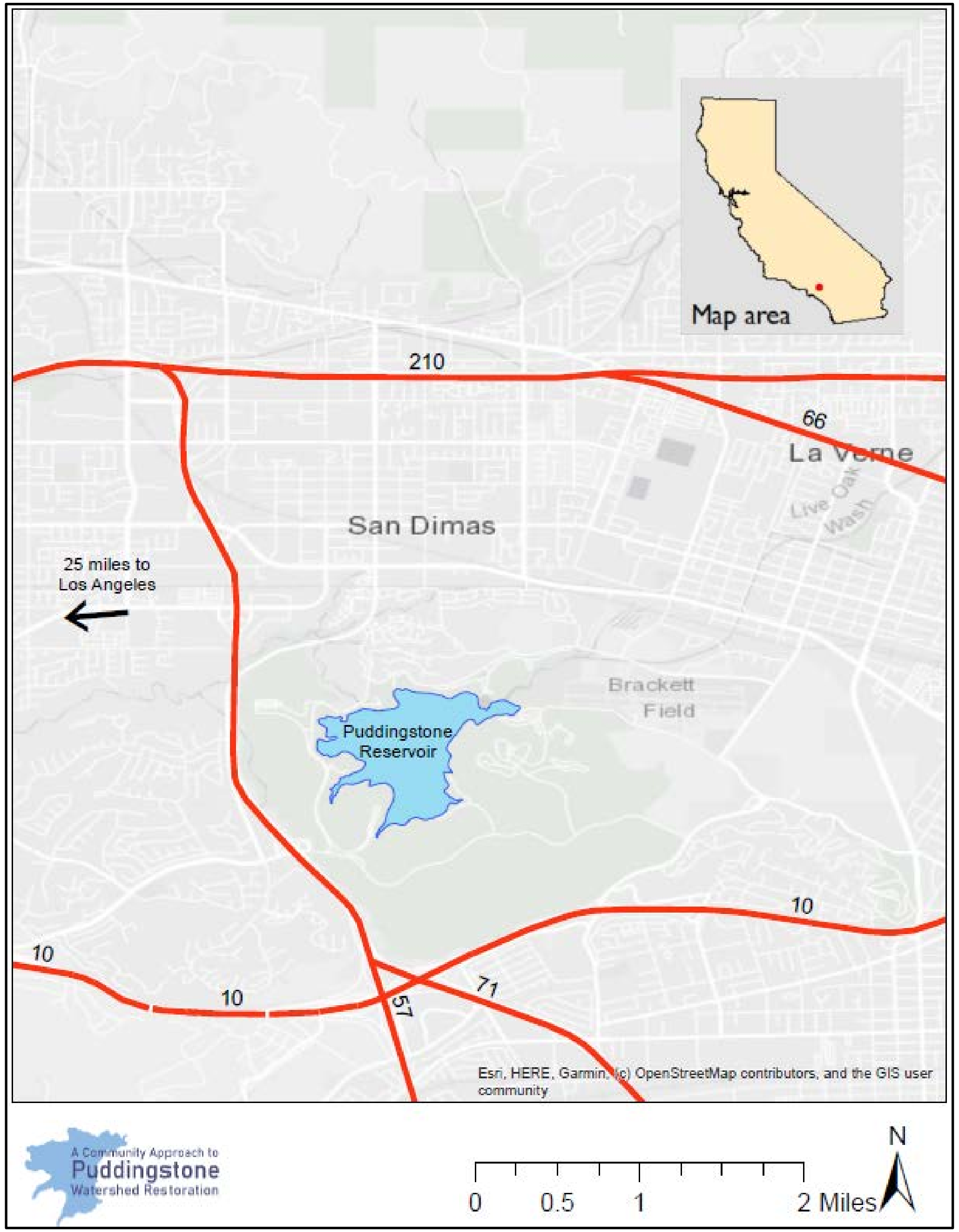
John Robinson, Principal
John Robinson Consulting, Inc.

Ben Macaluso, VP
WestLAND Group, Inc.

John Diaz
Los Angeles County
Parks & Recreation

Jose Caprile
Los Angeles County
Public Works

# Site & Context




# Background

- Near the cities of La Verne, Pomona, & San Dimas
- Puddingstone Reservoir was created upon the completion of the Puddingstone Dam in 1928

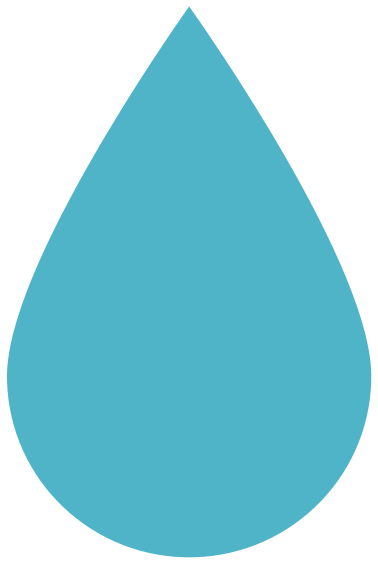
# The Puddingstone Community

- Community uses Puddingstone Reservoir for recreational purposes
- Local businesses rely on the traffic the attraction brings

**Bonelli Bluffs RV Park**

- Fish caught in the summer must be released due to high mercury content
- Water quality is so bad they need to shut down swimming areas

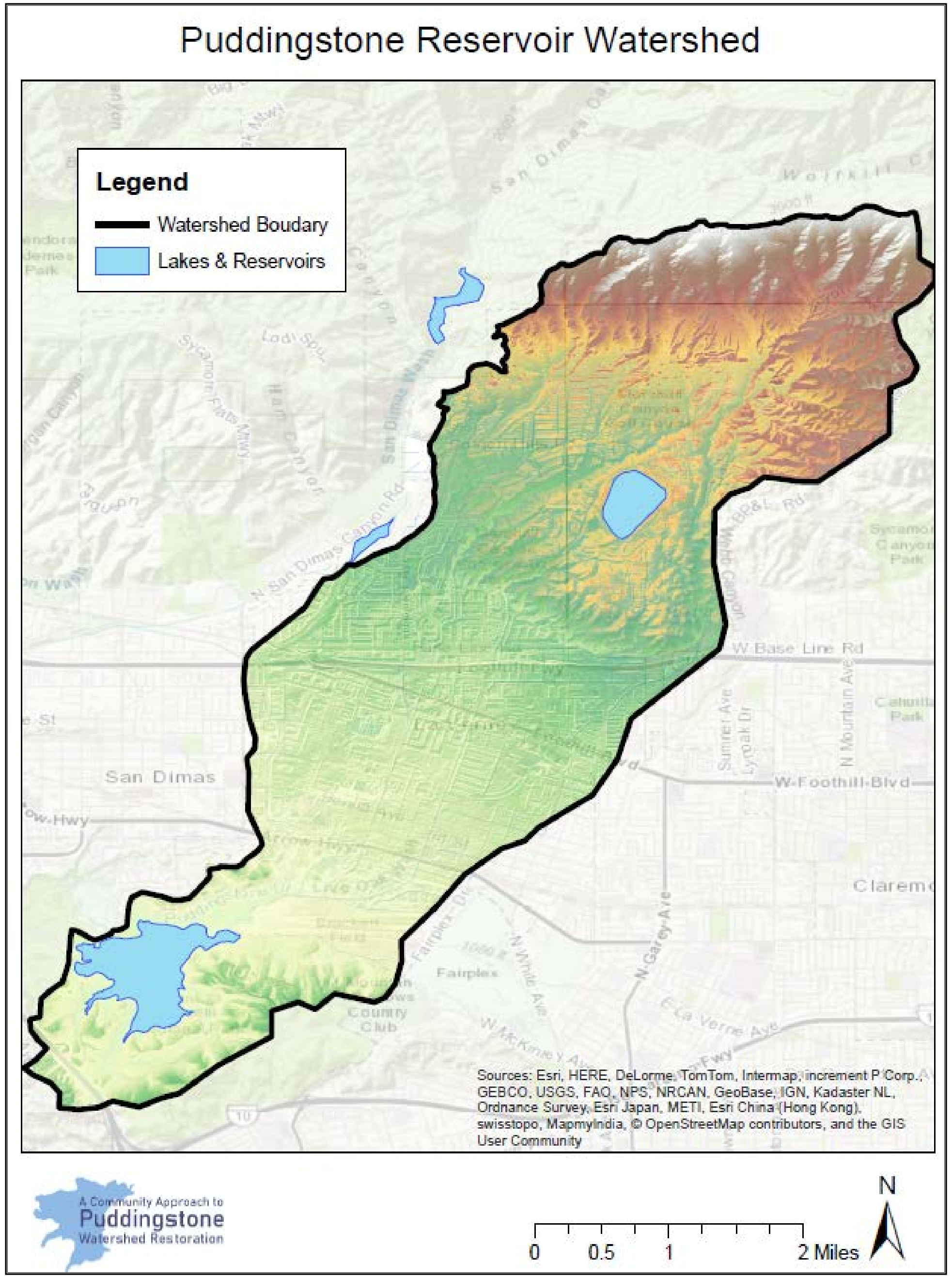

# Hydrology



# Watershed Characteristics

This data has been collected to compute flow calculations for the watershed.

| | |
|---|---|
| Watershed Length (ft) | 39,653 |
| Stream Length (ft) | 23,800 |
| Watershed Area ($ft^2$) | 363,500 |
| Watershed Area ($mi^2$) | 13 |
| Highest Elevation (ft) | 3,584 |
| Lowest Elevation (ft) | 944 |
| Basin Relief (ft) | 2,640 |
| Overall Slope | 6.6% |
| Highest Elevation of Stream (ft) | 1,536 |
| Lowest Elevation of Stream (ft) | 944 |
| Stream Relief (ft) | 592 |
| Stream Slope | 2.5% |



# Problem Statement

# What problems are there with the site?

Polluted Runoff Flowing In From Live Oak Wash Creates An Undesirable Odor

Low Dissolved Oxygen & High Organic Matter: Overall Appearance of Reservoir

Mercury, DDT, PCBs: Eating Fish Can Harm People & Ultimately Harm Businesses

# Water Quality

Surface Water Analysis

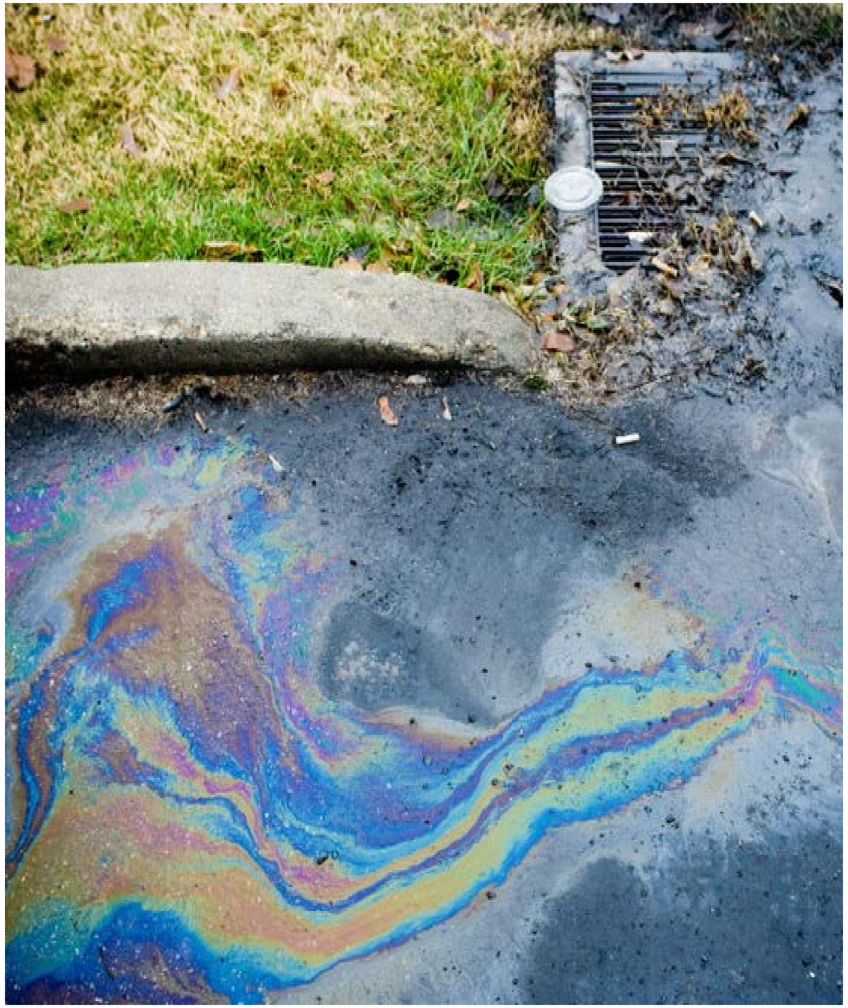
Sediment Analysis

# Surface Water Analysis

| Test | Unit | Results | Condition | Goal |
| --- | --- | --- | --- | --- |
| Turbidity | NTU | 2.6 | Typical for fresh waters | <10 |
| Conductivity | uS/cm | 472.9 | Typical for fresh waters | 50-1500 |
| Free Reactive Phosphorus | ug/L | 5.0 | Contribute to algae growth | N/A |
| Dissolved Oxygen | mg/L | 8.6 | Able to support most fish | >6 |
| Chlorophyll a | ug/L | <10 | Mesotrophic | 0 – 2.6 |
| Total Phosphorus | ug/L | 31.0 | Eutrophic waters | <12 |
| Alkalinity | mg/L as $CaCO_3$ | 111.6 | Buffered | >101 |
| Total Hardness | mg/L as $CaCO_3$ | 36.0 | Soft | 0 – 60 |
| Total Nitrate | mg/L | <0.02 | Typical for fresh waters | <1 |
| Nitrite | mg/L | <0.02 | Typical for fresh waters | <1 |
| Nitrate | mg/L | <0.02 | Typical for fresh waters | <1 |
| Total Kjeldahl Nitrogen | mg/L | 0.5 | Typical for fresh waters | <1 |
| Total Nitrogen | mg/L | 0.5 | Typical for fresh waters | <1 |
| pH | N/A | 7.4 | Typical for fresh waters | 6 – 9 |
| Mercury in Fish Tissue | ppm | 0.686 | High Concentrations | 0.22 |

## EPA Surface Water Standards

Sampling Date: 9/27/2019
Performed by: Aquatechnex LLC



# Polluted Runoff

DDT

Chlordane

Phosphorus



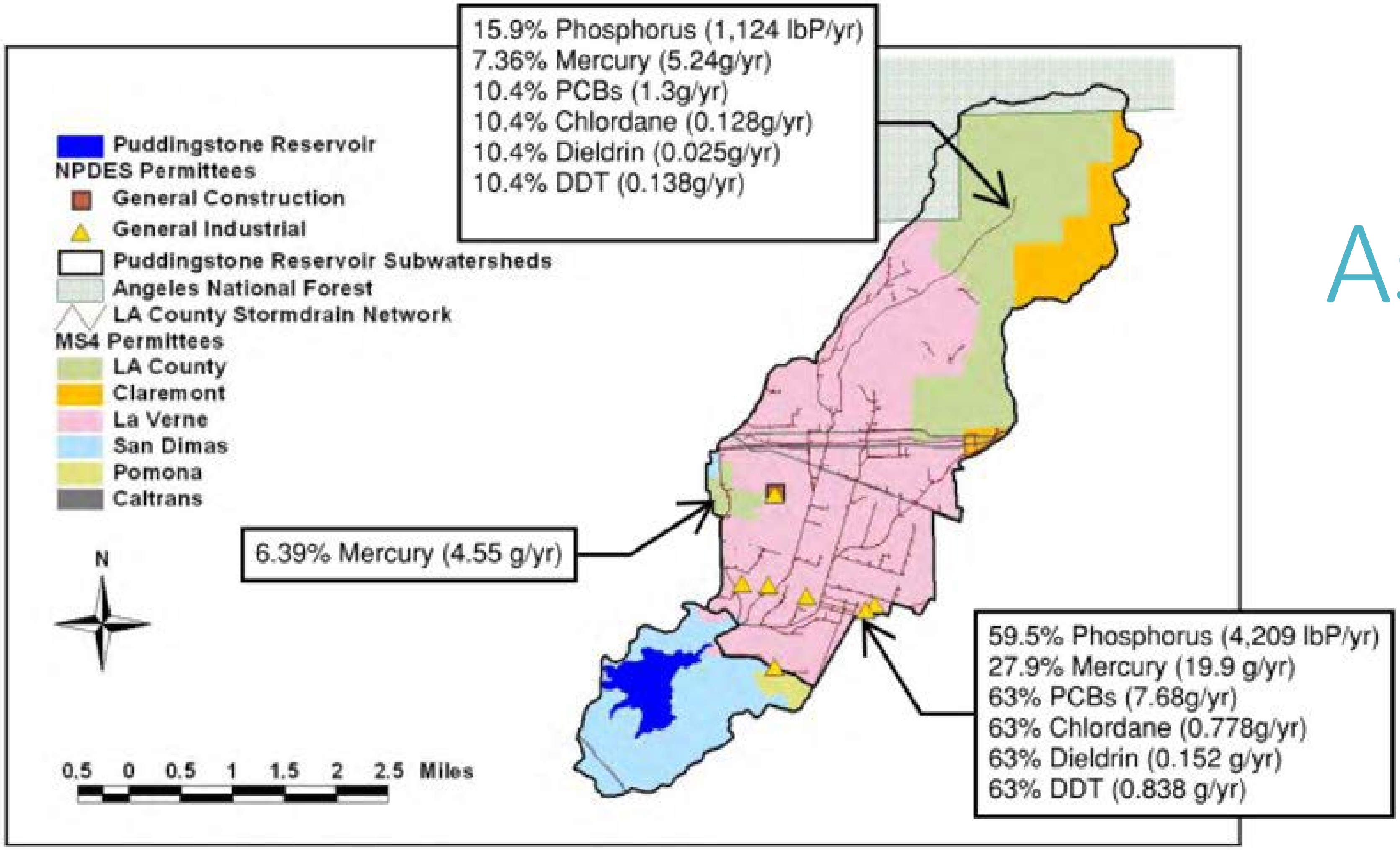
# Low Dissolved Oxygen & High Organic Matter

Algal Blooms

Murky Water

Odor

# Source Assessment



# Sediment Analysis

EPA Region IX Study– March 2012

Los Angeles Area Lakes – TMDLs

Puddingstone Reservoir

| Contaminant | Unit | Results | Goal |
|---|---|---|---|
| PCBs | ug/kg | 4.99 | 0.59 |
| Chlordane | ug/kg | 2.15 | 0.75 |
| Dieldrin | ug/kg | 1.32 | 0.22 |
| DDT | ug/kg | 7.44 | 3.94 |

# Mercury & PCBs

# Environmental Impact Report

## Areas Analyzed

AESTHETICS

AIR QUALITY

BIOLOGICAL RESOURCES

CULTURAL RESOURCES

HYDROLOGY AND WATER QUALITY

NOISE

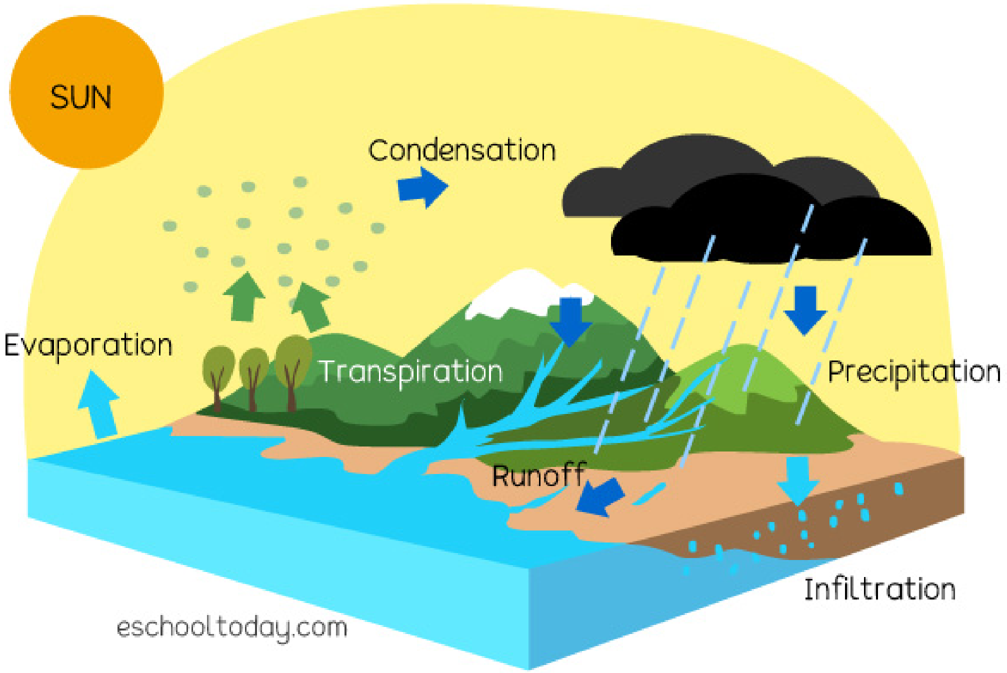
RECREATION

# Why do these problems need to be solved now & What happens if they are not?

- Human Health
- Groundwater Contamination
- Climate Change
- Urbanization
- Wildfires

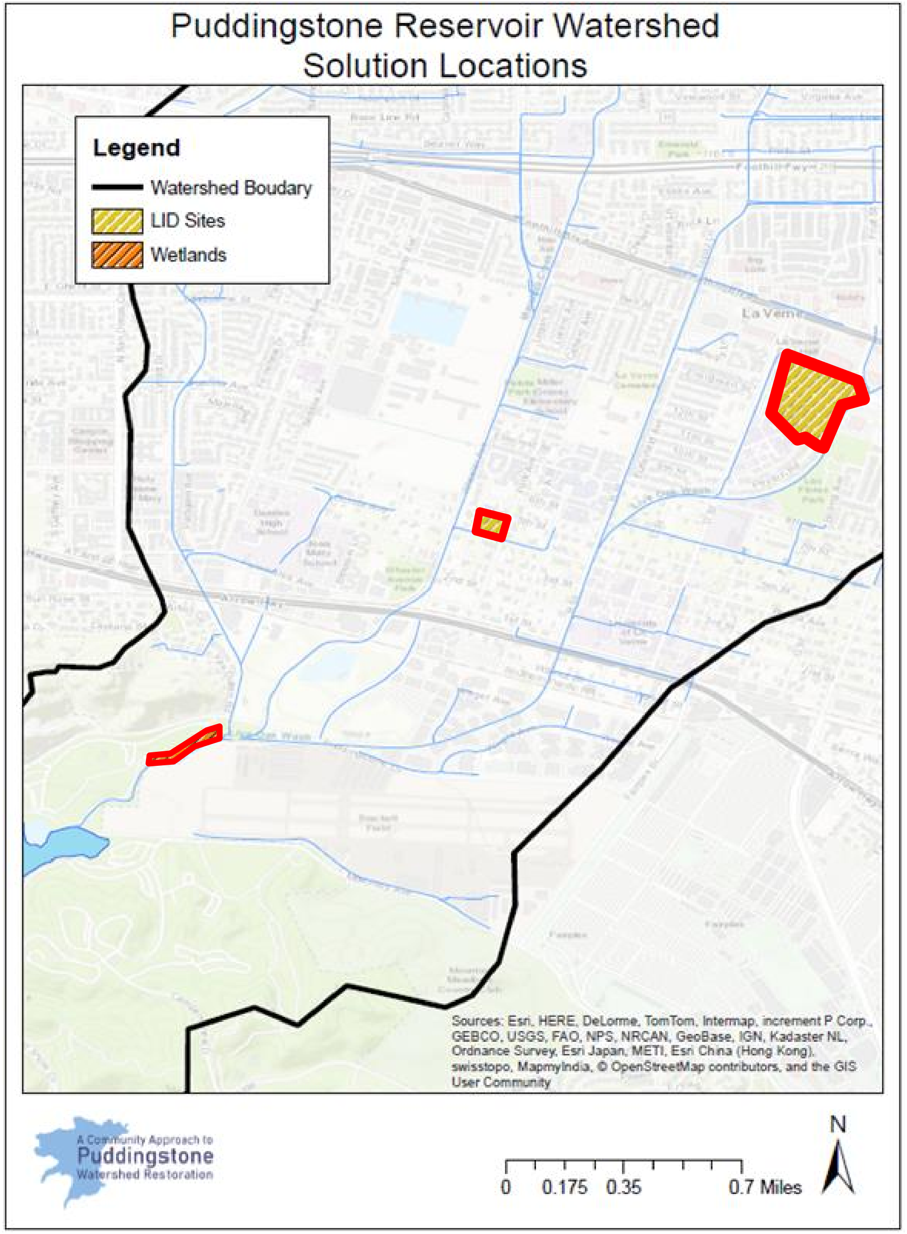
# Proposed Solutions

# Scope




"Restoration of a process is more likely to succeed than restoration aimed at a fixed endpoint."

- *Wohl et al (2005)*




# Treatment Process

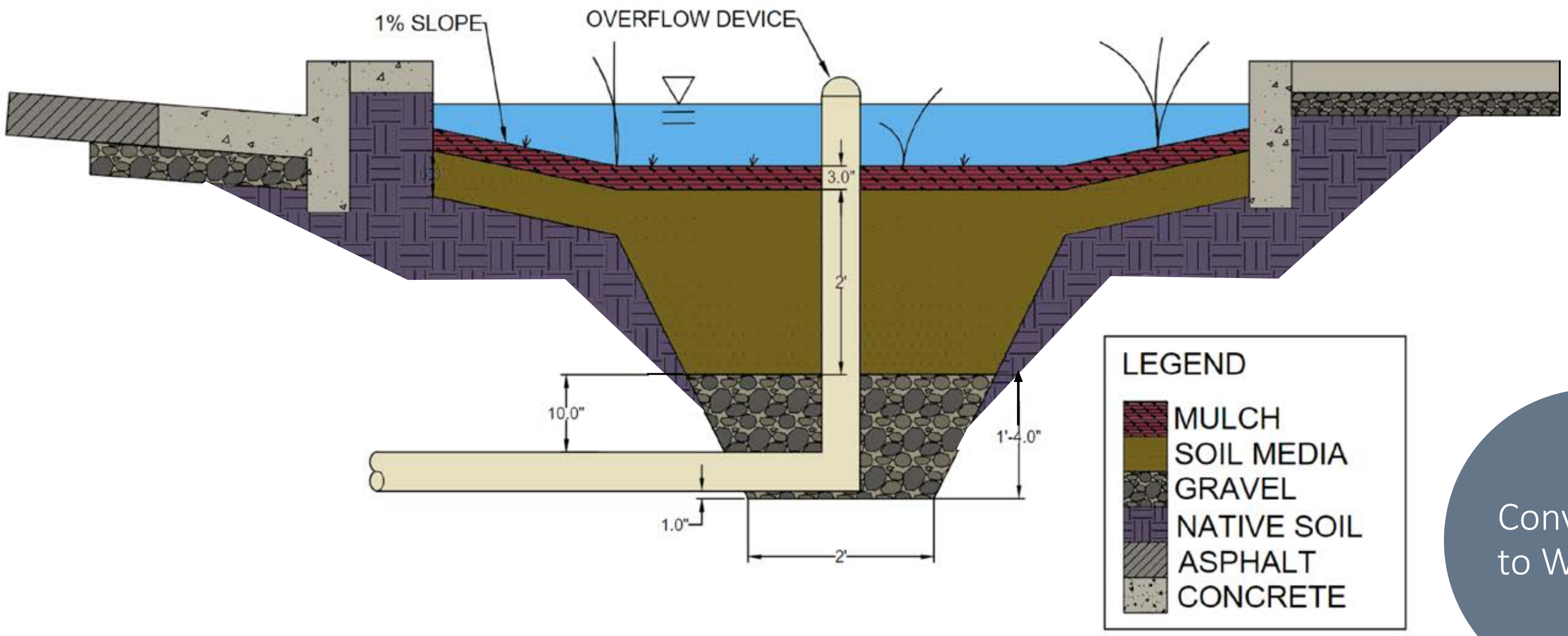
Heavy Metals & Nitrogen — **Biofiltration**

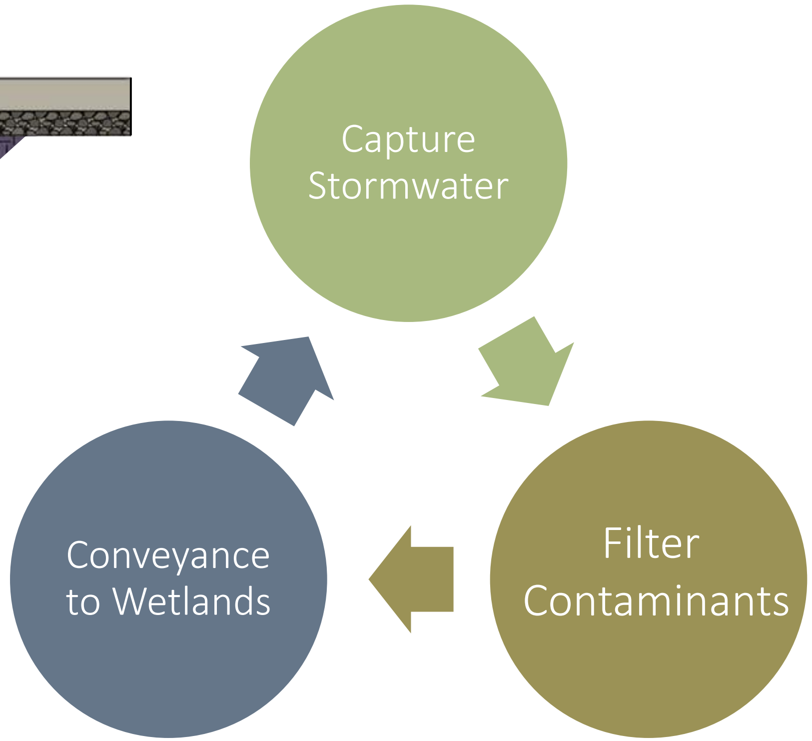

Mercury — **Chemical Treatment**

Phosphorous & Remaining Nitrogen — **Wetlands**

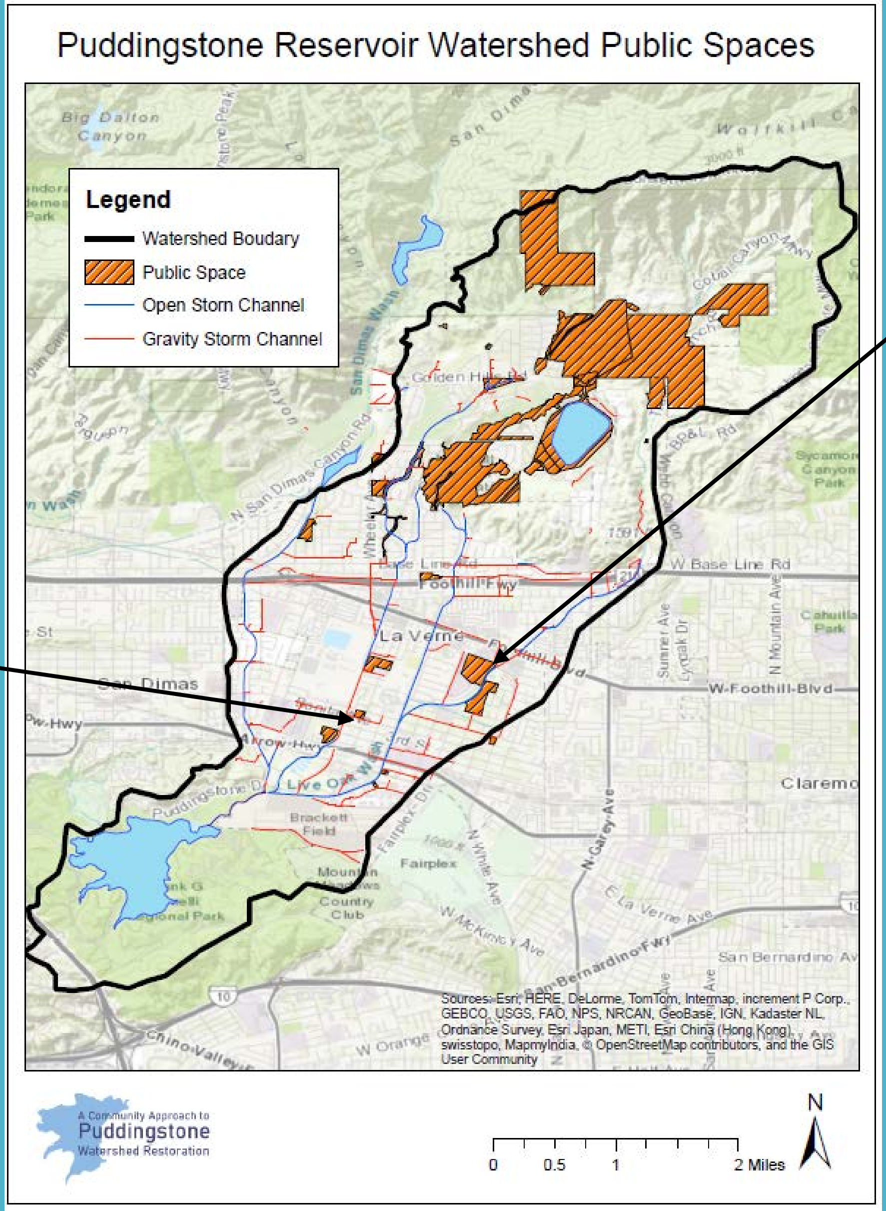
# Low Impact Development

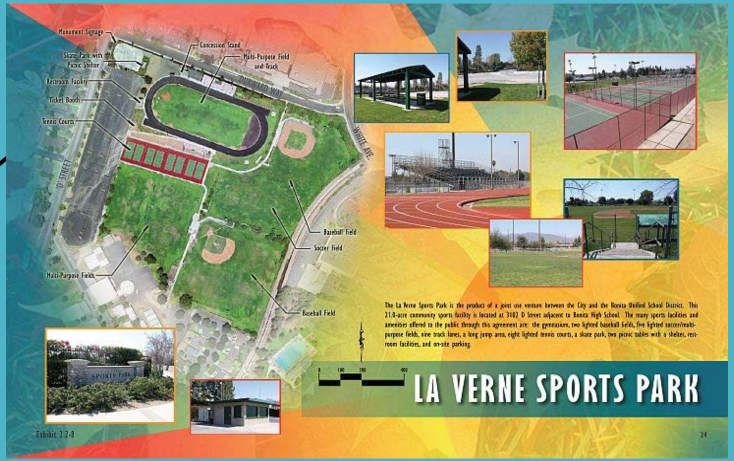
# Treating Stormwater with LIDs

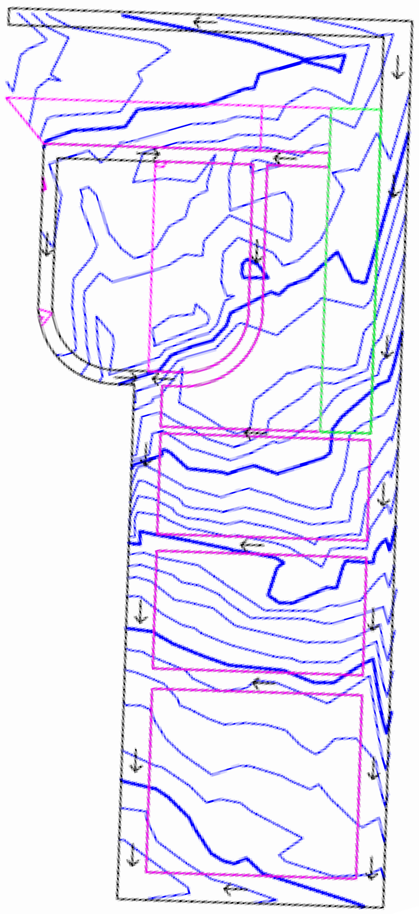


# LID
# Retrofit Sites

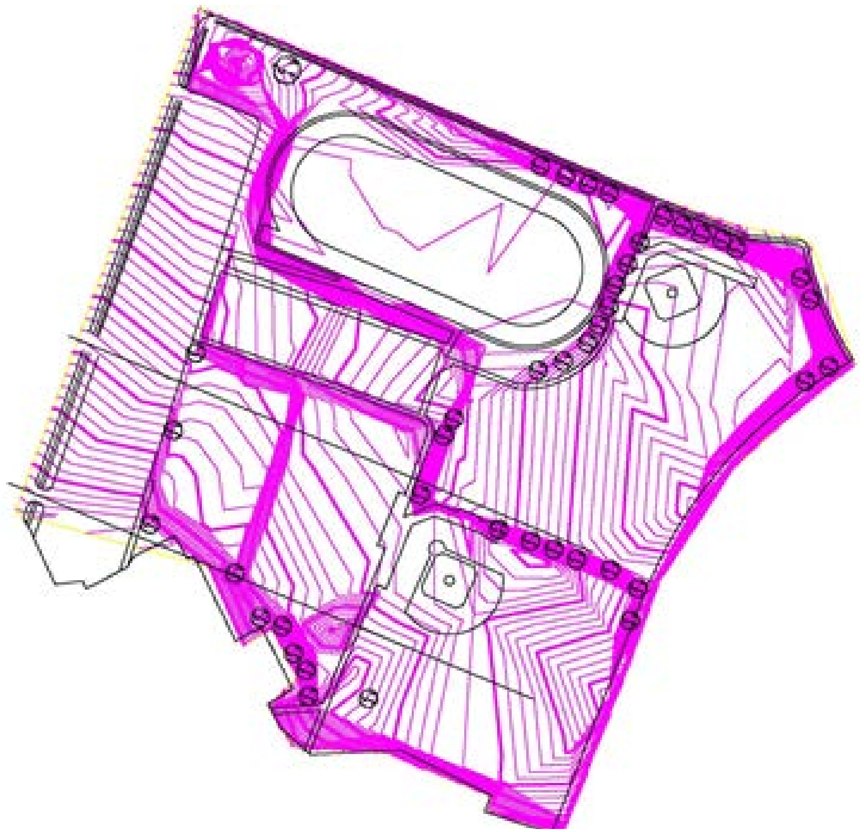


# Kuns Park

| | |
|---|---|
| 24000 cf | Southwest Corner Inlet |
| 4950 cf | Southeast Corner Inlet |

# La Verne Sports Park

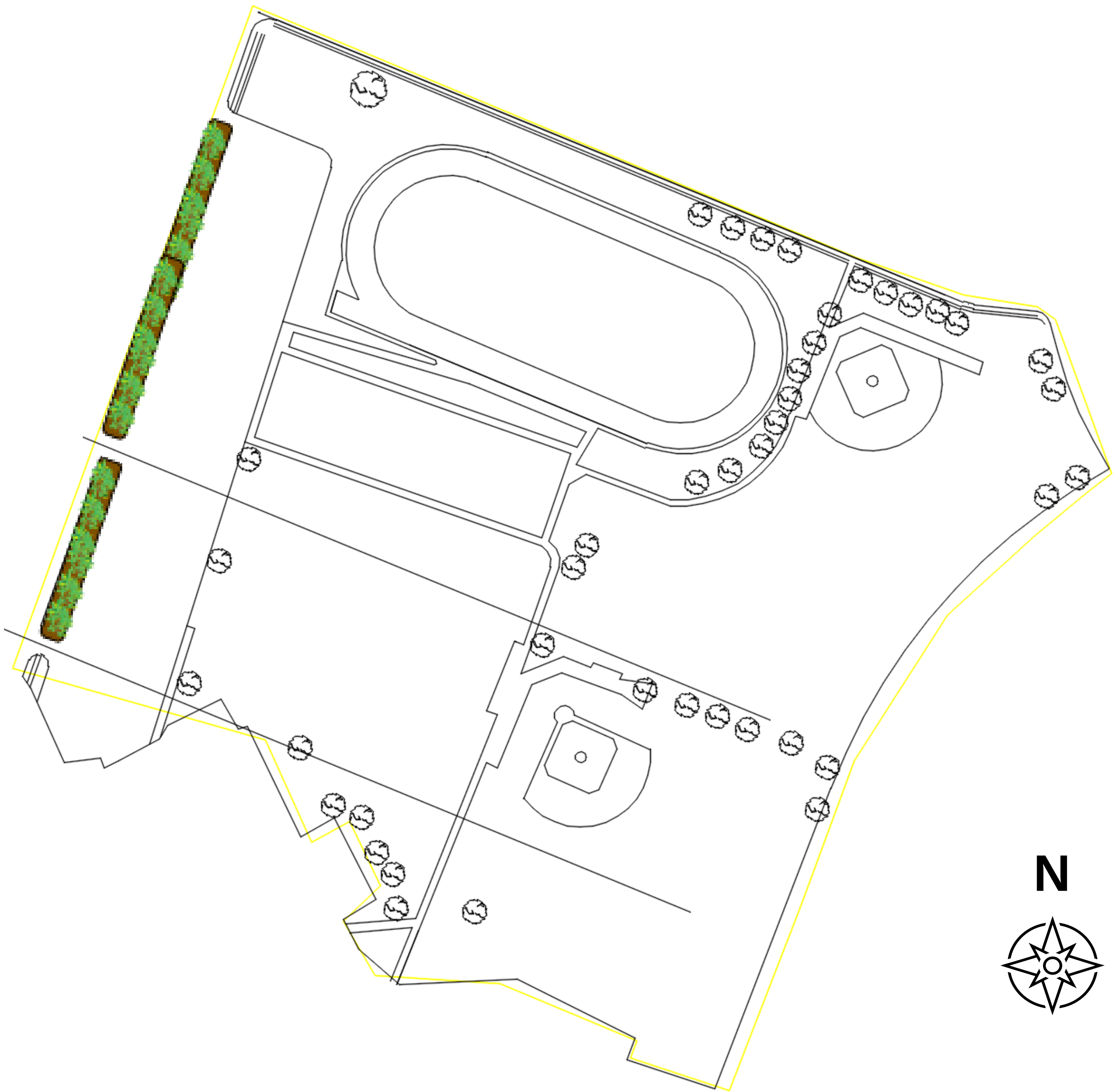
| | |
|---|---|
| Design Volume | 30853 cf |




# Design - Kuns

Bioretention: 4800 $ft^2$

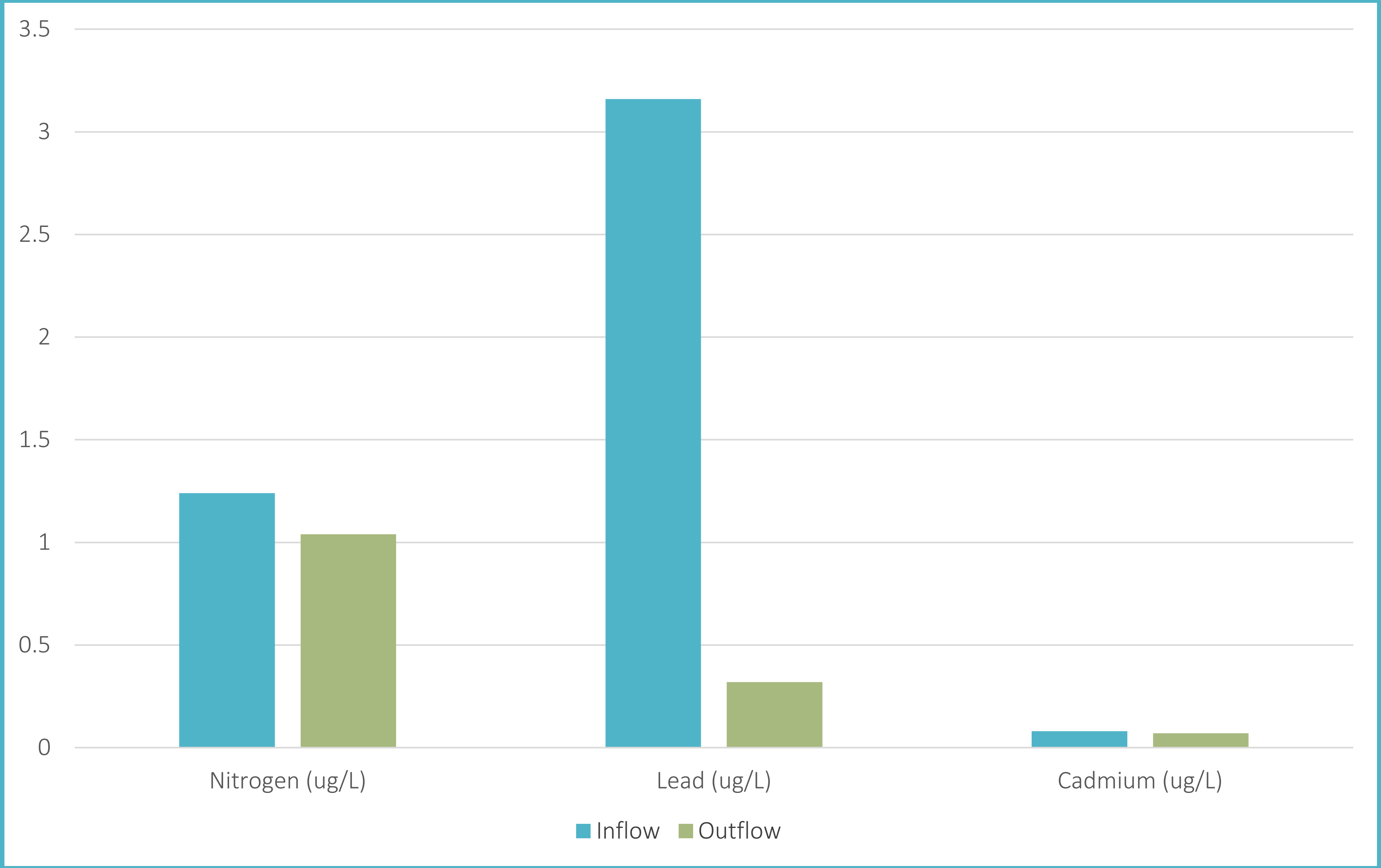
Bioswales: 200 ft X 2 ft base




# Design – La Verne Sports

Bioretention: 2000 $ft^2$

Bioswales: 1000 ft X 2 ft base




# Treatment Efficiency

# Challenges

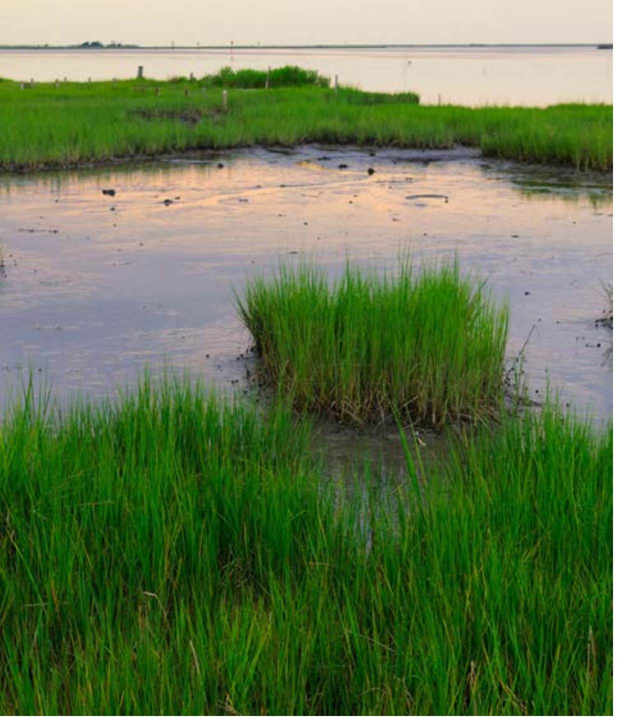
Limited Space

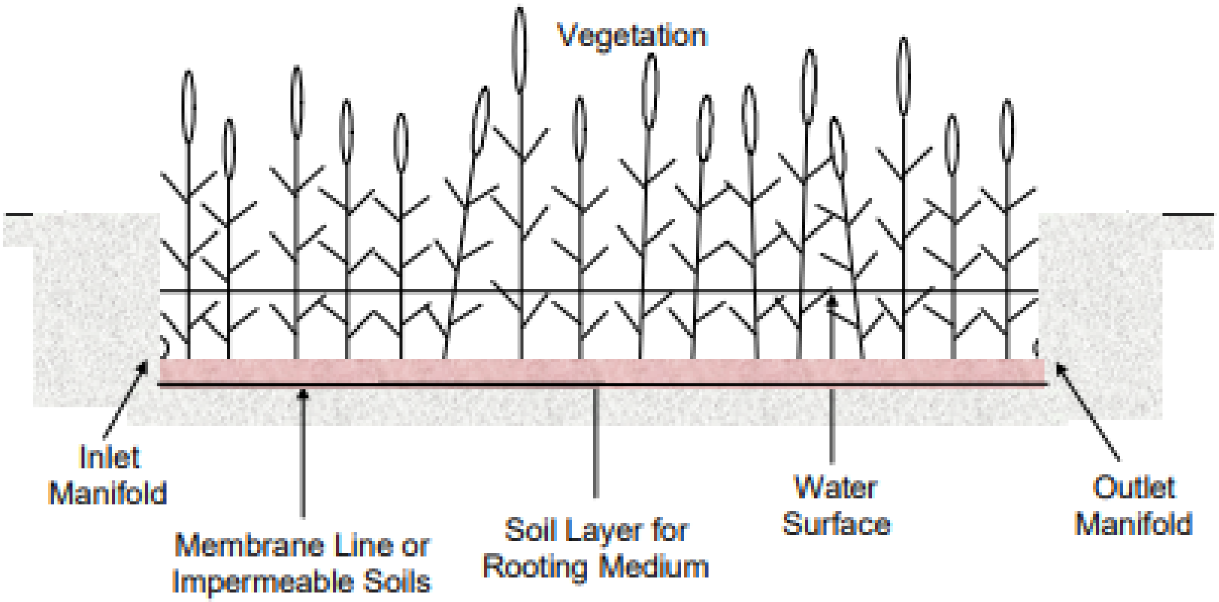
Potential Community Resistance

Limited Contaminant Capture

# Constructed Wetlands

NUTRIENTS & MERCURY






# Benefits of Constructed Wetlands

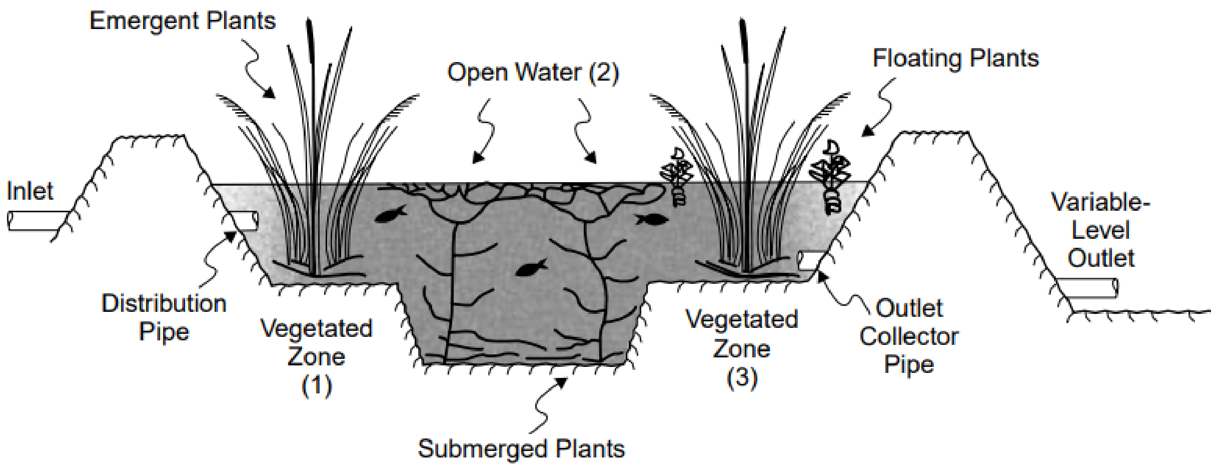
| | | |
|---|---|---|
| Improve | Water quality |
| Provide | Wildlife habitats |
| Store | Floodwaters |
| Maintain | Surface water flows in dry periods |

| Constituent | Mean Influent (mg/L) | Mean Effluent (mg/L) | Percent Removal (%) |
|---|---|---|---|
| BOD5 | 70 | 15 | 79 |
| TSS | 69 | 15 | 78 |
| TKN as N | 18 | 11 | 39 |
| NH3 /NH4 as N | 9 | 7 | 22 |
| NO3 as N | 3 | 1 | 67 |
| TN | 12 | 4 | 67 |
| TP | 4 | 2 | 50 |
| Dissolved P | 3 | 2 | 33 |
| Fecal Coliforms (#/100mL) | 73,000 | 1,320 | 98 |

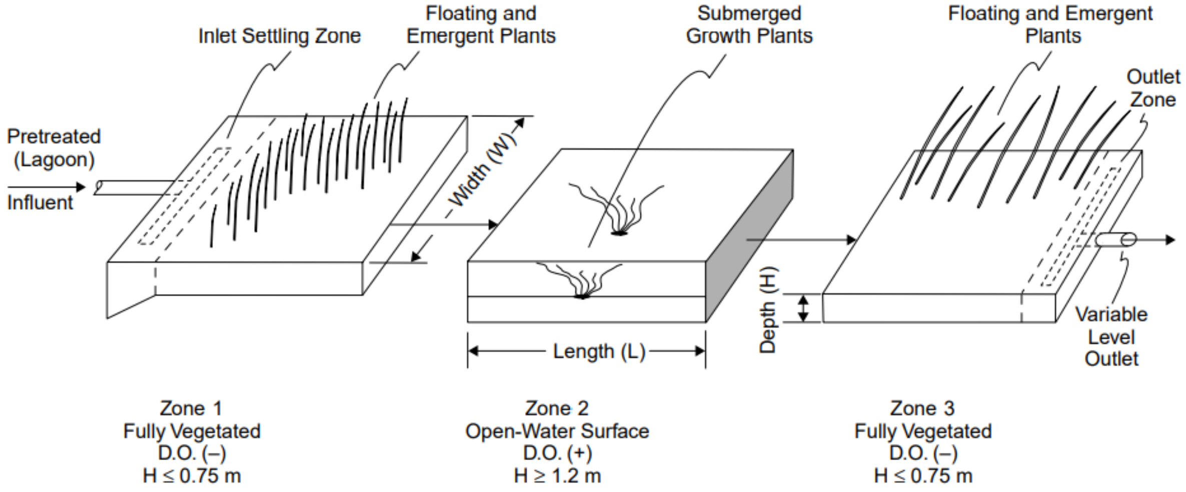
*Source: Free Water Surface Wetlands for Wastewater Treatment: A Technology Assessment Factsheet (EPA)*

# Summary of Performance For 27 Different Wetland Systems

# Free Water Surface Wetlands



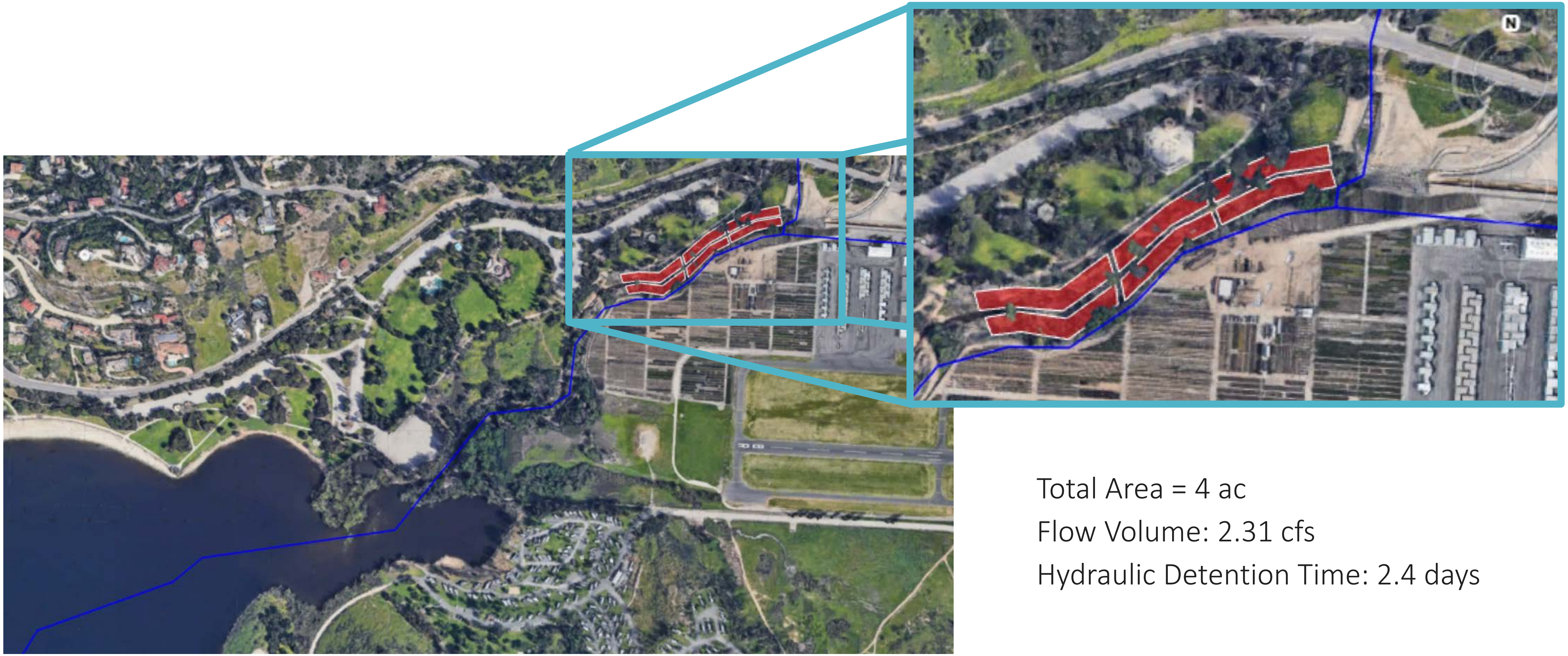

Profile of a Three-zone Constructed Wetland Cell




Elements of a Free Water Surface Constructed Wetland

*Source: Design Manual: Constructed Wetlands Treatment of Municipal Wastewater (EPA)*

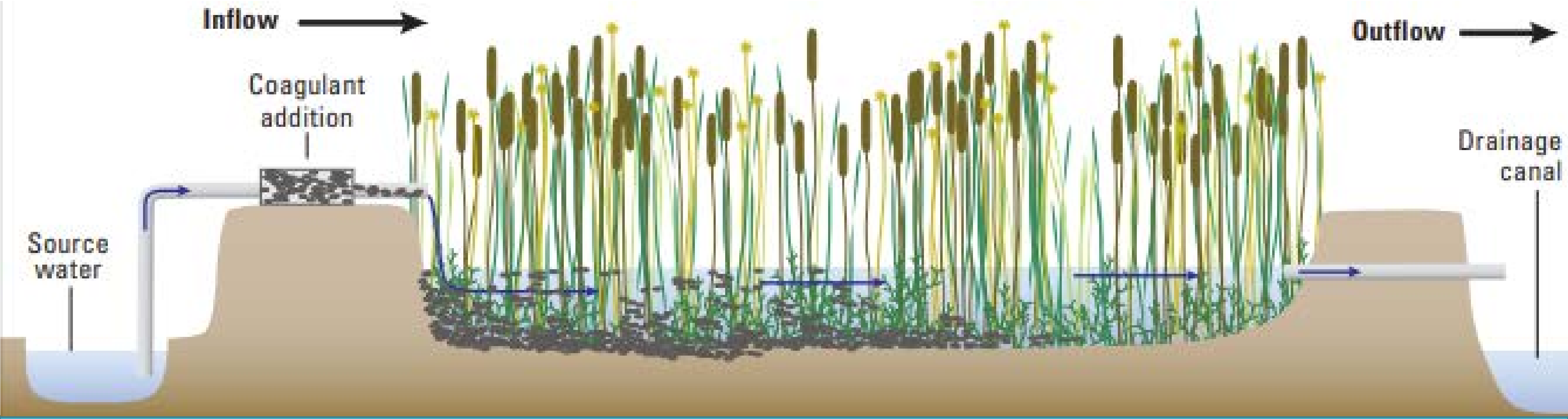
# Proposed Wetland Location




Total Area = 4 ac

Flow Volume: 2.31 cfs

Hydraulic Detention Time: 2.4 days




# Low Intensity Chemical Dosing

Utilizes coagulation to decrease the contaminants in water.

The constructed wetlands will retain the flocculate and reduce costs of off-site disposal.

The filtered MeHg concentrations decreased by 40-70%.



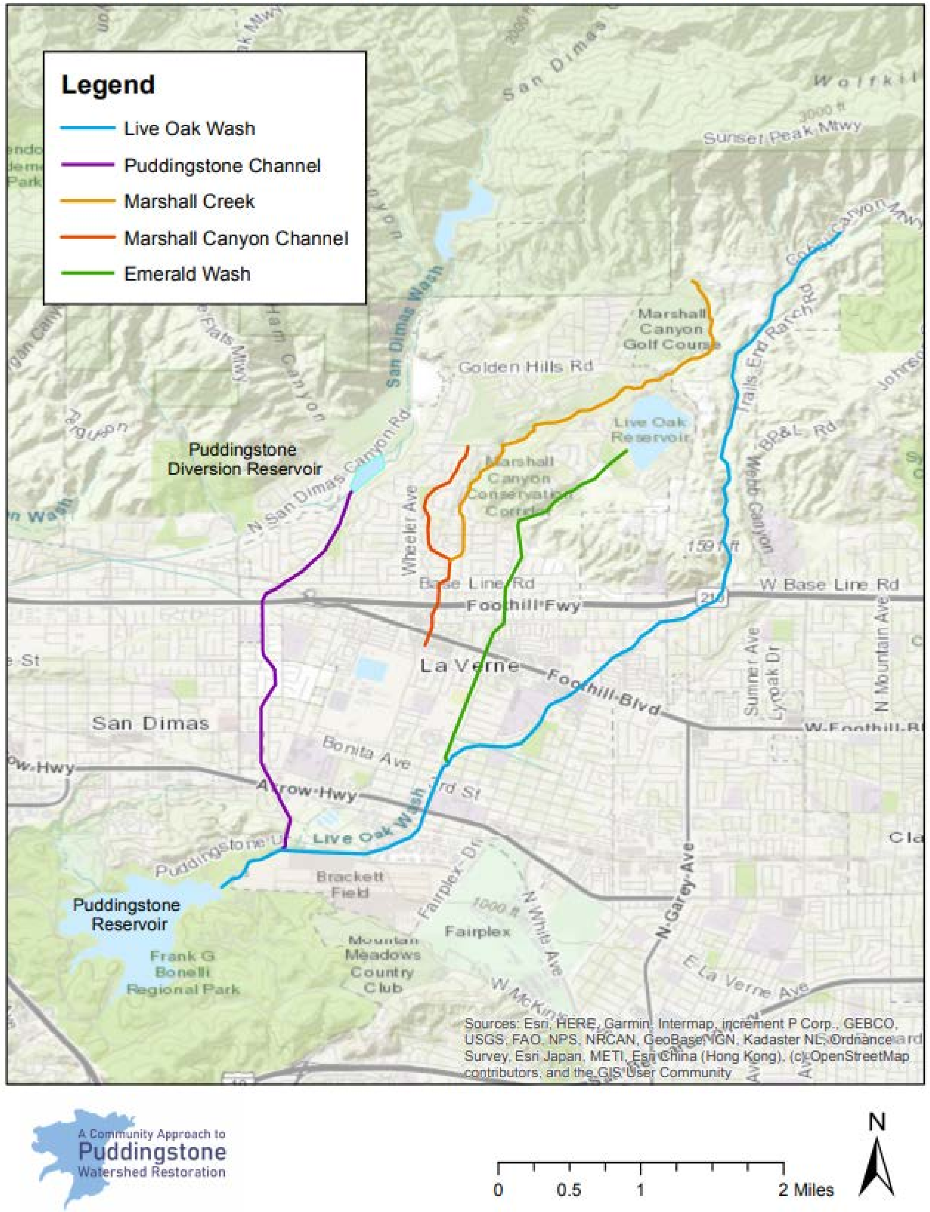
# Restoration Plant Species

# Modeling the Stream

Our goal is to model the stream on HEC-RAS to show the effectiveness of LIDs to remove contaminants in the stream.

- Stream before project implementation
- Stream after implementation of LIDs and restoration efforts

## Streams and Open Channels in Watershed



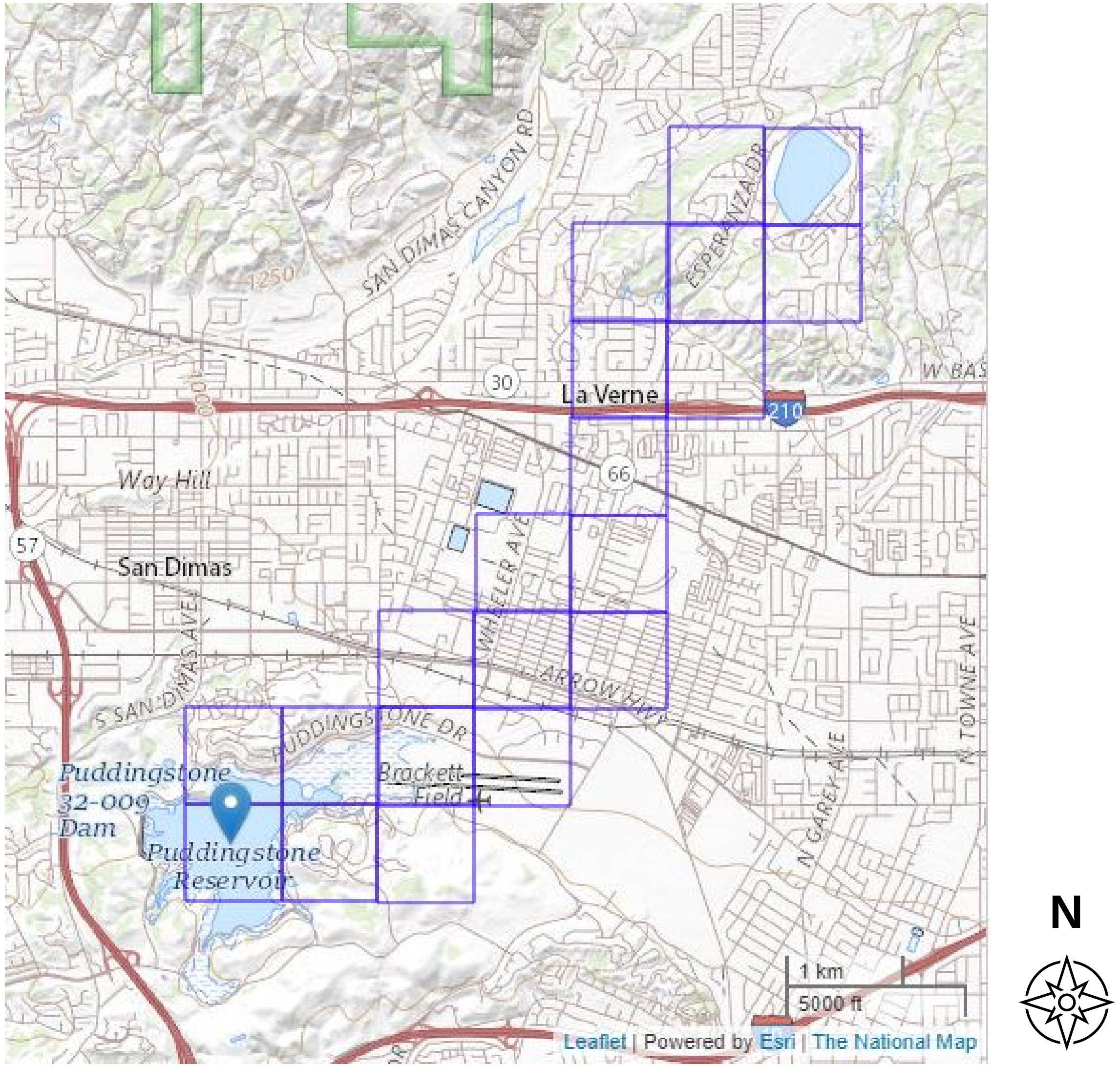

## Project Stream

# Model Data

## USGS Lidar Point Cloud CA Los Angeles (Published 2018)

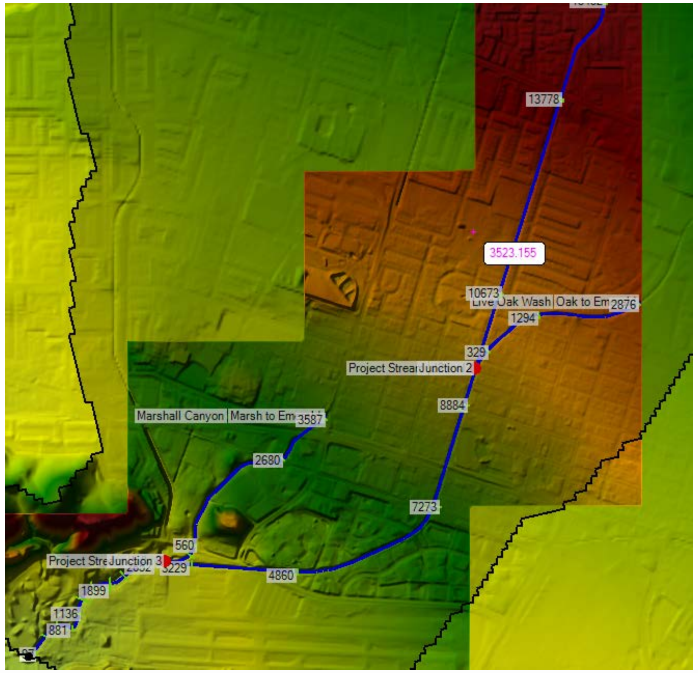
### Creating a DEM

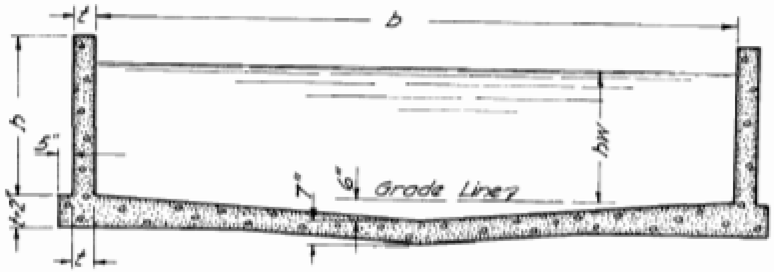
- Convert LAZ to LAS with LAStools
- Combine LAS files to one dataset
- Las Dataset > Filter > Ground
- LAS to Raster



# HEC-RAS Model

- HEC-RAS model created with RAS Mapper tools
- GeoTiff and ESRI (NAD83) data used for spatial referencing
- Channel geometry found via LA County storm drain index

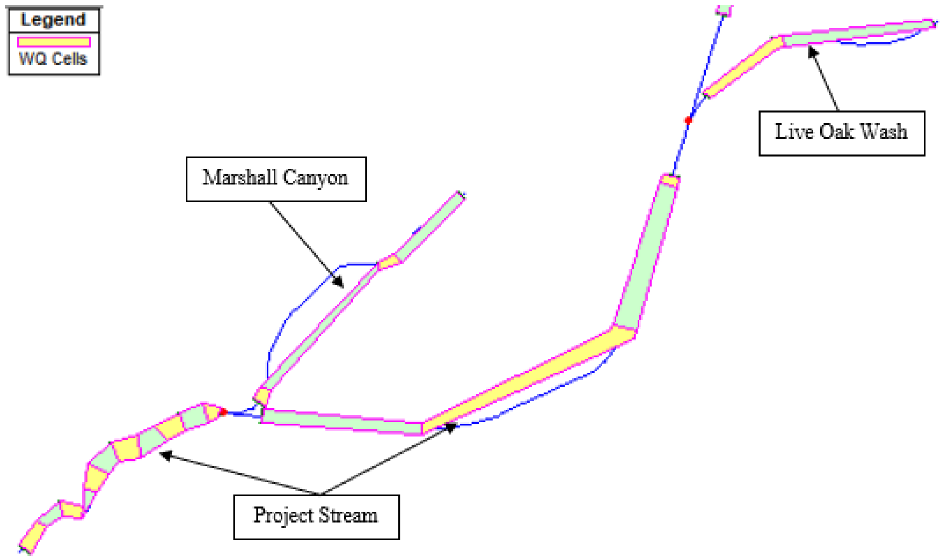



TYPICAL SECTION

| THEORETICAL HYDRAULIC ELEMENTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Section № | b | h | t | hw | n | A | s | V | Q |
| 1 | 36' | 6' | 7" | 6.0' | .014 | 216 | .00583 | 21.5 | 4620 |
| 2 | 32' | 5' | " | 3.0' | " | 160 | .0138 | 29.0 | 4550 |
| 3 | 20 | 5.5' | " | 5.5' | " | 110 | .01125 | 25.8 | 2800 |
| 4 | " | 6.0' | " | 5.7' | " | 114 | .00939 | 23.8 | 2,700 |
| 5 | 11 | " | " | 6.0' | " | 66 | .01435 | 24.7 | 1,650 |

# HEC-RAS Water Quality Analysis




- WQA performed using temperature modeling, nutrient modeling, and arbitrary constituent tools
- Steady flow analysis performed in addition to WQA
- WQA models demonstrates efficacy of project solution

# Funding

# Cost Considerations

## CAPITAL COST

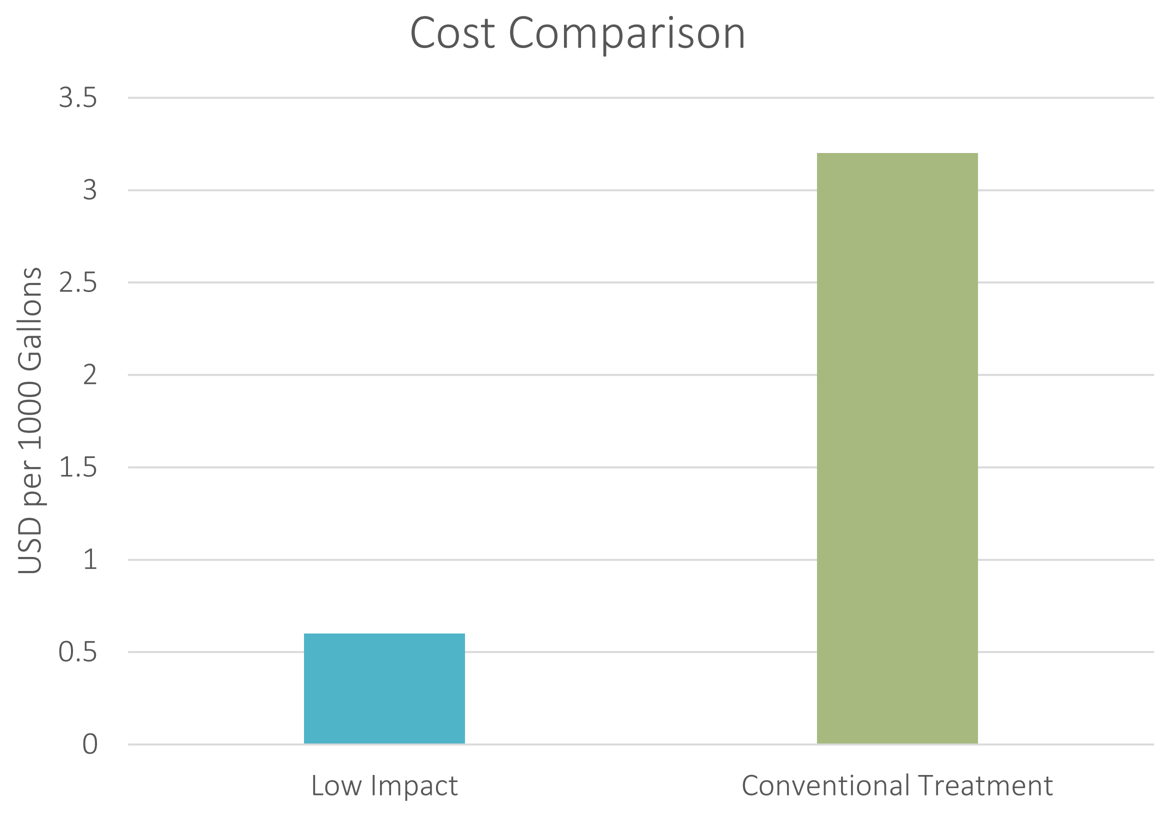
- Outreach
- Clearing & Grubbing
- Plumbing
- Vegetation
- Construction
- Contingency

## OPERATIONS & MAINTENANCE

- Wages
- PAC
- Dredging
- Revegetation
- Inspection
- Irrigation
- Monitoring

# Value: Life-Cycle Analysis

| | |
|---|---|
| Capital Cost | $ 1.87-3.82 Million |
| Maintenance | $140,000 Per Year |
| Present Worth Cost | $5.2 Million |
| **Value** | **$0.60 per 1000 Gallons** |



# Funding Opportunities

## Measure W

Los Angeles County

## Prop 1

State Water Control Board

California Department of Water Resources


# Thank You! Any Questions?

For more information visit our website:
2020seniorproject.wixsite.com/restorepuddingstone