

Webinar Overview

- Presenter:
 - ▣ Amanda Ludlow – Principal Scientist
- Moderator:
 - ▣ Tanya Bissell
- Length of Webinar: (1) hour
- Questions:
 - ▣ Mid & Post Presentation
 - ▣ Please submit via the viewing panel
- For More Information or Comments:
 - ▣ Contact Tanya Bissell at: tbissell@rouxinc.com

Sustainable Stormwater Management For Industrial Facilities

Presented by:
Amanda Ludlow, Principal Scientist
Roux Associates, Inc.



October 20, 2015

Overview

- Sustainable Stormwater Management
 - ▣ Green Infrastructure (GI) Techniques
 - ▣ Benefits
- Industrial Stormwater Management
 - ▣ Environmental and Regulatory Drivers
 - ▣ Design Considerations
- Techniques for Existing Industry
- Case Study – New Industry

Stormwater Management

Conventional

- Goals
 - ▣ Prevent flooding onsite
 - ▣ Quantity control
 - ▣ Quickly convey runoff offsite
- Effects
 - ▣ Decreased groundwater recharge
 - ▣ Increased runoff volume
- End Result
 - ▣ Down gradient flooding
 - ▣ Erosion
 - ▣ Water quality degradation
 - ▣ Large end-of-pipe BMP requirements

Sustainable

- Goal
 - ▣ Mimic predevelopment hydrologic regime by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source
- Methods
 - ▣ Limit disturbance
 - ▣ Preserve sensitive site features
 - ▣ Minimize grading
 - ▣ Reduce impervious surfaces
 - ▣ Source control
 - ▣ Micro scale stormwater management
 - ▣ Create multiple sub-watersheds
 - ▣ Lengthen flow paths (increase T_c)

Green Infrastructure (GI)

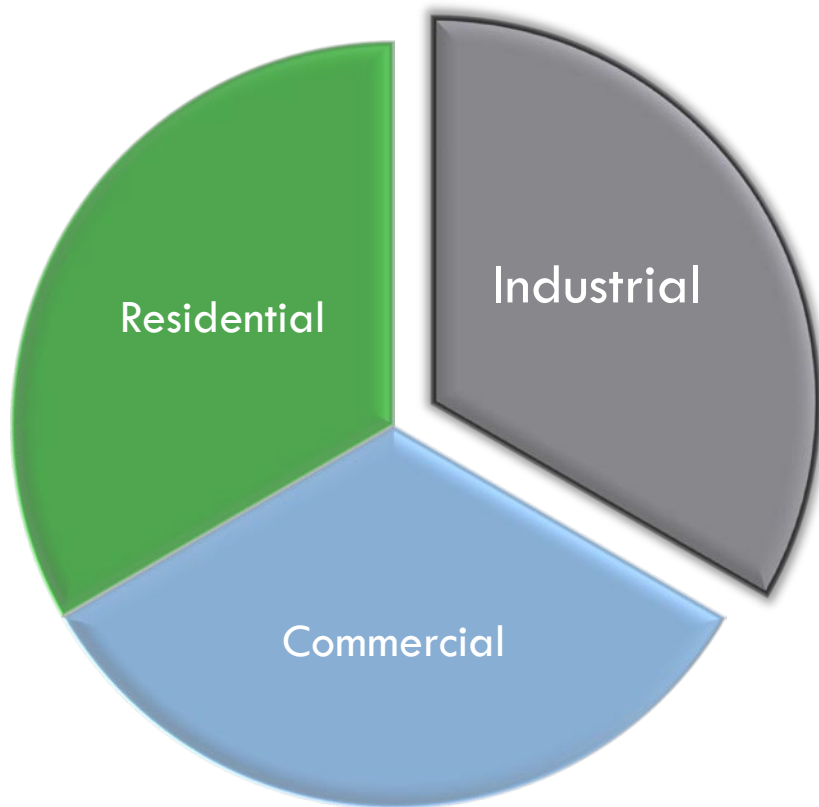
- Natural systems that capture, cleanse and reduce stormwater runoff using plants, soils and microbes
 - ▣ *Green Roofs*
 - ▣ *Grass Filter Strips*
 - ▣ *Bioswales*
 - ▣ *Bioretention*



Benefits

- Infiltration replenishes groundwater supplies
 - ▣ *Increase aquifer recharge*
 - ▣ *Maintain base flows to streams and wetlands*
- Reduced runoff and sediment discharge
 - ▣ *Lower maintenance costs*
 - ▣ *Increased treatment capacity*
- Improves water quality and public health
- Enhanced aesthetics
- Creates habitat

Sustainable Stormwater/GI



- Residential
 - ▣ Low Impact Development
 - ▣ Better Site Design
 - ▣ Stormwater Credits
 - ▣ GreenStreets
- Commercial
 - ▣ LEED Certification
- Industrial

Conventional Industrial Design

- Impervious Surfaces
 - ▣ Capture and conveyance
 - ▣ Quantity control
- Gravel Surface Cover
 - ▣ Pathway to groundwater
- Large End-of-Pipe Treatment



Regulatory Drivers

- ❑ Stricter SPDES limits
- ❑ Antiquated end-of-pipe solutions
 - ❑ Cannot provide sufficient treatment
- ❑ Limited land availability

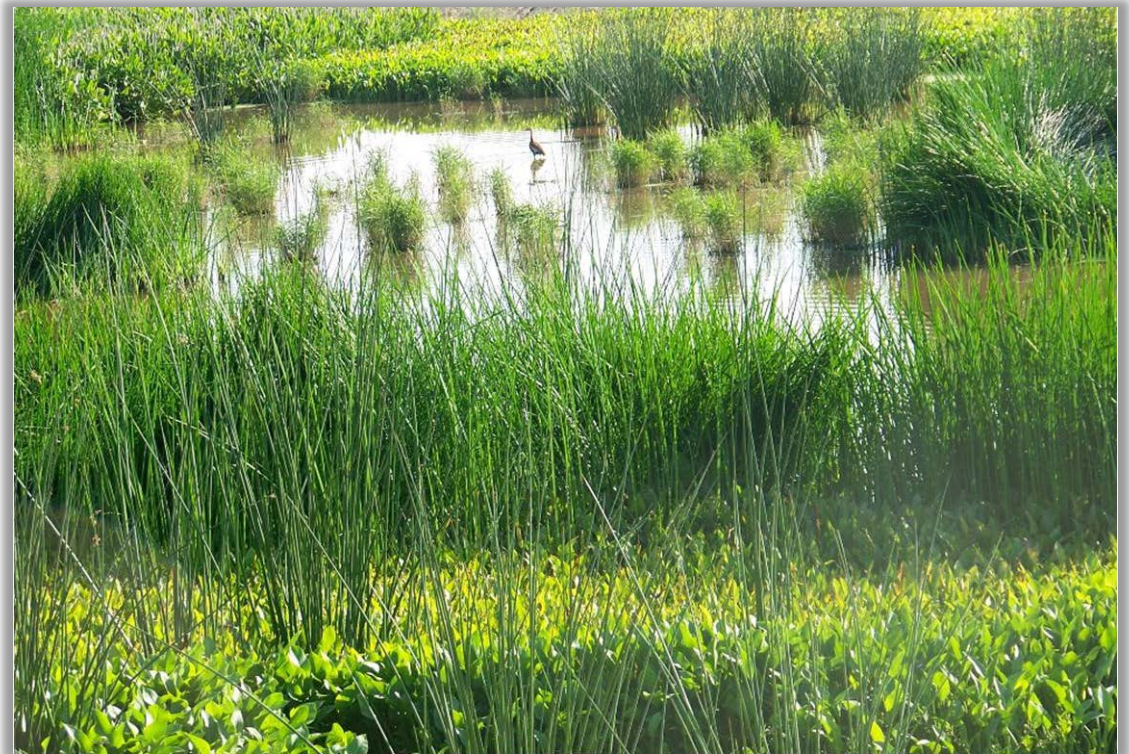


Need Creative Solutions

Top Total Maximum Daily Load (TMDL) Constituents	
Mercury	Phosphorus
Iron	Nitrogen
Aluminum	- Ammonia
Manganese	- Nitrate
Copper	Sediment
Lead	PCBs
Selenium	Pathogens
Zinc	BOD
Cadmium	COD
Arsenic	

Engineered Natural Systems

- *Technologies that optimize natural processes to clean contaminated soils and water*
 - ▣ Sustainable
 - ▣ Resilient
 - ▣ Passive
 - ▣ Low O&M
 - ▣ Long Life
 - ▣ High PR



ENS Technologies

- Engineered Wetlands
 - ▣ *Surface Flow*
 - ▣ *Subsurface Flow*
- Natural Media Filters
 - ▣ *Engineered Soil Profiles*
 - ▣ *Compost Filters*
 - ▣ *Bioswales*
- Phytotechnology
 - ▣ *Hydraulic Control*
 - ▣ *Enhanced Biodegradation*
 - ▣ *Phytostabilization*
- Green Infrastructure
 - ▣ *Bioswales*
 - ▣ *Bioretention/Raingardens*
 - ▣ *Stormwater Wetlands*

Natural Media Filtration (NMF)

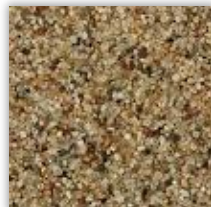
The use of natural materials to filter, adsorb and sequester contaminants from groundwater, wastewater, and/or stormwater.

□ Media Types

- Compost
- Peat
- Sand
- Gravel
- Limestone
- Native Soils
- Waste Materials

□ Removal Mechanisms

- Filtration
- Adsorption
- Precipitation
- Degradation
- pH neutralization



Photos provided by: Google Images

GI Techniques using NMFs

NATURAL MEDIA FILTRATION

Residential/Commercial

Industrial Applications

Grass Filter Strips →

Engineered Soil Profiles

Bioswales →

Bioswales

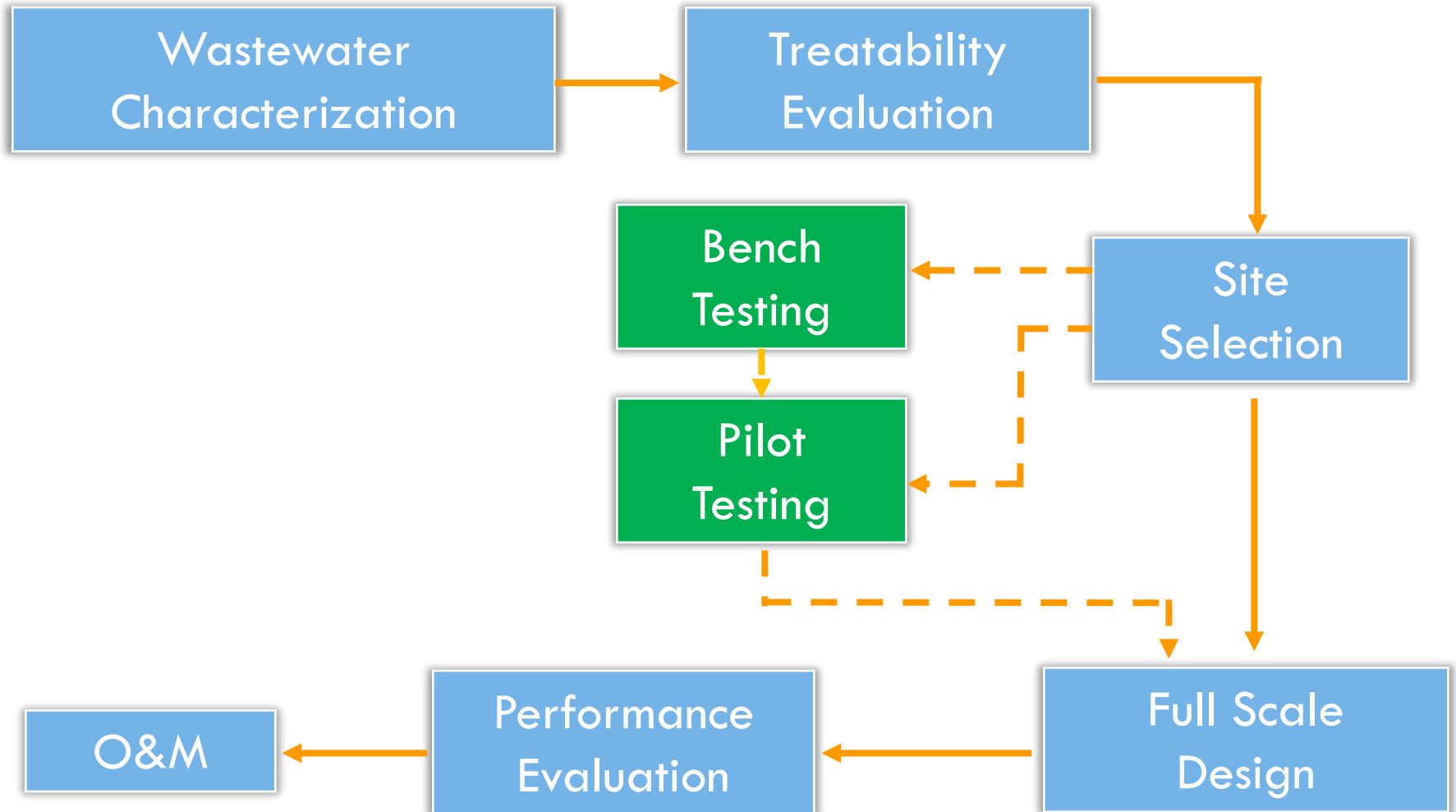
Bioretention →

Natural Media Filters

Stormwater Wetlands →

Engineered Wetlands

Design Process



Proof of Technology

Bench Scale



Small Pilot



Large Pilot



Design Considerations

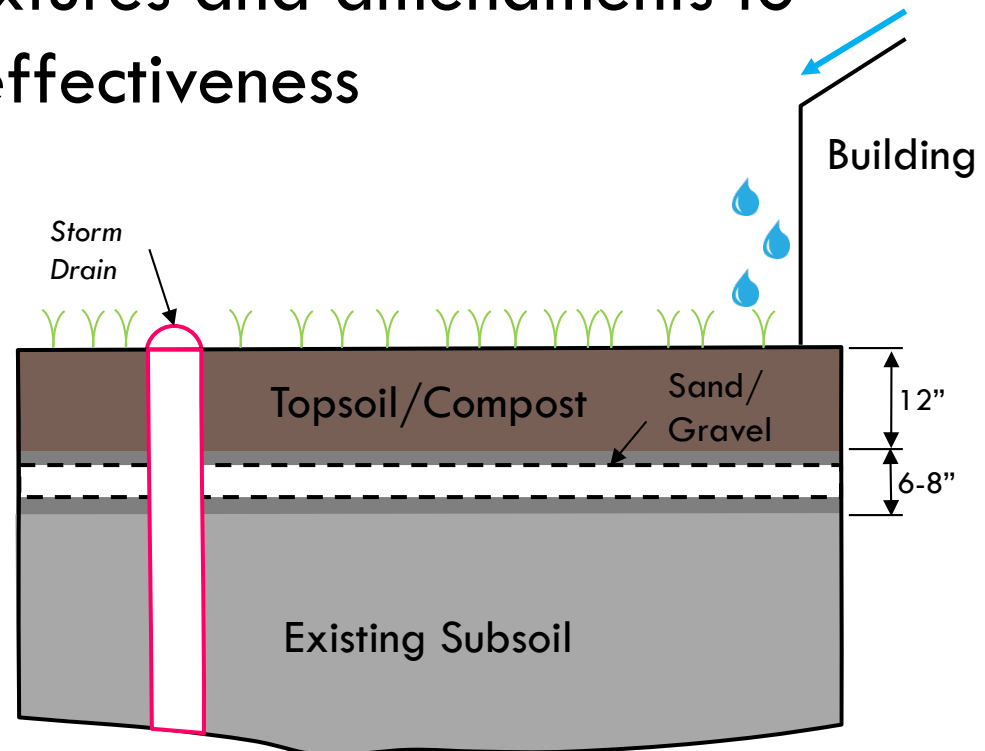
- Contaminants of Concern (COC)
 - ▣ Fate and transport
 - ▣ Potential phytotoxicity
- Site Specific Conditions
 - ▣ Surface cover
 - ▣ Soils
 - ▣ Groundwater
- Spill Containment
 - ▣ Need for pretreatment
- O&M
 - ▣ Low Maintenance not “NO” Maintenance

Mid-Talk Break

Questions?

Engineered Soil Profiles (ESPs)

- Vegetated surfaces designed to treat sheet flow from adjacent surfaces
- Utilize specific soil mixtures and amendments to maximize treatment effectiveness
 - ▣ Reduce Velocities
 - ▣ Filtration
 - ▣ Adsorption



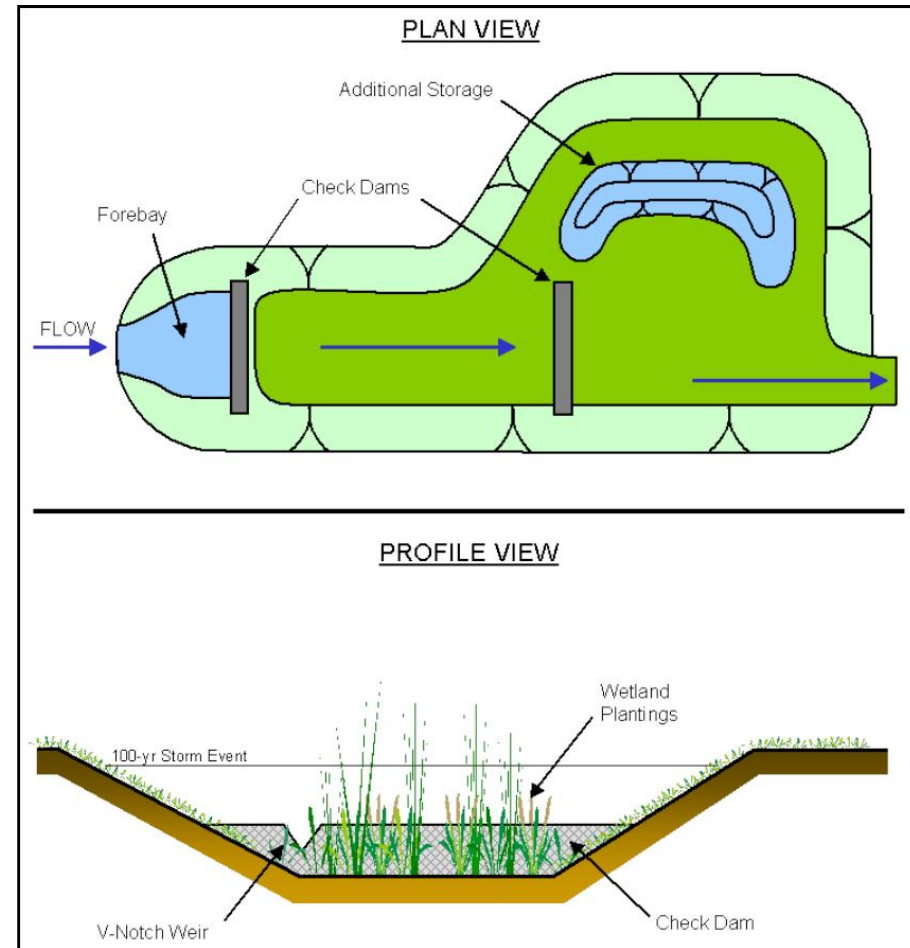
South Carolina



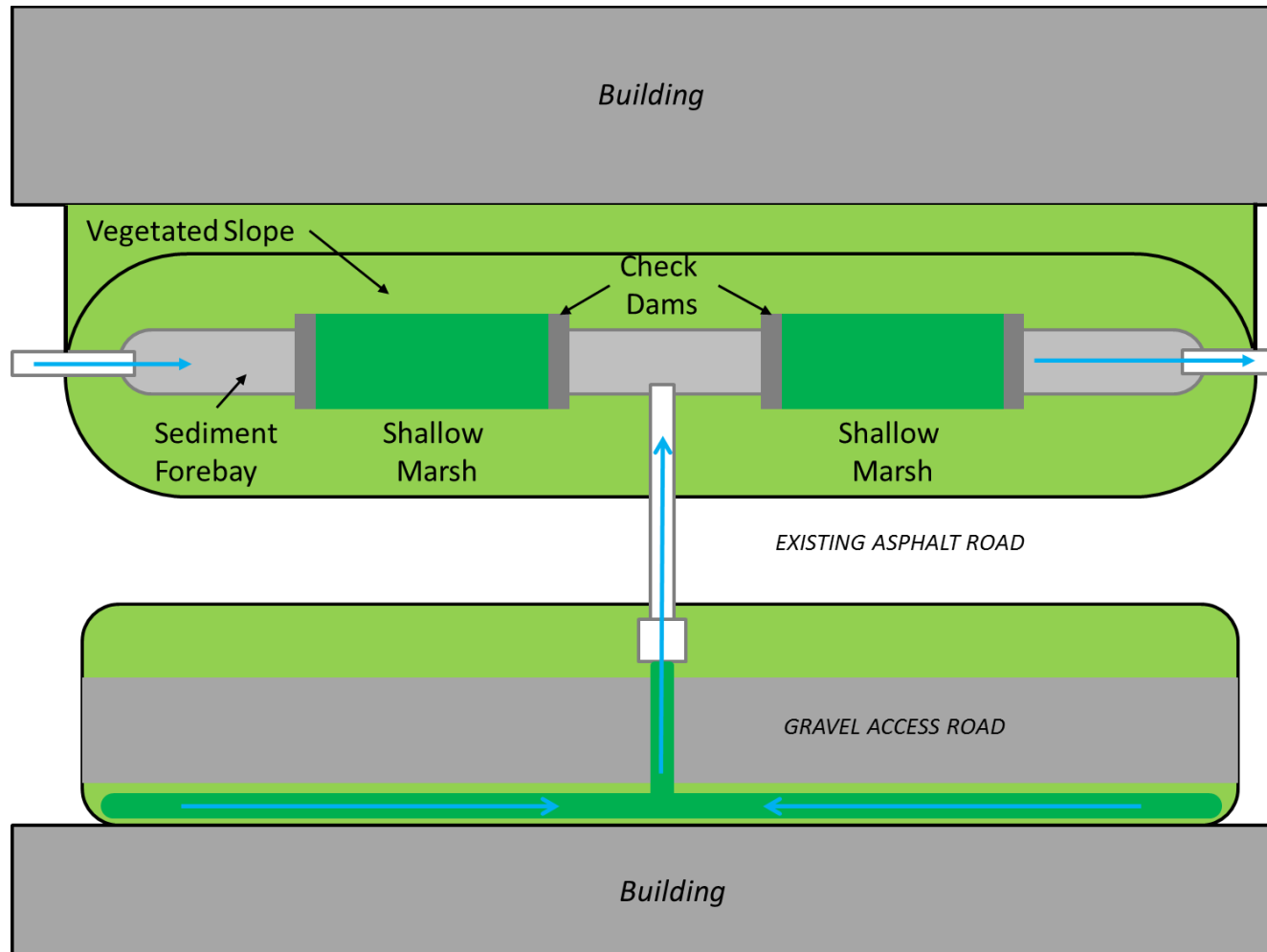
New York

Bioswales

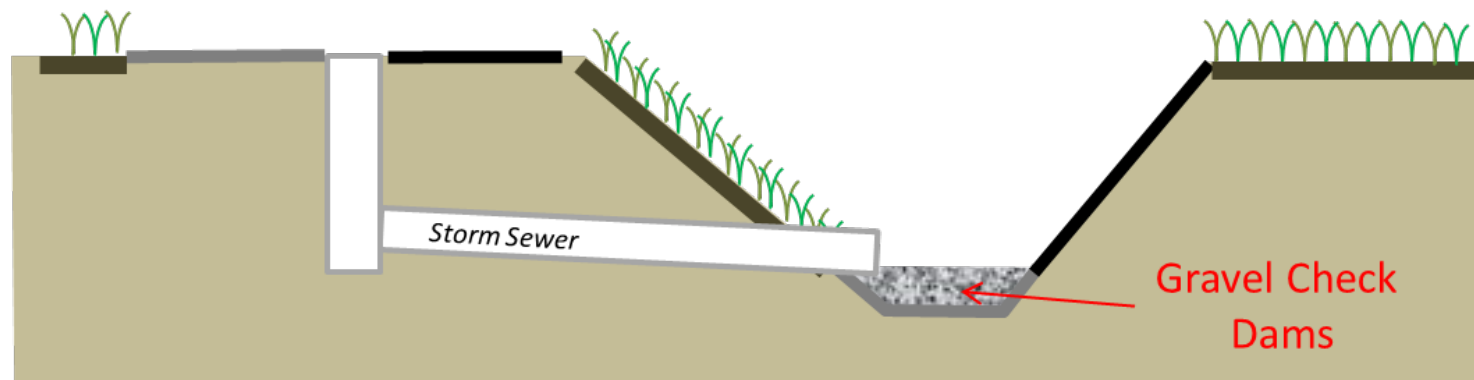
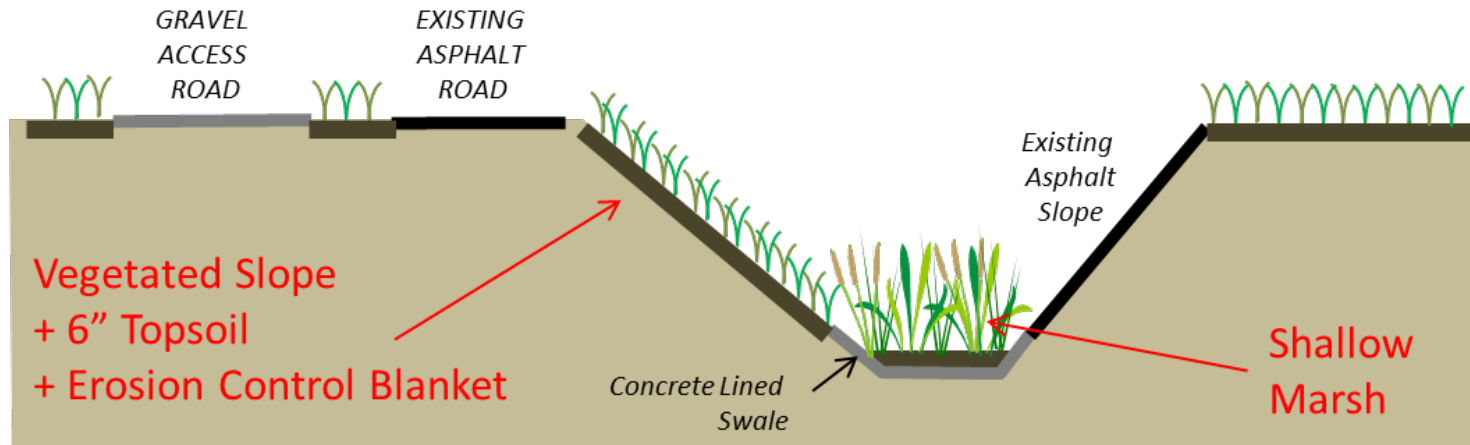
- Vegetated, open channels designed to treat, attenuate, and convey stormwater runoff
- Vegetation
 - ▣ Attenuate velocities
 - ▣ Filtration
- Check Dams
 - ▣ Ponding
 - ▣ Sedimentation
 - ▣ Filtration
 - ▣ pH neutralization



Bioswales, WA



Bioswales, WA



Bioswales, WA

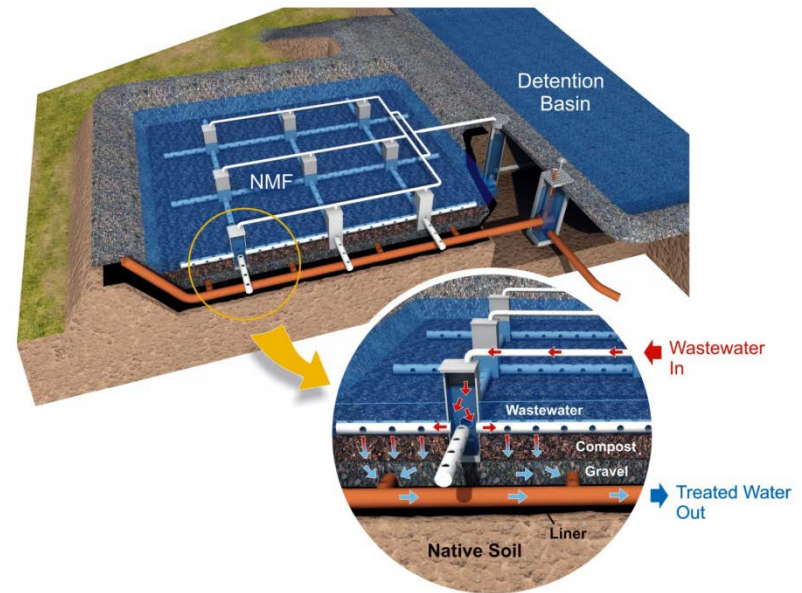


Natural Media Filtration (NMF)

The use of natural materials to filter, adsorb and sequester contaminants from groundwater, wastewater, and/or stormwater.

□ Media Types

- ▣ Compost
- ▣ Peat
- ▣ Sand
- ▣ Gravel
- ▣ Limestone
- ▣ Native Soils
- ▣ Waste Materials



Compost NMF for Metal Removal

Copper and Selenium Removal



- Filtration
- Adsorption
- Metal Precipitation

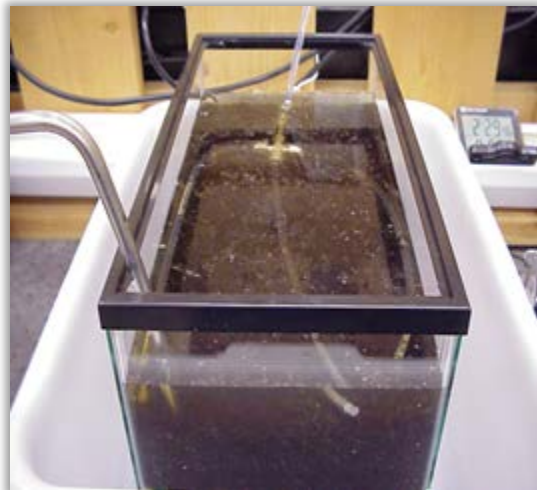
Boron Removal



Compost NMF for PCB removal

- Filtration
- Adsorption
- Reductive Dechlorination

Bench Scale



Field Pilot



Full Scale



Liner Installation



Compost Installation



Natural Media Filter, PA



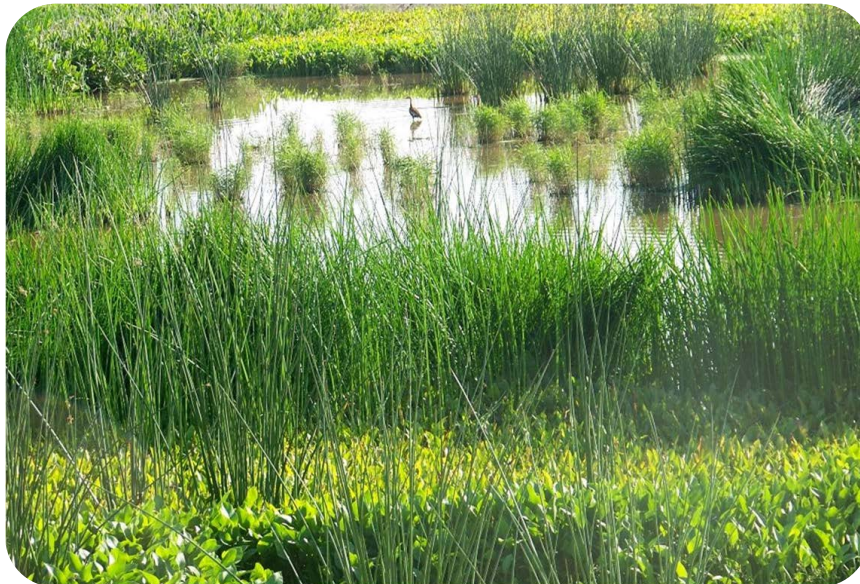
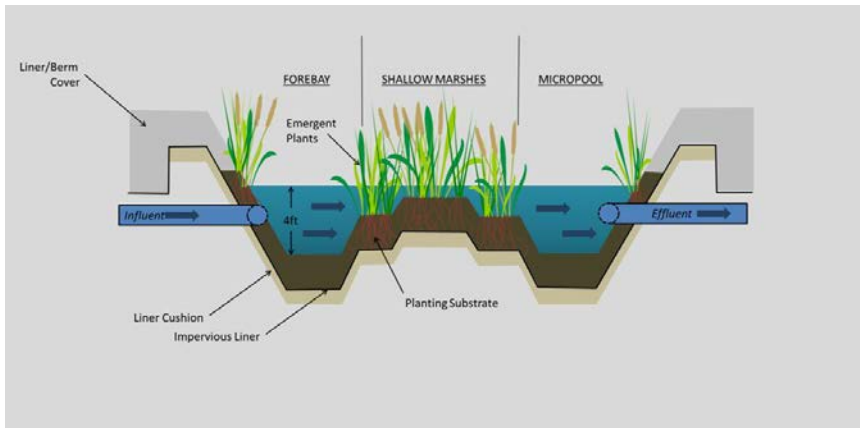
Engineered Wetlands

Engineered treatment system designed to achieve water quality improvements by maximizing processes that occur in natural wetlands

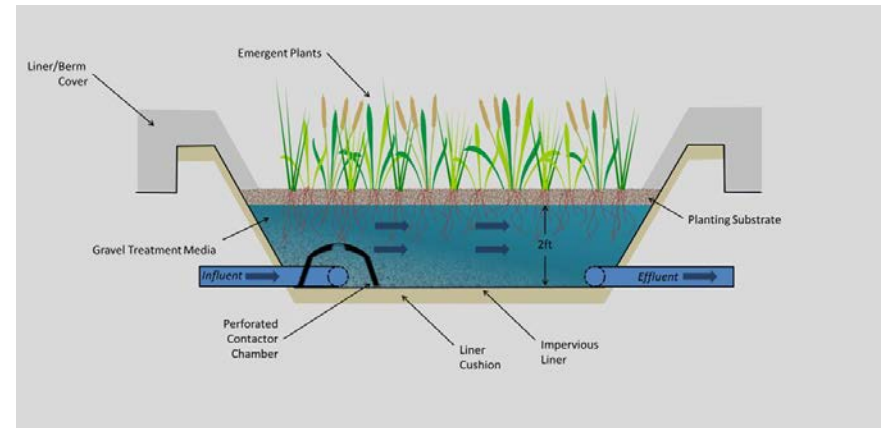
- Mine Drainage
 - Metals
 - TSS
 - pH
- Sanitary Wastewater
 - Nutrients
 - Pathogens
- Landfill Leachate
 - Metals
 - Ammonia
- Agricultural Runoff
 - TSS
 - Nutrients
- Airport
 - Glycol
 - BOD
- Urban and Industrial Stormwater
 - Metals
 - Nutrients
 - Solids
 - PCBs
- Industrial Wastewater
 - Metals
 - BTEX
 - PAHs
- Groundwater Remediation
 - Metals
 - BTEX
 - PAHs
 - Chlorinated Solvents

Types

Surface Flow (SF)



Subsurface Flow (SSF)



SF for Metal Removal, TX



SF for Metal Removal, NJ



SSF for Fluoride Removal, SC



SSF for BTEX Removal, RI



Case Study: Smelter, Iceland



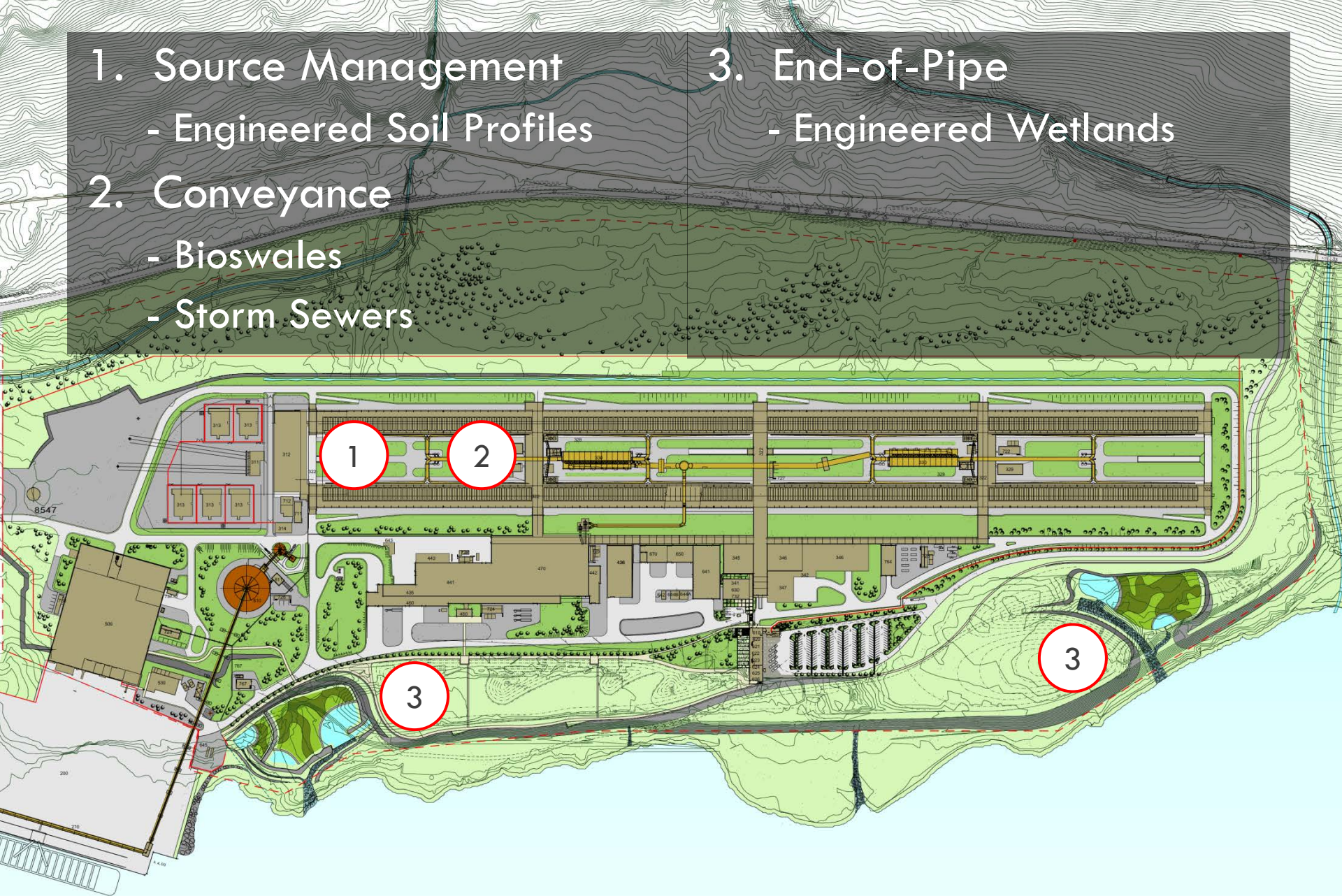
Particulate Emissions

- sodium fluoride
- aluminum fluoride
- PAHs

Design Plan

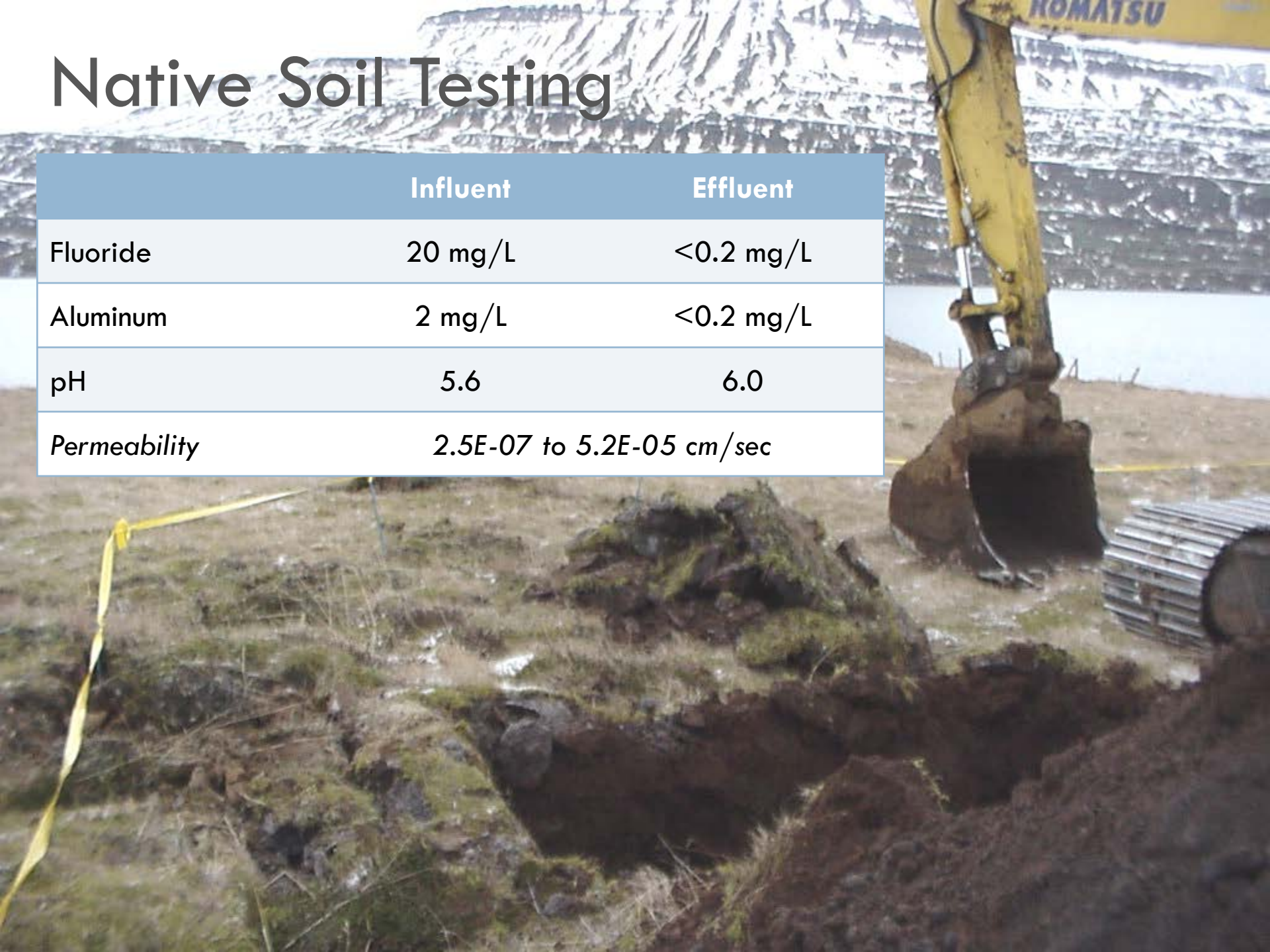
- 1. Source Management
 - Engineered Soil Profiles
- 2. Conveyance
 - Bioswales
 - Storm Sewers

- 3. End-of-Pipe
 - Engineered Wetlands

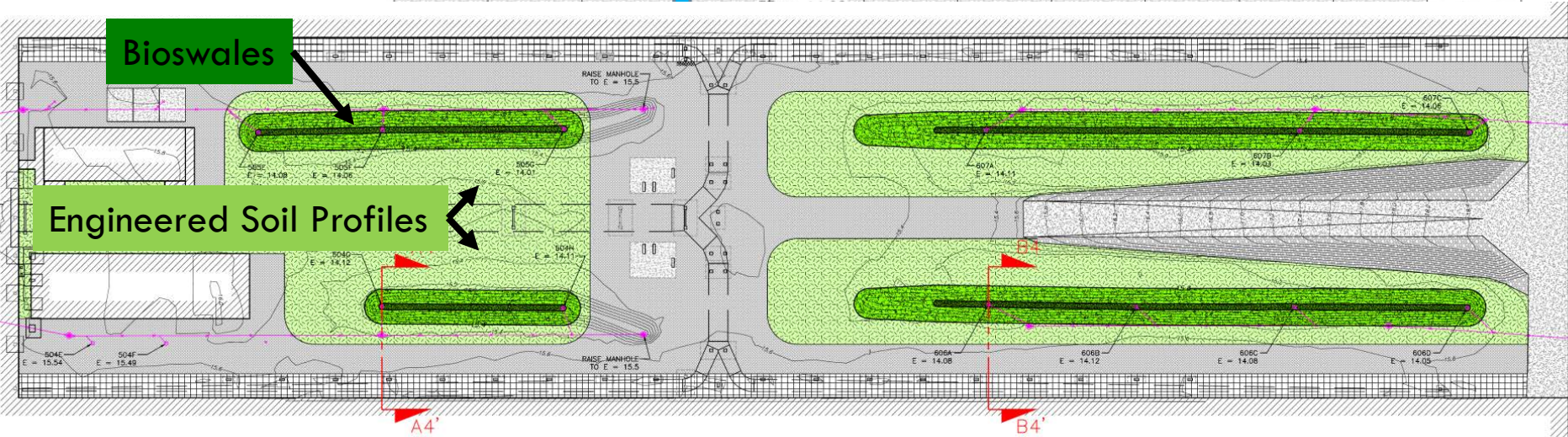
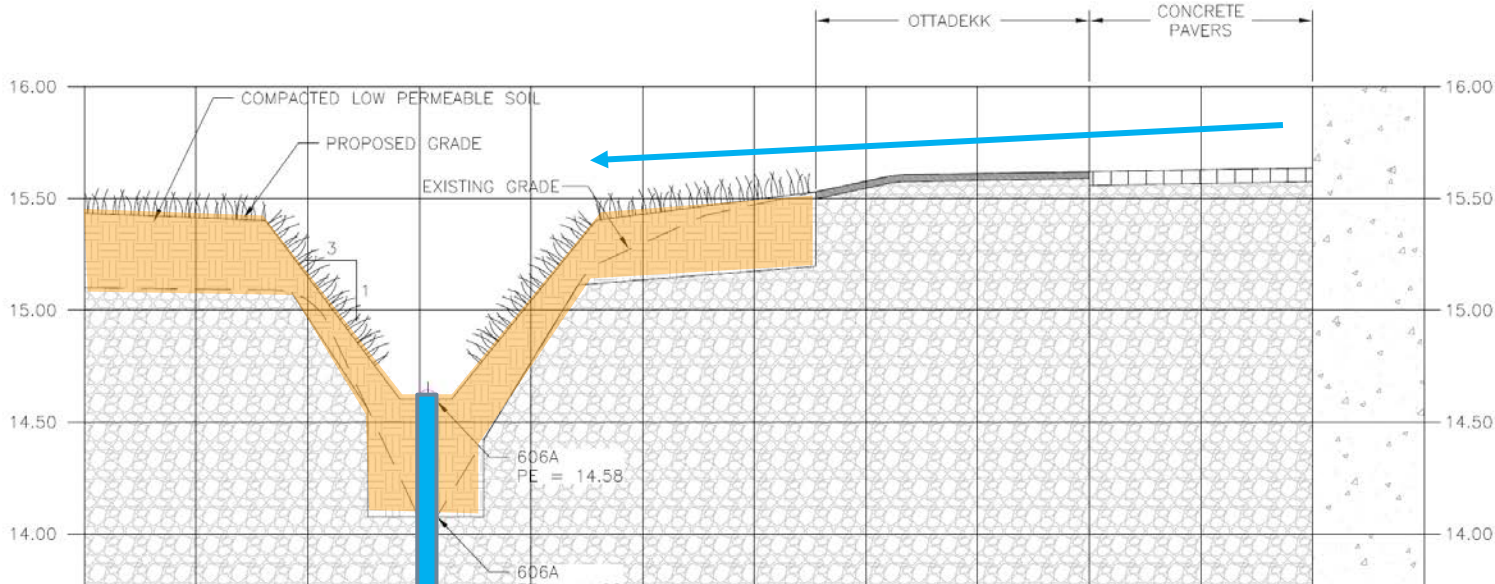


Native Soil Testing

	Influent	Effluent
Fluoride	20 mg/L	<0.2 mg/L
Aluminum	2 mg/L	<0.2 mg/L
pH	5.6	6.0
Permeability	2.5E-07 to 5.2E-05 cm/sec	



Engineered Soil Profiles and Bioswales



Engineered Soil Profiles



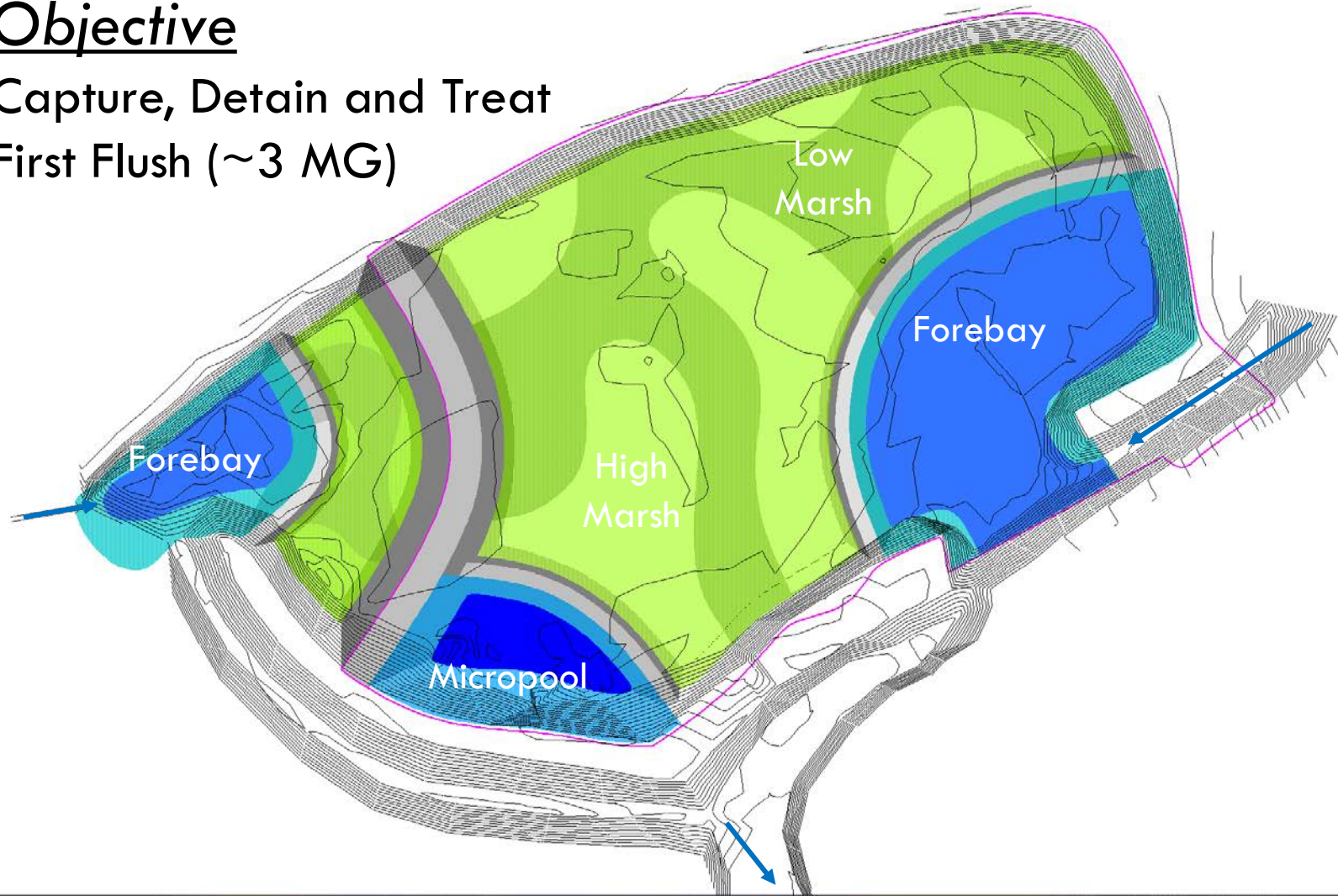
Bioswales



SF Engineered Wetlands

Objective

Capture, Detain and Treat
First Flush (~3 MG)



SF Engineered Wetlands



Plant Sources





Vegetation Harvesting



Operation



Summary

- Sustainable Stormwater Management
 - ▣ Extensively utilized in both residential and commercial development... Industrial
- Site Specific Design
 - ▣ COCs Fate and Transport
 - ▣ Existing Soils
 - ▣ Vegetation
 - ▣ O&M
- Existing Industry
 - ▣ Incorporate GI techniques to improve end-of-pipe performance
- New Industrial Development
 - ▣ Incorporate sustainable practices into site design
 - ▣ Maximize use of local resources
 - ▣ Reduce need for future remediation/repairs

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Questions?

Contact Roux Associates at 1-800-322-7689

www.rouxinc.com

