# BIOLOGICAL TREATMENT AND VOLUME REDUCTION OPTIONS TO ADDRESS NUMERIC NUTRIENT CRITERIA IN STORMWATER

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# Biological Treatment

## Vegetative/Algal

- Swales
- Bioswales
- Littoral Shelves
- Floating Islands
- Wetland Treatment
- Green Roofs

## Microbial

- Biofiltration
- Rain Gardens

# Swales

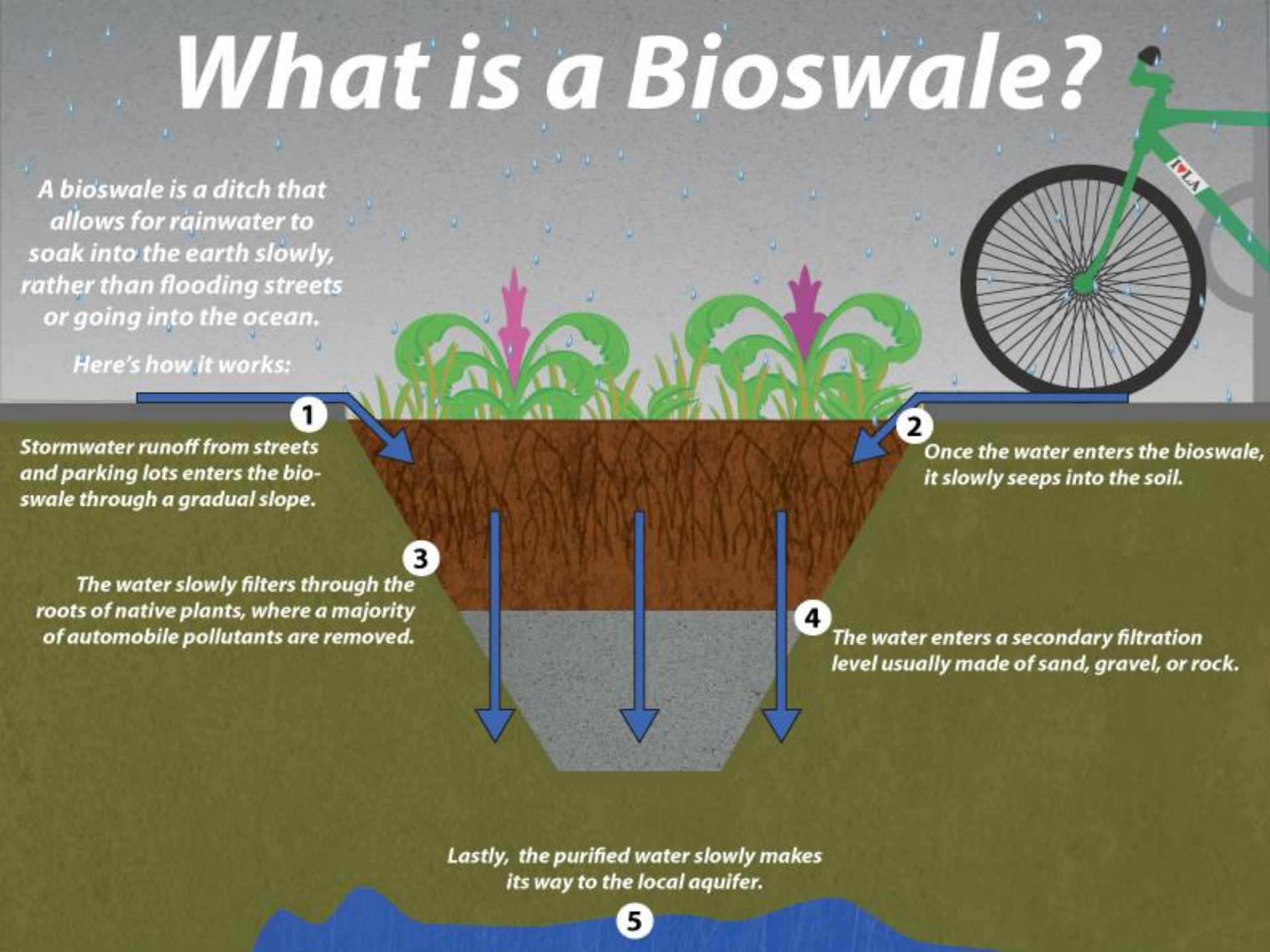
- Conveyance
- Treatment
- Vegetated Natural Buffer
- First Line of Defense

Removal Efficiency based upon Infiltration Volume

# Bioswales

- Shallow Bioretention or Swales with a twist!
- Upland Bioswales
- Wetland Bioswales

# What is a Bioswale?

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# Littoral Shelves

- Associated with wet detention ponds
  - Shallow area below Normal Water Level
  - Planted with emergent vegetation or natural colonization
  - 30% of pond area
  - Concentrated at outfall
  - Wildlife habitat
  - Removal Efficiency – 10% TN and 10% TP

# Floating Islands

- Managed Aquatic Plant Systems (MAPS)
- Commercially available
- Floating plant trays
- Anchored with exclusion netting
- 5% of pond surface area
- 12% removal
- 20-40% removal credit for TN and TP

# Floating Islands

Advantages

- Away form homeowner
- Shape, size and species are customizable
- Greater removal efficiency credit than littoral shelves

Disadvantages

- Similar nuisance/exotic species control
- Annual biomass harvesting and replanting

# Wetland Treatment

- Part of treatment train
- Isolated and wholly owned
- Pre-treatment required
- Maintain natural fluctuation range
- Maximize sheet flow, minimize channelization
- Off-line system if natural, may be in-line if man-made
- Maintain plant assemblages

# Wetland Nutrient Removal

- Limited removal by rooted plants
- Periphyton/algae
- Bacteria
- Varies by season
- 1.0 mg/L TN limit
- Removal based on retention volume or removal efficiency data
- True Value is underestimated

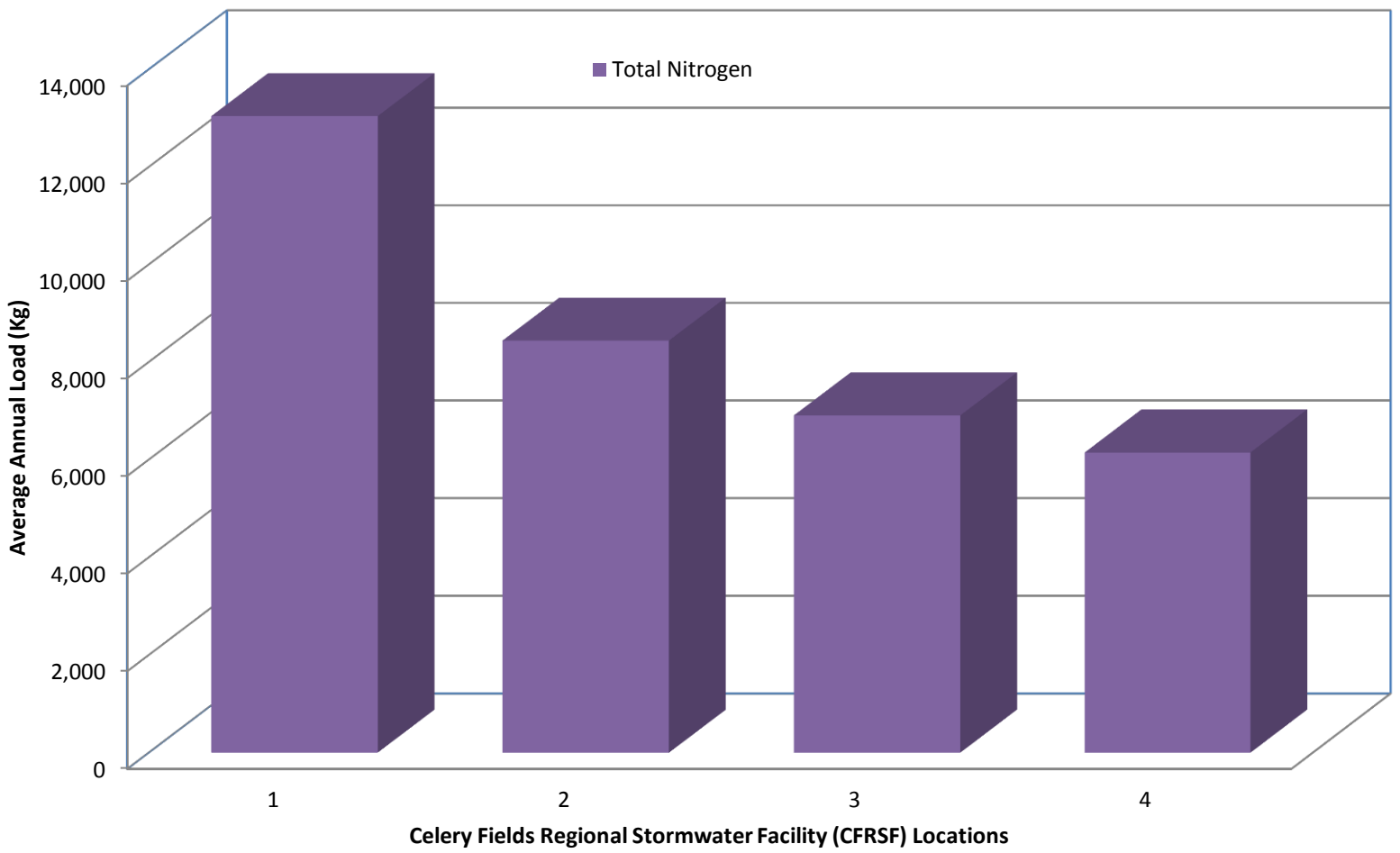


Figure 15. Average annual TN loads for the duration of the study for each of the cells.

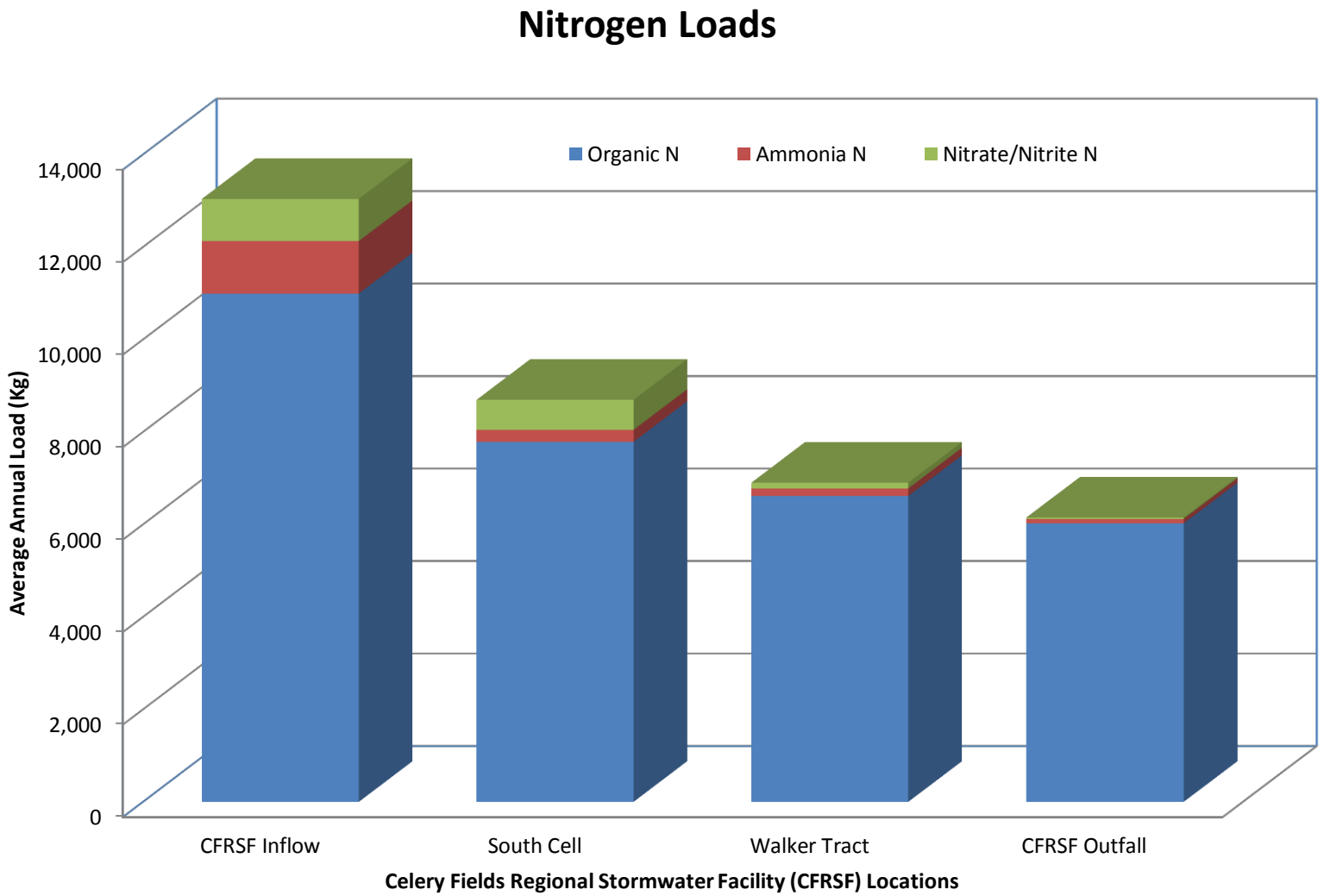


Figure 15. Average annual TN loads for the duration of the study for each of the cells.

# Green Roofs

- Vegetation
- Growth media, pollution-control media
- Cistern
- Effectiveness based upon volume captured and reused

# Biofiltration

- Microbial and soil treatment
- Associated with bioswales, and rain gardens
- Detention system with lined underdrain
- Soil elements may be incorporated into Underdrain Filtration requirements
- 80% TN and TP removal efficiency

# Biofiltration

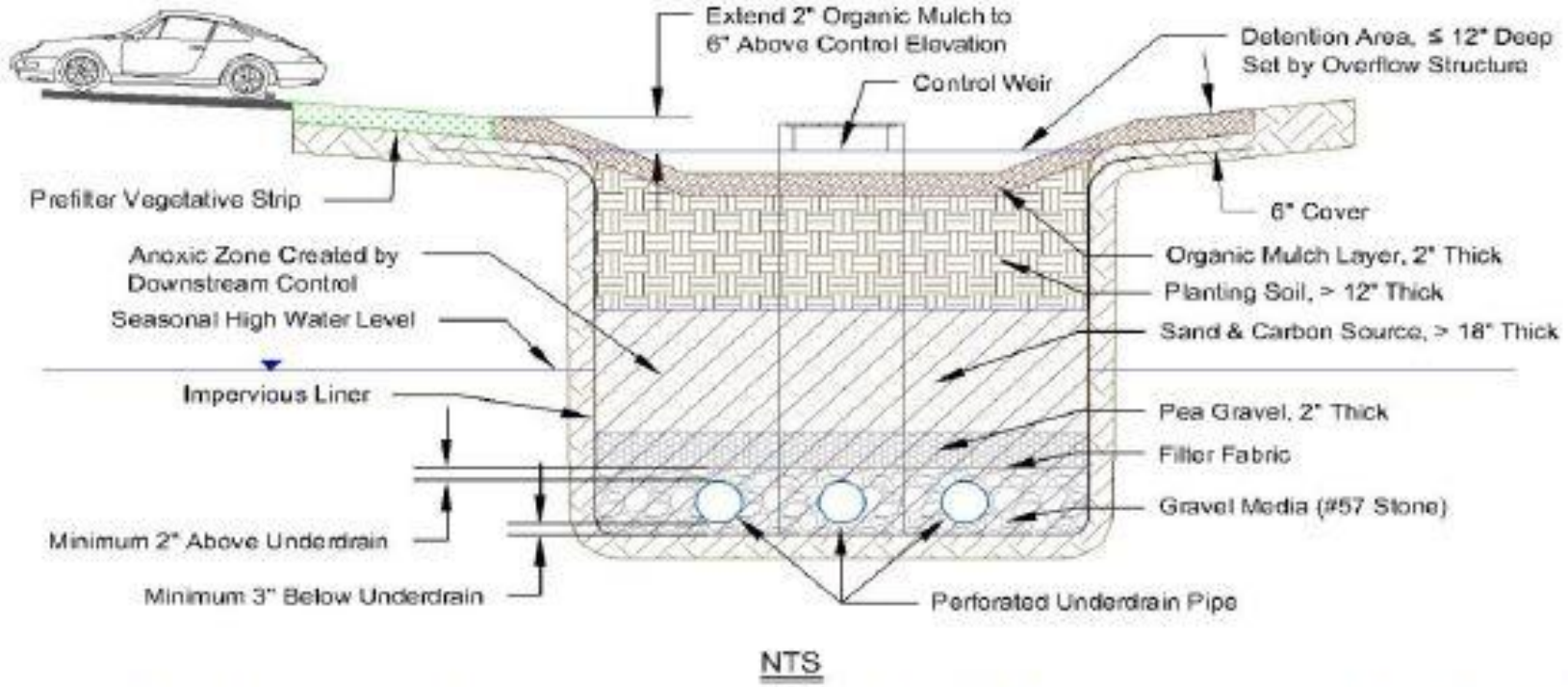


**Figure 3.6-2 Cross Section View of a Detention System with Biofiltration**

# Rain Gardens

- Rainwater Vs. Stormwater Runoff
- Variation of a Bioswale for rainwater
- Can include biofiltration or retention
- Removal efficiency based upon volume removed or treated

# Volume Reduction

- NNCs are concentrations, but loads are more critical
- Load = concentration x volume
- Don’t assume that everything run offs
- Evaporation, transpiration and infiltration

# McIntosh Park

- Two year storm event study
- 5,600 acre+ watershed
- Three BMPs (Sump, Wetland, Alum) in series
- 54% volume reduction


# Celery Fields

- Two year storm event study
- 3,965 acre watershed
- Treatment train (ponds, pond with littoral shelves, wetlands)
- 34% volume reduction

# Rainwater Harvesting

- Rain Barrels
- Cisterns/Vaults
- Irrigation
- Gray water/Reuse

# Stormwater Harvesting

- Pretreatment required, minimally filtration
- Treated Stormwater Reuse
- Ponds, cisterns/vaults
- Metering of reuse
- Load reduction based on volume reused

# Stormwater Harvesting

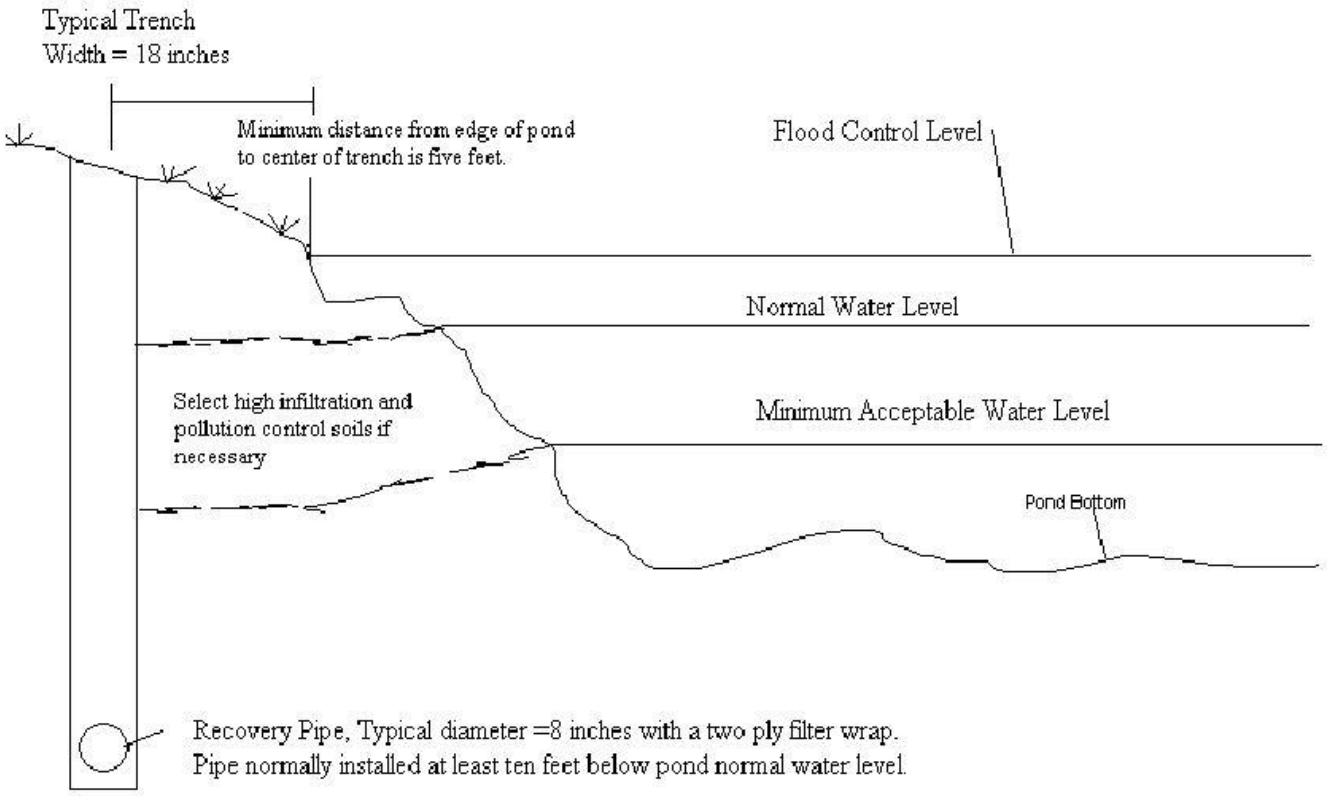


**Figure 3.3-3 Horizontal Well Construction Details**

# Questions?