Why Sustainable Site Design?

- Reduces site construction costs
- Increases developable land
- Embraces the triple bottom line approach

Natural Stormwater Drainage Strategies

- Natural biological systems
- Not a "new" science
- Can be used anywhere
- Custom designed to fit site

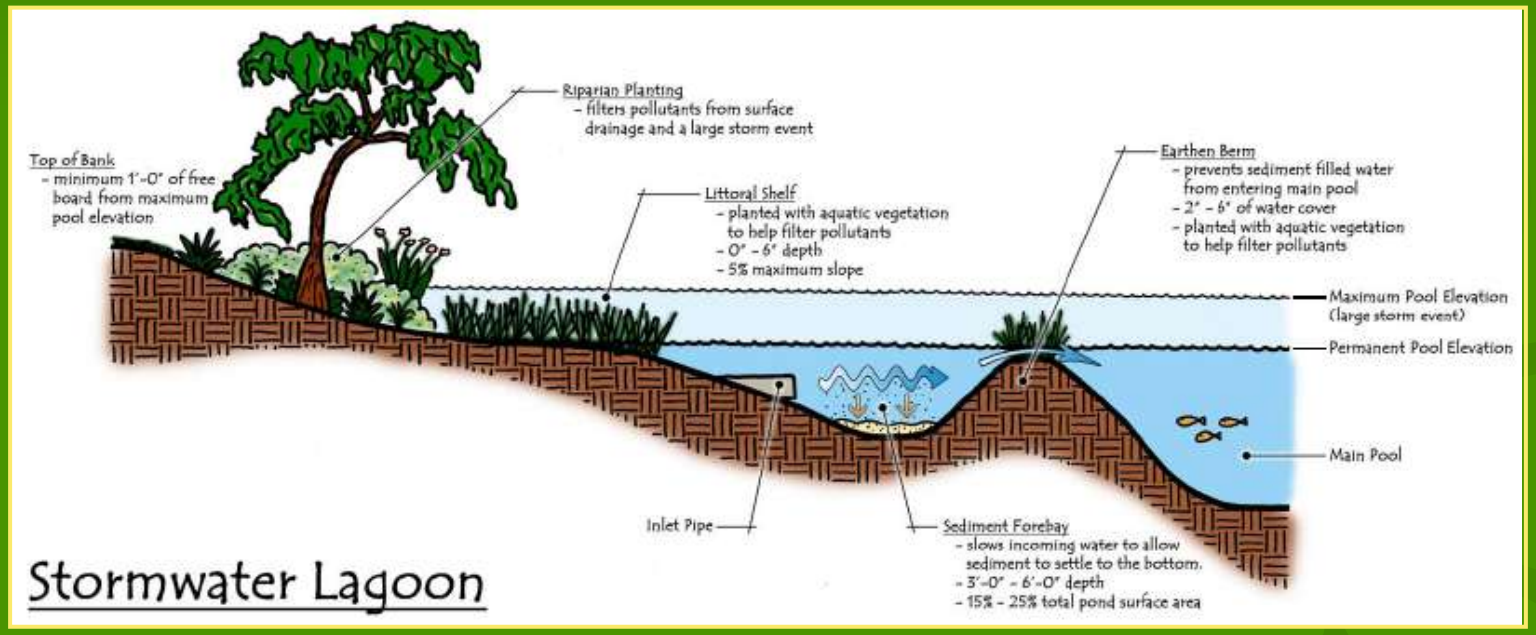
Natural Stormwater Drainage Practices

BMP's (Best Management Practices)

- Runoff Conveyance Practices
- Runoff Storage Practices
- Filtration Practices
- Infiltration Practices

BMP's (Best Management Practices)

- Runoff Conveyance Practices
- Runoff Storage Practices



Littoral/ Aquatic Shelves

- Provides aerobic zone
- Promotes growth of beneficial microorganisms
- Increases surface area
- Safety zone
- Area of greatest biologic activity

WETLAND PLANTS

Georgia Southern University Center for Wildlife Education

Common Rush
Juncus effusus

Yellow Canna
Canna flaccida

Swamp Loosestrife
Decodon verticillatus

Pipewort
Eriocaulon decangulare

Arrowhead
Sagittaria latifolia

Lizard's Tail
Saururus cernuus

Voodoo Orchid
Cleistes divaricata

Blue Flag Iris
Iris versicolor

Copper Iris
Iris fulva

Bulrush
Scirpus californicus

White Top Sedge
Dichromena colorata

Swamp Lily
Crinum americanum

Grass-Pink Orchid
Calopogon pulchellus

Golden Club
Orontium aquaticum

Pitcher Plant
Sarracenia sp.

Pitcher Plant
Sarracenia sp.

Pitcher Plant
Sarracenia sp.

Duckweed
Lemna perpusilla

Water-Meal
Wolffia columbiana

PLANT PALETTE

Georgia Southern University Center for Wildlife Education

TREES

Red Maple
Loblolly Bay
Tulip Tree
Black Gum
Willow Oak
Pond Cypress


Pond Cypress
Taxodium ascendens


Red Maple
Acer rubrum


Tulip Tree
Liriodendron tulipifera


Redbud
Cercis canadensis


Black Gum
Nyssa aquatica


Willow Oak
Quercus phellos


Sweetbay
Magnolia virginiana


Wax Myrtle
Myrica cerifera


Yaupon Holly
Ilex vomitoria

UNDERSTORY TREES

Redbud
Yaupon Holly
Sweetbay
Wax Myrtle

SHRUBS

Sweetshrub
Buttonbush
Inkberry
Pepperbush
Leucothoe
Saw Palm


Buttonbush
Cephalanthus occidentalis


Inkberry
Ilex glabra


Sweetshrub
Calycanthus floridus


Pepperbush
Clethra alnifolia


Coastal Leucothoe
Leucothoe axillaris


Cinnamon Fern
Osmunda cinnamomea

GRASSES/GROUNDCOVERS


Liatris
Liatris spicata


Common Rush
Juncus effusus

Wiregrass
Sedges
Rushes
Liatris
Sweet Grass
Cinnamon Fern

Sources for images:

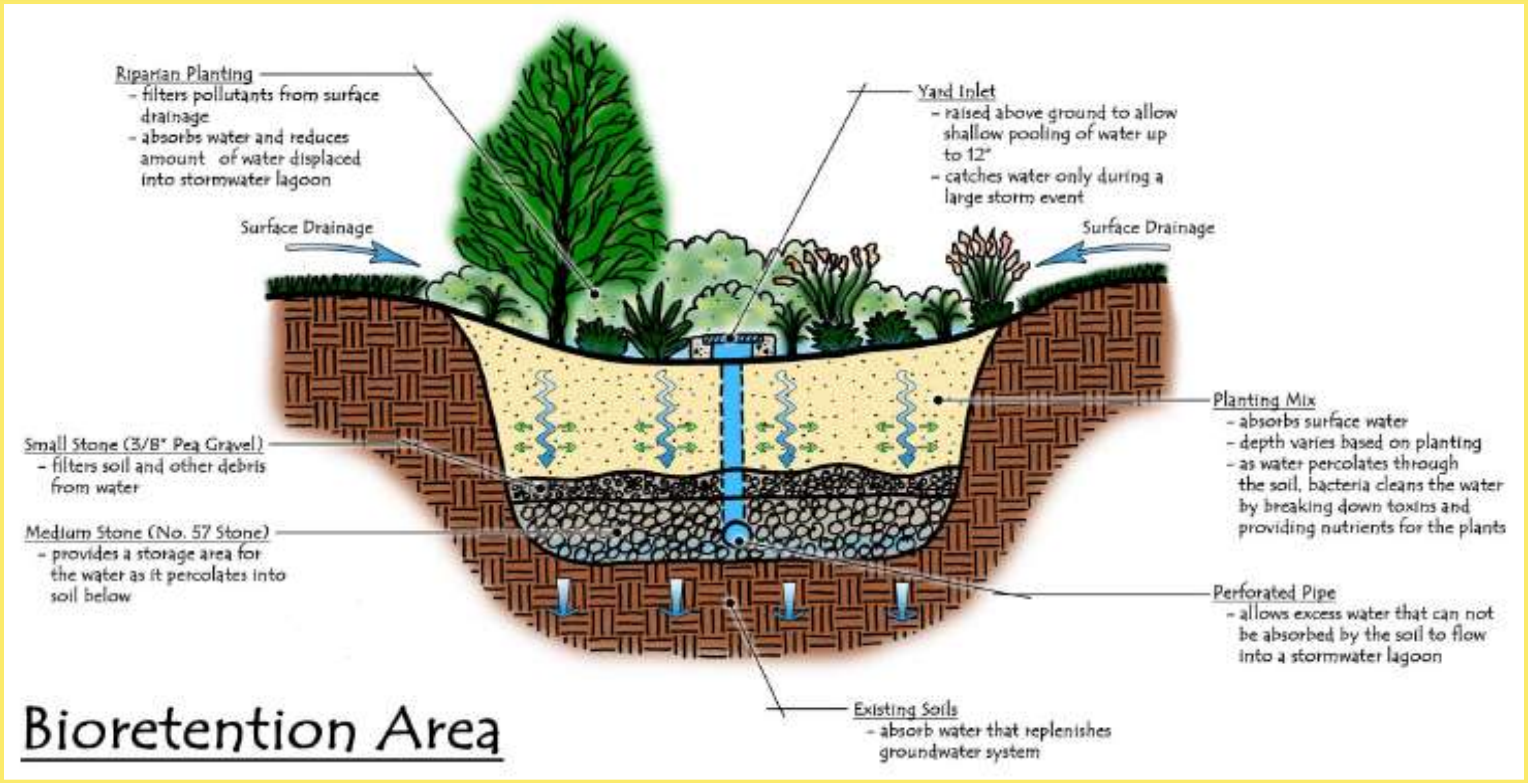
Combined Benefits

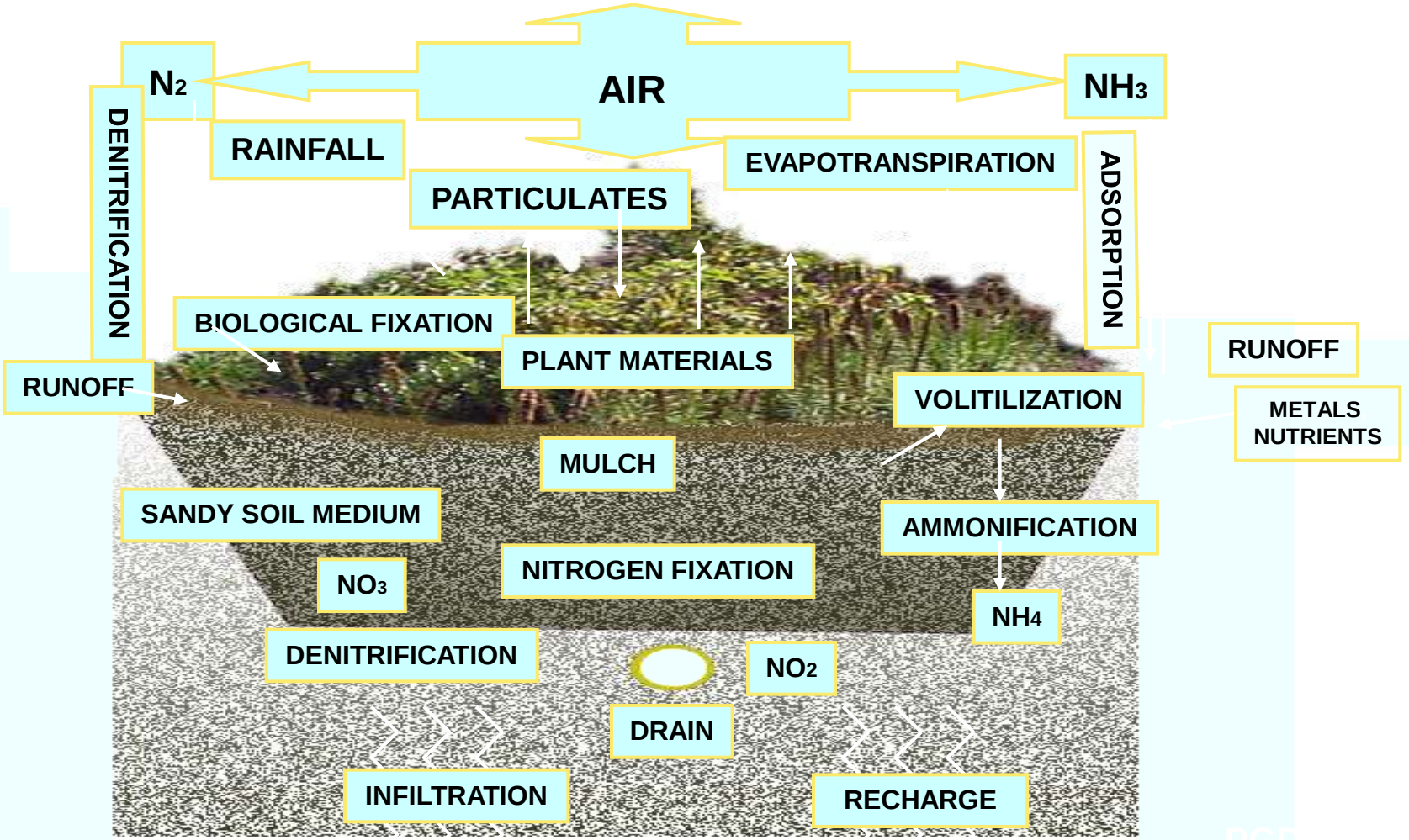
- Slows down the water
- Provides wildlife habitat
- Creates beauty
- Cleans the water

Bad Examples

BMP's - Filtration Practices

- Biological Process is the Key:
  - They do not fail
  - Require very little maintenance
  - Physical breakdown of pollutants into harmless substances

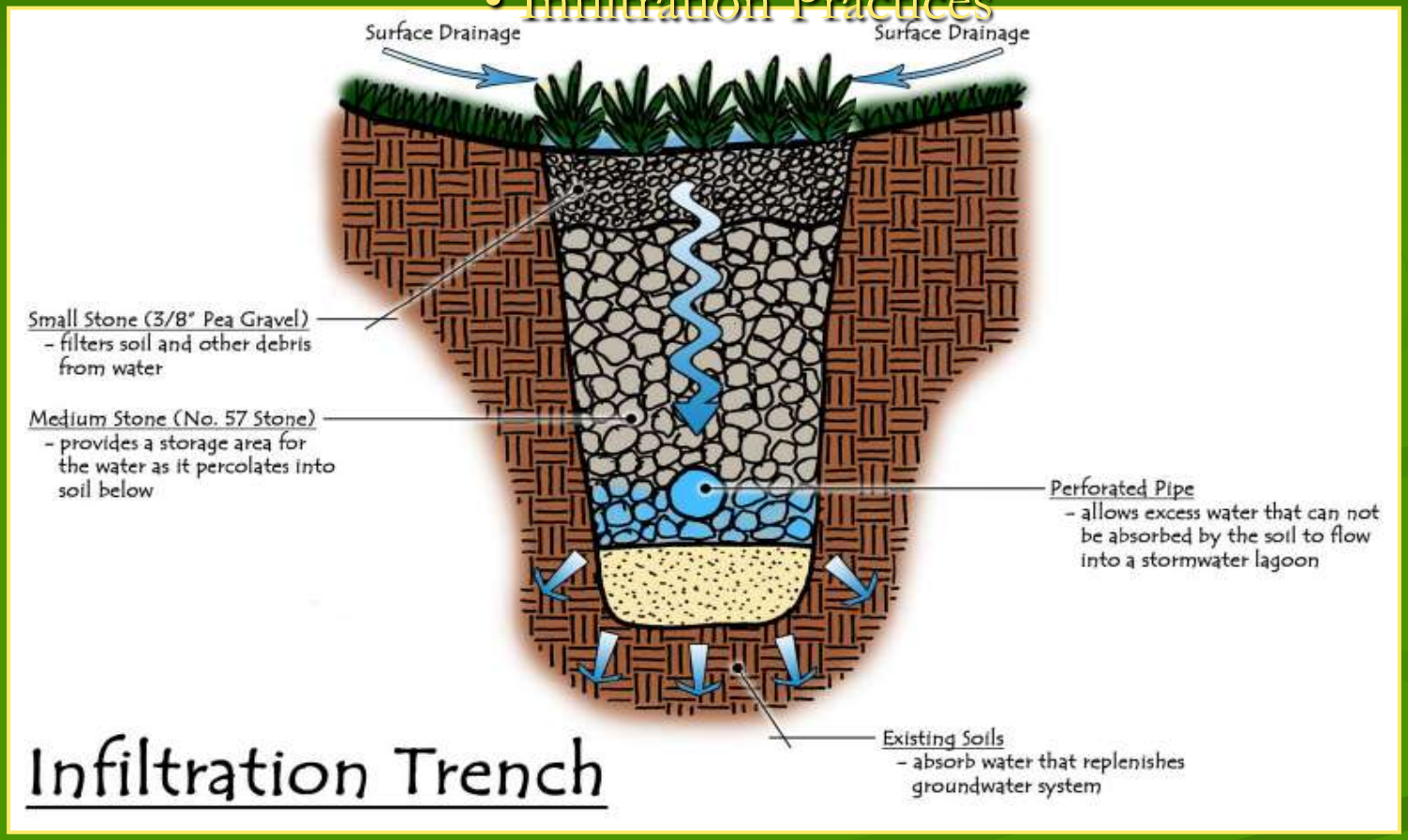




Nitrogen Cycle for Bioretention

BMP's (Best Management Practices)

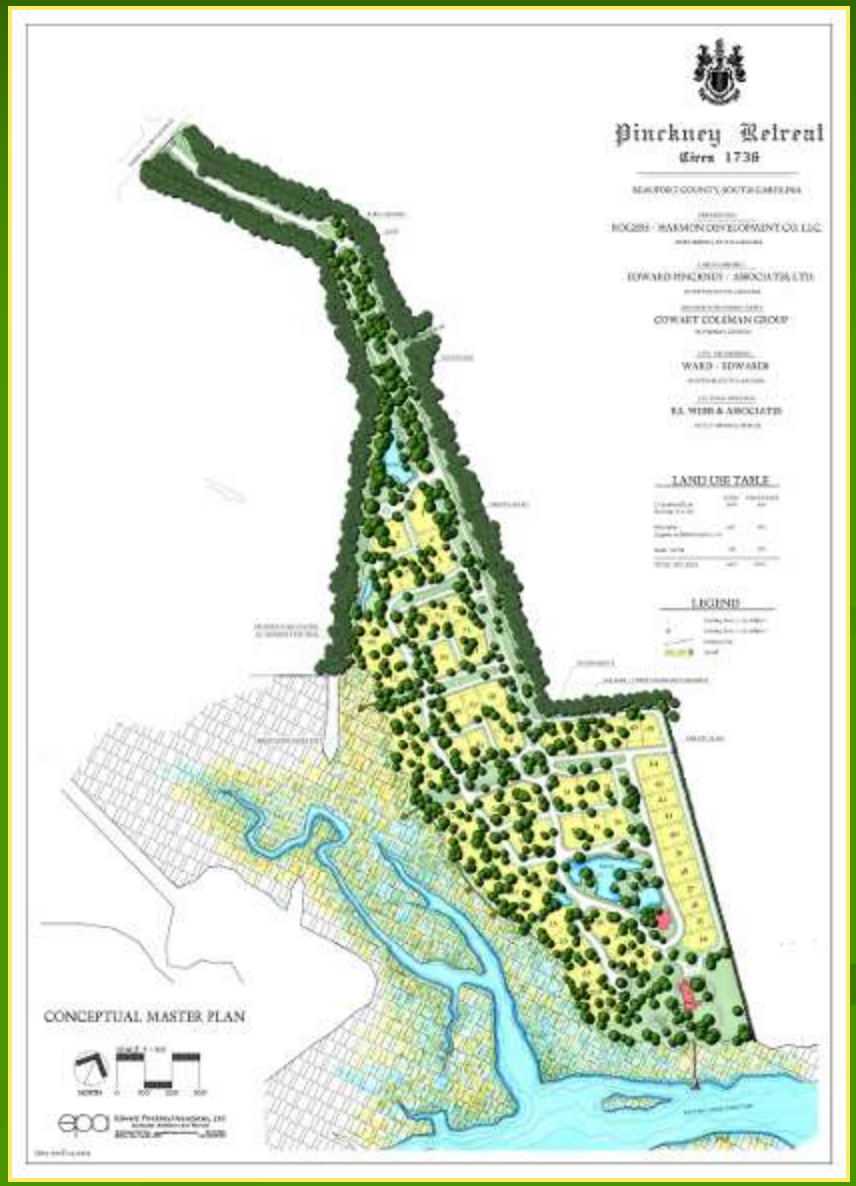
- Infiltration Practices



Related Projects

Pinckney Retreat
Residential Community using Natural Stormwater Drainage and LID Principles

- 35-acres
- 76 residential lots
- Traditional neighborhood design
- Historical home and landscape
- Water and Marsh front
- Preserved Live Oak trees
- One of only 2 Honor Awards in SC for Sustainable Design in 2008



Pinckney Retreat

Pinckney Retreat

Pinckney Retreat

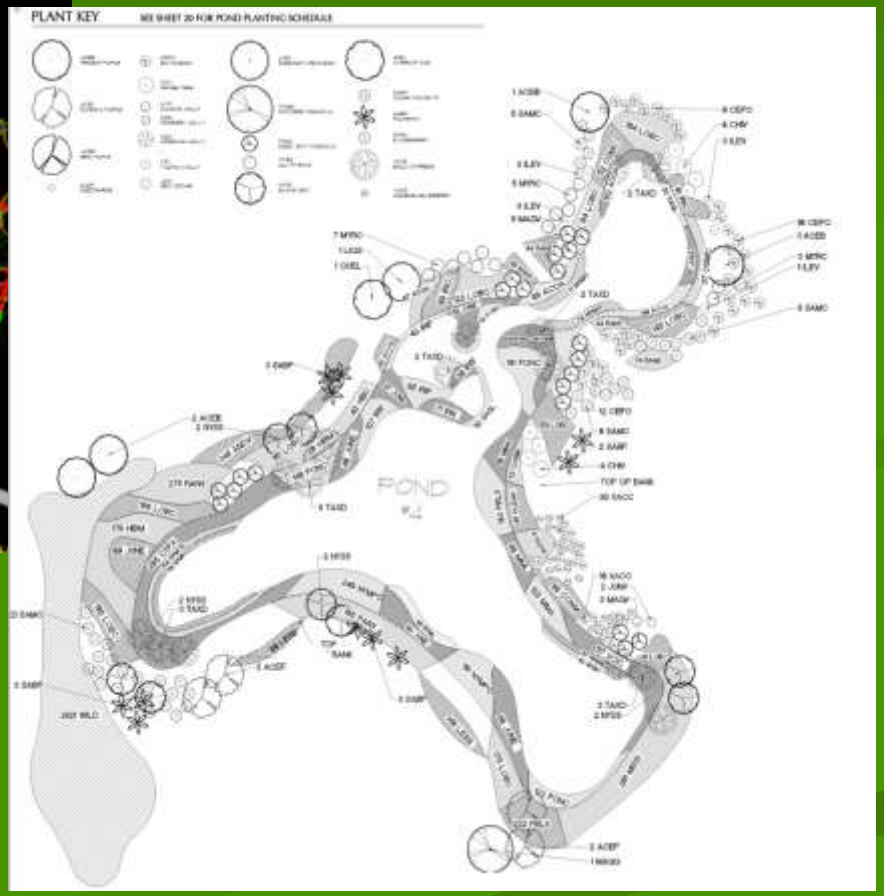
Pinckney Retreat

Related Projects

University of South Carolina – Beaufort

Campus Planning and Complete Natural Stormwater System

- Central courtyards organize campus
- Stormwater ponds with littoral shelves and forebays provide water quality



- Functional Pond Design
- Encourage Filtration through plant placement

University of South Carolina – Beaufort

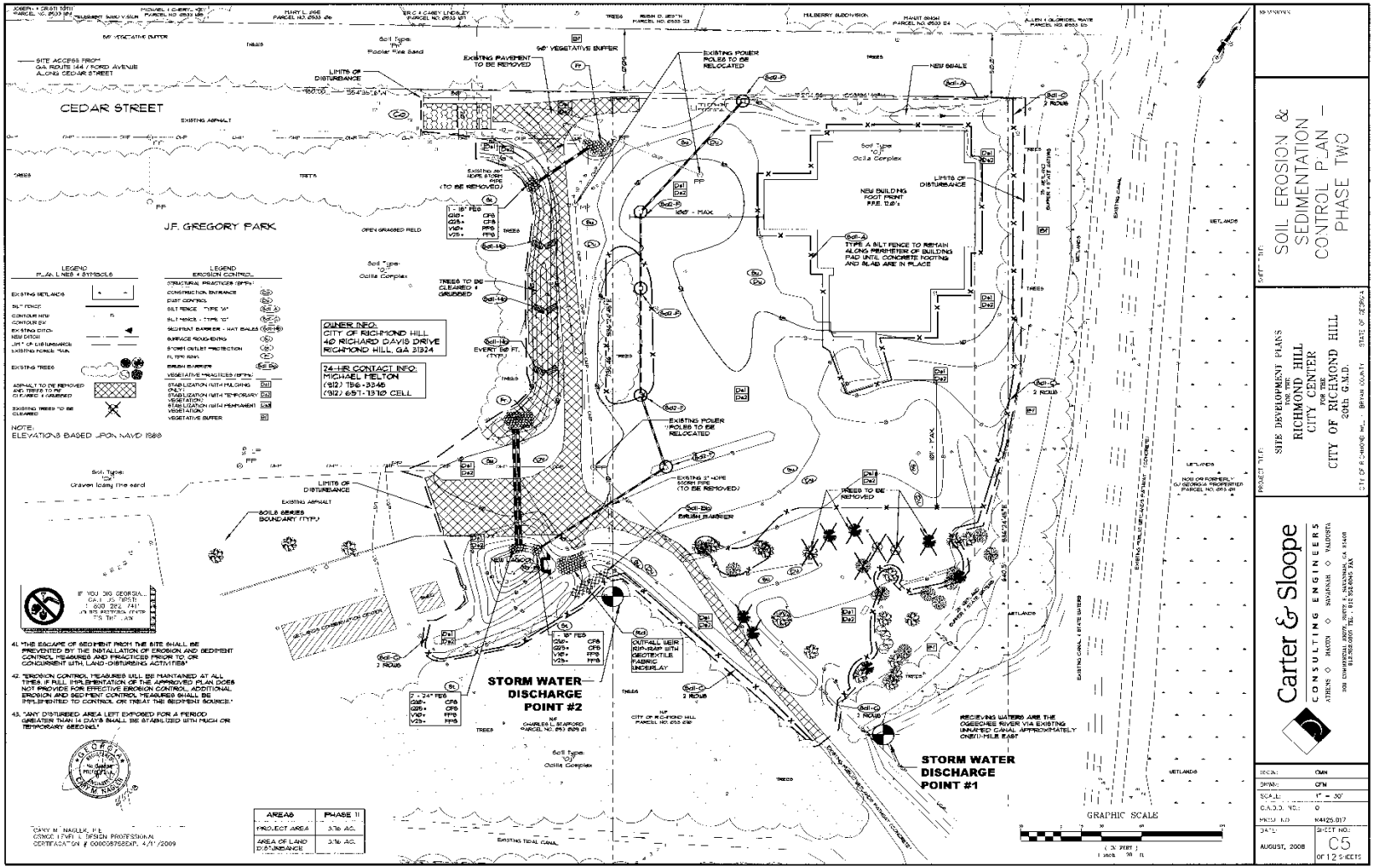
Lagoon Construction

University of South Carolina – Beaufort

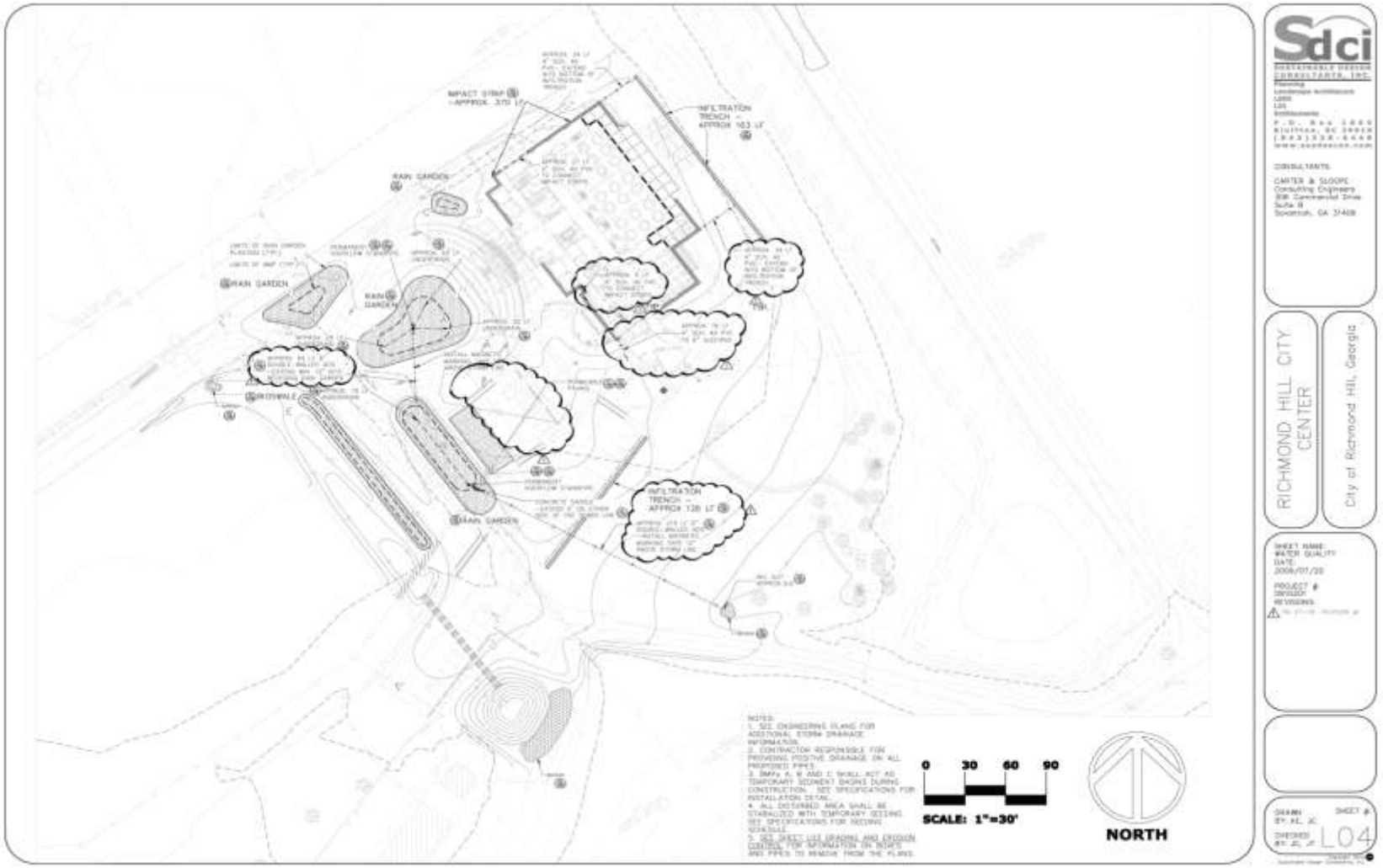
Front Lagoon One Year Following Planting

University of South Carolina – Beaufort

Richmond Hill Engineer Plan



Richmond Hill Water Quality Plan

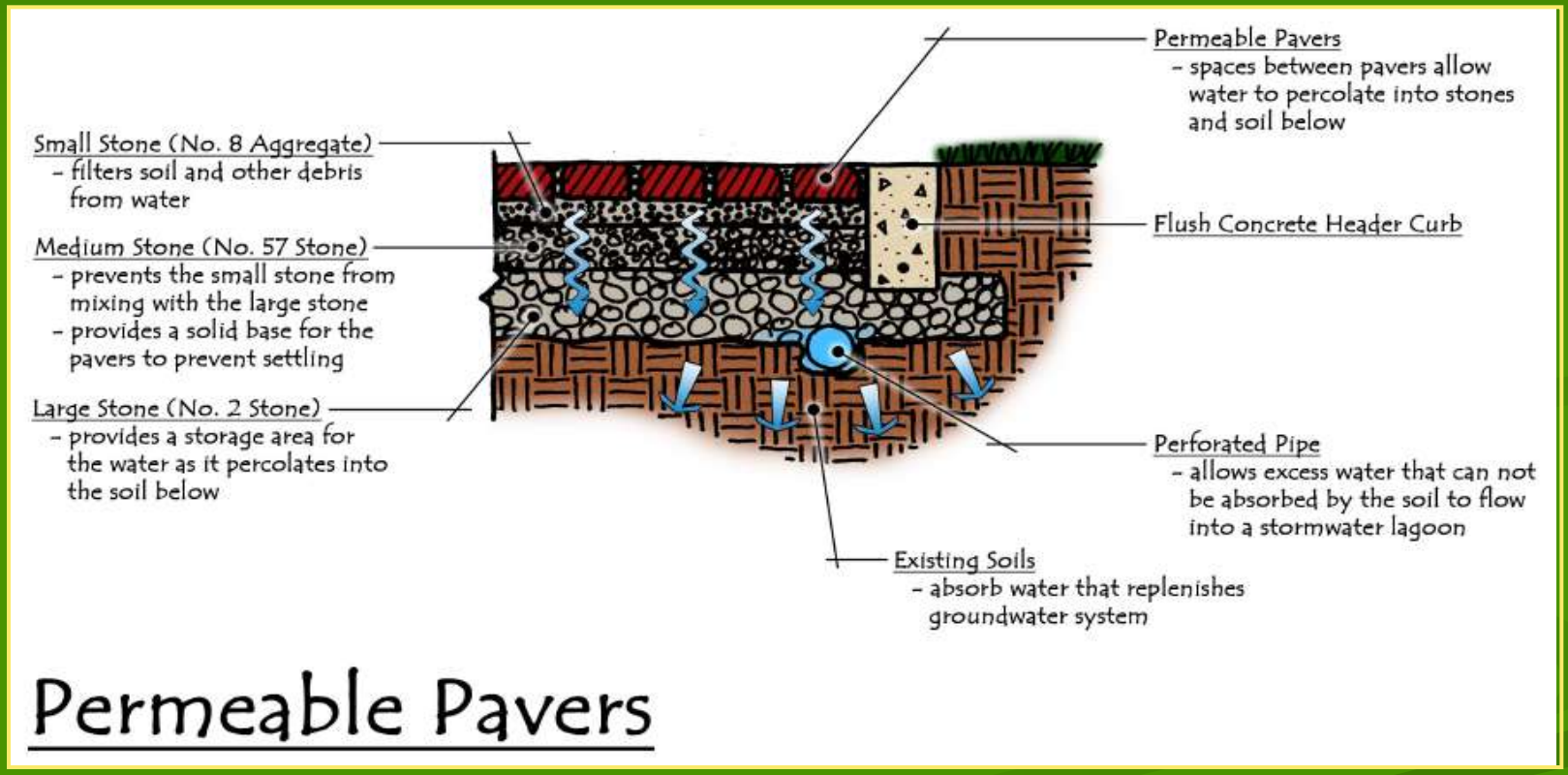


Landscape Plan

Landscape Plan Installed

BMP's (Best Management Practices)

• Infiltration Practices



Permeable/ Porous Paving

- Encourages infiltration
- Reduces heat island
- Traps heavy metals

Low Impact Landscaping

- Planting native, drought-tolerant plants
- Converting turf areas to groundcovers, shrubs and trees
- Amending soil to improve infiltration rates
- Planting wildflower meadows rather than turf along medians and in open space
- Encouraging longer grass length – strips, not areas
- Reforestation

How do these efforts translate into the "Development Program"?

1. Conserve Natural Areas
2. Minimize Development Impact
3. Maintain Site Runoff Rate
4. Integrated Management Practices

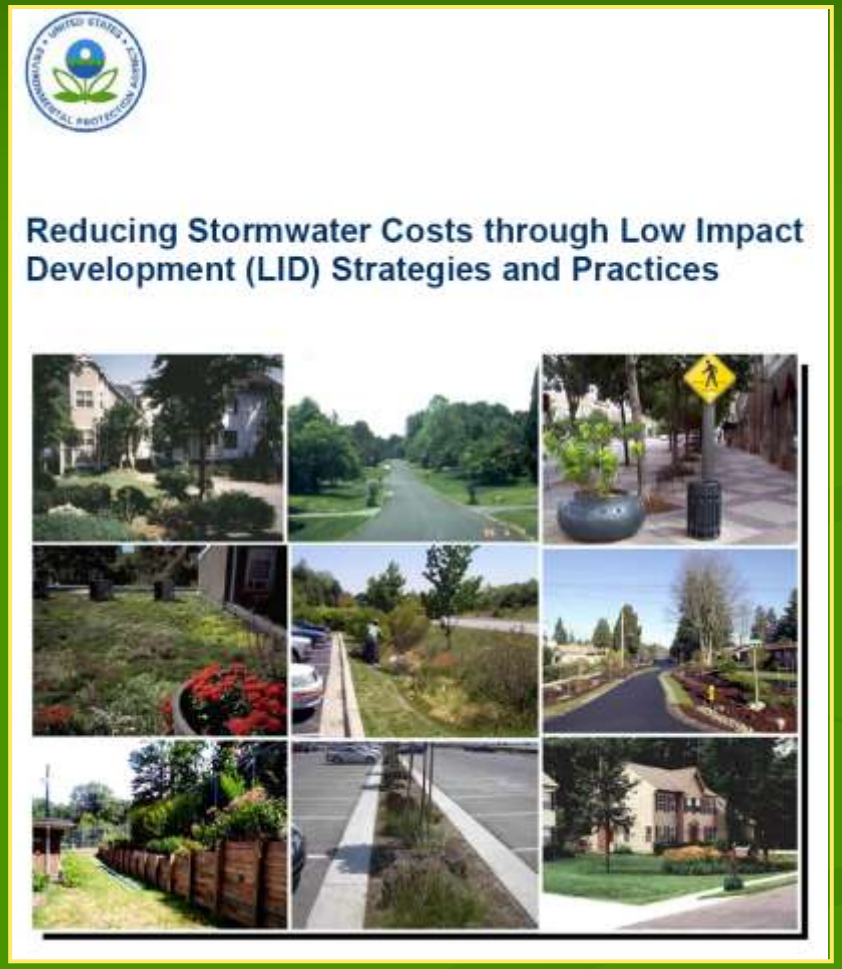

Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

Table 1. Summary of LID Practices Employed in the Case Studies

Name	LID Techniques							
	Biore-tention	Cluster Building	Reduced Impervious Area	Swales	Permeable Pavement	Vegetated Landscaping	Wetlands	Green Roofs
2nd Avenue SEA Street	✓		✓	✓				
Auburn Hills	✓		✓	✓		✓	✓	
Bellingham Parking Lot Retrofits	✓							
Central Park Commercial Redesigns	✓			✓				
Crown Street	✓		✓	✓				
Gap Creek			✓			✓		
Garden Valley	✓	✓		✓	✓		✓	
Kensington Estates		✓	✓		✓	✓	✓	
Laurel Springs	✓	✓	✓	✓				
Mill Creek		✓	✓	✓				
Poplar Street Apartments	✓			✓			✓	
Portland Downspout Disconnection*			✓					
Prairie Crossing	✓		✓	✓		✓		
Prairie Glen	✓	✓	✓	✓		✓	✓	
Somerset	✓			✓				
Tellabs Corporate Campus	✓			✓		✓	✓	
Toronto Green Roofs								✓

Table 2. Summary of Cost Comparisons Between Conventional and LID Approaches[a]

Project	Conventional Development Cost	LID Cost	Cost Difference[b]	Percent Difference[b]
2nd Avenue SEA Street	$868,803	$651,548	$217,255	25%
Auburn Hills	$2,360,385	$1,598,989	$761,396	32%
Bellingham City Hall	$27,600	$5,600	$22,000	80%
Bellingham Bloedel Donovan Park	$52,800	$12,800	$40,000	76%
Gap Creek	$4,620,600	$3,942,100	$678,500	15%
Garden Valley	$324,400	$260,700	$63,700	20%
Kensington Estates	$765,700	$1,502,900	–$737,200	-96%
Laurel Springs	$1,654,021	$1,149,552	$504,469	30%
Mill Creek[c]	$12,510	$9,099	$3,411	27%
Prairie Glen	$1,004,848	$599,536	$405,312	40%
Somerset	$2,456,843	$1,671,461	$785,382	32%
Tellabs Corporate Campus	$3,162,160	$2,700,650	$461,510	15%

United States Environmental Protection Agency

2008
HGTV Green Home
LEED – for Homes Gold Rating

- Integrated Project Planning
- Quality Management for Durability
- Site Selection
- Infrastructure
- Community Resources and Public Transit
- Access to Open Space
- Site Stewardship
- Landscaping
- Shading of Hardscapes
- Surface Water Management
- Non-Toxic Pest Control
- Water Reuse
- High Efficiency Irrigation System

This project was completed while working for a previous employer.

Conceptual Site Plan

Park Place Outreach Youth Shelter

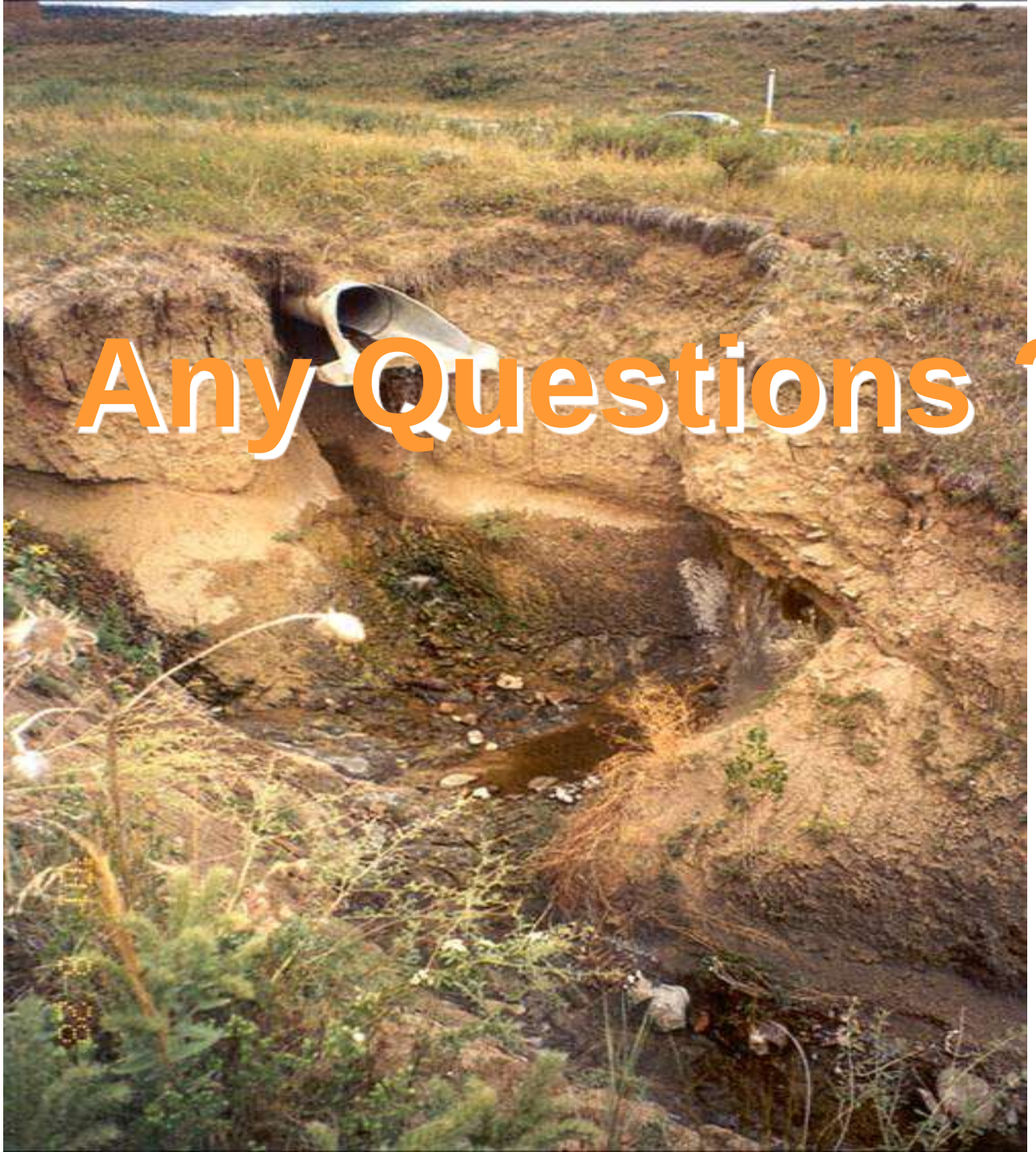
LEED - NC Silver Rating

- Integrated Project Planning
- Quality Management for Durability
- Alternative Transportation
- Infrastructure
- Community Resources and Public Transit
- Maximum Open Space
- Native Landscaping
- Reduced Heat Island Effect
- Storm Water Design – Quality Control
- Regional Materials
- Use of Recycled Content
- High Efficiency Irrigation System

This project was completed while working for a previous employer.

For More Information

- Center for Watershed Protection
  www.cwp.org
- The Low Impact Development Center
  www.lowimpactdevelopment.org
- Stormwater Research Center
  www.stormwatercenter.net
- U.S. Environmental Protection Agency
  www.epa.gov/owow/nps/urban.html
- UW Center for Urban Water Resources
  www.depts.washington.edu/cuwrm/
- Mecklenburg County Water Quality Program
  www.charmeck.org/Departments/Stormwater
- Prince George's County Bioretention Manual
  co.pg.md.us/Government/AgencyIndex/DER/ESD/Bioretention


Any Questions ?