Campus and Community Sustainability Conference

Stormwater Management and Low Impact Development Session

3:00 - 4:30 pm

UF UNIVERSITY of FLORIDA
IFAS Extension

Alachua County, Florida

Session's Speakers

- Mark Clark

  Extension Specialist, Wetlands and Water Quality
  Assistant Professor, Soil and Water Science Department
  University of Florida

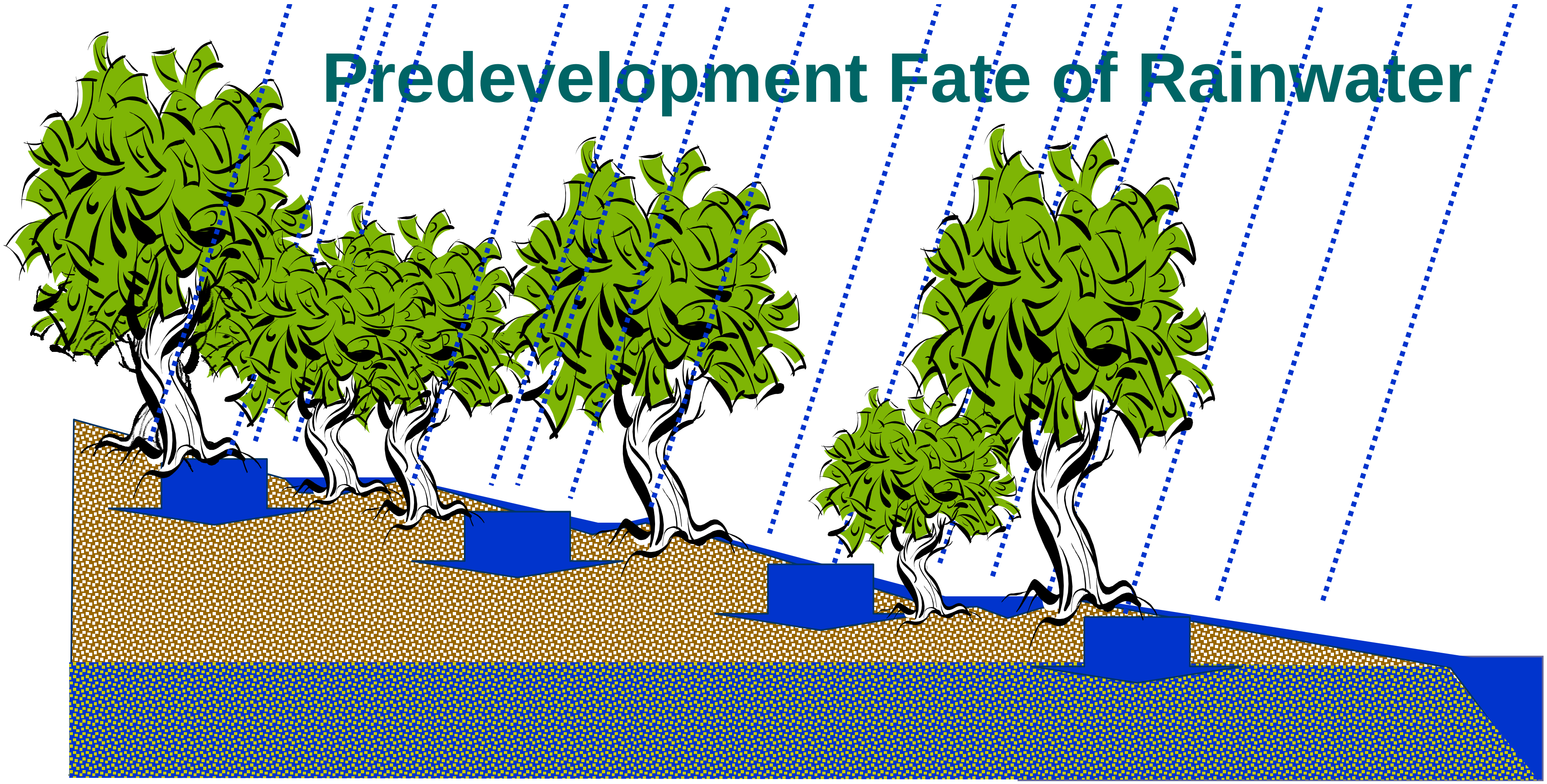
- Stephen Hofstetter

  Senior Environmental Planner
  Alachua County Environmental Protection Department

Outline

- Fate of rainfall pre- and post-development
- Conventional stormwater approach
- Low Impact Development (LID) alternatives
- Obstacles to LID
- Action Items

Predevelopment Fate of Rainwater



- Interception – rain that never hits the ground – lost to evaporation 5-35%
- Infiltration – soil composition (texture) & amount of compaction
- Depression storage – natural depressions throughout the landscape
- Runoff quantity – variable; difference between rainfall rate, infiltration rate & amount of depression storage
- Runoff rate – slow, dependent on slope & “roughness” of flow path

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Impacts of Development

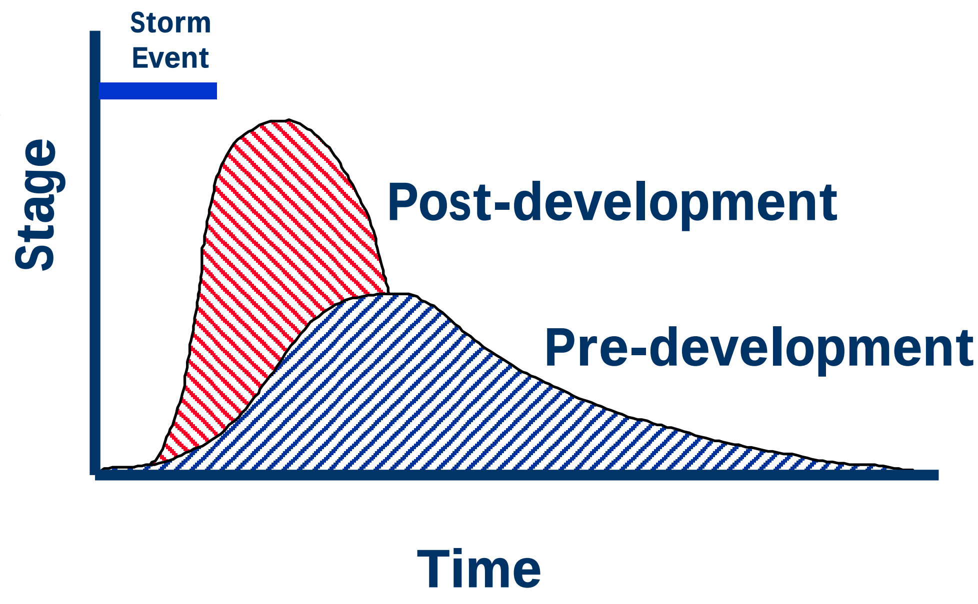
- **Interception**
  - Typically reduced with loss of tree cover and size of trees
- **Infiltration**
  - Reduced with soil compaction and increased impervious surface area
- **Depression storage**
  - Reduced by leveling landscape and providing positive drainage
- **Runoff Rate**
  - Faster due to smooth surfaces, removal of depression storage and facilitating runoff with ditches and pipe.

Watershed Chemistry Change

Pollutant	Primary Sources
Nutrients, Nitrogen and Phosphorus	Atmosphere, fertilizer application
Lead	Leaded gas, tire wear, lubricants
Zinc	Tire wear, motor oil, grease
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fungicides and insecticides
Cadmium	Tire wear, insecticides
Chromium	Metal plating, moving engine parts, brake linings
Nickel	Diesel fuel and gasoline, lubricating oils, metal plating, bushing wear brake linings, asphalt
Petroleum	Spills, leaks or blow-by of motor lubricants antifreeze and hydraulic fluids, asphalt
Pathogens	Animal waste, septic tanks, sewer line spills
Synthetic organics	Industrial processes, pesticides, spills, asphalt

Post Development Result

- Change in Quantity
  - Increased runoff volume
  - Shorter time to concentration
- Changes in Quality
  - Transport of dissolved and particulate contaminants
  - Bank erosion of conveyance system
  - Thermal pollution
  - Freshwater pollution



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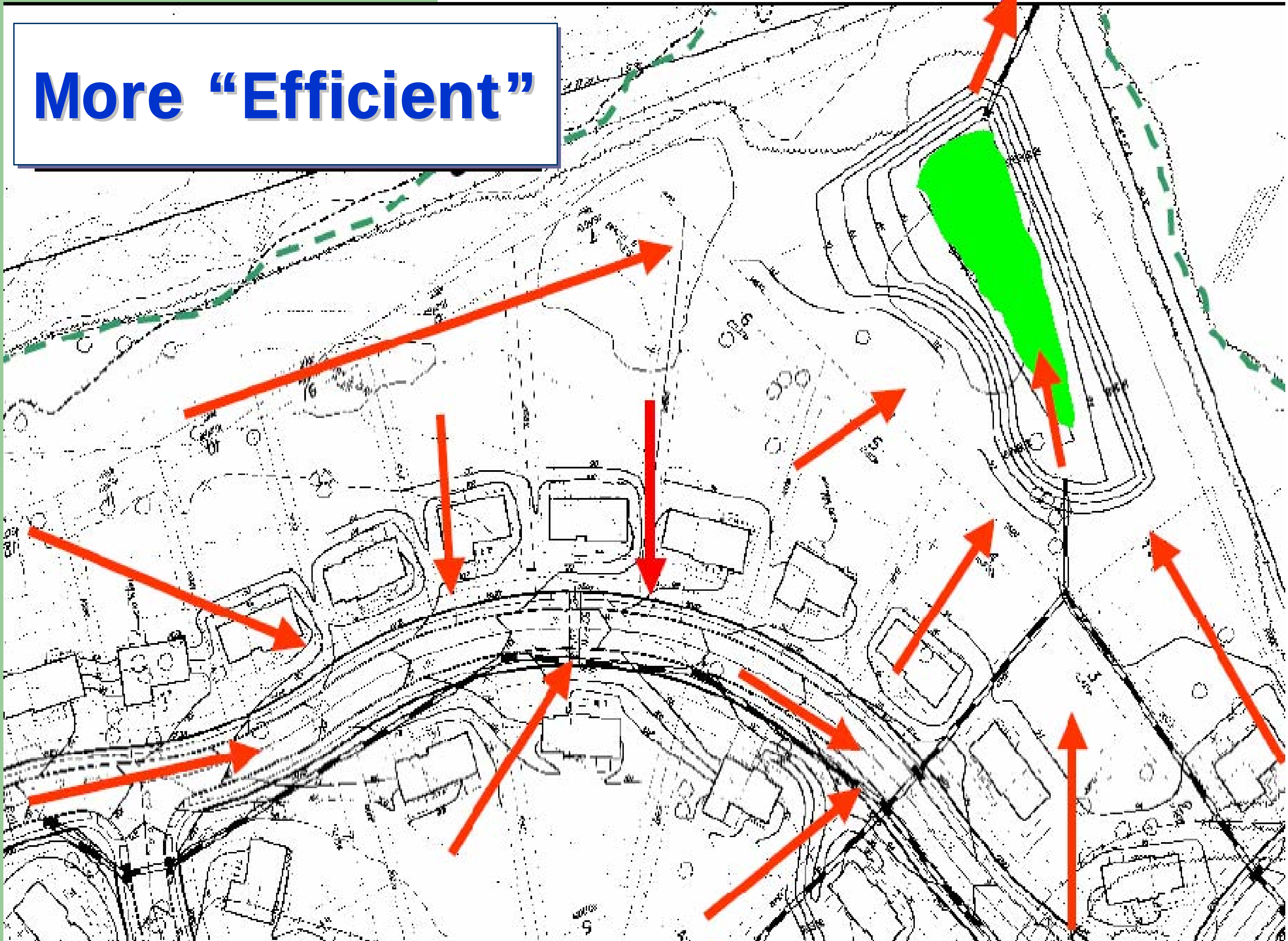
Conventional Runoff Routing

More “Efficient”



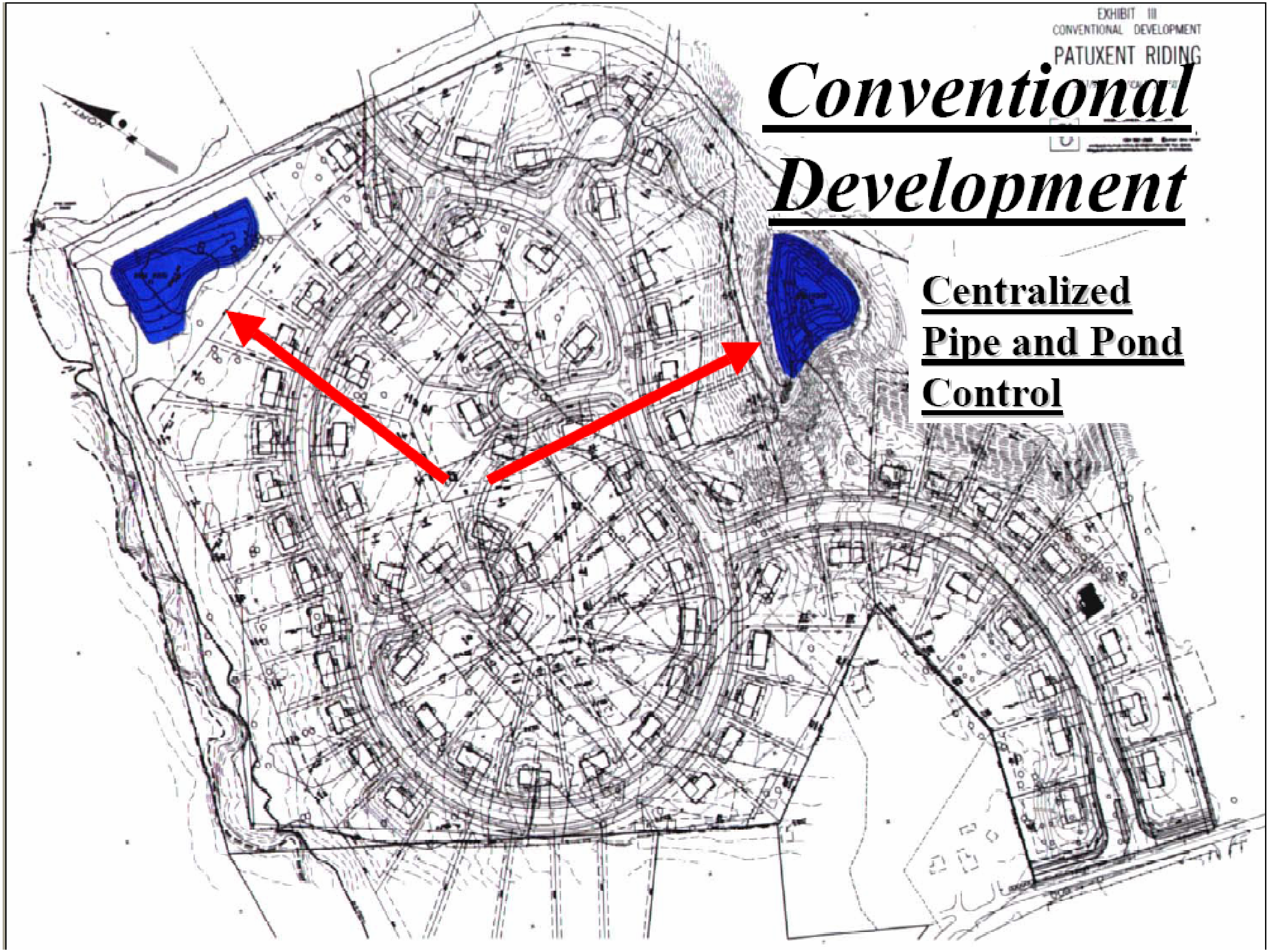


EXHIBIT III
CONVENTIONAL DEVELOPMENT
PATUXENT RIDING
Conventional Development
Centralized Pipe and Pond Control

Implications of Centralized Approach

- Very effective at addressing quantity issues especially infrequent/extreme events
  - Moves water away from roads, dwellings, infrastructure
- Can compromise hydrologic character of small/frequent events and the ability to treat contaminants
  - Conveys volume and contaminants to one location
  - Dilutes contaminants
  - Increases water volume to treat
  - Management system is typically down hill from source, often in closer proximity to groundwater or surface waterbody.
  - Soil and vegetative treatment potential is often reduced due to greater water depth, higher head, smaller area and shorter contact time for sorption.

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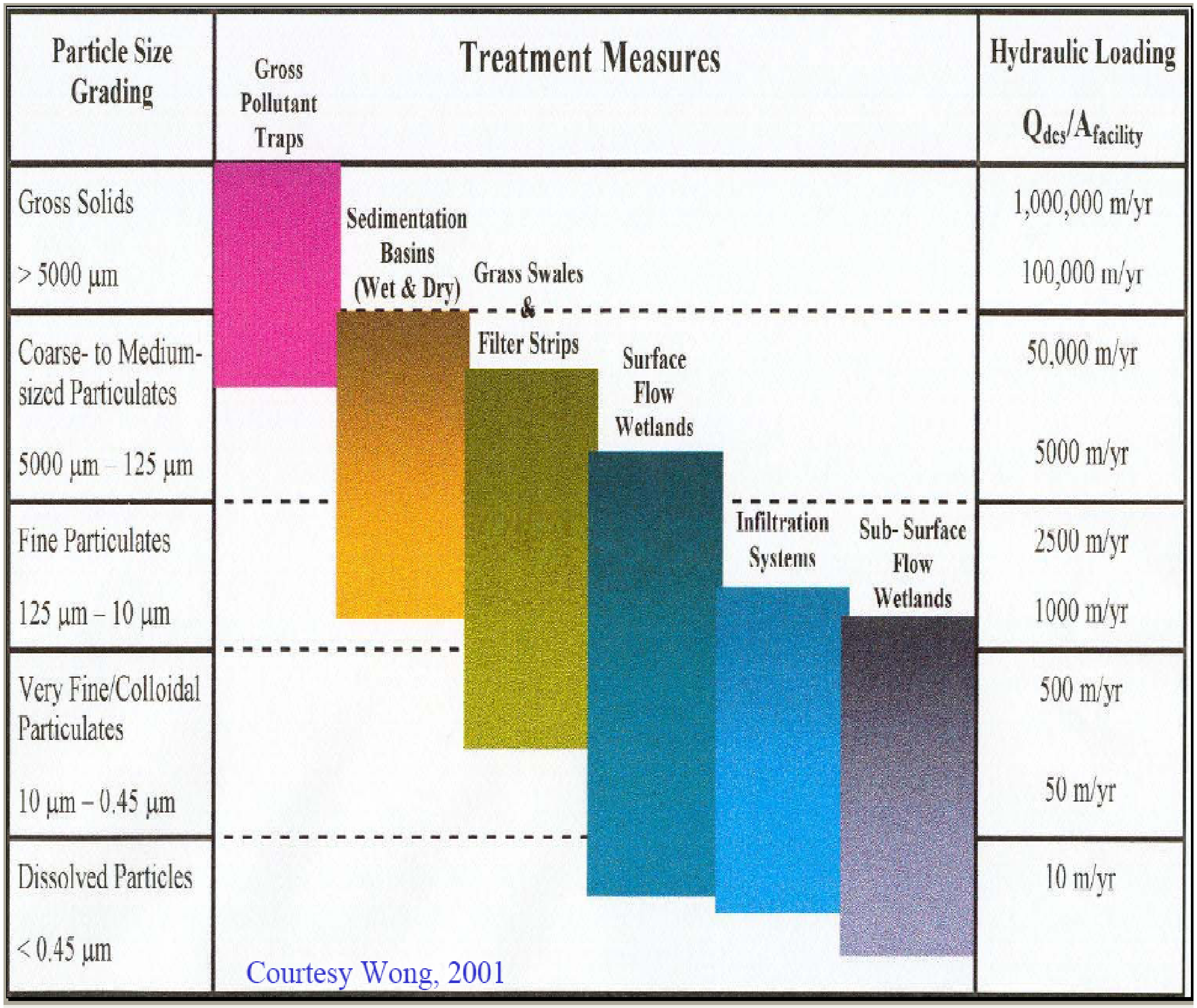
Quantity - Quality Tradeoff

Quality

Less treatment

More treatment



Quantity

High volume

Low volume

Low Impact Development?

- *Stormwater and land development strategies at the parcel or subdivision scale that emphasis conservation and use of on-site natural features integrated with engineered, small scale hydrologic controls to more closely mimic pre-development hydrologic conditions.*

- Retain, Detain, Recharge, Filter, Use

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Low Impact Development: Principal Objectives

- Minimize changes to natural environmental services and enhance processes where feasible.
- **Interception** - retain existing & promote new.
- **Infiltration** - minimize compaction, minimize impervious, facilitate infiltration as close to impervious source as possible.
- **Depression storage** - retain existing and promote new in conjunction with infiltration.
- **Link Stormwater to Soil and Vegetation Processes**
  - maximize contact area and time.

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Soil and Vegetation Processes in Pollutant Removal

- Vegetation
  - assimilation, accumulation, immobilization, carbon sequestration
- Soil organisms (organic matter)
  - Biodegradation, immobilization, transformation, volitization, bioturbation
- Soil chemistry
  - Adsorption, precipitation

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Integrated Management Practices: Top down treatment train

- Green Roofs
- Rainwater Harvesting
- Permeable Surfaces
- Depression storage - Bioretention
- Vegetated Swales
- Enhance Stormwater Ponds

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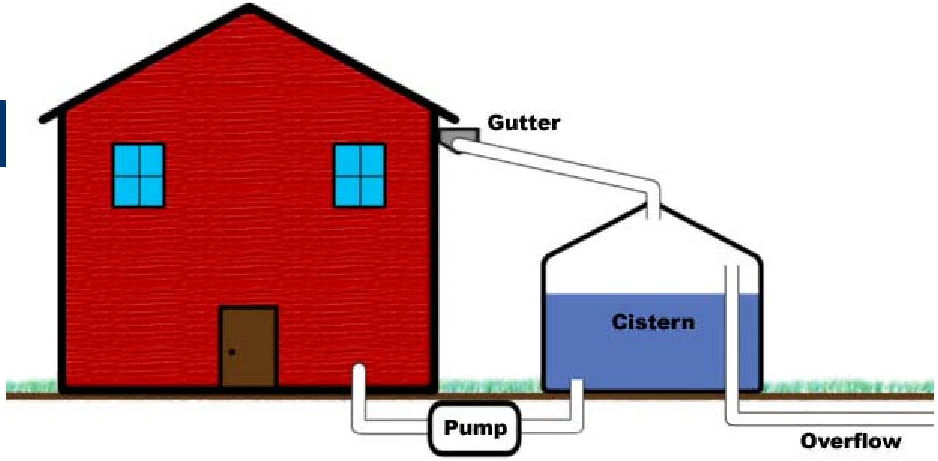
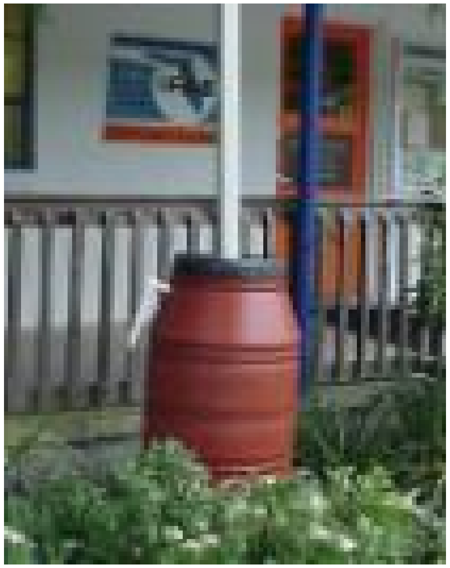
Ecoroof: Green-roof

- Top of the watershed
- Hydrologic benefit
  - Retention, Detention, Treatment
- Additional benefits
  - Aesthetic
  - Thermal insulator, evaporative cooling, reduced heat island effect

Rainwater Harvesting

- Often cleanest water depending on location
- At the lot scale, roofs can represents the largest % of impervious area
- Depending on storage capacity, significant reduction in source and time to concentration
- Can be used for irrigation or slowly released to maximize infiltration





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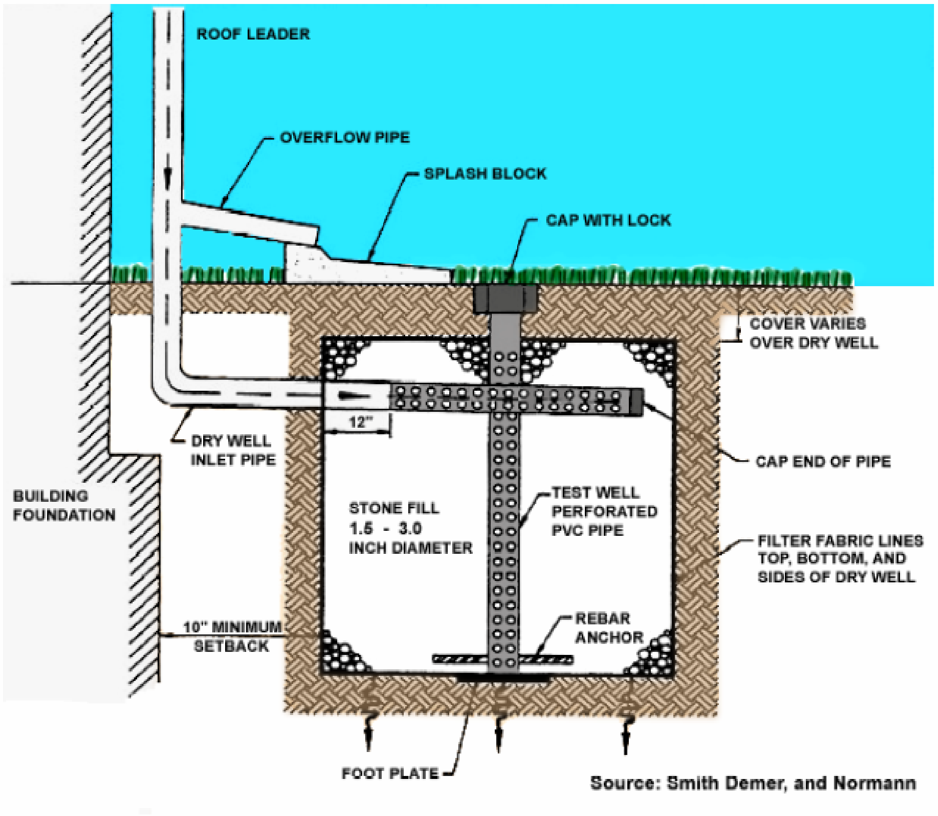
Dry Well / Exfiltration

- Rooftop runoff directed to dry well or seepage pit
- Volume scaled for design storm and soil infiltration rates
- Hollow tank or porous media



(Source: Smith, Derner, and Normann)

Pennsylvania Stormwater Management Manual 2004

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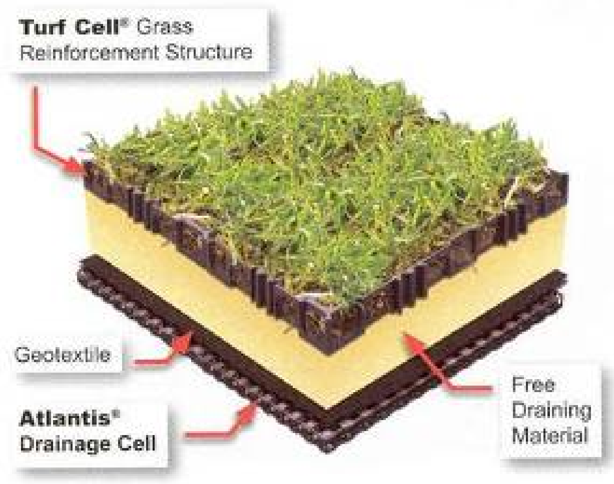
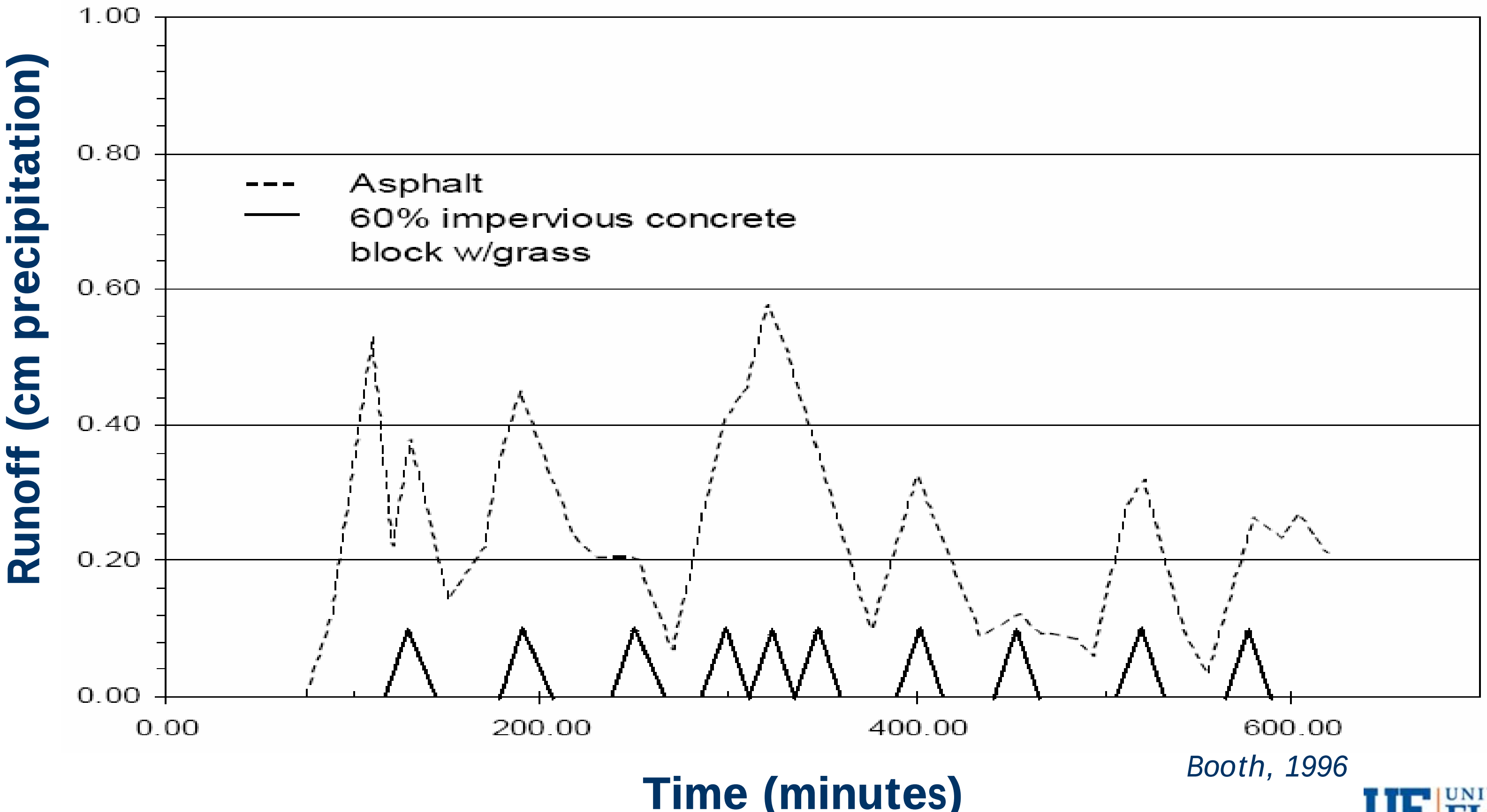
Exfiltration Tank



Semipermeable Surfaces

60% Impervious Block vs. Asphalt



Booth, 1996

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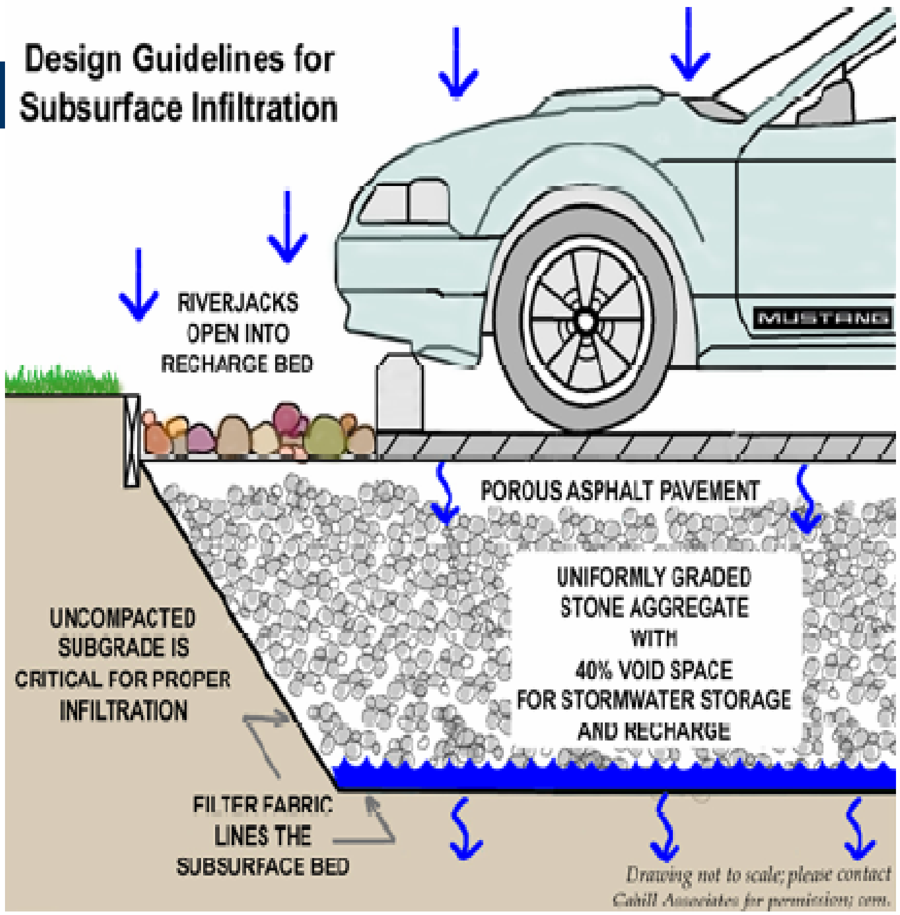
Permeable Surfaces

Permeable Asphalt

Permeable Concrete

Design of Porous Asphalt Subsurface

- Pervious surface
- Choker layer
- Coarse aggregate layer provides pore volume storage
- Geotextile bed and sides
- Uncompacted subsoil for proper infiltration



Pennsylvania Stormwater Management Manual 2004

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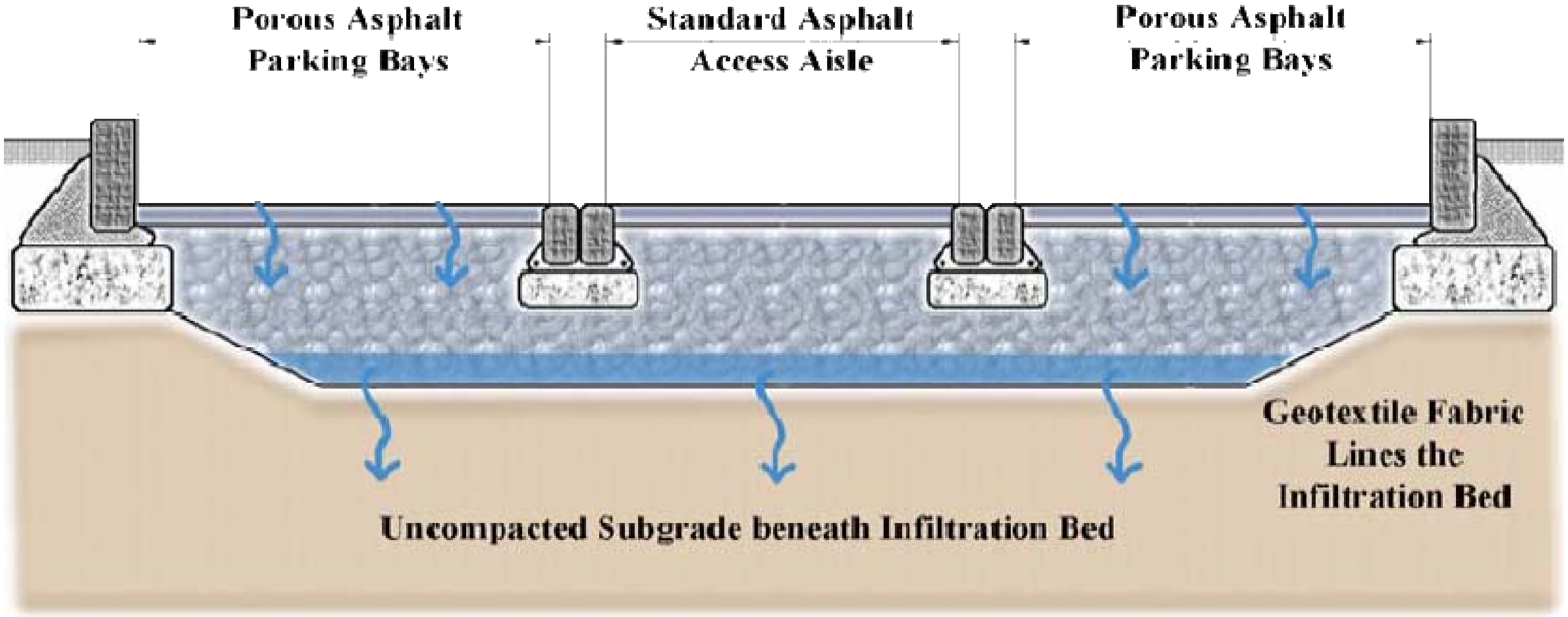
Porous Asphalt Application



Pennsylvania Stormwater Management Manual 2004

Consideration with Permeable and semipermeable Surfaces

- Permeable concrete
  - 20% greater cost
  - Quality control difficult – but improving
- Pavers
  - Range of cost
- Porous asphalt
  - Same material costs – subsurface preparation greater than conventional depending on site
- Maintenance
  - Regular vacuuming
  - Timing of implementation during construction phase

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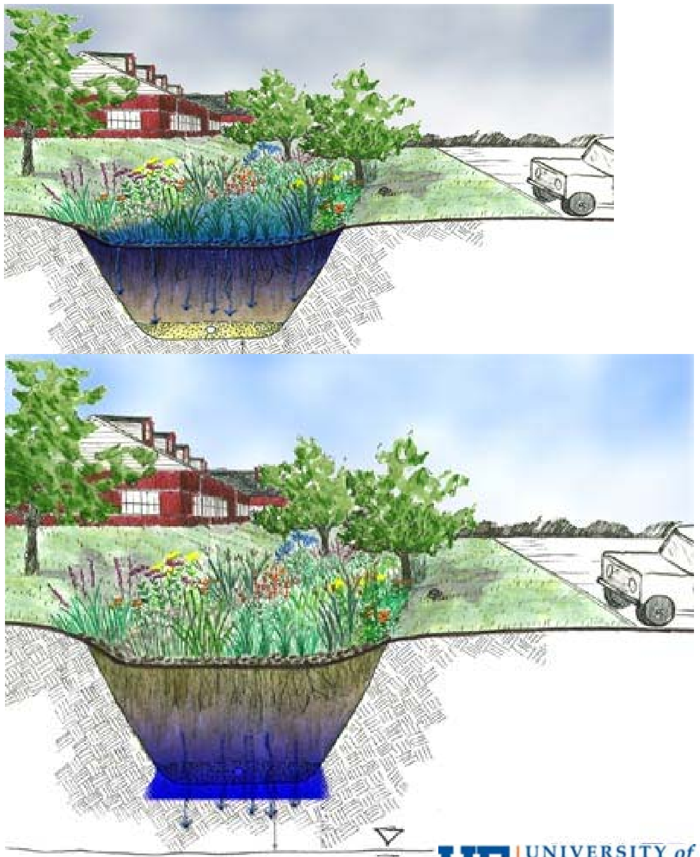
Depression Storage: Rain Garden / Bioretention

- Hydrologic benefit
  - Off line retention,
  - Dispersed volume management
- Treatment
  - Increased area for soil filtration
- Additional benefits
  - Aesthetic
  - Vegetative diversity
  - Habitat



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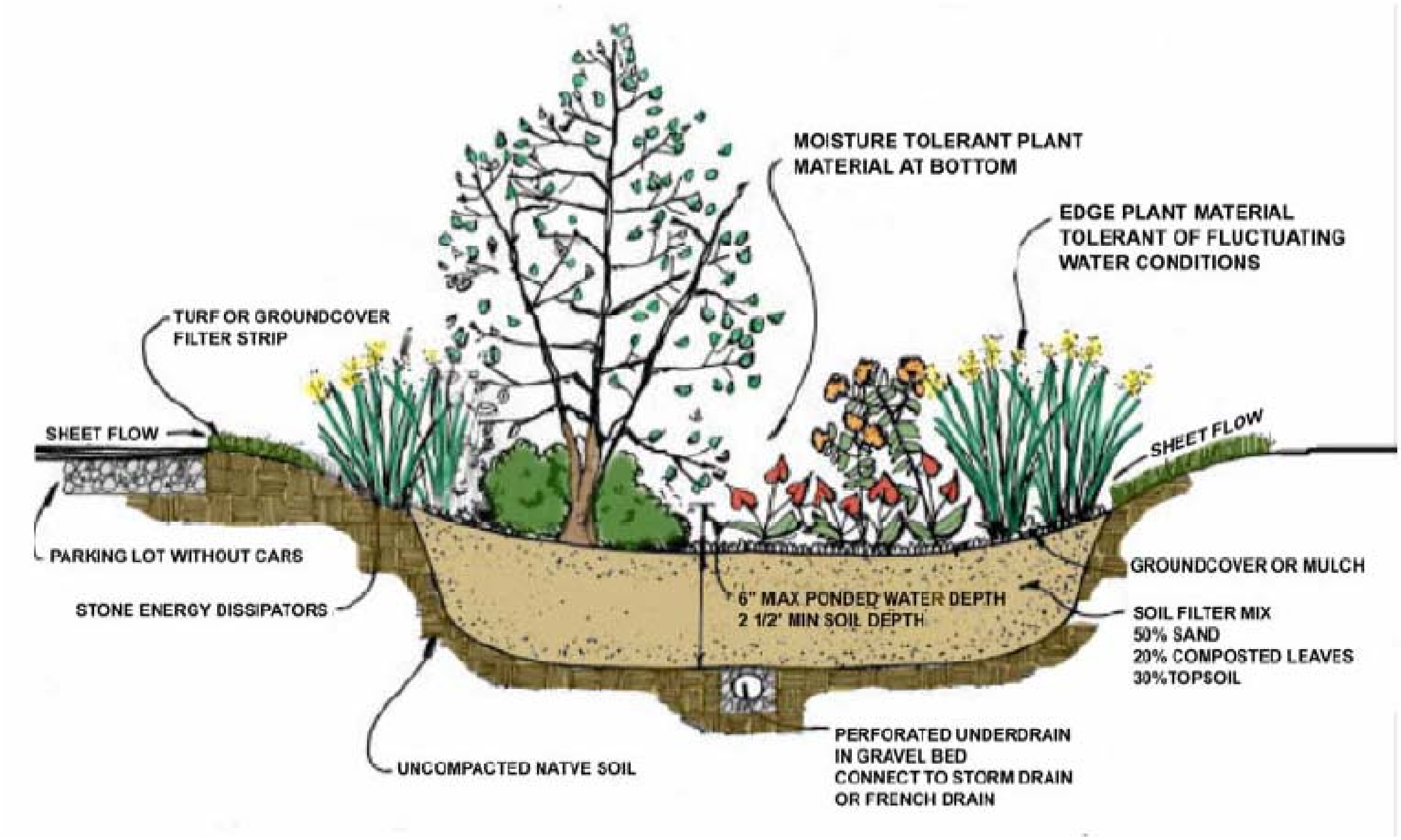
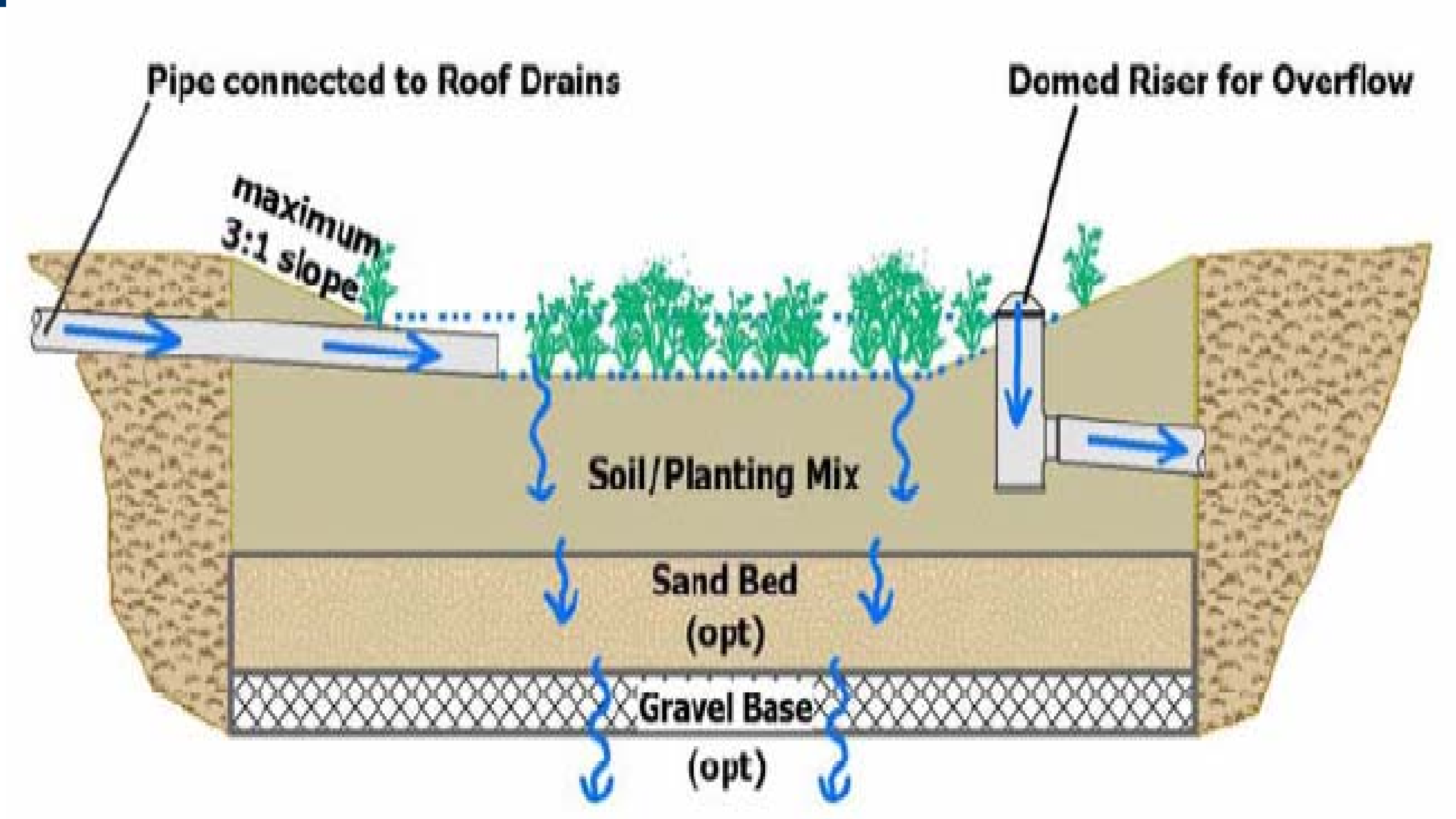
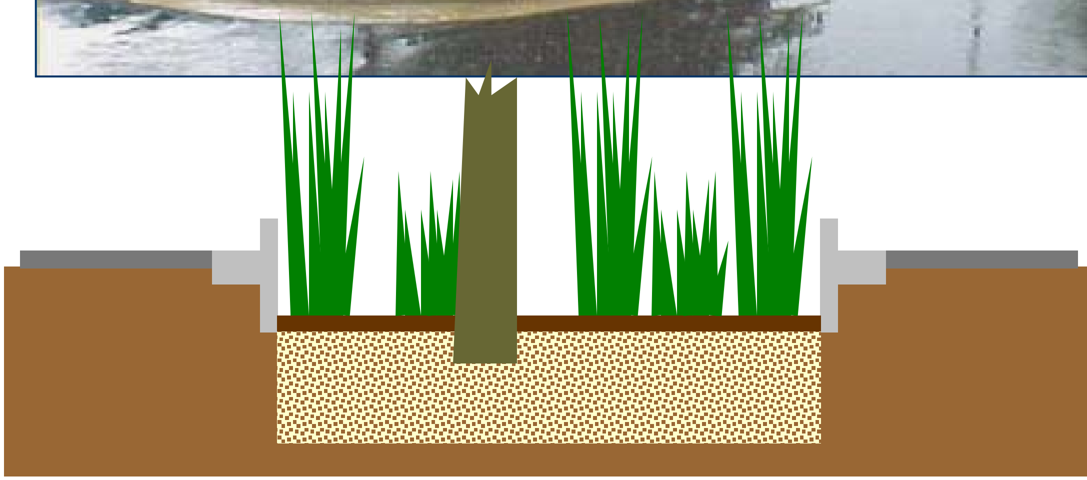
Rain Garden in Poorly Drained Soil (Under Drain)

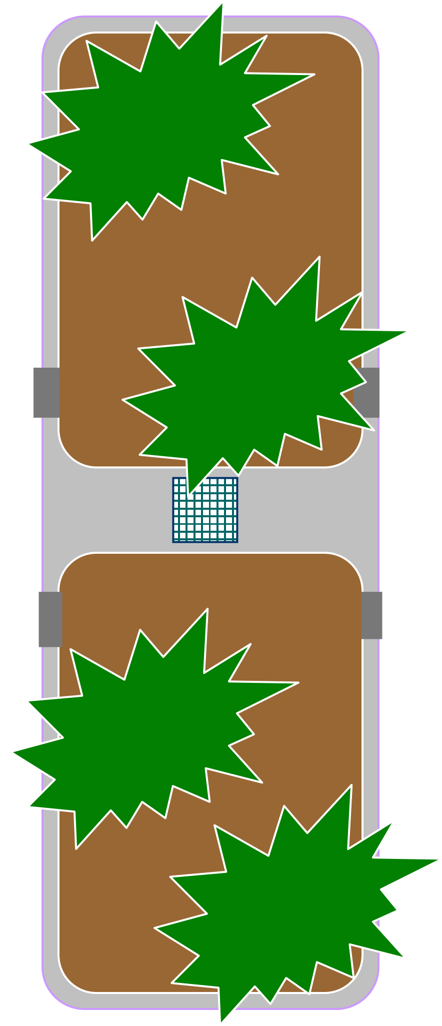


Rain Garden in Well Drained Soil



Parking Lot Application
(Curb Cut in Parking Island)

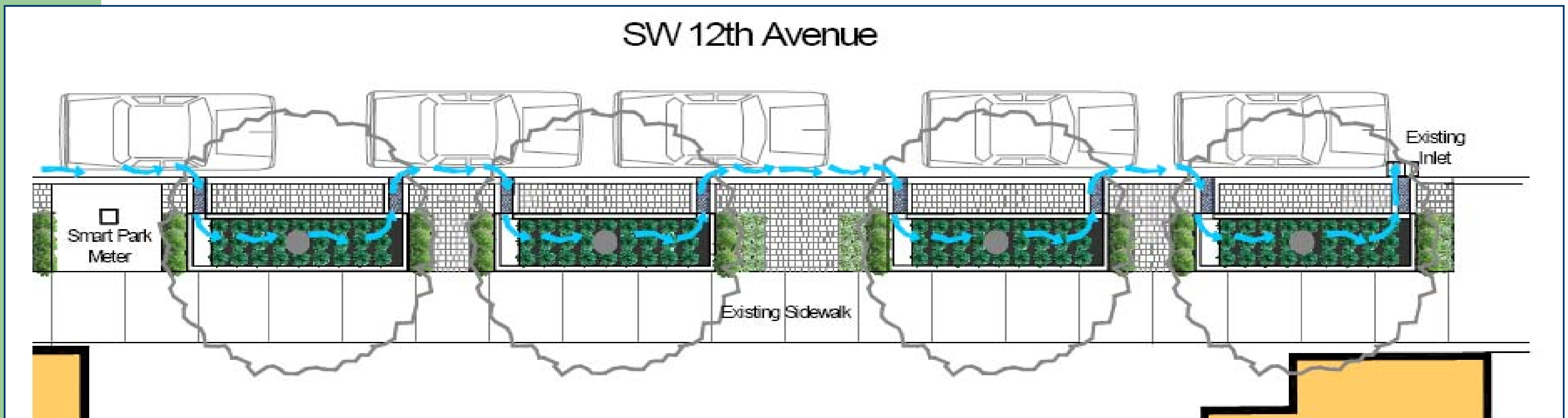




Parking Lot Application (Parking Island / Bioretention Swale)

Residential Neighborhood application (Trench Drain to Median)

Portland's "Green Streets"



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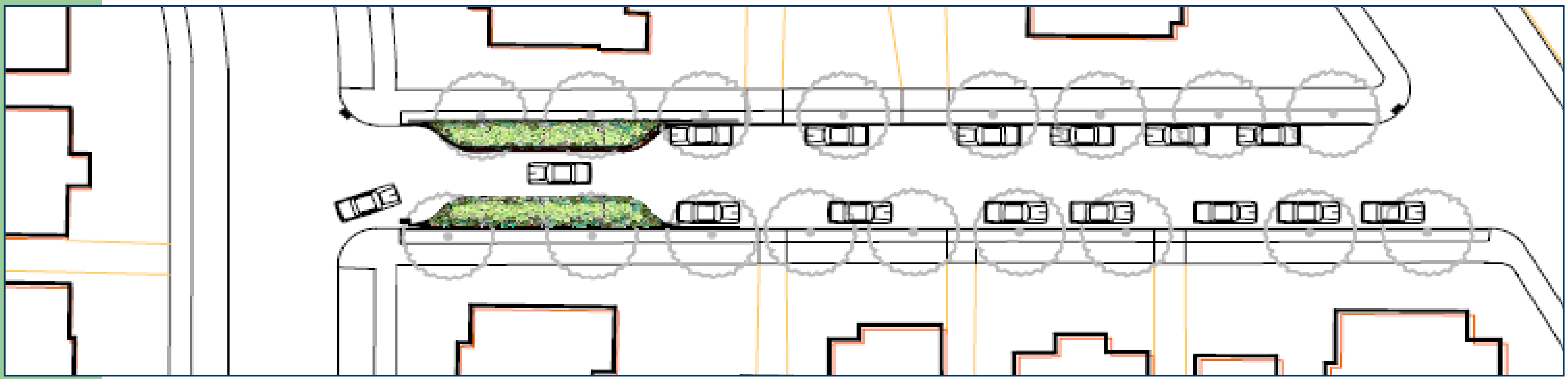

Bioretention Water Quality Benefits (Parking Lot Runoff)

Beltway Plaza, MD

	Cu	Pb	Zn	P	TKN	NH_4^+	NO_3^-	TN
Removal	97%	>95%	>95%	65%	52%	92%	16%	49%

Inglewood Center, MD

	Cu	Pb	Zn	Ca	P	TKN	NO_3^-
Removal	43%	70%	64%	27%	87%	67%	15%

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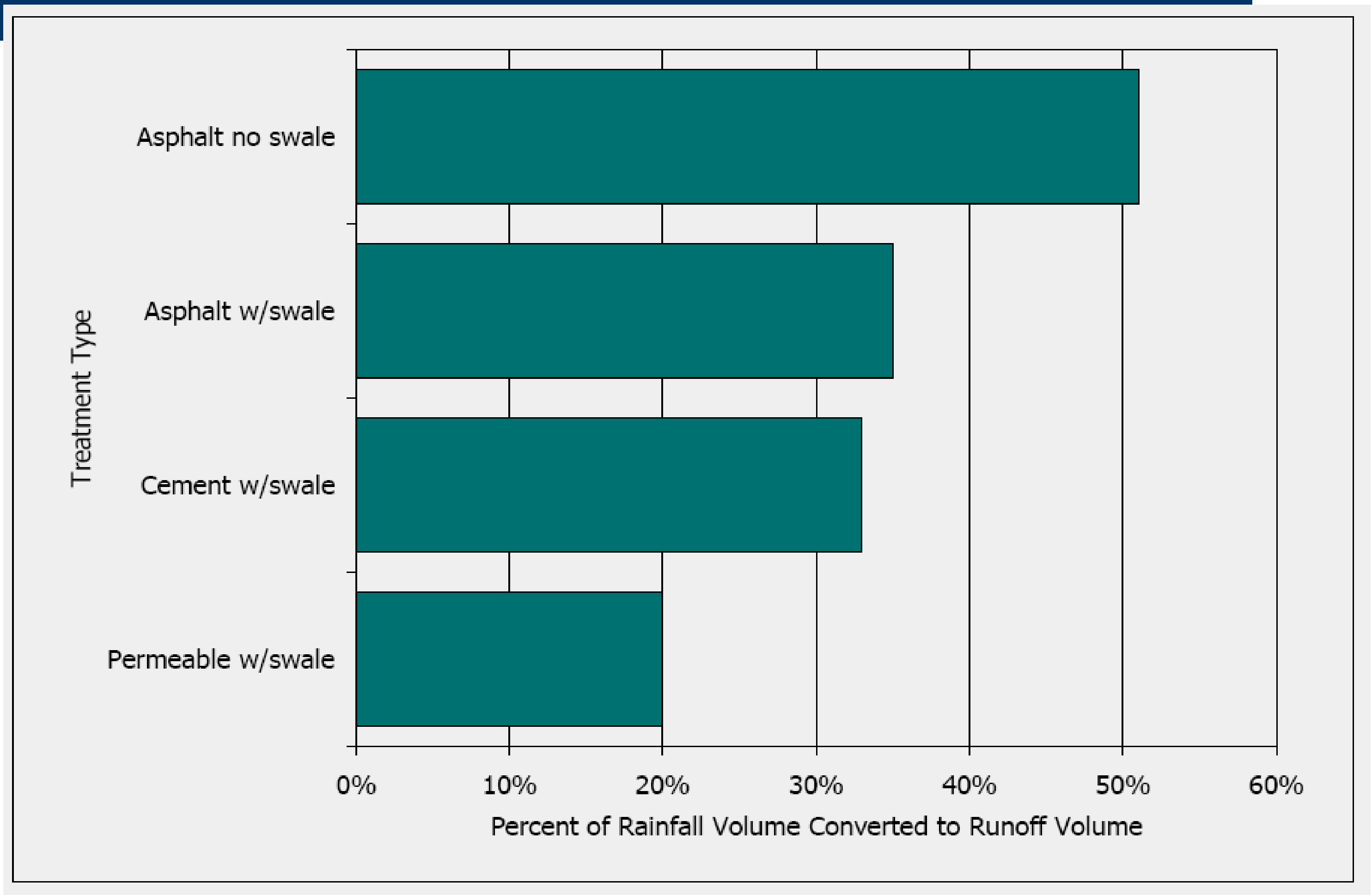
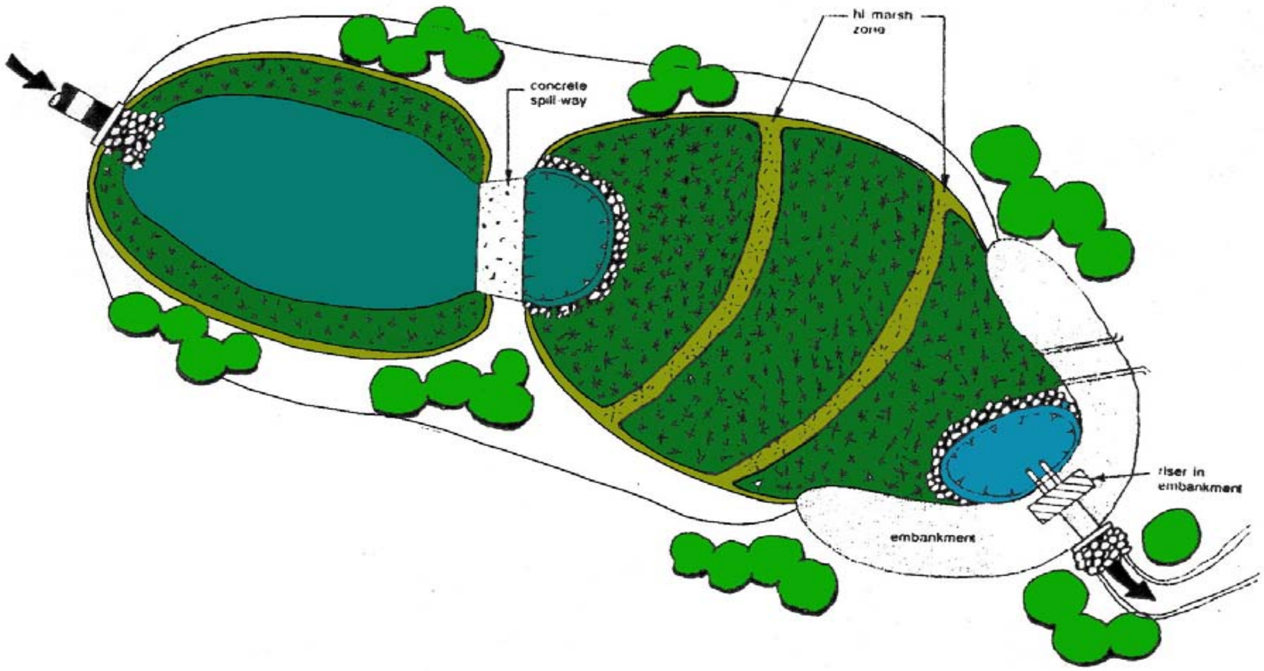
Runoff Reduction with LID



Stormwater Basin Enhancement

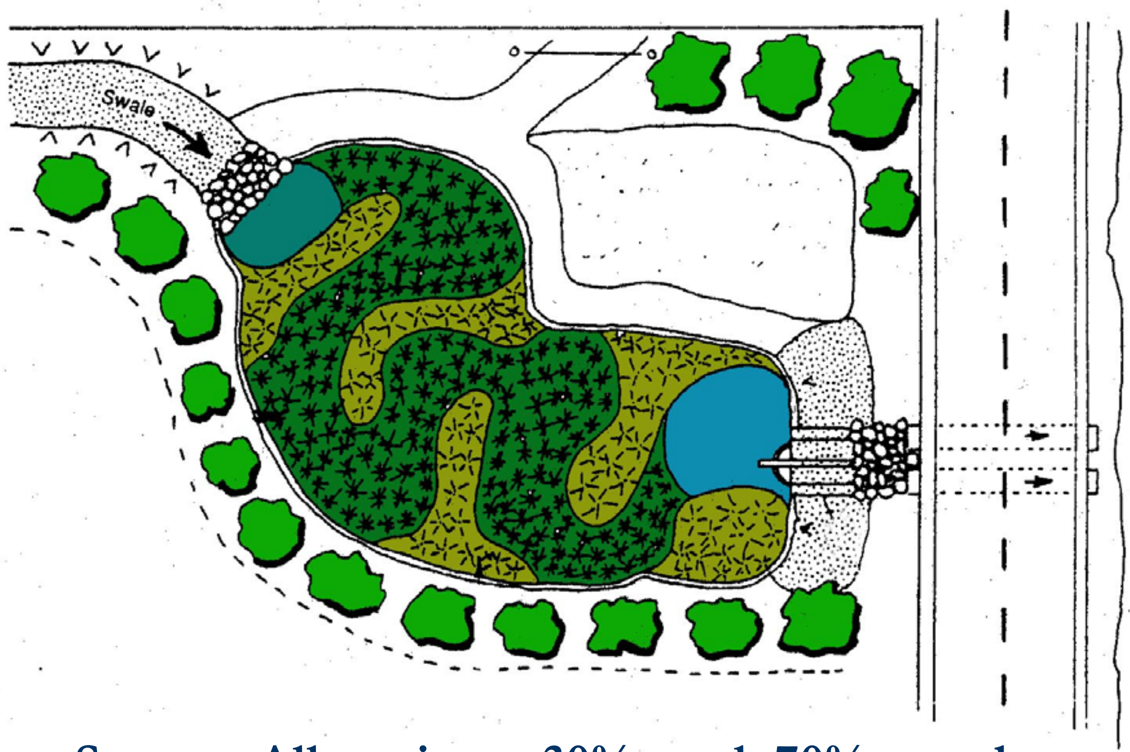
- Integrated Management Practices can reduce runoff volume and contaminants, however stormwater management may still require retention/detention basins
- Promoting natural biological processes in a stormwater basin can significantly improve water quality.
- To maximize treatment benefits, basin should have 60-80% macrophyte cover (FDEP recommending minimum of 30% littoral shelf), forebay, inlet-outlet separation and treatment flow path,.
- Enhanced basin can also be integrated as a community amenity by lowering slope, providing attractive plantings, integrating walking paths, and promoting interaction

Pond Wetland System



Storage Allocation – 70% pool, 30% marsh
Area Allocation – 25% low marsh, 30% high marsh, 45% pool

"Pocket" Wetland System

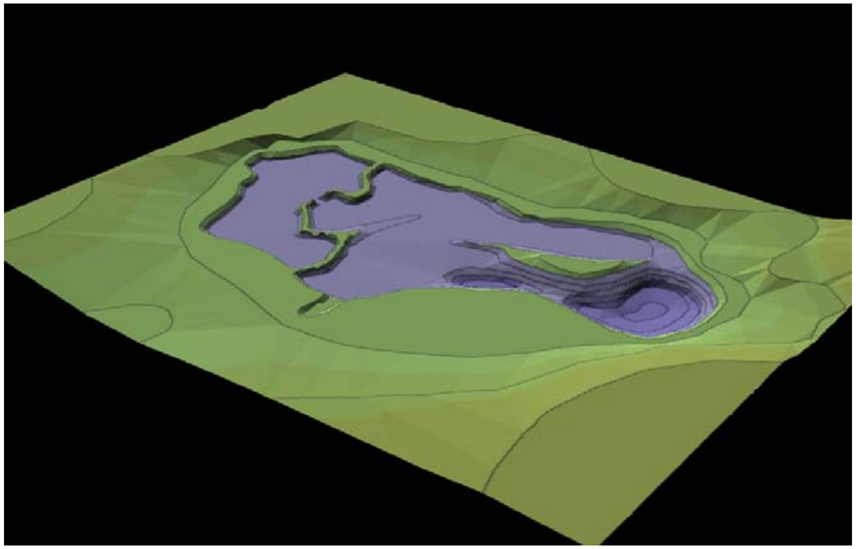


Storage Allocation – 30% pool, 70% marsh
Area Allocation – 40% low marsh, 50% high marsh, 10% pool

Shallow Marsh System

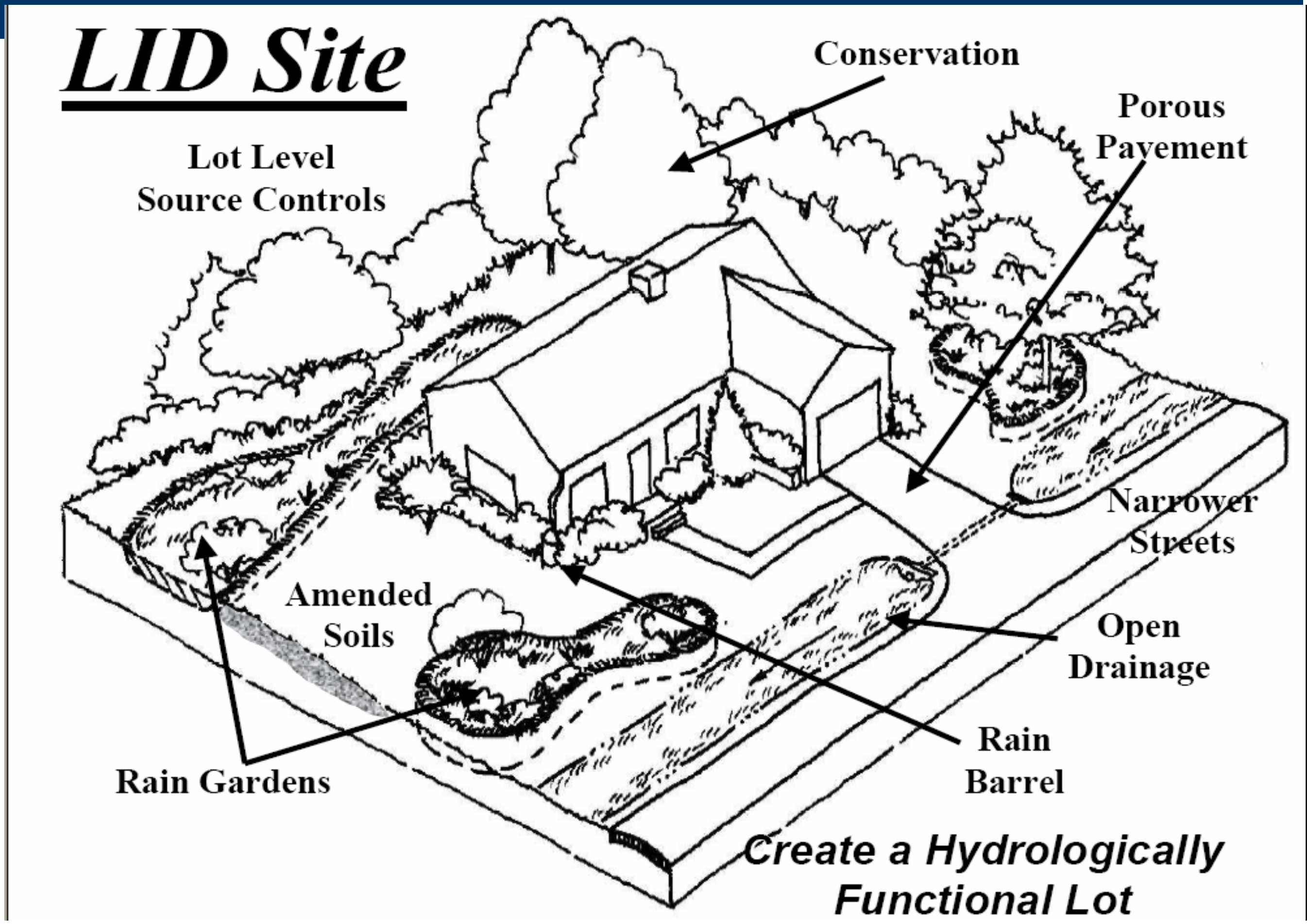
Storage Allocation – 40% pool, 60% marsh
Area Allocation – 40% low marsh, 40% high marsh, 20% pool

Enhanced Stormwater Basins



Complex topography = Diverse hydrologic conditions + Native vegetation =
Enhanced treatment function, Habitat, Aesthetics, Educational Opportunities

LID at the Parcel Scale



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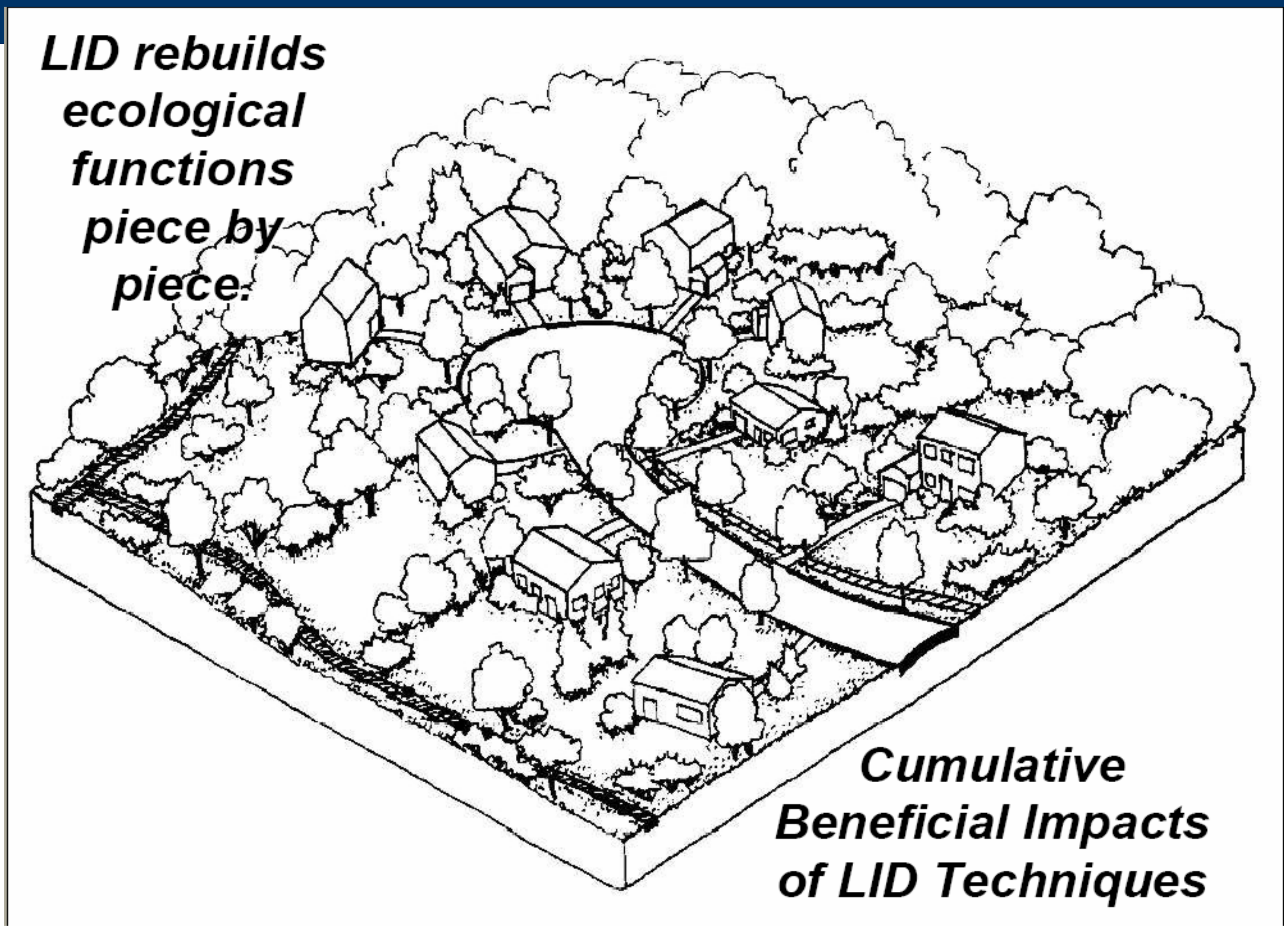
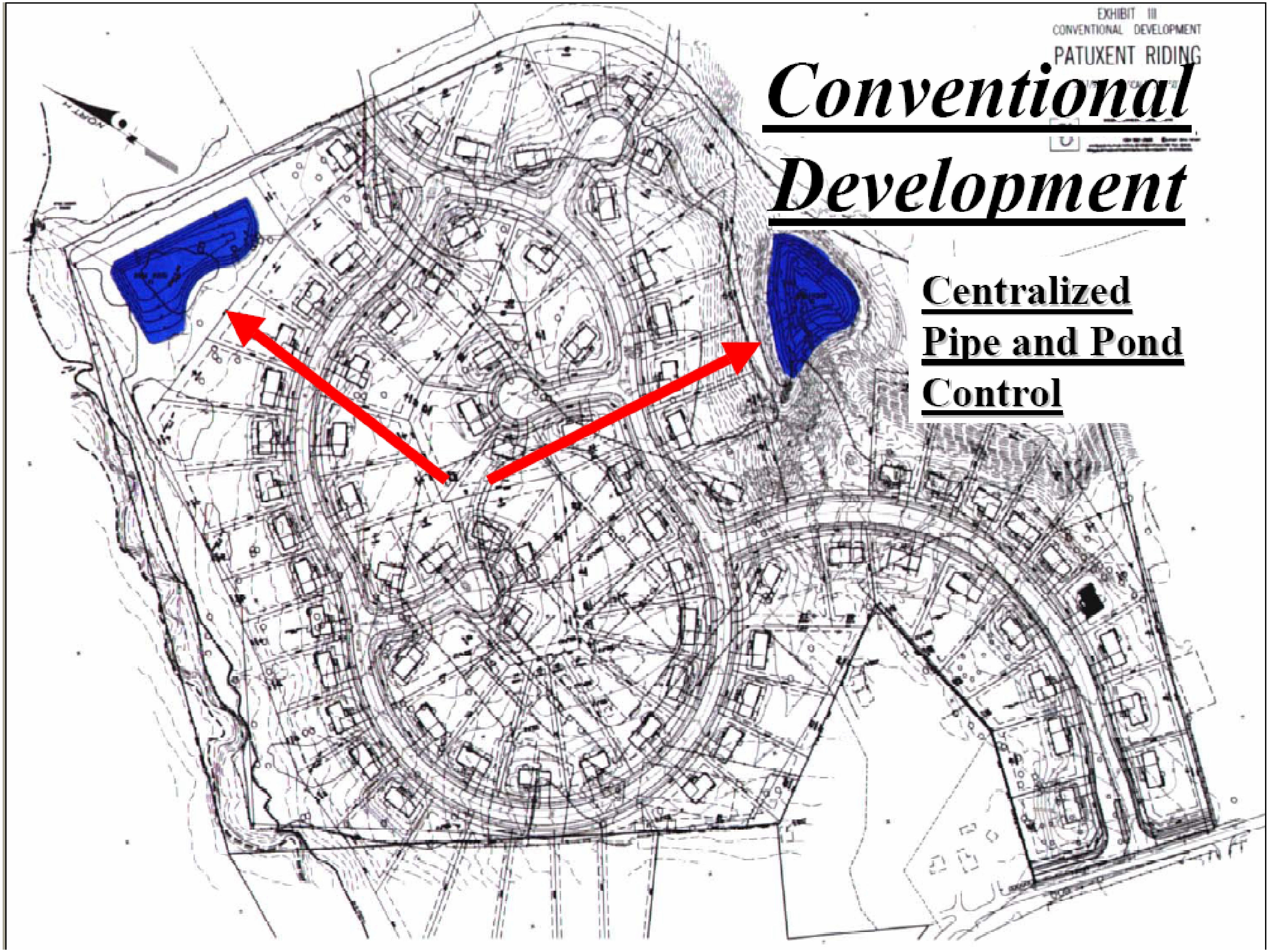
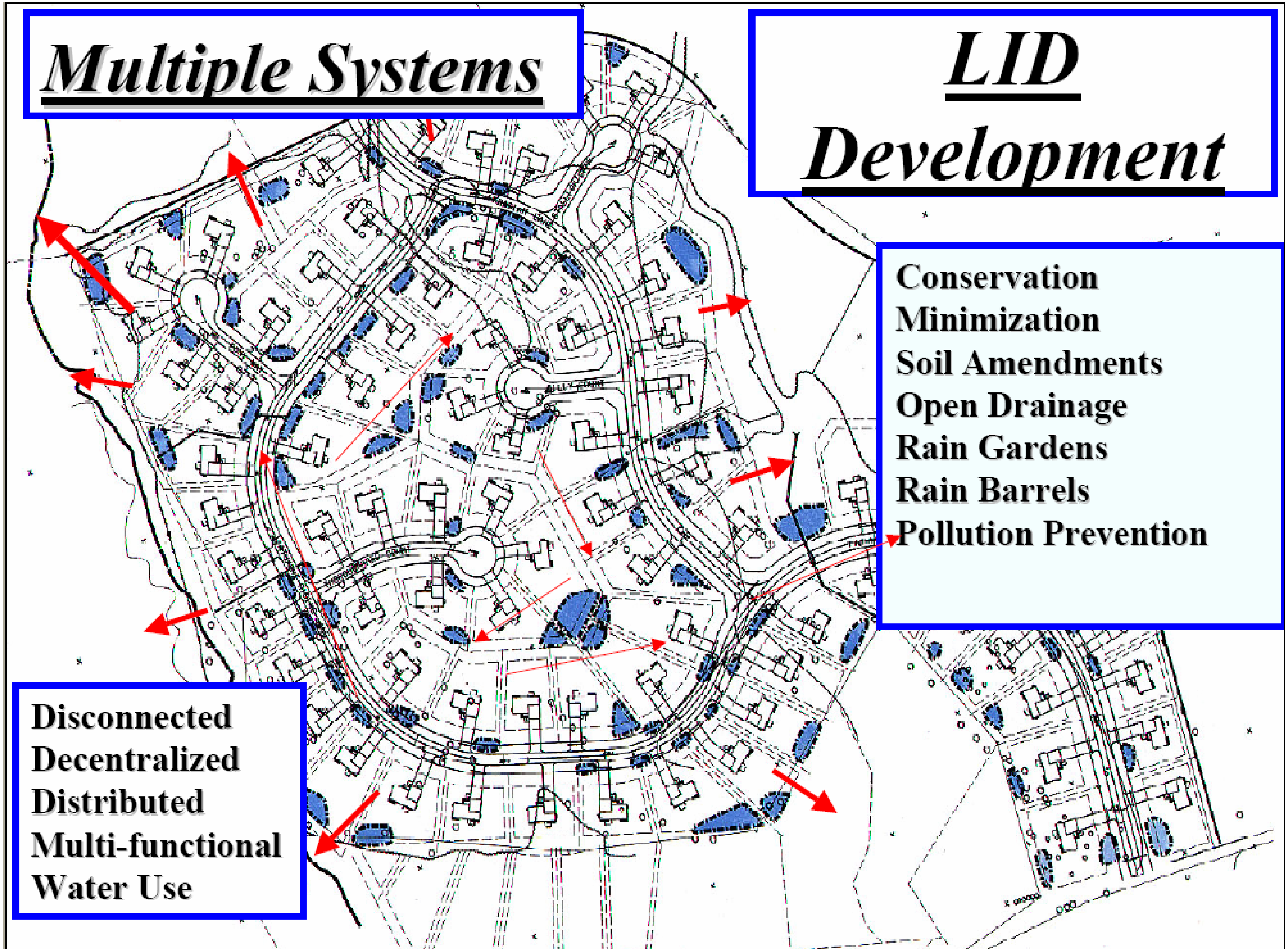
LID at the Subdivision Scale



Conventional Development

Centralized Pipe and Pond Control





Multiple Systems
LID Development
Conservation
Minimization
Soil Amendments
Open Drainage
Rain Gardens
Rain Barrels
Pollution Prevention
Disconnected
Decentralized
Distributed
Multi-functional
Water Use

LID and Stormwater in Florida

- Obstacles
- Motivating factors
- Future direction

Obstacles to LID

- Policy [Regulations]
  (zoning and building codes, health standards)
- Lack of incentive
  (funding, streamlined process, supplies)
- Public apathy
  (political and cultural perspectives)
- Marketability?
- Knowledge/Science
  (developers & regulators/planners lack available information)

Motivation

- Concerns for Water quality and quantity
- Aquifer & Springs Protection
- Local pressures for green development
- Increasing population pressures – need for change
- Create incentives

Alachua County Regulations

LID Related	*Old Code (1996)*	*New Code (2005)*
Open space	10% landscaped	20 to 50%
Tree canopy	15%	20% (30% in 20 yrs)
Habitat protection	Limited	25%, 50%
Wetland buffers	35' Avg (75' OFW)	75' Avg (150' OFW)
Clustering	Optional	Over 24 units in Ag
Water quality protection	Yes	Similar
Stormwater	100-yr storm	Critical storm
Stormwater in open space		Biodiversity & Water Quality Protection
Native landscaping	No	Yes

Local changes – Alachua County Examples

- New Alachua County code requires:
  - 20% to 50 % Open Space
  - Habitat and wildlife protection (Strategic Ecosystems, Significant Habitat)
  - Increased wetland buffer protection (75’ average buffers, 150’ for OFWs)
  - Stormwater requires enhanced landscaping and water quality protection
  - Clustering of development in agricultural areas if over 24 units
  - Enhances water quality protection in karst and high recharge areas
- Save our Springs Ordinance coming next
- Transfer of Development Rights Program coming soon

Action Items - Research

- Find willing sites
- Monitor sites for data

Implement research
exemptions

Action Items – Regulatory Process

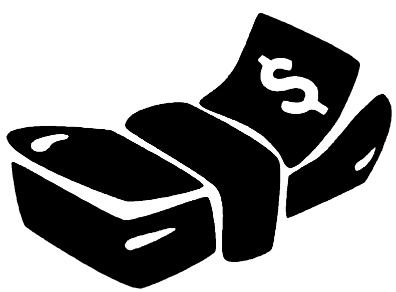
- Encourage agencies to take risks
- Cooperation between agency and developer
- Statewide rules
- New local regulations
- Model CCR’s

Action Item - Education

- Establish Education opportunities
- Certification
- Establish demonstration sites

Action Item - Finances

- Evaluate costs and benefits of LID
- Seek financial support for research
- Establish incentives by local government for homeowners
- Identify long-term owners for research sites



Questions and Answers

- Mark Clark
- Stephen Hofstetter