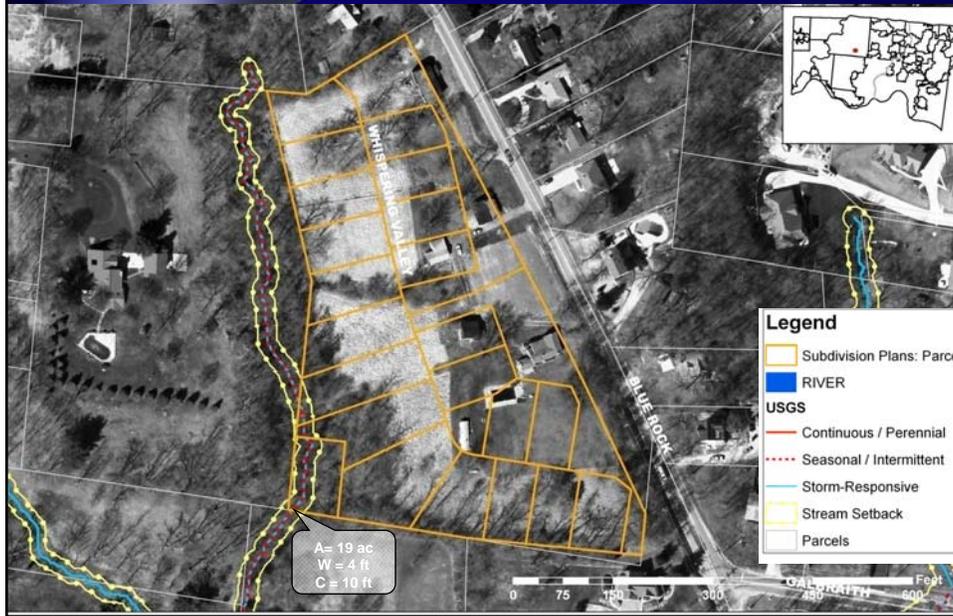


Development patterns accommodate setbacks

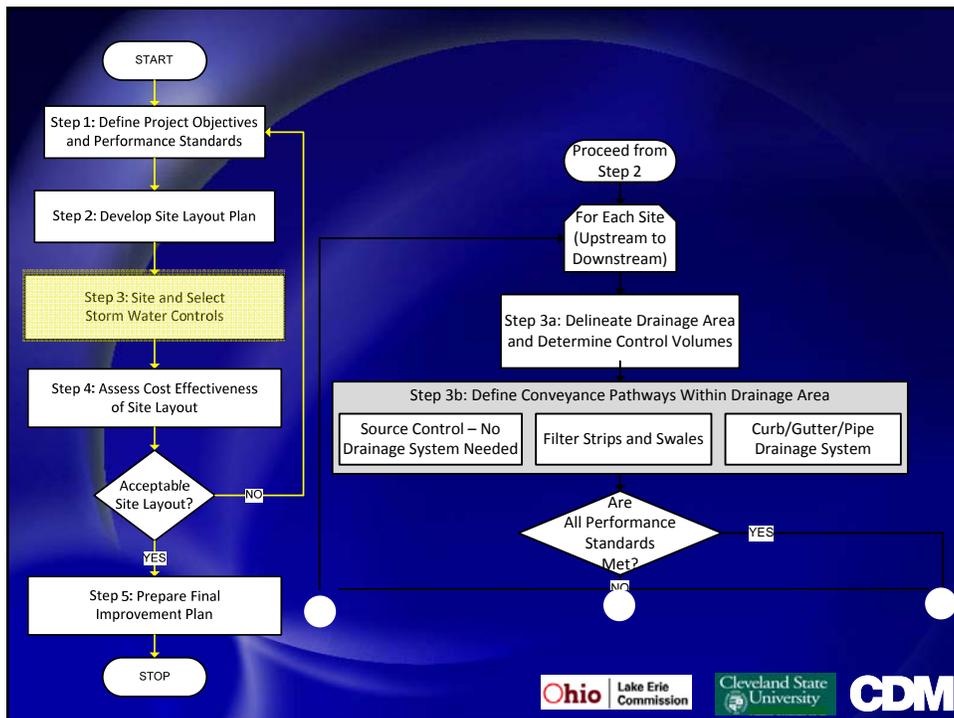


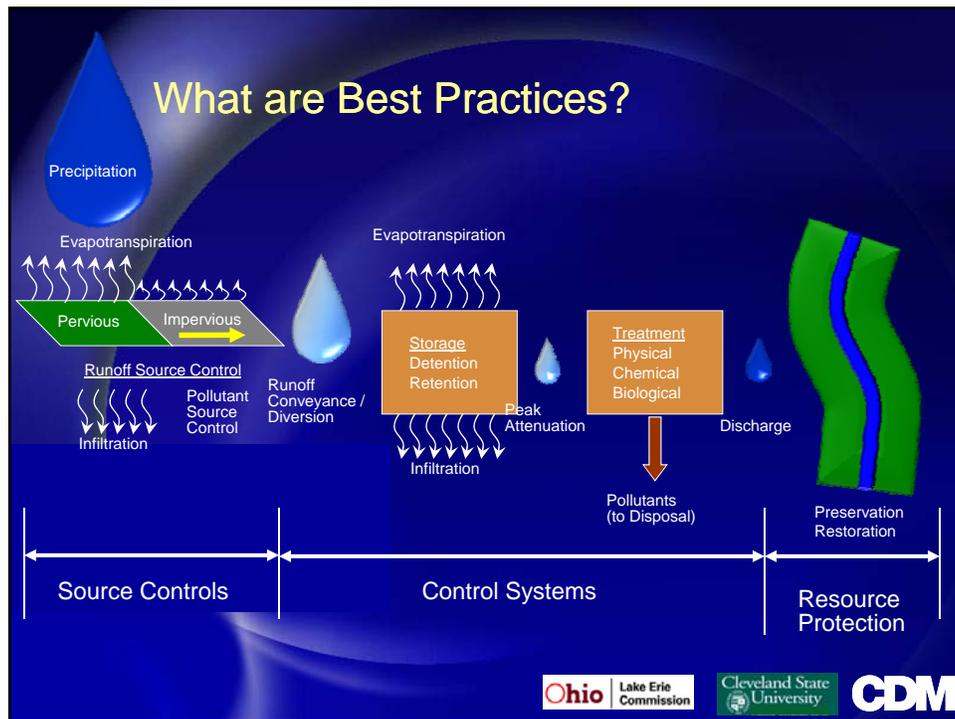
Development patterns accommodate setbacks



Section 6

STEP 3: SITING AND SIZING STORM WATER CONTROLS



Best Local Land Use Practices to Illustrate through Case Studies

- ◆ Imperviousness control (e.g., reduce, disconnect, permeable materials)
- ◆ Vegetated filter strips and swales
- ◆ Infiltration practices (e.g., rain gardens, trenches, dry wells)
- ◆ Filters / underdrains (bioretention, soil amendments, sand, other)
- ◆ Basins (wet, dry, wetland, vaults)
- ◆ Stream, floodplain, and wetland enhancements / setbacks
- ◆ Integrated Combinations of Practices

Logos at the bottom: Ohio, Lake Erie Commission, Cleveland State University, CDM

Opportunities and Barriers : Less Imperviousness

Source Controls



Opportunities and Barriers : Permeable Pavements

Source Controls



Opportunities and Barriers : Disconnected Downspouts

Source Controls



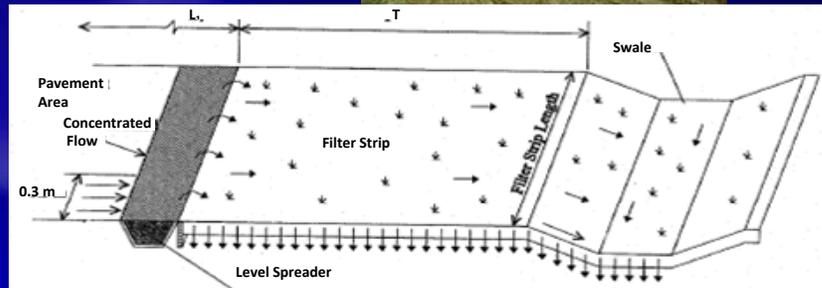
Opportunities and Barriers : Rain Barrels and Cisterns

Source Controls



Conveyance / Treatment Systems for
Yards / Roads / Parking

Opportunities and Barriers : Filter Strips and Swales



Backyard swales are common within many developments



Opportunities and Barriers : Rain Gardens

Control Systems for Yards



The slide features three photographs of rain gardens. The top-left photo shows a garden with tall purple flowers and yellow ones. The top-right photo shows a garden with pink and purple flowers near a tree. The bottom photo shows a garden with purple and white flowers next to a white picket fence.

Opportunities and Barriers : Pocket Wetlands

Control Systems for Yards



The slide features a single photograph of a pocket wetland, showing tall green grasses growing in a shallow, muddy area next to a body of water.

Control Systems for Roads / Parking

Opportunities and Barriers : Bioretention



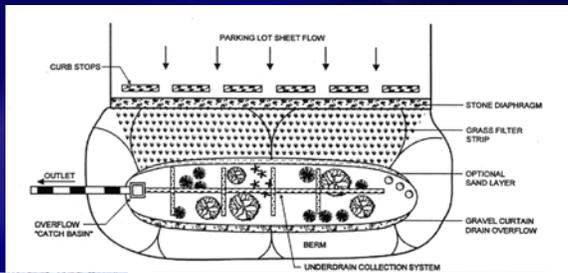
drain

Center for Watershed Protection



Control Systems for Roads / Parking

Opportunities and Barriers : Bioretention



Control Systems for Roads / Parking

Opportunities and Barriers : Bioretention



Control Systems for Sites/Regions

Opportunities and Barriers : Pocket Park with Best Practices



Opportunities and Barriers : Basins for Water Quality / Quantity Control

Control Systems for Sites/Regions



Dry Extended Detention Basin



Wet Pond - Eutrophication



Wet Pond - Solids Settling



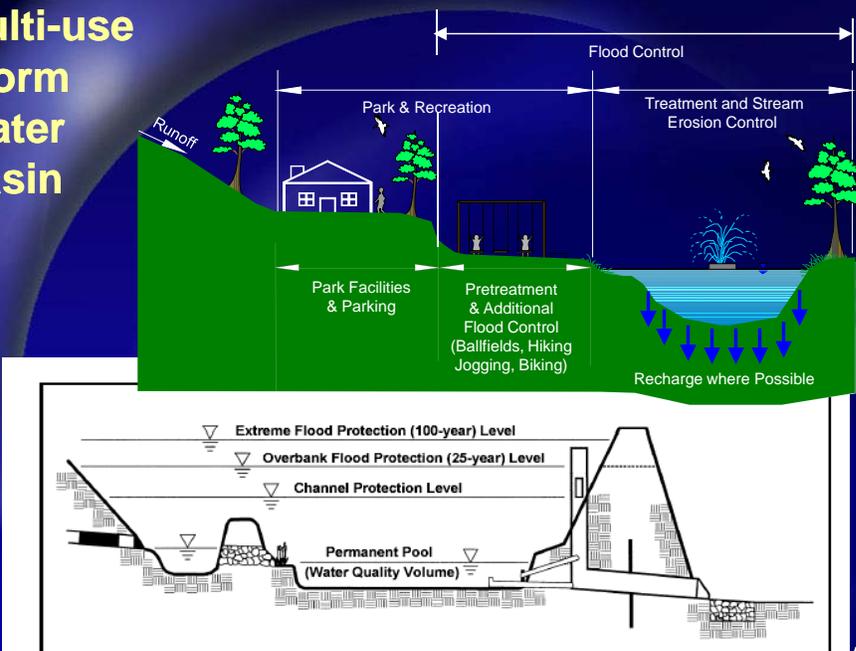
Wetland

Photo Copyright 1999, Center for Watershed Protection






Multi-use Storm Water Basin



The diagram illustrates a multi-use storm water basin with the following components and levels:

- Runoff:** Water entering from the left.
- Park & Recreation:** Area with trees and a house.
- Park Facilities & Parking:** Area with a building and parking lot.
- Pretreatment & Additional Flood Control:** Area with ballfields, hiking, jogging, and biking.
- Treatment and Stream Erosion Control:** Area with a fountain and stream.
- Recharge where Possible:** Indicated by blue arrows pointing down into the ground.
- Flood Control:** Indicated by a long double-headed arrow at the top.

The cross-section shows the following levels:

- Extreme Flood Protection (100-year) Level:** The highest level, indicated by a dashed line.
- Overbank Flood Protection (25-year) Level:** The level of the basin walls, indicated by a solid line.
- Channel Protection Level:** The level of the stream bed, indicated by a dashed line.
- Permanent Pool (Water Quality Volume):** The lowest level, indicated by a solid line.






Opportunities and Barriers : Integrated Water Quality / Quantity Control

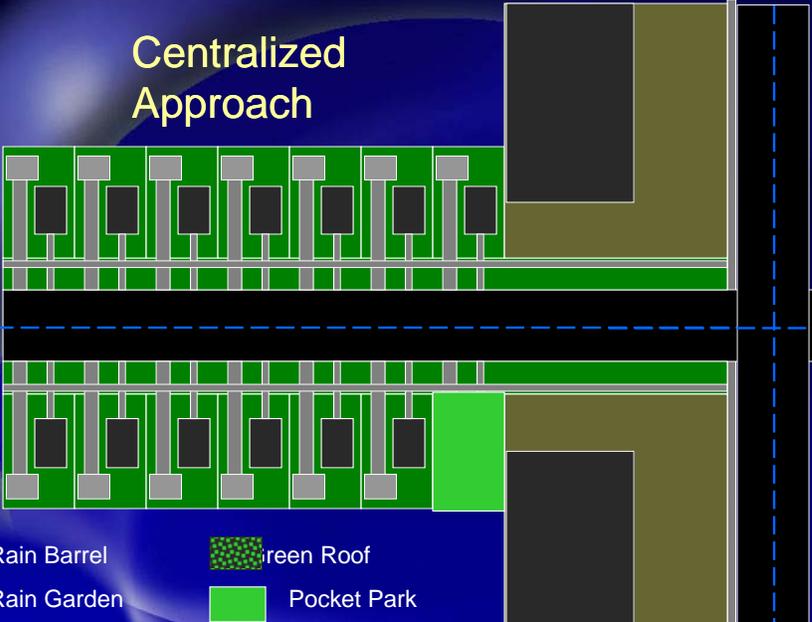
Control Systems for Sites/Regions



Bruns Ave. Elementary School Wetland and BMP Demonstration Project; Charlotte, NC

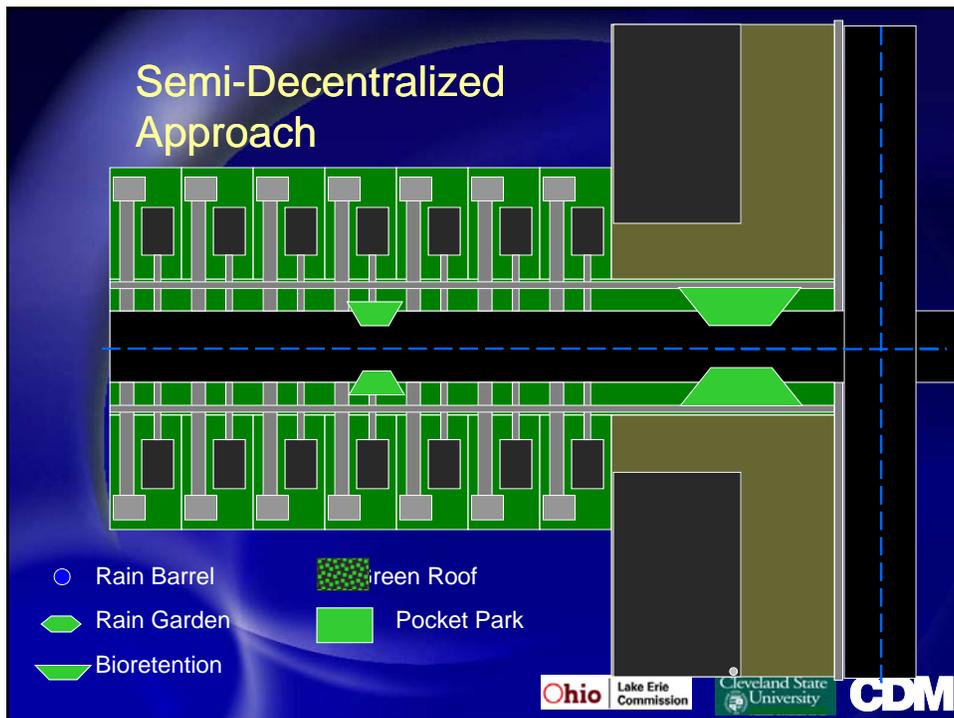
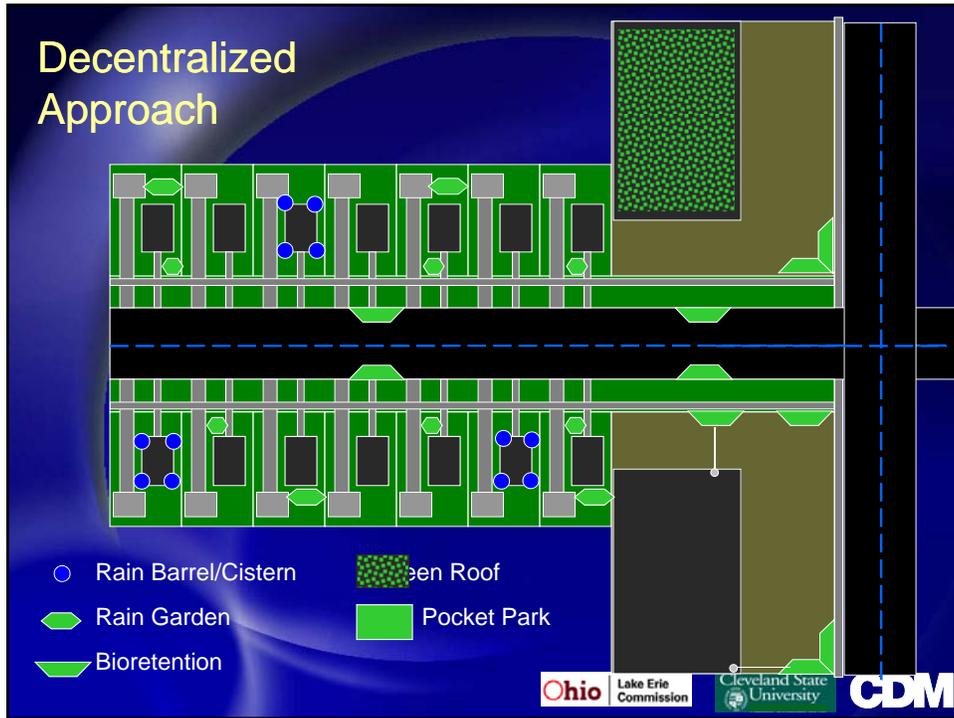
  

Centralized Approach

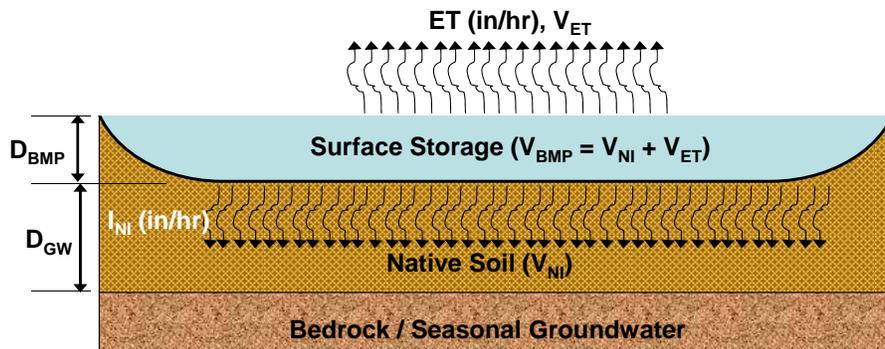


-  Rain Barrel
-  Rain Garden
-  Bioretention
-  Green Roof
-  Pocket Park

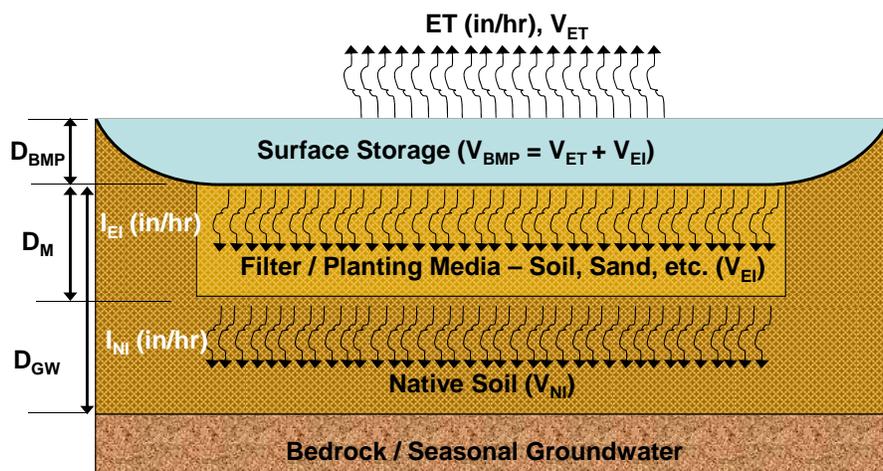
  



Infiltration Basin



Combination Filter / Infiltrator

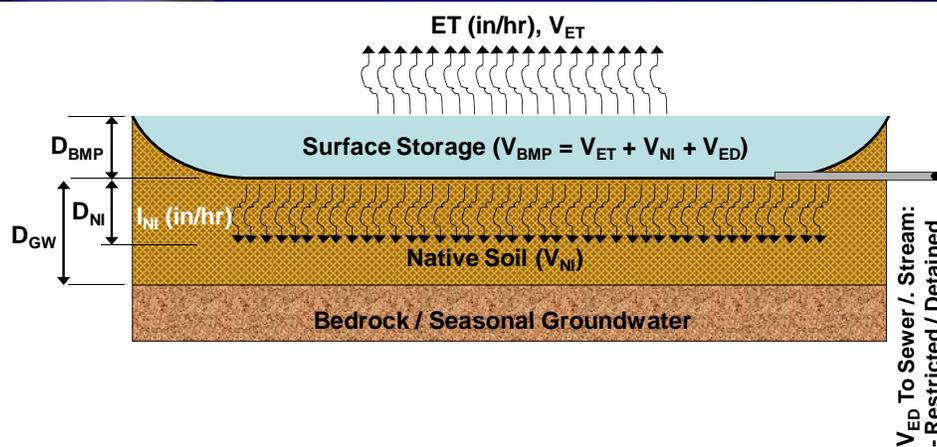


Combination Filter / Infiltrator

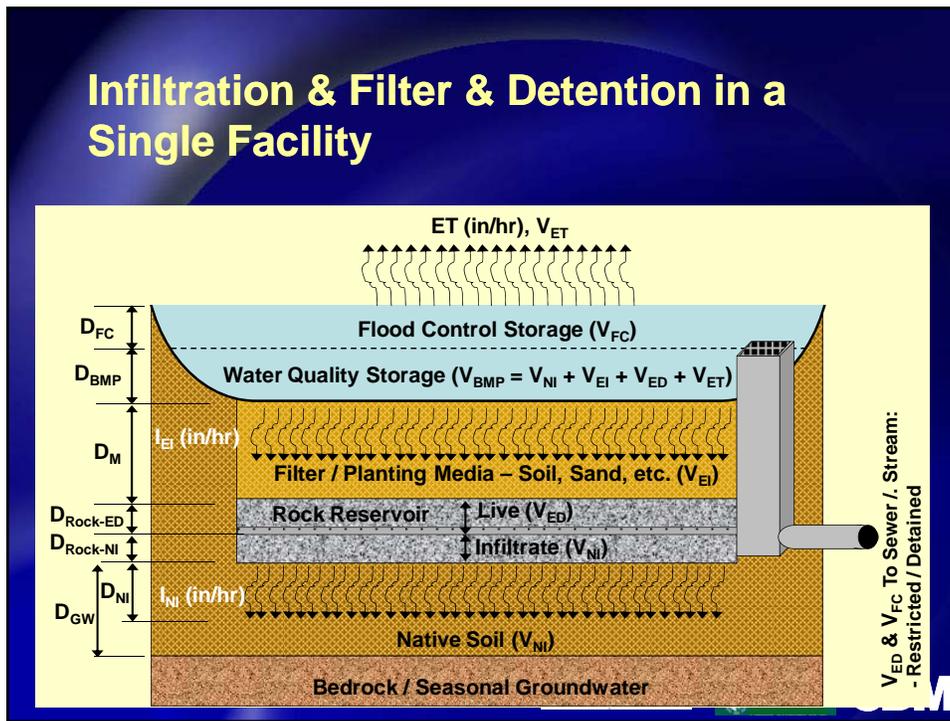


DM

Extended Dry Detention Basin



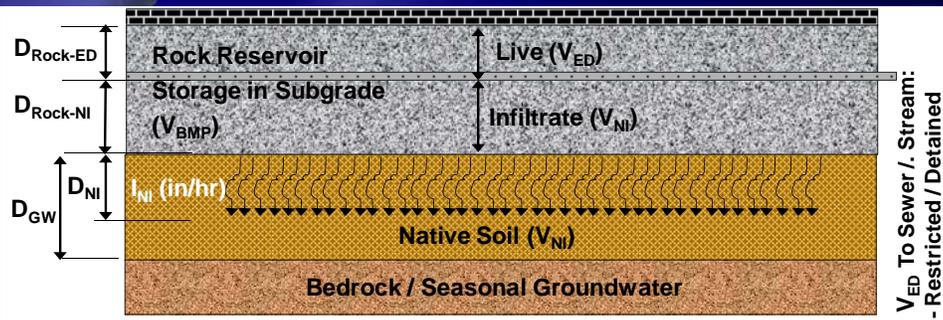
Infiltration & Filter & Detention in a Single Facility



Permeable Pavement



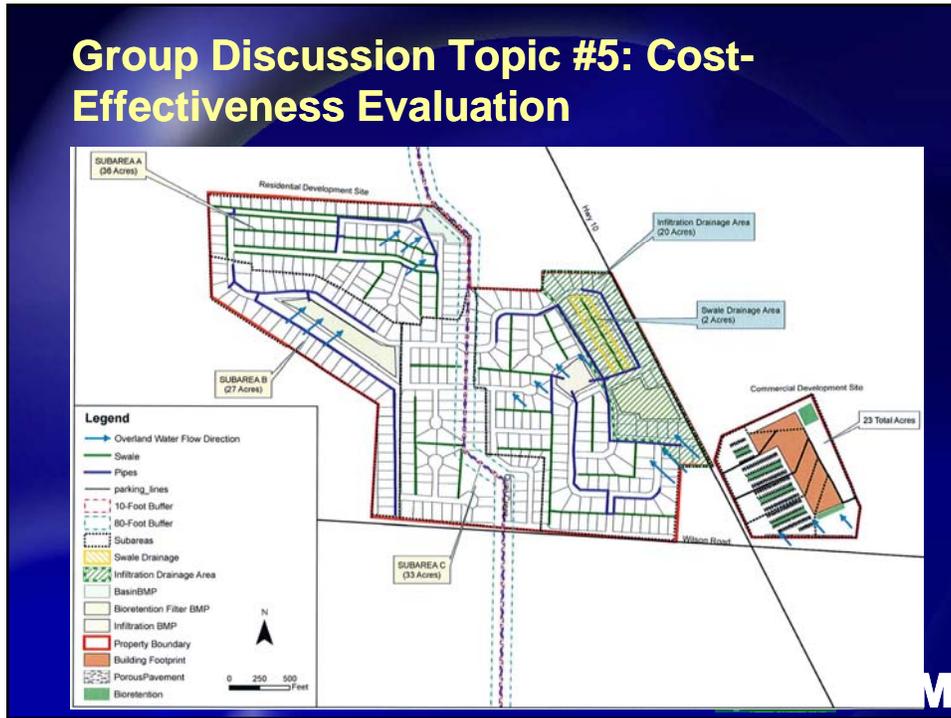
Permeable Pavement with Infiltration and Detention



Conventional Sub-division Design



Group Discussion Topic #5: Cost-Effectiveness Evaluation



Cost Tables Here – Conventional Design

Conceptual Cost Estimate for Conventional Development

Initial Costs		Unit Cost			Unit	Number	Average Total
Item	low	high	average				
Land Purchase	\$ 9,800	\$ 13,000	\$ 11,400	ac	164	\$ 1,869,600	

Development Costs		Unit Costs			Unit	Number	Total
Item	low	high	average				
Site Clearing	\$ 4,000	\$ 7,000	\$ 5,500	acre	165		
Residential Street -curb/gutter	\$ 100	\$ 130	\$ 115	ft	22,700		
Storm Sewer System	\$ 100	\$ 140	\$ 120	ft	22,700		
Other Utilities	\$ 75	\$ 120	\$ 98	ft	11,000		
Flood Control Detention ¹	\$ 8	\$ 10	\$ 9	cu. yd.	62,600		
Flood Control Pumps	\$ 3,000	\$ 6,000	\$ 4,500	ea	4		
Residential Construction ²	\$ 150,000	\$ 210,000	\$ 190,000	ea	387		
Permitting	\$ 5,000	\$ 15,000	\$ 10,000	lump sum	1		
Total							

Revenue		Unit Costs			Unit	Number
Item	low	high	average			
Lot Price - Sales	\$ 198,000	\$ 242,000	\$ 220,000	ea	387	

Profit **Total**

Notes:
¹4 dry detention ponds over 7.76 acres at 5 foot depth
²2,400 sq. ft. wood frame structure - \$78/ft²

Cost Tables Here – Low Impact Design

Conceptual Cost Estimate for Low Impact Development

Initial Costs		Unit Cost			Average	
Item	low	high	average	Unit	Number	Total
Land Purchase	\$ 9,800	\$ 13,000	\$ 11,400	ac	164	\$ 1,869,600

Development Costs		Unit Costs			Total	
Item	low	high	average	Unit	Number	Total
Site Clearing	\$ 4,000	\$ 7,000	\$ 5,500	acre	149.1	
Residential Street -curb/gutter	\$ 100	\$ 130	\$ 115	ft	11,700	
Residential Street - swale	\$ 85	\$ 115	\$ 100	ft	11,000	
Storm Sewer System	\$ 100	\$ 140	\$ 120	ft	12,000	
Other Utilities	\$ 75	\$ 120	\$ 98	ft	11,000	
Residential Construction ¹	\$ 150,000	\$ 230,000	\$ 190,000	ea	383	
Permitting	\$ 5,000	\$ 15,000	\$ 10,000	lump sum	1	
Bioretention Filter BMP	\$ 10	\$ 14	\$ 12	ft ²	1,200	
Infiltration BMP ²	\$ 18	\$ 24	\$ 21	ft ²	32,700	
Basin BMP	\$ 8	\$ 10	\$ 9	cu. yd.	1400	
Swale	\$ 4	\$ 19	\$ 11	ft	16900	
Total						

Revenue		Unit Costs			Total	
Item	low	high	average	Unit	Number	Total
Lot Price - Sales	\$ 200,700	\$ 245,300	\$ 223,000	ea	383	

Profit Total

Notes:
¹2,400 sq. ft. wood frame structure - \$78/ft²
²32,700 ft² required to infiltrate WQv over depth of 1 foot; remaining area is conserved as open space

Discussion Group Topic No. 3 – Site Layout and Design

- ◆ Step 1 – Establish Objectives and Performance Standards (lunch)
- ◆ Step 2 – Site Layout
 - Evaluate Site/Design Conditions: soils, water resources, zoning, etc. Lay Out Conservation/Development Areas (15 mins)
 - Lay out roads/lots: conservation development approach (30 mins)
- ◆ Step 3 – Locate (and size) BMPs (30 mins)
- ◆ Step 4 – Triple Bottom Line Evaluation (15 mins)

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- ◆ Integrated Combinations of Practices



Wrap Up

1. Discuss and Review Group Reports
 - What is your plan?
 - How did it compare to the conventional plan in TBL evaluation?
2. What are the most important "next steps" to implement Best Practices?
3. Suggestions for improving the workshop

THANKS FOR ATTENDING!

