LOW IMPACT DEVELOPMENT
WHY SHOULD I USE IT?
WHAT IS IT?
HOW DO I DO IT?

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In memory of Hank Higginbotham, PE

PRESENTATION OUTLINE

- Florida stormwater rule history
- WHY are higher load reductions needed?
- HOW determine if needed?
- WHAT is “net improvement”?
- HOW achieve “net improvement”?
- Low Impact Development BMPs

STATEWIDE STORMWATER TREATMENT PROGRAMS

STATE	YEAR	STATE	YEAR
Florida	1979, 1982	Rhode Island	2002
Maryland	1984	Wisconsin	2002
Virginia	1990	New Jersey	2003
Delaware	1991	Pennsylvania	2007
South Carolina	1992	Michigan	2007
Massachusetts	1998	Minnesota	2007

We Were the Model Program

FLORIDA'S STORMWATER RULES

1979	Chapter 17- 4.248, F.A.C.
1982	Chapter 17- 25, F.A.C.
1994	Chapter 62- 25, F.A.C.
2013	Chapter 62-330, F.A.C.

Water management district handbooks and rules

TECHNOLOGY BASED RULE

- Performance Standard
- BMP Design Criteria
- Presumption of compliance

PERFORMANCE STANDARD FOR NEW STORMWATER DISCHARGES (62-40.432, F.A.C.)

Stormwater quality – Original Rule

- 80% average annual load reduction
- 95% average annual load reduction

"Of Total Suspended Solids"

Stormwater quality – 1990 (62-40 adoption)

- 80% average annual load reduction
- 95% average annual load reduction

"Of pollutants that cause or contribute"

BUT RULES WERE NEVER UPDATED

BMP DESIGN CRITERIA ARE DYNAMIC!

- 1979 17 - 4.248, FAC implemented
- 1982 17- 25, FAC implemented
- 1984 Modify BMP Design Criteria
- 1985 Wetland BMP Design Criteria

Florida's BMP design criteria are very outdated and other state programs have passed us by!

DESIGN CRITERIA PRESUMPTION REBUTTED!

Evaluation of Current Stormwater Design Criteria within the State of Florida

Final Report

Prepared for:

FLORIDA

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

FDEP Contract No. SO108

June 2007

Prepared By:

Harvey H. Harper, Ph.D., P.E.
David M. Baker, P.E.

Environmental Research & Design, Inc.
3419 Trentwood Blvd., Suite 102
Orlando, FL 32812

This section provides an analysis of potential modifications to existing stormwater design criteria within the State of Florida to meet the performance objectives outlined in the Water Resource Implementation Rule (Chapter 62-40 FAC). This rule requires that stormwater management systems achieve at least an 80% reduction of the average annual load of pollutants that would cause or contribute to violations of State water quality standards. If the stormwater management system discharges to a designated OFW or other protected waterbody, the performance criteria increases to a 95% reduction. Based on the analyses presented in Section 5.2, with the exception of the SMRWMD design criteria for on-line dry retention, existing stormwater design criteria fail to consistently meet either the 80% or 95% target goals outlined in Chapter 62-40.

UNIFIED STORMWATER RULE CONCEPTS

- Increase nutrient load removal
- Clear language on impaired waters requirements
- BMP treatment train load reduction credits
- Credits for nonstructural and LID BMPs
  - ✓Preserving vegetation, minimize clearing
  - ✓Green roof/cistern systems
  - ✓Pervious concrete
  - ✓Florida Friendly Landscaping
  - ✓Disconnect impervious areas
- Redevelopment treatment section
- Compensating treatment (WQ Banking)
- Retrofit section

WHEN ARE HIGHER LEVELS OF STORMWATER TREATMENT REQUIRED?

Discharges to OFWs

- Must meet "antidegradation" standard
- Presumptive = 95% load reduction

Discharges to Impaired Waters

- Must meet "net improvement" standard
- Must demonstrate load reduction achieved

WHY ARE HIGHER LEVELS OF STORMWATER TREATMENT REQUIRED?

Section 402(p) of Federal Clean Water Act

- Establishes NPDES stormwater permits
- Construction permit requires treatment to meet WQS
- MS4 permit requires local governments to reduce pollutant loadings
- MS4 permit requires reducing pollutant loads to achieve TMDLs
- MS4 permit requires load tracking/reporting

WHY ARE HIGHER LEVELS OF STORMWATER TREATMENT REQUIRED?

SECTION 373.414(1)(b)3., Florida Statutes

3. If the applicant is unable to meet water quality standards because existing ambient water quality does not meet standards, the governing board or the department shall consider mitigation measures proposed by or acceptable to the applicant *that cause net improvement of the water quality in the receiving body of water for those parameters which do not meet standards.*

WHY ARE HIGHER LEVELS OF STORMWATER TREATMENT REQUIRED?

Section 373.414(1)(b)3., F.S.

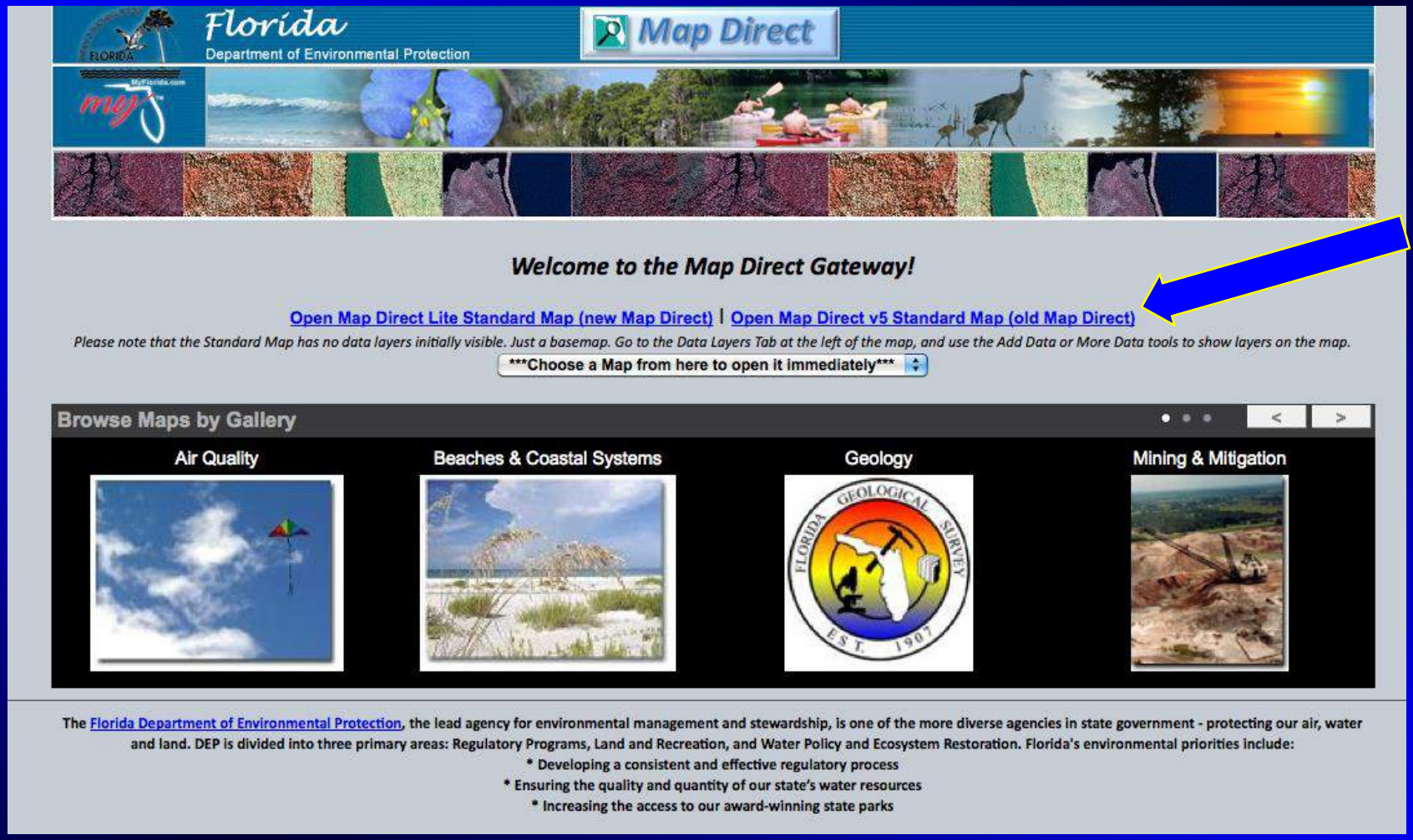
- To discharge to an impaired water body, one can't add more pollutants causing the impairment since it doesn't meet WQS
- Treatment level must cause "net improvement of the water quality in the receiving water body."
- Post-development load < pre-development load

HOW DETERMINE IF WATER BODY IS AN OFW, IS IMPAIRED, OR HAS AN ADOPTED TMDL?

- Use DEP's Map Direct to determine if water body or WBID is an OFW or it's impairment and TMDL status
- Use DEP's Map Direct to see if project site is within the 12 unit HUC (subwatershed) of an impaired water body
- Use DEP's TMDL Tracker system to see if a TMDL is adopted, or check 62-304, F.A.C.
- Use EPA's Ask Waters system

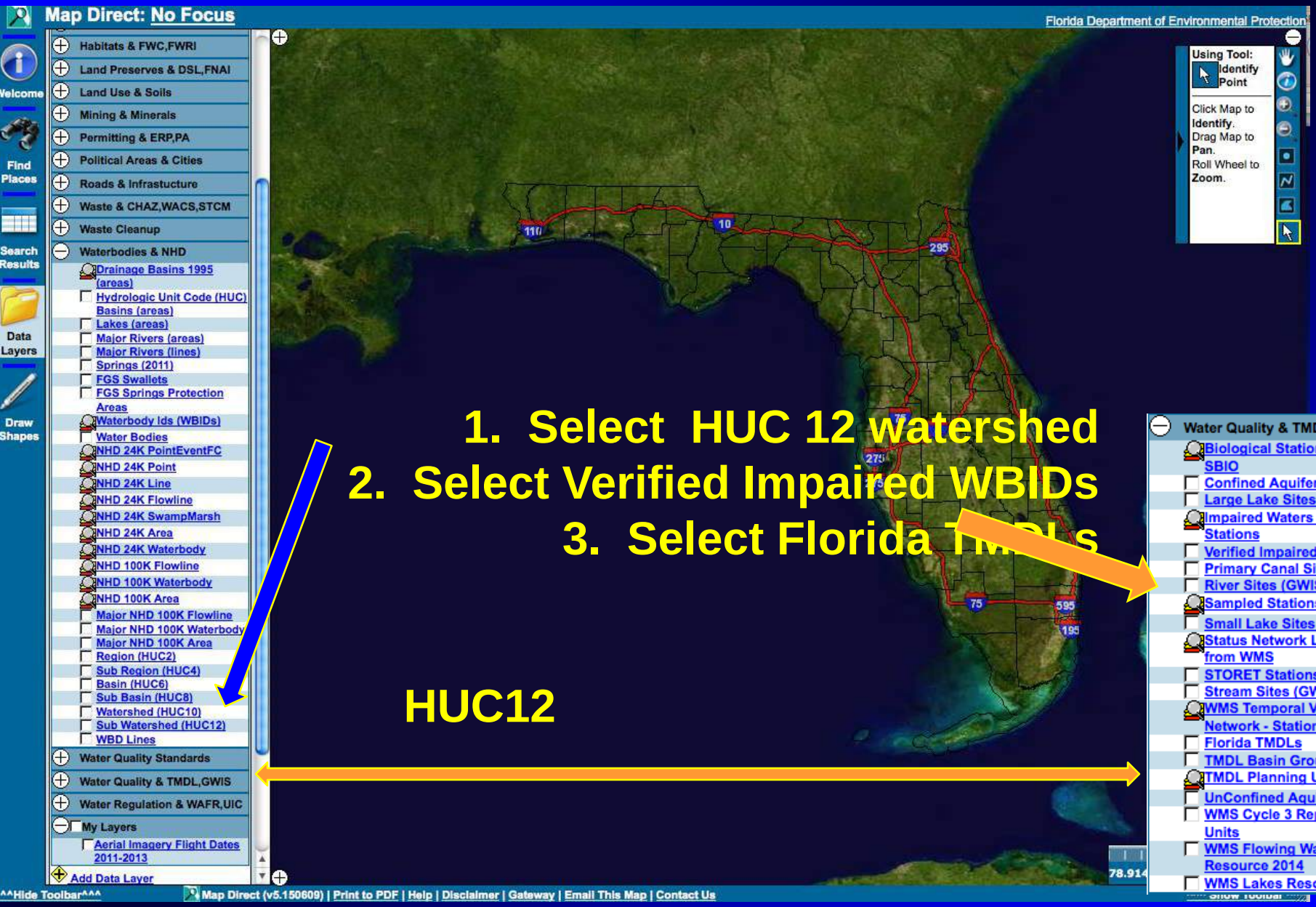
DEP MAP DIRECT SYSTEM

http://ca.dep.state.fl.us/mapdirect/gateway.jsp



Click This Map

SELECT DATA LAYERS



MAP DIRECT ADDRESS INFORMATION

Map Direct: No Focus

Florida Department of Environmental Protection

Welcome

Find Places

Search Results

Data Layers

Draw Shapes

Sub Watershed (HUC12) (1 found)

[1]

OBJECTID	1214
TNMID	{FFB2 26DE E9ED
METASOURCEID	Null
SOURCEDATADESC	Null
SOURCEORIGINATOR	Null
SOURCEFEATUREID	Null
LOADDATE	13584
GNIS_ID	Null
AREAACRES	10750
AREASQKM	435.0
STATES	FL
HUC12	03090
NAME	North St. Lu
HUTYPE	U
HUMOD	SC
TOHUC	03090
NONCONTRIBUTINGACRES	0
NONCONTRIBUTINGSQKM	0
SHAPE.AREA	43536
SHAPE.LEN	18504

Go To This Place

Florida TMDLs (2 found)

[1] ST LUCIE RIVER (NORTH FORK).
TMDL Param: Fecal Coliform
Pollutant: Fecal Coliform
TMDL Status: State Adopted
TMDL and EPA Approved
Group 2: St. Lucie - Loxahatchee.
Southeast Regulatory District.
Go to this Place

[2] ST LUCIE RIVER (NORTH FORK).
TMDL Param: Dissolved Oxygen and Nutrient
Pollutant: TN, TP, and BOD
TMDL Status: State Adopted
TMDL and EPA Approved
Group 2: St. Lucie - Loxahatchee.
Southeast Regulatory District

Using Tool: Selection Box

Click Map or Drag Box to **Identify** Selected Area. Roll Wheel to **Zoom**.

Result #1/8. More... options

Lat/Lon:27.31726089, -80.36570954

Sub Watershed (HUC12)

[1]

OBJECTID	1214
TNMID	{FFB2FBCF-26DE-4483-8A4D-E9EDC161913B}
METASOURCEID	Null
SOURCEDATADESC	Null
SOURCEORIGINATOR	Null

NW MARION AVE
NW AVON AVE
NW AZALEA AVE
NW BAYSHORE BLVD
NW CARMELITE ST
NW PEACH ST
NW AILEEN ST
NW DOREEN ST
NW FRIAR ST
NW HEATHER ST
NW BILLIAR AVE
St. Lucie - Loxahatchee
NW PRIMA VISTA BLVD
SW PRIMA VISTA BLVD
SW BUSWELL AVE
SW BUTLER AVE
SW VIOLET AVE
SW LUCERO DR
SW DOLORES AVE
SW FREDRICA ST
SW EMPIRE ST
SW CYNTHIA ST
SW GRANADEER ST
SW HOGAN ST
SW HIBISCUS ST
SW DORCHESTER ST
417 feet

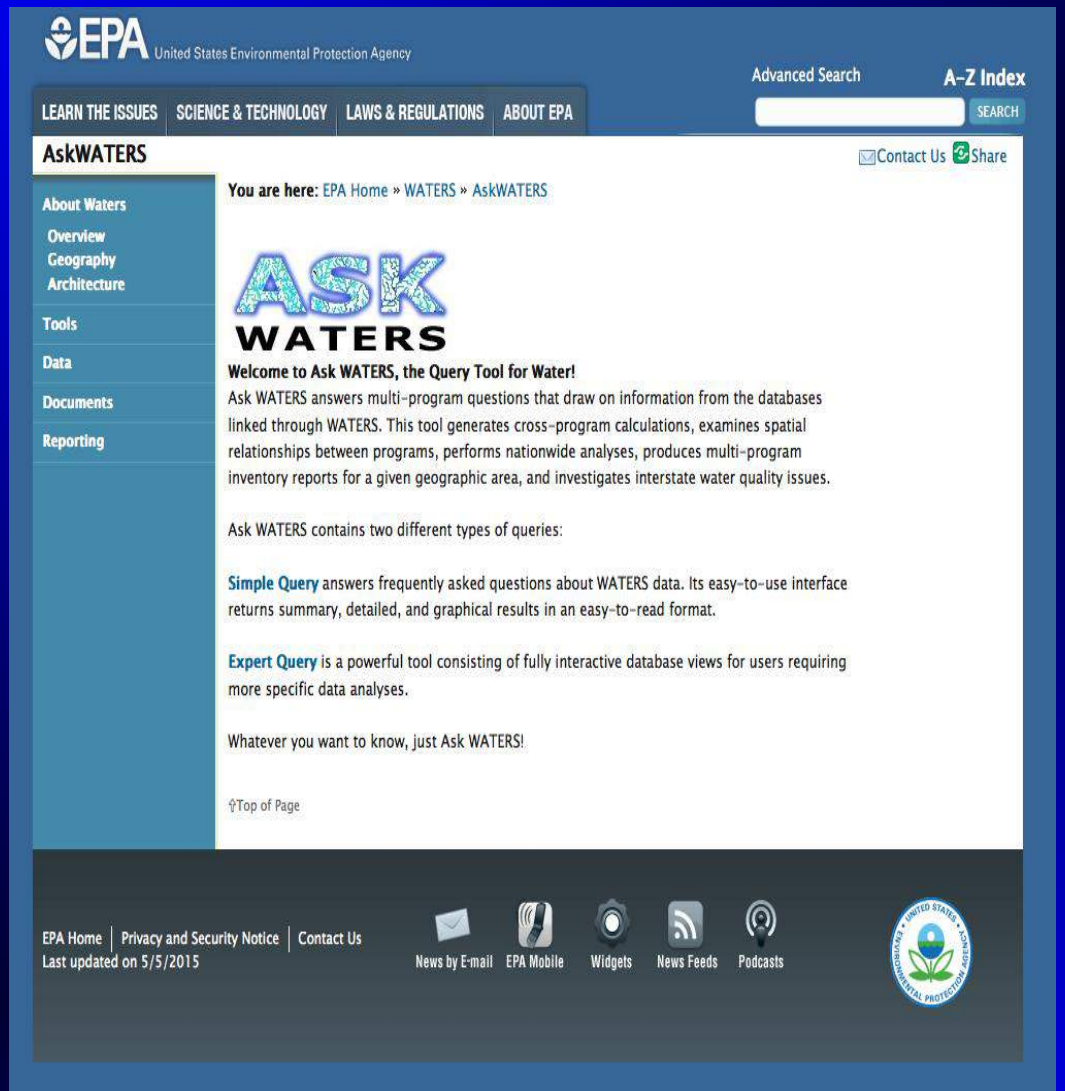
Pan N W E S

Zoom Back Full Next 1:5,000

^^^Hide Toolbar^^^ Map Direct (v5.150609) | Print to PDF | Help | Disclaimer | Gateway | Email This Map | Contact Us ^^^ Show Toolbar ^^^

EPA ASK WATERS WEB SITE

http://iaspub.epa.gov/apex/waters/f?p=ASKWATERS: M



Use the Expert Query Tool

DEP TMDL TRACKER WEB SITE

http://www.dep.state.fl.us/water/watersheds/assessment/tmdl-tracker.htm

Watershed Assessment

TMDL Tracker

Release 2.0 of the TMDL Tracker web application is now available through the FDEP Business Portal. With this release easy access to watershed assessment and TMDL information from Florida's Department of Environmental Protection is now provided to the public through the internet.

Use this web application's **TMDL Reports** and **Dashboards** to access **TMDL status**, **Assessment**, and **Permit information**.

You may also be able to determine if a WBID is **impaired**. Click on this link to **get easy to follow instructions on how to access this information.**

- The **TMDL Report** provides access to downloadable TMDL documents.
- Under the **Dashboard** link, the **Water Quality Tab** provides a snapshot of **TMDL information** allowing results to be filtered by **DEP District**, **TMDL Document Status**, or **Pollutant**.
- Under the **Dashboard** link, the **Assessment Tab** provides a snapshot of **Assessment information** allowing results to be filtered by **DEP District, Assessment Category**, or **Basin Group**.
- Also under the **Dashboard** link, the **Permit Tab** allows for searches based on **Waterbody Name**, **WBID** (waterbody segment id), **Wastewater Facility ID** or **Wastewater Facility Name**.
  - This powerful tool also provides spatial searches using latitude and longitude coordinates.
  - Search results can be confirmed through links to the MapDirect map browser.

Access the TMDL Tracker Web Application

For more information, send e-mail to Kevin O'Donnell (Kevin.ODonnell@dep.state.fl.us)

Watershed Assessment
2600 Blair Stone Road - Mail Station 3560
Tallahassee, FL, 32399-2400
Phone: (850) 245-8433

Also can check Chapter 62-304, FAC

WHAT IS “NET IMPROVEMENT”?

Verified impaired water body

- **DEP/WMDs require one pound less loading of the pollutant(s) causing impairment after development**
- **Recommend at least 10% reduction in post-development loading to meet statutory intent.**

Impaired water body with adopted TMDL

Post-development load < pre-development load – WLA % reduction

VERY HIGH LEVEL OF TREATMENT

- Typical wet ponds get 35% TN, 55% TP removal
- Net Improvement can require as much as 90% removal to meet TMDL (26% WLA)
- Need to use combination of structural and nonstructural pollution prevention BMPs including Low Impact Development BMPs

POLLUTANT LOAD = (CONCENTRATION) * (VOLUME)

Stormwater volume factors:

- **Rainfall variables: when, where, how long, how intense, time between storms**
- **Natural stormwater variables include soils, geology, SHWT, topography, vegetation**
- **Human stormwater variables include land use, site design, soil compaction, percent imperviousness, % DCIA**

Table 9–5 Runoff curve numbers for urban areas [1]

Cover description cover type and hydrologic condition	Average percent impervious area [2]	-- CN for hydrologic soil group -- A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

STORMWATER EVENT MEAN CONCENTRATIONS

Stormwater Event Mean Concentrations (mg/l)						
Land Use Category	Total N	Total P	BOD	TSS	Copper	Zinc
Low Density Residential[1]	1.61	0.191	4.7	23.0	0.008	0.031
Single Family	2.07	0.327	7.9	37.5	0.016	0.062
Multi-Family	2.32	0.520	11.3	77.8	0.009	0.086
Low Intensity Commercial	1.18	0.179	7.7	57.5	0.018	0.094
High Intensity Commercial	2.40	0.345	11.3	69.7	0.015	0.160
Light Industrial	1.20	0.260	7.6	60.0	0.003	0.057
Highway	1.64	0.220	5.2	37.3	0.032	0.126
Natural Vegetated Community	1.15	0.055	1.4	4.7	0.003	0.007
Agricultural Land Uses						
Pasture	3.47	0.621	5.1	94.3	-	-
Citrus	2.24	0.183	2.55	15.5	0.003	0.012
Row Crops	2.65	0.593	-	19.8	0.022	0.030
Conventional rooftops	1.05	0.12				
1. Average of single-family and undeveloped values						

Florida EMC data base – June 2012

HOW DO WE REDUCE STORMWATER LOADING?

- Reduce stormwater pollutant concentrations
- Reduce stormwater volume
- Reduce pollutants using source controls and public education
- Better site design – integrate stormwater into site and its landscaping
- Minimize imperviousness, especially DCIA
- Structural stormwater BMPs

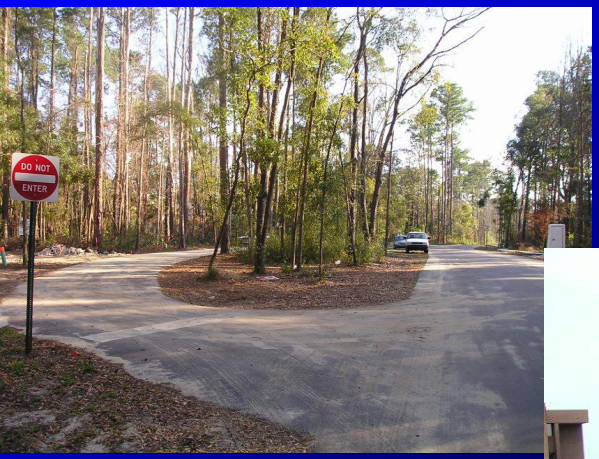
WHY LID?
ADDED BMPs IN TOOL BOX

- Promote development and redevelopment through greater flexibility
- Build local economy and promote “urban regeneration”
- Get higher levels of stormwater treatment
- Keep loads out of MS4
- Protect local taxpayers and water bodies

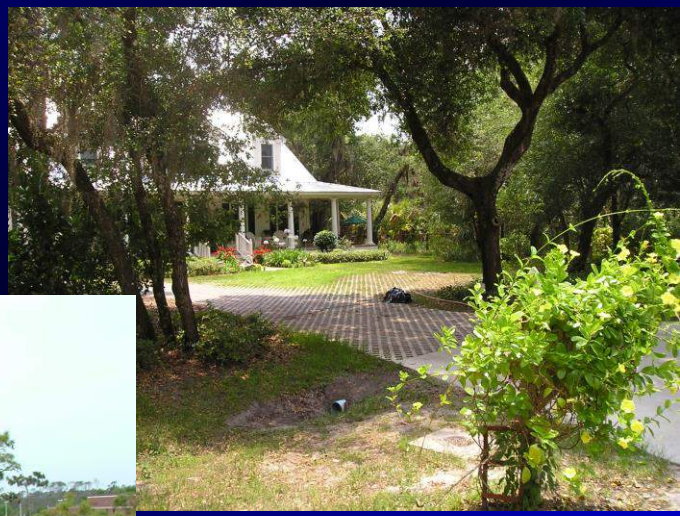
- Pervious Pavement
  - Concrete
  - Pavers
- Rain Gardens / Bio Swales
- Street Infiltration Basins
- Bio Filtration Planter Boxes
- Green Gutters

City of Palmetto
Urban regeneration project

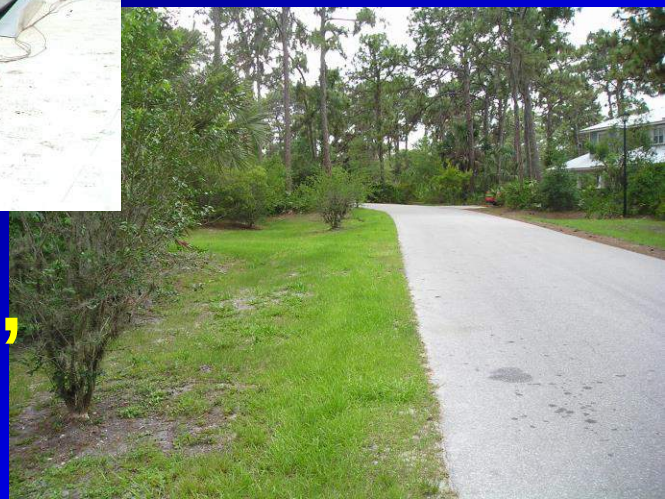
LOW IMPACT DESIGN
HOW DO IT?



Mederra, Gainesville



Baldwin Park, Orlando



River Forest, Bradenton

WHAT IS LOW IMPACT DEVELOPMENT?

- Comprehensive watershed approach
- Hydrology is integrating framework
- Maintain predevelopment volume and hydrology
- Combine nonstructural pollution prevention BMPs with structural BMPs
- Control stormwater at the source
- Create multifunctional landscape and infrastructure

Pollution and Hydrologic Prevention

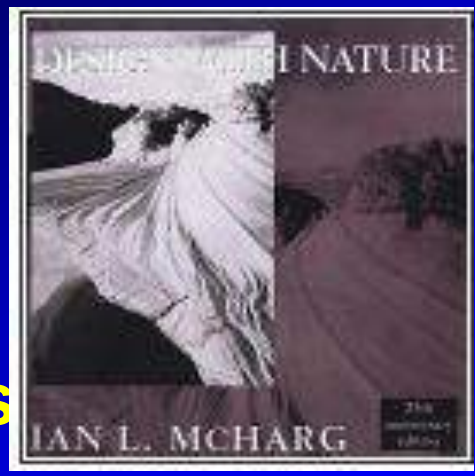
WHAT LOW IMPACT DEVELOPMENT IS NOT

LID is NOT a silver bullet solution to all stormwater problems

- Additional nonstructural and structural tools in the BMP tool box
- Infiltration BMPs do not work everywhere

LID is NOT a new idea

- "Designing with Nature" 1969 book by Ian McHarg
- FL stormwater program has always promoted retention BMPs



LOW IMPACT DEVELOPMENT PRINCIPLES TO REDUCE STORMWATER VOLUME/LOADS

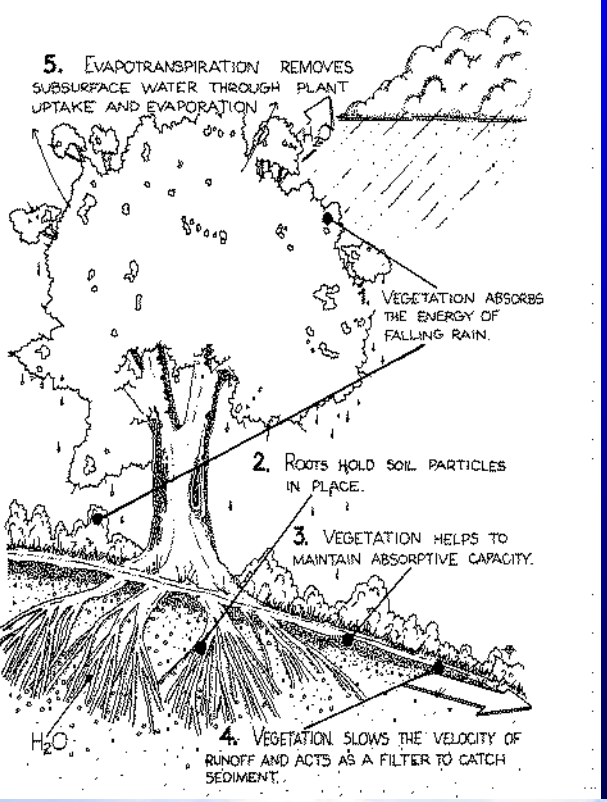
- Consider stormwater as a resource
- Protect/avoid sensitive areas
- Minimize disturbed areas / soil compaction
- Minimize loss of vegetation and trees
- Plant more trees – intercept rainfall
- Maximize infiltration/stormwater harvesting
- Minimize imperviousness, especially DCIA
- Integrate stormwater BMPs into landscaping
- Cluster development
- Use innovative planning tools (TDR)

SOURCE CONTROLS FOR POLLUTION PREVENTION

- Minimize clearing, removal of trees, vegetation
- Include urban reforestation
- Minimize imperviousness, esp. DCIA
  - Minimize soil compaction
  - Narrow streets, pervious parking, recessed tree islands
  - Greenroof/cistern systems for large roofs
  - Roof runoff to cisterns, pervious areas
- Minimize pollutants
  - Florida-friendly landscaping & fertilizers
  - Proper use of reclaimed water
  - Pet waste pick up and disposal

NATURAL AREA CONSERVATION OR REFORESTATION

- Credit for preserving natural areas
- Debit for clearing/ landscaping – soil compaction

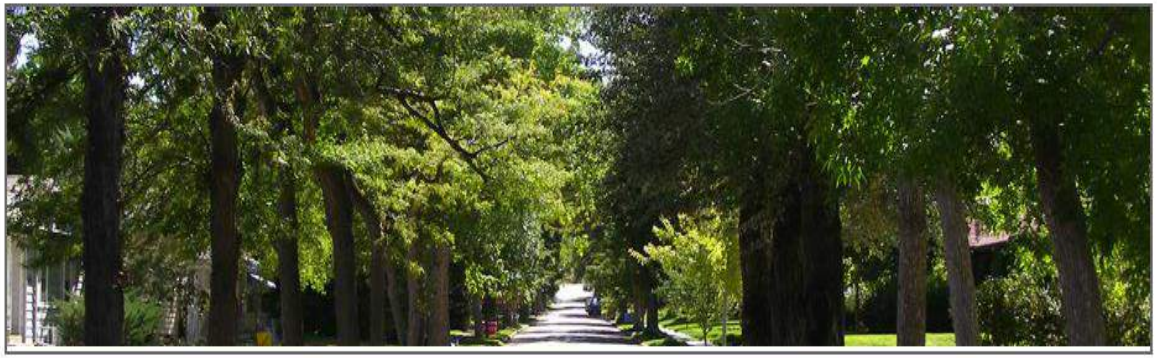


THE STORMWATER BENEFITS OF TREES

Planting trees in urban areas intercepts and evaporates rain and reduces stormwater volume and loads

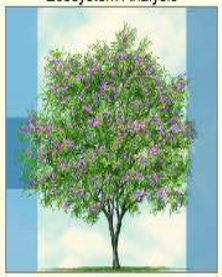
Interceptor Tree BMP
Up to 15% reduction in stormwater volume

NEED DATA!



Home | About | Applications | Utilities | Resources | Support | News

Desert Canopy Ecosystem Analysis



A US Forest Service Northern Research Station Guide

Visit the Video Learning Page

What is i-Tree?

i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools. The i-Tree Tools help communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the structure of community trees and the environmental services that trees provide.

Since the initial release of the i-Tree Tools in August 2006, numerous communities, non-profit organizations, consultants, volunteers and students have used i-Tree to report on individual trees, parcels, neighborhoods, cities, and even entire states. By understanding the local, tangible ecosystem services that trees provide, i-Tree users can link urban forest management activities with environmental quality and community livability. Whether your interest is a single tree or an entire forest, i-Tree provides baseline data that you can use to demonstrate value and set priorities for more effective decision-making.

i-Tree Tools are in the public domain and are freely accessible. We invite you to explore this site to learn more about how i-Tree can make a difference in your community.

Follow i-Tree on Twitter

What's New?

Check out updated April 2015 i-Tree User Maps
International user map and United States user map

i-Tree Eco: Modelling the Lungs of our Cities - Part1
The importance of U.K. urban forest assessments>>

i-Tree Eco: Modelling the Lungs of our Cities - Part2
The London i-Tree Eco project>>

Breathe Easy: Urban Forests for Human Health
Archived ACT webinar featuring Dave Nowak>>

Baltimore Gas and Electric provide over 4,200 free trees
BGE promotes Energy-Saving trees planting program>>

Delmarva Power to provide 1,500 free trees
Energy-Saving Trees program in Delaware & Maryland>>

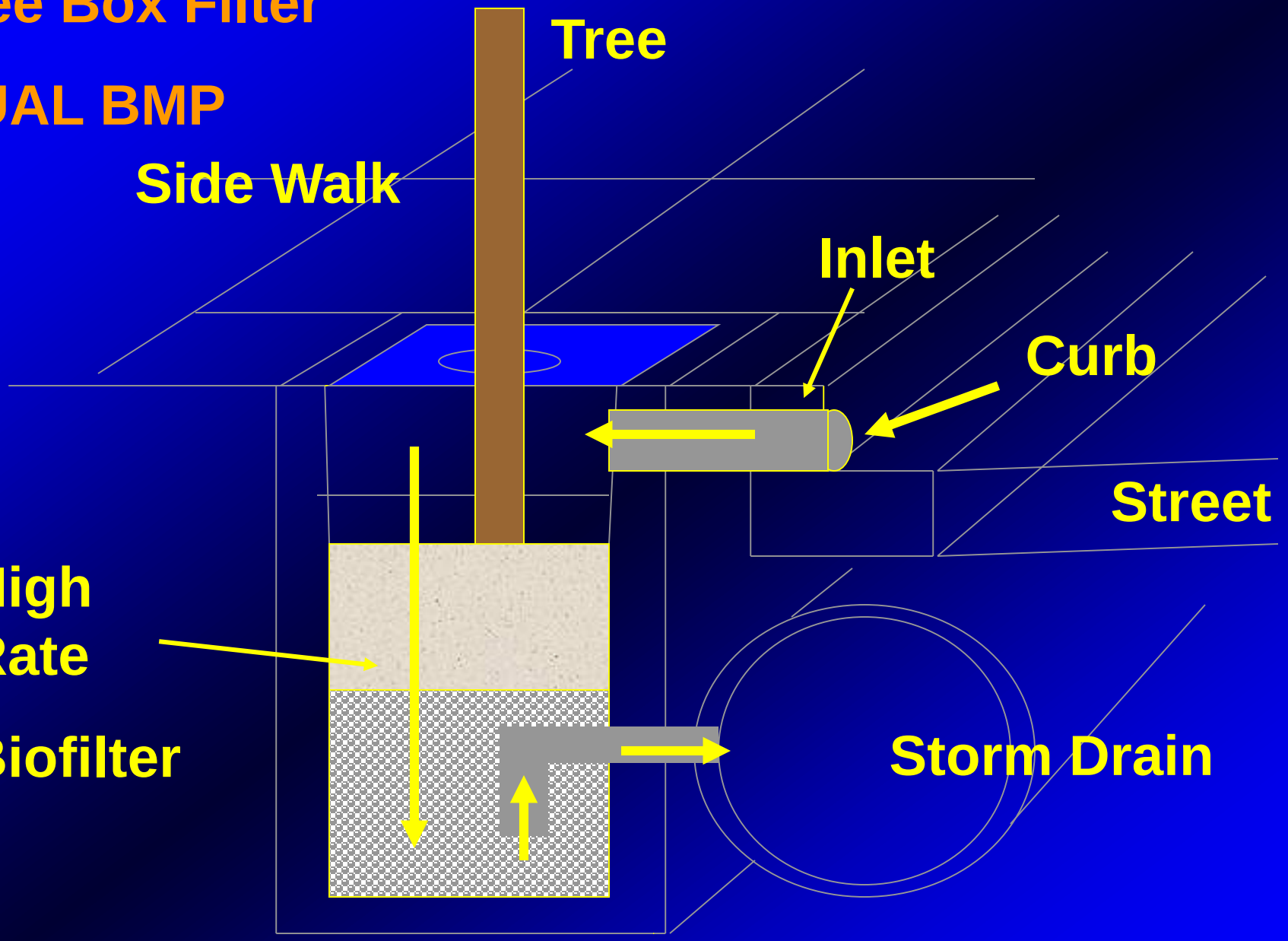
< >

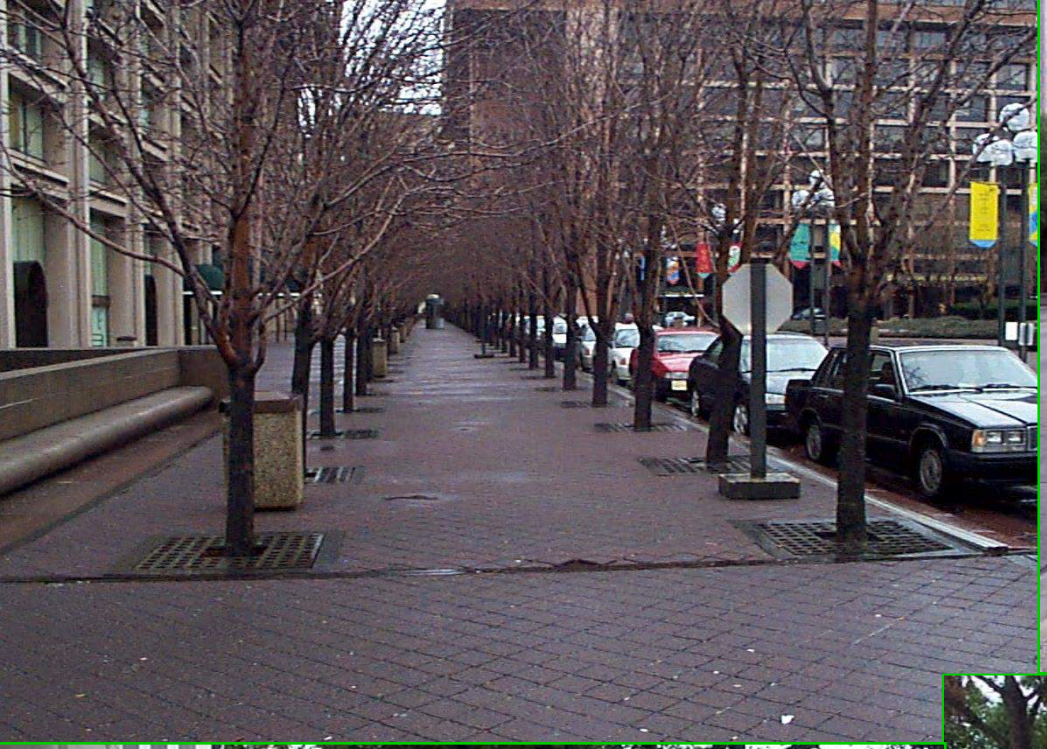
I-TREE TOOLS

http://www.itreetools.org/

Tree Box Filter

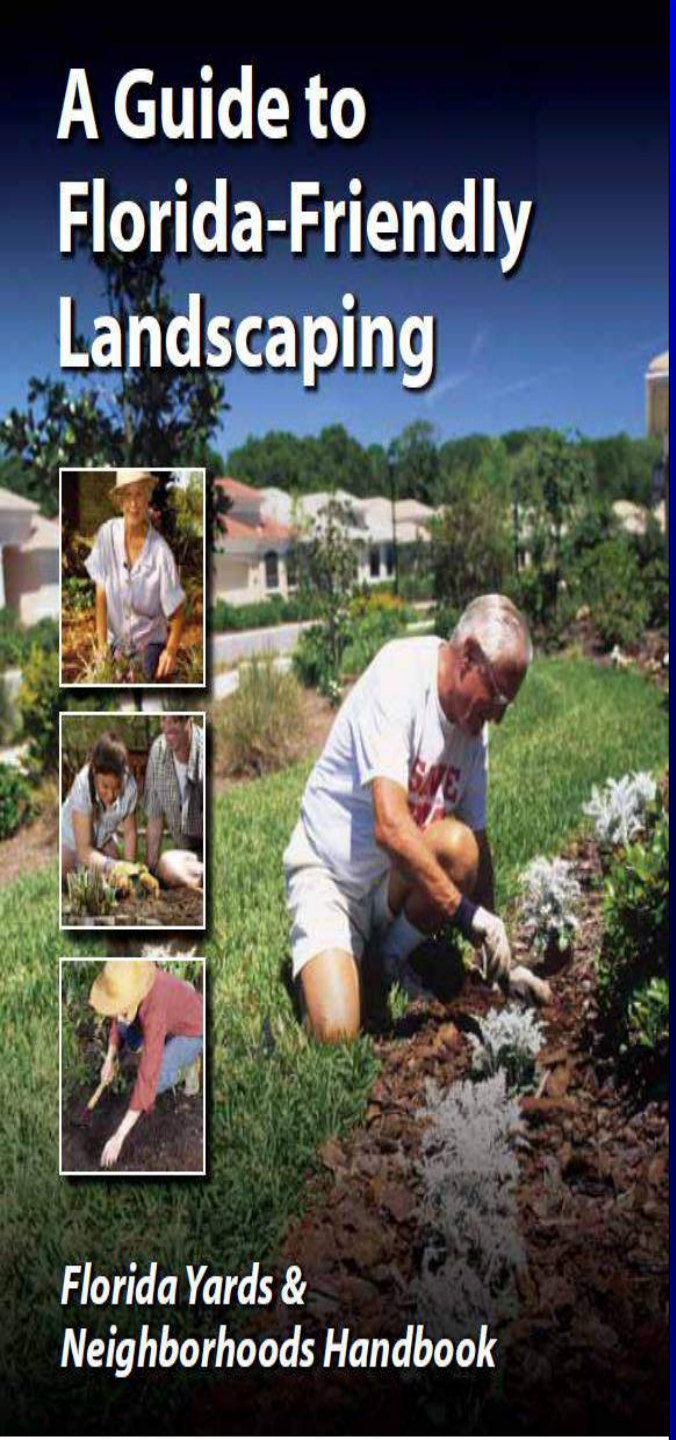
DUAL BMP





FLORIDA LANDSCAPES ARE PPP SOURCES

Florida Friendly Landscaping and Fertilizers



FLORIDA-FRIENDLY LANDSCAPING PRINCIPLES

1. Right plant, right place
2. Water efficiently, use stormwater
3. Fertilize properly
4. Mulch
5. Attract wildlife
6. Manage yard pests properly
7. Recycle clippings and leaves
8. Reduce runoff
9. Protect the waterfront

http://www.floridayards.org

GUARANTEED ANALYSIS

TOTAL NITROGEN (N).....14.00 %
14.45% Urea Nirtogen (N)*

SOLUBLE POTASH (K_2O).....26.00 %

SULFUR (S) Total.....19.70 %
10.50% Free sulfur (S)
9.20% Combined sulfur (S)

IRON (Fe) Total.....0.96 %
0.19% Water Soluble Iron (Fe)

MANGANESE (Mn) Total.....0.48 %
0.1% Water Soluble Manganese (Mn)

DERIVED FROM: Polymer Coated Sulfur Coated Urea, Sulfate of Potash, Iron Oxide, Manganese Oxide.

CHLORINE (Cl) Max 2.00%

*7.00% Slowly Available Urea Nitrogen from Polymer Coated Sulfur Coated Urea.

USE FLORIDA-FRIENDLY FERTILIZERS

15 - 0 - 15

(N) Total Nitrogen | (P_2O_5) Phosphorus | (K_2O) Potassium

DACS Urban Turf Fertilizer Label Rule

- Effective July 1, 2009
- Only specified fertilizers on turf
  - No or low phosphorus (< 0.5%)
  - Slow release nitrogen
- Maximum application rates
  - 0.25 lbs P/1000 sf per app
  - 0.50 lbs P/1000 sf per year
  - 0.7 lbs available N/1000 sf

PET WASTE: A major source of nutrients and bacteria pollutants

- Pets deposit up to 0.5 lbs/day of pet waste
- Contributes to bacterial & nutrient pollution

Animal	Average fecal coliform per gram of feces	Fecal coliform load per day
Human	13,000,000	1,921,920,000
Dog	23,000,000	7,728,000,000
Cow	230,000	5,358,080,000
Horse	12,600	293,529,600

LAND CLEARING, VEGEATION REMOVAL AND SOIL COMPACTION

80% compaction on first pass of equipment

SOIL COMPACTION AND INFILTRATION RATES

SOIL TYPE	INFILTRATION RATE (in/hr)	
	Pitt et. al.	Gregory
Sandy soils	13.0	14.8 – 25
Compacted sandy soils	1.4	0.3 - 6.9
Clay soils	9.8	NA
Compacted or wet clay soils	0.2	NA

Source: Pitt, Chen, and Clark, 2001; Gregory et. Al, 2006

THE INFLUENCE OF DCIA ON STORMWATER VOLUME

Zone 4

Mean Annual Runoff Coefficients (C Values) as a Function of DCIA Percentage and Non-DCIA Curve Number (CN)

Percent DCIA																			
0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
0.004	0.045	0.086	0.127	0.168	0.209	0.250	0.291	0.332	0.373	0.414	0.455	0.496	0.536	0.577	0.618	0.659	0.700	0.741	0.782
0.007	0.048	0.089	0.129	0.170	0.211	0.252	0.293	0.333	0.374	0.415	0.456	0.497	0.537	0.578	0.619	0.660	0.701	0.741	0.782
0.011	0.051	0.092	0.133	0.173	0.214	0.254	0.295	0.336	0.376	0.417	0.458	0.498	0.539	0.579	0.620	0.661	0.701	0.742	0.782
0.016	0.056	0.096	0.137	0.177	0.217	0.258	0.298	0.339	0.379	0.419	0.460	0.500	0.540	0.581	0.621	0.662	0.702	0.742	0.783
0.022	0.062	0.102	0.142	0.182	0.222	0.262	0.302	0.342	0.382	0.423	0.463	0.503	0.543	0.583	0.623	0.663	0.703	0.743	0.783
0.030	0.070	0.109	0.149	0.189	0.228	0.268	0.308	0.347	0.387	0.427	0.466	0.506	0.546	0.585	0.625	0.664	0.704	0.744	0.783
0.040	0.080	0.119	0.158	0.197	0.236	0.275	0.314	0.353	0.393	0.432	0.471	0.510	0.549	0.588	0.627	0.667	0.706	0.745	0.784
0.054	0.092	0.131	0.169	0.208	0.246	0.285	0.323	0.362	0.400	0.438	0.477	0.515	0.554	0.592	0.631	0.669	0.708	0.746	0.785
0.071	0.109	0.147	0.184	0.222	0.259	0.297	0.335	0.372	0.410	0.447	0.485	0.522	0.560	0.598	0.635	0.673	0.710	0.748	0.785
0.096	0.132	0.168	0.205	0.241	0.277	0.314	0.350	0.387	0.423	0.459	0.496	0.532	0.568	0.605	0.641	0.678	0.714	0.750	0.787
0.130	0.165	0.199	0.234	0.268	0.303	0.338	0.372	0.407	0.442	0.476	0.511	0.546	0.580	0.615	0.650	0.684	0.719	0.754	0.788
0.182	0.214	0.246	0.278	0.310	0.342	0.374	0.406	0.438	0.470	0.502	0.534	0.566	0.599	0.631	0.663	0.695	0.727	0.759	0.791
0.266	0.294	0.322	0.350	0.378	0.406	0.433	0.461	0.489	0.517	0.545	0.573	0.600	0.628	0.656	0.684	0.712	0.740	0.767	0.795
0.429	0.449	0.469	0.488	0.508	0.528	0.547	0.567	0.587	0.606	0.626	0.646	0.665	0.685	0.705	0.725	0.744	0.764	0.784	0.803
0.616	0.626	0.636	0.647	0.657	0.667	0.678	0.688	0.699	0.709	0.719	0.730	0.740	0.750	0.761	0.771	0.782	0.792	0.802	0.813

Agriculture land use (pasture)

No DCIA, CN for D soils = 89 **C = .249**

SF residential land use

¼ acre lots - DCIA = 40%, CN for lawns, D soils = 84 C =.431

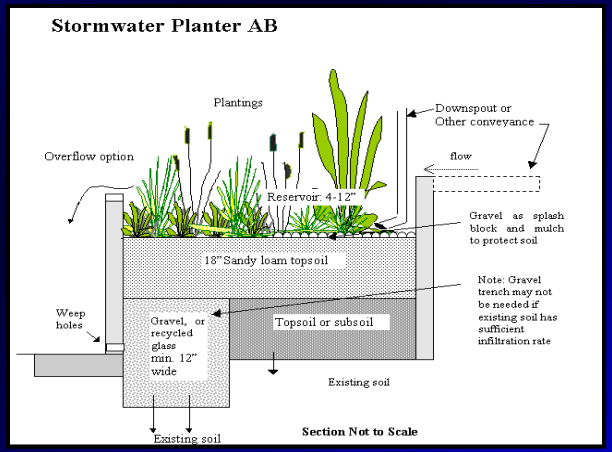
DISCONNECTING DIRECTLY CONNECTED IMPERVIOUS AREAS (DCIA)

USING LOW IMPACT DEVELOPMENT TO REDUCE IMPERVIOUSNESS

- Tailor and decrease road width
- Minimize road length
- Use pervious pavements for parking
- Reduce required parking spaces
- Reduce parking space size
- Use one way angled parking
- Minimize paved driveways/size
- Side walks on one side only

LID STRUCTURAL BMPS

- Infiltration BMPs
  - Green roof/cistern systems
  - Pervious pavements
  - Rain gardens
- Biofiltration BMPs
  - Street tree filters
  - Landscape filter boxes
  - Upflow filters
- Detention with stormwater harvesting



REDUCING IMPERVIOUSNESS IN PARKING LOTS

Nonstructural tools

- Reduce required parking spaces
- Reduce parking space size
- Use one way angled parking

Structural tools

- Use pervious pavements for parking
  - Pervious concrete
  - Turf block/pavers
  - Geoweb and sod

BUT, THIS MAY REQUIRE CODE OR CULTURAL CHANGE

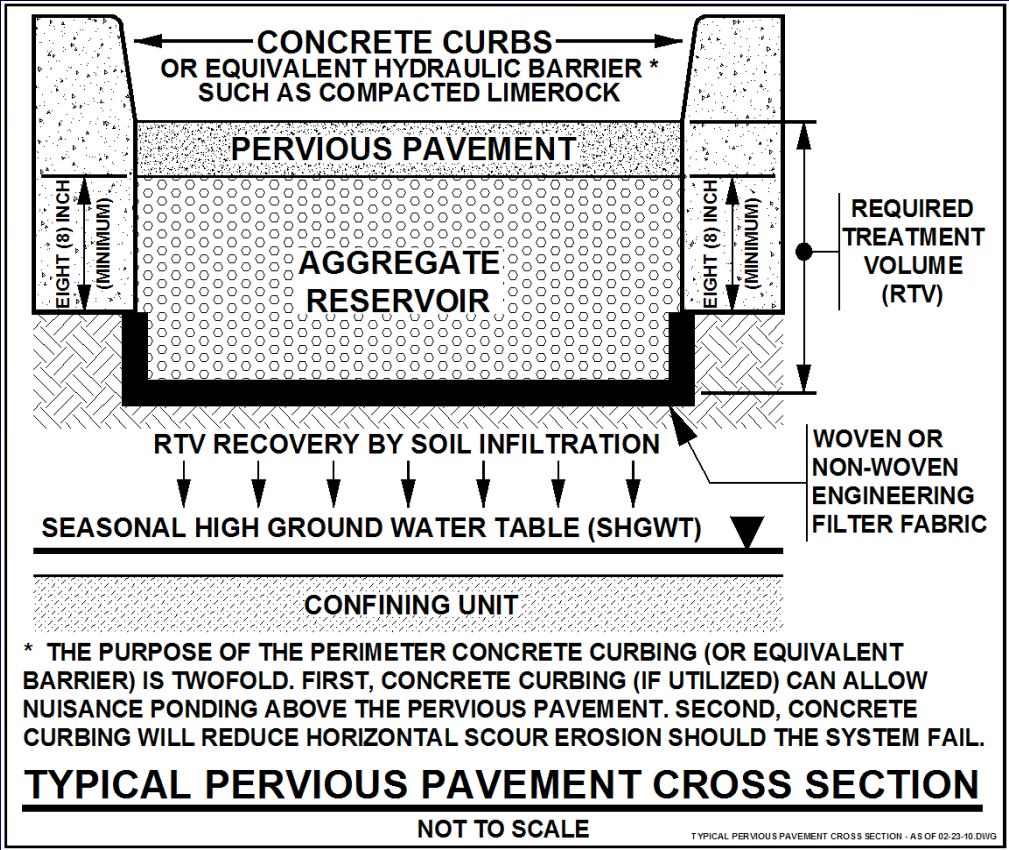
REDUCING PARKING LOT IMPERVIOUSNESS AND DCIA

RECESSED ROAD MEDIANS AS BMPs


STOP

LID BMP = POROUS PAVEMENTS

- Pervious Concrete
- Flexi-pave™
- Permeable Concrete Pavers
- Pervious Asphalt
- Others



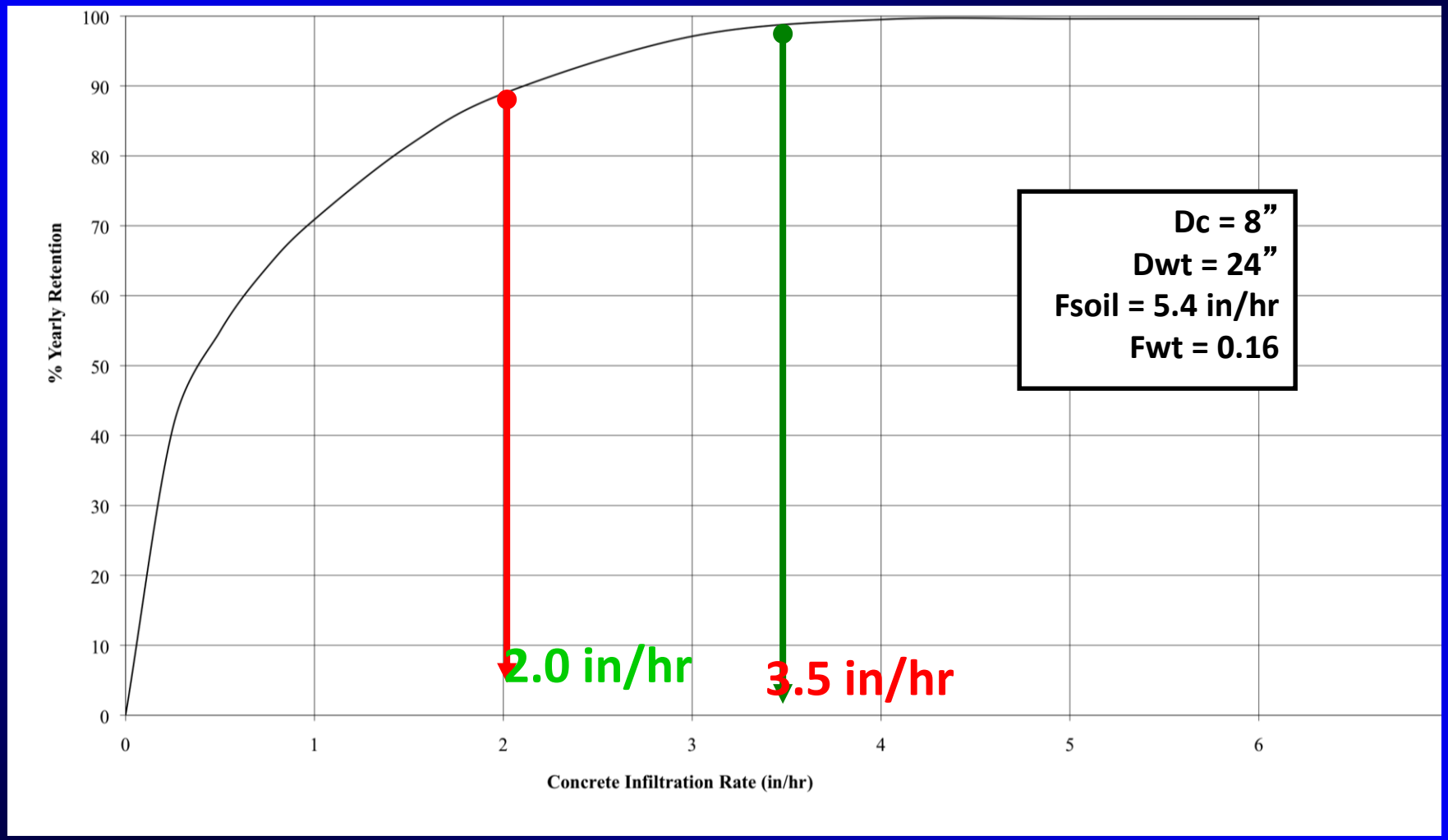
Pervious Pavement

Good design is important, but ---
You have to locate it properly, build it right and you have to maintain it.

PERMEABLE PAVEMENT DESIGN REQUIREMENTS

- Is the site appropriate?
- SHWT at least 2’ below bottom
- Treatment volume using retention curves
- Design per specs/perc rate – min 2”/hr
- Compaction – max 92-95% to min of 24 inches
- Master certified contractor
- Quarterly vacuum sweeping
- ERIK testing and recertification
- Signage to keep muddy vehicles off

PERCENT YEARLY RETENTION



Recommendations – Pervious Pavement

Rear Ripper / Scarifier

http://safety.cat.com/cda/files/861819/7/140M.pdf

Ripper		
Ripping Depth, Maximum	428 mm	16.8 in
Ripper Shank Holders	5	
Ripper Shank Holder Spacing	533 mm	21 in
Penetration Force	9026 kg	19,900 lb
Pryout Force	8555 kg	18,861 lb
Machine Length Increase, Beam Raised	919 mm	36.2 in

Maximum ripping depth = 16.8 inches.

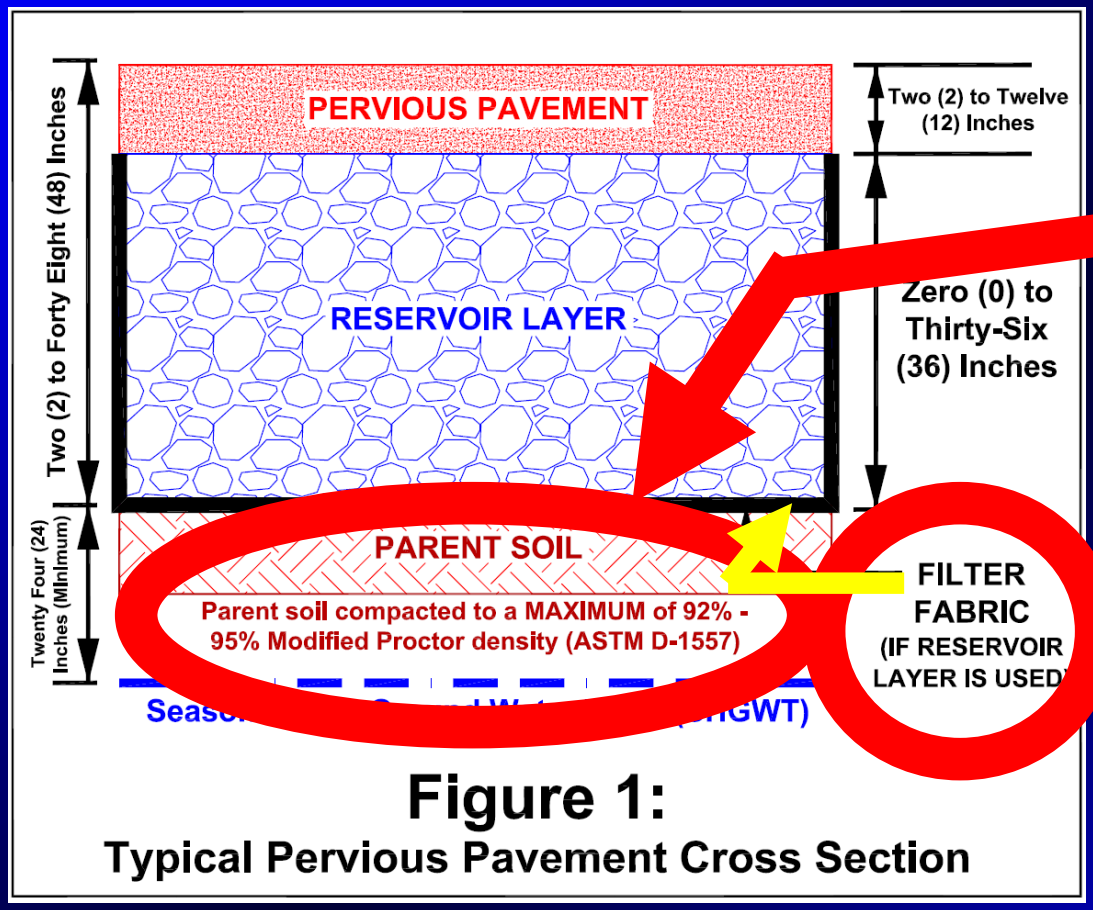


Figure 1:
Typical Pervious Pavement Cross Section

- **Parent soil** - MAXIMUM compaction of 92% - 95% Modified Proctor density (ASTM D-1557) to a total depth of 24 - 36 * inches.
- **Redevelopment projects** – existing pavement section (including compacted base & stabilized sub-grade) to be removed. Underlying soils to be scarified to a minimum 24 - 36 * inch depth and re-graded / proof rolled to a MAXIMUM compaction of 92% Standard Proctor density (ASTM D698-00a).
- **Heavy wheel loads** – if proposed (not recommended , then alternate methods of pavement design must be utilized (i.e. structural / permeable geo-fabrics above the parent soil).

* As a point of reference, the North Carolina DENR requires a vertical saturated hydraulic conductivity ≥ 0.52 in/hr for the soil horizon below the base of the pavement system to a total depth of 36 inches.

The issue of placing pervious pavement systems over HSG “B/D” soils.

For both storm water QUALITY and QUANTITY computations.

Fluctuation of the SHGWT in HSG "B/D" Soils

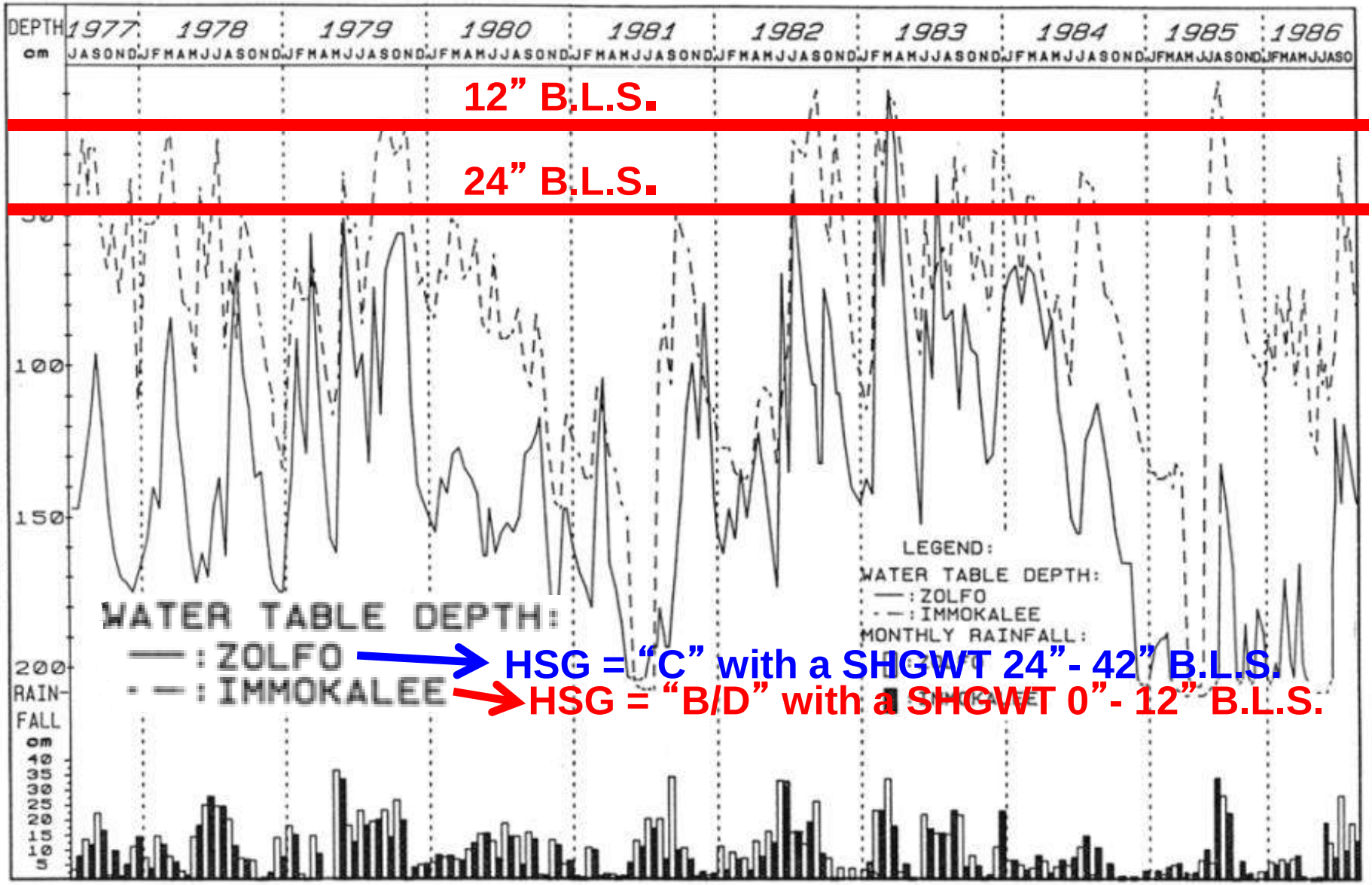
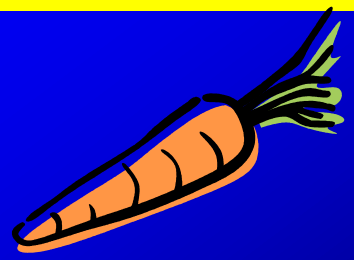
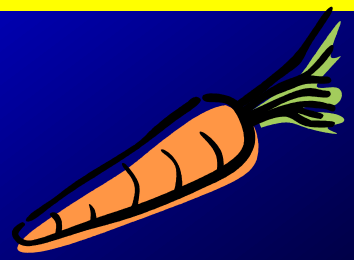


Fig. 1. Water table fluctuation in Immokalee and Zolfo soils and precipitation collected.

HYDE & FORD: WATER TABLE FLUCTUATION

Recommendations – pervious pedestrian walks & bicycle paths

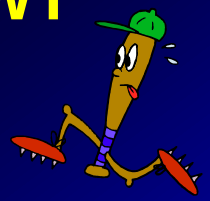




- For water quality credit on HSG = "B/D" soils (SHGWT depth of 0" to 12" below the bottom of the pervious pavement system): 80% (credit) of the pervious pedestrian walk & bike path areas can be subtracted from the total contributing area when computing the storm water treatment volume.
- For water quality credit on HSG = "A", "B" or "C" soils (SHGWT depth of greater than 24" below the bottom of the pervious pavement system): 100% (credit) of the pervious pedestrian walk & bike path areas can be subtracted from the total contributing area when computing the storm water treatment volume.
- Perimeter curbs will NOT be required for pervious walks & bike paths.
- Unless there are public safety concerns, slopes should not be an issue for pervious pedestrian walks & bike paths.

Recommendations – pervious pavement parking lots and access drives

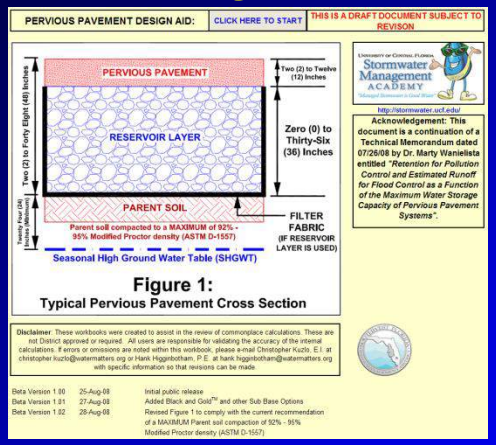
- Consider these types of applications as dry "retention systems" for up – gradient treatment train credit

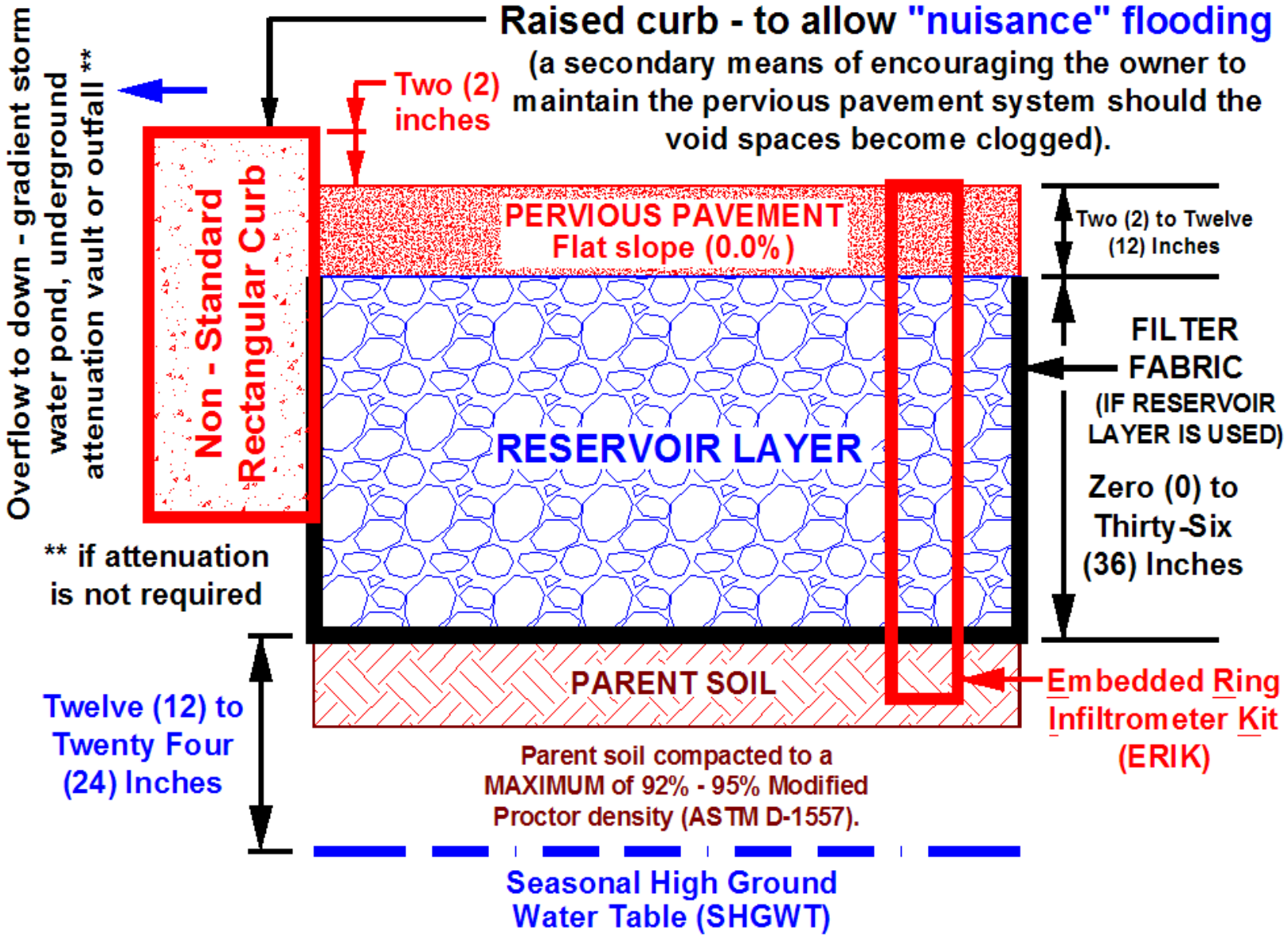
- For water quantity credit (Curve Number (CN) or Rational "C" coefficient computations) the SHGWT <u>shall</u> be greater that 24" below the <u>bottom of the</u> pervious pavement <u>system</u>)



- The Required Treatment Volume (RTV) shall be recovered (to the <u>bottom of the</u> pervious pavement <u>system</u>) within seventy two (72) hours, with a safety factor of two (2.0)

Pervious Pavement "Design Aid"





Potential Pervious Pavement Cross Section #1

Scale: None

Refer to the next slide for information on the ERIK device.

Embedded Ring Infiltrometer Kit (ERIK)

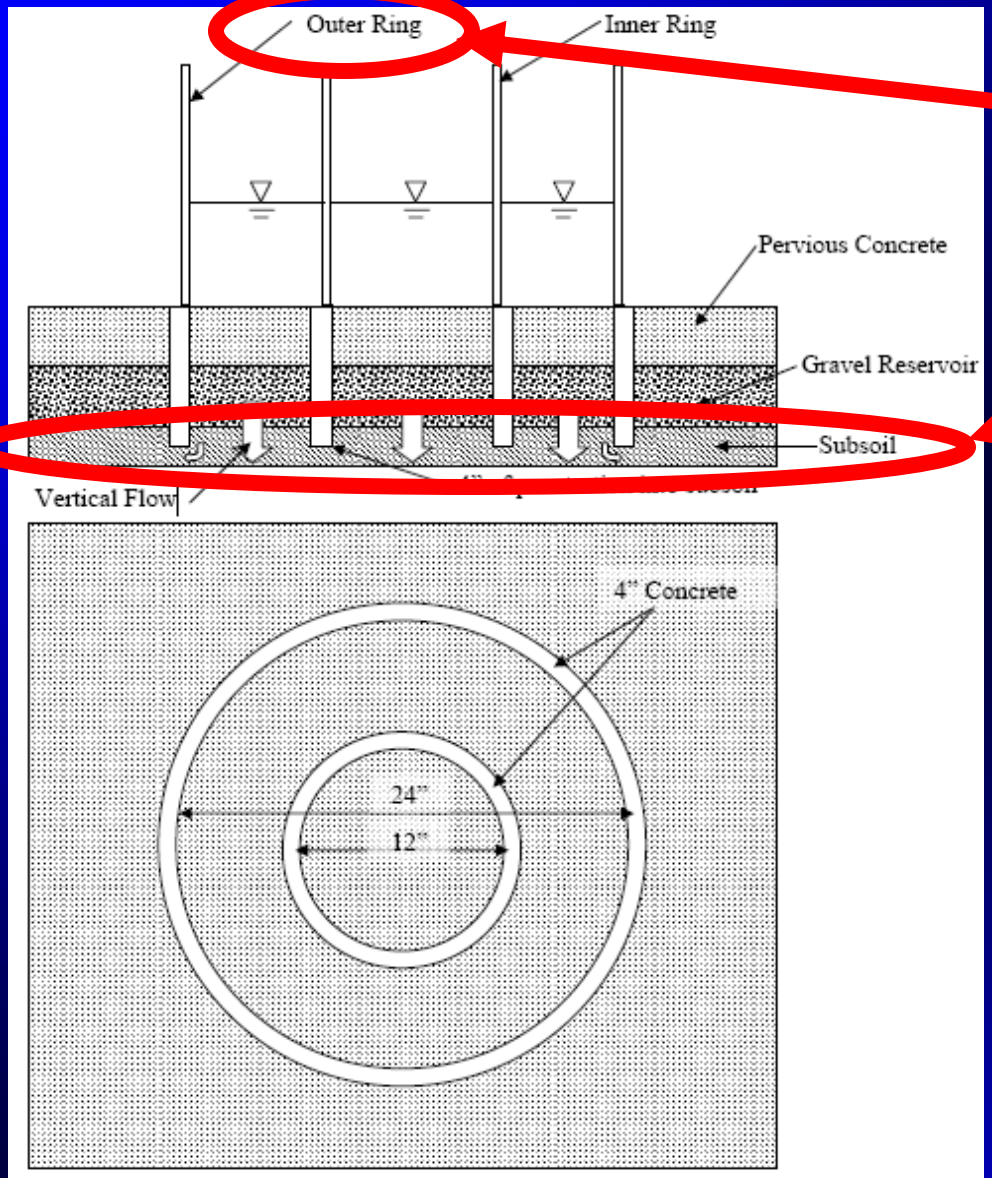


Figure 42: Design profile for Embedded Infiltrometer installation

A single ring ERIK infiltrometer is acceptable provided that is embedded into the subsoil as shown in Figure 42.

For more information on this in-situ infiltration monitor (ERIK), refer to the UCF research paper entitled "*Construction and Maintenance Assessment of Pervious Concrete Pavements - Final Draft*", dated January, 2007, available at: http://stormwater.ucf.edu/research_publications.asp

ERIK
(Embedded Ring Infiltrometer

Placement, Striking, Pizza Cutter and 7 day Curing

PERVIOUS CONCRETE INFORMATION

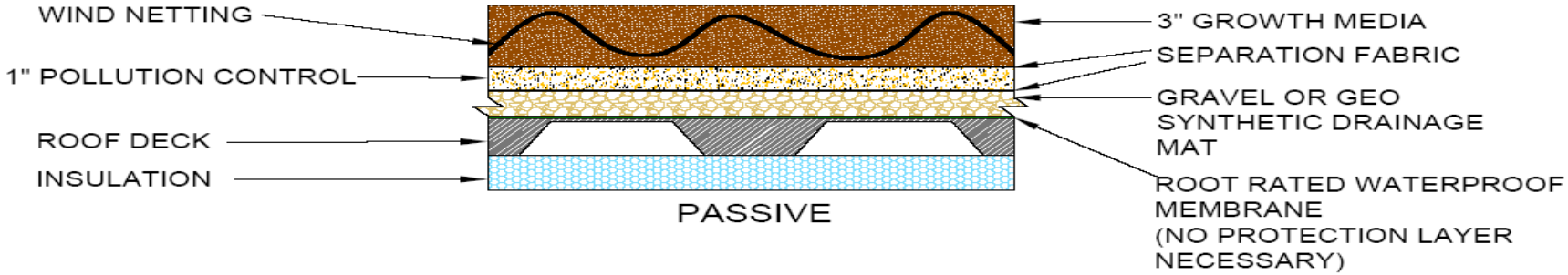
- Florida Concrete & Products Assn
- http://www.fcpa.org/
- www. ConcreteParkingLots.com
- Manuals
- Training classes – certification of contractors-Master
- Training videos
- Min. 2”/hr perc rate

PERVIOUS CONCRETE PITFALLS TO AVOID

- Pervious concrete is different
  - Batching
  - Pouring/finishing
  - Maintenance
- Contractor training and certification are essential
- Must be regularly swept with vacuum sweeper

WHAT IS A GREEN ROOF?

- Vegetated roof cover
- Active (Intensive): Deep media, intended for public access
- Passive (Extensive): Shallow media, intended for maintenance access only, designed for



FLORIDA PILOT GREEN ROOFS

South Florida – 2003 – Bonita Bay Shadow Wood Preserve

August 2003

August 2007

Central Florida – 2005 – UCF Student Union

North Florida – 2011 – Escambia County One Stop Building

BENEFITS OF GREEN ROOFS

- Economic benefit
- Stormwater management
- Improve air quality
- Moderate urban heat island effect
- Building insulation
- Reduce energy consumption
- Sound insulation
- Health and horticultural therapy
- Recreation
- Food supply
- Habitat and wildlife biodiversity
- Aesthetics

GREEN ROOF/CISTERN SYSTEM DESIGN CONSIDERATIONS

- Building structural integrity
- Treatment volume per retention BMPs
- Waterproof membrane, drainage layer, pollution control media, growth media
- Preventing wind uplift – 3’ tall parapet
- Plants – selection, spacing, density
- Roof drain to cistern or other storage
- Irrigation – roof plants, excess for landscape

ROOF SUPPORT FOR A GREEN ROOF

Up to 70 lbs/SF

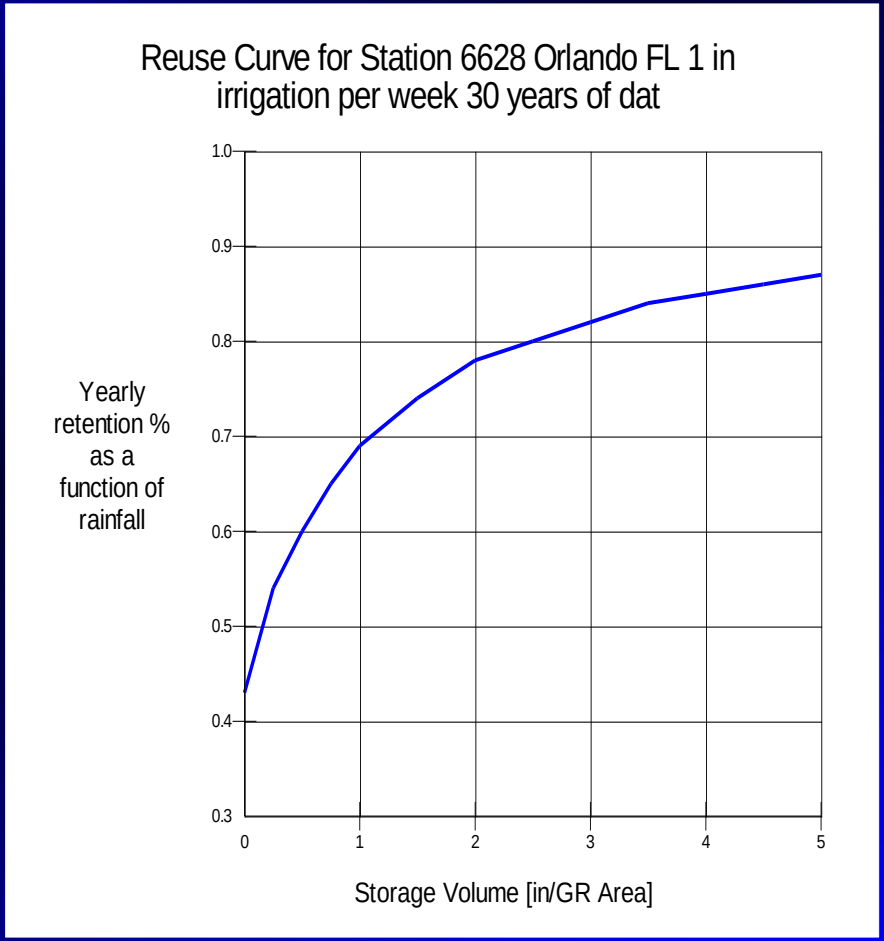
Up to 35 lbs/SF

Up to 50 lbs/SF

Up to 25 lbs/SF

CSTORM Model for Green Roof Cistern Design

- **Cistern Design**
  - **Use CSTORM Model**
  - **Choose desired yearly stormwater retention volume**
  - **Use respective cistern volume**
  - **Storage volume will vary with location**



GREEN ROOFS IN FLORIDA

- Introduced to Florida in 2003: Now, at least 20 locations in Florida and others underway
  - UCF Student Union, physical science and Stormwater Lab (3)
  - FSGE (Envirohome) (2) in Indialantic
  - Bonita Bay (first one and has been modified for irrigation)
  - New American Home in Orlando
  - Charlotte County Stadium
  - UF Perry Construction Yard Building
  - Tecta-America Building in Sanford (tray vs. continuous)
  - Romano Eco Center in Lake Worth
  - Honda Headquarters in Clermont
  - Escambia County One Stop Permit Building
  - Residence on Casey Key
  - Orlando Fire Station #1
  - Environmental Center, Key West
  - Kimley-Horn in Vero Beach
  - Gulf Coast College in Panama City

FSGE Integrated Site Design
green roofs, pervious pave, and landscape swales

- 4500+ gallons

GREEN ROOF STORMWATER PRICE COMPARISON

100,000 square foot roof				
	Down Town Orlando [Magnolia]	Lee Road and I-4	University Blvd.	International Drive
Pond Price (Including Land Cost)	$5,800,000.00	$1,550,000.00	$1,200,000.00	$2,100,000.00
Green Roof Price	$1,400,000.00	$1,400,000.00	$1,400,000.00	$1,400,000.00
Realized savings	$4,400,000.00	$150,000.00	-$200,000.00	$700,000.00

Green Roof price includes the first year of maintenance while the Pond price does not include any maintenance or fencing, green roof cost = $14/sq ft.

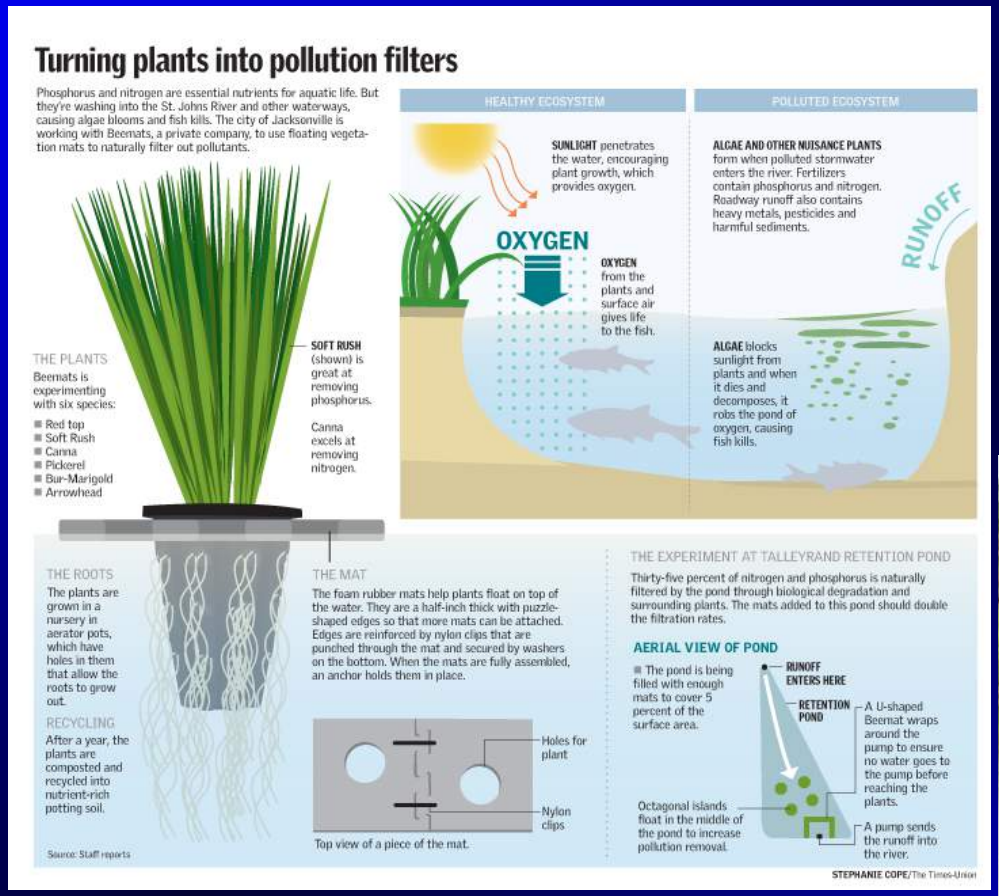
IMPROVING WET DETENTION NUTRIENT REMOVAL EFFECTIVENESS

Get 35% TN load reduction and 55% TP load reduction

Can either reduce TN/TP concentrations or reduce volume discharged

DETENTION TIME	TP REMOVAL Eff= 44.53 + (6.146*lnTd)+(0.145*(lnTd)^2	TN REMOVAL Eff = (43.75*Td)/(4.38+Td)
7	57.04	26.91
14	61.51	33.32
21	64.12	36.20
30	66.42	38.18
50	69.71	40.23
100	74.01	41.91
150	76.78	42.51
200	78.63	42.81
250	80.07	43.00

BEEMATS – FLOATING WETLAND MATS



LID BMP - RAINWATER HARVESTING

WHAT? Capturing roof runoff for non-potable uses, such as irrigation, car washing, toilet flushing, and potable uses.

WHY?

1. To capture and use valuable freshwater resource
2. To reduce volume of stormwater discharged off-site
3. Save and maintain groundwater.
4. Save and enhance vegetation
5. Reduce salt water intrusion.


Runoff Use
Consumption
Reduction
Save $100 / yr.
HOPKINS
6 16 '96

LID BMP - STORMWATER HARVESTING

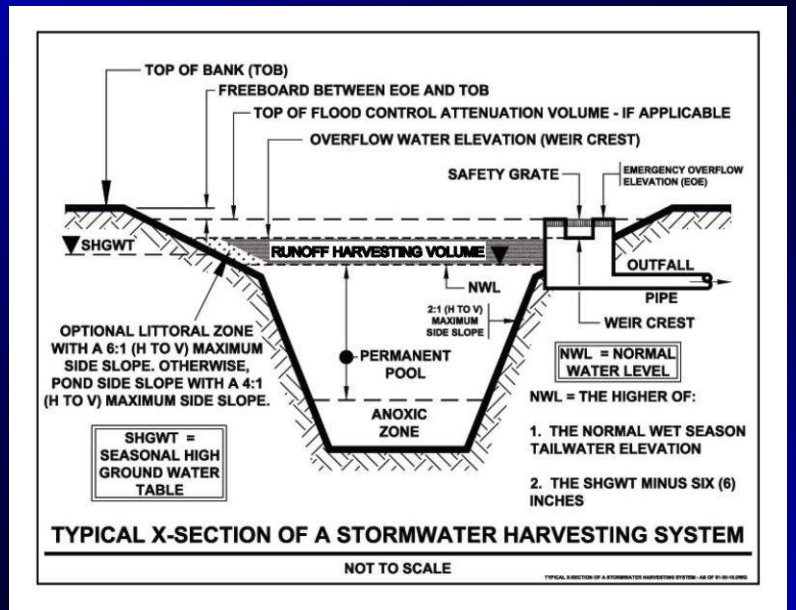
WHAT? Using retained or detained stormwater for non-potable uses, such as irrigation, car washing, toilet flushing, wet-land enhancement, etc.

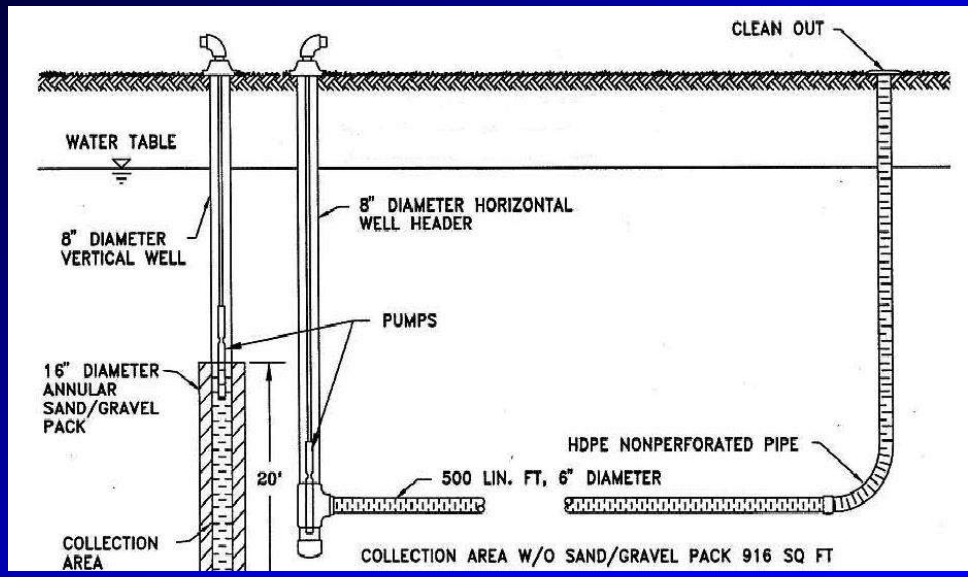
WHY?

1. To lower the cost of water supply.
2. Increase BMP effectiveness and reduce stormwater pollution into surface waters.
3. Save and maintain groundwater.
4. Save and enhance vegetation
5. Reduce salt water intrusion.

STORMWATER HARVESTING DESIGN CONSIDERATIONS

- Design with REV curves
- Determine EIA = C*A to get storage volume
- Must be pretreated = horizontal well or equiv
- Over 600 horizontal wells in Florida
- Determine irrigation schedule





South Bay Utilities Inc.

- Upscale residential
- Some Commercial
- No CUP
- No FPSC

- 50¢/1,000 gallons
- Shallow horizontal wells
- Customer agreements 900 homes - HOA

Schroeder Manatee Utilities, Inc.

- Approximately 32,000 acre service area
- Lower potable water requirements
- Exclusive service area

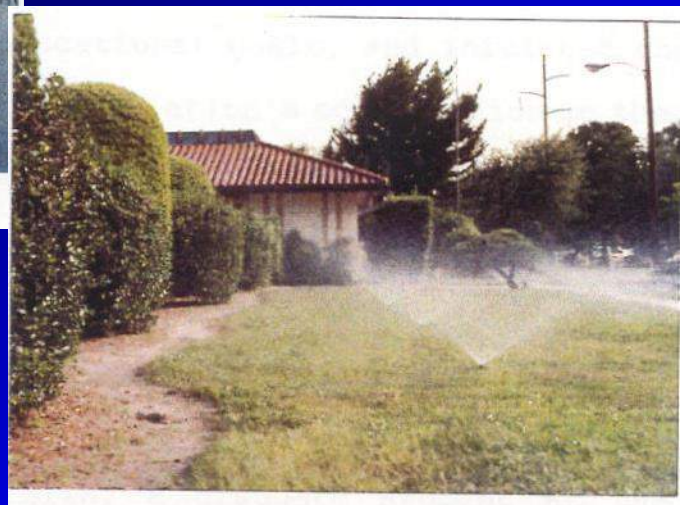
- 27¢/1,000 gallons - FPSC
- Horizontal wells, lakes, canals, shallow 4” wells
- Use of approximately 4 MGD

Project SMART - Winter Park Florida (retrofit)

COLLECTS RUNOFF WATER

Regional wet detention pond serving roadway and commercial property

CONTROLS POLLUTION



AND REUSES THE WATER

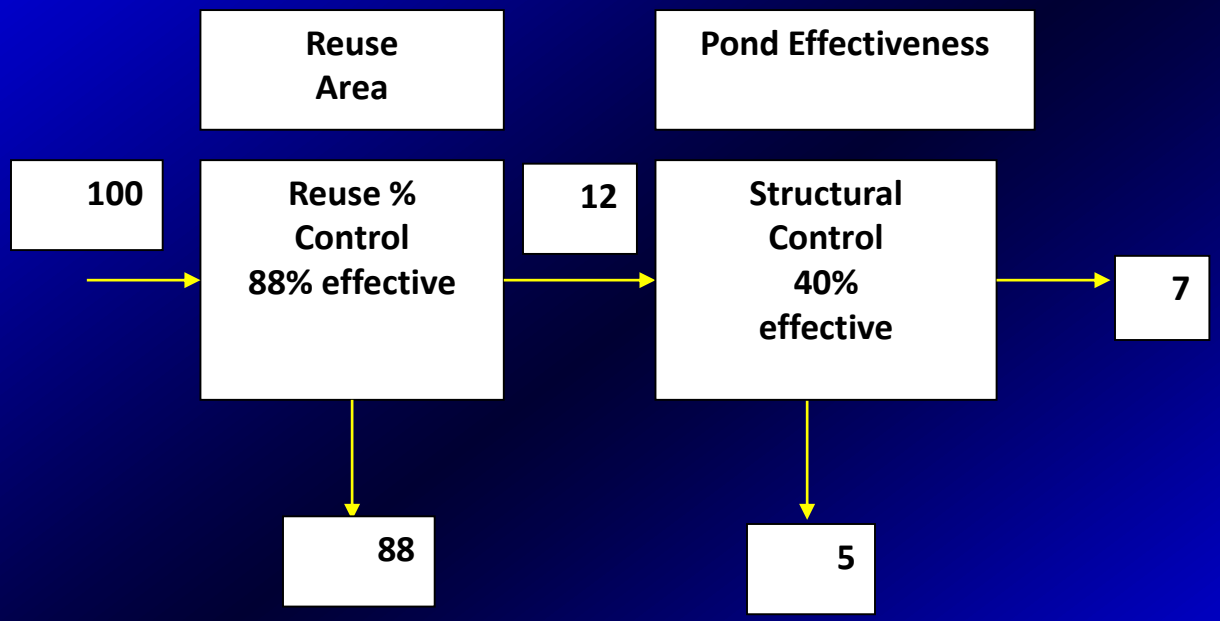
Water harvesting for irrigation of lawns
Community saved potable water
as well as money.

Golf Course and I-4 Stormwater Management Plan

- Plan – Provide water on golf course to improve the play and image of the course.
- FDOT – We got the water for you.
- WIN WIN FDOT and a high school gets stormwater plans, citizens get a real golf course.
- All get stormwater treatment and saving of potable water that would otherwise be used for irrigation.
- And oh yes, Wekiva is protected.

Enhanced Nitrogen Removal of a Detention Pond by Harvesting the Detained Water

- 88% of water not discharged: N mass removed is 100[1-{(1-.88)(1-.4)}] = 93%
- 88 acre-feet supplied to 48 acres (from 24 acres, 50 inch rain, @ 88%)
- @$2.00/1000 gallons, net revenue is about $1000/acre irrigated/year.*
- make up water is = Need – Harvested = 145.6 – 88 = 57.6 Acre-Feet.



*Assumes a production and delivery cost of about $0.45/1000 gallons

KEY POINTS

- The harvesting pond is considered as a supplemental water supply.
- Can be managed to benefit downstream and local users.
- Water use agreements are needed (supplemental supply).
- Must have a storage area (existing pond or new area) and storage can be underground.
- Since pumps are used, must maintain operating records using meters or flow time operation.
- Over 600 Systems have been designed and permitted in the State.

HOW TO DESIGN EFFECTIVE STORMWATER BMP TREATMENT TRAINS AND QUANTIFY LOAD REDUCTIONS

- Presumptive design criteria not useful for discharges to impaired water bodies
- Must be able to quantify the pre-development stormwater loadings
- Must be able to quantify the post-development stormwater loadings
- Must be able to quantify and demonstrate "net improvement"

BMPTRAINS MODEL

- Model developed in cooperation with DEP, WMDs
- Model is in the public domain
- Model incorporates the latest information relative to designing stormwater treatment systems in Florida:
  - Florida annual rainfall by zones
  - Statewide Event Mean Concentrations
  - Statewide stormwater BMP effectiveness data
  - Latest LID BMP effectiveness data
  - Stormwater LID BMP design criteria (developed for Statewide Stormwater Rule and refined)

Water is the lifeblood of Florida


County Public Library