WHEN AND WHY HIGHER LEVELS OF STORMWATER TREATMENT ARE REQUIRED AND HOW TO ACHIEVE THEM

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WATERSHED MANAGEMENT SERVICES, LLC

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

- Performance Standard
- BMP Design Criteria
- Presumption of compliance
- Updating of BMP Design Criteria

PERFORMANCE STANDARD FOR NEW STORMWATER DISCHARGES (62-40.432, FAC)

Stormwater quality – Original Rule

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

"Of Total Suspended Solids"

Stormwater quality – 1990

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

"Of pollutants that cause or contribute"

BUT RULES WERE NEVER UPDATED

Evaluation of Current Stormwater Design Criteria within the State of Florida

Final Report

Prepared for:

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

FDEP Contract No. SO108

June 2007

Prepared By:

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DESIGN CRITERIA PRESUMPTION REBUTTED!

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 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
- Net improvement = antidegradation

Discharges to Impaired Waters

- Must meet “net improvement” standard
- Must demonstrate load reduction achieved

IMPAIRED WATERS IN FLORIDA

- 2,776 spreadsheet lines of water bodies in cumulative FDEP 303(d) list!
- Most common impairments are nutrients, DO and fecal coliforms

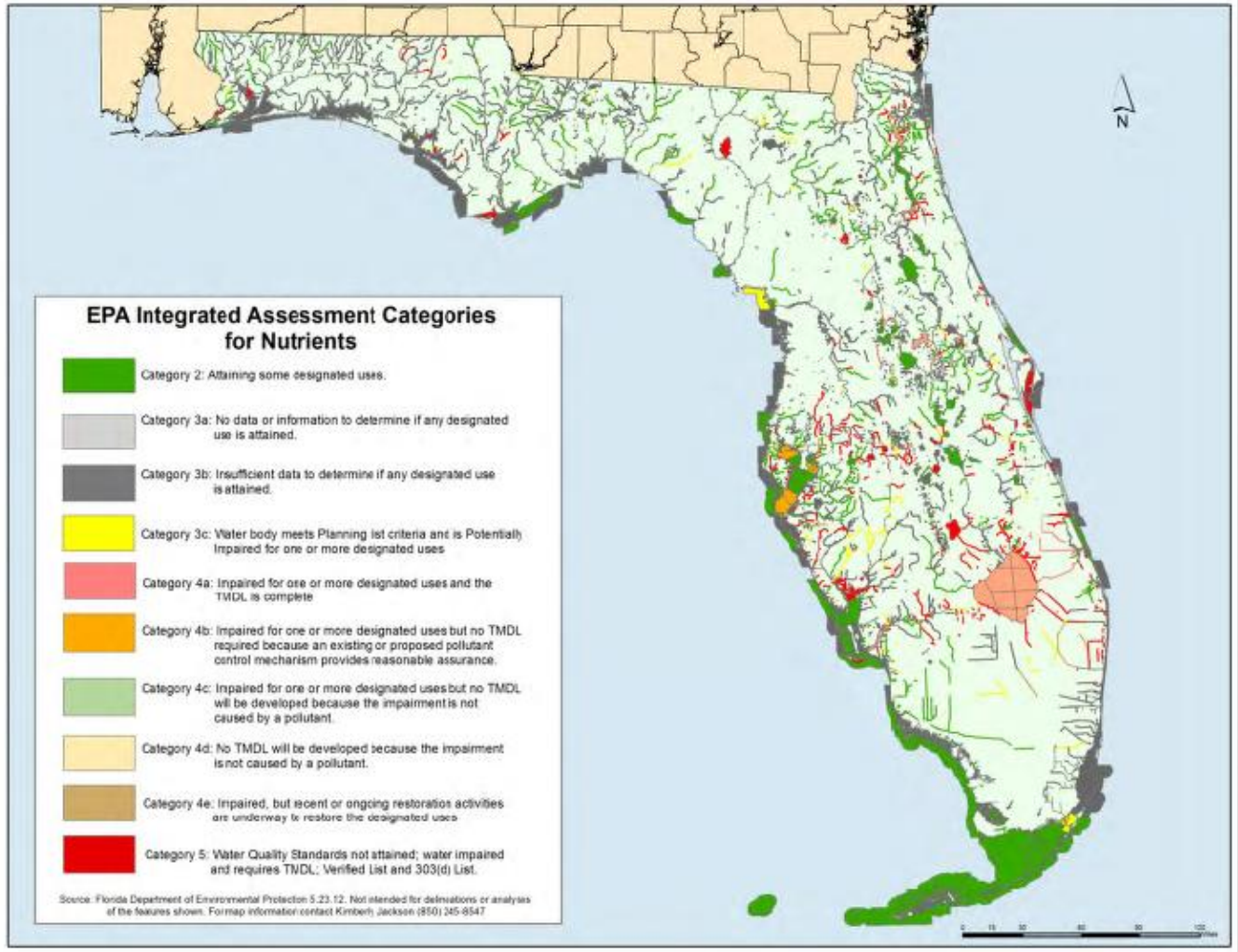


Table 8.3a. Miles of Rivers/Streams Impaired by Cause

able. Column 1 lists the parameter assessed, Column 2 lists the number of impaired wa lists the total miles impaired.

Parameter Assessed	*Number Impaired*	*Miles Impaired*
DO	699	5,975
Fecal Coliform	338	2,685
Mercury (in fish tissue)	249	2,903
Nutrients (chlorophyll *a*)	153	1,014
Biology	36	320
Nutrients (other than chlorophyll *a*)	28	18
Iron	17	314
Lead	14	123
Specific Conductance	10	111
Bacteria (shellfish harvesting classification)	10	82
Turbidity	10	83
Un-ionized Ammonia	7	69
TP	6	76
Biochemical Oxygen Demand	2	21
Copper	2	3
TDS	2	6
Silver	1	6
Chloride	1	0
Dioxin	1	2
TSS	1	3

IMPAIRED WATERS IN FLORIDA

Table 8.3b. Square Miles of Lakes Impaired by Cause

e. Column 1 lists the parameter assessed, Column 2 lists the number of impaired lists the total square miles impaired.

Parameter Assessed	*Number Impaired*	*Square Miles Impaired*
Mercury (in fish tissue)	127	1,344
DO	112	280
Nutrients (TSI)	36	107
Fecal Coliform	11	15
Iron	7	526
Lead	5	7
pH	4	308
Un-ionized Ammonia	3	4
Copper	2	19
Turbidity	2	1
Silver	1	12
Nutrients (other than TSI)	1	0
Thallium	1	6

Table 8.3c. Square Miles of Estuaries Impaired by Cause

nn table. Column 1 lists the parameter assessed, Column 2 lists the number of impaired wateri lists the total square miles impaired.

Parameter Assessed	*Number Impaired*	*Square Miles Impaired*
Mercury (in fish tissue)	504	5,163
DO	151	1,198
Fecal Coliform	99	896
Nutrients (chlorophyll *a*)	92	678
Bacteria (shellfish harvesting classification)	76	1,084
Copper	28	378
Iron	18	162
Nutrients (other than chlorophyll *a*)	13	76
Lead	4	29
Biochemical Oxygen Demand	1	38
Turbidity	1	11

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

NOTE: DEP HAS REVISED MAP DIRECT. HOW TO IS FOR REVISED SYSTEM

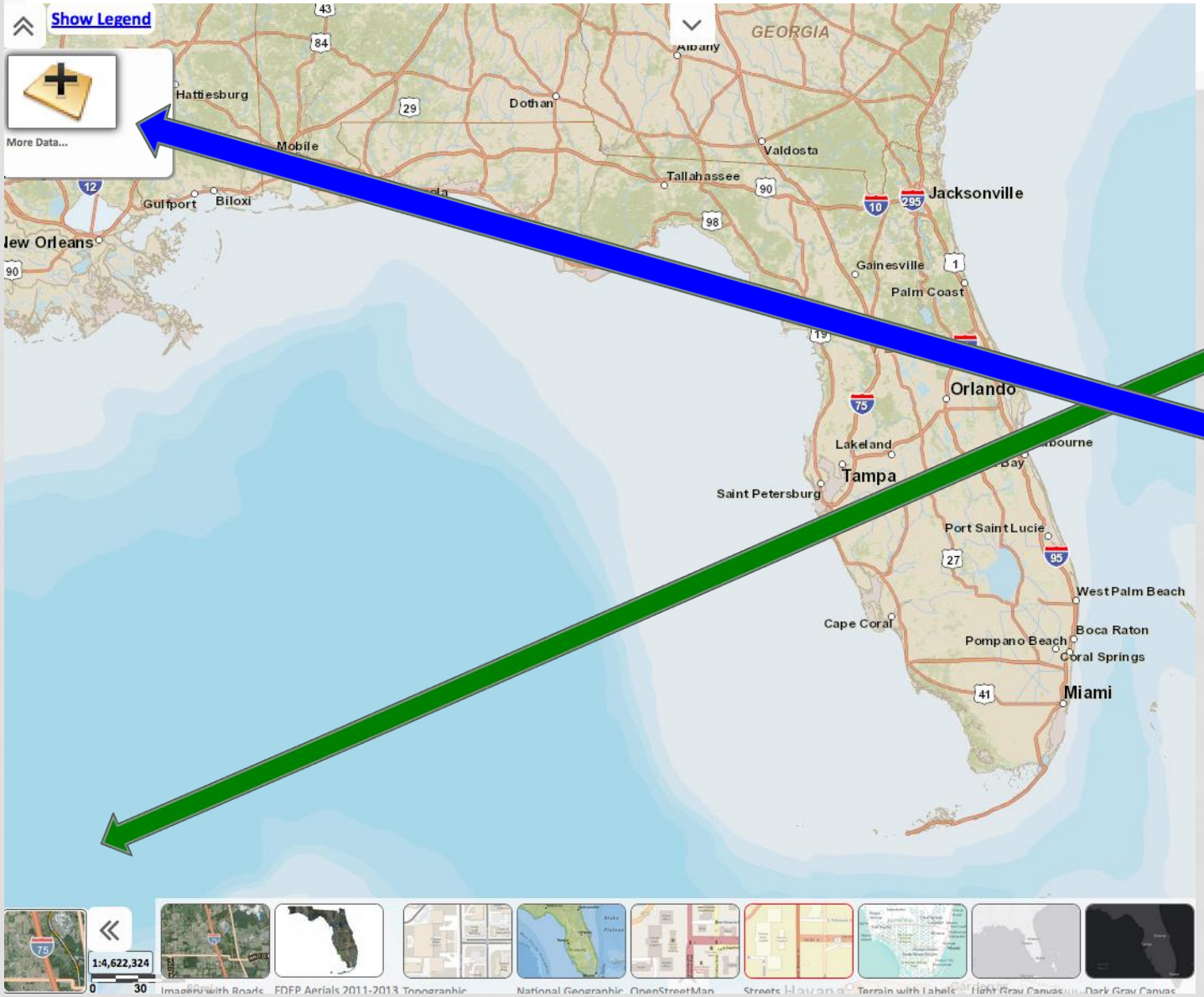
- Use **DEP's TMDL Tracker** system to see if a TMDL is adopted, or check 62-304, F.A.C.
- Use **EPA's Ask Waters** system

DEP MAP DIRECT SYSTEM

HTTP://CA.DEP.STATE.FL.US/MAPDIRECT

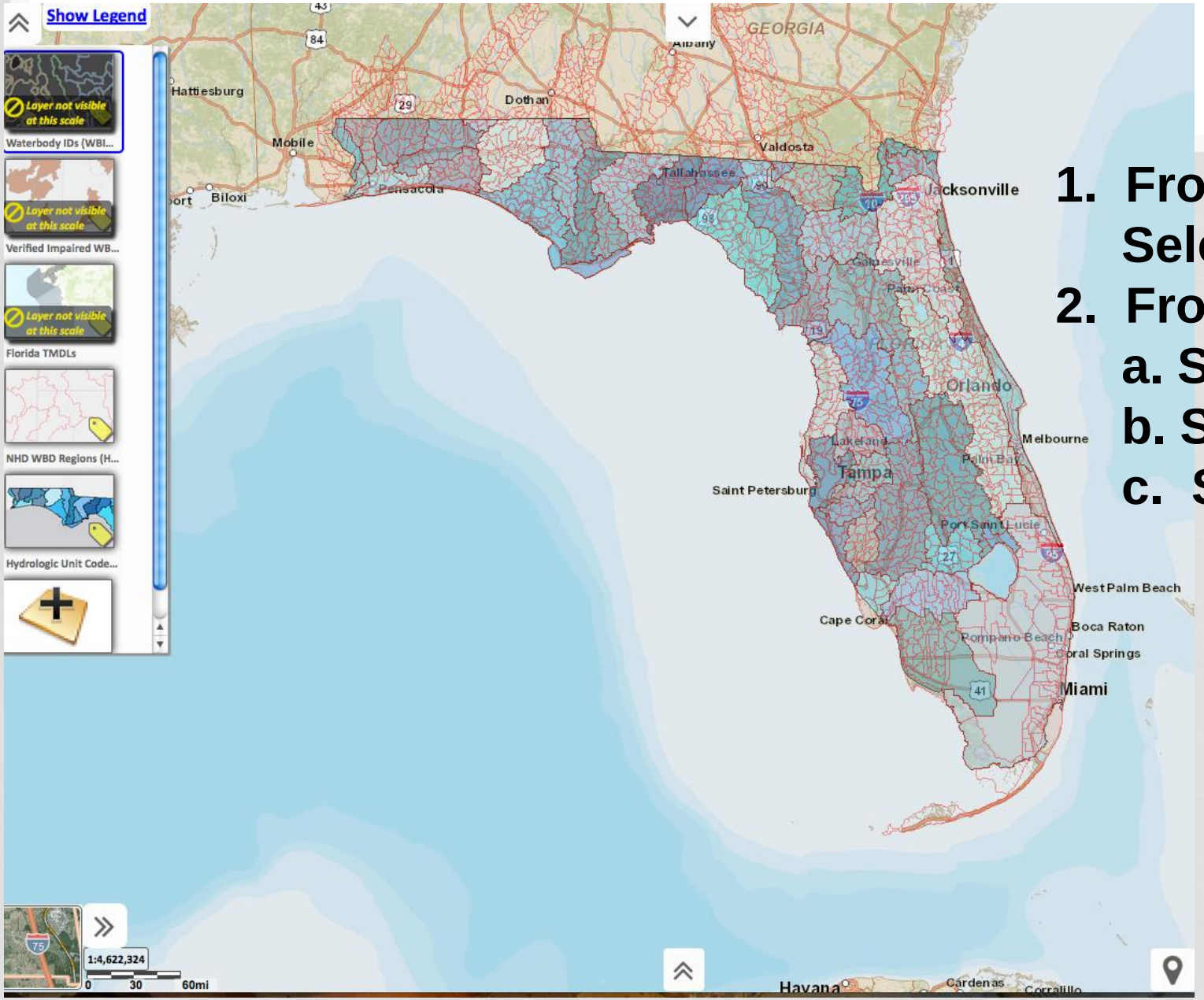
Click This Map

SELECT BASEMAP AND DATA LAYERS



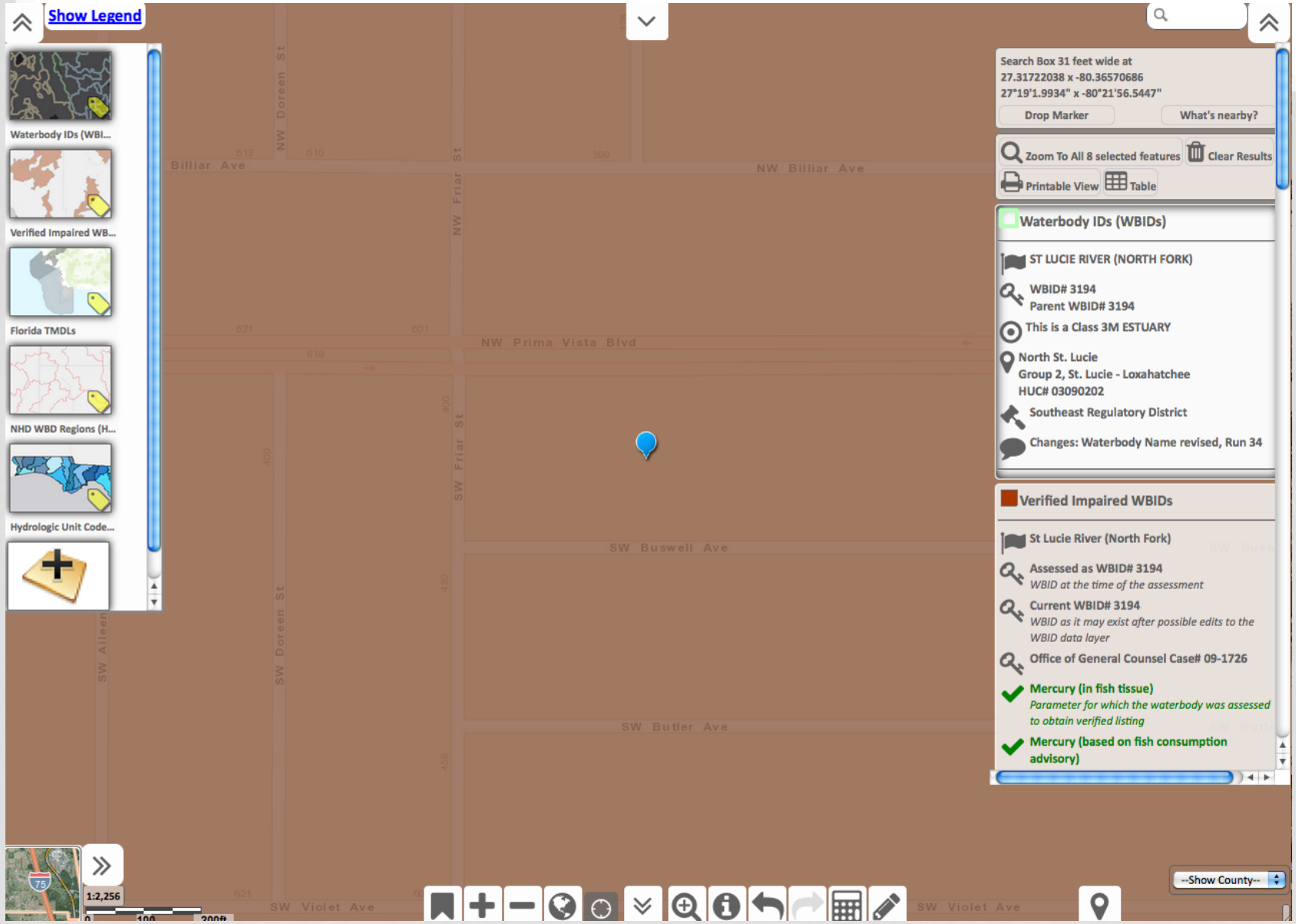
1. Select Basemap from options at arrow in left bottom of map
2. Open Data Layers by clicking on arrow at upper left of map, and then on + More Data

MAP DIRECT - SELECT DATA LAYERS



1. From NHD Data Layer
   Select HUC 12 sub-watershed
2. From Watershed Assessment
   a. Select Verified Impaired WBIDs
   b. Select Florida TMDLs
   c. Select WBIDs

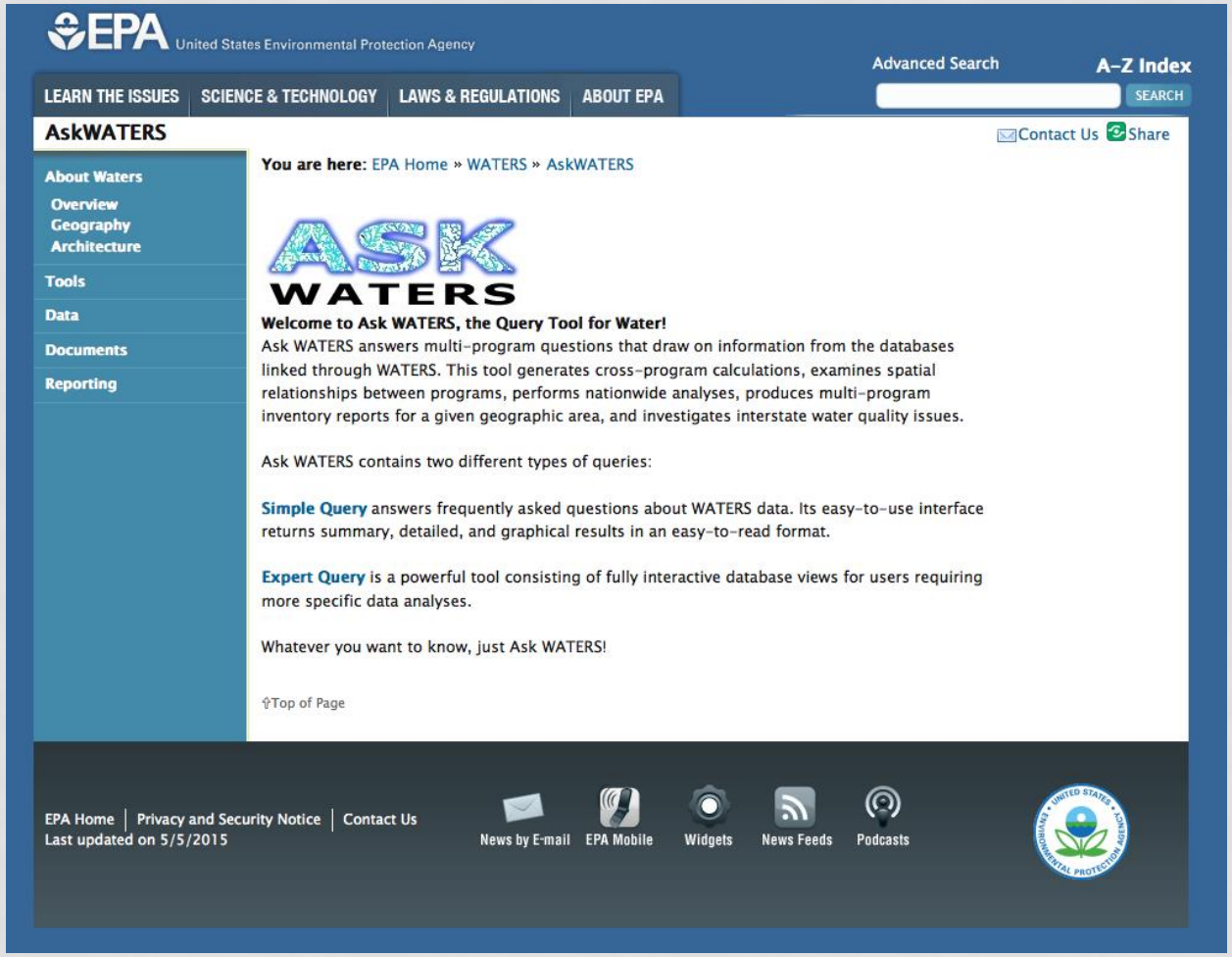
MAP DIRECT – ENTER ADDRESS, WQ RESULTS



1. Be sure desired data layers are turned “on”
2. Enter address into search box in upper right hand corner
3. Results for each data layer will be shown

EPA ASK WATERS WEB SITE

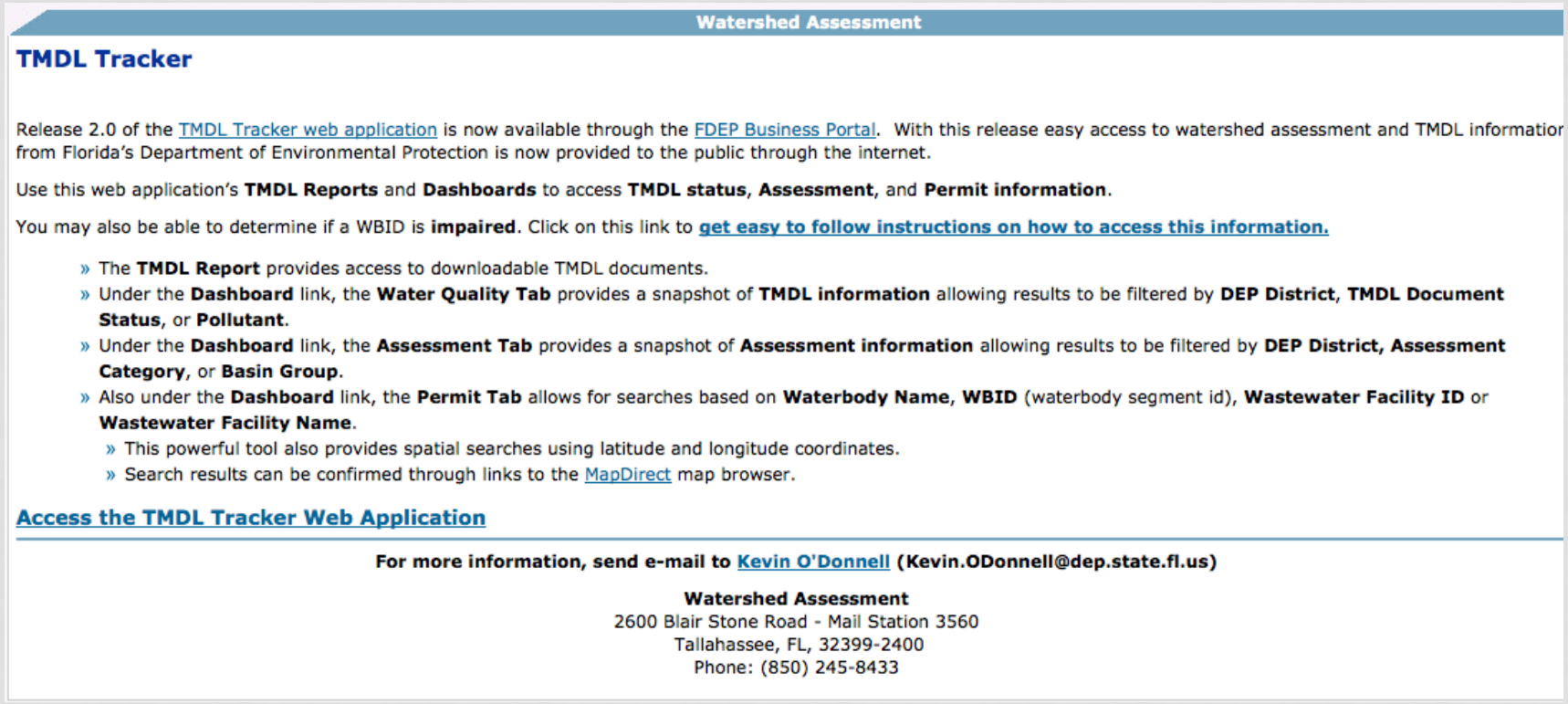
http://iaspub.epa.gov/apex/waters/f?p=ASKWATERS: MAIN_MENU



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

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.

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

NET IMPROVEMENT = VERY HIGH LEVEL OF STORMWATER 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** include 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

Florida EMC data base – June 2013

AWT wastewater

TN = 3mg/l

TP = 1 mg/l

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						

INSIDE BMPTRAINS: UNDERSTANDING THE UNDERLYING DATA AND ASSUMPTIONS

1. How do I determine what land use type I have?
   - What is the natural vegetative community?
   - One giving highest pre-development load?
   - One giving lowest post-development load?
   - One the EMCs are based on?
2. How do I calculate a weighted EMC?
   Dr. Hardin will show us later
3. BMP design criteria and effectiveness?

TABLE 4-1

GENERAL LAND USE CATEGORIES
FOR RUNOFF CHARACTERIZATION DATA

GENERAL CATEGORY	DESCRIPTION
Low-Density Residential	Rural areas with lot sizes greater than 1 acre or less than one dwelling unit per acre; internal roadways associated with the homes are also included
Single-Family Residential	Typical detached home community with lot sizes generally less than 1 acre and dwelling densities greater than one dwelling unit per acre; duplexes constructed on one-third to one-half acre lots are also included in this category; internal roadways associated with the homes are also included
Multi-Family Residential	Residential land use consisting primarily of apartments, condominiums, and cluster-homes; internal roadways associated with the homes are also included
Low-Intensity Commercial	Areas which receive only a moderate amount of traffic volume where cars are parked during the day for extended periods of time; these areas include universities, schools, professional office sites, and small shopping centers; internal roadways associated with the development are also included
High-Intensity Commercial	Land use consisting of commercial areas with high levels of traffic volume and constant traffic moving in and out of the area; includes downtown areas, commercial sites, regional malls, and associated parking lots; internal roadways associated with the development are also included
Industrial	Land uses include manufacturing, shipping and transportation services, sewage treatment facilities, water supply plants, and solid waste disposal; internal roadways associated with the development are also included
Highway	Includes major road systems, such as interstate highways and major arteries and thoroughfares; roadway areas associated with residential, commercial, and industrial land use categories are already included in loading rates for these categories
Agriculture	Includes cattle, grazing, row crops, citrus, and related activities
Open/ Undeveloped	Includes open space, barren land, undeveloped land which may be occupied by native vegetation, rangeland, and power lines; this land does not include golf course areas which are heavily fertilized and managed; golf course areas have runoff characteristics most similar to single-family residential areas
Mining/ Extractive	Includes a wide variety of mining activities for resources such as phosphate, sand, gravel, clay, shell, etc.
Wetlands	Include a wide range of diverse wetland types, such as hardwood wetlands, cypress stands, grassed wetlands, freshwater marsh, and mixed wetland associations
Open Water/ Lakes	Land use consists of open water and lakes, rivers, reservoirs, and other open waterbodies

INSIDE BMPTRAINS: UNDERSTANDING THE UNDERLYING DATA AND ASSUMPTIONS

- Land use EMCs are from Florida EMC data base
- Dr. Harper maintains data base
- Table 4-1 2007 ERD report to DEP describes the land uses for which EMCs are included
- Open/Undeveloped data base expanded. Can use site specific or overall mean EMC

INSIDE BMPTRAINS: UNDERSTANDING THE UNDERLYING DATA AND ASSUMPTIONS

3. BMP design criteria and effectiveness?

- Most of BMPs in BMPTRAINS are new, LID BMPs
- BMP design criteria from 2010 Statewide Stormwater Treatment draft Applicant Handbook plus refinements based on new data/experience
- Not in current ERP Applicant Handbooks
- Even retention BMPs have different treatment volumes
- BMP effectiveness is based monitoring data or long term modeling

INSIDE BMPTRAINS: UNDERSTANDING THE UNDERLYING DATA AND ASSUMPTIONS

BMP Design and Effectiveness Example – Stormwater Harvesting Systems

- Effectiveness based on 1991 report “Design Curves for the Reuse of Stormwater” – convert wet detention to partial retention system
- Assumes irrigate twice/week, not after rain
- Must reduce efficiency if irrigate contributing DA
- More than just a pvc pipe and pump!
- Different control structure, horizontal well or sand filter, pumps, flow meters, irrigation system, record keeping to verify “retention volume”

HOW DO WE REDUCE STORMWATER LOADING?

- Reduce stormwater pollutant concentrations
- Reduce stormwater volume

- Better site design – integrate stormwater into site
- Minimize imperviousness, especially DCIA
- Reduce pollutants using source controls including public education
- BMP Treatment Train with nonstructural and structural stormwater BMPs

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

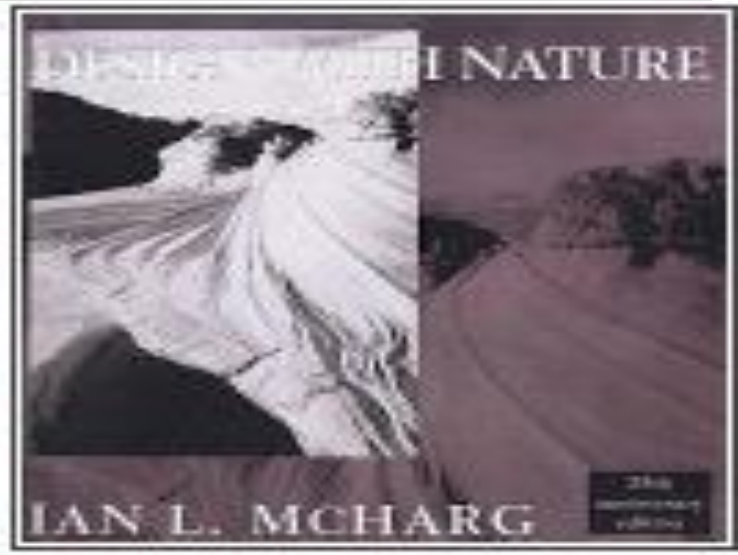
WHAT LOW IMPACT DEVELOPMENT IS NOT

LID is NOT a silver bullet solution to all stormwater problems

- Additional nonstructural and structural tools in the BMP tool box
- Infiltration BMPs don't work throughout Florida

LID is NOT a new idea

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



WHY LID?
ADDED BMPS IN YOUR 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 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 design
  - Florida-friendly fertilizers
  - Proper use of reclaimed water
  - Pet waste pick up and disposal

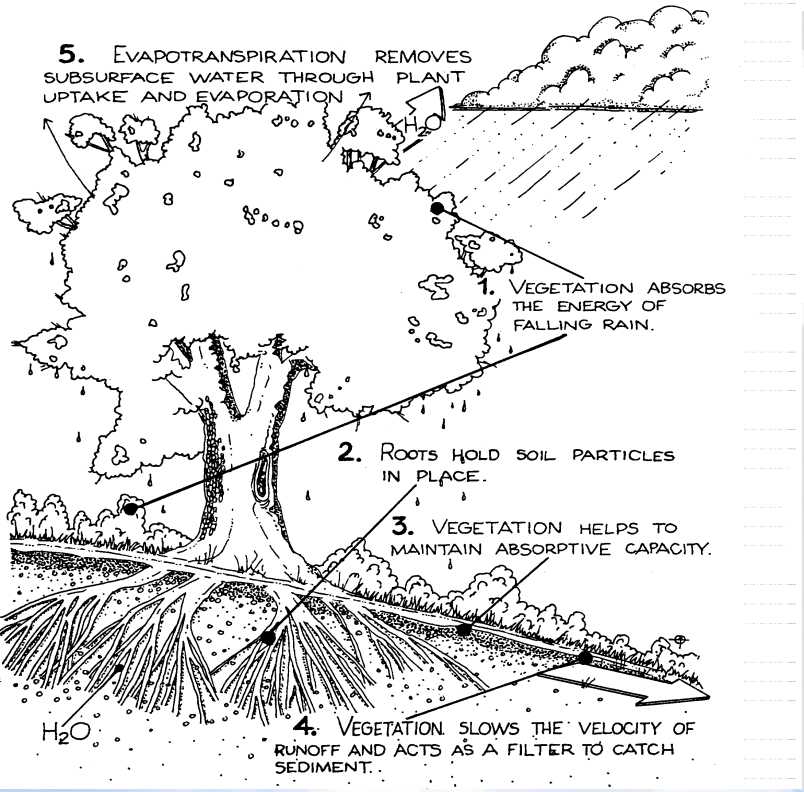
LAND CLEARING, VEGETATION REMOVAL AND SOIL COMPACTION

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 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 MORE DATA AND SITES!

TREES ARE STORMWATER BMPS!

American Forests (www.americanforests.org)

City of Jacksonville Land Cover***	1992 Acres	2002 Acres	% Change of landcover type
Forest/woody wetlands	234,262.4	205,320.0	-12.4%
Open Space	48,692.9	59,825.0	22.9%
Developed Area	150,869.8	175,685.3	16.4%
Open Wetlands	49,745.5	45,816.7	-7.9%
Water	56,772.9	55,787.0	-1.7%

	Forest/ Woody Wetlands (acres)	Stormwater Management Value (cu.ft.)	Stormwater Management Value** ($)	Air Pollution Annual Removal Value (lbs.)	Air Pollution Annual Removal Value ($)
City of Jacksonville 1992	234,262	984 million	$1.97 billion	22.3 million	$55.4 million
City of Jacksonville 2002	205,320	928 million	$1.86 billion	19.6 million	$48.5 million
Change	-12.4%	-56 million	-113 million	-2.76 million	-6.84 million

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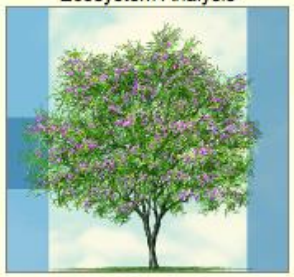
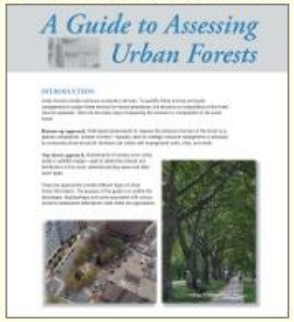
Desert Canopy Ecosystem Analysis



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/

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

Land Development Codes must be revised

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)

NDCIA CN	Percent DCIA																				
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
30	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	0.823
35	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	0.823
40	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	0.823
45	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	0.823
50	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	0.823
55	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	0.823
60	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	0.823
65	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	0.823
70	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	0.823
75	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	0.823
80	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	0.823
85	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	0.823
90	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	0.823
95	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	0.823
98	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	0.823

Agriculture land use (pasture) - No DCIA, CN for D soils = 90 C = .266

SF residential land use

¼ acre lots - DCIA = 40%, CN for lawns, D soils = 85 C = .701

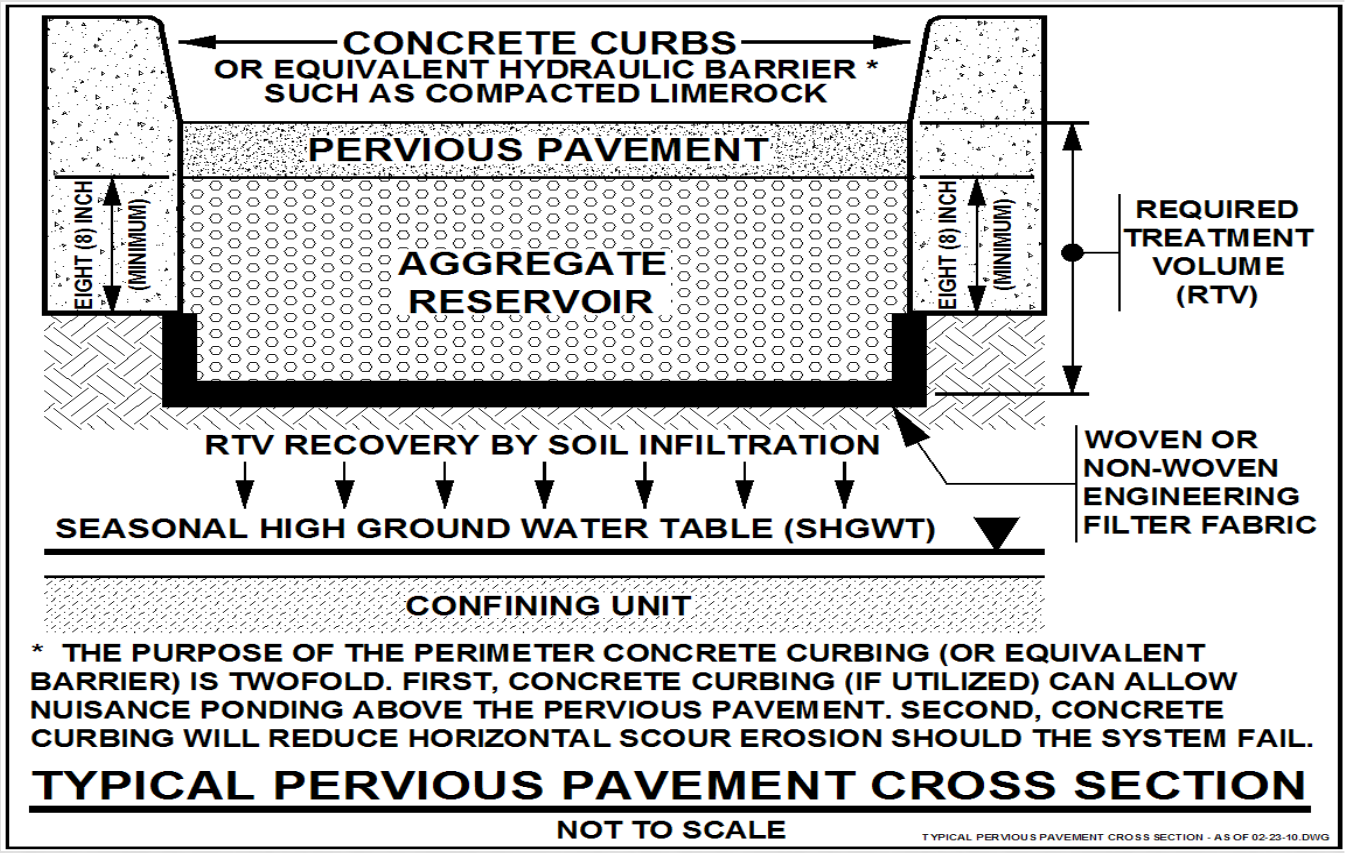
REDUCING PARKING LOT IMPERVIOUSNESS AND DCIA

RECESSED ROAD MEDIANS AS BMPs

DISCONNECTING DIRECTLY CONNECTED IMPERVIOUS AREAS (DCIA)

LID BMP = POROUS PAVEMENTS

- Pervious Concrete
- Flexi-pave™
- 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 to annual vacuum sweeping
- ERIK testing and recertification
- Signage to keep muddy vehicles off

EMBEDDED RING INFILTROMETER KIT (ERIK)

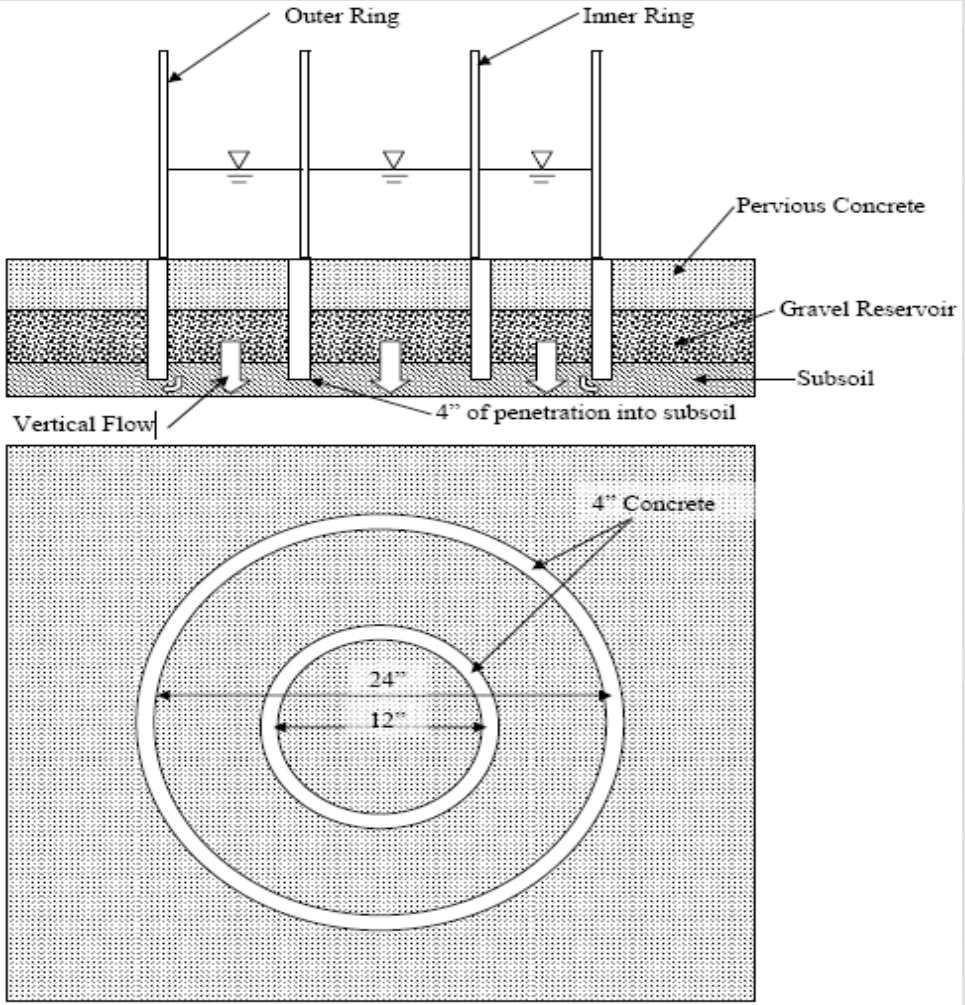


Figure 42: Design profile for Embedded Infiltrometer installation

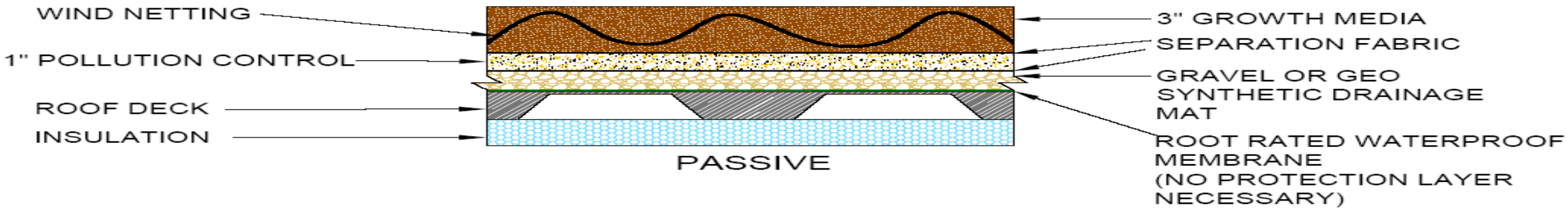
A single ring ERIK infiltrometer is acceptable provided that is embedded into the subsoil as shown in Figure 42.

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

PLACEMENT, STRIKING, PIZZA CUTTER AND 7 DAY CURING

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

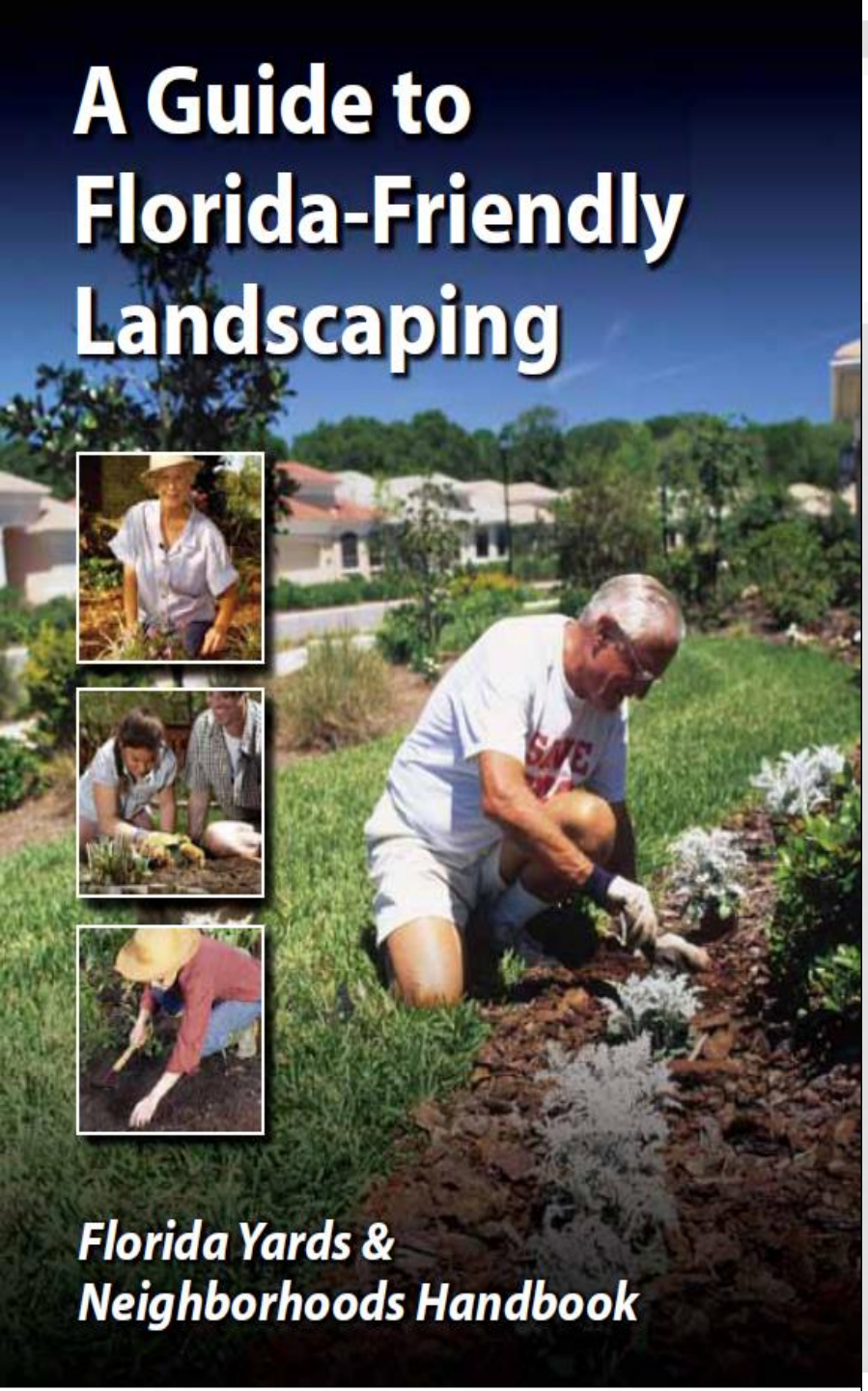
South Florida – 2003 – Bonita Bay Shadow Wood Preserve

August 2003

August 2007

Central Florida – 2005 – UCF Student Union

North Florida – 2011 – Escambia County One Stop Building



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 ($K_2 0$).....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 encouraged
- Maximum application rates
  - 0.25 lbs P/1000 sf per application
  - 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 and 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

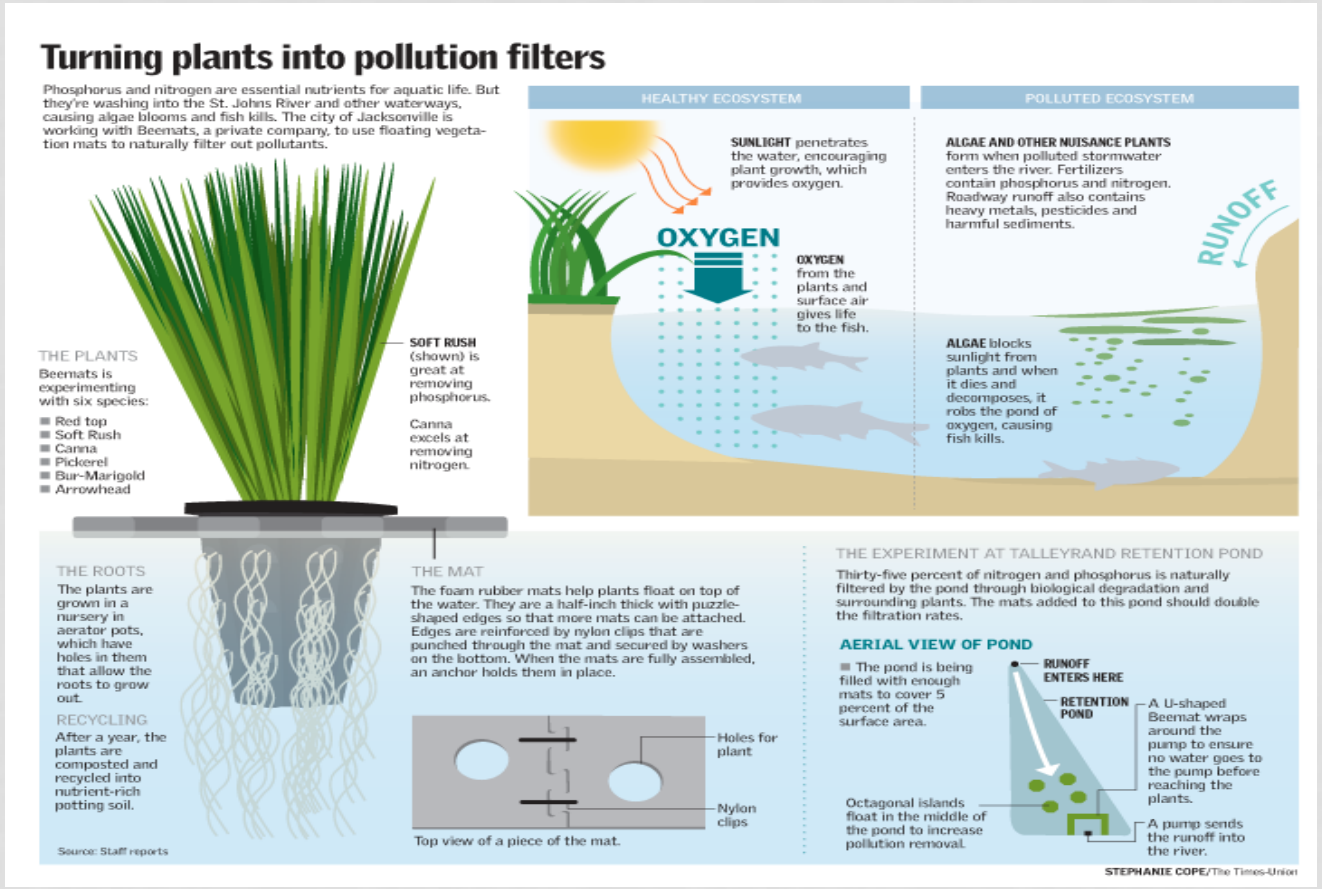
IMPROVING WET DETENTION NUTRIENT REMOVAL EFFECTIVENESS

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 - STORMWATER HARVESTING

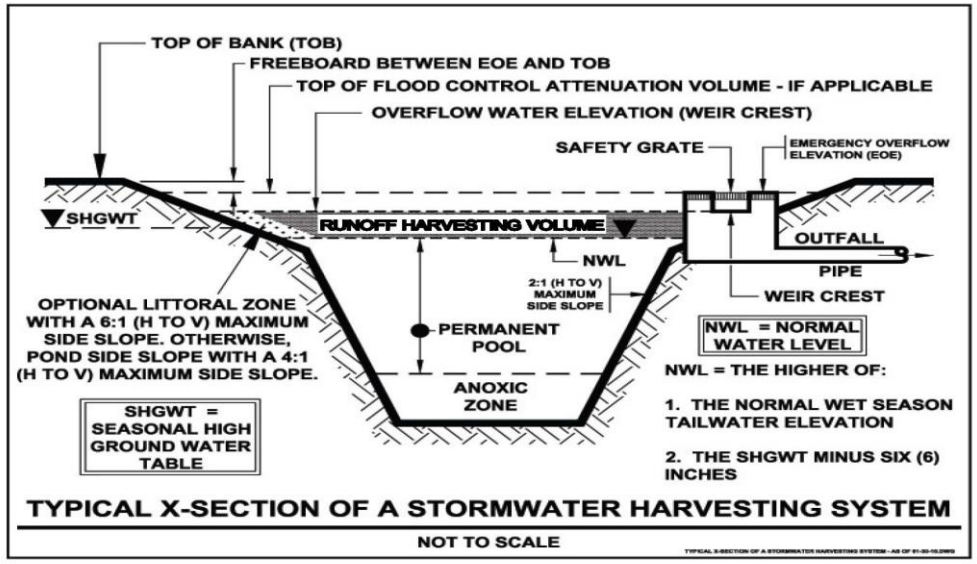
WHAT? Using retained or detained stormwater for non-potable uses, such as irrigation, car washing, toilet flushing, wet-land enhancement, etc.

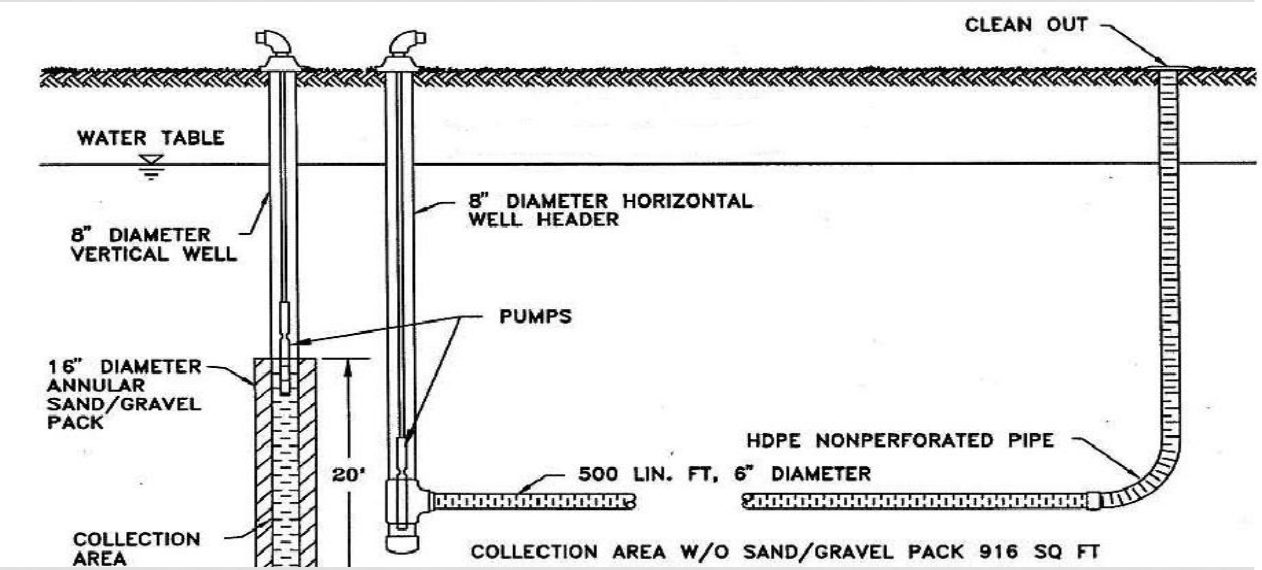
WHY?

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 700 horizontal wells in Florida
- Determine irrigation schedule





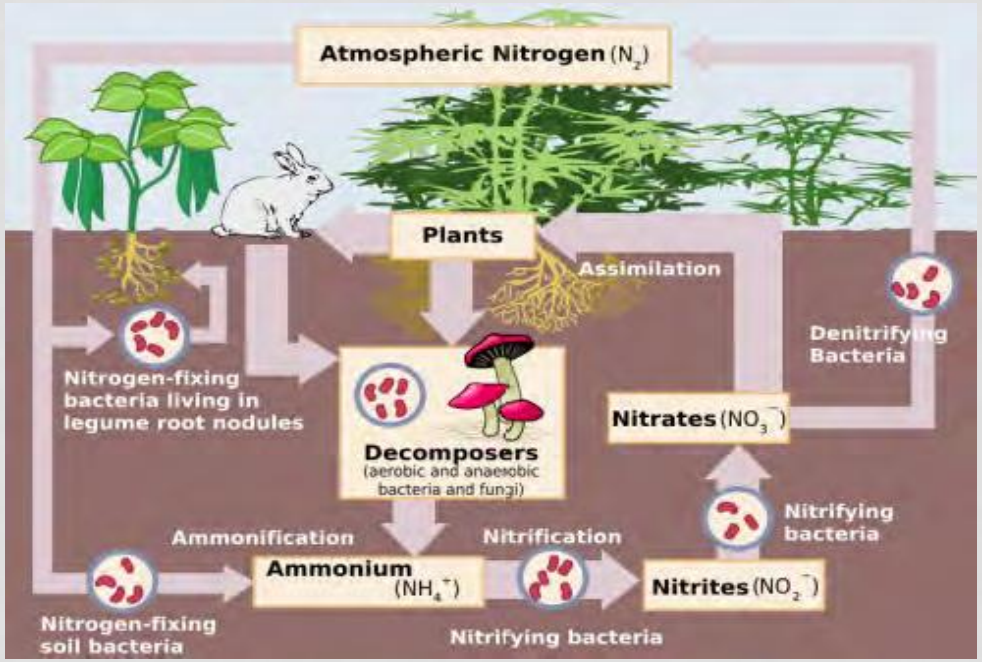
PROTECTING GROUND WATER IN SPRINGSHEDS WITH RETENTION BMPS

- Retention BMP load reduction effectiveness based on % of annual RO infiltrated
- ERP rules assume retention BMPs are 100% effective for surface water discharges
- Recent monitoring of retention BMPs in springsheds show they are source of Nitrate loading
- TN is converted into Nitrate, enters ground water

HOW MODIFY RETENTION BMPS TO REDUCE NITRATE LOADING TO GROUND WATER

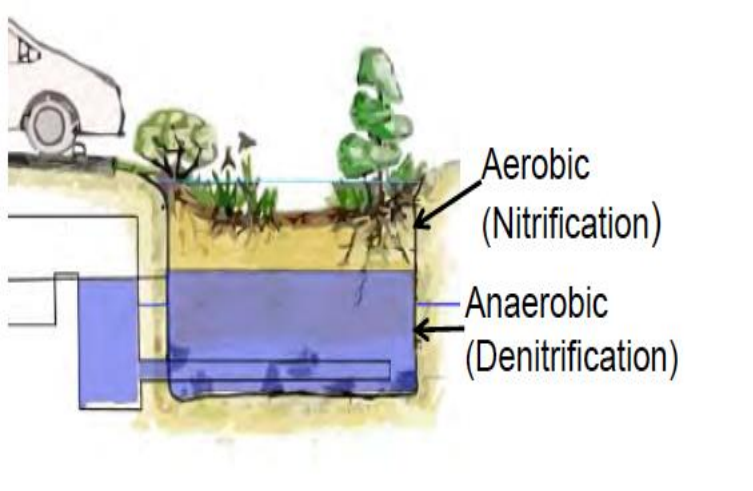
- **Soil characteristics are the key**

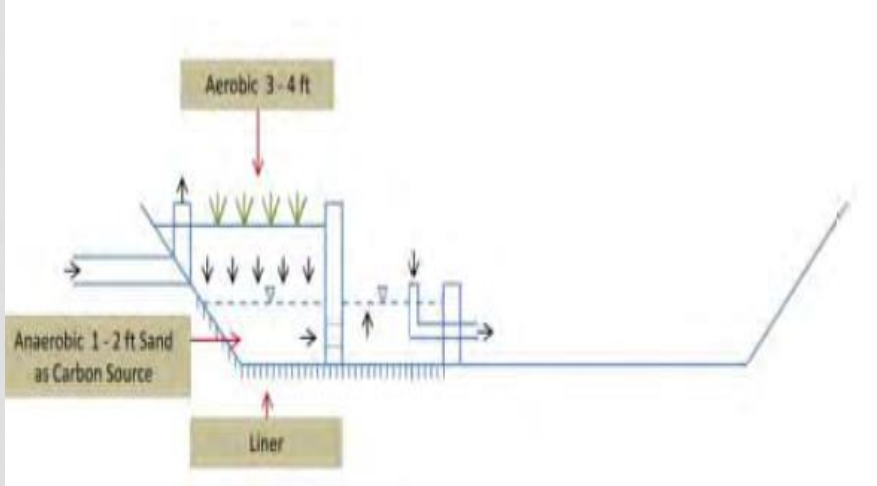
Hunters Trace (HT)	Parameter	South Oak (SO)
Lower	Water Table	Higher
Higher	Infiltration Rate	Lower
Lower	Clay soils	Higher
Lower	CEC	Higher
Higher	DO	Lower
Lower	Alkalinity	Higher
Lower	Organic Carbon	Higher
Higher	Nitrate	Lower
No	Nitrate Decline with Time	Yes



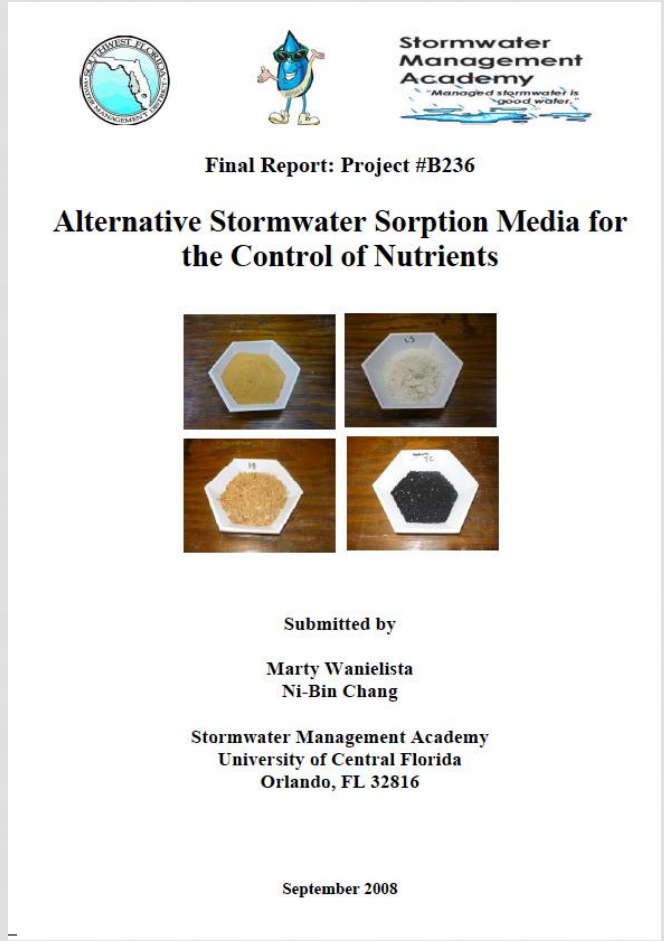
- **Need to activate the Nitrogen Cycle – TN – Ammonification – Nitrification – Denitrification**
- **Add Biosorption Activated Media (BAM) to slow infiltration rate**

BMPTRAINS AND USE OF BIOSORPTION ACTIVATED MEDIA IN RETENTION BMPS





- 1 foot thick BAM layer – reduce NOx 60%
- 2 feet = 70%
- Many types of BAM – see 2008 report
- Part of Rain Garden BMP in BMPTRAINS



Stormwater Management Academy

"Managed stormwater is good water."

Final Report: Project #B236

Alternative Stormwater Sorption Media for the Control of Nutrients

Submitted by

Marty Wanielista
Ni-Bin Chang

Stormwater Management Academy
University of Central Florida
Orlando, FL 32816

September 2008

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

- Current “presumptive BMP design criteria” do not achieve high level of treatment needed for discharges to impaired water bodies – need LID BMPs
- 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)

USE OF BMPTRAINS MODEL

- Evaluate whether a project is meeting Net Improvement
- Evaluate site planning/BMP treatment train options
- Evaluate load reduction of BMP treatment train options
- Used to evaluate ERP/BMP options for projects in Lee County, Pinellas County
- Used to evaluate BMP options for St. Joe Sector Plan in Bay County

4.8 acre redevelopment
Existing Land Use:
- **4 parcels commercial**
- **2 redeveloped in 1980s**

Nearly all impervious

How can you get 80% TP and 55% TN load reduction from stormwater?

Pinellas County Feasibility Studies

Seminole Center – Existing Conditions

Pinellas County, Florida

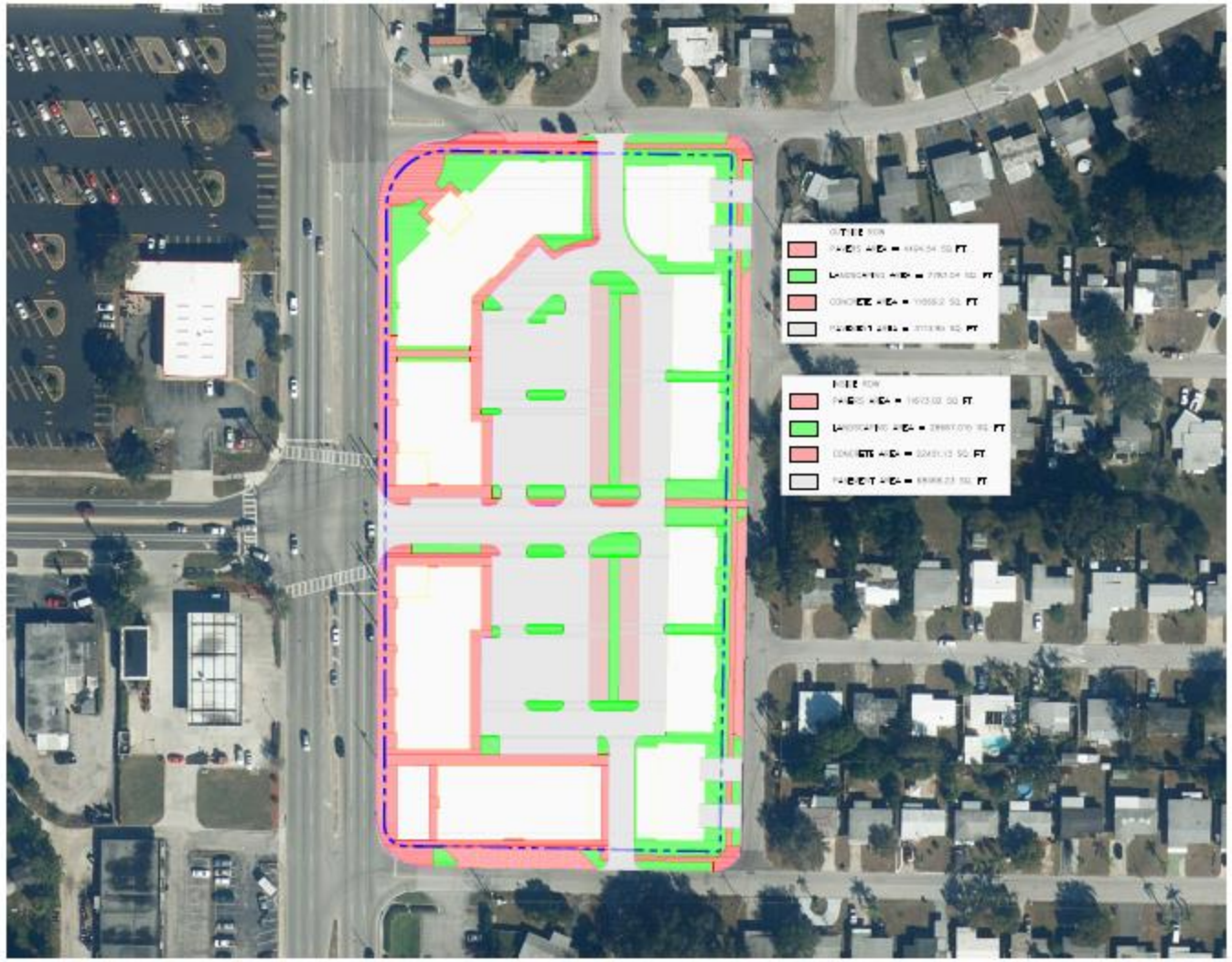
Cardno
Shaping the Future
CLEARWATER

Edit View Window Help

Open | 1 / 1 | 26.4% | Tools | Fill & Sign | Comm

Layers

- $SHT_LOGO
- 0
- C-BLDG
- C-BOUNDARY
- C-BRNG
- C-Curb
- C-CurbB
- C-FEAT
- C-PAVERS-L
- C-SIDEWALK
- C-TEXT
- C-WIPEOUT-L
- G-TITL-L
- G-TITL-LINE
- G-TITL-T
- P-Site Stats-L
- _AERIAL



Mixed Use redevelop
Stormwater treatment
BMP Treatment Train:

- **Pervious parking**
- **Retention Rain Gardens in recessed landscaping**
- **80 Tree Wells to infiltrate runoff**
- **8 Interceptor trees at impervious parking**
- **Florida-friendly landscaping**

Pinellas County Feasibility Studies

ole Center - Conceptual Redevelopment Plan

Pinellas County, Florida

34.00 x 22.00 in

Water is the lifeblood of Florida


Public Library