

Florida Department of Environmental Protection



3rd Tuesday Training

Stormwater and Permitting

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April 21, 2015





Some Notes About the Presenter

- Although I can be serious, I usually choose not to be
- I often use humor to emphasize points
- Unfortunately, I have a very rudimentary sense of humor
- I ~~sometimes~~ frequently exaggerate for comedic effect

Topics

- Why is Stormwater an Issue
- How is Stormwater Regulated?
- How is Stormwater Controlled?
- Special Case Stuff
- Basic Reference Materials and Random Thoughts





Is Stormwater a Problem?





Is Stormwater a Problem?

Reporting under Section 303(d) CWA:

States report to EPA that over 40% of assessed waters too polluted for fishing or swimming

Hundreds of impaired water segments in Florida due to stormwater



Total Number of Impaired Waters Reported: 29,007

Top 100 Impairments

NOTE: Click on the underlined "Impairments Reported" value to see a listing of those waters with the impairment. Click on the underlined "General Impairment" value to see a listing of those waters with the impairment.

General Impairment	Impairments Reported	Percent of Reported
PATHOGENS	7546	14.12
METALS	6562	12.28
NUTRIENTS	5343	10.00
SEDIMENT/SILTATION	5012	9.38
ORGANIC ENRICHMENT/LOW DO	4356	8.15
FISH CONSUMPTION ADVIS.	3173	5.94
PH	2671	5.00
OTHER HABITAT ALTERATIONS	2403	4.50
THERMAL MODIFICATIONS	2152	4.03
BIOLOGICAL CRITERIA	2116	3.96
FLOW ALTERATION	1464	2.74
PESTICIDES	1399	
TURBIDITY	1013	
SUSPENDED SOLIDS	957	1.79
SALINITY/TDS/CHLORIDES	929	1.74
CAUSE UNKNOWN	896	1.68
PCBS	794	1.49

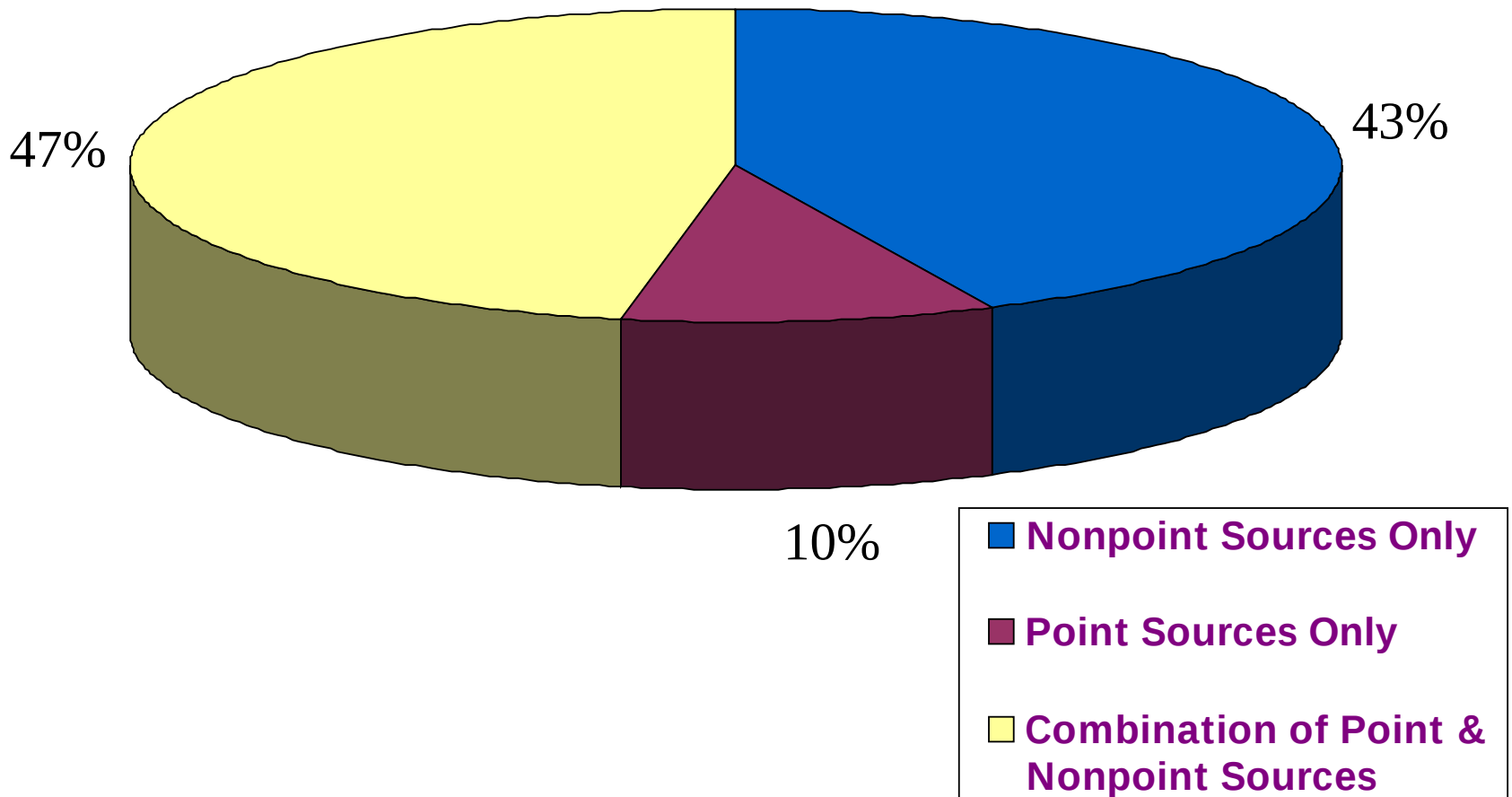
1. Pathogens

2. Metals

3. Nutrients

4. Sediment

Sources of Impairment by Category from the EPA 303(d) List





The Stormwater Problem

Humans cause:

- Changes in land use
- Development in floodplains
- Alteration of natural stormwater systems
- Compaction of soil, imperviousness
- “Drainage” systems
- Addition of pollutants

Resulting in:

- Decreased recharge
- Increased speed of runoff
- Increased volume of runoff
- Increased pollutants



Evolution of Stormwater Management

- Drainage



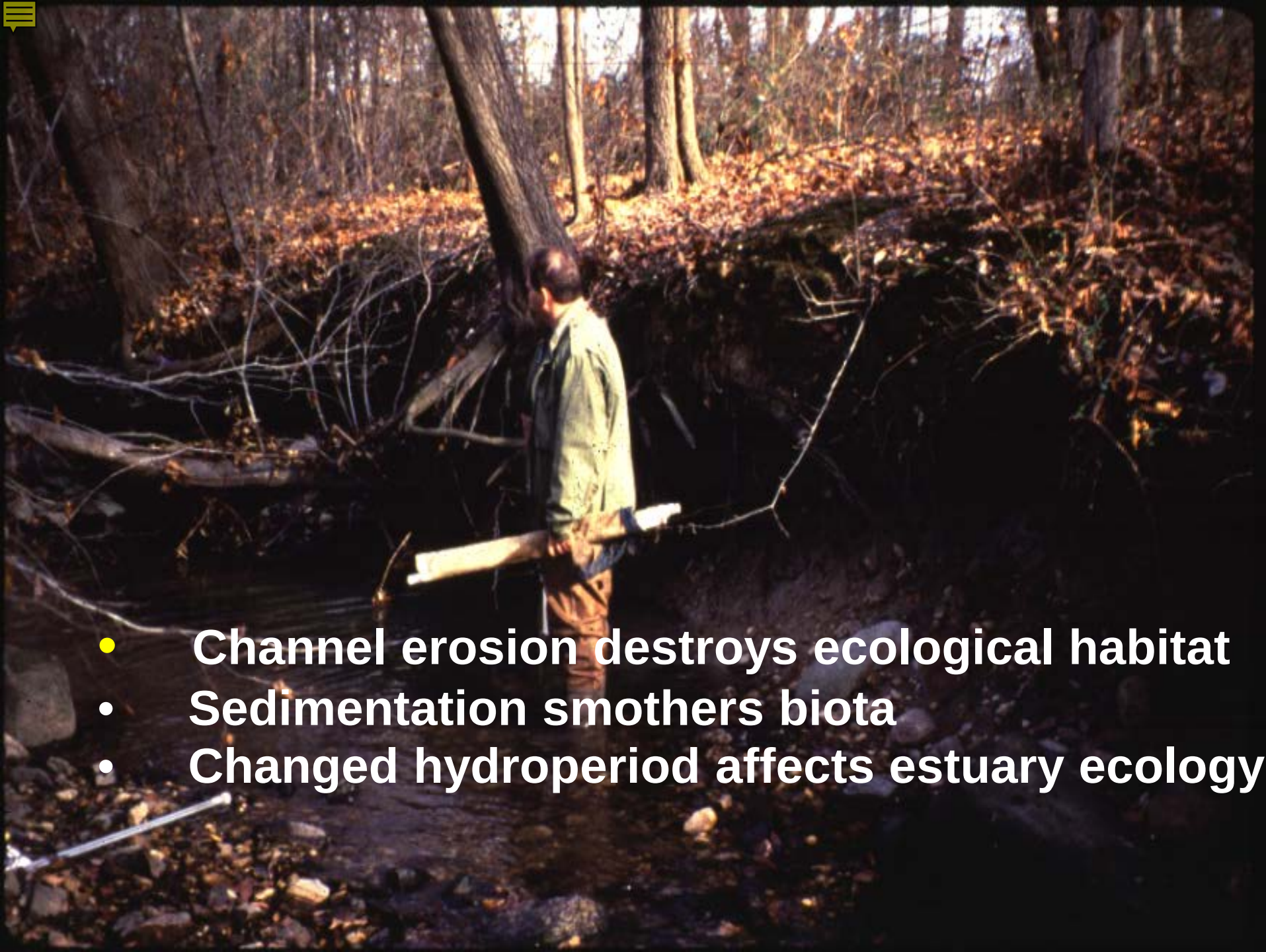
Evolution of Stormwater Management

- Water was the common enemy
- Minimal funding except for flood control
- Assimilative capacity > pollutant load
- People didn't understand, or care. Unless they got flooded!



Management Dictum

- Ditch to daylight
- Drain wetlands
- Limited science or data
- Limited flood management
- No environmental linkage



- **Channel erosion destroys ecological habitat**
- **Sedimentation smothers biota**
- **Changed hydroperiod affects estuary ecology**

Evolution of Stormwater Management

- Drainage
- Stormwater Treatment



Evolution of Stormwater Management

Stormwater is Polluted!

- >200,000 program sampling results
- Few federal resources or mandates
- Few states implemented programs
- Assimilative capacity $\leq$ pollutant load



Management Dictum

- Drainage still rules
- Increased science & data
- BMP development
- New environmental linkage



Evolution of Stormwater Management

- Drainage
- Stormwater Treatment
- Stormwater Retrofitting
- Watershed Management





Evolution of Stormwater Management

Paying for Past Sins

- Water is viewed as a critical resource
- Increased funding for conservation/WQ
- Assimilative capacity < pollutant load
- Protecting groundwater is an issue
- People begin to focus on water issues

Management Dictum

- Integrated watershed management
- TMDLs set to restore beneficial uses
- BMAPs adopted to meet TMDL goals
- Push for stormwater reuse
- Restore wetland/riparian buffers





Federal Regulatory Response

Federal - 1987 Clean Water Act Amendments

- Defined Certain Stormwater Discharges as “Point Source”
- **Stormwater Regulation under NPDES:**
 - Illicit Discharge Connections to Stormwater
 - Industrial Activities per SIC Code
 - Construction Activities (as subset of Industrial Discharges)





Florida's Regulatory Approach

- Stormwater is NOT a Point Source
- Cannot Regulate as if Stormwater Behaves as a Point-Source Waste Stream



Stormwater is Non-Steady State

- Variable Flow
- Variable Strength
- Monitoring is Snapshot at Best
- Permit Conditions for “Monitoring”
Not Really Feasible





Issues Affecting BMP Treatment Efficiency

- Antecedent Rainfall Period
- Rainfall Volume & Intensity
- Land Use & Soils
- Extremes in Climatic Conditions
- Hydraulics-Health of Biota
- Maintenance Frequency
- Activities within the Watershed





So...How Deal with Stormwater?

- Approach is “Best Management Practice-Based” with “Presumptive Criteria”
- Target is Removal of **80% Annual Average Load** of Post-Development Pollutants
- Also, **95% Removal** Target for OFWs
- ***Minimum*** Targets Codified in Chapter 62-40.432(2)(a), F.A.C.



Recent Legislation Confirms Presumptive Approach

Section 373.4131(3)(b):

(b) If a stormwater management system is designed in accordance with the stormwater treatment requirements and criteria adopted by the department or a water management district under this part, the system design is **presumed** not to cause or contribute to violations of applicable state water quality standards.

2012 Florida Legislature



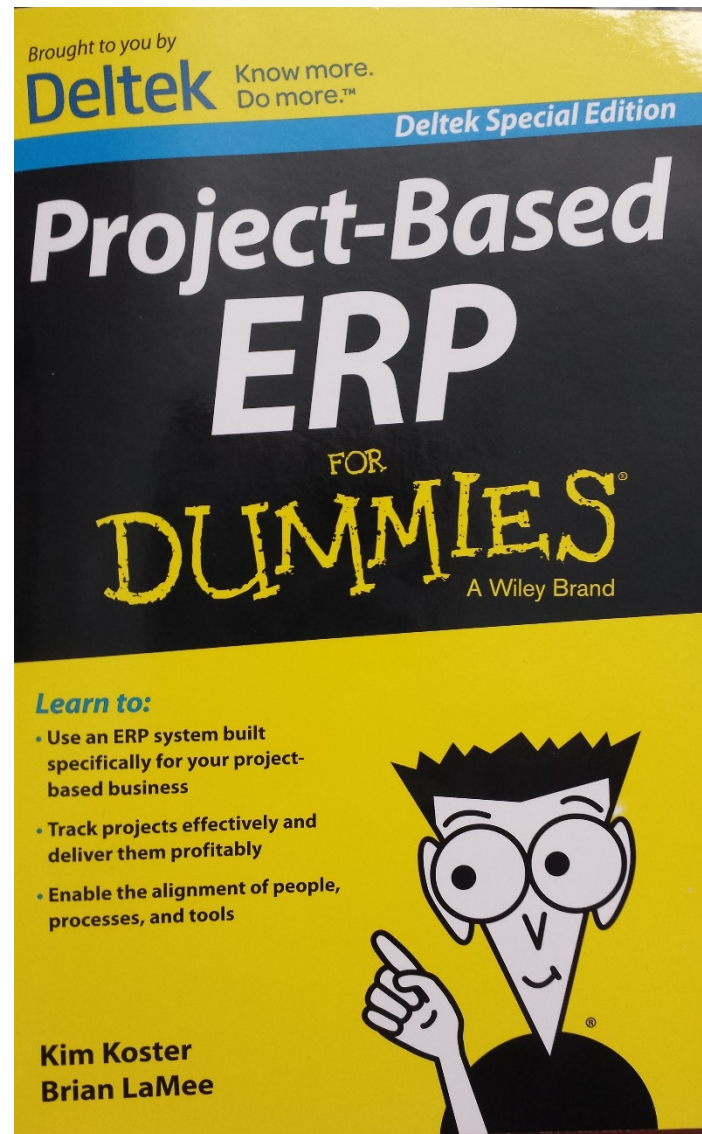
Florida's Regulatory Response

- 1978 Chapter 17- 4.248, F.A.C.
- 1982 Chapter 17- 25, F.A.C.
- 1994 Chapter 62- 25, F.A.C.
- 1994-6 Water Management District ERP rules
(except NWFWMMD)
- 2007 Chapter 62-346, F.A.C. NWFWMMD
Stormwater Rules
- 2010 Full ERP in Panhandle
- 2013 Chapter 62-330, F.A.C. Statewide ERP

Note: Statewide ERP did NOT significantly change stormwater rules



Working with Ch. 62-330, F.A.C.

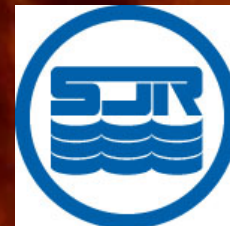


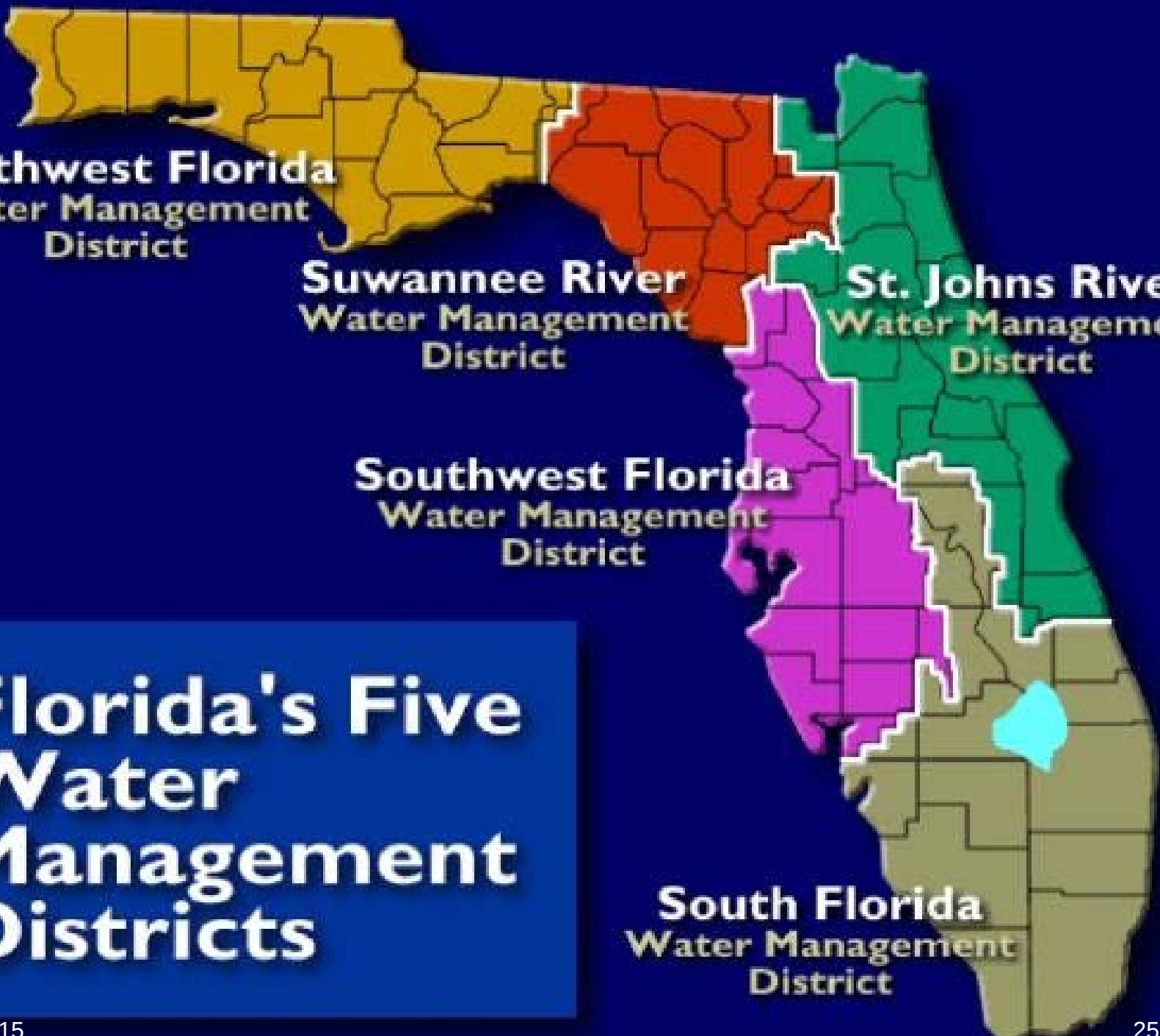
“One ~~Ring~~ Rule to Bind Them?”

Rule and AH I
(Admin and
Wetland Criteria)



AH II
(Stormwater
Criteria)





**Northwest Florida
Water Management
District**

**Suwannee River
Water Management
District**

**St. Johns River
Water Management
District**

**Southwest Florida
Water Management
District**

Florida's Five Water Management Districts

**South Florida
Water Management
District**



Operating Agreement – Why?

- One Rule adopted and implemented by DEP
- Water Management Districts also implement the same rule
- However, which Agency has jurisdiction is determined by the operating agreement
- Largely an “activity-based” split of jurisdiction



Operating Agreement

- List of activities where ERP goes to DEP
- List of activities where ERP goes to WMD
- Activities NOT specifically attributed to the WMD, are **DEP's by default** (See section II.A.1)
- Typically, if activity is merely a subcomponent of a larger activity, the larger activity determines jurisdiction – think “Primary” Activity
- Industrial park with hazardous drum example



Operating Agreement - Options

- If wrong Agency receives application, forwarded to the right agency within 5 days...clock is ticking
- Special Case Agreement – “Wrong” agency can go ahead with a permit application for good cause
- Compliance and Enforcement conducted by the Agency that should have authority under the Agreement



Types of Authorizations

Are you exempt? 62-330.051, F.A.C.

- District Specific (Section 1.3, AH II)
- Statutory (Section 373.406, 373.4145(3), or 403.813(1), F.S.)
- Aquatic Plant and Organic Detrital Control & Removal
- Bridges, Driveways and Roadways
- Dock, Pier, Boat Ramp and Other Boating-Related Work

Subject to Limitations!

Types of Authorizations

Are you exempt? 62-330.051, F.A.C.

- Freshwater Fish Attractors
- Maintenance and Restoration
- Navigation Aids
- Pipes or Culverts
- Recreational Paths
- Sampling and Testing
- Seawall, Riprap, and Other Shoreline Stabilization



Subject to Limitations!



Types of Authorizations

Are you exempt? 62-330.051, F.A.C.

- Single-Family Residences
- Utilities
- Modification or reconstruction of an existing conveyance system constructed prior to the need to obtain a permit
- Construction, alteration, maintenance, or removal of wholly-owned, artificial surface waters

Subject to Limitations!

Exempt?



Subject to Rule Caveats and Notifications

Exempt?

- All exemptions are subject to limitations in their scope
- Most can be constructed without authorization, but some require notification
- Read the rule!
- When in doubt, verify the exemption with agency



Types of Authorizations

- If not exempt, General Permit?
- Chapter 62-330.407, F.A.C. – Onward —————→
(48 to choose from!)
- Very specific in nature
- Limited in scope
- Pre-issued by rule
- 30 day notice





Ch. 403.814(12), F.S. a.k.a. “10-2”

A general permit is granted for the construction, alteration, and maintenance of a stormwater management system serving a total project area of **up to 10 acres**. When the stormwater management system is designed, operated, and maintained in accordance with applicable rules adopted pursuant to part IV of Chapter 373, there is a rebuttable presumption that the discharge for such system will comply with state water quality standards. The construction of such a system may proceed **without any further agency action** by the department or water management district if, within 30 days **after** construction begins, an electronic self-certification is submitted to the department or water management district that certifies the proposed system was designed by a Florida registered professional to meet the following requirements:



Ch. 403.814(12), F.S. a.k.a. “10-2”

- a) The total project area involves less than 10 acres and less than 2 acres of impervious surface;
- b) No activities will impact wetlands or other surface waters;
- c) No activities are conducted in, on, or over wetlands or other surface waters;
- d) Drainage facilities will not include pipes having diameters greater than 24 inches, or the hydraulic equivalent, and will not use pumps in any manner;
- e) The project is not part of a larger common plan, development, or sale; and
- f) The project does not:
 - 1. Cause adverse water quantity or flooding impacts to receiving water and adjacent lands;
 - 2. Cause adverse impacts to existing surface water storage and conveyance capabilities;
 - 3. Cause a violation of state water quality standards; or
 - 4. Cause an adverse impact to the maintenance of surface or ground water levels or surface water flows established pursuant to s. 373.042 or a work of the district established pursuant to s. 373.086.



SWERP Thresholds

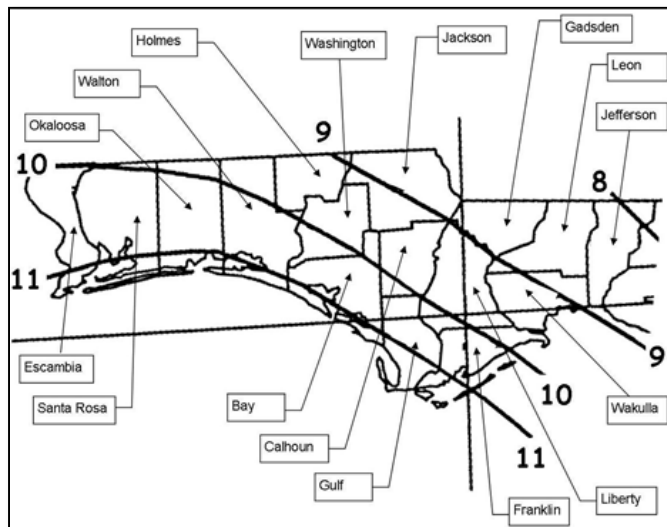
Ch. 62-330.020(2)(a-j)

- In, on, or over wetlands or other surface waters
- $\geq 4,000$ sq.ft. impervious and semi-impervious area subject to vehicular traffic
- $\geq 9,000$ sq.ft. impervious and semi-impervious total
- Total project area > 1 acre
- Capacity to impound ≥ 40 acre-feet
- Any dam > 10 feet high
- Part of a common plan of development or sale
- Dry storage of ≥ 10 vessels
- Exceeds threshold in Section 1.2 of AH II
- Modification or alteration of previously permitted project



Design Requirements for Surface Water Management Systems

- A (mostly) non-mathematical approach^(*)
- Stormwater Quantity
 - Rate and volume controls (i.e., flooding)
- Stormwater Quality

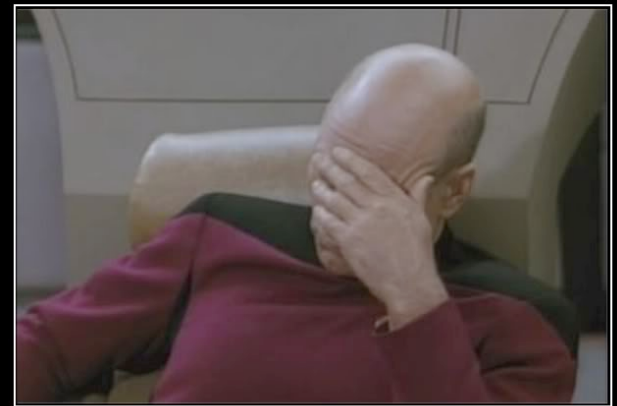


^(*) If it can't be expressed in figures, it is not science; it is opinion. (Robert Heinlein)



Stormwater Quality

- Five different stormwater “rules”
- Five different sets of criteria (defined in A.H. II)
- Different for each WMD
- Also different for each Best Management Practice (BMP)



F A C E P A L M

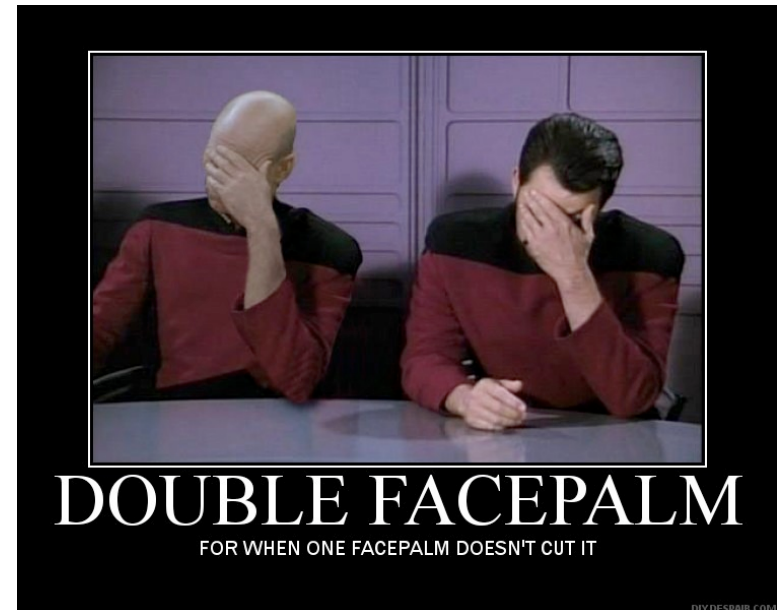


Basis of Criteria

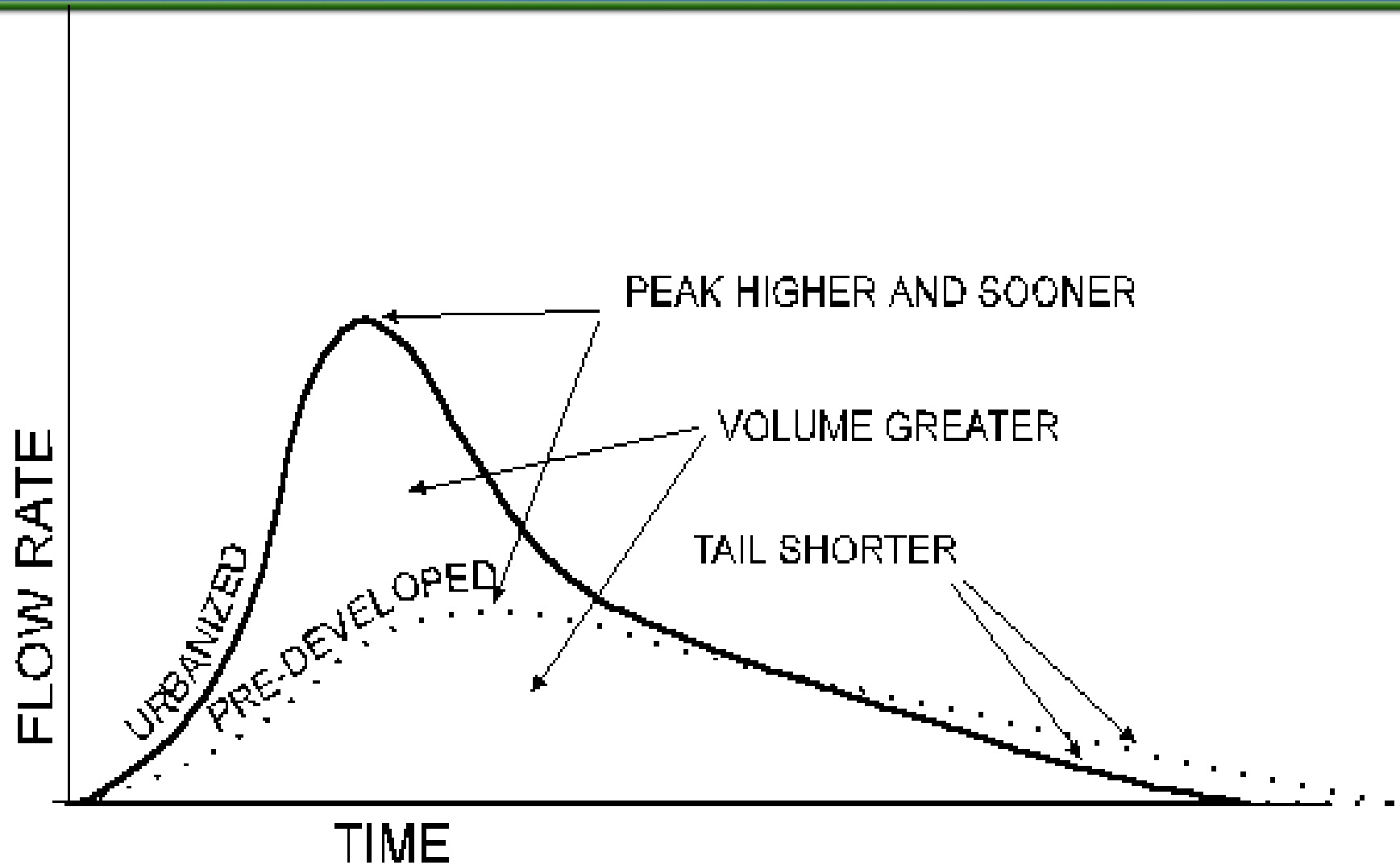
- Based on “First Flush” phenomena
- ~80% of Florida storms are one-inch or less
- Pollutant removal goal is 80% of the average annual pollutant load
- Therefore, if you treat 80% of the runoff from a one-inch storm, you’ve theoretically achieved the goal.
- Usually called “treatment volume” by practitioners

Stormwater Quantity

- Five different stormwater “rules”
- Five different sets of criteria (defined in A.H. II)
- Different for each WMD
- Not required for every system
- Rate of runoff
- Volume of runoff
- Flooding



Basis of Criteria



Six Major Types of Surface Water Management Systems



“Dry” Retention Ponds



“Wet” Detention Ponds



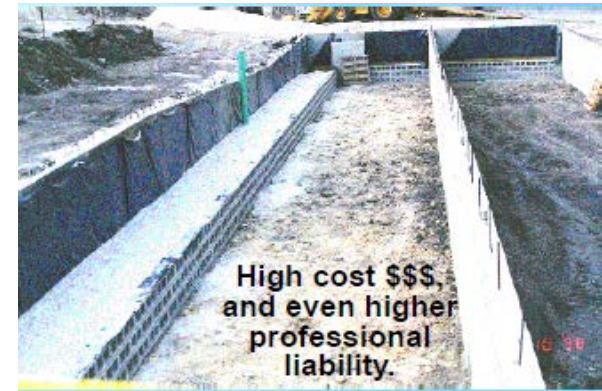
“Filtered” Ponds



Underground Exfiltration
Trenches



Pervious Pavement



Underground Vaults
(a poor design option)

Maintenance worker safety is a concern in these types of “confined space” systems due to the anaerobic environment.



“That which we call a rose....”

- Dry Retention
- Underdrain
- Exfiltration
- Wet Detention
- Detention with Filtration
- Swales
- Wetland Stormwater Management System
- Vegetated Natural Buffers
- Stormwater Harvesting (a.k.a. Reuse)
- “Alternative Criteria”?



What to Include in an Application

- What Sections of the Application Must I Fill Out?
- Section A
 - Beneficial Information for Expediting Review of Stormwater
- Section E
 - Supplemental Information Required for Works or Other Activities Involving a Stormwater Management System

Form 62-330.060(1)

JOINT APPLICATION FOR
INDIVIDUAL ENVIRONMENTAL RESOURCE PERMIT/
AUTHORIZATION TO USE STATE-OWNED
SUBMERGED LANDS/
FEDERAL DREDGE AND FILL PERMIT

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION/
WATER MANAGEMENT DISTRICTS/
U.S. ARMY CORPS OF ENGINEERS

Effective October 1, 2013





What Sections of the Application Must I Fill Out?

Does the project involve....	Section							
	A- General Information	B- Single Family Projects	C- Wetlands and other Surface Waters	D- Structures or Works in Surface Waters	E- Stormwater Management System	F- State-owned Submerged Lands	G- Mitigation Banks	H- Mines
Fill in wetlands or waters for a single family residence?	X	X						
Docks, shoreline stabilization, seawalls associated with a single family residence?	X	X				X, if applicable		
Wetland impacts (other than associated with an individual residence)?	X		X					
Boating facilities, a marina, jetty, reef, or dredging?	X		X	X		X if applicable		
Any work on state owned submerged land?	X		X			X		
Construction of a stormwater management system?	X		X, if applicable		X			
Constructing a mitigation bank?	X		X		X, if applicable		X	
Creating a mine?	X		X, if applicable					X

Note- if you are required to provide Section B, then you do not have to provide any other Sections, unless the activities are on state-owned submerged lands. In that case, Section F will also be required.



Section A: Part 1

- D. Describe in general terms the proposed project, system, works, or other activities. For permit modifications, please briefly describe the changes requested to the permit:

This is always a good way for the reviewers to be able to get a general overview of the proposed project, prior to reviewing the submitted information.

- E. For activities in, on, or over wetlands or other surface waters, check the type of federal dredge and fill permit requested (if known): ☐ Individual ☐ Programmatic General permit #: SAJ
☐ General ☐ Nationwide permit #: ☐ Not Applicable ☐ Not sure

- F. Project/Activity Street/Road Address or other location (if applicable):
City: County(ies): Zip:

Note: For utility, road, or ditch/canal activities, provide a starting and ending point using street names and nearest house numbers or provide length of project in miles along named streets or highways.

This helps us identify things like whether the project is within a SKA or is adjacent to previously permitted systems.

- G. Project location map and Section, Township, and Range information (use additional sheets if needed):
Please attach a location map showing the location and boundaries of the proposed activity in relation to major intersections or other landmarks. The map should also contain a north arrow and a graphic scale; show Section(s), Township(s), and Range(s); and must be of sufficient detail to allow a person unfamiliar with the site to find it.

Section(s):	Township:	Range:	Land Grant name, if applicable:
Section(s):	Township:	Range:	
Section(s):	Township:	Range:	

- H. Latitude (DMS) ° ' " Longitude (DMS) ° ' " (Taken from central location of the activity). Explain source for obtaining latitude and longitude (i.e. U.S.G.S. Quadrangle Map, GPS, online resource):

REMEMBER: These are in Degrees Minutes and Seconds!

- I. Tax Parcel Identification Number(s):



- K. Project area or phase area: acres *This will help us to determine if water quantity is required.*
- L. Name of waterbody(ies) (if known) in which activities will occur or into which the system will discharge:

Whether the discharge is to an OFW.

The following questions (M-O) are not applicable to activities related to a single-family residence, including private single-family residential docks, piers, seawalls or boat ramps.

- M. Is it part of a larger plan of development or sale? ☐ yes ☐ no
- N. Impervious or semi-impervious area excluding wetlands and other surface waters (if applicable):
 acres or square feet *Also help us to determine if water quantity is required.*
- O. Volume of water the system is capable of impounding (if applicable): acre-feet.

PART 2: SUPPLEMENTAL INFORMATION, AND PERMIT HISTORY

- A. Is this an application to modify an existing Environmental Resource Permit, or to construct or implement part of a multi-phase project, such as a project with a Conceptual Approval permit? ☐ Yes ☐ No *If you answered "yes", please provide permit numbers below:*

AGENCY	DATE	PERMIT/APPLICATION NO.	PROJECT NAME

- B. Indicate if there have been any **pre-application meeting(s)** or other discussions about the proposed project, system or activity. If so, please provide the date(s), location(s) of the meeting, and the name(s) of Agency staff that attended the meeting(s): *Pre-application meetings are STRONGLY encouraged! They generally speed up the review of the project and eliminate some questions prior to submittal.*

AGENCY	DATE	LOCATION	MEETING ATTENDEES



Coordination with Other Agencies

- ERP applications and permits serve as many things for various state and federal programs
- A LOT goes on “behind the scenes” regarding this coordination
- Much of this is never even known by the applicant or permittee



Coordination with Army Corps

See Section 1.3.1 of A.H. Volume I

- Permit application serves for ERP and ACOE “Fill” Permit under Section 404 of Clean Water Act, and others
- Per Operating Agreement with ACOE, State forwards applications to the Corps
- ERP Permit constitutes Water Quality Certification for Federal “Fill” Permits
- ERP Permit constitutes a Finding of Consistency or Waiver under Florida’s Federally Approved Coastal Zone Management Program (for coastal counties)



Florida Fish & Wildlife Conservation Commission (FWC)

- Section 10.2.2, A.H. Volume I:
- For ERP applications in wetland or surface waters, forwarded to FWC for review and comment
- We MUST consider comments and recommendations, if any, provided by FWC



Florida Department of State

- Section 10.2.3.6 of A.H., Volume I:
- For ERP applications in Wetland or Surface Waters, Forwarded to Division of Historical Resources (DHR) for review and comment

Special Case Stuff





Chapter 62-25, F.A.C.





Chapter 62-25, F.A.C.

- Enacted in 1982 (as Chapter 17-25, F.A.C.)
- Renumbered in 1994
- Delegation for general permits to City of Tallahassee in 1996
- Sunset in 4 of 5 WMD's 1994-1996
- Sunset in Panhandle October 1, 2007
- Mostly GPs, not modifiable and never expire
- Addressed water quality *only*

Legal Under 62-25?





Was My Site Permitted?

Construction Date

- Pre-1982, may have been grandfathered
- 1982 – 1994-96 (2007 in Panhandle), may have a Ch. 62-25 permit
- 2007 – 2013, may have a Ch. 62-346 permit (only in NWFWMMD)





Was My Site Permitted?

Location: In Tallahassee

- Pre-1996, issued by DEP
- 1996 – 2007, issued by City of Tallahassee
- 1996 – 2007 and no City issued permit, may have been issued by DEP (City limits subject to change)

No Permit

- Activities reviewed as new construction under Ch. 62-330, F.A.C.
- Reduction in impervious surface or pollutant loading *may* be exempted. §373.406(6), F.S.
- When in doubt, consult your local ERPA





Ch. 62-25, F.A.C. Permit

- No increase in authorized project area
- No alteration of treatment BMP
- No change in activity type
- Still authorized (no new permit)





Ch. 62-25 or -346, F.A.C. Permit

- Increase in project area
- Altered project design (new impervious resulting in modification of BMP)
- Altered treatment BMP (relocation, change in treatment type, addition or removal of BMPs, change in capacity, change in discharge)
- Altered activity (increased pollutant load)
- New permit required (under Ch. 62-330)
- See [NWFWMD A.H. II, Appendix D](#)
- Consult your ERPA



Discharge into Waters That Do Not Meet Standards

(a.k.a. Impaired Waters)





Impaired Waters: Problems and Pollution Sources

Major Pollutants of Concern

- Nutrients, nutrients, nutrients!
- Oxygen demanding substances
- Bacteria

Major Sources of Pollutants

Stormwater – existing development

Stormwater – future development

Stormwater – agriculture

Leaching – agriculture, landscape, OSDS



Direct Discharge

AH I 2.0(a)26. “Direct discharge” means a discharge without prior opportunity for mixing and dilution sufficient to prevent a lowering of the existing ambient water quality.

Direct Discharge



Direct Discharge?





8.2.3 Activities Discharging into Waters That Do Not Meet Standards

In instances where an applicant is unable to meet water quality standards because existing ambient water quality does not meet standards, and the activity will cause or contribute to this existing condition, mitigation for water quality impacts can consist of water quality enhancement that achieves a **net improvement**. In these cases, the applicant must propose and agree to implement mitigation measures that will cause net improvement of the water quality in the receiving waters for those contributed parameters that do not meet water quality standards.



Outstanding Florida Waters

- Listed in Ch. 62-302.700, F.A.C.
- Mentioned in Rule 36 times
- Mentioned in AH I 12 times
- Recall that target removal is 95% Annual Average Load of Post-Development Pollutants
- AH IIs define this as 150% of treatment volume



Compensatory Treatment

- In each WMDs AH II; 5 different references.
- *Generally*, 2 options
 - Overtreatment
 - Off-site compensation
- Must be in same drainage basin, meet removal goals as though entire site is treated



TRIPLE FACEPALM





Technical Release #55 (TR-55)

<http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/manage/hydrology/?cid=stelprdb1042925>



United States
Department of
Agriculture

**Natural
Resources
Conservation
Service**

**Conservation
Engineering
Division**

Technical
Release 55

June 1986

Urban Hydrology for Small Watersheds

TR-55



Free (no cost \$\$\$) training document



Hydrology/Hydraulics & Soil Mechanics Training Series Modules

<http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/manage/hydrology/?cid=stelprdb1044570>

Intro to Hydrology Module 101 (2.2 Mb)

Precipitation Module 102 (2.2 Mb)

Runoff Concepts I Module 103 (972 Kb)

Runoff Curve numbers I Module 104 (12.7 Mb)

Runoff Computation Module 105 (1.6 Mb)

Peak Discharge Module 106 (4 Mb)

Hydrographs I Module 107 (0.9 Mb)

Drainage Hydrology Module 108 (3.5 Mb)

Design Hydrology I Module 109 (4.4 Mb)

Structure Hydraulics Module 110 (2.6 Mb)

Reservoir Flood Routing I Module 111 (1.7 Mb)

Open Channel Hydraulics Module 112 (4.8 Mb)

Streamflow I Module 115 (1.6 Mb)

Watershed Yield I Module 116 (1 Mb)

H&H in SCS Module 201 (1.8 Mb)

Runoff Concepts II Module 203 (1.5 Mb)

Runoff Curve numbers II Module 204 (1.6 Mb)

SCS Runoff Equation Module 205 (1.8 Mb)

Time of Concentration Module 206A (1.9 Mb)

Peak q Graphical Method Module 206B (1.7 Mb)

Peak q Tabular Method Module 206C (3.3 Mb)

Peak q Other Methods Module 206D (2.2 Mb)

Hydrographs II Module 207 (4 Mb)

Design Hydrology – Dams Module 209 (4.6 Mb)

Reservoir Flood Routing II Module 211 (2.8 Mb)

Streamflow II Module 215 (1.8 Mb)

Watershed Yield II Module 216 (1.6 Mb)

Storm Reports Module 317 (4.2 Mb)

Soils – Unified Soil Classification System Module 1

Table of Contents (117 Kb)

Part A: Terms and Definitions (1.7 Mb)

Part B: Laboratory Data (3.7 Mb)

Part C: Field Procedures (1.8 Mb)

Appendices (3.6 Mb)

Entire Document (warning! big file) (7.3 Mb)

Soils – Soil Compaction Module 5

Part A introduction (1.9 Mb)

Part B, non-gravelly (2.7 Mb)

Part C, gravelly (1.3 Mb)

Part D, coarse (1.5 Mb)

Part E, evaluation (2.7 Mb)

Entire Document (warning! big file) (10.1 Mb)



Free (no cost \$\$\$) training documents



“Voodoo Hydrology”

Available at http://www.stormh2o.com/SW/Editorial/Voodoo_Hydrology_37.aspx

Provides insights into the “black box” nature of urban stormwater design and the assumptions under which we operate.

My favorite quote: “I love urban hydrology. They can never prove you are wrong, only inconsistent.”



By Andrew J. Reese

Free (no cost \$\$\$) article by Andrew J. Reese, P.E., LEED AP



Hydrology Webinar Series

By Dr. Mariano Guardo, PhD, PE, D.WRE, with our Engineering, Hydrology and Geology Program

4 Part lecture series (in 6 webinars)

Located at:

[http://publicfiles.dep.state.fl.us/DWRM/slerp/Monthly Webinar Series/Hydrology Parts1-4](http://publicfiles.dep.state.fl.us/DWRM/slerp/Monthly_Webinar_Series/Hydrology_Parts1-4)

Food for Thought

There never seems to be enough time and \$\$\$ to conduct field reconnaissance, obtain field topographic survey information, digital photography or soils data, nor to verify the results of computer modeling. **However, there is always enough time and \$\$\$ to defend yourself in an Administrative Hearing or a Court of Law.**

Statue of justice atop the dome of the Old Baily court in London, a woman (without a blindfold), holding in her right hand a sword standing for the power to punish, and in her left hand a balance standing for equity.

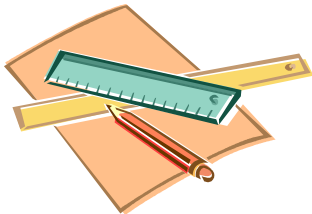


Unfortunately, too many P.E.s/E.I.s totally rely on GIS/internet data without ever visiting the field, or obtaining the site specific information noted above.

Slide credit: Hank Higginbotham

Additional Items for Consideration

- All analysis results are only as good as their input data
- Engineering computations must be accurate, but they do NOT need to be precise in most cases
- Computer algorithms may be precise, but many times they are inaccurate (i.e., bad programming code, garbage in / garbage out, etc).
- Manual (pencil and paper) computations can be just as accurate as computer algorithms
- An engineer MUST review computer output to see if it is reasonable (i.e. spot check using manual computations)
- **Think!** – do not get in the bad habit of relying on the “black box” to do the thinking for you.





Accuracy verses Precision

What is the difference?

Accuracy – a computed value that is close to the actual value

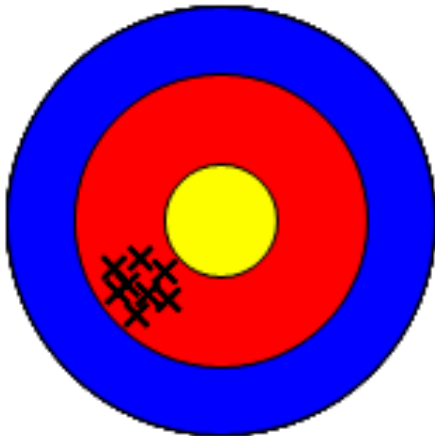
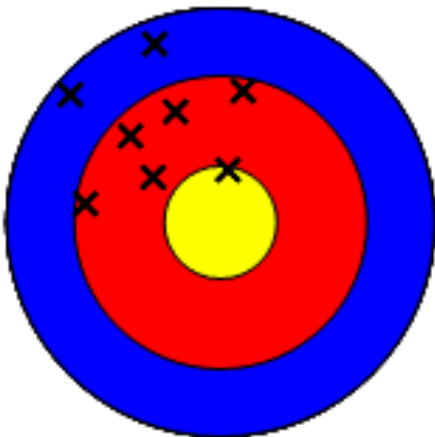
Precision – refers to the fineness of a measurement

Engineering calculations must always be accurate. But the accuracy stems from careful measurements and correctly applied scientific principles, not from an overstatement of precision by writing too many significant figures in the answer.

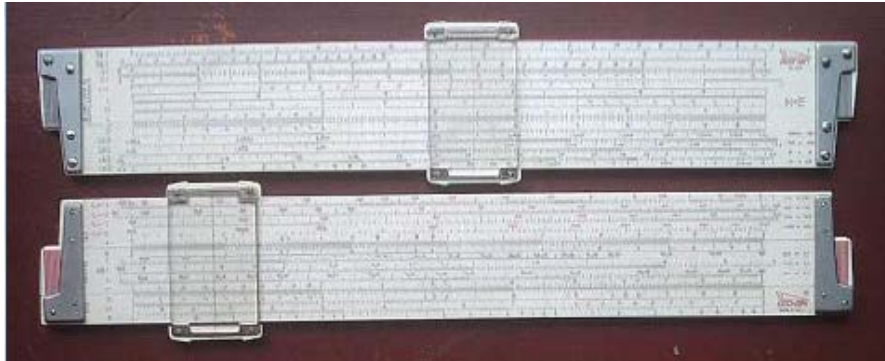
Source: Introduction to Hydraulics & Hydrology, with Applications for Storm Water Management, 2007, by John E. Gribbin

Slide credit: Hank Higginbotham

Accuracy verses Precision

	Accurate	Inaccurate (systematic error)
Precise		
Imprecise (reproducibility error)		

Accuracy – An Example



Keuffel & Esser 68-1100 Deci-Lon 10" Duplex Slide Rule

A slide rule (such as the K&S Deci-Lon above) has a computational accuracy of two (2) decimal places



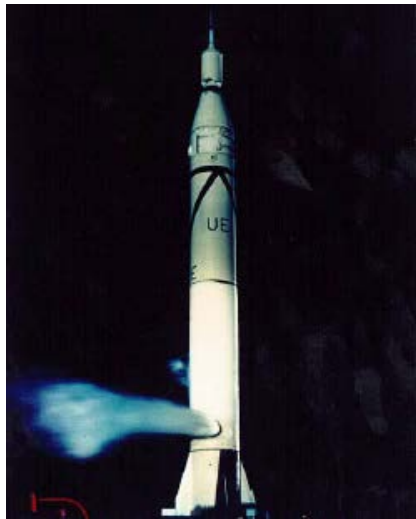
Hoover Dam
(Colorado River)

Designed in the
early 1930s

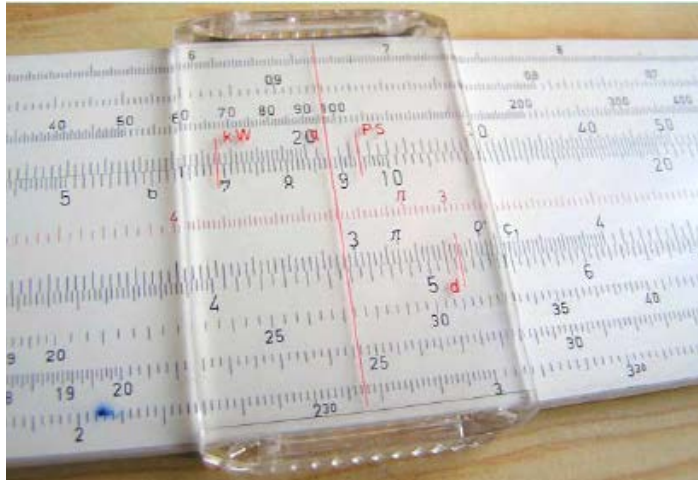
Two (2) decimal places is close enough for most storm water engineering computations

Accuracy – An Example

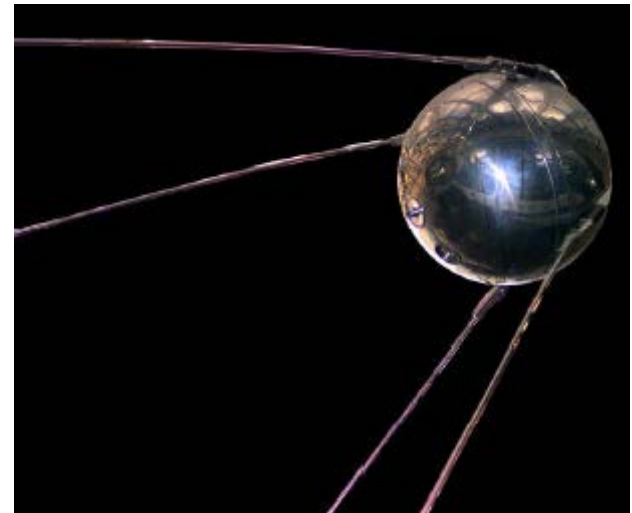
If the United States and the former Soviet Union placed rockets and satellites into orbit in the 1950's & 1960's using slide rules, then **why** do P.E.s and E.I.s think that storm water computations “must” be performed with desktop or laptop computers?



U.S. Explorer
Rocket (1958)



Typical Slide rule with
magnifying cursor



Soviet Sputnik
Satellite (1957)

The first slide rules were invented and refined during the
17th Century (1600s)



Discussion

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Long distance hiker. Award winning zymurgist. Superb chef. Advanced degreed engineer and scientist. Obsessive reader and collector of any written material. Skilled swordsman. Music connoisseur. Magnificent liar.