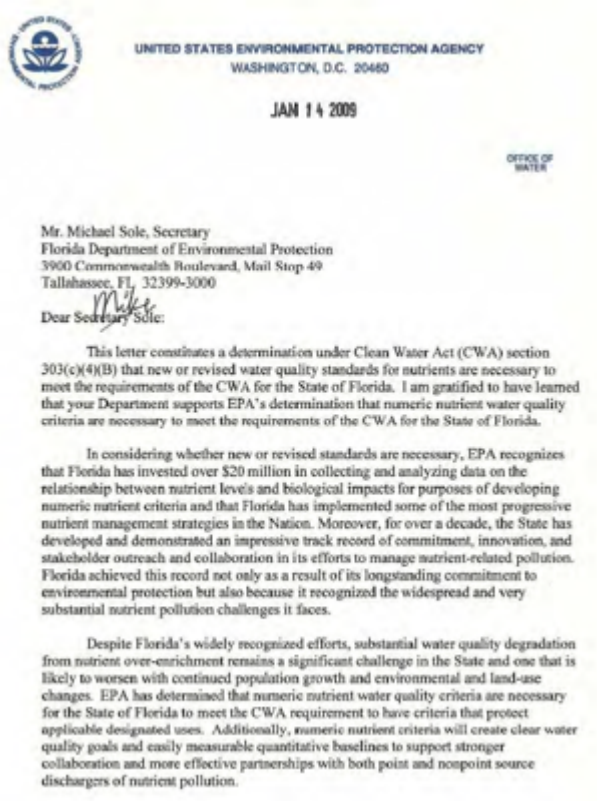
Don’t miss the Low Hanging Fruit!

Quantifying water quality treatment for improvements to “grandfathered” roadways with Site Specific Alternative Criteria

Overview of Presentation

- Purpose
- Indian River Lagoon
- NNC and TMDL's
- Grandfathered Roadways
- Pollutant Load Reduction Computation



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 14 2009

OFFICE OF WATER

Mr. Michael Sole, Secretary
Florida Department of Environmental Protection
3900 Commonwealth Boulevard, Mail Stop 49
Tallahassee, FL 32399-3000

Dear Secretary Sole:

This letter constitutes a determination under Clean Water Act (CWA) section 303(c)(4)(B) that new or revised water quality standards for nutrients are necessary to meet the requirements of the CWA for the State of Florida. I am gratified to have learned that your Department supports EPA's determination that numeric nutrient water quality criteria are necessary to meet the requirements of the CWA for the State of Florida.

In considering whether new or revised standards are necessary, EPA recognizes that Florida has invested over $20 million in collecting and analyzing data on the relationship between nutrient levels and biological impacts for purposes of developing numeric nutrient criteria and that Florida has implemented some of the most progressive nutrient management strategies in the Nation. Moreover, for over a decade, the State has developed and demonstrated an impressive track record of commitment, innovation, and stakeholder outreach and collaboration in its efforts to manage nutrient-related pollution. Florida achieved this record not only as a result of its longstanding commitment to environmental protection but also because it recognized the widespread and very substantial nutrient pollution challenges it faces.

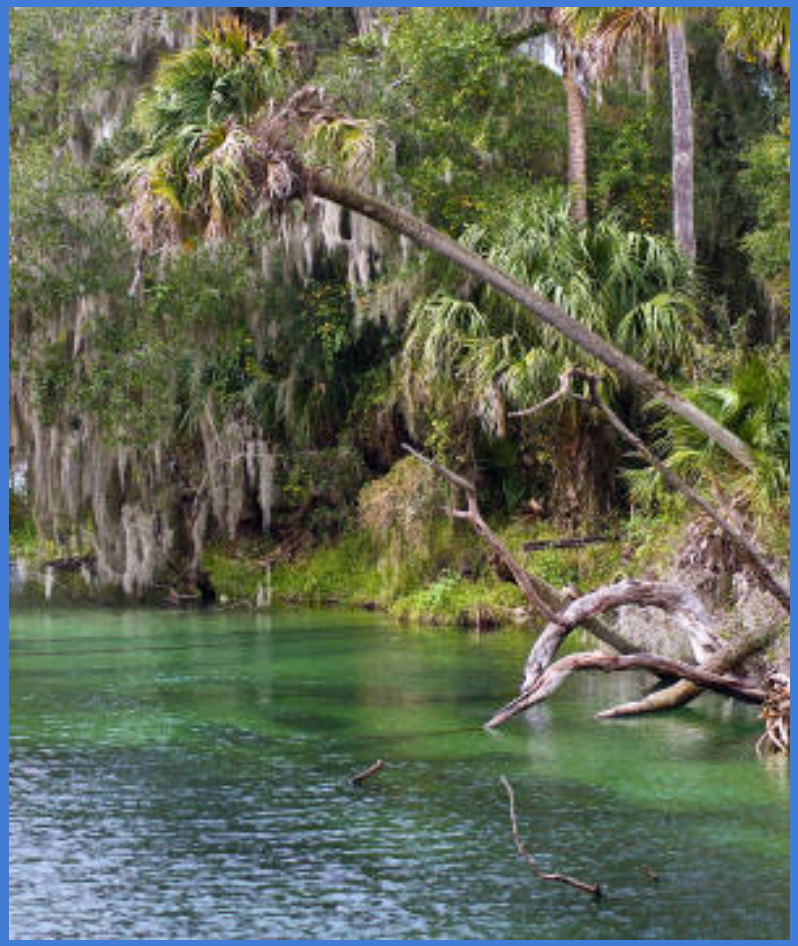
Despite Florida's widely recognized efforts, substantial water quality degradation from nutrient over-enrichment remains a significant challenge in the State and one that is likely to worsen with continued population growth and environmental and land-use changes. EPA has determined that numeric nutrient water quality criteria are necessary for the State of Florida to meet the CWA requirement to have criteria that protect applicable designated uses. Additionally, numeric nutrient criteria will create clear water quality goals and easily measurable quantitative baselines to support stronger collaboration and more effective partnerships with both point and nonpoint source dischargers of nutrient pollution.

Purpose of Training

- To educate on the pollutant load tracking for "grandfathered" roadway development projects
- Properly identify and account for the source and treatment of stormwater pollution
- Make sure we are treating the correct cause of the nutrient impairments in our waters!

Who this applies to?

- MS4 Permit Holders
  - FDOT
  - Municipalities
  - Roadway entities
- Consultants
  - Engineers & Scientists
- Regulatory staff
- Floridians!



Why does this apply to you?

- Important to correctly identify the source of pollution
- Millions of dollars are spent each year in Florida to fight stormwater pollution, & protect water resources - $1.4 Billion projected over 15 years
  - $50 million - in 2013 allocated for Springs restoration projects
  - $26.9 million - for Indian River Lagoon in state budget
  - $20 million - Brevard County Muck Dredging Project
- Find the source/cause, treat the problem at the source!

"It costs $20 to buy a lb. of fertilizer, and $20,000 to clean it up"

Indian River Lagoon

- $3.7 Billion annual economic engine
- Lagoon – shallow estuary separated from ocean by barrier islands
- 156-mile long estuary (~40% of FL east coast)
  - 6 coastal counties in the IRL watershed (Volusia →Palm Beach)
  - One of most biologically diverse estuaries in North America

History of Pollution

- Land development prior to E&S controls and Stormwater treatment
- Agriculture – significant land disturbance from natural lands state
- Legacy load (sediments in waterbodies)
- Until 1990's – utilities directly discharged more than 50 MGD of sewage to lagoon
- Population boom – doubled in 5-county region over past 30 years

Central Indian River Lagoon TMDL

- Nutrient TMDL adopted for main stem of IRL in March 2009
- Basin Management Action Plan (BMAP) adopted Jan. 2013 – to implement nutrient TMDL's
- Focus on water quality conditions necessary for seagrass regrowth at historic sea grass water depth limits
  - Based on multi-year composite seagrass coverage
  - **Biological response of seagrass** – most important factor to evaluate success

Continued assessment of seagrass depths to determine if BMAP will be required

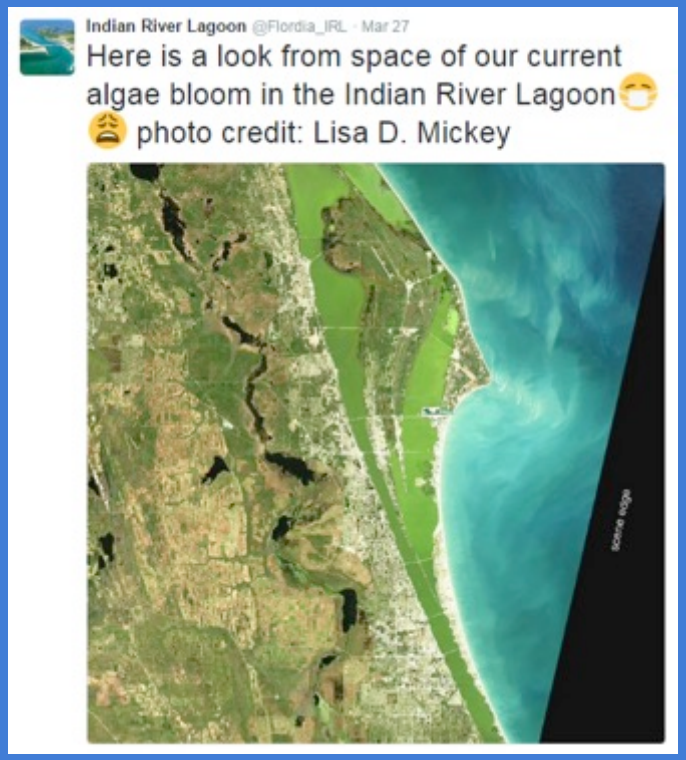
- Total Reductions to Date (2015 Progress Report)
  - 44,325 lbs/yr TN
  - 10,934 lbs/yr TP

Central Indian River Lagoon

- Still seeing algal blooms in IRL – as of summer 2016
- Could legacy sediment be a bigger problem than we think? Other factors?
- Make sure we are accurately documenting land based pollutant load reductions so that DEP can better determine where the pollutant load problem is coming from!
- If we are treating the land based stormwater treatment, and still seeing algal blooms = maybe the nutrients already in the water are the problem!

Central Indian River Lagoon

- 2016 Fish kill in NIRL
- Public Involvement
- Social Media Presence



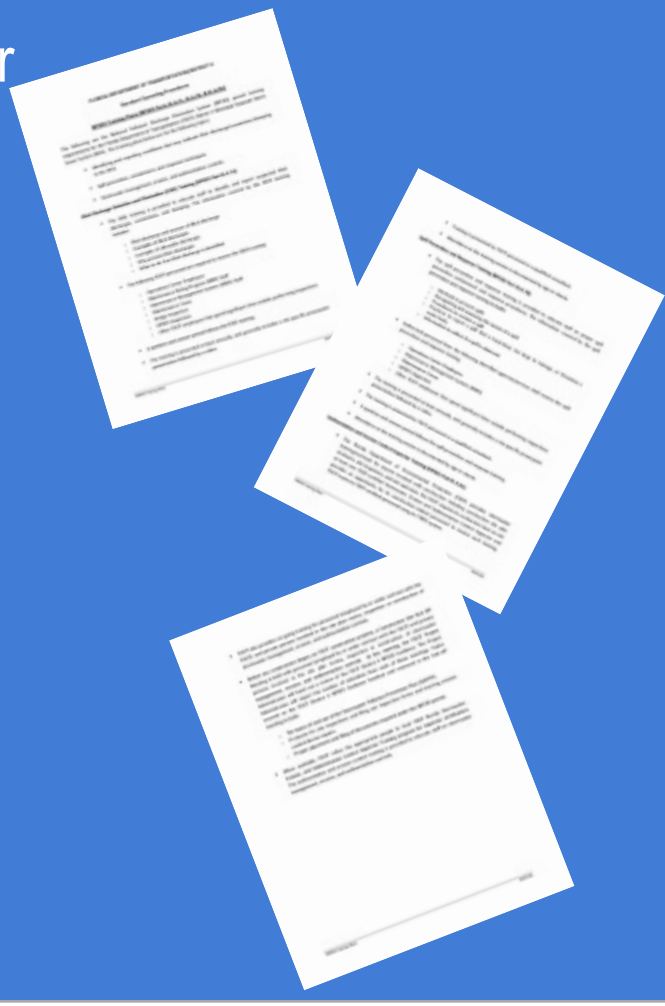
Numeric Nutrient Criteria and TMDLs

http://www.dep.state.fl.us/water/tmdl/final_tmdl.htm

Why are TMDL's so complex

- Nature did not "go to college", or attend your regulatory training!

- Legacy sediment
- The Science is ever evolving
- *Models – HSPF, PLSM, SWIL*
- *Identifying and tracking the source of pollutants is complex*
  - *Nutrients are chemical compounds that have complex interactions in the environment*
  - *Carbon, Nitrogen, Phosphorus Cycles*
  - *External inputs – atmospheric deposition, groundwater*



Numeric Nutrient Criteria (NNC)

- F.A.C. 62-302.530(47)(b) states that "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna."
- The method for numerically interpreting this NNC, on a site-specific basis, is provided in Rule 62-302.531 (FAC) using a hierarchical process

Numeric Nutrient Criteria (NNC)

Figure 2.2 *The hierarchy for numerically interpreting the NNC*

Nutrient Total Maximum Daily Loads, Site Specific Alternative Criteria, Estuary-specific Criteria, and Water Quality Based Effluent Limitations

↓

Stressor-Response Relationships (lakes & springs)

↓

Reference stream-based thresholds combined with biological data (flora and fauna)

↓

Narrative (wetlands, intermittent streams, South Florida flowing waters)

Grandfather?

- What is a "grandfathered" road anyway?
- An existing roadway – in this case: one that is being redeveloped, repaved, or widened
  - AND it must be a roadway that was constructed prior to State Stormwater Management permitting requirements
- Pollutant Load Screening Model - FDEP

PLSM Model

- Grandfathered roadways are accounted for in the pollutant loading calculations of the PLSM model – have already been included in the Waste Load Allocation (WLA)
- So if we are improving water quality that affects the WLA = we are reducing pollutant load towards our BMAP

Sources of Pollutants[1] from Roadways

- **Street Pavement**
  - Aggregate material, binder, fillers, surface substances (0.05-0.1 in/yr of pavement surface worn away)
- **Motor Vehicles**
  - Fluids, lubricants, particles from tires or brake lining, exhaust, emissions collected on roadway surface, corrosion products, vehicle parts, etc.
  - Asbestos; many heavy metals including lead, zinc, and copper
  - Organics, nutrients, & suspended solids which have become attached to the vehicle surface or underside
- **Land Surface**
  - Depends on surface cover of Right-of-Way, and amount of traffic
- **Litter**
- **Chemicals used for roadway maintenance**
  - Fertilizers, pesticides & herbicides

Sources of Pollutants[1] from Roadways

Sediments!

- Sand, silt, clay and organic matter with a particle size larger than dissolved molecules or ions
- <u>Sediment is the largest contributor by volume to nonpoint source pollution in the United States!</u>
- Suspended matter is generated primarily through erosion processes during rain events
- Pollutants such as nutrients (Nitrogen & Phosphorus) attached to sediment particles

Sources of Pollutants[1] from Roadways

Nutrients

- Enter runoff through sources such as fertilizers, plant matter (grass clippings), detergents, washing fluids, soil leaching, animal wastes
- May be present as either dissolved ions or in particulate form
  - In general:
    - About 40-50% of nitrogen and phosphorus in runoff is in a dissolved form; While 50-60% exists in a particulate form
    - Dissolved forms of Nitrogen include ammonia, nitrite/nitrate (NO_x) – available to plants & algae
    - Orthophosphorus (orthophosphate, SRP) is the common dissolved form of Phosphorus available to plants & algae

Typical Stormwater Treatment for Roadways

- Wet Detention Basins
- Retention Basins
- Exfiltration (French drains)
- Baffle Boxes
- Grassed Swales
- Street Sweeping
- Litter Pickup
- Fertilizer Cessation

Pollutant Load Reduction Computation

- Accounting procedure to document pollutant load reduction – “grandfathered” roadways being re-developed
- Calculate how many pounds of pollutant load reduction is provided vs. pollutant load reduction required
- Essentially how much treatment is provided “above and beyond” permitting requirements

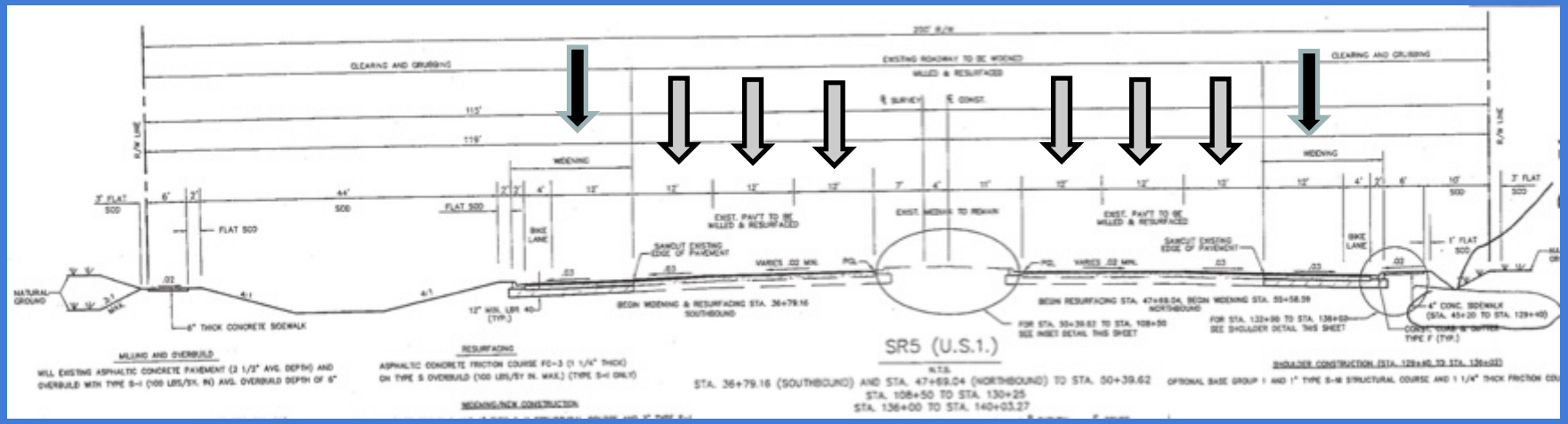
Pollutant Load Reduction Computation

- Review Water Management District permit and water quality based stormwater requirements

- Determine if original roadway lanes were constructed prior to water quality permitting requirements (i.e. these roadway lanes would be "grandfathered" in regard to stormwater quality treatment for the WLA in the PLSM)

- In the PLSM model, land use from the year 2000 was used, and therefore these roadways have been modeled as impervious, and are included in the Waste Load Allocation (WLA); Ch. 62-304.520 F.A.C. – so when the roadway is re-developed this load (existing pavement) is already accounted for as going into the CIRL

Pollutant Load Reduction Computation



Grey - Existing "grandfathered" roadway lanes, no treatment required, BUT already accounted for in Waste Load Allocation in PLSM model. <u>AND therefore this pollutant load reduction can be quantified and used towards the BMAP and PLRG.</u>

Black – new roadway lanes (widening project), Require stormwater treatment for new development permit criteria, and are counted as "untreated" in PLSM model

Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

STEPS:

1. Identify that project meets requirements of "grandfathered" condition
   a) Developed prior to ERP stormwater requirements (1995)
   b) Provides treatment "above and beyond" permit requirements
   c) Must be re-developed after the year 2000 (cut-off)
2. Define treated acres draining to BMP's – based on Engineer's design
3. Clip GIS based PLSM load – to determine pollutant load
4. Calculate Pollutant load from GIS PLSM model data
5. Determine treatment area efficiencies provided, using BMP Efficiencies Table
6. Quantify treatment area efficiency "above and beyond" requirements for new lanes (existing lanes, all treatment is above and beyond)
7. Multiply Pollutant loads (both TN and TP, respectively) by the calculated treatment efficiency provided → Yields the Pollutant Load Reduction Value for both TN and TP, respectively

Pollutant Load Reduction Computation

STEP 4:

Calculate Pollutant load from GIS PLSM model data

The calculations for the PLSM model are as follows for each polygon:

1. Determine the appropriate EMC value for TN and TP. Examine GRID_CODE (Column I), which contains either a 1 or a 0. When GRID_CODE contains a 0, the polygon is "treated," and the EMC values are calculated:
   a. EMC TN (Column J) = 0.7 * TN_MG_L (Column G)
   b. EMC TP (Column K) = 0.5 * TP__MG_L (Column H)
   c. Otherwise, the EMC TN = TN_MG_L, and the EMC TP = TP_MG_L
2. Calculate the annual runoff :
   a. Multiply the AVG_ANNUAL (rainfall, inches) (Column F)* C (Annual runoff coefficient, unitless) (Column E)* ACRES (polygon area in acres) (Column C).
   b. Convert the result to cubic meters per year.
   c. Round the annual runoff (cubic meters per year) to the nearest integer.
3. Calculate the nitrogen load:
   a. Multiply the appropriate EMC TN (see step 1.a, mg/L) times the annual runoff (rounded, cubic meters per year) to get the nitrogen load.
   b. Convert the loads to pounds per year.
   c. Round the loads to the nearest integer.
4. Calculate the phosphorus load:
   a. Multiply the appropriate EMC TP (see step 1.b, mg/L) times the annual runoff (rounded, cubic meters per year) to get the phosphorus load.
   b. Convert the loads to pounds per year.
   c. Round the loads to the nearest 0.1 pounds.
5. Sum the loads across polygons.

Pollutant Load Reduction Computation

STEP 4:
Calculate Pollutant load from GIS PLSM model data

OBJECTID *	LUCODE	HYDRGRP	MEAN_ANNUA Rain (in)	LC_HYDRO	RO_C	TN_MG_L	TP_MG_L	TSS_MG_L	RO_VOL_M3	GRID_CODE	Shape_Area (m^2)	Area (ac)	EMC TN	EMC TP	Annual Runoff (ac-ft)	Annual Runoff (m3)	TN Load (lbs/yr)	TP Load (lbs/yr)
1	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	186.2	0	383.1293	0.094673	0.84	0.24	0.31	386.53	0.72	0.2
2	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	168	0	65.42992	0.016168	0.84	0.24	0.05	66.01	0.12	0.03
3	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	26.1	0	34.18513	0.008447	0.84	0.24	0.03	34.49	0.06	0.02
4	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	42.3	0	64.71838	0.015992	0.84	0.24	0.05	65.29	0.12	0.03
5	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	154.3	0	334.7136	0.082709	0.84	0.24	0.27	337.68	0.63	0.18
7	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	57.3	0	66.97385	0.01655	0.84	0.24	0.05	67.57	0.13	0.04
8	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	106	0	183.8295	0.045425	0.84	0.24	0.15	185.46	0.34	0.1
9	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	21.5	0	13.32175	0.003292	0.84	0.24	0.01	13.44	0.02	0.01
11	8140	B/D	56.58	140 B/D	.703	1.2	0.48	45	129.8	0	222.4491	0.054968	0.84	0.24	0.18	224.42	0.42	0.12
12	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	111.9	0	149.2399	0.036878	0.84	0.24	0.12	150.56	0.28	0.08
13	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	68.6	0	107.7787	0.026633	0.84	0.24	0.09	108.73	0.2	0.06
14	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	235.7	0	181.0718	0.044744	0.84	0.24	0.15	182.68	0.34	0.1
15	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	136.9	0	284.884	0.070396	0.84	0.24	0.23	287.41	0.53	0.15
16	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	351.3	0	558.6857	0.138054	0.84	0.24	0.46	563.64	1.04	0.3
18	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	82.9	0	158.2202	0.039097	0.84	0.24	0.13	159.62	0.3	0.08
19	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	277.8	0	335.9779	0.083022	0.84	0.24	0.27	338.96	0.63	0.18
20	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	91.2	0	32.91702	0.008134	0.84	0.24	0.03	33.21	0.06	0.02
22	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	168.1	0	100.4077	0.024811	0.84	0.24	0.08	101.3	0.19	0.05
23	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	388.7	0	618.7419	0.152894	0.84	0.24	0.51	624.23	1.16	0.33
27	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	123.9	0	212.0908	0.052409	0.84	0.24	0.17	213.97	0.4	0.11
28	8140	B/D	56.58	140 B/D	0.703	1.2	0.48	45	393.7	0	756.2752	0.186879	0.84	0.24	0.62	762.99	1.41	0.4
428	8140	C	56.58	140 C	0.777	1.2	0.48	45	2709.5	1	354.2655	0.087541	1.2	0.48	0.32	395.03	1.05	0.42
												152.326				Total	1578	592.41
																	TN	TP

Pollutant Load Reduction Computation

STEP 5:
Determine treatment area efficiencies provided, using BMP Efficiencies Table for Central Indian River Lagoon

Central and North Indian River Lagoon (IRL) Basin Management Action Plans (BMAPs)
Best Management Practice (BMP) Efficiencies

Standard BMPs	TP % Reduction	TN % Reduction	Data Source
Retention BMPs (includes basins, exfiltration trenches, etc.)	Reduction from appropriate table in Appendix F using percent directly connected impervious area (DCIA), non-DCIA curve number (CN), and rainfall zone	Reduction from appropriate table in Appendix F using percent DCIA, non-DCIA CN, and rainfall zone	Appendix F Draft Stormwater Treatment Applicant's Handbook (Florida Department of Environmental Protection)
Wet detention ponds	Reduction from Figure 13.2 given the project's residence time, which is based on the flow from the model	Reduction from Figure 13.3 given the project's residence time, which is based on the flow from the model	Figures 13.2 and 13.3 in Draft Stormwater Treatment Applicant's Handbook
BMP treatment trains using a combination of BMPs	Use BMP Treatment Train (TT) equation: BMP TT Efficiency = $Eff_1 + ((1-Eff_1)*Eff_2)$	Use BMP Treatment Train (TT) equation: BMP TT Efficiency = $Eff_1 + ((1-Eff_1)*Eff_2)$	Draft Stormwater Treatment Applicant's Handbook
Dry detention	10	10	Harper, H. & D. Baker. 2007. *Evaluation of Current Stormwater Design Criteria within the State of Florida.*
Baffle box	2.3	0.5	Final Report Contract S0236 Effectiveness of Baffle Boxes
Nutrient baffle box (2nd generation)	15.5	19.05	Final Report Contract S0236 Effectiveness of Baffle Boxes
Catch basin inserts/inlet filters	Evaluated on a case-by case basis	Evaluated on a case-by case basis	Case-by-case
Grass swales with swale blocks or raised culverts	Use retention BMPs above	Use retention BMPs above	Draft Stormwater Treatment Applicant's Handbook
Grass swales without swale blocks or raised culverts	50% of value for grass swales with swale blocks or raised culverts	50% of value for grass swales with swale blocks or raised culverts	Draft Stormwater Treatment Applicant's Handbook
Alum injection	90	50	Evaluation of Harper data
Stormwater reuse	Detention/retention project - estimate amount water not discharged annually because used for irrigation.	Detention/retention project - estimate amount water not discharged annually because used for irrigation.	Evaluated on a case-by-case basis

Note: The Draft Stormwater Treatment Applicant's Handbook is located at: http://www.dep.state.fl.us/water/wetlands/erp/rules/stormwater/docs/ah_rule_draft_031710.pdf

Provisional BMPs	TP % Reduction	TN % Reduction	Data Source
Stormceptor	13	2	Final Report Contract S0095 Sanford Stormceptor project
Continuous deflective separation (CDS) units	10	Not applicable	Final Report Contract WM793 Broadway Outfall Project
Floating islands	20	20	Chapter 14 Draft Stormwater Treatment Applicant's Handbook
Street sweeping	Determine pounds of materials removed and multiply by values to be provided by the Florida Stormwater Association (FSA) University of Florida (UF) municipal separate storm sewer system (MS4) BMP project	Determine pounds of materials removed and multiply by values to be provided by FSA UF MS4 BMP project	Final Report of FSA UF MS4 BMP Project
Public education	1-6, depending on extent of program	1-6, depending on extent of program	Evaluation of Center for Watershed Protection (CWP). 2002. *Watershed Treatment Model Version 3.1.* See separate calculation spreadsheet.

Distribution Page 1 of 1 August 2010

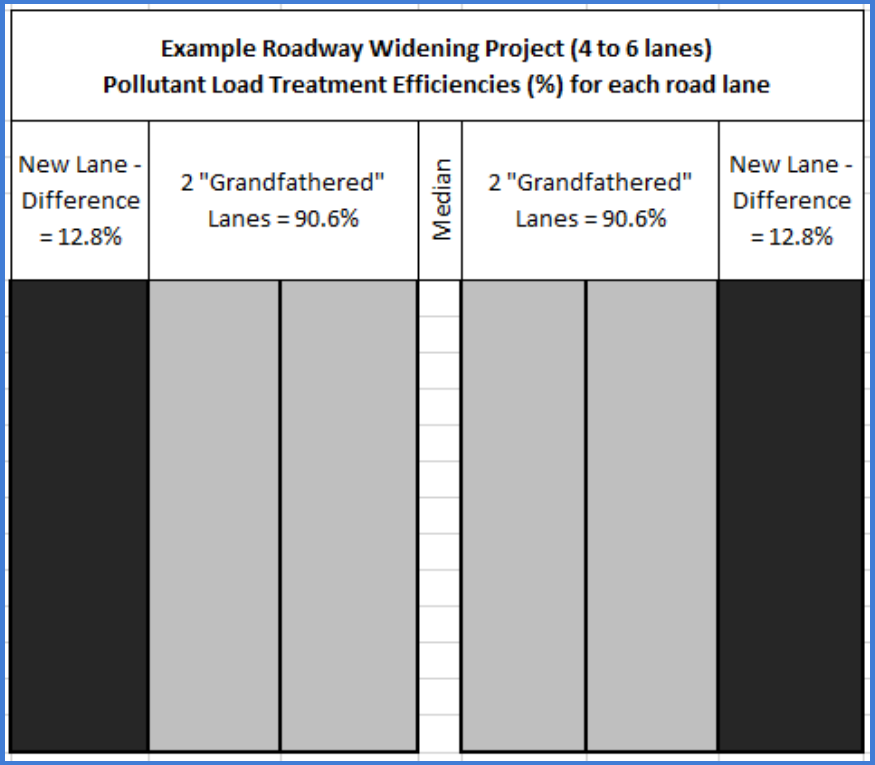
Pollutant Load Reduction Computation

STEP 5:
Determine treatment area efficiencies for: Swale Treatment
STEP 6: Find Treatment efficiency "above and beyond"

Treated acres:	152.32	ac			
Volume	21.37	ac-ft	14.28	ac-ft	
Offline Retention	Provided		Required		Difference
retention	1.68	inches	1.13	inches	0.56
efficiency	90.6%		77.8%		12.8%
Online Retention	Provided		Required		Difference
retention	1.68	inches	1.13	inches	0.558561
efficiency	90.6%		77.8%		12.8%

4 Grandfathered Lanes – treatment provided above & beyond =90.6%

2 New Lanes – treatment difference (above and beyond requirement) = 12.8%



Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

STEP 7:
Multiply Pollutant loads (both TN and TP, respectively) by the calculated treatment efficiency provided → Yields the Pollutant Load Reduction Value for both TN and TP, respectively

$$=((TN\ Load * \%\ Eff.\ Provided\ Ex.\ lanes * \#of\ ex.\ lanes/\ \#\ of\ total\ lanes\ )+$$
$$(TN\ Load * \%\ Eff.\ Provided\ New\ lanes * (\#\ of\ new\ lanes/\#\ of\ total\ lanes\ )$$

Units
- TN or TP Load = lbs/yr
- % Efficiency Provided = should be in decimal for calculation

Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

STEP 7:
Multiply Pollutant loads (both TN and TP, respectively) by the calculated treatment efficiency provided → Yields the Pollutant Load Reduction Value for both TN and TP, respectively

$$TN=((1578 lbs/yr\ TN*0.906*4/6)+(1578 lbs/yr\ TN*0.128*(2/6))$$ = 1,020.4 lbs/yr

$$TP=((592.4 lbs/yr\ TN*0.906*4/6)+(592.4 lbs/yr\ TN*0.128*(2/6))$$ = 383.1 lbs/yr T

Units
- TN or TP Load = lbs/yr
- % Efficiency Provided = should be in decimal for calculation

Pollutant Load Reduction Computation – Example 4 lanes to 6 lane widening project

Pollutant Load Reduction from Existing "grandfathered" lanes

Pollutant Load Reduction from New lanes "above and beyond" ERP requirements

$$TN = ((1578\,lbs/yr\ TN * 0.906 * 4/6) + (1578\,lbs/yr\ TN * 0.128 * (2/6))) = 1{,}020.4\ \text{lbs/y}$$

$$TP = ((592.4\,lbs/yr\ TN * 0.906 * 4/6) + (592.4\,lbs/yr\ TN * 0.128 * (2/6))) = 383.1\ \text{lbs/y}$$

TN = 953.1 lbs/yr
TP = 357.8 lbs/yr

TN = 67.3 lbs/yr
TP = 25.3 lbs/yr

Take Home Message

- Are you accounting for your Water Quality activities appropriately?

- Leave no stone unturned
- Know the difference between your permitting requirements – and the TMDL, BMAP, and/or NNC (Waste Load Allocation) requirements = not always the same!
- **Know where the load is coming from. So we are addressing the correct sources!**

Questions?

Patrick Shearer, PE

Project Engineer

E Sciences Inc.

pshearer@esciencesinc.com

References

1. Harper, Harvey H., Ph.D., P.E., *Stormwater Chemistry and Water Quality: Estimating Pollutant Loadings and Evaluation of Best Management Practices for Water Quality Improvements.*