Technical Memorandum: Model-Based Estimates of Nitrogen Load Reductions Associated with Fertilizer Restriction Implementation

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FINAL REPORT

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SCOPE AND INTENT

At the request of its Policy Board, the Tampa Bay Estuary Program (TBEP) coordinated four workshops on residential fertilizer use guidelines from April 8 – June 10, 2008. The intent was to develop regionally appropriate guidelines that could be incorporated into a local ordinance, should a local government elect to do so. It is hoped that implementation of fertilizer application guidelines specific for this region may reduce stormwater runoff pollutant loads to Tampa Bay – a key goal of TBEP's overall nitrogen reduction strategy. This would support local government efforts to meet regulatory requirements to reduce nutrient loading in designated Impaired Waters of the Tampa Bay watershed.

Several regional recommendations were developed from these workshops (Table 1), summarized in a final report (TBEP 2008), and subsequently presented to the TBEP's Management and Policy Boards for adoption at their August 22, 2008 meetings. At these meetings, the TBEP Management and Policy Boards endorsed the regional recommendations developed through the stakeholder workgroup meetings, including the June 1 - Sept. 30 rainy season ban on non-agricultural nitrogen fertilizer applications.

Consequently, the TBEP Policy Board also directed staff to develop a technical background document summarizing the relative contribution of non-agricultural fertilizer application in the Tampa Bay watershed and provide estimates (best available based on existing literature) of potential nitrogen load reductions associated with implementation of the application recommendations. This document serves as the technical background document requested by the TBEP Policy Board, and upon review by the TBEP Nitrogen Management Consortium, will be provided to the FDEP and EPA for their review in order to establish load reduction credits for any municipality in the Tampa Bay watershed who implements these regional recommendations. Also at the direction of the TBEP Policy Board, TBEP staff will recommend that the NMC request that FDEP and EPA provide concurrence with the findings of this report, here in, to establish nitrogen load reduction credits based upon these analyses or to provide alternative recommendations of fertilizer application restriction implementation credits.

SUMMARY OF RECOMMENDATIONS

It is recommended that the reduction percentage estimates summarized for fertilizer restrictions in this document be applied in addition to any education credits as provided under FDEP directive, if the regional non-agricultural fertilizer application recommendations (including a June 1-Sept 30 ban on N fertilization application) are incorporated and implemented through adoption of a local ordinance. This would potentially result in a 5% TN load reduction credit for education and an additional 4.1% reduction credit (on average) for implementation of the recommended ordinance. Either bay segment-specific or

jurisdiction-specific TN load reduction estimates, as listed in the Recommendations section of this document, can be used in place of the baywide average, if an entity feels these modeled reduction estimates are more applicable to their jurisdiction. In the absence of updated land use information or boundary specific distributions of urbanized land uses, it is recommended that the baywide average be used to apply fertilizer restriction implementation reduction credits to total nitrogen loads attributed to specific entities.

Table 1: Summary of regional fertilizer guidelines as developed through the TBEP sponsored workshops. *Non-agricultural fertilizer application was recommended by TBEP Management Board instead of "residential fertilizer."

Key Issue		Recommendation(s)
Licensing/Certification of Lawn Care Professional	**1**	All site supervisors and managers of professional lawn care companies should be required to attaincertification in the Florida Green Industries Best Management Practices (BMPs) for Protection of Water Resources in Florida training coordinated by the Florida Department of Environmental Protection and taught by professionals with the University of Florida's Institute of Food and Agricultural Sciences. Other employees of lawn and landscape maintenance companies should be required to complete less intensive, task-specific training (i.e., proper mowing, proper fertilization, mulching, debris cleanup, etc) within 90 days of hiring. This less intensive training could be provided by BMP-certified trainers within the company and provided annually or whenever an update is needed due to changes in the state-approved BMPs or local ordinances.
	2	Certification of additional Spanish-speaking BMP trainers and BMP courses taught in Spanish should be strongly encouraged.
	3	A baywide or Tampa Bay region" license or certificate should be created, encompassing Hillsborough, Manatee and Pinellas counties, so that commercial fertilizer applicators would not have to obtain separate BMP certification in each community in which they do business. Reciprocity should be strongly encouraged so that any Tampa Bay community with a fertilizer ordinance recognizes and accepts the regional certification. A special decal denoting this regional certification should be created, and all lawn care/landscape companies who have obtained BMP certification should be required to display this decal on their service vehicles.
Buffer Zones	**1**	Fertilizer should not be applied by either professional applicators or homeowners within 10 feet of a waterway (defined as a bay, river, lake, stream, pond, canal, wetland or any other water body), unless a deflector shield is used. With a deflector shield, fertilizer may be applied as close as 3 feet from a water body.
	2	Waterfront property owners should be encouraged to establish a 6-foot low-maintenance or no mow" zone of plants instead of turfgrass adjacent to waterways to reduce the potential for fertilizer residues entering bodies of water.
Application Timing (Two Alternative Options Developed from Workshops)	**1a**	Ban non-agricultural nitrogen fertilizer application* from June 1 - September 30
	1b	Allow a one-time, slow-release nitrogen fertilizer application (non-agricultural)* from June 1 - September 30 upon a professional determination of nitrogen deficiency.
Reclaimed Water	**1**	Educational information about the amount of nitrogen contained in reclaimed water (treated wastewater) should be provided to homeowners in communities where reclaimed water is provided for irrigation of residential lawns.
Additional Issues Related to Public Education, Outreach & Application Guideline Compliance	**1**	Education about proper fertilizer use is critically needed
	2	Education about slow-release nitrogen fertilizer is important to make homeowners aware that use of these products may not produce an immediate "greening" response in their lawns
	3	Proper irrigation management is critical and inextricably linked to proper fertilization
	4	Controlling spillage of fertilizer and organic debris on non-vegetated areas (including impervious surfaces) is critical
	5	Use of deflector shields is an important element of fertilizer BMPs
	6	No phosphorous fertilizer should be applied at any time of year in the Tampa Bay region without a soil test showing a phosphorous deficiency
	7	No Nitrogen fertilizer should be applied on newly established turf for the first 30 days
	8	Consistent guidelines for fertilizer application are needed for the Tampa Bay region
	9	Adequate enforcement is a key issue that needs to be addressed
	10	Guidelines should encourage the use of trained, certified professionals to apply fertilizer
	11	All landscape maintenance contracts should specify compliance with the DEP Green Industries Best Management Practices
	12	Improve timing and dissemination of public educational materials

ADDITIONAL BACKGROUND INFORMATION

Contribution of Fertilizer in Stormwater Runoff

Soil infiltration (Kelling and Peterson 1975), fertilizer application rate (Barth 1995), and irrigation practices/storm event timing (Linde and Watschke 1997; Shuman 2004) all affect the resulting percentage of fertilizer composed in runoff from urbanized areas where nutrient fertilization through landscape management practices takes place. Most urbanized areas tend to have highly compacted soils and/or a higher degree of impervious surfaces than more natural lands. As a result, the fraction of rainfall which becomes surface water runoff and therefore the total nutrient loading from these areas tends to be high. Added to this is the degree of saturation of the underlying soils both in terms of its nutrient and hydrologic adsorption. If soils are saturated during fertilizer application, then the propensity for nutrient fertilizer and decomposing lawn material to contribute towards runoff concentrations is greater upon subsequent rain events (Linde and Watschke 1997). The combination of these factors tends to "mean that lawn runoff is probably a major source, if not the major source, of nutrients in watersheds with high percentages of residential land" (Table 1; Baker 2007).

Table 1: Comparison of nutrient concentrations of lawn runoff to treated and untreated sewage and lower concentration limits causing lake eutrophication (Adapted from Baker 2007).

	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
Lawn runoff	3-5	0.5-2.0
Raw sewage	38	6.5
Effluent from a typical US metropolitan treatment plant	4.2	0.4
Tampa Bay Estuary direct discharges	3 max	-
Effluent from secondary treatment plant	3-5	2-7
Concentrations typical of eutrophic lakes	1	<0.1

In the Tampa Bay watershed, few studies have investigated the underlying contribution of fertilizer to total nutrient loads to the bay or to surface water runoff from various land uses. One study of the Lake Tarpon watershed found that an estimated 79% of the groundwater nitrogen load to the lake was derived from fertilizer sources (LBG 2004). The land uses within the Lake Tarpon watershed are fairly urbanized (>48%) compared to other areas of the bay and were historically converted from citrus agriculture, so this estimate of fertilizer contribution to groundwater nitrogen loadings is likely at the higher range of estimates.

In other areas of the country, typical ranges of fertilizer contribution within stormwater runoff are between 10 – 25% depending on soil conditions and

application timing prior to storm events (Linde and Watschke 1997; Groffman et. al 2004; Schuman 2004). As such, these values tend to be conservative estimates of potential fertilizer derived nutrient contributions in typical wet-season, urbanized runoff. Because relatively little information exists for the exact contribution of fertilizer in urbanized runoff, especially for the Tampa Bay watershed, a range of values from 10% (conservative) to 79% (liberal) were used to develop estimates of reductions associated with a rainy season prohibition of fertilizer application.

Estimated Compliance of Fertilizer Ordinances

Likewise, with the recent enactment of new fertilizer ordinances in several municipalities in Florida (Lee, Charlotte, Sarasota, and St. Johns counties, and the city of Sanibel) (TBEP 2008) in 2007 and 2008, information regarding expected compliance rates of fertilizer application prohibitions – if the ordinance includes these stipulations – has not yet been generated. These enacted ordinances rely strongly on education of the public and retail fertilizer sales outlets to convey the proper fertilization maintenance schedules to their customers in order to achieve compliance of any prohibitions. Recently the Florida Department of Environmental Protection (FDEP 2008) provided for load reduction credits (≤5%) to be granted towards efforts that could include fertilizer application education; however, the expected rates of implementation and compliance of any educational efforts was still widely unknown.

In Minnesota, regional and state phosphorus fertilizer restriction laws were enacted in 2004 and 2005, respectively (MDA 2007). In 2006, it was estimated that phosphorus fertilizer use (in tons) decreased by 48% after adoption of these laws. Much of these anticipated reductions in use were associated with the replacement and availability of phosphorus-free fertilizers at retail sales outlets. As of this writing, no other estimates of expected compliance rates for fertilizer ordinance implementation are known for similar rule enactments prohibiting the use of nutrient fertilizers.

Based on the available information regarding expected compliance rates and changes in use associated with the enactment of fertilizer prohibitions, a range of values from 10% (conservative) to 75% (liberal) were used to develop estimates of compliance rates across urbanized land uses where fertilizer application would be expected. These compliance rates were applied to the urbanized areas of the Tampa Bay watershed for wet-season estimates of N loads in combination with the expected reductions associated with the varying percent contributions of N fertilizer to urbanized runoff as described above.

OBJECTIVES

Determine the range of expected nitrogen load reductions associated with fertilizer restriction implementation according to the TBEP regional recommendations which include a June 1 – Sept. 30 rainy season prohibition of nitrogen fertilizer application.

METHOD USED TO ASSESS IMPLEMENTATION

A GIS, model-based methodology was employed to characterize the nitrogen load reductions associated with recommended fertilizer restriction implementation within the Tampa Bay watershed. This methodology was similar to that used to estimate nonpoint source pollutant loads to ungaged portions of the watershed from previous load estimate reports generated for the Tampa Bay Nitrogen Management Consortium and to fulfill Reasonable Assurance submittals to FDEP (Zarbock et al. 1994, 1996b; Pribble et al. 2001; Poe et al. 2005; Janicki Environmental 2008).

Specifically, the model estimates were generated to determine the nitrogen load reductions expected across typical urbanized land uses (Table 2) and areas in the watershed (Figure 1) that would be subject to the June 1 – Sept. 30 rainy season prohibition of nitrogen fertilizer application. A range of estimates of compliance (10%-75%) and fertilizer contribution (10%-79%) to run-off derived nitrogen loads were used to develop the estimates. These ranges encompassed the purported compliance rates and fertilizer contributions to surface water runoff that were found from a literature survey as described above.

Table 2: Urbanized land uses as identified from the 2006 SWFWMD Land Use/Land Cover GIS database using the Florida Land Use and Cover Classification System (FLUCCS; SWFWMD 2006) and their associated Coastal Land Use Codes, descriptions, and expected total nitrogen event mean concentrations (mg/L) as utilized by the TBEP to generate load estimates to Tampa Bay (Poe et al. 2005).

Florida Land Use Cover Classification Code (FLUCCSCODE)	FLUCCS Code Description	Coastal Land Use Code (CLUC)	CLUC Description	TBEP Total Nitrogen Event Mean Concentrations (mg/L)
1100	RESIDENTIAL LOW DENSITY < 2 DWELLING UNITS	1	Low Density Residential	1.90
1200	RESIDENTIAL MED DENSITY 2->5 DWELLING UNIT	2	Medium Density Residential	2.23
1300	RESIDENTIAL HIGH DENSITY	3	High Density Residential	2.08
1700	INSTITUTIONAL	7	Institutional	1.18
1800	RECREATIONAL	8	Range/Open Lands	1.19
1820	GOLF COURSES	8	Range/Open Lands	1.19
1900	OPEN LAND	8	Range/Open Lands	1.19

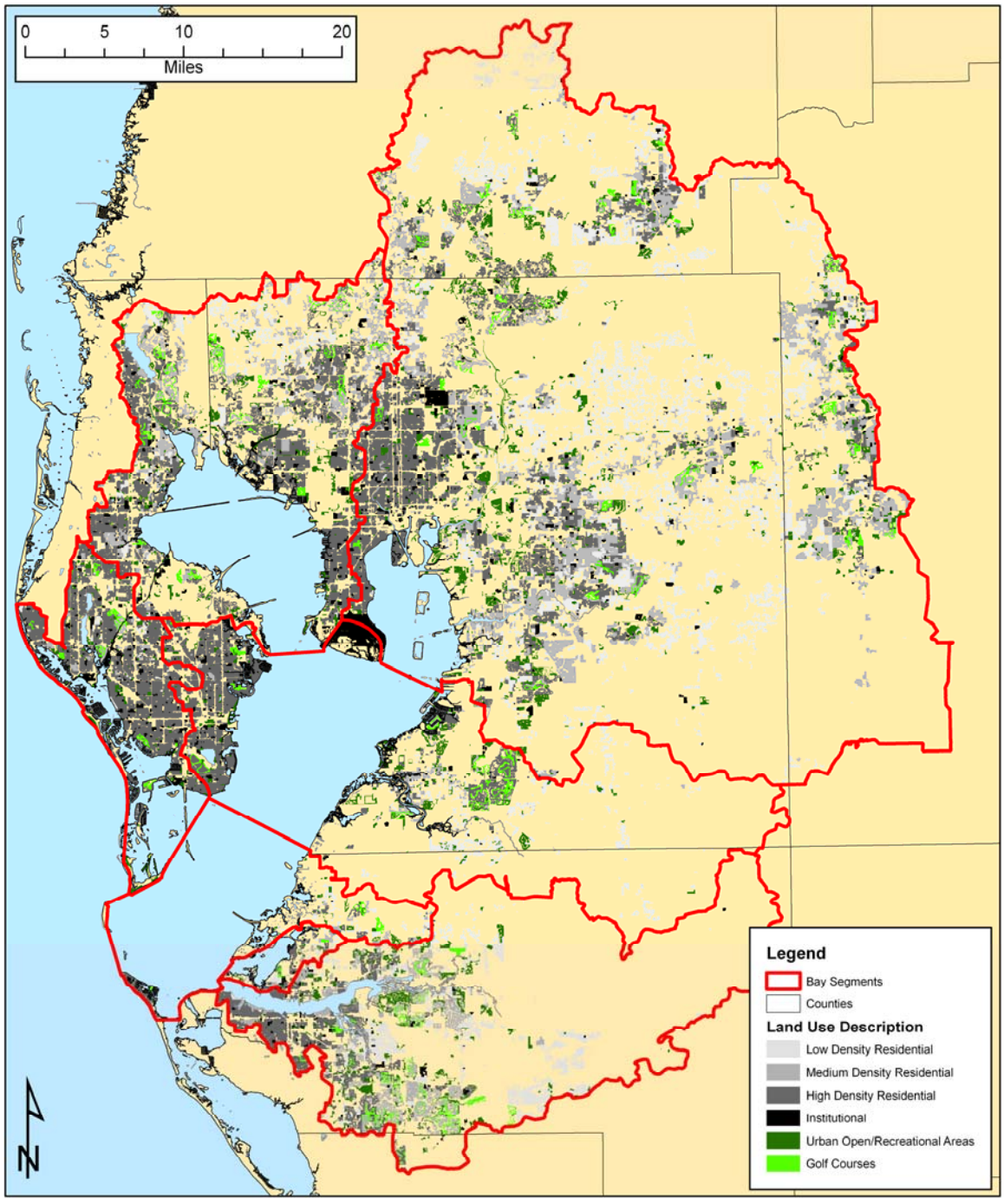

Figure 1: Urbanized land uses within the Tampa Bay watershed that would potentially be affected by fertilizer application ordinances.

Data Sources

Average Wet and Dry Season Rainfall

Average regional rainfall estimates were obtained for the wet (June – Sep.) and dry (Oct. – May) seasons over USGS defined subbasins of the Tampa Bay watershed from the SWFWMD (2008). Period of record (1915 – present) rainfall totals based on area-weighted average values were used to determine the

average total seasonal precipitation (in.) for discrete subbasins of the watershed (Table 2). These estimates were used as the basis for hydrologic inputs to modeled estimates of total nitrogen loads from urbanized areas in the watershed.

Table 2: Average total seasonal precipitation (in.) in USGS defined subbasins of the Tampa Bay watershed (SWFWMD 2008).

Period of Record Seasonal Average (1915-2008)	USGS Subbasin				
	Tampa Bay/Coastal Areas	Hillsborough River	Alafia River	Little Manatee River	Manatee River
Dry Season	20.99	22.62	21.73	21.36	20.93
Wet Season	30.66	31.00	30.96	31.95	32.91

Land Use/Land Cover Data

Land use/land cover GIS data for 2006 were obtained from the SWFWMD and incorporated into the load estimate model (SWFWMD 2006). The land use data were recorded following the Florida Land Use Cover Classification System (FLUCCS) level 3 developed by the Florida Department of Transportation Thematic Mapping Section (FDOT 1985).

For the purpose of assigning land use-specific runoff and pollutant loading factors, the 7 urbanized FLUCCS land uses were aggregated into 5 Coastal Land Use Code (CLUC) classes (Table 1; Appendices A & B), as presented in the most recent load estimate report prepared for Tampa Bay (2004-2007) (Janicki Environmental 2008). The aggregated land use classification system was developed by examining the source literature for the FLUCCS land uses, and combining hydrologically-similar land uses based on stormwater runoff coefficients and land use specific pollutant loading factors. Land use-specific stormwater runoff coefficients and pollutant concentrations were determined from a review of field investigations from central and south Florida, as described below.

Soil Data

The soils coverage includes discrete polygons of individual soil series (types) as identified and delineated by the USDA Natural Resources Conservation Service (NRCS) in the Hillsborough, Pinellas, Manatee, Polk, Pasco, and Sarasota county soil surveys. The GIS coverage of these data was obtained from the SWFWMD (2002). The discrete soils polygons represented a soil series, and were aggregated by hydrologic soil groups (A – D). The NRCS has assigned a hydrologic group identification to each soil series to indicate runoff generating characteristics. "A" soils, in general, generate the least, and "D" soils the most amount of runoff for a given rainfall. The soils coverage was intersected with the land use coverage to provide the GIS layer used to estimate runoff coefficients. Each unique combination of land use type, soil series, and season has been assigned an associated runoff coefficient value (Appendix A).

Land Use-Specific Runoff Coefficients & Stormwater Quality Concentrations

Land use-specific runoff coefficients were obtained from published literature, including references for the west-central and south Florida geographic area. A range of runoff coefficient values for each land use was developed to account for seasonal changes in rainfall/runoff relationships, and for local soils conditions, as described in Zarbock et al. (1994) and used for previously modeled current and future load conditions for the Tampa Bay estuary (Zarbock et al. 1996a; Janicki et al. 2001). These coefficients are presented in Appendix A.

An extensive list of regional water quality concentration data for nonpoint source total nitrogen has been compiled for the modeling effort, and is described in Zarbock et al. (1994; 1996b), Pribble et al. (2001), Poe et al. (2005) and Janicki Environmental (2008). The values are from a number of stormwater sampling programs and represent averaged values from multiple samples from each program (Appendix B).

Modeling Approach

All nonpoint source loads for baseline conditions were estimated using a model-based approach for urbanized areas in the Tampa Bay watershed (Table 1; Figure 1), as follows:

$$TN_L = \sum_{ij} LU_i \cdot EMC_i \cdot (RF_j \cdot RU_{ij}), \text{ where:}$$

TN_L = total annual nitrogen load across urbanized land use category i and seasonal category j (tons),
LU_i = area of urbanized land use category i (acres),
EMC_i = land use specific event mean total nitrogen concentration (mg/L),
RF_j = USGS basin-specific rainfall in dry and wet season category j (in.),
RU_{ij} = land use and soil-type specific runoff coefficient for land use category i and seasonal category j.

Reductions associated with fertilizer ordinance implementation for a rainy season prohibition of fertilizer application were applied to wet season load estimates across all urbanized land uses according to the following adjustments to the loading model employed above. Reduction estimates encompassed the estimated contribution of fertilizer to urbanized runoff, as follows prorating the expected fertilizer contribution to the difference between an urbanized land use and a natural land use:

$$EMC_{(adjusted)i} = EMC_i - [(EMC_i - EMC_{forest}) \cdot X], \text{ where:}$$

$EMC_{(adjusted)i}$ = adjusted land use specific event mean concentration based upon a scaled contribution of fertilizer to the runoff concentration,

EMC_i = land use specific event mean total nitrogen concentration (mg/L),

EMC_{forest} = event mean total nitrogen concentration (mg/L) of a forested land use (1.02 mg/L),

X = 10%, 25%, 50%, and 79% contribution of fertilizer to the difference between an urbanized land use and a forested land use.

These adjusted EMC values were utilized in conjunction with an estimated compliance level across the urbanized land uses for wet season load estimates, as follows:

$$LU_{(adjusted)i} = LU_i \cdot Y, \text{ where:}$$

$LU_{(adjusted)i}$ = adjusted area of urbanized land use category i under 25%, 38%, 50%, and 75% compliance levels (acres),

LU_i = area of urbanized land use category i (acres),

Y = 25%, 38%, 50%, and 75% compliance rates across the urbanized land use category i.

Final reduction estimates were calculated at the 16 different combinations of fertilizer contribution and compliance rates using the TN_L equation above. These reduction estimates were subtracted from the baseline loads and an average annual load reduction percentage was determined across jurisdictional boundaries, bay segments, and baywide for the Tampa Bay estuary watershed.

FINDINGS

Baywide Nitrogen Loads and Yields from Urbanized Land Uses & Associated Modeled Reduction Estimates

Total baseline nitrogen loads from urbanized land uses within the entire Tampa Bay Estuary Program defined watershed were estimated to be 2024 tons/yr based upon average rainfall conditions (Table 3). In the context of previous average estimates for the Tampa Bay watershed generated from all nonpoint sources for the 1992-1994 (1723 tons/yr), 1995-1998 (3,151 tons/yr), 1999-2003 (2,559 tons/yr), and 2004-2007 (2,175 tons/yr) time periods, the urbanized load estimate generated for the bay from this modeling approach were in-line but slightly higher than those reported by Poe et al. (2005) and Janicki Env. (2008). Associated reductions from the baseline load ranged from 0.3% (6.7 tons), according to a 10% compliance rate and 10% contribution of fertilizer to wet-season, urbanized runoff to 19.6% (396 tons), according to a 75% compliance rate and 79% contribution of fertilizer to wet-season, urbanized runoff (Table 3; Figure 2).

Table 3: Model-based estimates of annual average total nitrogen loads (tons) from urbanized land uses of the entire Tampa Bay watershed and expected loads after reductions associated with fertilizer restriction implementation have been applied based upon varying levels of compliance and fertilizer contribution to wet-season runoff. Recommended reduced load estimates are highlighted in blue text.

Fertilizer Contribution	10% Compliance	25% Compliance	50% Compliance	75% Compliance
Baseline Urbanized Runoff		***2023.66***		
10% of Urbanized Runoff	2016.98 (-0.3%)	2006.95 (-0.8%)	1990.23 (-1.7%)	1973.51 (-2.5%)
25% of Urbanized Runoff	2006.95 (-0.8%)	1981.87 (-2.1%)	**1940.07 (-4.1%)**	1898.28 (-6.2%)
50% of Urbanized Runoff	1990.23 (-1.7%)	1940.07 (-4.1%)	1856.49 (-8.3%)	1772.9 (-12.4%)
79% of Urbanized Runoff	1970.84 (-2.6%)	1891.59 (-6.5%)	1759.52 (-13.1%)	1627.45 (-19.6%)

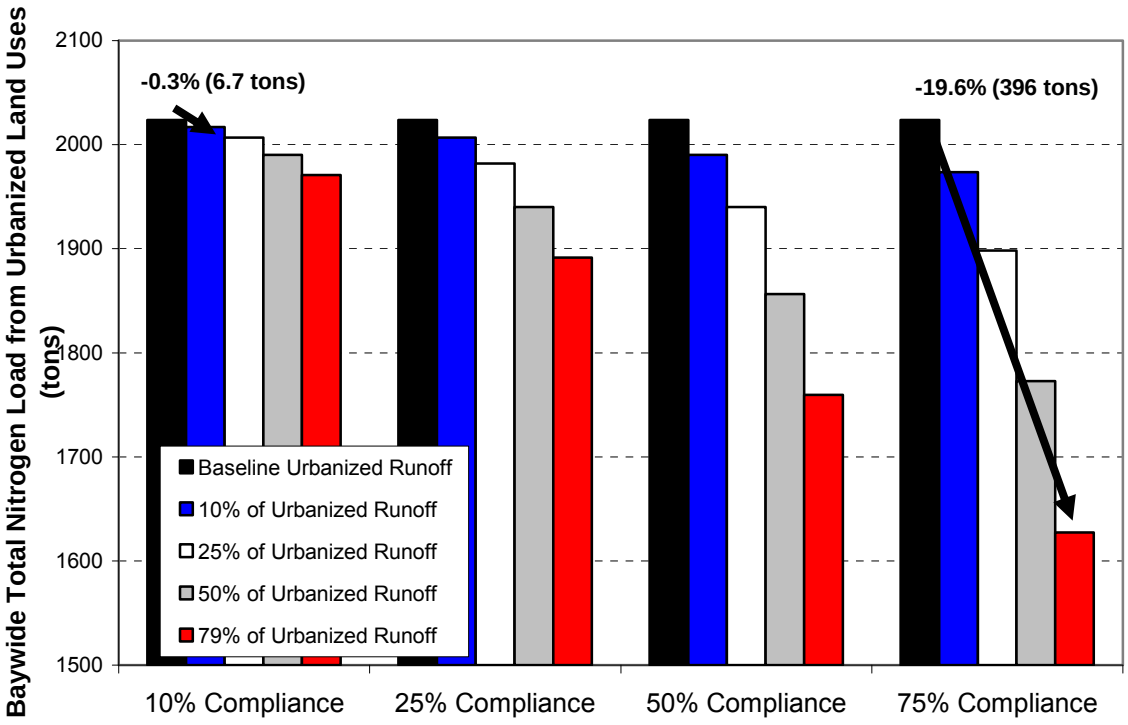

Figure 2: Range of model-based estimates of annual average total nitrogen loads (tons/yr) from urbanized land uses of the entire Tampa Bay watershed and expected reduced loads (%) associated with fertilizer restriction implementation based upon varying levels of compliance and fertilizer contribution to wet-season runoff.

Average yield from urbanized land uses in the entire watershed was estimated to be 9.69 lbs/acre. Again, this estimate is higher than what has been previously reported for the Tampa Bay watershed (~5.4 lbs/acre/yr), but is comparable to values generated for other Southwest Florida estuaries (2.4 – 10 lbs/acre/yr) (Tomasko 2002) and urbanized areas in Baltimore (7.0 lbs/acre/yr) (Groffman et al. 2004). Associated reductions in yields ranged from 0.04 lbs/acre/yr – 1.9 lbs/acre/yr depending upon compliance rate and fertilizer contribution to wet season runoff (Table 4).

Table 4: Model-based estimates of average annual total nitrogen yields (lbs/acre/yr) from urbanized land uses of the entire Tampa Bay watershed and expected loads after reductions associated with fertilizer restriction implementation have been applied based upon varying levels of compliance and fertilizer contribution to wet-season runoff.

Fertilizer Contribution	10% Compliance	25% Compliance	50% Compliance	75% Compliance
Baseline Urbanized Runoff		***9.69***		
10% of Urbanized Runoff	9.65	9.61	9.53	9.45
25% of Urbanized Runoff	9.61	9.49	9.29	9.09
50% of Urbanized Runoff	9.53	9.29	8.89	8.49
79% of Urbanized Runoff	9.43	9.05	8.42	7.79

Bay Segment Nitrogen Loads and Yields from Urbanized Land Uses & Associated Modeled Reduction Estimates

Baseline average total nitrogen loads (tons/yr) from urbanized land uses within the major bay segment watersheds of Tampa Bay ranged from 16.7 tons/yr for Terra Ceia Bay to 907.3 tons/yr for Hillsborough Bay (Table 5). Resulting baseline yields from urbanized land uses ranged from 8.5 lbs/acre/yr for the Hillsborough Bay segment to 13.3 lbs/acre/yr for the Boca Ciega Bay segment indicating that denser residential urbanization was present in the Boca Ciega Bay segment. This is further corroborated by the spatial distribution of the urbanized land uses investigated in the discrete bay segments of the Tampa Bay watershed (Figure 1).

Associated percent reductions from the baseline, bay segment specific loads ranged from 0.3% in the majority of the bay segments' watersheds, according to a 10% compliance rate and 10% contribution of fertilizer to wet-season, urbanized runoff to 20.4% in the Manatee River and Terra Ceia Bay segment watersheds, according to a 75% compliance rate and 79% contribution of fertilizer to wet-season, urbanized runoff (Table 5). The range of estimated total load reductions was about 0.1 tons/yr in the Lower Tampa Bay and Terra Ceia Bay segment watersheds to 175.7 tons/yr in the Hillsborough Bay segment watershed. Again, these total load reduction ranges were based on the array of conservative to liberal assumptions for compliance rates and fertilizer contribution to wet-season, urbanized runoff.

Table 5: Model-based estimates of average annual total nitrogen loads (tons/yr) and yields (lbs/acre/yr) from urbanized land uses of the major bay segments of Tampa Bay and expected loads after reductions associated with fertilizer restriction implementation have been applied based upon varying levels of compliance and fertilizer contribution to wet-season runoff. Recommended estimates are highlighted in gray and italics.

Fertilizer Contribution Scenario	Bay Segment	Acres	Baseline Load	10% Compliance	25% Compliance	50% Compliance	75% Compliance	Baseline Yield	10% Compliance	25% Compliance	50% Compliance	75% Compliance
10%	**Old Tampa Bay**	**76787.0**	**420.3**	418.9 (-0.3%)	416.7 (-0.8%)	413.1 (-1.7%)	409.6 (-2.6%)	10.9	10.9	10.9	10.8	10.7
	Hillsborough Bay	**212859.2**	**907.3**	904.3 (-0.3%)	899.9 (-0.8%)	892.5 (-1.6%)	885.0 (-2.5%)	8.5	8.5	8.5	8.4	8.3
	Middle Tampa Bay	**38246.0**	**204.0**	203.4 (-0.3%)	202.5 (-0.8%)	200.9 (-1.6%)	199.3 (-2.3%)	10.7	10.6	10.6	10.5	10.4
	Lower Tampa Bay	**4805.3**	**21.0**	20.9 (-0.3%)	20.8 (-0.9%)	20.6 (-1.7%)	20.4 (-2.5%)	8.7	8.7	8.6	8.6	8.5
	Boca Ciega Bay	**35673.4**	**236.4**	235.6 (-0.3%)	234.5 (-0.8%)	232.5 (-1.6%)	230.6 (-2.5%)	13.3	13.2	13.1	13.0	12.9
	Manatee River	**46324.2**	**218.0**	217.3 (-0.3%)	216.1 (-0.9%)	214.3 (-1.7%)	212.4 (-2.6%)	9.4	9.4	9.3	9.3	9.2
	Terra Ceia Bay	**3181.2**	**16.7**	16.6 (-0.4%)	16.5 (-0.9%)	16.4 (-1.7%)	16.2 (-2.6%)	10.5	10.4	10.4	10.3	10.2
	Tampa Bay	**417876.3**	**2023.7**	**2017.0 (-0.3%)**	**2007.0 (-0.8%)**	**1990.2 (-1.7%)**	**1973.5 (-2.5%)**	**9.7**	**9.7**	**9.6**	**9.5**	**9.4**
25%	**Old Tampa Bay**	**76787.0**	**420.3**	416.7 (-0.8%)	411.4 (-2.1%)	*402.4 (-4.3%)*	393.5 (-6.4%)	10.9	10.9	10.7	10.5	10.2
	Hillsborough Bay	**212859.2**	**907.3**	899.9 (-0.8%)	888.7 (-2.0%)	*870.2 (-4.1%)*	851.7 (-6.1%)	8.5	8.5	8.4	8.2	8.0
	Middle Tampa Bay	**38246.0**	**204.0**	202.5 (-0.8%)	200.1 (-1.9%)	*196.1 (-3.9%)*	192.1 (-5.8%)	10.7	10.6	10.5	10.3	10.0
	Lower Tampa Bay	**4805.3**	**21.0**	20.8 (-0.9%)	20.5 (-2.1%)	*20.1 (-4.2%)*	19.7 (-6.2%)	8.7	8.6	8.5	8.4	8.2
	Boca Ciega Bay	**35673.4**	**236.4**	234.5 (-0.8%)	231.6 (-2.1%)	*226.7 (-4.1%)*	221.8 (-6.2%)	13.3	13.1	13.0	12.7	12.4
	Manatee River	**46324.2**	**218.0**	216.1 (-0.9%)	213.3 (-2.1%)	*208.6 (-4.3%)*	204.0 (-6.4%)	9.4	9.3	9.2	9.0	8.8
	Terra Ceia Bay	**3181.2**	**16.7**	16.5 (-0.9%)	16.3 (-2.2%)	*16.0 (-4.3%)*	15.6 (-6.5%)	10.5	10.4	10.3	10.0	9.8
	Tampa Bay	**417876.3**	**2023.7**	**2007.0 (-0.8%)**	**1981.9 (-2.1%)**	***1940.1 (-4.1%)***	**1898.3 (-6.2%)**	**9.7**	**9.6**	**9.5**	**9.3**	**9.1**
50%	**Old Tampa Bay**	**76787.0**	**420.3**	413.1 (-1.7%)	402.4 (-4.3%)	384.5 (-8.5%)	366.6 (-12.8%)	10.9	10.8	10.5	10.0	9.5
	Hillsborough Bay	**212859.2**	**907.3**	892.5 (-1.6%)	870.2 (-4.1%)	833.1 (-8.2%)	796.1 (-12.3%)	8.5	8.4	8.2	7.8	7.5
	Middle Tampa Bay	**38246.0**	**204.0**	200.9 (-1.6%)	196.1 (-3.9%)	188.2 (-7.8%)	180.2 (-11.7%)	10.7	10.5	10.3	9.8	9.4
	Lower Tampa Bay	**4805.3**	**21.0**	20.6 (-1.7%)	20.1 (-4.2%)	19.2 (-8.3%)	18.4 (-12.5%)	8.7	8.6	8.4	8.0	7.6
	Boca Ciega Bay	**35673.4**	**236.4**	232.5 (-1.6%)	226.7 (-4.1%)	216.9 (-8.2%)	207.2 (-12.4%)	13.3	13.0	12.7	12.2	11.6
	Manatee River	**46324.2**	**218.0**	214.3 (-1.7%)	208.6 (-4.3%)	199.3 (-8.6%)	189.9 (-12.9%)	9.4	9.3	9.0	8.6	8.2
	Terra Ceia Bay	**3181.2**	**16.7**	16.4 (-1.7%)	16.0 (-4.3%)	15.2 (-8.6%)	14.5 (-12.9%)	10.5	10.3	10.0	9.6	9.1
	Tampa Bay	**417876.3**	**2023.7**	**1990.2 (-1.7%)**	**1940.1 (-4.1%)**	**1856.5 (-8.3%)**	**1772.9 (-12.4%)**	**9.7**	**9.5**	**9.3**	**8.9**	**8.5**

Table 5 (cont'd): Model-based estimates of average annual total nitrogen loads (tons/yr) and yields (lbs/acre/yr) from urbanized land uses of the major bay segments of Tampa Bay and expected loads after reductions associated with fertilizer restriction implementation have been applied based upon varying levels of compliance and fertilizer contribution to wet-season runoff.

Fertilizer Contribution Scenario	Bay Segment	Acres	Baseline Load	10% Compliance	25% Compliance	50% Compliance	75% Compliance	Baseline Yields	10% Compliance	25% Compliance	50% Compliance	75% Compliance
79%	**Old Tampa Bay**	**76787.0**	**420.3**	409.0 (-2.7%)	392.0 (-6.7%)	363.8 (-13.4%)	335.5 (-20.2%)	10.9	10.7	10.2	9.5	8.7
	Hillsborough Bay	**212859.2**	**907.3**	883.9 (-2.6%)	848.7 (-6.5%)	790.1 (-12.9%)	731.6 (-19.4%)	8.5	8.3	8.0	7.4	6.9
	Middle Tampa Bay	**38246.0**	**204.0**	199.0 (-2.5%)	191.5 (-6.1%)	179.0 (-12.3%)	166.4 (-18.4%)	10.7	10.4	10.0	9.4	8.7
	Lower Tampa Bay	**4805.3**	**21.0**	20.4 (-2.6%)	19.6 (-6.5%)	18.2 (-13.1%)	16.8 (-19.7%)	8.7	8.5	8.2	7.6	7.0
	Boca Ciega Bay	**35673.4**	**236.4**	230.3 (-2.6%)	221.0 (-6.5%)	205.6 (-13.0%)	190.2 (-19.5%)	13.3	12.9	12.4	11.5	10.7
	Manatee River	**46324.2**	**218.0**	212.1 (-2.7%)	203.2 (-6.8%)	188.4 (-13.6%)	173.6 (-20.4%)	9.4	9.2	8.8	8.1	7.5
	Terra Ceia Bay	**3181.2**	**16.7**	16.2 (-2.7%)	15.5 (-6.8%)	14.4 (-13.6%)	13.3 (-20.4%)	10.5	10.2	9.8	9.1	8.3
	Tampa Bay	**417876.3**	**2023.7**	**1970.8 (-2.6%)**	**1891.6 (-6.5%)**	**1759.5 (-13.1%)**	**1627.5 (-19.6%)**	**9.7**	**9.4**	**9.1**	**8.4**	**7.8**

Jurisdictional Nitrogen Loads and Yields from Urbanized Land Uses & Associated Modeled Reduction Estimates

Estimates of total nitrogen loads and associated reduced loads with 10% (Table 6), 25% (Table 7), 50% (Table 8), and 79% (Table 9) contributions of fertilizer to wet-season, urbanized runoff in discrete jurisdictions of the Tampa Bay watershed varied according to the acreage and degree of urbanized lands within each jurisdiction. Total nitrogen baseline loads were least from the City of St. Leo in Pasco County (~0.01 tons/yr based upon about 1.4 acres of urbanized land uses falling within the watershed), and greatest from unincorporated Hillsborough County (729.1 tons/yr over 166,783 acres of urbanized land uses). Estimated load reductions were relatively indecipherable for small, modestly urbanized or undeveloped jurisdictions (e.g. the Community Development District of Heritage Harbour Marketplace and the City of St. Leo) based on the GIS model employed. However, regardless of jurisdictional size and for those jurisdictions with a greater degree of medium to high residential densities composing the urbanized land uses within the jurisdictions' boundaries, estimated reductions in total nitrogen loads were evident across all modeled levels of compliance and fertilizer contribution to runoff (Tables 6–9).

Baseline average estimated nitrogen yields ranged from 3.45 lbs/acre (Community Development District of Heritage Harbour Marketplace) to 14.4 lbs/acre (City of Redington Beach). Estimated reductions in yields resulting from fertilizer ordinance implementation ranged from non-estimable to 2.93 lbs/acre (City of Kenneth City).

Table 6: Model-based estimates of annual average total nitrogen loads (tons/yr) and yields (lbs/acre/yr) from urbanized land uses of the major bay segments of Tampa Bay and expected reduced loads associated with fertilizer restriction implementation based upon varying levels of compliance and a 10% fertilizer contribution to wet-season runoff.

Jurisdiction	Acres	Total Nitrogen Load (tons/yr)					Average Nitrogen Yield (lbs./acre)				
		Baseline	Compliance Rate				Baseline	Compliance Rate			
			10%	25%	50%	75%		10%	25%	50%	75%
CDD: Greyhawk Landing	429.7	1.99	1.98	1.97	1.96	1.94	9.26	9.22	9.17	9.12	9.03
CDD: Harbourage at Braden River	41.4	0.26	0.26	0.26	0.26	0.26	12.57	12.57	12.57	12.57	12.57
CDD: Heritage Harbour	580.9	2.47	2.46	2.45	2.43	2.41	8.50	8.47	8.44	8.37	8.30
CDD: Heritage Harbour Marketplace	40.5	0.07	0.07	0.07	0.07	0.07	3.45	3.45	3.45	3.45	3.45
CDD: Lakewood Ranch	2829.7	12.99	12.95	12.88	12.76	12.65	9.18	9.15	9.10	9.02	8.94
CDD: Lexington	106.1	0.49	0.49	0.49	0.49	0.48	9.24	9.24	9.24	9.24	9.05
CDD: Tara	347.0	1.73	1.73	1.72	1.70	1.69	9.97	9.97	9.91	9.80	9.74
CDD: University Place	160.5	0.94	0.93	0.93	0.92	0.91	11.71	11.59	11.59	11.47	11.34
CDD: Waterlefe	307.7	1.52	1.51	1.50	1.49	1.48	9.88	9.81	9.75	9.68	9.62
City of Bradenton	3659.8	24.56	24.47	24.34	24.12	23.90	13.42	13.37	13.30	13.18	13.06
City of Clearwater	5901.3	35.96	35.84	35.67	35.37	35.08	12.19	12.15	12.09	11.99	11.89
City of Gulfport	1548.6	10.61	10.58	10.53	10.44	10.36	13.70	13.66	13.60	13.48	13.38
City of Indian Shores	14.9	0.08	0.08	0.08	0.08	0.08	10.73	10.73	10.73	10.73	10.73
City of Kenneth City	388.9	2.90	2.89	2.87	2.85	2.83	14.91	14.86	14.76	14.66	14.55
City of Lakeland	5469.1	23.82	23.75	23.64	23.45	23.26	8.71	8.69	8.64	8.58	8.51
City of Largo	5201.4	32.40	32.29	32.12	31.85	31.57	12.46	12.42	12.35	12.25	12.14
City of Madeira Beach	296.8	1.98	1.98	1.97	1.95	1.94	13.34	13.34	13.28	13.14	13.07
City of N. Redington Beach	61.8	0.42	0.41	0.41	0.41	0.41	13.59	13.27	13.27	13.27	13.27
City of Oldsmar	1749.9	9.34	9.30	9.25	9.17	9.09	10.67	10.63	10.57	10.48	10.39
City of Palmetto	1931.5	10.82	10.78	10.73	10.64	10.55	11.20	11.16	11.11	11.02	10.92
City of Pinellas Park	5266.8	32.28	32.17	32.00	31.72	31.45	12.26	12.22	12.15	12.05	11.94
City of Plant City	5215.3	24.66	24.58	24.46	24.26	24.06	9.46	9.43	9.38	9.30	9.23
City of Redington Beach	113.9	0.82	0.81	0.81	0.80	0.80	14.40	14.22	14.22	14.05	14.05
City of Redington Shores	105.3	0.64	0.63	0.63	0.63	0.62	12.16	11.97	11.97	11.97	11.78
City of S. Pasadena	200.7	1.22	1.22	1.21	1.20	1.19	12.15	12.15	12.06	11.96	11.86
City of Safety Harbor	2387.3	12.91	12.87	12.80	12.69	12.58	10.82	10.78	10.72	10.63	10.54
City of San Antonio	312.1	1.40	1.39	1.38	1.37	1.36	8.97	8.91	8.84	8.78	8.72
City of Seminole	4787.8	29.73	29.63	29.48	29.23	28.98	12.42	12.38	12.31	12.21	12.11
City of St. Leo	1.4	0.01	0.01	0.01	0.01	0.01	14.21	14.21	14.21	14.21	14.21
City of St. Petersburg	26138.7	183.06	182.46	181.58	180.10	178.62	14.01	13.96	13.89	13.78	13.67
City of St. Petersburg Beach	833.1	5.26	5.24	5.21	5.17	5.13	12.63	12.58	12.51	12.41	12.32
City of Tampa	32622.0	185.84	185.23	184.32	182.79	181.27	11.39	11.36	11.30	11.21	11.11
City of Tarpon Springs	189.5	0.74	0.74	0.74	0.73	0.72	7.81	7.81	7.81	7.71	7.60
City of Temple Terrace	2993.0	13.38	13.33	13.26	13.15	13.04	8.94	8.91	8.86	8.79	8.71
City of Treasure Island	506.4	3.06	3.05	3.04	3.01	2.99	12.09	12.05	12.01	11.89	11.81
City of Zephyrhills	2519.7	9.46	9.43	9.39	9.32	9.24	7.51	7.49	7.45	7.40	7.33
Unincorporated Hills. Co.	166783.2	729.14	726.75	723.17	717.20	711.23	8.74	8.71	8.67	8.60	8.53
Unincorporated Manatee Co.	44729.1	198.45	197.77	196.76	195.07	193.39	8.87	8.84	8.80	8.72	8.65
Unincorporated Pasco Co.	36225.7	147.20	146.72	146.01	144.81	143.62	8.13	8.10	8.06	7.99	7.93
Unincorporated Pinellas Co.	24811.2	144.53	144.04	143.32	142.11	140.90	11.65	11.61	11.55	11.46	11.36
Unincorporated Polk Co.	28176.7	114.36	113.97	113.39	112.42	111.45	8.12	8.09	8.05	7.98	7.91
Unincorporated Sarasota Co.	582.1	3.24	3.23	3.21	3.18	3.15	11.13	11.10	11.03	10.93	10.82
Unresolved Areas	1307.9	6.95	6.92	6.89	6.83	6.78	10.63	10.58	10.54	10.44	10.37
Total Tampa Bay	417876.3	2023.7	2017.0	2007.0	1990.2	1973.5	9.69	9.65	9.61	9.53	9.45

Table 7: Model-based estimates of annual average total nitrogen loads (tons/yr) and yields (lbs/acre/yr) from urbanized land uses of the major bay segments of Tampa Bay and expected reduced loads associated with fertilizer restriction implementation based upon varying levels of compliance and a 25% fertilizer contribution to wet-season runoff. Recommended reduced load estimates are highlighted in gray.

Jurisdiction	Acres	Total Nitrogen Load (tons/yr)					Average Nitrogen Yield (lbs./acre)				
		Baseline	Compliance Rate				Baseline	Compliance Rate			
			10%	25%	50%	75%		10%	25%	50%	75%
CDD: Greyhawk Landing	429.7	1.99	1.97	1.95	1.90	1.86	9.26	9.17	9.08	8.84	8.66
CDD: Harbourage at Braden River	41.4	0.26	0.26	0.26	0.25	0.25	12.57	12.57	12.57	12.09	12.09
CDD: Heritage Harbour	580.9	2.47	2.45	2.42	2.37	2.32	8.50	8.44	8.33	8.16	7.99
CDD: Heritage Harbour Marketplace	40.5	0.07	0.07	0.07	0.07	0.07	3.45	3.45	3.45	3.45	3.45
CDD: Lakewood Ranch	2829.7	12.99	12.88	12.71	12.43	12.14	9.18	9.10	8.98	8.79	8.58
CDD: Lexington	106.1	0.49	0.49	0.48	0.47	0.46	9.24	9.24	9.05	8.86	8.68
CDD: Tara	347.0	1.73	1.72	1.69	1.66	1.62	9.97	9.91	9.74	9.57	9.34
CDD: University Place	160.5	0.94	0.93	0.92	0.89	0.87	11.71	11.59	11.47	11.09	10.84
CDD: Waterlefe	307.7	1.52	1.50	1.48	1.45	1.42	9.88	9.75	9.62	9.42	9.23
City of Bradenton	3659.8	24.56	24.34	24.01	23.46	22.92	13.42	13.30	13.12	12.82	12.53
City of Clearwater	5901.3	35.96	35.67	35.23	34.49	33.75	12.19	12.09	11.94	11.69	11.44
City of Gulfport	1548.6	10.61	10.53	10.40	10.19	9.98	13.70	13.60	13.43	13.16	12.89
City of Indian Shores	14.9	0.08	0.08	0.08	0.07	0.07	10.73	10.73	10.73	9.39	9.39
City of Kenneth City	388.9	2.90	2.87	2.84	2.78	2.72	14.91	14.76	14.61	14.30	13.99
City of Lakeland	5469.1	23.82	23.64	23.36	22.89	22.43	8.71	8.64	8.54	8.37	8.20
City of Largo	5201.4	32.40	32.12	31.71	31.02	30.33	12.46	12.35	12.19	11.93	11.66
City of Madeira Beach	296.8	1.98	1.97	1.94	1.90	1.86	13.34	13.28	13.07	12.80	12.54
City of N. Redington Beach	61.8	0.42	0.41	0.41	0.40	0.39	13.59	13.27	13.27	12.95	12.62
City of Oldsmar	1749.9	9.34	9.25	9.13	8.93	8.73	10.67	10.57	10.43	10.21	9.98
City of Palmetto	1931.5	10.82	10.73	10.59	10.37	10.15	11.20	11.11	10.97	10.74	10.51
City of Pinellas Park	5266.8	32.28	32.00	31.59	30.90	30.21	12.26	12.15	12.00	11.73	11.47
City of Plant City	5215.3	24.66	24.46	24.16	23.66	23.16	9.46	9.38	9.27	9.07	8.88
City of Redington Beach	113.9	0.82	0.81	0.80	0.78	0.77	14.40	14.22	14.05	13.70	13.52
City of Redington Shores	105.3	0.64	0.63	0.62	0.61	0.60	12.16	11.97	11.78	11.59	11.40
City of S. Pasadena	200.7	1.22	1.21	1.20	1.17	1.15	12.15	12.06	11.96	11.66	11.46
City of Safety Harbor	2387.3	12.91	12.80	12.63	12.36	12.08	10.82	10.72	10.58	10.35	10.12
City of San Antonio	312.1	1.40	1.38	1.37	1.34	1.31	8.97	8.84	8.78	8.59	8.40
City of Seminole	4787.8	29.73	29.48	29.11	28.49	27.87	12.42	12.31	12.16	11.90	11.64
City of St. Leo	1.4	0.01	0.01	0.01	0.01	0.01	14.21	14.21	14.21	14.21	14.21
City of St. Petersburg	26138.7	183.06	181.58	179.36	175.67	171.97	14.01	13.89	13.72	13.44	13.16
City of St. Petersburg Beach	833.1	5.26	5.21	5.15	5.04	4.93	12.63	12.51	12.36	12.10	11.84
City of Tampa	32622.0	185.84	184.32	182.03	178.22	174.40	11.39	11.30	11.16	10.93	10.69
City of Tarpon Springs	189.5	0.74	0.74	0.73	0.71	0.70	7.81	7.81	7.71	7.50	7.39
City of Temple Terrace	2993.0	13.38	13.26	13.09	12.81	12.53	8.94	8.86	8.75	8.56	8.37
City of Treasure Island	506.4	3.06	3.04	3.00	2.94	2.88	12.09	12.01	11.85	11.61	11.37
City of Zephyrhills	2519.7	9.46	9.39	9.28	9.09	8.91	7.51	7.45	7.37	7.22	7.07
Unincorporated Hills. Co.	166783.2	729.14	723.17	714.22	699.29	684.37	8.74	8.67	8.56	8.39	8.21
Unincorporated Manatee Co.	44729.1	198.45	196.76	194.23	190.01	185.79	8.87	8.80	8.68	8.50	8.31
Unincorporated Pasco Co.	36225.7	147.20	146.01	144.22	141.23	138.25	8.13	8.06	7.96	7.80	7.63
Unincorporated Pinellas Co.	24811.2	144.53	143.32	141.50	138.48	135.45	11.65	11.55	11.41	11.16	10.92
Unincorporated Polk Co.	28176.7	114.36	113.39	111.93	109.51	107.09	8.12	8.05	7.94	7.77	7.60
Unincorporated Sarasota Co.	582.1	3.24	3.21	3.17	3.10	3.03	11.13	11.03	10.89	10.65	10.41
Unresolved Areas	1307.9	6.95	6.89	6.81	6.66	6.52	10.63	10.54	10.41	10.18	9.97
Total Tampa Bay	417876.3	2023.7	2007.0	1981.9	1940.1	1898.3	9.69	9.61	9.49	9.29	9.09

Table 8: Model-based estimates of annual average total nitrogen loads (tons/yr) and yields (lbs/acre/yr) from urbanized land uses of the major bay segments of Tampa Bay and expected reduced loads associated with fertilizer restriction implementation based upon varying levels of compliance and a 50% fertilizer contribution to wet-season runoff.

Jurisdiction	Acres	Total Nitrogen Load (tons/yr)					Average Nitrogen Yield (lbs./acre)				
		Baseline	Compliance Rate				Baseline	Compliance Rate			
			10%	25%	50%	75%		10%	25%	50%	75%
CDD: Greyhawk Landing	429.7	1.99	1.96	1.90	1.81	1.72	9.26	9.12	8.84	8.42	8.01
CDD: Harbourage at Braden River	41.4	0.26	0.26	0.25	0.24	0.23	12.57	12.57	12.09	11.60	11.12
CDD: Heritage Harbour	580.9	2.47	2.43	2.37	2.27	2.17	8.50	8.37	8.16	7.82	7.47
CDD: Heritage Harbour Marketplace	40.5	0.07	0.07	0.07	0.07	0.07	3.45	3.45	3.45	3.45	3.45
CDD: Lakewood Ranch	2829.7	12.99	12.76	12.43	11.86	11.30	9.18	9.02	8.79	8.38	7.99
CDD: Lexington	106.1	0.49	0.49	0.47	0.45	0.43	9.24	9.24	8.86	8.49	8.11
CDD: Tara	347.0	1.73	1.70	1.66	1.58	1.51	9.97	9.80	9.57	9.11	8.70
CDD: University Place	160.5	0.94	0.92	0.89	0.85	0.80	11.71	11.47	11.09	10.59	9.97
CDD: Waterlefe	307.7	1.52	1.49	1.45	1.38	1.32	9.88	9.68	9.42	8.97	8.58
City of Bradenton	3659.8	24.56	24.12	23.46	22.37	21.28	13.42	13.18	12.82	12.22	11.63
City of Clearwater	5901.3	35.96	35.37	34.49	33.01	31.54	12.19	11.99	11.69	11.19	10.69
City of Gulfport	1548.6	10.61	10.44	10.19	9.77	9.34	13.70	13.48	13.16	12.62	12.06
City of Indian Shores	14.9	0.08	0.08	0.07	0.07	0.07	10.73	10.73	9.39	9.39	9.39
City of Kenneth City	388.9	2.90	2.85	2.78	2.66	2.54	14.91	14.66	14.30	13.68	13.06
City of Lakeland	5469.1	23.82	23.45	22.89	21.96	21.04	8.71	8.58	8.37	8.03	7.69
City of Largo	5201.4	32.40	31.85	31.02	29.64	28.25	12.46	12.25	11.93	11.40	10.86
City of Madeira Beach	296.8	1.98	1.95	1.90	1.82	1.75	13.34	13.14	12.80	12.27	11.79
City of N. Redington Beach	61.8	0.42	0.41	0.40	0.38	0.36	13.59	13.27	12.95	12.30	11.65
City of Oldsmar	1749.9	9.34	9.17	8.93	8.52	8.12	10.67	10.48	10.21	9.74	9.28
City of Palmetto	1931.5	10.82	10.64	10.37	9.92	9.48	11.20	11.02	10.74	10.27	9.82
City of Pinellas Park	5266.8	32.28	31.72	30.90	29.52	28.13	12.26	12.05	11.73	11.21	10.68
City of Plant City	5215.3	24.66	24.26	23.66	22.66	21.66	9.46	9.30	9.07	8.69	8.31
City of Redington Beach	113.9	0.82	0.80	0.78	0.75	0.71	14.40	14.05	13.70	13.17	12.47
City of Redington Shores	105.3	0.64	0.63	0.61	0.59	0.56	12.16	11.97	11.59	11.21	10.64
City of S. Pasadena	200.7	1.22	1.20	1.17	1.12	1.07	12.15	11.96	11.66	11.16	10.66
City of Safety Harbor	2387.3	12.91	12.69	12.36	11.80	11.24	10.82	10.63	10.35	9.89	9.42
City of San Antonio	312.1	1.40	1.37	1.34	1.28	1.23	8.97	8.78	8.59	8.20	7.88
City of Seminole	4787.8	29.73	29.23	28.49	27.25	26.01	12.42	12.21	11.90	11.38	10.87
City of St. Leo	1.4	0.01	0.01	0.01	0.01	0.01	14.21	14.21	14.21	14.21	14.21
City of St. Petersburg	26138.7	183.06	180.10	175.67	168.27	160.88	14.01	13.78	13.44	12.88	12.31
City of St. Petersburg Beach	833.1	5.26	5.17	5.04	4.82	4.61	12.63	12.41	12.10	11.57	11.07
City of Tampa	32622.0	185.84	182.79	178.22	170.59	162.97	11.39	11.21	10.93	10.46	9.99
City of Tarpon Springs	189.5	0.74	0.73	0.71	0.68	0.65	7.81	7.71	7.50	7.18	6.86
City of Temple Terrace	2993.0	13.38	13.15	12.81	12.25	11.69	8.94	8.79	8.56	8.19	7.81
City of Treasure Island	506.4	3.06	3.01	2.94	2.82	2.70	12.09	11.89	11.61	11.14	10.66
City of Zephyrhills	2519.7	9.46	9.32	9.09	8.72	8.35	7.51	7.40	7.22	6.92	6.63
Unincorporated Hills. Co.	166783.2	729.14	717.20	699.29	669.45	639.60	8.74	8.60	8.39	8.03	7.67
Unincorporated Manatee Co.	44729.1	198.45	195.07	190.01	181.57	173.13	8.87	8.72	8.50	8.12	7.74
Unincorporated Pasco Co.	36225.7	147.20	144.81	141.23	135.26	129.29	8.13	7.99	7.80	7.47	7.14
Unincorporated Pinellas Co.	24811.2	144.53	142.11	138.48	132.42	126.37	11.65	11.46	11.16	10.67	10.19
Unincorporated Polk Co.	28176.7	114.36	112.42	109.51	104.66	99.82	8.12	7.98	7.77	7.43	7.09
Unincorporated Sarasota Co.	582.1	3.24	3.18	3.10	2.96	2.83	11.13	10.93	10.65	10.17	9.72
Unresolved Areas	1307.9	6.95	6.83	6.66	6.38	6.10	10.63	10.44	10.18	9.76	9.33
Total Tampa Bay	417876.3	2023.7	1990.2	1940.1	1856.5	1772.9	9.69	9.53	9.29	8.89	8.49

Table 9: Model-based estimates of annual average total nitrogen loads (tons/yr) and yields (lbs/acre/yr) from urbanized land uses of the major bay segments of Tampa Bay and expected reduced loads associated with fertilizer restriction implementation based upon varying levels of compliance and a 79% fertilizer contribution to wet-season runoff.

Jurisdiction	Acres	Total Nitrogen Load (tons/yr)					Average Nitrogen Yield (lbs./acre)				
		Baseline	Compliance Rate				Baseline	Compliance Rate			
			10%	25%	50%	75%		10%	25%	50%	75%
CDD: Greyhawk Landing	429.7	1.99	1.94	1.85	1.71	1.57	9.26	9.03	8.61	7.96	7.31
CDD: Harbourage at Braden River	41.4	0.26	0.26	0.25	0.23	0.21	12.57	12.57	12.09	11.12	10.15
CDD: Heritage Harbour	580.9	2.47	2.41	2.31	2.15	1.99	8.50	8.30	7.95	7.40	6.85
CDD: Heritage Harbour Marketplace	40.5	0.07	0.07	0.07	0.07	0.07	3.45	3.45	3.45	3.45	3.45
CDD: Lakewood Ranch	2829.7	12.99	12.63	12.10	11.21	10.31	9.18	8.93	8.55	7.92	7.29
CDD: Lexington	106.1	0.49	0.48	0.46	0.42	0.39	9.24	9.05	8.68	7.92	7.35
CDD: Tara	347.0	1.73	1.68	1.61	1.49	1.38	9.97	9.68	9.28	8.59	7.95
CDD: University Place	160.5	0.94	0.91	0.87	0.80	0.72	11.71	11.34	10.84	9.97	8.97
CDD: Waterlefe	307.7	1.52	1.47	1.41	1.30	1.20	9.88	9.55	9.16	8.45	7.80
City of Bradenton	3659.8	24.56	23.87	22.83	21.10	19.38	13.42	13.04	12.48	11.53	10.59
City of Clearwater	5901.3	35.96	35.03	33.63	31.30	28.97	12.19	11.87	11.40	10.61	9.82
City of Gulfport	1548.6	10.61	10.35	9.94	9.28	8.61	13.70	13.37	12.84	11.99	11.12
City of Indian Shores	14.9	0.08	0.08	0.07	0.07	0.06	10.73	10.73	9.39	9.39	8.05
City of Kenneth City	388.9	2.90	2.82	2.71	2.52	2.33	14.91	14.50	13.94	12.96	11.98
City of Lakeland	5469.1	23.82	23.23	22.35	20.89	19.42	8.71	8.49	8.17	7.64	7.10
City of Largo	5201.4	32.40	31.52	30.22	28.03	25.85	12.46	12.12	11.62	10.78	9.94
City of Madeira Beach	296.8	1.98	1.93	1.86	1.73	1.61	13.34	13.01	12.54	11.66	10.85
City of N. Redington Beach	61.8	0.42	0.41	0.39	0.36	0.33	13.59	13.27	12.62	11.65	10.68
City of Oldsmar	1749.9	9.34	9.08	8.69	8.05	7.41	10.67	10.38	9.93	9.20	8.47
City of Palmetto	1931.5	10.82	10.54	10.11	9.41	8.70	11.20	10.91	10.47	9.74	9.01
City of Pinellas Park	5266.8	32.28	31.40	30.09	27.91	25.73	12.26	11.92	11.43	10.60	9.77
City of Plant City	5215.3	24.66	24.03	23.08	21.50	19.93	9.46	9.22	8.85	8.25	7.64
City of Redington Beach	113.9	0.82	0.80	0.76	0.71	0.66	14.40	14.05	13.35	12.47	11.59
City of Redington Shores	105.3	0.64	0.62	0.60	0.56	0.52	12.16	11.78	11.40	10.64	9.88
City of S. Pasadena	200.7	1.22	1.19	1.14	1.06	0.99	12.15	11.86	11.36	10.56	9.86
City of Safety Harbor	2387.3	12.91	12.56	12.03	11.15	10.27	10.82	10.52	10.08	9.34	8.60
City of San Antonio	312.1	1.40	1.36	1.31	1.22	1.13	8.97	8.72	8.40	7.82	7.24
City of Seminole	4787.8	29.73	28.94	27.77	25.81	23.85	12.42	12.09	11.60	10.78	9.96
City of St. Leo	1.4	0.01	0.01	0.01	0.01	0.01	14.21	14.21	14.21	14.21	14.21
City of St. Petersburg	26138.7	183.06	178.39	171.38	159.70	148.02	14.01	13.65	13.11	12.22	11.33
City of St. Petersburg Beach	833.1	5.26	5.12	4.92	4.57	4.23	12.63	12.29	11.81	10.97	10.15
City of Tampa	32622.0	185.84	181.02	173.79	161.75	149.70	11.39	11.10	10.65	9.92	9.18
City of Tarpon Springs	189.5	0.74	0.72	0.69	0.64	0.59	7.81	7.60	7.28	6.76	6.23
City of Temple Terrace	2993.0	13.38	13.02	12.49	11.60	10.71	8.94	8.70	8.35	7.75	7.16
City of Treasure Island	506.4	3.06	2.98	2.87	2.68	2.48	12.09	11.77	11.34	10.58	9.79
City of Zephyrhills	2519.7	9.46	9.23	8.88	8.29	7.70	7.51	7.33	7.05	6.58	6.11
Unincorporated Hills. Co.	166783.2	729.14	710.28	681.98	634.83	587.67	8.74	8.52	8.18	7.61	7.05
Unincorporated Manatee Co.	44729.1	198.45	193.12	185.11	171.78	158.45	8.87	8.64	8.28	7.68	7.08
Unincorporated Pasco Co.	36225.7	147.20	143.43	137.77	128.34	118.90	8.13	7.92	7.61	7.09	6.56
Unincorporated Pinellas Co.	24811.2	144.53	140.70	134.96	125.40	115.84	11.65	11.34	10.88	10.11	9.34
Unincorporated Polk Co.	28176.7	114.36	111.29	106.70	99.04	91.39	8.12	7.90	7.57	7.03	6.49
Unincorporated Sarasota Co.	582.1	3.24	3.15	3.02	2.80	2.59	11.13	10.82	10.38	9.62	8.90
Unresolved Areas	1307.9	6.95	6.77	6.50	6.05	5.60	10.63	10.35	9.94	9.25	8.56
Total Tampa Bay	417876.3	2023.7	1970.8	1891.6	1759.5	1627.5	9.69	9.43	9.05	8.42	7.79

RECOMMENDATIONS

A range of fertilizer restriction reduction estimates were generated according to GIS, model-based total nitrogen loads from urbanized land uses within the Tampa Bay watershed. Depending on the estimated relative contribution of fertilizer to wet-season urbanized runoff, the degree of expected compliance of a fertilizer ordinance, and the adoption of an ordinance in jurisdictions throughout the watershed, baywide total nitrogen load reductions estimates could be as high as 396 tons/yr. Granted this estimate is based upon a relatively high contribution of fertilizer to resulting wet-season urbanized loads (79%) as seen in groundwater nitrogen loads in the Lake Tarpon watershed (LBG 2004) and a relatively high compliance rate with any enacted wet-season prohibition of fertilizer application (75%).

Conservatively, fertilizer contributions to urbanized runoff probably approaches 25% in urbanized areas during wet-season, saturated soil conditions based on research from other states (Linde and Watschke 1997; Groffman et. al 2004; Schuman 2004). In addition, the very first estimates of expected compliance of fertilizer application prohibitions have been generated in the state of Minnesota in response to phosphorus-free fertilizer regulations first implemented in 2004 (MDA 2007). As a result of these regulations, the Minnesota Department of Agriculture (2007) estimated that phosphorus fertilizer use dropped by 48%. According to the findings of these studies, it is recommended that the Nitrogen Management Consortium propose fertilizer ordinance implementation reductions associated with a wet-season prohibition of non-agricultural nitrogen fertilizer application based on a 25% contribution of fertilizer to wet-season urbanized runoff and a resulting compliance level of 50% of any enacted ordinance. Given these conservative levels, the following reduction estimates are proposed for the region and are requested for EPA and FDEP concurrence. In the absence of updated land use information or boundary specific distributions of urbanized land uses, it is recommended that the baywide average be used to apply fertilizer restriction implementation reductions to total nitrogen loads attributed to specific entities.

Recommended Baywide Average Estimated Total Nitrogen Load Reduction Based upon 2006 Urbanized Land Use Spatial Distribution:

- 4.1% reduction in loads attributed to urbanized land uses

Recommended Bay Segment-Specific Average Estimated Total Nitrogen Load Reduction Based upon 2006 Urbanized Land Use Spatial Distribution:

- Old Tampa Bay: 4.3 % reduction in urbanized total nitrogen loads
- Hillsborough Bay: 4.1 % reduction in urbanized total nitrogen loads
- Middle Tampa Bay: 3.9 % reduction in urbanized total nitrogen loads
- Lower Tampa Bay: 4.2 % reduction in urbanized total nitrogen loads
- Boca Ciega Bay: 4.1 % reduction in urbanized total nitrogen loads
- Manatee River: 4.3 % reduction in urbanized total nitrogen loads
- Terra Ceia Bay: 4.3 % reduction in urbanized total nitrogen loads

Recommended Jurisdiction-Specific Average Estimated Total Nitrogen Load Reduction Based upon 2006 Urbanized Land Use Spatial Distribution:

- CDD: Greyhawk Landing: 4.52% reduction
- CDD: Harbourage at Braden River: 3.85% reduction
- CDD: Heritage Harbour 4.05% reduction
- CDD: Heritage Harbour Marketplace: 4.1% (Baywide average)
- CDD: Lakewood Ranch: 4.31% reduction
- CDD: Lexington: 4.08% reduction
- CDD: Tara: 4.05% reduction
- CDD: University Place: 5.32% reduction
- CDD: Waterlefe: 4.61% reduction
- City of Bradenton: 4.48% reduction
- City of Clearwater: 4.09% reduction
- City of Gulfport: 3.96% reduction
- City of Indian Shores: 4.1% (Baywide average)
- City of Kenneth City: 4.14% reduction
- City of Lakeland: 3.90% reduction
- City of Largo: 4.26% reduction
- City of Madeira Beach: 4.04% reduction
- City of N. Redington Beach: 4.76% reduction
- City of Oldsmar: 4.39% reduction
- City of Palmetto: 4.16% reduction
- City of Pinellas Park: 4.28% reduction
- City of Plant City: 4.06% reduction
- City of Redington Beach: 4.88% reduction
- City of Redington Shores: 4.69% reduction
- City of S. Pasadena: 4.10% reduction
- City of Safety Harbor: 4.26% reduction
- City of San Antonio: 4.29% reduction
- City of Seminole: 4.17% reduction
- City of St. Leo: 4.1% (Baywide average)
- City of St. Petersburg: 4.04% reduction
- City of St. Petersburg Beach: 4.18% reduction
- City of Tampa: 4.10% reduction
- City of Tarpon Springs: 4.05% reduction
- City of Temple Terrace: 4.26% reduction
- City of Treasure Island: 3.92% reduction
- City of Zephyrhills: 3.91% reduction
- Unincorporated Hills. Co.: 4.09% reduction
- Unincorporated Manatee Co.: 4.25% reduction
- Unincorporated Pasco Co.: 4.06% reduction
- Unincorporated Pinellas Co.: 4.19% reduction
- Unincorporated Polk Co.: 4.24% reduction
- Unincorporated Sarasota Co.: 4.32% reduction

Incorporation of Fertilizer Restriction and FDEP Recommended Education Credits

FDEP has developed a basis of credits for education efforts (July 25, 2008) for use in developing BMAPs. The instructions provided by FDEP state that "quantitative credit can be given to stormwater management entities (such as local governments) for public education and outreach efforts that target nutrient reductions. Up to a five percent stormwater load reduction in both total nitrogen and total phosphorus for education and outreach efforts can be listed on the BMAP project table. The five percent load reduction estimate is based on the Environmental Protection Agency Center for Watershed Protection's Watershed Treatment Model."

Examples of acceptable education activities in FDEP's instructions include:

- Local funding to implement the Florida Yards and Neighborhoods within the city or county.
- Local land development codes or ordinances that require Florida Friendly landscaping on all new developments, require commercial landscapers to obtain training and certification through Green Industry BMP program, require irrigation systems per Sections 125.568 and 166.048, F.S. and Section 373.185, F.S., and which specify fertilizer application rates and types. Local ordinances that control pet waste and require that residents pick up and properly dispose of pet wastes. Full credit given if local codes include all four components, partial credit for programs that only require one or two components. Model ordinances are available at http://www.dep.state.fl.us/water/nonpoint/pubs.htm .
- Implementation of public service announcements on local cable or commercial television and radio stations.
- Informational pamphlets on pollution prevention, fertilizer application, Florida Friendly Landscaping, water conservation, septic tank maintenance, etc.
- Websites to provide information on reducing nutrient pollution for homeowners and businesses.
- Inspection program and public call-in number to address illicit discharges.

Section H. Fertilizer Management in the model ordinance referenced in FDEP's instructions states that "Private homeowners are encouraged to utilize the recommendations of the University of Florida IFAS Florida Yards and Neighborhoods program and the University of Florida IFAS Fact Sheet ENH-860." IFAS Fact Sheet ENH-860 includes total amounts of N recommended for various lawn turf types, with instructions to "divide annual rates into 2 to 8 applications depending on location and management levels. Apply no more than 1 lb N/1000 square feet per application."

Fact Sheet ENH-860 also refers to IFAS publication SL 21, revised in May 2007, entitled “General Recommendations for Fertilization of Turfgrasses on Florida Soils”(Sartain 2007) for turf grass fertilization guidelines. SL 21 includes recommendations for application timing for Central Florida turfgrass species which all include at least one application of slow release N fertilizer and one complete fertilizer application (which also includes N) during the Tampa Bay area rainy season (June 1 – September 30).

Implementation of the recommendations for Tampa Bay non-agricultural fertilizer application, specifically elimination of N fertilizer application from June 1 – Sept 30th, would reduce the estimated N loadings below the reductions due to implementation of the education guidelines provided by FDEP as summarized above.

It is recommended that the reduction percentage estimates summarized for fertilizer restrictions in this document be applied in addition to any education credits as listed by FDEP, if the regional non-agricultural fertilizer application recommendations (including a June 1-Sept 30 ban on N fertilization application) are incorporated and implemented through adoption of a local ordinance. This would potentially result in a 5% TN load reduction credit for education and an additional 4.1% reduction credit (on average) for implementation of the recommended ordinance.

REFERENCES

Baker, L.A. 2007. Stormwater Pollution: Getting at the Source. Stormwater(Nov.-Dec. 2007): Hyperlink: http://www.stormcon.com/sw_0711_stormwater.html .

Barth, C. 1995. Nutrients: from the Lawn to the Stream. Watershed Protection Techniques. 2(1): 239-246.

Groffman, P.M., N.L. Law, K.T. Belt, L.E. Band, and G.T. Fisher. 2004. Nitrogen fluxes and retention in urban watershed ecosystems. Ecosystems 7:393-403.

Florida Department of Environmental Protection (FDEP). 2008. Basin Management Action Plan: For the Implementation of Total Maximum Daily Loads for Nutrients Adopted by the Florida Department of Environmental Protection for the Lower St. Johns River Basin Main Stem. Developed by the Lower St. Johns River TMDL Executive Committee. Final Draft. 192 pp.

Janicki Environmental, Inc. 2008. Estimates of total nitrogen, total phosphorus, total suspended solids, and biochemical oxygen demand loadings to Tampa Bay, Florida: 2004-2007. Prepared for: Florida Department of Environmental Protection.

Kelling, K.A., and A.E. Peterson. 1975. “Urban Lawn Infiltration Rates and Fertilizer Runoff Losses Under Simulated Rainfall.” Soil Sci. Soc. Am. Proc. 39: 348–352.

Leggette, Brashears, and Graham, Inc. (LBG). 2004. Lake Tarpon Ground-Water Nutrient Study, Task 4: Final Report. Prepared for the Pinellas County Department of Environmental Management and Southwest Florida Water Management District. 169 pp.

Linde, D.L., and T.L. Watschke. 1997. “Nutrients and Sediment in Runoff from Creeping Bentgrass and Perennial Ryegrass Turf.” J. Environ. Quality 26: 1248–1254.

Minnesota Department of Agriculture (MDA). 2007. Report to the Minnesota Legislature: Effectiveness of the Minnesota Phosphorus Lawn Fertilizer Law. Prepared by the Minnesota Department of Agriculture, Pesticide and Fertilizer Management Division. 41 pp.

Shuman, L.M. 2004. “Runoff of Nitrate Nitrogen and Phosphorus From Turf Grass After Watering-in.” Communications in Soil Science and Plant 35: 9–24.

Southwest Florida Water Management District (SWFWMD). 2006. Land use cover/classifications. GIS shapefile database: http://www.swfwmd.state.fl.us/data/gis/layer_library/metadata/lu06.html

Tampa Bay Estuary Program (TBEP). 2008. Final report from the workgroup to develop residential fertilizer use guidelines for the Tampa Bay region. Report prepared by the Tampa Bay Estuary Program. August 2008. Hyperlink: http://www.tbeptech.org/Fertilizer/Res%20Fertilizer%20final%20report-August%2014_%202008.pdf.

Tomasko, D.A. 2002. Status and trends of seagrass coverage in Tampa Bay, with reference to other Southwest Florida estuaries pp. 11-20 *in* H. Greening, ed. Seagrass Management: It's Not Just Nutrients. Tampa Bay Estuary Program, St. Petersburg, FL.

Zarbock, H., A. Janicki, D. Wade, D. Heimbuch, and H. Wilson. 1994. Estimates of Total Nitrogen, Total Phosphorus, and Total Suspended Solids Loadings to Tampa Bay, Florida. Technical Publication #04-94. Prepared by Coastal Environmental, Inc. Prepared for Tampa Bay National Estuary Program. St. Petersburg, FL.

Zarbock, H., A. Janicki, D. Wade, S. Janicki, and R. Pribble. 1996a. Model-based estimates of total nitrogen loading to Tampa Bay. Prepared for: Tampa Bay National Estuary Program. Prepared by: Coastal Environmental, Inc. Tampa Bay National Estuary Program Technical Publication #05-96.

Zarbock, H., A. Janicki, and S. Janicki. 1996b. Estimates of total nitrogen, total phosphorus, and total suspended solids loadings to Tampa Bay, Florida. Technical Appendix: 1992-94 total nitrogen loads to Tampa Bay. Technical Publication #19-96. Prepared by Coastal Environmental, Inc. Prepared for Tampa Bay National Estuary Program. St. Petersburg, FL.

APPENDIX A:
Land Use-specific Seasonal Runoff Coefficients (adapted from Janicki Environmental, Inc. 2008)

Coastal Land Use Classification and Land Use Type	Hydrologic Soil Group	Dry Season Runoff Coeff.	Wet Season Runoff Coeff.
1- Low Density Residential	A	0.15	0.25
	B	0.18	0.28
	C	0.21	0.31
	D	0.24	0.34
	B/D	0.18	0.34
2 - Medium Density Residential	A	0.25	0.35
	B	0.3	0.4
	C	0.35	0.45
	D	0.4	0.5
	B/D	0.3	0.5
3 - High Density Residential	A	0.35	0.5
	B	0.42	0.57
	C	0.5	0.65
	D	0.58	0.75
	B/D	0.42	0.75
7 - Institutional	A	0.4	0.5
	B	0.45	0.55
	C	0.5	0.6
	D	0.55	0.65
	B/D	0.45	0.65
8 - Range/Open Lands	A	0.1	0.18
	B	0.14	0.22
	C	0.18	0.26
	D	0.22	0.3
	B/D	0.14	0.3

APPENDIX B:
Land Use Specific Water Quality Concentrations

URBAN LAND USES						
Land Use Classification			Land Use-Specific Water Quality Concentrations			
Coastal Land Use Classification	Land Use Description	Reference	TN (mg/L)	TP (mg/L)	TSS (mg/L)	BOD (mg/L)
1 (LDR)	Low Density Single Family Residential (SFR)	(1)	2.31	0.40	33.0	-
		(1)	2.14	0.32	28.0	-
		(1)	0.605	0.073	7.2	-
		(1)	1.18	0.307	3.5	-
		(1)	3.0	0.45	-	-
		(1)	2.2	0.25	-	-
		(4)	1.87	0.39	-	-
		(8)	1.46	0.401	19.0	-
		(9)	1.56	0.27	20.8	-
		(10)	2.04	0.593	49.7	-
		(11)	2.88	0.72	56.8	-
		(13)	-	-	-	4.4
		min	0.605	0.073	3.5	-
		mean	1.93	0.380	27.3	4.4
		max	2.88	0.598	56.8	-
2 (MDR)	Medium Density (See notes)	mean	2.04	0.44	33.5	- 7.4 -
3 (HDR)	Multifamily Residential	(1)	1.61	0.33	53.0	-
		(1)	2.57	0.45	36.8	-
		(1)	4.68	0.72	95.6	-
		(1)	1.91	0.73	-	-
		(1)	1.02	0.033	67.6	-
		(1)	1.91	0.51	14.3	-
		(4)	1.65	0.33	-	-
		(8)	2.05	1.34	29.0	-
		(9)	2.04	0.282	10.7	-
		(10)	2.05	0.150	8.3	-
		(11)	2.00	0.56	41	-
		(13)	-	-	-	11.0
		min	1.02	0.033	8.3	-
		mean	2.14	0.49	39.6	11.0
		max	4.68	1.34	95.6	-
7	Institutional	(4)	1.18	0.15	35 (e)	-
		(13)	-	-	-	8.2

APPENDIX B (Cont'd):

Land Use Classification			Land Use-Specific Water Quality Concentrations			
Coastal Land Use Classification	Land Use Description	Reference	TN (mg/L)	TP (mg/L)	TSS (mg/L)	BOD (mg/L)
8	Open Space/ Non-forested	(1)	1.38	0.07	17.3	-
		(1)	0.90	0.02	4.8	-
		(1)	1.47	0.07	-	-
		(4)	1.02	0.16	-	-
		(13)	-	-	-	1.45

Notes: Concentrations for CLUCCS code 2 (MDR) are an average of CLUCCS codes 1 (LDR) and 3 (HDR).

References

(1) Harper, H.H. 1991. Estimation of Loading Rate Parameters for Tampa Bay Watershed. Southwest Florida Water Management District. Brooksville, Florida.

(2) Delwiche, Lora L.D. and D.A. Haith. 1983. Loading Functions for Predicting Nutrient Losses from Complex Watersheds. Water Resources Bulletin vol. 19, no. 6. p. 951-959.

(3) Haith, D. A. and L.L. Shoemaker. 1987. Generalized Watershed Loading Function for Stream Flow Nutrients. Water Resources Bulletin. vol. 23, no. 3. p. 471-477.

(4) Camp, Dresser, & McKee. 1992. Point/Non-Point Source Loading Assessment for Sarasota Bay. SBNEP, Sarasota, Florida.

(5) Andrews, W.J. 1992. Reconnaissance of Water Quality at Nine Dairy Farms in North Florida, 1990-1991. USGS WRI 92-4058. Tallahassee, Florida.

(6) Flannery, M.S. et al. 1991. Increased Nutrient Loading and Baseflow Supplementation in the Little Manatee Watershed. in: Treat, F.S. and P.A. Clark (eds.) Proceedings, Tampa Bay Area Scientific Information Symposium 2. 1991 February 27-March 1. Tampa, Florida. p. 369-396.

(7) Allhands, M. 1993. Water Quality Data for Gator Slough Groves. Agricultural Management Services. Punta Gorda, Florida.

(8) Hillsborough County Engineering Services. 1993. NPDES Part 2 Application. Tampa, FL.

(9) City of Tampa Stormwater Management Division. 1994. NPDES Part 2 Application. Tampa, FL.

(10) Pinellas County Department of Environmental Management. 1993. NPDES Part 2 Application. Clearwater, FL.

(11) City of St. Petersburg Engineering Department. 1993. NPDES Part 2 Application. St. Petersburg, FL.

(12) Carr, D.W. and B.T. Rushton. 1995. Integrating a Native Herbaceous Wetland into Stormwater Management. Southwest Florida Water Management District Stormwater Research Program. Brooksville, FL.

(13) Harper, H.H. 1994. Stormwater Loading Rate Parameters for Central and South Florida. Environmental Research & Design, Inc. Orlando, FL.