Sanibel Nutrient Management Plan Phase 2:

Development of Stormwater Runoff Coefficients, Nutrient Concentrations and Loading Estimates for Sanibel Island, Florida

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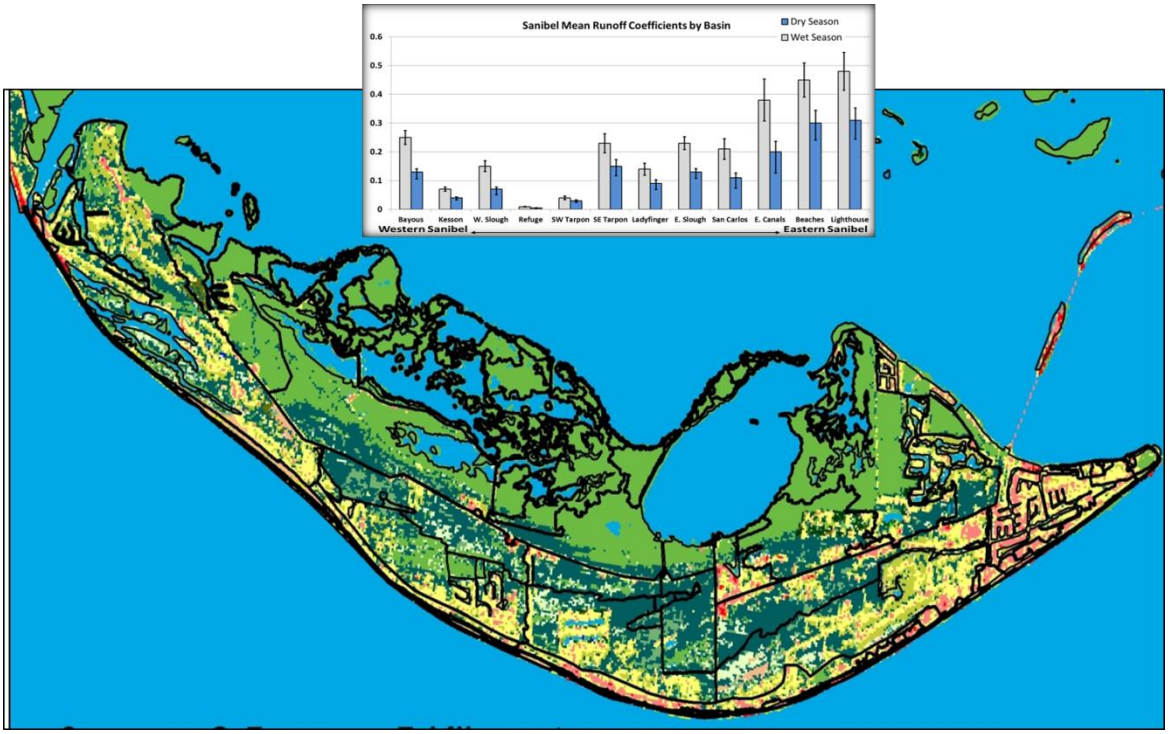

Executive Summary

The City of Sanibel's Department of Natural Resources is developing a Comprehensive Nutrient Management Plan in four phases. Phase 1 was completed in November 2013. That initial work summarized and evaluated existing water quality data, identified watershed basins and land uses, and provided nutrient loading estimates to land surfaces and waterbodies by basin. These initial loading estimates were based upon best literature-based runoff coefficients and nutrient concentrations for Florida.

Phase 1 of the Comprehensive Nutrient Management Plan identified a number of data insufficiencies. One of the most important needs was the accurate determination of stormwater runoff volumes and concentrations for the land use types contributing nutrient loads to Sanibel's waters.

This report summarizes Phase 2 work, including the GIS-based development of stormwater runoff coefficients and collection of rain event nutrient samples in order to define Sanibel-specific runoff concentrations. New coefficients and concentrations are now available for the major land classes to address data deficiencies identified in Phase 1. With these Sanibel-specific coefficients and concentrations, accurate nutrient load estimates can be made. Nutrient loading rates were calculated and presented by land class and drainage basin.

Impervious surface area of each anthropogenic land class on Sanibel was determined using ARC GIS 10 tools. The Florida DEP-modified SCS curve number method was used with the impervious surface information to derive land class and basin specific stormwater runoff coefficients which are the amount of rainfall which actually runs off Sanibel's surface (and into adjacent waterbodies) divided by the total amount of rainfall.

The Sanibel-specific runoff coefficients developed in this effort changed the estimated annual stormwater runoff from Sanibel by 24% over Phase 1 from 7,464,000 m^3/yr. to 5, 609,000 m^3/yr. The more accurate runoff volumes obtained from these new coefficients reduced the total nutrient loading estimates from Sanibel considerably.

Local stormwater nutrient concentration values were also needed to more accurately represent loads from Sanibel. Stormwater runoff was sampled from different land classes during dry and wet seasons. Mean nutrient concentrations were found for each land class for total nitrogen (TN), total phosphorus (TP), inorganic nitrogen (IN) and inorganic phosphorus (OP). The Sanibel-specific stormwater nutrient concentrations for TN, IN and TP were generally lower than best literature values used in Phase 1. New estimated TN loads using concentration data developed here were 55% lower than phase 1 estimates (12, 659 kg/yr. to 5655 kg/yr.) and TP loads 33% lower than previous estimates (2, 431 kg/yr. to 1,631 kg/yr.). In contrast, stormwater

OP concentrations were significantly greater than Phase 1 estimates and corresponding estimated loads were 28% greater than Phase 1 best estimates (778 kg/yr. to 997 kg/yr.).

The TN loading rate for Sanibel (3.1 kg/ha.-yr.) was much lower compared to rates in the Caloosahatchee (8.1 kg/ha.-yr.) and Saint Lucie Estuary (SLE; 6.4 kg/ha.-yr.) watersheds. However Sanibel's TP loading rate (0.9 kg/ha.-yr.) was similar to the Caloosahatchee (0.9 kg/ha.-yr.) and SLE (1.3 kg/ha.-yr.). The Caloosahatchee and SLE watersheds have large areas of intense agriculture and urban development and their nutrient loading rates might be expected to be significantly greater than Sanibel where about 65% of the island area is nature preserve with no agriculture and only moderate urbanization. The comparably high TP loading rate on Sanibel indicates that Sanibel has significant sources of phosphorus runoff. The direct runoff of reclaimed wastewater used for irrigation is the most probable source of this phosphorus. Efforts should be made to eliminate any direct discharges or leaks of reclaimed water into waterbodies (such as sprinkler heads flowing into stormwater ponds or estuary waters).

The highest nutrient concentrations in stormwater runoff were at the island's three golf courses. The golf courses had similar nutrient loading characteristics and were found to be the single largest source of OP loads (35%) from the island even though they make up less than 9 percent of the island's area. Golf courses are the largest reclaim water users on the island based on metered water use. Reclaimed water used for irrigation is relatively high in inorganic phosphorus compared to nitrogen. Inorganic phosphorus and nitrogen are responsible for algae blooms. Runoff sampling sites which used reclaim water for irrigation had significantly greater OP concentrations than sites without reclaimed water use.

The medium density residential land class had the greatest loads of TN, TP and IN. This is due to large land area covered by medium density residential and relatively greater runoff coefficients than low density residential. Our recommendation is to implement BMPs at golf courses and medium density residential lands to further reduce nutrient loadings.

The Sanibel Slough east basin had the highest overall nutrient loads, contributing from 18-22% of the total load leaving Sanibel. Phosphorus loads from the east basin were 2 to 3 times greater than loading rates in the west basin. This corresponds to significantly greater TP and OP concentrations found in the east basin surface water during Phase 1 evaluation. Nitrogen loading rates were also greater in the east basin compared to the west. The east basin has a greater area of medium density residential land class and has one golf course while the west basin has no golf course.

Total nitrogen concentrations in stormwater runoff were found to be significantly greater in the dry season when fertilizer application is allowed on Sanibel. However no greater concentration of inorganic nitrogen, total phosphorus or inorganic phosphorus was found in the dry season as might be expected due to fertilizer application. This finding may reflect success of

existing City of Sanibel BMPs (i.e. fertilizer ordinance) at reducing the runoff of fertilizer even when use is allowed.

The Sanibel Slough and the many stormwater retention systems (lakes and ponds) on Sanibel are intimately connected to the upper water table aquifer. Groundwater flows to lakes, ponds, the slough, the gulf and the estuary. Nutrient loads are carried with this groundwater flow and loading rates to surface waters may be significant compared to stormwater loads. Phase 3 of developing the Comprehensive Nutrient Management Plan for the City will evaluate groundwater nutrient concentrations and flow rates.

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Introduction

The City of Sanibel has been successful in implementing strategies to improve the environment and to sustain natural resources that support the nature and tourism-based economy of the island. Examples include implementation of the Sanibel Plan, the installation of island-wide sanitary sewer, the acquisition of conservation lands, adoption of a fertilizer ordinance, the enforcement of vegetation standards, and Golf Course BMP report cards. In 2007, the City implemented a fertilizer ordinance to reduce nutrient loading to Sanibel waterbodies from harmful fertilization practices. The City has also been monitoring water quality at 12 sites throughout the island since 2002. And, as part of its diligence in continuing to reduce nutrient loads from the island, the City has a prioritized a long list of possible new BMPs including installation of a nitrogen bioreactor in the Sanibel Slough, the design of a filtering marsh for the slough, and flow monitoring for major stormwater discharge locations.

Barrier islands are surrounded by salt water and often have a freshwater lens or surficial aquifer which contains lower salinity water. Sanibel Island is a barrier island that contains an inland body of freshwater, commonly called the Sanibel River or Sanibel Slough. This waterbody was originally a series of swampy lakes and wetlands which were connected by channelization to control the mosquito population. Historically, the slough discharged to the Gulf of Mexico at two locations where breaches in the dune system occurred during the times of high water levels in the wet season. Today the Sanibel Slough is managed as two basins (east and west) separated by a control structure at Tarpon Bay Road (N26.42752, W82.08021). The western basin has a control structure located north of Sanibel Captiva Rd. (N26.43879, W82.088) which discharges to Tarpon Bay and into waters managed by the J.N. “Ding” Darling National Wildlife Refuge. The eastern basin has a control structure located on Beach Rd. (N26.44311, W82.03989) which allows discharges into the eastern residential canal system. Discharges from the western basin control structure are rare, while the eastern basin control structure can discharge continuously during the wet season. Decreasing trends in certain nutrient concentrations within the Sanibel Slough indicate that the City of Sanibel’s actions taken to date have had positive impacts, however the slough remains classified as impaired by Florida DEP due to elevated nitrogen, phosphorus and chlorophyll *a* levels (FDEP 2014).

To address the Sanibel Slough impairment, a Comprehensive Nutrient Management Plan is being developed by the City’s Natural Resources Department and includes a list of short and long-term projects and best management practices (BMPs) to systematically reduce stormwater runoff and nutrient pollution to the Sanibel Slough and nearshore waters. The City has laid out development of a Comprehensive Nutrient Management Plan in four phases. Phase 1 was completed in November 2013, which summarized and evaluated existing water quality data, identified watershed basins and land uses, and provided nutrient loading estimates to land surfaces and waterbodies by basin (Thompson and Milbrandt 2013).

Phase 1 of the Comprehensive Nutrient Management Plan identified several key data gaps. One of the most important information needs was the accurate determination of stormwater runoff volumes and concentrations for the land use types contributing nutrient loads to Sanibel's waters. Development of Sanibel-specific stormwater runoff coefficients and nutrient concentrations permits calculation of actual loading rates and are not dependent on best information available in scientific literature. The City of Sanibel contracted the SCCF Marine Laboratory to develop runoff coefficients and concentrations as Phase 2 of its Comprehensive Nutrient Management Plan implementation. In this Phase 2 report, the Sanibel-specific coefficients are presented and explained and are combined with results of stormwater runoff sampling (nutrient concentrations) to provide refined nutrient loading estimates. Activities in subsequent phases will include flow monitoring of the Sanibel Slough, groundwater nutrient loading estimates, and development of a list of projects which accomplish nutrient load reduction.

Phase 2 of the Sanibel Comprehensive Nutrient Management Plan is composed of three parts. The first component is development of Sanibel-specific stormwater runoff coefficients to allow more accurate estimates of stormwater runoff volumes for the basins and land classes found on Sanibel. The second component consists of storm event sampling and sample analyses to determine mean nutrient concentrations for each major land class and basin. The third component consists of combining runoff data with concentration data and producing revised nutrient loading estimates for Sanibel.

Methods

Sanibel-Specific Stormwater Runoff Coefficients

Twelve watershed basins were previously delineated for Sanibel Island (Thompson and Milbrandt 2013). Within these basins, land use classes were identified using South Florida Water Management District (SFWMD) FLUCCS Level 2 classifications and areal coverage for each class calculated using ARCGIS 10® capabilities (Thompson and Milbrandt 2013). A majority of the land use was low, medium and high density residential with commercial and institutional uses representing the balance of the anthropogenic classes. For this analysis, wetlands, forested wetlands, lakes, streams and other waterbodies were considered to be down-gradient receiving waterbodies of anthropogenically-affected stormwater runoff. A stormwater runoff coefficient of zero was used for these classes and pollutant concentrations were not associated with them (nutrient load assumed to zero since these are receiving waterbodies). Anthropogenically affected land classes analyzed for nutrient loadings included, low, medium and high density residential, commercial, institutional, golf courses, beaches, parks, utilities, brush land, and disturbed lands. These land classes were assigned runoff coefficients and nutrient concentrations. To estimate the percent of impervious surface area for each land class, ARCGIS 10® was used

on subsamples of each land use class within each watershed basin. At least 20% of the total impervious area of each class was directly digitized and the area determined (Tables 1-6). Impervious surfaces were classified as buildings or pavement. Buildings included swimming pools and tennis courts. Pavement included roads, driveways and sidewalks. These surfaces were considered to be 100% impervious regardless of construction (shell and gravel surfaces considered 100% impervious). Impervious area was reported in table form by land use class and basin (Tables 1-6).

For comparison purposes the proportion of impervious surface on Sanibel was also estimated using the US Forest Service iTree® Canopy analysis tool (USDA 2014). Using this method, random points are analyzed for land class type within a boundary area on Google Earth maps. A shapefile of Sanibel containing 10,062 acres was analyzed using 400 randomly generated points which were categorized in one of 15 classes. A standard error of less than ±2% was achieved for all 15 land types. The roadways and buildings land classes were added together to derive the total percent impervious surface on Sanibel.

The Soil Conservation Service (SCS) curve number (CN) method was used to develop runoff coefficients from impervious cover data following guidelines used by Florida DEP in estimating runoff volumes for nutrient loading (Harper and Baker 2007). In this method impervious surface coverage, soil characteristics, vegetation and rainfall data are combined to provide runoff volume estimates. Estimating the total volume of storm runoff from a watershed using the SCS CN method requires calculation of three components of runoff: 1.) runoff from directly connected impervious areas (DCIA); 2.) runoff from non-directly connected impervious areas (nDCIA) and; 3.) runoff from pervious surface area.

The SCS curve number methodology utilizes separate calculations for runoff volume generated from DCIA and nDCIA areas. An impervious area is considered to be directly connected if runoff from the area flows directly into a drainage system or water body. Areas are also considered to be directly connected if runoff from the area occurs as a concentrated shallow flow that is conveyed through a pervious area, such as a roadside swale, and then into a drainage system. The method assumes that after allotting for some initial retention, all rainfall which occurs on directly connected impervious areas becomes stormwater runoff.

Non-directly connected impervious areas (nDCIA) include all impervious areas which are not considered to be directly connected. The SCS model assumes that runoff generated in these areas has the opportunity to infiltrate into the soil, depending upon the soil types and land cover characteristics, before significant runoff begins. The runoff-generating characteristics of nDCIA areas are quantified through the use of a curve number. A curve number is a hydrologic factor which is used to reflect the runoff potential of a particular land use and soil type. Theoretical values for curve numbers range from 0-100, with low values reflecting low runoff potential and higher values reflecting high runoff potential. Using the SCS method modified by Florida DEP, curve numbers were developed specifically for Sanibel land use classes and watershed basins.

The following equation from Natural Resources Conservation Service Technical Release TR 55 was used to calculate Sanibel-specific curve numbers (USDA 1986):

CN = [(CNos) x (1- ISC*i*)] + [(98) x (ISC*i*)]

Where*:*

CNos= the runoff potential of the soil assuming the area is open space (OS), in good hydrologic condition, and that the soil is not frozen; the CNos for HSGs A, B, C, and D are 39, 61, 74, and 80, respectively (National Engineering Handbook, 2004),

ISC = the percent of land use category (*i)* that is impervious,

1-ISC = the percent of land use category (*i)* that is pervious,

98 = maximum potential runoff.

Per NRCS soil maps, Sanibel soil types were assumed to be hydrologic soil group (HSG) B/D, meaning that in dry season the HSG is B with good drainage characteristics (> 0.3”/hour) while in wet season, the HSG is D and drainage is compromised by a high water table and is less than 0.05 inches/hr. For the purpose of HSG classification, soils were grouped as B from October 15th through July 1st and classified as D from July 1st through October 15th.

Maximum potential stormwater retention (S) by the soil is calculated using the equation: **S = (1000/CN) – 10**. Runoff volume is then estimated with the equation: **Q= (P – 0.2S)^2/ (P + 0.8S),** where Q is depth of runoff in inches and P is precipitation in inches. To produce runoff, P must be greater than 0.2S. If P is less than or equal to 0.2S, then the runoff amount is essentially zero. When P is greater than 0.2S, multiplying the Q value by the area of the site gives the volume of runoff produced.

The DCIA portion is calculated using **Q = P- 0.1,** When precipitation is less than 0.1 inches, Q DCIA is zero. This factor represents the initial retention of the rainwater within irregularities in the impervious surface. For determination of percent DCIA and percent nDCIAs, the Florida DEP estimates of percent DCIA (Table 7a) was modified to take in account Sanibel’s 1989 ordinance requiring stormwater retention on all building sites (Sanibel Code Sec. 118). For each watershed basin, all development after 1989 was designated to have 0percent DCIA. For all land developed before 1989, the DEP values for estimated percent DCIA were used. The percent impervious area determined through GIS delineation for each basin and land use is then divided into percent DCIA and percent nDCIA using the modified DEP estimates of percent DCIA based on percentage of land developed before 1989 (Table 7b).

To calculate runoff from pervious areas in each basin, the percent pervious surface area for each land use in each basin was obtained by subtracting the delineated percent impervious area determined through GIS analyses from the total area for that land use. A pervious area curve number

was then determined for each land use class using the FDEP guidelines (Table 8a). Runoff volume was estimated using the curve number formulas with local precipitation data.

Soil moisture condition (antecedent moisture condition) at the time of a rain event can have significant impact on the runoff generated (FDEP 2007). Following Florida DEP methodology, adjustments were made to the curve numbers when the antecedent 5-day rainfall was greater than 1.1 inches in the dry season or 2.1 inches in the wet season. Modified curve numbers (Table 8b) were calculated for these conditions (antecedent moisture condition III) using this equation:

$$CN(III) = 23CN/(10+0.13CN)$$

The equation produces greater runoff estimates for moist conditions than periods with less antecedent soil moisture.

Using the methods summarized above, runoff coefficients were calculated (per land class and basin) for rainfall data from 2011, 2012 and 2013.These three years had rainfall totals similar to the annual average for Sanibel (42 inches), however the distribution and abundance of rain events differed between years. All analyses in this report used rainfall data collected at MesoWest station TS755 (University of Utah), located at the J.N. Ding Darling National Wildlife Refuge. Mean runoff coefficients for Sanibel were calculated from values obtained from utilizing these three years of data.

Sanibel-Specific Stormwater Runoff Nutrient Concentrations

Water samples were collected from the following land use types; 1.) low density residential; 2.) medium density residential; 3.) high density residential; 4.) commercial and: 5.) golf courses. A total of 102 water samples were collected over the course of the study period (12 months). Sampling events were divided among land use types in similar proportion as relative area of that land use on Sanibel (Table 9). A total of 31percent of the stormwater runoff samples (n=32) were taken from medium density residential, 24% (24 samples) from low density residential, 21% (n=21) from high density residential, and 9% (n=10) from commercial land types. An additional 15% (n=15) were obtained from the three golf courses on Sanibel. For each land use type, 3 permanent sites and an additional number of randomly selected sites were sampled to allow analyses of inter- and intra-site variance (Table 9). A total of 57 unique sites were sampled during Phase 2 (Figure 1, Table 10).

Table 9. Sampling event information for development of runoff concentration values.

Sampling Event	Date	Season	Precipitaion (In)	Total Number Samples	Number Permanent Sites	Number Random Sites	Number LowDen	Number MedDen	Number HighDen	Number Comrcl	Number Golf Course
1	1/30/2014	Dry	1.5	20	12	8	6	6	5	3	0
2	3/6/2014	Dry	0.65	20	15	5	5	6	3	3	3
3	7/7/2014	Dry	0.4	12	7	5	3	3	3	0	3
4	7/15/2014	Wet	1.1	20	13	7	4	8	4	1	3
5	9/2/2014	Wet	0.59	9	3	6	2	3	1	0	3
6	9/17/2014	Wet	0.5	21	12	9	4	6	5	3	3
Total				**102**	**62**	**40**	**24**	**32**	**21**	**10**	**15**

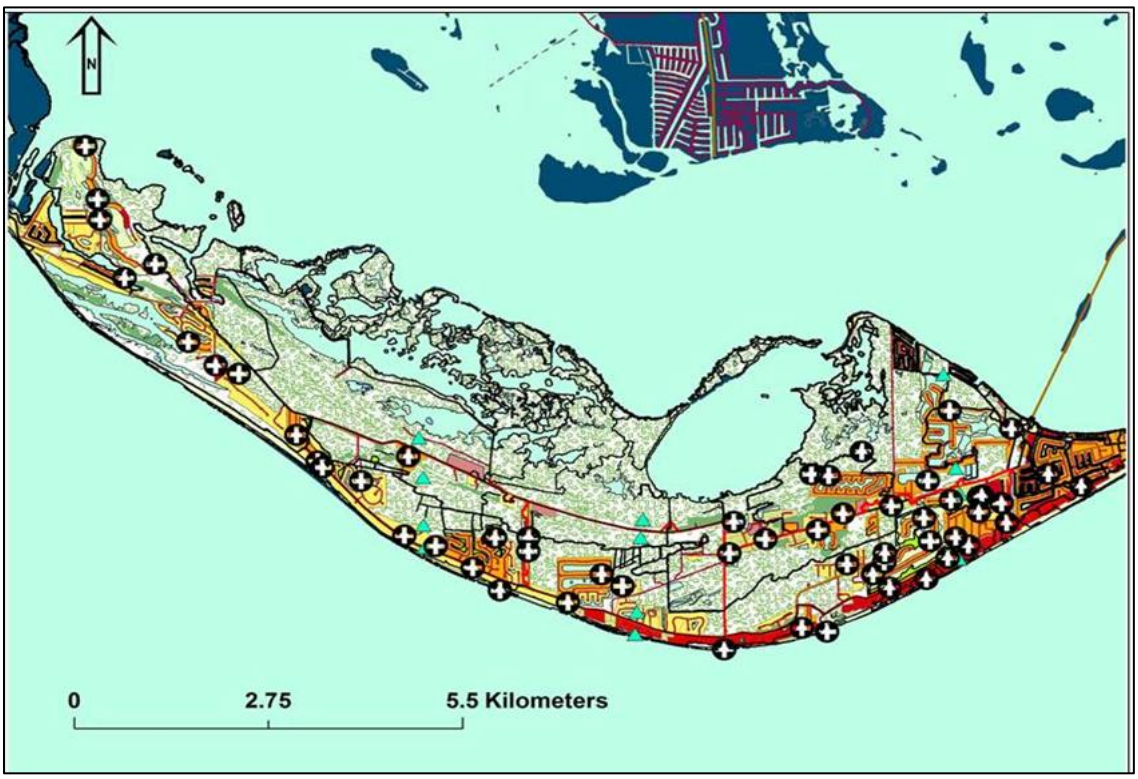

Figure 1. Stormwater sampling sites used to estimate nutrient concentrations for Sanibel land classes.

Additional factors included in the sampling design were seasonality (wet versus dry), fertilizer application season, and size of rain event. Since fertilizer application season corresponds with dry season, these two factors were considered as one. Fifty two (51%) samples were taken during the fertilizer application (dry) season and 50 during the no fertilizer application (wet) season (Table 9). For each season (wet/dry), 3 sampling events were captured. Sampling events were scheduled based upon two precipitation classes; 1.) 0.4-1 inches (2 events

each season) or 2.) greater than 1 inch (1 event each season). The effect of reclaimed water use or non-use within a basin was analyzed post-hoc.

In addition to the water sampling described above, three fixed beach sampling stations were established in the Gulf of Mexico adjacent to Sanibel Island at Beach Access One, Tarpon Bay Rd., and Algiers Beach. These stations were also sampled during 6 monitoring trips for the same water quality parameters listed previously. Data from gulf-side sampling is lacking but needed to evaluate nutrient gradients.

Samples were collected directly from pooled or flowing stormwater areas following Florida DEP SOP FS2100 guidelines and using analysis-specific dedicated bottles. Samples for nutrient analysis were preserved to a pH less than 2 with sulfuric acid and placed on ice for transport to Lee County Environmental Laboratory. Orthophosphate samples were filtered through a 0.7 micron filter immediately upon collection and preserved in ice water. All nutrient analyses were completed within the required sample holding period by Lee County Lab which is NELAP certified.

Sanibel-Specific Nutrient Loading Estimates

Nutrient loadings to waterbodies by land use type were revised for each basin. As described, annual Sanibel-specific runoff volumes were calculated for wet and dry season using the custom-derived runoff coefficients. Runoff volume was then multiplied by the mean Sanibel-specific nutrient concentration for the season and results added to obtain annual loading. Loading estimates were then compared to previous estimates made in Phase 1 which were based upon best available runoff and concentration data from literature (Thompson and Milbrandt 2013). Non-parametric statistical analyses (Wilcoxon and Mann-Whitney) were used to test for significant differences between new loading estimates and previous loading estimates at alpha = 0.05.

Results and Discussion

Sanibel-Specific Stormwater Runoff Coefficients

In the Phase 2 analysis, runoff coefficients (C) and volume estimates using the SCS curve number method for three recent years in which total annual precipitation on Sanibel was near the annual mean of 42 inches were computed. As described in the methods, the curve number method for estimating stormwater runoff is based upon the proportion of impervious surface cover, soil hydrologic groups, daily precipitation, antecedent moisture condition and to some extent vegetative cover. Each of these variables was addressed during this analysis. In general, annual variability in stormwater runoff (runoff coefficient) for a given area such as Sanibel is a

characteristic of the variability in precipitation events. Runoff for any two years with similar total rain volume will vary significantly due to seasonal distribution, intensity and duration.

Based on direct digitization of land areas, Sanibel land types were primarily wetland forests and residential as classified by SFWMD FLUCCS 2 level. There were 10,062 acres analyzed for this project and 56% was either forested or other type of wetland and not considered to produce runoff in the analysis (Table 11). Low, medium and high density residential, commercial, institutional, golf course, park, beach, utility, brush land and disturbed land classes (anthropogenic land classes) were defined to be those producing nutrient loads. The anthropogenically influenced land classes made up 36% of Sanibel. About 13.2% or 1,334 acres of Sanibel was estimated to be impervious land cover while over 8,700 acres was estimated to be pervious. Buildings made up slightly more than half of the impervious area at 6.7% and roadways were about 6.5% of the impervious area analyzed (Table 11). For comparison, the USDA Forest Service iTree® Canopy software produced an estimate of 12.8% total impervious surface area (Table 12), with roadway at 6.8% compared to buildings at 6.0%. This estimate is based on a smaller sample size but is consistent with impervious area estimates based on direct digitization.

Table 11. Sanibel overall % impervious surface area by land class. No data collected is indicated by ND.

Land Class	Area (Acres)	% Pavement	% Building	% Impervious	% Pervious	Acres Impervious	Acres Pervious
Low Density Residential	825	14.1	13.6	27.7	72.3	228.4	596.3
Medium Density Residential	1,281	15.6	19.8	35.4	64.6	453.6	827.7
High Density Residential	452	18.6	23.8	42.3	57.7	191.4	261.0
Commercial and Services	259	32.8	13.9	65.8	34.2	170.4	88.6
Institutional (School)	62	31.2	14.8	46.0	54.0	28.5	33.4
Recreational (Golf Course)	303	7.1	2.0	9.1	90.9	27.6	275.5
Recreational (Beach)	285	ND	ND	5.0	95.0	14.3	270.8
Recreational (Parks)	11	ND	ND	20.0	80.0	2.2	9.0
Utilities	25	ND	ND	78.0	22.0	19.3	5.4
Shrub and Brushland	587	ND	ND	14.0	86.0	82.2	504.9
Disturbed Land	72	ND	ND	55.0	45.0	39.8	32.5
Upland Hardwood Forests	270	ND	ND	16.0	84.0	43.2	226.7
Lakes/Reservoirs	134	0.0	0.0	0.0	100.0	0.0	134.1
Wetlands (Other)	15	0.0	0.0	0.0	100.0	0.0	15.1
Wetland Forests	5,500	0.0	0.0	0.0	100.0	0.0	5500.5
Total	10,062	6.5	6.7	13.2	86.8	1300.8	8781.4

Further evaluation revealed larger variation in the proportion of impervious surface area between classes than between the same land class in different basins. In general, the proportion of impervious surface area increased from golf courses to low density to medium density to high

density residential areas (Table 11). Commercial land types had the highest proportion of impervious surface area. Low density residential had a higher proportion of its impervious surface as road and sidewalk compared to buildings. However, commercial land types had an even greater proportion of impervious surface as pavement, due to parking lots. Medium and high density residential had a higher proportion of its impervious surface as buildings compared to paved surfaces.

The proportion of directly connected impervious area (DCIA) ranged between 5% and 63% dependent upon land class type and the percentage of development occurring after the 1989 stormwater design ordinance (Table 7b). Commercial land classes had the highest proportion DCIA while drainage basins on the east end of the island had the highest proportion of development which occurred before 1990 (Table 7b).

Annual rainfall for 2011, 2012 and 2013 was 42, 33.9 and 44.6 inches respectively compared to the annual mean of 42 inches for Sanibel. The SCS curve number method assumes all land surfaces including impervious have some initial rain storage potential. Lands with a greater proportion of pervious soils produce less runoff, and more rain falls before any runoff is produced. The antecedent moisture condition also effects runoff potential. The initial storage potential of soils is reduced when soil moisture remains from previous rain events. There were 21, 16, and 19 days in 2011, 2012 and 2013 respectively when the antecedent moisture condition was classified as III, meaning enough soil moisture was present from the preceding rain event to increase the proportion of runoff in the current rain event (Table 13).

The annual average number of days with rain events from 2011-2013 was 100. About 40% of the rain days produced no surface water runoff. The difference in rain event distribution and intensity is observed in evaluation of annual precipitation (Table 13). The highest percentage of rain days producing runoff from impervious surface occurred in 2013, while a greater proportion of events in 2011 produced runoff from pervious surfaces and a lower proportion of produced impervious surface runoff. In general 54-63% of rain events recorded during 2011-2013 (or 52 - 69 days each year) were greater than 0.1 inches, producing runoff from impervious surfaces. Only 15-24% of rain events (or 14 – 26 days each year) produced runoff from pervious surfaces.

Due to the change in soil hydric group designation between seasons, the rain storage potential of pervious surfaces increases drastically in dry season compared to wet season. The change in hydric group by season on Sanibel is caused by the elevation of water table levels during the wet season. When the water table is at or near the soil surface, less precipitation can be stored within the soil before runoff occurs. In 2011 only 32% of the rain volume fell in dry season compared to greater than 42% in 2012 and 2013. Because a higher proportion of rain fell when the water table affected runoff characteristics (wet season) in 2011, a higher overall proportion of rain which fell on pervious surfaces that year produced runoff (Table 13).

Curve numbers used in the Florida DEP/SCS methodology for estimating runoff volume were greater for land classes that had a higher proportion of impervious surfaces (Table 14). They were also greater for wet season compared to dry. Larger curve numbers result in greater volume estimates for stormwater runoff. Estimated total stormwater runoff volume from anthropogenic land classes ranged between 9,640,000 m^3 in 2012 and 12,695,000 m^3 in 2013 (Table 15-17). Medium density residential was the largest contributor to the anthropogenic runoff volume while institutional land class was by far the smallest contributor (Appendix 1). The eastern and western basins of Sanibel Slough were areas contributing the greatest discharge volume while the SW Tarpon Bay and refuge basins contributed least (Table 15-17).

Runoff coefficients are simply total estimated stormwater volume discharged from a land area divided by total rain volume which fell in that area (Table 18, Appendix 1). Sanibel-specific runoff coefficients were derived by taking the mean stormwater runoff values for 2011-2013 and dividing that by the mean total volume of rainfall (Table 18, Appendix 1). Coefficient estimates made in this study were highest for commercial land types and lowest for golf courses (Table 18 and Figure 2). They were also greater for the wet season compared to the dry season (Table 18 and Figure 2). In general, coefficients were greater for the eastern basins than the western basins (Table 19 and Figure 3). Compared to the coefficients used for the Phase 1 estimates of nutrient loadings, the Sanibel-specific values are generally lower (Table 18 and Figure 4). As noted previously, Sanibel-specific coefficients were generated for anthropogenic land classes only.

Table 18. Mean Sanibel-specific runoff coefficients and standard deviations derived from Phase 2 GIS-based analyses. Coefficients from literature which were used in Phase 1 of this project are also given for comparison.

Sanibel Specific Runoff Coefficients	Mean C				Phase 1 Coefficients	
Land Use	Dry Season	StDev	Wet Season	StDev	Dry Season	Wet Season
LowDenRes	0.12	0.01	0.33	0.042	0.21	0.31
MedDenRes	0.18	0.008	0.38	0.037	0.35	0.45
HighDenRes	0.27	0.006	0.45	0.038	0.5	0.65
Commercial	0.44	0.014	0.59	0.046	0.78	0.97
Institutional	0.18	0.03	0.42	0.048	0.5	0.6
Golf Course	0.04	0.02	0.25	0.04	0.18	0.26

Using the runoff coefficients developed in this study, the estimated mean annual runoff from Sanibel is 24.9% less than that estimated in Phase 1, falling from 7,464,010 to 5,608,500 m^3/yr. (Table 20). The dry season coefficients were 41.1% less while the wet season values were 20.5% less than that estimated in Phase 1 (Table 20).

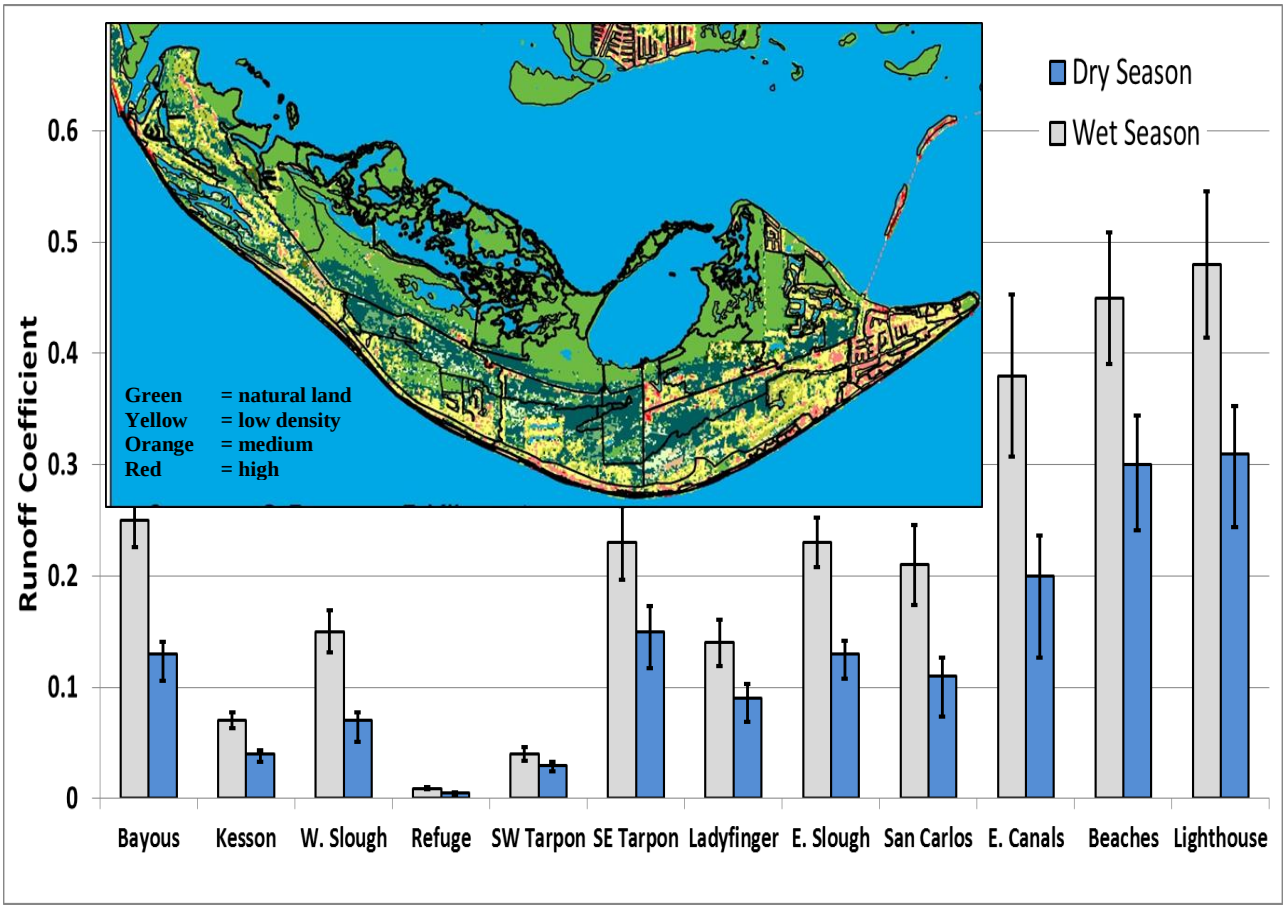

Figure 3. Overall mean runoff coefficients for individual Sanibel drainage basins with inset of Sanibel Island showing decreased runoff in center area of island which contains higher percentage of land in natural state (green).

Table 20. Comparison of stormwater runoff nutrient loading estimates from Sanibel from the Phase 1 study to the revised estimates from this study (Phase 2).

	Phase 1 (m^3/yr.)			Phase 2 (m^3/yr.)			% Change		
	DrySeason	WetSeason	Total	DrySeason	WetSeason	Total	DrySeason	WetSeason	Total
Runoff (m^3/yr.)	1,587,493	5,876,517	**7,464,010**	935,446	4,673,054	**5,608,500**	-41.1	-20.5	**-24.9**
TN Load (Kg/yr.)	2,692	9,967	**12,659**	950	4705	**5655**	-64.7	-52.8	**-55.3**
IN Load (Kg/yr.)	881	3,261	**4,142**	191	1358	**1549**	-78.3	-58.4	**-62.6**
TP Load (Kg/yr.)	517	1,914	**2,431**	171	1460	**1631**	-66.9	-23.7	**-32.9**
OP Load (Kg/yr.)	165	613	**778**	96	901	**997**	-42.0	47.1	**28.1**

Sanibel-Specific Stormwater Runoff Nutrient Concentrations

Mean Sanibel-specific stormwater runoff nutrient concentrations varied between land class, and season. Most notably, nitrogen and phosphorus concentrations were greatest for golf course runoff compared to the other land classes analyzed (Table 21 and Figures 5-8). For pooled

land class data, TN was significantly greater during dry (fertilizer) season compared to wet (no-fertilizer) season (paired t-test, n=37, T= 3.1, p= 0.004). In dry season TN concentrations were greater in the low density residential and decreased through the more developed medium and high density residential, and commercial classes (Figure 5). A higher proportion of organic matter in less developed land classes may explain this unexpected gradient. This trend wasn't evident in the wet season likely due to less decomposition time for organics between rain events and larger/more frequent freshwater flushing. Inorganic nitrogen ranged from 12.4% to 53.0% of the TN during dry season compared to 25% to 40% during wet season. The greater IN variability during the dry season may be a reflection of fertilizer application at some of the sample sites. Inorganic nitrogen concentrations did not vary significantly between land classes or between seasons except for the golf course land type (Figure 6). Golf course runoff had greater IN than other land classes but concentrations measured during the dry season were not significantly greater than the wet season (Kruskal Wallis, n = 15, p = 0.141). The restrictions on fertilizer use during wet season are not applicable to golf courses and would explain this result. TP and OP appeared to be greater during the wet season for all land classes (Figures 7 and 8), but no significant differences could be found (Kruskal Wallis, n = 31, p >0.1). Golf course runoff again had the highest concentrations of TP and OP compared to other land classes.

Table 21. Sanibel specific mean nutrient concentrations for stormwater runoff by land use class.

Sanibel Specific Runoff Concentrations	Mean TN Conc (mg/l)		Mean IN Conc (mg/l)		Mean TP Conc (mg/l)		Mean OP Conc (mg/l)	
Land Use Class	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
LowDenRes	1.61	0.71	0.199	0.244	0.24	0.32	0.085	0.077
MedDenRes	1.22	1.13	0.160	0.413	0.27	0.36	0.200	0.219
HighDenRes	1.04	1.33	0.258	0.267	0.22	0.31	0.107	0.250
Commercial	0.66	0.51	0.110	0.159	0.15	0.15	0.049	0.062
Golf Course	4.32	2.28	2.290	0.517	1.21	1.69	1.087	1.526

Nutrient concentrations in golf course stormwater runoff were generally greater than concentrations found in their stormwater retention ponds (Table 22). As expected, a higher proportion of the nutrient concentration in the runoff is inorganic compared to nutrients in stormwater ponds. Concentrations of inorganic nutrients are generally reduced in these stormwater pond systems (Table 22) as a result of dilution with groundwater, sediment adsorption, assimilation into plants and algae and microbial denitrification.

Of 102 total stormwater runoff samples taken, 29 (29%) had concentrations above the Florida DEP numeric nutrient criteria of 1.54 mg/l for TN. The numeric nutrient criterion for phosphorus (0.12 mg/l) was exceeded in 75% of the samples. All golf course samples were in the highest 25th percentile of all samples for nutrient levels. A few noteworthy sample sites with high levels of phosphorus and nitrogen were medium density residential sites in The Dunes, Wulfert Rd., and Pine Tree Dr. and a high density site at the end of Bowman's Beach Rd (Table 23).

Mean runoff concentrations computed in this Phase 2 effort were generally lower than concentrations borrowed from other studies and used in Phase 1 estimates (Figures 5 through 8). Concentrations of organic and inorganic nitrogen and phosphorus found in Sanibel's golf course runoff were the exception. For golf courses, the mean TN concentration was up to 2.5 times greater than literature estimates (Figure 5), while TP concentrations were 5 to 10 times greater than the estimates used in Phase 1 (Figure 7). The contrast with literature values was even greater for OP with levels from golf courses over 10 times greater than the literature estimates (Figure 8). This finding resulted in greater nutrient loading estimates for the three golf courses while other land classes generally had reduced estimates compared to the Phase 1 work. The proportion of the total nutrient load leaving Sanibel which is attributable to golf courses is significantly greater than first estimated.

Stormwater runoff from sites using reclaimed water for irrigation was compared to similar sites which did not use reclaim water. In this analysis, samples were paired by similar land class, basin and event number to control for the variability in these factors. Significantly greater concentrations of OP were found in areas using reclaimed water (0.202 mg/l) compared to those not using reclaimed water (0.091 mg/l) (Paired t-test, $n= 21$, $p= 0.07$). However statistically significant lower concentrations of TN (0.87 vs 1.51 mg/l) were found for areas using reclaimed water (Paired t-test, $n= 21$, $p> 0.01$). No differences were found in TP or IN between sites using reclaimed water and those which were not. Analysis of historical data during Phase 1 of this project found significantly higher surface water concentrations of OP in basins where large volumes of reclaimed water were used (Thompson and Milbrandt. 2013). The greater concentration of OP in runoff samples at sites using reclaimed irrigation water reveals reclaimed water as a principal source of OP (and TP) in surface waters of Sanibel. The significantly lower levels of TN at sites using reclaimed water may be a characteristic of the type of lawn where reclaimed water is used. In general, sites using reclaimed water may have lower vegetative cover and a more "manicured" and maintained lawn. These sites would have less dissolved organic matter (containing TN) in the runoff. The greater concentration of OP found at reclaimed water sites was only marginally significant. Annual reclaimed water usage was 8-11% of the total rainfall volume in basins where it is used. This suggests that reclaimed water can be a significant source of groundwater recharge in addition to rain, possibly affecting groundwater quality. However, if reclaimed water is a main source for OP in surface waters, the direct leakage or application of reclaimed water to the surface waters (from miss-aimed irrigation nozzles) is the most probable route (rather than stormwater runoff) since most phosphorus can be immobilized in soils. Due to the route of the reclaimed water supply piping, most sites using reclaimed water are located near the beach south of Gulf Drive. These sites likely have the greatest percentage of sand and lesser organic material than sites from other parts of the island. Sandy soils have the weakest capacity to immobilize OP (University of Hawaii 2014), allowing OP from irrigation to runoff. The higher OP concentrations found in basins using reclaimed water may be partially due to continuous percolation of reclaimed irrigation water through sandy,

pervious surfaces and into the groundwater. The groundwater would then be the source of nutrient loading to adjacent water bodies.

Golf courses had the highest concentrations of inorganic and total nitrogen and phosphorus in their stormwater runoff (Figure 5-8). Although the estimated runoff coefficients for golf courses are relatively low ($c = 0.04$-0.25), the high concentrations of nutrients in the runoff make golf courses a significant source of nutrient pollution. The constant irrigation of golf course lands with reclaimed water increases the potential of groundwater transfer of anthropogenic nutrients to the adjacent estuary, lakes and the Gulf of Mexico. Phase 1 of this project estimated over 7,000 kilograms of nitrogen and 3,000 kg of phosphorus are applied annually to golf course grounds through reclaimed water usage alone (from actual reclaimed water flow and concentration data). Fertilizer is then applied in addition to this loading, resulting in high concentrations in stormwater runoff and potentially in groundwater.

A paired t-test on pooled data was unable to find a seasonal difference (dry versus wet) between overall mean concentrations of TP, OP and IN in stormwater runoff ($n = 37$, $p > 0.6$). However a significantly greater mean concentration of TN was found in the dry (fertilizer) season compared to the no-fertilizer (wet) season. When data was analyzed by land class the only significant difference was an apparent higher TN in dry season for low density residential land classes (Kruskal Wallis, $n= 22$, $p = 0.027$). Runoff from medium and high density residential, commercial and golf course land classes showed no significant differences in nutrient concentrations (TN, TP, IN, OP) between the dry (fertilizer) and wet (no-fertilizer season). These findings are somewhat contrary to expected findings. Analysis of time series surface water data in Phase 1 revealed that nutrient concentrations were lower in Sanibel Slough after the fertilizer ordinance was enacted in 2007. The ordinance bans residential application of fertilizer from July through September each year and specifies maximum fertilizer loading rates and fertilizer types for the remainder of the year. The failure to find significant lower nutrient concentrations (for pooled data) during the dry, no-fertilizer season is either due to insufficient sample size or it reflects truly insignificant differences in stormwater runoff nutrient concentrations. The similarity of mean stormwater runoff nutrient concentrations between no-fertilizer and fertilizer periods suggest that either fertilizer BMPs have minimized fertilizer runoff year-round, or BMP's have had little effect, or fertilizer-based nutrient runoff has not been reduced significantly during the no-fertilizer season.

Nutrient loading analyses performed in Phase 1 of this study used literature-based runoff concentrations taken from studies done in Florida. We found mean Sanibel-specific runoff concentrations to be significantly lower (Mann-Whitney, $n = 8$, $p < 0.01$) than literature values for TN, TP and IN using pooled land class data excluding golf courses (Figures 5-8). Phase 1 of this study found significantly lower concentrations of IN and TP in the Sanibel Slough after implementation of the fertilizer ordinance. Taken together these findings strengthen the argument that already implemented BMPs are having a positive effect on reducing nutrient runoff and indeed fertilizer-based runoff may be relatively low all year. However an increasing trend in OP

and significantly greater concentration of OP in the Sanibel Slough after the fertilizer ordinance implementation provide a warning that all forms of nutrients are not on the decrease. As discussed in the Phase 1 report, high concentrations of OP in Sanibel's surface waters may be associated with reclaim water usage. The annual volume of reclaim water used for irrigation has varied between 22.5 and 38.5 million gallons per year since 2010 (Figure 9) based upon irrigation needs. Concentrations of OP are relatively high in the reclaimed water. If runoff of fertilizer based nutrients has been reduced through BMPs, we would expect IN concentrations and loadings to be reduced as we have found. However if BMP efforts have effectively kept phosphorus loadings from fertilizers low, then the OP in reclaimed water becomes the main phosphorus source. Sampling now detects OP more often and at higher concentrations than previously due to an excess of OP (relative to IN) in the Sanibel Slough.

Sanibel-Specific Nutrient Loading Estimates

Estimates of nutrient loads to waterbodies using Sanibel-specific coefficients and concentrations developed in this effort include: 5,655 kg TN/yr; 1,549 kg IN/yr; 1,631 kg TP/yr; and 997 kg OP/yr (Tables 24-27). These annual loads were released from 1,837 hectares (4,540 acres) of watershed (wetlands excluded). The estimated annual loading rates are found to be: 3.1 kg TN/ha/yr and 0.9 kg TP/ha/yr. Nutrient loading rate estimates including only the same land classes as those evaluated for Sanibel (wetlands and wetland forests excluded) were 8.05 kg TN/ha/yr and 0.90 kg TP/ha/yr for the Caloosahatchee River watershed and 6.43 kg TN/ha/yr plus 1.31 kg TP/ha/yr. for the Saint Lucie Estuary (SLE) watershed (Soil and Water Engineering 2008). The Sanibel TN loading rate is much lower than either the Caloosahatchee or SLE watersheds, while the TP loading is comparable to those watersheds. The two larger watersheds used for comparisons have large areas of intensive agriculture and urban areas and a lower percentage of preserved natural lands than Sanibel. Sanibel has also implemented numerous island-wide BMPs to date aimed at lowering nutrient loads. Lower loading rates are to be expected on Sanibel. However, the phosphorus loading rate on Sanibel is not lower than the two comparison estuaries. Total nitrogen loading rates on Sanibel may be reduced compared to other watersheds because of local efforts to preserve natural land, BMPs which reduce nitrogen preferentially over phosphorus and its lack of agriculture or other intensive land development. Total phosphorus loading rates remain relatively higher due to soil characteristics (more sand = less soil adsorption of P), and the use of reclaimed water (which contains relatively higher P levels than other nutrient sources) over a greater percentage of its land area.

Sanibel stormwater runoff nutrient load estimates for TN, IN and TP were significantly lower than Phase 1 values using Sanibel-specific runoff coefficients and concentrations (Table 20). The revised estimate of stormwater TN load was 55% less (from 12,659 to 5,655 kg/yr.) and IN was 63% less (4,142 to 1,549 kg/yr.) than the previous estimates. Phase 2 estimates for TP load decreased by 33% (2431 to 1631 kg/yr.). In contrast, estimated OP loading increased by 28% (778 to 997 kg/yr.) over Phase 1 predicted values (Table 20). The estimated decrease in TN loading was driven in almost equal parts by reductions in stormwater volume (24% reduction)

and concentration estimates (31% reduction). A greater proportion of the estimated IN load reduction was attributable to reduced concentration estimates (39%) compared to runoff volume estimate reduction (24%). Change in the estimated TP load was mostly due to reduction in runoff volume as opposed to reduction in concentration (24% versus 8%) suggesting concentration estimates taken from the literature for TP were fairly accurate. The 28% increase in the OP loading estimate despite the runoff volume reduction, reflects an underestimate of concentrations in Phase 1 as a result of using literature values.

Table 24. Annual Sanibel stormwater TN loading to waterbodies calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual TN Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean TN Conc (mg/l)		Sanibel TN Loading (kg/yr)		Total TN Loading (kg/yr)
Land Use				Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
Low Density Residential	825	0.257	0.709	0.12	0.33	1.61	0.71	165	557	722
Medium Density Residential	1281	0.257	0.709	0.18	0.38	1.22	1.13	292	1579	1870
High Density Residential	452	0.257	0.709	0.27	0.45	1.04	1.33	132	778	910
Commercial and Services	259	0.257	0.709	0.44	0.59	0.66	0.51	78	223	301
Institutional (School)	62	0.257	0.709	0.18	0.42	1.18	1.18	14	88	102
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	4.32	2.28	54	495	549
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	1.93	1.93	5	19	24
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	1.82	1.82	37	125	162
Shrub and Brushland	587	0.257	0.709	0.14	0.3	1.2	1.2	103	606	709
Disturbed Land	72	0.257	0.709	0.55	0.65	1.5	1.5	62	202	264
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0.2	0.2	9	33	42
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					950	4705	**5655**

Table 25. Annual Sanibel stormwater IN loading to waterbodies calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual IN Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean IN Conc (mg/l)		Sanibel IN Loading (kg/yr)		Total IN Loading (kg/yr)
Land Use				Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
Low Density Residential	825	0.257	0.709	0.12	0.33	0.20	0.24	20	190	211
Medium Density Residential	1281	0.257	0.709	0.18	0.38	0.16	0.41	38	577	615
High Density Residential	452	0.257	0.709	0.27	0.45	0.26	0.27	33	156	189
Commercial and Services	259	0.257	0.709	0.44	0.59	0.11	0.16	13	70	83
Institutional (School)	62	0.257	0.709	0.18	0.42	0.50	0.50	6	37	43
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	2.29	0.52	29	112	141
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	0.73	0.73	2	7	9
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	0.5	0.5	10	34	44
Shrub and Brushland	587	0.257	0.709	0.14	0.3	0.2	0.2	17	101	118
Disturbed Land	72	0.257	0.709	0.55	0.65	0.543	0.543	22	73	96
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0	0	0	0	0
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					191	1358	**1549**

Table 26. Annual Sanibel stormwater TP loading to waterbodies calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual TP Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean TP Conc (mg/l)		Sanibel TP Loading (kg/yr)		Total TP Loading (kg/yr)
Land Use				Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
Low Density Residential	825	0.257	0.709	0.12	0.33	0.24	0.32	25	251	276
Medium Density Residential	1281	0.257	0.709	0.18	0.38	0.27	0.36	65	506	570
High Density Residential	452	0.257	0.709	0.27	0.45	0.22	0.31	28	182	209
Commercial and Services	259	0.257	0.709	0.44	0.59	0.15	0.15	18	64	82
Institutional (School)	62	0.257	0.709	0.18	0.42	0.15	0.15	2	11	13
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	1.21	1.69	15	367	382
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	0.4	0.4	1	4	5
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	0.27	0.27	5	19	24
Shrub and Brushland	587	0.257	0.709	0.14	0.3	0.07	0.07	6	35	41
Disturbed Land	72	0.257	0.709	0.55	0.65	0.15	0.15	6	20	26
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0.01	0.01	0	2	2
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					171	1460	**1631**

Table 27. Annual stormwater OP loading to waterbodies adjacent to Sanibel calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual OP Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean OP Conc (mg/l)		Sanibel OP Loading (kg/yr)		Total OP Loading (kg/yr)
Land Use				Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
Low Density Residential	825	0.257	0.709	0.12	0.33	0.09	0.08	9	60	69
Medium Density Residential	1281	0.257	0.709	0.18	0.38	0.20	0.22	48	305	353
High Density Residential	452	0.257	0.709	0.27	0.45	0.11	0.25	14	146	160
Commercial and Services	259	0.257	0.709	0.44	0.59	0.05	0.06	6	27	33
Institutional (School)	62	0.257	0.709	0.18	0.42	0.06	0.06	1	4	5
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	1.09	1.53	14	332	345
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	0.143	0.143	0	1	2
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	0.08	0.08	2	6	7
Shrub and Brushland	587	0.257	0.709	0.14	0.3	0.03	0.03	3	15	18
Disturbed Land	72	0.257	0.709	0.55	0.65	0.03	0.03	1	4	5
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0	0	0	0	0
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					96	901	**997**

Though stormwater nutrient loading rates on Sanibel are low compared to other watersheds, Phase 1 of this project found that TN and TP increased significantly in the Sanibel Slough after rainfall events. Loads are significant enough to raise concentrations in the Sanibel Slough after rain events, encouraging consideration of additional BMPs to decrease loads. In addition, IN was found to be significantly greater in nearshore estuarine surface water samples after rain events (Thompson and Milbrandt 2013).

The medium density residential land class is the greatest source of loadings for TN, IN and TP (Figures 10 through 12). This is primarily due to its larger total area than other classes. Though comprising a small part of the land area, golf courses were the leading source of inorganic phosphorus loads (Figure 13). Golf courses make up about 9% of the anthropogenic land area on Sanibel and produce 35% of the inorganic phosphorus (OP) load. The inorganic forms of nitrogen and phosphorus are preferred by algae and thus most likely to cause blooms. Compared to Phase 1 estimates, the golf course land class substantially increased in its relative importance as a phosphorus source. The higher measured concentrations of nutrients in golf course stormwater samples compared to the Phase 1 estimates accounted for the entire increase in golf course loading values. The Sanibel-specific golf course runoff coefficients developed during this work were slightly lower than the estimates used in Phase 1 (Table 18). A recommended priority is to target load reduction efforts at medium density residential and golf course land classes.

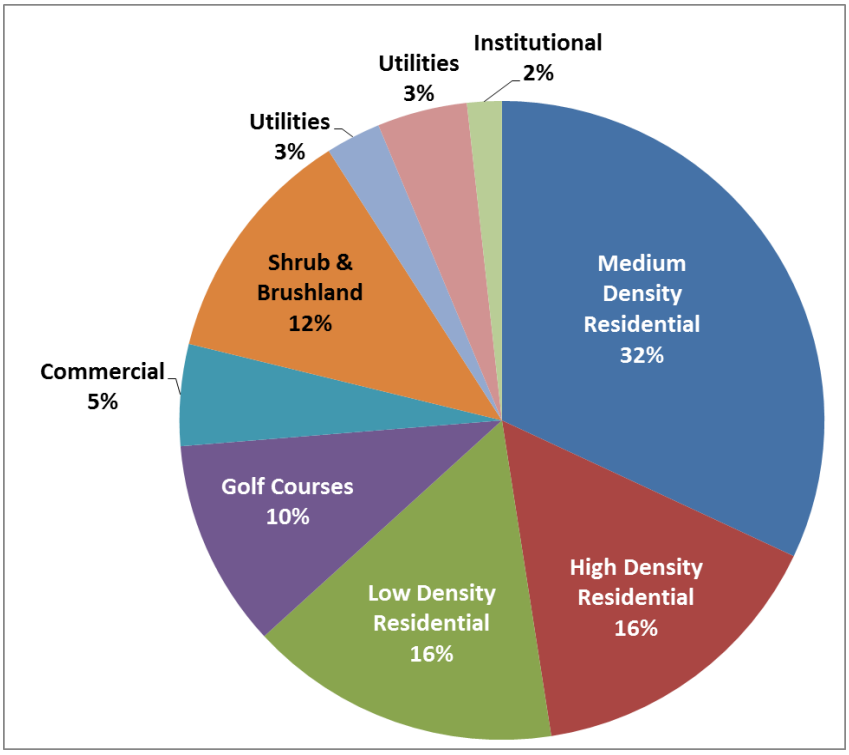

Figure 10. Proportion of estimated TN loading by each anthropogenic land class on Sanibel.

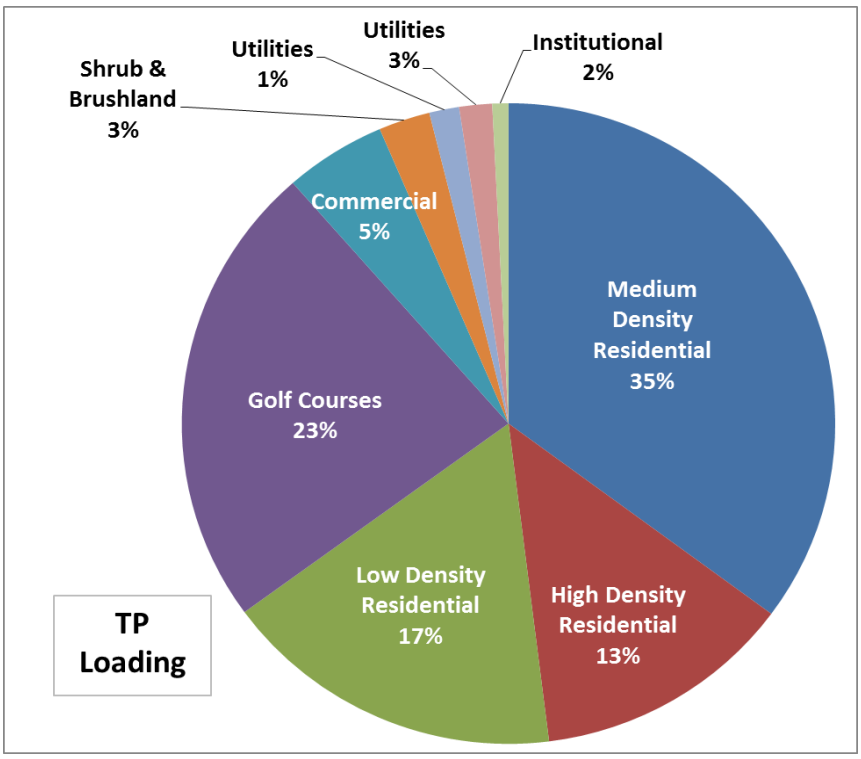

Figure 11. Proportion of estimated TP loading by each anthropogenic land class on Sanibel.

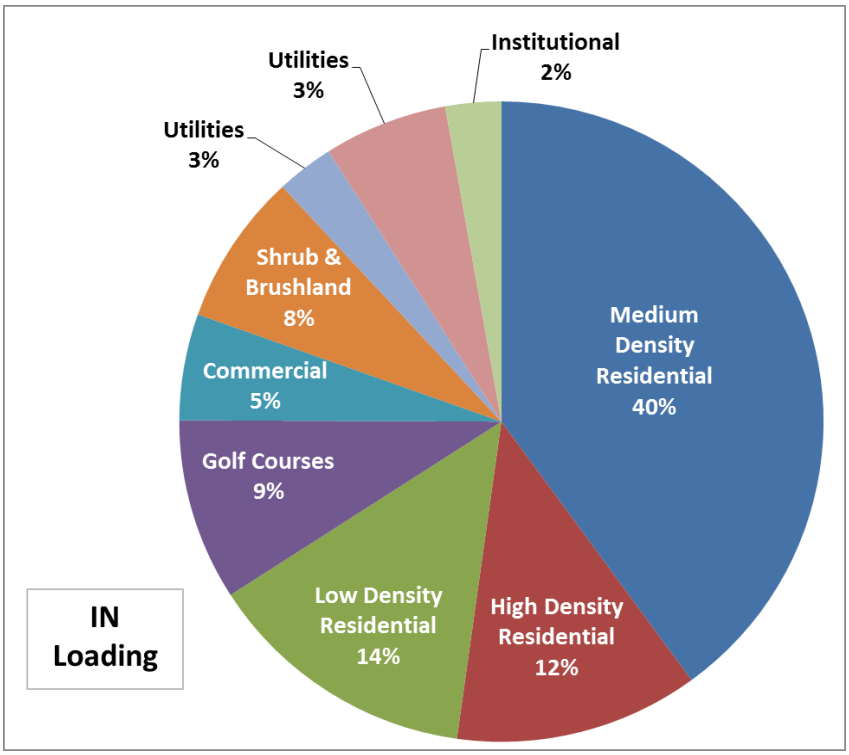

Figure 12. Proportion of estimated IN loading by each anthropogenic land class on Sanibel.

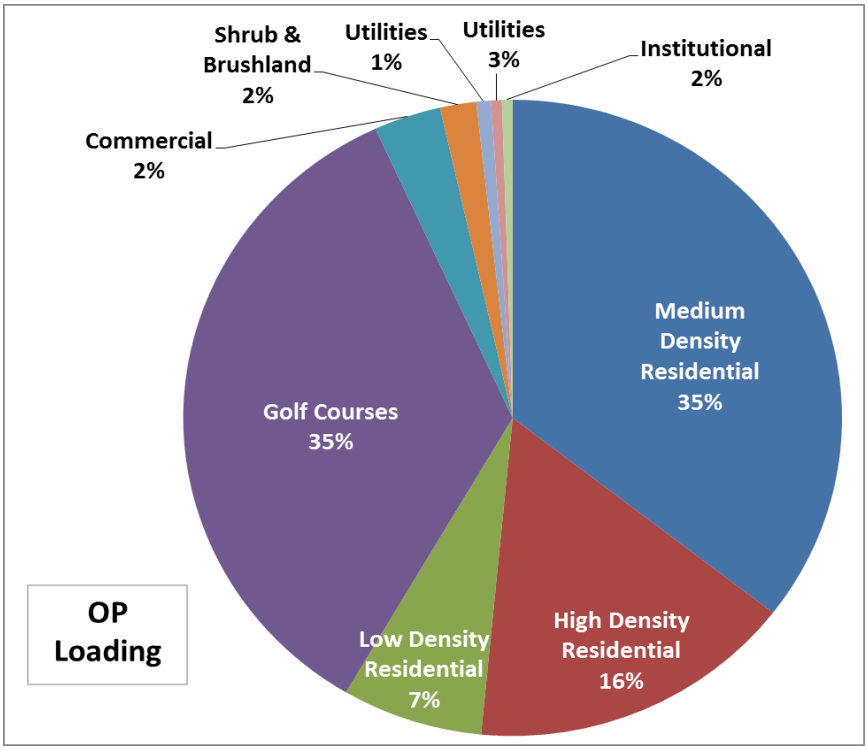

Figure 13. Proportion of estimated OP loading by each anthropogenic land class on Sanibel.

The east slough basin had the largest proportion of Sanibel's nutrient load (Figures 14 through 16; Table 28) accounting for between 18-22% of the total mass of nutrients leaving Sanibel. This basin has a relatively large area, the highest proportion of medium density residential land plus a golf course. In Phase 1, significantly greater TP and OP concentrations were found in the east basin of Sanibel Slough compared to the west basin. The annual stormwater TP and OP loads from the east basin were 341.3 kg and 227.6 kg respectively which were added to approximately 21.8 hectares of Sanibel Slough water surface area in that basin. The annual loading rate to the waterbody was approximately 15.6 kg.TP/ha-yr. and 10.4 kg OP/ha/yr. The TP and OP loading in the west basin was 236.1 and 97.8 kg respectively discharged into 28.9 hectares of west slough water surface area. This results in a loading rate of 8.2 kg TP/ha/yr and 3.4 kg OP/ha/yr in the west slough. Assuming the cross sectional area of the Sanibel Slough is similar in each basin, the loading rate for TP in the east basin is twice as high as the west basin and OP loads are 3 times as great. No significant differences in surface water nitrogen concentrations were found between the Sanibel Slough basins in Phase 1. However, loading rates in the east slough were also greater for TN (45.3 vs. 30.8 kg./ha-yr.) and IN (12.7 vs. 8.5 kg./ha-yr.) than the west slough. This loading data supports the surface water concentration findings in Phase 1, and leads to a recommendation that the east basin may be a priority for BMPs compared to the west basin.

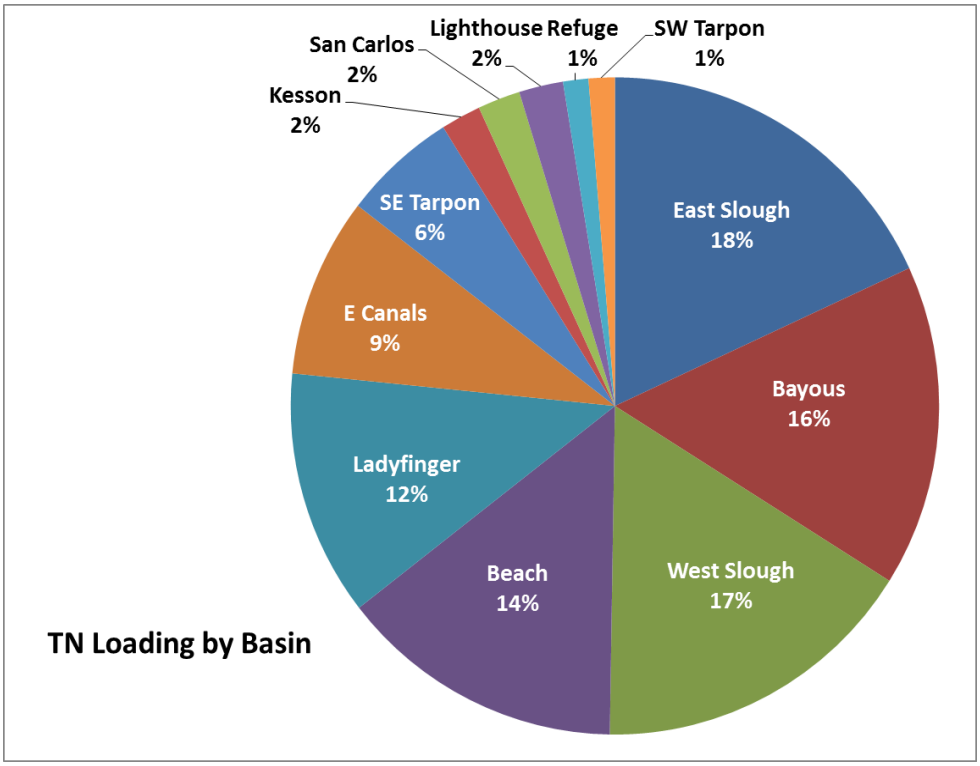

Figure 14. Proportion of estimated TN loading from each discharge basin on Sanibel.

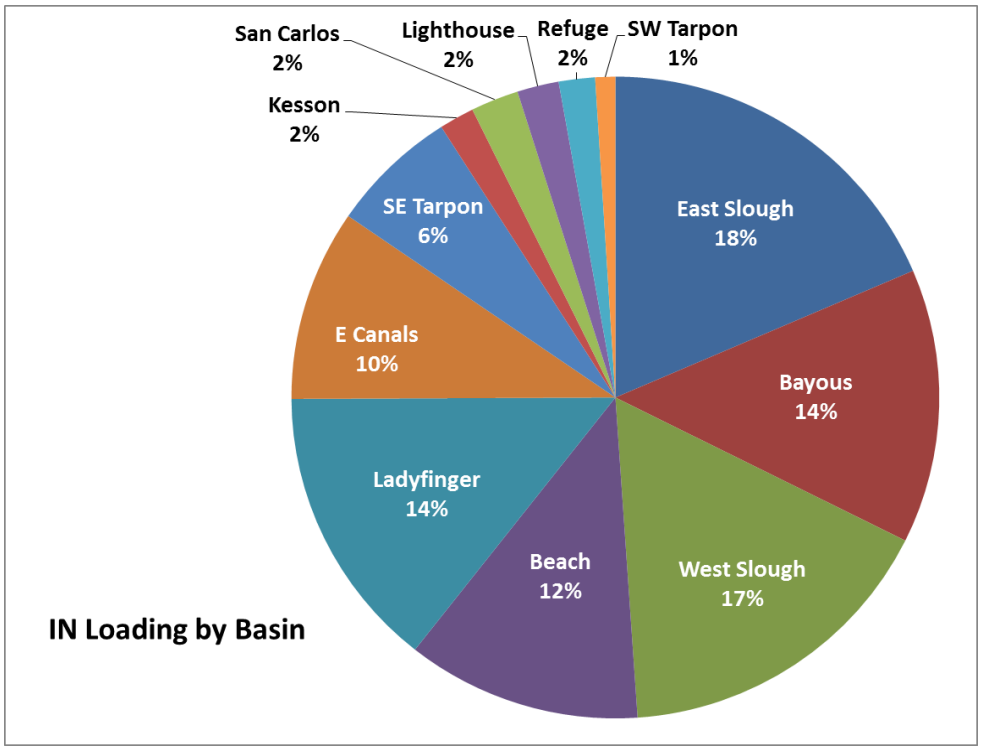

Figure 15. Proportion of estimated IN loading from each discharge basin on Sanibel.

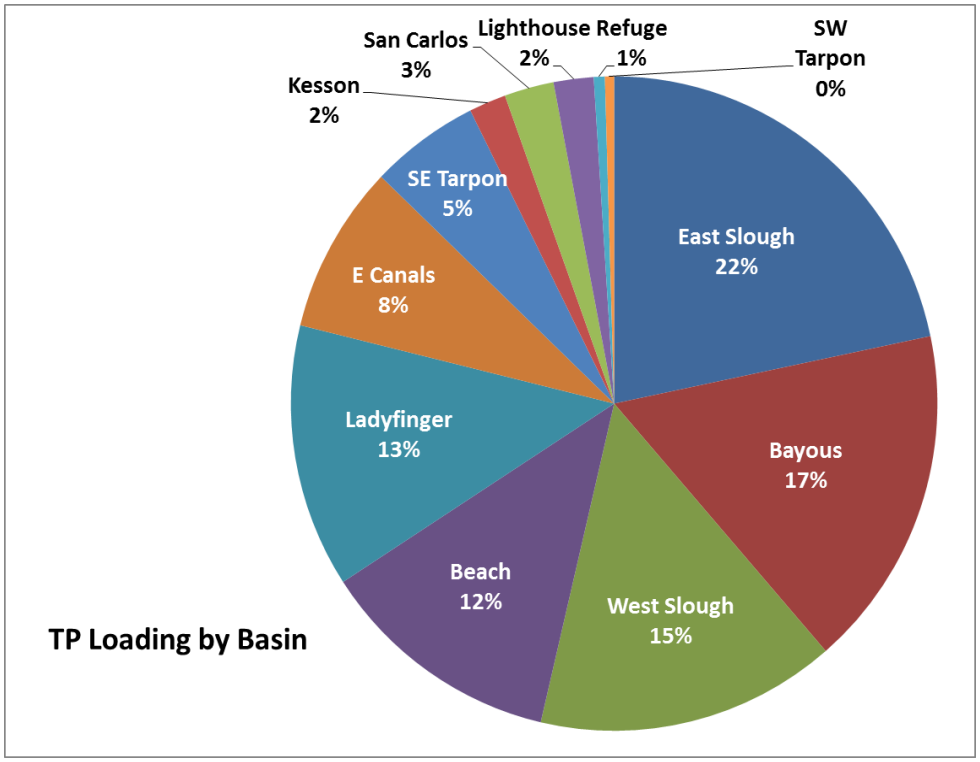

Figure 16. Proportion of estimated TP loading from each discharge basin on Sanibel.

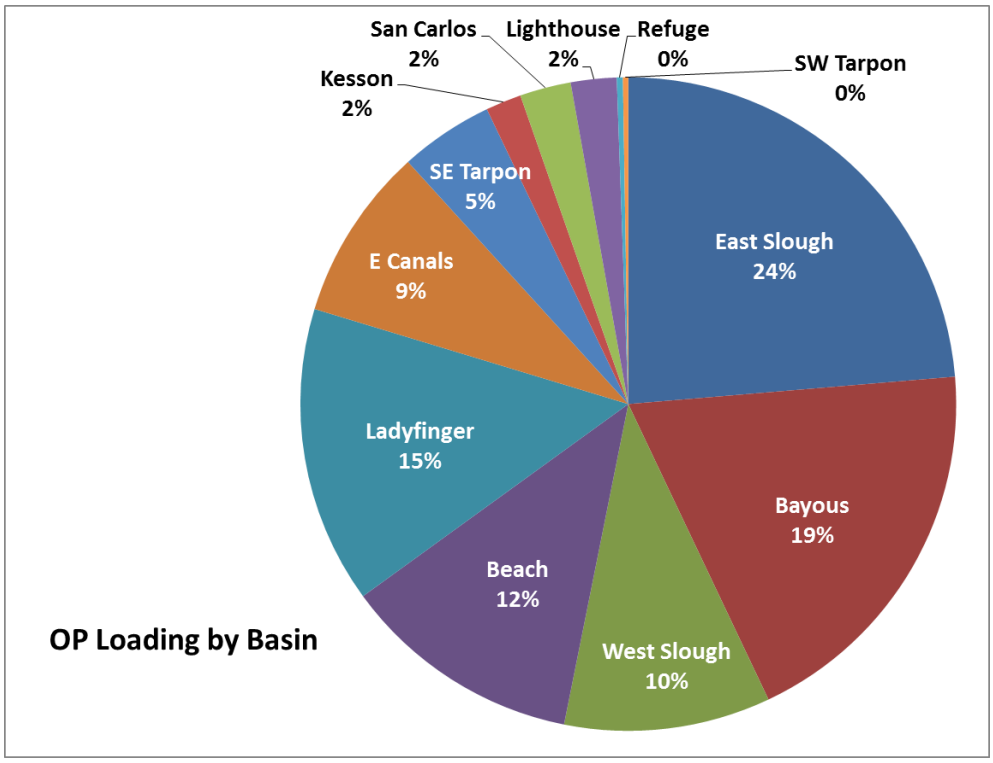

Figure 17. Proportion of estimated OP loading from each discharge basin on Sanibel.

The three basins with golf courses (east slough, bayous and ladyfinger) are the basins with greatest inorganic phosphorus loadings (Figures 15 and 17; Table 28). The nitrogen and phosphorus in reclaimed water (which is used for golf course irrigation) are primarily in inorganic form. The considerable proportion of nutrient load contributed by the west slough basin is primarily due to its large land area (19% of total). In contrast, the refuge basin has a large relative land area (28% of total) but a very small proportion of nutrient load due to its lack of development and significant wetland classes assigned no runoff in this evaluation.

Sanibel bayous basin estuarine surface water samples had the highest concentration of TP and TN among estuarine sites in near shore waters in Phase 1. Surface water concentrations of TN and TP were also significantly greater than those found in the refuge basin estuarine samples. The loading estimates in this work support those findings with the bayous basin contributing high total nutrient loads while the refuge basin had the lowest (Table 28).

Stormwater systems (community ponds and lakes) on Sanibel collect and retain much of the stormwater runoff in several of the drainage basins. Nutrient concentrations are typically high compared to all Florida lakes and approach levels found in stormwater runoff. The stormwater systems have been designed to contain a design storm runoff volume without discharge. However some of the systems do discharge regularly and interact with estuarine waters and the Sanibel Slough system (Thompson 2013). In addition, these systems are directly connected to the water table aquifer and groundwater moves through the porous sands of the island to the Sanibel Slough, the estuary, and the ocean. In Phase 3, we will evaluate groundwater nutrient loadings to and from Sanibel waterbodies and compare those loads to surface water runoff.

Conclusions

Development of Sanibel-specific runoff coefficients and concentrations significantly lowered estimates of nutrient loading rates originally developed in Phase 1 (Thompson and Milbrandt 2013). Stormwater runoff coefficients are now available for the major anthropogenic land classes and unique values are available for each of the 12 Sanibel drainage basins defined in Phase 1. Sanibel-specific coefficients were derived using revised runoff models and resulted in an estimate of total stormwater runoff from Sanibel that was 24% less than values calculated in Phase 1. In general lower nutrient loading rates were found after analyzing nutrients in water samples collected during storm events. The lower runoff volume compared to estimates derived from Florida-specific literature values is likely a result of conditions unique to Sanibel such as soil type and connectivity of stormwater areas. The City of Sanibel has also implemented stormwater retention requirements, impervious surface limitations, and vegetation and fertilizer ordinances. This combined with an acutely aware community and City Council makes Sanibel unique and well positioned to address nutrient management effectively.

Mean nutrient concentrations obtained from water samples collected in Phase 2 during precipitation events further refined loading estimates. The new data reduced TN loading estimates by 55% and IN loading by 62% compared to Phase 1 loading estimates. However, we found inorganic phosphorus concentrations in Sanibel runoff to be greater than those found in Phase 1. The new loading estimates for inorganic phosphorus (OP) increased 28% over Phase 1 estimates even though runoff rates decreased 24%. The increase in inorganic phosphorus loading was due to the finding of higher phosphorus concentrations in stormwater runoff. Estimated total phosphorus (TP) loads decreased by 33% suggesting that the total phosphorus concentration estimates used in Phase 1 were close or slightly higher than actual levels found.

As expected, Sanibel's stormwater TN loading rates were found to be lower than rates for the Caloosahatchee and Saint Lucie watersheds which have large areas of intensive agricultural and urban land uses. However Sanibel's TP loading rate was as high as those agricultural and urbanized watersheds. The main source of phosphorus on Sanibel is reclaimed water used for irrigation. The mean OP concentrations in runoff from sites using reclaimed water was significantly greater than sites not using reclaimed water. Phase 1 found significantly greater OP concentrations in basins which used reclaimed water. Modeling done in that initial work found that a 30% reduction in phosphorus would be necessary before any reduction in algae biomass could occur in Sanibel Slough (Thompson and Milbrandt 2013). The reduction in runoff of phosphorus from reclaimed water should be one of the highest priorities of any additional BMP programs undertaken on Sanibel.

Golf courses and medium density residential land classes proved to be the largest contributors to nutrient loads. Golf courses made up 9% of the anthropogenic land area while they are the source of over 35% of the inorganic phosphorus load from Sanibel. Inorganic nutrients are known to cause algae blooms and fish kills. Medium density residential nutrient concentrations were highly variable with many sample sites having concentrations well above nutrient criteria for nitrogen and phosphorus while others had very low levels. The variability is likely due to differences in fertilizer use between landowners and time since last application. When considering BMPs for the reduction of nutrient loads to the Sanibel Slough and Pine Island Sound, resources may be wisely focused on golf courses and medium density residential land classes. Specifically the fact that there are only 3 golf courses but they contribute so significantly to loading, making them a logical choice for nutrient loading reduction activities.

The eastern basin of Sanibel Slough was found to contain significantly greater concentrations of TP and OP than the western basin during Phase 1 evaluation (Thompson and Milbrandt 2013). In this effort, we found TP and OP stormwater loading rates to the eastern slough basin were 2-3 times greater than those in the western slough. In addition, TN and IN loading rates were greater in the eastern slough. The east slough basin accounted for 18-22% of the total mass of stormwater runoff-associated nutrients leaving Sanibel.

Nutrient loads from Sanibel bayous basin were highest amongst watersheds discharging to the estuary. This finding corresponds to significantly greater concentrations in that basin's estuary surface water samples compared to the wildlife refuge basin (Thompson and Milbrandt 2013). The very low stormwater nutrient loads originating in the Wildlife Refuge basin corresponded to the lowest nutrient concentrations in estuarine surface waters found in Phase 1. This basin may serve as a 'control' for implementation of BMPs in other basins.

Comparisons of nutrient concentrations between dry (fertilizer allowed) and wet (no-fertilizer) season found only TN to be greater during fertilizer season. The expected greater concentration of IN in dry season runoff was not realized and this may be a credit to city-wide BMPs including the fertilizer ordinance.

Findings in this work and in Phase 1 suggest groundwater may have significant interaction with surface waters. Its known connectivity with the Gulf of Mexico and Pine Island Sound provides another route for nutrients to move from Sanibel. Stormwater pond systems which are intended to hold runoff, redirect it to aquifers providing an indirect route for discharge to surface waters. To get a complete picture of nutrient loading from Sanibel to adjacent waterbodies, estimates of groundwater flows and concentrations are needed. Phase 3 of this project involves estimating groundwater nutrient concentrations and discharge rates. Water table aquifer monitoring wells will be installed at representative locations throughout Sanibel. Groundwater flow rates will be estimated using slug in and slug out methods (ASTM 2014) at the well sites. Historical groundwater flow monitoring data will be combined with this new data to estimate flow rates for the differing hydrologic areas of the island. The estimated flow rates will be combined with groundwater sampling results to get estimates of nutrient loadings through Sanibel groundwater.

The Sanibel Slough is listed by Florida DEP as impaired due to enriched nutrient concentrations. With this classification comes the requirement of developing a basin action management plan (BMAP) which will initiate an efficient, information-based implementation of activities designed to improve water quality in the slough. The information provided in the Sanibel Nutrient Management Plan will guide the activity of resource managers by highlighting the major sources and areas requiring attention.

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Table 1 . Percent pervious and impervious surface area for low density residential land class by drainage basin. The percentage of the total low density land area analyzed during the GIS analysis is also given.

Low Density Residential	Basin	Area (m^2)	% Pavement	% Building	% Impervious	% Pervious	Percentage of Area Analyzed with GIS
	East Slough	454,054	17.8	12.0	29.8	70.2	31.4
	West Slough	1,383,205	13.5	14.0	27.4	72.6	25.0
	Bayous	526,087	12.4	9.7	22.1	77.9	62.1
	Beach	594,883	15.8	17.7	33.5	66.5	28.5
	Ladyfinger	16,187	12.4	9.7	22.1	77.9	0.0
	SE Tarpon	72,842	7.1	9.7	16.9	83.1	81.9
	E Canals	809	17.8	12.0	29.8	70.2	0.0
	Lighthouse	0					
	Kesson	97,933	12.4	9.7	22.1	77.9	0.0
	San Carlos	60,702	11.3	21.2	32.4	67.6	28.8
	SW Tarpon	1,214	12.4	9.7	22.1	77.9	0.0
	Refuge	1,619	12.4	9.7	22.1	77.9	0.0
	Overall Mean		14.1	13.6	27.7	72.3	33.1

Table 2. Percent pervious and impervious surface area for medium density residential land class by drainage basin. The percentage of the medium density land area analyzed during the GIS analysis is also given.

Med. Density Residential	Basin	Area (m^2)	% Pavement	% Building	% Impervious	% Pervious	Percentage of Area Analyzed with GIS
	East Slough	936,031	15.7	24.0	39.7	60.3	21.6
	West Slough	856,308	16.5	18.7	35.2	64.8	22.5
	Bayous	519,612	12.1	23.4	35.5	64.5	21.4
	Beach	68,796	12.9	22.3	35.2	64.8	49.3
	Ladyfinger	797,225	15.0	19.6	34.6	65.4	23.7
	SE Tarpon	462,000	17.6	15.5	33.1	66.9	26.3
	E Canals	971,238	16.5	17.4	33.9	66.1	21.7
	Lighthouse	134,355	16.5	17.4	33.9	66.1	0.0
	Kesson	32,779	12.1	23.4	35.5	64.5	0.0
	San Carlos	202,341	14.8	19.1	33.9	66.1	23.6
	SW Tarpon	0					
	Refuge	4,856	16.5	18.7	35.2	64.8	0.0
	Overall Mean		15.6	19.8	35.4	64.6	22.2

Table 3. Percent pervious and impervious surface area for high density residential land class by drainage basin. The percentage of the high density land area analyzed during the GIS analysis is also given.

High Density Residential	Basin	Area (m^2)	% Pavement	% Building	% Impervious	% Pervious	Percentage of Area Analyzed with GIS
	East Slough	312,415	21.8	26.3	48.1	51.9	29.9
	West Slough	6,879	17.5	30.0	47.6	52.4	0.0
	Bayous	91,458	17.5	30.0	47.6	52.4	39.9
	Beach	1,072,409	16.6	21.6	38.2	61.8	33.3
	Ladyfinger	0					
	SE Tarpon	0					
	E Canals	149,732	22.9	27.0	49.9	50.1	58.5
	Lighthouse	127,880	22.9	27.0	49.9	50.1	0.0
	Kesson	0					
	San Carlos	0					
	SW Tarpon	0					
	Refuge	0					
	Overall Mean		18.6	23.8	42.3	57.7	32.7

Table 4. Percent pervious and impervious surface area for the commercial land class by drainage basin. The percentage of the commercial land area analyzed during the GIS analysis is also given.

Commercial	Basin	Area (m^2)	% Pavement	% Building	% Impervious	% Pervious	Percentage of Area Analyzed with GIS
	East Slough	368,666	49.0	16.4	65.5	34.5	34.3
	West Slough	65,559	53.8	14.2	67.9	32.1	44.7
	Bayous	59,083	53.8	14.2	67.9	32.1	0.0
	Beach	93,077	23.0	26.3	49.3	50.7	100.0
	Ladyfinger	48,562	49.0	16.4	65.5	34.5	0.0
	SE Tarpon	341,957	17.2	8.2	25.4	74.6	26.3
	E Canals	6,474	49.0	16.4	65.5	34.5	0.0
	Lighthouse	0					
	Kesson	0					
	San Carlos	0					
	SW Tarpon	12,545	53.8	14.2	67.9	32.1	0.0
	Refuge	9,712	53.8	14.2	67.9	32.1	0.0
	Overall Mean	1,005,635	36.5	14.2	50.7	49.3	33.7

Table 5. Percent pervious and impervious surface area for the institutional land class by drainage basin. The percentage of the institutional land area analyzed during the GIS analysis is also given.

Institutional	Basin	Area (m^2)	% Pavement	% Building	% Impervious	% Pervious	Percentage of Area Analyzed with GIS
	East Slough	34,398	31.2	14.8	46.0	54.0	0.0
	West Slough	46,113	31.2	14.8	46.0	54.0	46.9
	Bayous	0					
	Beach	0					
	Ladyfinger	0					
	SE Tarpon	57,869	31.2	14.8	46.0	54.0	0
	E Canals	0					
	Lighthouse	0					
	Kesson	0					
	San Carlos	0					
	SW Tarpon	10,522	31.2	14.8	46.0	54.0	0
	Refuge	91,863	31.2	14.8	46.0	54.0	0
	Overall Mean		31.2	14.8	46.0	54.0	9

Table 6. Percent pervious and impervious surface area for the golf course land class by drainage basin. The percentage of the institutional land area analyzed during the GIS analysis is also given.

Golf Course Land Class - Basin	Area (m^2)	% Pavement	% Building	% Impervious	% Pervious	% Area Analyzed with GIS
Bayous						
Sanctuary Golf Course	445,300	5.5	2.0	7.5	92.5	100
Ladyfinger						
Dunes Golf Course	295,000	11.8	2.7	14.5	85.5	100
East Slough						
Beachview Golf Course	403,000	5.4	1.5	6.9	93.1	100
Overall Mean		7.1	2.0	9.1	90.9	100

Tables 7 a.) Percentage of directly connected impervious surfaces (DCIA) for each land class as specified in Florida DEP methodology for estimating stormwater runoff. b.) Modified % DCIA for each land use class on Sanibel taking into account the stormwater ordinance effective in October 1989 which eliminated DCIA.

A.)

Land Use	DEP % DCIA
LowDenRes	15
MedDenRes	25
HiDenRes	40
Comm	75
Instit.	25

B.)

Basin	LowDensity		MedDensity		HighDensity		Commmercial		Institutional	
	% < 1990	% DCIA	% < 1990	% DCIA	% < 1990	% DCIA	% < 1990	% DCIA	% < 1990	% DCIA
EastSlough	0.66	0.10	0.66	0.17	0.66	0.26	0.66	0.50	0.66	0.17
WestSlough	0.80	0.12	0.80	0.20	0.80	0.32	0.80	0.60	0.80	0.20
Bayous	0.60	0.09	0.60	0.15	0.60	0.24	0.60	0.45	0.60	0.15
Beach	0.79	0.12	0.79	0.20	0.79	0.32	0.79	0.59	0.79	0.20
Ladyfinger	0.84	0.13	0.84	0.21	0.84	0.34	0.84	0.63	0.84	0.21
SETarpon	0.78	0.12	0.78	0.20	0.78	0.31	0.78	0.59	0.78	0.20
ECanals	0.81	0.12	0.81	0.20	0.81	0.32	0.81	0.61	0.81	0.20
Lighthouse	0.83	0.12	0.83	0.21	0.83	0.33	0.83	N/A	0.83	0.21
Kesson	0.61	0.09	0.61	0.15	0.61	N/A	0.61	N/A	0.61	0.15
SanCarlos	0.82	0.12	0.82	0.21	0.82	N/A	0.82	N/A	0.82	0.21
SWTarpon	0.71	0.11	0.71	0.18	0.71	N/A	0.71	0.53	0.71	0.18
Refuge	0.33	0.05	0.33	0.08	0.33	N/A	0.33	0.25	0.33	0.08

Table 8 a. and b. Wet and dry season curve numbers (CN) and soil storage (S) coefficients calculated for pervious surfaces on Sanibel using SCS curve number method. Table a.) represents normal antecedent moisture conditions while table b.) represents antecedent moisture condition III.

a.) Normal antecedent moisture condition.

Land Use	For Pervious Surfaces			
	DryCN	DryS	WetCN	WetS
LowDenRes	61.0	6.4	80.0	2.5
MedDenRes	61.0	6.4	80.0	2.5
HiDenRes	61.0	6.4	80.0	2.5
Comm	61.0	6.4	80.0	2.5
Instit.	61.0	6.4	80.0	2.5

b.) Antecedent moisture condition III.

Land Use	For Pervious Surfaces			
	DryCN	DryS	WetCN	WetS
LowDenRes	78.2	2.8	90.2	1.1
MedDenRes	78.2	2.8	90.2	1.1
HiDenRes	78.2	2.8	90.2	1.1
Comm	78.2	2.8	90.2	1.1
Instit.	78.2	2.8	90.2	1.1

Table 9. Sampling event information for development of runoff concentration values.

Sampling Event	Date	Season	Precipitaion (In)	Total Number Samples	Number Permanent Sites	Number Random Sites	Number LowDen	Number MedDen	Number HighDen	Number Comrcl	Number Golf Course
1	1/30/2014	Dry	1.5	20	12	8	6	6	5	3	0
2	3/6/2014	Dry	0.65	20	15	5	5	6	3	3	3
3	7/7/2014	Dry	0.4	12	7	5	3	3	3	0	3
4	7/15/2014	Wet	1.1	20	13	7	4	8	4	1	3
5	9/2/2014	Wet	0.59	9	3	6	2	3	1	0	3
6	9/17/2014	Wet	0.5	21	12	9	4	6	5	3	3
Total				**102**	**62**	**40**	**24**	**32**	**21**	**10**	**15**

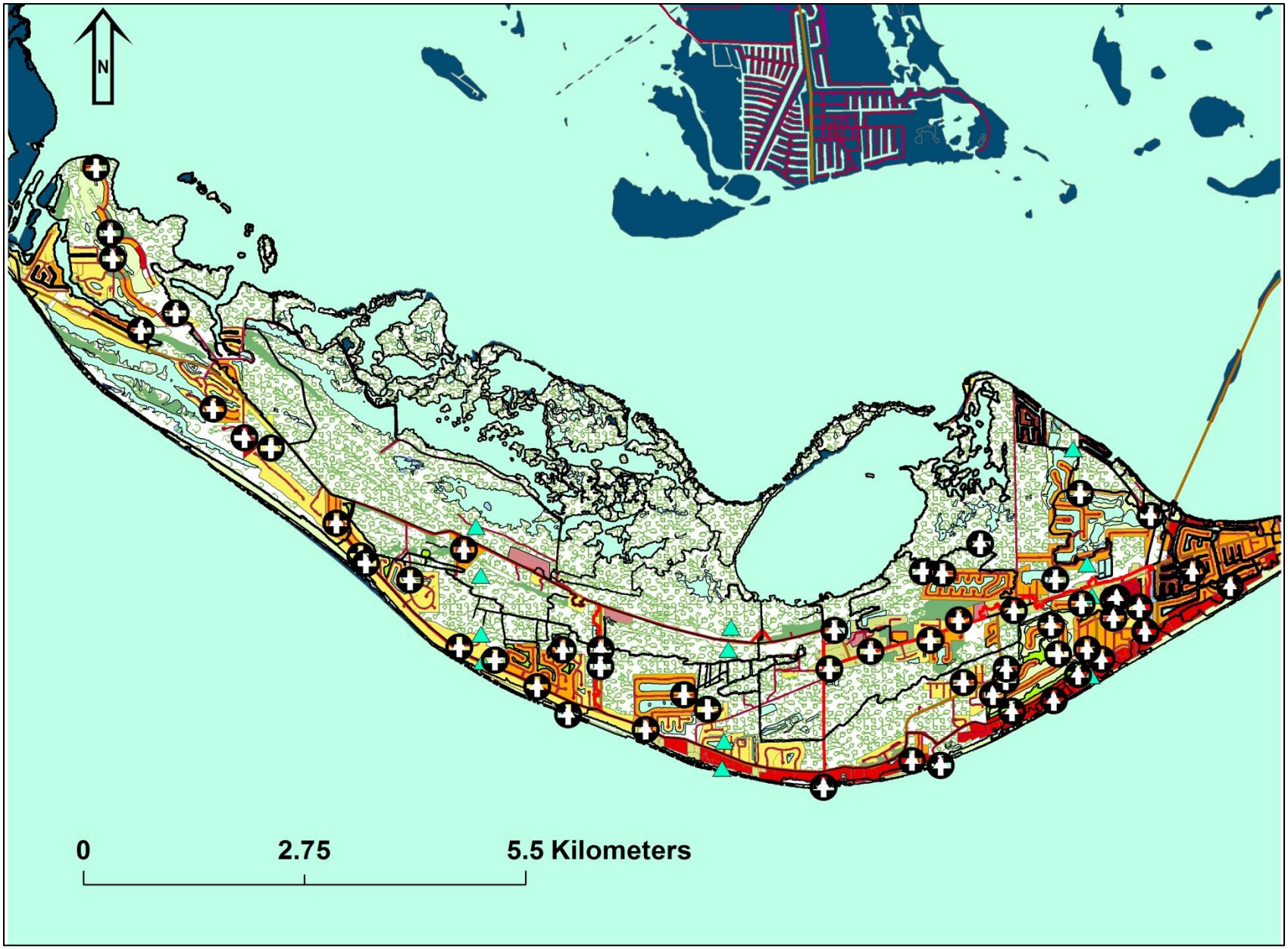


Figure 1. Sample sites used for collecting stormwater runoff concentration data.

Table 10. Description of sampling stations for collecting stormwater runoff concentration data.

Station	Sample_date	24hr_precip	TN	IN	TP	OP	Land Use	Basin	Wet Dry Season	Reclaimed Water	Event #
SNR01	1/30/2014	1.5	7	0.232	1.6	1.14	Medium Res	Ladyfinger lakes	Dry	No	1
SNR04	1/30/2014	1.5	2.2	0.234	0.76	0.27	Low Res	East Slough	Dry	No	1
SN03	1/30/2014	1.5	1.4	0.247	0.49	0.14	Low Res	East Slough	Dry	No	1
SN05	1/30/2014	1.5	0.71	0.132	0.4	0.3	Medium Res	East Slough	Dry	No	1
SN04	1/30/2014	1.5	0.59	0.085	0.29	0.13	High Res	Beach	Dry	Yes	1
SN10	1/30/2014	1.5	4.1	0.307	0.25	0.03	Low Res	West Slough	Dry	No	1
SN06	1/30/2014	1.5	2.2	0.217	0.22	0.05	High Res	East Slough	Dry	No	1
SN02	1/30/2014	1.5	0.55	0.089	0.22	0.13	High Res	Beach	Dry	Yes	1
SN08	1/30/2014	1.5	0.28	0.096	0.21	0.03	Commercial	East Slough	Dry	No	1
SNR08	1/30/2014	1.5	0.67	0.079	0.19	0.14	Medium Res	Sanibel Bayous	Dry	No	1
SN07	1/30/2014	1.5	0.41	0.097	0.13	0.1	Medium Res	Ladyfinger lakes	Dry	Yes	1
SN01	1/30/2014	1.5	0.4	0.102	0.13	0.07	Commercial	East Slough	Dry	No	1
SN12	1/30/2014	1.5	2.2	0.148	0.11	0.02	Low Res	West Slough	Dry	No	1
SNR07	1/30/2014	1.5	0.7	0.146	0.1	0.06	Low Res	West Slough	Dry	No	1
SNR02	1/30/2014	1.5	0.3	0.078	0.084	0.02	Medium Res	SE Tarpon	Dry	No	1
SNR05	1/30/2014	1.5	0.39	0.087	0.083	0.08	High Res	Beach	Dry	No	1
SNR06	1/30/2014	1.5	0.57	0.079	0.066	0.05	Low Res	West Slough	Dry	Yes	1
SNR03	1/30/2014	1.5	0.34	0.107	0.055	0.04	High Res	Beach	Dry	No	1
SN09	1/30/2014	1.5	0.32	0.074	0.047	0.03	Commercial	East Slough	Dry	No	1
SN11	1/30/2014	1.5	0.26	0.086	0.027	0.02	Medium Res	West Slough	Dry	No	1
SNGC03	3/6/2014	0.65	9.2	9.200	1.7	1.41	GC	Sanibel Bayous	Dry	Yes	2
SNGC01	3/6/2014	0.65	5.4	1.214	1.6	1.59	GC	Ladyfinger lakes	Dry	Yes	2
SNGC02	3/6/2014	0.65	3.6	0.333	0.57	0.48	GC	East Slough	Dry	Yes	2
SN07	3/6/2014	0.65	1.3	0.305	0.29	0.28	Medium Res	Ladyfinger lakes	Dry	Yes	2
SN02	3/6/2014	0.65	1.2	0.254	0.25	0.24	High Res	Beach	Dry	Yes	2
SN08	3/6/2014	0.65	0.94	0.107	0.25	0.05	Commercial	East Slough	Dry	No	2
SN04	3/6/2014	0.65	1.1	0.219	0.24	0.23	High Res	Beach	Dry	Yes	2
SNR30	3/6/2014	0.65	1.4	0.248	0.21	0.16	Medium Res	SE Tarpon	Dry	No	2
SN01	3/6/2014	0.65	1.1	0.214	0.21	0.09	Commercial	East Slough	Dry	No	2
SNR44	3/6/2014	0.65	1.2	0.092	0.19	0.15	Low Res	West Slough	Dry	Yes	2
SN10	3/6/2014	0.65	3.5	0.186	0.18	0.06	Low Res	West Slough	Dry	No	2
SN06	3/6/2014	0.65	2.3	0.088	0.18	0.06	High Res	East Slough	Dry	No	2
SN03	3/6/2014	0.65	1.1	0.089	0.13	0.02	Low Res	East Slough	Dry	No	2

Table 10 (cont). Description of sampling stations for collecting stormwater runoff concentration data.

Station	Sample_date	24hr_precip	TN	IN	TP	OP	Land Use	Basin	Wet Dry Season	Reclaimed Water	Event #
SNR40	3/6/2014	0.65	1	0.078	0.12	0.03	Low Res	East Slough	Dry	No	2
SN05	3/6/2014	0.65	0.4	0.091	0.11	0.1	Medium Res	East Slough	Dry	No	2
SN12	3/6/2014	0.65	1.5	0.079	0.09	0.06	Low Res	West Slough	Dry	No	2
SNR36	3/6/2014	0.65	1.3	0.105	0.09	0.08	Medium Res	East Slough	Dry	Yes	2
SN09	3/6/2014	0.65	0.9	0.066	0.06	0.02	Commercial	East Slough	Dry	No	2
SN11	3/6/2014	0.65	0.6	0.282	0.04	0.02	Medium Res	West Slough	Dry	No	2
SNGC03	7/7/2014	0.35	4.2	2.1	1.9	1.85	GC	Sanibel Bayous	Dry	Yes	3
SNGC02	7/7/2014	0.35	2	0.49	0.89	0.69	GC	East Slough	Dry	Yes	3
SNR18	7/7/2014	0.35	1.7	1.18	0.73	0.13	High Res	Sanibel Bayous	Dry	No	3
SNGC01	7/7/2014	0.35	1.5	0.39	0.58	0.51	GC	Ladyfinger lakes	Dry	Yes	3
SNR49	7/7/2014	0.35	1.3	0.73	0.37	0.17	Low Res	West Slough	Dry	No	3
SN03	7/7/2014	0.35	0.1	0.17	0.27	0.05	Low Res	East Slough	Dry	No	3
SNR34	7/7/2014	0.35	1	0.2	0.21	0.15	Medium Res	East Slough	Dry	No	3
SN02	7/7/2014	0.35	0.8	0.21	0.19	0.1	High Res	Beach	Dry	Yes	3
SNR11	7/7/2014	0.35	1	0.27	0.13	0.08	High Res	Beach	Dry	Yes	3
SN07	7/7/2014	0.35	0.5	0.14	0.13	0.1	Medium Res	Ladyfinger lakes	Dry	Yes	3
SN05	7/7/2014	0.35	0.4	0.29	0.04	0.03	High Res	Beach	Dry	No	3
SNR50	7/7/2014	0.35					Low Res	West Slough	Dry	No	3
SNGC01	7/15/2014	1.1	2.7	0.93	2.9	2.79	GC	Ladyfinger lakes	Wet	Yes	4
SNGC03	7/15/2014	1.1	2.3	0.61	2.6	2.53	GC	Sanibel Bayous	Wet	Yes	4
SNR19	7/15/2014	1.1	2.2	0.65	1.5	1.43	Medium Res	Sanibel Bayous	Wet	No	4
SNR20	7/15/2014	1.1	1.7	0.97	1.2	0.24	Medium Res	Sanibel Bayous	Wet	No	4
SN12	7/15/2014	1.1	1.8	0.55	0.76	0.08	Low Res	West Slough	Wet	No	4
SN03	7/15/2014	1.1	0.1	0.1	0.71	0.13	Low Res	East Slough	Wet	No	4
SNGC02	7/15/2014	1.1	2	0.44	0.7	0.48	GC	East Slough	Wet	Yes	4
SN04	7/15/2014	1.1	2.9	0.7	0.38	0.35	High Res	Beach	Wet	Yes	4
SNR35	7/15/2014	1.1	0.2	0.1	0.25	0.17	Medium Res	East Slough	Wet	No	4
SN06	7/15/2014	1.1	1.5	0.17	0.22	0.06	High Res	East Slough	Wet	No	4
SNR51	7/15/2014	1.1	1.1	0.24	0.22	0.12	Low Res	Sanibel Bayous	Wet	No	4
SNR05	7/15/2014	1.1	0.2	0.19	0.21	0.19	High Res	Beach	Wet	Yes	4
SN09	7/15/2014	1.1	0.9	0.3	0.18	0.05	Commercial	East Slough	Wet	No	4
SN05	7/15/2014	1.1	0.1	0.08	0.16	0.14	Medium Res	East Slough	Wet	No	4
SNR37	7/15/2014	1.1	1.1	0.12	0.15	0.07	Medium Res	East Slough	Wet	No	4

Table 10 (cont). Description of sampling stations for collecting stormwater runoff concentration data.

Station	Sample_date	24hr_precip	TN	IN	TP	OP	Land Use	Basin	Wet Dry Season	Reclaimed Water	Event #
SN10	7/15/2014	1.1	0.8	0.11	0.14	0.11	Low Res	West Slough	Wet	No	4
SN02	7/15/2014	1.1	0.3	0.18	0.14	0.13	High Res	Beach	Wet	Yes	4
SN07	7/15/2014	1.1	0.6	0.24	0.11	0.1	Medium Res	Ladyfinger lakes	Wet	Yes	4
SNR23	7/15/2014	1.1	0.3	0.23	0.09	0.09	Medium Res	West Slough	Wet	No	4
SN11	7/15/2014	1.1	0.1	0.08	0.01	0	Medium Res	West Slough	Wet	No	4
SNGC01	41884	0.59	2.6	0.57	1.6	1.19	GC	Ladyfinger lakes	Wet	Yes	5
SNGC02	41884	0.59	2.5	0.64	1.9	1.75	GC	East Slough	Wet	Yes	5
SNGC03	41884	0.59	0.5	0.15	0.9	0.84	GC	Sanibel Bayous	Wet	Yes	5
SNR10	41884	0.59	0.2	0.1	0.05	0.04	High Res	East Slough	Wet	Yes	5
SNR47	41884	0.59	0.4	0.1	0.11	0.02	Low Res	West Slough	Wet	No	5
SNR60	41884	0.59	0.8	0.58	0.21	0.04	Low Res	West Slough	Wet	Yes	5
SNR26	41884	0.59	0.5	0.16	0.21	0.16	Medium Res	West Slough	Wet	No	5
SNR58	41884	0.59	0.1	0.09	0.19	0.05	Medium Res	East Slough	Wet	No	5
SNR59	41884	0.59	0.2	0.11	0.07	0.04	Medium Res	East Slough	Wet	No	5
SNR52	41899	0.5	1.2	0.54	0.2	0.17	Low Res	Sanibel Bayous	Dry	No	6
SN01	41899	0.5	0.7	0.19	0.11	0.11	Commercial	East Slough	Wet	No	6
SNR55	41899	0.5	0.4	0.09	0.09	0.05	Commercial	SE Tarpon	Wet	No	6
SNR56	41899	0.5	0.1	0.06	0.2	0.04	Commercial	SE Tarpon	Wet	No	6
SNGC01	41899	0.5	3.2	0.58	1.3	1.26	GC	Ladyfinger lakes	Wet	Yes	6
SNGC02	41899	0.5	1.7	0.11	1	0.78	GC	East Slough	Wet	Yes	6
SNGC03	41899	0.5	3	0.62	2.3	2.12	GC	Sanibel Bayous	Wet	Yes	6
SN02	41899	0.5	1.6	0.22	0.48	0.37	High Res	Beach	Wet	Yes	6
SN04	41899	0.5	0.8	0.13	1.3	1.31	High Res	Beach	Wet	Yes	6
SN06	41899	0.5	1.4	0.13	0.11	0.02	High Res	East Slough	Wet	No	6
SNR13	41899	0.5	1.1	0.69	0.08	0.02	High Res	East Canals	Wet	No	6
SNR14	41899	0.5	3.3	0.17	0.15	0	High Res	East Slough	Wet	No	6
SN03	41899	0.5	0.6	0.2	0.37	0.06	Low Res	East Slough	Wet	No	6
SN12	41899	0.5					Low Res	West Slough	Wet	No	6
SNR54	41899	0.5	0.1	0.06	0.05	0.05	Low Res	West Slough	Wet	No	6
SN05	41899	0.5	0.5	0.19	0.14	0.11	Medium Res	East Slough	Wet	No	6
SN07	41899	0.5	0.4	0.21	0.12	0.06	Medium Res	Ladyfinger lakes	Wet	Yes	6
SN11	41899	0.5	0.2	0.06	0.02	0.01	Medium Res	West Slough	Wet	No	6
SNR22	41899	0.5	8.9	3.25	0.79	0.59	Medium Res	West Slough	Wet	No	6
SNR38	41899	0.5	0.7	0.1	0.2	0.08	Medium Res	East Canals	Wet	No	6
SNR57	41899	0.5	1.5	0.4	0.96	0.39	Medium Res	Sanibel Bayous	Wet	No	6

Table 11. Sanibel overall % impervious surface area by land class. No data collected is indicated by ND.

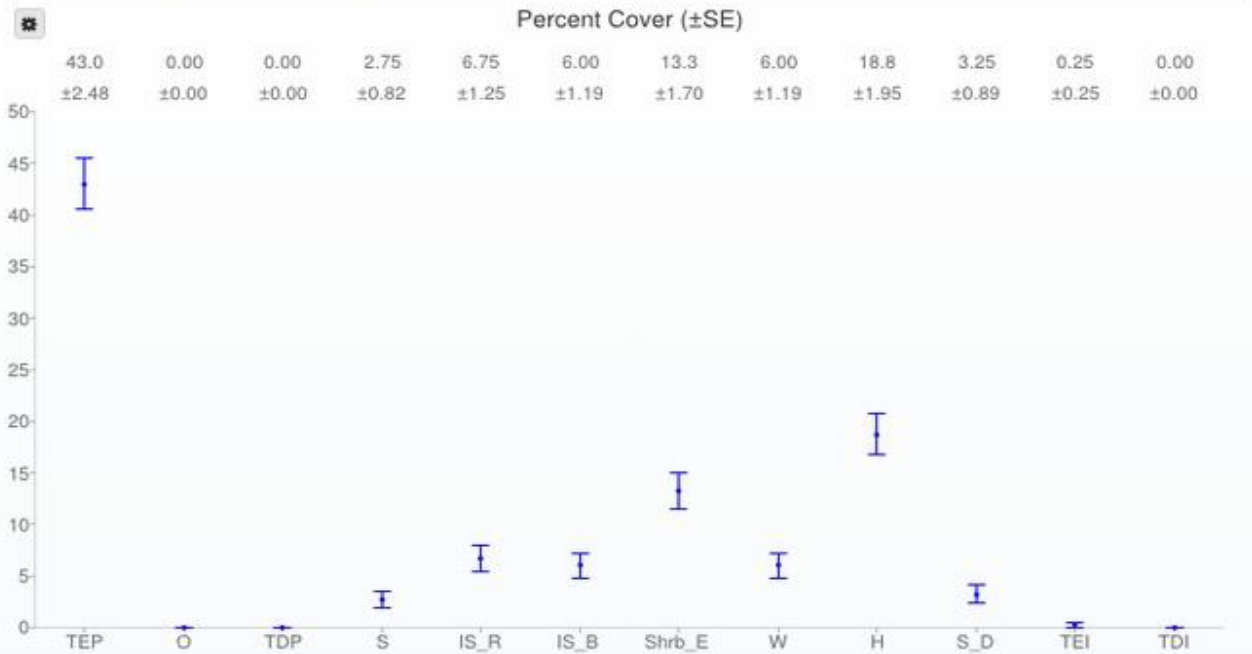
Land Class	Area (Acres)	% Pavement	% Building	% Impervious	% Pervious	Acres Impervious	Acres Pervious
Low Density Residential	825	14.1	13.6	27.7	72.3	228.4	596.3
Medium Density Residential	1,281	15.6	19.8	35.4	64.6	453.6	827.7
High Density Residential	452	18.6	23.8	42.3	57.7	191.4	261.0
Commercial and Services	259	32.8	13.9	65.8	34.2	170.4	88.6
Institutional (School)	62	31.2	14.8	46.0	54.0	28.5	33.4
Recreational (Golf Course)	303	7.1	2.0	9.1	90.9	27.6	275.5
Recreational (Beach)	285	ND	ND	5.0	95.0	14.3	270.8
Recreational (Parks)	11	ND	ND	20.0	80.0	2.2	9.0
Utilities	25	ND	ND	78.0	22.0	19.3	5.4
Shrub and Brushland	587	ND	ND	14.0	86.0	82.2	504.9
Disturbed Land	72	ND	ND	55.0	45.0	39.8	32.5
Upland Hardwood Forests	270	ND	ND	16.0	84.0	43.2	226.7
Lakes/Reservoirs	134	0.0	0.0	0.0	100.0	0.0	134.1
Wetlands (Other)	15	0.0	0.0	0.0	100.0	0.0	15.1
Wetland Forests	5,500	0.0	0.0	0.0	100.0	0.0	5500.5
Total	10,062	6.5	6.7	13.2	86.8	1300.8	8781.4

Table 12. Sanibel overall % impervious as estimated by USDA iTree® Canopy.

i-Tree Canopy v6.1

Cover Assessment and Tree Benefits Report

Estimated using random sampling statistics on 9/17/14



Cover Class	Description	Abbr.	Points	% Cover
EvergreenTree_Pervious	EvergreenTree, pervious under	TEP	172	43.0 ±2.48
Other	All other surfaces	O	0	0.00 ±0.00
DeciduousTreePervious	deciduous tree with pervious surface below	TDP	0	0.00 ±0.00
Bare soil_natural	Natural Bare soil - minimal veg	S	11	2.75 ±0.82
Impervious_Roadway	Roadway, driveway, sidewalk	IS_R	27	6.75 ±1.25
Impervious building	Impervious surface due to building	IS_B	24	6.00 ±1.19
Evergreen shrub	Evergreen shrub	Shrb_E	53	13.3 ±1.70
Water	Water or waterbody	W	24	6.00 ±1.19
Herbaceous	herbaceous vegetation	H	75	18.8 ±1.95
DisturbedSoil	Soil which has been compacted by human activity	S_D	13	3.25 ±0.89
Evergreen Tree Impervious below	Evergreen tree with impervious surface below	TEI	1	0.25 ±0.25
Deciduous tree impervious	Deciduous tree with impervious surface below	TDI	0	0.00 ±0.00

Table 13. Annual precipitation event description for 2011-2013. Impervious surface runoff occurs when precipitation is greater than 0.1 inches. Pervious surface runoff occurs when precipitation is greater than 0.5 inches in wet season or 1.28 inches in the dry season.

Year	Total Precip (In)	Number Rain Days	% Rain Volume in Dry Season	Number Days With AMCIII	% Rain Days With Impervious Runoff	% Rain Days With Pervious Runoff	Total Rain Volume (m^3)
2011	42	96	32.6	21	54.2	24	11,947,714
2012	33.9	92	42.2	16	61.9	15.2	9,639,718
2013	44.6	112	43.2	19	62.5	23.2	12,695,500

Table 14. Composite curve numbers calculated for each land use and basin on Sanibel.

Basin	LowDensity				MedDensity				HighDensity				Commmercial				Institutional			
	DryCN	WetCN	DryS	WetS	DryCN	WetCN	DryS	WetS	DryCN	WetCN	DryS	WetS	DryCN	WetCN	DryS	WetS	DryCN	WetCN	DryS	WetS
EastSlough	77.9	88.3	2.8	1.3	82.2	90.5	2.2	1.0	84.4	91.4	1.8	0.9	90.2	94.7	1.1	0.6	84.5	91.4	1.8	0.9
WestSlough	75.4	86.8	3.3	1.5	78.3	88.3	2.8	1.3	83.3	90.8	2.0	1.0	88.6	93.5	1.3	0.7	84.5	91.4	1.8	0.9
Bayous	73.2	85.9	3.7	1.6	80.5	89.8	2.4	1.1	85.2	92.1	1.7	0.9	88.6	93.5	1.3	0.7	N/A	N/A	N/A	N/A
Beach	80.0	89.5	2.5	1.2	78.3	88.3	2.8	1.3	78.3	89.0	2.8	1.2	86.9	92.6	1.5	0.8	N/A	N/A	N/A	N/A
Ladyfinger	72.1	85.4	3.9	1.7	78.5	88.8	2.7	1.3	84.4	91.4	1.8	0.9	90.2	94.7	1.1	0.6	N/A	N/A	N/A	N/A
SETarpon	69.1	84.0	4.5	1.9	78.4	89.0	2.8	1.2	N/A	N/A	N/A	N/A	87.6	92.9	1.4	0.8	84.5	91.4	1.8	0.9
ECanals	77.9	88.3	2.8	1.3	77.9	88.3	2.8	1.3	84.5	91.5	1.8	0.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lighthouse	N/A	N/A	N/A	N/A	81.0	90.2	2.3	1.1	84.3	91.4	1.9	0.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kesson	73.2	85.9	3.7	1.6	79.3	88.6	2.6	1.3	85.1	92.0	1.7	0.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SanCarlos	78.3	88.2	2.8	1.3	77.7	88.2	2.9	1.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SWTarpon	75.4	86.8	3.3	1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	88.6	93.5	1.3	0.7	84.5	91.4	1.8	0.9
Refuge	75.4	86.8	3.3	1.5	78.3	88.3	2.8	1.3	N/A	N/A	N/A	N/A	88.6	93.5	1.3	0.7	84.5	91.4	1.8	0.9

Table 15. Sanibel overall runoff coefficient (C) calculation tables for 2011.

2011 Sanibel Overall	Area (m^2)	2011 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2011 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2011 Total RainVolume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2011 Runoff m^3/yr	2011 Composite C
East Slough	2,105,564	731,090	155,376	6,486	161,862	0.22	1,514,591	448,339	240,563	688,902	0.45	2,245,681	603,716	247,049	850,764	0.38
West Slough	2,358,064	818,762	121,940	8,869	130,809	0.16	1,696,221	357,305	328,968	686,273	0.40	2,514,984	479,245	337,838	817,082	0.32
Bayous	1,196,240	415,356	57,808	4,468	62,276	0.15	860,489	174,278	165,708	339,986	0.40	1,275,845	232,086	170,176	402,262	0.32
Beach	1,829,165	635,119	141,594	6,196	147,789	0.23	1,315,770	369,789	229,810	599,600	0.46	1,950,889	511,383	236,006	747,389	0.38
Ladyfinger	861,974	299,293	59,969	2,973	62,942	0.21	620,042	158,857	110,272	269,129	0.43	919,335	218,827	113,245	332,071	0.36
SE Tarpon	934,668	324,534	87,605	2,817	90,423	0.28	672,333	224,832	104,501	329,333	0.49	996,866	312,438	107,318	419,756	0.42
E Canals	1,128,253	391,750	76,379	3,881	80,260	0.20	811,584	206,367	143,949	350,316	0.43	1,203,334	282,746	147,830	430,575	0.36
Lighthouse	262,235	91,053	22,068	824	22,892	0.25	188,633	59,316	30,563	89,879	0.48	279,686	81,385	31,387	112,771	0.40
Kesson	130,712	45,386	4,606	540	5,146	0.11	94,025	14,482	20,041	34,524	0.37	139,410	19,088	20,582	39,670	0.28
San Carlos	263,043	91,333	15,307	950	16,258	0.18	189,214	43,010	35,248	78,258	0.41	280,547	58,318	36,198	94,516	0.34
SW Tarpon	24,281	8,431	2,532	57	2,589	0.00	17,466	7,326	2,115	9,440	0.00	25,897	9,858	2,172	12,030	0.46
Refuge	108,050	37,517	3,032	308	3,340	0.09	77,723	19,772	11,433	31,205	0.40	115,240	22,804	11,741	34,545	0.30
Total	11,202,249	3,889,622	748,217	38,370	786,586	0.20	8,058,091	2,083,674	1,423,171	3,506,845	0.44	11,947,714	2,831,891	1,461,540	4,293,431	**0.36**

Table 16. Sanibel overall runoff coefficient (C) calculation tables for 2012.

2012 Sanibel Overall	Area (m^2)	2012 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2012 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2012 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2012 Runoff m^3/yr	2012 Composite C
East Slough	2,105,564	763,944	155,277	19,467	174,744	0.23	1,047,814	282,583	115,737	398,321	0.38	1,811,758	437,860	135,204	573,064	0.32
West Slough	2,358,064	856,001	123,035	26,611	149,646	0.17	1,173,691	223,168	159,030	382,198	0.33	2,029,692	346,203	185,641	531,844	0.26
Bayous	1,196,240	434,158	57,909	13,404	71,313	0.16	595,366	109,407	79,988	189,395	0.32	1,029,524	167,316	93,392	260,708	0.25
Beach	1,829,165	663,762	142,758	18,590	161,348	0.24	910,318	237,072	110,461	347,532	0.38	1,574,080	379,830	129,050	508,880	0.32
Ladyfinger	861,974	312,657	60,112	8,920	69,032	0.22	428,910	101,463	52,978	154,441	0.36	741,567	161,575	61,898	223,473	0.30
SE Tarpon	934,668	339,052	89,120	8,462	97,583	0.29	465,096	144,783	50,189	194,972	0.42	804,149	233,903	58,651	292,554	0.36
E Canals	1,128,253	409,231	76,230	11,643	87,873	0.21	561,403	131,500	69,115	200,615	0.36	970,634	207,730	80,758	288,487	0.30
Lighthouse	262,235	95,116	22,056	2,472	24,528	0.26	130,484	37,737	14,651	52,388	0.40	225,600	59,793	17,123	76,916	0.34
Kesson	130,712	47,461	4,599	1,621	6,220	0.13	65,065	8,889	9,705	18,594	0.29	112,526	13,488	11,326	24,814	0.22
San Carlos	263,043	95,440	15,263	2,851	18,114	0.19	130,902	27,122	16,975	44,097	0.34	226,342	42,385	19,826	62,211	0.27
SW Tarpon	24,281	8,808	2,772	172	2,944	0.00	12,082	4,704	1,012	5,716	0.00	20,890	7,476	1,184	8,660	0.41
Refuge	108,050	39,192	5,942	928	6,870	0.18	53,765	13,230	5,468	18,698	0.35	92,956	19,173	6,396	25,568	0.28
Total	11,202,249	4,064,821	755,073	115,141	870,214	0.21	5,574,897	1,321,659	685,307	2,006,966	0.36	9,639,718	2,076,732	800,449	2,877,181	**0.30**

Table 17. Sanibel overall runoff coefficient (C) calculation tables for 2013.

2013 Sanibel Overall	Area (m^2)	2013 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2013 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2013 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2013 Runoff m^3/yr	2013 Composite C
East Slough	2,105,564	1,029,984	206,597	16,731	223,328	0.22	1,356,661	397,761	167,970	565,730	0.42	2,386,645	604,358	184,701	789,059	0.33
West Slough	2,358,064	1,153,059	165,000	22,934	187,935	0.16	1,518,999	311,360	229,794	541,155	0.36	2,672,058	476,361	252,729	729,090	0.27
Bayous	1,196,240	584,977	76,136	11,537	87,673	0.15	770,611	155,774	115,667	271,441	0.35	1,355,587	231,910	127,204	359,114	0.26
Beach	1,829,165	894,488	196,339	16,005	212,344	0.24	1,178,340	318,511	160,602	479,113	0.41	2,072,829	514,850	176,608	691,458	0.33
Ladyfinger	861,974	421,524	82,302	7,662	89,964	0.21	555,285	139,316	77,013	216,329	0.39	976,809	221,619	84,675	306,293	0.31
SE Tarpon	934,668	457,440	124,987	7,265	132,252	0.29	602,408	196,173	73,004	269,177	0.45	1,059,848	321,160	80,269	401,429	0.38
E Canals	1,128,253	551,668	103,890	10,000	113,890	0.21	726,764	192,363	100,528	292,891	0.40	1,278,432	296,253	110,528	406,781	0.32
Lighthouse	262,235	128,220	29,811	2,042	31,852	0.25	168,917	54,007	20,524	74,531	0.44	297,137	83,818	22,565	106,383	0.36
Kesson	130,712	63,912	6,058	1,398	7,456	0.12	84,197	13,802	13,998	27,800	0.33	148,109	19,860	15,396	35,256	0.24
San Carlos	263,043	128,615	20,652	2,452	23,104	0.18	169,438	39,832	24,619	64,451	0.38	298,052	60,484	27,071	87,555	0.29
SW Tarpon	24,281	11,888	3,743	147	3,890	0.00	15,653	7,029	1,477	8,506	0.00	27,541	10,772	1,624	12,396	0.45
Refuge	108,050	52,843	6,461	794	7,255	0.14	69,610	23,906	7,987	31,893	0.46	122,453	30,367	8,781	39,148	0.32
Total	11,202,249	5,478,617	1,021,977	98,967	1,120,944	0.20	7,216,883	1,849,834	993,183	2,843,018	0.39	12,695,500	2,871,812	1,092,150	3,963,962	**0.31**

Table 18. Mean Sanibel-specific runoff coefficients and standard deviations derived from Phase 2 GIS-based analyses. Coefficients from literature which were used in Phase 1 of this project are also given for comparison.

Sanibel Specific Runoff Coefficients	Mean C				Phase 1 Coefficients	
Land Use	Dry Season	StDev	Wet Season	StDev	Dry Season	Wet Season
LowDenRes	0.12	0.01	0.33	0.042	0.21	0.31
MedDenRes	0.18	0.008	0.38	0.037	0.35	0.45
HighDenRes	0.27	0.006	0.45	0.038	0.5	0.65
Commercial	0.44	0.014	0.59	0.046	0.78	0.97
Institutional	0.18	0.03	0.42	0.048	0.5	0.6
Golf Course	0.04	0.02	0.25	0.04	0.18	0.26

Figure 2. Mean Sanibel-specific wet and dry season runoff coefficients from Phase 2 GIS-based analyses for each land class analyzed.

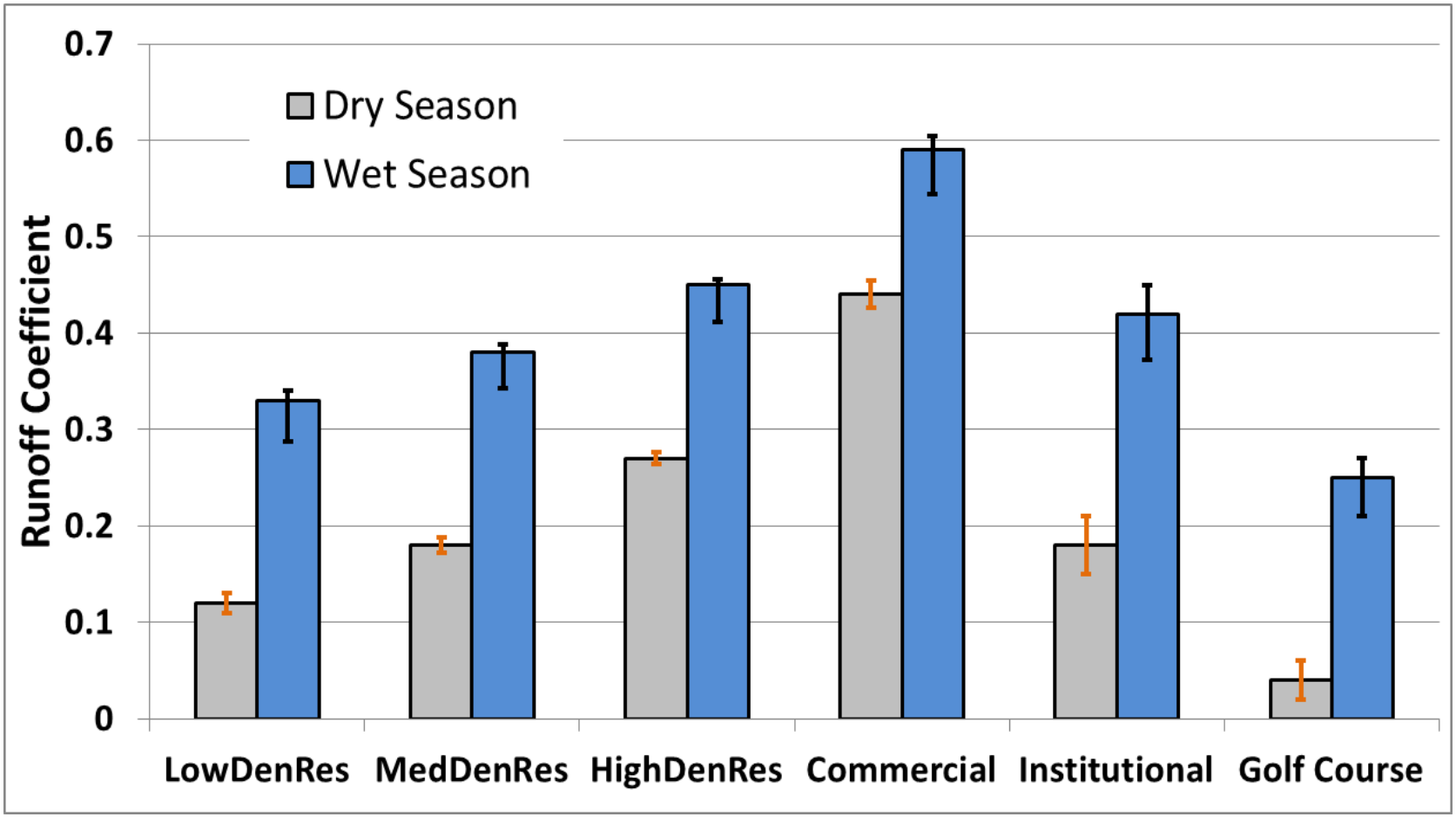


Table 19. Mean runoff coefficients for individual Sanibel drainage basins and standard deviations derived from Phase 2 GIS-based analyses. These coefficients represent mean proportion of rainfall which runs off of the total area of each basin including wetlands which were considered to contribute no anthropogenic runoff in Phase 2 analyses.

Sanibel Overall Runoff Coefficients	**Mean C**			
Basin	**Dry Season**	**StDev**	**Wet Season**	**StDev**
Lighthouse	0.32	0.049	0.48	0.072
Beach	0.3	0.048	0.45	0.064
E. Canals	0.2	0.042	0.38	0.083
San Carlos	0.18	0.033	0.36	0.067
E. Slough	0.22	0.022	0.39	0.041
Ladyfinger	0.27	0.041	0.41	0.067
SE Tarpon	0.27	0.045	0.41	0.063
SW Tarpon	0.2	0.025	0.33	0.045
Refuge	0.22	0.034	0.41	0.064
W. Slough	0.16	0.02	0.35	0.048
Kesson	0.17	0.017	0.31	0.031
Bayous	0.16	0.014	0.31	0.031

Figure 3. Overall mean runoff coefficients for individual Sanibel drainage basins with inset of Sanibel Island showing decreased runoff in center area of island which contains higher percentage of land in natural state (green).

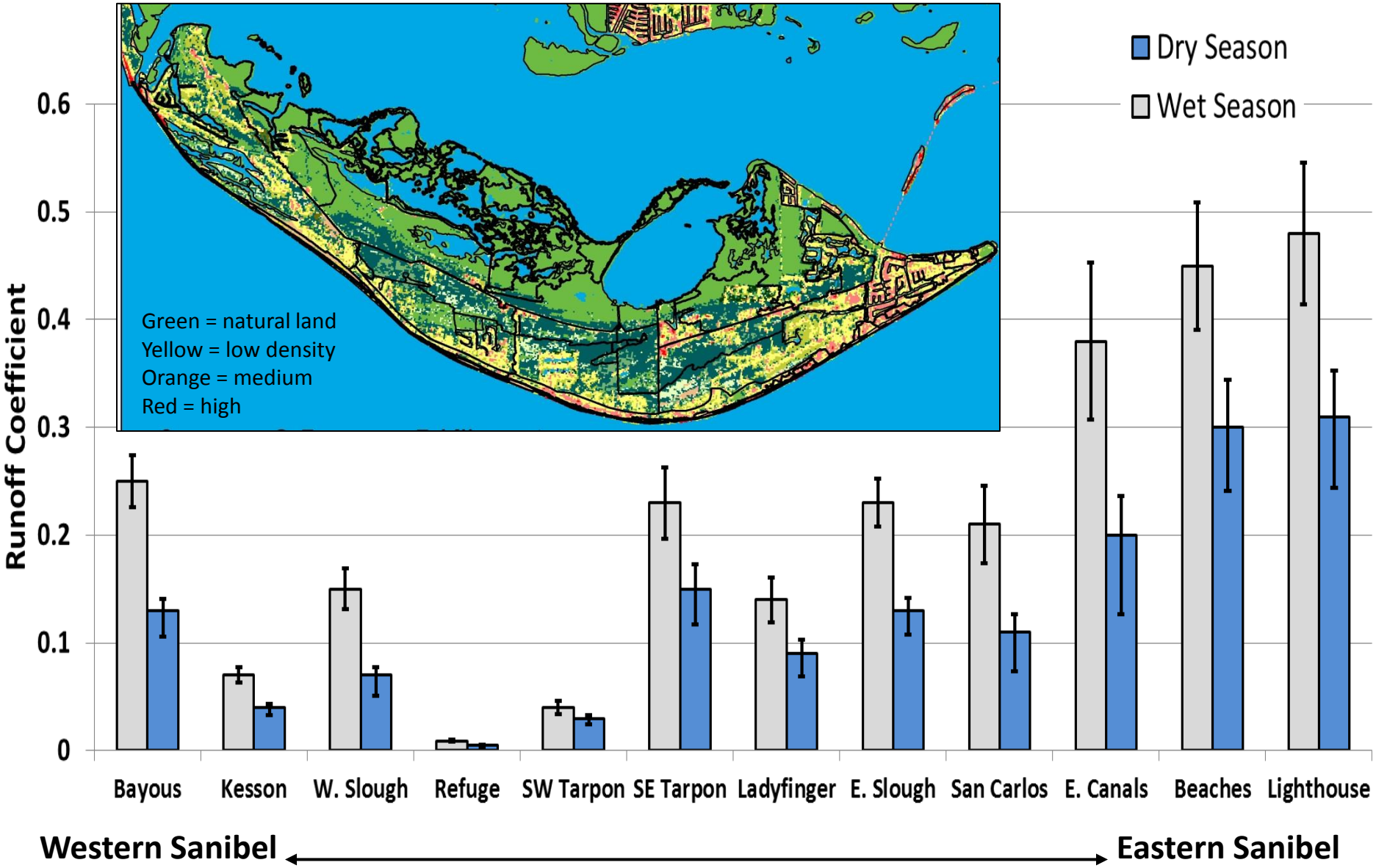


Figure 4. Sanibel specific runoff coefficients developed in Phase 2 compared to coefficients used in Phase 1 runoff estimates.

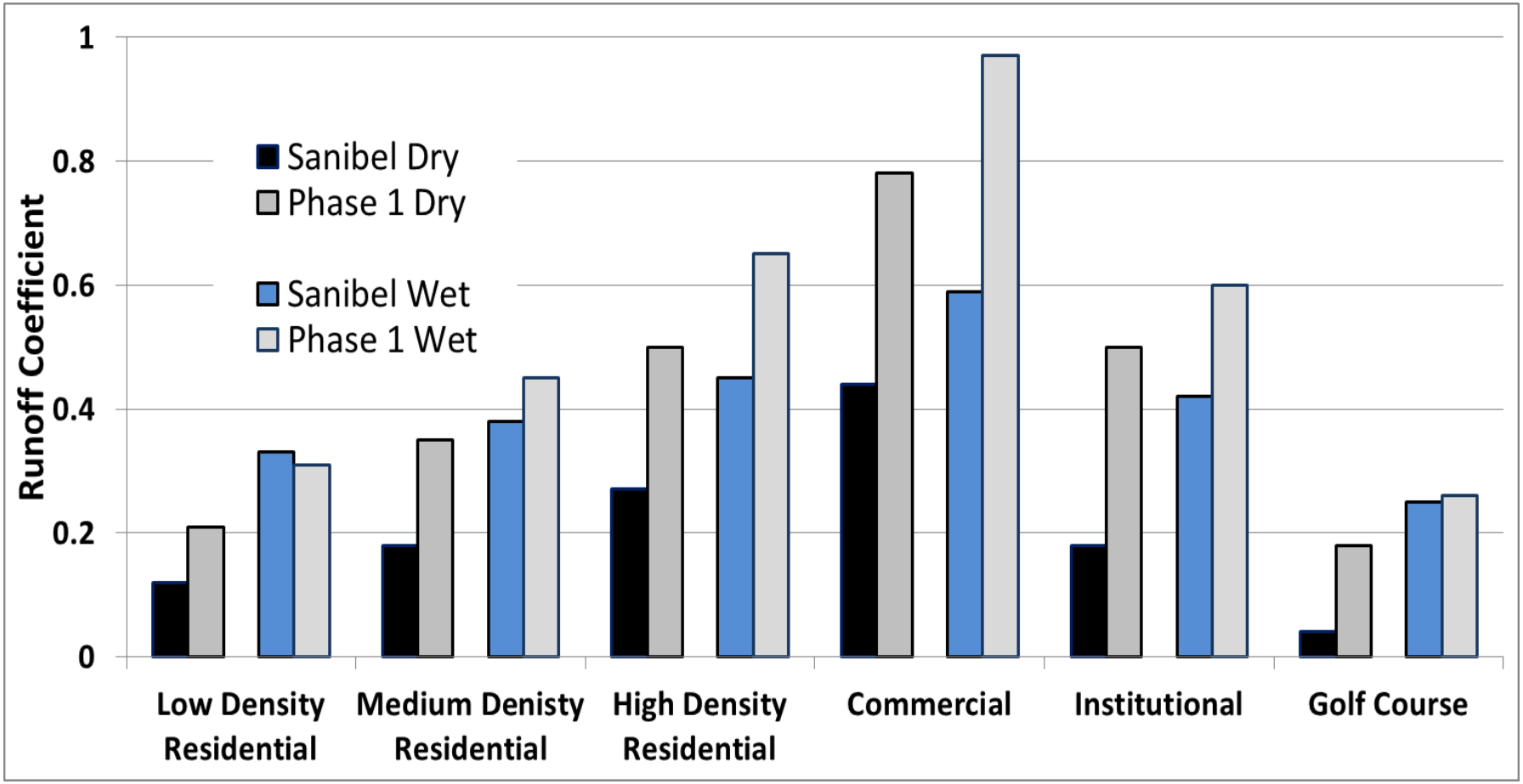


Table 20. Comparison of stormwater runoff nutrient loading estimates from Sanibel from the Phase 1 study to the revised estimates from this study (Phase 2).

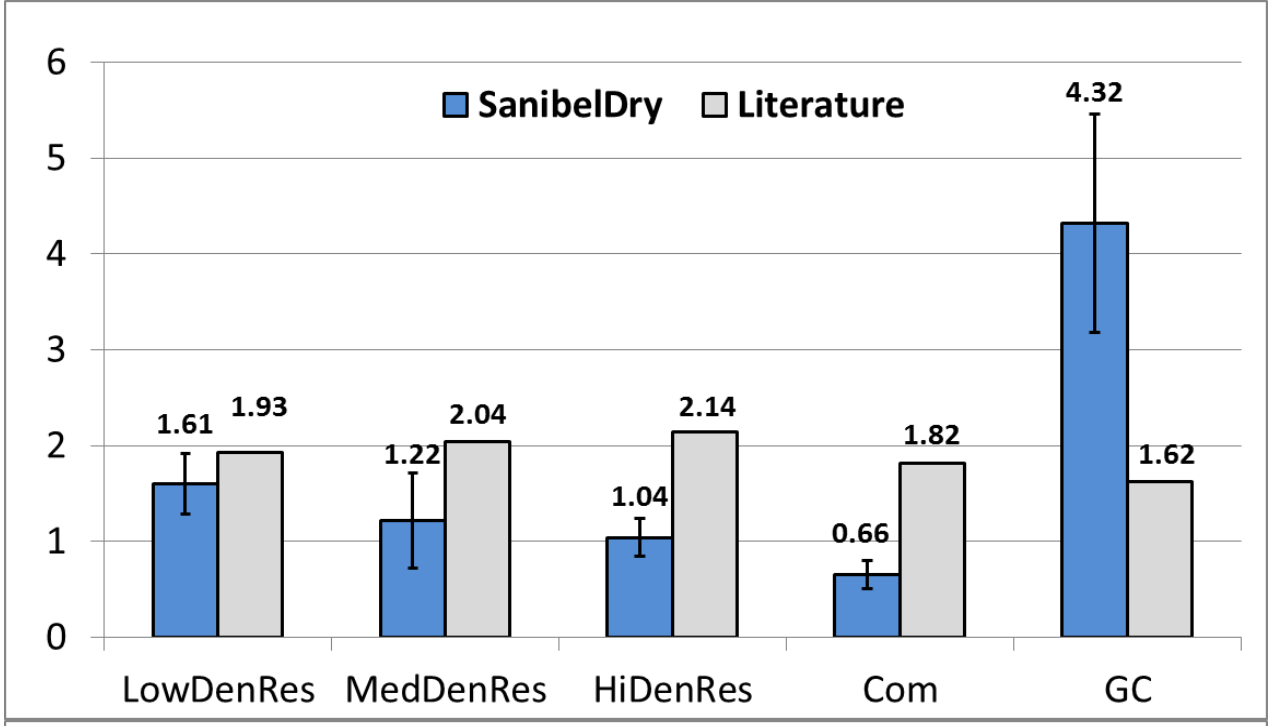
	Phase 1 (m^3/yr.)			Phase 2 (m^3/yr.)			% Change		
	DrySeason	**WetSeason**	**Total**	**DrySeason**	**WetSeason**	**Total**	**DrySeason**	**WetSeason**	**Total**
Runoff (m^3/yr.)	1,587,493	5,876,517	**7,464,010**	935,446	4,673,054	**5,608,500**	-41.1	-20.5	**-24.9**
TN Load (Kg/yr.)	2,692	9,967	**12,659**	950	4705	**5655**	-64.7	-52.8	**-55.3**
IN Load (Kg/yr.)	881	3,261	**4,142**	191	1358	**1549**	-78.3	-58.4	**-62.6**
TP Load (Kg/yr.)	517	1,914	**2,431**	171	1460	**1631**	-66.9	-23.7	**-32.9**
OP Load (Kg/yr.)	165	613	**778**	96	901	**997**	-42.0	47.1	**28.1**

Table 21. Sanibel specific mean nutrient concentrations for stormwater runoff by land use class.

Sanibel Specific Runoff Concentrations	Mean TN Conc (mg/l)		Mean IN Conc (mg/l)		Mean TP Conc (mg/l)		Mean OP Conc (mg/l)	
Land Use Class	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season
LowDenRes	1.61	0.71	0.199	0.244	0.24	0.32	0.085	0.077
MedDenRes	1.22	1.13	0.160	0.413	0.27	0.36	0.200	0.219
HighDenRes	1.04	1.33	0.258	0.267	0.22	0.31	0.107	0.250
Commercial	0.66	0.51	0.110	0.159	0.15	0.15	0.049	0.062
Golf Course	4.32	2.28	2.290	0.517	1.21	1.69	1.087	1.526

Figure 5. Mean total nitrogen (TN) concentrations for Sanibel land classes in a.) dry and b.) wet season. Values used in Phase 1 estimates (literature values) are also shown for comparison.

a.)



b.)

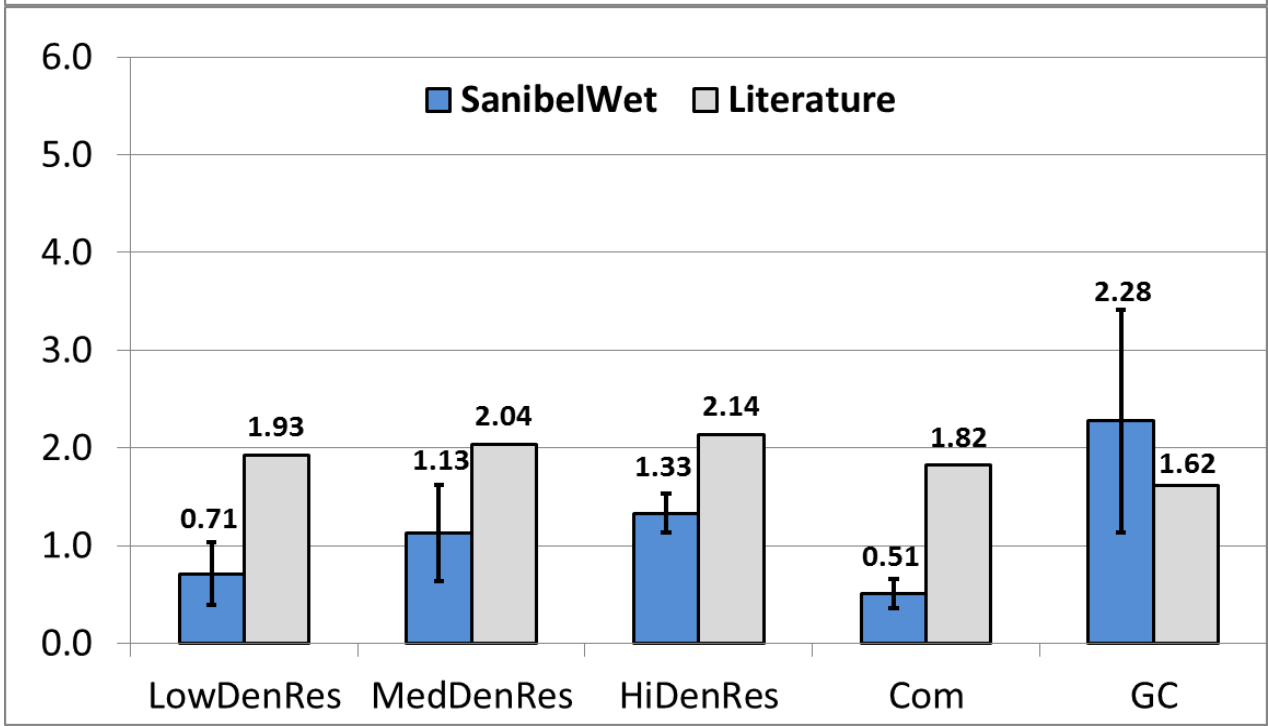
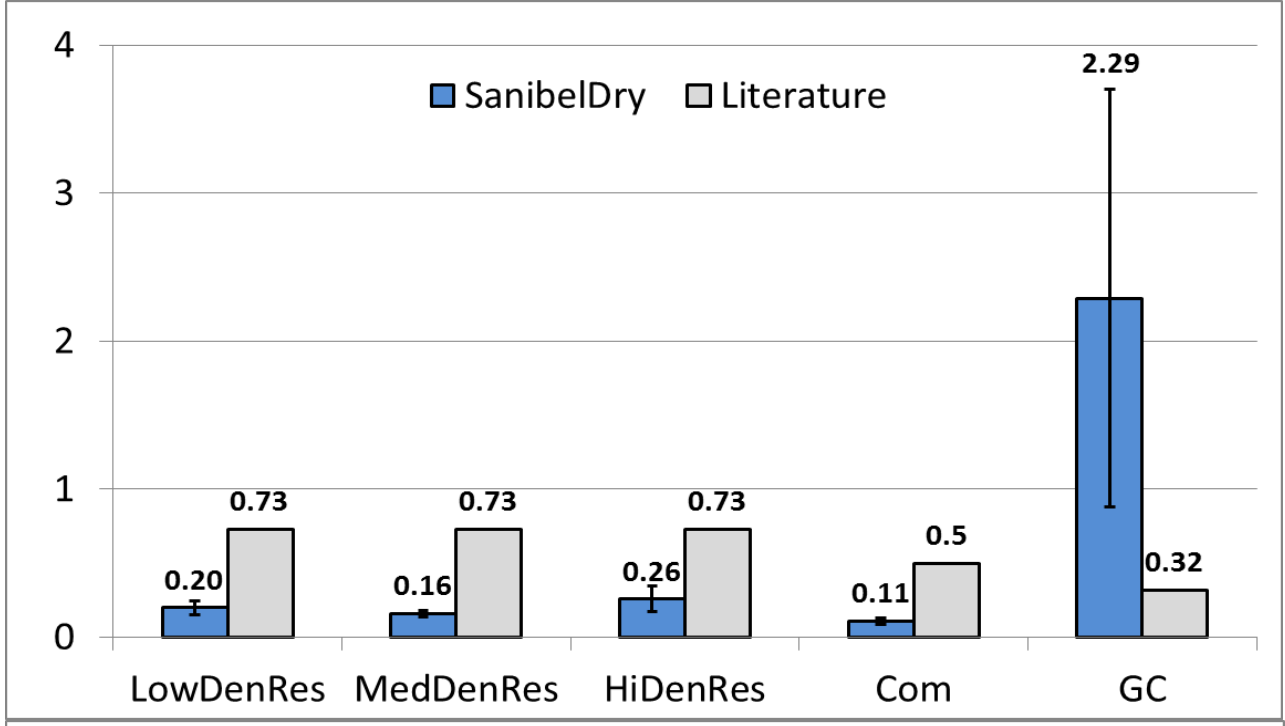


Figure 6. Mean inorganic nitrogen (IN) nitrogen concentrations for Sanibel land classes in a.) dry and b.) wet season. Values used in Phase 1 estimates (literature values) are also shown for comparison.

a.)



b.)

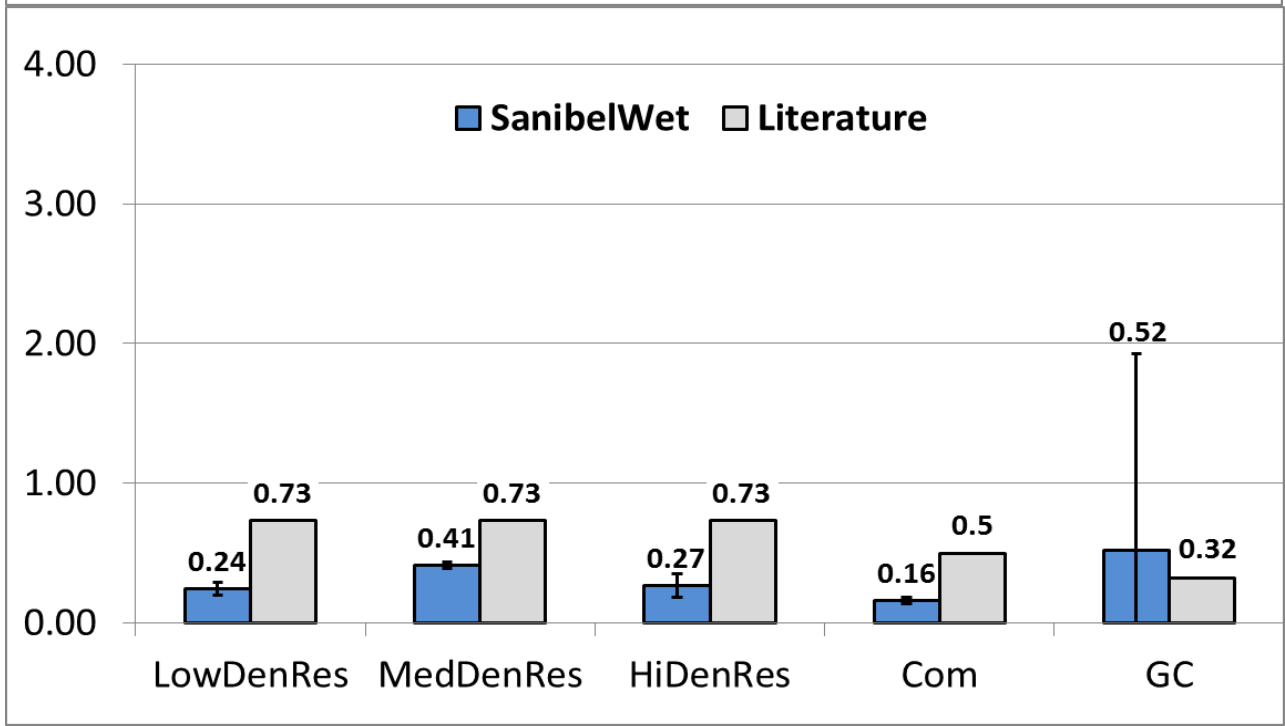
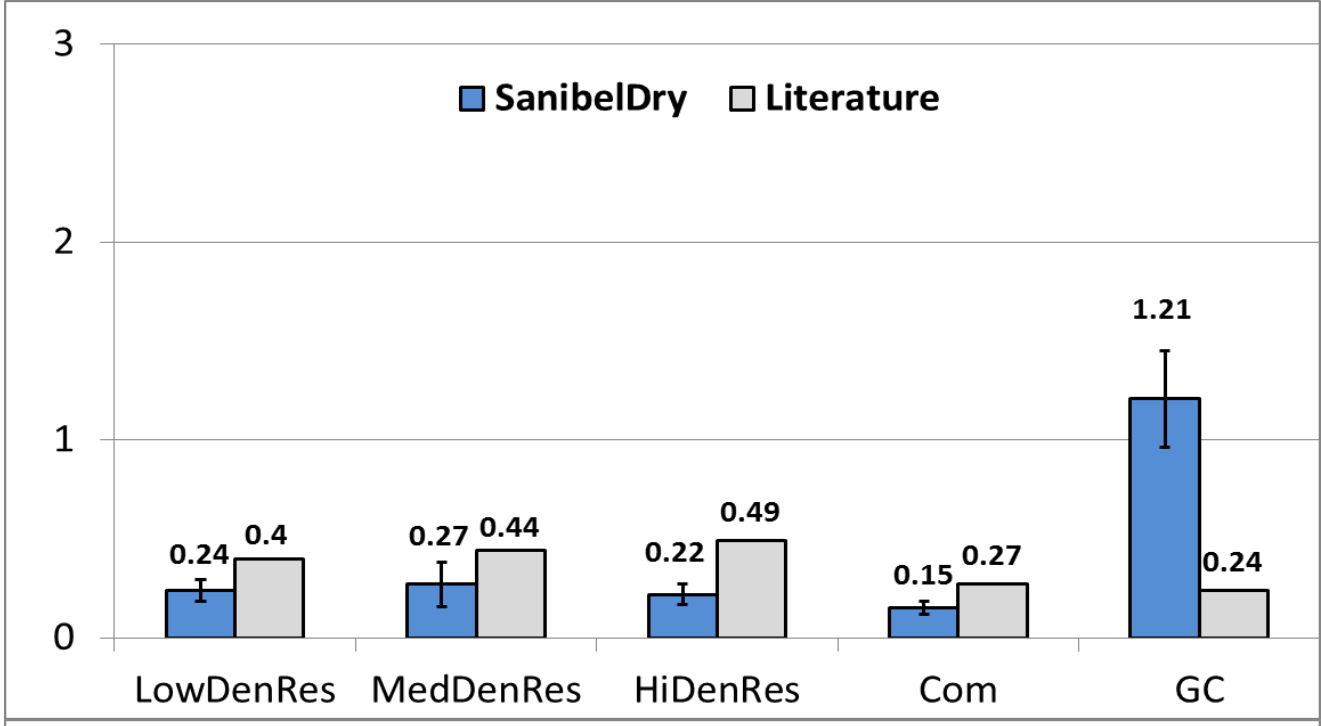


Figure 7. Mean total phosphorus (TP) concentrations for Sanibel land classes in a.) dry and b.) wet season. Values used in Phase 1 estimates (literature values) are also shown for comparison.

a.)



b.)

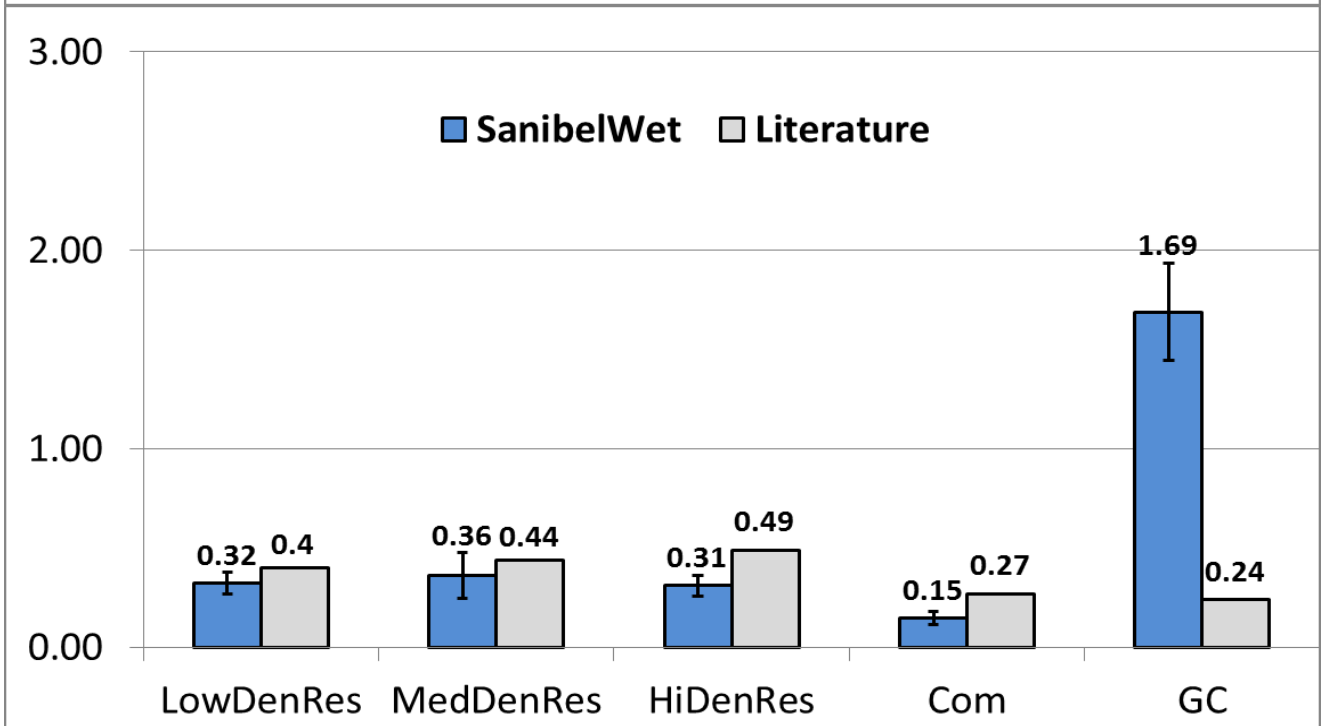
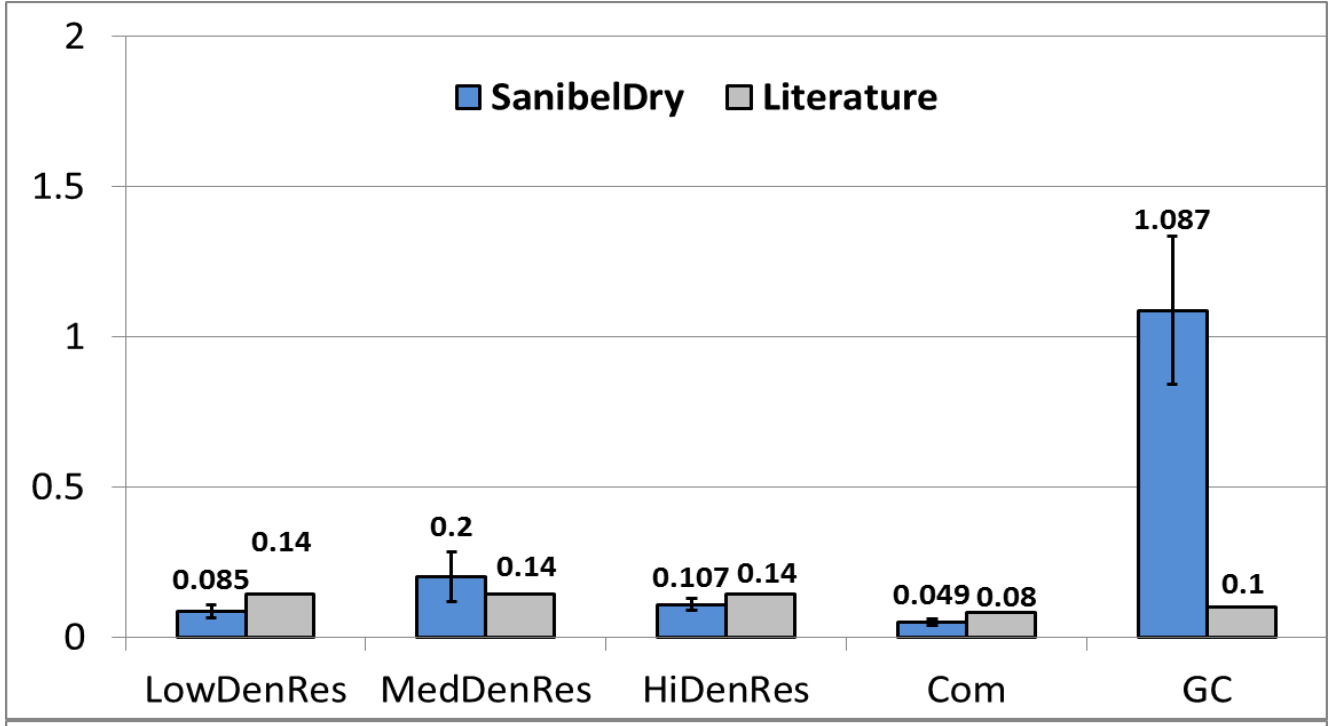


Figure 8. Mean orthophosphate (OP) concentrations for Sanibel land classes in a.) dry and b.) wet season. Values used in Phase 1 estimates (literature values) are also shown for comparison.

a.)



b.)

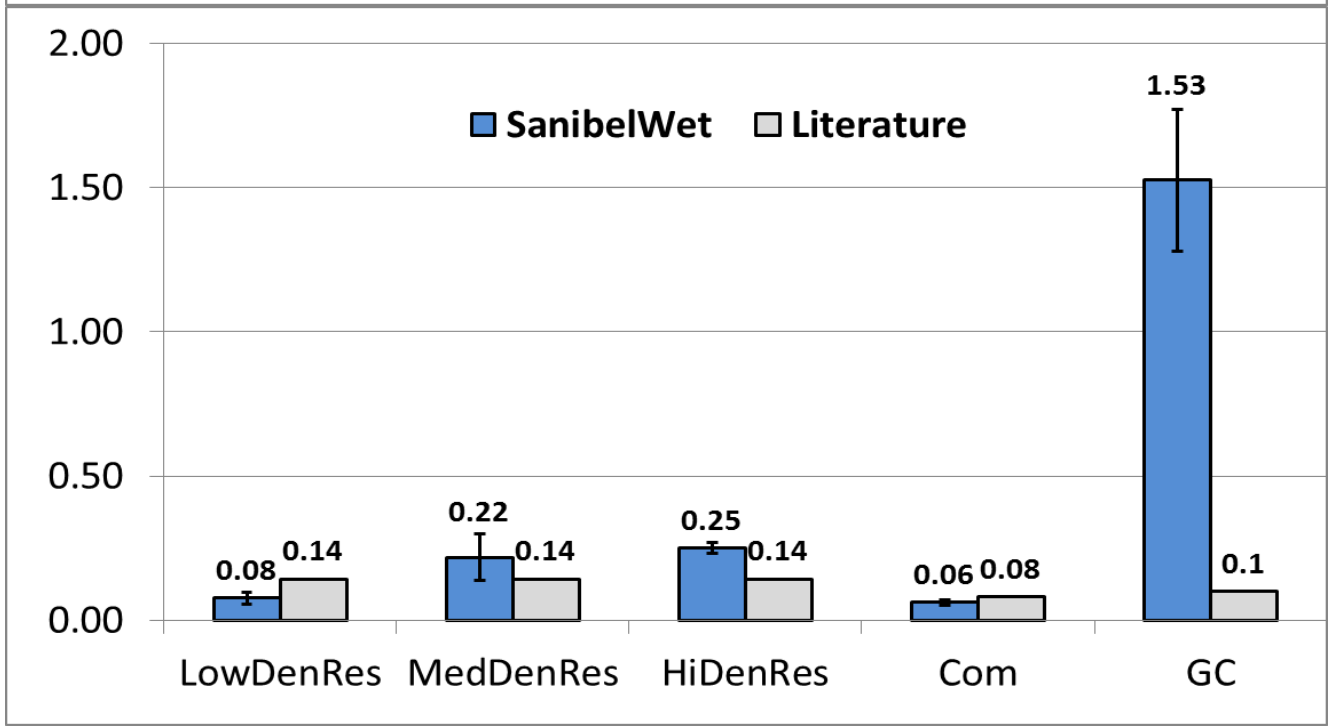


Figure 9. Total reclaimed water used for irrigation on Sanibel since 2010 (in 1000 gallons).

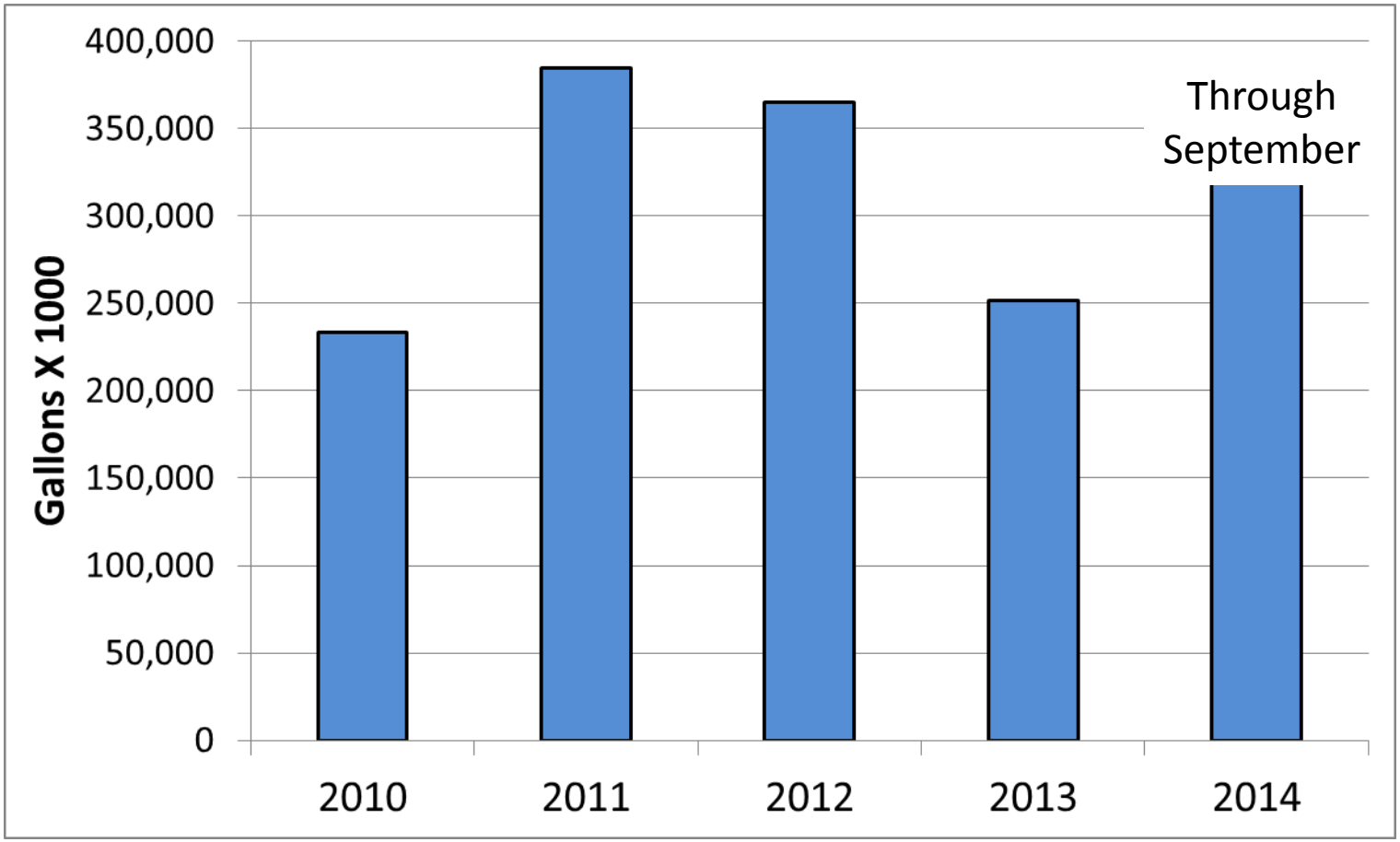


Table 22. Mean nutrient concentrations for Sanibel golf course runoff and stormwater systems. ND = No data available.

Golf Course	Mean Golf Course Runoff TN	Mean TN in Stormwater System	Mean Golf Course Runoff IN	Mean IN in Stormwater System	Mean Golf Course Runoff TP	Mean TP in Stormwater System	Mean Golf Course Runoff OP	Mean OPin Stormwater System
Dunes	3.08	3.90	0.74	0.25	1.60	0.09	1.47	0.02
Beachview	2.36	2.70	0.40	0.24	1.01	0.17	0.83	0.09
Sanctuary	3.84	3.10	2.53	ND	1.88	0.80	1.75	ND

Table 23. Individual results for nutrient runoff sampling during Phase 2.

Station	Sample_date	24hr_precip	TN	IN	TP	OP	LU	Basin	Wet Dry Season	Reclaimed Water	Event #
SNR01	1/30/2014	1.5	7	0.232	1.6	1.14	Medium Res	Ladyfinger lakes	Dry	NR	1
SNR04	1/30/2014	1.5	2.2	0.234	0.76	0.27	Low Res	East Slough	Dry	NR	1
SN03	1/30/2014	1.5	1.4	0.247	0.49	0.14	Low Res	East Slough	Dry	NR	1
SN05	1/30/2014	1.5	0.71	0.132	0.4	0.3	Medium Res	East Slough	Dry	NR	1
SN04	1/30/2014	1.5	0.59	0.085	0.29	0.13	High Res	Beach	Dry	R	1
SN10	1/30/2014	1.5	4.1	0.307	0.25	0.03	Low Res	West Slough	Dry	NR	1
SN06	1/30/2014	1.5	2.2	0.217	0.22	0.05	High Res	East Slough	Dry	NR	1
SN02	1/30/2014	1.5	0.55	0.089	0.22	0.13	High Res	Beach	Dry	R	1
SN08	1/30/2014	1.5	0.28	0.096	0.21	0.03	Commercial	East Slough	Dry	NR	1
SNR08	1/30/2014	1.5	0.67	0.079	0.19	0.14	Medium Res	Sanibel Bayous	Dry	NR	1
SN07	1/30/2014	1.5	0.41	0.097	0.13	0.1	Medium Res	Ladyfinger lakes	Dry	R	1
SN01	1/30/2014	1.5	0.4	0.102	0.13	0.07	Commercial	East Slough	Dry	NR	1
SN12	1/30/2014	1.5	2.2	0.148	0.11	0.02	Low Res	West Slough	Dry	NR	1
SNR07	1/30/2014	1.5	0.7	0.146	0.1	0.06	Low Res	West Slough	Dry	NR	1
SNR02	1/30/2014	1.5	0.3	0.078	0.084	0.02	Medium Res	SE Tarpon	Dry	NR	1
SNR05	1/30/2014	1.5	0.39	0.087	0.083	0.08	High Res	Beach	Dry	NR	1
SNR06	1/30/2014	1.5	0.57	0.079	0.066	0.05	Low Res	West Slough	Dry	R	1
SNR03	1/30/2014	1.5	0.34	0.107	0.055	0.04	High Res	Beach	Dry	NR	1
SN09	1/30/2014	1.5	0.32	0.074	0.047	0.03	Commercial	East Slough	Dry	NR	1
SN11	1/30/2014	1.5	0.26	0.086	0.027	0.02	Medium Res	West Slough	Dry	NR	1
SNGC03	3/6/2014	0.65	9.2	9.200	1.7	1.41	GC	Sanibel Bayous	Dry	R	2
SNGC01	3/6/2014	0.65	5.4	1.214	1.6	1.59	GC	Ladyfinger lakes	Dry	R	2
SNGC02	3/6/2014	0.65	3.6	0.333	0.57	0.48	GC	East Slough	Dry	R	2
SN07	3/6/2014	0.65	1.3	0.305	0.29	0.28	Medium Res	Ladyfinger lakes	Dry	R	2
SN02	3/6/2014	0.65	1.2	0.254	0.25	0.24	High Res	Beach	Dry	R	2
SN08	3/6/2014	0.65	0.94	0.107	0.25	0.05	Commercial	East Slough	Dry	NR	2
SN04	3/6/2014	0.65	1.1	0.219	0.24	0.23	High Res	Beach	Dry	R	2
SNR30	3/6/2014	0.65	1.4	0.248	0.21	0.16	Medium Res	SE Tarpon	Dry	NR	2
SN01	3/6/2014	0.65	1.1	0.214	0.21	0.09	Commercial	East Slough	Dry	NR	2
SNR44	3/6/2014	0.65	1.2	0.092	0.19	0.15	Low Res	West Slough	Dry	R	2
SN10	3/6/2014	0.65	3.5	0.186	0.18	0.06	Low Res	West Slough	Dry	NR	2
SN06	3/6/2014	0.65	2.3	0.088	0.18	0.06	High Res	East Slough	Dry	NR	2
SN03	3/6/2014	0.65	1.1	0.089	0.13	0.02	Low Res	East Slough	Dry	NR	2

Table 23 (cont.) Individual results for nutrient runoff sampling during Phase 2.

Station	Sample_date	24hr_precip	TN	IN	TP	OP	LU	Basin	Wet Dry Season	Reclaimed Water	Event #
SNR40	3/6/2014	0.65	1	0.078	0.12	0.03	Low Res	East Slough	Dry	NR	2
SN05	3/6/2014	0.65	0.4	0.091	0.11	0.1	Medium Res	East Slough	Dry	NR	2
SN12	3/6/2014	0.65	1.5	0.079	0.09	0.06	Low Res	West Slough	Dry	NR	2
SNR36	3/6/2014	0.65	1.3	0.105	0.09	0.08	Medium Res	East Slough	Dry	R	2
SN09	3/6/2014	0.65	0.9	0.066	0.06	0.02	Commercial	East Slough	Dry	NR	2
SN11	3/6/2014	0.65	0.6	0.282	0.04	0.02	Medium Res	West Slough	Dry	NR	2
SNGC03	7/7/2014	0.35	4.2	2.1	1.9	1.85	GC	Sanibel Bayous	Dry	R	3
SNGC02	7/7/2014	0.35	2	0.49	0.89	0.69	GC	East Slough	Dry	R	3
SNR18	7/7/2014	0.35	1.7	1.18	0.73	0.13	High Res	Sanibel Bayous	Dry	NR	3
SNGC01	7/7/2014	0.35	1.5	0.39	0.58	0.51	GC	Ladyfinger lakes	Dry	R	3
SNR49	7/7/2014	0.35	1.3	0.73	0.37	0.17	Low Res	West Slough	Dry	NR	3
SN03	7/7/2014	0.35	0.1	0.17	0.27	0.05	Low Res	East Slough	Dry	NR	3
SNR34	7/7/2014	0.35	1	0.2	0.21	0.15	Medium Res	East Slough	Dry	NR	3
SN02	7/7/2014	0.35	0.8	0.21	0.19	0.1	High Res	Beach	Dry	R	3
SNR11	7/7/2014	0.35	1	0.27	0.13	0.08	High Res	Beach	Dry	R	3
SN07	7/7/2014	0.35	0.5	0.14	0.13	0.1	Medium Res	Ladyfinger lakes	Dry	R	3
SN05	7/7/2014	0.35	0.4	0.29	0.04	0.03	High Res	Beach	Dry	NR	3
SNR50	7/7/2014	0.35					Low Res	West Slough	Dry	NR	3
SNGC01	7/15/2014	1.1	2.7	0.93	2.9	2.79	GC	Ladyfinger lakes	Wet	R	4
SNGC03	7/15/2014	1.1	2.3	0.61	2.6	2.53	GC	Sanibel Bayous	Wet	R	4
SNR19	7/15/2014	1.1	2.2	0.65	1.5	1.43	Medium Res	Sanibel Bayous	Wet	NR	4
SNR20	7/15/2014	1.1	1.7	0.97	1.2	0.24	Medium Res	Sanibel Bayous	Wet	NR	4
SN12	7/15/2014	1.1	1.8	0.55	0.76	0.08	Low Res	West Slough	Wet	NR	4
SN03	7/15/2014	1.1	0.1	0.1	0.71	0.13	Low Res	East Slough	Wet	NR	4
SNGC02	7/15/2014	1.1	2	0.44	0.7	0.48	GC	East Slough	Wet	R	4
SN04	7/15/2014	1.1	2.9	0.7	0.38	0.35	High Res	Beach	Wet	R	4
SNR35	7/15/2014	1.1	0.2	0.1	0.25	0.17	Medium Res	East Slough	Wet	NR	4
SN06	7/15/2014	1.1	1.5	0.17	0.22	0.06	High Res	East Slough	Wet	NR	4
SNR51	7/15/2014	1.1	1.1	0.24	0.22	0.12	Low Res	Sanibel Bayous	Wet	NR	4
SNR05	7/15/2014	1.1	0.2	0.19	0.21	0.19	High Res	Beach	Wet	R	4
SN09	7/15/2014	1.1	0.9	0.3	0.18	0.05	Commercial	East Slough	Wet	NR	4
SN05	7/15/2014	1.1	0.1	0.08	0.16	0.14	Medium Res	East Slough	Wet	NR	4
SNR37	7/15/2014	1.1	1.1	0.12	0.15	0.07	Medium Res	East Slough	Wet	NR	4

Table 23 (cont). Individual results for nutrient runoff sampling during Phase 2.

Station	Sample_date	24hr_precip	TN	IN	TP	OP	LU	Basin	Wet Dry Season	Reclaimed Water	Event #
SN10	7/15/2014	1.1	0.8	0.11	0.14	0.11	Low Res	West Slough	Wet	NR	4
SN02	7/15/2014	1.1	0.3	0.18	0.14	0.13	High Res	Beach	Wet	R	4
SN07	7/15/2014	1.1	0.6	0.24	0.11	0.1	Medium Res	Ladyfinger lakes	Wet	R	4
SNR23	7/15/2014	1.1	0.3	0.23	0.09	0.09	Medium Res	West Slough	Wet	NR	4
SN11	7/15/2014	1.1	0.1	0.08	0.01	0	Medium Res	West Slough	Wet	NR	4
SNGC01	41884	0.59	2.6	0.57	1.6	1.19	GC	Ladyfinger lakes	Wet	R	5
SNGC02	41884	0.59	2.5	0.64	1.9	1.75	GC	East Slough	Wet	R	5
SNGC03	41884	0.59	0.5	0.15	0.9	0.84	GC	Sanibel Bayous	Wet	R	5
SNR10	41884	0.59	0.2	0.1	0.05	0.04	High Res	East Slough	Wet	R	5
SNR47	41884	0.59	0.4	0.1	0.11	0.02	Low Res	West Slough	Wet	NR	5
SNR60	41884	0.59	0.8	0.58	0.21	0.04	Low Res	West Slough	Wet	R	5
SNR26	41884	0.59	0.5	0.16	0.21	0.16	Medium Res	West Slough	Wet	NR	5
SNR58	41884	0.59	0.1	0.09	0.19	0.05	Medium Res	East Slough	Wet	NR	5
SNR59	41884	0.59	0.2	0.11	0.07	0.04	Medium Res	East Slough	Wet	NR	5
SNR52	41899	0.5	1.2	0.54	0.2	0.17	Low Res	Sanibel Bayous	Dry	NR	6
SN01	41899	0.5	0.7	0.19	0.11	0.11	Commercial	East Slough	Wet	NR	6
SNR55	41899	0.5	0.4	0.09	0.09	0.05	Commercial	SE Tarpon	Wet	NR	6
SNR56	41899	0.5	0.1	0.06	0.2	0.04	Commercial	SE Tarpon	Wet	NR	6
SNGC01	41899	0.5	3.2	0.58	1.3	1.26	GC	Ladyfinger lakes	Wet	R	6
SNGC02	41899	0.5	1.7	0.11	1	0.78	GC	East Slough	Wet	R	6
SNGC03	41899	0.5	3	0.62	2.3	2.12	GC	Sanibel Bayous	Wet	R	6
SN02	41899	0.5	1.6	0.22	0.48	0.37	High Res	Beach	Wet	R	6
SN04	41899	0.5	0.8	0.13	1.3	1.31	High Res	Beach	Wet	R	6
SN06	41899	0.5	1.4	0.13	0.11	0.02	High Res	East Slough	Wet	NR	6
SNR13	41899	0.5	1.1	0.69	0.08	0.02	High Res	East Canals	Wet	NR	6
SNR14	41899	0.5	3.3	0.17	0.15	0	High Res	East Slough	Wet	NR	6
SN03	41899	0.5	0.6	0.2	0.37	0.06	Low Res	East Slough	Wet	NR	6
SN12	41899	0.5					Low Res	West Slough	Wet	NR	6
SNR54	41899	0.5	0.1	0.06	0.05	0.05	Low Res	West Slough	Wet	NR	6
SN05	41899	0.5	0.5	0.19	0.14	0.11	Medium Res	East Slough	Wet	NR	6
SN07	41899	0.5	0.4	0.21	0.12	0.06	Medium Res	Ladyfinger lakes	Wet	R	6
SN11	41899	0.5	0.2	0.06	0.02	0.01	Medium Res	West Slough	Wet	NR	6
SNR22	41899	0.5	8.9	3.25	0.79	0.59	Medium Res	West Slough	Wet	NR	6
SNR38	41899	0.5	0.7	0.1	0.2	0.08	Medium Res	East Canals	Wet	NR	6
SNR57	41899	0.5	1.5	0.4	0.96	0.39	Medium Res	Sanibel Bayous	Wet	NR	6

Table 24. Annual Sanibel stormwater TN loading to waterbodies calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual TN Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean TN Conc (mg/l)		Sanibel TN Loading (kg/yr)		Total TN Loading (kg/yr)
Land Use				Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
Low Density Residential	825	0.257	0.709	0.12	0.33	1.61	0.71	165	557	722
Medium Density Residential	1281	0.257	0.709	0.18	0.38	1.22	1.13	292	1579	1870
High Density Residential	452	0.257	0.709	0.27	0.45	1.04	1.33	132	778	910
Commercial and Services	259	0.257	0.709	0.44	0.59	0.66	0.51	78	223	301
Institutional (School)	62	0.257	0.709	0.18	0.42	1.18	1.18	14	88	102
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	4.32	2.28	54	495	549
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	1.93	1.93	5	19	24
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	1.82	1.82	37	125	162
Shrub and Brushland	587	0.257	0.709	0.14	0.3	1.2	1.2	103	606	709
Disturbed Land	72	0.257	0.709	0.55	0.65	1.5	1.5	62	202	264
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0.2	0.2	9	33	42
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					950	4705	**5655**

Table 25. Annual Sanibel stormwater IN loading to waterbodies calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual IN Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean IN Conc (mg/l)		Sanibel IN Loading (kg/yr)		Total IN Loading (kg/yr)
Land Use				**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**	**Dry Season**	**Wet Season**	
Low Density Residential	825	0.257	0.709	0.12	0.33	0.20	0.24	20	190	211
Medium Density Residential	1281	0.257	0.709	0.18	0.38	0.16	0.41	38	577	615
High Density Residential	452	0.257	0.709	0.27	0.45	0.26	0.27	33	156	189
Commercial and Services	259	0.257	0.709	0.44	0.59	0.11	0.16	13	70	83
Institutional (School)	62	0.257	0.709	0.18	0.42	0.50	0.50	6	37	43
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	2.29	0.52	29	112	141
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	0.73	0.73	2	7	9
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	0.5	0.5	10	34	44
Shrub and Brushland	587	0.257	0.709	0.14	0.3	0.2	0.2	17	101	118
Disturbed Land	72	0.257	0.709	0.55	0.65	0.543	0.543	22	73	96
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0	0	0	0	0
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					191	1358	**1549**

Table 26. Annual Sanibel stormwater TP loading to waterbodies calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual TP Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean TP Conc (mg/l)		Sanibel TP Loading (kg/yr)		Total TP Loading (kg/yr)
Land Use				Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
Low Density Residential	825	0.257	0.709	0.12	0.33	0.24	0.32	25	251	276
Medium Density Residential	1281	0.257	0.709	0.18	0.38	0.27	0.36	65	506	570
High Density Residential	452	0.257	0.709	0.27	0.45	0.22	0.31	28	182	209
Commercial and Services	259	0.257	0.709	0.44	0.59	0.15	0.15	18	64	82
Institutional (School)	62	0.257	0.709	0.18	0.42	0.15	0.15	2	11	13
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	1.21	1.69	15	367	382
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	0.4	0.4	1	4	5
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	0.27	0.27	5	19	24
Shrub and Brushland	587	0.257	0.709	0.14	0.3	0.07	0.07	6	35	41
Disturbed Land	72	0.257	0.709	0.55	0.65	0.15	0.15	6	20	26
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0.01	0.01	0	2	2
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					171	1460	**1631**

Table 27. Annual stormwater OP loading to waterbodies adjacent to Sanibel calculated with Sanibel-specific runoff coefficients and concentration data.

Estimated Annual OP Loading	Area (acres)	Annual Dry Season Rain (m)	Annual Wet Season Rain (m)	Sanibel Specific Runoff Coefficient		Sanibel Specific Mean OP Conc (mg/l)		Sanibel OP Loading (kg/yr)		Total OP Loading (kg/yr)
Land Use				Dry Season	Wet Season	Dry Season	Wet Season	Dry Season	Wet Season	
Low Density Residential	825	0.257	0.709	0.12	0.33	0.09	0.08	9	60	69
Medium Density Residential	1281	0.257	0.709	0.18	0.38	0.20	0.22	48	305	353
High Density Residential	452	0.257	0.709	0.27	0.45	0.11	0.25	14	146	160
Commercial and Services	259	0.257	0.709	0.44	0.59	0.05	0.06	6	27	33
Institutional (School)	62	0.257	0.709	0.18	0.42	0.06	0.06	1	4	5
Recreational (Golf Courses)	303	0.257	0.709	0.04	0.25	1.09	1.53	14	332	345
Recreational (Beach)	285	0.257	0.709	0.5	0.6	0	0	0	0	0
Recreational (Parks)	11	0.257	0.709	0.21	0.31	0.143	0.143	0	1	2
Utilities (Island Water)	25	0.257	0.709	0.78	0.97	0.08	0.08	2	6	7
Shrub and Brushland	587	0.257	0.709	0.14	0.3	0.03	0.03	3	15	18
Disturbed Land	72	0.257	0.709	0.55	0.65	0.03	0.03	1	4	5
Upland Hardwood Forests	270	0.257	0.709	0.16	0.21	0	0	0	0	0
Lakes/Reservoirs	134	0.257	0.709	0	0	0	0	0	0	0
Wetlands (Other)	15	0.257	0.709	0	0	0	0	0	0	0
Wetland Forests	5500	0.257	0.709	0	0	0	0	0	0	0
Total	10062	0.257	0.709					96	901	**997**

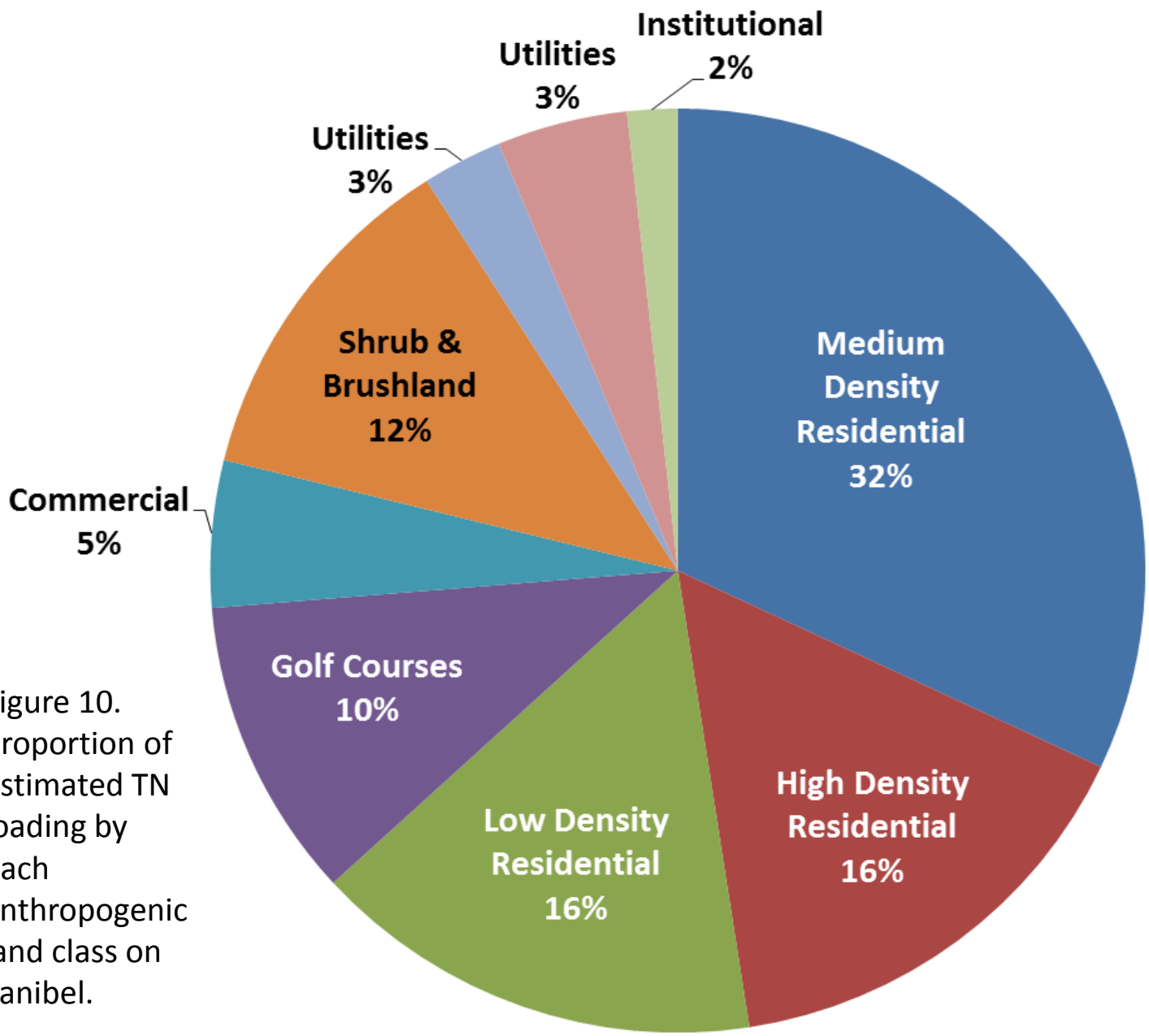


Figure 10. Proportion of estimated TN loading by each anthropogenic land class on Sanibel.

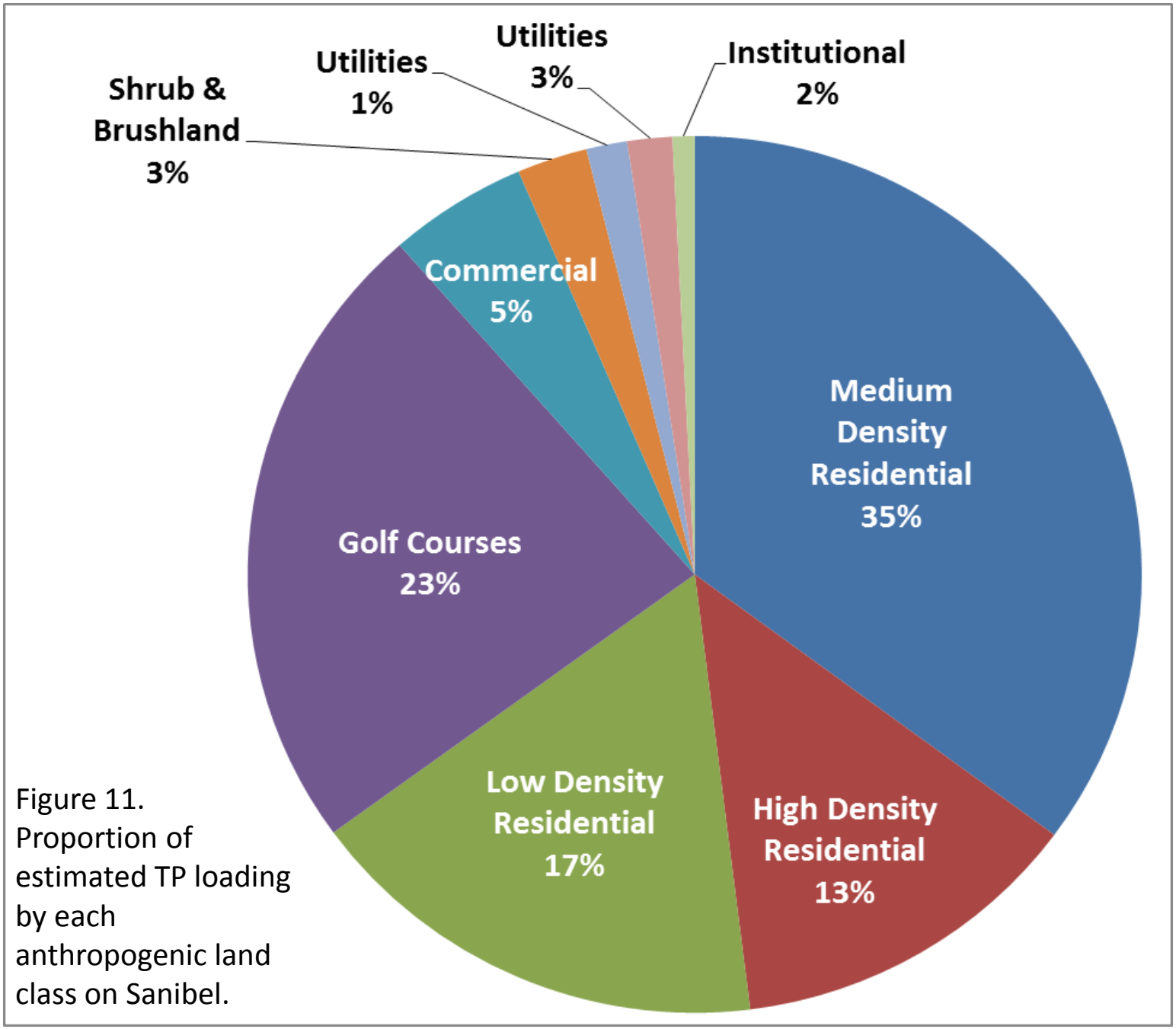


Figure 11. Proportion of estimated TP loading by each anthropogenic land class on Sanibel.

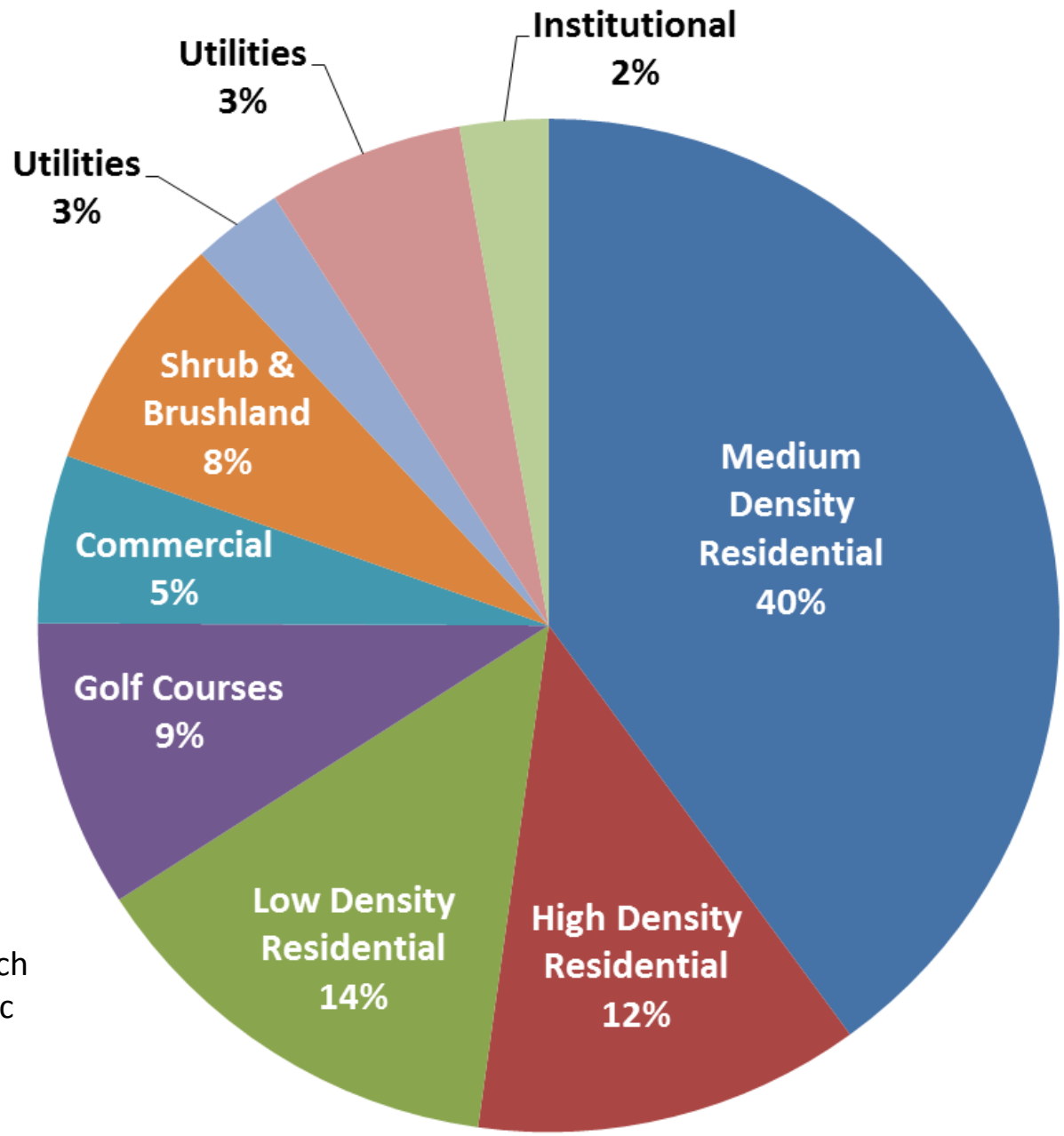


Figure 12. Proportion of estimated IN loading by each anthropogenic land class on Sanibel.

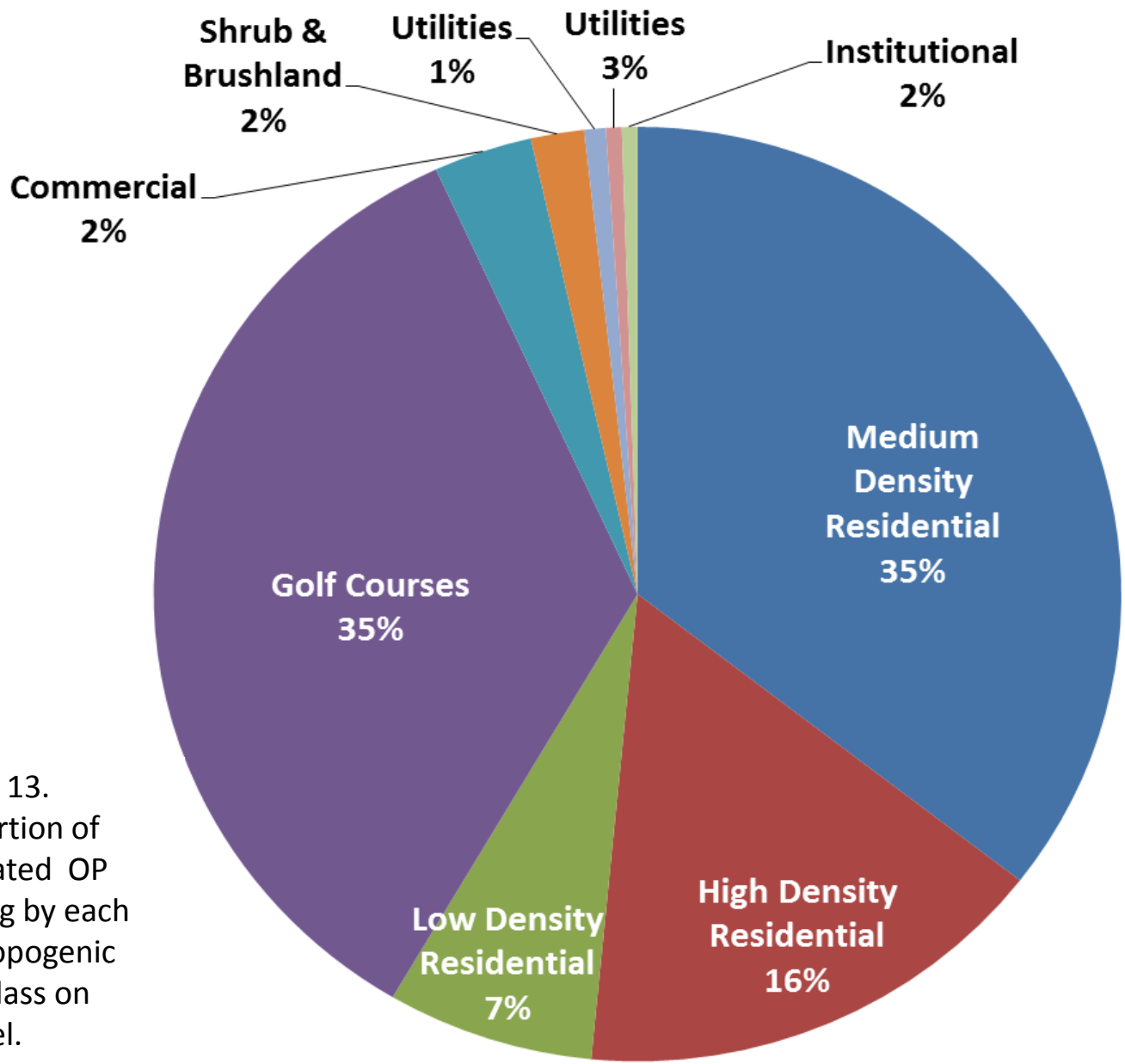


Figure 13. Proportion of estimated OP loading by each anthropogenic land class on Sanibel.

Table 28. Stormwater runoff nutrient (a.) loads and (b.) loading rates for each Sanibel basin. Note that loading rates shown here are calculated over entire basin area and did not exclude non-anthropogenic land classes.

a.)

Basin	TN Load (kg/yr)	TP Load (kg/yr)	IN Load (kg/yr)	OP Load (kg/yr)
West Slough	890.5	236.1	246.9	97.8
East Slough	988.4	341.3	276.6	227.6
Beaches	776.2	191.6	174.7	114.1
East Canals	482.9	131.2	143.8	82.5
Bayous	863.4	266.7	206.2	185.7
Ladyfinger Lakes	660.8	204.9	213.6	141.4
SE Tarpon	310.3	86.1	95.5	44.5
Lighthouse	120.1	31.4	31.1	21.7
San Carlos Bay	114.4	37.8	35.4	23.2
Refuge	70.8	8.7	27.0	2.9
SW Tarpon Bay	69.0	7.2	14.9	2.5
Kesson Bayou	107.0	27.6	25.8	15.5
Sanibel Overall	5453.9	1570.7	1491.6	959.5

b.)

Basin	TN Load (kg/ha-yr)	TP Load (kg/ha-yr)	IN Load (kg/ha-yr)	OP Load (kg/ha-yr)
West Slough	1.20	0.32	0.33	0.13
East Slough	2.08	0.72	0.58	0.48
Beaches	2.50	0.62	0.56	0.37
East Canals	3.74	1.02	1.11	0.64
Bayous	2.26	0.70	0.54	0.49
Ladyfinger Lakes	1.66	0.52	0.54	0.36
SE Tarpon	1.58	0.44	0.49	0.23
Lighthouse	3.43	0.90	0.89	0.62
San Carlos Bay	2.08	0.69	0.65	0.42
Refuge	0.08	0.01	0.03	0.00
SW Tarpon Bay	0.38	0.04	0.08	0.01
Kesson Bayou	0.62	0.16	0.15	0.09
Sanibel Overall	1.39	0.40	0.38	0.25

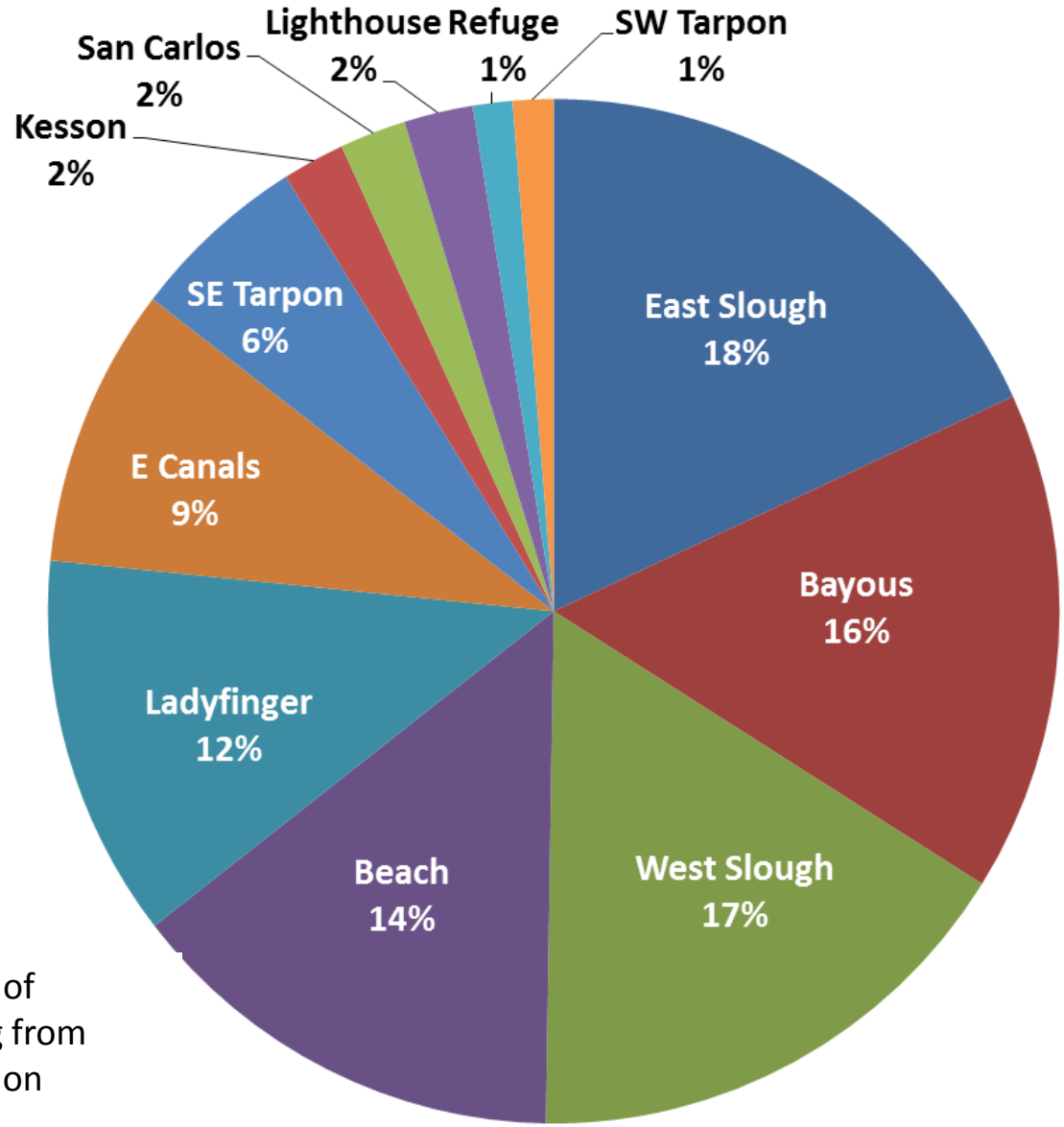


Figure 14. Proportion of estimated TN loading from each discharge basin on Sanibel.

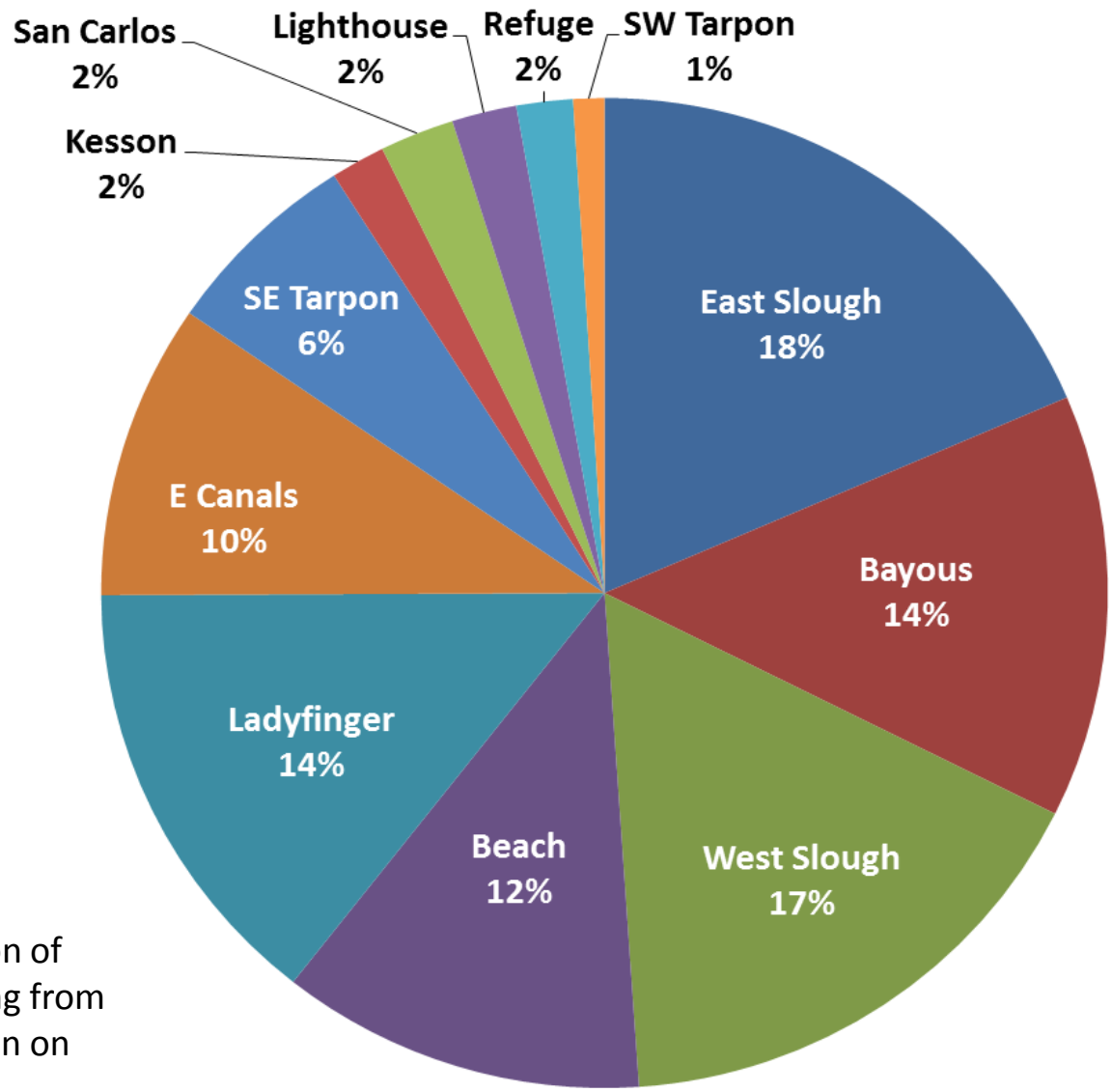


Figure 15. Proportion of estimated IN loading from each discharge basin on Sanibel.

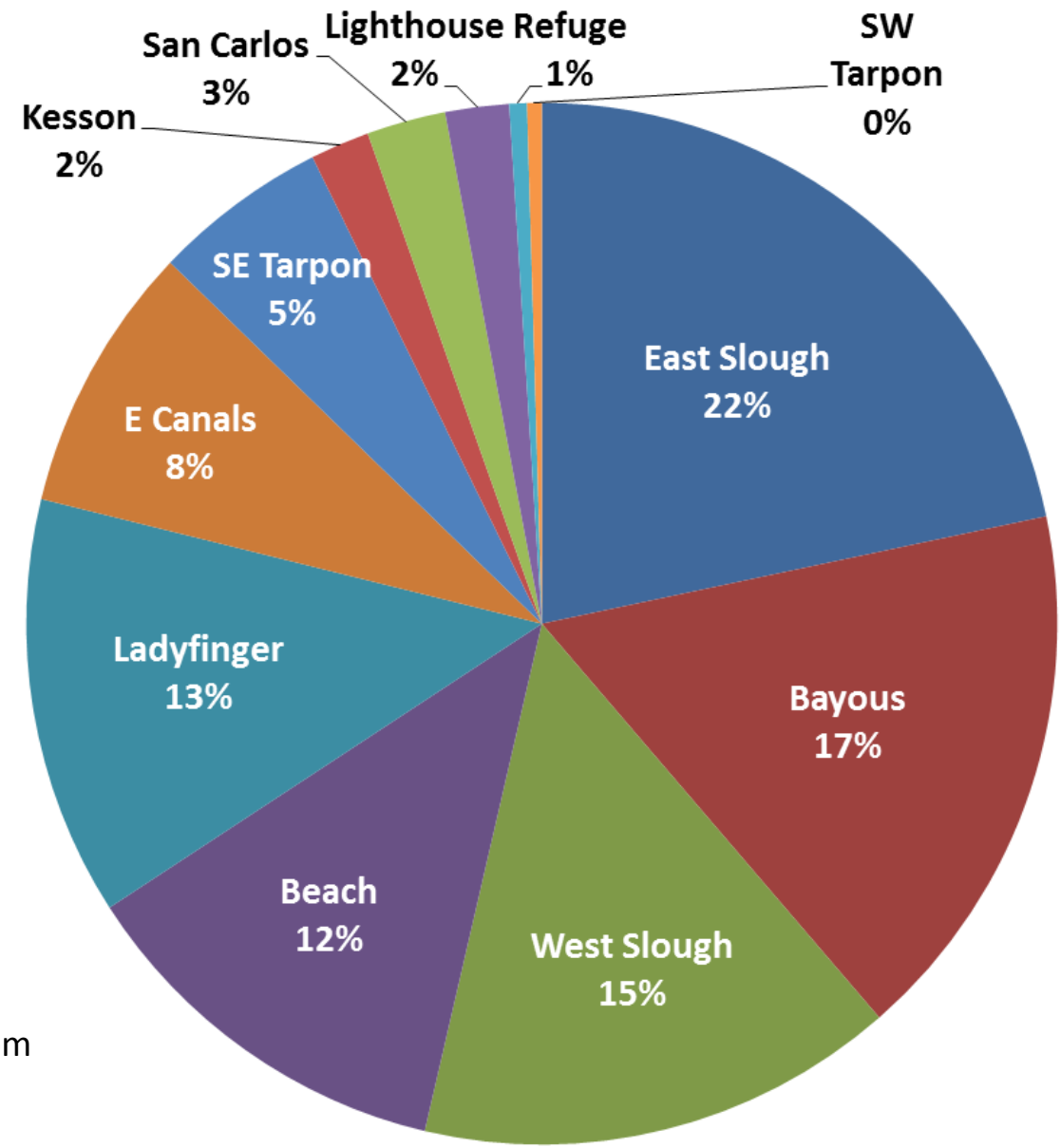


Figure 16. Proportion of estimated TP loading from each discharge basin on Sanibel.

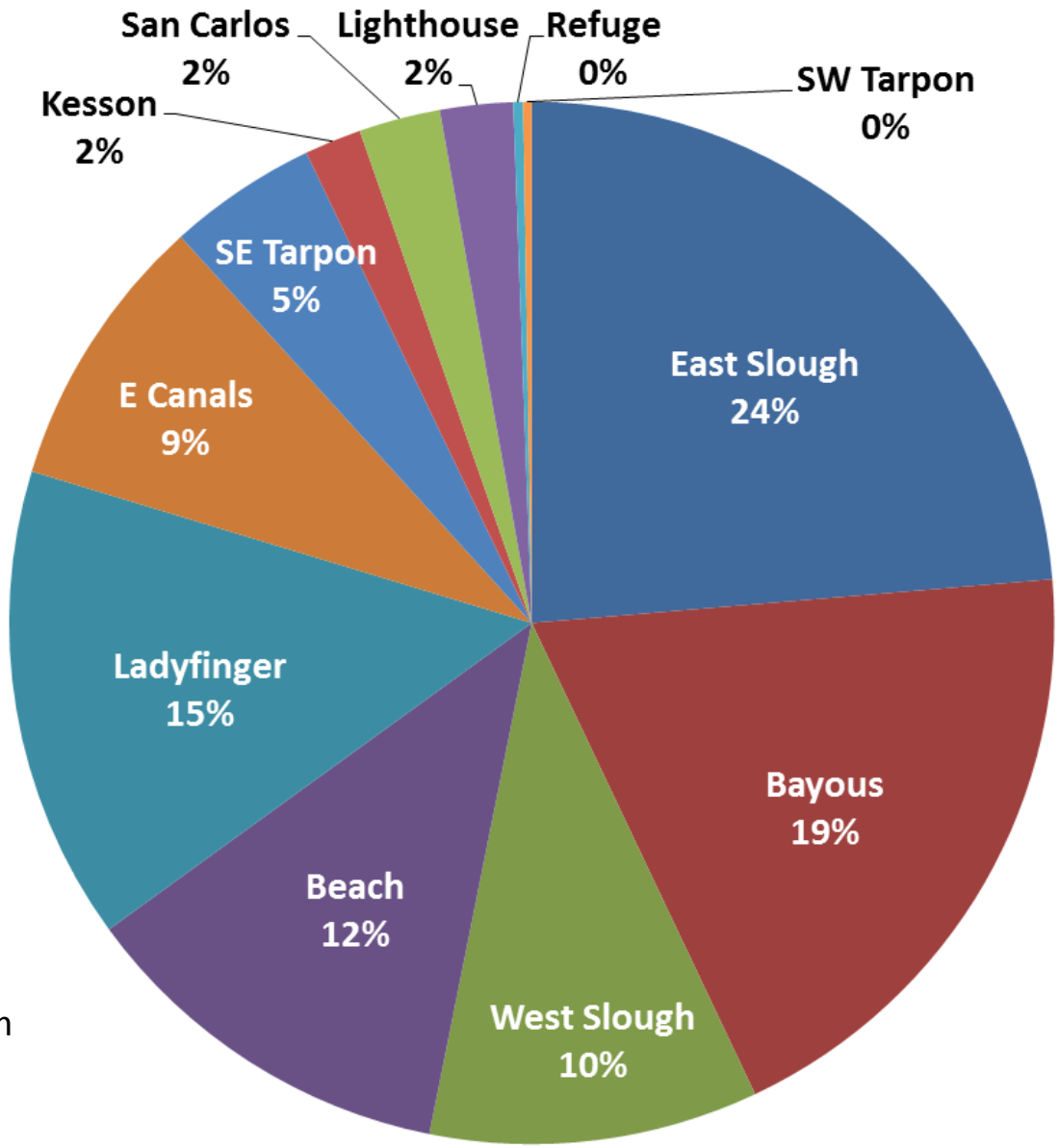


Figure 17. Proportion of estimated OP loading from each discharge basin on Sanibel.

Appendix 1
Runoff volume and coefficient calculation tables for each land class

Low density residential land class runoff coefficient (C) calculation tables: a.) 2011; b.) 2012; c.) 2013.

Low Density Residential	Area (m^2)	2011 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2011 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2011 Total RainVolume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2011 Runoff m^3/yr	2011 Composite C
East Slough	454,054	157,656	16,555	1,781	18,336	0.12	326,614	56,631	66,065	122,696	0.38	484,269	73,186	67,846	141,031	0.29
West Slough	1,383,205	480,274	54,507	5,612	60,119	0.13	994,978	170,791	208,136	378,927	0.38	1,475,252	225,298	213,747	439,046	0.30
Bayous	526,087	182,667	15,395	2,290	17,685	0.10	378,429	48,607	84,941	133,548	0.35	561,096	64,002	87,231	151,234	0.27
Beach	594,883	206,554	26,195	2,211	28,406	0.14	427,916	87,418	81,993	169,411	0.40	634,470	113,613	84,204	197,817	0.31
Ladyfinger	16,187	5,620	589	71	660	0.12	11,644	1,583	2,617	4,200	0.36	17,264	2,172	2,687	4,859	0.28
SE Tarpon	72,842	25,292	2,440	338	2,778	0.11	52,397	6,311	12,546	18,857	0.36	77,689	8,750	12,884	21,635	0.28
E Canals	809	281	34	3	37	0.13	582	107	117	224	0.39	863	141	121	261	0.30
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	97,933	34,004	2,901	426	3,327	0.10	70,446	9,260	15,812	25,072	0.36	104,450	12,161	16,238	28,399	0.27
San Carlos	60,702	21,077	2,669	229	2,898	0.14	43,665	8,771	8,505	17,276	0.40	64,741	11,440	8,734	20,174	0.31
SW Tarpon	1,214	422	45	5	50	0.12	873	155	176	331	0.38	1,295	200	181	381	0.29
Refuge	1,619	562	37	7	44	0.08	1,165	151	245	396	0.34	1,727	188	252	439	0.25
Total	3,209,535	1,114,408	121,367	12,972	134,339	0.12	2,308,708	389,784	481,153	870,938	0.38	3,423,117	511,151	494,126	1,005,277	**0.29**

Low Density Residential	Area (m^2)	2012 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2012 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2012 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2012 Runoff m^3/yr	2012 Composite C
East Slough	454,054	164,921	16,334	5,343	21,677	0.13	226,046	33,667	32,061	65,728	0.29	390,968	50,001	37,404	87,406	0.22
West Slough	1,383,205	502,408	54,451	16,835	71,285	0.14	688,615	103,820	101,007	204,827	0.30	1,191,022	158,271	117,842	276,113	0.23
Bayous	526,087	191,085	15,283	6,870	22,153	0.12	261,907	29,813	41,222	71,035	0.27	452,992	45,096	48,092	93,188	0.21
Beach	594,883	216,073	26,197	6,632	32,828	0.15	296,157	52,243	39,791	92,034	0.31	512,230	78,439	46,423	124,862	0.24
Ladyfinger	16,187	5,879	584	212	796	0.14	8,059	1,027	1,270	2,297	0.29	13,938	1,611	1,482	3,093	0.22
SE Tarpon	72,842	26,458	2,423	1,015	3,438	0.13	36,264	3,995	6,089	10,084	0.28	62,721	6,418	7,103	13,522	0.22
E Canals	809	294	33	9	43	0.15	403	64	57	121	0.30	697	97	66	164	0.24
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	97,933	35,571	2,879	1,279	4,158	0.12	48,755	5,587	7,674	13,261	0.27	84,326	8,467	8,952	17,419	0.21
San Carlos	60,702	22,048	2,635	688	3,323	0.15	30,220	5,270	4,127	9,398	0.31	52,268	7,905	4,815	12,721	0.24
SW Tarpon	1,214	441	45	14	60	0.14	604	93	85	178	0.29	1,045	138	100	238	0.23
Refuge	1,619	588	37	20	57	0.10	806	93	119	212	0.26	1,394	131	139	269	0.19
Total	3,209,535	1,165,767	120,902	38,917	159,819	0.14	1,597,835	235,674	233,501	469,174	0.29	2,763,602	356,575	272,418	628,993	**0.23**

Low Density Residential	Area (m^2)	2013 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2013 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2013 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2013 Runoff m^3/yr	2013 Composite C
East Slough	454,054	222,010	20,972	4,615	25,587	0.12	292,476	47,922	46,148	94,070	0.32	514,486	68,895	50,763	119,657	0.23
West Slough	1,383,205	676,318	72,258	14,539	86,797	0.13	890,983	144,926	145,389	290,315	0.33	1,567,301	217,184	159,928	377,112	0.24
Bayous	526,087	257,230	20,413	5,933	26,347	0.10	338,876	41,464	59,334	100,798	0.30	596,106	61,877	65,267	127,144	0.21
Beach	594,883	290,868	33,299	5,727	39,026	0.13	383,190	74,668	57,275	131,943	0.34	674,058	107,967	63,002	170,969	0.25
Ladyfinger	16,187	7,915	860	183	1,042	0.13	10,427	1,551	1,828	3,379	0.32	18,341	2,410	2,011	4,421	0.24
SE Tarpon	72,842	35,616	3,428	876	4,304	0.12	46,921	5,335	8,764	14,099	0.30	82,537	8,763	9,640	18,403	0.22
E Canals	809	396	44	8	52	0.13	521	102	82	184	0.35	917	146	90	236	0.26
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	97,933	47,884	3,854	1,105	4,958	0.10	63,083	8,703	11,045	19,749	0.31	110,967	12,557	12,150	24,707	0.22
San Carlos	60,702	29,680	3,440	594	4,034	0.14	39,101	7,493	5,941	13,434	0.34	68,781	10,933	6,535	17,468	0.25
SW Tarpon	1,214	594	56	12	68	0.11	782	143	123	266	0.34	1,376	199	135	334	0.24
Refuge	1,619	792	39	17	56	0.07	1,043	156	171	327	0.31	1,834	195	188	383	0.21
Total	3,209,535	1,569,302	158,663	33,610	192,273	0.12	2,067,403	332,464	336,100	668,564	0.32	3,636,705	491,127	369,710	860,837	**0.24**

Medium density residential land class runoff coefficient (C) calculation tables: a.) 2011; b.) 2012; c.) 2013.

Medium Density Residential	Area (m^2)	2011 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2011 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2011 Total RainVolume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2011 Runoff m^3/yr	2011 Composite C
East Slough	936,031	325,007	55,291	3,044	58,335	0.18	673,313	170,405	112,911	283,317	0.42	998,320	225,696	115,956	341,652	0.34
West Slough	856,308	297,326	53,070	2,991	56,061	0.19	615,966	148,201	110,933	259,133	0.42	913,292	201,270	113,923	315,194	0.35
Bayous	519,612	180,419	26,746	1,808	28,553	0.16	373,771	82,391	67,043	149,435	0.40	554,190	109,137	68,851	177,988	0.32
Beach	68,796	23,887	4,225	240	4,465	0.19	49,487	11,831	8,913	20,744	0.42	73,374	16,056	9,154	25,210	0.34
Ladyfinger	797,225	276,811	50,961	2,811	53,771	0.19	573,466	137,877	104,257	242,134	0.42	850,277	188,837	107,067	295,905	0.35
SE Tarpon	462,000	160,415	27,482	1,666	29,148	0.18	332,330	75,596	61,780	137,376	0.41	492,744	103,078	63,446	166,523	0.34
E Canals	971,238	337,231	60,120	3,461	63,582	0.19	698,639	163,598	128,388	291,986	0.42	1,035,870	223,718	131,850	355,568	0.34
Lighthouse	134,355	46,650	8,958	479	9,437	0.20	96,645	24,840	17,760	42,600	0.44	143,296	33,797	18,239	52,037	0.36
Kesson	32,779	11,381	1,705	114	1,819	0.16	23,579	5,222	4,229	9,452	0.40	34,960	6,928	4,343	11,271	0.32
San Carlos	202,341	70,256	12,638	721	13,359	0.19	145,550	34,239	26,743	60,982	0.42	215,806	46,878	27,464	74,342	0.34
SW Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
Refuge	4,856	1,686	168	18	185	0.11	3,493	557	649	1,207	0.35	5,179	725	667	1,392	0.27
Total	4,985,541	1,731,070	301,364	17,352	318,717	0.18	3,586,239	854,756	643,608	1,498,364	0.42	5,317,309	1,156,121	660,960	1,817,081	**0.34**

Medium Density Residential	Area (m^2)	2012 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2011 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2012 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2012 Runoff m^3/yr	2012 Composite C
East Slough	936,031	339,510	55,348	9,133	64,481	0.19	465,756	107,658	54,242	161,899	0.35	805,266	163,006	63,374	226,380	0.28
West Slough	856,308	310,593	53,419	8,972	62,391	0.20	426,087	94,584	53,291	147,875	0.35	736,680	148,003	62,264	210,266	0.29
Bayous	519,612	188,470	26,974	5,423	32,396	0.17	258,552	52,057	32,207	84,264	0.33	447,021	79,031	37,630	116,661	0.26
Beach	68,796	24,953	4,254	721	4,975	0.20	34,232	7,561	4,282	11,843	0.35	59,185	11,816	5,003	16,819	0.28
Ladyfinger	797,225	289,163	51,138	8,433	59,571	0.21	396,688	87,731	50,084	137,815	0.35	685,851	138,870	58,517	197,386	0.29
SE Tarpon	462,000	167,573	27,565	4,997	32,562	0.19	229,885	48,180	29,679	77,858	0.34	397,458	75,745	34,676	110,421	0.28
E Canals	971,238	352,280	60,081	10,384	70,465	0.20	483,274	104,342	61,677	166,019	0.34	835,554	164,423	72,061	236,484	0.28
Lighthouse	134,355	48,732	8,983	1,437	10,420	0.21	66,853	15,852	8,532	24,384	0.36	115,585	24,836	9,968	34,804	0.30
Kesson	32,779	11,889	1,719	342	2,061	0.17	16,310	3,302	2,032	5,333	0.33	28,200	5,021	2,374	7,395	0.26
San Carlos	202,341	73,392	12,628	2,163	14,791	0.20	100,682	21,852	12,847	34,699	0.34	174,074	34,480	15,010	49,490	0.28
SW Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
Refuge	4,856	1,761	173	53	226	0.13	2,416	392	312	704	0.29	4,178	566	364	930	0.22
Total	4,985,541	1,808,316	302,284	52,057	354,340	0.20	2,480,735	543,511	309,184	852,695	0.34	4,289,051	845,795	361,241	1,207,036	**0.28**

Medium Density Residential	Area (m^2)	2013 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2013 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2013 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2013 Runoff m^3/yr	2013 Composite C
East Slough	936,031	457,672	70,377	7,841	78,218	0.17	602,939	154,502	78,822	233,324	0.39	1,060,611	224,879	86,663	311,542	0.29
West Slough	856,308	418,692	71,669	7,708	79,377	0.19	551,586	131,588	77,490	209,078	0.38	970,277	203,256	85,198	288,454	0.30
Bayous	519,612	254,064	34,482	4,656	39,138	0.15	334,705	74,567	46,804	121,370	0.36	588,769	109,049	51,459	160,508	0.27
Beach	68,796	33,638	5,696	619	6,315	0.19	44,315	11,446	6,226	17,672	0.40	77,952	17,143	6,845	23,987	0.31
Ladyfinger	797,225	389,803	69,428	7,243	76,671	0.20	513,528	121,303	72,811	194,115	0.38	903,331	190,732	80,054	270,786	0.30
SE Tarpon	462,000	225,895	37,380	4,294	41,673	0.18	297,595	66,439	43,163	109,602	0.37	523,489	103,819	47,456	151,275	0.29
E Canals	971,238	474,887	81,748	8,918	90,666	0.19	625,617	154,851	89,654	244,504	0.39	1,100,504	236,598	98,572	335,170	0.30
Lighthouse	134,355	65,693	11,932	1,152	13,083	0.20	86,544	22,297	11,577	33,873	0.39	152,237	34,229	12,728	46,957	0.31
Kesson	32,779	16,027	2,204	294	2,498	0.16	21,114	5,099	2,953	8,051	0.38	37,142	7,303	3,246	10,549	0.28
San Carlos	202,341	98,935	17,212	1,858	19,070	0.19	130,337	32,338	18,678	51,016	0.39	229,271	49,551	20,536	70,086	0.31
SW Tarpon	0	0	N/A	0	0		0	N/A	0	0		0	0	0	0	
Refuge	4,856	2,374	198	45	243	0.10	3,128	550	454	1,004	0.32	5,502	748	500	1,248	0.23
Total	4,985,541	2,437,680	402,326	44,627	446,953	0.18	3,211,406	774,979	448,631	1,223,610	0.38	5,649,087	1,177,305	493,258	1,670,563	**0.30**

High density residential land class runoff coefficient (C) calculation tables: a.) 2011; b.) 2012; c.) 2013.

High Density Residential	Area (m^2)	2011 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2011 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2011 Total RainVolume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2011 Runoff m^3/yr	2011 Composite C
East Slough	312,415	108,476	27,139	875	28,014	0.26	224,729	76,781	32,446	109,226	0.49	333,205	103,920	33,320	137,240	0.41
West Slough	6,879	2,389	674	19	694	0.29	4,948	1,585	714	2,299	0.46	7,337	2,259	734	2,993	0.41
Bayous	91,458	31,756	7,465	259	7,724	0.24	65,788	21,878	9,590	31,468	0.48	97,544	29,344	9,848	39,192	0.40
Beach	1,072,409	372,360	95,880	3,569	99,450	0.27	771,414	234,371	132,391	366,762	0.48	1,143,774	330,251	135,961	466,212	0.41
Ladyfinger	0	0	0	0	0		0	0	0	0		0	0	0	0	
SE Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
E Canals	149,732	51,990	15,131	404	15,535	0.30	107,706	40,181	14,990	55,171	0.51	159,696	55,312	15,394	70,706	0.44
Lighthouse	127,880	44,402	13,110	345	13,456	0.30	91,988	34,477	12,802	47,279	0.51	136,390	47,587	13,147	60,735	0.45
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
Refuge	0	0	0	0	0		0	0	0	0		0	0	0	0	
Total	1,760,773	611,372	159,400	5,471	164,872	0.27	1,266,573	409,272	202,933	612,205	0.48	1,877,945	568,673	208,404	777,077	**0.41**

High Density Residential	Area (m^2)	2012 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2012 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2012 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2012 Runoff m^3/yr	2012 Composite C
East Slough	312,415	113,317	26,802	2,624	29,426	0.26	155,453	47,786	15,507	63,293	0.41	268,770	74,588	18,131	92,720	0.34
West Slough	6,879	2,495	615	58	673	0.27	3,423	1,006	341	1,348	0.39	5,918	1,622	399	2,021	0.34
Bayous	91,458	33,173	7,464	776	8,239	0.25	45,508	13,613	4,583	18,196	0.40	78,681	21,077	5,359	26,436	0.34
Beach	1,072,409	388,976	97,037	10,708	107,745	0.28	533,616	153,697	63,275	216,972	0.41	922,591	250,734	73,983	324,717	0.35
Ladyfinger	0	0	0	0	0		0	0	0	0		0	0	0	0	
SE Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
E Canals	149,732	54,310	15,026	1,212	16,238	0.30	74,505	25,424	7,164	32,588	0.44	128,814	40,449	8,377	48,826	0.38
Lighthouse	127,880	46,384	13,072	1,035	14,108	0.30	63,631	21,885	6,119	28,004	0.44	110,015	34,957	7,154	42,112	0.38
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
Refuge	0	0	0	0	0		0	0	0	0		0	0	0	0	
Total	1,760,773	638,653	160,016	16,414	176,430	0.28	876,136	263,411	96,990	360,401	0.41	1,514,789	423,427	113,404	536,831	**0.35**

High Density Residential	Area (m^2)	2013 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2013 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2013 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2013 Runoff m^3/yr	2013 Composite C
East Slough	312,415	152,755	35,946	2,252	38,199	0.25	201,240	67,327	22,643	89,970	0.45	353,996	103,273	24,896	128,169	0.36
West Slough	6,879	3,363	876	50	926	0.28	4,431	1,335	499	1,834	0.41	7,795	2,211	549	2,760	0.35
Bayous	91,458	44,718	9,746	661	10,407	0.23	58,912	19,233	6,641	25,874	0.44	103,631	28,979	7,302	36,281	0.35
Beach	1,072,409	524,354	135,465	9,207	144,672	0.28	690,786	201,263	92,553	293,816	0.43	1,215,140	336,728	101,759	438,488	0.36
Ladyfinger	0	0	0	0	0		0	0	0	0		0	0	0	0	
SE Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
E Canals	149,732	73,211	20,531	1,042	21,574	0.29	96,449	35,176	10,476	45,652	0.47	169,660	55,707	11,518	67,225	0.40
Lighthouse	127,880	62,527	17,879	890	18,769	0.30	82,373	31,710	8,947	40,657	0.49	144,900	49,589	9,837	59,426	0.41
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	0	0	0	0	0		0	0	0	0		0	0	0	0	
Refuge	0	0	0	0	0		0	0	0	0		0	0	0	0	
Total	1,760,773	860,930	220,445	14,101	234,546	0.27	1,134,191	356,043	141,760	497,803	0.44	1,995,121	576,488	155,861	732,349	**0.37**

Commercial land class runoff coefficient (C) calculation tables: a.) 2011; b.) 2012; c.) 2013.

Commercial	Area (m^2)	2011 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2011 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2011 Total RainVolume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2011 Runoff m^3/yr	2011 Composite C
East Slough	368,666	128,007	54,255	686	54,941	0.43	265,192	137,083	25,428	162,511	0.61	393,199	191,339	26,113	217,452	0.55
West Slough	65,559	22,763	11,146	113	11,260	0.49	47,158	26,578	4,207	30,786	0.65	69,922	37,725	4,321	42,045	0.60
Bayous	59,083	20,515	8,202	111	8,313	0.41	42,500	21,401	4,134	25,535	0.60	63,015	29,602	4,246	33,848	0.54
Beach	93,077	32,318	15,293	176	15,468	0.48	66,953	36,170	6,513	42,683	0.64	99,271	51,463	6,688	58,151	0.59
Ladyfinger	48,562	16,862	8,420	92	8,511	0.50	34,932	19,398	3,398	22,796	0.65	51,794	27,818	3,490	31,307	0.60
SE Tarpon	341,957	118,734	54,571	645	55,217	0.47	245,979	130,262	23,927	154,190	0.63	364,713	184,834	24,573	209,406	0.57
E Canals	6,474	2,248	1,094	12	1,106	0.49	4,657	2,481	453	2,934	0.63	6,905	3,575	465	4,040	0.59
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	12,545	4,356	1,971	22	1,993	0.00	9,024	4,915	803	5,717	0.00	13,380	6,886	824	7,710	0.58
Refuge	9,712	3,372	683	17	700	0.21	6,986	1,572	621	2,194	0.31	10,358	2,256	638	2,894	0.28
Total	1,005,635	349,175	155,635	1,873	157,508	0.45	723,381	379,861	69,484	449,346	0.62	1,072,556	535,496	71,358	606,854	**0.57**

Commercial	Area (m^2)	2012 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2012 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2012 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2012 Runoff m^3/yr	2012 Composite C
East Slough	368,666	133,720	54,499	2,065	56,564	0.42	183,443	88,943	12,153	101,096	0.55	317,163	143,442	14,218	157,660	0.50
West Slough	65,559	23,779	11,159	342	11,500	0.48	32,621	17,381	2,011	19,392	0.59	56,400	28,540	2,352	30,892	0.55
Bayous	59,083	21,430	8,189	336	8,525	0.40	29,399	13,924	1,976	15,900	0.54	50,829	22,113	2,312	24,424	0.48
Beach	93,077	33,760	15,270	529	15,799	0.47	46,314	23,571	3,113	26,683	0.58	80,074	38,841	3,642	42,483	0.53
Ladyfinger	48,562	17,614	8,389	276	8,665	0.49	24,164	12,705	1,624	14,329	0.59	41,778	21,094	1,900	22,994	0.55
SE Tarpon	341,957	124,032	54,932	1,943	56,875	0.46	170,153	84,661	11,436	96,096	0.56	294,185	139,593	13,379	152,972	0.52
E Canals	6,474	2,348	1,089	37	1,126	0.48	3,221	1,670	217	1,887	0.59	5,570	2,760	253	3,013	0.54
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	12,545	4,550	1,999	65	2,065	0.00	6,242	3,201	384	3,585	0.00	10,792	5,201	449	5,649	0.52
Refuge	9,712	3,523	1,096	50	1,147	0.33	4,833	2,082	297	2,379	0.49	8,355	3,178	347	3,526	0.42
Total	1,005,635	364,756	156,623	5,643	162,267	0.44	500,390	248,138	33,209	281,347	0.56	865,146	404,761	38,853	443,614	**0.51**

Commercial	Area (m^2)	2013 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2013 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2013 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2013 Runoff m^3/yr	2013 Composite C
East Slough	368,666	180,727	76,508	1,765	78,274	0.43	237,849	121,351	17,762	139,113	0.58	418,576	197,859	19,527	217,387	0.52
West Slough	65,559	32,138	15,908	292	16,201	0.50	42,296	23,200	2,939	26,138	0.62	74,434	39,108	3,231	42,339	0.57
Bayous	59,083	28,964	11,495	287	11,782	0.41	38,118	20,511	2,888	23,399	0.61	67,082	32,005	3,175	35,180	0.52
Beach	93,077	45,628	21,879	452	22,331	0.49	60,050	31,133	4,549	35,683	0.59	105,678	53,012	5,002	58,013	0.55
Ladyfinger	48,562	23,806	12,014	236	12,250	0.51	31,330	16,462	2,374	18,836	0.60	55,136	28,476	2,609	31,086	0.56
SE Tarpon	341,957	167,634	78,896	1,661	80,557	0.48	220,617	111,480	16,714	128,194	0.58	388,251	190,376	18,375	208,751	0.54
E Canals	6,474	3,174	1,567	31	1,598	0.50	4,177	2,235	316	2,551	0.61	7,350	3,802	348	4,150	0.56
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	12,545	6,150	2,788	56	2,844	0.00	8,094	4,552	561	5,112	0.00	14,243	7,340	616	7,956	0.56
Refuge	9,712	4,761	1,319	43	1,362	0.29	6,266	3,539	434	3,973	0.63	11,027	4,858	477	5,335	0.48
Total	1,005,635	492,982	222,374	4,824	227,198	0.46	648,795	334,463	48,537	383,000	0.59	1,141,778	556,837	53,361	610,197	**0.53**

Institutional land class runoff coefficient (C) calculation tables: a.) 2011; b.) 2012; c.) 2013.

Institutional	Area (m^2)	2011 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2011 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2011 Total RainVolume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2011 Runoff m^3/yr	2011 Composite C
East Slough	34,398	11,944	2,136	100	2,236	0.19	24,743	7,439	3,713	11,152	0.45	36,687	9,575	3,814	13,389	0.36
West Slough	46,113	16,011	2,542	134	2,676	0.17	33,170	10,149	4,978	15,128	0.46	49,182	12,692	5,112	17,804	0.36
Bayous	0	0	0	0	0		0	0	0	0		0	0	0	0	
Beach	0	0	0	0	0		0	0	0	0		0	0	0	0	
Ladyfinger	0	0	0	0	0		0	0	0	0		0	0	0	0	
SE Tarpon	57,869	20,093	3,112	168	3,280	0.16	41,627	12,664	6,247	18,911	0.45	61,720	15,776	6,416	22,191	0.36
E Canals	0	0	0	0	0		0	0	0	0		0	0	0	0	
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	10,522	3,653	516	31	547	0.00	7,569	2,256	1,136	3,392	0.00	11,222	2,772	1,167	3,939	0.35
Refuge	91,863	31,896	2,143	267	2,411	0.08	66,080	17,492	9,917	27,409	0.41	97,976	19,635	10,185	29,820	0.30
Total	240,765	83,598	10,450	701	11,150	0.13	173,189	50,000	25,992	75,992	0.44	256,787	60,450	26,693	87,143	**0.34**

Institutional	Area (m^2)	2012 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2012 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2012 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2012 Runoff m^3/yr	2012 Composite C
East Slough	34,398	12,477	2,294	302	2,595	0.21	17,116	4,529	1,775	6,304	0.37	29,593	6,822	2,076	8,899	0.30
West Slough	46,113	16,726	3,392	404	3,796	0.23	22,945	6,376	2,379	8,756	0.38	39,671	9,768	2,784	12,552	0.32
Bayous	0	0	0	0	0		0	0	0	0		0	0	0	0	
Beach	0	0	0	0	0		0	0	0	0		0	0	0	0	
Ladyfinger	0	0	0	0	0		0	0	0	0		0	0	0	0	
SE Tarpon	57,869	20,990	4,200	507	4,707	0.22	28,795	7,947	2,986	10,933	0.38	49,785	12,147	3,493	15,640	0.31
E Canals	0	0	0	0	0		0	0	0	0		0	0	0	0	
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	10,522	3,816	727	92	820	0.00	5,236	1,410	543	1,953	0.00	9,052	2,138	635	2,773	0.31
Refuge	91,863	33,320	4,635	805	5,441	0.16	45,710	10,663	4,740	15,403	0.34	79,030	15,298	5,545	20,843	0.26
Total		87,328	15,248	2,111	17,359	0.20	119,801	30,926	12,423	43,348	0.36	207,130	46,173	14,534	60,707	**0.29**

Institutional	Area (m^2)	2013 Dry Season RainVolume	Dry Season Impervious Runoff m^3/yr	Dry Season Pervious Runoff m^3/yr	Total Dry Season Runoff m^3/yr	Dry Season C	2013 Wet Season RainVolume	Wet Season Impervious Runoff m3/yr	Wet Season Pervious Runoff m3/yr	Total Wet Season Runoff m^3/yr	Wet Season C	2013 Total Rain Volume	Total Impervious Runoff m^3/yr	Total Pervious Runoff m^3/yr	Total 2013 Runoff m^3/yr	2013 Composite C
East Slough	34,398	16,819	2,793	258	3,051	0.18	22,157	6,659	2,594	9,253	0.42	38,976	9,452	2,852	12,304	0.32
West Slough	46,113	22,547	4,289	346	4,634	0.21	29,703	10,313	3,477	13,790	0.46	52,250	14,601	3,823	18,424	0.35
Bayous	0	0	0	0	0		0	0	0	0		0	0	0	0	
Beach	0	0	0	0	0		0	0	0	0		0	0	0	0	
Ladyfinger	0	0	0	0	0		0	0	0	0		0	0	0	0	
SE Tarpon	57,869	28,295	5,284	434	5,718	0.20	37,276	12,918	4,364	17,282	0.46	65,571	18,202	4,798	23,000	0.35
E Canals	0	0	0	0	0		0	0	0	0		0	0	0	0	
Lighthouse	0	0	0	0	0		0	0	0	0		0	0	0	0	
Kesson	0	0	0	0	0		0	0	0	0		0	0	0	0	
San Carlos	0	0	0	0	0		0	0	0	0		0	0	0	0	
SW Tarpon	10,522	5,145	899	79	978	0.00	6,778	2,334	793	3,127	0.00	11,922	3,233	872	4,105	0.34
Refuge	91,863	44,916	4,905	689	5,594	0.12	59,173	19,661	6,927	26,589	0.45	104,089	24,567	7,616	32,183	0.31
Total		117,722	18,170	1,805	19,975	0.17	155,087	51,885	18,156	70,041	0.45	272,809	70,055	19,961	90,016	**0.33**

Golf course land class runoff coefficient (C) calculation tables: a.) 2011; b.) 2012; c.) 2013.

a.)

Golf Course	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C
Dunes	295000	314631	0.86	8.4	7.2	0.12	9.18	1.13	0.02	35.2	0.77	14263.5	53814.7	0.22
Beachview	403000	429818	0.93	8.4	7.8	0.06	7.57	0.45	0.01	35.2	0.35	8177.3	80051.2	0.21
Sanctuary	445300	474933	0.93	8.4	7.8	0.06	7.57	0.48	0.01	35.2	0.39	9862.0	87883.5	0.21
Total	1143300	1219382	0.90		22.8			2.06			1.51	32302.8	221749.4	

b.)

Golf Course	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C
Dunes	295000	254013	0.86	4.58	3.9	0.12	5.17	0.64	0.02	26.71	0.59	9164.3	29341.8	0.15
Beachview	403000	347007	0.93	4.58	4.3	0.06	4.81	0.28	0.01	26.71	0.27	5639.6	43647.0	0.14
Sanctuary	445300	383430	0.93	4.58	4.2	0.06	4.81	0.31	0.01	26.71	0.29	6805.7	47917.4	0.14
Total	1143300	984450			12.4			1.23			1.15	21609.5	120906.2	

c.)

Golf Course	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C
Dunes	295000	334263	0.86	6.27	5.4	0.12	7.10	0.87	0.02	36.42	0.80	12548.1	40168.8	0.16
Beachview	403000	456637	0.93	6.27	5.8	0.06	6.54	0.39	0.01	36.42	0.36	7677.3	59752.5	0.15
Sanctuary	445300	504567	0.93	6.27	5.8	0.06	6.54	0.42	0.01	36.42	0.40	9264.8	65598.8	0.15
Total	1143300	1295466			17.0			1.68			1.57	29490.3	165520.1	

Appendix 2
Runoff Coefficients for Sanibel Land Classes by Basin

Low Density Residential Mean Runoff Coefficients for Wet and Dry Seasons

Low Density Residential	2011 C		2012 C		2013 C		**Mean C**		**StDev C**	
	Dry	Wet	Dry	Wet	Dry	Wet	**Dry**	**Wet**	**Dry**	**Wet**
East Slough	0.12	0.38	0.13	0.29	0.12	0.32	**0.12**	**0.33**	**0.009**	**0.043**
West Slough	0.13	0.38	0.14	0.30	0.13	0.33	**0.13**	**0.33**	**0.009**	**0.042**
Bayous	0.10	0.35	0.12	0.27	0.10	0.30	**0.11**	**0.31**	**0.010**	**0.042**
Beach	0.14	0.40	0.15	0.31	0.13	0.34	**0.14**	**0.35**	**0.009**	**0.043**
Ladyfinger	0.12	0.36	0.14	0.29	0.13	0.32	**0.13**	**0.32**	**0.010**	**0.038**
SE Tarpon	0.11	0.36	0.13	0.28	0.12	0.30	**0.12**	**0.31**	**0.010**	**0.042**
E Canals	0.13	0.39	0.15	0.30	0.13	0.35	**0.14**	**0.35**	**0.008**	**0.043**
Lighthouse										
Kesson	0.10	0.36	0.12	0.27	0.10	0.31	**0.11**	**0.31**	**0.010**	**0.042**
San Carlos	0.14	0.40	0.15	0.31	0.14	0.34	**0.14**	**0.35**	**0.008**	**0.043**
SW Tarpon	0.12	0.38	0.14	0.29	0.11	0.34	**0.12**	**0.34**	**0.011**	**0.042**
Refuge	0.08	0.34	0.10	0.26	0.07	0.31	**0.08**	**0.31**	**0.014**	**0.039**
Overall Mean	**0.12**	**0.37**	**0.13**	**0.29**	**0.12**	**0.33**	**0.12**	**0.33**	**0.010**	**0.042**

Medium Density Residential Mean Runoff Coefficients for Wet and Dry Seasons

Medium Density Residential	2011 C		2012 C		2013 C		**Mean C**		**StDev C**	
	Dry	Wet	Dry	Wet	Dry	Wet	**Dry**	**Wet**	**Dry**	**Wet**
East Slough	0.18	0.42	0.19	0.35	0.17	0.39	**0.18**	**0.39**	**0.010**	**0.037**
West Slough	0.19	0.42	0.20	0.35	0.19	0.38	**0.19**	**0.38**	**0.007**	**0.037**
Bayous	0.16	0.40	0.17	0.33	0.15	0.36	**0.16**	**0.36**	**0.009**	**0.037**
Beach	0.19	0.42	0.20	0.35	0.19	0.40	**0.19**	**0.39**	**0.007**	**0.038**
Ladyfinger	0.19	0.42	0.21	0.35	0.20	0.38	**0.20**	**0.38**	**0.006**	**0.038**
SE Tarpon	0.18	0.41	0.19	0.34	0.18	0.37	**0.19**	**0.37**	**0.007**	**0.038**
E Canals	0.19	0.42	0.20	0.34	0.19	0.39	**0.19**	**0.38**	**0.006**	**0.038**
Lighthouse	0.20	0.44	0.21	0.36	0.20	0.39	**0.21**	**0.40**	**0.008**	**0.039**
Kesson	0.16	0.40	0.17	0.33	0.16	0.38	**0.16**	**0.37**	**0.009**	**0.038**
San Carlos	0.19	0.42	0.20	0.34	0.19	0.39	**0.19**	**0.39**	**0.006**	**0.038**
SW Tarpon										
Refuge	0.11	0.35	0.13	0.29	0.10	0.32	**0.11**	**0.32**	**0.013**	**0.027**
Overall Mean	**0.18**	**0.41**	**0.19**	**0.34**	**0.17**	**0.38**	**0.18**	**0.38**	**0.008**	**0.037**

High Density Residential Mean Runoff Coefficients for Wet and Dry Seasons

High Density Residential	2011 C		2012 C		2013 C		**Mean C**		**StDev C**	
	Dry	Wet	Dry	Wet	Dry	Wet	**Dry**	**Wet**	**Dry**	**Wet**
East Slough	0.26	0.49	0.26	0.41	0.25	0.45	**0.26**	**0.45**	**0.005**	**0.039**
West Slough	0.29	0.46	0.27	0.39	0.28	0.41	**0.28**	**0.42**	**0.011**	**0.037**
Bayous	0.24	0.48	0.25	0.40	0.23	0.44	**0.24**	**0.44**	**0.008**	**0.039**
Beach	0.27	0.48	0.28	0.41	0.28	0.43	**0.27**	**0.44**	**0.005**	**0.036**
Ladyfinger										
SE Tarpon										
E Canals	0.30	0.51	0.30	0.44	0.29	0.47	**0.30**	**0.47**	**0.002**	**0.037**
Lighthouse	0.30	0.51	0.30	0.44	0.30	0.49	**0.30**	**0.48**	**0.002**	**0.038**
Kesson										
San Carlos										
SW Tarpon										
Refuge										
Overall Mean	**0.28**	**0.49**	**0.28**	**0.41**	**0.27**	**0.45**	**0.27**	**0.45**	**0.006**	**0.038**

Commercial Land Use Class Mean Runoff Coefficients for Wet and Dry Seasons

Commercial	2011 C		2012 C		2013 C		**Mean C**		**StDev C**	
	Dry	Wet	Dry	Wet	Dry	Wet	**Dry**	**Wet**	**Dry**	**Wet**
East Slough	0.43	0.61	0.42	0.55	0.43	0.58	**0.43**	**0.58**	**0.005**	**0.031**
West Slough	0.49	0.65	0.48	0.59	0.50	0.62	**0.49**	**0.62**	**0.010**	**0.029**
Bayous	0.41	0.60	0.40	0.54	0.41	0.61	**0.40**	**0.59**	**0.005**	**0.039**
Beach	0.48	0.64	0.47	0.58	0.49	0.59	**0.48**	**0.60**	**0.011**	**0.032**
Ladyfinger	0.50	0.65	0.49	0.59	0.51	0.60	**0.50**	**0.62**	**0.011**	**0.032**
SE Tarpon	0.47	0.63	0.46	0.56	0.48	0.58	**0.47**	**0.59**	**0.011**	**0.032**
E Canals	0.49	0.63	0.48	0.59	0.50	0.61	**0.49**	**0.61**	**0.012**	**0.022**
Lighthouse										
Kesson										
San Carlos										
SW Tarpon	0.46	0.63	0.45	0.57	0.46	0.63	**0.46**	**0.61**	**0.004**	**0.034**
Refuge	0.21	0.31	0.33	0.49	0.29	0.63	**0.27**	**0.48**	**0.060**	**0.160**
Overall Mean	**0.44**	**0.60**	**0.44**	**0.56**	**0.45**	**0.61**	**0.44**	**0.59**	**0.014**	**0.046**

Institutional Land Class Runoff Coefficients for Wet and Dry Seasons

Institutional	2011 C		2012 C		2013 C		**Mean C**		**StDev C**	
	Dry	Wet	Dry	Wet	Dry	Wet	**Dry**	**Wet**	**Dry**	**Wet**
East Slough	0.19	0.45	0.21	0.37	0.18	0.42	**0.19**	**0.41**	**0.014**	**0.041**
West Slough	0.17	0.46	0.23	0.38	0.21	0.46	**0.20**	**0.43**	**0.030**	**0.046**
Bayous										
Beach										
Ladyfinger										
SE Tarpon	0.16	0.45	0.22	0.38	0.20	0.46	**0.20**	**0.43**	**0.031**	**0.046**
E Canals										
Lighthouse										
Kesson										
San Carlos										
SW Tarpon	0.15	0.45	0.21	0.37	0.19	0.46	**0.18**	**0.43**	**0.033**	**0.048**
Refuge	0.08	0.41	0.16	0.34	0.12	0.45	**0.12**	**0.40**	**0.044**	**0.058**
Overall Mean	0.15	0.44	0.21	0.37	0.18	0.45	**0.18**	**0.42**	**0.030**	**0.048**

Golf course land class runoff coefficients for wet and dry seasons.

Golf Course	2011 C		2012 C		2013 C		**Mean C**		**StDev C**	
	Dry	Wet	Dry	Wet	Dry	Wet	**Dry**	**Wet**	**Dry**	**Wet**
East Slough	0.03	0.29	0.05	0.21	0.02	0.24	**0.03**	**0.25**	**0.015**	**0.040**
West Slough										
Bayous	0.03	0.29	0.05	0.21	0.02	0.24	**0.03**	**0.25**	**0.015**	**0.040**
Beach										
Ladyfinger	0.04	0.30	0.06	0.22	0.03	0.26	**0.04**	**0.26**	**0.015**	**0.040**
SE Tarpon										
E Canals										
Lighthouse										
Kesson										
San Carlos										
SW Tarpon										
Refuge										
Overall Mean	0.03	0.29	0.05	0.21	0.02	0.25	**0.04**	**0.25**	**0.015**	**0.040**

Appendix 3
Tables used for calculation of values used in this report

Percent pervious and impervious surface (DCIA + nDCIA) area for land classes and drainage basins on Sanibel. DCIA=directly connected impervious area; nDCIA=non-directly connected impervious area.

Basin	LowDensity				MedDensity				HighDensity			
	Area (m^2)	% Pervious	% nDCIA	% DCIA	Area (m^2)	% Pervious	% nDCIA	% DCIA	Area (m^2)	% Pervious	% nDCIA	% DCIA
EastSlough	454054	0.70	0.20	0.10	936031	0.60	0.23	0.17	312415	0.52	0.22	0.26
WestSlough	1383205	0.73	0.15	0.12	856308	0.65	0.15	0.20	6879	0.52	0.16	0.32
Bayous	526087	0.78	0.13	0.09	519612	0.65	0.21	0.15	91458	0.52	0.24	0.24
Beach	594883	0.67	0.22	0.12	68796	0.65	0.15	0.20	1072409	0.62	0.07	0.32
Ladyfinger	16187	0.78	0.09	0.13	797225	0.65	0.14	0.21	0	N/A	N/A	N/A
SETarpon	72842	0.83	0.05	0.12	462000	0.67	0.14	0.20	0	N/A	N/A	N/A
ECanals	809	0.70	0.18	0.12	971238	0.66	0.14	0.20	149732	0.50	0.18	0.32
Lighthouse	0	N/A	N/A	N/A	134355	0.62	0.18	0.21	127880	0.50	0.17	0.33
Kesson	97933	0.78	0.13	0.09	32779	0.65	0.20	0.15	0	N/A	N/A	N/A
SanCarlos	60702	0.68	0.20	0.12	202341	0.66	0.13	0.21	0	N/A	N/A	N/A
SWTarpon	1214	0.70	0.19	0.11	0	N/A	N/A	N/A	0	N/A	N/A	N/A
Refuge	1619	0.73	0.22	0.05	4856	0.67	0.25	0.08	0	N/A	N/A	N/A

Basin	Commmercial				Institutional			
	Area (m^2)	% Pervious	% nDCIA	% DCIA	Area (m^2)	% Pervious	% nDCIA	% DCIA
EastSlough	368666	0.35	0.16	0.50	34398	0.54	0.30	0.17
WestSlough	65559	0.32	0.08	0.60	46113.00	0.54	0.26	0.20
Bayous	59083	0.35	0.20	0.45	0	N/A	N/A	0.15
Beach	93077	0.35	0.06	0.59	0	N/A	N/A	0.20
Ladyfinger	48562	0.35	0.02	0.63	0	N/A	N/A	0.21
SETarpon	341957	0.35	0.07	0.59	57869	0.54	0.27	0.20
ECanals	6474	0.35	0.04	0.61	0	N/A	N/A	0.20
Lighthouse	0	N/A	N/A	N/A	0	N/A	N/A	0.21
Kesson	0	N/A	N/A	N/A	0	N/A	N/A	0.15
SanCarlos	0	N/A	N/A	N/A	0	N/A	N/A	0.21
SWTarpon	12545	0.32	0.15	0.53	10522	0.54	0.28	0.18
Refuge	9712	0.32	0.43	0.25	91863	0.54	0.38	0.08

Descriptive statistics for nutrient concentrations in runoff from Sanibel land classes in **dry season**. Mean concentrations shown here are used to derive loading estimates.

Variable	LU	N	Mean	Median	StDev	SE	Minimum	Maximum
TN	Low Res	13	1.605	1.3	1.14	0.316	0.12	4.1
	Med Res	13	1.217	0.67	1.782	0.494	0.26	7
	High Res	12	1.042	0.895	0.694	0.2	0.34	2.3
	Commercial	6	0.655	0.645	0.361	0.147	0.28	1.1
	GolfCourse	6	4.32	3.9	2.79	1.14	1.5	9.2
IN	Low Res	13	0.1988	0.148	0.1765	0.049	0.078	0.733
	Med Res	13	0.1598	0.132	0.0828	0.023	0.078	0.305
	High Res	12	0.2582	0.214	0.3015	0.087	0.085	1.182
	Commercial	6	0.1098	0.099	0.0535	0.0218	0.066	0.214
	GolfCourse	6	2.29	0.85	3.45	1.41	0.33	9.2
TP	Low Res	13	0.2408	0.18	0.1982	0.055	0.066	0.76
	Med Res	13	0.27	0.13	0.413	0.114	0.027	1.6
	High Res	12	0.2187	0.205	0.1801	0.052	0.036	0.73
	Commercial	6	0.1512	0.17	0.0852	0.0348	0.047	0.25
	GolfCourse	6	1.207	1.245	0.596	0.243	0.57	1.9
OP	Low Res	13	0.0854	0.058	0.0757	0.021	0.017	0.272
	Med Res	13	0.2	0.101	0.2958	0.082	0.015	1.138
	High Res	12	0.1068	0.0895	0.0681	0.0196	0.025	0.239
	Commercial	6	0.0492	0.041	0.0253	0.0103	0.023	0.091
	GolfCourse	6	1.087	1.049	0.601	0.245	0.477	1.847

Table 60. Descriptive statistics for nutrient concentrations in runoff from Sanibel land classes in **wet season**. Mean concentrations shown here are used to derive loading estimates.

Variable	LU	N	Mean	Median	StDev	SE	Minimum	Maximum
TN	Low	8	0.71	0.68	0.56	0.20	0.1	1.8
	Medium	17	1.13	0.45	2.10	0.51	0.1	8.9
	High	10	1.33	1.25	1.07	0.34	0.2	3.3
	Commerci	4	0.51	0.55	0.35	0.17	0.1	0.87
	GC	9	2.28	2.50	0.82	0.27	0.5	3.2
IN	Low	8	0.244	0.158	0.207	0.073	0.062	0.579
	Medium	17	0.413	0.158	0.768	0.186	0.061	3.247
	High	10	0.267	0.172	0.229	0.072	0.098	0.703
	Commerci	4	0.159	0.138	0.108	0.054	0.062	0.298
	GC	9	0.517	0.583	0.253	0.084	0.112	0.926
TP	Low	8	0.321	0.215	0.273	0.096	0.049	0.760
	Medium	17	0.362	0.16	0.454	0.110	0.006	1.500
	High	10	0.311	0.18	0.373	0.118	0.048	1.300
	Commerci	4	0.146	0.145	0.053	0.026	0.092	0.200
	GC	9	1.689	1.6	0.787	0.262	0.700	2.900
OP	Low	8	0.077	0.073	0.041	0.014	0.020	0.134
	Medium	17	0.219	0.099	0.344	0.084	0.004	1.426
	High	10	0.250	0.096	0.394	0.125	0.004	1.306
	Commerci	4	0.062	0.048	0.033	0.016	0.040	0.110
	GC	9	1.526	1.259	0.816	0.272	0.476	2.785

Low Density Residential Land Class Dry Season: a.) 2011; b.) 2012; c.) 2013.

a.

Low Density Res.	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	454054	157656	0.70	0.2	0.2	0.20	1.87	0.37	0.10	10.74	1.06	16554.5	1781.2	0.12	33107.7
West Slough	1383205	480274	0.73	0.2	0.2	0.15	1.71	0.26	0.12	10.74	1.29	54507.0	5611.5	0.13	100857.5
Bayous	526087	182667	0.78	0.2	0.2	0.13	1.42	0.19	0.09	10.74	0.97	15395.2	2290.1	0.10	38360.0
Beach	594883	206554	0.67	0.2	0.1	0.22	2.13	0.46	0.12	10.74	1.27	26195.3	2210.6	0.14	43376.4
Ladyfinger	16187	5620	0.78	0.2	0.2	0.09	0.85	0.08	0.13	10.74	1.35	589.2	70.6	0.12	1180.3
SE Tarpon	72842	25292	0.83	0.2	0.2	0.05	1.19	0.06	0.12	10.74	1.26	2439.8	338.3	0.11	5311.3
E Canals	809	281	0.70	0.2	0.2	0.18	1.87	0.33	0.12	10.74	1.30	33.7	3.2	0.13	59.0
Lighthouse	0	0		0.2	0.0		0.00	0.00		10.74	0.00	0.0	0.0		0.0
Kesson	97933	34004	0.78	0.2	0.2	0.13	1.42	0.18	0.09	10.74	0.98	2900.7	426.3	0.10	7140.9
San Carlos	60702	21077	0.68	0.2	0.1	0.20	2.04	0.41	0.12	10.74	1.32	2669.0	229.3	0.14	4426.1
SW Tarpon	1214	422	0.70	0.2	0.2	0.19	1.71	0.33	0.11	10.74	1.14	45.4	4.7	0.12	88.5
Refuge	1619	562	0.73	0.2	0.2	0.22	1.71	0.38	0.05	10.74	0.53	37.3	6.6	0.08	118.1
Total	3209535	1114408			1.8			3.06			12.49	121367.2	12972.3		234025.7
													Total Runoff		134339.5
													% Previous Predicted		0.57
													Calculated CN Runoff C		0.12

b.

Low Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	454054	164921	0.70	0.66	0.5	0.20	1.81	0.36	0.10	10.67	1.06	16334.0	5343.5	0.13	34633.5
West Slough	1383205	502408	0.73	0.66	0.5	0.15	1.75	0.27	0.12	10.67	1.28	54450.7	16834.5	0.14	105505.6
Bayous	526087	191085	0.78	0.66	0.5	0.13	1.40	0.18	0.09	10.67	0.96	15282.6	6870.3	0.12	40127.9
Beach	594883	216073	0.67	0.66	0.4	0.22	2.17	0.47	0.12	10.67	1.26	26196.5	6631.8	0.15	45375.4
Ladyfinger	16187	5879	0.78	0.66	0.5	0.09	0.81	0.08	0.13	10.67	1.34	584.2	211.7	0.14	1234.7
SE Tarpon	72842	26458	0.83	0.66	0.5	0.05	1.18	0.06	0.12	10.67	1.25	2423.2	1014.8	0.13	5556.1
E Canals	809	294	0.70	0.66	0.5	0.18	1.79	0.32	0.12	10.67	1.30	33.2	9.5	0.15	61.7
Lighthouse	0	0	0.00	0.66	0.0	0.00	0.00	0.00	0.00	10.67	0.00	0.0	0.0	0.00	0.0
Kesson	97933	35571	0.78	0.66	0.5	0.13	1.40	0.18	0.09	10.67	0.98	2879.5	1278.9	0.12	7470.0
San Carlos	60702	22048	0.68	0.66	0.4	0.20	1.97	0.40	0.12	10.67	1.31	2635.1	687.9	0.15	4630.1
SW Tarpon	1214	441	0.70	0.66	0.5	0.19	1.73	0.33	0.11	10.67	1.14	45.4	14.2	0.14	92.6
Refuge	1619	588	0.73	0.66	0.5	0.22	1.73	0.38	0.05	10.67	0.53	37.4	19.8	0.10	123.5
Total	3209535	1165767.3			5.3			3.03			12.40	120901.8	38916.8		244811.1
													Total Runoff		159818.6
													% Previous Predicted		0.65
													C (dry)		0.14

c.

Low Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	454054	222010	0.70	0.57	0.4	0.20	1.45	0.29	0.10	15.46	1.53	20972.1	4614.8	0.12	46622.0
West Slough	1383205	676318	0.73	0.57	0.4	0.15	1.31	0.20	0.12	15.46	1.86	72258.4	14538.9	0.13	142026.8
Bayous	526087	257230	0.78	0.57	0.4	0.13	1.04	0.14	0.09	15.46	1.39	20413.1	5933.4	0.10	54018.4
Beach	594883	290868	0.67	0.57	0.4	0.22	1.72	0.37	0.12	15.46	1.83	33299.0	5727.5	0.13	61082.3
Ladyfinger	16187	7915	0.78	0.57	0.4	0.09	1.52	0.14	0.13	15.46	1.95	859.7	182.8	0.13	1662.1
SE Tarpon	72842	35616	0.83	0.57	0.5	0.05	0.84	0.04	0.12	15.46	1.81	3427.7	876.4	0.12	7479.4
E Canals	809	396	0.70	0.57	0.4	0.18	1.45	0.26	0.12	15.46	1.88	43.9	8.2	0.13	83.1
Lighthouse	0	0	N/A	0.57	0.0	N/A	0.00	0.00	N/A	15.46	0.00	0.0	0.0		0.0
Kesson	97933	47884	0.78	0.57	0.4	0.13	1.04	0.13	0.09	15.46	1.41	3853.8	1104.5	0.10	10055.7
San Carlos	60702	29680	0.68	0.57	0.4	0.20	1.64	0.33	0.12	15.46	1.90	3440.1	594.1	0.14	6232.9
SW Tarpon	1214	594	0.70	0.57	0.4	0.19	0.86	0.17	0.11	15.46	1.65	55.9	12.3	0.11	124.7
Refuge	1619	792	0.73	0.57	0.4	0.22	0.86	0.19	0.05	15.46	0.77	39.2	17.1	0.07	166.2
Total	3209535	1569302			4.6			2.26			17.97	158662.9	33610.0		329553.4
													Total Runoff		192272.9
													% Previous Predicted		0.58
													C (dry)		0.12

Low Density Residential Land Class Wet Season: a.) 2011; b.) 2012; c.) 2013.

a.

Low Density Res.	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	454054	326614	0.70	8.16	5.7	0.20	12.51	2.49	0.10	24.46	2.42	56631.1	66064.6	0.38	101250.3
West Slough	1383205	994978	0.73	8.16	5.9	0.15	12.51	1.93	0.12	24.46	2.94	170791.3	208135.9	0.38	308443.2
Bayous	526087	378429	0.78	8.16	6.4	0.13	10.96	1.44	0.09	24.46	2.20	48607.2	84941.3	0.35	117313.0
Beach	594883	427916	0.67	8.16	5.4	0.22	13.33	2.89	0.12	24.46	2.90	87417.7	81993.1	0.40	132654.0
Ladyfinger	16187	11644	0.78	8.16	6.4	0.09	8.16	0.77	0.13	24.46	3.08	1582.7	2616.9	0.36	3609.6
SE Tarpon	72842	52397	0.83	8.16	6.8	0.05	10.56	0.55	0.12	24.46	2.86	6310.6	12546.0	0.36	16243.2
E Canals	809	582	0.70	8.16	5.7	0.18	12.51	2.23	0.12	24.46	2.97	106.9	117.4	0.39	180.4
Lighthouse	0	0		8.16	0.0		0.00	0.00		24.46	0.00	0.0	0.0		0.0
Kesson	97933	70446	0.78	8.16	6.4	0.13	11.46	1.48	0.09	24.46	2.24	9260.0	15812.1	0.36	21838.2
San Carlos	60702	43665	0.68	8.16	5.5	0.20	13.33	2.68	0.12	24.46	3.01	8771.2	8505.0	0.40	13536.0
SW Tarpon	1214	873	0.70	8.16	5.7	0.19	12.51	2.42	0.11	24.46	2.60	154.9	176.1	0.38	270.7
Refuge	1619	1165	0.73	8.16	6.0	0.22	11.11	2.45	0.05	24.46	1.21	150.6	245.0	0.34	361.0
Total	3209535	2308708			65.8			21.32			28.43	389784.2	481153.3		715699.6
													Total Runoff		870937.5
													% Previous Predicted		1.22
													Calculated CN Runoff C		0.38

b.

Low Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	454054	226046	0.70	3.96	2.8	0.20	6.69	1.33	0.10	16.04	1.59	33667.4	32060.7	0.29	70074.3
West Slough	1383205	688615	0.73	3.96	2.9	0.15	6.69	1.03	0.12	16.04	1.92	103820.3	101007.1	0.30	213470.6
Bayous	526087	261907	0.78	3.96	3.1	0.13	6.01	0.79	0.09	16.04	1.44	29813.3	41221.5	0.27	81191.2
Beach	594883	296157	0.67	3.96	2.6	0.22	7.19	1.56	0.12	16.04	1.90	52242.9	39790.7	0.31	91808.5
Ladyfinger	16187	8059	0.78	3.96	3.1	0.09	5.07	0.48	0.13	16.04	2.02	1026.8	1270.0	0.29	2498.1
SE Tarpon	72842	36264	0.83	3.96	3.3	0.05	5.44	0.28	0.12	16.04	1.88	3995.2	6088.5	0.28	11241.7
E Canals	809	403	0.70	3.96	2.8	0.18	6.55	1.17	0.12	16.04	1.95	64.1	57.0	0.30	124.9
Lighthouse	0	0	0.00	3.96	0.0	0.00	0.00	0.00	0.00	16.04	0.00	0.0	0.0	0.00	0.0
Kesson	97933	48755	0.78	3.96	3.1	0.13	6.01	0.78	0.09	16.04	1.47	5587.3	7673.5	0.27	15114.0
San Carlos	60702	30220	0.68	3.96	2.7	0.20	7.19	1.45	0.12	16.04	1.97	5270.3	4127.4	0.31	9368.2
SW Tarpon	1214	604	0.70	3.96	2.8	0.19	6.69	1.29	0.11	16.04	1.71	92.6	85.5	0.29	187.4
Refuge	1619	806	0.73	3.96	2.9	0.22	6.69	1.48	0.05	16.04	0.79	93.3	118.9	0.26	249.9
Total	3209535	1597835			31.9			11.63			18.65	235673.5	233500.9	0.3	495328.8
													Total Runoff		469174.4
													% Previous Predicted		0.95
													C (wet)		0.29

c.

Low Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	454054	292476	0.70	5.7	4.0	0.20	10.45	2.08	0.10	20.96	2.08	47922.4	46148.0	0.32	90667.6
West Slough	1383205	890983	0.73	5.7	4.1	0.15	10.45	1.61	0.12	20.96	2.52	144925.7	145389.1	0.33	276204.8
Bayous	526087	338876	0.78	5.7	4.4	0.13	9.29	1.22	0.09	20.96	1.89	41463.9	59334.0	0.30	105051.5
Beach	594883	383190	0.67	5.7	3.8	0.22	11.35	2.46	0.12	20.96	2.48	74668.2	57274.6	0.34	118789.0
Ladyfinger	16187	10427	0.78	5.7	4.4	0.09	12.03	1.13	0.13	20.96	2.64	1550.7	1828.0	0.32	3232.3
SE Tarpon	72842	46921	0.83	5.7	4.7	0.05	8.29	0.43	0.12	20.96	2.45	5335.2	8763.8	0.30	14545.4
E Canals	809	521	0.70	5.7	4.0	0.18	13.60	2.43	0.12	20.96	2.55	102.2	82.0	0.35	161.5
Lighthouse	0	0	N/A	5.7	0.0	N/A	0.00	0.00	N/A	20.96	0.00	0.0	0.0		0.0
Kesson	97933	63083	0.78	5.7	4.4	0.13	12.21	1.58	0.09	20.96	1.92	8703.4	11045.2	0.31	19555.7
San Carlos	60702	39101	0.68	5.7	3.9	0.20	11.35	2.28	0.12	20.96	2.58	7493.3	5941.0	0.34	12121.3
SW Tarpon	1214	782	0.70	5.7	4.0	0.19	12.48	2.41	0.11	20.96	2.23	143.3	123.0	0.34	242.4
Refuge	1619	1043	0.73	5.7	4.2	0.22	12.48	2.75	0.05	20.96	1.04	155.8	171.1	0.31	323.3
Total	3209535	2067403			46.0			20.38			24.37	332464.0	336099.8		640894.8
													Total Runoff		668563.7
													% Previous Predicted		1.04
													C (wet)		0.32

Medium Density Residential Land Class Dry Season: a.) 2011; b.) 2012; c.) 2013.

a.

Med Density Res.	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	936031	325007	0.60	0.22	0.1	0.23	2.39	0.55	0.17	10.74	1.77	55290.8	3044.2	0.18	113752.4
West Slough	856308	297326	0.65	0.22	0.1	0.15	1.92	0.29	0.20	10.74	2.15	53069.7	2990.8	0.19	104063.9
Bayous	519612	180419	0.65	0.22	0.1	0.21	2.03	0.42	0.15	10.74	1.61	26745.9	1807.5	0.16	63146.5
Beach	68796	23887	0.65	0.22	0.1	0.15	1.92	0.30	0.20	10.74	2.12	4225.1	240.3	0.19	8360.5
Ladyfinger	797225	276811	0.65	0.22	0.1	0.14	1.92	0.26	0.21	10.74	2.26	50960.5	2810.8	0.19	96883.8
SE Tarpon	462000	160415	0.67	0.22	0.1	0.14	1.82	0.25	0.20	10.74	2.09	27482.2	1665.6	0.18	56145.2
E Canals	971238	337231	0.66	0.22	0.1	0.14	1.92	0.26	0.20	10.74	2.17	60120.4	3461.4	0.19	118031.0
Lighthouse	134355	46650	0.66	0.22	0.1	0.18	2.26	0.40	0.21	10.74	2.23	8957.9	478.8	0.20	16327.7
Kesson	32779	11381	0.65	0.22	0.1	0.20	2.03	0.41	0.15	10.74	1.64	1705.4	114.0	0.16	3983.5
San Carlos	202341	70256	0.66	0.22	0.1	0.13	1.92	0.26	0.21	10.74	2.20	12638.4	721.0	0.19	24589.8
SW Tarpon	0	0	0.00	0.22	0.0	0.00	0.00	0.00	0.00	10.74	0.00	0.0	0.0		0.0
Refuge	4856	1686	0.67	0.22	0.1	0.25	1.92	0.48	0.08	10.74	0.89	167.9	17.5	0.11	590.1
Total	4985541	1731069.6			1.6			3.87				301364.4	17352.2		605874.4
													Total Runoff		318716.5
													% Previous Predicted		0.53
													Calculated CN Runoff C		0.18

b.

Med Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	936031	339509.68	0.60	0.66	0.4	0.23	2.45	0.57	0.17	10.67	1.76	55348.0	9132.5	0.19	118828.4
West Slough	856308	310593.19	0.65	0.66	0.4	0.15	2.12	0.32	0.20	10.67	2.13	53419.0	8972.5	0.20	108707.6
Bayous	519612	188469.51	0.65	0.66	0.4	0.21	2.16	0.44	0.15	10.67	1.60	26973.9	5422.6	0.17	65964.3
Beach	68796	24953.135	0.65	0.66	0.4	0.15	2.12	0.33	0.20	10.67	2.11	4254.3	720.9	0.20	8733.6
Ladyfinger	797225	289163.07	0.65	0.66	0.4	0.14	2.09	0.28	0.21	10.67	2.24	51138.3	8432.5	0.21	101207.1
SE Tarpon	462000	167572.94	0.67	0.66	0.4	0.14	1.97	0.27	0.20	10.67	2.08	27565.3	4996.9	0.19	58650.5
E Canals	971238	352279.68	0.66	0.66	0.4	0.14	2.01	0.27	0.20	10.67	2.16	60081.1	10384.3	0.20	123297.9
Lighthouse	134355	48732.171	0.66	0.66	0.4	0.18	2.38	0.42	0.21	10.67	2.21	8983.3	1436.5	0.21	17056.3
Kesson	32779	11889.337	0.65	0.66	0.4	0.20	2.16	0.44	0.15	10.67	1.63	1719.3	342.1	0.17	4161.3
San Carlos	202341	73391.509	0.66	0.66	0.4	0.13	2.01	0.27	0.21	10.67	2.19	12628.1	2163.0	0.20	25687.0
SW Tarpon	0	0	0.00	0.66	0.0	0.00	0.00	0.00	0.00	10.67	0.00	0.0	0.0		0.0
Refuge	4856	1761.3295	0.67	0.66	0.4	0.25	2.12	0.52	0.08	10.67	0.88	173.2	52.5	0.13	616.5
Total	4985541	1808315.5			4.7			4.14				302283.9	52056.5		632910.4
													Total Runoff		354340.5
													% Previous Predicted		0.56
													C (dry)		0.20

c.

Med Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	936031	457672	0.60	0.567	0.3	0.23	1.76	0.41	0.17	15.46	2.55	70377.1	7840.7	0.17	160185.3
West Slough	856308	418692	0.65	0.567	0.4	0.15	1.34	0.20	0.20	15.46	3.09	71668.6	7708.2	0.19	146542.1
Bayous	519612	254064	0.65	0.567	0.4	0.21	1.43	0.29	0.15	15.46	2.32	34482.0	4655.7	0.15	88922.5
Beach	68796	33638	0.65	0.567	0.4	0.15	1.34	0.21	0.20	15.46	3.05	5696.2	619.3	0.19	11773.2
Ladyfinger	797225	389803	0.65	0.567	0.4	0.14	1.34	0.18	0.21	15.46	3.25	69428.4	7242.8	0.20	136431.1
SE Tarpon	462000	225895	0.67	0.567	0.4	0.14	1.25	0.17	0.20	15.46	3.01	37379.6	4293.6	0.18	79063.2
E Canals	971238	474887	0.66	0.567	0.4	0.14	1.34	0.18	0.20	15.46	3.13	81747.6	8918.2	0.19	166210.4
Lighthouse	134355	65693	0.62	0.567	0.3	0.18	1.64	0.29	0.21	15.46	3.21	11931.8	1151.6	0.20	22992.5
Kesson	32779	16027	0.65	0.567	0.4	0.20	1.43	0.29	0.15	15.46	2.36	2204.4	293.7	0.16	5609.6
San Carlos	202341	98935	0.66	0.567	0.4	0.13	1.34	0.18	0.21	15.46	3.17	17212.1	1858.0	0.19	34627.1
SW Tarpon	0	0	N/A	0.567	0.0	N/A	0.00	0.00	N/A	15.46	N/A	N/A	0.0		0.0
Refuge	4856	2374	0.67	0.567	0.4	0.25	1.34	0.33	0.08	15.46	1.28	198.1	45.2	0.10	831.0
Total	4985541	2437680			4.0			2.74				402326.1	44626.9		853188.1
													Total Runoff		446953.1
													% Previous Predicted		0.52
													C (Dry)		0.18

Medium Density Residential Land Class Wet Season: a.) 2011; b.) 2012; c.) 2013.

a.

Med Density Res.	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	936031	673313	0.60	8.16	4.9	0.23	13.50	3.13	0.17	24.46	4.04	170405.3	112911.4	0.42	302991.0
West Slough	856308	615966	0.65	8.16	5.3	0.15	12.64	1.92	0.20	24.46	4.89	148200.7	110932.6	0.42	277184.8
Bayous	519612	373771	0.65	8.16	5.3	0.21	12.55	2.57	0.15	24.46	3.67	82391.3	67043.4	0.40	168197.2
Beach	68796	49487	0.65	8.16	5.3	0.15	12.55	1.94	0.20	24.46	4.83	11830.9	8913.2	0.42	22269.1
Ladyfinger	797225	573466	0.65	8.16	5.3	0.14	12.30	1.67	0.21	24.46	5.14	137876.9	104256.7	0.42	258059.8
SE Tarpon	462000	332330	0.67	8.16	5.5	0.14	12.30	1.67	0.20	24.46	4.77	75595.5	61780.0	0.41	149548.3
E Canals	971238	698639	0.66	8.16	5.4	0.14	12.30	1.68	0.20	24.46	4.95	163597.8	128388.3	0.42	314387.4
Lighthouse	134355	96645	0.66	8.16	5.4	0.18	12.55	2.20	0.21	24.46	5.08	24839.5	17760.4	0.44	43490.4
Kesson	32779	23579	0.65	8.16	5.3	0.20	12.55	2.54	0.15	24.46	3.73	5222.3	4229.3	0.40	10610.5
San Carlos	202341	145550	0.66	8.16	5.4	0.13	12.30	1.65	0.21	24.46	5.01	34239.1	26743.1	0.42	65497.3
SW Tarpon	0	0	0.00	8.16	0.0	0.00	0.00	0.00	0.00	24.46	0.00	0.0	0.0		0.0
Refuge	4856	3493	0.67	8.16	5.5	0.25	10.10	2.50	0.08	24.46	2.02	557.1	649.4	0.35	1571.9
Total	4985541	3586239.2			58.5			23.48				854756.5	643607.9		1613807.7
													Total Runoff		1498364.4
													% Previous Predicted		0.93
													Calculated CN Runoff C		0.42

b.

Med Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	936031	465755.92	0.60	3.92	2.4	0.23	8.11	1.88	0.17	16.04	2.65	107657.5	54241.8	0.35	209590.2
West Slough	856308	426086.87	0.65	3.92	2.5	0.15	7.50	1.14	0.20	16.04	3.21	94583.8	53291.1	0.35	191739.1
Bayous	519612	258551.66	0.65	3.92	2.5	0.21	7.50	1.54	0.15	16.04	2.41	52056.9	32207.1	0.33	116348.2
Beach	68796	34231.926	0.65	3.92	2.5	0.15	7.50	1.16	0.20	16.04	3.17	7561.5	4281.8	0.35	15404.4
Ladyfinger	797225	396688	0.65	3.92	2.6	0.14	7.09	0.96	0.21	16.04	3.37	87731.4	50084.1	0.35	178509.6
SE Tarpon	462000	229884.73	0.67	3.92	2.6	0.14	7.19	0.98	0.20	16.04	3.13	48179.8	29678.6	0.34	103448.1
E Canals	971238	483274.43	0.66	3.92	2.6	0.14	7.19	0.98	0.20	16.04	3.25	104342.2	61676.7	0.34	217473.5
Lighthouse	134355	66853.167	0.66	3.92	2.6	0.18	7.50	1.32	0.21	16.04	3.33	15852.3	8532.0	0.36	30083.9
Kesson	32779	16310.371	0.65	3.92	2.5	0.20	7.50	1.52	0.15	16.04	2.45	3301.7	2031.7	0.33	7339.7
San Carlos	202341	100682.05	0.66	3.92	2.6	0.13	7.19	0.96	0.21	16.04	3.29	21851.6	12847.2	0.34	45306.9
SW Tarpon	0	0	0.00	3.92	0.0	0.00	0.00	0.00	0.00	16.04	0.00	0.0	0.0		0.0
Refuge	4856	2416.2776	0.67	3.92	2.6	0.25	7.50	1.86	0.08	16.04	1.32	392.3	311.9	0.29	1087.3
Total	4985541	2480735.4			28.1			14.30				543511.0	309184.2		1116330.9
													Total Runoff		852695.2
													% Previous Predicted		0.76
													C (wet)		0.34

c.

Med Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	936031	602939	0.60	5.7	3.4	0.23	13.10	3.04	0.17	20.96	3.46	154501.7	78822.2	0.39	271322.4
West Slough	856308	551586	0.65	5.7	3.7	0.15	12.22	1.86	0.20	20.96	4.19	131587.6	77490.1	0.38	248213.5
Bayous	519612	334705	0.65	5.7	3.7	0.21	12.22	2.51	0.15	20.96	3.14	74566.6	46803.7	0.36	150617.2
Beach	68796	44315	0.65	5.7	3.7	0.15	15.60	2.41	0.20	20.96	4.14	11446.4	6225.6	0.40	19941.5
Ladyfinger	797225	513528	0.65	5.7	3.7	0.14	11.68	1.59	0.21	20.96	4.40	121303.4	72811.4	0.38	231087.5
SE Tarpon	462000	297595	0.67	5.7	3.8	0.14	11.58	1.57	0.20	20.96	4.09	66439.2	43162.7	0.37	133917.5
E Canals	971238	625617	0.66	5.7	3.8	0.14	14.89	2.03	0.20	20.96	4.24	154850.6	89653.7	0.39	281527.7
Lighthouse	134355	86544	0.62	5.7	3.5	0.18	12.45	2.18	0.21	20.96	4.35	22296.9	11576.6	0.39	38944.8
Kesson	32779	21114	0.65	5.7	3.7	0.20	14.46	2.93	0.15	20.96	3.20	5098.6	2952.5	0.38	9501.5
San Carlos	202341	130337	0.66	5.7	3.8	0.13	14.89	2.00	0.21	20.96	4.30	32338.5	18677.8	0.39	58651.5
SW Tarpon	0	0	N/A	5.7	0.0	N/A	0.00	0.00	N/A	20.96	N/A	N/A	0.0		0.0
Refuge	4856	3128	0.67	5.7	3.8	0.25	11.03	2.73	0.08	20.96	1.73	549.9	454.4	0.32	1407.6
Total	4985541	3211406			40.6			24.85				774979.2	448630.6		1445132.8
													Total Runoff		1223609.8
													% Previous Predicted		0.85
													C (Wet)		0.38

High Density Residential Land Class Dry Season: a.) 2011; b.) 2012; c.) 2013.

a.

High Density Res.	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	312415	108476.11	0.52	0.22	0.11	0.22	2.7	0.6	0.26	10.74	2.84	27139.2	874.8	0.26	54238.1
West Slough	6879	2388.5126	0.52	0.22	0.11	0.16	2.6	0.4	0.32	10.74	3.44	674.5	19.3	0.29	1194.3
Bayous	91458	31755.864	0.52	0.22	0.12	0.24	2.6	0.6	0.24	10.74	2.58	7465.1	258.5	0.24	15877.9
Beach	1072409	372359.71	0.62	0.22	0.14	0.07	1.9	0.1	0.32	10.74	3.39	95880.2	3569.4	0.27	186179.9
Ladyfinger	0	0	0.00	0.22	0.00	0.00	2.7	0.00	0.00	10.74	0.00	0.0	0.0		0.0
SE Tarpon	0	0	0.00	0.22	0.00	0.00	0.0	0.00	0.00	10.74	0.00	0.0	0.0		0.0
E Canals	149732	51989.646	0.50	0.22	0.11	0.18	2.8	0.5	0.32	10.74	3.48	15130.9	404.1	0.30	25994.8
Lighthouse	127880	44402.238	0.50	0.22	0.11	0.17	2.8	0.5	0.33	10.74	3.57	13110.4	345.2	0.30	22201.1
Kesson	0	0	0.00	0.22	0.00	0.00	2.7	0.00	0.00	10.74	0.00	0.0	0.0		0.0
San Carlos	0	0	0.00	0.22	0.00	0.00	0.0	0.00	0.00	10.74	0.00	0.0	0.0		0.0
SW Tarpon	0	0	0.00	0.22	0.00	0.00	0.0	0.00	0.00	10.74	0.00	0.0	0.0		0.0
Refuge	0	0	0.00	0.22	0.00	0.00	0.0	0.00	0.00	10.74	0.00	0.0	0.0		0.0
Total	1760773	611372.08			0.7			2.7			19.3	159400.3	5471.2		305686.0
												Total Runoff	164871.5		
												% Previous Predicted	0.54		
												Calculated CN Runoff C	0.27		

b.

High Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	312415	113317	0.52	0.66	0.34	0.22	2.7	0.6	0.26	10.67	2.77	26802.0	2624.3	0.26	56658.3
West Slough	6879	2495	0.52	0.66	0.34	0.16	0.7	0.1	0.32	10.67	3.41	615.1	57.8	0.27	1247.5
Bayous	91458	33173	0.52	0.66	0.35	0.24	2.7	0.7	0.24	10.67	2.56	7463.8	775.6	0.25	16586.5
Beach	1072409	388976	0.62	0.66	0.41	0.07	2.1	0.1	0.32	10.67	3.41	97037.1	10708.1	0.28	194487.8
Ladyfinger	0	0	0	0.66	0.00	0.00	2.7	0.00	0.00	10.67	0.00	0.0	0.0		0.0
SE Tarpon	0	0	0	0.66	0.00	0.00	0.0	0.00	0.00	10.67	0.00	0.0	0.0		0.0
E Canals	149732	54310	0.5	0.66	0.33	0.18	3.0	0.5	0.32	10.67	3.41	15025.8	1212.4	0.30	27154.8
Lighthouse	127880	46384	0.5	0.66	0.33	0.17	3.0	0.5	0.33	10.67	3.52	13072.3	1035.5	0.30	23191.8
Kesson	0	0	0	0.66	0.00	0.00	2.7	0.00	0.00	10.67	0.00	0.0	0.0		0.0
San Carlos	0	0	0	0.66	0.00	0.00	0.0	0.00	0.00	10.67	0.00	0.0	0.0		0.0
SW Tarpon	0	0	0	0.66	0.00	0.00	0.0	0.00	0.00	10.67	0.00	0.0	0.0		0.0
Refuge	0	0	0	0.66	0.00	0.00	0.0	0.00	0.00	10.67	0.00	0.0	0.0		0.0
Total	1760773	638653			2.1			2.5			19.1	160016.1	16413.7		319326.7
												Total Runoff	176429.8		
												% Previous Predicted	0.55		
												C (dry)	0.28		

c.

High Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	312415	152755	0.52	0.567	0.29	0.22	2.1	0.4	0.26	15.46	4.08	35946.2	2252.4	0.25	76377.7
West Slough	6879	3363	0.52	0.567	0.29	0.16	0.4	0.1	0.32	15.46	4.95	876.4	49.6	0.28	1681.7
Bayous	91458	44718	0.52	0.567	0.29	0.24	2.0	0.5	0.24	15.46	3.71	9746.2	660.7	0.23	22359.2
Beach	1072409	524354	0.62	0.567	0.35	0.07	1.3	0.1	0.32	15.46	4.89	135465.3	9206.6	0.28	262177.2
Ladyfinger	0	0	N/A	0.567	0.00	N/A	2.1	0.00	N/A	15.46	0.00	0.0	0.0		0.0
SE Tarpon	0	0	N/A	0.567	0.00	N/A	0.0	0.00	N/A	15.46	0.00	0.0	0.0		0.0
E Canals	149732	73211	0.5	0.567	0.28	0.18	2.2	0.4	0.32	15.46	5.01	20531.5	1042.1	0.29	36605.7
Lighthouse	127880	62527	0.5	0.567	0.28	0.17	2.2	0.4	0.33	15.46	5.13	17879.0	890.0	0.30	31263.5
Kesson	0	0	N/A	0.567	0.00	N/A	2.0	0.00	N/A	15.46	0.00	0.0	0.0		0.0
San Carlos	0	0	N/A	0.567	0.00	N/A	0.0	0.00	N/A	15.46	0.00	0.0	0.0		0.0
SW Tarpon	0	0	N/A	0.567	0.00	N/A	0.0	0.00	N/A	15.46	0.00	0.0	0.0		0.0
Refuge	0	0	N/A	0.567	0.00	N/A	0.0	0.00	N/A	15.46	0.00	0.0	0.0		0.0
Total	1760773	860930.0			1.8			1.9			27.8	220444.5	14101.4		430465.0
												Total Runoff	234545.9		
												% Previous Predicted	0.54		
												C (Dry)	0.27		

High Density Residential Land Class Wet Season: a.) 2011; b.) 2012; c.) 2013.

a.

High Density Res.	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	312415	224728.86	0.52	8.16	4.24	0.22	14.8	3.2	0.26	24.46	6.46	76780.8	32445.6	0.49	146073.8
West Slough	6879	4948.2573	0.52	8.16	4.24	0.16	7.8	1.2	0.32	24.46	7.83	1585.0	714.4	0.46	3216.4
Bayous	91458	65788.3	0.52	8.16	4.28	0.24	14.8	3.5	0.24	24.46	5.87	21878.4	9589.5	0.48	42762.4
Beach	1072409	771413.82	0.62	8.16	5.04	0.07	13.3	0.9	0.32	24.46	7.73	234370.7	132391.2	0.48	501419.0
Ladyfinger	0	0	0.00	8.16	0.00	0.00	14.9	0.00	0.00	24.46	0.00	0.0	0.0		0.0
SE Tarpon	0	0	0.00	8.16	0.00	0.00	0.0	0.00	0.00	24.46	0.00	0.0	0.0		0.0
E Canals	149732	107706.42	0.50	8.16	4.09	0.18	15.1	2.6	0.32	24.46	7.93	40180.7	14989.9	0.51	70009.2
Lighthouse	127880	91987.665	0.50	8.16	4.09	0.17	14.9	2.5	0.33	24.46	8.12	34476.7	12802.3	0.51	59792.0
Kesson	0	0	0.00	8.16	0.00	0.00	14.9	0.00	0.00	24.46	0.00	0.0	0.0		0.0
San Carlos	0	0	0.00	8.16	0.00	0.00	0.0	0.00	0.00	24.46	0.00	0.0	0.0		0.0
SW Tarpon	0	0	0.00	8.16	0.00	0.00	0.0	0.00	0.00	24.46	0.00	0.0	0.0		0.0
Refuge	0	0	0.00	8.16	0.00	0.00	0.0	0.00	0.00	24.46	0.00	0.0	0.0		0.0
Total	1760773	1266573.3			26.0			14.0			43.9	409272.3	202933.0		823272.7
												Total Runoff	612205.3		
												% Previous Predicted	0.74		
												Calculated CN Runoff C	0.48		

b.

High Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	312415	155453	0.52	3.9	2.03	0.22	8.4	1.9	0.26	16.04	4.17	47786.4	15507.1	0.41	101044.7
West Slough	6879	3423	0.52	3.9	2.03	0.16	3.9	0.6	0.32	16.04	5.13	1006.4	341.4	0.39	2224.9
Bayous	91458	45508	0.52	3.9	2.05	0.24	8.4	2.0	0.24	16.04	3.85	13612.9	4583.2	0.40	29580.3
Beach	1072409	533616	0.62	3.9	2.41	0.07	7.3	0.5	0.32	16.04	5.13	153696.8	63275.2	0.41	346850.2
Ladyfinger	0	0	0	3.9	0.00	0.00	8.5	0.00	0.00	16.04	0.00	0.0	0.0		0.0
SE Tarpon	0	0	0	3.9	0.00	0.00	0.0	0.00	0.00	16.04	0.00	0.0	0.0		0.0
E Canals	149732	74505	0.5	3.9	1.95	0.18	8.6	1.6	0.32	16.04	5.13	25423.6	7164.3	0.44	48428.0
Lighthouse	127880	63631	0.5	3.9	1.95	0.17	8.5	1.4	0.33	16.04	5.29	21885.2	6118.7	0.44	41360.3
Kesson	0	0	0	3.9	0.00	0.00	8.5	0.00	0.00	16.04	0.00	0.0	0.0		0.0
San Carlos	0	0	0	3.9	0.00	0.00	0.0	0.00	0.00	16.04	0.00	0.0	0.0		0.0
SW Tarpon	0	0	0	3.9	0.00	0.00	0.0	0.00	0.00	16.04	0.00	0.0	0.0		0.0
Refuge	0	0	0	3.9	0.00	0.00	0.0	0.00	0.00	16.04	0.00	0.0	0.0		0.0
Total	1760773	876136			12.4			8.0			28.7	263411.2	96990.0		569488.4
												Total Runoff	360401.3		
												% Previous Predicted	0.63		
												C (wet)	0.41		

c.

High Density Res.	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	312415	201240	0.52	5.7	2.96	0.22	13.6	3.0	0.26	20.96	5.53	67327.0	22643.3	0.45	130806.2
West Slough	6879	4431	0.52	5.7	2.96	0.16	5.8	0.9	0.32	20.96	6.71	1335.0	499.0	0.41	2880.2
Bayous	91458	58912	0.52	5.7	2.96	0.24	13.5	3.2	0.24	20.96	5.03	19232.6	6641.5	0.44	38292.9
Beach	1072409	690786	0.62	5.7	3.52	0.07	11.6	0.8	0.32	20.96	6.62	201263.2	92552.9	0.43	449010.8
Ladyfinger	0	0	N/A	5.7	0.00	N/A	16.3	0.00	N/A	20.96	0.00	0.0	0.0		0.0
SE Tarpon	0	0	N/A	5.7	0.00	N/A	0.0	0.00	N/A	20.96	0.00	0.0	0.0		0.0
E Canals	149732	96449	0.5	5.7	2.86	0.18	14.0	2.5	0.32	20.96	6.79	35175.7	10475.9	0.47	62691.8
Lighthouse	127880	82373	0.5	5.7	2.86	0.17	16.8	2.8	0.33	20.96	6.96	31710.0	8947.1	0.49	53542.5
Kesson	0	0	N/A	5.7	0.00	N/A	16.2	0.00	N/A	20.96	0.00	0.0	0.0		0.0
San Carlos	0	0	N/A	5.7	0.00	N/A	0.0	0.00	N/A	20.96	0.00	0.0	0.0		0.0
SW Tarpon	0	0	N/A	5.7	0.00	N/A	0.0	0.00	N/A	20.96	0.00	0.0	0.0		0.0
Refuge	0	0	N/A	5.7	0.00	N/A	0.0	0.00	N/A	20.96	0.00	0.0	0.0		0.0
Total	1760773	1134191.4			18.1			13.2			37.6	356043.5	141759.7		737224.4
												Total Runoff	497803.2		
												% Previous Predicted	0.68		
												C (wet)	0.44		

Commercial Land Class Dry Season: a.) 2011; b.) 2012; c.) 2013.

a.

Commercial	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	368666	128007.5	0.35	0.22	0.08	0.16	3.0	0.5	0.50	10.74	5.32	54255.2	685.6	0.43	99845.8
West Slough	65559	22763.26	0.32	0.22	0.07	0.08	3.2	0.2	0.60	10.74	6.44	11146.4	113.4	0.49	17755.3
Bayous	59083	20514.68	0.35	0.22	0.08	0.20	3.2	0.6	0.45	10.74	4.83	8201.7	111.5	0.41	16001.5
Beach	93077	32318.01	0.35	0.22	0.08	0.06	1.8	0.1	0.59	10.74	6.36	15292.9	175.6	0.48	25208.0
Ladyfinger	48562	16861.6	0.35	0.22	0.08	0.02	3.0	0.1	0.63	10.74	6.77	8419.6	91.6	0.50	13152.0
SE Tarpon	341957	118733.6	0.35	0.22	0.08	0.07	0.0	0.0	0.59	10.74	6.28	54571.4	645.1	0.47	92612.2
E Canals	6474	2247.889	0.35	0.22	0.08	0.04	3.0	0.1	0.61	10.74	6.52	1093.8	12.2	0.49	1753.4
Lighthouse	0	0	0	0.22	0.00	0.00	0.0	0.0	0.00	10.74	0.00	0.0	0.0		0.0
Kesson	0	0	0	0.22	0.00	0.00	0.0	0.0	0.00	10.74	0.00	0.0	0.0		0.0
San Carlos	0	0	0	0.22	0.00	0.00	0.0	0.0	0.00	10.74	0.00	0.0	0.0		0.0
SW Tarpon	12545	4355.85	0.32	0.22	0.07	0.15	3.2	0.5	0.53	10.74	5.72	1970.9	21.6	0.46	3397.6
Refuge	9712	3372.181	0.32	0.22	0.07	0.43	0.3	0.1	0.25	10.74	2.66	683.2	16.8	0.21	2630.3
Total	1005635	349174.6			0.7			2.2			50.9	155635.0	1873.3		272356.2
												Total Runoff	157508.4		
												% Previous Predicted	0.58		
												Calculated CN Runoff C	0.45		

b.

Commercial	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	368666	133720	0.35	0.66	0.23	0.16	3.4	0.5	0.50	10.67	5.28	54499.3	2065.2	0.42	104301.3
West Slough	65559	23779	0.32	0.66	0.21	0.08	3.8	0.3	0.60	10.67	6.40	11158.7	341.7	0.48	18547.6
Bayous	59083	21430	0.35	0.66	0.23	0.20	3.3	0.7	0.45	10.67	4.80	8188.8	335.8	0.40	16715.5
Beach	93077	33760	0.35	0.66	0.23	0.06	2.4	0.1	0.59	10.67	6.32	15270.2	529.0	0.47	26332.9
Ladyfinger	48562	17614	0.35	0.66	0.23	0.02	4.0	0.1	0.63	10.67	6.72	8389.0	276.0	0.49	13738.9
SE Tarpon	341957	124032	0.35	0.66	0.23	0.07	1.3	0.1	0.59	10.67	6.24	54932.0	1943.3	0.46	96744.9
E Canals	6474	2348	0.35	0.66	0.23	0.04	3.4	0.1	0.61	10.67	6.48	1089.4	36.8	0.48	1831.6
Lighthouse	0	0	0	0.66	0.00	0.00	0.0	0.0	0.00	10.67	0.00	0.0	0.0		0.0
Kesson	0	0	0	0.66	0.00	0.00	0.0	0.0	0.00	10.67	0.00	0.0	0.0		0.0
San Carlos	0	0	0	0.66	0.00	0.00	0.0	0.0	0.00	10.67	0.00	0.0	0.0		0.0
SW Tarpon	12545	4550	0.32	0.66	0.21	0.15	4.1	0.6	0.53	10.67	5.66	1999.5	65.2	0.45	3549.2
Refuge	9712	3523	0.32	0.66	0.21	0.43	4.1	1.8	0.25	10.67	2.67	1096.4	50.5	0.33	2747.7
Total	1005635	364756			2.0			4.3			50.6	156623.4	5643.3		284509.6
												Total Runoff	162266.7		
												% Previous Predicted	0.57		
												C (dry)	0.44		

c.

Commercial	Area (m^2)		%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	368666	180727	0.345	0.57	0.20	0.16	3.2	0.5	0.50	15.46	7.65	76508.4	1765.3	0.43	140602.2
West Slough	65559	32138	0.321	0.57	0.18	0.08	3.5	0.3	0.60	15.46	9.28	15908.4	292.1	0.50	25003.0
Bayous	59083	28964	0.35	0.57	0.20	0.20	3.5	0.7	0.45	15.46	6.96	11494.6	287.0	0.41	22533.1
Beach	93077	45628	0.35	0.57	0.20	0.06	1.6	0.1	0.59	15.46	9.16	21878.5	452.2	0.49	35497.8
Ladyfinger	48562	23806	0.35	0.57	0.20	0.02	0.0	0.0	0.63	15.46	9.74	12014.0	235.9	0.51	18520.6
SE Tarpon	341957	167634	0.35	0.57	0.20	0.07	0.6	0.0	0.59	15.46	9.04	78895.7	1661.2	0.48	130415.9
E Canals	6474	3174	0.35	0.57	0.20	0.04	3.2	0.1	0.61	15.46	9.39	1567.0	31.4	0.50	2469.1
Lighthouse	0	0	N/A	0.57	0.00	N/A	0.0	0.0	N/A	15.46	0.00	0.0	0.0		0.0
Kesson	0	0	N/A	0.57	0.00	N/A	0.0	0.0	N/A	15.46	0.00	0.0	0.0		0.0
San Carlos	0	0	N/A	0.57	0.00	N/A	0.0	0.0	N/A	15.46	0.00	0.0	0.0		0.0
SW Tarpon	12545	6150	0.32	0.57	0.18	0.15	3.5	0.5	0.53	15.46	8.23	2788.3	55.7	0.46	4784.4
Refuge	9712	4761	0.32	0.57	0.18	0.43	3.5	1.5	0.25	15.46	3.83	1318.6	43.1	0.29	3704.0
Total	1005635	492982			1.7			3.8			73.3	222373.6	4824.0		383530.1
												Total Runoff	227197.6		
												% Previous Predicted	0.59		
												C (Dry)	0.46		

Commercial Land Class Wet Season: a.) 2011; b.) 2012; c.) 2013.

a.

Commercial	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	368666	265191.8	0.35	8.16	2.82	0.16	15.8	2.5	0.50	24.46	12.11	137083.4	25427.8	0.61	257236.0
West Slough	65559	47158.42	0.32	8.16	2.62	0.08	16.3	1.3	0.60	24.46	14.68	26578.4	4207.2	0.65	45743.7
Bayous	59083	42500.06	0.35	8.16	2.86	0.20	16.3	3.3	0.45	24.46	11.01	21400.6	4134.2	0.60	41225.1
Beach	93077	66952.89	0.35	8.16	2.86	0.06	14.0	0.8	0.59	24.46	14.49	36170.1	6512.8	0.64	64944.3
Ladyfinger	48562	34932.01	0.35	8.16	2.86	0.02	15.8	0.3	0.63	24.46	15.41	19397.9	3398.0	0.65	33884.0
SE Tarpon	341957	245979.2	0.35	8.16	2.86	0.07	10.6	0.7	0.59	24.46	14.31	130262.3	23927.4	0.63	238599.9
E Canals	6474	4656.929	0.35	8.16	2.86	0.04	5.4	0.2	0.61	24.46	14.86	2481.4	453.0	0.63	4517.2
Lighthouse	0	0	0	8.16	0.00	0.00	0.0	0.0	0.00	24.46	0.00	0.0	0.0		0.0
Kesson	0	0	0	8.16	0.00	0.00	0.0	0.0	0.00	24.46	0.00	0.0	0.0		0.0
San Carlos	0	0	0	8.16	0.00	0.00	0.0	0.0	0.00	24.46	0.00	0.0	0.0		0.0
SW Tarpon	12545	9023.97	0.32	8.16	2.61	0.15	16.3	2.4	0.53	24.46	13.02	4914.8	802.6	0.63	8753.3
Refuge	9712	6986.114	0.32	8.16	2.61	0.43	0.7	0.3	0.25	24.46	6.05	1572.5	621.3	0.31	6776.5
Total	1005635	723381.4			24.9			11.8			115.9	379861.4	69484.2		701680.0
												Total Runoff	449345.6		
												% Previous Predicted	0.64		
												Calculated CN Runoff C	0.62		

b.

Commercial	Area (m^2)	Rain Volume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	368666	183443	0.35	3.90	1.35	0.16	9.7	1.6	0.50	16.04	7.94	88942.8	12153.0	0.55	177939.7
West Slough	65559	32621	0.32	3.90	1.25	0.08	10.3	0.8	0.60	16.04	9.62	17381.1	2010.8	0.59	31642.6
Bayous	59083	29399	0.35	3.90	1.37	0.20	10.3	2.1	0.45	16.04	7.22	13924.0	1975.9	0.54	28516.9
Beach	93077	46314	0.35	3.90	1.37	0.06	8.1	0.5	0.59	16.04	9.50	23570.7	3112.7	0.58	44924.4
Ladyfinger	48562	24164	0.35	3.90	1.37	0.02	9.7	0.2	0.63	16.04	10.11	12704.8	1624.0	0.59	23438.9
SE Tarpon	341957	170153	0.35	3.90	1.37	0.07	5.6	0.4	0.59	16.04	9.38	84660.6	11435.9	0.56	165048.4
E Canals	6474	3221	0.35	3.90	1.37	0.04	9.7	0.4	0.61	16.04	9.74	1670.4	216.5	0.59	3124.7
Lighthouse	0	0	0	3.90	0.00	0.00	0.0	0.0	0.00	16.04	0.00	0.0	0.0		0.0
Kesson	0	0	0	3.90	0.00	0.00	0.0	0.0	0.00	16.04	0.00	0.0	0.0		0.0
San Carlos	0	0	0	3.90	0.00	0.00	0.0	0.0	0.00	16.04	0.00	0.0	0.0		0.0
SW Tarpon	12545	6242	0.32	3.90	1.25	0.15	10.3	1.5	0.53	16.04	8.50	3201.2	383.6	0.57	6054.9
Refuge	9712	4833	0.32	3.90	1.25	0.43	10.3	4.4	0.25	16.04	4.01	2081.9	297.0	0.49	4687.6
Total	1005635	500390			11.9			11.8			76.0	248137.6	33209.4		485378.2
												Total Runoff	281347.0		
												% Previous Predicted	0.58		
												C (Wet)	0.56		

c.

Commercial	Area (m^2)		%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C	Previous Estimate m3/yr
East Slough	368666	237849	0.345	5.70	1.97	0.16	16.1	2.6	0.50	20.96	10.38	121350.8	17762.1	0.58	230349.8
West Slough	65559	42296	0.321	5.70	1.83	0.08	17.2	1.4	0.60	20.96	12.58	23199.5	2938.9	0.62	40962.6
Bayous	59083	38118	0.35	5.70	2.00	0.20	21.2	4.2	0.45	20.96	9.43	20510.8	2887.8	0.61	36916.2
Beach	93077	60050	0.35	5.70	2.00	0.06	13.0	0.8	0.59	20.96	12.42	31133.2	4549.4	0.59	58156.3
Ladyfinger	48562	31330	0.35	5.70	2.00	0.02	7.1	0.1	0.63	20.96	13.20	16462.4	2373.6	0.60	30342.5
SE Tarpon	341957	220617	0.35	5.70	2.00	0.07	8.8	0.6	0.59	20.96	12.26	111480.4	16714.0	0.58	213661.5
E Canals	6474	4177	0.35	5.70	2.00	0.04	20.2	0.9	0.61	20.96	12.73	2235.0	316.4	0.61	4045.1
Lighthouse	0	0	N/A	5.70	0.00	N/A	0.0	0.0	N/A	20.96	0.00	0.0	0.0		0.0
Kesson	0	0	N/A	5.70	0.00	N/A	0.0	0.0	N/A	20.96	0.00	0.0	0.0		0.0
San Carlos	0	0	N/A	5.70	0.00	N/A	0.0	0.0	N/A	20.96	0.00	0.0	0.0		0.0
SW Tarpon	12545	8094	0.32	5.70	1.82	0.15	21.2	3.1	0.53	20.96	11.16	4551.8	560.6	0.63	7838.4
Refuge	9712	6266	0.32	5.70	1.82	0.43	21.2	9.2	0.25	20.96	5.19	3539.1	434.0	0.63	6068.2
Total	1005635	648795			17.4			22.8			99.4	334463.0	48536.8		628340.5
												Total Runoff	382999.7		
												% Previous Predicted	0.61		
												C (Wet)	0.59		

Golf course land class runoff coefficient (C) calculation tables: a.) 2011; b.) 2012; c.) 2013.

a.)

Golf Course	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C
Dunes	295000	314631	0.86	8.4	7.2	0.12	9.18	1.13	0.02	35.2	0.77	14263.5	53814.7	0.22
Beachview	403000	429818	0.93	8.4	7.8	0.06	7.57	0.45	0.01	35.2	0.35	8177.3	80051.2	0.21
Sanctuary	445300	474933	0.93	8.4	7.8	0.06	7.57	0.48	0.01	35.2	0.39	9862.0	87883.5	0.21
Total	1143300	1219382	0.90		22.8			2.06			1.51	32302.8	221749.4	

b.)

Golf Course	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C
Dunes	295000	254013	0.86	4.58	3.9	0.12	5.17	0.64	0.02	26.71	0.59	9164.3	29341.8	0.15
Beachview	403000	347007	0.93	4.58	4.3	0.06	4.81	0.28	0.01	26.71	0.27	5639.6	43647.0	0.14
Sanctuary	445300	383430	0.93	4.58	4.2	0.06	4.81	0.31	0.01	26.71	0.29	6805.7	47917.4	0.14
Total	1143300	984450			12.4			1.23			1.15	21609.5	120906.2	

c.)

Golf Course	Area (m^2)	RainVolume	%Perv	PervPrecip	PervRunoff	%nDCIA	nDCIAPrecip	nDCIARunoff	%DCIA	DCIAPrecip	DCIARunoff	Impervious Runoff m^3/yr	Pervious Runoff m^3/yr	C
Dunes	295000	334263	0.86	6.27	5.4	0.12	7.10	0.87	0.02	36.42	0.80	12548.1	40168.8	0.16
Beachview	403000	456637	0.93	6.27	5.8	0.06	6.54	0.39	0.01	36.42	0.36	7677.3	59752.5	0.15
Sanctuary	445300	504567	0.93	6.27	5.8	0.06	6.54	0.42	0.01	36.42	0.40	9264.8	65598.8	0.15
Total	1143300	1295466			17.0			1.68			1.57	29490.3	165520.1	

Table used for calculating stormwater loadings for west Sanibel Slough basin.

Sanibel Slough West Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*	*IN Dry Conc*	*IN Wet Conc*	*Annual IN Loading (kg/yr)*	*Dry TN Conc*	*Wet TN Conc*	*Annual TN Loading (kg/yr)*	*Dry OP Conc*	*Wet OP Conc*	*Annual OP Loading (kg/yr)*	*Dry TP Conc*	*Wet TP Conc*	*Annual TP Loading (kg/yr)*
Low Density Residential	341.7	0.13	0.257	46201	0.33	0.709	323548	**0.20**	0.2438	88.1	**1.61**	0.713	304.8	**0.09**	0.0769	28.8	**0.24**	0.321	115.0
Medium Density Residential	211.6	0.19	0.257	41815	0.38	0.709	230717	**0.16**	0.413	102.0	**1.22**	1.13	311.6	**0.20**	0.2185	58.8	**0.27**	0.362	94.8
High Density Residential	1.7	0.28	0.257	495	0.42	0.709	2049	0.26	0.267	0.7	1.04	1.332	3.2	0.11	0.25	0.6	0.22	0.311	0.7
Commercial and Services	16.2	0.49	0.257	8256	0.62	0.709	28819	0.11	0.1588	5.5	0.66	0.509	20.1	0.05	0.0615	2.2	0.15	0.146	5.4
Institutional (School)	11.4	0.2	0.257	2371	0.43	0.709	14065	0.5	0.5	8.2	1.18	1.18	19.4	0.06	0.06	1.0	0.15	0.15	2.5
Recreational (Golf Courses)	0	0.04	0.257	0	0.25	0.709	0	2.29	0.5166	0.0	4.32	2.276	0.0	1.09	1.526	0.0	1.21	1.689	0.0
Recreational (Beach)	0	0.5	0.257	0	0.6	0.709	0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0	0.31	0.709	0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities (Island Water)	7.1	0.78	0.257	5760	0.97	0.709	19761	0.5	0.5	12.8	1.82	1.82	46.4	0.08	0.08	2.0	0.27	0.27	6.9
Shrub and Brushland	147.8	0.14	0.257	21521	0.3	0.709	127226	0.2	0.2	29.7	1.2	1.2	178.5	0.03	0.03	4.5	0.07	0.07	10.4
Disturbed Land	0	0.55	0.257	0	0.65	0.709	0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	41.3	0.16	0.257	6873	0.21	0.709	24886	0	0	0.0	0.2	0.2	6.4	0	0	0.0	0.01	0.01	0.3
Lakes/Reservoirs	12.9	0	0.257	0	0	0.709	0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0	0	0.709	0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	1046	0	0.257	0	0	0.709	0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0	0	0.709	0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**1838**	**0.07**		**133293**	**0.15**		**771070**			**246.9**			**890.5**			**97.8**			**236.1**

Table used for calculating stormwater loadings for east Sanibel Slough basin.

Sanibel Slough East Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	112.2	0.12	0.257	14003.6	0.33	0.709	106239.6	**0.20**	0.2438	28.7	**1.61**	0.71	98.2	**0.09**	0.0769	9.4	**0.24**	0.321	37.5
Medium Density Residential	231.1	0.18	0.257	43265.2	0.39	0.709	258609.2	**0.16**	0.413	113.7	**1.22**	1.13	344.9	**0.20**	0.2185	65.2	**0.27**	0.362	105.3
High Density Residential	77.2	0.26	0.257	20876.5	0.45	0.709	99680.3	0.26	0.267	32.0	1.04	1.33	154.5	0.11	0.25	27.1	0.22	0.311	35.6
Commercial and Services	91.1	0.43	0.257	40743.0	0.58	0.709	151609.3	0.11	0.1588	28.5	0.66	0.51	103.9	0.05	0.0615	11.3	0.15	0.146	28.2
Institutional (School)	8.5	0.19	0.257	1679.7	0.60	0.709	14633.5	0.5	0.5	8.2	1.18	1.18	19.2	0.06	0.06	1.0	0.15	0.15	2.4
Recreational (Golf Course)	96.9	0.04	0.257	4031.3	0.25	0.709	69509.3	2.29	0.5166	45.1	4.32	2.276	175.6	1.09	1.526	110.5	1.21	1.689	122.3
Recreational (Beach)	0	0.5	0.257	0.0	0.60	0.709	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities (WWTP)	8	0.78	0.257	6490.1	0.97	0.709	22265.9	0.5	0.5	14.4	1.82	1.82	52.3	0.08	0.08	2.3	0.27	0.27	7.8
Shrub and Brushland	29.8	0.14	0.257	4339.2	0.30	0.709	25651.7	0.2	0.2	6.0	1.2	1.2	36.0	0.03	0.03	0.9	0.07	0.07	2.1
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	24.3	0.16	0.257	4043.8	0.21	0.709	14642.2	0	0	0.0	0.2	0.2	3.7	0	0	0.0	0.01	0.01	0.2
Lakes/Reservoirs	5.3	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	493	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**1177.4**	**0.11**		**139472.5**	**0.23**		**762841.1**			**276.6**			**988.4**			**227.6**			**341.3**

Table used for calculating stormwater loadings for Sanibel beach basin.

Sanibel Beaches Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	146.9	0.14	0.257	21390.3	0.35	0.709	147526.2	**0.20**	0.2438	40.2	**1.61**	0.713	139.5	**0.09**	0.0769	13.2	**0.24**	0.3211	52.5
Medium Density Residential	17.0	0.19	0.257	3359.5	0.39	0.709	19023.6	**0.16**	0.413	8.4	**1.22**	1.13	25.6	**0.20**	0.2185	4.8	**0.27**	0.362	7.8
High Density Residential	264.9	0.27	0.257	74389.6	0.44	0.709	334436.8	0.26	0.267	108.5	1.04	1.332	523.0	0.11	0.25	91.6	0.22	0.311	120.3
Commercial and Services	22.9	0.48	0.257	11432.5	0.60	0.709	39424.5	0.11	0.1588	7.5	0.66	0.509	27.6	0.05	0.0615	3.0	0.15	0.1455	7.5
Institutional (School)	0.0	0.18	0.257	0.0	0.42	0.709	0.0	0.5	0.5	0.0	1.18	1.18	0.0	0.06	0.06	0.0	0.15	0.15	0.0
Recreational (Golf Course)	0.0	0.04	0.257	0.0	0.25	0.709	0.0	2.29	0.5166	0.0	4.32	2.276	0.0	1.09	1.526	0.0	1.21	1.689	0.0
Recreational (Beach)	235	0.5	0.257	122209.3	0.60	0.709	404574.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0.0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	0.0	0.78	0.257	0.0	0.97	0.709	0.0	0.5	0.5	0.0	1.82	1.82	0.0	0.08	0.08	0.0	0.27	0.27	0.0
Shrub and Brushland	50.1	0.14	0.257	7295.1	0.30	0.709	43125.9	0.2	0.2	10.1	1.2	1.2	60.5	0.03	0.03	1.5	0.07	0.07	3.5
Disturbed Land	0.0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	0.5	0.16	0.257	83.2	0.21	0.709	301.3	0	0	0.0	0.2	0.2	0.1	0	0	0.0	0.01	0.01	0.0
Lakes/Reservoirs	2	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	28.2	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**767.5**	**0.30**		**240159**	**0.45**		**988412.9**			**174.7**			**776.2**			**114.1**			**191.6**

Table used for calculating stormwater loadings for east canals basin.

East Canals Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	0.2	0.14	0.257	29.1	0.35	0.709	200.9	**0.20**	0.2438	0.1	**1.61**	0.713	0.2	**0.09**	0.0769	0.0	**0.24**	0.3211	0.1
Medium Density Residential	240	0.19	0.257	47427.6	0.38	0.709	261682.3	**0.16**	0.413	115.7	**1.22**	1.13	353.4	**0.20**	0.2185	66.7	**0.27**	0.362	107.5
High Density Residential	37	0.3	0.257	11544.9	0.47	0.709	49897.5	0.26	0.267	16.3	1.04	1.332	78.5	0.11	0.25	13.7	0.22	0.311	18.0
Commercial and Services	1.6	0.49	0.257	815.4	0.61	0.709	2800.5	0.11	0.1588	0.5	0.66	0.509	2.0	0.05	0.0615	0.2	0.15	0.1455	0.5
Institutional (School)	0	0.18	0.257	0.0	0.42	0.709	0.0	0.5	0.5	0.0	1.18	1.18	0.0	0.06	0.06	0.0	0.15	0.15	0.0
Recreational (Golf Course)	0	0.04	0.257	0.0	0.25	0.709	0.0	2.29	0.5166	0.0	4.32	2.276	0.0	1.09	1.526	0.0	1.21	1.689	0.0
Recreational (Beach)	0.2	0.5	0.257	104.0	0.60	0.709	344.3	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	6.9	0.21	0.257	1507.1	0.31	0.709	6137.5	0.73	0.73	5.6	1.93	1.93	14.8	0.143	0.143	1.1	0.4	0.4	3.1
Utilities	0	0.78	0.257	0.0	0.97	0.709	0.0	0.5	0.5	0.0	1.82	1.82	0.0	0.08	0.08	0.0	0.27	0.27	0.0
Shrub and Brushland	28.2	0.14	0.257	4106.2	0.30	0.709	24274.5	0.2	0.2	5.7	1.2	1.2	34.1	0.03	0.03	0.9	0.07	0.07	2.0
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	0	0.16	0.257	0.0	0.21	0.709	0.0	0	0	0.0	0.2	0.2	0.0	0	0	0.0	0.01	0.01	0.0
Lakes/Reservoirs	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	5.8	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**319.9**	**0.20**		**65534.3**	**0.38**		**345337.4**			**143.8**			**482.9**			**82.5**			**131.2**

Table used for calculating stormwater loadings for Sanibel bayous basin.

Sanibel Bayous Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	130	0.11	0.257	14873.1	0.31	0.709	115633.7	**0.20**	0.2438	31.1	**1.61**	0.713	106.3	**0.09**	0.0769	10.2	**0.24**	0.3211	40.7
Medium Density Residential	128.3	0.16	0.257	21350.7	0.36	0.709	132528.3	**0.16**	0.413	58.1	**1.22**	1.13	175.7	**0.20**	0.2185	33.2	**0.27**	0.362	53.7
High Density Residential	22.6	0.24	0.257	5641.4	0.43	0.709	27884.1	0.26	0.267	8.9	1.04	1.332	43.0	0.11	0.25	7.6	0.22	0.311	9.9
Commercial and Services	14.6	0.4	0.257	6074.1	0.59	0.709	24716.3	0.11	0.1588	4.6	0.66	0.509	16.6	0.05	0.0615	1.8	0.15	0.1455	4.5
Institutional (School)	0	0.17	0.257	0.0	0.42	0.709	0.0	0.5	0.5	0.0	1.18	1.18	0.0	0.06	0.06	0.0	0.15	0.15	0.0
Recreational (Golf Course)	109.7	0.04	0.257	4563.9	0.25	0.709	78691.2	2.29	0.5166	51.1	4.32	2.28	198.8	1.09	1.526	125.0	1.21	1.689	138.4
Recreational (Beach)	17.2	0.5	0.257	8944.7	0.60	0.709	29611.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	1.1	0.78	0.257	892.4	0.97	0.709	3061.6	0.5	0.5	2.0	1.82	1.82	7.2	0.08	0.08	0.3	0.27	0.27	1.1
Shrub and Brushland	250	0.14	0.257	36402.8	0.30	0.709	215199.2	0.2	0.2	50.3	1.2	1.2	301.9	0.03	0.03	7.5	0.07	0.07	17.6
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	90.2	0.16	0.257	15010.4	0.21	0.709	54350.7	0	0	0.0	0.2	0.2	13.9	0	0	0.0	0.01	0.01	0.7
Lakes/Reservoirs	99.3	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	9.9	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	72.3	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**945.2**	**0.12**		**113753**	**0.25**		**681676.5**			**206.2**			**863.4**			**185.7**			**266.7**

Table used for calculating stormwater loadings for ladyfinger lakes basin.

Ladyfinger Lakes Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	4	0.13	0.257	540.8	0.32	0.709	3672.7	**0.20**	0.2438	1.0	**1.61**	0.713	3.5	**0.09**	0.0769	0.3	**0.24**	0.3211	1.3
Medium Density Residential	197	0.2	0.257	40979.1	0.38	0.709	214797.5	**0.16**	0.413	95.3	**1.22**	1.13	292.6	**0.20**	0.2185	55.1	**0.27**	0.362	88.8
High Density Residential	0	0.27	0.257	0.0	0.45	0.709	0.0	0.26	0.267	0.0	1.04	1.332	0.0	0.11	0.25	0.0	0.22	0.311	0.0
Commercial and Services	12	0.51	0.257	6365.3	0.62	0.709	21347.8	0.11	0.1588	4.1	0.66	0.509	15.0	0.05	0.0615	1.6	0.15	0.1455	4.1
Institutional (School)	0	0.17	0.257	0.0	0.42	0.709	0.0	0.5	0.5	0.0	1.18	1.18	0.0	0.06	0.06	0.0	0.15	0.15	0.0
Recreational (Golf Course)	70.1	0.04	0.257	2916.4	0.25	0.709	50284.9	2.29	0.5166	32.7	4.32	2.276	127.0	1.09	1.526	79.9	1.21	1.689	88.5
Recreational (Beach)	0	0.5	0.257	0.0	0.60	0.709	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	0	0.78	0.257	0.0	0.97	0.709	0.0	0.5	0.5	0.0	1.82	1.82	0.0	0.08	0.08	0.0	0.27	0.27	0.0
Shrub and Brushland	0	0.14	0.257	0.0	0.30	0.709	0.0	0.2	0.2	0.0	1.2	1.2	0.0	0.03	0.03	0.0	0.07	0.07	0.0
Disturbed Land	60.9	0.55	0.257	34837.4	0.65	0.709	113582.2	0.543	0.543	80.6	1.5	1.5	222.6	0.03	0.03	4.5	0.15	0.15	22.3
Upland Hardwood Forests	0	0.16	0.257	0.0	0.21	0.709	0.0	0	0	0.0	0.2	0.2	0.0	0	0	0.0	0.01	0.01	0.0
Lakes/Reservoirs	6.3	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	633.8	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**984.1**	**0.08**		**85639.1**	**0.14**		**403685.1**			**213.6**			**660.8**			**141.4**			**204.9**

Table used for calculating stormwater loadings for SE Tarpon Bay basin.

Sanibel SE Tarpon Bay Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	18	0.12	0.257	2246.6	0.31	0.709	16010.8	**0.20**	0.2438	4.4	**1.61**	0.713	15.0	**0.09**	0.0769	1.4	**0.24**	0.3211	5.7
Medium Density Residential	114.1	0.19	0.257	22547.9	0.37	0.709	121134.2	**0.16**	0.413	53.6	**1.22**	1.13	164.3	**0.20**	0.2185	31.0	**0.27**	0.362	49.9
High Density Residential	0	0.27	0.257	0.0	0.45	0.709	0.0	0.26	0.267	0.0	1.04	1.332	0.0	0.11	0.25	0.0	0.22	0.311	0.0
Commercial and Services	84.5	0.47	0.257	41306.7	0.59	0.709	143050.1	0.11	0.1588	27.3	0.66	0.509	99.9	0.05	0.0615	10.8	0.15	0.1455	27.1
Institutional (School)	14.3	0.2	0.257	2974.6	0.43	0.709	17643.5	0.5	0.5	10.3	1.18	1.18	24.3	0.06	0.06	1.2	0.15	0.15	3.1
Recreational (Golf Course)	0	0.04	0.257	0.0	0.25	0.709	0.0	2.29	0.5166	0.0	4.32	2.276	0.0	1.09	1.526	0.0	1.21	1.689	0.0
Recreational (Beach)	0	0.5	0.257	0.0	0.60	0.709	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	0	0.78	0.257	0.0	0.97	0.709	0.0	0.5	0.5	0.0	1.82	1.82	0.0	0.08	0.08	0.0	0.27	0.27	0.0
Shrub and Brushland	0	0.14	0.257	0.0	0.30	0.709	0.0	0.2	0.2	0.0	1.2	1.2	0.0	0.03	0.03	0.0	0.07	0.07	0.0
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	44.1	0.16	0.257	7338.8	0.21	0.709	26572.8	0	0	0.0	0.2	0.2	6.8	0	0	0.0	0.01	0.01	0.3
Lakes/Reservoirs	2.3	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	208	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**485.3**	**0.15**		**76415**	**0.23**		**324411.4**			**95.5**			**310.3**			**44.5**			**86.1**

Table used for calculating stormwater loadings for SE Tarpon Bay basin.

Sanibel Lighthouse Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	0	0.12	0.257	0.0	0.33	0.709	0.0	**0.20**	0.2438	0.0	**1.61**	0.713	0.0	**0.09**	0.0769	0.0	**0.24**	0.3211	0.0
Medium Density Residential	33.2	0.21	0.257	7251.4	0.40	0.709	38104.6	**0.16**	0.413	16.9	**1.22**	1.13	51.9	**0.20**	0.2185	9.8	**0.27**	0.362	15.8
High Density Residential	31.6	0.3	0.257	9859.9	0.48	0.709	43521.9	0.26	0.267	14.2	1.04	1.332	68.2	0.11	0.25	11.9	0.22	0.311	15.7
Commercial and Services	0	0.44	0.257	0.0	0.60	0.709	0.0	0.11	0.1588	0.0	0.66	0.509	0.0	0.05	0.0615	0.0	0.15	0.1455	0.0
Institutional (School)	0	0.18	0.257	0.0	0.42	0.709	0.0	0.5	0.5	0.0	1.18	1.18	0.0	0.06	0.06	0.0	0.15	0.15	0.0
Recreational (Golf Course)	0	0.04	0.257	0.0	0.25	0.709	0.0	2.29	0.5166	0.0	4.32	2.276	0.0	1.09	1.526	0.0	1.21	1.689	0.0
Recreational (Beach)	21.7	0.5	0.257	11284.9	0.60	0.709	37358.6	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	0	0.78	0.257	0.0	0.97	0.709	0.0	0.5	0.5	0.0	1.82	1.82	0.0	0.08	0.08	0.0	0.27	0.27	0.0
Shrub and Brushland	0	0.14	0.257	0.0	0.30	0.709	0.0	0.2	0.2	0.0	1.2	1.2	0.0	0.03	0.03	0.0	0.07	0.07	0.0
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	0	0.16	0.257	0.0	0.21	0.709	0.0	0	0	0.0	0.2	0.2	0.0	0	0	0.0	0.01	0.01	0.0
Lakes/Reservoirs	0.2	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**86.7**	**0.31**		**28396.2**	**0.48**		**118985.1**			**31.1**			**120.1**			**21.7**			**31.4**

Table used for calculating stormwater loadings for San Carlos Bay basin.

Sanibel San Carlos Bay Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	15	0.14	0.257	2184.2	0.35	0.709	15063.9	**0.20**	0.2438	4.1	**1.61**	0.713	14.2	**0.09**	0.0769	1.3	**0.24**	0.3211	5.4
Medium Density Residential	50	0.19	0.257	9880.8	0.38	0.709	54517.1	**0.16**	0.413	24.1	**1.22**	1.13	73.6	**0.20**	0.2185	13.9	**0.27**	0.362	22.4
High Density Residential	0	0.27	0.257	0.0	0.45	0.709	0.0	0.26	0.267	0.0	1.04	1.332	0.0	0.11	0.25	0.0	0.22	0.311	0.0
Commercial and Services	0	0.44	0.257	0.0	0.60	0.709	0.0	0.11	0.1588	0.0	0.66	0.509	0.0	0.05	0.0615	0.0	0.15	0.1455	0.0
Institutional (School)	0	0.18	0.257	0.0	0.42	0.709	0.0	0.5	0.5	0.0	1.18	1.18	0.0	0.06	0.06	0.0	0.15	0.15	0.0
Recreational (Golf Course)	6.3	0.04	0.257	262.1	0.25	0.709	4519.2	2.29	0.5166	2.9	4.32	2.276	11.4	1.09	1.526	7.2	1.21	1.689	7.9
Recreational (Beach)	0	0.5	0.257	0.0	0.60	0.709	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	3.9	0.21	0.257	851.8	0.31	0.709	3469.0	0.73	0.73	3.2	1.93	1.93	8.3	0.143	0.143	0.6	0.4	0.4	1.7
Utilities	0	0.78	0.257	0.0	0.97	0.709	0.0	0.5	0.5	0.0	1.82	1.82	0.0	0.08	0.08	0.0	0.27	0.27	0.0
Shrub and Brushland	5.6	0.14	0.257	815.4	0.30	0.709	4820.5	0.2	0.2	1.1	1.2	1.2	6.8	0.03	0.03	0.2	0.07	0.07	0.4
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	0	0.16	0.257	0.0	0.21	0.709	0.0	0	0	0.0	0.2	0.2	0.0	0	0	0.0	0.01	0.01	0.0
Lakes/Reservoirs	0.2	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	3.6	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	51.3	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**135.9**	**0.10**		**13994.3**	**0.21**		**82389.7**			**35.4**			**114.4**			**23.2**			**37.8**

Table used for calculating stormwater loadings for Wildlife Refuge basin.

Sanibel Wildlife Refuge Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	0.4	0.08	0.257	33.3	0.31	0.709	355.8	**0.20**	0.2438	0.1	**1.61**	0.713	0.3	**0.09**	0.0769	0.0	**0.24**	0.3211	0.1
Medium Density Residential	1.2	0.11	0.257	137.3	0.32	0.709	1101.8	**0.16**	0.413	0.5	**1.22**	1.13	1.4	**0.20**	0.2185	0.3	**0.27**	0.362	0.4
High Density Residential	0	0.27	0.257	0.0	0.45	0.709	0.0	0.26	0.267	0.0	1.04	1.332	0.0	0.11	0.25	0.0	0.22	0.311	0.0
Commercial and Services	2.4	0.27	0.257	674.0	0.48	0.709	3305.5	0.11	0.1588	0.6	0.66	0.509	2.1	0.05	0.0615	0.2	0.15	0.1455	0.6
Institutional (School)	22.7	0.12	0.257	2833.2	0.40	0.709	26053.5	0.5	0.5	14.4	1.18	1.18	34.1	0.06	0.06	1.7	0.15	0.15	4.3
Recreational (Golf Course)	0	0.04	0.257	0.0	0.25	0.709	0.0	2.29	0.5166	0.0	4.32	2.276	0.0	1.09	1.526	0.0	1.21	1.689	0.0
Recreational (Beach)	0	0.5	0.257	0.0	0.60	0.709	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	0	0.78	0.257	0.0	0.97	0.709	0.0	0.5	0.5	0.0	1.82	1.82	0.0	0.08	0.08	0.0	0.27	0.27	0.0
Shrub and Brushland	0	0.14	0.257	0.0	0.30	0.709	0.0	0.2	0.2	0.0	1.2	1.2	0.0	0.03	0.03	0.0	0.07	0.07	0.0
Disturbed Land	8.6	0.55	0.257	4919.6	0.65	0.709	16039.5	0.543	0.543	11.4	1.5	1.5	31.4	0.03	0.03	0.6	0.15	0.15	3.1
Upland Hardwood Forests	9.2	0.16	0.257	1531.0	0.21	0.709	5543.5	0	0	0.0	0.2	0.2	1.4	0	0	0.0	0.01	0.01	0.1
Lakes/Reservoirs	0.3	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0.4	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	2028.2	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**2073.4**	**0.00**		**10128.3**	**0.01**		**52399.6**			**27.0**			**70.8**			**2.9**			**8.7**

Table used for calculating stormwater loadings for SW Tarpon Bay basin.

Sanibel SW Tarpon Bay Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	0.3	0.12	0.257	37.4	0.34	0.709	292.7	**0.20**	0.2438	0.1	**1.61**	0.713	0.3	**0.09**	0.0769	0.0	**0.24**	0.3211	0.1
Medium Density Residential	0	0.18	0.257	0.0	0.38	0.709	0.0	**0.16**	0.413	0.0	**1.22**	1.13	0.0	**0.20**	0.2185	0.0	**0.27**	0.362	0.0
High Density Residential	0	0.27	0.257	0.0	0.45	0.709	0.0	0.26	0.267	0.0	1.04	1.332	0.0	0.11	0.25	0.0	0.22	0.311	0.0
Commercial and Services	3.1	0.46	0.257	1483.2	0.61	0.709	5425.9	0.11	0.1588	1.0	0.66	0.509	3.7	0.05	0.0615	0.4	0.15	0.1455	1.0
Institutional (School)	2.6	0.18	0.257	486.8	0.42	0.709	3133.3	0.5	0.5	1.8	1.18	1.18	4.3	0.06	0.06	0.2	0.15	0.15	0.5
Recreational (Golf Course)	0	0.04	0.257	0.0	0.25	0.709	0.0	2.29	0.5166	0.0	4.32	2.276	0.0	1.09	1.526	0.0	1.21	1.689	0.0
Recreational (Beach)	0	0.5	0.257	0.0	0.60	0.709	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	3.4	0.78	0.257	2758.3	0.97	0.709	9463.0	0.5	0.5	6.1	1.82	1.82	22.2	0.08	0.08	1.0	0.27	0.27	3.3
Shrub and Brushland	29.1	0.14	0.257	4237.3	0.30	0.709	25049.2	0.2	0.2	5.9	1.2	1.2	35.1	0.03	0.03	0.9	0.07	0.07	2.1
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	21.8	0.16	0.257	3627.8	0.21	0.709	13135.8	0	0	0.0	0.2	0.2	3.4	0	0	0.0	0.01	0.01	0.2
Lakes/Reservoirs	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	392.1	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**452.4**	**0.03**		**12630.7**	**0.04**		**56499.8**			**14.9**			**69.0**			**2.5**			**7.2**

Table used for calculating stormwater loadings for Kesson Bayou basin.

Sanibel Kesson Bayou Land Use and Description	*Area (Acres)*	*Dry Season Runoff Coefficient*	*Annual Dry Season Rain (m)*	*Annual Dry Season Runoff (m^3)*	*Wet Season Runoff Coefficient*	*Annual Wet Season Rain (m)*	*Annual Wet Season Runoff (m^3)*		*Runoff IN (mg/l)*	*Annual IN Loading (kg/yr)*		*Runoff TN (mg/l)*	*Annual TN Loading (kg/yr)*		*Runoff OP (mg/l)*	*Annual OP Loading (kg/yr)*		*Runoff TP (mg/l)*	*Annual TP Loading (kg/yr)*
Low Density Residential	24.2	0.11	0.257	2768.7	0.31	0.709	21525.7	**0.20**	0.2438	5.8	**1.61**	0.713	19.8	**0.09**	0.0769	1.9	**0.24**	0.3211	7.6
Medium Density Residential	8.1	0.16	0.257	1347.9	0.37	0.709	8599.4	**0.16**	0.413	3.8	**1.22**	1.13	11.4	**0.20**	0.2185	2.1	**0.27**	0.362	3.5
High Density Residential	0	0.27	0.257	0.0	0.45	0.709	0.0	0.26	0.267	0.0	1.04	1.332	0.0	0.11	0.25	0.0	0.22	0.311	0.0
Commercial and Services	0	0.44	0.257	0.0	0.60	0.709	0.0	0.11	0.1588	0.0	0.66	0.509	0.0	0.05	0.0615	0.0	0.15	0.1455	0.0
Institutional (School)	0	0.18	0.257	0.0	0.42	0.709	0.0	0.5	0.5	0.0	1.18	1.18	0.0	0.06	0.06	0.0	0.15	0.15	0.0
Recreational (Golf Course)	8.4	0.04	0.257	349.5	0.25	0.709	6025.6	2.29	0.5166	3.9	4.32	2.276	15.2	1.09	1.526	9.6	1.21	1.689	10.6
Recreational (Beach)	0	0.5	0.257	0.0	0.60	0.709	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Recreational (Parks)	0	0.21	0.257	0.0	0.31	0.709	0.0	0.73	0.73	0.0	1.93	1.93	0.0	0.143	0.143	0.0	0.4	0.4	0.0
Utilities	4.2	0.78	0.257	3407.3	0.97	0.709	11689.6	0.5	0.5	7.5	1.82	1.82	27.5	0.08	0.08	1.2	0.27	0.27	4.1
Shrub and Brushland	23.9	0.14	0.257	3480.1	0.30	0.709	20573.0	0.2	0.2	4.8	1.2	1.2	28.9	0.03	0.03	0.7	0.07	0.07	1.7
Disturbed Land	0	0.55	0.257	0.0	0.65	0.709	0.0	0.543	0.543	0.0	1.5	1.5	0.0	0.03	0.03	0.0	0.15	0.15	0.0
Upland Hardwood Forests	28.1	0.16	0.257	4676.2	0.21	0.709	16931.9	0	0	0.0	0.2	0.2	4.3	0	0	0.0	0.01	0.01	0.2
Lakes/Reservoirs	0.1	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetlands (Other)	0.6	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Wetland Forests	330.2	0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Rivers/Stream/Slough		0	0.257	0.0	0.00	0.709	0.0	0	0	0.0	0.00	0	0.0	0	0	0.0	0	0	0.0
Total Upland Area	**427.8**	**0.04**		**16029.7**	**0.07**		**85345.1**			**25.8**			**107.0**			**15.5**			**27.6**