BIOSWALE BASIS OF DESIGN
59th Street Bioswale Pilot Project

MIB2003.01S

Revision No. 1

FINAL

Prepared For:

The City of Miami Beach

March 15,2019

WADE TRIM

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1.0 PURPOSE

The City of Miami Beach is investigating the use of stormwater infrastructure best management practices to address water quality issues for Biscayne Bay, which is designated an Outstanding Florida Water by the Florida Department of Environmental Protection. As new infrastructure is being contemplated by the City for the La Gorce neighborhood to address climate resiliency, integrating stormwater best management practices such as bioswales is one of the strategies that can be deployed to address both water quality (treatment) and quantity (attenuation) concerns. As an initial investigation into bioswales, the City is seeking to implement demonstration projects as means to test the efficacy and value of this technology to provide water quality improvements and attenuation of the runoff from developed areas of the City.

2.0 PROJECT DESCRIPTION

West 59th Street in the La Gorce neighborhood was targeted for this demonstration project because of historical flooding of the low-lying homes along the street. The bioswale demonstration project is located within the West 59th Street 60-foot wide right-of-way between Alton Road and Biscayne Bay as shown in Appendix 1-Location Map. The runoff from the existing roads and sidewalks will be managed by a series of proposed bioswales. For the purposes of this study, the design target is to manage the first 1.5-inches of the storm events within a typical year. Runoff from the impervious road and sidewalks will be directed to multiple depressional storage areas (bioswales) where the design volume runoff will be captured and not discharged to the stormwater collection system of underground pipes unless the storm event is larger than the 1.5-inch design volume. Appendix 2 provides the details of the existing stormwater and utilities within the project area.

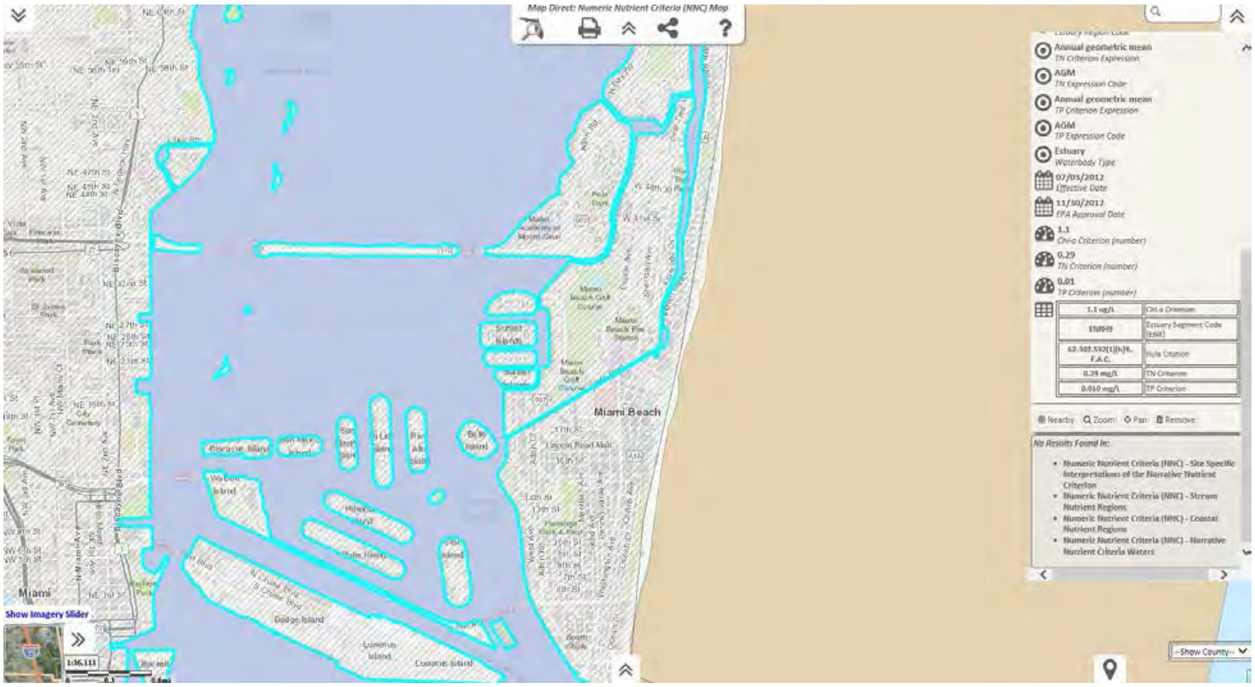
3.0 BIOSWALE OBJECTIVES

Bioswales can improve stormwater runoff water quality by allowing solids and other pollutants to settle out of the water naturally in the bioswale depressions and the engineered soils beneath the surface of the basin rather than passing into storm sewers and eventually the waterways and ecosystems. The objective of this evaluation will focus on quantifying the benefits of using this approach and identifying feasible design alternatives to provide the water quality and volume attenuation benefits for the target demonstration site. Bioswale stormwater best management practice was selected by the City to be demonstrated at this site since it will provide on-site retention of the runoff from lawns, driveways and roads within a residential neighborhood that is ripe for other infrastructure improvements.

4.0 REGULATORY AND STAKEHOLDER CONSIDERATIONS

As part of this evaluation, applicable regulatory requirements and stakeholder considerations were identified and reviewed to understand their impact on the design of the bioswales. These design criteria for the bioswales are summarized below. The test project area lies within WBID 322H and discharges to Southern North Bay within the Biscayne Bay Aquatic Preserve, see Figure 1.

Figure 1. WBID Map



As of the last assessment data the project area had been identified as shown in Table 1:

Table 1 – WBID Impairment Summary

Assessment Date	Basis for Listing	Assessment Category	Assessment Category Description
5/12/2006	Nitrate	2	Not Impaired
11/2/2010	Dissolved Oxygen	4D	No Causative Pollutant
11/2/2010	Fecal Coliform	5	Verified for Impairment
11/2/2010	Mercury (in fish tissue)	5	Verified for Impairment
11/2/2010	Nutrients (Chlorophyll-a)	3B	Insufficient data
11/2/2010	Nutrients (Historic Chlorophyll-a)	3B	Insufficient data

Per the Florida Department of Environmental Protection (FDEP), Biscayne Bay is listed as an Estuary, with Biscayne Bay falling under Florida Administrative Code 62-302.532, and an Outstanding Florida Waterway, (OFW), with water quality standards set forth in sections 62-4.242(2) and (3), F.A.C. In discussions with the South Florida Water Management District, SFWMD, the area has no formal associated WBID's, thus water quantity requirements are per the presumptive criteria plus 50%, 1.5-inches, to meet existing OFW criteria. Outstanding Florida Water facts can be found in Appendix 3.

The Wade Trim design team identified the drainage area (DA) and sub-catchments as well as assigned the appropriate runoff estimates for each catchment. From this data the runoff estimates for the design storm (1.5-inches) were produced. This volume was then used to size the bioretention basins within the demonstration project area as defined by the City. Alternative designs for the basins were explored and the team recommended that three demonstration bioswale designs could be developed to manage the design storm. Each alternative had design differences that would allow evaluation of the performance based on the design variations and constraints of the site.

4.1 DESIGN STORM ANALYSIS

Rainfall required to meet the water quality requirement of 1.5-inches was used in this evaluation. The use of this runoff volume was assumed to capture the high-frequency, low-volume events within the typical rainfall year in Miami Beach. Daily precipitation totals from the nearest National Weather Station to the project site, Station S29Z, located within grid L9 of the DBHydro Hydrologic Monitoring Map in Appendix 4 data was used and can be found via the SWFWMD website at:
https://www.sfwmd.gov/weather-radar/rainfall-historical/sites-and-basins

4.2 BIOSWALE INFRASTRUCTURE SIZING AND PERFORMANCE

In optimal conditions the minimum separation from the seasonal groundwater elevation and the bottom of the bioswale is two-feet to ensure consistent infiltration rates for the bioswale. For this reason, an infiltration volume was not included in the sizing of the basins due to the high-water table occurring at the demonstration site. If an infiltration volume is used, it would require a more detailed soil evaluation and determination from a geotechnical engineer on an appropriate infiltration rate for the soils at each basin site. Therefore, the total basin area and soil matrix is designed to capture the design storm of 1.5-inches. Runoff reductions from this project will reduce the runoff entering Biscayne Bay 92% of the time in a typical year. The total volume removed was compared to the existing condition calculation to determine runoff reductions.

4.3 NUTRIENT AND TSS REMOVAL PERFORMANCE

Urbanized areas such as the demonstration site export large quantities of pollutants during rain events to the areas receiving waters. To reduce the impacts to receiving waters from the high concentration of pollutants contained in this runoff, bioretention basins can be implemented to effectively remove these pollutants.

Based on the runoff volume generated for the design event, an estimate of the event means concentrations (EMC's) for Nitrates (TN), Total Phosphorus (TP) and Total Suspended Sediments (TSS) was estimated and this was compared to the expected bioswale pollutant removal efficiencies. The estimated efficiency percentages were derived from the similar published sources as that used for the pollutant EMC's. Table 2 summarizes the annual pollutant load removed by capture of the design rainfall event (1.5-inches) using bioretention.

Based on the project site area, 1.84-acres, the treatment volume require to treat 1.5-inches of rainfall would be 5220-cubic feet (cf). This calculation excluded the area over the bioswales. Complete CN, DCIA and Bioswale capacity calculations can be found in Appendix 5. Based on Nitrate, Phosphorous and Total Suspended Solids (TSS) removal efficiencies of 70%, 90% and 80% respectively; we found that the test BMPS could capture 64% of the Nitrates, 83% of the Phosphorous and 73% of the TSS that are currently discharging uninhibited to Biscayne Bay. Table 2 below provides the pertinent design input data and findings, see Appendix 6 for rainfall data and nutrient removal calculations.

Table 2 – Bioswale Design Input and Findings

59th Street	1.82	acres			
Rainfall	180	days			
Total Rainfall	65.42	inches			
events less than 1.5"	171	days			
1.5 or less first flush	60.24	inches			
Residential Roads Nutrient Loading					
Nitrogen loading	0.47	mg/l			
Phosphorus loading	0.39	mg/l			
TSS Loading	85.3	mg/l			
Nitrate Loading before Treatment		3.16	kg/year	6.95	lb/year
Phosphorus Loading before Treatment		2.62	kg/year	5.77	lb/year
TSS Loading before Treatment		573.6	kg/year	1261.9	lb/year
Nitrate Bypass BMP		0.25	kg/year	0.55	lb/year
Phosphorus Bypass BMP		0.21	kg/year	0.46	lb/year
TSS Bypass BMP		45.4	kg/year	99.9	lb/year
Nitrate Removal Efficiency		70%			
Phosphorus Removal Efficiency		90%			
TSS Removal Efficiency		80%			
Annual Mass Removal					
Nitrate Treat Capture		2.04	kg/year	4.48	lb/year
Phosphorus Treatment Capture		2.17	kg/year	4.78	lb/year
TSS Treatment Capture		422.5	kg/year	929.6	lb/year

5.0 BIOSWALE DESIGN ALTERNATIVES AND MAINTENANCE

This bioswale design approach is a radical departure from traditional residential street stormwater management. Streets represent a significant portion of the impervious surfaces within a residential neighborhood and consequently contribute a large percentage of the stormwater runoff. In the traditional neighborhood street design, the right-of-way is planted with turf grasses and graded to be higher than the gutter pan of the road. Further, runoff drains from the individual lot, across the sidewalk, across the grass strip and into the gutter. The road is usually crowned in the middle so each side of the road drains to the gutter pan. The road drainage is then routed to a series of catch basins and piped to a nearby receiving water. While effective in moving the runoff from the street, it also moves runoff pollutants efficiently to the receiving waters and eliminates the opportunity for the rainfall to infiltrate the soils within the neighborhood greenspace of the public right-of-way.

The alternatives detailed in this report provide for a bioswale solution that “re-wires” the traditional runoff management method by diverting runoff from the streets to shallow depressions that are designed as linear shallow bioswale basin located between the curb and the right-of-way line. This diversion of the flow allows for the runoff entering the basin to be cleansed by the soil media and plantings within the bioswale as well as delay the runoff peak discharge until hours or days after the rain event. Further, the resultant discharge from the bioswale underdrain is significantly reduced due to the sponge-like capacity of the engineered soil mix used in the bioretention basins; where a percentage of the runoff entering the basin is held in pore spaces of the soil for later use by the plantings or infiltrated into the groundwater to recharge the shallow aquifer. The proposed site plan shows how runoff from the streets is directed to the gateway bioswales and routed through the existing stormwater pipes to a final large bioswale in the undeveloped right-of-way near the shoreline for final treatment prior to discharge to Biscayne Bay (See Appendix 7).

In this demonstration project, three alternative designs for these bioretention basins were developed. Alternatives 1 and 2 are site planned as gateway features located at the Alton Road/ W 59th Street intersection and due to this position have added design details because it is sited as a gateway landscape feature within the streetscape. Additional design elements such as signage and public education exhibits could be added as part of the final design package.

As was noted earlier, the mechanics of the basin are composed of a shallow depression (6”) that has a bottom that is landscaped and composed of soils and vegetation to capture and treat runoff from the street. The engineered components of soil mixes, aggregate storage layers, and landscape plantings provide significant benefits for pollutant removal and biological uptake of pollutant metals and chemicals from the street runoff. Bioswales are especially appropriate for small drainage areas such as the demonstration site, the loading ratio of the drainage area to the basins is 8:1 and well within the maximum recommended ratio of 20:1. The engineered soil mixes provide additional field capacity over topsoil and can provide a minimum of 40% pore storage space to 60% pore storage space dependent on the final selection of the components of the soil mix. For this evaluation we have assumed the lower value of 40%.

There are subtle differences in the bioswale designs below the surface to demonstrate alternative water storage solutions such as using aggregates and pipe bundles to permit storage beneath the sidewalk zone as well design details for the basin edge treatments. Alternative 1 has full contact with existing subsoils beneath the engineered soil mix to allow for infiltration. The constraint to this solution is the high groundwater condition will be an issue at times during King Tides. Alternative 2 provides for a more robust storage layer that has an optional pipe-bundle storage zone beneath the sidewalk and behind and below the curb. The addition of pipe bundles will allow enhanced storage within a small footprint for the bioswale. In both alternatives, the sidewalk and curb will need to be reconstructed if the demonstrated design is to be implemented.

Alternative 3 is designed with a solid bottom to prevent high groundwater conditions from infiltrating the basin during high tides. This is especially important due to its proximity to the bay and its topographic elevation. While similar in overall structure, it does provide a larger footprint than the other linear bioswales and is designed to serve as a final polishing of the runoff prior to discharge to the bay. A flap gate can be added to the underdrain outfall to allow additional isolation from the high groundwater conditions at this specific location. See Appendix 8 for a detail of each alternative.

The aesthetic treatments are conceptually demonstrated in the three cross-sections for the alternatives. In Alternative 1, the bioswale edges near the sidewalks are layered with native stone to transition the slope near the sidewalk to the bottom of the basin and create a clean-defined edge near the pedestrian way. High impact plantings create seasonal color and texture while also providing nutrient and heavy metal sequestration. The plantings can provide the landscape enhancements that will transition the street edges to the landscape treatments of the residential lots of the neighborhood.

5.1 BIOSWALE MAINTENANCE

Bioretention cells and bioswales require routine maintenance to ensure hydrologic performance and aesthetic appeal. However, maintenance consists of the following categories:

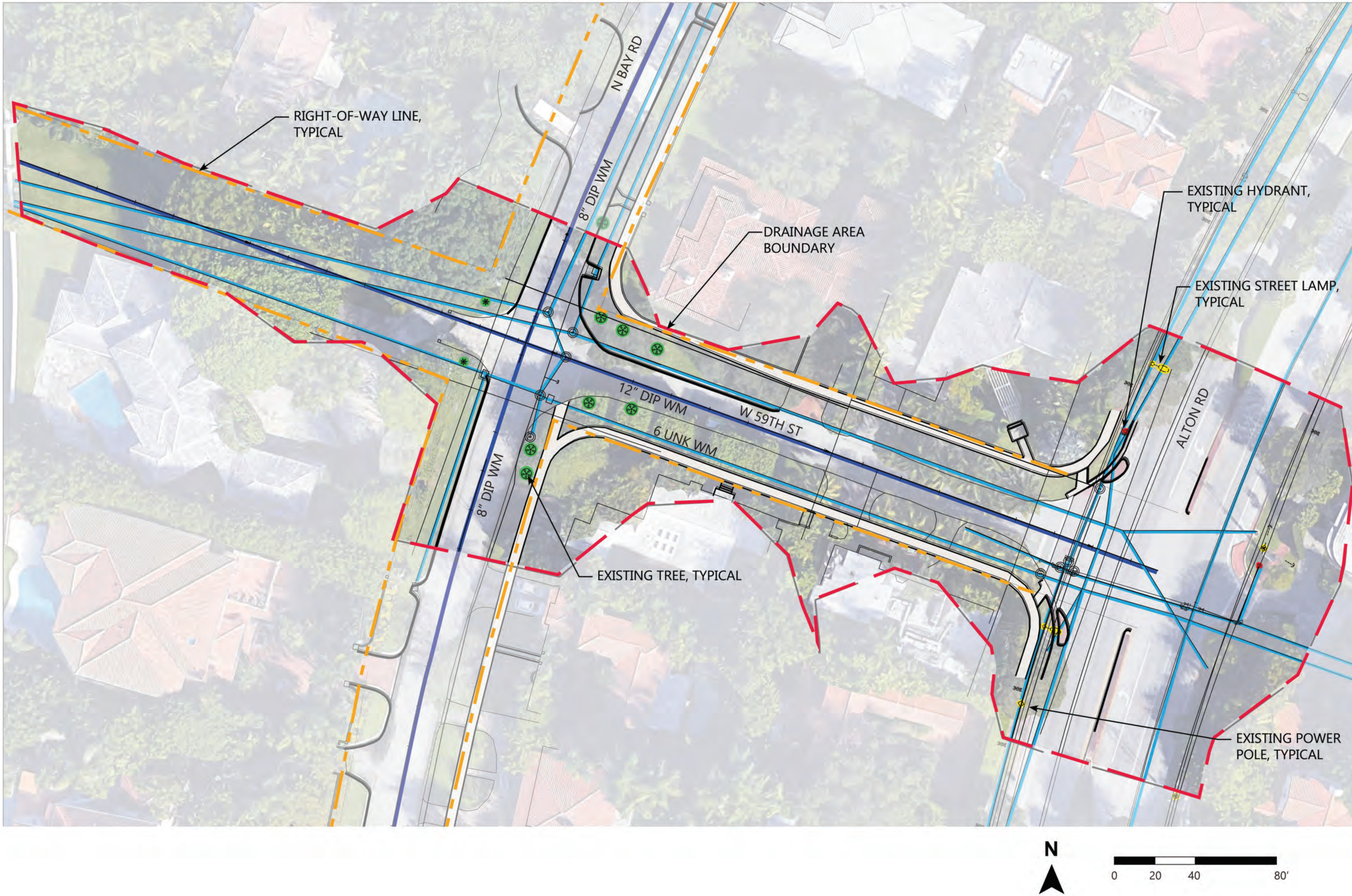
- Irrigation: Water landscaping plants routinely throughout the first growing season (one inch of water per week). It is recommended to use native or adapted species to minimize any required irrigation. If drought-tolerant native plants are chosen, only water in times of significant drought after the plants are established. Otherwise, water as necessary.
- Weeding/Pruning: Prune landscaping plants and remove weeds approximately once per month depending on plants chosen and desired aesthetics. Perennial plants, if used, should be trimmed to ground at the end of the growing season to promote root growth. Remove excess trimmed organic material.
- Mulch: Mulch should be replenished every year or as necessary. It is important to not have a landscaping contract in place that specifies adding mulch annually since it is unnecessary and even undesirable to have excess mulch. If surface erosion is evident after heavy rains, mulch should be re-spread with consideration of adding velocity control measures, such as stone, in areas that experience repeat erosion.
- Sedimentation: Excess sediment can cause surface clogging and excessive ponding. Inspect semi-annually for sediment accumulation and remove any sediment buildup from road runoff. Add mulch or level existing mulch if sediment removal caused significant removal of mulch.
- Aesthetics: Inspect twice a year for trash or dead plants (or more frequently as needed). Trash and dead plant material should be removed and mulch re-spread, if necessary. The Field Guide for Maintaining Rain Gardens, Swales and Stormwater Planters (Oregon State University 2013) is a good maintenance reference and includes maintenance check lists, suggestions, and instructional photos.

APPENDIX 1.0
LOCATION MAP


LA GORCE ISLAND
ALLISON RD.
PARK VIEW ISLAND
ALLISON ISLAND
BISCAYNE BAY
W 63RD ST
INDIAN CREEK DR.
ATLANTIC OCEAN
LA GORCE DR.
PINE TREE DR.
W 59TH ST
PROJECT AREA
LA GORCE GOLF COURSE
907
A1A
ALTON RD
N BAY RD
N
0
300
600
1200'

APPENDIX 2.0

EXISTING CONDITIONS



RIGHT-OF-WAY LINE, TYPICAL
N BAY RD
8" DIP WM
DRAINAGE AREA BOUNDARY
EXISTING HYDRANT, TYPICAL
EXISTING STREET LAMP, TYPICAL
12" DIP WM
W 59TH ST
6 UNK WM
ALTON RD
8" DIP WM
EXISTING TREE, TYPICAL
EXISTING POWER POLE, TYPICAL
N
0
20
40
80'

APPENDIX 3.0
OUTSTANDING FLORIDA WATER FACTS

Florida Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Noah Valenstein
Secretary

FACTSHEET ABOUT OUTSTANDING FLORIDA WATERS (OFW)

Authority: Section 403.061(27), Florida Statutes, grants the Department of Environmental Protection (DEP) the power to establish rules that provide for a special category of waterbodies within the state, to be referred to as "Outstanding Florida Waters," which shall be worthy of special protection because of their natural attributes.

Implementing Agency: DEP is the agency that designates a waterbody as an OFW; however, each OFW must be approved by an arm of DEP known as the Environmental Regulation Commission (ERC). The ERC is a seven-member citizen's body appointed by the Governor.

Regulatory Significance: Projects regulated by the Department or a Water Management District (WMD) that are proposed within an OFW must not lower existing ambient water quality, which is defined for purposes of an OFW designation as the water quality at the time of OFW designation or the year before applying for a permit, whichever water quality is better. In general, DEP cannot issue permits for ***direct*** discharges to OFWs that would lower ambient (existing) water quality. In most cases, this deters new wastewater discharges directly into an OFW, and requires increased treatment for stormwater discharging directly into an OFW. DEP also may not issue permits for ***indirect*** discharges that would significantly degrade a nearby waterbody designated as an OFW.

In addition, activities or discharges within an OFW, or which significantly degrade an OFW, must meet a more stringent public interest test. The activity or discharge must be "clearly in the public interest." For example, activities requiring an Environmental Resource Permit (ERP), such as dredging or filling within a wetland or other surface water or construction/operation of a stormwater system, must be clearly in the public interest instead of not contrary to the public interest.

In determining whether an activity or discharge that requires an ERP permit is not contrary to the public interest or is clearly in the public interest, DEP or the a WMD must consider and balance the following factors:

1. Whether the activity will adversely affect the public health, safety, welfare or the property of others;
2. Whether the activity will adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats;
3. Whether the activity will adversely affect navigation or the flow of water or cause harmful erosion or shoaling;
4. Whether the activity will adversely affect the fishing or recreational values or marine productivity in the vicinity of the activity;
5. Whether the activity will be of a temporary or permanent nature;
6. Whether the activity will adversely affect or will enhance significant historical and archaeological resources under the provisions of S. 267.061; and
7. The current condition and relative value of functions being performed by areas affected by the proposed activity.

See § 373.414(1)(a), Fla. Stat. (2010).

Activities or Discharges Not Affected by an OFW Designation:

Some activities are not impacted by an OFW designation simply because they do not require a permit from DEP or a WMD (exempt activities). Additionally, other activities are grandfathered under the OFW rule. Below are several examples of both scenarios.

1. Permitted activities or discharges existing on the date of designation and activities with a complete application on the date of designation, which are "grandfathered."
2. Activities **not** regulated by DEP for water quality protection purposes, such as fishing regulations, setback ordinances, restrictions on boat motor types, and boat speeds.
3. Restoration of seawalls at previous locations.
4. Construction of non-commercial boat docks, on pilings, of less than 500 square feet.
5. Temporary lowering of water quality during construction activities (with special restrictions).
6. Activities to allow or enhance public use, or to maintain pre-existing activities (with certain safeguards required by Rule 62-4.242(2)(b), F.A.C.).

List of OFWs: A complete listing of Outstanding Florida Waters is provided in Rule 62-302.700 (9), Florida Administrative Code. Outstanding Florida Waters ***generally*** include surface waters in the following areas:

- National Parks
- National Wildlife Refuges
- National Seashores
- National Preserves
- National Marine Sanctuaries and Estuarine Research Reserves
- National Forests (certain waters)
- State Parks & Recreation Areas
- State Preserves and Reserves
- State Ornamental Gardens and Botanical Sites
- Environmentally Endangered Lands Program, Conservation and Recreational Lands Program, and Save Our Coast Program Acquisitions
- State Aquatic Preserves
- Scenic and Wild Rivers (both National and State)
- "Special Waters"

"Special Waters" OFWs include 41 of Florida's 1700 rivers, several lakes and lake chains, several estuarine areas, and the Florida Keys:	
Apalachicola River	Myakka River (lower part)
Aucilla River	Ochlocknee River
Blackwater River	Oklawaha River
Butler Chain of Lakes	Orange Lake, River Styx, and Cross
Chassahowitzka River System	Perdido River
Chipola River	Rainbow River
Choctawhatchee River	St. Marks River
Clermont Chain of Lakes	Santa Fe River System
Crooked Lake	Sarasota Bay Estuarine System
Crystal River	Shoal River
Econlockhatchee River System	Silver River
Estero Bay Tributaries	Spruce Creek
Florida Keys	Suwannee River
Hillsborough River	Tomoka River
Homosassa River System	Wacissa River
Kingsley Lake & Black Creek	Wakulla River

Lake Disston	Weekiwachee Riverine System
Lake Powell	Wekiva River
Lemon Bay Estuarine System	Wiggins Pass Estuarine System
Little Manatee River	Withlacoochee Riverine and Lake
Lochloosa Lake	

Note: The rule language describing the above "Special Water" OFWs is more detailed. For further information, refer to paragraph 62-302.700(9)(i), Florida Administrative Code.

Requirements For a "Special Water" OFW Designation:

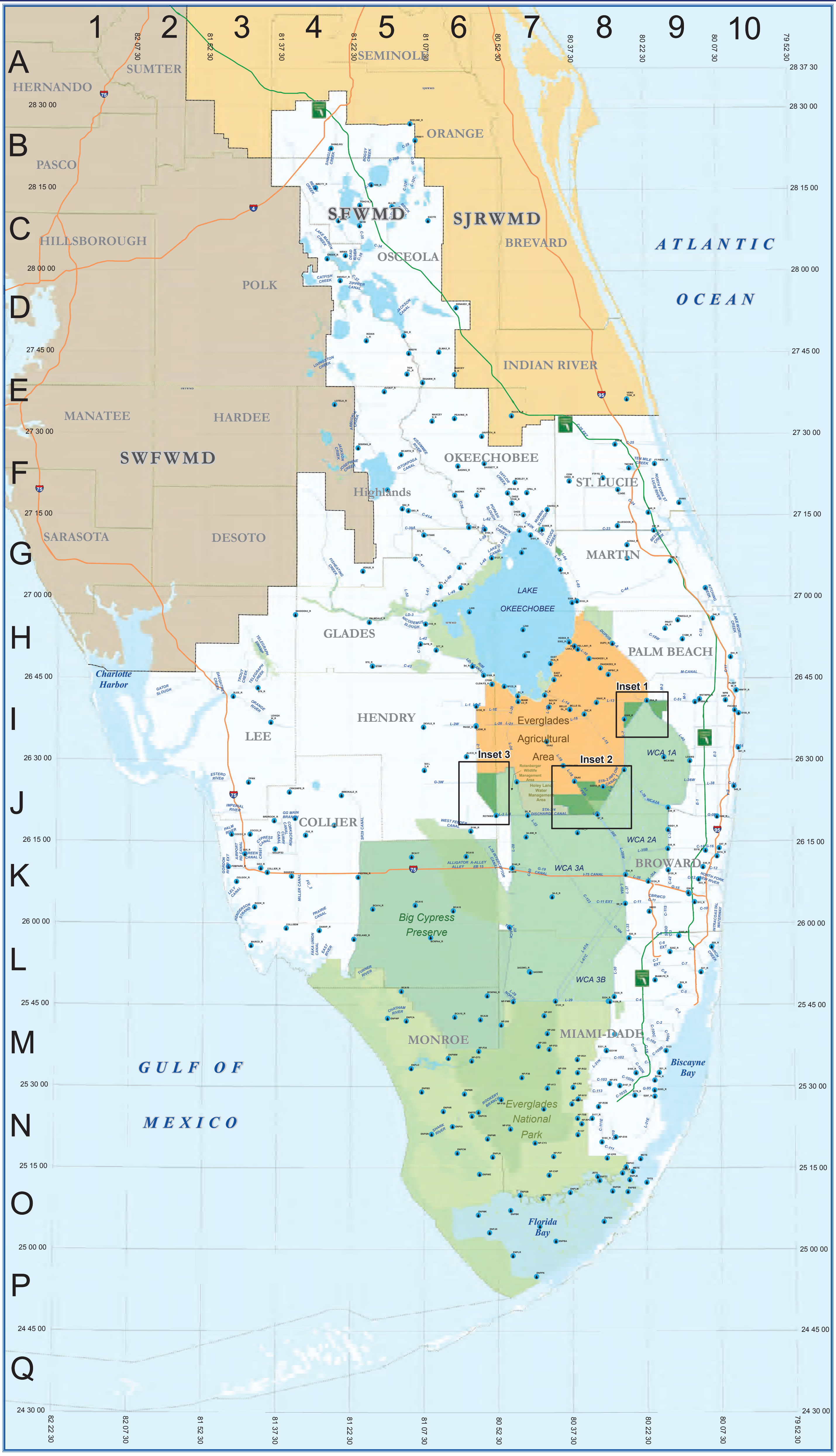
1. Rulemaking procedures pursuant to Chapter 120, F.S., must be followed;
2. At least one fact-finding workshop must be held in the affected area;
3. All local county or municipal governments and state legislators whose districts or jurisdictions include all or part of a water body proposed for Special Water designation must be notified at least 60 days prior to the workshop in writing by the Secretary of DEP;
4. A prominent public notice must be placed in a newspaper of general circulation in the area of the proposed Special Water at least 60 days prior to the workshop;
5. An economic impact analysis, consistent with Chapter 120, must be prepared that provides a general analysis of the effect of OFW designation on local growth and real estate development, including such factors as impacts on planned or potential residential, industrial, agricultural or other development or expansion; and
6. The Environmental Regulation Commission may designate a water of the state as a Special Water after making a finding that the waters are of exceptional recreational or ecological significance and a finding that the environmental, social, and economic benefits of the designation outweigh the environmental, social, and economic costs (Rule 62-302.700(5), F.A.C.).

For More Information Contact: Department of Environmental Protection, Water Quality Standards Program at (850) 245-8346 or view the Water Quality Standards website at https://floridadep.gov/dear/water-quality-standards.

November 2017

APPENDIX 4.0
DBHYDRO HYDROLOGIC MONITORING MAP

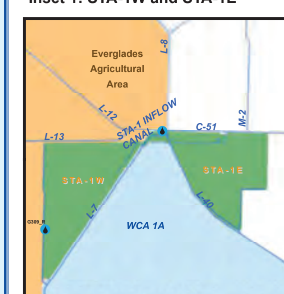
SITE	GRID	SITE	GRID
ACRA2	G 8	NP-CR2	N 8
ACRAWX	G 8	NP-CY3	N 7
ALICO	I 6	NP-EPSW	N 8
ALL2	C 5	NP-FMB	L 7
AVEMAR	J 4	NP-IFS	M 8
AVONPK	E 5	NP-N10	N 8
BASING	F 6	NP-OT3	M 6
BCA10	M 6	NP-P37	N 7
BCA14	K 5	NP-P38	N 7
BCA15	K 6	NP-RG1	M 8
BCA16	K 5	NP-RG2	M 8
BCA17	K 5	NP-ROB	N 8
BCA18	K 6	NP-TSB	N 8
BCA19	L 5	NSID1	J 9
BCA20	M 6	OKEE FOR	F 7
BCA4	L 6	OKEEFS	F 7
BCA9	L 6	OPAL	F 7
BEELNE	B 5	PAHOKEE1	H 8
BELLE GL	I 7	PAHOKEE2	H 8
BELLW	I 7	PAIGE	I 6
BLUEG	G 8	PALM	H 5
BRDROOK	J 3	PEAVINE	E 6
BSET	F 6	PEL LAK1	H 8
C18W	H 9	PEL LAK2	H 8
C24SE	F 8	PINEGLD	H 9
CFSW	I 6	PLANT IN	I 10
CLEW.FS	I 6	PRATT AN	H 9
COCO1	J 3	R-127	N 8
COCO3	J 3	R3110	N 7
COCOA R	B 5	ROCKK	E 7
COLGOV	K 3	ROOK	K 3
COLLILND	K 3	ROTNWX	J 6
COLSEM	L 4	ROYAL PA	N 8
COPLND	L 5	S123	M 9
COWCRK	F 7	S124	K 9
CREEKR	C 4	S125	K 9
CRKSWPS	J 4	S127	G 6
CV5	H 6	S129	G 6
DANHP	L 4	S12D	L 7
DAV2	F 7	S13	K 9
DEVILS	I 5	S131	H 6
DUP3	H 8	S133	G 7
EAA2	I 7	S135	G 7
EAA5	J 8	S140	K 7
EAST BEA	H 7	S140W	K 7
EAST SHO	I 7	S153	H 8
ELMAX	D 6	S154	G 6
ENPBA	O 7	S155	I 10
ENPBD	N 5	S155A	I 9
ENPBK	O 7	S165	M 8
ENPBN	O 8	S167	M 8
ENPBR	N 6	S169	H 6
ENPBS	O 8	S177	N 8
ENPCA	M 5	S179	N 8
ENPCN	N 6	S18C	N 8
ENPCW	N 6	S190	J 6
ENPDK	O 8	S191	G 7
ENPGB	O 7	S2	I 7
ENPGI	N 6	S20F	N 9
ENPHC	N 8	S20G	N 9
ENPHR	N 6	S21	M 9
ENPJK	O 6	S21A	M 9
ENPLB	O 8	S26	L 9
ENPLM	O 7	S27	L 9
ENPLN	N 6	S28Z	L 9
ENPLO	M 5	S29	L 9
ENPLR	P 7	S29Z	L 9
ENPLS	O 8	S3	I 7
ENPMK	O 6	S30	L 8
ENPNR	N 6	S308	H 8
ENPPK	P 7	S33	K 9
ENPSR	N 6	S331	M 8
ENPTB	O 7	S331W	M 8
ENPTC	O 8	S334	L 8
ENPTE	N 6	S335	L 8
ENPWB	O 7	S336	L 8
ENPWE	O 6	S338	M 8
ENPWP	M 5	S34	K 8
ENPWW	M 6	S352	H 7
EVER8	N 8	S36	K 9
EXOT	C 6	S37A	K 9
FDMPARK	K 3	S37B	K 9
FHCHSX	I 10	S38	K 9
FKSTRN	K 5	S386B	G 7
FLYG	F 6	S39	J 9
FPWX	J 3	S40	J 10
FT PIERC	F 9	S41	I 10
FTPIER	F 8	S44	H 10
FU5	J 4	S46	H 9
G136	I 6	S47B	H 5
G309	I 8	S49	F 9
G331D	J 8	S59	B 5
G373	J 7	S5A	I 9
G3ANE	J 8	S5AX	I 8
G3ANW	J 7	S6	J 8
G3AS	K 7	S61W	C 5
G3AS33	L 7	S65	D 5
G3ASW	L 7	S65AMW	E 5
G3ASWX	L 7	S65DWX	F 6
G54	K 9	S68	F 5
G56	J 9	S6Z	I 8
G57	K 10	S7	J 8
GG3	K 3	S70	G 5
GG7	J 4	S71	G 6
GOLDF2	K 3	S72	G 6
GRFFTH	F 6	S75	G 5
HGS5X	H 7	S75WX	G 5
I75W2	K 3	S77	H 6
IMMOLF	J 4	S78	H 5
INDIANL	D 5	S78W	H 5
INRCTY	B 4	S79	I 3
JBTS	O 8	S7Z	J 7
JDWX	G 9	S8	J 7
KENAN1	D 6	S80	G 9
KIRCOF	C 4	S82	F 5
KREF	E 5	S83	F 5
L001	G 7	S84	G 6
L005	H 6	S9	K 8
L006	H 7	S97	G 9
L2GW	I 6	S99	F 8
LEHI	I 3	SBAY	I 7
LOTELA	E 4	SBDD	K 9
LXWS	J 9	SCRG	B 4
LZ40	H 7	SEBRNG	F 5
MARCO	L 3	SFCD	I 7
MAXCYN	E 6	SGGEWX	K 4
MAXCYS	E 6	SIXL3	J 5
MBTS	O 8	SLEE	I 3
MCARTH	F 5	SNIVLY	D 4
MDTS	N 8	SVWX	F 9
MIALCK	I 7	TICK	E 5
MIAMI	L 9	TMCWX	F 8
MOBL	F 7	TOHO10	C 5
NP-201	M 7	TPTS	O 9
NP-202	M 7	VENUSR	G 5
NP-203	M 7	VERO TOW	E 8
NP-205	M 7	WCA1ME	I 9
NP-206	M 7	WHID	H 4
NP-33	M 7	WLNB	F 7
NP-34	M 6	WPB AIRP	I 10
NP-35	N 7	WPBC	H 8
NP-36	M 7	WRWX	C 4
NP-44	N 7	WSTWPB	I 9
NP-A13	N 7	WWTP	I 10
NP-CHP	O 7		



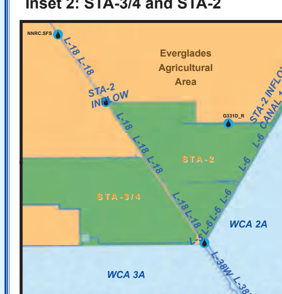
Location Map

Detailed Inset Maps

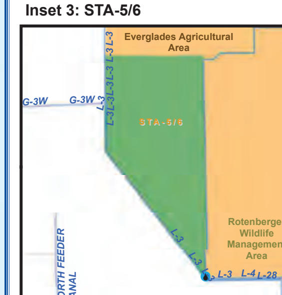
Inset 1: STA-1W and STA-1E



Inset 2: STA-3/4 and STA-2



Inset 3: STA-5/6



Site/Station Definition:

STATION:
A specific coordinate that indicate where data (observation, sampling or monitoring) are collected. Data are usually assigned to stations by various classifications such as stage, flow, weather, and water quality. A coordinate may have more than one station associated with it. The name given to a station has traditionally been similar to, or an exact duplicate of, the corresponding site name.

SITE:
A representative point used to designate one or more stations that are associated by proximity or project. Site level representation is to provide clarity for small scale mapping in lieu of displaying a high density of associated stations. The site location is often based on the position of a recording device such as a remote terminal unit (RTU), or can be derived from a common sense location between the associated stations. A site should not be viewed as an area feature with specific boundaries but simply as a representative location of activity.

Map Key

Hydrometerologic Sites
Active Surface Water

- Rain
- WMD Border Line
- Canal
- County Boundaries
- Storm Water Treatment Areas (STA)
- EAA Boundary
- Big Cypress Reserve
- Water Conservation Areas (WCA)
- Everglades National Park

Base Credits:
Base from South Florida Water Mgmt. District.
State plane projection, Florida east zone, NAD83-HARN, US feet.

South Florida Water Management District
3301 Gun Club Road, West Palm Beach, Florida 33406
(561) 686-8800; www.sfwmd.gov

DBHydro Hydrologic Monitoring: Active Rain Sites

0 20 40 Miles
0 30 60 Kilometers

January 2018

IMPORTANT DISCLAIMER:

This map is a conceptual or planning tool only.The South Florida Water Management District does not guarantee or make any representation regarding the information contained herein. It is not self-executing or binding, and does not affect the interests of any persons or properties, including any present or future right or use of real property.

Monitoring sites represent current and active locations monitored by SFWMD, other agencies and contractors. The data for monitoring sites are stored in DBHYDRO corporate database.Status of non-SFWMD data is based on the date of the most recent data received. All sites coordinates are gathered using approved professional- grade GPS receivers with sub-meter accuracy.

IT GEOSPATIAL SERVICES

User Name: bibsen   Remedy Ticket SR: 60610   Map Produced on Date: 2/1/2018 2:37:52 PM   Document Path: \\ad.sfwmd.gov\dfsroot\GS\GSBiz\MONITOR\ATMOSPHERE\Rain\mxd\Rain.mxd

APPENDIX 5.0
CN, DCIA, AND BIOSWALE CAPACITY CALCULATIONS

CN Computations for WBID Water Quality Calculations

Wade-Trim Project Number :	MIB2003
Wade-Trim Project Name :	BioSwale
Designed by:	MR
Date :	8/31/2018
	Type 1

Test - PRE-DEVELOPMENT (acres) 1.84

Land Use Type	SCS Soil Type	Hydrologic group	SCS Curve # CN	Area Covered	Weight CN value	TSS mg/l	Phosphorus mg/l	Nitrate mg/l
Other Impervious		B/D	0	0.00	0.00	0	0	0
Commercial or Business (85%) imper.		B/D	0	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D		0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	1.84	147.20	55	0.4	0.33
DCIA			0	0	0	0	0	0
Composite CN	80.00		Composite Area:	1.84		55	0.4	0.33
% DCIA	0.00		Total Area:	1.84				

Post Test 1.84

Land Use Type	SCS Soil Type	Hydrologic group	SCS Curve # CN	Area Covered	Weight CN value	TSS mg/l	Phosphorus mg/l	Nitrate mg/l
Other Impervious		B/D	98	0.37	36.26	21	0.13	0.32
Commercial or Business (85%) imper.		B/D	95	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D	98	0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	0.87	69.60	180	2.22	1.46
DCIA			98	0.6	58.8	86	0.39	0.47
Composite CN	85.37		Composite Area:	1.24		117.375	1.203	0.908
% DCIA	32.61		Total Area:	1.84				

Volume Required for 1.5-inches over Area	5228.80				
minus area of the Bioswale	Pipe Size (in)	% Voids	Length	Width	Height
Volume in Voids (Bioretention Soil Mix)		40	115.00	9.00	1.00
Volume in Voids (Rock Bed)	6.00	50	115.00	9.00	1.00
Volume Provided (cf)	923.35				

CN Computations for WBID Water Quality Calculations

Wade-Trim Project Number :	MIB2003
Wade-Trim Project Name :	BioSwale
Designed by:	MR
Date :	8/31/2018
	Type 2

Test - PRE-DEVELOPMENT (acres) 1.84

Land Use Type	SCS Soil Type	Hydrologic group	SCS Curve # CN	Area Covered	Weight CN value	TSS mg/l	Phosphorus mg/l	Nitrate mg/l
Other Impervious		B/D	0	0.00	0.00	0	0	0
Commercial or Business (85%) imper.		B/D	0	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D		0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	1.84	147.20	55	0.4	0.33
DCIA			0	0	0	0	0	0
Composite CN	80.00		Composite Area:	1.84		55	0.4	0.33
% DCIA	0.00		Total Area:	1.84				

Post Test 1.84

Land Use Type	SCS Soil Type	Hydrologic group	SCS Curve # CN	Area Covered	Weight CN value	TSS mg/l	Phosphorus mg/l	Nitrate mg/l
Other Impervious		B/D	98	0.37	36.26	21	0.13	0.32
Commercial or Business (85%) imper.		B/D	95	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D	98	0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	0.87	69.60	180	2.22	1.46
DCIA			98	0.6	58.8	86	0.39	0.47
Composite CN	85.37		Composite Area:	1.24		117.375	1.203	0.908
% DCIA	32.61		Total Area:	1.84				

Volume Required for 1.5-inches over Area	5228.80				
minus area of the Bioswale	Pipe Size (in)	% Voids	Length	Width	Height
Volume in Voids (Bioretention Soil Mix)		40	115.00	9.00	1.50
Volume in Voids (Rock Bed)	6.00	50	115.00	9.00	1.00
Volume Provided (cf)	1130.35				

CN Computations for WBID Water Quality Calculations

Wade-Trim Project Number :	MIB2003
Wade-Trim Project Name :	BioSwale
Designed by:	MR
Date :	8/31/2018
	Type 3

Test - PRE-DEVELOPMENT (acres) 1.84

Land Use Type	SCS Soil Type	Hydrologic group	SCS Curve # CN	Area Covered	Weight CN value	TSS mg/l	Phosphorus mg/l	Nitrate mg/l
Other Impervious		B/D	0	0.00	0.00	0	0	0
Commercial or Business (85%) imper.		B/D	0	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D		0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	1.84	147.20	55	0.4	0.33
DCIA			0	0	0	0	0	0
Composite CN	80.00		Composite Area:	1.84		55	0.4	0.33
% DCIA	0.00		Total Area:	1.84				

Post Test 1.84

Land Use Type	SCS Soil Type	Hydrologic group	SCS Curve # CN	Area Covered	Weight CN value	TSS mg/l	Phosphorus mg/l	Nitrate mg/l
Other Impervious		B/D	98	0.37	36.26	21	0.13	0.32
Commercial or Business (85%) imper.		B/D	95	0.00	0.00	0	0	0
Dirt		B/D		0.00	0.00	0	0	0
Wetlands/Water		B/D	98	0.00	0.00	0	0	0
Woods		B/D		0.00	0.00	0	0	0
Grass/Open Space (Good Cond)		B/D	80	0.87	69.60	180	2.22	1.46
DCIA			98	0.6	58.8	86	0.39	0.47
Composite CN	85.37		Composite Area:	1.24		117.375	1.203	0.908
% DCIA	32.61		Total Area:	1.84				

Volume Required for 1.5-inches over Area	5228.80				
minus area of the Bioswale	Pipe Size (in)	% Voids	Length	Width	Height
Volume in Voids (Bioretention Soil Mix)		40	170.00	16.00	2.00
Volume in Voids (Rock Bed)	6.00	50	170.00	16.00	1.00
Volume Provided (cf)	3523.95				

APPENDIX 6.0
RAINFALL DATA AND NUTRIENT REMOVAL CALCULATIONS

DBHydro Hydrologic Monitoring: Active Rain Site - Station S29Z

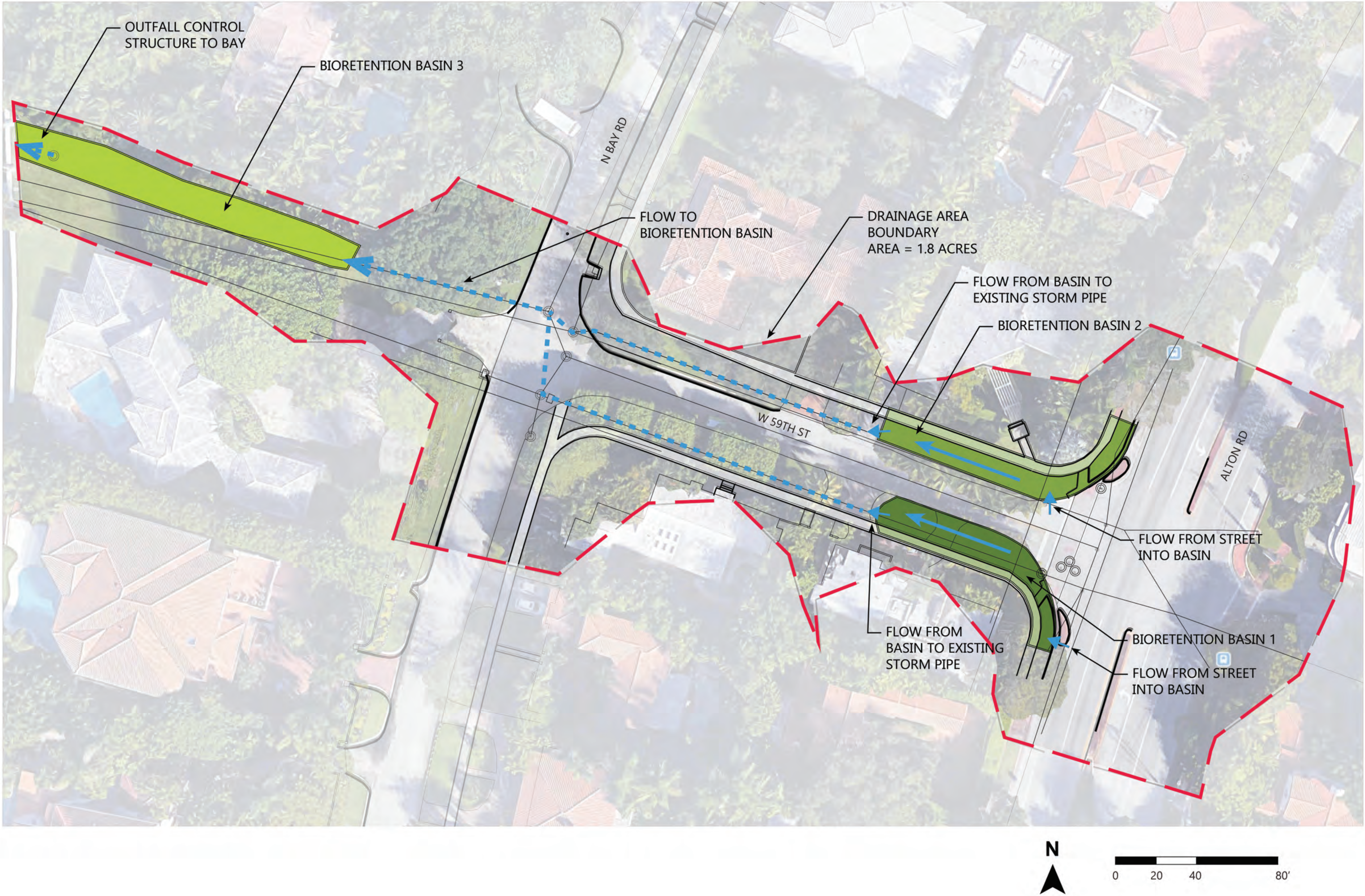
Date	Rainfall	Event less 1.5 inches	Event under 1.5 inches	Count of Events under 1.5 inches
2-Oct-18	0.02	0	0.02	1
1-Oct-18	0.43	0	0.43	1
30-Sep-18	0.11	0	0.11	1
29-Sep-18	0.16	0	0.16	1
28-Sep-18	0.01	0	0.01	1
27-Sep-18	0.01	0	0.01	1
26-Sep-18	0.01	0	0.01	1
25-Sep-18	0.01	0	0.01	1
22-Sep-18	0.21	0	0.21	1
20-Sep-18	0.26	0	0.26	1
17-Sep-18	0.01	0	0.01	1
16-Sep-18	0.01	0	0.01	1
15-Sep-18	2.67	1.17	1.5	0
10-Sep-18	0.11	0	0.11	1
9-Sep-18	0.01	0	0.01	1
8-Sep-18	0.14	0	0.14	1
7-Sep-18	0.05	0	0.05	1
6-Sep-18	0.07	0	0.07	1
5-Sep-18	0.19	0	0.19	1
4-Sep-18	1.69	0.19	1.5	0
3-Sep-18	0.62	0	0.62	1
2-Sep-18	0.42	0	0.42	1
1-Sep-18	0.07	0	0.07	1
31-Aug-18	0.49	0	0.49	1
30-Aug-18	0.95	0	0.95	1
29-Aug-18	0.06	0	0.06	1
28-Aug-18	0.44	0	0.44	1
27-Aug-18	0.05	0	0.05	1
26-Aug-18	0.29	0	0.29	1
24-Aug-18	0.21	0	0.21	1
23-Aug-18	1.51	0.01	1.5	0
22-Aug-18	0.1	0	0.1	1
19-Aug-18	0.24	0	0.24	1
18-Aug-18	0.03	0	0.03	1
17-Aug-18	0.28	0	0.28	1
15-Aug-18	0.06	0	0.06	1
14-Aug-18	1.25	0	1.25	1
13-Aug-18	0.3	0	0.3	1
12-Aug-18	0.89	0	0.89	1
11-Aug-18	1.91	0.41	1.5	0
10-Aug-18	0.69	0	0.69	1
8-Aug-18	0.01	0	0.01	1
7-Aug-18	0.19	0	0.19	1
6-Aug-18	0.22	0	0.22	1
5-Aug-18	0.02	0	0.02	1
4-Aug-18	0.22	0	0.22	1
2-Aug-18	0.01	0	0.01	1
31-Jul-18	0.32	0	0.32	1
30-Jul-18	0.33	0	0.33	1
29-Jul-18	0.19	0	0.19	1
28-Jul-18	0.32	0	0.32	1
27-Jul-18	0.02	0	0.02	1
26-Jul-18	0.71	0	0.71	1
25-Jul-18	0.12	0	0.12	1
24-Jul-18	0.58	0	0.58	1
23-Jul-18	0.01	0	0.01	1
22-Jul-18	0.07	0	0.07	1
21-Jul-18	0.11	0	0.11	1
20-Jul-18	0.01	0	0.01	1
19-Jul-18	0.9	0	0.9	1
18-Jul-18	0.08	0	0.08	1
17-Jul-18	0.03	0	0.03	1

14-Jul-18	0.01	0	0.01	1
13-Jul-18	0.07	0	0.07	1
12-Jul-18	0.58	0	0.58	1
11-Jul-18	2.2	0.7	1.5	0
9-Jul-18	0.01	0	0.01	1
8-Jul-18	0.01	0	0.01	1
4-Jul-18	0.07	0	0.07	1
2-Jul-18	0.66	0	0.66	1
1-Jul-18	0.06	0	0.06	1
30-Jun-18	1.42	0	1.42	1
29-Jun-18	0.25	0	0.25	1
28-Jun-18	0.01	0	0.01	1
25-Jun-18	0.3	0	0.3	1
24-Jun-18	0.24	0	0.24	1
16-Jun-18	0.31	0	0.31	1
16-Jun-18	0.31	0	0.31	1
15-Jun-18	0.96	0	0.96	1
14-Jun-18	0.01	0	0.01	1
13-Jun-18	0.04	0	0.04	1
12-Jun-18	0.07	0	0.07	1
11-Jun-18	0.17	0	0.17	1
10-Jun-18	0.36	0	0.36	1
9-Jun-18	0.03	0	0.03	1
8-Jun-18	0.61	0	0.61	1
5-Jun-18	0.01	0	0.01	1
2-Jun-18	0.01	0	0.01	1
1-Jun-18	0.02	0	0.02	1
31-May-18	0.6	0	0.6	1
30-May-18	0.28	0	0.28	1
29-May-18	0.01	0	0.01	1
28-May-18	1.17	0	1.17	1
27-May-18	0.95	0	0.95	1
26-May-18	1.25	0	1.25	1
25-May-18	0.14	0	0.14	1
21-May-18	0.61	0	0.61	1
20-May-18	3.07	1.57	1.5	0
19-May-18	0.11	0	0.11	1
18-May-18	0.97	0	0.97	1
17-May-18	0.47	0	0.47	1
16-May-18	1.56	0.06	1.5	0
15-May-18	0.52	0	0.52	1
14-May-18	1.41	0	1.41	1
13-May-18	0.05	0	0.05	1
7-May-18	0.07	0	0.07	1
6-May-18	0.09	0	0.09	1
5-May-18	0.95	0	0.95	1
4-May-18	0.23	0	0.23	1
28-Apr-18	0.47	0	0.47	1
24-Apr-18	0.12	0	0.12	1
23-Apr-18	1.13	0	1.13	1
22-Apr-18	0.29	0	0.29	1
16-Apr-18	0.16	0	0.16	1
12-Apr-18	0.01	0	0.01	1
11-Apr-18	0.53	0	0.53	1
6-Apr-18	0.07	0	0.07	1
27-Mar-18	0.06	0	0.06	1
13-Mar-18	0.31	0	0.31	1
12-Mar-18	0.01	0	0.01	1
11-Mar-18	0.02	0	0.02	1
8-Mar-18	0.09	0	0.09	1
28-Feb-18	0.28	0	0.28	1
27-Feb-18	0.03	0	0.03	1
26-Feb-18	0.01	0	0.01	1
24-Feb-18	0.07	0	0.07	1
23-Feb-18	0.14	0	0.14	1
20-Feb-18	0.06	0	0.06	1
11-Feb-18	0.01	0	0.01	1

9-Feb-18	0.18	0	0.18	1	
4-Feb-18	0.11	0	0.11	1	
3-Feb-18	0.01	0	0.01	1	
30-Jan-18	0.05	0	0.05	1	
28-Jan-18	0.04	0	0.04	1	
16-Jan-18	0.01	0	0.01	1	
13-Jan-18	0.05	0	0.05	1	
12-Jan-18	0.01	0	0.01	1	
11-Jan-18	0.34	0	0.34	1	
10-Jan-18	0.34	0	0.34	1	
9-Jan-18	0.05	0	0.05	1	
4-Jan-18	0.05	0	0.05	1	
3-Jan-18	0.66	0	0.66	1	
10-Dec-17	0.27	0	0.27	1	
5-Dec-17	0.01	0	0.01	1	
30-Nov-17	0.35	0	0.35	1	
29-Nov-17	0.6	0	0.6	1	
28-Nov-17	0.09	0	0.09	1	
24-Nov-17	0.78	0	0.78	1	
22-Nov-17	0.01	0	0.01	1	
21-Nov-17	0.41	0	0.41	1	
17-Nov-17	0.05	0	0.05	1	
16-Nov-17	0.69	0	0.69	1	
14-Nov-17	0.09	0	0.09	1	
13-Nov-17	0.25	0	0.25	1	
12-Nov-17	0.02	0	0.02	1	
11-Nov-17	0.22	0	0.22	1	
10-Nov-17	0.01	0	0.01	1	
9-Nov-17	0.1	0	0.1	1	
7-Nov-17	0.05	0	0.05	1	
5-Nov-17	0.04	0	0.04	1	
4-Nov-17	0.08	0	0.08	1	
29-Oct-17	2.05	0.55	1.5	0	
26-Oct-17	0.07	0	0.07	1	
25-Oct-17	1.15	0	1.15	1	
22-Oct-17	0.08	0	0.08	1	
21-Oct-17	0.76	0	0.76	1	
20-Oct-17	0.21	0	0.21	1	
19-Oct-17	0.05	0	0.05	1	
17-Oct-17	0.03	0	0.03	1	
15-Oct-17	0.5	0	0.5	1	
14-Oct-17	0.09	0	0.09	1	
13-Oct-17	0.73	0	0.73	1	
12-Oct-17	0.04	0	0.04	1	
10-Oct-17	0.01	0	0.01	1	
7-Oct-17	0.04	0	0.04	1	
6-Oct-17	2.02	0.52	1.5	0	
5-Oct-17	1.28	0	1.28	1	
4-Oct-17	0.42	0	0.42	1	
3-Oct-17	0.9	0	0.9	1	
2-Oct-17	0.28	0	0.28	1	
	65.42	5.18	60.24	171	
59th Street		1.82	acres		
Rainfall		180	days		
Total Rainfall		65.42	inches		
events less than 1.5"		171	days		
1.5 or less first flush		60.24	inches		
Residential Roads Nutrient Loading					
Nitrogen loading		0.47	mg/l		
Phosphorus loading		0.39	mg/l		
TSS Loading		85.3	mg/l		
Nitrate Loading before Treatment			3.16	kg/year	6.95 lb/year
Phosphorus Loading before Treatment			2.62	kg/year	5.77 lb/year
TSS Loading before Treatment			573.60	kg/year	1261.92 lb/year

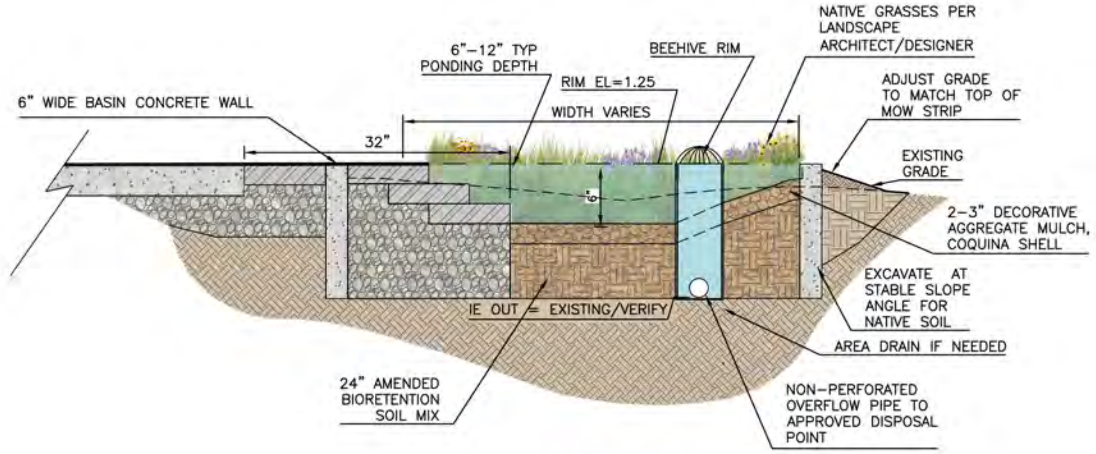
Nitrate Bypass BMP	0.25	kg/year	0.55 lb/year
Phosphorus Bypass BMP	0.21	kg/year	0.46 lb/year
TSS Bypass BMP	45.42	kg/year	99.92 lb/year
Nitate Removal Effic	0.70		
Phosphorus Removal Effic	0.90		
TSS Removal Effic	0.80		
Annual Mass Removal			
Nitrate Treat Capture	2.04	kg/year	4.48 lb/year
Phosphorus Treatment Capture	2.17	kg/year	4.78 lb/year
TSS Treatment Capture	422.55	kg/year	929.60 lb/year

APPENDIX 7.0
PROPOSED SITE PLAN

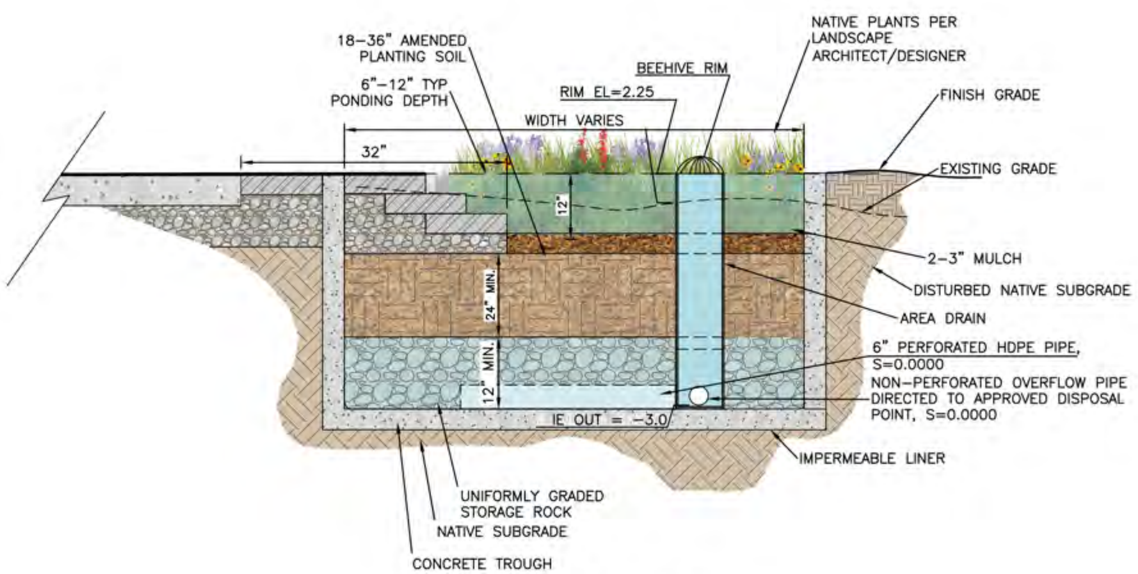


OUTFALL CONTROL STRUCTURE TO BAY
BIORETENTION BASIN 3
N BAY RD
FLOW TO BIORETENTION BASIN
DRAINAGE AREA BOUNDARY AREA = 1.8 ACRES
FLOW FROM BASIN TO EXISTING STORM PIPE
BIORETENTION BASIN 2
W 59TH ST
ALTON RD
FLOW FROM STREET INTO BASIN
BIORETENTION BASIN 1
FLOW FROM STREET INTO BASIN
FLOW FROM BASIN TO EXISTING STORM PIPE
N
0
20
40
80'

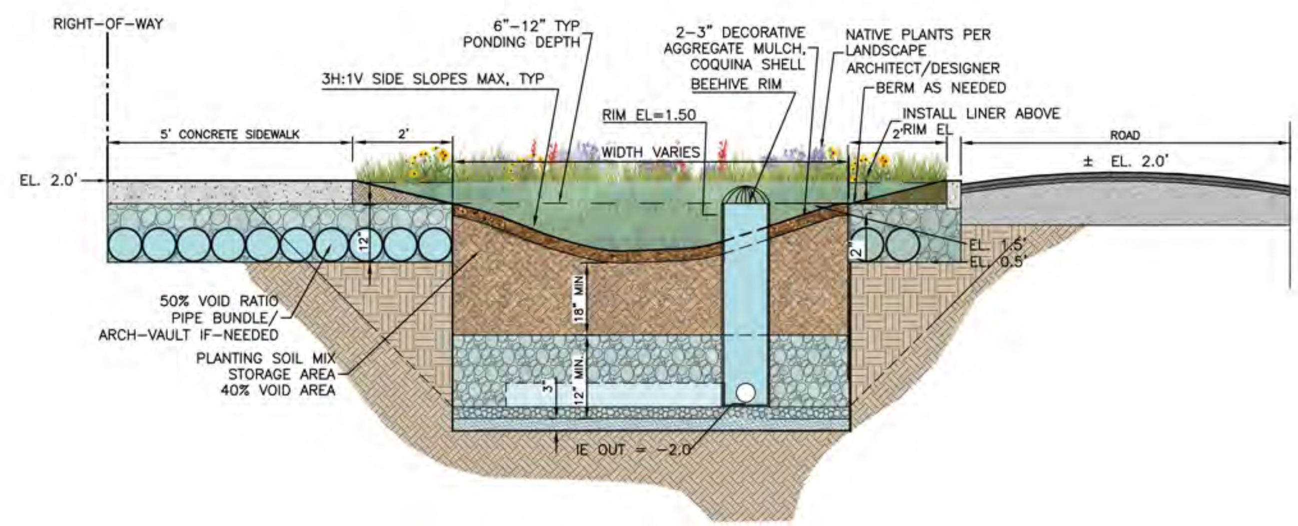
APPENDIX 8.0
PROPOSED BIOSWALE DETAILS



ALTERNATIVE I



ALTERNATIVE III



ALTERNATIVE II

MIAMIBEACH
CAPITAL IMPROVEMENT PROJECTS OFFICE
1700 CONVENTION CENTER DRIVE, MIAMI BEACH, FL 33139

NEIGHBORHOOD: CITY OF MIAMI BEACH
W 59TH ST - BIOSWALES

TITLE: BIOSWALE DETAILS

WADE TRIM
Gables Corporate Plaza
2100 Ponce De Leon Blvd, Suite 970
Coral Gables, FL 33134
(786) 505-6370
www.wadetrim.com

CITY MANAGER: JIMMY L. MORALES
DIRECTOR OF PUBLIC WORKS: ROY COLEY
CITY ENGINEER: NELSON PEREZ-JACOME,PE
CIP DIRECTOR: DAVID MARTINEZ, P.E.

ENGINEER OF RECORD:
DESIGN ENGINEER:
DRAWN BY:
CHECKER:
SCALE:

ENGINEER OF RECORD:
HOLLY KREMERS, P.E.
NO. 68130

NO.	DATE	REVISION	APP'D. BY
5			
4			
3			
2			
1			

File Name: CST–PLTS–Details.dwg
Survey Reference:
Field Book: Page: Work Order:
Date: 3/21/19 Sheet: