NORTH MIAMI
FLORIDA

City of North Miami

Stormwater Master Plan Update

Final Report

September 2012

CDM Smith

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Executive Summary

ES-1. Introduction and Background

In 2011, the City of North Miami (City) authorized CDM Smith to perform an update to the City's Stormwater Master Plan (SWMP) in order to evaluate its stormwater management practices, infrastructure, funding, and regulatory policies. In 2000, the City completed the development of the Phase II Stormwater Master Plan. The primary purpose of this document was to propose a long-term plan to mitigate chronic flooding areas that meet the Miami-Dade County Department of Permitting Environment and regulatory Affairs (PERA) Level of Service (LOS) requirements for local roads. The plan identified and ranked areas relative to flooding and water quality concerns. The majority of the recommended capital improvements have been constructed. Since the completion of construction, no major flooding issues have been reported.

This document is an update to the original 2000 SWMP that incorporates the completed construction projects while identifying any remaining priority flooding and water quality concerns. This SWMP update supports the City's understanding of its PSMS and needs in order to comply with City and PERA LOS standards, National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit requirements (City is a co-permitee to Miami-Dade County) and Federal Emergency Management Agency (FEMA) requirements and audits. The SWMP update provides the City a defined and defensible document that will support decisions related to capital improvements as well as those of its overall stormwater management program

The City is located in the northeast region of Miami-Dade County (**Figure ES-1**) within southeast Florida. The City services a municipality of approximately 9.5 square miles inclusive of approximately 57,000 residents. Since its incorporation in 1926, the City has developed and maintained a primary stormwater management system (PSMS) that discharges to various natural and manmade canals tributary to the Biscayne Bay, which is listed as a protected Outstanding Florida Water (OFW). The City is a highly urbanized coastal community adjacent to the Intracoastal Waterway, and is characterized by relatively low-lying topography. It has a subtropical climate

Figure ES-1
Location Map

with high intensity rainfall, tidal influences, high amounts of impervious area, and limited available surface storage.

ES-2. Methodology

As part of data evaluation effort, CDM Smith compiled data for the development of the SWMP update. Data from various City departments, South Florida Water Management District (SFWMD), Miami-Dade County, as well as several other sources were compiled. The data included existing reports/studies, geographic information systems (GIS) coverages, topography, land use, soils, stormwater structure inventory, stormwater models, water quality, permit, repetitive property loss information and floodplain management compliance documents.

Using this information, CDM Smith converted the City's existing hydrologic and hydraulic (H&H) model that was originally developed using XP-SWMM Version 7 model for the 2000 SWMP. CDM Smith converted the model from the proprietary XP-SWMM format to the public domain US EPA Stormwater Management Model, Version 5 (SWMM5) format. H&H components of the model were updated to reflect further refinement, improvements implemented in the past decade, as well as incorporate conduits that were omitted from the original model.

Model parameter estimates were checked against limited available data from the City for flooding locations during an unnamed that occurred on October 3, 2000. Estimates of flood depth measurements based on review of photographs and discussions with City staff were performed as part of the validation stage. Storm event rainfall data was retrieved from three different SFWMD rain gauges.

ES-3. Level of Service (LOS)

The primary purposes of LOS criteria are to protect public safety and property. Program goals are to maintain passable roads for emergency and evacuation traffic, and control flood stages below homes and buildings as practicable. The LOS criteria are first used to identify and define potential problem areas using the stormwater model developed for this study. The LOS criteria are then used to evaluate the effectiveness of improvements. LOS decisions will directly affect the size and cost of proposed improvement alternatives. The City's current LOS was established in the 2000 SWMP and uses the PERA standards. In order to simplify the LOS evaluation, the following criteria were applied:

- Road Class No. 1: Emergency (LOS for these locations were only evaluated for the 100-year simulation);
- Road Class No. 2: Arterial (LOS for these locations were only evaluated at the road crown for the 5-year 24-hour simulation and 10-year 72-hour simulations); and,
- Road Class No. 3: Local (LOS for these locations were only evaluated at the road crown for the 5-year 24-hour simulation).

The City's validated PSMS model was evaluated using SWMM5 under existing land use conditions for the following purposes:

- Evaluate design storm simulations of the 2-yr, 24-hour; 5-yr, 24-hour; 10-yr, 72-hour; 25-yr, 72-hour and 100-yr, 72-hour events. The design storm simulations were performed for the existing hydrologic and hydraulic conditions;

- Locate and prioritize water quantity (flooding) problem areas within the City; and,
- Perform alternative improvement evaluations.

ES-4. Alternatives Analysis

Alternatives were applied using a tiered approach ranging from straightforward solutions (Tier 1) that may only resolve some of the flooding but not all, to the more complex (Tier 3) solutions with the goal of solving flooding problems for areas that currently do not meet LOS goals. Tier 1 solutions typically consist of exfiltration only, and demonstrate the hydraulic benefits that can be anticipated through the installation of networks of exfiltration trenches in the problem areas. Tier 2 solutions build upon the exfiltration benefits through the addition of underground storage vaults, in-system storage, wet detention, stormwater pump stations, and upgrades of existing outfalls of no more than one standard pipe diameter (e.g., 30-inch to 36-inch, 42-inch to 48-inch). In the event that a feasible solution developed within the Tier 2 outfall constraints did not completely alleviate flooding, a Tier 3 solution was proposed including the outfall upgrades that would be necessary to alleviate all LOS deficiencies within a problem area.

Overall, CDM Smith presents details on approximately $58million in capital improvements proposed for the City's primary stormwater management system. **Figure ES-2** shows the locations of the proposed (future need), current (under construction) and completed (construction completed) projects to address existing problem areas.

ES-5. Water Quality and Regulatory Review

CDM Smith performed a water quality evaluation as part of this SWMP update. The City's stormwater best management practices (BMP) were inventoried and available water quality data from PERA was analyzed. The only water quality impairment currently affecting the City is for the Lower Arch Creek Basin which is listed for mercury in fish tissue. Many of the waterbodies in the state have this impairment, and the majority of the mercury is from atmospheric deposition. FDEP is currently developing a statewide total maximum daily load (TMDL) to address the mercury impairments. CDM Smith also reviewed existing TMDLs for the City and there are currently no draft or final TMDLs affecting the City. Additionally, a review of pending state and federal regulations for water quality and stormwater treatment were also included as part of the SWMP update.

ES-6. Floodplain Management

In an effort to reduce the number of properties which have repetitive losses, the National Flood Insurance Program (NFIP) Community Rating System (CRS) program classifies communities which have more than ten unmitigated repetitive loss properties as Category C communities. The City is a Category C community and the NFIP CRS program requires these communities to create and maintain a FPMP. As part of the SWMP update, CDM Smith reviewed the City's most recent (2009) Floodplain Management Plan (FPMP) and made recommendations on where improvements could be made. After performing the review, it was determined the City's FPMP will need to be updated to reflect the direction provided in the 2007 *NFIP CRS Coordinator's Manual* and the *NFIP CRS Example Plans*, and to meet the anticipated NFIP CRS requirements changes proposed as part of the *NFIP CRS 2012 CRS Coordinator Manual Changes* (2012 Changes).

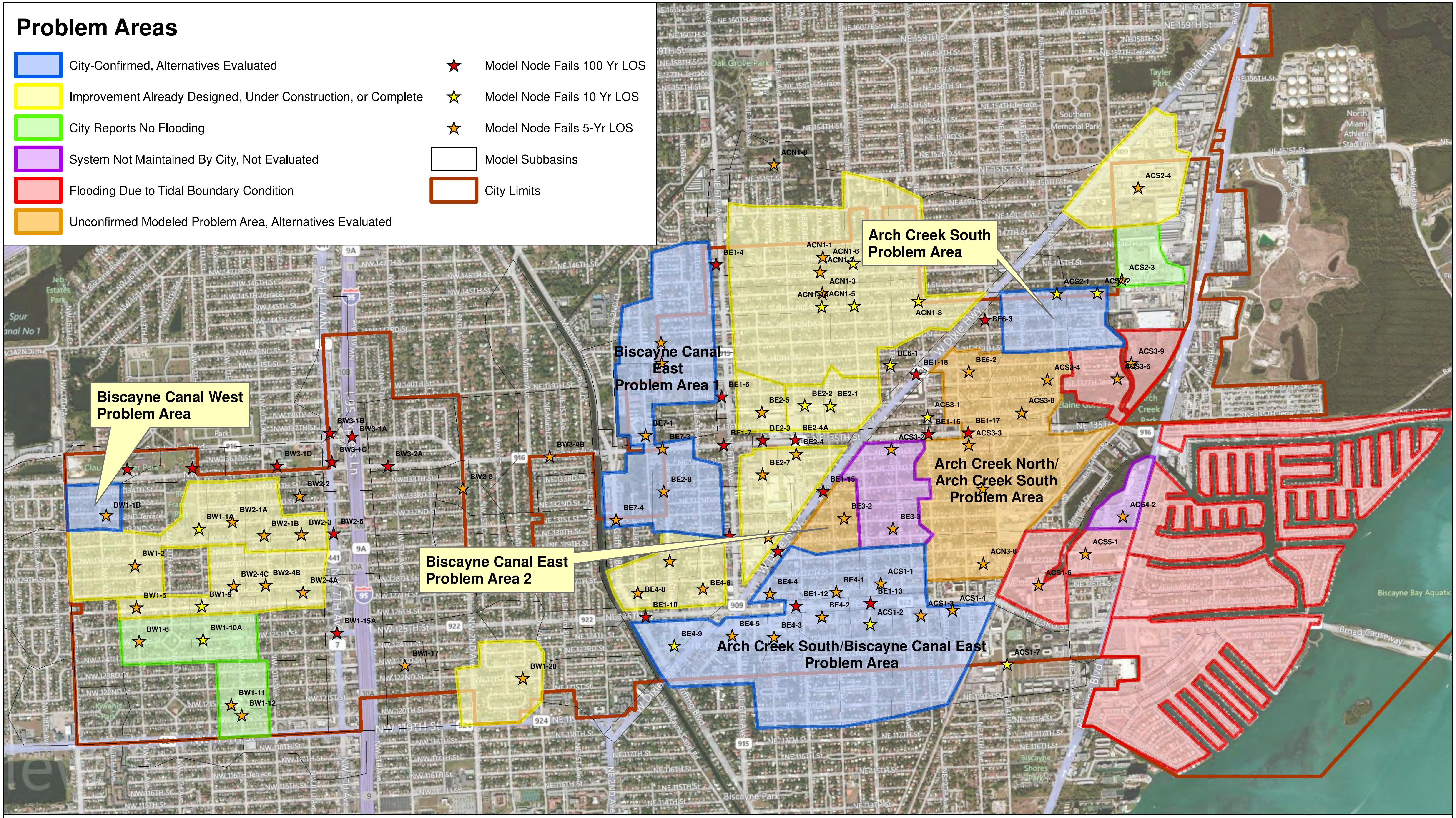

Figure ES-2

City of North Miami
Problem Area and Proposed Capital Improvement Locations

CDM Smith

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CDM Smith also evaluated the impact of the proposed changes in the 2012 Changes document on the City's CRS point total and class rating and made recommendations for improvement to the City's participation in the program based on the proposed changes. The 2012 Changes document includes changes which have the potential to both increase and decrease the points awarded to the City for its existing participation in the program. Measures were proposed to help mitigate loss of points and to take advantage of opportunities to gain points under the proposed 2012 changes.

ES-7. Recommended Plan

As part of the alternatives analysis and stormwater funding evaluation, CDM Smith recommends a phased implementation program over the next 50 years to address LOS deficiencies within the City's PSMS. Recommended alternatives were developed based on a tiered system (as previously described), so that solutions could be phased, thus enabling the City to budget for long-term capital costs. **Tables ES-1** and **ES-2** present the tiered estimated conceptual capital costs as well as a timeline for implementation.

Table ES-1 City of North Miami Stormwater Master Plan Estimated Conceptual Capital Cost Summary

Problem Area	SWMP Update Section	Reported Problem Area	Max. Depth of Flooding	Design Storm Event	Tier 1 Total Costs	Additional Tier 2 Costs	Additional Tier 3 Costs	Total Project Cost (All Tiers)*
Biscayne Canal West Problem Area	5.1.1	√	0.10	5-year	City R/W \$0 (Alt 1 - local, meet LOS) County R/W \$300,000	City R/W \$430,000 (Alt 2 - regional) County R/W \$1,080,000		\$430,000
Biscayne Canal East Problem Area 1	5.1.2	√	1.30	5-year	\$3,700,000 (does not meet LOS)	\$2,900,000 (mostly meets LOS[1])	\$1,350,000 (meets LOS)	\$7,950,000
Arch Creek South/Biscayne Canal East Problem Area	5.1.3	√	2.50	5-year	\$7,200,000 (mostly meets LOS[1])	\$20,300,000 (meets LOS)		\$27,500,000
Arch Creek South Problem Area	5.1.4	√	1.00	5-year	\$1,500,000 (does not meet LOS)	\$4,800,000 (mostly meets LOS[1])	\$500,000 (meets LOS)	\$6,800,000
Arch Creek North/Arch Creek South Problem Area	5.1.5		2.80	5-year	\$8,300,000 (does not meet LOS)	\$6,600,000 (meets LOS)		\$14,900,000
Biscayne Canal East Problem Area 2	5.1.6		0.70	5-year	\$350,000 (meets LOS)			\$360,000
							Totals:	\$57,940,000

[1] Flooding is alleviated at at least 50 percent of the deficient model nodes

Table ES-2 City of North Miami Stormwater Master Plan Update Phased Capital Improvement Schedule

Problem Area	SWMP Update Section	Reported Problem Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022 - 2031	2032-2041	2042-2051	2052-2061
Biscayne Canal West Problem Area	5.1.1	√						◆	◆	◆	◆	◆	◆			
Biscayne Canal East Problem Area 1	5.1.2	√	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		
Arch Creek South/Biscayne Canal East Problem Area	5.1.3	√	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		
Arch Creek South Problem Area	5.1.4	√						◆	◆	◆	◆	◆	◆	◆		
Arch Creek North/Arch Creek South Problem Area	5.1.5												◆	◆	◆	◆
Biscayne Canal East Problem Area 2	5.1.6												◆			

[1] Total costs include the preceding tier's total cost (e.g., Tier 2 costs are inclusive of Tier 1 costs)

Tier 1 Implementation◆

Tier 2 Implementation◆

Tier 3 Implementation◆

Section 1

Background and Purpose

1.1. Background

Figure 1-1
Location Map

The City of North Miami (City) is located in the northeast region of Miami-Dade County (**Figure 1-1**) within southeast Florida. The City services a municipality of approximately 9.5 square miles inclusive of approximately 57,000 residents. Since its incorporation in 1926, the City has developed and maintained a primary stormwater management system (PSMS) that discharges to various natural and manmade canals tributary to the Biscayne Bay, which is listed as a protected Outstanding Florida Water (OFW). The City is a highly urbanized coastal community adjacent to the intracoastal waterway, and is characterized by relatively low-lying topography. It has a subtropical climate with high-intensity rainfall, tidal influences, high amounts of impervious area, and limited available surface storage.

In the Year 2000, the City completed the development of the Phase II Stormwater Master Plan (2000 SWMP). The primary purpose of this document was to propose a long-term plan to mitigate chronic flooding areas that meet the Miami-Dade County Department of Permitting, Environment and Regulatory Affairs (PERA) Level of Service (LOS) requirements for local roads (This department was formerly known as the Department of Environmental Resources Management (DERM)). The plan identified and ranked areas relative to flooding and water quality concerns. Since 2000, the majority of the recommended capital improvements have been constructed and/or designed. Some designed projects are still awaiting funding. Since the completion of construction, no major flooding issues have been reported.

1.2. Purpose

This document is an update to the original 2000 SWMP that incorporates the completed construction projects while identifying any remaining priority flooding and water quality concerns. This stormwater master plan (SWMP) update supports the City's understanding of its PSMS and needs in order to comply with City and PERA LOS standards, National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit requirements (City is a co-permitee to Miami-Dade County) and Federal Emergency Management Agency (FEMA) requirements and audits. The SWMP update provides the City a defined and defensible document that will support decisions related to capital improvements, as well as those of its overall stormwater management program. The tasks under the SWMP Update include:

- Data Evaluation;
- Stormwater Quantity Model and Evaluations;
- Water Quality Evaluations;
- Alternatives Evaluation and Recommendations;
- Stormwater Funding Evaluations;
- FEMA Community Rating System (CRS) Assistance;
- Floodplain Management Plan (FPMP) Review; and
- Regulatory Framework Assistance.

Section 2

Data Collection and Evaluation

This section summarizes the data collected for development of the SWMP update. CDM Smith compiled data from the City, South Florida Water Management District (SFWMD), Miami-Dade County, as well as several other sources. The data include existing reports/studies, geographic information systems (GIS) coverages, topography, land use, soils, stormwater structure inventory, water quality and repetitive property loss information. The following narrative provides a summary of the data collected and applicability of the data to the SWMP update. Several data gaps were also identified.

2.1. Base Map Features

Mapping for the SWMP update was completed using the ESRI GIS software package Arcview® Version 10. GIS layers for the mapping effort were obtained from the City, Miami-Dade County and SFWMD. The base map developed for the City area, shown on **Figure 2-1**, includes the digital aerial photography, City limits, parcels and roadways. The roadways shapefile was obtained from the City and designates class for each roadway by category 0 through 7, but does not provide local, collector, arterial or state roadway attributes to be utilized for roadway LOS designation.

2.2. Existing Studies and Modeling

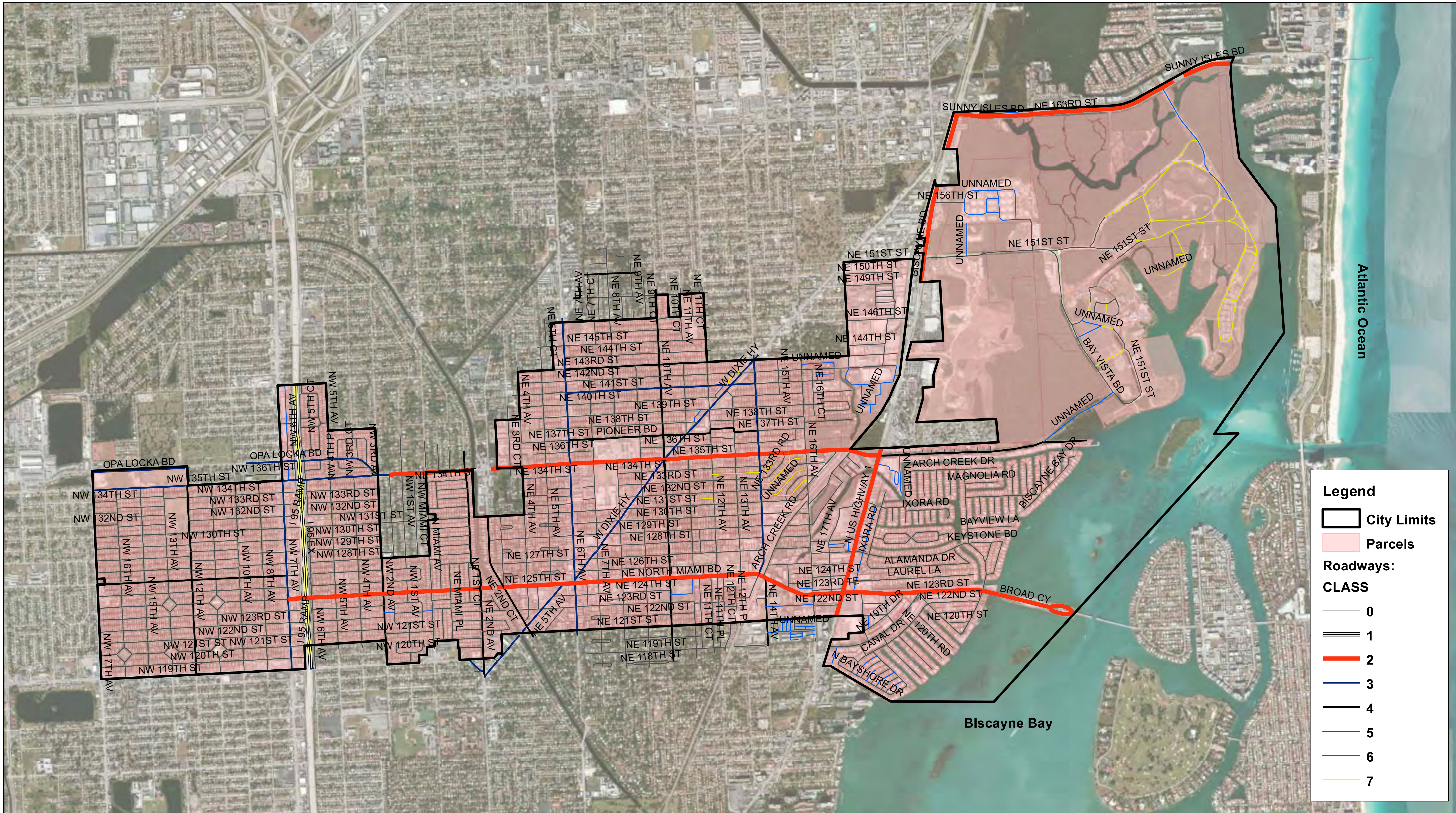
A variety of existing studies/reports and stormwater models were obtained from the City and other government agencies. These data are described in the following paragraphs.

2.2.1. Existing Stormwater Models

Existing stormwater models obtained under this effort include the XP-SWMM originally developed for the City of North Miami Phase II SWMP (PBS&J, 2000) and PERA's hydrologic and water quality models.

The XP-SWMM, which was developed as part of the City of North Miami Phase II SWMP, was a digital representation (hydrologic and hydraulic) of the City's PSMS. In the 2000 model, the City area was delineated into 101 subbasins where runoff was calculated. As part of the modeling effort, hydraulic characteristics were developed for 273 model nodes and 291 model links. As part of the SWMP update, CDM Smith converted the 2000 XP-SWMM to the public domain US EPA SWMM version 5.0 (SWMM5) to simulate flows and stages for the City's PSMS. Hydrologic and hydraulic parameters from the 2000 XP-SWMM were reviewed and updated as necessary. Discussion regarding the development of the hydrologic and hydraulic parameters is provided in **Section 3**.

PERA was contacted regarding the availability of water quality assessments (i.e., modeling) performed for the City. PERA indicated that approximately 50 percent of the City (the area within the Intracoastal Basin) has not been modeled yet. CDM Smith was provided with existing monitoring data available data from the PERA monitoring stations within the City limits. Data provided includes water quality information collected during PERA's regular monthly monitoring program over the last 10 years. CDM Smith reviewed this information, and a detailed summary is provided in **Section 4**.



City of North Miami Base Map

Figure 2-1

0 1,250 2,500 5,000 Feet

Data Sources: City of North Miami and Bing® Web Services aerial photography

CDM Smith

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2.2.2. Existing Studies and Reports

The following studies and reports have been collected for development of the SWMP.

2.2.2.1. City of North Miami Phase II SWMP Report (2000 SWMP)

In 2000, the City completed development of the Phase II Stormwater Master Plan (2000 SWMP), conducted by PBS&J. The 2000 SWMP followed the Phase I Stormwater Master Plan (Phase I SWMP), which was developed by CH2M-Hill in 1998. The 2000 SWMP accomplished the following goals:

1. Identified and ranked areas within the City by the severity of flooding and water quality;
2. Included hydrologic and hydraulic modeling of the existing and proposed systems (including practicable capital improvement options); and,
3. Recommended capital improvements to alleviate flooding. This summary of the 2000 SWMP report is focused on the list of priority-ranked subbasins and projects identified by the plan and the criteria used to develop the recommendations included in the report.

The City is a co-permitee with Miami-Dade County on the NPDES permit. Since 1996, PERA has served as the lead permitting agency. The NPDES permit requires the City to develop a stormwater master plan and estimate the annual pollutant loads discharged into the stormwater receiving canals. The City received numerous flooding complaints over several years, leading to development of a stormwater master plan.

The 2000 SWMP proposed a long-term capital improvement plan (CIP) for relieving chronic flooding within the City. The purpose was to meet PERA's LOS requirements for local roads. The PERA LOS for local roads allows street flooding up to the crown of the street using the 5-year, 24-hour SFWMD design storm (7.5 inches based on the 1988 SFWMD standards), and the LOS designation of more intense storms for higher class roadways. As part of the 2000 SWMP, a Surface and Stormwater Management Plan (SSM) was also developed for the City. The SSM was intended to comply with the National Flood Insurance Program's (NFIP) Community Rating System (CRS) guidelines for stormwater master plans, and through the 2000 SWMP activities the City would be eligible for additional points. These additional points through the NFIP CRS were intended to provide the City the ability to obtain a lower class rating and thereby allow flood insurance policy holders a rate reduction. The improvements proposed by the 2000 SWMP were primarily intended for stormwater quantity control; water quality improvement was considered secondary.

The following paragraphs describe the individual elements of the 2000 SWMP

2.2.2.1.1. Data Collection and Evaluation

Prior to subbasin prioritization and model development, data were collected for the 9.5 square mile City area to be analyzed by the 2000 SWMP. The Phase I SWMP was used as the basis of analysis for the 2000 SWMP. The 2000 SWMP utilized subbasin delineation, total area, runoff and pollutant loading from the Phase I SWMP for subbasin prioritization calculations. Various other data were obtained from SFWMD and the City for the 2000 SWMP development. Areas affected by major storm events (February, September, and November 1998 and October 15-16, 1999) were toured and data were collected for the purpose of comparative evaluation. The data collected were used to compare the severity of flooding observed versus that of flooding expected for design storms (model calibration).

2.2.2.1.2. Subbasin Problem Identification and Prioritization

Several qualitative and quantitative factors were considered for subbasin ranking including Citizen's Complaint Score (CCS), Drainage Score (DS), Flood Zone Elevations Score (FZES), Flood Problem Severity Score (FPSS), and Water Quality Score (WQS).

The CCS was created by compiling records of historic drainage problems assigning each a qualitative score of severity based on the type of complaint and the action taken to correct the drainage problem. The CSS considered whether an Operation and Maintenance (O&M) solution was provided to address each complaint and effectiveness of the O & M solution provided.

The DS was calculated as a combination of drainage availability and drainage relief. Each subbasin was visually inspected to assess the adequacy of drainage within the area, while anticipated runoff and discharge potential were also considered as measures of drainage relief to generate each DS. It is important to note that the Biscayne Canal, Arch Creek Canal and Biscayne Bay provide most of the drainage relief within the City. Each subbasin relieves its stormwater discharge through a positive drainage pipe into the surrounding water body and fluctuations of these water bodies affect the potential stormwater discharge from the subbasins.

FEMA flood elevations were compared to the lowest road crown elevation within each subbasin to populate the FZESs. The FPSS was calculated considering degree of exceedance of the LOS and an inventory count of exceedances of the LOS for several infrastructure types including habitable structures, several roadway class types and canal banks.

The WQS considered twelve priority pollutants by comparing the pollutant loading (from Phase I SWMP) for each subbasin and also comparing the equivalent pollutant concentration against the then DERM criteria for the pollutant. The WQS considered five-day Biochemical Oxygen Demand (BOD5), Carbonaceous Oxygen Demand (COD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Nitrogen (TN), Total Kjeldahl Nitrogen (TKN), Total Phosphorus (TP), Dissolved Phosphorus (DP), Cadmium (Cd), Copper (Cu), Lead (Pb), and Zinc (Zn). The annual loading for each subbasin was calculated using the following equation:

$$L_x = 2.72 \times EMC \times Q$$

Where:

L_x = annual loading in lb/yr

2.72 = conversion factor

EMC = event mean concentration (i.e., concentration of the pollutant in mg/l)

Q = annual runoff volume

EMCs from the Phase I SWMP were used in the loading calculation.

The individual scores calculated for each of criterion were entered into an equation with the weighted average of each criterion resulting in a rank for each subbasin. The following equation was used to rank the subbasins:

Rank = 0.3 (CCS) + 0.01 (DS) + 0.01 (FZES) + 0.59 (FPSS) + 0.09 (WQS)

Higher ranked subbasins, such as the top-ranked Arch Creek Pump Station basin, were determined to be most critical and highest priority for stormwater capital improvements.

2.2.2.1.3. Model Development and Results

Following subbasin prioritization, the Phase I SWMP subbasins were refined for model development. The refined subbasins retained the subbasin prioritization rank initially assigned to each area. Because the refined subbasins were more detailed and covered smaller areas, there are several subbasins with the same rank. A copy of the resultant priority subbasins figure from the 2000 SWMP is provided in **Appendix A**.

The XP-SWMM model was used to model the stormwater system within the City limits. The existing system model results indicated that most of the system experiences major street flooding for the 5-year, 24-hour design storm event. Iterative model runs were made with various combinations of french drain disposal capacity and/ or pipe size increases to reduce major flooding. Results of the iterative model runs were used to compile the priority list of projects and recommendations.

2.2.2.1.4. 2000 SWMP Priority List of Projects and Recommendations

For the majority of the subbasins, modeling of potential capital improvements suggested that the construction of independent french drain systems would alleviate much of the flooding for the 5-year, 24-hour storm event (7.5 inches). Therefore, approximately 8,500 lineal feet of french drain was proposed for the top 20 priority basins.

For subbasins in the Arch Creek North Basin, french drains would not be sufficient to attain the required LOS. Therefore addition of a major stormwater interceptor pipe was recommended to convey additional flow to the existing Arch Creek Pump Station. Similarly, in the area of 130th Street, east of West Dixie Highway, a major interceptor would be required along with french drains. A copy of the Priority List of Projects from the 2000 SWMP is also included in Appendix A.

2.2.2.1.5. Activities Subsequent to the 2000 SWMP

To date, the City has implemented the majority of the recommendations made as part of the 2000 SWMP. These largely include french drains, exfiltration trenches and some gravity wells. The City has completed design for Basins 12 and 13 and is currently seeking funding for construction of these last remaining alternative improvements recommended in the 2000 SWMP.

2.2.2.2. 2009 City of North Miami Floodplain Management Plan

CDM Smith obtained and reviewed the 2009 City of North Miami Floodplain Management Plan (FPMP). As mentioned earlier, the City currently participates in the NFIP and the NFIP's CRS program allows residents the possibility of receiving a discount on flood insurance. This discount is commensurate with the City's level of participation and implementation of floodplain management and public information activities. Depending on a community's level of participation, the CRS will assign a rate class ranging from 1 to 10. As of October 2009, the City ranks in the top 3 percent of all communities participating in the NFIP, with a class rating of 5; this rating corresponds to a 25 percent discount on flood insurance premiums for properties within the floodplain and a 10 percent discount on premiums for properties outside the floodplain. The FPMP counts as one of these activities. The FPMP itself consists of plan organization, public involvement, coordination with other activities, hazard assessment, problem assessment, goals, review of possible activities, an action plan, and plan adoption. CDM Smith also obtained the most recent re-certification report for the City's CRS program. A more detailed review of the City's FPMP and CRS program is provided in Section 6.

CDM Smith obtained and reviewed the City's Flood Hazard Information Pamphlet, dated 2010. The document is intended for City residents, providing a general explanation of the City's stormwater system, the risk of flooding, the City's flood warning system and provides flood protection tips. Regarding the flood warning system, the City utilizes the National Weather Service to issue flood advisories at least 6 hours prior to, and throughout expected heavy rainfall events. Also, the City dispatches police vehicles through the neighborhoods that may be impacted, using sirens and loud speakers to issue warnings. Designated evacuation routes include US Highway 1 (Biscayne Boulevard), NE 125th Street, NE 135th Street and Interstate 95.

2.2.2.3. Tidal Boundary Condition Investigation, Coastal Systems International Inc. (CSI, 2010)

As part of the work performed by CDM Smith for the City of Miami Beach (CDM Smith, Draft 2010), a report was prepared by Coastal Systems International, Inc. (CSI) on tidal boundary conditions. This report provided recommendations for stillwater conditions to be used within the vicinity of the City of Miami Beach. The report provided recommendations on mean high water (MHW), tailwater elevations and influences of the aforementioned on groundwater levels. Information in the report was extrapolated to support development of boundary conditions for the City of North Miami's modeling update efforts.

2.3. Stormwater Inventory and Neighborhood Surveys

Applicable data from the available project-level as-built drawings and record drawings were incorporated into the digital stormwater inventory GIS coverages and digital stormwater atlas data provided by the City; therefore an exhaustive review of as-builts and record drawings was not performed as part of this effort.

2.3.1. Stormwater Atlas

The City provided a digital stormwater atlas in AutoCAD® and GIS format which includes locations of stormwater features and best management practices (BMPs). Within the stormwater atlas, several types of stormwater structures and BMP features have been identified, including:

- 2,293 City-owned stormwater catch basins (604 catch basins owned by others (i.e., private, state and County));
- 366 stormwater manholes;
- 174 stormwater outfalls (two major) - outfalls to canals, Arch Creek and the Intracoastal Waterway;
- 113 recharge wells;
- 4 pump stations;
- 9.5 miles of exfiltration trench; and,
- 38.8 miles of stormwater pipe.

Also, City catch basin cleaning routes (dated 2006) have been provided in AutoCAD format.

2.3.2. Neighborhood Surveys

The City provided numerous survey files in AutoCAD format, containing stormwater system survey data and roadway elevation data. The extent of these data covers most of the City's PSMS area, and includes catch basin elevations, pipe inverts and roadway elevations in most areas. The coverage area is delineated on **Figure 2-2**. It is important to note that existing survey data was not identified for building structures, channels, or channel bank areas.

2.4. Aerial Imagery and Topographic Data

Aerial imagery for the City was obtained from Bing® Maps Web services, which provides worldwide orthographic aerial and satellite imagery. The Bing® Maps Web services aerial imagery is accessed by ESRI GIS Arcview® directly from the Bing® Maps server. The aerial photography is current (2011/2012) and is routinely updated.

Topographic data were obtained from SFWMD and are represented as a 10-foot digital elevation model (DEM) of bare earth for portions of Miami-Dade County. The DEM was created using data from the 2007 Florida Division of Emergency Management (FDEM) Statewide Coastal LiDAR (Light Detection and Ranging) project delivery blocks flown between July 2007 and April 2008. **Figure 2-3** shows the DEM coverage for the project area. The elevations shown are in the North American Vertical Datum of 1988 (NAVD88). The DEM topography data was supplemented by existing survey data to delineate and refine hydrologic boundaries, develop open channel hydraulic data (cross sections, lengths, roughnessess and slopes). The DEM was also be used to extract data for various other SWMP modeling and evaluation tasks. Elevations within the City generally range from -12.9 ft to 15 ft-NAVD88.

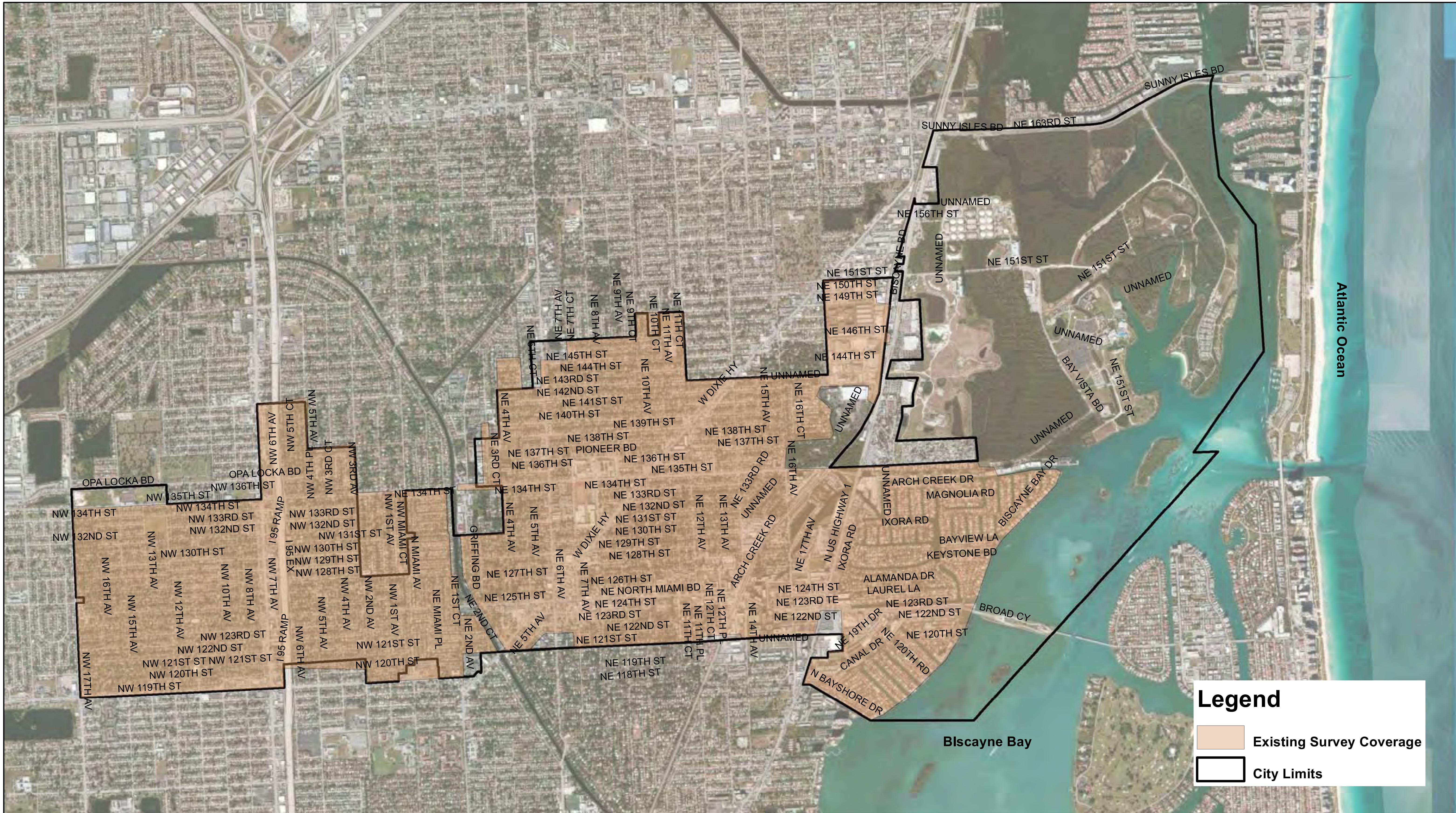
The City currently references all of their data to the 1929 National Geodetic Vertical Datum (NGVD29) but would prefer to be consistent with FEMA's standards for this SWMP update. Therefore all elevations reported in this SWMP update will be referenced to NAVD88.

2.5. Land Use

For the purposes of this SWMP update, land uses provided by the SFWMD for Year 2000 still represent existing land use. The City is approximately 99 percent built out and has had minimal changes to its land use since the previous 2000 SWMP was completed. Therefore, the 2000 land use designations, obtained from SFWMD for the Composite Land Use for the South Florida Water Management Model 2000, are expected to be generally consistent with current land uses. Existing land uses within the City limits, are shown on **Figure 2-4**. Existing land use within the City limits is approximately 40 percent residential, 15 percent water bodies, 14 percent commercial, 10 percent wetland, 7 percent institutional, and the remaining 14 percent is comprised of a variety of other common land use types.

For this SWMP update, the land uses were reviewed and verified with recent aerial photography. The verified land use designations were grouped into categories of relatively homogenous geophysical parameters to be assigned to each subbasin for modeling purposes (Section 3).

Because the City is virtually built-out, future land use composition is projected to be almost identical to the existing land use composition. Therefore, future land use data were not been compiled for this SWMP update.



City of North Miami
Existing Survey Coverage

0 1,250 2,500 5,000 Feet

Figure 2-2

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Data Sources: City of North Miami and Bing® Web Services aerial photography

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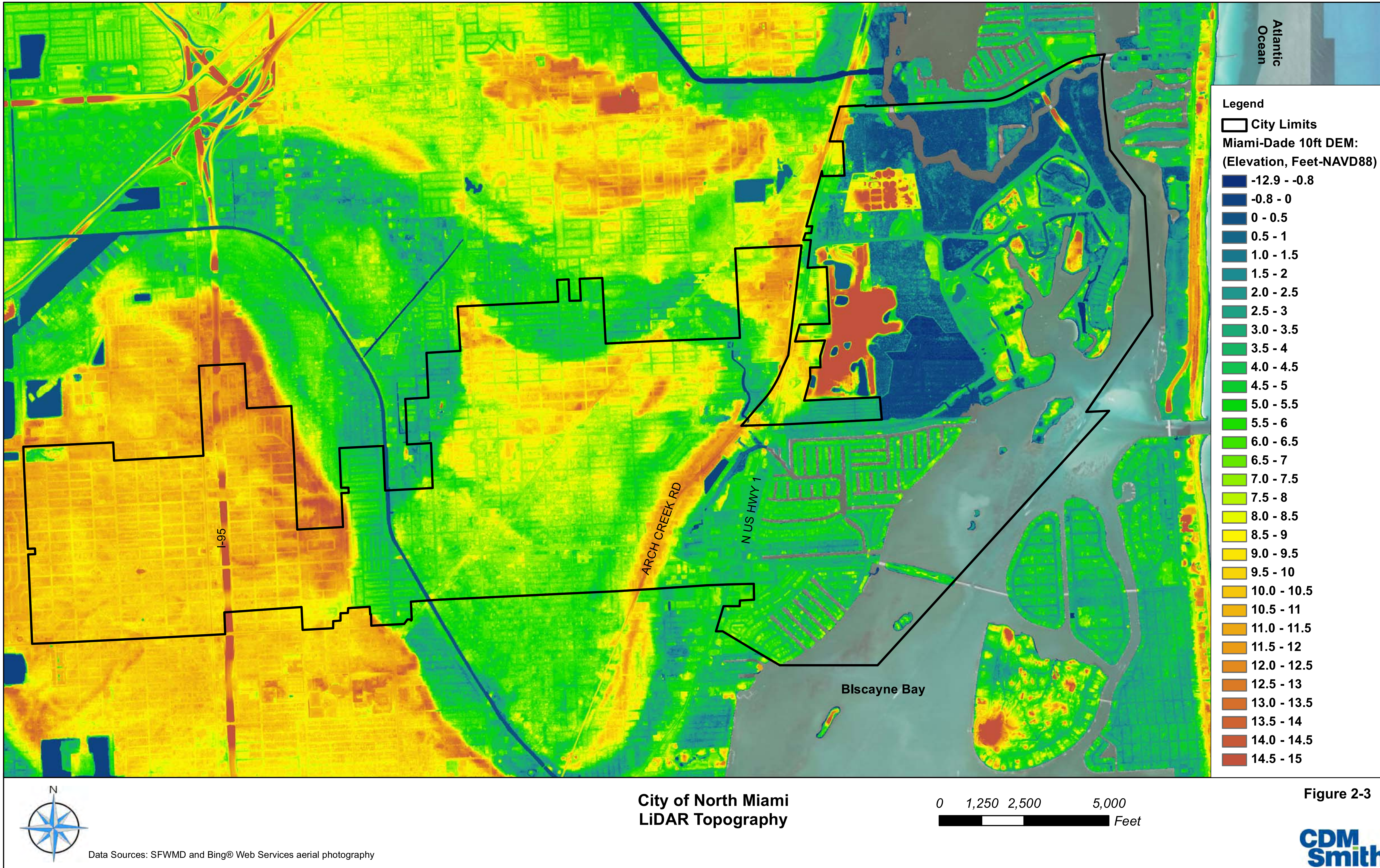

City of North Miami
LiDAR Topography

Figure 2-3

Data Sources: SFWMD and Bing® Web Services aerial photography

CDM Smith

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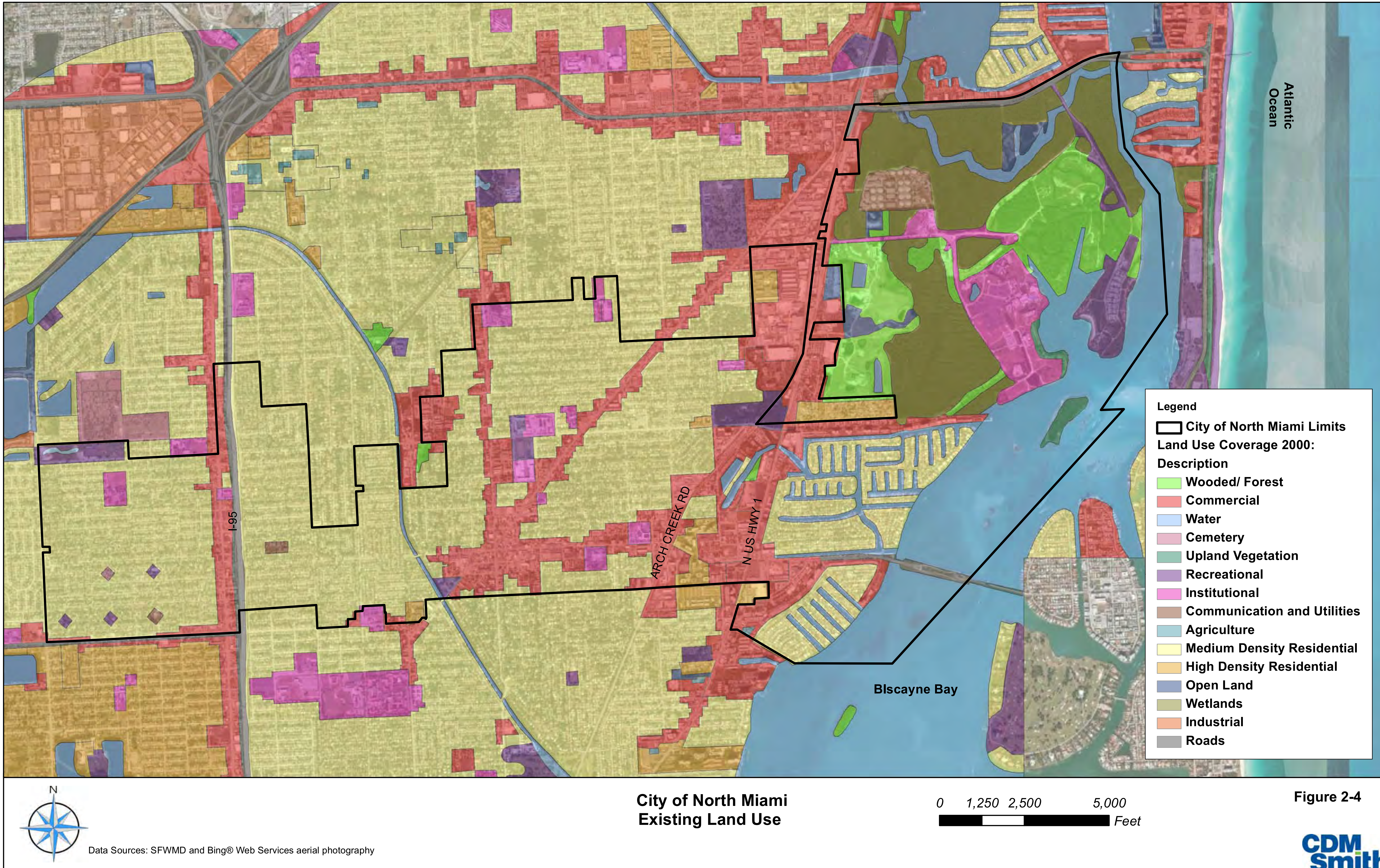

City of North Miami
Existing Land Use

Figure 2-4

Data Sources: SFWMD and Bing® Web Services aerial photography

CDM Smith

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2.6. Soil Parameters

Soil series coverage data and soil boring data are described in the following sections.

2.6.1. NRCS Soils Coverage

Soil series and hydrologic soil group (HSG) data were obtained from the soils coverage developed by the Natural Resources Conservation Service (NRCS) in 2010. HSG and soil series data are utilized to quantify runoff/ infiltration potential within the City for stormwater modeling purposes. HSG designations describe soil characteristics as follows: HSG A is comprised of soils having very high infiltration potential and low runoff potential. HSG D is characterized by soils with a very low infiltration potential and high runoff potential. HSG B and C are designated between the A and D categories. The NRCS soils coverage for the project area is shown on **Figure 2-5**. The majority of the soils within the City are designated as “Urban Land” soil series, which is not assigned a HSG by NRCS. Urban land typically has a large amount of impervious area and is expected to have a high runoff potential.

2.6.2. Soil Borings

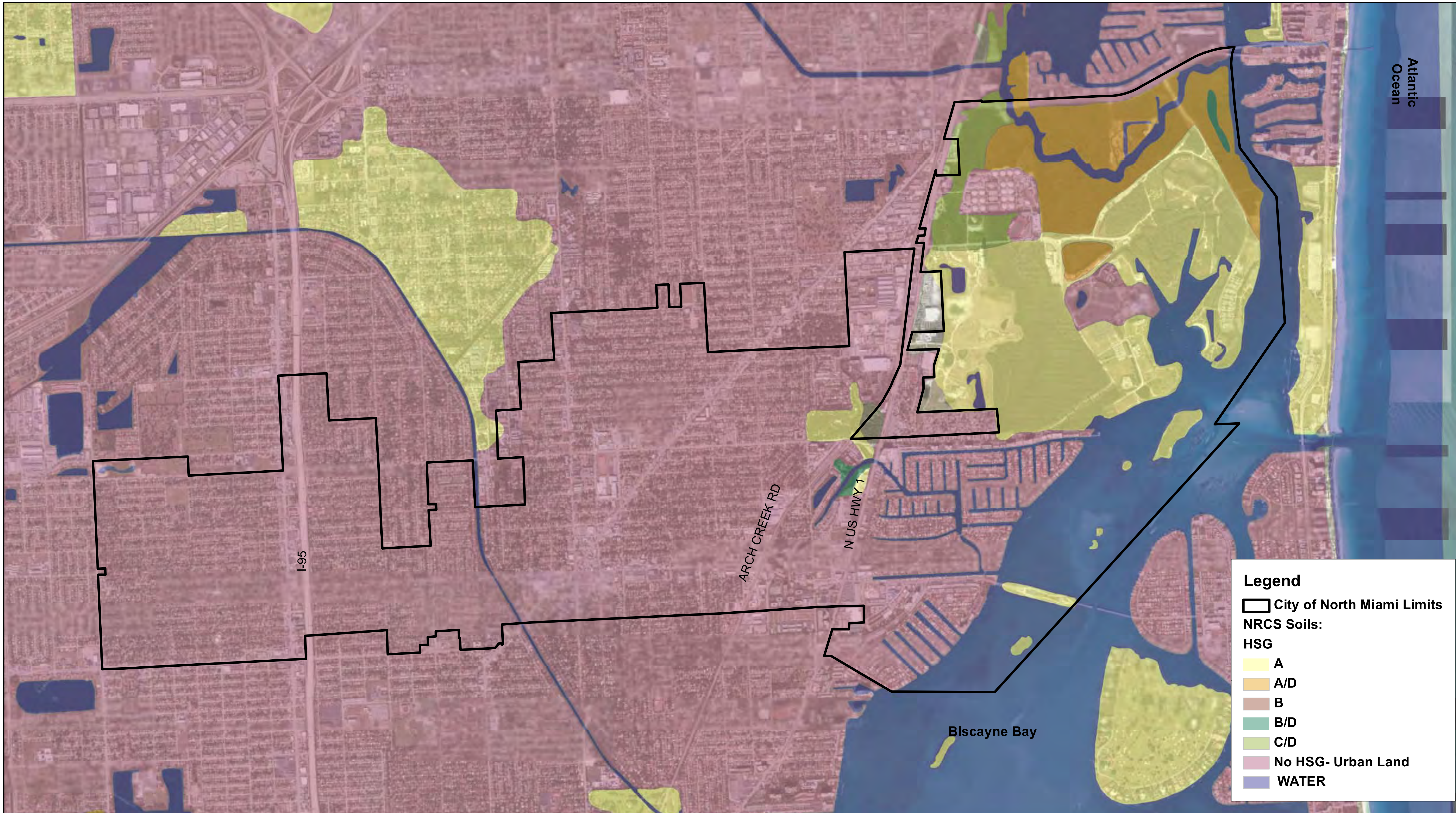
The City has provided soil boring data with percolation test results for approximately 60 locations within the City. The soil borings were performed for City construction projects in June 2000, October 2002 and April 2003 by All State Engineering and Testing Consultants, Inc. Soil boring data indicates (based on 2003 data) that groundwater is generally 8 to 10 feet below ground surface in most areas of the city, but as little as 4 to 6 feet below ground surface in some areas. Natural soils (i.e., located below backfilled soils) are typically sands with good infiltration capacity from 10 to 15 feet below land surface.

2.7. Identified Problem Areas

Up-to-date repetitive property loss data, related to stormwater claims, were provided by the City. The repetitive loss claims file consists of a list of addresses of properties within the City that have experienced personal/ tangible property loss due to flooding. Specifics of repetitive loss information are governed by privacy act laws and therefore will not be discussed in detail in the SWMP update.

Formal stormwater complaint records for the City do not exist. Stormwater complaint data would be valuable to the City over time. Therefore, CDM Smith recommends that City staff begin compiling a database of severe problem areas based on informal stormwater complaints and observation by City staff of recent and historical stormwater problem areas.

Discussions with the City indicated that NE 3rd Court is a historical flooding problem area as it is a low lying area that discharges into a canal. The area is currently serviced by a Miami-Dade County pump station. The 143rd Street and NE 12th Avenue pump station experiences clogging. The City also stated they have had problems at 131st and 123rd Streets where manatees were found in the City’s stormwater infrastructure. These general locations of these problem areas are shown on **Figure 2-6**.



City of North Miami
Soil Classification

Figure 2-5

Data Sources: National Resources Conservation Service (NRCS) and Bing® Web Services aerial photography

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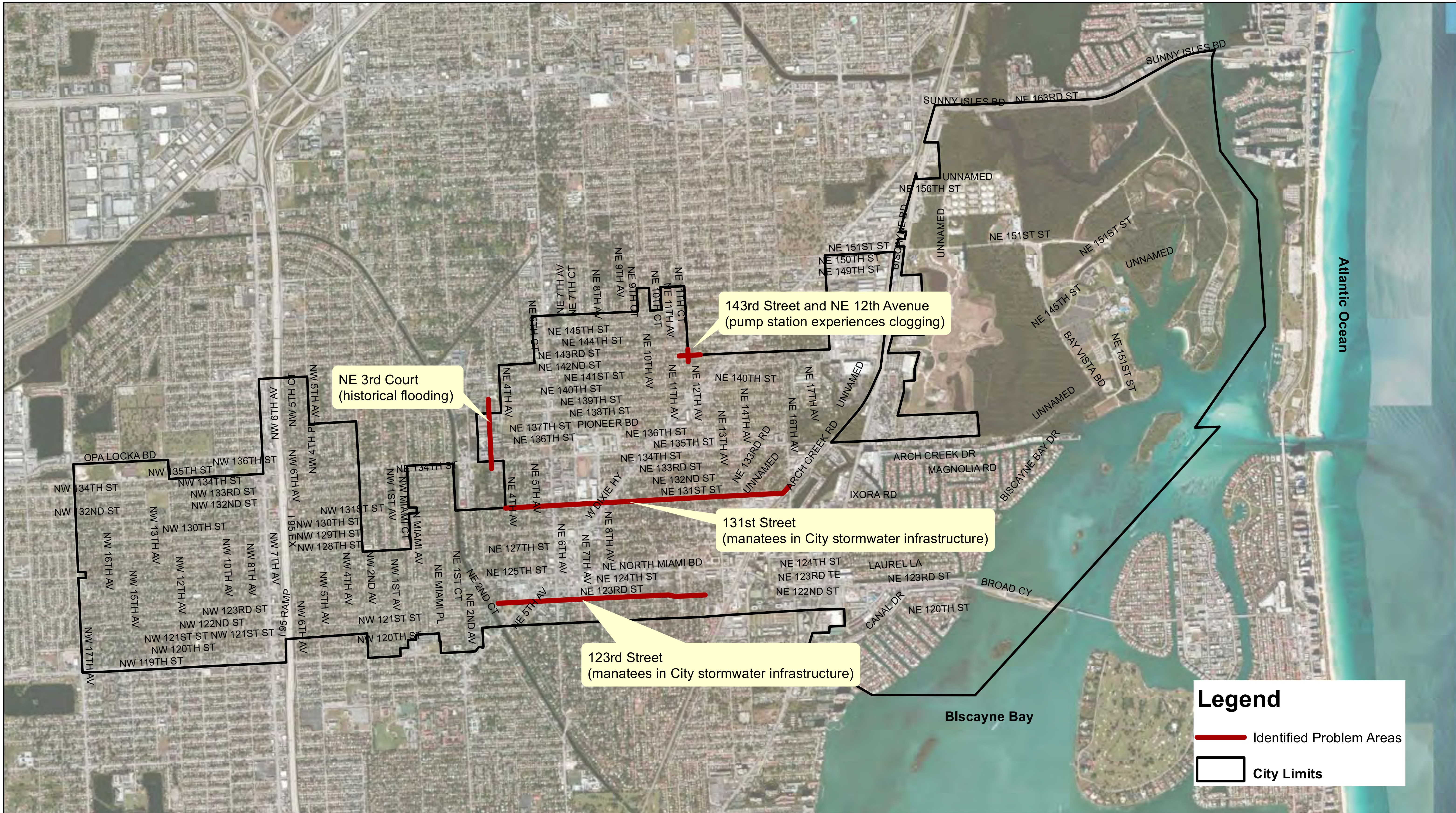

City of North Miami
Identified Problem Areas

Figure 2-6

0 1,250 2,500 5,000 Feet

N

Data Sources: City of North Miami and Bing® Web Services aerial photography

CDM Smith

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2.8. Summary of Data Gaps

Data gaps were identified and are summarized as follows:

- Roadway coverage with attributes to be utilized for roadway LOS designation. This should include roadways designations such as “local”, “collector”, “minor arterial” and “major arterial”;
- In developing this SWMP update, it was observed that not all project-level as-built information has been incorporated into the stormwater atlas;
- Date, source, purpose, and professional surveyor certification for stormwater inventory data and existing surveys. Information was provided from previous surveying efforts. Documentation regarding the certification of this information helps support the accuracy of the data utilized in the development of the SWMP; and
- Existing survey data for building structures, channels or channel bank areas. This information allows for confirmation of structural flooding and boundary conditions related to the canals and channels throughout the City.

Section 3

Stormwater Model Update

This section focuses on the development of the City-wide hydrologic and hydraulic (H&H) model update. As part of this SWMP update, surface water H&H modeling was performed using the US EPA Stormwater Management Model, Version 5 (SWMM5) to estimate and evaluate flooding LOS and alternative solutions to meet LOS.

3.1. US EPA Stormwater Management Model (SWMM)

SWMM is a dynamic hydrologic, hydraulic, and water quality model capable of performing design storm event and long-term continuous simulations of surface rainfall, evaporation, runoff, infiltration and groundwater base flow, hydraulic storage and routing in open channel and pipe systems, water quality, and BMPs. The hydrologic and hydraulic model components of SWMM5 were used for the SWMP update.

The hydrologic component (formerly called RUNOFF) operates by applying precipitation across hydrologic units (HUs), and then through overland flow and infiltration conveying surface runoff and groundwater base flow to loading points in the user-defined stormwater management system. Runoff and base flow hydrographs for these loading points provide input for hydraulic routing in downstream reaches.

The hydraulic flow routing routine of SWMM5 (formerly called EXTRAN) uses a link-node (also called conduit-junction) representation of the stormwater management system to dynamically route flows using the Saint-Venant equation for gradually-varied unsteady flow. The dynamic flow routing considers both storage and conveyance and allows for branched and looped network representation of the following:

- Pipe, culvert, bridge, and open channel conduit conveyance (e.g., overland-street flow, swales, ditches, and canals);
- Surface, lake, underground, and open channel storage;
- Backwater effects and tidal flow reversals;
- Both free surface and pressure flow;
- Local losses for entrances, bends, obstructions, and exits-outfalls;
- Control structures such as weirs, orifices, valves, gates, and pump stations;
- Outfalls as tidal variation, fixed, free, and measured/simulated stage-time boundary conditions;
- Rating curves for special application conduits such as recharge wells and exfiltration systems, connections to other models pump stations, and/or various boundary conditions; and,
- Other special structures/links as needed.

Control rules may be used to operate the structures based on timing and/or stage and flow conditions within the model.

The model schematic for the City's PSMS is presented in **Figures 3-1** through **3-3**. The schematics show the delineation of hydrologic units, conveyance conduits, overland flow channels, storage junctions, and outfall nodes. The schematics provide a visual reference between the physical system and the numerical model. The hydrologic and hydraulic components of the City's PSMS model will be discussed in later sections.

3.2. Stormwater Model Update

The basis for modeling update effort is the XP-SWMM Version 7 model developed by Atkins (formerly known as PBS&J), for the 2000 SWMP. CDM Smith converted the model from the proprietary XP-SWMM format to the public domain SWMM5 format, and updated the hydrologic and hydraulic components of the model to reflect development and improvements implemented in the past decade, as well as to incorporate conduits that were omitted from the original model. The model conversion and update process is detailed in this section.

3.2.1. XP-SWMM Conversion

The XP-SWMM model package, published by XP Software, is a proprietary software package that incorporates the US EPA SWMM hydraulic model engine. The model provides the ability to export XP-SWMM to an US EPA SWMM5 format. However, XP-SWMM stores certain types of input data in a manner that is not fully consistent with the syntax of SWMM5, and these elements sometimes fail to convert correctly, resulting in a loss of model integrity. CDM Smith used the XP-SWMM export tool to perform the bulk of the conversion of the hydraulic component of the model. Following the conversion, a thorough node-by-node and link-by-link comparison was performed to verify that all aspects of the XP-SWMM hydraulic model were properly carried over to the new SWMM5.

3.2.2. Hydrologic Model Updates

The hydrologic component of the 2000 XP-SWMM was developed using the Technical Release No. 55 guidance published by the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture (USDA), commonly known as the "SCS Method". However, the SCS method of runoff estimation is incompatible with the hydrologic (RUNOFF) component of SWMM5. Therefore, the hydrologic component of the model was newly constructed for the purposes of this project.

The hydrologic model component of SWMM5 simulates the rates of runoff generated from HUs using a non-linear reservoir approximation (Manning's equation). Topographic data (Section 2.4), land use (Section 2.5), and soils data (Section 2.6) are used to develop a series of parameters including overland flow width and slope, overland roughness coefficients, initial abstraction, and soil infiltration and storage. The SWMM method uses these parameters to calculate a runoff hydrograph for each HU; these hydrographs are routed to the specified node in the hydraulic model component.

HU delineations developed for the 2000 SWMP were used as the basis for the hydrologic model development. Unit boundaries were modified using the most recent LiDAR topography (Section 2.4). Additionally, several HUs were further subdivided to provide the necessary resolution to model newly-added hydraulic conduits. Several HU boundaries were extended beyond City limits to account for off-site drainage that may be routed through City's PSMS. The purpose of this inclusion was to account for stormwater runoff that is conveyed through different city, county or state maintained

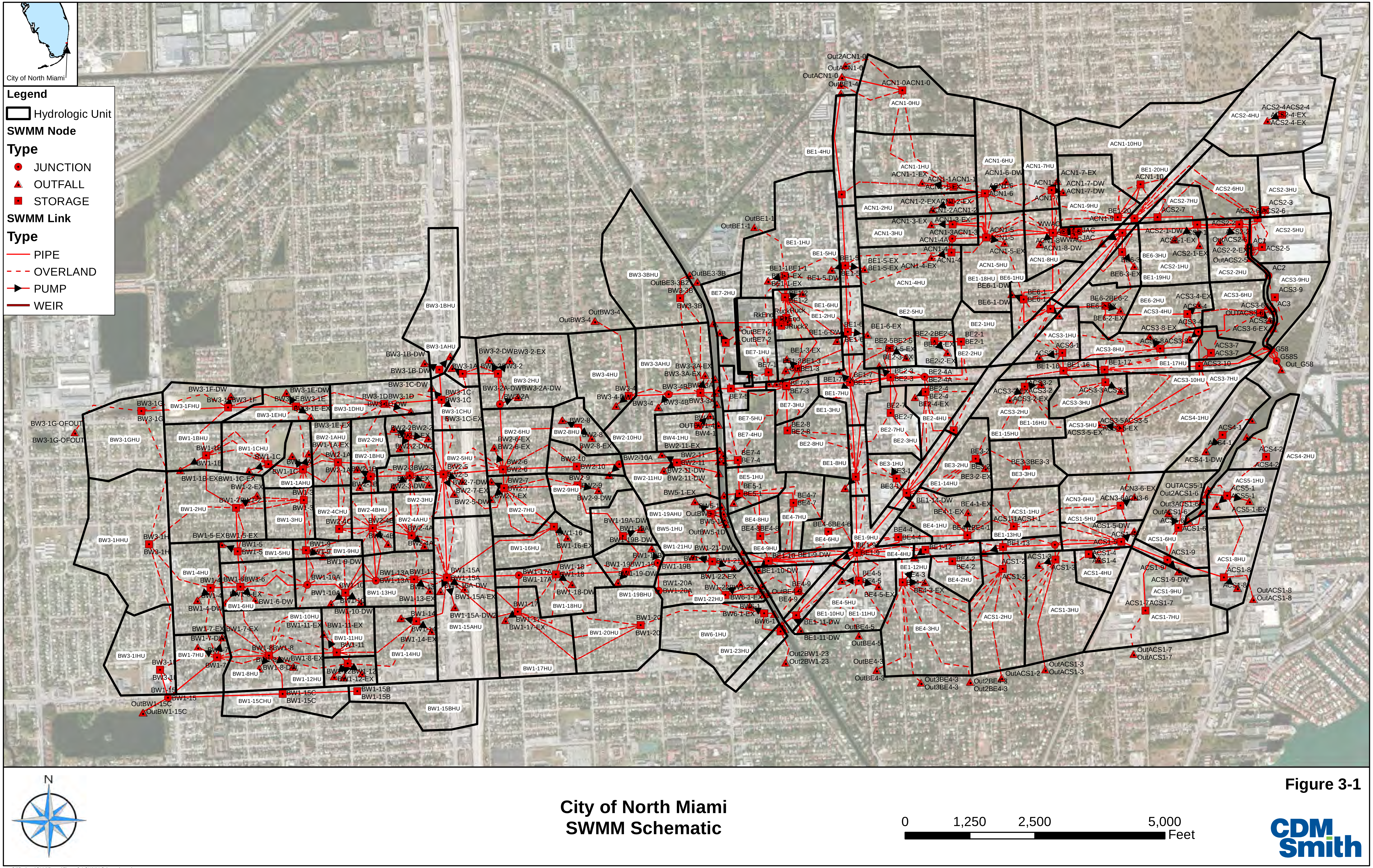

Figure 3-1

City of North Miami
SWMM Schematic

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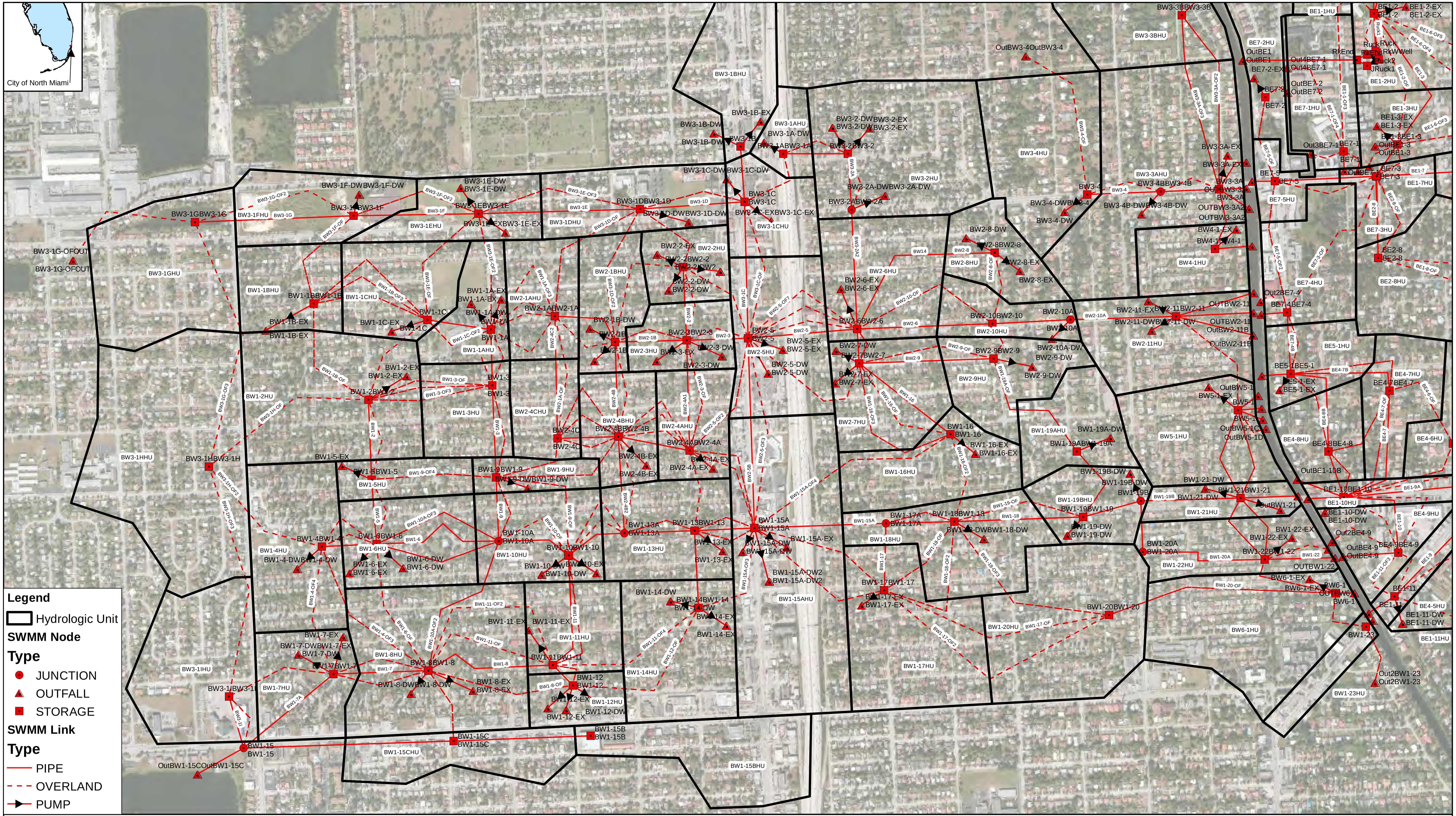

Figure 3-2

City of North Miami
SWMM Schematic - West Section

0 750 1,500 3,000 Feet

C:\Projects\COMB\Report\Figure 2-2 SWMM Schematic West.mxd

Figure 3-3

City of North Miami
SWMM Schematic - East Section

0 1,000 2,000 4,000 Feet

CDM Smith

systems. Runoff from these areas was simulated in order to identify deficiencies and/or improvements that may be the responsibility of entities adjacent to the City (i.e., FDOT, Miami-Dade County, etc.). Overall, the number of HUs increased from 101 in the 2000 SWMP model to 147 in the updated SWMM5. The Oleta, Keystone, and Sans Souci neighborhoods were not modeled explicitly in SWMM since these areas are tidally-influenced and already acknowledged to be low-lying and flood-prone (See **Appendix G**). Updated HU boundaries are shown in **Figures 3-4** and **3-5**. A comparison of the new hydrologic unit boundaries to the HUs of the 2000 SWMP model is presented in **Figure 3-6**. **Table B-1** of **Appendix B** shows the values used in the calculation of the area-weighted overland flow parameters.

Land use data were used to estimate imperviousness, surface friction factors, and initial abstractions for each HU. Existing land use conditions were obtained using the SFWMD land use data (2000), available aerial photographs and field investigations. For this project, the land uses were grouped into six categories of relatively homogeneous geophysical parameters. Present land uses within the City include:

- Open or vacant lots/parks;
- Low density residential;
- Medium density residential;
- High density residential;
- Light industrial and commercial; and,
- Water bodies and watercourses.

Figure 3-7 shows the distribution of land use for the project area. The percent imperviousness of each hydrologic unit is one of the parameters used by the SWMM5 hydrologic model to determine the volume and rate of surface water runoff. A summary of the land use categories is presented in **Table 3-1**. Additionally, the table lists the percent of Directly Connected Impervious Area (DCIA) and the percent of Non-DCIA (NDCIA) assigned to each land use category. The DCIA represents all the impervious surfaces that are directly connected to the stormwater system. The NDCIA represents the impervious surfaces that have a pervious buffer prior to discharge into the stormwater system. Based on this information, the area-weighted average percent imperviousness for each hydrologic unit was computed using the percent of each land use category within a HU for existing land use conditions. Table 2-1 lists land use types and the corresponding hydrologic parameters.

Based on discussions with the City and review of current aerial photography, the 2000 SFWMD land use data also represents present land use. Due to the near built-out conditions of the City, CDM Smith made minor adjustments where needed to the 2000 land use data to represent current conditions. For this reason, future land use conditions were not simulated.

Each soil type was assigned a soil series and a hydrologic soil group (HSG) designated by NRCS. HSG “A” is comprised of soils having very high infiltration potential and low runoff potential. Hydrologic HSG “D” is characterized by soils with a very low infiltration potential and a high runoff potential. HSGs “B” and “C” are designated between these two categories. For the purposes of this study, dual class soil groups were initially assigned to the more conservative value (lower infiltration potential).

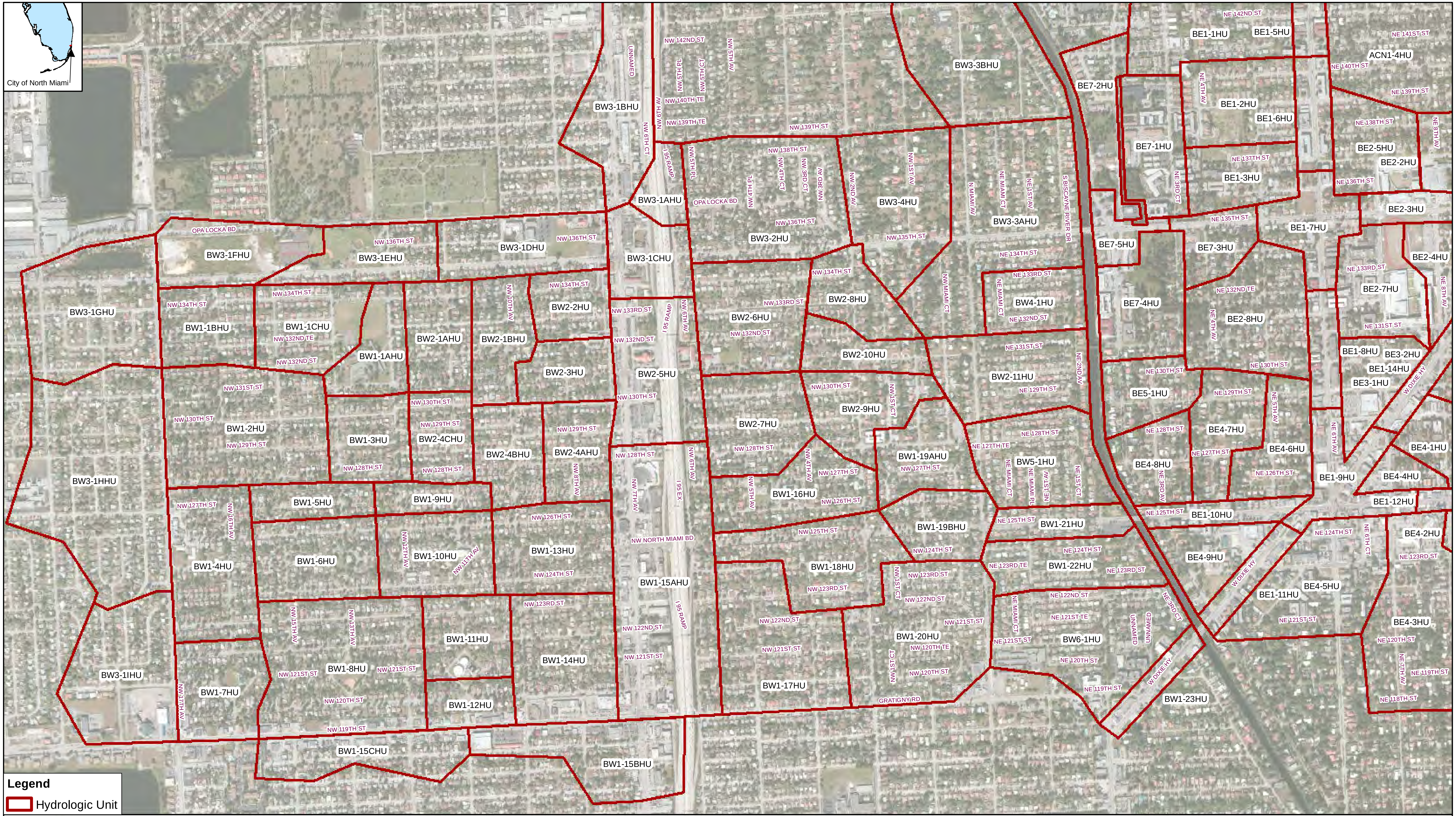

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Figure 3-4

City of North Miami
Hydrologic Units - West Section

0 750 1,500 3,000 Feet

CDM Smith

C:\Projects\COMB\Report\Figure 3-4 Subbasins West.mxd

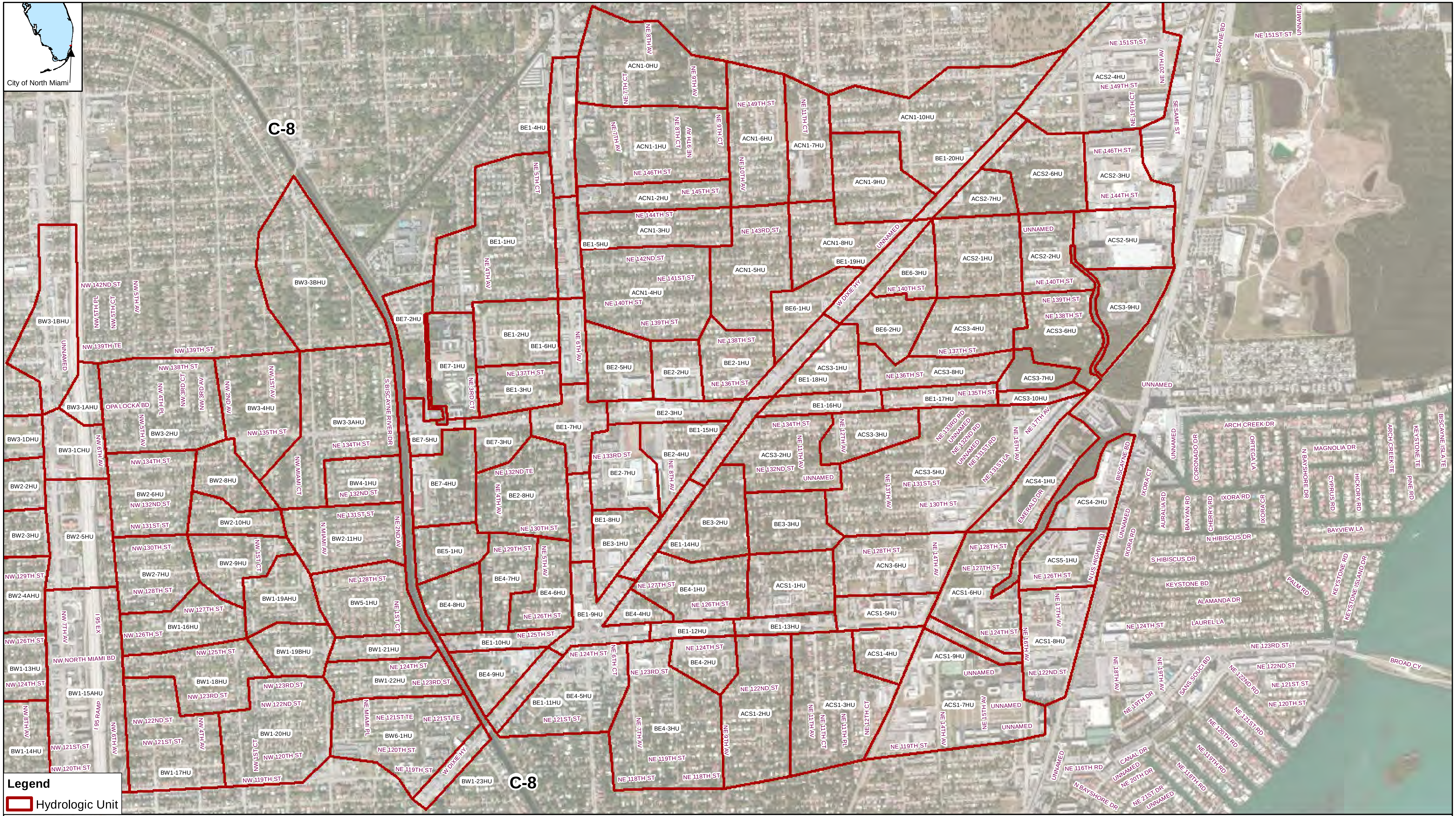

Figure 3-5

City of North Miami
Hydrologic Units - East Section

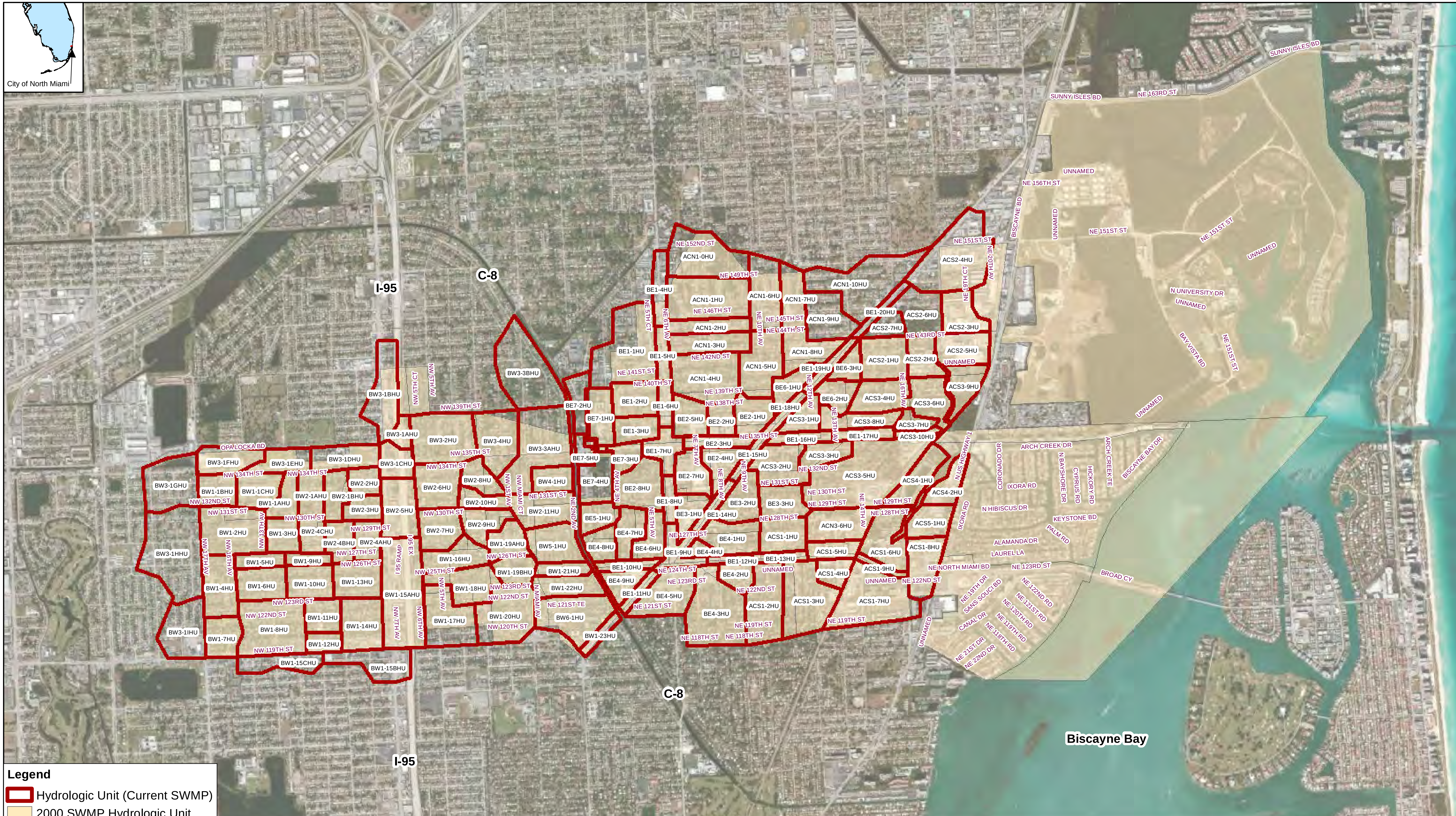

Figure 3-6

City of North Miami
Hydrologic Units (Comparison)

0 2,550 5,100 10,200 Feet

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CDM Smith

C:\Projects\COMB\Report\Figure 3-6 Subbasins Compare.mxd

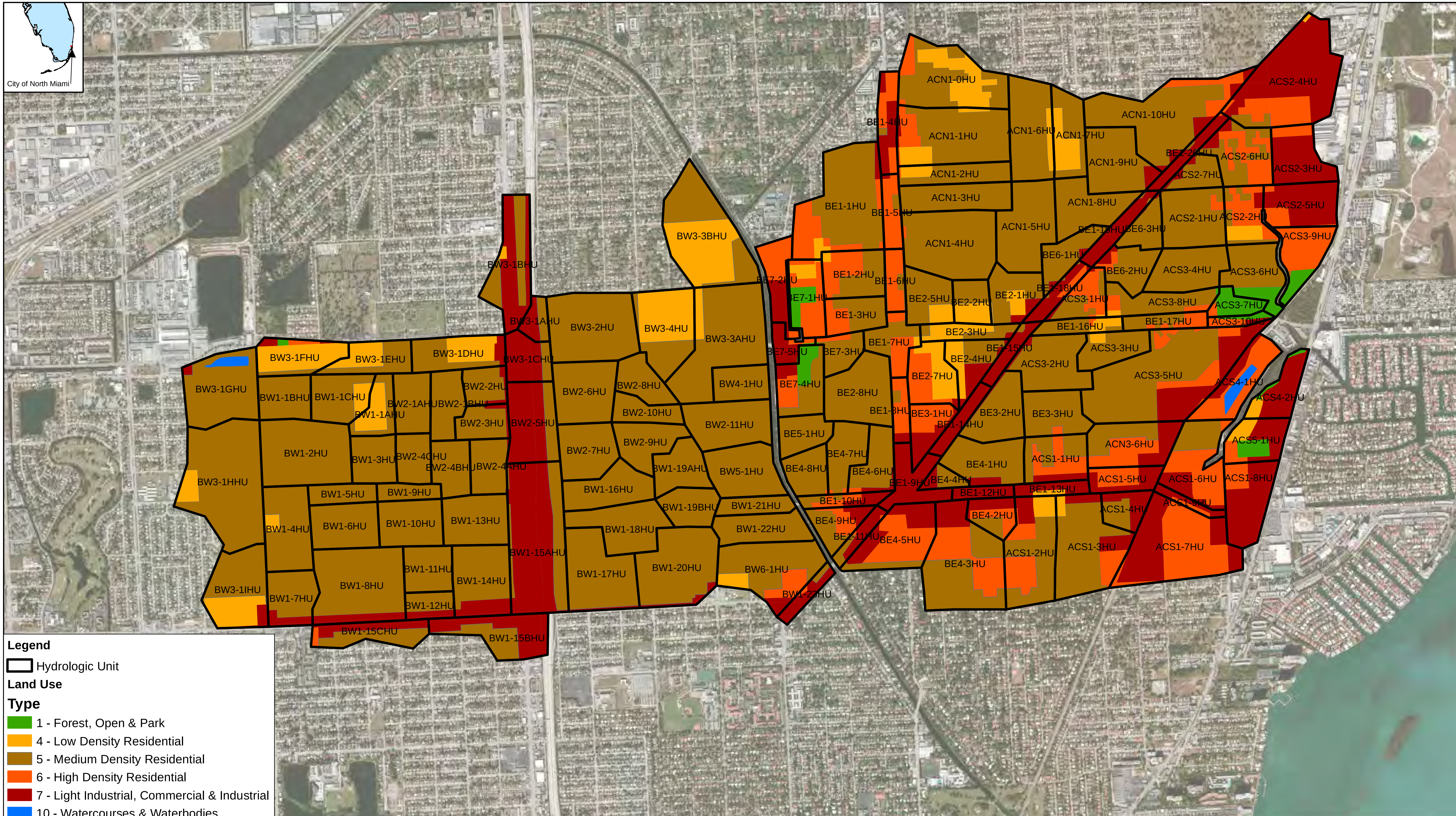

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Figure 3-7

City of North Miami
Land Use

0 1,250 2,500 5,000
Feet

CDM Smith

C:\Projects\CNM\Report\Figure 3-7 Land Use.mxd

Table 3-1 Hydrologic Parameters by Land Use

Parameter/ Land Use Category	Open /Park	Golf Course	Low Density Residential	Medium Density Residential/ Single Family	High Density Residential Low-Rise	Light Industrial/ Commercial	Heavy Industrial	Wet-lands	Water Bodies
% Impervious	5.0	5.0	15.0	35.0	82.0	90.0	90.0	100.0	100.0
% DCIA	1.0	1.0	7.5	23.0	65.0	81.0	81.0	100.0	100.0
Impervious Manning's n	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.300	0.024
Pervious Manning's n	0.40	0.300	0.250	0.250	0.250	0.250	0.25	N/A	N/A
Impervious Initial Abstraction (inches)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.50	0.10
Pervious Initial Abstraction (inches)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	N/A	N/A
% Impervious	5.0	5.0	15.0	35.0	82.0	90.0	90.0	100.0	100.0

Soil group percentages for each HU were estimated by overlaying a map of the HU boundaries on the NRCS soil map. From the overlay map, the percentage of each soil group within a HU was estimated using GIS tools. The infiltration database was developed using the Horton equation soil parameters. As previously described in Section 2.6, many locations in the NRCS soil survey did not contain a soil group classification for hydrologic group. For this reason, soils were re-classified based on elevation and proximity to the average wet season groundwater table. Land elevations greater than 12.0 ft-NAVD were designated as Class A soils. Land elevations greater than 10.0 ft-NAVD but less than 12.0 ft-NAVD were designated as Class B soils. Elevations greater than 8.0 ft-NAVD but less than 10.0 were designated as Class C soils and elevations 8.0 ft-NAVD or less were designated as Class D soils. **Figure 3-8** shows the re-classified soil distribution based on the hydrologic soil group classification and elevation. **Table B-2** of **Appendix B** tabulates the soil classification by percentage for each hydrologic unit. The re-classified soils were then used to determine weighted Horton soil characteristics including maximum and minimum infiltration rates, and soil storage.

The Horton infiltration equation option in SWMM5 was used to calculate the rate and volume of water that infiltrates into the soil. Based on this equation, infiltration is computed as:

$$f_t = f_{min} + (f_{max} - f_{min})e^{kt}$$

where:

ft = the infiltration capacity of the soil (in/hr) at time t;

fmin = the minimum (or final) infiltration capacity (in/ hr);

fmax = the maximum (or initial) infiltration capacity (in/hr);

k = an exponential decay constant (hr-1); and

t = time (hr).

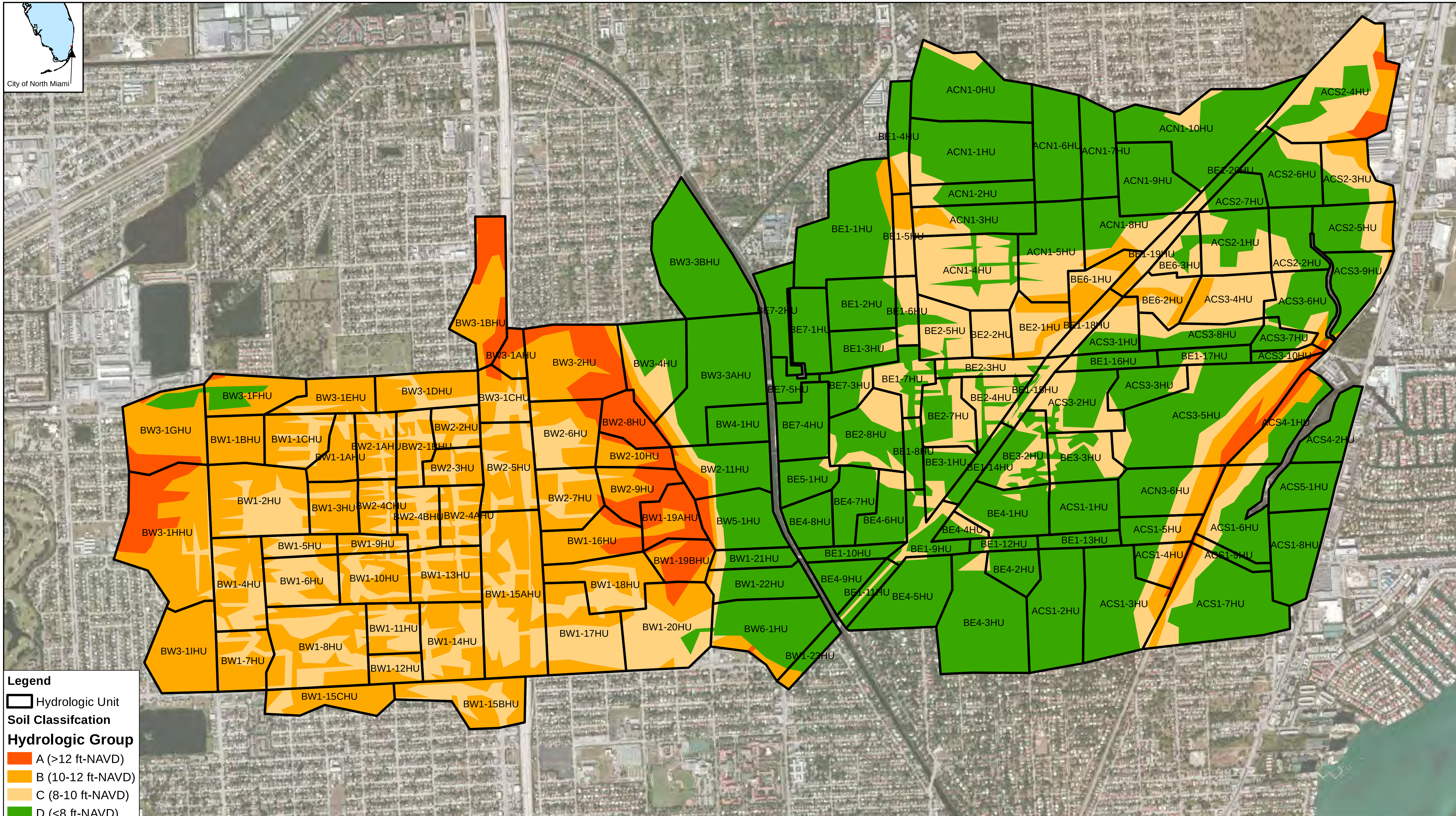

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Figure 3-8

City of North Miami
Soil Classification

0 1,250 2,500 5,000
Feet

CDM Smith

C:\Projects\COMB\Report\Figure 3-8 Soils.mxd

The decay constant, k, is an empirical parameter that controls the rate of decrease in infiltration capacity during a rainfall event. The infiltration rate is expected to decrease exponentially from the maximum capacity down to the minimum capacity. For example, a lower decay constant gives a slower rate of decrease in infiltration capacity, and a higher decay constant forces the infiltration capacity to reach its minimum value more quickly.

Area-weighted infiltration parameters were computed based on the percentage of each HSG within each HU. Infiltration parameters are weighted by the proportion of pervious and NDCIA surfaces in each hydrologic unit. Although no infiltration occurs over NDCIA surfaces, the resulting runoff is directed to an infiltrating pervious surface area. The average depth to groundwater table was estimated for each HU based on a long-term average from groundwater monitoring wells. Data from the August 2000 edition of the SFWMD Basis of Review for Environmental Resource Permit (ERP) Applications was used to estimate the available soil storage capacity based on depth to the groundwater table. Soil storage varies depending on antecedent moisture condition (AMC). This model uses average wet season antecedent moisture condition (AMC II), which may be defined as the soil condition when the previous 5-day rainfall volume totals between 1.4 and 2.1 inches. Using this condition produces conservative results that might be typical of wet season rain events. **Table 3-2** below displays the soil parameters by soil type (hydrologic group) for the AMC II.

Table 3-2 Global Soil Parameters

Soil Type	Max Infiltration Rate (in/hr)	Min Infiltration Rate (in/hr)	Decay Rate (1/sec x 10-4)	Dry Time (days)	Soil Storage (in)
A	12.0	1.00	5.56	1.0	6.75
B	9.0	0.50	5.56	1.0	5.0
C	6.0	0.25	5.56	1.0	3.8
D	4.0	0.10	5.56	1.0	1.4

The percent by area of each soil type within a HU is combined with the global parameters to calculate each HU's specific infiltration parameters. Groundwater was considered in the hydrologic model by use of infiltration rates and soil storage. SWMM5 considers increasing groundwater elevations and saturated conditions when groundwater rises to land surface. Surficial aquifer groundwater parameters were used for evaluations of recharge wells and exfiltration systems.

3.2.3. Hydraulic Model Updates

The hydraulic components of the 2000 XP-SWMM was updated to include new stormwater collection and conveyance system components constructed by the City since the original model development. The model updates also include older system elements that were previously not included in the original model. Hydraulic parameters for these conduits, including length, material (for culverts and lined channels), inverts, and minor losses, were obtained from the stormwater inventory and neighborhood surveys.

Several conduits in the City limits within Florida Department of Transportation (FDOT) right-of-way were not included in the original model and have been incorporated into this model update. Several of these FDOT conduits were identified from available AutoCAD® files, but were lacking hydraulic parameters in the City's stormwater inventory. For these conduits, the following assumptions were made:

- Conduits draining comparatively larger tributary areas are estimated to have an 18-inch diameter;
- Conduits draining comparatively smaller tributary areas are estimated to have a 15-inch diameter;
- Manning's roughness coefficient is assumed to be 0.014; and,
- Conduit slope is assumed to be approximately one foot per 1,000 feet (0.001).

Limited information was available on Miami-Dade County stormwater infrastructure within or adjacent to City systems. CDM Smith relied upon information from the City regarding County-owned systems and their functionality.

For documented systems, overland flow conduits were added to the model to allow for simulation of flow over street surfaces and within floodplains when surcharged conduits are predicted to exceed grate/manhole elevation (for storm sewers), top-of-road (for culverts at road crossings), or top-of-bank (for open channels). These conduits were modeled as open channels with irregular cross-sections; one cross-sectional transect was developed per open channel segment using the LiDAR topographic data, with elevations taken at 10-foot intervals along the transect.

The SWMM5 update contains 516 links and 371 nodes, 154 of which are storage nodes. **Tables B-3** through **B-5** of **Appendix B** provides the hydraulic model input data by link and by node.

Stage-storage-area relationships were computed for each storage node using the combined topography from the surveys with LiDAR. The stage/area relationships at 0.5 or 1.0 foot intervals of depth above node invert were calculated from the surface as appropriate. Not all HUs have related storage junctions as some HUs have no storage beyond that which is represented in the model links.

Exfiltration trenches (also called french drains) are utilized throughout the City as a stormwater BMP. In the SWMM5, exfiltration flows were estimated using guidance provided in the Environmental Resource Permit Information Manual, Volume IV (SFWMD, 2011). The exfiltration trench length for each basin was estimated from the GIS inventory and hydrologic conductivity of soils from soil boring logs, both provided by the City. Wet season groundwater table was estimated from historical data for four USGS monitoring wells located within the City. Exfiltration trenches were modeled to replicate the SFWMD equations for saturated and unsaturated sections of trench as stage-flow relationships (pumps) that turn on at a specified depth where there is sufficient driving head to facilitate exfiltration. An equivalent pump representation for the exfiltration capacity is connected to a SWMM node and discharges to a free outfall representing a subsurface formation. The rating curves were developed using the SFWMD methodology to determine the appropriate length of trench needed to provide a given treatment volume for a set of trench parameters. In this case, the rating curve was estimated per unit length of trench, and the treatment volume and associated flow rate vary for a given set of trench parameters.

The flow rate may be calculated as:

$$\delta = K_s H_2 W = +2K_s[D_u(H_2 - 0.5D_u) + D_3 H_2$$

Where:

δ = flow rate per foot of trench (cfs/ft);

K_s = hydraulic conductivity of the soils in cfs/ft^2/ft of head (note that the SFWMD PIM simply uses K, where K_s is used here to differentiate from other K values such as hydraulic losses);

H_2 = depth to water (ft);

W = width of the trench;

D_u = unsaturated trench depth (ft); and

D_s = saturated trench depth (ft).

Table B-6 of **Appendix B** summarizes the estimation of exfiltration flows for each hydrologic unit.

Recharge wells (i.e., shallow auger wells) throughout the City were likewise included in the SWMM5 update. These gravity wells were simulated using a pump and outfall; a flow of 1.5 cubic feet per second (cfs) was used for each well, to commence when the model stage exceeded one foot above grade, in order to account for the hydraulic head required for the gravity well to attain full flow.

Pump stations were represented by stage-flow links connected to an inflow storage node that serves as the wet well. The outflow section of the link is connected to a node that serves as an outfall or force main to an outfall. In the SWMM5 update there is one type (Type 3) of pump utilized for the modeled pump stations. The Type 3 is an in-line pump where flow varies continuously with head difference between the inlet and outlet nodes.

Stormwater outfalls have been included in the SWMM5. These are modeled as pipes, overland flow links or pumps discharging into receiving waters. Typically for master planning purposes, a 1-year tidal stillwater flood stage is used as a boundary condition with rainfall design storms. Per the Federal Emergency Management Agency (FEMA), the stillwater elevation is the maximum storm-induced water-surface elevation, primarily a combination of the normal astronomic tide and the storm surge. Stillwater elevations do not include the effect of waves. To obtain the 1-year tidal stage boundary condition, a regression analysis was conducted from the stillwater elevations published in the current FEMA FIS (2009). The stillwater elevations were shown in the FIS at various transects along the shoreline of Miami-Dade County. **Figure C-1** in **Appendix C** provides an excerpt from the FEMA FIS showing a transect location map. Transect 8 provides stillwater elevation information for the City of North Miami. **Table 3-3** provides the stillwater elevations at Transect No. 8 for the 10-, 50-, 100- and 500-year floods. **Appendix B** includes supporting information for this evaluation.

Table 3-3 FEMA Stillwater Elevations at Location Transect No. 8

Stillwater Elevations (ft-NAVD)			
10-Year	50-Year	100-Year	500-Year
5.5	6.0	6.3	7.2

Source: FEMA Flood Insurance Study September 2009

A power curve regression was computed using the FEMA stillwater elevations for the 10-, 50-, 100- and 500-year floods. Based on the available transect data, power regression equations were derived to describe the curve and understand how the regression line fits the existing data points. The regression equation was then used to extrapolate events (e.g., 1-year stillwater) outside of a given data range. The power curve regression reported the extrapolated 1-year tidal stage for Biscayne Bay Transect No. 8 as approximately 4.6 ft-NAVD (6.1 ft-NGVD) with a coefficient of determination (R2) value of 0.985. The one-year stillwater was not used as a boundary condition because the initial water level greater than 4.0 ft-NAVD would have resulted in the assumption of many locations being flooded at the beginning of the simulation. Instead, other data were used, as explained below.

Measured tidal data from NOAA's website were not available for any of the North Miami outfalls to Biscayne Bay. However, utilizing historical predicted/measured data from Virginia Key and predicted tidal data for Indian Creek Golf Club just across Biscayne Bay, a mean high tide of 1.0 ft-NAVD was estimated for North Miami. There are two surface water bodies managed by the SFWMD, Arch Creek and the C8 canal that serve as outfalls for the City North Miami stormwater system. Historical data at Structure G58 for Arch Creek and S28 for the C8 canal were also utilized in estimating determining tailwater conditions for the model. Based on this review, the design storm simulations use a fixed stage boundary condition of 1.0 ft NAVD, the estimated mean high tide.

3.2.4. Model Validation

Model validation refers to reviewing model results, comparing them to expected, reasonable values or those measured in the field during an actual rainfall event. Model parameters are adjusted as needed to better match measured or field conditions. This exercise serves as verification of the model results, and helps to establish model reliability.

The SWMM5 results for the City's PSMS were checked against limited available data from the City for flooding locations during an unnamed storm event that occurred on October 3, 2000. Rainfall was highly variable as measured from three different SFWMD rain gauges and ranged from 11.5 to 15.1 inches over 48 hours as shown on **Figure 3-9**. The rain volume for the "No Name" storm within City limits was interpolated to be 13.5 inches. **Figure 3-10** shows the approximate extent of ponding locations as noted by the City. Depths and duration of flooding were not available. SFWMD operates a gated structure on Arch Creek. This gate was opened just after the peak of the storm. For this reason, SWMM5 results are tabulated for three scenarios to check for varied results based on gate operations. The model results shown in **Table D-1** of **Appendix D** generally match the ponding locations.

3.3. Design Storm Simulations

Once the SWMM5 model was validated, CDM Smith then initiated the design storm event simulations. Rainfall data were used to generate stormwater runoff hydrographs for each HU represented in the design storm event hydrologic model. Design storm events are usually designated to reflect the return period of the rainfall depth and the event duration. For example, a 25-year, 72-hour design event describes a rainfall depth over a 3-day period that has a four percent (1/25) chance of occurring at a particular location in any given year.

Table 3-4 summarizes storm rainfall volumes used for the SWMM5 design-storm event simulations taken from the SFWMD Basis of Review for Environmental Resource Permit Applications (March 2009). The standard SFWMD rainfall distributions were used for the 24-hour and 72-hour periods. The rainfall hyetographs for the production simulations are shown in **Figures E-1** through **E-5** of **Appendix E**.

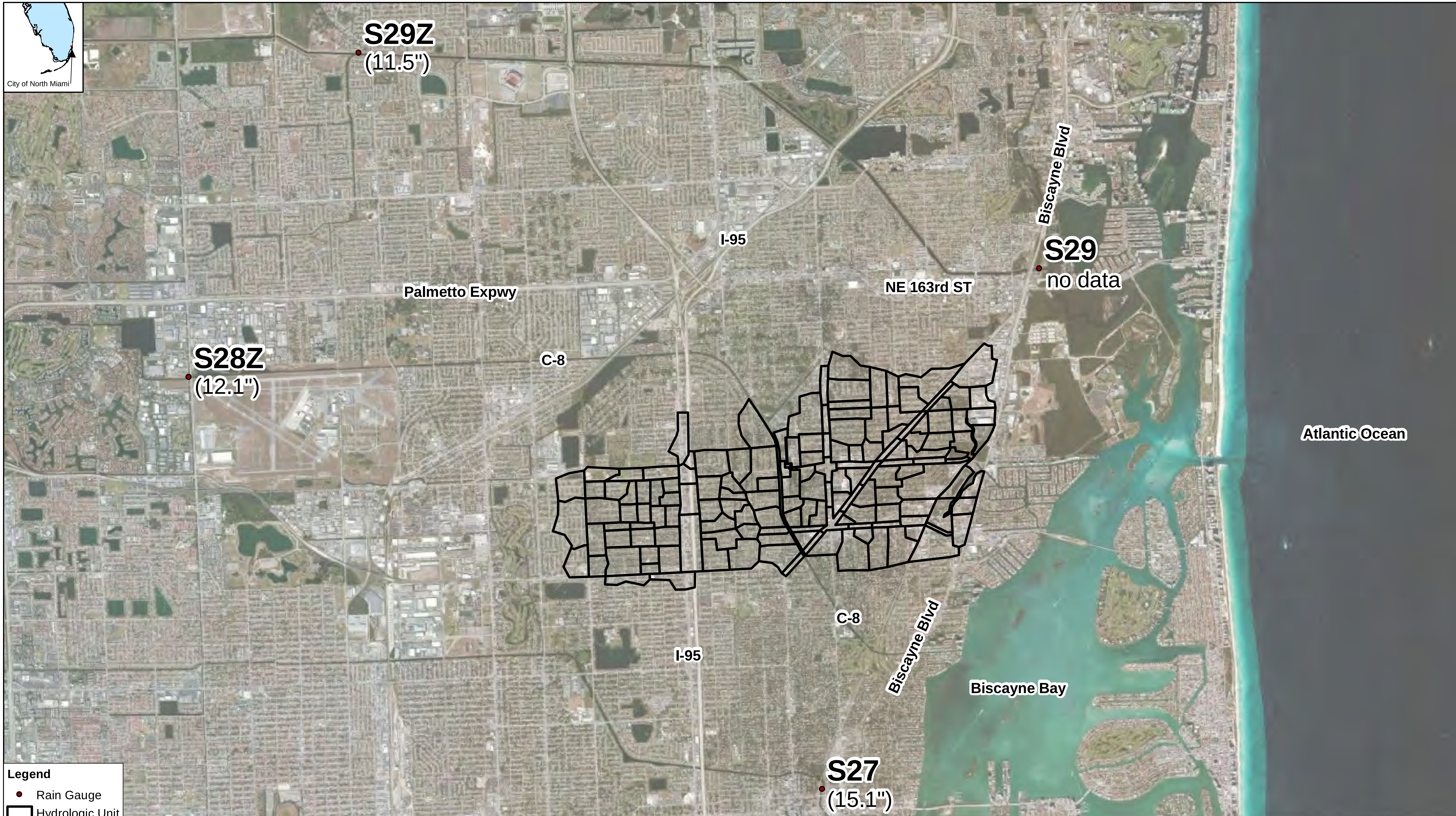

Figure 3-9

City of North Miami
SFWMD Rain Gauge Locations, Precip Totals
Validation Storm October 3, 2000

CDM Smith

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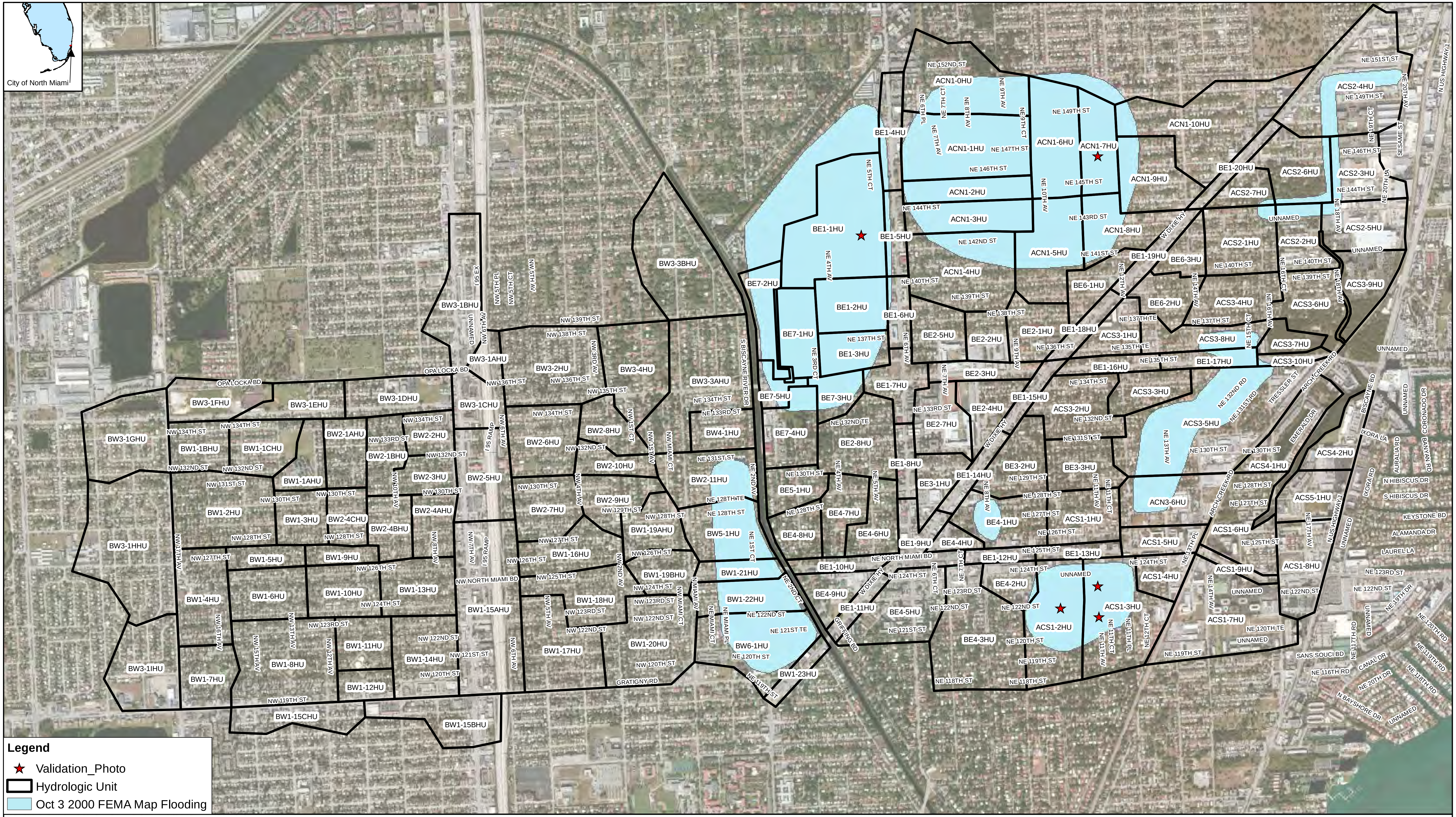

N

City of North Miami
Model Validation Locations
October 3, 2000 Storm Event

0 1,250 2,500 5,000 Feet

Figure 3-10

C:\Projects\CNM\Report\Figure 3-10 Validation Storm Oct 3 2000.mxd

Table 3-3 Rainfall Depths for Design Storm Simulations

Design Storm Event	Rainfall Volume (in)
2-year, 24-hour	4.2
5-year, 24-hour	5.9
10-year, 72-hour	9.9
25-year, 72-hour	11.0
100-year, 72-hour	14.0

3.3.1. Level of Service (LOS)

The primary purposes of LOS criteria are to protect public safety and property. Program goals are to maintain passable roads for emergency and evacuation traffic, and control flood stages below homes and buildings as practicable. The LOS criteria are first used to identify and define potential problem areas using the stormwater model developed for this study. The LOS criteria are then used to evaluate the effectiveness of improvements. LOS decisions directly affect the size and cost of proposed improvement alternatives.

Some older sections of the City's stormwater management system may provide inadequate flood protection of streets and provide little or no treatment of runoff prior to discharge. The LOS for the stormwater management system establishes the performance standard, and LOS can vary for new development versus retrofit conditions where various physical and cost constraints can create a situation of diminishing returns. The City's current LOS was established in the 2000 SWMP and uses the PERA standard shown in **Table 3-5**:

Table 3-4 PERA LOS Definition

Type of Infrastructure	Design Storm Event	LOS Criteria
Biscayne Canal (Primary)	100-Year	Top of Bank
Miami-Dade County Canals (Secondary)	25-Year	Top of Bank
Residential, commercial and public structures	100-Year	15 feet from front step
Principal Arterial (Evacuation Routes)	100-Year	Impassable at 8 inches above top of crown
Minor Arterial (4-lane roads in high traffic areas)	10-Year	To outer edges of traffic lanes
Collector Roads (2-lane roads on residential and commercial areas)	5-Year (except 10-year for a bridge or culvert in the canal system)	To crown of street
Local roads (residential roads)	5-Year	To crown of street or within 15 feet of occupied structure, whichever is lower
Biscayne Canal (Primary)	100-Year	Top of Bank
Miami-Dade County Canals (Secondary)	25-Year	Top of Bank
Residential, commercial and public structures	100-Year	15 feet from front step

Type of Infrastructure	Design Storm Event	LOS Criteria
Principal Arterial (Evacuation Routes)	100-Year	Impassable at 8 inches above top of crown
Minor Arterial (4-lane roads in high traffic areas)	10-Year	To outer edges of traffic lanes
Collector Roads (2-lane roads on residential and commercial areas)	5-Year (except 10-year for a bridge or culvert in the canal system)	To crown of street
Local roads (residential roads)	5-Year	To crown of street or within 15 feet of occupied structure, whichever is lower

Source: City of North Miami Phase II Stormwater Master Plan (Atkins, 2000)

In order to simplify the LOS evaluation, the following criteria were applied:

- Road Class No. 1: Emergency (LOS for these locations will only be evaluated for the 100-year simulation);
- Road Class No. 2: Arterial (LOS for these locations will be evaluated at the road crown for the 5-year 24-hour simulation and 10-year 72-hour simulations); and,
- Road Class No. 3: Local (LOS for these locations will be evaluated at the road crown for the 5-year 24-hour simulation).

3.3.2. Design Storm Event Modeling Results

The City's validated PSMS model was evaluated using SWMM5 under existing land use conditions for the following purposes:

- Evaluate design storm simulations of the 2-yr, 24-hour; 5-yr, 24-hour; 10-yr, 72-hour; 25-yr, 72-hour and 100-yr, 72-hour events. The design storm simulations were performed for the existing hydrologic and hydraulic conditions;
- Locate and prioritize water quantity (flooding) problem areas within the City; and,
- Perform alternative improvement evaluations (see Section 5).

Figures 3-11 through **3-14** show the locations predicted by the model that do not meet the LOS criteria for the 2-year, 5-year, 10-year, and 100-year simulations, respectively. For the 100-year LOS evaluation, the flooding of private structures was not included due to limited survey information. **Tables F-1** and **F-2** in **Appendix F** summarize the peak stage, flood depth, and LOS for these simulations at select locations in the project area.

CDM Smith provided the City with the LOS results to review and comment. Problem areas were grouped together based on proximity and common systems (**Figure 3-15**). Problem areas that require development of an alternative were confirmed by the City. During the City's review it was apparent that some problem areas were previously addressed by the City, yet not incorporated into the stormwater atlas and neighborhood surveys that was used by CDM Smith to update the model. Other problem areas are a result of re-defining the boundary condition or being within the floodplain and

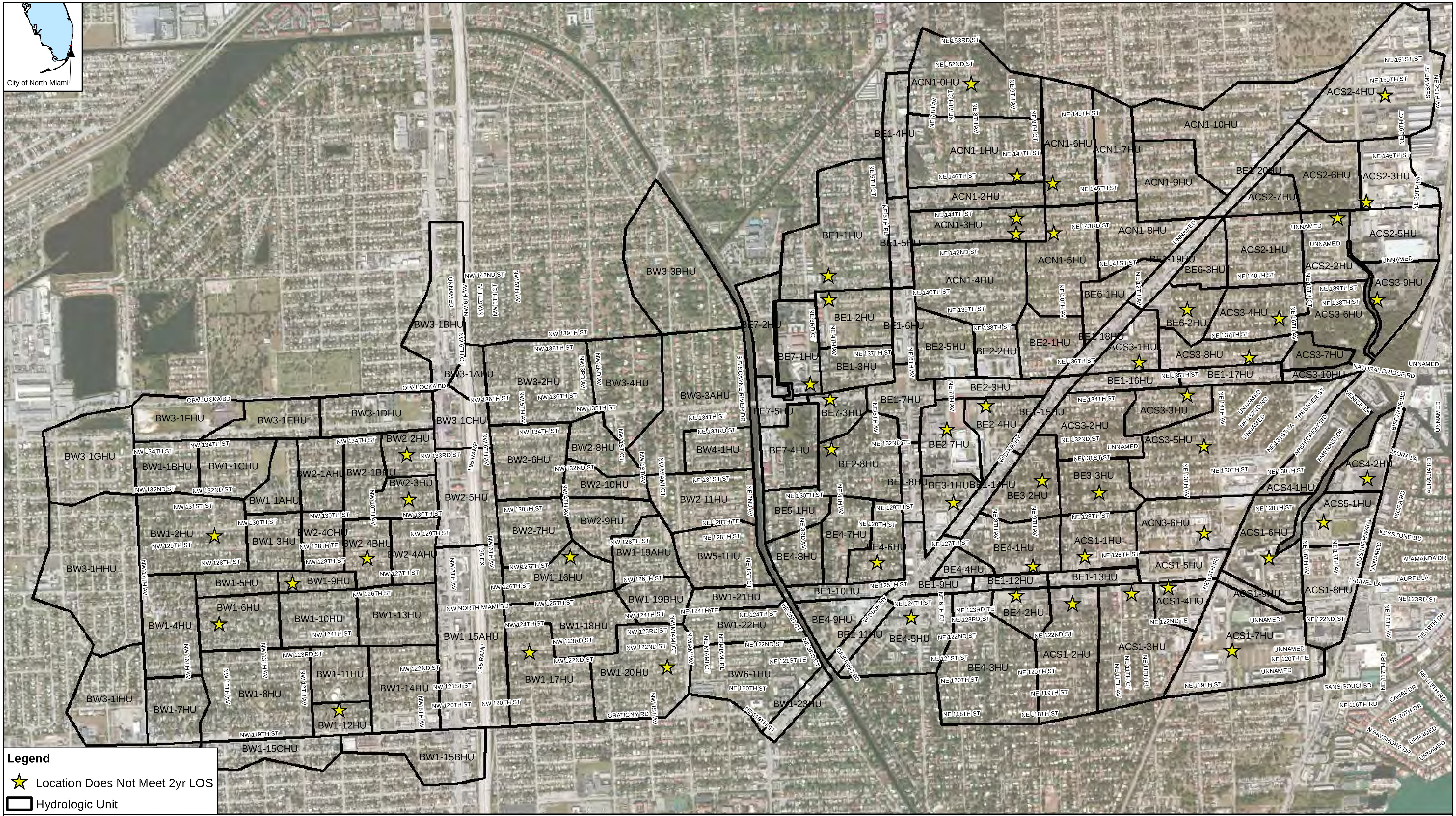

Figure 3-11

City of North Miami
LOS Results for 2-Year Design Storm Event Simulation
Local and Arterial Streets

CDM Smith

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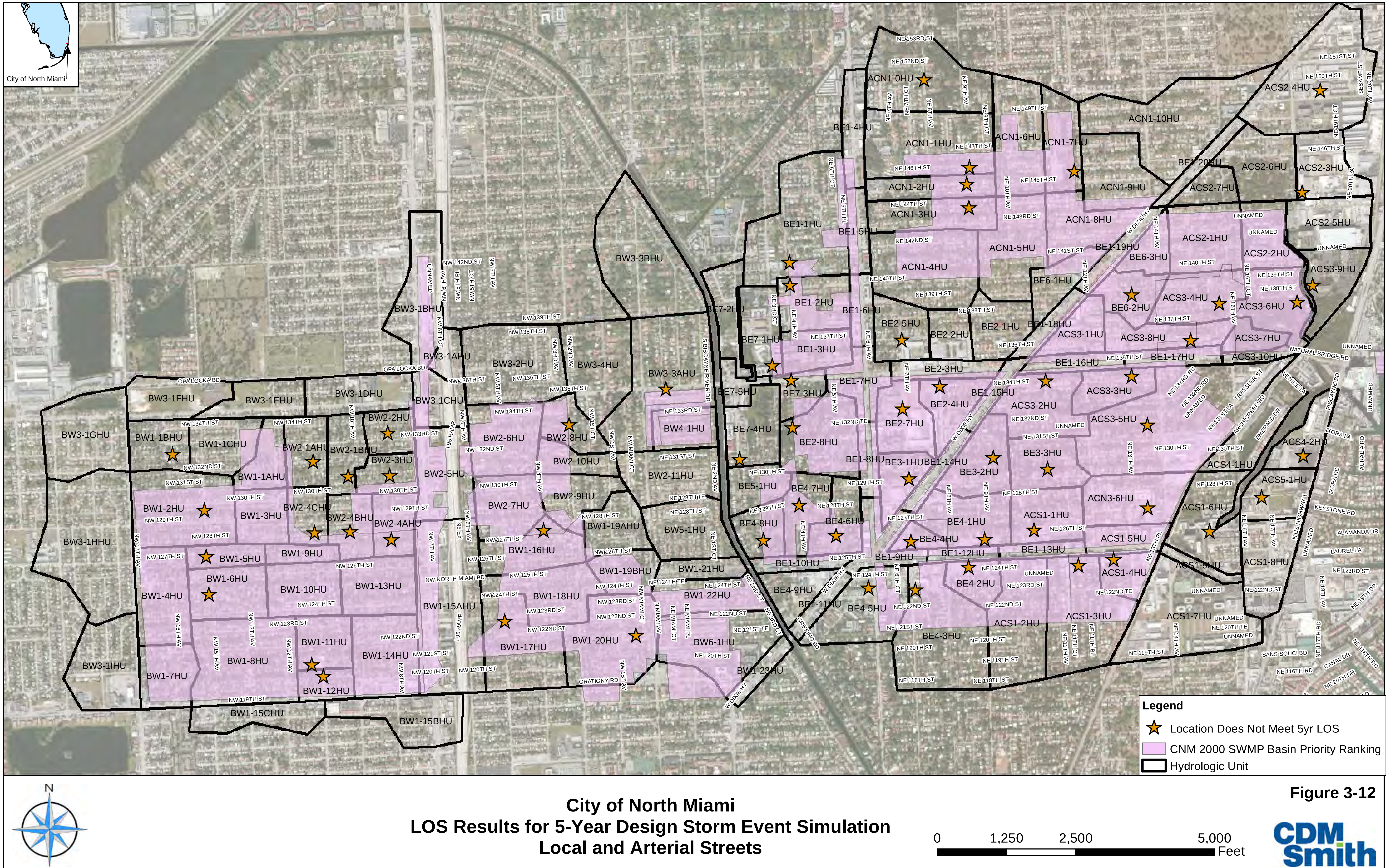

Figure 3-12

City of North Miami
LOS Results for 5-Year Design Storm Event Simulation
Local and Arterial Streets

CDM Smith

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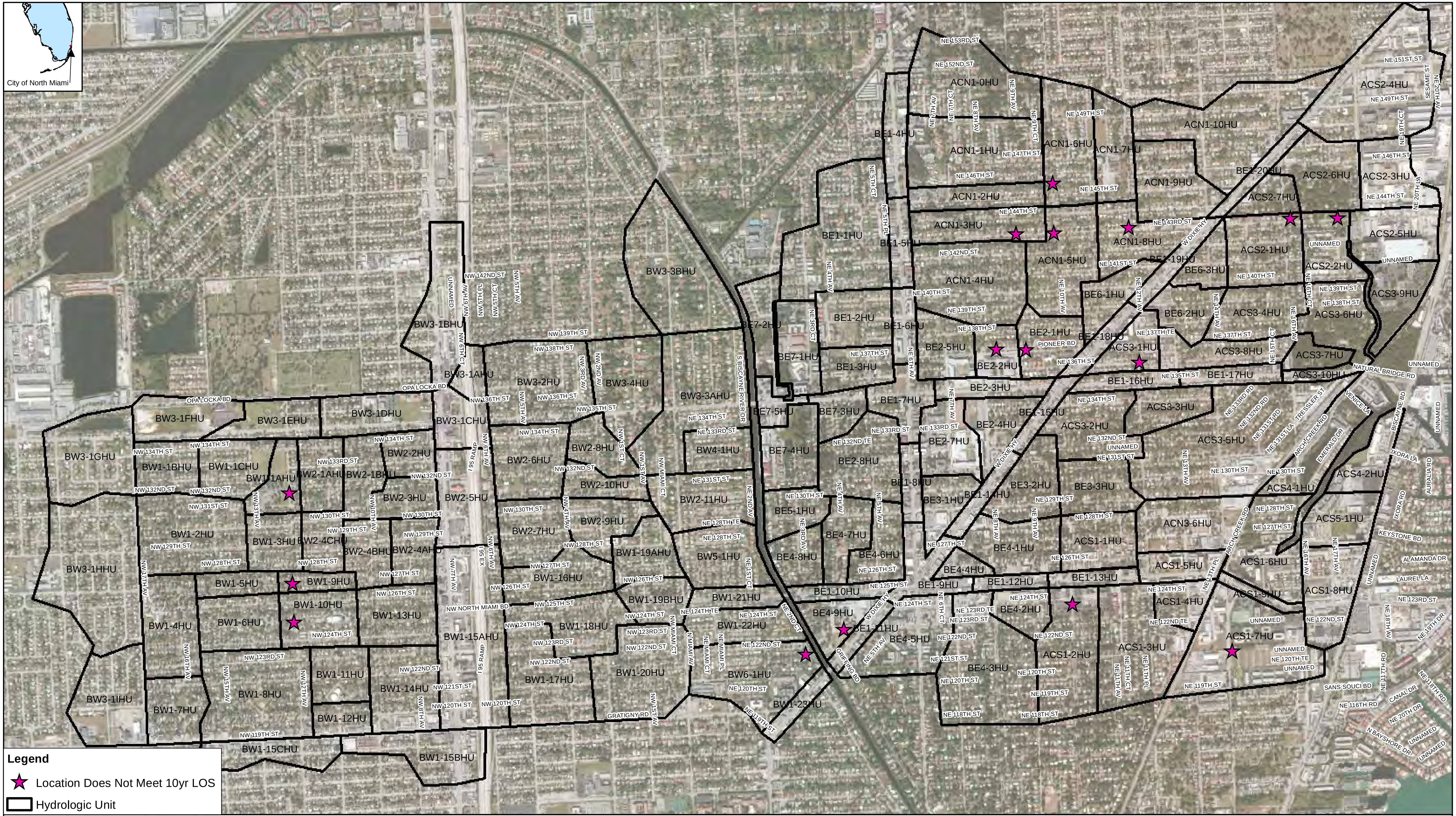

City of North Miami
LOS Results for 10-Year Design Storm Event Simulation
Arterial Streets Only

Figure 3-13

0 1,250 2,500 5,000 Feet

CDM Smith

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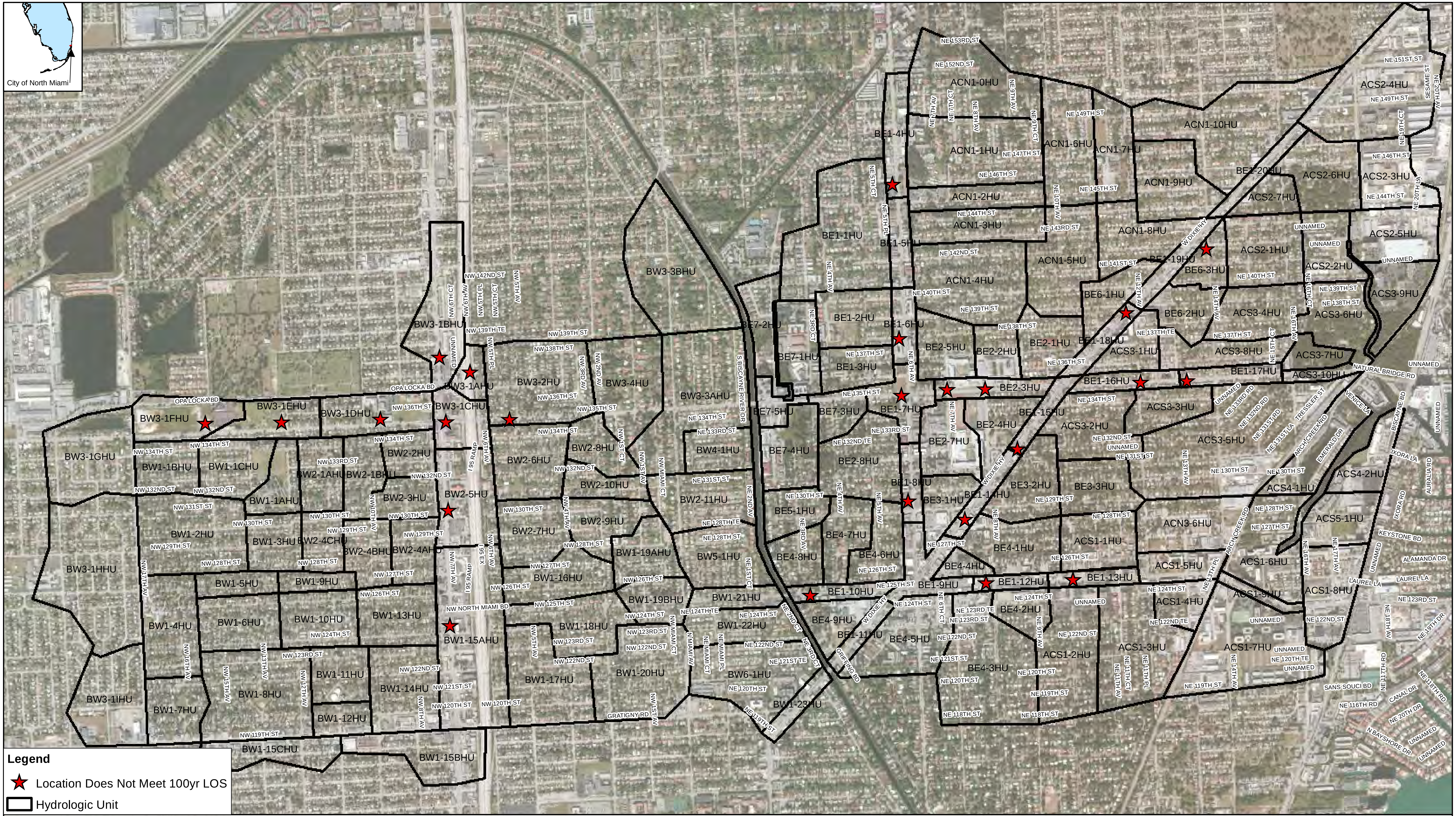

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City of North Miami
LOS Results for 100-Year Design Storm Event Simulation
Emergency Routes Only

Figure 3-14

0 1,250 2,500 5,000 Feet

CDM Smith

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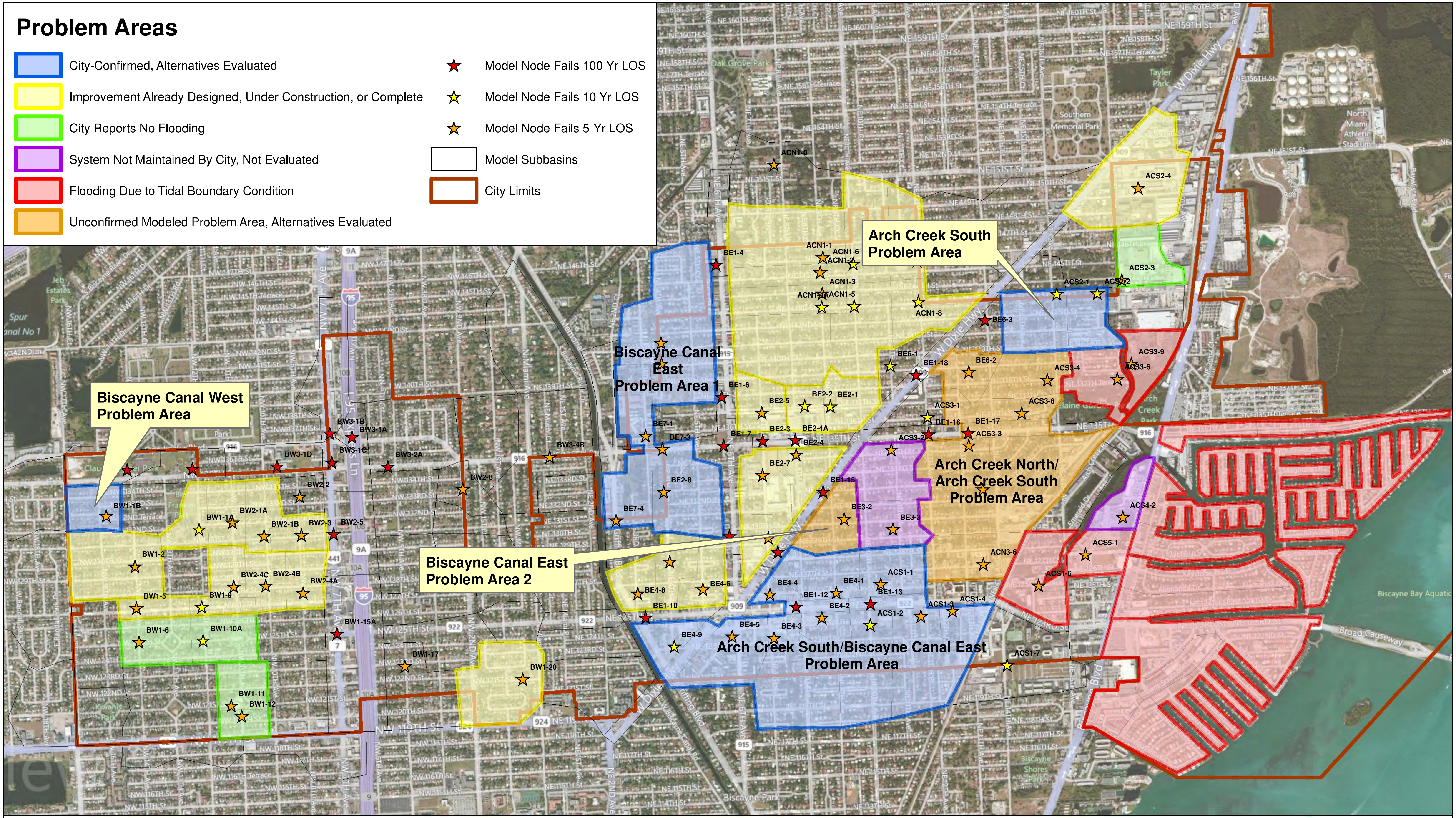

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Figure 3-15

City of North Miami
Modeled Problem Areas

0 875 1,750 3,500 Feet

CDM Smith

G:\North Miami\Alternatives Analysis\Figures\Revised\Fig3-15_Modeled Problem Areas.mxd perneznybj 03/27/12 subject to inundation. Several problem areas were identified that the City could not corroborate the results based on local knowledge. Most of these are less than 0.3 feet of flooding and result from estimating critical elevations based on LiDAR information as there was limited survey information to confirm structural flooding and boundary conditions related to the canals and channels throughout the City. These are indicated as such in **Appendix F**.

Based on input from the City, the San Souci and Keystone neighborhoods of North Miami were not included in the SWMM5 update. These areas are considered to be tidally-influenced, and acknowledged to be naturally flood-prone because of low-lying terrain. The analysis of the stormwater systems in the area were evaluated independently. Stormwater runoff for this region was estimated using the rational method. The area was sub-divided into hydrologic units as shown in **Figure 3-16**. The rational method peak runoff results for the 2-year and 5-year storm events are summarized in **Table G-1** of **Appendix G**. **Table G-2** includes the estimation of time of concentration for each basin.

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City of North Miami
Rational Method Hydrologic Units for San Souci & Keystone

Figure 3-16

0 1,250 2,500 5,000 Feet

CDM Smith

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Section 4

Water Quality and Regulatory Review

This section summarizes the water quality evaluation performed as part of this SWMP update. Included is a summary of the City's stormwater best management practices (BMP) inventory data as well as analysis of available water quality data. CDM Smith also summarized designated water quality impairments in the City and pending state and federal regulations for water quality and stormwater treatment.

4.1. Best Management Practices (BMP) Inventory

CDM Smith obtained and reviewed the City's AutoCAD and GIS data that comprise the City's stormwater structure inventory. This is a comprehensive digital representation of the City's stormwater infrastructure. Within this inventory, several stormwater BMP types were identified including exfiltration trenches (e.g., french drains), recharge wells (e.g., auger wells) and baffles. Due to the number of structures and the level of detail of stormwater elements, it was difficult to show these elements in a graphical legible format. Therefore, CDM Smith inventoried these BMP structures using GIS tools and summarized the attribute information. A GIS shapefile in digital format has been provided on the data disk attached to this report for reference purposes. The summary tables have been provided in **Appendix H**.

In general, 1,144 polyline segments representing exfiltration trenches were identified, 113 point attributes representing recharge wells, and 11 point attributes representing baffles were inventoried. Upon visual inspection of the AutoCAD and GIS data, it was observed that in numerous cases, the polyline segments representing exfiltration trenches are incomplete or lack connectivity to adjacent infrastructure elements. An example is shown in **Figure 4-1**. Therefore, in the summary table in Appendix H, more than one polyline segment may represent the same exfiltration trench. It is recommended that the City review this coverage and complete the polyline connectivity of the exfiltration attributes in order to have an accurate representation of unique elements as well as pipe lengths. It should be noted that there was also limited attribute data available for the recharge wells other than the unique ID assigned by CDM Smith. An example of the recharge well inventory within the City is shown in **Figure 4-2**.

Figure 4-1
Exfiltration Trench Example

4.1.1. BMP Performance

Figure 4-2
Example Recharge Well Inventory

In terms of performance, CDM Smith quantified the existing capacity of exfiltration trench volume based on the data input to the SWMM, which is discussed in greater detail in Section 4. There is approximately 49,000 linear feet of exfiltration trenches within the City with a cumulative capacity of 813,780 ft^3. CDM Smith developed capture curves using the Networked Storage Treatment Overflow Runoff (NetSTORM) modeling software (**Figure 4-3**). NetSTORM was applied to estimate average annual rainfall and runoff volume capture. The model was applied for 44 years of rainfall record and uses the rational method and hourly time-step to estimate runoff and capture by storage and treatment devices. Storage volumes were varied between 0.25 and 2.5 inches which is also consistent with SFWMD's requirements. The model is based on a range of impervious area represented by rational method coefficients (C) from 0.6 to 1.0. CDM Smith estimated that the overall C value for the modeled tributary area is 0.6. Based on the equivalent volume in inches and estimated tributary area served, the exfiltration trenches are generally expected to capture approximately 30 percent of the average annual rainfall volume. Recharge wells within the City also capture an additional amount of rainfall volume; however, the City has indicated these types of BMPs have not been able to consistently maintain their designed performance. Due to the built-out nature of the City, storage opportunities are limited, so end-of-pipe treatments (i.e., baffle boxes) may be desirable to provide additional pollutant removal.

In terms of pollutant removal, performance for exfiltration varies depending on the inches of retention as well as whether the system is off-line or on-line. Based on CDM Smith's review of the City's inventory data, approximately 27 percent of the City's exfiltration are off-line systems. General pollutant removal rates for both exfiltration and recharge wells based on the literature are summarized in **Table 4-1**.

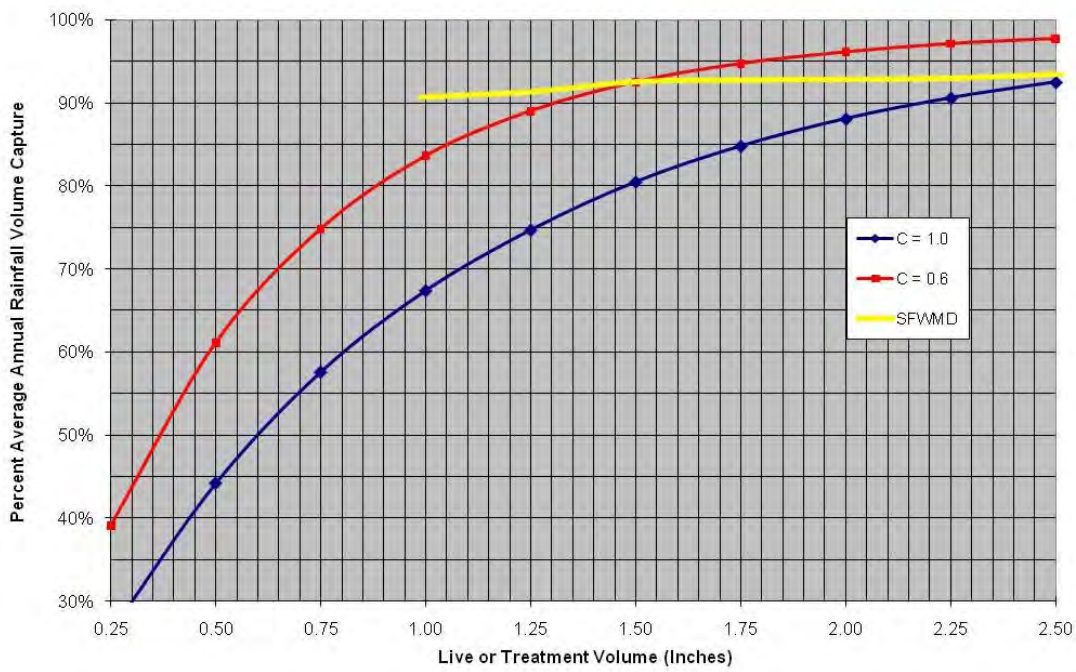


Figure 4-3
Average Annual Volume Capture

Table 4-1 Pollutant Removal Efficiencies for Exfiltration and Recharge Well BMPs

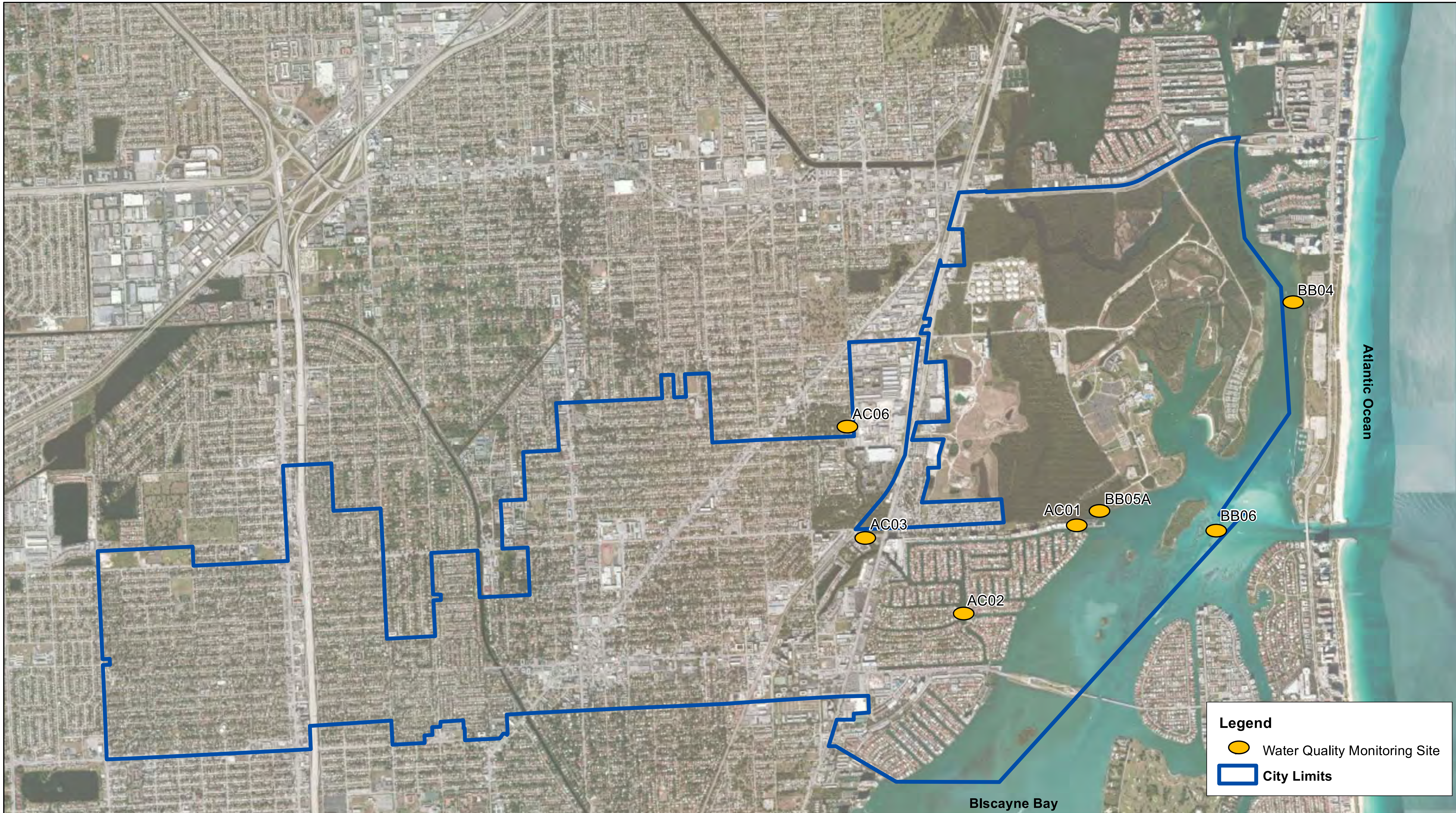
Parameter	% Removal
Biochemical Oxygen Demand (BOD5)	75
Chemical Oxygen Demand (COD)	75
Total Suspended Solids (TSS)	85
Total Dissolved Solids (TDS)	80
Total Phosphorus (TP)	55
Dissolved Phosphorus (DP)	55
Total Kjeldahl Nitrogen (TKN)	50
Nitrite plus Nitrate Nitrogen (NO2N + NO3N)	50
Lead (Pb)	80
Copper (Cu)	80
Zinc (Zn)	80
Cadmium (Cd)	80

1 - Sources: Beaufort County BMP Manual, CDM's Water Quality Matrix, and the SFWMD BMP Manual, which references the work of Schueler (Controlling Urban Runoff, 1987).

4.2. Water Quality Data Evaluation

Available water quality data was requested and obtained from PERA. The provided data were collected during PERA's regular monthly monitoring program over the last 10 years. CDM Smith reviewed the water quality data and identified the stations that had a sufficient period of record of data for the following 12 EPA NPDES indicator pollutants identified previously in Table 4-1.

Water quality sampling stations are shown on **Figure 4-4**. The data were compiled and summarized by station using a Microsoft® Access database. Due to the substantial amount of data collected over a



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Aerial Source: Bing® Web Services aerial photography

City of North Miami
PERA Water Quality Sampling Stations

0 1,250 2,500 5,000 Feet

Figure 4-4

CDM Smith

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long time period, a limited statistical analysis was used to determine if trends existed at any of the stations. Correlation coefficients were used to measure the strength of association between two continuous variables (e.g., concentration vs. time). The correlation coefficient is used to determine if one variable generally increases as the second increases, if it decreases as the second increases, or whether the patterns of the variation have no relationship. A Spearman's rho correlation was used to determine what type of relationship, if any, exists between concentration and time for each of the water bodies analyzed. The Spearman's rho correlation is based on rank and measures relationships where the "y" variable generally increases or decreases as the "x" variable increases. These correlations may be linear or nonlinear. This method of correlation is also resistant to the effects of outliers in the data.

Once it is determined if a relationship exists using the Spearman's rho correlation, it is then necessary to determine if this relationship is statistically significant or not (i.e., there is a high confidence level that a trend exists). To accomplish this objective, a null hypothesis was formulated (i.e., there is no trend with respect to time) and an acceptable error rate was established (i.e., $\alpha = 0.05$ error rate or 0.95 confidence rate)). This is the probability of rejecting the null hypothesis (i.e., there is a trend with respect to time). The test is then run and the probability (p) is computed. If $p \leq \alpha$, then the probability of this occurrence is too low to accept the null hypothesis, it is rejected, and the data set is found to be statistically significant. A summary of the current condition statistical relationships is provided in **Table 4-2A**. A summary of the statistical analysis from the previous permit cycle (Year 2005) at the same monitoring sites is provided in **Table 4-2B**. A summary of the statistical analysis is provided below.

4.2.1. Biochemical Oxygen Demand (BOD5)

There were limited data for BOD5. For stations that did have BOD5 results reported, all the results were below the detection limit, therefore the data were not statistically analyzed.

4.2.2. Chemical Oxygen Demand (COD5)

There were also limited data for COD. Only stations ACO3 and AC06 had COD results reported. Only the data for AC06 was found to be statistically significant at the 0.05 level. Based on the correlation coefficients, COD concentrations have increased over time at station AC06.

4.2.3. Nitrate and Nitrite Nitrogen (NO2N + NO3N)

NO2N+NO3N data were reported for all stations. The data for stations AC02 and AC06 were found to be statistically significant at the 0.05 level. Based on the correlation coefficients, NO2N+NO3N concentrations have significantly increased over time.

4.2.4. Total Kjeldahl Nitrogen (TKN)

TKN results were reported for all stations. Only the data for AC06 was found to be statistically significant at the 0.05 level. Based on the correlation coefficients, TKN concentrations have decreased over time.

4.2.5. Total Phosphorus (TP)

TP results were reported for all stations. The data for stations AC03 and AC06 were found to be statistically significant at the 0.05 level. Based on the correlation coefficients, TP concentrations have decreased over time.

Table 4-2A City of North Miami Stormwater Master Plan Update Water Quality Trend Analysis (Current Conditions)

Parameter	Station																			
	ACO1					ACO2					ACO3					AC06				
	Rs	P	Trend	Avg	Median	Rs	P	Trend	Avg	Median	Rs	P	Trend	Avg	Median	Rs	P	Trend	Avg	Median
Biochemical Oxygen Demand											BDL					BDL				
Chemical Oxygen Demand											0.571	0.1500	---	120.29	124	0.614	0.0001	increasing	66	29
Nitrate and Nitrite	-0.067	0.438	---	0.06	0.06	0.196	0.020	increasing	0.07	0.07	-0.151	0.0725	---	0.1158	0.085	0.170	0.0431	increasing	0.04	0.03
Total Kjeldahl Nitrogen	0.225	0.337	---	0.21	0.16	BDL					0.161	0.5730	---	0.98	1.015	-0.515	0.0002	decreasing	1.4	1.3
Total Phosphorus	0.164	0.054	---	0.01	0.01	0.127	0.137	---	0.01	0.01	-0.552	0.0000	decreasing	0.09	0.074	-0.323	0.0020	decreasing	0.13	0.12
Total Dissolved Solids											0.036	0.9050	---	14290	14754	0.527	0.0007	increasing	4821	780
Total Suspended Solids	0.571	0.150	---	98	96						0.071	0.8430	---	48	50	0.603	0.0001	increasing	23	12
Lead											BDL					BDL				
Zinc											-0.073	0.6480	---	7.9	5.3	-0.385	0.0272	decreasing	9.5	5.0
Copper											BDL					BDL				
Cadmium											BDL					BDL				

Parameter	Station														
	BB04					BB05A					BB06				
	Rs	P	Trend	Avg	Median	Rs	P	Trend	Avg	Median	Rs	P	Trend	Avg	Median
Biochemical Oxygen Demand															
Chemical Oxygen Demand															
Nitrate and Nitrite	-0.034	0.685	---	0.03	0.02	-0.101	0.233	---	0.03	0.02	BDL				
Total Kjeldahl Nitrogen	BDL					BDL					BDL				
Total Phosphorus	-0.126	0.144	---	0.01	0.01	0.161	0.063	---	0.01	0.01	0.151	0.079	---	0.006	0.004
Total Dissolved Solids															
Total Suspended Solids	0.179	0.660	---	81	82	0.6	0.242	---	83	66	0.036	0.905	---	93	86
Lead															
Zinc						BDL									
Copper						BDL									
Cadmium						BDL									

Notes:

1. Trend analysis is based on Spearman Rank Correlation nonparametric test.

2. The Correlation Rank Coefficient (Rs value) indicates whether the trend is increasing (positive value) or decreasing (negative value) with time.

3. Probability value P of less than or equal to 0.05 was considered statistically significant.

4. For most stations and parameters, no statistically significant trend was identified.

5. BDL denotes majority of data was below detection limits and a trend analysis could not be performed.

Table 4-2B City of North Miami Water Quality Trend Analysis (Previous Permit Cycle) Parameter

Parameter	Station													
	ACO1		ACO2		ACO3		AC06		BB04		BB05A		BB06	
	Avg	Median	Avg	Median	Avg	Median	Avg	Median	Avg	Median	Avg	Median	Avg	Median
Biochemical Oxygen Demand					BDL		BDL							
Chemical Oxygen Demand					29	29	23	22						
Nitrate and Nitrite	0.07	0.06	0.07	0.07	0.1423	0.090	0.03	0.02	0.03	0.02	0.03	0.02	BDL	
Total Kjeldahl Nitrogen	0.03	0.03	BDL		1.00	1.00	1.9	1.9			BDL		BDL	
Total Phosphorus	0.01	0.01	0.01	0.01	0.11	0.109	0.18	0.18	0.01	0.01	0.01	0.01	0.007	0.004
Total Dissolved Solids							690	529						
Total Suspended Solids							12	6						
Lead					BDL		BDL							
Zinc					8.0	5.4	12.5	10.3			BDL			
Copper					BDL		BDL				BDL			
Cadmium					BDL		BDL				BDL			

Notes:

1. Data is for Year 2000-2005 monitored data

CDM Smith

4.2.6. Total Dissolved Solids (TDS)

There were limited data for TDS. Only stations ACO3 and AC06 had results reported. The data for station AC06 was found to be statistically significant at the 0.05 level. Based on the correlation coefficients, TDS concentrations have increased over time at this location.

4.2.7. Total Suspended Solids (TSS)

TSS results were reported for most stations. Only the data for AC06 was found to be statistically significant at the 0.05 level. Based on the correlation coefficients, TSS concentrations have increased over time.

4.2.8. Lead (Pb)

There were limited data for Pb. For stations that did have Pb results reported, all the results were below the detection limit, therefore the data were not statistically analyzed.

4.2.9. Zinc (Zn)

There were limited data for Zn. Only stations ACO3 and AC06 had results reported above the detection limit. The data for station AC06 was found to be statistically significant at the 0.05 level. Based on the correlation coefficients, Zn concentrations have decreased over time at this location.

4.2.10. Copper (Cu)

There were limited data for Cu. For stations that did have Cu results reported, all the results were below the detection limit, therefore the data were not statistically analyzed.

4.2.11. Cadmium (Cd)

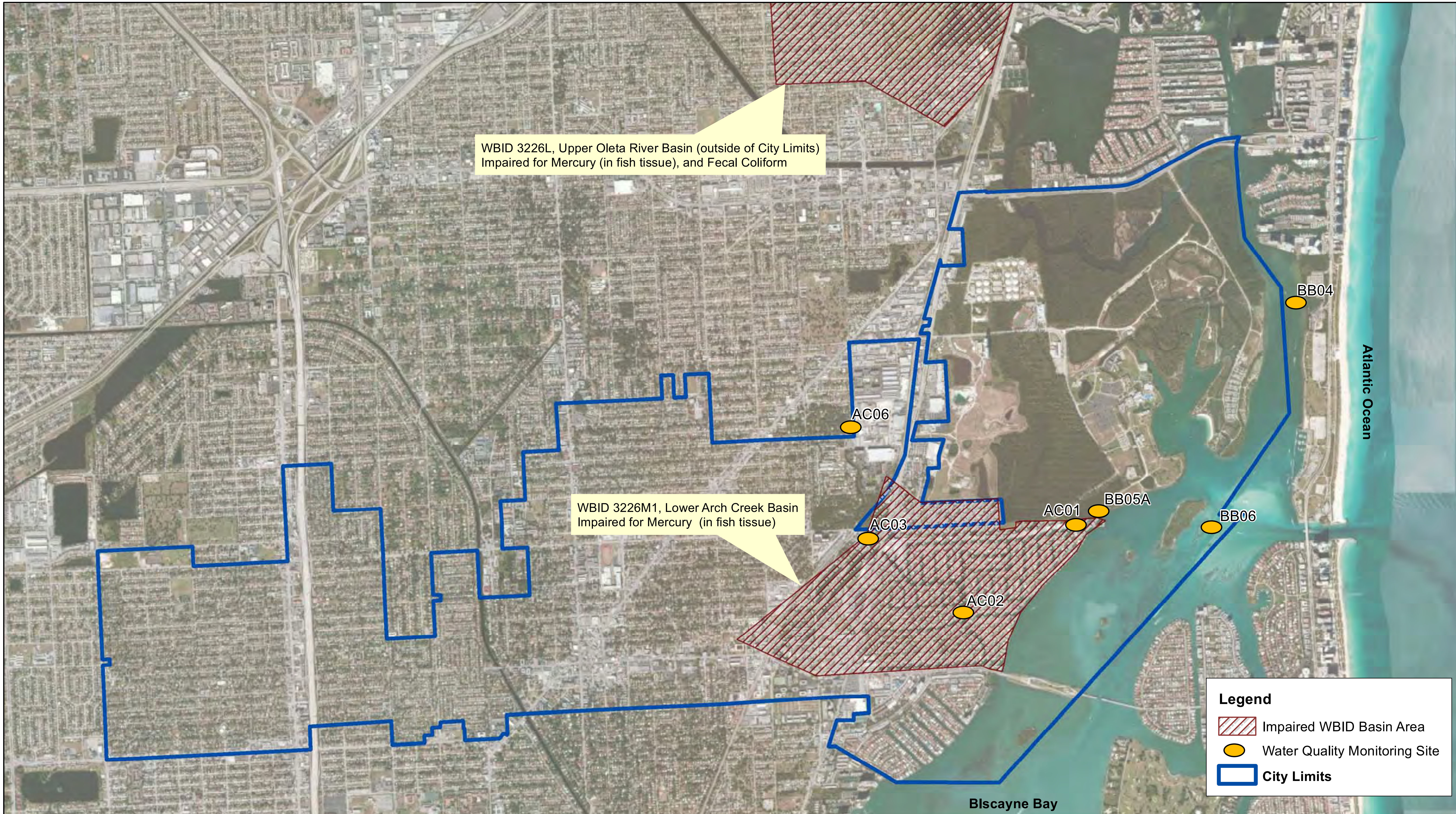
There were limited data for Cd. For stations that did have Cd results reported, all the results were below the detection limit, therefore the data were not statistically analyzed.

Overall, the water quality at stations near the City exhibit no trend or a decreasing trend with time, with the exception of COD, NO2N+NO3N, TDS and TSS. Additionally, several of the parameters (BOD5, Pb, Cu and Cd) were all sampled below the detection limit which indicates very low concentrations of these pollutants.

4.3. Impaired Waters Summary

The Florida Department of Environmental Protection (FDEP) has divided the state into five basin groups for assessment of water quality status, and these groups are evaluated on a five-year cycle to determine if the waterbodies within each basin are meeting the state's water quality standards. The City is in the Southeast Coast – Biscayne Bay planning unit, which is part of Group 4.

The Cycle 2 assessment for impaired waters for the Group 4 waterbodies was completed in 2010 and was based on data from the verified period (VP), which is defined as 2003 through June 30, 2010. CDM Smith reviewed the verified list for the Southeast Coast – Biscayne Bay planning unit and identified those water body identification (WBID) units that have been listed as impaired within the vicinity of North Miami. The impaired WBIDs are shown in **Figure 4-5**. The impairments have been summarized below in **Table 4-3**.



Aerial Source: Bing® Web Services aerial photography

City of North Miami
Impaired Waters

Figure 4-5

CDM Smith

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Table 4-3 Verified List of Impairments

WBID	Water Segment Name	Water Body Type	Parameters Assessed Using the Impaired Surface Waters Rule (IWR)	Concentration of Criterion or Threshold Not Met	Current Integrated Category† - Final Assessment	Priority for TMDL Development	Comments
3226L	Oleta River (Upper Segment)	Estuary	Fecal Coliform	≤ 400 Counts / 100 mL	5	Low	Impaired based on number of exceedances. This will be added to the 303(d) list.
3226L	Oleta River (Upper Segment)	Estuary	Mercury (in fish tissue)	Exceeds DoH Threshold (< 0.3 ppm)	5	High*	Verified impairment based on DOH marine fish consumption advisory data from 2004 .
3226M1	Arch Creek (Lower Segment)	Estuary	Mercury (in fish tissue)	Exceeds DoH Threshold (< 0.3 ppm)	5	High*	Verified impairment based on DOH marine fish consumption advisory data from 2004.

†5 - Water quality standards are not attained and a TMDL is required.

It appears that the only impairment directly affecting the City is for WBID 3226M1 (Lower Arch Creek Basin) which is listed for mercury in fish tissue. Many of the waterbodies in the state have this impairment, and the majority of the mercury is from atmospheric deposition. FDEP is currently developing a statewide total maximum daily load (TMDL) to address the mercury impairments. CDM Smith also reviewed existing TMDLs for the City and there are currently no draft or final TMDLs affecting the City.

4.4. Regulatory Framework

Over the last several years, several significant related water quality and stormwater regulation issues have emerged that will likely impact the City in the near future. They are:

- The ongoing TMDL program by FDEP;
- The Numeric Nutrient Criteria proposed by US EPA;
- The Numeric Nutrient Criteria proposed by FDEP;
- The draft Unified Statewide Stormwater Rule as proposed by FDEP;
- Upcoming US EPA NPDES Municipal Separate Storm Sewer Systems (MS4) Rule revisions in December 2012;
- Recently adopted changes to the City's FDEP issued NPDES MS4 Permit.

4.4.1. FDEP TMDL Program

The TMDL program is required by the Clean Water Act to identify the maximum allowable loads for all sources to impaired waters and also identify the load reductions to achieve the designated use(s). The FDEP leads this effort working with local stakeholders including water management districts, cities, counties, and private interests. The TMDL program works to develop a scientifically sound database of information and calibrated-validated hydrology, hydraulic, and water quality models to identify the TMDL, build on pollutant load reduction goals (PLRGs), support the load allocation and reduction process, and establish the foundation for evaluations of management practices to improve water quality. Based on these efforts, it is the most watershed-specific information for informed decisions for water quality and water environmental health. Enforcement would be through NPDES permitting for domestic wastewater, industrial wastewater and MS4 stormwater outfalls.

4.4.2. US EPA Numeric Nutrient Rule

In 1998, the US EPA produced the National Strategy for the Development of Regional Nutrient Criteria, requiring US EPA to produce nutrient criteria guidance documents by 2000. It also required states that have narrative nutrient criteria to develop numeric nutrient criteria (NNC).

The State of Florida Numeric Nutrient Criteria Development Plan (FDEP, March 2009), prepared by FDEP describes Florida's plan for development of regional NNC via the use of a technical advisory committee (TAC). The TAC first met in January of 2001 and has continued to meet more than 25 times since its formation. It was made up of scientists and practitioners whose experience related to lake, river and/or estuarine water quality with members from local government, engineering and scientific consultants, university representatives and environmental interests. With FDEP staff providing facilitation and technical resources, the TAC addressed lake and riverine nutrients first, and later turned to estuarine NNC in June of 2008.

Environmental interests in Florida filed a complaint in the U.S. District Court in July 2008 (amended in January 2009), alleging that US EPA had failed to perform its "non-discretionary duty" to set NNC for Florida according to section 304(a) of the Clean Water Act. In January 2009, US EPA issued a statement that, for the state of Florida (and only Florida), new or revised nutrient criteria are necessary to meet the requirements of the Clean Water Act. In December 2009, US EPA entered into a consent decree with the environmental plaintiffs, requiring US EPA to issue draft NNC for flowing streams and lakes in Florida in January 2010 and for estuaries in January 2011. Final NNC for flowing streams and lakes (outside of the South Florida Region) were promulgated by October 15, 2010. A second rule for estuaries, coastal waters and flowing waters in the South Florida Region was proposed to be completed by March 2012. Lawsuits were filed by several public and private entities challenging the rule including the State of Florida, SFWMD, the Florida Water and Environment Association (FWEA), Florida Stormwater Association (FSA), and Florida League of Cities. Also, in the last few months, FDEP petitioned EPA to rescind the issuance of the NNC because Florida was planning to adopt Florida-developed NNC.

When the final NNC for flowing streams and lakes (outside of the South Florida Region) were promulgated in October 2010, US EPA provided a 15-month implementation period until the rule became effective. This 15-month implementation period was originally due to end on March 6, 2012. US EPA is now proposing to extend the effective date to June 4, 2012. This extension will allow US EPA to work with FDEP as steps are taken to finalize and submit the new State standards for numeric nutrient criteria to US EPA for review (see sub-section 5.4.3).

4.4.3. State of Florida Numeric Nutrient Criteria Development

In April 2011, FDEP submitted a petition to US EPA requesting the withdrawal of the January 2009 determination that NNC are necessary in Florida and repeal the Federal rulemaking completed in 2010 to establish such criteria for inland lakes and streams, and refrain from proposing or promulgating any further NNC. The petition outlined FDEP's intent to undertake its own rulemaking for nutrient criteria for state waters. US EPA is prepared to withdraw the federal inland standards if FDEP adopts, and EPA approves, their own protective and scientifically sound numeric standards. In addition, US EPA is prepared to adjust the timetables for implementing the inland rule and proposing the estuarine and coastal waters rule if FDEP's rulemaking efforts progress in accordance with FDEP's proposed schedule to avoid overlap with the final stages of the state rulemaking process.

In 2011, FDEP held a series of public workshops to present information about the proposed changes to rules 62-302, Florida Administrative Code (FAC) and 62-303, FAC. The draft rules were presented to the Florida Environmental Regulation Commission (ERC) which were subsequently adopted on December 8, 2011. The draft regulations must now be ratified by the Florida legislature during the 2012 legislative session. The amendments to rule chapters 62-302, FAC and 62-303, FAC have been transmitted to the Florida Legislature.

FDEP's rule concept for numeric criteria establishes a hierarchy of site specific numeric interpretation of narrative nutrient criterion in the following order:

1. Nutrient site specific analyses (e.g., adopted TMDLs, site specific alternative criteria (SSAC), estuary-specific numeric interpretations);

2. Cause and effect relationships (applies to water bodies without site specific interpretations and are currently derived for lakes and springs); and,

3. Reference-based thresholds combined with biological data to evaluate attainment (only applies to water bodies without site specific interpretations and cause and effect criteria; currently only proposed for streams).

The narrative standard continues where numeric interpretation is unavailable (e.g., wetlands, intermittent streams, Class III flowing waters in South Florida). For estuaries, FDEP developed estuary-specific nutrient standards that can be found in the draft version of 63-302, FAC. Section 62-302.532, FAC provides draft estuary-specific numeric interpretations of the narrative nutrient criterion for northern Biscayne Bay and are summarized in **Table 4-4**.

Table 4-4 Draft Numeric Standards for Biscayne Bay

Estuary	Total Phosphorus	Total Nitrogen	Chlorophyll-a
Biscayne Bay – Northern North Bay	0.012 mg/L	0.30 mg/L	1.7 µg/L

Standard is defined as annual geometric means that shall not be exceeded more than once in a three year period.

CDM Smith compared the water quality data summarized in Table 4-2 to the thresholds defined in Table 4-4. Although geometric means were not calculated in Table 4-2, a general comparison was made to generally assess whether or not measured water quality data are meeting or exceeding the draft thresholds. The ambient water quality at stations AC01 and AC02 are below the nutrient limits for Northern Biscayne Bay. This is positive as these represent the two most downstream stations in the Arch Creek system before discharging to Biscayne Bay. Further upstream, ambient water quality measured at Stations AC03 and AC06 is well above the State's draft nutrient thresholds. However, the statistical results at these stations show phosphorus to be decreasing over time. AC06 is physically located just outside the City limits but may be receiving runoff from areas within City limits. The remaining stations (BB04, BB05A , BB06), all located within Biscayne Bay all have nutrient concentrations well below the draft nutrient limits. As these stations are well within Biscayne Bay, water quality is also being influenced by more than just the City's discharge from its MS4.

4.4.4. SFWMD and FDEP Unified Statewide Stormwater Rule

The SFWMD and FDEP have been working with various groups in southwest Florida over the last decade in the development of supplemental water quality criteria for ERPs in order to better protect water quality. These supplemental criteria would give credit for additional non-traditional BMPs and encourage stormwater reuse while controlling the average annual volume of discharge and nutrients to historic (pre-development) levels. This would encourage stormwater reuse. FDEP has been working to extend these criteria to a unified statewide rule that considers variations in hydrology and physical characteristics across Florida. If adopted as it has been drafted today, this rule would exempt retrofits for stormwater systems that provide some load reduction, such as stormwater master plan projects with water quality BMP features. The rule is currently on hold. The current design requirements under the proposed rule can be found in the *Draft Environmental Resource Permit Stormwater Quality Applicant's Handbook, Design Requirements for Stormwater Treatment Systems in Florida* (FDEP and the Water Management Districts, 2010).

4.4.5. US EPA NPDES MS4 Revisions

As discussed above, the US EPA is currently updating the MS4 permit program and the new rule is expected to contain additional requirements for BMPs and documentation on their performance and costs. Specifically the proposed federal rulemaking is considering the following key actions:

- Develop performance standards from newly developed and redeveloped sites to better address stormwater management as projects are built;
- Explore options for expanding the protections of the MS4 program;
- Evaluate options for establishing and implementing a municipal program to reduce discharges from existing development;
- Evaluate establishing a single set of minimum measures requirements for regulated MS4s. However, industrial requirements may only apply to regulated MS4s serving populations of 100,000 or more; and,
- Explore options for establishing specific requirements for transportation facilities.

The rule is anticipated to be issued in December 2012.

4.4.6. State NPDES MS4 Revisions

The City is a co-permittee under FDEP Permit No. FLS000003-003 issued to Miami-Dade County to discharge stormwater from the MS4. Miami-Dade County is in the third cycle of its permit and recently was issued the renewed permit in June 2011. Although the NPDES regulations have not changed, several portions of the revised permit represent a significant increase in reporting items for the purposes of satisfying the NPDES Annual Report (AR). Major changes that may impact the City include the following:

1. For most permit elements, the City is now required to submit a written plan outlining its standard operating procedures (SOPs). This must be done completed during Year 1 of the permit. There are a total of 21 SOPs that must be prepared for various elements of the current permit (See **Appendix M**).

2. Under Table II.A.1.a, several of the structural controls now have an increased frequency inspection compared to the previous permit.

3. Table II.A.1.a of the permit now requires that a minimum of 10 percent of the total number of structures (pipes, culverts, inlets, catch basins, grates, ditches, swales and other stormwater conveyances) are inspected annually. For a community like the City with highly urbanized area, this could represent a significant increase in man-hours and therefore costs if the City is already not performing inspections at this frequency.

4. Under Part III.A.3 Roadways, the City must collect and report street sweepings that are consistent with the Florida Stormwater Association MS4 Project to calculate the total nitrogen (TN) and total phosphorus (TP) load reductions.

5. Under Part III.A.6 Pesticides, Herbicides, and Fertilizer Application, all personnel applying fertilizer shall be trained through the Green Industry BMP Program by January, 2014. The City is now required to maintain and report a list of the personnel and contractors who have been trained through the Green Industry BMP Program.

6. Under Part III.A.6 Pesticides, Herbicides, and Fertilizer Application, all local governments are encouraged to adopt a Florida-friendly Landscaping Ordinance similar to the one set forth in the document "Florida-friendly Guidance Models for Ordinances, Covenants and Restrictions." Adoption of the ordinance is required within 24 months of permit issuance.

7. Under Part V.A Annual Loadings and Event Mean Concentrations, if the total annual pollutant loadings have not decreased over the past two permit cycles, the permittee is required to re-evaluate its stormwater management program (SWMP) and identify and submit revisions to its SWMP, as appropriate, to reduce pollutant loadings, especially to impaired waters, in the Year 4 annual report. As PERA has had the responsibility of performing pollutant loading for the entire Miami-Dade County area, this may not directly affect the City, although they may be required to provide supporting documentation.

8. The AR shall include as an attachment an evaluation of the effectiveness of the permittee's SWMP in reducing pollutant loads discharged from the MS4. At a minimum, the City will need to be provide an explanation of how its SWMP is addressing each of the following:

    a. Have stormwater pollutant loadings discharged from the MS4 decreased? Why or why not?

    b. Which components of the SWMP are working well and are effective in reducing stormwater pollutant loadings? Why are they effective?

    c. Which components of the SWMP are not working well and need to be revised to make them more effective in reducing stormwater pollutant loadings?

d. Which components of the SWMP do not contribute to reducing stormwater pollutant loads and could be revised or eliminated, and why?

e. Is the monitoring program providing data that can be used to assess the effectiveness of the SWMP in reducing stormwater pollutant loadings, assess the effectiveness of specific BMPs, and determine where stormwater retrofitting projects should be prioritized for implementation?

Section 5

Alternatives Analysis

5.1. Alternative Analysis Overview

This section describes the application of the updated SWMM5 to evaluate alternative solutions for the problem areas identified in Section 3 and illustrated in Figure 3-15.

Alternatives were applied using a tiered approach ranging from straightforward solutions (Tier 1) that may only resolve some of the flooding but not all, to the more complex (Tier 3) solutions with the goal of solving flooding problems for areas that currently do not meet LOS goals. Tier 1 solutions typically consist of exfiltration only, the City's currently preferred and historically most effective BMP, and demonstrate the hydraulic benefits that can be anticipated through the installation of networks of exfiltration trenches in the problem areas. Tier 2 solutions build upon the exfiltration benefits through the addition of underground storage vaults, in-system storage, wet detention, stormwater pump stations, and upgrades of existing outfalls of no more than one standard pipe diameter (e.g., 30-inch to 36-inch, 42-inch to 48-inch). In the event that a feasible solution developed within the Tier 2 outfall constraints did not completely alleviate flooding, a Tier 3 solution was proposed including the outfall upgrades that would be necessary to address LOS deficiencies within a problem area.

The following subsections define the problem area characteristics and existing conditions results, the proposed improvements to alleviate level of service deficiencies within the problem areas, and conceptual cost estimates for the proposed improvements.

5.1.1. Biscayne Canal West Problem Area

The Biscayne Canal West Problem Area lies in the northwest corner of the City and is generally bounded by NW 135 St (north), NW 132nd St (south), NW 17th Ave (west), and NW 15th Ave (east). The area is exclusively residential and lies within a closed basin with no identifiable outfall. The area is currently served by several exfiltration trenches.

The City has identified this area as a historical flooding problem. Existing condition model results predict 0.1 feet of flooding near the intersection of NW 132nd St and NW 16th Ave (Node BW1-1B) for the 5-year 24-hour design storm.

Alternatives analyses indicate that the installation of additional exfiltration trenches in the vicinity of the problem area would provide sufficient hydraulic benefit to alleviate flooding for the 5-year 24-hour design storm. The project area is divided between City and County right-of way. Two Tier 1 alternatives were developed; Alternative 1 presents a localized solution to the problem area, whereas Alternative 2 presents a regional solution that can provide additional hydraulic and water quality benefits to the surrounding areas. Alternatives 1 and 2 are illustrated in **Figure 5-1** and **Figure 5-2**, respectively.

City of North Miami
Stormwater Master Plan Update

Figure 5-1
Biscayne Canal West Problem Area
Tier 1 Alternative 1
Local Exfiltration Trenches

CDM Smith

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City of North Miami
Stormwater Master Plan

0 175 350 700
Feet

Figure 5-2
Biscayne Canal West Problem Area
Proposed Alternative 2
Regional Treatment

CDM Smith

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5.1.1.1. Alternative 1

As shown in Figure 5-1, Alternative 1 includes the installation of 680 linear feet (LF) of exfiltration trenches within County right-of-way in the immediate vicinity of the problem area. Additional piping and inlets to collect and route runoff to the exfiltration trenches will be necessary to ensure the optimal utilization of the exfiltration trenches. For maximum effectiveness, certain improvements were required outside of the City right-of-way.

The proposed improvements are expected to alleviate flooding for the 5-year 24-hour design storm (**Table 5-1**). The conceptual cost estimate for the implementation of Alternative 1 is approximately $300,000. Since all the improvements were identified outside the City right-of-way, the City may consider a cost-share program with the County to alleviate the regional flooding. A cost breakdown is provided in **Appendix I** in **Table I-1**.

Table 5-1 Biscayne Canal West Problem Area – Model Results

Deficient Node	Existing Stage (5-yr/24-hr)	Critical Stage	Alternative 1		Alternative 2	
			Stage	Meets LOS?	Stage	Meets LOS?
BW1-1B	10.2	10.1	10.1	Yes	10.1	Yes

5.1.1.2. Alternative 2

Alternative 2 includes installing a new collection and conveyance system in the problem area and routing runoff to a proposed regional treatment system consisting of 1,800 LF of exfiltration trench under Ben Franklin Park, east of the localized flooding. The exfiltration trenches should be located and placed in such a manner as to avoid disturbance of the sports fields in the park. Approximately 7,100 LF of 15-inch reinforced concrete pipe (RCP) and a sufficient number of curb or ditch-bottom inlets would be placed in the area to collect the runoff from the drainage area between NW 17th Ave and the park.

As shown in Table 5-1, this solution provides an equivalent hydraulic benefit for the deficient node BW1-1B as Alternative 1. However, model results indicate that this alternative provides reduction in flood stages for other nodes in the region. The alternative will provide improved regional water quality benefit as well as aquifer recharge. The conceptual cost estimate for the implementation of Alternative 2 is approximately $1,500,000, of which $427,000 is within the City right-of-way. A cost breakdown between City and County cost is provided in **Appendix I** in **Table I-2**.

5.1.2. Biscayne Canal East Problem Area 1

The Biscayne Canal East Problem Area lies in the north central portion of the City and is generally bounded by NE 143rd St (north), NE 129th St (south), Biscayne Canal (west) and NE 6th Ave (east). The vicinity of the problem area is largely residential with some commercial development. Existing gravity outfalls along NE 135th Street, NE 131st Street, and NE 3rd Ct, as well as a stormwater pump station under Ruck Park serve as the primary stormwater conveyance systems for the problem area.

The City has identified this area as one of historic flooding concern. Model results indicate several locations within the area with 5-year LOS deficiencies:

- 0.9 feet of flooding at NE 141st St and NE 4th Ave (Node BE1-1);

- 0.6 feet of flooding at NE 139th St and NE 4th Ave (Node BE1-2);
- 1.3 feet of flooding at NE 132nd St and NE 4th Ave (Node BE2-8);
- 0.2 feet of flooding at NE 3rd Ct southwest of NE 138th St (Node BE7-1);
- 1.2 feet of flooding at NE 4th Ave south of NE 135th St (Node BE7-3); and
- 0.1 feet of flooding at NE 131st St east of Griffing Blvd (Node BE7-4).

5.1.2.1. Tier 1

As shown in **Figures 5-3** and **5-4**, Tier 1 includes the installation of 12,500 LF of exfiltration trenches in the problem area. Exfiltration trench layouts as shown in Figures 5-3 and 5-4 utilize available space in City right-of-way, as well as in Ruck Park. Additional piping and inlets to collect and route runoff to the exfiltration trenches will be necessary to ensure the optimal utilization of the exfiltration trenches.

The proposed improvements reduce flood stages for several deficient nodes **(Table 5-2)**; exfiltration alone is expected to provide one foot of flood reduction for node BE2-8 for the 5-year/24-hour design storm. However, model results indicate that exfiltration alone will not correct any of the deficient nodes in the problem area. A conceptual cost estimate for the exfiltration trenches and associated collection systems in Tier 1 is approximately $3,700,000. A cost breakdown is provided in **Appendix I** in **Table I-3.**

Table 5-2 Biscayne Canal East Problem Area 1 – Model Results

Deficient Node	Existing Stage (5-yr/24-hr)	Critical Stage	Tier 1		Tier 2		Tier 3	
			Stage	Meets LOS?	Stage	Meets LOS?	Stage	Meets LOS?
BE1-1	3.2	2.3	3.1	No	1.9	Yes	1.9	Yes
BE1-2	3.0	2.4	2.9	No	1.9	Yes	1.9	Yes
BE2-8	6.5	5.2	5.5	No	5.1	Yes	5.1	Yes
BE7-1	2.9	2.7	2.9	No	2.8	No	2.6	Yes
BE7-3	3.7	2.5	3.7	No	3.5	No	2.4	Yes
BE7-4	3.1	3.0	3.1	No	3.0	Yes	3.0	Yes

5.1.2.2. Tier 2

Additional storage and conveyance upgrades were added to the Tier 1 exfiltration trenches to provide additional flood reduction. Tier 2 solutions, illustrated in **Figures 5-5** and **5-6**, include the following:

- Installation of 1,040 LF of 5-ft x 10-ft concrete box culvert (CBC) to replace the 36-inch trunkline along NE 4th St that currently feeds the Ruck Park Pump Station. This provides in-system storage as well as increases conveyance to and optimum use of the Ruck Park Pump Station, which appears to have a greater capacity than what the existing 36-inch pipe can convey to the pump station.
- The upsizing of the existing outfall at NE 3rd Ct from 15-inch to 24-inch RCP. This provided additional capacity for runoff to exit the system in a manner which should be readily acceptable by regulatory agencies.

N

City of North Miami
Stormwater Master Plan

0 200 400 800
Feet

Figure 5-3
Biscayne Canal East Problem Area 1 (North)
Tier 1 Alternatives
Exfiltration Only

CDM Smith

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N

City of North Miami
Stormwater Master Plan

0 200 400 800
Feet

Figure 5-4
Biscayne Canal East Problem Area 1 (South)
Tier 1 Alternatives
Exfiltration Only

CDM Smith

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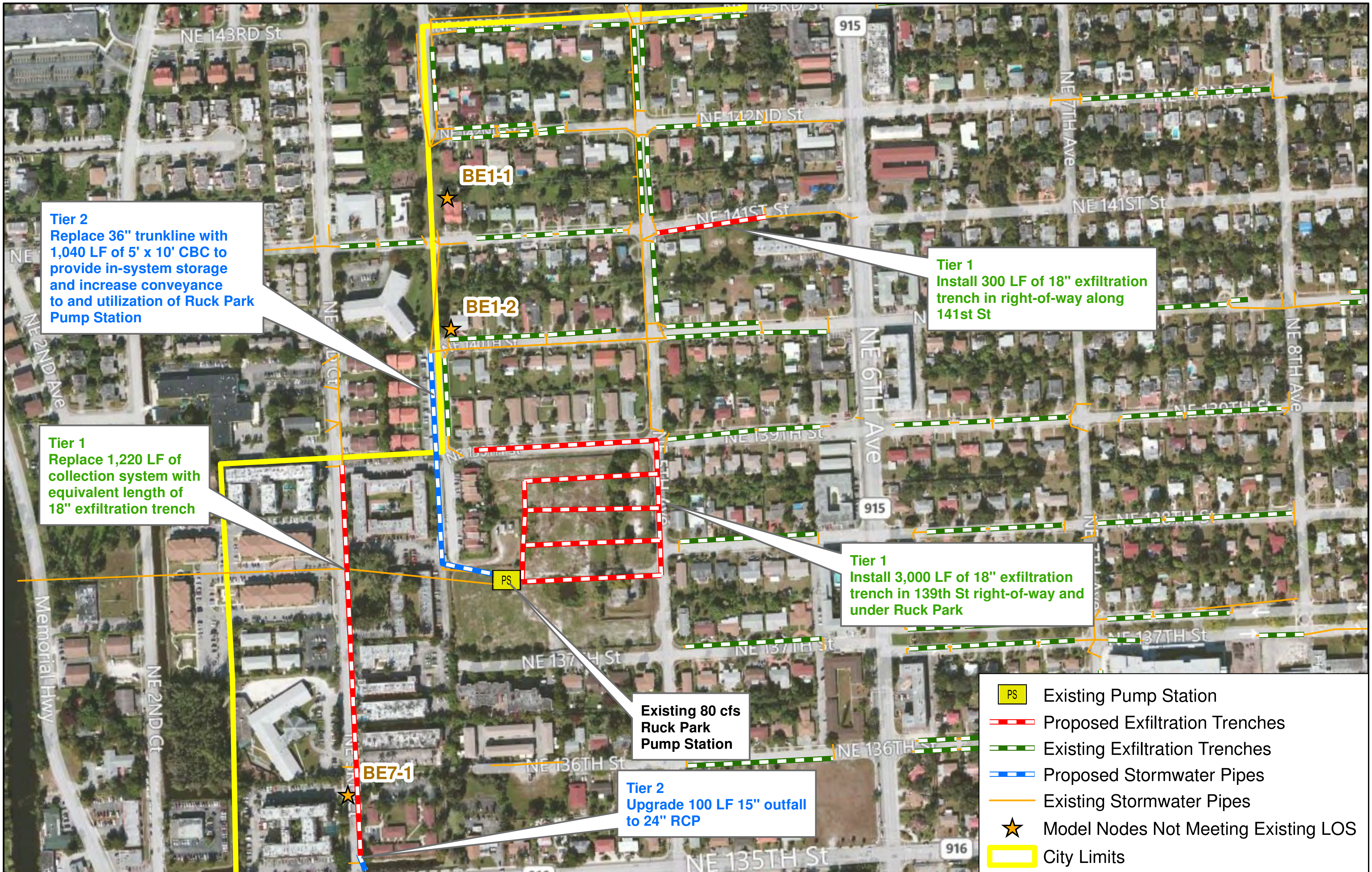

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City of North Miami
Stormwater Master Plan

0 200 400 800 Feet

Figure 5-5
Biscayne Canal East Problem Area 1 (North)
Tier 2 Alternatives
Exfiltration, Storage, and Outfall Upgrades

CDM Smith

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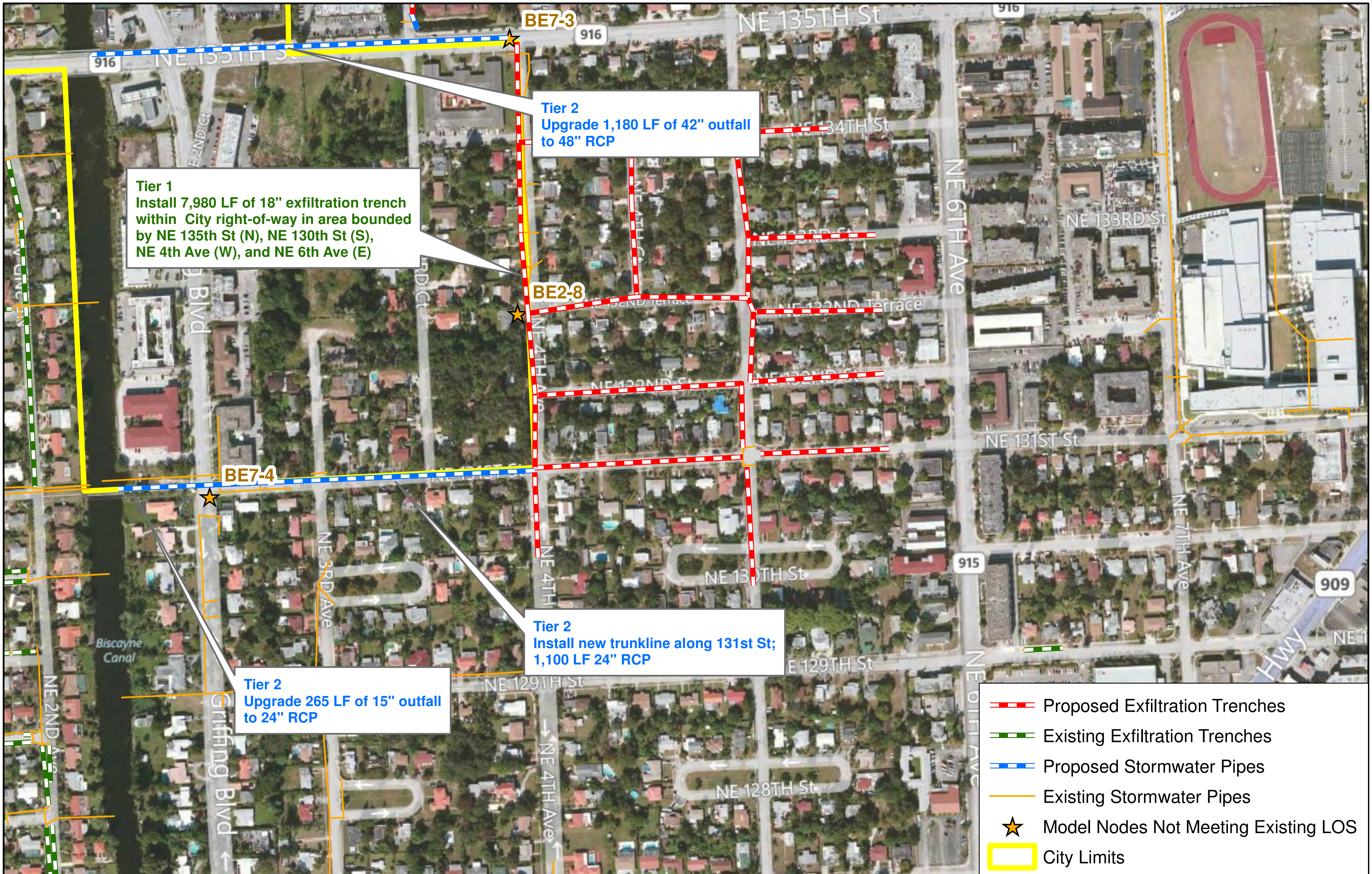

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0 200 400 800 Feet

City of North Miami
Stormwater Master Plan

Figure 5-6
Biscayne Canal East Problem Area 1 (South)
Tier 2 Alternatives
Exfiltration, Storage, and Outfall Upgrades

CDM Smith

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- The upsizing of the existing outfall at NE 135th Street from 42-inch to 48-inch RCP. This improvement will require coordination with Miami-Dade County, as the outfall into Biscayne Canal West lies outside of City limits, as well as with FDOT, as NE 135th Street is considered FDOT right-of-way. As with the previous outfall upgrade discussed above, the single pipe size upsizing is generally accepted by local regulatory agencies with little permitting effort required.

- The upsizing of the existing outfall at NE 131st St from 15-inch to 24-inch RCP, with the construction of a new 24-inch trunkline along NE 131st St from NE 4th Ave to the upgraded outfall. These improvements will provide increased capacity for the system on the south side of NE 135th St.

The proposed improvements alleviate LOS deficiencies for four of the six deficient nodes in the problem area (Table 5-2); flood stage reductions of over one foot are provided in several areas. Model results indicate reduction in flood stages for nodes BE7-1 and BE7-3; however, the flood stage reductions are insufficient to correct the LOS deficiencies at these locations. A conceptual cost estimate for the Tier 2 improvements, including the Tier 1 exfiltration trenches, is approximately $6,600,000. A cost breakdown is provided in **Appendix I** in **Table I-4.**

5.1.2.1. Tier 3

In order to address the two remaining LOS deficiencies in the Biscayne Canal East Problem Area 1, further outfall upgrades are proposed. Tier 3 improvements include an upsizing of the existing outfall along NE 3rd Ct from 15-inch to 30-inch RCP, and an upsizing of the existing outfall along NE 135th St from 42-inch RCP to 4-foot by 7-foot CBC. These improvements are illustrated in **Figure 5-7** and **Figure 5-8**.

As shown in Table 5-2 below, the proposed improvements are predicted to alleviate the LOS deficiencies at the two remaining nodes, BE7-1 and BE7-3. Whereas these improvements are expected to provide the greatest reduction in flood stages, they are expected to require the most coordination for regulatory approval and the greatest permitting effort of the alternative tiers. A conceptual cost estimate for the Tier 3 solution approximately $7,900,000. A cost breakdown is provided in **Appendix I** in **Table I-5.**

5.1.3. Arch Creek South/Biscayne Canal East Problem Area

The Arch Creek South/Biscayne Canal East Problem Area is located in the south central portion of the City and is generally bounded by NE 128th St (north), NE 121st St (south), Biscayne Canal (west), and the railroad (east). The area has a mix of commercial and residential development. Outfalls along NE 125th St and Dixie Highway serve as the primary outlets for the western part of the problem area; runoff from the eastern extent of the problem area is conveyed to a separate outfall on NE 125th St and ultimately discharges to Arch Creek.

The City has identified this area as a historic flooding concern. Model results indicate several locations within the area with 5-year LOS deficiencies:

- 0.4 feet of flooding at NE 126th St west of NE 11th Ave (Node ACS1-1);

- 0.5feet of flooding at NE 123rd St west of NE 10th Ave (Node ACS1-2);

N

0 200 400 800 Feet

City of North Miami
Stormwater Master Plan

Figure 5-7
Biscayne Canal East Problem Area 1 (North)
Tier 3 Alternatives
Exfiltration, Storage, and Outfall Upgrades

CDM Smith

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Stormwater Master Plan

Figure 5-8
Biscayne Canal East Problem Area 1 (South)
Tier 3 Alternatives
Exfiltration, Storage, and Outfall Upgrades

CDM Smith

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- 2.5 feet of flooding at NE 121st St west of NE 11th Ave (Node ACS1-3);
- 0.7 feet of flooding at NE 12th Ave north of NE 124th St (Node ACS1-4);
- 1.4 feet of flooding at NE 127th St west of NE 8th Ave (Node BE4-1);
- 0.6 feet of flooding at NE 123rd St and NE 9th Ave (Node BE4-2);
- 0.1 feet of flooding at NE 8th Ave north of NE 121st St (Node BE4-3);
- 0.3 feet of flooding at NE 7th Ave north of NE 125th St (Node BE4-4);
- 0.3 feet of flooding at NE 124th St and NE 6th Ave (Node BE4-5); and
- 0.5 feet of flooding at NE 123rd St and Griffing Blvd (Node BE4-9).

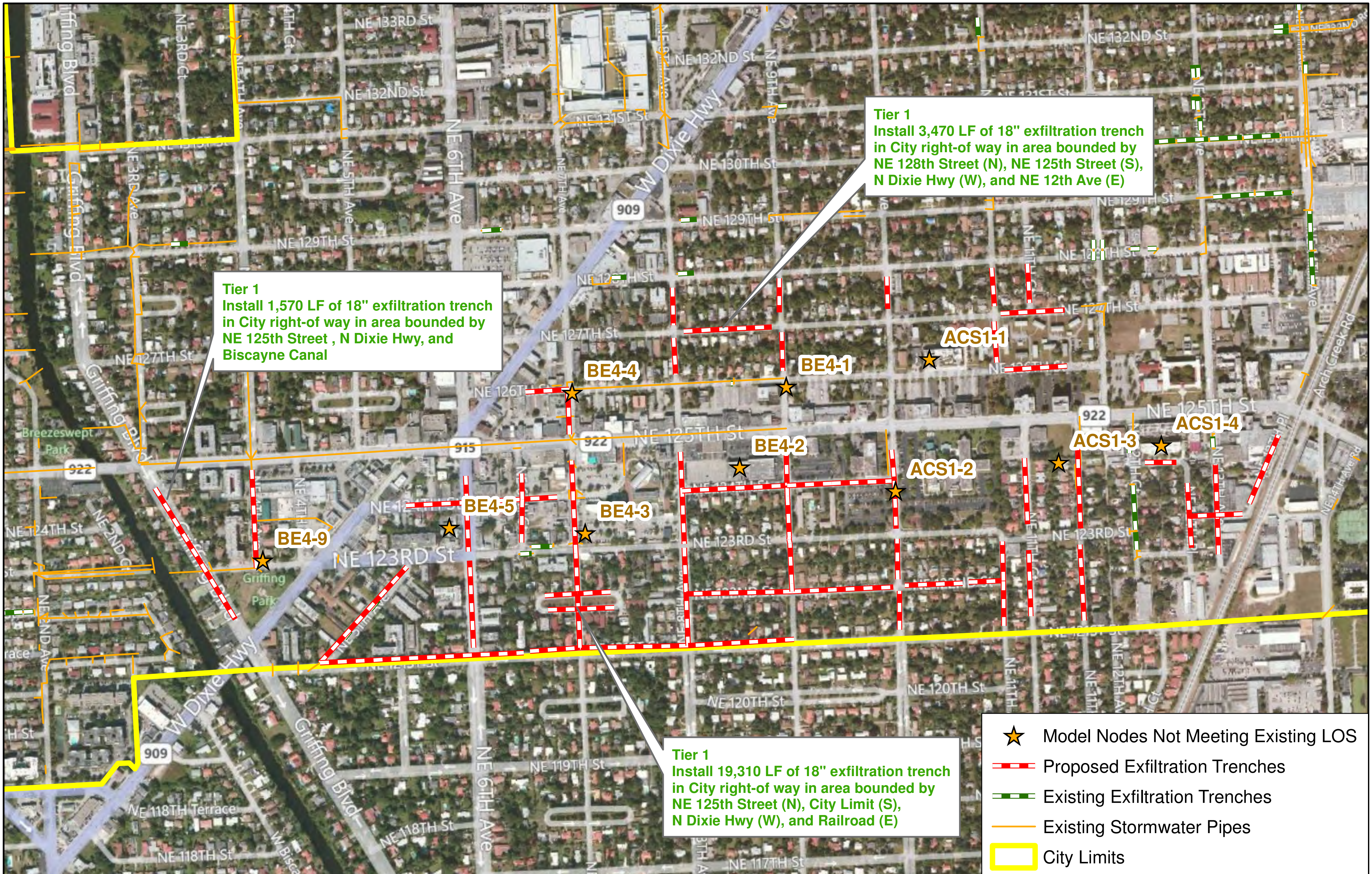
5.1.3.1. Tier 1

As shown in **Figure 5-9**, Tier 1 includes the installation of 24,350 LF of exfiltration trenches in the problem area. Exfiltration trench layouts as shown in Figure 5-9 utilize available space in City right-of-way. Additional piping and inlets to collect and route runoff to the exfiltration trenches will be necessary to ensure the optimal utilization of the exfiltration trenches.

As shown in **Table 5-3** below, the proposed improvements significantly reduce flood stages for several deficient nodes; exfiltration alone is expected to provide sufficient flood stage reduction to correct the 5-year LOS deficiencies at nodes ACS1-1, ACS1-2, BE4-1, BE4-2, BE4-3, and BE4-4. A review of available geotechnical data and soil borings indicate high hydraulic conductivity in many of the local soils, thereby allowing for significant soil storage and aquifer recharge through exfiltration. Model results indicate that exfiltration alone will not provide any significant hydraulic benefit for the four remaining LOS deficiencies. A conceptual cost estimate for the exfiltration trenches and associated collection systems in Tier 1 is approximately $7,200,000. A cost breakdown is provided in **Appendix I** in **Table I-6.**

Table 5-3 Arch Creek South/Biscayne Canal East Problem Area – Model Results

Deficient Node	Existing Stage (5-yr/24-hr)	Critical Stage	Tier 1		Tier 2	
			Stage	Meets LOS?	Stage	Meets LOS?
ACS1-1	6.1	5.7	5.7	Yes	5.6	Yes
ACS1-2	6.3	5.8	5.7	Yes	5.7	Yes
ACS1-3	6.3	3.8	5.7	No	3.6	Yes
ACS1-4	6.8	6.1	6.8	No	5.6	Yes
BE4-1	7.1	5.7	5.7	Yes	5.7	Yes
BE4-2	6.6	6.0	6.0	Yes	6.0	Yes
BE4-3	6.1	6.0	5.7	Yes	5.7	Yes
BE4-4	6.9	6.6	5.7	Yes	5.7	Yes
BE4-5	6.3	6.0	6.2	No	6.0	Yes
BE4-9	5.4	4.9	5.3	No	4.6	Yes



City of North Miami
Stormwater Master Plan

Figure 5-9
Arch Creek South/Biscayne Canal East Problem Area
Tier 1 Alternative
Exfiltration Only

N

0 400 800 1,600 Feet

CDM Smith

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5.1.3.2. Tier 2

Additional storage and conveyance upgrades were added to the Tier 1 exfiltration trenches to provide additional flood reduction. Tier 2 solutions, illustrated in **Figure 5-10**, include the following:

- Installation of underground storage vaults and a stormwater pump station to correct the LOS deficiencies at ACS1-3 and ACS1-4. Node ACS1-3 represents an area of significantly lower elevation than the surrounding area, thereby precluding a feasible gravity outfall solution to alleviate the flooding at this area. Therefore, a collection system is proposed to convey runoff to a 0.5 acre, 9-feet deep underground storage facility (0.45 ac-ft volume) at a vacant lot at the corner of NE 12th Ave and NE 125th St. This facility will contain a wet well for a 120 cfs pump station, which will pump runoff through a mile of 48-inch force main to a 0.7-acre, 10-feet deep underground storage facility (0.7 ac-ft volume) under Griffing Park. A 40 cfs pump station in the Griffing Park facility will pump collected stormwater into the upgraded Dixie Highway outfall (discussed below).

- The upsizing of the existing outfall along NE 125th St into the Biscayne Canal from 18-inch to 24-inch RCP. Upsizing this outfall will require coordination with FDOT, as NE 125th St is FDOT right-of-way.

- The upsizing of the existing outfall at NE 123rd Street into the Biscayne Canal from 24-inch to 30-inch RCP.

- The upsizing of the Dixie Highway outfall into Biscayne Canal from 60-inch to 66-inch, combined with the upsizing of the 18-inch pipe along NE 7th Ave, that connects to the existing outfall from 18-inch to 36-inch. Upsizing the Dixie Highway outfall will require coordination with FDOT, as Dixie Highway is FDOT right-of-way.

As shown in Table 5-3 below, the proposed improvements alleviate LOS deficiencies for the four remaining deficient nodes that were not sufficiently alleviated through the use of exfiltration alone. As all LOS deficiencies were corrected within Tier 2 constraints, no Tier 3 solutions were proposed for this problem area that may require more complex permitting. A conceptual cost estimate for the Tier 2 improvements, including the Tier 1 exfiltration trenches, is approximately $27,400,000. A cost breakdown is provided in **Appendix I** in **Table I-7.**

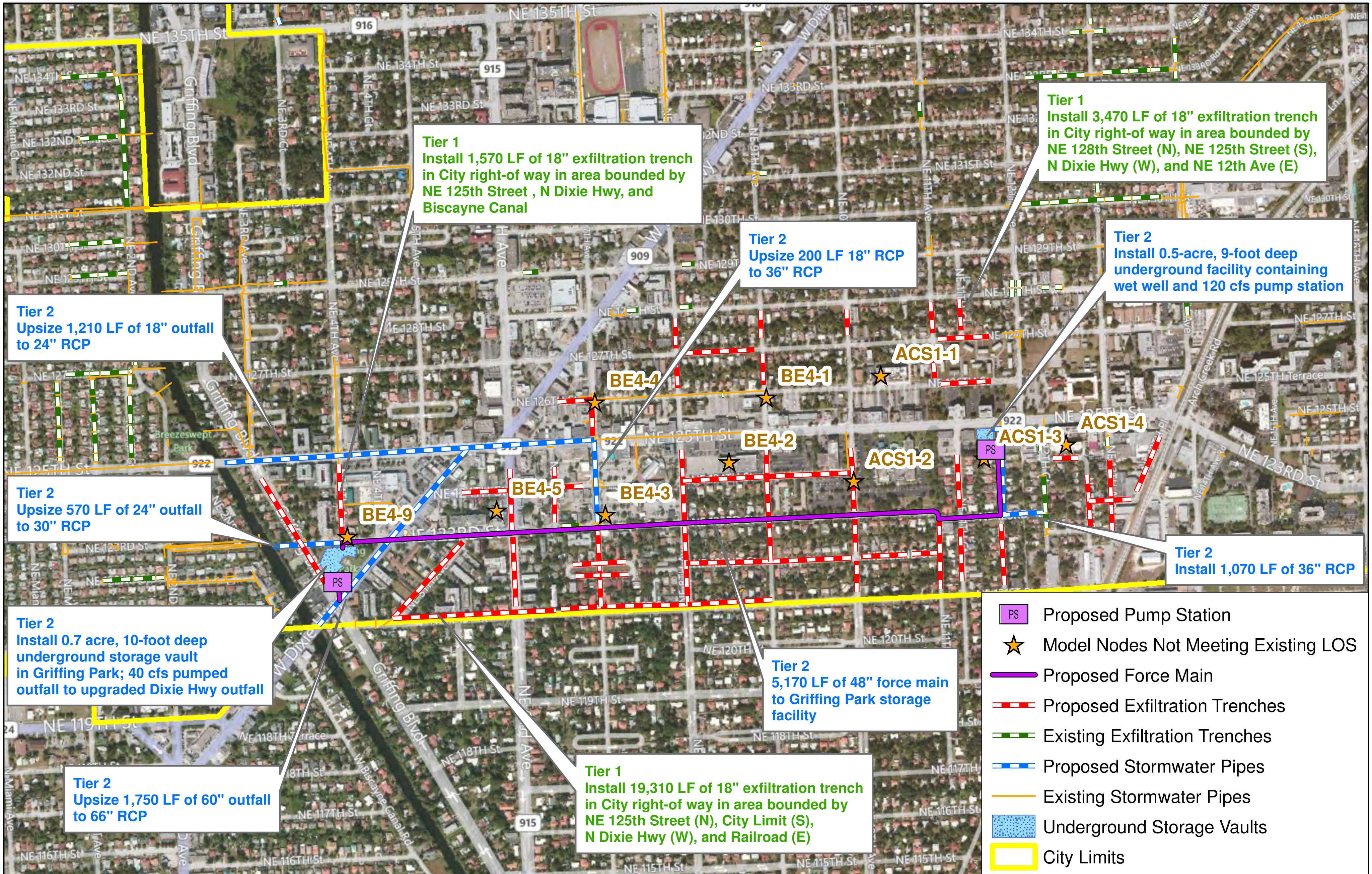
5.1.4. Arch Creek South Problem Area

The Arch Creek South Problem Area is located in the northeast corner of the City and is generally bounded by NE 143rd St (north), NE 140th St (south), NE 14th Ave (west), and Arch Creek (east). The area is largely residential with some institutional development. An outfall into Arch Creek along NE 142nd St, connecting to an FDOT system along 143rd St, and an outfall at NE 140th St serve as the primary outlets for the problem area.

The City has identified this area as one of concern. Model results indicate two locations within the area with 10-year LOS deficiencies:

- 0.4 feet of flooding at NE 143rd St and NE 16th Ave (Node ACS2-1); and

- 1.0 feet of flooding at NE 142nd St east of NE 17th Ave (Node ACS2-2).



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City of North Miami
Stormwater Master Plan Update

Figure 5-10
Arch Creek South/Biscayne Canal East Problem Area
Tier 2 Alternatives
Exfiltration, Storage, and Outfall Upgrades

0 500 1,000 2,000
Feet

CDM Smith

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5.1.4.1. Tier 1

As shown in **Figure 5-11**, Tier 1 includes the installation of 4,790 LF of exfiltration trenches in the problem area. Exfiltration trench layouts as shown in Figure 5-12 utilize available space in City right-of-way. Additional piping and inlets to collect and route runoff to the exfiltration trenches will be necessary to ensure the optimal utilization of the exfiltration trenches.

As shown in **Table 5-4** below, the proposed improvements provide minimal hydraulic and flood control benefit. A review of available geotechnical data and soil borings indicate low hydraulic conductivity in many of the local soils; while the exfiltration trenches will provide considerable water quality benefit, the soils are not conducive to providing significant flood relief. A conceptual cost estimate for the exfiltration trenches and associated collection systems in Tier 1 is approximately $1,500,000. A cost breakdown is provided in Appendix I in **Table I-8.**

Table 5-4 Arch Creek South Problem Area – Model Results

Deficient Node	Existing Stage (5-yr/24-hr)	Critical Stage	Tier 1		Tier 2		Tier 3	
			Stage	Meets LOS?	Stage	Meets LOS?	Stage	Meets LOS?
ACS2-1	5.2	4.8	5.1	No	4.7	Yes	4.7	Yes
ACS2-2	4.6	3.6	4.6	No	4.2	No	3.6	Yes

5.1.4.2. Tier 2

Additional storage and conveyance upgrades were added to the Tier 1 exfiltration trenches to provide additional flood reduction. Tier 2 solutions, illustrated in **Figure 5-12**, include the following:

- The upsizing of the existing NE 142nd and NE 143rd Street outfall into Arch Creek from 30-inch to 36-inch RCP. Upsizing this outfall will require coordination with FDOT, as NE 143rd St is FDOT right-of-way.

- The upsizing of the existing outfall along NE 140th St into Arch Creek from 24-inch to 30-inch RCP. A new 30" trunkline is proposed to convey runoff from areas to the west (represented by node ACS2-1) to the upgraded outfall.

- A 3 ac-ft underground storage facility at a vacant lot at NE 17th Ct. A 35 cfs pump station in the facility will drain the facility to the upgraded 142nd St outfall into Arch Creek. The facility will be fed by a series of collection systems and a 42-inch trunkline along NE 141st St.

As shown in Table 5-4 below, the proposed improvements reduce 10-year flood stages up to 0.5 feet and correct the LOS deficiency at ACS2-1; however, the flood stage reductions at ACS2-2 are insufficient to correct this LOS deficiency. A conceptual cost estimate for the Tier 2 improvements, including the Tier 1 exfiltration trenches, is approximately $6,300,000. A cost breakdown is provided in Appendix I in **Table I-9.**

5.1.4.3. Tier 3

In order to correct the remaining LOS deficiency in the Arch Creek South problem area, further outfall upgrades are proposed. Tier 3 improvements include an upsizing of the existing outfall at NE 142nd St from 30-inch to 42-inch RCP, and an upsizing of the existing outfall along NE 140th St from 24-inch RCP to 42-inch RCP. These improvements are illustrated in **Figure 5-13**.

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City of North Miami
Stormwater Master Plan Update

0 150 300 600
Feet

Figure 5-11
Arch Creek South Problem Area
Tier 1 Alternatives
Exfiltration Only

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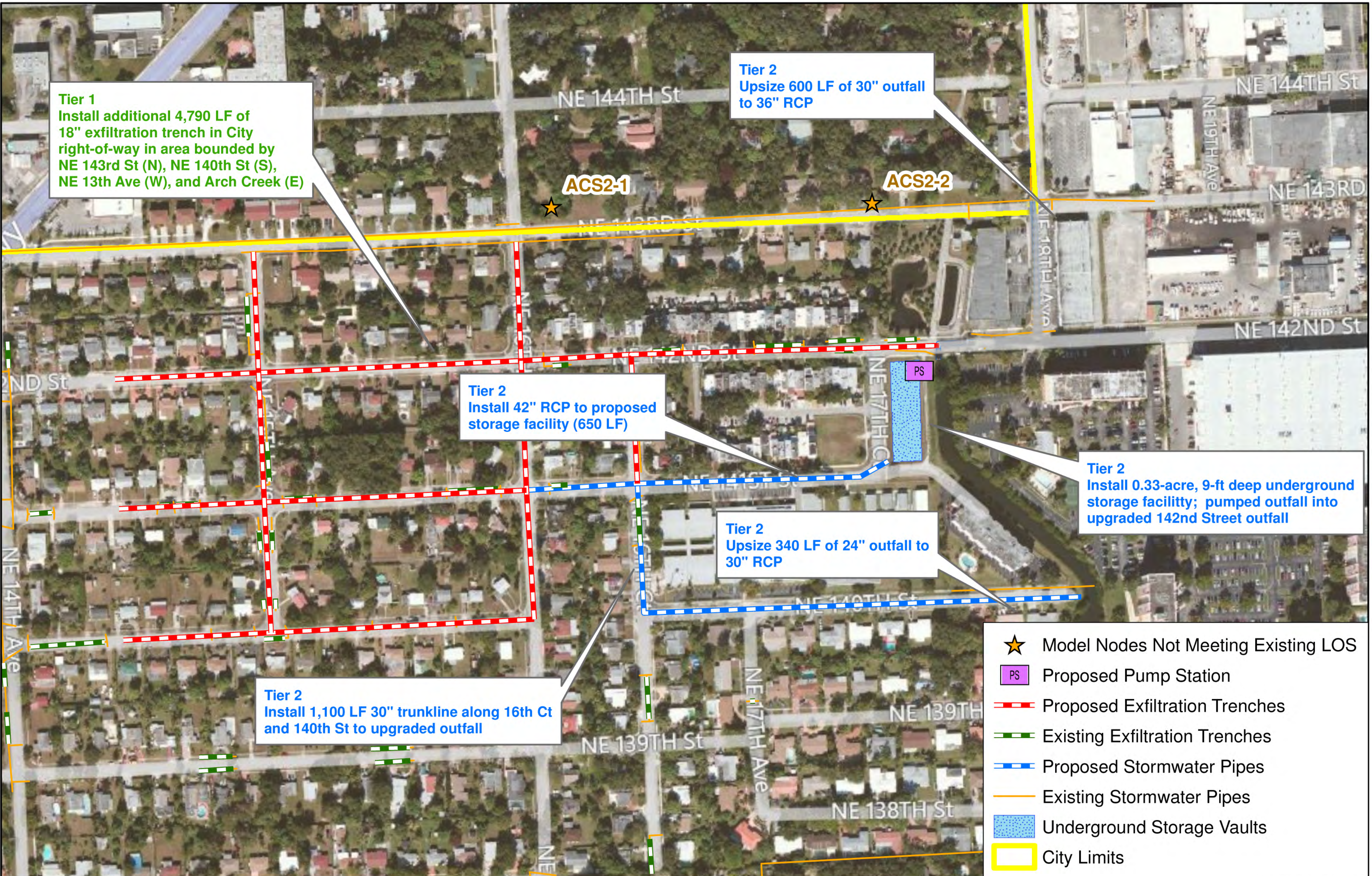

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City of North Miami
Stormwater Master Plan Update

0 150 300 600 Feet

Figure 5-12
Arch Creek South Problem Area
Tier 2 Alternatives
Exfiltration, Storage, and Outfall Upgrades

CDM Smith

N

0 150 300 600
Feet

City of North Miami
Stormwater Master Plan Update

Figure 5-13
Arch Creek South Problem Area
Tier 3 Alternatives
Exfiltration, Storage, and Outfall Upgrades

CDM Smith

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As shown in Table 5-4 below, the proposed improvements are predicted to alleviate the LOS deficiencies at the remaining deficient node, ACS2-2. Whereas these improvements are expected to provide the greatest reduction in flood stages, they are expected to have the greatest permitting complexity of all the alternative tiers. A conceptual cost estimate for the Tier 3 solution approximately $6,800,000. A cost breakdown is provided in **Appendix I** in **Table I-10.**

5.1.5. Arch Creek North/Arch Creek South Problem Area

The Arch Creek North/Arch Creek South Problem Area is located in the eastern portion of the City and is generally bounded by NE 140th St (north), NE 126th St (south), NE 12th Ave (west), and Arch Creek (east). The area has a mix of commercial and residential development. The primary outfall for the problem area is a 42-inch RCP trunkline along NE 135th St, which discharges into Arch Creek immediately upstream of the railroad crossing. A 24-inch outfall at NE 137th Terrace provides additional outlet capacity to Arch Creek.

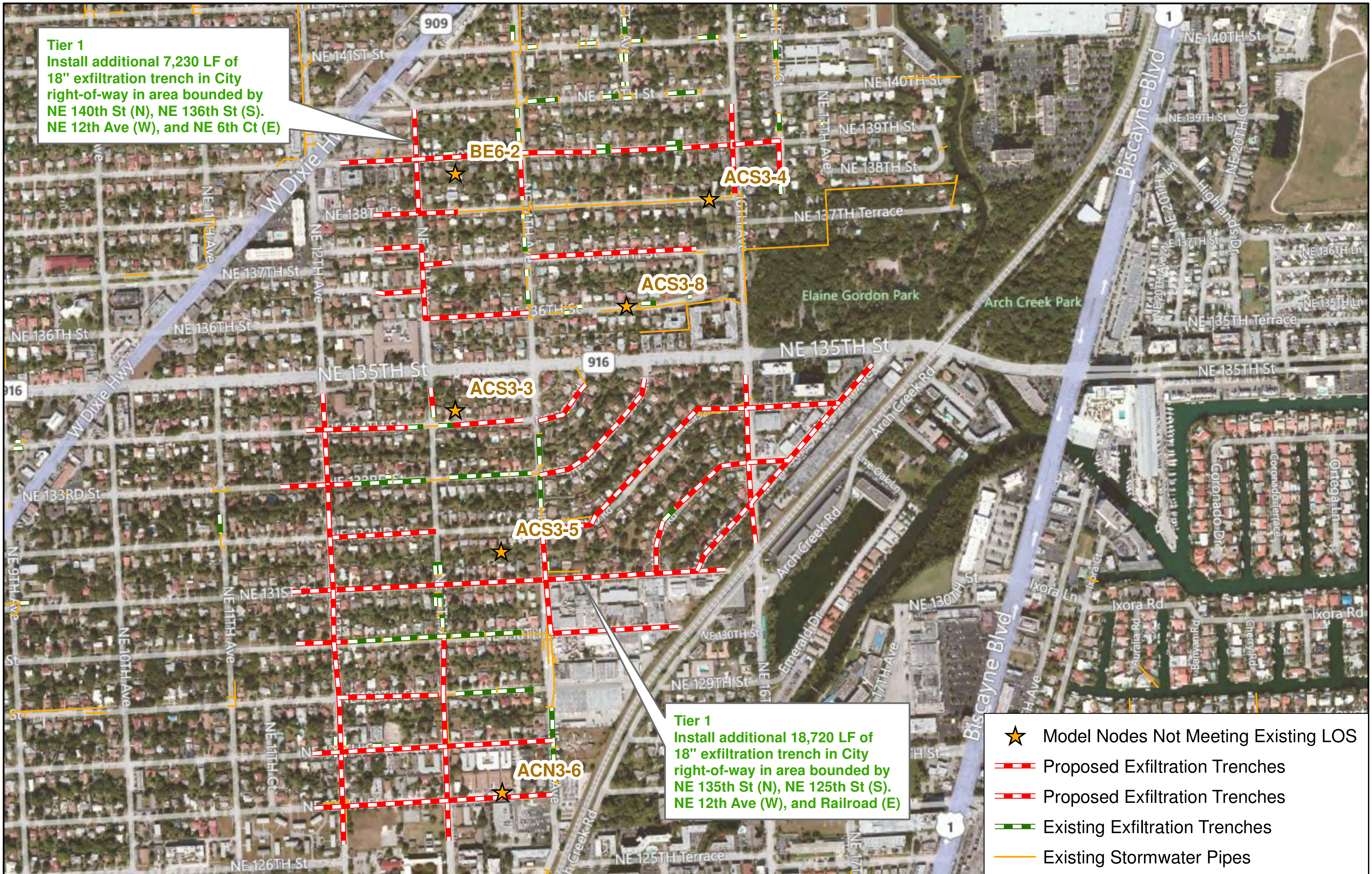
Model results indicate several locations within the area with 5-year LOS deficiencies:

- 0.8 feet of flooding at NE 127th St west of NE 12th Ave (Node ACN3-6);
- 0.8 feet of flooding at NE 13th Ave north of NE 134th St (Node ACS3-3);
- 0.7 feet of flooding at NE 138th St west of NE 16th Ave (Node ACS3-4);
- 1.5 feet of flooding at NE 132nd St west of NE 14th Ave (Node ACS3-5);
- 2.8 feet of flooding at NE 136th St west of NE 15th Ave (Node ACS3-8); and
- 1.3 feet of flooding at NE 138th St east of NE 13th Ave (Node BE6-2).

5.1.5.1. Tier 1

As shown in **Figure 5-14**, Tier 1 includes the installation of 25,950 LF of exfiltration trenches in the problem area. Exfiltration trench layouts as shown in Figure 5-14 utilize available space in City right-of-way. Additional piping and inlets to collect and route runoff to the exfiltration trenches will be necessary to ensure the optimal utilization of the exfiltration trenches.

As shown in **Table 5-5** below, the proposed improvements significantly reduce flood stages for several deficient nodes; exfiltration alone is expected to provide sufficient flood stage reduction to alleviate the 5-year LOS deficiencies at node ACN3-6, and provides over a foot of flood stage reduction at node ACS3-5. A review of available geotechnical data and soil borings indicate high hydraulic conductivity in the problem area soils south of NE 135th St, thereby allowing for significant soil storage through exfiltration. However, model results indicate that exfiltration alone will not provide sufficient hydraulic benefit to alleviate five of the six LOS deficiencies in the problem area. A conceptual cost estimate for the exfiltration trenches and associated collection systems in Tier 1 is approximately $8,200,000. A cost breakdown is provided in **Appendix I** in **Table I-11.**



City of North Miami
Stormwater Master Plan Update

Figure 5-14
Arch Creek North/Arch Creek South Problem Area
Tier 1 Alternatives
Exfiltration Only

CDM Smith

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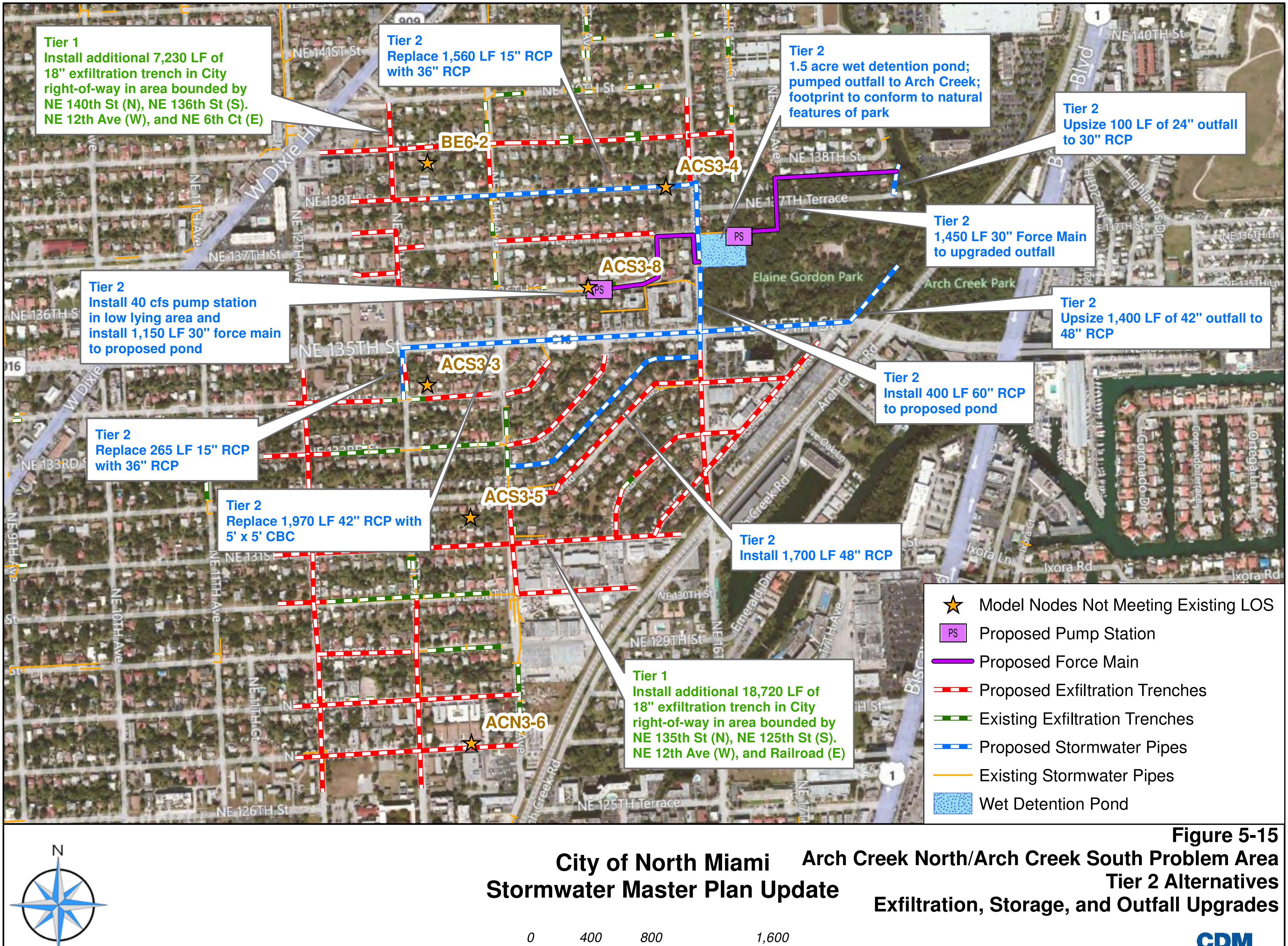
Table 5-5 Arch Creek North/Arch Creek South Problem Area – Model Results

Deficient Node	Existing Stage (5-yr/24-hr)	Critical Stage	Tier 1		Tier 2	
			Stage	Meets LOS?	Stage	Meets LOS?
ACN3-6	6.0	5.2	5.2	Yes	5.2	Yes
ACS3-3	6.5	5.7	6.4	No	5.6	Yes
ACS3-4	7.5	6.8	7.1	No	5.0	Yes
ACS3-5	6.0	4.5	4.8	No	4.4	Yes
ACS3-8	6.1	3.3	5.8	No	2.9	Yes
BE6-2	8.5	7.2	8.2	No	6.5	Yes

5.1.5.2. Tier 2

Additional storage and conveyance upgrades were added to the Tier 1 exfiltration trenches to provide additional flood reduction. Tier 2 solutions, illustrated in **Figure 5-15**, include the following:

- Upsizing of the existing outfall along NE 135th St from 42-inch to 48-inch RCP. Upsizing of this outfall will require coordination with FDOT, as NE 135th St is FDOT right-of-way.
- The installation of various conveyance upgrades connecting to the upgraded outfall. These include:
  - 1,700 LF of 48" RCP from NE 132nd St and NE 14th Ave (Node ACS3-5), connecting to the upgraded outfall at NE 135th St and NE 16th Ave.
  - Replacing 1,970 LF of 42-inch pipe along 135th Street with 5' x 5' CBC, providing in-system storage and low-head loss conveyance.
  - Upgrading the existing 18-inch RCP from NE 13th Ave and NE 134th St (Node ACS3-3) to 36-inch RCP.
- Upsizing the existing outfall at NE 137th Terrace from 24-inch to 30-inch RCP.
- The installation of a 1.5-acre wet detention pond in Elaine Gordon Park. The pond will provide water quality benefits and peak flow mitigation, and can provide wildlife habitat and other educational benefits to accompany the mission of Elaine Gordon Park as a natural preserve. The water level in the pond will be controlled by a 40 cfs pump station, which will pump treated runoff through a 30-inch force main to the upgraded outfall at NE 137th Terrace. The pond will treat runoff from the south by means of a 5' x 5' CBC pipe from NE 135th St and NE 16th Ave, and will treat runoff from the north and west by means of an incoming 36-inch RCP trunkline.
- The installation of a 40 cfs pump station on NE 136th St. This area, represented by Node ACS3-8, is a low-lying area for which a gravity drainage solution is not be feasible to achieve LOS. The facility will pump runoff through a 30-inch force main to the proposed wet detention pond at Elaine Gordon Park.



City of North Miami
Stormwater Master Plan Update

Figure 5-15
Arch Creek North/Arch Creek South Problem Area
Tier 2 Alternatives
Exfiltration, Storage, and Outfall Upgrades

CDM Smith

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As shown in Table 5-3 below, the proposed improvements alleviate LOS deficiencies for the five outstanding deficient nodes that were not sufficiently alleviated through the use of exfiltration alone. As all LOS deficiencies were corrected within Tier 2 constraints, no Tier 3 solutions were proposed for this problem area that may require advanced permitting effort. A conceptual cost estimate for the Tier 2 improvements, including the Tier 1 exfiltration trenches, is approximately $14,900,000. A cost breakdown is provided in **Appendix I** in **Table I-12.**

5.1.6. Biscayne Canal East Problem Area 2

The Biscayne Canal East Problem Area 2 lies in the central portion of the City and is generally bounded by NE 131 St (north), NE 129th St (south), Dixie Highway (west), and NE 10th Ave (east). The area has a mix of commercial and residential development and lies within a closed basin with no identifiable outfall. The area is currently served by several exfiltration trenches.

Existing condition model results predict 0.7 feet of flooding near the intersection of NE 129th St and NE 8th Ave (Node BE3-2) for the 5-year/24-hour design storm.

A Tier 1 alternatives analysis indicates that the installation of additional exfiltration trenches in the vicinity of the problem area should provide sufficient hydraulic benefit to alleviate flooding for the 5-year/24-hour design storm. As shown in **Figure 5-16**, the addition of 900 LF of exfiltration trench in the problem area is expected to provide sufficient hydraulic benefit to reduce flood stages below critical elevation. Soil boring data in the vicinity indicates the presence of soils with high hydraulic conductivity, and as such exfiltration trenches can provide significant storage and flood control benefit.

Model results are presented in **Table 5-6**. A conceptual cost estimate for the proposed improvements is approximately $350,000. A cost breakdown is presented in Appendix I in **Table I-13**.

Table 5-6 Biscayne Canal East Problem Area 2 – Model Results

Deficient Node	Existing Stage (5-yr/24-hr)	Critical Stage	Tier 1	
			Stage	Meets LOS?
BE3-2	7.2	6.5	6.5	Yes

City of North Miami
Stormwater Master Plan

Figure 5-16
Biscayne Canal East Problem Area 2
Tier 1 Alternatives
Exfiltration Only

CDM Smith

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5.2. Operations and Maintenance (O&M) Needs

The City's O&M activities related to their stormwater infrastructure are structured to be in compliance with the requirements set forth in the NPDES joint permit with Miami-Dade County. A complete listing of the inspection and maintenance frequencies required per the NPDES permit are included in **Appendix J**. The City currently does not have a centralized reporting system for stormwater-related complaints. CDM Smith performed a field visit in January 2012. Based on the field visit and discussions with City staff, there are no apparent O&M needs. Current inspection and maintenance frequencies appear to be appropriate for a municipality of this size.

CDM Smith obtained current information on the City's stormwater assets both directly from the City (**Table 5-7**) as well as from the City's most recent MS4 NPDES Annual Report, dated March 2011. The following sub-sections describe the inspection and maintenance activities required for the types of structure summarized in Table 5-7.

Table 5-7 Stormwater Assets

Asset	Quantity	Units
Exfiltration Trench	122,879	Linear feet
Pollution Control Box	unknown	N/A
Pump Stations	unknown	N/A
Major Outfalls	7	N/A
Catch Basins	2,172	N/A
Canal Ends	31	N/A
Auger Wells	238	N/A

5.2.1. Structural Controls Inspection and Maintenance

The City's stormwater system and any stormwater structural control is operated in a manner to reduce the discharge of pollutants to the maximum extent practicable (MEP). The following paragraphs discuss the City's stormwater components and assess O&M activities performed in compliance with regulatory mandates. The assessment of the O&M program is discussed in order of the structural control items listed in the City's NDPES permit (Table II.A.1.a- Inspection and Maintenance Schedule for structural controls and roadways).

5.2.1.1. Exfiltration Trenches/French Drains

Exfiltration trenches and french drains are installed below catch basins throughout the City to redirect surface water and groundwater from a specific area while preventing potential damage to building foundations. French drains are inspected and maintained by the Public Works Department. Maintenance activities are performed in response to immediate problems such as flooding and/or customer complaints. At a minimum, maintenance should be performed on an as-needed basis based on inspection to assure proper operation (based on the City's MS4 NPDES permit). Cleaning and maintaining the french drains maximizes the level of service of the stormwater system while preventing damage to building foundations. Due to the number of exfiltration trenches within the City, clogging can occur more frequently and may require increased maintenance frequencies.

5.2.1.2. Pollution Control Boxes

Pollution control boxes such as baffle boxes and catch basin inserts are inspected and maintained by the Public Works Department. Inspections are required quarterly, at a minimum while maintenance is required on an as-needed basis based on inspection to assure proper operation (based on the City's MS4 NPDES permit). Cleaning baffle boxes, catch basin inserts and other pollution control boxes reduces the amount of debris/trash blocking stormwater from entering the system.

5.2.1.3. Stormwater Pump Station

The City currently owns and operates several stormwater pump stations. Inlets, bar screens and other associated components are inspected for debris to assure that pumps operate efficiently. The pump stations are required to be inspected semi-annually and more frequently as needed. Maintenance is performed on an as-needed basis (based on the City's MS4 NPDES permit).

5.2.1.4. Major Outfalls

Stormwater outfalls are inspected annually as required by the City's MS4NPDES permit. The annual inspection and maintenance of stormwater inlets and outfalls assures that the outfall is in good working conditions and stormwater is flowing properly. Inspection activities include assuring that the pipe is not clogged with debris or sediment, there is no seepage around the pipe and/or the bank around the outfall is not eroded. Maintenance activities are performed as needed. Typical maintenance activities include removal and properly disposal of debris and/or sediment, repair of structural damage and inspection to verify that discharge does not cause erosion and sedimentation. Adequately cleaning and maintaining stormwater outfalls reduces the discharge of pollutants to open water bodies. It also assures that stormwater flows properly.

5.2.1.5. Pipes/Culverts, Catch Basins/Inlets and Stormwater Conveyances

Catch basins, inlets, storm sewer pipelines and canals help to convey stormwater to the appropriate treatment and disposal structures. Under the City's current MS4 NPDES permit, they are now required to inspect a minimum of 10 percent of the total number of structures each year. Maintenance is required on an as needed basis to ensure proper operation. Maintenance activities can include repairing any damages, removing accumulated sediments and litter/debris to maintain proper flow conditions.

5.2.1.6. Auger Wells

Auger wells, although not listed in the maintenance schedule of the City's NPDES MS4 permit, should be periodically maintained. In terms of routine maintenance, any trash screens, racks, separator units that remove debris, floatables and solids should be routinely cleaned. In terms of long term maintenance, wells should be assessed periodically due to age or lack of performance. Video logging can be done to inspect the well casing for evidence of failure. Occasionally, the wells will need to be jetted to remove leaves and debris.

5.3. Stormwater Funding Evaluation

This section of the SWMP presents an analysis of the funding of the City's Stormwater Utility Fund (SUF). Financial performance is projected through FY 2061 based on the City's FY 2012 budget (http://www.northmiamifl.gov/government/budget/files/FY_12_Preliminary_Budget_Final.pdf).

5.3.1. Customer Usage and Growth

This analysis estimates that approximately 37,000 equivalent residential units (ERUs) are currently being served by the City. The City's FY 2012 budget reflects gross stormwater utility fee revenue billings of $2.5M based on 37,000 ERUs. The analysis assumes utility collections are approximately 97 percent of billings. To project revenues beyond FY 2012, CDM Smith assumes billing a constant 37,000 annual ERUs at a collection rate of 97 percent, yielding an effective revenue generation base of 35,919 ERUs.

5.3.2. Projected Financial Results at Prevailing Rates

If the SWMP identified improvements start being implemented in FY 2013, the current reserves for future capital projects will not be sufficient to allow the SUF to cover the identified capital expenditures at under its current fee structure. Grants and loans are discussed as additional funding options in Section 5.3.5.

5.3.3. Projected Financial Results with Stormwater Rate Adjustments

It is projected that between FY2013 and 2061, a 3 to 4 percent annual increase in the stormwater utility fee to $24.00 per month per ERU by FY 2061 would be necessary to meet the current minimum debt service coverage requirements without any grants or additional external funding.

5.3.4. Comparison of Stormwater Utility Rates

Table 5-8 compares Florida local government's monthly stormwater utility fees, as compiled by the Florida Stormwater Association. Comparing only Broward and Miami-Dade County municipalities, the communities of Cooper City, Key Biscayne, Lauderhill, Miami Beach, Oakland Park, and Tamarac have stormwater utility fees in excess of the City of North Miami's current fee. With pending regulations and requirements, it is probable that several other local governments will be required to implement similar sized stormwater utility fee modifications over the next 50 years.

5.3.5. Grant and Loan Opportunities

Another method to provide funding for a portion of the City's stormwater management program is through grants (external funding without significant cost to the municipality) and cost sharing (partial external funding). In both cases, there are associated costs to the municipality. For grants, there are costs related to obtaining the grant (applications, environmental assessments, etc.) and these serve more for capital or regionally important projects. However, for either grants or cost sharing, governments may be able to accomplish the study, design and construction of capital projects for half or less of the total cost. It is important to note that cost sharing funds are not typically for O&M, and local governments need to plan for their own funding of O&M. Sources of grants and cost sharing funds are described below.

5.3.5.1. Water Management District (WMD)

There are two sources of WMD funding, both of which require cost sharing: cooperative funds and Surface Water Improvement and Management Act (SWIM) funds. Cooperative funds uses water management district ad valorem funds and projects are competitively selected. These funds provide generally 50 percent funding for projects which are mutually beneficial to the municipality and WMD. Cooperative funding can also provide the revenue for capital construction, generally for water quality and ecosystem enhancement projects as well as water supply improvements. SWIM funds refer to the Surface Water Improvement and Management Act which was developed to improve the quality of priority water bodies in Florida. Recently such funding has been limited although there are some funds available. As with cooperative funds, SWIM funds are for cost-shared projects. As of late, funding of these programs through the State Legislature has been significantly reduced.

5.3.5.2. State of Florida

As with the water management district, there are a number of ways to fund projects with the state of Florida (usually through FDEP). First, periodically, the Legislature provides FDEP with grant funding for stormwater purposes. The grants are generally small and currently there are no grants available. Second, the legislature allows low interest loan funds to be made available for stormwater management projects. These loans have interest rates less than the Prime Lending Rate. The stormwater loan program is relatively new and the process to obtain the loans can be tedious.

FDEP's Nonpoint Source (NPS) Management Section also administers grant money it receives from USEPA through Section 319(h) of the Federal Clean Water Act. These grant funds can be used to implement projects or programs that will help to reduce nonpoint sources of pollution. Projects or programs must be conducted within the state's NPS priority watersheds, which are the state's SWIM watersheds and National Estuary Program waters. All projects must include at least a 40% nonfederal match. Examples of fundable projects include: demonstration and evaluation of BMPs, nonpoint pollution reduction in priority watersheds, ground water protection from nonpoint sources, public education programs on nonpoint source management, etc.

In the 2005-06 legislative session, Senate Bill (SB) 444 authorized the Water Protection and Sustainability Program which defines funding for alternative water supplies, TMDL implementation and research, SWIM activities and small community grants. Grants will be distributed based on application and approval by each appropriate WMD. Even so, counties, cities, water management districts and special districts can apply for the grants. Unfortunately, due to the existing poor economic conditions, this fund is very limited and FDEP is not currently funding significant programs in this fashion.

Other grants which may have some applicability to stormwater projects are the Florida Recreation Development Assistance Program (FRDAP) grants administered by FDEP. These are competitive, reimbursement grant programs which provide financial assistance for acquisition or development of land for public outdoor recreation (which may include creative stormwater components).

5.3.5.3. Federal Government

In recent years, even though the USEPA has begun requiring stormwater management permits (NPDES MS4 permits), no new funding has been provided from the federal government to the states. Of course, the low interest loan program for the states is seeded by the federal government but direct grant or cost sharing money is not available. There are funds potentially available for water resources projects through the U.S, Army Corps of Engineers or the National Resources Conservation Service (NRCS) and sometimes in the recent past as a direct consequence of federal legislative activity (e.g., American Recovery and Reinvestment Act (ARRA)). As above, there are generally some costs to obtain these funds and the funds are usually restricted to capital projects which have significant public or statewide benefits.

Transportation Investment Generating Economic Recovery (TIGER) grants are awarded on a competitive basis to transportation projects aimed at promoting a range of modes of transportation. These grants can fund transportation projects which emphasize green infrastructure and stormwater collection improvements.

5.3.5.3.1. FEMA grants

FEMA funding can be secured for capital improvement projects that seek to reduce flooding in locations that experience historic or repeated flooding (i.e., repetitive losses). There are four different FEMA grant programs which relate to flood hazard mitigation. Three of them are competitive by state, so the top proposals in a state are entitled to a set amount of funding, while one is nationally competitive. The grants range from a few thousand dollars to more than a $1 million, depending on the program. For example, the Flood Mitigation Assistance program is usually over $500,000 but less than $1 million. The amount of funding per year per state per program varies.

Hazard Mitigation Grant Program: Funding under this program is disaster specific and identified by Congress at time of disaster declaration or soon after. FEMA will pay up to 75 percent, with State or grantee paying 25 percent match (cash and in-kind). Application due dates for the Hazard Mitigation Grant Program are disaster dependent.

Flood Mitigation Assistance Program: This program includes funding for measures which reduce flooding risk to buildings, such as Flood Mitigation Plans or property purchase. The grant funds projects at 75 percent/25 percent (Federal/non-Federal cost share).

Repetitive Flood Claims Program: This program provides funding for purchasing/demolishing buildings and property which have filed multiple flood-loss claims. FEMA may contribute 100 percent of cost if other sources are not available.

Pre-disaster Mitigation Program: This program provides funding for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. The data for available funding for this grant is not available.

Section 6

Floodplain Management

This section provides a summary of the City's current floodplain management activities, specifically relating to the City's Floodplain Management Plan (FPMP) and participation in the Community Rating System (CRS).

6.1. Floodplain Management Plan (FPMP) Review

As part of the SWMP update, CDM Smith reviewed the City's most recent (2009) Floodplain Management Plan (FPMP) and made recommendations on where improvements could be made. The FEMA NFIP CRS *2007 Coordinator's Manual* does not specify what information must be in a FPMP. However, the CRS program only credits plans which follow the standard planning process found in Section 511 of the *Coordinator's Manual*. The process for creating a FPMP focuses specifically on the importance of identifying local flood hazards, as relates to repetitive losses in particular. Per the *Coordinator's Manual*, repetitive loss properties account for approximately one-third of flood claims nationwide, costing the NFIP an estimated $200 million per year. In an effort to reduce the number of properties which have repetitive losses, the NFIP CRS program classifies communities which have more than ten unmitigated repetitive loss properties as Category C communities. The NFIP CRS program requires Category C communities to create and maintain a FPMP (Coordinator's Manual, p 500-6). The City of North Miami is currently a Category C community. In order to help maintain the City's current CRS rating, CDM initiated a review of the City's current FPMP. This review included:

- Review of the City's current FPMP;
- Review of FEMA's NFIP CRS *Example Plans* (*Example Plans*), 2007;
- Review of FEMA's NFIP CRS *Coordinator's Manual* (*2007 Coordinator's Manual*), 2007; and,
- Review of FEMA's NFIP CRS *2012 CRS Coordinator Manual Changes* (*2012 Changes*), 2011.

After performing the review, it was determined the City's FPMP will need to be updated to reflect the direction provided in the *2007 Coordinator's Manual* and the *Example Plans*, and to meet the anticipated NFIP CRS requirements changes proposed in the *2012 Changes*. The following sections summarize the review of the FPMP and its impacts. It is recommended that any changes to the FPMP occur after the revised CRS Coordinator's Manual is published in 2012.

6.1.1. Anticipated Impact of 2012 CRS Policy Changes to North Miami FPMP

The anticipated changes from the *2007 Coordinator's Manual* to the 2012 edition will most likely result in a changed approach of the program. Changes include: focusing on result oriented activities, revamping the CRS point values, and providing additional guidance for specific activities and documentation of activities. Specifically, changes for the FPMP are focused on tying identified problems to specific solutions. Creation of the FPMP falls under the CRS Activity 510 which is a 10-step process. One specific change is to require the FPMP to show how the problems that are identified and described in steps 4 and 5 are addressed in steps 6 and 8, as listed below (2012 Changes, p 32):

- Step 4 - Assessing the local hazards;

- Step 5 - Identifying and assessing specific problems related to all hazards identified in Step 4;
- Step 6 - Creating goals to address each problem identified in Step 5; and
- Step 8 - Creating an action plan which addresses all of the problems identified in Step 5.

The changes outlined in the *2012 Changes* are expected to increase the importance of activities which impact:

1. Flood loss reduction;
2. Flood insurance; and
3. Protecting natural floodplain functions.

In order to provide for better tracking of activities being performed by entities, new documentation requirements are recommended. Specific to the FPMP, changes include assigning a higher value for activities which provide greater distribution of the repetitive loss area analysis, increasing from the *2007 Coordinator's Manual* point value of 50 to the proposed point value of 140 (2012 Changes, p. 32). Additionally the overall value of CRS Activity 510 – Floodplain Management Planning has increased from the *2007 Coordinator's Manual* point value of 359 to the proposed point value of 657 (2012 Changes, p. 32). This change in point structure has directly increased the value of the FPMP in the CRS system. The increase in point value for CRS Activity 510 – Floodplain Management Planning offers the opportunity for the City to mitigate proposed loss of points occurring in other activity areas in the *2012 Changes*. This review did not evaluate point changes for each step in the FPMP guidance as the *2012 Changes* did not provide the point break out for each step. For additional information regarding the requirements and changes affecting the City's CRS rating, please refer to subsection 6.2 (CRS) in this document.

6.1.2. Recommendations for the North Miami FPMP

The following recommendations are provided for the North Miami FPMP. It is anticipated that these recommendations will gain additional points under Activity 510 in the CRS program. However, the number of points which could possibly be earned by implementing these recommendations is not predictable at this time, as the *2012 Changes* does not provide sufficient information to do so. As a result, the following recommendations are general, and are intended to meet the general guidelines and goals for the FPMP outlined in *2012 Changes*.

The CRS program itself is shifting focus to the importance of tying identified problems with proposed solutions, along with tracking the successes and failures of the proposed solutions addressing the FPMP goals (2012 Changes, p. 32). As a result of the change in focus, reviewing current activities, creating new activities and ranking each activity have a dual benefit in that they meets the expected criteria of the CRS program and make the FPMP a valuable tool for the City. Following are some recommended changes for specific activities performed under the CRS Activity 510 – Floodplain Management Planning, especially as it relates to the City's FPMP and the City's annually submitted CRS Status of Action Plan Implementation (FPMP progress report):

1. Revise current FPMP chapters to reflect the required link between Steps 4, 5, 6 and 8 and specifically annotate which pieces of the plan are addressing each of the ten specific steps (2012 Changes, p. 32).

- All hazards identified in Step 4 must be assessed in Step 5.
- Utilize nomenclature (subheadings or titles) to specifically identify the problems identified in Step 5, in order to easily associate the identified problems with the goals from Step 6, and activities associated with each identified problem in Step 8.

  Example:

  Step 5- identify specific problem with specific title: Problem 1 – Repetitive loss properties;
  Step 6 - Problem 1 – Goal remove repetitive loss properties from flood danger;
  Step 8 - Problem 1 – Improve drainage system to reduce flooding in repetitive loss area.
- Update FPMP Chapter 5 to include the process for creating and updating the CRS-mandated Application and Recertification Program Data Table per Community CRS Coordinator's Letter dated August 1, 2011. This table will need to be submitted as part of the annual progress report to FEMA. **Table 6-1** Application and Recertification Program Data provides a list of data.

Table 6-1 Application and Recertification Program Data

1	Number of buildings in the SFHA (bSF) as of last report
2	Number of new manufactured homes installed since last report
3	Number of other 1 – 4 family structures constructed since last report
4	Number of all other structures constructed/installed since last report
5	Number of buildings removed/demolished since last report
6	Number of buildings affected by map revisions since last report (+ or -)
7	Number of buildings affected by corporate limits changes (+ or -)
8	Current total number of buildings in the SFHA (bSF) (sum of lines 1 – 7)
9	Number of substantial improvement/damage projects since last report
10	Number of repetitive loss properties mitigated since last report
11	Number of LOMRs and map revisions (not LOMAs) since last report
12	Acreage of area(s) (aSFHA) as of the last report
13	Acreage of area(s) affected by map revisions since last report (+ or -)
14	Acreage of area(s) affected by corporate limits changes (+ or -)
15	Current acreage of the SFHA (aSFHA) (sum of lines 11 – 13)

- Update FPMP Chapter 7 to include the City's capability to implement the activities that have been reviewed (2012 Changes, p. 32).
- Add a chapter or section to the FPMP specifically calling out "Step 10 Activity: Implement, evaluate and revise". The information included here will annotate how the plan will be periodically evaluated and revised (2007 Coordinator's Manual, p. 510-29).

2. Prioritize identified problems and then prioritize associated activities in order to meet Step 8 requirements regarding the prioritization of actions (2007 Coordinator's Manual, p. 510-18).
   - Determine if smaller and more easily funded mitigation activities can be identified and initiated in order to meet both the City and the CRS program the overall goals of reducing flood damage.

- Investigate the feasibility of changing current, unfunded, large activities into smaller, lower cost activities.

  Example*:*

  Project 12: Gravity Sewer Systems Improvements for Groundwater Infiltration Reduction has a total project cost of $6 million. This project calls for lining existing sewer lines and rehabilitating existing manholes to reduce infiltration of stormwater. Breaking this project into smaller projects in which sections of the sewer system are lined and associated manholes are rehabilitated will break up project costs. Lower project costs of components should increase the opportunity to find funding sources.

3. Increase the distribution of the "Status of Action Plan Implementation" (meets the annual FPMP Progress Report). Revise the information included in annually submitted Status of Action Plan Implementation (2007 Coordinator's Manual, p. 510-27).

   - Provide public access to all FPMP documentation, to include repetitive loss area analysis documents on the City's website, in order to meet the wider distribution of analyses requirements and Step 2 public involvement (2012 Changes, p. 32).

   - Revise the "Status of Action Plan Implementation". Tracking of all identified FPMP activities identified in Step 8 needs to be included in this document. For example, "Step 10 Activity: Implement, evaluate and revise," should be added to activities currently listed in the FPMP Progress Report.

   - Create a more concise summary of the action plans (Step 8) for identified repetitive loss areas. Add more specific details to how the identified repetitive loss properties will be mitigated through planned activities (2012 Changes, p. 32 and 2007 Coordinator's Manual 510-22 and -23).

     – This summary should be included in the annual repetitive loss areas letter distributed by the City as part of the current public outreach.

     – Include map showing current floodplain, unmitigated and mitigated repetitive flood areas and any other areas benefiting from mitigation (wetlands, etc).

4. Verify and document City ordinances which promote Wetlands Protection, Coastal Barrier Protection and any other ordinances or codes which promote flood protection, especially natural floodplain functions.

6.1.3. Floodplain Management Summary

While the CRS states that no one step or activity is more important than any other, it does focus specifically on the importance of identifying local flood hazards, especially as they relate to repetitive losses. Following the 10-Step process outlined in the *2007 Coordinator's Manual* is highly recommended as it provides an easy reference to display all of the City's CRS FPMP-related activities. Employing the 10-Step process keeps the FPMP focused on specific local flood issues, along with establishing goals to address each identified problem, and finally tying the proposed activities to a specifically identified flood problem. Focusing on these key areas will meet both the criteria set by the

CRS program as well as provide a living tool for the City to track the activities to pursue, the activities completed, and which activities were successful in reducing local flood issues.

6.2. Community Rating System (CRS) Program

Involvement in the CRS program reduces NFIP flood insurance premiums within the participating community. The program has designated Activities which the community undertakes. The Activities have been developed by FEMA to:

- Reduce flood damage to insurable property;
- Strengthen and support the insurance aspects of the NFIP; and
- Encourage a comprehensive approach to floodplain management.

The latest guidance from FEMA for the program is from 2007, and is titled "National Flood Insurance Program Community Rating System Coordinator's Manual, FIA-15/2007" (*2007 Coordinator's Manual*). The guidance splits Activities into the following categories:

- Category 300: Public Information – Activities which inform the public about flood hazards, flood insurance, and flood protection measures;
- Category 400: Mapping and Regulatory – Activities which enact and enforce regulations which exceed the NFIP's minimum requirements;
- Category 500: Flood Damage Reduction– Activities which reduce flood damages to existing buildings;
- Category 600: Flood Preparedness Activities– Activities which organize the community to be ready for a flood and thus reduce damages and loss of life.

The Activities are shown by category in **Table 6-2**.

Each Activity has a series of subactivities associated with it, and these subactivities are assigned points. The total of these points determines the class rating given to the community, as shown in **Table 6-3**. Reductions in flood insurance premiums are dependent on the rating of the community. The City of North Miami currently has achieved a rating of Class 5 with 2,861 points.

Table 6-2 List of CRS Program Activities

Category 300: Public Information Subactivities
310 Elevation Certificates
320 Map Information Service
330 Outreach Projects
340 Hazard Disclosure
350 Flood Protection Information
360 Flood Protection Assistance
370 Flood Insurance Promotion
Category 400: Mapping and Regulatory Subactivities
410 Additional Flood Data
420 Open Space Preservation
430 Higher Regulatory Standards
440 Flood Data Maintenance
450 Stormwater Management
Category 500: Flood Damage Reduction Subactivities
510 Floodplain Management
520 Acquisition and Relocation
530 Flood Protection
540 Drainage System Maintenance
Category 600: Flood Preparedness Subactivities
610 Flood Warning Program
620 Levee Safety
630 Dam Safety

Table 6-3 CRS Class Ratings

Minimum Total Points	CRS Class Rating
4,500	1
4,000	2
3,500	3
3,000	4
2,500	5
2,000	6
1,500	7
1,000	8
500	9
0	10

6.2.1. CRS Program Updates

The CRS program is in the process of being updated, and proposed changes to the program resulting from the update process will take effect in 2012. The proposed changes are outlined in the document "2012 CRS Coordinator's Manual Changes" (*2012 Changes*), which is attached as **Appendix K**. The version of this document used for this analysis is dated October 20th, 2011. The changes include modification of points assigned to subactivities, and could adversely affect the class rating of North Miami. The final 2012 CRS guidance has not been released, and therefore changes to the program discussed in this document are not final.

This section evaluates the impact of the proposed changes in the *2012 Changes* document on North Miami's point total and class rating and makes recommendations for improvement to the City's participation in the program based on the proposed changes. Detailed data outlining the subactivities the City currently participates in were not available at the time of the writing of this report. As a result, recommendations made in this section are intended to provide general direction for the City's future participation in the CRS program.

6.2.1.1. Class 4 Prerequisites

The next class rating North Miami could advance to Class 4. FEMA has specific requirements for a Class 4 community beyond a minimum point total. These requirements are summarized in **Table 6-4**. The requirements to reach Class 7 and Class 9 are also included in the CRS program, and these are outlined in Table 6-4 as well.

6.2.2. Impact of Proposed 2012 Changes on North Miami

Figure 6-1 shows the points North Miami currently has attained listed by Activity compared to the points available in the 2007 CRS Guidance. Also plotted in Figure 6-1 are the new point totals by Activity available in the *2012 Changes* document. These are also given in **Table 6-5**. The point totals in Figure 6-1 and Table 6-5 do not take into account the effect of multipliers or impact adjustments.

The proposed changes to the CRS program in the *2012 Changes* document affect the point totals of every Activity. Not all losses by an Activity directly result in a loss of points to the CRS program, as some subactivities are transferred between Activities in the *2012 Changes* document. Because both gains and losses to Activities are discussed in this section, points associated with transferred subactivities are properly accounted for.

In general, the changes to Activity points reflect a shifting priority of the CRS program. The goal of these changes is to emphasize the restoration and preservation of natural floodplain functions.

The potential impact of point gains and losses are discussed in the following sections.

Table 6-4 Minimum Requirements for Class 4, 7, and 9 Ratings

Item	Activities (Subactivities)	Minimum Points
-	Class 9 Prerequisite – Additional text added to statement signed by CEO of community (see CRS Guidance for exact wording of text)	-
-	Class 5 Prerequisite - Building Code Effectiveness Grading Schedule score of 5/5	10
1	Class 4 - All Activities Participated In	3,000
2	Activity 430 (Freeboard subactivity)	100
3	Activity 430 (Subactivities other than Freeboard)	250
4	Activity 450 (Watershed Management Plan)	80
5	Activity 450 (Watershed Management Plan) - manages runoff for storms up to and including the 100-year event	25
6	Activity 450 (Watershed Management Plan) - Impact Adjustment	None; The Watershed Management Plan must be demonstrated to cover at least 50% of growth
7	Activity 510	50% of total available points in Activity, partially comprised of at least 50% of available points in steps 2, 5, and 8
8	Activities 420 (Natural Functions Open Space & Natural Shoreline Protection subactivities); Activity 430 (Prohibition of Fill subactivity); Activity 440 (Additional Map Data Natural Functions Layer subactivity); Activity 450 (Low Impact Development; Watershed Management Plan Items c, e, f, and g; Erosion and Sediment Control; and Water Quality subactivities); Activity 510 (Natural Floodplain Functions Plan subactivity)	Not yet determined; Minimum points will be the cumulative points for the listed subactivities
9	Category 600 *Prerequisites* – Inventory of levees resulting in flooding of developed area if failed with a map of affected areas; Inventory of dams resulting in flooding of developed areas if failed with a map of areas affected; Assessment of the impact of a flood caused by failure of the levees and dams on life and property.	None; Documentation of the activities listed is required without points assigned for doing so
10	Activity 610	Not yet determined; Minimum points will be the cumulative points for all subactivities in Activity 610

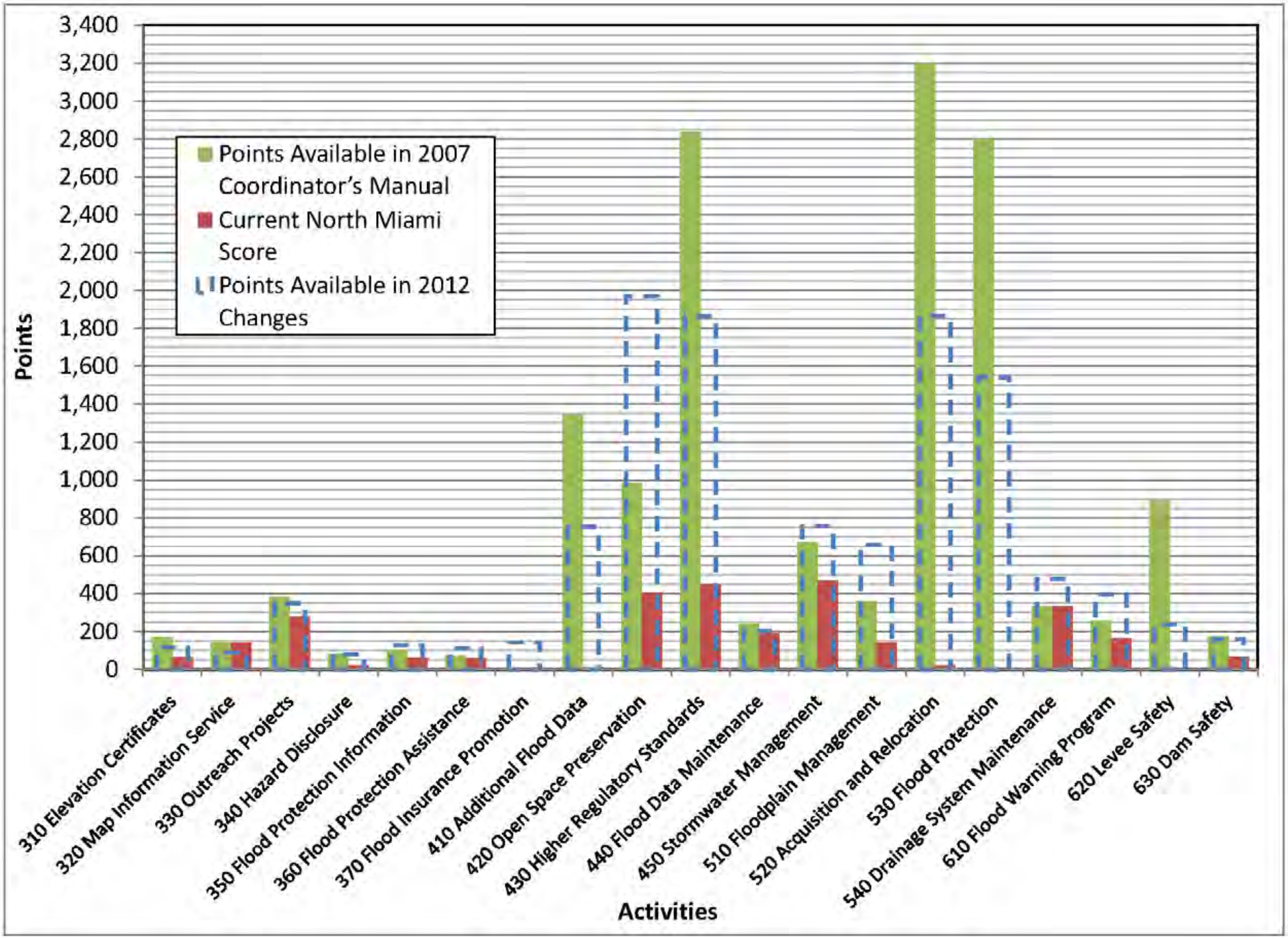


Figure 6-1
Comparison of Points by CRS Activity

Table 6-5 CRS Program Points by Activity

Category/Activity	2007 CRS Guidance Points	North Miami Score	*2012 Changes* Points
Category 300: Public Information Subactivities			
310 Elevation Certificates	172	65	116
320 Map Information Service	140	140	90
330 Outreach Projects	380	277	350
340 Hazard Disclosure	81	20	80
350 Flood Protection Information	102	60	127
360 Flood Protection Assistance	71	57	112
370 Flood Insurance Promotion*	0	0	140
Category Total	946	619	1,015
Category 400: Mapping and Regulatory Subactivities			
410 Additional Flood Data	1,346	11	752
420 Open Space Preservation	900	405	1,970
430 Higher Regulatory Standards	2,740	449	1,862
440 Flood Data Maintenance	239	189	202
450 Stormwater Management	670	467	755
Category Total	5,895	1,521	5,541
Category 500: Flood Damage Reduction Subactivities			
510 Floodplain Management	359	140	657
520 Acquisition and Relocation	3,200	20	1,866
530 Flood Protection	2,800	0	1,540
540 Drainage System Maintenance**	330	330	478
Category Total	6,689	490	4,541
Category 600: Flood Preparedness Subactivities			
610 Flood Warning Program	255	164	395
620 Levee Safety	900	0	237
630 Dam Safety	175	67	158
Category Total	1,330	231	790
Total Points	**15,040**	**2,861**	**11,887**

* - New Activity introduced in *2012 Guidance*
**- Total Points for Activity Not Finalized

6.2.2.1. Activities with Point Losses

The Activities with points lost in the *2012 Changes* document are shown in ascending order by points lost in **Table 6-6**, with the current North Miami point total for each.

Table 6-6 Points Losses Outlined in 2012 Changes

Activity	Points Lost in *2012 Changes* document	North Miami Score	North Miami Points at Risk of Being Lost
520 Acquisition and Relocation	-1,334	20	20
530 Flood Protection	-1,260	0	0
430 Higher Regulatory Standards	-878	449	449
620 Levee Safety	-663	0	0
410 Additional Flood Data	-594	11	11
310 Elevation Certificates	-56	65	56
320 Map Information Service	-50	140	50
440 Flood Data Maintenance	-37	189	37
330 Outreach Projects	-30	277	30
630 Dam Safety	-17	67	17
340 Hazard Disclosure	-1	20	1
Total	-4,920	1,238	671

6.2.2.1.1. Activities 520 and 530

Although Activities 520 and 530 have large point losses in the *2012 Changes* document, the losses will not have a large effect on the community's class rating as it does not currently receive significant amounts of points from the Activities.

6.2.2.1.2. Activity 430

North Miami does participate in subactivities and gain significant points under Activity 430, and therefore the loss of points for the Activity has more potential to impact the City's class rating. The subactivities for Activity 430 either:

- Remain unchanged but with lower point totals;
- Are moved to Activity 420;
- Or, are made into new subactivities.

The migration of subactivities to Activity 420 is not described in detail in *2012 Changes*, and it is therefore unknown if this will cause a loss of points for North Miami. The Activity 430 subactivities which North Miami currently participates in should be evaluated against the final 2012 CRS guidance when it is released to gage the full impact of the changes to the Activity. Participation in this Activity is required for North Miami to advance to Class 4 as outlined in Items 2 and 3 in Table 6-4, and the City should attempt to meet minimum participation requirements to aid in its advancement to a Class 4 rating.

6.2.2.1.3. Remaining Activities with Point Losses (Activities 620, 410, 310, 320, 440, 330, 630, and 340)

The remaining Activities with point losses combined represent a loss of 1,448 points. The City currently scores 769 points from the Activities, of which a maximum of 202 are at risk of being lost. It is unlikely that the City would lose all 202 points, but as previously stated, specific data detailing the subactivities engaged in by the community were not available at the time of the writing of this report. As a result, it is unknown the total amount points that could be lost in these Activities is unknown at this time.

If the City were to lose all 578 points, it would be downgraded from a Class 5 to Class 6 community. When the final 2012 CRS guidance is released, the impact of changes to these Activities should be evaluated against the City's current participation in them to determine any point losses and the overall impact to the City's class rating.

6.2.2.2. Activities with Point Gains

The Activities with points gained in the *2012 Changes* document are shown in descending order by total points gained in **Table 6-7**, with the current North Miami point total for each.

Table 6-7 Point Gains Outlined in 2012 Guidance

Activity	Total Points in *2012 Changes* document	North Miami Score	Additional Points Available to North Miami
420 Open Space Preservation	1,970	405	1,565
510 Floodplain Management	657	140	517
540 Drainage System Maintenance**	478	330	148
370 Flood Insurance Promotion*	140	0	140
610 Flood Warning Program	395	164	231
450 Stormwater Management	755	467	288
360 Flood Protection Assistance	112	57	55
350 Flood Protection Information	127	60	67
Total	4,634	1,623	3,011

* - Activity 370 is new in the *2012 Changes* document
** - Total Points for Activity Not Finalized

6.2.2.2.1. Activity 420

Activity 420 gains the most points, with the total available increased to 1,970. This increase more than doubles the points previously available, and reflects the shifting priorities of the CRS program to creating and maintaining open, natural spaces in the floodplain. With the exception of Low-Density Zoning, all subactivities in Activity 420 observe an increase in points. The subactivities North Miami currently participates in for this Activity should be evaluated against the final 2012 CRS guidance when it is available to investigate opportunities to claim additional points for subactivities already being completed.

6.2.2.2.2. Activity 510

Activity 510 gains the second-most amount of points with 298 in the *2012 Changes* document. This creates a total of 657 points available for the Activity. The points available for the Floodplain Management Plan (FPMP) subactivity increases by 123 points, and specific recommendations for the

North Miami FPMP were included under sub-section 6.1.2. The increases in points assigned to the remaining two subactivities in Activity 510, Repetitive Loss Area Analyses and Natural Floodplain Function Plan, should be evaluated to find opportunities to claim additional points for existing subactivities.

6.2.2.2.3. Activities 450 and 610

Subactivities associated with Activities 450 and 610 in the *2012 Changes* document are mostly unchanged but observe increased points associated with them, and these should also be evaluated for opportunities to claim additional points for existing subactivities participated in by the City.

6.2.2.2.4. Activities 370 and 540

Point gains for Activities 370 and 540 are primarily due to new subactivities added by the *2012 Changes* document. The *2012 Changes* document adds Inspecting/Maintaining Storage Basins as a subactivity to Activity 540 and it comprises the majority of additional points available in the Activity. Activity 370 is new to the program by the *2012 Changes* document, and it contains multiple subactivities which have been moved from other Activities. Both Activities 370 and 540 should be evaluated to find opportunities to claim additional points from subactivities which are already engaged in by North Miami.

6.2.2.2.5. Activities 350 and 360

Activities 350 and 360 also have increased point totals under the proposed *2012 Changes* document, and these increases are larger if accompanied by a Program for Public Information (PPI). The PPI is new in the *2012 Changes* document, and increases the points available for subactivities under Activities 350 and 360. The PPI is itself a subactivity under Activity 330, and it is recommended that the City investigate the creation of a PPI, as discussed in the following section.

6.2.3. Recommendations for North Miami CRS Program

The *2012 Changes* document includes changes which have the potential to both increase and decrease the points awarded North Miami for its existing participation in the program. The following measures are proposed to help mitigate loss of points and to take advantage of opportunities to gain points in the proposed 2012 changes.

6.2.3.1. Inventory Actual Point Gains and Losses

When it is released, the effect of the changes to the CRS program outlined in the final 2012 CRS Guidance to the North Miami point total and class rating should the assessed. The previous sections "Activities with Point Losses" and "Activities with Point Gains" provide a guide for the evaluation process by outlining significant changes to each Activity as they relate to the North Miami existing participation in the CRS program.

The evaluation of point gains and losses for the City's current CRS participation should be completed and an inventory of the changes created. The following sections are options for subactivity involvement which increase the City's point total under the *2012 Changes* document. The point change inventory will aid in selection of which of the options or combination of the options is most beneficial to North Miami.

6.2.3.2. New Subactivity Participation

Following an inventory of point gains and losses, the following recommendations should be considered for evaluating the City's further participation in the CRS program.

6.2.3.2.1. Activity 350

The goal of this Activity is to provide the public with additional pertinent information to flooding not already covered in other Activities. These include keeping a library of 12 specific FEMA documents and pertinent local documents as well as maintaining a website with information from Activity 330, flood warning information, real time gage data or links, and posting of elevation certificates. Given that the City already participates in this Activity, it may be feasible to easily gain more points from it with minor modification to existing efforts.

6.2.3.2.2. Activities 360 and 370

Activity 360 includes a series of subactivities related to providing information on the protection of property from flooding on an individual basis. These are closely related to the subactivities associated with Activity 370. Activity 370 is a new Activity, with all new subactivities and a total of 140 points associated with it.

The goal of Activity 370 is to improve flood insurance coverage, and its subactivities include a four step planning process to evaluate existing insurance coverage and develop and implement a plan to increase coverage. The remaining subactivity is for having an expert available to advise residents about flood insurance. It is recommended that the City investigate participation in this new Activity.

The subactivities associated with Activity 360 include advising individuals on property protection and financial assistance with additional points given for advice given based on site visits. Additional points are also available if the person giving advice is trained by the Emergency Management Institute. If an individual or group of people were designated to give advice about flood insurance for Activity 370, the same individual or group would be well-positioned to fulfill the subactivity requirements for Activity 360.

6.2.3.2.3. Activity 420

Subactivities associated with Activity 420 have the objective of preventing flood damage by keeping floodprone lands free of development as well as protecting and enhancing floodplain functions. Because North Miami is almost completely developed, it is not likely that pursuit of these subactivities will yield significant points for North Miami, and it is not recommended to pursue them at this time.

6.2.3.2.4. Activity 450

The City's existing participation in Activity 450 is already quite high, and its ability to further participate in additional subactivities may be limited. One subactivity that the City may be able to gain additional points from is the Watershed Master Plan, which increases from 225 points to 315. The *2012 Changes* document does not describe in detail how the City could take advantage of the newly available points, but does indicate that some of the new points will be awarded for having a dedicated source of funding for implementation of stormwater management projects. An example of such a source is a stormwater user fee.

The other subactivity gaining points in *2012 Changes* is the Stormwater Management Regulations. These regulations include limitations on future development. Because North Miami is highly developed in its existing state, it is unlikely that additional points could be gained from this subactivity. The City should, however, attempt to meet the requirements of Items 4, 5, and 6 in Table 6-4 in order to progress to Class 4.

6.2.3.2.5. Activity 510

It is recommended that North Miami pursue the additional points available in Activity 510 for the FPMP and Repetitive Loss Area Analyses (RLAA) subactivities.

Points available for the FPMP increase from 294 to 417 under *2012 Changes*. Specific recommendations for the Floodplain Management Planning subactivity are given in sub-section 6.1.2 of this report.

The RLAA activity is separate from the RLAA subactivity, and is a 5-step process which identifies repetitive loss areas and establishes mitigation plans to reduce future losses. The points available for the subactivity increase from 50 to 140 under *2012 Changes*. If the City has an existing RLAA, points are awarded under the *2012 Changes* document for more detailed mitigation activity plans. Any existing RLAA should be evaluated to find if its level of detail matches the requirements of the final 2012 CRS guidance, and if so, the additional points should be claimed. If insufficient detail is found in the existing RLAA to claim the additional points, or if no RLAA analysis exists, the City's FPMP committee may be well-positioned to amend an existing RLAA with additional detail or create an RLAA, as necessary.

In order for North Miami to progress to Class 4, at least half of total available points in this Activity must be attained. In addition, the points received for this activity must be comprised of at least half of available points in steps 2 (Involve the Public), 5 (Assess the Problem), and 8 (Draft an Action Plan) of the FPMP subactivity.

6.2.3.2.6. Activity 540

The total points for Activity 540 increase from 300 to 478 under the *2012 Changes* document. Much of the increase in available points is due to a new subactivity, Inspecting/Maintaining Storage Basins. It is recommended that the City investigate if it can claim additional points for inspection of storage basins.

6.2.3.2.7. Activity 610

Activity 610 includes subactivities related to flood warning and response. In *2012 Changes*, a new prerequisite to this Activity is added which requires that information must be provided to residents and business owners in the community detailing safety measures that should be taken in the event of a flood. The City is already participating in this category, and will need to meet the requirements of this new prerequisite to guarantee that it continues to receive points for its existing participation.

The City's participation in this Activity should be evaluated against the final 2012 guidance when it is released to find any opportunities to gain additional points by building on the City's current flood warning and response systems. In order for North Miami to progress to Class 4, a minimum point total must be achieved for this Activity. This minimum point total has not yet been determined.

6.2.3.3. Program for Public Information Creation

Included in Activity 330 for the *2012 Changes* document is the subactivity "Program for Public Information (PPI)". This subactivity involves the creation of a program to identify gaps in public knowledge of flooding issues within a community and create, implement, and monitor public information programs to address these gaps. The development of this program is assigned points, but it also has the effect of increasing points available for other subactivities, as shown in **Table 6-8**.

Table 6-8 Impact of Creation of a PPI

Activity	*2012 Changes* Points Available without PPI	*2012 Changes* Additional Points Available with PPI
330 Outreach Projects	275	75
340 Hazard Disclosure	66	14
350 Flood Protection Information	98	29
360 Flood Protection Assistance	75	37
540 Drainage System Maintenance	463	15
Total Additional Points Possible with PPI		170

Specific guidance on the development of a PPI is given in the document "Changes to Subactivity 330" developed by FEMA, which is attached in **Appendix L**. This guidance states that the FPMP committee could also serve as the committee to develop the PPI. The City has a well-established FPMP committee which has been well informed of public knowledge and opinion and because of this it is well positioned to develop a PPI.

6.2.3.4. Submittal Layout and Organization

The submittal to FEMA of CRS program participation documentation should be organized so as to clearly correlate points claimed by North Miami to the documentation substantiating why the points can be claimed. The following are recommended to accomplish this.

After an inventory of points gained and lost under the final 2012 guidance is completed, the results should be summarized in a table preceding the documentation included in its CRS application, and the points claimed by the City should be referenced to the documentation attached which supports the claim. An example of the layout of such a table is given for Activity 310 in **Table 6-9**.

Table 6-9 Example of Table Layout for Organization of CRS Submittal to FEMA

Category/Activity	North Miami Points Claimed	Documentation – CRS Application Page Numbers
Category 300: Public Information Activities		
310 Elevation Certificates		
Elevation Certificates	56	Pages 68 - 115
Elevation Certificates for post-FIRM Buildings	56	Pages 68 - 85
Elevation Certificates for pre-FIRM Buildings	15	Pages 86 - 115
Total	127	

To include all Categories, Activities, and Subactivities

Because the verification process is iterative and typically extends over a period of months, this type of documentation will be helpful as a resource which all parties involved can reference and quickly and easily understand the City's CRS participation.

6.2.3.5. Conclusion

As summarized in Table 6-6, North Miami is potentially at risk of losing 671 points. It is unlikely that all points would be completely lost, due to the migration of subactivities between Activities, but if all 671 points were lost, the community would be downgraded to a Class Rating 6, with 2,190 points. To regain Class 5 status, the City would need to gain 310 points. **Table 6-10** summarizes Activities which could be participated in and represent an efficient path whereby the City could gain 310 points.

Table 6-10 Potential Activities Gain

Activity	Additional Points Available to North Miami in *2012 Changes*
370 Flood Insurance Promotion*	140
540 Drainage System Maintenance**	148
510 Floodplain Management	517

* - Activity 370 is new in the *2012 Changes* document
** - Total Points for Activity Not Finalized

Recommended participation in these activities is detailed in the previous sub-section 6.2.3.2 (New Subactivity Participation). These Activities include subactivities which the City may be able to complete with less effort than subactivities associated with other Activities.

The new Activity 370 (Flood Insurance Promotion) includes subactivities closely related to efforts the City currently undertakes.

The City has obtained all available points in Activity 540 under the 2007 Coordinator's Manual, and because of this it may be able to implement new efforts without significant effort to gain the points added in the 2012 Changes document.

Recommended revisions to the City's FPMP, which is a subactivity in Activity 510, are summarized in sub-section 6.1.2 of this report. Because the City already plans to review its FPMP, it may be able to gain a part of the 310 points through the revision effort.

Should the City retain most of its current points under the 2012 revisions to CRS policy, this plan may also represent a "shortest path" to achieving the point total required for Class 4 status.

Section 7

Recommended Plan

This section presents recommendations for the SWMP and overall stormwater management.

7.1. Project Phasing

As part of the alternatives analysis and stormwater funding evaluation (Section 5), CDM Smith recommends a phased implementation program over the next 50 years to address LOS deficiencies within the City's PSMS. Recommended alternatives were developed based on a tiered system, so that solutions could be phased, thus enabling the City to budget for long-term capital costs.

As part of the SWMP-tiered recommendation approach, exfiltration trenches (Tier 1) are a primary component of the BMP treatment train that provides reduction in stormwater flood frequency and duration, reductions in freshwater volumes and pollutant loads discharged to tidal waters, and increases in aquifer recharge.

If exfiltration could not resolve the LOS deficiencies alone, Tier 2 recommendations were made that largely consisted of additional storage and conveyance upgrades (i.e., underground storage vaults, stormwater pump stations, upsizing of existing outfalls). In the case that Tier 2 recommendations still could not address the flooding entirely, Tier 3 recommendations were made. These mainly consist of further outfall upgrades which may pose additional permitting challenges (e.g., ERP for peak flow and stage control) and coordination issues based on jurisdiction (e.g., FDOT). **Table 7-1** provides a summary of the recommended capital improvements that address LOS deficiencies. The associated tiered conceptual capital cost estimates are summarized in **Table 7-2**.

Based on historical flooding problem areas and the depth of flooding predicted by the SWMM, CDM Smith developed a phased capital improvement schedule. LOS deficiencies with the greatest depth of flooding and were confirmed by the City as problem areas were given the highest priority (i.e., Biscayne Canal East Problem Area 1 and Arch Creek South/Biscayne Canal East Problem Area). LOS deficiencies with a lesser degree of flooding but yet still confirmed by the City as a problem area were given the next highest level of priority (i.e., Biscayne Canal West Problem Area and Arch Creek South Problem Area). Finally, problem areas predicted by the SWMM but not confirmed by the City were considered as a least priority (Arch Creek North/Arch Creek South Problem Area and Biscayne Canal East Problem Area 2). This provides time for additional observation of these areas during future storm events and/or refinement/verification of the SWMM in these areas as more detailed information on flooding is collected.

Based on these established priorities, a capital improvement schedule was developed as shown in **Table 7-3**. A total of $12,700,000 is recommended to be phased over the next 10 years. These include all Tier 1 costs for the priority problem areas confirmed by the City. As shown in Table 7-3, their distribution over the first 10 years was based on the predicted depth of flooding and magnitude of estimated conceptual costs (i.e., more expensive projects were distributed over the entire 10 years whereas the less expensive Tier 1 costs were distributed over 5 years). Tier 2 projects for priority

Table 7-1 City of North Miami Stormwater Master Plan Update Summary of Recommended Improvements

Problem Area	SWMP Update Section	Historic Problem Area	Tier 1	Tier 2	Tier 3
Biscayne Canal West Problem Area	5.1.1	√	Installation of 680 ft of exfiltration trenches (Alternative 1 - County r/w)		
	5.1.1		Additional 1,800 ft of exfiltration trenches and conveyance utilizing Ben Franklin Park (Alternative 2 - regional option)		
Biscayne Canal East Problem Area 1	5.1.2	√	Installation of 12,500 ft of exfiltration trenches	Additional storage and conveyance upgrades (in-system storage, upsizing outfalls)	Further outfall upgrades
Arch Creek South/Biscayne Canal East Problem Area	5.1.3	√	Installation of 24,350 ft of exfiltration trenches	Additional storage and conveyance upgrades (underground storage vaults, stormwater pump station, upsizing of existing outfalls)	
Arch Creek South Problem Area	5.1.4	√	Installation of 4,790 ft of exfiltration trenches	Additional storage and conveyance upgrades (underground storage vaults, upsizing of existing outfalls)	Further outfall upgrades
Arch Creek North/Arch Creek South Problem Area	5.1.5		Installation of 25,950 ft of exfiltration trenches	Additional storage and conveyance upgrades (piping, upsizing outfalls, stormwater pump station, wet detention at Elaine Gordon Park)	
Biscayne Canal East Problem Area 2	5.1.6		Installation of 900 ft of exfiltration trenches		

Table 7-2 City of North Miami Stormwater Master Plan Estimated Conceptual Capital Cost Summary

Problem Area	SWMP Update Section	Reported Problem Area	Max. Depth of Flooding	Design Storm Event	Tier 1 Total Costs	Additional Tier 2 Costs	Additional Tier 3 Costs	Total Project Cost (All Tiers)*
Biscayne Canal West Problem Area	5.1.1	√	0.10	5-year	City R/W $0 (Alt 1 - local, meet LOS) County R/W $300,000	City R/W $430,000 (Alt 2 - regional) County R/W $1,080,000		$430,000
Biscayne Canal East Problem Area 1	5.1.2	√	1.30	5-year	$3,700,000 (does not meet LOS)	$2,900,000 (mostly meets LOS[1])	$1,350,000 (meets LOS)	$7,950,000
Arch Creek South/Biscayne Canal East Problem Area	5.1.3	√	2.50	5-year	$7,200,000 (mostly meets LOS[1])	$20,300,000 (meets LOS)		$27,500,000
Arch Creek South Problem Area	5.1.4	√	1.00	5-year	$1,500,000 (does not meet LOS)	$4,800,000 (mostly meets LOS[1])	$500,000 (meets LOS)	$6,800,000
Arch Creek North/Arch Creek South Problem Area	5.1.5		2.80	5-year	$8,300,000 (does not meet LOS)	$6,600,000 (meets LOS)		$14,900,000
Biscayne Canal East Problem Area 2	5.1.6		0.70	5-year	$350,000 (meets LOS)			$360,000
							Totals:	$57,940,000

[1] Flooding is alleviated at at least 50 percent of the deficient model nodes

Table 7-3 City of North Miami Stormwater Master Plan Update Phased Capital Improvement Schedule

Problem Area	SWMP Update Section	Reported Problem Area	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022 - 2031	2032-2041	2042-2051	2052-2061
Biscayne Canal West Problem Area	5.1.1	√						◆	◆	◆	◆	◆	◆			
Biscayne Canal East Problem Area 1	5.1.2	√	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		
Arch Creek South/Biscayne Canal East Problem Area	5.1.3	√	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆		
Arch Creek South Problem Area	5.1.4	√						◆	◆	◆	◆	◆	◆	◆		
Arch Creek North/Arch Creek South Problem Area	5.1.5												◆	◆	◆	◆
Biscayne Canal East Problem Area 2	5.1.6												◆			

[1] Total costs include the preceding tier's total cost (e.g., Tier 2 costs are inclusive of Tier 1 costs)

Tier 1 Implementation◆

Tier 2 Implementation◆

Tier 3 Implementation◆

problem areas confirmed by the City are recommended to be implemented after 2022, with some extended phasing into 2032. This phasing is due primarily to limitations in the availability of funding for the additional $28,400,000 estimated for Tier 2 projects. Tier 3 projects (where applicable) are then scheduled for 2032 or beyond.

Lastly, problem areas predicted by the stormwater model evaluations (SWMM) but not confirmed by the City were postponed out to at least 2022, or until additional information is collected and flooding can be further verified.

7.2. Other Recommendations

In addition to the capital improvements recommended for LOS deficiencies, a number of recommendations were made throughout this SWMP update related to other areas of the City's overall stormwater management program. These are summarized as follows:

Filling of Data Gaps

- Roadway coverage with attributes to be utilized for roadway LOS designation. This should include roadways designations such as "local", "collector", "minor arterial" and "major arterial";
- In developing this SWMP update, it was observed that not all project-level as-built information had been incorporated into the stormwater atlas;
- Add date, source, purpose, and professional surveyor certification for stormwater inventory data and existing surveys. Information was provided from previous surveying efforts. Documentation regarding the certification of this information helps support the accuracy of the data utilized in the development of the SWMP; and
- Existing survey data for building structures, channels or channel bank areas. This information allows for confirmation of structural flooding and boundary conditions related to the canals and channels throughout the City.

Stormwater Model Update

- Survey high water marks for future significant rainfall events. Model verification for the SWMP update was based on estimated flooding depths based on photographs provided by the City. A more accurate verification (and therefore confirmation of problem areas) of the stormwater model can be performed based on certified survey data.

Water Quality and Regulatory Review

- Review and refine stormwater atlas for completeness and accuracy of facilities inventory. Upon visual inspection of the AutoCAD and GIS data, it was observed that in numerous cases, the polyline segments representing exfiltration trenches are incomplete or lack connectivity to adjacent infrastructure elements.
- Continue to coordinate with PERA on water quality monitoring. Concentrations of several water quality parameters have increased over time. While there are currently no TMDLs or impairments (other than mercury) affecting the City, it is recommended to be proactive regarding these issues as future impairments may occur. This is especially important as new

numeric standards for nutrients recommended by the state for Northern Biscayne Bay are expected to be adopted.

- A complete and up-to-date stormwater atlas will also assist the City with complying with their NPDES MS4 permit. The City is now required to inspect 10 percent of their stormwater infrastructure annually. It is important to quantify and identify areas that constitute 10 percent of the City's MS4 so that the appropriate staffing and resources are dedicated to this activity. Additionally, the implementation of recent flood control projects that incorporate water quality benefits (i.e., exfiltration) will allow the City to garner additional pollutant load credits. In addition to documenting the location of exfiltration trenches in the City (via the stormwater atlas), it will also be important to estimate the tributary area served by these stormwater facilities. This should be taken into account in future iterations of pollutant loading analyses required by the NPDES MS4 permit.

Floodplain Management Update

- Update the City's FPMP to reflect the direction provided in the 2007 Coordinator's Manual and the Example Plans, and to meet the anticipated NFIP CRS requirements changes proposed in FEMA's NFIP CRS *2012 CRS Coordinator Manual Changes.*

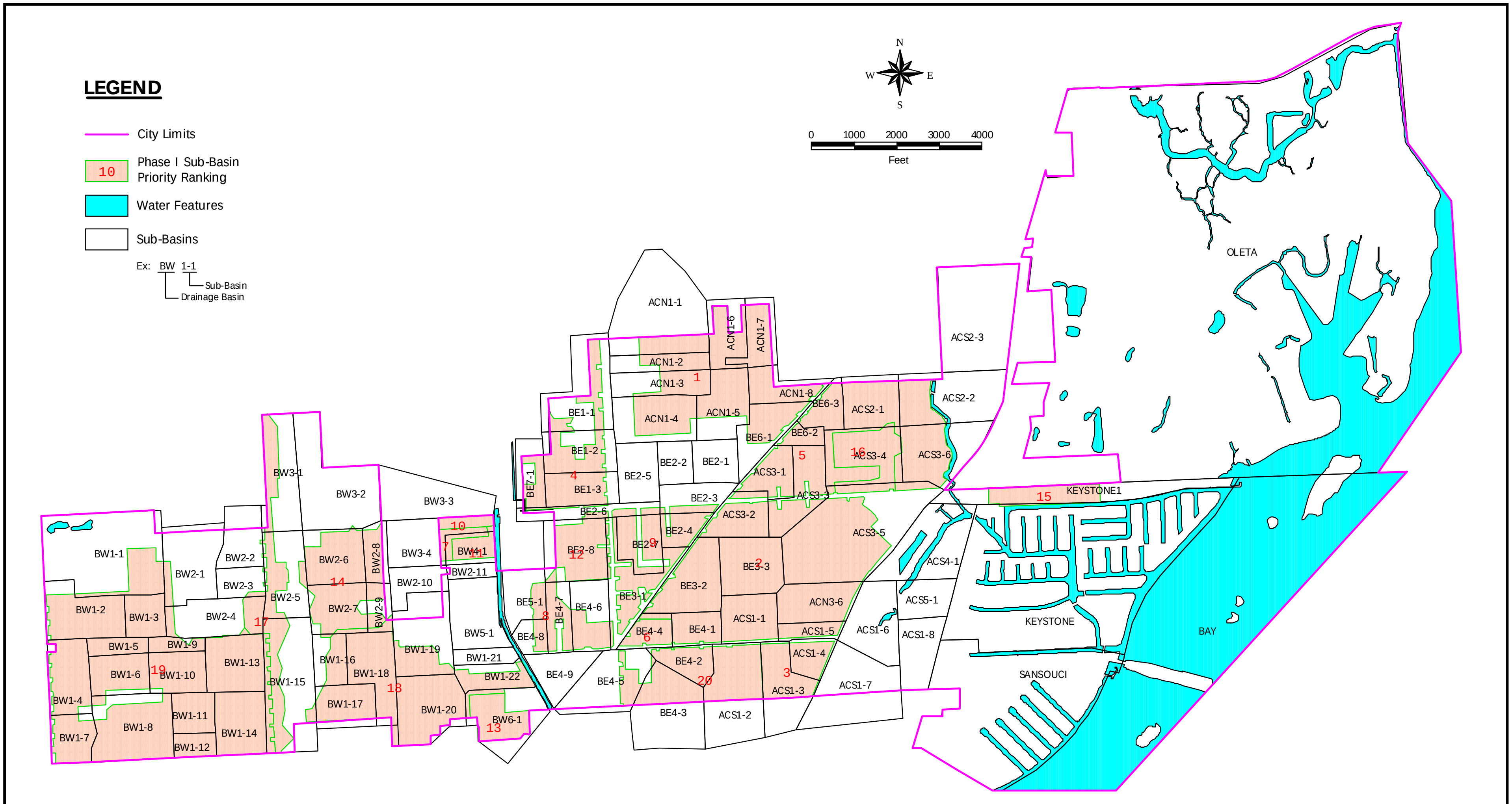
- FEMA's NFIP CRS *2012 CRS Coordinator Manual Changes* document includes changes which have the potential to both increase and decrease the points awarded to North Miami for its existing participation in the CRS program. Implement the recommended measures to help mitigate loss of points and to take advantage of opportunities to gain points in the proposed FEMA's NFIP CRS *2012 CRS Coordinator Manual Changes*.

Project/Permitting Coordination

- Continued coordination with FDOT, Miami-Dade County, PERA and adjacent cities on CIP implementation and regulatory issues such as TMDLs and NPDES MS4 permitting.

Appendix A

2000 SWMP Priority Subbasins



Dated: 9/28/00

PBSJ

City of North Miami Phase II Stormwater Master Plan
Revised Priority Basins

Appendix A

Appendix A

Priority List of Projects

Project Number	Basin Ranking	Basin/Subbasin	Description	Required	Units	Unit Cost	Per	Estimated Construction Cost	Engineering and Contingencies Cost	Total Estimate
1	1	Arch Creek North[1]	36-inch RCP	1600	LF	$ 65	/LF	$ 104,000	$ 31,200	$ 135,200
			Catch basins	8	ea	$ 2,200	/ea	$ 17,600	$ 5,280	$ 22,880
SUB-TOTAL Project 1								*$ 121,600*	*$ 36,480*	*$ 158,080*
2	1	ACN1-1	French Drains	159	LF	$ 500	/LF	$ 79,500	$ 23,850	$ 103,350
3	1	ACN1-2	French Drains	105	LF	$ 500	/LF	$ 52,500	$ 15,750	$ 68,250
4	1	ACN1-5	French Drains	321	LF	$ 500	/LF	$ 160,500	$ 48,150	$ 208,650
5	1	ACN1-7	French Drains	449	LF	$ 500	/LF	$ 224,500	$ 67,350	$ 291,850
6	2	Arch Creek South[2]	24-inch RCP	1300	LF	$ 45	/LF	$ 58,500	$ 17,550	$ 76,050
			36-inch RCP	2200	LF	$ 65	/LF	$ 143,000	$ 42,900	$ 185,900
			36-inch RCP	1700	LF	$ 65	/LF	$ 110,500	$ 33,150	$ 143,650
			Rail Road Crossing	200	LF	$ 300	/LF	$ 60,000	$ 18,000	$ 78,000
			Catch basins	24	ea	$ 2,200	/ea	$ 52,800	$ 15,840	$ 68,640
SUB-TOTAL Project 13								*$ 424,800*	*$ 127,440*	*$ 552,240*
7	2	ACN3-6	French Drains	518	LF	$ 500	/LF	$ 259,000	$ 77,700	$ 336,700
8	2	ACS1-5	French Drains	386	LF	$ 500	/LF	$ 193,000	$ 57,900	$ 250,900
9	2	ACS3-5	French Drains	1693	LF	$ 500	/LF	$ 846,500	$ 253,950	$ 1,100,450
10	2	BE4-1	French Drains	67	LF	$ 500	/LF	$ 33,500	$ 10,050	$ 43,550
11	2	BE4-4	French Drains	128	LF	$ 500	/LF	$ 64,000	$ 19,200	$ 83,200
12	3	ACS1-4	French Drains	242	LF	$ 500	/LF	$ 121,000	$ 36,300	$ 157,300
13	4	BE1-1	French Drains	591	LF	$ 500	/LF	$ 295,500	$ 88,650	$ 384,150
14	4	BE1-2	French Drains	655	LF	$ 500	/LF	$ 327,500	$ 98,250	$ 425,750
15	4	BE1-3	French Drains	1665	LF	$ 500	/LF	$ 832,500	$ 249,750	$ 1,082,250
16	5	ACS2-1	French Drains	234	LF	$ 500	/LF	$ 117,000	$ 35,100	$ 152,100
17	5	ACS2-2	French Drains	269	LF	$ 500	/LF	$ 134,500	$ 40,350	$ 174,850
18	5	ACS3-1	French Drains	469	LF	$ 500	/LF	$ 234,500	$ 70,350	$ 304,850
19	5	ACS3-3	French Drains	135	LF	$ 500	/LF	$ 67,500	$ 20,250	$ 87,750
20	5	ACS3-4	French Drains	579	LF	$ 500	/LF	$ 289,500	$ 86,850	$ 376,350
21	5	ACS3-5	French Drains	1693	LF	$ 500	/LF	$ 846,500	$ 253,950	$ 1,100,450
22	5	BE6-3	French Drains	64	LF	$ 500	/LF	$ 32,000	$ 9,600	$ 41,600
23	7	BW3-4	French Drains	1093	LF	$ 500	/LF	$ 546,500	$ 163,950	$ 710,450
24	7	BW4-1	French Drains	1060	LF	$ 500	/LF	$ 530,000	$ 159,000	$ 689,000
25	8	BE2-8	French Drains	1954	LF	$ 500	/LF	$ 977,000	$ 293,100	$ 1,270,100
26	8	BE4-7	French Drains	378	LF	$ 500	/LF	$ 189,000	$ 56,700	$ 245,700
27	9	BE2-7	French Drains	134	LF	$ 500	/LF	$ 67,000	$ 20,100	$ 87,100
28	9	BE3-1	French Drains	359	LF	$ 500	/LF	$ 179,500	$ 53,850	$ 233,350
29	10	BW3-3	French Drains	1245	LF	$ 500	/LF	$ 622,500	$ 186,750	$ 809,250
30	10	BW3-4	French Drains	1093	LF	$ 500	/LF	$ 546,500	$ 163,950	$ 710,450
31	11	BW3-4	French Drains	1093	LF	$ 500	/LF	$ 546,500	$ 163,950	$ 710,450
32	12	BE3-1	French Drains	359	LF	$ 500	/LF	$ 179,500	$ 53,850	$ 233,350
32	14	BW2-7	French Drains	402	LF	$ 500	/LF	$ 201,000	$ 60,300	$ 261,300
33	19	BW1-1	French Drains	57	LF	$ 500	/LF	$ 28,500	$ 8,550	$ 37,050
33	19	BW1-3	French Drains	36	LF	$ 500	/LF	$ 18,000	$ 5,400	$ 23,400
34	19	BW1-5	French Drains	172	LF	$ 500	/LF	$ 86,000	$ 25,800	$ 111,800
34	19	BW1-9	French Drains	49	LF	$ 500	/LF	$ 24,500	$ 7,350	$ 31,850
35	20	ACS1-2	French Drains	328	LF	$ 500	/LF	$ 164,000	$ 49,200	$ 213,200
35	20	BE4-3	French Drains	246	LF	$ 500	/LF	$ 123,000	$ 36,900	$ 159,900

Priority List of Projects

Project Number	Basin Ranking	Basin/Subbasin	Description	Required	Units	Unit Cost	Per	Estimated Construction Cost	Engineering and Contingencies Cost	Total Estimate
36	20	BE4-5	French Drains	225	LF	$ 500	/LF	$ 112,500	$ 33,750	$ 146,250
Total								**$ 10,898,900**	**$ 3,269,670**	**$ 14,168,570**

1 Proposed Arch Creek 36-inch interceptor within NE 144th Street will provide relief for: ACN 1-1, ACN 1-2, ACN 1-3, ACN 1-4, and ACN 1-5.

2 Proposed NE 130th Street 36-inch intertceptor (east of NE 9th Avenue to Arch Creek) will provide relief for: ACS 3-5, ACS3-6, BE3-2 and BE3-3.

Appendix B

SWMM5 Input Parameters

Appendix B-1: SWMM Hydrologic Data

Existing Conditions											
Hydrologic Units	Width	Area	% DCIA	Slope	Manning's Roughness		Initial Abstractions		Max Inf Rate	Min Inf Rate	Soil Storage
					Impervious	Pervious	Impervious	Pervious			
(HUs)	(ft)	(Ac)	(%)	(%)			(in)	(in)	(in/hr)	(in/hr)	(in)
ACN1-0HU	1,963	58.6	21.1%	0.32	0.015	0.218	0.1	0.230	3.60	0.10	1.38
ACN1-10HU	1,999	76.1	33.3%	0.36	0.015	0.207	0.1	0.223	3.41	0.09	1.31
ACN1-1HU	1,646	62.5	26.9%	0.19	0.015	0.212	0.1	0.226	3.47	0.09	1.31
ACN1-2HU	823	22.5	21.1%	0.33	0.015	0.216	0.1	0.229	3.81	0.11	1.65
ACN1-3HU	926	30.1	23.0%	0.35	0.015	0.213	0.1	0.227	4.42	0.17	2.10
ACN1-4HU	1,440	59.3	23.4%	0.11	0.015	0.213	0.1	0.226	4.75	0.19	2.83
ACN1-5HU	1,954	44.9	23.0%	0.45	0.015	0.213	0.1	0.227	4.33	0.16	2.20
ACN1-6HU	1,248	43.2	21.7%	0.18	0.015	0.215	0.1	0.228	3.41	0.09	1.19
ACN1-7HU	1,151	27.3	16.7%	0.27	0.015	0.221	0.1	0.232	3.51	0.09	1.23
ACN1-8HU	1,507	31.5	23.6%	0.43	0.015	0.213	0.1	0.226	4.45	0.17	2.20
ACN1-9HU	1,318	37.9	26.9%	0.26	0.015	0.212	0.1	0.226	3.40	0.09	1.23
ACN3-6HU	1,803	37.8	53.3%	0.53	0.015	0.188	0.1	0.210	4.09	0.17	1.95
ACS1-1HU	1,197	29.1	47.6%	0.20	0.015	0.193	0.1	0.213	3.04	0.08	1.08
ACS1-2HU	1,968	51.0	39.1%	0.12	0.015	0.203	0.1	0.220	3.20	0.08	1.12
ACS1-3HU	2,894	59.3	35.0%	0.43	0.015	0.207	0.1	0.223	3.76	0.12	1.58
ACS1-4HU	867	15.7	54.4%	0.67	0.015	0.197	0.1	0.216	5.17	0.26	2.76
ACS1-5HU	1,275	17.5	73.6%	0.52	0.015	0.145	0.1	0.183	3.14	0.13	1.53
ACS1-6HU	2,215	41.9	55.8%	1.05	0.015	0.181	0.1	0.206	3.67	0.14	1.75
ACS1-7HU	2,187	74.4	72.4%	0.41	0.015	0.146	0.1	0.184	2.72	0.10	1.20
ACS1-8HU	2,040	34.9	78.2%	0.27	0.015	0.142	0.1	0.181	2.16	0.05	0.75
ACS1-9HU	390	6.6	77.0%	0.75	0.015	0.143	0.1	0.182	2.78	0.11	1.26
ACS2-1HU	1,519	36.8	24.9%	0.49	0.015	0.212	0.1	0.226	4.21	0.15	2.21
ACS2-2HU	1,393	24.1	43.9%	0.50	0.015	0.198	0.1	0.217	3.54	0.11	1.60
ACS2-3HU	1,129	28.7	78.6%	0.46	0.015	0.141	0.1	0.181	3.32	0.15	1.83
ACS2-4HU	2,990	81.8	74.7%	0.26	0.015	0.154	0.1	0.188	3.86	0.19	2.21
ACS2-5HU	1,148	31.5	78.0%	0.54	0.015	0.142	0.1	0.181	2.77	0.10	1.32
ACS2-6HU	1,868	34.7	46.3%	0.51	0.015	0.193	0.1	0.214	3.30	0.10	1.39
ACS2-7HU	1,113	14.2	30.2%	0.49	0.015	0.211	0.1	0.225	3.38	0.09	1.22
ACS3-10HU	662	6.4	45.2%	0.68	0.015	0.298	0.1	0.222	4.95	0.23	2.47
ACS3-1HU	1,242	18.8	46.4%	0.31	0.015	0.192	0.1	0.213	3.95	0.15	2.05
ACS3-2HU	1,522	36.7	25.2%	0.16	0.015	0.213	0.1	0.226	4.15	0.14	2.12
ACS3-3HU	1,014	21.0	21.8%	0.24	0.015	0.215	0.1	0.228	3.70	0.11	1.55
ACS3-4HU	1,627	30.9	23.0%	0.44	0.015	0.213	0.1	0.227	5.48	0.25	3.37
ACS3-5HU	2,754	109.6	41.7%	0.30	0.015	0.203	0.1	0.220	4.74	0.22	2.32
ACS3-6HU	1,722	31.0	17.9%	0.60	0.015	0.261	0.1	0.231	4.36	0.16	2.04
ACS3-7HU	1,975	11.0	8.2%	1.82	0.015	0.371	0.1	0.241	4.19	0.13	1.77
ACS3-8HU	915	25.4	28.3%	0.44	0.015	0.212	0.1	0.224	3.93	0.13	1.90
ACS3-9HU	1,411	25.5	51.9%	0.49	0.015	0.247	0.1	0.210	3.16	0.09	1.26
ACS4-1HU	2,203	30.1	73.4%	0.72	0.017	0.148	0.1	0.185	3.84	0.20	1.95
ACS4-2HU	1,325	20.9	64.9%	0.39	0.015	0.227	0.1	0.214	3.04	0.08	1.06
ACS5-1HU	1,432	24.1	48.3%	0.32	0.015	0.271	0.1	0.225	3.34	0.08	1.17
BE1-10HU	882	11.3	59.4%	0.30	0.015	0.181	0.1	0.206	2.83	0.07	1.00
BE1-11HU	1,117	9.6	64.3%	0.27	0.015	0.184	0.1	0.208	3.14	0.09	1.33
BE1-12HU	694	7.6	80.6%	0.21	0.015	0.141	0.1	0.180	2.21	0.06	0.83
BE1-13HU	948	10.0	67.8%	0.22	0.015	0.186	0.1	0.209	2.91	0.07	1.02
BE1-14HU	925	11.3	80.7%	0.19	0.015	0.140	0.1	0.180	2.20	0.06	0.83
BE1-15HU	1,032	10.2	77.5%	0.23	0.015	0.154	0.1	0.189	3.27	0.13	1.91
BE1-16HU	901	12.8	20.6%	0.16	0.015	0.218	0.1	0.229	3.70	0.11	1.51
BE1-17HU	1,167	13.1	40.0%	0.27	0.015	0.198	0.1	0.217	3.36	0.10	1.37
BE1-18HU	1,073	11.6	75.5%	0.21	0.015	0.151	0.1	0.187	4.07	0.19	2.44
BE1-19HU	1,026	13.2	79.2%	0.18	0.015	0.147	0.1	0.184	3.87	0.18	2.33
BE1-1HU	2,034	78.6	33.6%	0.33	0.015	0.206	0.1	0.222	3.58	0.11	1.40
BE1-20HU	757	10.8	78.5%	0.24	0.015	0.150	0.1	0.186	2.53	0.08	1.09
BE1-2HU	1,239	28.9	40.7%	0.26	0.015	0.198	0.1	0.217	3.16	0.08	1.14
BE1-3HU	1,047	20.7	37.2%	0.50	0.015	0.201	0.1	0.219	3.27	0.09	1.23
BE1-4HU	1,398	19.4	71.6%	0.35	0.015	0.151	0.1	0.187	3.02	0.11	1.40
BE1-5HU	1,302	13.4	60.9%	0.23	0.015	0.163	0.1	0.194	4.54	0.22	2.70
BE1-6HU	1,230	12.4	55.4%	0.24	0.015	0.175	0.1	0.202	3.73	0.14	2.16
BE1-7HU	1,622	21.4	40.4%	0.18	0.015	0.198	0.1	0.217	3.97	0.14	2.11

Appendix B-1: SWMM Hydrologic Data

Existing Conditions											
Hydrologic Units	Width	Area	% DCIA	Slope	Manning's Roughness		Initial Abstractions		Max Inf Rate	Min Inf Rate	Soil Storage
					Impervious	Pervious	Impervious	Pervious			
(HUs)	(ft)	(Ac)	(%)	(%)			(in)	(in)	(in/hr)	(in/hr)	(in)
BE1-8HU	1,094	11.0	62.8%	0.23	0.015	0.163	0.1	0.195	2.78	0.08	1.19
BE1-9HU	1,489	22.7	80.8%	0.15	0.015	0.140	0.1	0.180	2.44	0.08	1.12
BE2-1HU	1,254	25.1	26.7%	0.20	0.015	0.215	0.1	0.228	6.14	0.30	3.65
BE2-2HU	1,059	15.9	15.6%	0.29	0.015	0.223	0.1	0.233	5.45	0.23	3.42
BE2-3HU	1,082	15.4	16.2%	0.17	0.015	0.224	0.1	0.233	4.99	0.20	2.96
BE2-4HU	1,392	22.3	35.6%	0.14	0.015	0.215	0.1	0.228	4.61	0.18	2.64
BE2-5HU	1,339	24.1	20.0%	0.30	0.015	0.217	0.1	0.229	4.87	0.19	2.92
BE2-7HU	1,373	27.1	37.0%	0.12	0.015	0.208	0.1	0.223	4.15	0.15	2.19
BE2-8HU	1,768	40.5	23.1%	0.36	0.015	0.213	0.1	0.227	4.11	0.14	2.06
BE3-1HU	1,297	18.4	71.9%	0.33	0.015	0.146	0.1	0.184	2.59	0.08	1.21
BE3-2HU	1,383	29.8	25.7%	0.15	0.015	0.213	0.1	0.226	3.99	0.13	1.93
BE3-3HU	1,391	27.5	24.5%	0.13	0.015	0.212	0.1	0.226	4.12	0.14	2.09
BE4-1HU	1,941	33.1	27.8%	0.30	0.015	0.212	0.1	0.226	3.48	0.09	1.33
BE4-2HU	896	15.6	59.6%	0.14	0.015	0.180	0.1	0.205	2.84	0.07	1.03
BE4-3HU	2,257	71.1	44.1%	0.12	0.015	0.197	0.1	0.216	3.15	0.08	1.15
BE4-4HU	785	7.5	42.5%	0.27	0.015	0.205	0.1	0.221	3.88	0.13	1.91
BE4-5HU	2,173	42.1	65.1%	0.17	0.015	0.166	0.1	0.196	2.59	0.07	0.92
BE4-6HU	1,737	22.3	29.7%	0.23	0.015	0.210	0.1	0.225	3.60	0.10	1.50
BE4-7HU	1,658	22.6	24.0%	0.32	0.015	0.213	0.1	0.226	3.39	0.09	1.21
BE4-8HU	1,194	18.3	23.3%	0.29	0.015	0.213	0.1	0.226	3.37	0.08	1.18
BE4-9HU	1,651	18.0	45.8%	0.21	0.015	0.197	0.1	0.216	3.09	0.08	1.08
BE5-1HU	1,429	18.2	23.0%	0.43	0.015	0.213	0.1	0.227	3.48	0.09	1.30
BE6-1HU	1,518	19.5	26.6%	0.40	0.015	0.212	0.1	0.226	6.64	0.34	3.83
BE6-2HU	1,729	20.3	31.5%	0.77	0.015	0.209	0.1	0.224	5.86	0.28	3.50
BE6-3HU	1,063	14.8	25.3%	0.29	0.015	0.213	0.1	0.226	4.58	0.18	2.64
BE7-1HU	1,228	25.4	40.5%	0.24	0.015	0.268	0.1	0.222	3.25	0.08	1.14
BE7-2HU	1,664	20.0	70.5%	0.64	0.015	0.156	0.1	0.186	2.30	0.06	0.81
BE7-3HU	1,212	14.4	28.6%	0.50	0.015	0.210	0.1	0.224	3.61	0.11	1.52
BE7-4HU	1,856	28.7	33.7%	0.68	0.015	0.257	0.1	0.226	3.36	0.08	1.18
BE7-5HU	968	9.4	75.2%	0.24	0.015	0.187	0.1	0.192	2.47	0.06	0.86
BW1-10HU	1,871	29.2	23.0%	0.15	0.015	0.213	0.1	0.227	6.56	0.34	3.80
BW1-11HU	2,208	22.1	23.0%	0.25	0.015	0.213	0.1	0.227	6.02	0.29	3.59
BW1-12HU	1,292	12.9	40.0%	0.34	0.015	0.206	0.1	0.222	6.03	0.30	3.55
BW1-13HU	2,430	32.4	23.2%	0.17	0.015	0.213	0.1	0.227	6.80	0.36	3.90
BW1-14HU	2,220	40.2	35.3%	0.14	0.015	0.209	0.1	0.224	6.25	0.31	3.65
BW1-15AHU	2,346	84.0	65.9%	0.07	0.015	0.183	0.1	0.207	5.58	0.29	3.23
BW1-15BHU	1,825	36.0	59.9%	0.12	0.015	0.191	0.1	0.212	5.83	0.30	3.38
BW1-15CHU	1,793	25.9	48.0%	0.16	0.015	0.200	0.1	0.218	6.80	0.37	3.82
BW1-16HU	1,402	30.1	23.0%	0.29	0.015	0.213	0.1	0.227	8.21	0.52	4.58

Appendix B-2: SWMM Soils Data

Hydrologic Units	Soil Type			
	A	B	C	D
ACN1-0HU	0.0%	0.0%	8.3%	91.7%
ACN1-10HU	0.0%	0.0%	8.5%	91.5%
ACN1-1HU	0.0%	0.0%	6.9%	93.1%
ACN1-2HU	0.0%	0.5%	21.1%	78.4%
ACN1-3HU	0.0%	16.9%	19.9%	63.3%
ACN1-4HU	0.0%	0.0%	81.5%	18.5%
ACN1-5HU	0.0%	6.1%	41.3%	52.7%
ACN1-6HU	0.0%	0.0%	0.0%	100.0%
ACN1-7HU	0.0%	0.0%	0.0%	100.0%
ACN1-8HU	0.0%	13.7%	29.8%	56.5%
ACN1-9HU	0.0%	0.0%	2.6%	97.4%
ACN3-6HU	3.3%	20.3%	14.3%	62.1%
ACS1-1HU	0.0%	0.0%	1.0%	99.0%
ACS1-2HU	0.0%	0.0%	0.0%	100.0%
ACS1-3HU	0.5%	6.3%	11.7%	81.5%
ACS1-4HU	7.1%	31.9%	26.8%	34.2%
ACS1-5HU	3.0%	21.1%	18.4%	57.4%
ACS1-6HU	1.0%	13.5%	22.6%	62.9%
ACS1-7HU	1.5%	9.6%	13.7%	75.1%
ACS1-8HU	0.0%	0.0%	0.0%	100.0%
ACS1-9HU	3.5%	11.0%	13.7%	71.7%
ACS2-1HU	0.0%	0.0%	51.2%	48.8%
ACS2-2HU	0.0%	0.0%	26.9%	73.1%
ACS2-3HU	0.4%	24.8%	45.3%	29.5%
ACS2-4HU	10.2%	11.1%	58.7%	20.0%
ACS2-5HU	0.0%	12.9%	24.2%	62.9%
ACS2-6HU	0.0%	0.0%	18.0%	82.0%
ACS2-7HU	0.0%	0.0%	2.8%	97.2%
ACS3-10HU	8.4%	20.7%	18.0%	52.9%
ACS3-1HU	0.0%	7.4%	43.9%	48.7%
ACS3-2HU	0.0%	0.0%	46.7%	53.3%
ACS3-3HU	0.0%	0.0%	17.4%	82.6%
ACS3-4HU	0.0%	16.4%	83.6%	0.0%
ACS3-5HU	10.7%	15.1%	15.8%	58.4%
ACS3-6HU	2.2%	6.5%	23.7%	67.5%
ACS3-7HU	0.0%	2.2%	16.8%	80.9%
ACS3-8HU	0.0%	0.0%	37.1%	62.9%
ACS3-9HU	0.0%	2.5%	9.2%	88.3%
ACS4-1HU	11.5%	33.5%	8.8%	46.1%
ACS4-2HU	0.0%	0.0%	0.0%	100.0%
ACS5-1HU	0.0%	0.0%	0.0%	100.0%
BE1-10HU	0.0%	0.0%	0.3%	99.7%
BE1-11HU	0.0%	0.0%	18.9%	81.1%
BE1-12HU	0.0%	0.0%	6.6%	93.4%
BE1-13HU	0.0%	0.0%	0.0%	100.0%
BE1-14HU	0.0%	0.0%	6.4%	93.6%
BE1-15HU	0.0%	0.0%	76.1%	23.9%
BE1-16HU	0.0%	0.0%	14.5%	85.5%
BE1-17HU	0.0%	0.0%	15.1%	84.9%
BE1-18HU	0.0%	34.9%	65.1%	0.0%
BE1-19HU	0.0%	29.3%	70.7%	0.0%
BE1-1HU	0.0%	6.7%	3.6%	89.7%
BE1-20HU	0.0%	0.0%	21.1%	78.9%
BE1-2HU	0.0%	0.0%	2.8%	97.2%
BE1-3HU	0.0%	0.0%	6.2%	93.8%
BE1-4HU	0.0%	17.5%	15.8%	66.6%
BE1-5HU	0.0%	40.7%	59.3%	0.0%
BE1-6HU	0.0%	0.0%	74.4%	25.6%
BE1-7HU	0.0%	0.0%	54.7%	45.3%
BE1-8HU	0.0%	0.0%	20.6%	79.4%

Appendix B-2: SWMM Soils Data

Hydrologic Units	Soil Type			
	A	B	C	D
BE1-9HU	0.0%	0.0%	29.5%	70.5%
BE2-1HU	0.0%	40.2%	59.8%	0.0%
BE2-2HU	0.0%	5.6%	94.4%	0.0%
BE2-3HU	0.0%	0.3%	79.8%	19.9%
BE2-4HU	0.0%	0.0%	71.2%	28.8%
BE2-5HU	0.0%	0.0%	83.0%	17.0%
BE2-7HU	0.0%	0.0%	52.3%	47.7%
BE2-8HU	0.0%	0.0%	43.3%	56.7%
BE3-1HU	0.0%	0.0%	32.1%	67.9%
BE3-2HU	0.0%	0.0%	37.5%	62.5%
BE3-3HU	0.0%	0.0%	45.1%	54.9%
BE4-1HU	0.0%	0.0%	8.0%	92.0%
BE4-2HU	0.0%	0.0%	2.7%	97.3%
BE4-3HU	0.0%	0.0%	3.6%	96.4%
BE4-4HU	0.0%	0.0%	39.8%	60.2%
BE4-5HU	0.0%	0.0%	1.3%	98.7%
BE4-6HU	0.0%	0.0%	16.7%	83.3%
BE4-7HU	0.0%	0.0%	1.4%	98.6%
BE4-8HU	0.0%	0.0%	0.0%	100.0%
BE4-9HU	0.0%	0.0%	0.0%	100.0%
BE5-1HU	0.0%	0.0%	5.9%	94.1%
BE6-1HU	0.0%	63.8%	36.2%	0.0%
BE6-2HU	0.0%	36.8%	63.2%	0.0%
BE6-3HU	0.0%	0.0%	72.4%	27.6%
BE7-1HU	0.0%	0.0%	0.0%	100.0%
BE7-2HU	0.0%	0.0%	0.0%	100.0%
BE7-3HU	0.0%	0.0%	18.3%	81.7%
BE7-4HU	0.0%	0.0%	0.3%	99.7%
BE7-5HU	0.0%	0.0%	0.0%	100.0%
BW1-10HU	0.0%	58.8%	41.2%	0.0%
BW1-11HU	0.0%	37.7%	62.3%	0.0%
BW1-12HU	0.0%	46.8%	53.2%	0.0%
BW1-13HU	0.0%	68.8%	31.2%	0.0%
BW1-14HU	0.0%	52.8%	47.2%	0.0%
BW1-15AHU	0.0%	60.6%	39.4%	0.0%
BW1-15BHU	0.0%	59.5%	40.5%	0.0%
BW1-15CHU	0.0%	87.1%	12.9%	0.0%
BW1-16HU	24.1%	75.9%	0.0%	0.0%
BW1-17HU	0.0%	41.2%	58.8%	0.0%
BW1-18HU	0.3%	64.9%	34.8%	0.0%
BW1-19AHU	77.8%	22.2%	0.0%	0.0%
BW1-19BHU	67.9%	32.1%	0.0%	0.0%
BW1-1AHU	0.0%	87.9%	12.1%	0.0%
BW1-1BHU	0.0%	100.0%	0.0%	0.0%
BW1-1CHU	0.0%	66.2%	33.8%	0.0%
BW1-20HU	5.3%	27.8%	62.6%	4.3%
BW1-21HU	0.0%	5.2%	10.8%	84.0%
BW1-22HU	0.0%	3.0%	8.7%	88.2%
BW1-23HU	0.0%	24.0%	0.1%	75.9%
BW1-2HU	0.0%	57.9%	42.1%	0.0%
BW1-3HU	0.0%	85.4%	14.6%	0.0%
BW1-4HU	0.0%	55.8%	44.2%	0.0%
BW1-5HU	0.0%	40.7%	59.3%	0.0%
BW1-6HU	0.0%	28.6%	71.4%	0.0%
BW1-7HU	0.0%	75.9%	24.1%	0.0%
BW1-8HU	0.0%	54.0%	46.0%	0.0%
BW1-9HU	0.0%	64.6%	35.4%	0.0%
BW2-10HU	36.7%	63.2%	0.1%	0.0%
BW2-11HU	15.3%	9.7%	8.9%	66.0%
BW2-1AHU	0.0%	66.5%	33.5%	0.0%

Appendix B-2: SWMM Soils Data

Hydrologic Units	Soil Type			
	A	B	C	D
BW2-1BHU	0.0%	62.3%	37.7%	0.0%
BW2-2HU	0.0%	51.8%	48.2%	0.0%
BW2-3HU	0.0%	76.0%	24.0%	0.0%
BW2-4AHU	0.0%	62.0%	38.0%	0.0%
BW2-4BHU	0.0%	41.4%	58.6%	0.0%
BW2-4CHU	0.0%	69.5%	30.5%	0.0%
BW2-5HU	0.0%	64.1%	35.9%	0.0%
BW2-6HU	9.6%	49.8%	40.5%	0.0%
BW2-7HU	1.9%	68.7%	29.4%	0.0%
BW2-8HU	99.9%	0.1%	0.0%	0.0%
BW2-9HU	55.2%	42.8%	2.0%	0.0%
BW3-1AHU	48.1%	50.7%	1.3%	0.0%
BW3-1BHU	44.4%	55.6%	0.0%	0.0%
BW3-1CHU	6.7%	47.7%	45.6%	0.0%
BW3-1DHU	0.0%	74.3%	25.7%	0.0%
BW3-1EHU	0.0%	88.6%	11.4%	0.0%
BW3-1FHU	1.9%	70.1%	0.0%	28.0%
BW3-1GHU	17.8%	70.7%	0.0%	11.4%
BW3-1HHU	33.5%	59.8%	6.7%	0.0%
BW3-1IHU	0.0%	99.5%	0.5%	0.0%
BW3-2HU	49.1%	50.3%	0.6%	0.0%
BW3-3AHU	1.2%	3.4%	4.1%	91.3%
BW3-3BHU	0.0%	0.0%	0.0%	100.0%
BW3-4HU	5.2%	12.3%	24.7%	57.8%
BW4-1HU	0.0%	0.0%	0.0%	100.0%
BW5-1HU	10.6%	5.1%	6.5%	77.7%
BW6-1HU	0.9%	11.3%	2.7%	85.1%

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
AC1	Overland	N/A	N/A	N/A	750	0.030	-10.0	-10.0
AC2	Overland	N/A	N/A	N/A	720	0.030	-10.0	-10.0
AC3	Overland	N/A	N/A	N/A	1,050	0.030	-10.0	-10.0
AC-FM.1	Force Main	1	3	N/A	3,980	0.012	-2.6	-2.6
ACN1-0	Culvert	1	1.5	N/A	900	0.014	-1.0	-2.0
ACN1-0-OF	Overland	N/A	N/A	N/A	100	0.030	3.5	3.4
ACN1-0-OF2	Overland	N/A	N/A	N/A	100	0.030	4.0	3.9
ACN1-1	Culvert	1	2	N/A	700	0.014	0.3	-0.6
ACN1-10	Culvert	1	1.5	N/A	650	0.014	-1.5	-2.0
ACN1-10-OF	Overland	N/A	N/A	N/A	100	0.030	3.2	3.1
ACN1-10-OF2	Overland	N/A	N/A	N/A	100	0.030	3.2	3.1
ACN1-1-OF	Overland	N/A	N/A	N/A	100	0.030	3.3	3.2
ACN1-1-OF2	Overland	N/A	N/A	N/A	100	0.030	3.4	3.3
ACN1-2	Culvert	1	1.5	N/A	650	0.014	0.5	-0.7
ACN1-2-OF	Overland	N/A	N/A	N/A	100	0.030	3.8	3.7
ACN1-2-OF2	Overland	N/A	N/A	N/A	100	0.030	3.4	3.3
ACN1-3	Culvert	1	1.5	N/A	620	0.014	0.2	-1.0
ACN1-3B	Culvert	1	1.5	N/A	620	0.014	0.2	-1.0
ACN1-3-OF	Overland	N/A	N/A	N/A	100	0.030	3.6	3.5
ACN1-3-OF2	Overland	N/A	N/A	N/A	100	0.030	3.6	3.5
ACN1-4	Culvert	1	1.25	N/A	295	0.014	3.5	0.0
ACN1-4A	Culvert	1	2.5	N/A	885	0.014	0.0	-1.5
ACN1-4-OF	Overland	N/A	N/A	N/A	100	0.030	5.8	5.7
ACN1-4-OF2	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
ACN1-5	Culvert	1	2.5	N/A	1,050	0.014	-1.5	-2.2
ACN1-5B	Culvert	1	3	N/A	1,600	0.014	-1.0	-2.4
ACN1-5-OF	Overland	N/A	N/A	N/A	100	0.030	3.4	3.3
ACN1-6	Culvert	1	3	N/A	970	0.014	-0.6	-1.5
ACN1-6-OF	Overland	N/A	N/A	N/A	100	0.030	3.9	3.8
ACN1-7	Culvert	1	2	N/A	650	0.014	-1.1	-2.0
ACN1-7-OF	Overland	N/A	N/A	N/A	100	0.030	4.3	4.2
ACN1-7-OF2	Overland	N/A	N/A	N/A	100	0.030	4.2	4.1
ACN1-7-OF3	Overland	N/A	N/A	N/A	100	0.030	4.3	4.2
ACN1-7-OF4	Overland	N/A	N/A	N/A	100	0.030	4.1	4.0
ACN1-8-OF	Overland	N/A	N/A	N/A	100	0.030	4.1	4.0
ACN1-8-OF2	Overland	N/A	N/A	N/A	100	0.030	3.4	3.3
ACN1-8-OF3	Overland	N/A	N/A	N/A	100	0.030	4.1	4.0
ACN1-8-OF4	Overland	N/A	N/A	N/A	50	0.030	4.1	4.0
ACN1-9	Culvert	1	1.5	N/A	900	0.014	-2.0	-2.5
ACN3-6-OF	Overland	N/A	N/A	N/A	100	0.030	4.7	4.6
ACS1-1-OF	Overland	N/A	N/A	N/A	100	0.030	4.7	4.6
ACS1-1-OF2	Overland	N/A	N/A	N/A	100	0.030	5.9	5.8
ACS1-2	Culvert	1	1.25	N/A	575	0.014	1.5	0.7
ACS1-2-OF	Overland	N/A	N/A	N/A	100	0.030	5.7	5.6
ACS1-2-OF2	Overland	N/A	N/A	N/A	100	0.030	5.1	5.0
ACS1-2-OF3	Overland	N/A	N/A	N/A	100	0.030	4.7	4.6
ACS1-2-OF4	Overland	N/A	N/A	N/A	100	0.030	5.8	5.7
ACS1-3	Culvert	1	1.25	N/A	300	0.014	0.5	0.0
ACS1-3A	Culvert	1	3	N/A	1,150	0.014	0.0	-1.0
ACS1-3A-OF	Overland	N/A	N/A	N/A	100	0.030	5.8	5.7
ACS1-3A-OF2	Overland	N/A	N/A	N/A	100	0.030	6.3	6.2
ACS1-3-OF	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
ACS1-4	Culvert	1	1	N/A	150	0.014	2.4	2.0
ACS1-4-OF	Overland	N/A	N/A	N/A	100	0.030	6.1	6.0
ACS1-4-OF2	Overland	N/A	N/A	N/A	100	0.030	6.4	6.3
ACS1-5	Culvert	1	3.5	N/A	1,500	0.014	-1.0	-3.5
ACS1-5-OF	Overland	N/A	N/A	N/A	100	0.030	6.6	6.5
ACS1-5-OF2	Overland	N/A	N/A	N/A	100	0.030	5.5	5.4
ACS1-6	Culvert	1	4	N/A	100	0.014	-8.0	-8.8
ACS1-6-OF	Overland	N/A	N/A	N/A	100	0.030	2.5	2.4

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
ACS1-6-OF2	Overland	N/A	N/A	N/A	100	0.030	3.0	2.9
ACS1-7	Culvert	1	1.25	N/A	1,600	0.014	3.9	0.7
ACS1-7-OF	Overland	N/A	N/A	N/A	100	0.030	4.0	3.9
ACS1-8	Culvert	1	2	N/A	880	0.014	1.1	-0.8
ACS1-8-OF	Overland	N/A	N/A	N/A	100	0.030	3.1	3.0
ACS1-8-OF2	Overland	N/A	N/A	N/A	100	0.030	3.7	3.6
ACS1-9	Culvert	1	4	N/A	790	0.014	-4.9	-8.0
ACS1-9-OF	Overland	N/A	N/A	N/A	100	0.030	3.6	3.5
ACS2-1	Culvert	1	2	N/A	1,000	0.014	-3.4	-3.9
ACS2-1A	Culvert	1	1.5	N/A	1,000	0.014	0.0	-0.5
ACS2-1-OF	Overland	N/A	N/A	N/A	100	0.030	4.1	4.0
ACS2-2	Culvert	1	2.5	N/A	600	0.014	-3.9	-4.2
ACS2-2A	Culvert	1	1.25	N/A	150	0.014	-0.5	-0.7
ACS2-2-OF	Overland	N/A	N/A	N/A	100	0.030	3.1	3.0
ACS2-3	Culvert	1	1.5	N/A	100	0.014	-2.5	-2.7
ACS2-3b	Culvert	2	1.5	N/A	100	0.014	-2.5	-2.7
ACS2-3-OF	Overland	N/A	N/A	N/A	100	0.030	3.7	3.6
ACS2-5	Culvert	1	1.25	N/A	330	0.014	-2.0	-2.4
ACS2-5-OF	Overland	N/A	N/A	N/A	100	0.030	2.5	2.4
ACS2-6	Culvert	1	2.5	N/A	500	0.014	-2.9	-3.5
ACS2-6-OF	Overland	N/A	N/A	N/A	100	0.030	3.8	3.7
ACS2-6-OF2	Overland	N/A	N/A	N/A	100	0.030	3.4	3.3
ACS2-7	Culvert	1	2	N/A	770	0.014	-3.1	-3.4
ACS2-7-OF	Overland	N/A	N/A	N/A	100	0.030	5.0	4.9
ACS3-1	Culvert	1	1.25	N/A	300	0.014	2.2	1.7
ACS3-10	Culvert	1	3.5	N/A	1,400	0.014	-3.4	-4.9
ACS3-10-OF	Overland	N/A	N/A	N/A	100	0.030	7.3	7.2
ACS3-10-OF2	Overland	N/A	N/A	N/A	100	0.030	6.9	6.8
ACS3-1-OF	Overland	N/A	N/A	N/A	100	0.030	6.7	6.6
ACS3-1-OF2	Overland	N/A	N/A	N/A	100	0.030	7.4	7.3
ACS3-2-OF	Overland	N/A	N/A	N/A	100	0.030	6.8	6.7
ACS3-2-OF2	Overland	N/A	N/A	N/A	100	0.030	6.4	6.3
ACS3-2-OF3	Overland	N/A	N/A	N/A	100	0.030	7.3	7.2
ACS3-3	Culvert	1	1.25	N/A	265	0.014	2.2	1.3
ACS3-3-OF	Overland	N/A	N/A	N/A	100	0.030	5.6	5.5
ACS3-3-OF2	Overland	N/A	N/A	N/A	100	0.030	5.9	5.8
ACS3-4	Culvert	1	1.25	N/A	360	0.014	1.7	1.2
ACS3-4-OF	Overland	N/A	N/A	N/A	100	0.030	6.9	6.8
ACS3-4-OF2	Overland	N/A	N/A	N/A	100	0.030	7.6	7.5
ACS3-5	Culvert	1	2	N/A	300	0.014	-2.1	-2.4
ACS3-6	Culvert	1	2	N/A	100	0.014	-1.0	-1.2
ACS3-6-OF	Overland	N/A	N/A	N/A	100	0.030	3.5	3.4
ACS3-7	Culvert	1	1	N/A	100	0.030	3.0	2.0
ACS3-7-OF	Overland	N/A	N/A	N/A	100	0.030	5.6	5.5
ACS3-8	Culvert	1	1.5	N/A	650	0.014	1.5	1.2
ACS3-8A	Culvert	1	2	N/A	1,600	0.014	1.2	-1.0
ACS3-8A-OF	Overland	N/A	N/A	N/A	50	0.030	7.7	7.6
ACS3-8A-OF2	Overland	N/A	N/A	N/A	100	0.030	6.8	6.7
ACS3-8B	Culvert	1	1.25	N/A	610	0.014	1.2	0.3
ACS3-8-OF	Overland	N/A	N/A	N/A	100	0.030	7.3	7.2
ACS3-8-OF2	Overland	N/A	N/A	N/A	100	0.030	4.5	4.4
ACS3-9-OF	Overland	N/A	N/A	N/A	100	0.030	2.7	2.6
ACS4-1-OF	Overland	N/A	N/A	N/A	100	0.030	4.0	3.9
ACS4-2-OF	Overland	N/A	N/A	N/A	100	0.030	4.1	4.0
ACS4-2-OF2	Overland	N/A	N/A	N/A	100	0.030	3.2	3.1
ACS5-1	Culvert	1	1.5	N/A	100	0.014	-1.3	-1.5
ACS5-1-OF	Overland	N/A	N/A	N/A	100	0.030	3.0	2.9
BE1-1	Culvert	1	3	N/A	340	0.014	-5.0	-5.6
BE1-10	Culvert	1	1.25	N/A	650	0.014	-1.6	-2.5
BE1-10A	Culvert	1	1.5	N/A	265	0.014	-3.6	-3.9

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BE1-10B	Culvert	1	1.25	N/A	265	0.014	-3.5	-3.9
BE1-10-OF	Overland	N/A	N/A	N/A	100	0.030	5.0	4.9
BE1-10-OF2	Overland	N/A	N/A	N/A	100	0.030	5.0	4.9
BE1-11	Culvert	1	5	N/A	150	0.014	-5.5	-5.6
BE1-11-OF	Overland	N/A	N/A	N/A	100	0.030	6.7	6.6
BE1-11-OF2	Overland	N/A	N/A	N/A	100	0.030	6.8	6.7
BE1-11-OF3	Overland	N/A	N/A	N/A	100	0.030	6.5	6.4
BE1-11-OF4	Overland	N/A	N/A	N/A	100	0.030	6.8	6.7
BE1-12	Culvert	1	4	N/A	1,380	0.014	-1.0	-2.1
BE1-12-OF	Overland	N/A	N/A	N/A	100	0.030	6.2	6.1
BE1-12-OF2	Overland	N/A	N/A	N/A	100	0.030	6.5	6.4
BE1-12-OF3	Overland	N/A	N/A	N/A	100	0.030	7.0	6.9
BE1-13	Culvert	1	2.5	N/A	950	0.014	0.7	0.0
BE1-13-OF	Overland	N/A	N/A	N/A	100	0.030	6.4	6.3
BE1-13-OF2	Overland	N/A	N/A	N/A	100	0.030	6.5	6.4
BE1-13-OF3	Overland	N/A	N/A	N/A	100	0.030	6.4	6.3
BE1-13-OF4	Overland	N/A	N/A	N/A	100	0.030	6.9	6.8
BE1-14	Culvert	1	2.5	N/A	1,200	0.014	-1.0	-2.0
BE1-14-OF	Overland	N/A	N/A	N/A	100	0.030	6.3	6.2
BE1-14-OF2	Overland	N/A	N/A	N/A	100	0.030	6.3	6.2
BE1-14-OF3	Overland	N/A	N/A	N/A	100	0.030	6.2	6.1
BE1-14-OF4	Overland	N/A	N/A	N/A	100	0.030	7.3	7.2
BE1-15	Culvert	1	2.5	N/A	1,600	0.014	0.5	-1.0
BE1-15-OF	Overland	N/A	N/A	N/A	100	0.030	7.2	7.1
BE1-15-OF2	Overland	N/A	N/A	N/A	100	0.030	7.5	7.4
BE1-15-OF3	Overland	N/A	N/A	N/A	100	0.030	7.3	7.2
BE1-15-OF4	Overland	N/A	N/A	N/A	100	0.030	7.6	7.5
BE1-16	Culvert	1	3.5	N/A	670	0.014	0.3	-0.6
BE1-16-OF	Overland	N/A	N/A	N/A	100	0.030	5.7	5.6
BE1-17	Culvert	1	3.5	N/A	1,970	0.014	-0.6	-3.4
BE1-17-OF	Overland	N/A	N/A	N/A	100	0.030	4.7	4.6
BE1-17-OF2	Overland	N/A	N/A	N/A	100	0.030	7.1	7.2
BE1-18	Culvert	1	1.5	N/A	1,800	0.014	2.0	0.0
BE1-18-OF	Overland	N/A	N/A	N/A	100	0.030	8.9	8.8
BE1-18-OF2	Overland	N/A	N/A	N/A	100	0.030	8.1	8.0
BE1-18-OF3	Overland	N/A	N/A	N/A	100	0.030	8.7	8.6
BE1-18-OF4	Overland	N/A	N/A	N/A	100	0.030	9.0	8.9
BE1-19	Culvert	1	1.5	N/A	900	0.014	-1.0	-2.5
BE1-19-OF	Overland	N/A	N/A	N/A	100	0.030	8.3	8.2
BE1-19-OF2	Overland	N/A	N/A	N/A	100	0.030	8.1	8.0
BE1-19-OF3	Overland	N/A	N/A	N/A	100	0.030	8.2	8.1
BE1-19-OF5	Overland	N/A	N/A	N/A	100	0.030	8.1	8.0
BE1-1A	Culvert	1	3	N/A	850	0.014	-3.6	-4.7
BE1-1-OF	Overland	N/A	N/A	N/A	100	0.030	3.5	3.4
BE1-1-OF2	Overland	N/A	N/A	N/A	100	0.030	3.0	2.9
BE1-1-OF3	Overland	N/A	N/A	N/A	100	0.030	2.8	2.6
BE1-20	Culvert	1	1.5	N/A	800	0.014	-2.5	-3.1
BE1-20-OF	Overland	N/A	N/A	N/A	100	0.030	5.2	5.1
BE1-20-OF2	Overland	N/A	N/A	N/A	100	0.030	5.3	5.2
BE1-20-OF3	Overland	N/A	N/A	N/A	100	0.030	5.2	5.1
BE1-20-OF4	Overland	N/A	N/A	N/A	100	0.030	5.3	5.2
BE1-20-OF5	Overland	N/A	N/A	N/A	100	0.030	8.2	8.1
BE1-2-OF	Overland	N/A	N/A	N/A	100	0.030	3.1	3.0
BE1-2-OF2	Overland	N/A	N/A	N/A	50	0.030	3.0	2.9
BE1-3	Culvert	1	1	N/A	650	0.014	-3.0	-3.9
BE1-3-2	Culvert	1	1.75	N/A	500	0.014	-2.5	-3.0
BE1-3B	Culvert	1	1.25	N/A	100	0.010	-2.0	-2.5
BE1-3-OF	Overland	N/A	N/A	N/A	100	0.030	2.5	2.4
BE1-4	Culvert	1	1.25	N/A	1,500	0.014	5.0	3.5
BE1-4-OF	Culvert	1	1	N/A	100	0.030	*	*

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BE1-4-OF2	Overland	N/A	N/A	N/A	100	0.030	5.4	5.3
BE1-5	Culvert	1	1.25	N/A	1,600	0.014	3.5	2.0
BE1-5-OF	Overland	N/A	N/A	N/A	100	0.030	8.5	8.4
BE1-5-OF2	Overland	N/A	N/A	N/A	100	0.030	8.4	8.3
BE1-5-OF3	Overland	N/A	N/A	N/A	100	0.030	8.4	8.3
BE1-5-OF4	Overland	N/A	N/A	N/A	100	0.030	8.5	8.4
BE1-5-OF5	Overland	N/A	N/A	N/A	100	0.030	8.5	8.4
BE1-6	Culvert	1	1.5	N/A	1,000	0.014	2.0	1.0
BE1-6-OF	Overland	N/A	N/A	N/A	100	0.030	7.1	7.0
BE1-6-OF2	Overland	N/A	N/A	N/A	100	0.030	7.5	7.4
BE1-6-OF3	Overland	N/A	N/A	N/A	100	0.030	7.0	6.9
BE1-6-OF4	Overland	N/A	N/A	N/A	100	0.030	7.0	6.9
BE1-6-OF5	Overland	N/A	N/A	N/A	100	0.030	7.1	7.0
BE1-7	Culvert	1	3.5	N/A	1,250	0.014	-2.9	-4.7
BE1-7A	Culvert	1	1.25	N/A	1,300	0.014	1.0	-1.0
BE1-7-OF	Overland	N/A	N/A	N/A	100	0.030	7.6	7.5
BE1-7-OF2	Overland	N/A	N/A	N/A	100	0.030	7.1	7.0
BE1-8	Culvert	1	1.5	N/A	1,900	0.014	-1.0	-3.0
BE1-8-OF	Overland	N/A	N/A	N/A	100	0.030	6.4	6.3
BE1-8-OF2	Overland	N/A	N/A	N/A	100	0.030	6.7	6.6
BE1-8-OF3	Overland	N/A	N/A	N/A	100	0.030	6.7	6.6
BE1-8-OF4	Overland	N/A	N/A	N/A	100	0.030	7.1	7.0
BE1-8-OF5	Overland	N/A	N/A	N/A	100	0.030	7.3	7.2
BE1-9	Culvert	1	5	N/A	1,600	0.014	-4.0	-5.5
BE1-9A	Culvert	1	1.5	N/A	943	0.014	-2.4	-3.6
BE1-9-OF	Overland	N/A	N/A	N/A	100	0.030	6.6	6.5
BE1-9-OF2	Overland	N/A	N/A	N/A	100	0.030	6.5	6.4
BE1-9-OF3	Overland	N/A	N/A	N/A	100	0.030	7.0	6.9
BE1-9-OF4	Overland	N/A	N/A	N/A	100	0.030	6.9	6.8
BE1-9-OF5	Overland	N/A	N/A	N/A	100	0.030	7.2	7.1
BE2-1	Culvert	1	2	N/A	670	0.014	1.0	0.8
BE2-1-OF	Overland	N/A	N/A	N/A	100	0.030	8.1	8.0
BE2-1-OF2	Overland	N/A	N/A	N/A	100	0.030	8.1	8.0
BE2-2	Culvert	1	1.5	N/A	500	0.024	1.7	1.0
BE2-2-OF	Overland	N/A	N/A	N/A	100	0.030	7.6	7.5
BE2-3A	Culvert	1	2.5	N/A	640	0.014	-0.4	-1.4
BE2-3B	Culvert	1	2.5	N/A	700	0.014	-1.9	-2.9
BE2-4	Culvert	1	1.25	N/A	590	0.014	-0.1	-0.9
BE2-4A	Culvert	1	2.25	N/A	690	0.014	0.6	-0.4
BE2-4A-OF	Overland	N/A	N/A	N/A	100	0.030	7.6	7.5
BE2-4A-OF2	Overland	N/A	N/A	N/A	50	0.030	7.5	7.4
BE2-4B	Culvert	1	2.25	N/A	695	0.014	-0.9	-1.9
BE2-5	Culvert	1	1.5	N/A	640	0.014	1.4	-0.4
BE2-5-OF	Overland	N/A	N/A	N/A	100	0.030	7.2	7.1
BE2-5-OF2	Overland	N/A	N/A	N/A	100	0.030	7.0	6.9
BE2-7	Culvert	1	1.25	N/A	700	0.014	-0.3	-1.9
BE2-7-OF	Overland	N/A	N/A	N/A	100	0.030	7.0	6.9
BE2-7-OF2	Overland	N/A	N/A	N/A	100	0.030	6.8	6.7
BE2-7-OF3	Overland	N/A	N/A	N/A	100	0.030	7.7	7.6
BE2-8	Culvert	1	1.25	N/A	800	0.024	2.0	-2.0
BE2-8-OF	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
BE3-1	Culvert	1	1.25	N/A	330	0.014	1.8	1.3
BE3-2-OF	Overland	N/A	N/A	N/A	100	0.030	6.7	6.6
BE3-2-OF2	Overland	N/A	N/A	N/A	100	0.030	7.1	7.2
BE3-2-OF3	Overland	N/A	N/A	N/A	100	0.030	6.4	6.3
BE3-2-OF4	Overland	N/A	N/A	N/A	100	0.030	7.6	7.5
BE3-2-OF5	Overland	N/A	N/A	N/A	100	0.030	6.9	6.8
BE3-3-OF	Overland	N/A	N/A	N/A	100	0.030	6.2	6.1
BE3-3-OF2	Overland	N/A	N/A	N/A	100	0.030	7.2	7.1
BE4-1A	Culvert	1	3	N/A	750	0.014	0.0	-1.0

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BE4-1-OF	Overland	N/A	N/A	N/A	100	0.030	6.7	6.6
BE4-1-OF2	Overland	N/A	N/A	N/A	100	0.030	6.8	6.7
BE4-2-OF	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
BE4-2-OF2	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
BE4-3	Culvert	1	1.5	N/A	200	0.014	0.6	-0.3
BE4-3-OF	Overland	N/A	N/A	N/A	100	0.030	5.8	5.7
BE4-3-OF2	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
BE4-3-OF3	Overland	N/A	N/A	N/A	100	0.030	6.3	6.2
BE4-3-OF4	Overland	N/A	N/A	N/A	100	0.030	5.4	5.3
BE4-3-OF5	Overland	N/A	N/A	N/A	100	0.030	5.9	5.8
BE4-3-OF6	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
BE4-3-OF7	Overland	N/A	N/A	N/A	100	0.030	5.5	5.4
BE4-4	Culvert	1	1.25	N/A	300	0.014	2.2	1.8
BE4-4-OF	Overland	N/A	N/A	N/A	100	0.030	6.6	6.5
BE4-4-OF2	Overland	N/A	N/A	N/A	100	0.030	6.6	6.5
BE4-5	Culvert	1	1.5	N/A	200	0.014	2.0	1.8
BE4-5-OF	Overland	N/A	N/A	N/A	100	0.030	5.9	5.8
BE4-6-OF	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
BE4-6-OF2	Overland	N/A	N/A	N/A	100	0.030	5.8	5.7
BE4-7	Culvert	1	1.25	N/A	615	0.014	2.0	1.1
BE4-7B	Culvert	1	1.5	N/A	950	0.014	-2.0	-2.4
BE4-7-OF	Overland	N/A	N/A	N/A	100	0.030	6.0	5.9
BE4-7-OF2	Overland	N/A	N/A	N/A	100	0.030	6.3	6.2
BE4-7-OF3	Overland	N/A	N/A	N/A	100	0.030	6.5	6.4
BE4-8	Culvert	1	1.25	N/A	500	0.014	-0.1	-0.8
BE4-8B	Culvert	1	1.25	N/A	500	0.014	-0.1	-0.8
BE4-8-OF	Overland	N/A	N/A	N/A	100	0.030	5.3	5.2
BE4-8-OF2	Overland	N/A	N/A	N/A	100	0.030	5.6	5.5
BE4-9	Culvert	1	2	N/A	570	0.014	-2.5	-3.3
BE4-9-OF	Overland	N/A	N/A	N/A	100	0.030	3.7	3.6
BE5-1	Culvert	1	2.5	N/A	300	0.014	-3.5	-3.8
BE5-1-OF	Overland	N/A	N/A	N/A	100	0.030	3.4	3.3
BE6-1	Culvert	1	1.25	N/A	300	0.014	1.5	0.0
BE6-1A	Culvert	1	1.25	N/A	1,000	0.014	2.0	-1.0
BE6-1B	Culvert	1	1.25	N/A	300	0.014	1.7	0.0
BE6-1-OF	Overland	N/A	N/A	N/A	100	0.030	7.8	7.7
BE6-1-OF2	Overland	N/A	N/A	N/A	100	0.030	7.9	7.8
BE6-2	Culvert	1	1.25	N/A	460	0.014	1.5	0.0
BE6-2B	Culvert	1	1.25	N/A	1,200	0.010	2.2	1.7
BE6-2-OF	Overland	N/A	N/A	N/A	100	0.030	8.1	8.0
BE6-2-OF2	Overland	N/A	N/A	N/A	100	0.030	8.1	8.0
BE6-3	Culvert	1	1.25	N/A	365	0.014	4.1	3.6
BE7-1	Culvert	1	1.25	N/A	100	0.014	-2.8	-3.3
BE7-1-OF	Overland	N/A	N/A	N/A	100	0.030	2.5	2.4
BE7-1-OF2	Overland	N/A	N/A	N/A	100	0.030	2.5	2.4
BE7-1-OF4	Overland	N/A	N/A	N/A	100	0.030	2.5	2.4
BE7-2-OF	Overland	N/A	N/A	N/A	100	0.030	2.6	2.5
BE7-3	Culvert	1	3.5	N/A	1,008	0.014	-4.7	-6.1
BE7-3-OF	Overland	N/A	N/A	N/A	100	0.030	3.1	3.0
BE7-3-OF2	Overland	N/A	N/A	N/A	100	0.030	3.5	3.4
BE7-3-OF3	Overland	N/A	N/A	N/A	100	0.030	3.5	3.4
BE7-4	Culvert	1	1.25	N/A	265	0.014	-3.5	-3.9
BE7-4B	Culvert	1	1.75	N/A	650	0.014	-2.5	-2.8
BE7-4-OF	Overland	N/A	N/A	N/A	100	0.030	2.5	2.4
BE7-5	Culvert	1	3.5	N/A	170	0.014	-6.1	-6.4
BE7-5-OF	Overland	N/A	N/A	N/A	100	0.030	4.3	4.2
BE7-5-OF2	Overland	N/A	N/A	N/A	100	0.030	3.7	3.6
BW1-10	Culvert	1	3.5	N/A	750	0.014	1.6	0.5
BW1-10A	Culvert	1	2.5	N/A	775	0.014	2.2	1.6
BW1-10A-OF	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BW1-10A-OF2	Overland	N/A	N/A	N/A	100	0.030	9.4	9.3
BW1-10A-OF3	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW1-10-OF	Overland	N/A	N/A	N/A	50	0.030	9.3	9.2
BW1-10-OF2	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW1-10-OF3	Overland	N/A	N/A	N/A	100	0.030	9.7	9.6
BW1-10-OF4	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW1-11	Culvert	1	3	N/A	1,180	0.014	2.1	1.6
BW1-11-OF	Overland	N/A	N/A	N/A	100	0.030	9.7	9.6
BW1-11-OF2	Overland	N/A	N/A	N/A	100	0.030	9.7	9.6
BW1-11-OF3	Overland	N/A	N/A	N/A	100	0.030	8.7	8.6
BW1-11-OF4	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW1-12	Culvert	1	1.25	N/A	570	0.014	2.4	1.8
BW1-12-OF	Overland	N/A	N/A	N/A	100	0.030	9.0	8.9
BW1-13	Culvert	1	4.5	N/A	650	0.014	-0.2	-0.5
BW1-13A	Culvert	1	3.5	N/A	720	0.014	0.5	0.1
BW1-13A-OF	Overland	N/A	N/A	N/A	100	0.030	8.0	7.9
BW1-13A-OF2	Overland	N/A	N/A	N/A	50	0.030	9.1	9.0
BW1-14	Culvert	1	2	N/A	800	0.014	0.9	-0.2
BW1-15A	Culvert	1	4.5	N/A	1,400	0.014	-0.5	-3.1
BW1-15A-OF	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW1-15A-OF2	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW1-15A-OF3	Overland	N/A	N/A	N/A	100	0.030	9.0	8.9
BW1-15A-OF4	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW1-15A-OF5	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW1-15A-OF6	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW1-15B	Culvert	1	1.5	N/A	2,000	0.014	2.5	1.5
BW1-15C	Culvert	1	1.5	N/A	1,300	0.014	2.0	1.5
BW1-15C-OF	Overland	N/A	N/A	N/A	100	0.030	10.0	9.9
BW1-16	Culvert	1	1.25	N/A	900	0.024	2.0	0.5
BW1-16-OF	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW1-16-OF2	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW1-16-OF3	Overland	N/A	N/A	N/A	100	0.030	9.7	9.6
BW1-17	Culvert	1	1.25	N/A	600	0.014	2.0	0.5
BW1-17A	Culvert	1	5	N/A	700	0.014	-3.1	-3.4
BW1-17A-OF	Overland	N/A	N/A	N/A	50	0.030	9.1	9.0
BW1-17-OF	Overland	N/A	N/A	N/A	100	0.030	8.5	8.4
BW1-17-OF2	Overland	N/A	N/A	N/A	100	0.030	8.3	8.2
BW1-18	Culvert	1	5	N/A	1,350	0.014	-3.5	-4.1
BW1-18-OF	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW1-18-OF2	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW1-18-OF3	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW1-19	Culvert	1	5	N/A	650	0.014	-4.1	-4.4
BW1-19A-OF	Overland	N/A	N/A	N/A	100	0.030	11.4	11.3
BW1-19A-OF2	Overland	N/A	N/A	N/A	100	0.030	11.7	11.6
BW1-19B	Culvert	1	2	N/A	1,265	0.014	4.0	-1.0
BW1-19B2	Culvert	1	5	N/A	520	0.014	-4.4	-4.7
BW1-19-OF	Overland	N/A	N/A	N/A	100	0.030	10.4	10.3
BW1-1A	Culvert	1	1.25	N/A	400	0.014	5.3	4.7
BW1-1A-OF	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW1-1A-OF2	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW1-1A-OF3	Overland	N/A	N/A	N/A	100	0.030	9.6	9.5
BW1-1A-OF4	Overland	N/A	N/A	N/A	100	0.030	9.6	9.5
BW1-1A-OF5	Overland	N/A	N/A	N/A	100	0.030	9.6	9.5
BW1-1A-OF6	Overland	N/A	N/A	N/A	100	0.030	9.6	9.5
BW1-1B-OF	Overland	N/A	N/A	N/A	100	0.030	9.9	9.8
BW1-1B-OF2	Overland	N/A	N/A	N/A	100	0.030	9.9	9.8
BW1-1B-OF3	Overland	N/A	N/A	N/A	100	0.030	9.9	9.8
BW1-1B-OF4	Overland	N/A	N/A	N/A	100	0.030	9.9	9.8
BW1-1C	Culvert	1	1.25	N/A	180	0.014	5.7	5.3
BW1-1C-OF	Overland	N/A	N/A	N/A	100	0.030	9.9	9.8

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BW1-1C-OF2	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW1-2	Culvert	1	2	N/A	930	0.014	6.1	5.1
BW1-20A	Culvert	1	5	N/A	1,420	0.014	-4.7	-5.4
BW1-20-OF	Overland	N/A	N/A	N/A	100	0.030	7.8	7.7
BW1-21	Culvert	1	2	N/A	350	0.014	-1.0	-2.0
BW1-21-OF	Overland	N/A	N/A	N/A	100	0.030	3.3	3.2
BW1-21-OF2	Overland	N/A	N/A	N/A	100	0.030	3.8	3.7
BW1-21-OF3	Overland	N/A	N/A	N/A	100	0.030	3.2	3.1
BW1-21-OF4	Overland	N/A	N/A	N/A	100	0.030	3.7	3.6
BW1-22	Culvert	1	5	N/A	730	0.014	-5.4	-5.8
BW1-22-OF	Overland	N/A	N/A	N/A	100	0.030	3.5	3.4
BW1-22-OF2	Overland	N/A	N/A	N/A	100	0.030	3.5	3.4
BW1-23	Culvert	1	5	N/A	150	0.014	-4.5	-5.0
BW1-23-OF	Overland	N/A	N/A	N/A	100	0.030	6.3	6.2
BW1-23-OF2	Overland	N/A	N/A	N/A	100	0.030	6.1	6.0
BW1-2-OF	Overland	N/A	N/A	N/A	100	0.030	8.9	8.8
BW1-3	Culvert	1	1.5	N/A	950	0.014	4.7	3.8
BW1-3-OF	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BW1-3-OF2	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW1-3-OF3	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW1-3-OF4	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW1-4	Culvert	1	1.5	N/A	260	0.014	5.4	4.1
BW1-4-OF	Overland	N/A	N/A	N/A	100	0.030	8.9	8.8
BW1-4-OF3	Overland	N/A	N/A	N/A	100	0.030	9.4	9.3
BW1-4-OF4	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW1-4-OF5	Overland	N/A	N/A	N/A	100	0.030	8.9	8.8
BW1-5	Culvert	1	2	N/A	715	0.014	5.1	4.1
BW1-5-OF	Overland	N/A	N/A	N/A	100	0.030	9.0	8.9
BW1-6	Culvert	1	2.5	N/A	1,490	0.014	4.1	2.2
BW1-6-OF	Overland	N/A	N/A	N/A	100	0.030	8.9	8.8
BW1-7	Culvert	1	2	N/A	905	0.014	5.3	4.1
BW1-7A	Culvert	1	1.25	N/A	180	0.014	2.0	1.5
BW1-7-OF	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW1-7-OF2	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW1-8	Culvert	1	2.5	N/A	1,460	0.014	4.1	2.1
BW1-8-OF	Overland	N/A	N/A	N/A	100	0.030	8.9	8.8
BW1-9	Culvert	1	1.5	N/A	710	0.014	3.8	2.2
BW1-9-OF	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW1-9-OF2	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW1-9-OF3	Overland	N/A	N/A	N/A	100	0.030	8.7	8.6
BW1-9-OF4	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW2-10	Culvert	1	6	N/A	800	0.014	-2.8	-3.2
BW2-10A	Culvert	1	6	N/A	1,050	0.014	-3.2	-4.7
BW2-10-OF	Overland	N/A	N/A	N/A	100	0.030	9.7	9.6
BW2-10-OF2	Overland	N/A	N/A	N/A	100	0.030	10.1	10.0
BW2-11	Culvert	1	6	N/A	850	0.014	-4.7	-5.1
BW2-11B	Culvert	1	1.5	N/A	150	0.014	-0.5	-1.0
BW2-11C	Culvert	1	1.5	N/A	150	0.014	-0.5	-1.0
BW2-11-OF	Overland	N/A	N/A	N/A	100	0.030	3.6	3.5
BW2-1A	Culvert	1	2.5	N/A	950	0.014	4.8	3.2
BW2-1A-OF	Overland	N/A	N/A	N/A	100	0.030	9.4	9.3
BW2-1A-OF2	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW2-1B	Culvert	1	3	N/A	665	0.014	3.2	1.5
BW2-1B-OF	Overland	N/A	N/A	N/A	100	0.030	8.8	8.7
BW2-1B-OF2	Overland	N/A	N/A	N/A	100	0.030	8.7	8.6
BW2-2	Culvert	1	1.5	N/A	915	0.014	2.7	1.5
BW2-2-OF	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW2-2-OF2	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW2-2-OF3	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW2-3	Culvert	1	3	N/A	650	0.014	1.5	0.3
BW2-3-OF	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW2-4A1	Culvert	1	1.5	N/A	1,000	0.014	3.4	1.4
BW2-4A2	Culvert	1	1.5	N/A	700	0.014	3.4	2.5
BW2-4A-OF	Overland	N/A	N/A	N/A	100	0.030	8.6	8.5
BW2-4A-OF2	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW2-4A-OF3	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW2-4B	Culvert	1	1.5	N/A	1,000	0.014	4.4	3.2
BW2-4B2	Culvert	1	1.25	N/A	800	0.014	2.5	0.5
BW2-4B-OF	Overland	N/A	N/A	N/A	100	0.030	8.5	8.4
BW2-4B-OF2	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW2-4B-OF3	Overland	N/A	N/A	N/A	100	0.030	8.5	8.4
BW2-4C1	Culvert	1	2	N/A	750	0.014	6.6	5.6
BW2-4C2	Culvert	1	2	N/A	1,300	0.014	6.6	4.8
BW2-4C-OF	Overland	N/A	N/A	N/A	100	0.030	9.0	8.9
BW2-4C-OF2	Overland	N/A	N/A	N/A	100	0.030	9.6	9.5
BW2-4C-OF3	Overland	N/A	N/A	N/A	100	0.030	9.6	9.5
BW2-4C-OF4	Overland	N/A	N/A	N/A	100	0.030	9.5	9.4
BW2-5	Culvert	1	3	N/A	1,400	0.014	0.3	-2.1

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BW2-5B	Culvert	1	3.5	N/A	1,900	0.014	0.4	-0.5
BW2-5-OF	Overland	N/A	N/A	N/A	100	0.030	10.0	9.9
BW2-5-OF2	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW2-5-OF3	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW2-5-OF4	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW2-5-OF5	Overland	N/A	N/A	N/A	100	0.030	9.4	9.2
BW2-5-OF6	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW2-5-OF7	Overland	N/A	N/A	N/A	100	0.030	9.4	9.2
BW2-6	Culvert	1	6	N/A	1,280	0.014	-2.1	-2.8
BW2-7	Culvert	1	3	N/A	370	0.014	-1.5	-2.1
BW2-7-OF	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW2-8	Culvert	1	1.25	N/A	1,000	0.014	-1.4	-2.8
BW2-8-OF	Overland	N/A	N/A	N/A	100	0.030	10.3	10.2
BW2-9	Culvert	1	1.25	N/A	1,280	0.024	4.4	1.5
BW2-9-OF	Overland	N/A	N/A	N/A	100	0.030	9.7	9.6
BW3-1A	Culvert	1	2	N/A	650	0.024	2.4	2.2
BW3-1A-OF	Overland	N/A	N/A	N/A	100	0.030	10.0	9.9
BW3-1A-OF2	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW3-1B	Culvert	1	1.5	N/A	800	0.014	3.0	2.5
BW3-1C	Culvert	1	3	N/A	1,300	0.014	1.5	0.4
BW3-1C-OF	Overland	N/A	N/A	N/A	100	0.030	8.9	8.8
BW3-1D	Culvert	1	1.5	N/A	1,000	0.014	2.5	1.5
BW3-1D-OF	Overland	N/A	N/A	N/A	100	0.030	9.2	9.1
BW3-1D-OF2	Overland	N/A	N/A	N/A	100	0.030	9.1	9.0
BW3-1D-OF3	Overland	N/A	N/A	N/A	100	0.030	9.0	8.9
BW3-1D-OF4	Overland	N/A	N/A	N/A	100	0.030	9.3	9.2
BW3-1E	Culvert	1	1.5	N/A	1,500	0.014	4.0	2.5
BW3-1E-OF	Overland	N/A	N/A	N/A	100	0.030	9.0	8.9
BW3-1E-OF2	Overland	N/A	N/A	N/A	100	0.030	9.4	9.3
BW3-1E-OF3	Overland	N/A	N/A	N/A	100	0.030	10.1	10.2
BW3-1F	Culvert	1	1.5	N/A	1,500	0.014	5.5	4.0
BW3-1F-OF	Overland	N/A	N/A	N/A	100	0.030	9.8	9.7
BW3-1F-OF2	Overland	N/A	N/A	N/A	100	0.030	9.9	9.8
BW3-1G	Culvert	1	1.5	N/A	900	0.014	6.0	5.5
BW3-1G-OF	Overland	N/A	N/A	N/A	100	0.010	10.7	10.6
BW3-1G-OF2	Overland	N/A	N/A	N/A	100	0.010	10.6	10.5
BW3-1G-OF3	Overland	N/A	N/A	N/A	100	0.030	10.6	10.5
BW3-1H-OF	Overland	N/A	N/A	N/A	100	0.030	10.0	9.9
BW3-1H-OF2	Overland	N/A	N/A	N/A	100	0.030	9.8	9.7
BW3-1H-OF3	Overland	N/A	N/A	N/A	100	0.030	9.7	9.6
BW3-1I	Culvert	1	1.25	N/A	180	0.014	2.0	1.5
BW3-1I-OF	Overland	N/A	N/A	N/A	100	0.030	10.0	9.9
BW3-1I-OF2	Overland	N/A	N/A	N/A	100	0.030	10.1	10.0
BW3-2A	Culvert	1	2.5	N/A	530	0.024	2.2	1.3
BW3-2A2	Culvert	1	3	N/A	1,280	0.014	0.9	-2.1
BW3-2A-OF	Overland	N/A	N/A	N/A	100	0.030	10.1	10.0
BW3-3A	Culvert	1	4.5	N/A	170	0.014	-4.5	-4.9
BW3-3A2	Culvert	1	1.25	N/A	150	0.014	0.0	-1.0
BW3-3A-OF	Overland	N/A	N/A	N/A	100	0.030	3.1	3.0
BW3-3A-OF2	Overland	N/A	N/A	N/A	100	0.030	2.9	2.8
BW3-3A-OF3	Overland	N/A	N/A	N/A	100	0.030	2.7	2.6
BW3-3B	Culvert	1	1.5	N/A	100	0.014	-1.0	-2.0
BW3-3B-OF	Overland	N/A	N/A	N/A	100	0.030	3.0	2.9
BW3-4	Culvert	1	2.5	N/A	830	0.014	-1.5	-4.1
BW3-4B	Culvert	1	3.5	N/A	720	0.014	-4.1	-4.5
BW3-4B-OF	Overland	N/A	N/A	N/A	100	0.030	3.1	3.0
BW3-4-OF	Overland	N/A	N/A	N/A	100	0.030	4.8	4.7
BW3-4-OF2	Overland	N/A	N/A	N/A	100	0.030	5.0	4.9
BW4-1	Culvert	1	1.5	N/A	150	0.014	0.0	-1.0
BW4-1-OF	Overland	N/A	N/A	N/A	100	0.030	2.9	2.8

Appendix B-3: SWMM Hydraulic Link Data (Pipes and Overland Flow)

Existing Conditions - Conduits								
Link Name	Link Type	No. of Barrels	Depth (ft)	Width (ft)	Length (ft)	Manning's Roughness	U/S Inv. (NAVD ft)	D/S Inv. (NAVD ft)
BW5-1	Culvert	1	1.25	N/A	100	0.014	0.0	-0.5
BW5-1B	Culvert	1	1.5	N/A	150	0.014	0.0	-0.5
BW5-1C	Culvert	1	1.25	N/A	150	0.014	0.0	-0.5
BW5-1-OF	Overland	N/A	N/A	N/A	100	0.030	3.3	3.2
BW6-1	Culvert	1	2	N/A	190	0.014	-0.2	-0.5
Dis-AC1.1	Culvert	1	2.5	N/A	100	0.012	-2.6	-2.6
Dis-AC2.1	Culvert	1	2.5	N/A	100	0.012	-2.6	-2.6
G58_1	Culvert	1	5	N/A	224	0.024	-9.0	-9.0
G58_2	Culvert	1	6	N/A	207	0.024	-9.0	-9.0
G58_3	Culvert	1	6	N/A	190	0.024	-9.0	-9.0
G58_4	Culvert	1	6	N/A	173	0.024	-9.0	-9.0
OutBW1-15	Culvert	1	1.5	N/A	300	0.014	1.5	0.0
PACN1-8	Culvert	1	4	N/A	50	0.014	-2.2	-2.5
Ruck1	Culvert	1	3	N/A	700	0.014	-5.6	-6.6
RuckFM1	Culvert	1	1.5	N/A	10	0.010	7.9	-8.2
RuckFM2	Culvert	1	1.5	N/A	10	0.010	7.9	-8.2
RuckIn	Culvert	1	5	N/A	200	0.014	-7.1	-7.1
RuckOut	Force Main	1	5	N/A	1,500	0.014	-8.2	-8.2

Appendix B-4: SWMM Hydraulic Link Data (Pumps, Exfiltration, Drainage Wells)

Existing Conditions - Pumps	
Pump Name	Max Capacity (cfs)
ACN1-1-EX	8.1
ACN1-2-EX	24.6
ACN1-3-EX	6.9
ACN1-4-EX	16.1
ACN1-5-EX	1.2
ACN1-6-DW	1.5
ACN1-7-DW	9.0
ACN1-7-EX	7.6
ACN1-8-DW	10.5
ACN3-6-EX	27.1
ACPmp1.1	43.4
ACPmp2.1	43.4
ACS1-3-EX	3.4
ACS1-4-EX	0.9
ACS1-5-DW	18.0
ACS1-6-DW	3.0
ACS1-8-DW	1.5
ACS1-9-DW	15.0
ACS2-1-DW	1.5
ACS2-1-EX	5.0
ACS2-2-EX	1.9
ACS2-4-EX	2.7
ACS3-1-DW	1.5
ACS3-2-DW	3.0
ACS3-2-EX	4.3
ACS3-3-EX	1.9
ACS3-4-EX	4.4
ACS3-5-EX	25.4
ACS3-6-EX	0.4
ACS3-8A-DW	3.0
ACS3-8-EX	0.7
ACS4-1-DW	1.5
ACS5-1-DW	6.0
ACS5-1-EX	0.1
BE1-10-DW	18.0
BE1-11-DW	7.5
BE1-12-DW	12.0
BE1-13-DW	10.5
BE1-14-DW	3.0
BE1-18-DW	3.0
BE1-19-DW	15.0
BE1-1-EX	12.8
BE1-2-EX	7.5
BE1-3-EX	0.6
BE1-5-DW	7.5
BE1-5-EX	0.9
BE1-6-DW	18.0
BE1-6-EX	0.5

Existing Conditions - Pumps	
Pump Name	Max Capacity (cfs)
BE1-7-DW	10.5
BE1-7-EX	2.5
BE1-8-DW	9.0
BE1-9-DW	25.5
BE2-2-EX	0.2
BE2-3-EX	0.1
BE2-4-EX	0.1
BE2-5-EX	11.3
BE3-1-EX	4.3
BE3-2-EX	6.0
BE4-1-EX	7.1
BE4-3-DW	19.5
BE4-3-EX	6.2
BE4-5-DW	4.5
BE4-5-EX	0.1
BE5-1-EX	0.1
BE6-1-DW	12.0
BE6-2-EX	1.1
BE6-3-EX	3.1
BE7-2-EX	0.1
BW1-10-DW	1.5
BW1-10-EX	0.1
BW1-11-EX	0.2
BW1-12-DW	1.5
BW1-12-DW2	3.0
BW1-12-EX	0.3
BW1-13-EX	4.9
BW1-14-DW	1.5
BW1-14-EX	8.3
BW1-15A-DW	1.5
BW1-15A-DW2	50.0
BW1-15A-EX	5.0
BW1-16-EX	0.2
BW1-17-EX	4.4
BW1-18-DW	18.0
BW1-19A-DW	15.0
BW1-19B-DW	7.5
BW1-19-DW	12.0
BW1-1A-DW	7.5
BW1-1A-EX	4.6
BW1-1B-EX	3.3
BW1-1C-EX	5.1
BW1-21-DW	15.0
BW1-21-EX	0.2
BW1-22-EX	0.1
BW1-2-EX	7.8
BW1-4-DW	15.0
BW1-5-EX	2.1

Existing Conditions - Pumps	
Pump Name	Max Capacity (cfs)
BW1-6-DW	3.0
BW1-6-EX	3.4
BW1-7-DW	13.5
BW1-7-EX	0.9
BW1-8-DW	12.0
BW1-8-EX	3.1
BW1-9-DW	1.5
BW2-10A-DW	3.0
BW2-11-DW	1.5
BW2-11-EX	0.9
BW2-1B-DW	1.5
BW2-1B-EX	2.9
BW2-2-DW	1.5
BW2-2-DW2	4.5
BW2-2-EX	1.6
BW2-3-DW	6.0
BW2-3-EX	1.0
BW2-4A-EX	8.9
BW2-4B-EX	3.0
BW2-5-DW	16.5
BW2-5-EX	7.8
BW2-6-EX	22.1
BW2-7-DW	1.5
BW2-7-EX	5.0
BW2-8-DW	12.0
BW2-8-EX	0.9
BW2-9-DW	15.0
BW3-1A-DW	9.0
BW3-1B-DW	10.5
BW3-1B-EX	2.8
BW3-1C-DW	21.0
BW3-1C-EX	0.6
BW3-1D-DW	7.5
BW3-1E-DW	12.0
BW3-1E-EX	0.4
BW3-1F-DW	3.0
BW3-2A-DW	9.0
BW3-2-DW	24.0
BW3-2-EX	0.2
BW3-3A-EX	2.5
BW3-4B-DW	3.0
BW3-4-DW	4.5
BW4-1-EX	3.4
BW5-1-EX	3.0
BW6-1-EX	0.4
RuckPmp1	40.0
RuckPmp2	40.0

Appendix B-5: SWMM Hydraulic Node Data

Existing Conditions- Nodes			
Node Name	**Node Type**	**Invert (ft NAVD)**	**Initial Stage (ft NAVD)**
AC1	Junction	-10.0	1.0
AC2	Junction	-10.0	1.0
AC3	Junction	-10.0	1.0
ACN1-0	Storage Junction	-5.0	1.0
ACN1-1	Storage Junction	-5.0	1.0
ACN1-10	Storage Junction	-5.0	1.0
ACN1-1-EX	Outfall	0.0	N/A
ACN1-2	Storage Junction	-5.0	1.0
ACN1-2-EX	Outfall	0.0	N/A
ACN1-3	Storage Junction	-5.0	1.0
ACN1-3-EX	Outfall	0.0	N/A
ACN1-4	Storage Junction	-5.0	1.0
ACN1-4A	Junction	-5.0	1.0
ACN1-4-EX	Outfall	0.0	N/A
ACN1-5	Storage Junction	-5.0	1.0
ACN1-5-EX	Outfall	0.0	N/A
ACN1-6	Storage Junction	-5.0	1.0
ACN1-6-DW	Outfall	0.0	N/A
ACN1-7	Storage Junction	-5.0	1.0
ACN1-7-DW	Outfall	0.0	N/A
ACN1-7-EX	Outfall	0.0	N/A
ACN1-8	Storage Junction	-5.0	1.0
ACN1-8-DW	Outfall	0.0	N/A
ACN1-9	Storage Junction	-5.0	1.0
ACN3-6	Storage Junction	-5.0	1.0
ACN3-6-EX	Outfall	0.0	N/A
ACS1-1	Storage Junction	-5.0	1.0
ACS1-2	Storage Junction	-5.0	1.0
ACS1-3	Storage Junction	-5.0	1.0
ACS1-3A	Junction	-5.0	1.0
ACS1-3-EX	Outfall	0.0	N/A
ACS1-4	Storage Junction	-5.0	1.0
ACS1-4-EX	Outfall	0.0	N/A
ACS1-5	Storage Junction	-5.0	1.0
ACS1-5-DW	Outfall	0.0	N/A
ACS1-6	Storage Junction	-9.0	1.0
ACS1-6-DW	Outfall	0.0	N/A
ACS1-7	Storage Junction	-5.0	1.0
ACS1-8	Storage Junction	-5.0	1.0
ACS1-8-DW	Outfall	0.0	N/A
ACS1-9	Storage Junction	-5.0	1.0
ACS1-9-DW	Outfall	0.0	N/A
ACS2-1	Storage Junction	-5.0	1.0
ACS2-1-DW	Outfall	0.0	N/A
ACS2-1-EX	Outfall	0.0	N/A
ACS2-2	Storage Junction	-5.0	1.0
ACS2-2-EX	Outfall	0.0	N/A
ACS2-3	Storage Junction	-5.0	1.0
ACS2-4	Storage Junction	-5.0	1.0
ACS2-4-EX	Outfall	0.0	N/A
ACS2-5	Storage Junction	-5.0	1.0
ACS2-6	Storage Junction	-5.0	1.0
ACS2-7	Storage Junction	-5.0	1.0
ACS3-1	Storage Junction	-5.0	1.0
ACS3-10	Storage Junction	-5.0	1.0
ACS3-1-DW	Outfall	0.0	N/A
ACS3-2	Storage Junction	-5.0	1.0
ACS3-2-DW	Outfall	0.0	N/A
ACS3-2-EX	Outfall	0.0	N/A
ACS3-3	Storage Junction	-5.0	1.0

Appendix B-5: SWMM Hydraulic Node Data

Existing Conditions- Nodes			
Node Name	**Node Type**	**Invert (ft NAVD)**	**Initial Stage (ft NAVD)**
ACS3-3-EX	Outfall	0.0	N/A
ACS3-4	Storage Junction	-5.0	1.0
ACS3-4-EX	Outfall	0.0	N/A
ACS3-5	Storage Junction	-5.0	1.0
ACS3-5-EX	Outfall	0.0	N/A
ACS3-6	Storage Junction	-5.0	1.0
ACS3-6-EX	Outfall	0.0	N/A
ACS3-7	Storage Junction	-5.0	1.0
ACS3-8	Storage Junction	-5.0	1.0
ACS3-8A	Junction	-5.0	1.0
ACS3-8A-DW	Outfall	0.0	N/A
ACS3-8-EX	Outfall	0.0	N/A
ACS3-9	Storage Junction	-5.0	1.0
ACS4-1	Storage Junction	-5.0	1.0
ACS4-1-DW	Outfall	0.0	N/A
ACS4-2	Storage Junction	-5.0	1.0
ACS5-1	Storage Junction	-5.0	1.0
ACS5-1-DW	Outfall	0.0	N/A
ACS5-1-EX	Outfall	0.0	N/A
BE1-1	Storage Junction	-5.0	1.0
BE1-10	Storage Junction	-5.0	1.0
BE1-10-DW	Outfall	0.0	N/A
BE1-11	Storage Junction	-7.0	1.0
BE1-11-DW	Outfall	0.0	N/A
BE1-12	Storage Junction	-5.0	1.0
BE1-12-DW	Outfall	0.0	N/A
BE1-13	Storage Junction	-5.0	1.0
BE1-13-DW	Outfall	0.0	N/A
BE1-14	Storage Junction	-5.0	1.0
BE1-14-DW	Outfall	0.0	N/A
BE1-15	Storage Junction	-5.0	1.0
BE1-16	Storage Junction	-5.0	1.0
BE1-17	Storage Junction	-5.0	1.0
BE1-18	Storage Junction	-5.0	1.0
BE1-18-DW	Outfall	0.0	N/A
BE1-19	Storage Junction	-5.0	1.0
BE1-19-DW	Outfall	0.0	N/A
BE1-1-EX	Outfall	0.0	N/A
BE1-2	Storage Junction	-6.0	1.0
BE1-20	Storage Junction	-5.0	1.0
BE1-2-EX	Outfall	0.0	N/A
BE1-3	Storage Junction	-5.0	1.0
BE1-3-EX	Outfall	0.0	N/A
BE1-4	Storage Junction	-5.0	1.0
BE1-5	Storage Junction	-5.0	1.0
BE1-5-DW	Outfall	0.0	N/A
BE1-5-EX	Outfall	0.0	N/A
BE1-6	Storage Junction	-5.0	1.0
BE1-6-DW	Outfall	0.0	N/A
BE1-6-EX	Outfall	0.0	N/A
BE1-7	Storage Junction	-5.0	1.0
BE1-7-DW	Outfall	0.0	N/A
BE1-7-EX	Outfall	0.0	N/A
BE1-8	Storage Junction	-5.0	1.0
BE1-8-DW	Outfall	0.0	N/A
BE1-9	Storage Junction	-5.0	1.0
BE1-9-DW	Outfall	0.0	N/A
BE2-1	Storage Junction	-5.0	1.0
BE2-2	Storage Junction	-5.0	1.0
BE2-2-EX	Outfall	0.0	N/A

Appendix B-5: SWMM Hydraulic Node Data

Existing Conditions- Nodes			
Node Name	**Node Type**	**Invert (ft NAVD)**	**Initial Stage (ft NAVD)**
BE2-3	Storage Junction	-5.0	1.0
BE2-3-EX	Outfall	0.0	N/A
BE2-4	Storage Junction	-5.0	1.0
BE2-4A	Junction	-5.0	1.0
BE2-4-EX	Outfall	0.0	N/A
BE2-5	Storage Junction	-5.0	1.0
BE2-5-EX	Outfall	0.0	N/A
BE2-7	Storage Junction	-5.0	1.0
BE2-8	Storage Junction	-5.0	1.0
BE3-1	Storage Junction	-5.0	1.0
BE3-1-EX	Outfall	0.0	N/A
BE3-2	Storage Junction	-5.0	1.0
BE3-2-EX	Outfall	0.0	N/A
BE3-3	Storage Junction	-5.0	1.0
BE4-1	Storage Junction	-5.0	1.0
BE4-1-EX	Outfall	0.0	N/A
BE4-2	Storage Junction	-5.0	1.0
BE4-3	Storage Junction	-5.0	1.0
BE4-3-DW	Outfall	0.0	N/A
BE4-3-EX	Outfall	0.0	N/A
BE4-4	Storage Junction	-5.0	1.0
BE4-5	Storage Junction	-5.0	1.0
BE4-5-DW	Outfall	0.0	N/A
BE4-5-EX	Outfall	0.0	N/A
BE4-6	Storage Junction	-5.0	1.0
BE4-7	Storage Junction	-5.0	1.0
BE4-8	Storage Junction	-5.0	1.0
BE4-9	Storage Junction	-5.0	1.0
BE5-1	Storage Junction	-5.0	1.0
BE5-1-EX	Outfall	0.0	N/A
BE6-1	Storage Junction	-5.0	1.0
BE6-1-DW	Outfall	0.0	N/A
BE6-2	Storage Junction	-5.0	1.0
BE6-2-EX	Outfall	0.0	N/A
BE6-3	Storage Junction	-5.0	1.0
BE6-3-EX	Outfall	0.0	N/A
BE7-1	Storage Junction	-5.0	1.0
BE7-2	Storage Junction	-5.0	1.0
BE7-2-EX	Outfall	0.0	N/A
BE7-3	Storage Junction	-7.0	1.0
BE7-4	Storage Junction	-5.0	1.0
BE7-5	Storage Junction	-7.0	1.0
BW1-10	Storage Junction	-5.0	1.0
BW1-10A	Junction	-5.0	1.0
BW1-10-DW	Outfall	0.0	N/A
BW1-10-EX	Outfall	0.0	N/A
BW1-11	Storage Junction	-5.0	1.0
BW1-11-EX	Outfall	0.0	N/A
BW1-12	Storage Junction	-5.0	1.0
BW1-12-DW	Outfall	0.0	N/A
BW1-12-DW2	Outfall	0.0	N/A
BW1-12-EX	Outfall	0.0	N/A
BW1-13	Storage Junction	-5.0	1.0
BW1-13A	Junction	-5.0	1.0
BW1-13-EX	Outfall	0.0	N/A
BW1-14	Storage Junction	-5.0	1.0
BW1-14-DW	Outfall	0.0	N/A
BW1-14-EX	Outfall	0.0	N/A
BW1-15	Junction	-5.0	1.0
BW1-15A	Storage Junction	-5.0	1.0

Appendix B-5: SWMM Hydraulic Node Data

Existing Conditions- Nodes			
Node Name	**Node Type**	**Invert (ft NAVD)**	**Initial Stage (ft NAVD)**
BW1-15A-DW	Outfall	0.0	N/A
BW1-15A-DW2	Outfall	0.0	N/A
BW1-15A-EX	Outfall	0.0	N/A
BW1-15B	Storage Junction	-5.0	1.0
BW1-15C	Storage Junction	-5.0	1.0
BW1-16	Storage Junction	-5.0	1.0
BW1-16-EX	Outfall	0.0	N/A
BW1-17	Storage Junction	-5.0	1.0
BW1-17A	Junction	-5.0	1.0
BW1-17-EX	Outfall	0.0	N/A
BW1-18	Storage Junction	-5.0	1.0
BW1-18-DW	Outfall	0.0	N/A
BW1-19	Storage Junction	-5.0	1.0
BW1-19A	Storage Junction	-5.0	1.0
BW1-19A-DW	Outfall	0.0	N/A
BW1-19B	Junction	-5.0	1.0
BW1-19B-DW	Outfall	0.0	N/A
BW1-19-DW	Outfall	0.0	N/A
BW1-1A	Storage Junction	-5.0	1.0
BW1-1A-DW	Outfall	0.0	N/A
BW1-1A-EX	Outfall	0.0	N/A
BW1-1B	Storage Junction	-5.0	1.0
BW1-1B-EX	Outfall	0.0	N/A
BW1-1C	Storage Junction	-5.0	1.0
BW1-1C-EX	Outfall	0.0	N/A
BW1-2	Storage Junction	-5.0	1.0
BW1-20	Storage Junction	-5.0	1.0
BW1-20A	Junction	-5.0	1.0
BW1-21	Storage Junction	-5.0	1.0
BW1-21-DW	Outfall	0.0	N/A
BW1-21-EX	Outfall	0.0	N/A
BW1-22	Storage Junction	-6.0	1.0
BW1-22-EX	Outfall	0.0	N/A
BW1-23	Storage Junction	-5.0	1.0
BW1-2-EX	Outfall	0.0	N/A
BW1-3	Storage Junction	-5.0	1.0
BW1-4	Storage Junction	-5.0	1.0
BW1-4-DW	Outfall	0.0	N/A
BW1-5	Storage Junction	-5.0	1.0
BW1-5-EX	Outfall	0.0	N/A
BW1-6	Storage Junction	-5.0	1.0
BW1-6-DW	Outfall	0.0	N/A
BW1-6-EX	Outfall	0.0	N/A
BW1-7	Storage Junction	-5.0	1.0
BW1-7-DW	Outfall	0.0	N/A
BW1-7-EX	Outfall	0.0	N/A
BW1-8	Storage Junction	-5.0	1.0
BW1-8-DW	Outfall	0.0	N/A
BW1-8-EX	Outfall	0.0	N/A
BW1-9	Storage Junction	-5.0	1.0
BW1-9-DW	Outfall	0.0	N/A
BW2-10	Storage Junction	-5.0	1.0
BW2-10A	Junction	-5.0	1.0
BW2-10A-DW	Outfall	0.0	N/A
BW2-11	Storage Junction	-5.0	1.0
BW2-11-DW	Outfall	0.0	N/A
BW2-11-EX	Outfall	0.0	N/A
BW2-1A	Storage Junction	-5.0	1.0
BW2-1B	Storage Junction	-5.0	1.0
BW2-1B-DW	Outfall	0.0	N/A

Appendix B-5: SWMM Hydraulic Node Data

Existing Conditions- Nodes			
Node Name	**Node Type**	**Invert (ft NAVD)**	**Initial Stage (ft NAVD)**
BW2-1B-EX	Outfall	0.0	N/A
BW2-2	Storage Junction	-5.0	1.0
BW2-2-DW	Outfall	0.0	N/A
BW2-2-DW2	Outfall	0.0	N/A
BW2-2-EX	Outfall	0.0	N/A
BW2-3	Storage Junction	-5.0	1.0
BW2-3-DW	Outfall	0.0	N/A
BW2-3-EX	Outfall	0.0	N/A
BW2-4A	Storage Junction	-5.0	1.0
BW2-4A-EX	Outfall	0.0	N/A
BW2-4B	Storage Junction	-5.0	1.0
BW2-4B-EX	Outfall	0.0	N/A
BW2-4C	Storage Junction	-5.0	1.0
BW2-5	Storage Junction	-5.0	1.0
BW2-5-DW	Outfall	0.0	N/A
BW2-5-EX	Outfall	0.0	N/A
BW2-6	Storage Junction	-5.0	1.0
BW2-6-EX	Outfall	0.0	N/A
BW2-7	Storage Junction	-5.0	1.0
BW2-7-DW	Outfall	0.0	N/A
BW2-7-EX	Outfall	0.0	N/A
BW2-8	Storage Junction	-5.0	1.0
BW2-8-DW	Outfall	0.0	N/A
BW2-8-EX	Outfall	0.0	N/A
BW2-9	Storage Junction	-5.0	1.0
BW2-9-DW	Outfall	0.0	N/A
BW3-1A	Storage Junction	-5.0	1.0
BW3-1A-DW	Outfall	0.0	N/A
BW3-1B	Storage Junction	-5.0	1.0
BW3-1B-DW	Outfall	0.0	N/A
BW3-1B-EX	Outfall	0.0	N/A
BW3-1C	Storage Junction	-5.0	1.0
BW3-1C-DW	Outfall	0.0	N/A
BW3-1C-EX	Outfall	0.0	N/A
BW3-1D	Storage Junction	-5.0	1.0
BW3-1D-DW	Outfall	0.0	N/A
BW3-1E	Storage Junction	-5.0	1.0
BW3-1E-DW	Outfall	0.0	N/A
BW3-1E-EX	Outfall	0.0	N/A
BW3-1F	Storage Junction	-5.0	1.0
BW3-1F-DW	Outfall	0.0	N/A
BW3-1G	Storage Junction	-5.0	1.0
BW3-1G-OFOUT	Outfall	0.0	N/A
BW3-1H	Storage Junction	-5.0	1.0
BW3-1I	Storage Junction	-5.0	1.0
BW3-2	Storage Junction	-5.0	1.0
BW3-2A	Junction	-5.0	1.0
BW3-2A-DW	Outfall	0.0	N/A
BW3-2-DW	Outfall	0.0	N/A
BW3-2-EX	Outfall	0.0	N/A
BW3-3A	Storage Junction	-5.0	1.0
BW3-3A-EX	Outfall	0.0	N/A
BW3-3B	Storage Junction	-5.0	1.0
BW3-4	Storage Junction	-5.0	1.0
BW3-4B	Junction	-5.0	1.0
BW3-4B-DW	Outfall	0.0	N/A
BW3-4-DW	Outfall	0.0	N/A
BW4-1	Storage Junction	-5.0	1.0
BW4-1-EX	Outfall	0.0	N/A
BW5-1	Storage Junction	-5.0	1.0

Appendix B-5: SWMM Hydraulic Node Data

Existing Conditions- Nodes			
Node Name	**Node Type**	**Invert (ft NAVD)**	**Initial Stage (ft NAVD)**
BW5-1-EX	Outfall	0.0	N/A
BW6-1	Storage Junction	-5.0	1.0
BW6-1-EX	Outfall	0.0	N/A
D-PS-AC1	Storage Junction	-2.6	-2.6
D-PS-AC2	Storage Junction	-2.6	-2.6
G58	Junction	-10.0	1.0
G58S	Junction	-9.3	1.0
JAC	Storage Junction	-2.6	-2.6
Out2ACN1-0	Outfall	0.0	1.0
Out2ACS1-6	Outfall	0.0	1.0
OUT2ACS4-1	Outfall	0.0	1.0
OUT2ACS5-1	Outfall	0.0	1.0
Out2BE1-3	Outfall	0.0	1.0
Out2BE4-3	Outfall	0.0	
Out2BE4-9	Outfall	0.0	1.0
Out2BE7-1	Outfall	0.0	1.0
Out2BE7-4	Outfall	0.0	1.0
Out2BW1-23	Outfall	0.0	
Out3ACN1-0	Outfall	0.0	1.0
Out3ACS1-6	Outfall	0.0	1.0
Out3BE4-3	Outfall	0.0	N/A
Out3BE7-1	Outfall	0.0	1.0
Out4BE7-1	Outfall	0.0	1.0
OutACN1-0	Outfall	-5.0	1.0
OutACS1-2	Outfall	0.0	N/A
OutACS1-3	Outfall	0.0	N/A
OutACS1-6	Outfall	-8.8	1.0
OutACS1-7	Outfall	0.0	N/A
OutACS1-8	Outfall	0.0	N/A
OutACS4-1	Outfall	0.0	1.0
OUTACS5-1	Outfall	-1.5	1.0
OutBE1	Outfall	-8.2	1.0
OutBE1-1	Outfall	0.0	N/A
OUTBE1-10	Outfall	-3.9	1.0
OutBE1-10B	Outfall	-3.9	1.0
OutBE1-11	Outfall	-6.0	1.0
OutBE1-3	Outfall	-3.8	1.0
OutBE1-4	Outfall	0.0	1.0
OutBE3-3B	Outfall	-2.0	1.0
OutBE3-3B2	Outfall	0.0	1.0
OutBE4-3	Outfall	0.0	N/A
OutBE4-5	Outfall	0.0	N/A
OutBE4-9	Outfall	-4.3	1.0
OutBE5-1	Outfall	-3.8	1.0
OutBE7-1	Outfall	-3.8	1.0
OutBE7-2	Outfall	0.0	1.0
OutBE7-4	Outfall	-3.9	1.0
OutBW1-15C	Outfall	-5.0	N/A
OutBW1-21	Outfall	-3.9	1.0
OUTBW1-22	Outfall	-5.8	1.0
OUTBW1-22A	Outfall	0.0	1.0
OutBW1-23	Outfall	-5.0	1.0
OUTBW1-4	Outfall	-1.0	1.0
OUTBW2-11	Outfall	-5.1	1.0
OutBW2-11B	Outfall	-1.0	1.0
OUTBW2-11C	Outfall	-1.0	1.0
OUTBW3-3	Outfall	-5.0	1.0
OUTBW3-3A2	Outfall	-2.5	1.0
OUTBW3-3A3	Outfall	0.0	1.0
OutBW3-4	Outfall	3.5	N/A

Appendix B-5: SWMM Hydraulic Node Data

Existing Conditions- Nodes			
Node Name	**Node Type**	**Invert (ft NAVD)**	**Initial Stage (ft NAVD)**
OutBW5-1	Outfall	-0.5	1.0
OutBW5-1B	Outfall	-0.5	1.0
OutBW5-1C	Outfall	-0.5	1.0
OutBW5-1D	Outfall	0.0	1.0
OUTBW6	Outfall	-0.5	1.0
OUTMBE2	Outfall	-6.4	1.0
RkEnd	Storage Junction	-8.2	-8.2
RkWWell	Storage Junction	-7.1	1.0
Ruck	Storage Junction	-7.1	1.0
WWAC	Storage Junction	-9.8	1.0
Out_G58	Outfall	-10.0	1.0

Table B-6: Exfiltration Rating Curve Estimation using SFWMD Equation

$\delta = K_sH_2W + 2K_s\,[D_u(H_2 - 0.5D_u) + D_sH_2]$ **Equation**

where:

δ = flow rate per foot of trench (cfs/ft);
K_s = hydraulic conductivity of the soils in cfs/ft^2/ft of head
H_2 = depth of water (ft)
W = width of trench (ft)
D_u = unsaturated trench depth (ft)
D_s = saturated trench depth (ft)

Variable			K_s	W	H_2	D_u	D_s	
Hydrologic Unit	GW * Elev. (ft-NAVD)	Trench # Length (ft)	Hydraulic @ Conductivity (cfs/ft^2/ft)	Width of Trench (ft)	Depth to Water (ft)	Unsat. Trench Depth (ft)	Saturated Trench Depth (ft)	Estimated Flow Rate (cfs)
ACN1-1HU	1.0	300	0.0011900	3.50	2.0	0.5	3.5	8.1
ACN1-2HU	1.0	907	0.0011900	3.50	2.0	0.5	3.5	24.6
ACN1-3HU	1.0	1586	0.0001900	3.50	2.0	0.5	3.5	6.9
ACN1-4HU	1.0	1872	0.0001900	3.50	5.0	3.5	0.5	16.1
ACN1-5HU	1.0	319	0.0001600	3.50	2.0	0.5	3.5	1.2
ACN1-7HU	1.0	310	0.0011000	3.25	2.0	0.5	3.5	7.6
ACN3-6HU	1.0	875	0.0007800	3.50	4.0	2.5	1.5	27.1
ACS1-3HU	1.0	92	0.0011500	3.50	3.0	1.5	2.5	3.4
ACS1-4HU	1.0	416	0.0000530	3.50	4.0	2.5	1.5	0.9
ACS2-1HU	1.0	1174	0.0001310	3.50	3.0	1.5	2.5	5.0
ACS2-2HU	1.0	440	0.0001310	3.50	3.0	1.5	2.5	1.9
ACS2-4HU	1.0	380	0.0001310	3.50	6.0	4.5	0.0	2.7
ACS3-2HU	1.0	116	0.0008700	3.00	5.0	3.5	0.5	4.3
ACS3-3HU	1.0	750	0.0000640	3.50	4.0	2.5	1.5	1.9
ACS3-4HU	1.0	612	0.0001310	3.50	6.0	4.5	0.0	4.4
ACS3-5HU	1.0	3123	0.0002520	3.50	3.0	1.5	2.5	25.4
ACS3-6HU	1.0	66	0.0001310	3.25	5.2	3.7	0.3	0.4
ACS3-8HU	1.0	300	0.0000690	3.50	3.0	1.5	2.5	0.7
ACS5-1HU	1.0	29	0.0000585	3.00	2.0	0.5	3.5	0.0
BE1-1HU	1.0	4017	0.0001400	3.50	2.0	0.5	3.5	12.8
BE1-2HU	1.0	2350	0.0001400	3.50	2.0	0.5	3.5	7.5
BE1-3HU	1.0	759	0.0000370	3.50	2.0	0.5	3.5	0.6
BE1-5HU	1.0	82	0.0001500	3.50	7.0	5.5	0.0	0.9
BE1-6HU	1.0	600	0.0000160	3.50	6.0	4.5	0.0	0.5
BE1-7HU	1.0	218	0.0002100	3.50	6.0	4.5	0.0	2.5
BE2-2HU	1.0	268	0.0000160	3.50	6.0	4.5	0.0	0.2
BE2-3HU	1.0	83	0.0000160	3.50	6.0	4.5	0.0	0.1
BE2-4HU	1.0	90	0.0000160	3.50	6.0	4.5	0.0	0.1
BE2-5HU	1.0	3199	0.0000780	3.50	5.0	3.5	0.5	11.3
BE3-1HU	1.0	120	0.0009000	3.50	4.0	2.5	1.5	4.3
BE3-2HU	1.0	152	0.0009200	3.00	5.0	3.5	0.5	6.0
BE4-1HU	1.0	204	0.0009200	3.00	4.0	2.5	1.5	7.1
BE4-3HU	1.0	219	0.0009000	3.25	3.0	1.5	2.5	6.2
BE4-5HU	1.0	62	0.0000450	3.25	3.0	1.5	2.5	0.1

Variable			K_s	W	H_2	D_u	D_s	
Hydrologic Unit	GW * Elev. (ft-NAVD)	Trench # Length (ft)	Hydraulic @ Conductivity (cfs/ft^2/ft)	Width of Trench (ft)	Depth to Water (ft)	Unsat. Trench Depth (ft)	Saturated Trench Depth (ft)	Estimated Flow Rate (cfs)
BE5-1HU	1.0	106	0.0000350	3.50	2.0	0.5	3.5	0.1
BE6-2HU	1.0	210	0.0001000	3.50	6.0	4.5	0.0	1.1
BE6-3HU	1.0	515	0.0001310	3.50	5.0	3.5	0.5	3.1
BE7-2HU	1.0	97	0.0000670	3.50	2.0	0.5	3.5	0.1
BW1-10HU	1.0	50	0.0000280	3.25	8.0	6.5	0.0	0.1
BW1-11HU	1.0	80	0.0000280	3.25	8.0	6.5	0.0	0.2
BW1-12HU	1.0	40	0.0000960	3.00	8.0	6.5	0.0	0.3
BW1-13HU	1.0	587	0.0000960	3.25	8.0	6.5	0.0	4.9
BW1-14HU	1.0	965	0.0000960	3.50	8.0	6.5	0.0	8.3
BW1-15AHU	1.0	510	0.0001100	3.50	8.0	6.5	0.0	5.0
BW1-16HU	1.0	20	0.0000840	3.50	8.0	6.5	0.0	0.2
BW1-17HU	1.0	560	0.0001100	3.50	7.0	5.5	0.0	4.4
BW1-1AHU	1.0	530	0.0000970	3.50	8.0	6.5	0.0	4.6
BW1-1BHU	1.0	520	0.0000700	3.50	8.0	6.5	0.0	3.3
BW1-1CHU	1.0	804	0.0000700	3.50	8.0	6.5	0.0	5.1
BW1-21HU	1.0	360	0.0000280	3.50	2.0	0.5	3.5	0.2
BW1-22HU	1.0	20	0.0000280	3.50	2.0	0.5	3.5	0.0
BW1-2HU	1.0	575	0.0001900	3.50	7.0	5.5	0.0	7.8
BW1-4HU	1.0	275	0.0001900	3.25	8.0	6.5	0.0	4.6
BW1-5HU	1.0	162	0.0001900	3.25	7.0	5.5	0.0	2.1
BW1-6HU	1.0	258	0.0001900	3.25	7.0	5.5	0.0	3.4
BW1-7HU	1.0	359	0.0000280	3.50	8.0	6.5	0.0	0.9
BW1-8HU	1.0	1250	0.0000280	3.50	8.0	6.5	0.0	3.1
BW2-11HU	1.0	1093	0.0000350	3.50	2.0	0.5	3.5	0.9
BW2-1BHU	1.0	575	0.0000560	3.50	8.0	6.5	0.0	2.9
BW2-2HU	1.0	325	0.0000560	3.50	8.0	6.5	0.0	1.6
BW2-3HU	1.0	100	0.0001100	3.50	8.0	6.5	0.0	1.0
BW2-4AHU	1.0	920	0.0001100	3.25	8.0	6.5	0.0	8.9
BW2-4BHU	1.0	381	0.0001100	3.50	7.0	5.5	0.0	3.0
BW2-5HU	1.0	795	0.0001100	3.50	8.0	6.5	0.0	7.8
BW2-6HU	1.0	2933	0.0000840	3.50	8.0	6.5	0.0	22.1
BW2-7HU	1.0	659	0.0000840	3.50	8.0	6.5	0.0	5.0
BW2-8HU	1.0	263	0.0000297	3.50	9.0	7.5	0.0	0.9
BW3-1BHU	1.0	555	0.0000570	3.50	8.0	6.5	0.0	2.8
BW3-1CHU	1.0	155	0.0000570	3.50	7.0	5.5	0.0	0.6
BW3-1EHU	1.0	51	0.0000970	3.50	8.0	6.5	0.0	0.4
BW3-2HU	1.0	33	0.0000570	3.50	8.0	6.5	0.0	0.2
BW3-3AHU	1.0	509	0.0001500	3.50	3.0	1.5	2.5	2.5
BW4-1HU	1.0	993	0.0001500	3.50	2.0	0.5	3.5	3.4
BW5-1HU	1.0	3349	0.0000280	3.50	3.0	1.5	2.5	3.0
BW6-1HU	1.0	449	0.0000280	3.50	3.0	1.5	2.5	0.4

* Source: Estimated from historical data from USGS monitoring wells located within the City of North Miami

Source: City of North Miami GIS shapefile

@ Source: City of North Miami Soil Boring logs

Appendix C

Federal Emergency Management Agency (FEMA) Flood Insurance Study Information

The following are figures and pages taken from the FEMA Flood Insurance Study for North Miami as part of the City of North Miami Stormwater Master Plan.

Figure C-1 - FEMA Transect Location Map

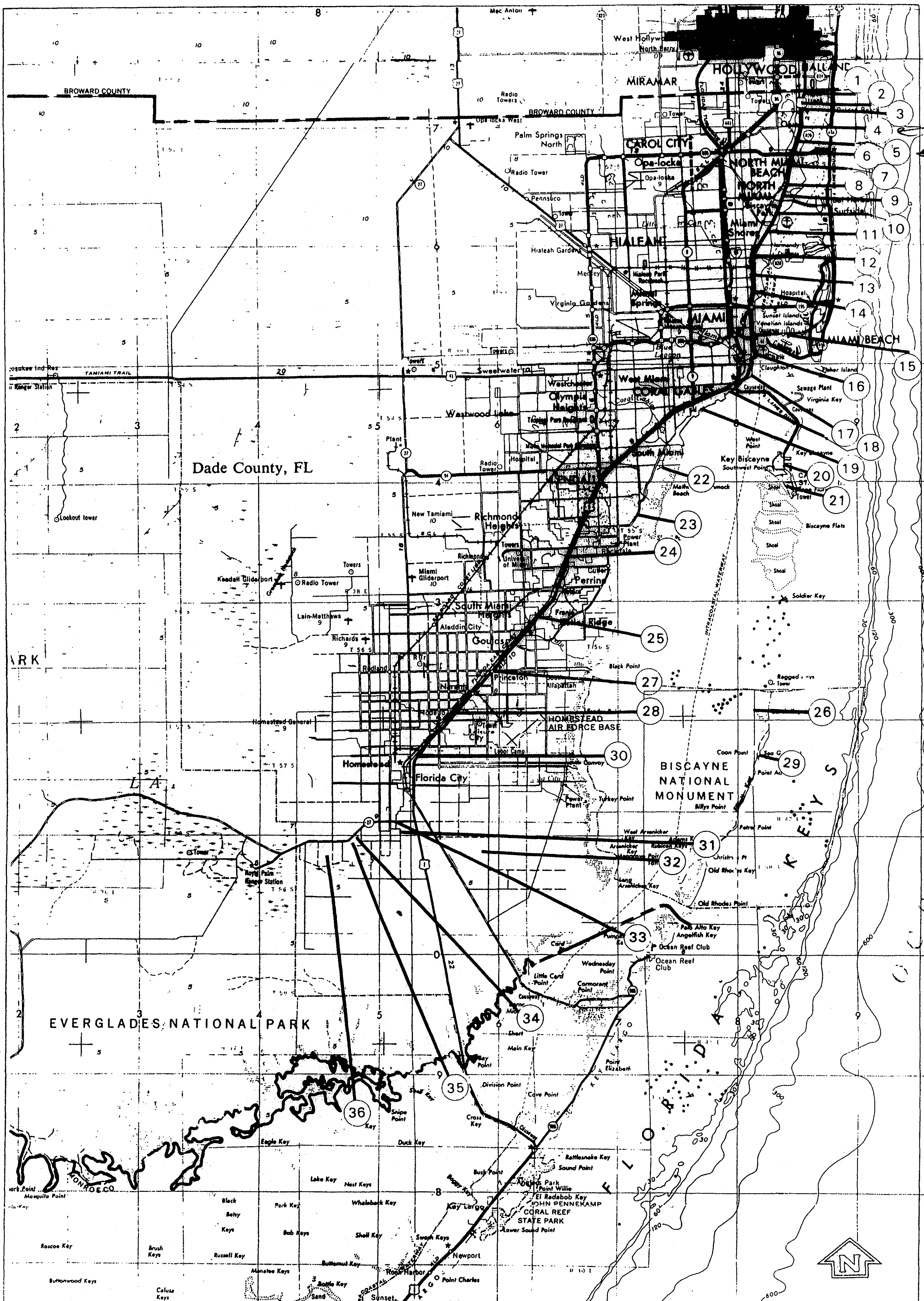


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIAMI-DADE COUNTY, FL AND INCORPORATED AREAS

APPROXIMATE SCALE

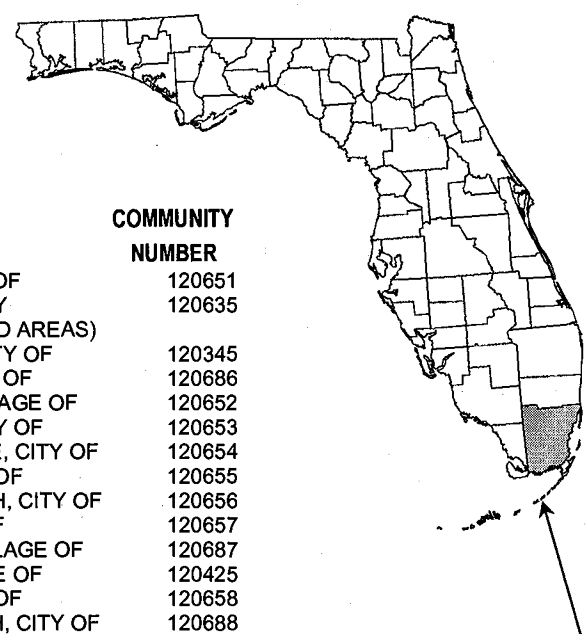
5 0 5 10 15 Miles

TRANSECT LOCATION MAP

FLOOD INSURANCE STUDY

MIAMI-DADE COUNTY, FLORIDA

AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
AVENTURA, CITY OF	120676
BAL HARBOUR VILLAGE, TOWN OF	120636
BAY HARBOR ISLANDS, TOWN OF	120637
BISCAYNE PARK, VILLAGE OF	120638
CORAL GABLES, CITY OF	120639
CUTLER BAY, TOWN OF	120218
DORAL, CITY OF	120041
EL PORTAL, VILLAGE OF	120640
FLORIDA CITY, CITY OF	120641
GOLDEN BEACH, TOWN OF	120642
HIALEAH, CITY OF	120643
HIALEAH GARDENS, CITY OF	120644
HOMESTEAD, CITY OF	120645
INDIAN CREEK VILLAGE, VILLAGE OF	120646
ISLANDIA, CITY OF	120647
KEY BISCAYNE, VILLAGE OF	120648
MEDLEY, TOWN OF	120649
MIAMI, CITY OF	120650

COMMUNITY NAME	COMMUNITY NUMBER
MIAMI BEACH, CITY OF	120651
MIAMI-DADE COUNTY (UNINCORPORATED AREAS)	120635
MIAMI GARDENS, CITY OF	120345
MIAMI LAKES, TOWN OF	120686
MIAMI SHORES, VILLAGE OF	120652
MIAMI SPRINGS, CITY OF	120653
NORTH BAY VILLAGE, CITY OF	120654
NORTH MIAMI, CITY OF	120655
NORTH MIAMI BEACH, CITY OF	120656
OPA-LOCKA, CITY OF	120657
PALMETTO BAY, VILLAGE OF	120687
PINECREST, VILLAGE OF	120425
SOUTH MIAMI, CITY OF	120658
SUNNY ISLES BEACH, CITY OF	120688
SURFSIDE, TOWN OF	120659
SWEETWATER, CITY OF	120660
VIRGINIA GARDENS, VILLAGE OF	120661
[1]WEST MIAMI, CITY OF	120662

[1]Non-Floodprone Community

REVISED:
SEPTEMBER 11, 2009

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
12086CV000A

FLOODING SOURCE AND TRANSECT	FLOOD INSURANCE RATE MAP PANEL	STILLWATER ELEVATIONS (feet NGVD) 10% (10-YEAR)	2% (50-YEAR)	1% (100-YEAR)	0.2% (500-YEAR)	ZONE	BASE FLOOD ELEVATION[1,2] (FEET NGVD)
Atlantic Ocean/ Intracoastal Waterway							
8	143, 144, 163	5.2	6.3	6.8	7.7	VE	9 – 11
		7.0	7.5	7.8	8.7	AE	8 – 10
9	143, 144, 163	5.2	6.4	6.8	7.7	VE	9 – 11
						AE	7 – 9
		6.7	7.5	7.9	8.5	AE	8 – 10
10	143, 144, 163	5.2	6.4	6.9	7.8	VE	9 – 11
						AE	7 – 9
		7.0	7.5	8.9	8.7	AE	9 – 11
11	306, 307, 326	5.2	6.4	6.9	7.8	VE	9 – 11
						AE	7 – 9
		6.8	7.4	8.9	8.4	AE	9 – 11
12	306, 307, 326	5.3	6.5	7.0	7.9	VE	9 – 11
						AE	7 – 9
		7.0	7.5	8.9	8.6	AE	8 – 10
13	306, 309, 328	5.4	6.6	7.1	8.1	VE	9 – 11
						AE	7 – 9
		6.8	7.3	7.6	8.3	AE	8 – 10
14	308, 309, 328	5.4	6.7	7.2	8.1	VE	9 – 11
						AE	7 – 9
		6.6	N/A	7.3	N/A	VE	9 – 10
						AE	7 - 9

[1]Rounded to the nearest foot and may include effects of wave action

[2]Due to map scale limitations, base flood elevations shown on map may represent average elevations for the zones depicted

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIAMI-DADE COUNTY, FL AND INCORPORATED AREAS

SUMMARY OF STILLWATER ELEVATIONS

ATLANTIC OCEAN/INTRACOASTAL WATERWAY

FLOODING SOURCE AND TRANSECT	FLOOD INSURANCE RATE MAP PANEL	STILLWATER ELEVATIONS (feet NGVD) 10% (10-YEAR)	2% (50-YEAR)	1% (100-YEAR)	0.2% (500-YEAR)	ZONE	BASE FLOOD ELEVATION[1,2] (FEET NGVD)
Atlantic Ocean/ Intracoastal Waterway							
15	312, 316, 317	5.4	6.7	7.1	8.1	VE	9 – 11
						AE	7 – 9
		6.8	8.5	9.3	10.2	AE	9 – 11
16	314, 318, 319	6.8	8.5	9.0	10.4	VE	11 – 13
						AE	9 – 11
		7.4	9.2	9.8	11.1	AE	10 – 12
		5.5	6.7	7.2	8.2	VE	9 – 11
						AE	8 – 9
17	318, 481, 482	8.3	10.4	10.9	12.9	VE	13 – 15
						AE	11 – 13
		5.9	7.2	7.8	8.8	VE	11 – 12
						AE	8 – 10
18	477, 481, 482, 484	8.7	10.8	11.5	13.4	VE	14 – 15
						AE	12 – 14
		6.0	7.3	7.8	8.8	VE	10 – 12
						AE	8 – 10
19	477, 483, 484	7.9	9.9	11.4	12.6	VE	13 – 16
						AE	11 – 13
		5.6	6.9	7.3	8.4	VE	9 – 11
						AE	7 – 9
		8.8	10.9	11.5	13.7	AE	12 - 14
		7.4	9.2	9.9	11.5	AE	10 – 12
		6.8	8.5	9.0	10.7	AE	9 - 11

[1]Rounded to the nearest foot and may include effects of wave action

[2]Due to map scale limitations, base flood elevations shown on map may represent average elevations for the zones depicted

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIAMI-DADE COUNTY, FL AND INCORPORATED AREAS

SUMMARY OF STILLWATER ELEVATIONS

ATLANTIC OCEAN/INTRACOASTAL WATERWAY

TABLE 4 – TRANSECT LOCATIONS, STILLWATER STARTING ELEVATIONS, AND INITIAL WAVE CREST ELEVATIONS - continued

		Elevation (Feet)	
Transect	Location	Stillwater	Wave Crest
8	From the Atlantic coastline, approximately 800 feet north of Bakers Haulover cut, westward across the Biscayne Bay floodplain in North Miami	6.8[1] 7.8[2]	10.5[1] 10.1[2]
9	From the Atlantic coastline, approximately 1,350 feet north of intersection of Kane Concourse and Collins Avenue in Bal Harbour, westward across the Biscayne Bay floodplain	6.8[1] 7.9[2]	10.5[1] 10.3[2]
10	From the Atlantic coastline, approximately 400 feet north of intersection of Surfside Boulevard/91st Street and Collins Avenue in Surfside, westward across the Biscayne Bay floodplain	6.9[1] 8.0[2]	10.7[1] 10.9[2]
11	From the Atlantic coastline, approximately 900 feet south of intersection of 85th Street and Collins Avenue in Miami Beach, westward across the Biscayne Bay floodplain	6.9[1] 8.0[2]	10.7[1] 10.9[2]
12	From the Atlantic coastline, approximately 850 feet north of intersection of West 63rd Street and Collins Avenue in Miami Beach, westward across the Indian Creek/Biscayne Bay floodplain	7.0[1] 8.0[2]	10.8[1] 10.1[2]
13	From the Atlantic coastline, approximately 4,900 feet south of intersection of West 63rd Street and Collins Avenue in Miami Beach, westward across the Indian Creek/Biscayne Bay floodplain	7.1[1] 7.6[2]	11.0[1] 9.5[2]
14	From the Atlantic coastline, approximately 800 feet north of intersection of Indian Creek Drive and Arthur Godfrey Road in Miami Beach, westward across the Indian Creek/Biscayne Bay floodplain	7.2[1] 7.3[2]	11.1[1] 10.0[2]
15	From the Atlantic coastline, approximately 1,400 feet south of intersection of Lincoln Road and Collins Avenue in Miami Beach, westward across the Biscayne Bay floodplain	7.1[1] 8.1[2]	11.0[1] 10.7[2]

[1]Atlantic Ocean (Open Coast) [2]Biscayne Bay

Appendix D

SWMM5 Model Validation Results

Table D-1: North Miami SWMM Peak Stage Results for Validation Storm October 3, 2000.

* Denotes that no survey was available and elevation was estimated from LIDAR			Oct 3, 2000 Storm (15.2-inch) Weir Elev = -2.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 1.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 3.4 ft-NAVD		
Node	**Road Crown Location**	**Road Crown Elev. (ft) NAVD**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Validation (Photo) Location Estimation Flood Depth (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**
ACN1-0	NE 151st St & NE 8th Ave *	4.0	5.4	1.4		5.4	1.4	0.0	5.4	1.4	0.0
ACN1-1	NE 146th St & NE 8th Ave	3.5	5.4	1.9		5.4	1.9	0.0	5.4	1.9	0.0
ACN1-2	NE 145th St W of NE 10th Ave	3.5	5.5	2.0		5.5	2.0	0.0	5.5	2.0	0.0
ACN1-3	NE 144th St W of NE 10th Ave	3.3	5.5	2.2		5.5	2.2	0.0	5.5	2.2	0.0
ACN1-4	NE 142nd St & NE 9th Ave	7.2	6.5	-		6.5	-	0.0	6.5	-	0.0
ACN1-4A	NE 143rd St & NE 9th Ave	3.7	5.5	1.8		5.5	1.8	0.0	5.5	1.8	0.0
ACN1-5	NE 143rd St & NE 10th Ave	3.1	5.5	2.4		5.5	2.4	0.0	5.5	2.4	0.0
ACN1-6	NE 145th St & NE 10th Ave	3.4	5.5	2.1		5.5	2.1	0.0	5.5	2.1	0.0
ACN1-7	NE 147th St & NE 11th Ct	3.9	5.5	1.6	1.0	5.5	1.6	0.0	5.5	1.6	0.0
ACN1-8	NE 143rd St & NE 12th Ave	4.2	5.5	1.3		5.5	1.3	0.0	5.5	1.3	0.0
ACN1-9	NE 144th St W of NE 14th Ave	2.5	5.5	3.0		5.5	3.0	0.0	5.5	3.0	0.0
ACN1-10	NE 146th St W of NE 14th Ave	2.5	5.5	3.0		5.5	3.0	0.0	5.5	3.0	0.0
ACN3-6	NE 127th St W of NE 12th Ave	5.2	7.2	2.0		7.2	2.0	0.0	7.2	2.0	0.0
ACS1-1	NE 126th St W of NE 11th Ave	5.7	7.2	1.5		7.2	1.5	0.0	7.2	1.5	0.0
ACS1-2	NE 123rd St W of NE 10th Ave	5.8	6.7	0.9	1.0	6.7	0.9	0.0	6.7	0.9	0.0
ACS1-3	NE 121st St W of NE 11th Ave *	3.8	6.7	2.9	2.0	6.7	2.9	0.0	6.8	3.0	0.0
ACS1-3A	NE 125th St W of NE 11th Ave *	7.2	7.1	-		7.2	-	0.0	7.2	-	0.0
ACS1-4	NE 12th Ave N of NE 124th St *	6.1	7.2	1.1		7.2	1.1	0.0	7.2	1.1	0.0
ACS1-5	NE 13th Ave N of NE 125th St	6.6	7.2	0.6		7.2	0.6	0.0	7.2	0.6	0.0
ACS1-6	NE 125th St E of NE 15th Ave	1.7	2.9	1.2		2.9	1.2	0.0	2.9	1.2	0.0
ACS1-7	NE 121st St & NE 14th Ave *	4.2	5.0	0.8		5.0	0.8	0.0	5.0	0.8	0.0
ACS1-8	NE 124th St W of NE 17th Ave	4.2	4.1	-		4.1	-	0.0	4.1	-	0.0
ACS1-9	NE 15th Ave S of NE 124th St *	4.6	4.0	-		4.0	-	0.0	4.0	-	0.0
ACS2-1	NE 143rd St & NE 16th Ave	4.8	5.0	0.2		5.0	0.2	0.0	5.8	1.0	0.8

Table D-1: North Miami SWMM Peak Stage Results for Validation Storm October 3, 2000.

* Denotes that no survey was available and elevation was estimated from LIDAR			Oct 3, 2000 Storm (15.2-inch) Weir Elev = -2.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 1.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 3.4 ft-NAVD		
Node	**Road Crown Location**	**Road Crown Elev. (ft) NAVD**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Validation (Photo) Location Estimation Flood Depth (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**
ACS2-2	NE 142nd St E of NE 17th Ave	3.6	4.4	0.8		4.4	0.8	0.0	5.8	2.2	1.4
ACS2-3	NE 144th St & NE 18th Ave	4.0	4.7	0.7		4.7	0.7	0.0	5.8	1.8	1.2
ACS2-4	NE 149th St & NE 18th Ave *	6.8	11.1	4.3		11.1	4.3	0.0	11.1	4.3	0.0
ACS2-5	NE 142nd St & NE 18th Ave *	3.6	3.4	-		3.8	0.2	0.4	5.8	2.2	2.4
ACS2-6	NE 144th St & NE 18th Ave	3.9	4.4	0.5		4.4	0.5	0.0	5.8	1.9	1.4
ACS2-7	NE 144th St & NE 15th Ave *	4.0	5.6	1.6		5.6	1.6	0.0	5.8	1.8	0.2
ACS3-1	NE 137th St & NE 12th Ave	6.8	7.7	0.9		7.7	0.9	0.0	7.7	0.9	0.0
ACS3-10	NE 135th St E of NE 16th Ave *	7.3	5.9	-		6.2	-	0.3	6.8	-	0.9
ACS3-2	NE 11th Ave S of NE 133rd St	6.8	7.4	0.6		7.4	0.6	0.0	7.4	0.6	0.0
ACS3-3	NE 13th Ave N of NE 134th St	5.7	7.3	1.6		7.3	1.6	0.0	7.4	1.7	0.1
ACS3-4	NE 138th St W of NE 16th Ave	6.8	7.8	1.0		7.8	1.0	0.0	7.8	1.0	0.0
ACS3-5	NE 132nd St W of NE 14th Ave	4.5	7.3	2.8		7.3	2.8	0.0	7.3	2.8	0.1
ACS3-6	NE 137th St E of NE 16th Ave	3.5	4.4	0.9		4.5	1.0	0.0	5.7	2.2	1.2
ACS3-7	NE 16th Ave N of NE 135th St *	6.7	6.0	-		6.1	-	0.1	6.1	-	0.1
ACS3-8	NE 136th St W of NE 15th Ave	3.3	7.3	4.0		7.3	4.0	0.0	7.4	4.1	0.1
ACS3-8A	NE 137th St & NE 16th Ave	7.2	6.0	-		6.0	-	0.0	6.5	-	0.5
ACS3-9	Unnamed *	3.0	3.3	0.3		3.7	0.7	0.4	5.7	2.7	2.3
ACS4-1	Emerald NE of NE 16th Ave	4.7	4.6	-		4.6	-	0.0	4.6	-	0.0
ACS4-2	17th Ave (Moefeld) N of NE 127th S	3.8	4.3	0.5		4.3	0.5	0.0	4.3	0.5	0.0
ACS5-1	NE 127th St E of 17th Ave (Moefeld)	3.2	4.0	0.8		4.0	0.8	0.0	4.0	0.8	0.0
BE1-1	NE 141st St & NE 4th Ave *	2.3	3.7	1.4	1.5	3.7	1.4	0.0	3.7	1.4	0.0
BE1-2	NE 139th St & NE 4th Ave *	2.4	3.7	1.3		3.7	1.3	0.0	3.7	1.3	0.0
BE1-3	NE 137th St & NE 4th Ave *	3.3	3.3	0.0		3.3	0.0	0.0	3.3	0.0	0.0
BE1-4	NE 6th Ave S of NE 151st St *	5.7	6.2	0.5		6.2	0.5	0.0	6.2	0.5	0.0

Table D-1: North Miami SWMM Peak Stage Results for Validation Storm October 3, 2000.

* Denotes that no survey was available and elevation was estimated from LIDAR			Oct 3, 2000 Storm (15.2-inch) Weir Elev = -2.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 1.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 3.4 ft-NAVD		
Node	**Road Crown Location**	**Road Crown Elev. (ft) NAVD**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Validation (Photo) Location Estimation Flood Depth (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**
BE1-5	NE 6th Ave S of NE 140th St *	9.5	8.8	-		8.8	-	0.0	8.8	-	0.0
BE1-6	NE 138th St & NE 6th Ave *	7.9	7.7	-		7.7	-	0.0	7.7	-	0.0
BE1-7	NE 136th St & NE 6th Ave *	7.6	7.7	0.1		7.7	0.1	0.0	7.7	0.1	0.0
BE1-8	NE 131st St & NE 6th Ave *	7.2	7.4	0.2		7.4	0.2	0.0	7.4	0.2	0.0
BE1-9	NE 127th St & NE 6th Ave *	7.6	5.2	-		5.2	-	0.0	5.2	-	0.0
BE1-10	NE 125th St & NE 3rd Ave *	5.8	5.8	0.0		5.8	0.0	0.0	5.8	0.0	0.0
BE1-11	Dixie Hwy NE of Grieffing *	6.1	2.0	-		2.0	-	0.0	2.0	-	0.0
BE1-12	NE 125th St & NE 9th Ave	7.0	6.6	-		6.6	-	0.0	6.6	-	0.0
BE1-13	NE 125th St & NE 10th Ave *	7.0	7.1	0.1		7.2	0.2	0.0	7.2	0.2	0.0
BE1-14	Dixie Hwy & NE 129th St *	7.1	7.4	0.3		7.4	0.3	0.0	7.4	0.3	0.0
BE1-15	Dixie Hwy & NE 134th St *	7.8	7.9	0.0		7.9	0.0	0.0	7.9	0.0	0.0
BE1-16	NE 135th St & NE 13th Ave *	6.2	7.3	1.1		7.3	1.1	0.0	7.4	1.2	0.1
BE1-17	NE 135th St W of NE 16th Ave *	5.1	7.3	2.2		7.3	2.2	0.0	7.4	2.3	0.1
BE1-18	Dixie Hwy & NE 136th St *	8.7	8.7	-		8.7	-	0.0	8.7	-	0.0
BE1-19	Dixie Hwy & NE 141st St *	9.6	8.6	-		8.6	-	0.0	8.6	-	0.0
BE1-20	Dixie Hwy & NE 145th St *	6.7	5.6	-		5.6	-	0.0	5.8	-	0.1
BE2-1	NE 137th St W of NE 9th Ave	8.3	8.6	0.3		8.6	0.3	0.0	8.6	0.3	0.0
BE2-2	NE 137th St W of NE 9th Ave	8.3	8.4	0.1		8.4	0.1	0.0	8.4	0.1	0.0
BE2-3	NE 135th St & NE 7th Ave *	7.3	7.9	0.6		7.9	0.6	0.0	7.9	0.6	0.0
BE2-4	NE 132nd St E of NE 8th Ave	7.2	7.9	0.7		7.9	0.7	0.0	7.9	0.7	0.0
BE2-4A	NE 135th St & NE 8th Ave *	7.8	8.0	0.2		8.0	0.2	0.0	8.0	0.2	0.0
BE2-5	NE 138th St & NE 7th Ave	7.0	7.8	0.8		7.8	0.8	0.0	7.8	0.8	0.0
BE2-7	NE 132nd St W of NE 7th Ave	7.1	7.9	0.8		7.9	0.8	0.0	7.9	0.8	0.0
BE2-8	NE 132nd St & NE 4th Ave *	5.2	7.3	2.1		7.3	2.1	0.0	7.3	2.1	0.0

Table D-1: North Miami SWMM Peak Stage Results for Validation Storm October 3, 2000.

* Denotes that no survey was available and elevation was estimated from LIDAR			Oct 3, 2000 Storm (15.2-inch) Weir Elev = -2.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 1.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 3.4 ft-NAVD		
Node	**Road Crown Location**	**Road Crown Elev. (ft) NAVD**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Validation (Photo) Location Estimation Flood Depth (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**
BE3-1	NE 129th St & NE 7th Ave	6.0	7.4	1.4		7.4	1.4	0.0	7.4	1.4	0.0
BE3-2	NE 129th St & NE 8th Ave	6.5	7.4	0.9		7.4	0.9	0.0	7.4	0.9	0.0
BE3-3	NE 129th St & NE 11th Ave	6.7	7.4	0.7		7.4	0.7	0.0	7.4	0.7	0.0
BE4-1	NE 127th St W of NE 8th Ave	5.7	7.4	1.7		7.4	1.7	0.0	7.4	1.7	0.0
BE4-2	NE 123rd St & of NE 9th Ave	6.0	6.7	0.7		6.7	0.7	0.0	6.7	0.7	0.0
BE4-3	NE 8th Ave N of NE 121st St	6.0	6.5	0.5		6.5	0.5	0.0	6.5	0.5	0.0
BE4-4	NE 7th Ave N of NE 125th St	6.6	7.1	0.5		7.1	0.5	0.0	7.1	0.5	0.0
BE4-5	NE 124th St & NE 6th Ave	6.0	6.5	0.5		6.5	0.5	0.0	6.5	0.5	0.0
BE4-6	NE 5th Ave N of NE 125th St	6.1	6.5	0.4		6.5	0.4	0.0	6.5	0.4	0.0
BE4-7	NE 4th Ave S of NE 129th St *	6.4	6.6	0.2		6.6	0.2	0.0	6.6	0.2	0.0
BE4-8	NE 3rd Ave S of NE 126th St *	5.7	5.9	0.2		5.9	0.2	0.0	5.9	0.2	0.0
BE4-9	NE 123rd St & Grieffing *	4.9	5.5	0.6		5.5	0.6	0.0	5.5	0.6	0.0
BE5-1	NE 129th St & Grieffiing *	5.3	3.7	-		3.7	-	0.0	3.7	-	0.0
BE6-1	NE 11th Ave S of NE 138th St	8.4	8.5	0.1		8.5	0.1	0.0	8.5	0.1	0.0
BE6-2	NE 138th St E of NE 13th Ave	7.2	8.7	1.5		8.7	1.5	0.0	8.7	1.5	0.0
BE6-3	NE 141st St & NE 14th Ave	6.6	8.6	2.0		8.6	2.0	0.0	8.6	2.0	0.0
BE7-1	NE 3rd Ave S of NE 138th St	2.7	3.2	0.5		3.2	0.5	0.0	3.2	0.5	0.0
BE7-2	NE 2nd Ct S of NE 141st St *	2.8	3.1	0.3		3.1	0.3	0.0	3.1	0.3	0.0
BE7-3	NE 4th Ave S of NE 135th St *	2.5	4.2	1.7		4.2	1.7	0.0	4.2	1.7	0.0
BE7-4	NE 131st St E of Grieffiing *	3.0	3.4	0.4		3.4	0.4	0.0	3.4	0.4	0.0
BE7-5	Grieffiing N of NE 135th St & *	4.2	2.2	-		2.2	-	0.0	2.2	-	0.0
BW1-1A	NW 12th Ave N of NW 133rd St	9.7	10.4	0.7		10.4	0.7	0.0	10.4	0.7	0.0
BW1-1B	NW 132nd St E of NW 16th Ave	10.1	10.4	0.3		10.4	0.3	0.0	10.4	0.3	0.0
BW1-1C	NW 13th Ave N of NW 132nd St	9.5	10.4	0.9		10.4	0.9	0.0	10.4	0.9	0.0

Table D-1: North Miami SWMM Peak Stage Results for Validation Storm October 3, 2000.

* Denotes that no survey was available and elevation was estimated from LIDAR			Oct 3, 2000 Storm (15.2-inch) Weir Elev = -2.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 1.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 3.4 ft-NAVD		
Node	**Road Crown Location**	**Road Crown Elev. (ft) NAVD**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Validation (Photo) Location Estimation Flood Depth (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**
BW1-2	NW 13th Ave N of NW 128th St	9.0	10.4	1.4		10.4	1.4	0.0	10.4	1.4	0.0
BW1-3	NW 130th St E of NW 13th Ave	9.6	10.4	0.8		10.4	0.8	0.0	10.4	0.8	0.0
BW1-4	NW 16th Ave N of NW 123rd St	9.6	10.4	0.8		10.4	0.8	0.0	10.4	0.8	0.0
BW1-5	NW 15th Ave N of NW 127th St	9.2	10.4	1.2		10.4	1.2	0.0	10.4	1.2	0.0
BW1-6	NW 126th St E of NW 15th Ave	8.7	10.4	1.7		10.4	1.7	0.0	10.4	1.7	0.0
BW1-7	NW 121st St & NW 16th Ave	9.8	10.4	0.6		10.4	0.6	0.0	10.4	0.6	0.0
BW1-8	NW 121st St & NW 13th Ave	9.7	10.4	0.7		10.4	0.7	0.0	10.4	0.7	0.0
BW1-9	NW 121st St E of NW 11th Ave	9.0	10.4	1.4		10.4	1.4	0.0	10.4	1.4	0.0
BW1-10	NW 125th St & NW 11th Ave	9.6	10.4	0.8		10.4	0.8	0.0	10.4	0.8	0.0
BW1-10A	NW 12th Ave S of NW 125th St	9.5	10.4	0.9		10.4	0.9	0.0	10.4	0.9	0.0
BW1-11	NW 121st St E of NW 11th Ave	9.3	10.4	1.1		10.4	1.1	0.0	10.4	1.1	0.0
BW1-12	NW 120th St W of NW 11th Ave	9.0	10.4	1.4		10.4	1.4	0.0	10.4	1.4	0.0
BW1-13	NW 126th St E of NW 8th Ave	9.4	10.3	0.9		10.3	0.9	0.0	10.3	0.9	0.0
BW1-13A	NW 125th St E of NW 9th Ave	9.4	10.4	0.9		10.4	0.9	0.0	10.4	0.9	0.0
BW1-14	NW 8th Ave S of NW 122nd St	9.5	10.4	0.9		10.4	0.9	0.0	10.4	0.9	0.0
BW1-15A	NW 122nd St W of NW 7th Ave	9.4	10.3	0.9		10.3	0.9	0.0	10.3	0.9	0.0
BW1-15B	NW 119th St W of NW 10th Ave	10.0	11.7	1.7		11.7	1.7	0.0	11.7	1.7	0.0
BW1-15C	NW 15th Ave S of NW 119th St	9.2	10.6	1.4		10.6	1.4	0.0	10.6	1.4	0.0
BW1-16	NW 4th Ave S of NW 127th St	9.8	10.3	0.4		10.3	0.4	0.0	10.3	0.4	0.0
BW1-17	NW 4th Ave S of NW 121st St	8.8	9.7	0.9		9.7	0.9	0.0	9.7	0.9	0.0
BW1-18	NW 4th Ave N of NW 124th St	8.9	9.5	0.6		9.5	0.6	0.0	9.5	0.6	0.0
BW1-19	NW 125th St W of NW 1st Ave	10.3	7.6	-		7.6	-	0.0	7.6	-	0.0
BW1-19A	NW 1st Ave N of NW 127th St	10.8	11.7	0.9		11.7	0.9	0.0	11.7	0.9	0.0
BW1-20	NW 120th St E of NW 1st Ave	7.6	9.4	1.8		9.4	1.8	0.0	9.4	1.8	0.0

Table D-1: North Miami SWMM Peak Stage Results for Validation Storm October 3, 2000.

* Denotes that no survey was available and elevation was estimated from LIDAR			Oct 3, 2000 Storm (15.2-inch) Weir Elev = -2.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 1.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 3.4 ft-NAVD		
Node	**Road Crown Location**	**Road Crown Elev. (ft) NAVD**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Validation (Photo) Location Estimation Flood Depth (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**
BW1-21	NE 1st Ave S of NE 125th St	3.8	4.4	0.6		4.4	0.6	0.0	4.4	0.6	0.0
BW1-22	NE 123rd Rd W of NE 2nd Ave	3.8	4.6	0.8		4.6	0.8	0.0	4.6	0.8	0.0
BW1-23	Dixie Hwy NE of NE 119th St *	6.1	1.0	-		1.0	-	0.0	1.0	-	0.0
BW2-1A	NW 134th St W of NW 11th Ave	9.3	10.4	1.1		10.4	1.1	0.0	10.4	1.1	0.0
BW2-1B	NW 131st St W of NW 10th Ave	9.2	10.3	1.1		10.3	1.1	0.0	10.3	1.1	0.0
BW2-2	NW 134th St E of NW 8th Ave	9.0	10.3	1.3		10.3	1.3	0.0	10.3	1.3	0.0
BW2-3	NW 131st St W of NW 8th Ave	9.0	10.3	1.3		10.3	1.3	0.0	10.3	1.3	0.0
BW2-4A	NW 8th Ave S of NW 128th St	9.0	10.3	1.3		10.3	1.3	0.0	10.3	1.3	0.0
BW2-4B	NW 128th St W of NW 10th Ave	8.9	10.4	1.5		10.4	1.5	0.0	10.4	1.5	0.0
BW2-4C	NW 129th St E of NW 11th Ave	9.4	10.4	1.0		10.4	1.0	0.0	10.4	1.0	0.0
BW2-5	NW 6th Ave S of NW 130th St	9.0	10.3	1.3		10.3	1.3	0.0	10.3	1.3	0.0
BW2-6	NW 131st St W of NW 5th Ave	9.0	10.2	1.2		10.2	1.2	0.0	10.2	1.2	0.0
BW2-7	NW 5th Ave S of NW 129th St	9.5	10.3	0.8		10.3	0.8	0.0	10.3	0.8	0.0
BW2-8	NW 133rd St W of NW 2nd Ave	10.1	10.8	0.7		10.8	0.7	0.0	10.8	0.7	0.0
BW2-9	NW 130th St W of NW 2nd Ave	9.7	10.3	0.6		10.3	0.6	0.0	10.3	0.6	0.0
BW2-10	NW 132nd St W of NW 2nd Ave	9.8	8.3	-		8.3	-	0.0	8.3	-	0.0
BW2-11	NE 130th St W of NE 2nd Ave	3.9	4.1	0.2		4.1	0.2	0.0	4.1	0.2	0.0
BW3-1A	NW 6th Ave S of NW 137th St *	9.8	10.3	0.5		10.3	0.5	0.0	10.3	0.5	0.0
BW3-1B	NW 7th Ave S of NW 140th St *	11.4	12.6	1.2		12.6	1.2	0.0	12.6	1.2	0.0
BW3-1C	NW 6th Ave S of NW 135th St	8.9	10.3	1.4		10.3	1.4	0.0	10.3	1.4	0.0
BW3-1D	NW 135th St W of NW 8th Ave *	9.4	10.3	0.9		10.3	0.9	0.0	10.3	0.9	0.0
BW3-1E	NW 135th St & NW 13th Ave *	9.2	10.4	1.2		10.4	1.2	0.0	10.4	1.2	0.0
BW3-1F	NW 135th St W of NW 15th Ave *	10.0	10.4	0.4		10.4	0.4	0.0	10.4	0.4	0.0
BW3-1G	NW 135th St W of NW 18th Ave *	9.5	9.8	0.3		9.8	0.3	0.0	9.8	0.3	0.0

Table D-1: North Miami SWMM Peak Stage Results for Validation Storm October 3, 2000.

* Denotes that no survey was available and elevation was estimated from LIDAR			Oct 3, 2000 Storm (15.2-inch) Weir Elev = -2.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 1.0 ft-NAVD			Oct 3, 2000 Storm (15.2-inch) Weir Elev = 3.4 ft-NAVD		
Node	**Road Crown Location**	**Road Crown Elev. (ft) NAVD**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Validation (Photo) Location Estimation Flood Depth (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**	**Oct 3, 2000 No Name Storm Peak Stage (ft) NAVD**	**Model Flood Depth (ft)**	**Diff in Peak Stage (ft)**
BW3-1H	NW 17th Ave S of NW 130th St *	9.5	10.6	1.1		10.6	1.1	0.0	10.6	1.1	0.0
BW3-1I	NW 17th Ave S of NW 123rd St *	9.2	10.6	1.4		10.6	1.4	0.0	10.6	1.4	0.0
BW3-2	NW 5th Ave S of NW 137th St *	10.4	10.5	0.1		10.5	0.1	0.0	10.5	0.1	0.0
BW3-2A	NW 135th St W of NW 5th Ave *	10.3	10.2	-		10.2	-	0.0	10.2	-	0.0
BW3-3A	NE 2nd Ave S of NE 135th St	2.7	3.6	0.9		3.6	0.9	0.0	3.6	0.9	0.0
BW3-3B	NE 139th St W of Biscayne Riv Dr *	2.7	3.6	0.9		3.6	0.9	0.0	3.6	0.9	0.0
BW3-4	Miami Ave S of NE 135th St	5.5	5.5	0.0		5.5	0.0	0.0	5.5	0.0	0.0
BW3-4B	NE 1st Ave N of NE 135th St *	2.5	3.6	1.1		3.6	1.1	0.0	3.6	1.1	0.0
BW4-1	NE 133rd St W of NE 2nd Ave	3.5	3.6	0.1		3.6	0.1	0.0	3.6	0.1	0.0
BW5-1	NE 127th St & NE 1st Ave	3.5	4.4	0.9		4.4	0.9	0.0	4.4	0.9	0.0
BW6-1	NE 2nd Ave N of NE 121st St	4.5	5.2	0.7		5.2	0.7	0.0	5.2	0.7	0.0

Appendix E

SFWMD Rainfall Distributions

Figure E-3: SFWMD 10-Year, 72-Hour Design Storm (9.9-inch)

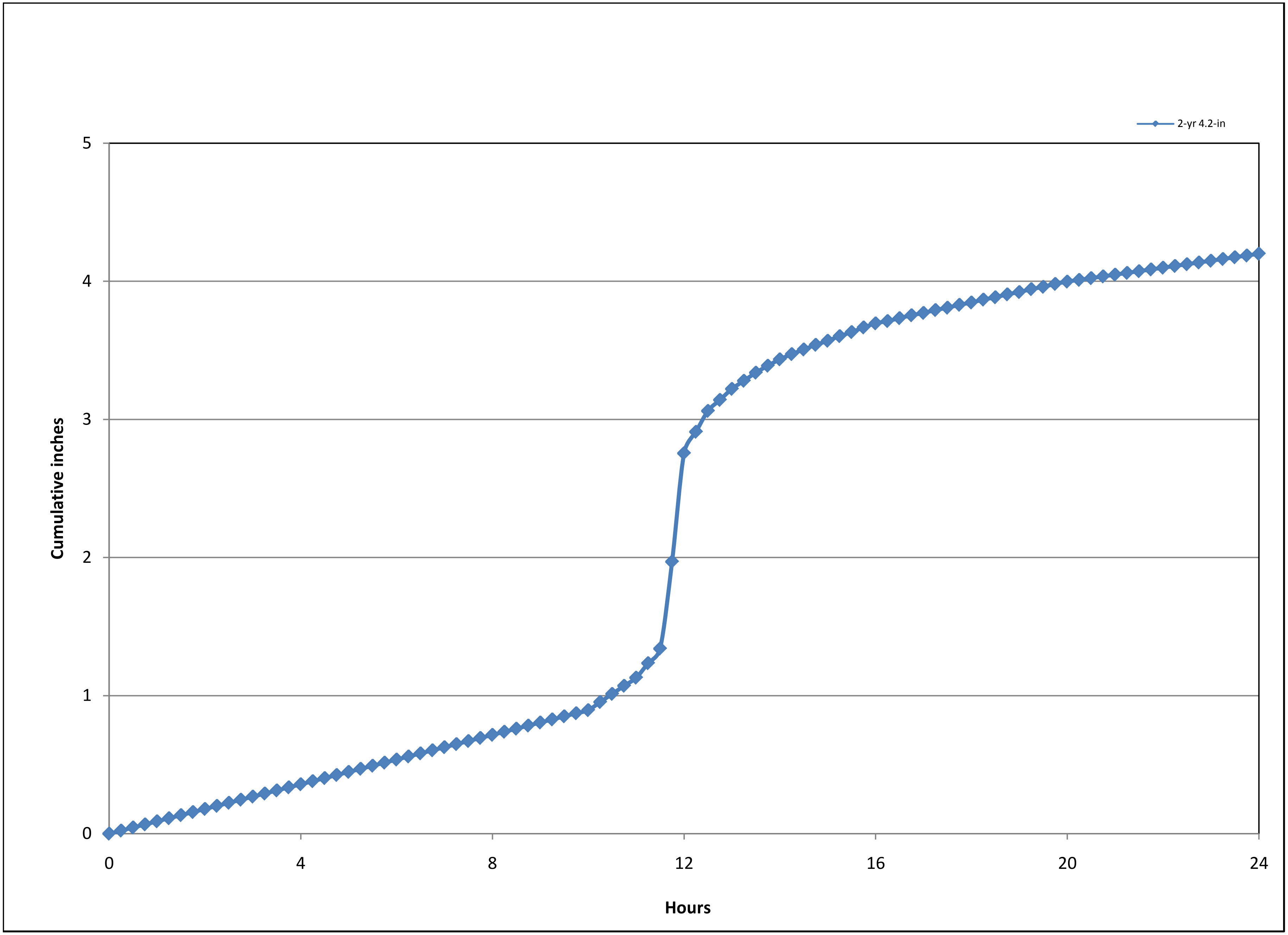


Figure E-3: SFWMD 10-Year, 72-Hour Design Storm (9.9-inch)

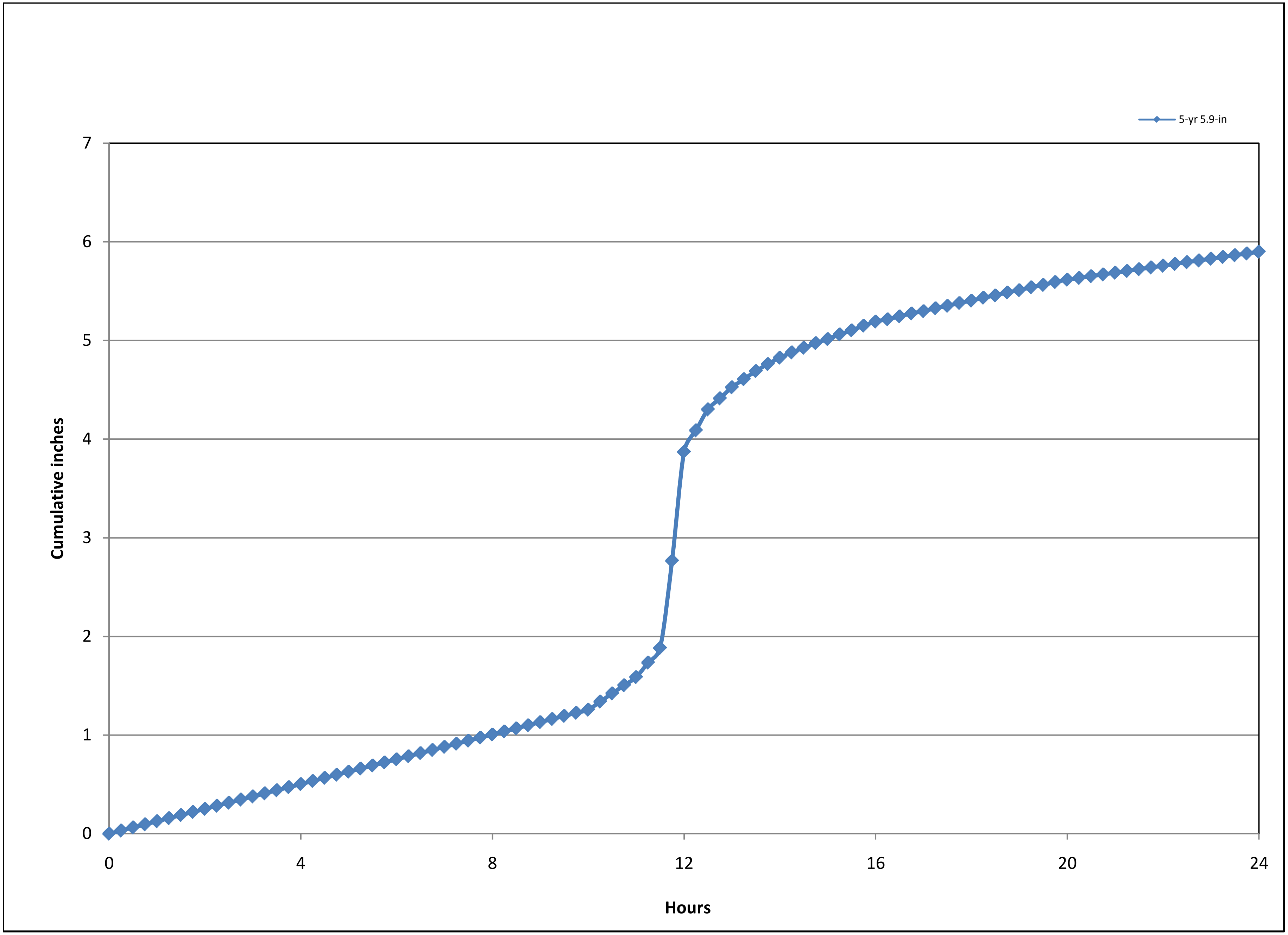


Figure E-3: SFWMD 10-Year, 72-Hour Design Storm (9.9-inch)

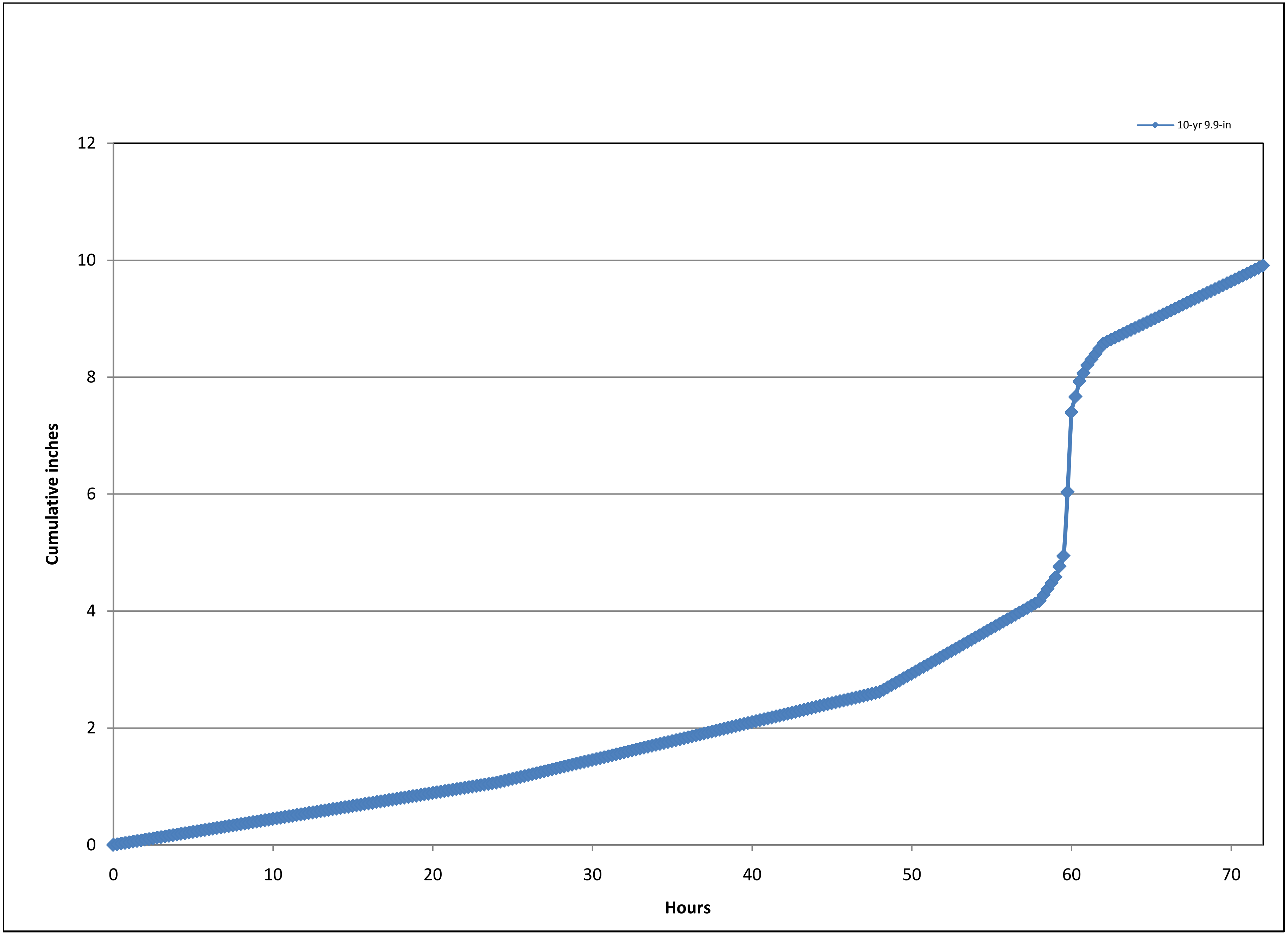


Figure E-3: SFWMD 10-Year, 72-Hour Design Storm (9.9-inch)

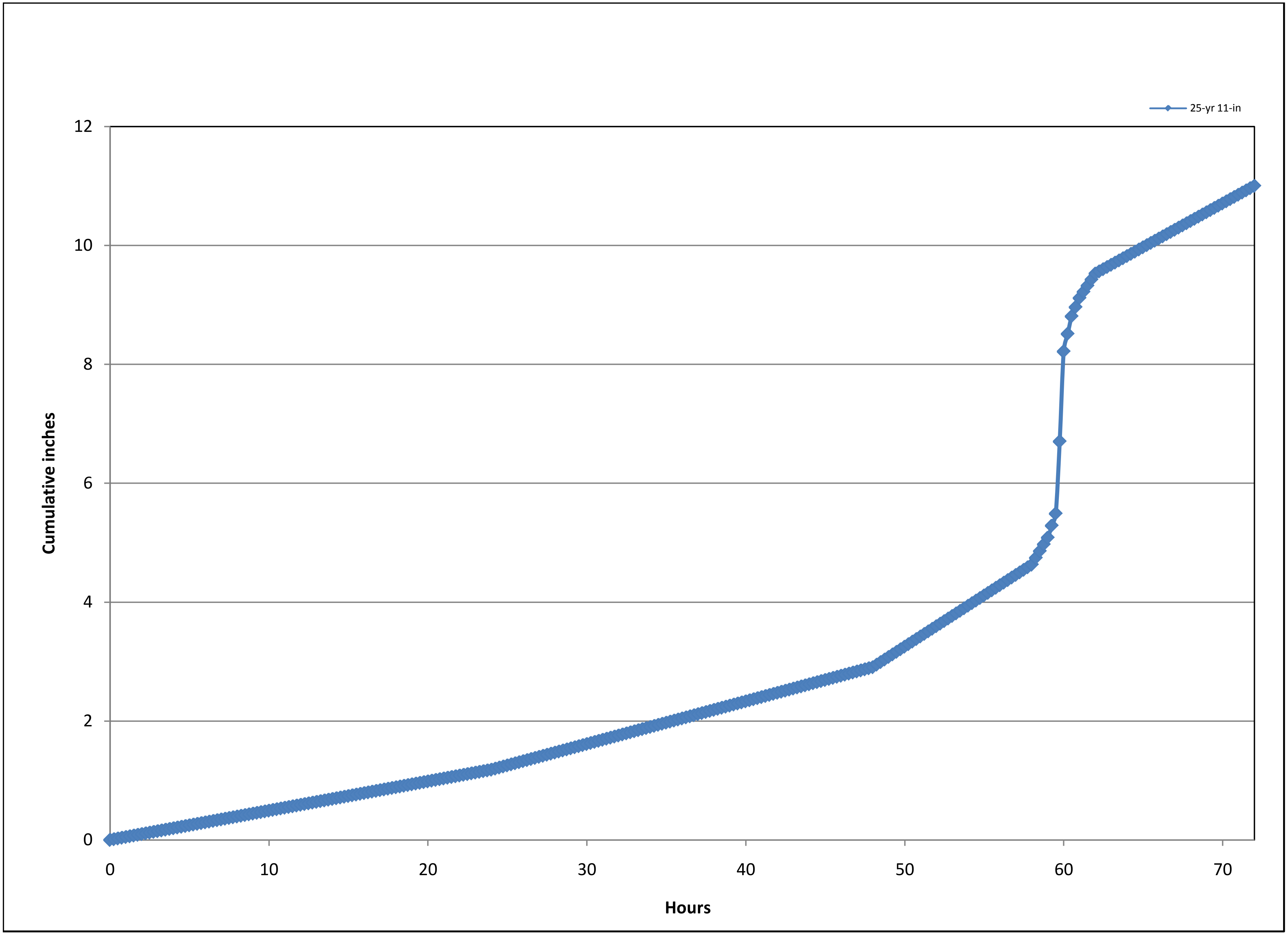
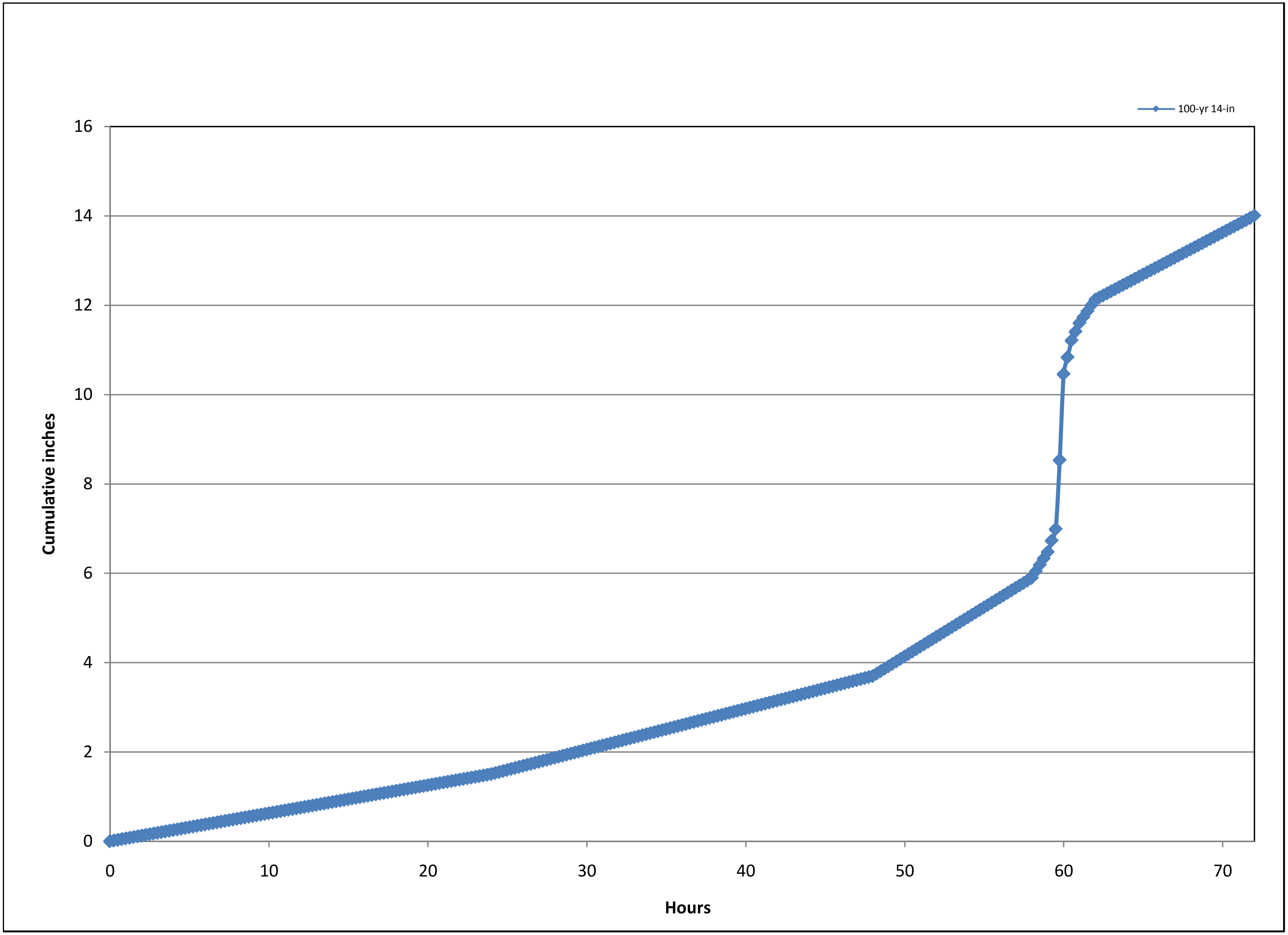


Figure E-3: SFWMD 10-Year, 72-Hour Design Storm (9.9-inch)



SFWMD Unit Hydrographs
24-Hour
Sum 1.0

Time	Distribution
0:00	0.005325
0:15	0.005325
0:30	0.005325
0:45	0.005325
1:00	0.005325
1:15	0.005325
1:30	0.005325
1:45	0.005325
2:00	0.005325
2:15	0.005325
2:30	0.005325
2:45	0.005325
3:00	0.005325
3:15	0.005325
3:30	0.005325
3:45	0.005325
4:00	0.005325
4:15	0.005325
4:30	0.005325
4:45	0.005325
5:00	0.005325
5:15	0.005325
5:30	0.005325
5:45	0.005325
6:00	0.005325
6:15	0.005325
6:30	0.005325
6:45	0.005325
7:00	0.005325
7:15	0.005325
7:30	0.005325
7:45	0.005325
8:00	0.005325
8:15	0.005325
8:30	0.005325
8:45	0.005325
9:00	0.005325
9:15	0.005325
9:30	0.005325
9:45	0.005325
10:00	0.014000
10:15	0.014000
10:30	0.014000
10:45	0.014000
11:00	0.025000
11:15	0.025000
11:30	0.150000

24-hour depth **4.2 in**
24 peak int **0.6 in/hr**

SFWMD Hydrographs
2- yr 24-Hour 4.2 inch
Sum = 4.2

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
0.00	0:00	0.02237	0.000
0.25	0:15	0.02237	0.022
0.50	0:30	0.02237	0.045
0.75	0:45	0.02237	0.067
1.00	1:00	0.02237	0.089
1.25	1:15	0.02237	0.112
1.50	1:30	0.02237	0.134
1.75	1:45	0.02237	0.157
2.00	2:00	0.02237	0.179
2.25	2:15	0.02237	0.201
2.50	2:30	0.02237	0.224
2.75	2:45	0.02237	0.246
3.00	3:00	0.02237	0.268
3.25	3:15	0.02237	0.291
3.50	3:30	0.02237	0.313
3.75	3:45	0.02237	0.335
4.00	4:00	0.02237	0.358
4.25	4:15	0.02237	0.380
4.50	4:30	0.02237	0.403
4.75	4:45	0.02237	0.425
5.00	5:00	0.02237	0.447
5.25	5:15	0.02237	0.470
5.50	5:30	0.02237	0.492
5.75	5:45	0.02237	0.514
6.00	6:00	0.02237	0.537
6.25	6:15	0.02237	0.559
6.50	6:30	0.02237	0.581
6.75	6:45	0.02237	0.604
7.00	7:00	0.02237	0.626
7.25	7:15	0.02237	0.649
7.50	7:30	0.02237	0.671
7.75	7:45	0.02237	0.693
8.00	8:00	0.02237	0.716
8.25	8:15	0.02237	0.738
8.50	8:30	0.02237	0.760
8.75	8:45	0.02237	0.783
9.00	9:00	0.02237	0.805
9.25	9:15	0.02237	0.828
9.50	9:30	0.02237	0.850
9.75	9:45	0.02237	0.872
10.00	10:00	0.05880	0.895
10.25	10:15	0.05880	0.953
10.50	10:30	0.05880	1.012
10.75	10:45	0.05880	1.071
11.00	11:00	0.10500	1.130
11.25	11:15	0.10500	1.235
11.50	11:30	0.63000	1.340

25-yr 72-hr storm = 14.5"

Time	Distribution
11:45	0.187000
12:00	0.037000
12:15	0.036000
12:30	0.019000
12:45	0.019000
13:00	0.014000
13:15	0.014000
13:30	0.012000
13:45	0.011000
14:00	0.009000
14:15	0.008000
14:30	0.008000
14:45	0.007000
15:00	0.008000
15:15	0.007000
15:30	0.008000
15:45	0.007000
16:00	0.004000
16:15	0.005000
16:30	0.005000
16:45	0.004000
17:00	0.005000
17:15	0.004000
17:30	0.005000
17:45	0.004000
18:00	0.005000
18:15	0.004000
18:30	0.005000
18:45	0.004000
19:00	0.005000
19:15	0.004000
19:30	0.005000
19:45	0.004000
20:00	0.003000
20:15	0.003000
20:30	0.003000
20:45	0.003000
21:00	0.003000
21:15	0.003000
21:30	0.003000
21:45	0.003000
22:00	0.003000
22:15	0.003000
22:30	0.003000
22:45	0.003000
23:00	0.003000
23:15	0.003000
23:30	0.003000
23:45	0.003000
0:00	0.000000

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
11.75	11:45	0.78540	1.970
12.00	12:00	0.15540	2.755
12.25	12:15	0.15120	2.911
12.50	12:30	0.07980	3.062
12.75	12:45	0.07980	3.142
13.00	13:00	0.05880	3.221
13.25	13:15	0.05880	3.280
13.50	13:30	0.05040	3.339
13.75	13:45	0.04620	3.389
14.00	14:00	0.03780	3.436
14.25	14:15	0.03360	3.473
14.50	14:30	0.03360	3.507
14.75	14:45	0.02940	3.541
15.00	15:00	0.03360	3.570
15.25	15:15	0.02940	3.604
15.50	15:30	0.03360	3.633
15.75	15:45	0.02940	3.667
16.00	16:00	0.01680	3.696
16.25	16:15	0.02100	3.713
16.50	16:30	0.02100	3.734
16.75	16:45	0.01680	3.755
17.00	17:00	0.02100	3.772
17.25	17:15	0.01680	3.793
17.50	17:30	0.02100	3.809
17.75	17:45	0.01680	3.830
18.00	18:00	0.02100	3.847
18.25	18:15	0.01680	3.868
18.50	18:30	0.02100	3.885
18.75	18:45	0.01680	3.906
19.00	19:00	0.02100	3.923
19.25	19:15	0.01680	3.944
19.50	19:30	0.02100	3.961
19.75	19:45	0.01680	3.982
20.00	20:00	0.01260	3.998
20.25	20:15	0.01260	4.011
20.50	20:30	0.01260	4.024
20.75	20:45	0.01260	4.036
21.00	21:00	0.01260	4.049
21.25	21:15	0.01260	4.061
21.50	21:30	0.01260	4.074
21.75	21:45	0.01260	4.087
22.00	22:00	0.01260	4.099
22.25	22:15	0.01260	4.112
22.50	22:30	0.01260	4.124
22.75	22:45	0.01260	4.137
23.00	23:00	0.01260	4.150
23.25	23:15	0.01260	4.162
23.50	23:30	0.01260	4.175
23.75	23:45	0.01260	4.187
24.00	0:00	0.00000	4.200

25-yr 72-hr storm = 14.5"

SFWMD Unit Hydrographs
24-Hour
Sum 1.0

Time	Distribution
0:00	0.005325
0:15	0.005325
0:30	0.005325
0:45	0.005325
1:00	0.005325
1:15	0.005325
1:30	0.005325
1:45	0.005325
2:00	0.005325
2:15	0.005325
2:30	0.005325
2:45	0.005325
3:00	0.005325
3:15	0.005325
3:30	0.005325
3:45	0.005325
4:00	0.005325
4:15	0.005325
4:30	0.005325
4:45	0.005325
5:00	0.005325
5:15	0.005325
5:30	0.005325
5:45	0.005325
6:00	0.005325
6:15	0.005325
6:30	0.005325
6:45	0.005325
7:00	0.005325
7:15	0.005325
7:30	0.005325
7:45	0.005325
8:00	0.005325
8:15	0.005325
8:30	0.005325
8:45	0.005325
9:00	0.005325
9:15	0.005325
9:30	0.005325
9:45	0.005325
10:00	0.014000
10:15	0.014000
10:30	0.014000
10:45	0.014000
11:00	0.025000
11:15	0.025000
11:30	0.150000

24-hour depth **5.9 in**
24 peak int **4.4 in/hr**

SFWMD Hydrographs
2- yr 24-Hour 5 inch
Sum = 5.9

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
0.00	0:00	0.03142	0.000
0.25	0:15	0.03142	0.031
0.50	0:30	0.03142	0.063
0.75	0:45	0.03142	0.094
1.00	1:00	0.03142	0.126
1.25	1:15	0.03142	0.157
1.50	1:30	0.03142	0.189
1.75	1:45	0.03142	0.220
2.00	2:00	0.03142	0.251
2.25	2:15	0.03142	0.283
2.50	2:30	0.03142	0.314
2.75	2:45	0.03142	0.346
3.00	3:00	0.03142	0.377
3.25	3:15	0.03142	0.408
3.50	3:30	0.03142	0.440
3.75	3:45	0.03142	0.471
4.00	4:00	0.03142	0.503
4.25	4:15	0.03142	0.534
4.50	4:30	0.03142	0.566
4.75	4:45	0.03142	0.597
5.00	5:00	0.03142	0.628
5.25	5:15	0.03142	0.660
5.50	5:30	0.03142	0.691
5.75	5:45	0.03142	0.723
6.00	6:00	0.03142	0.754
6.25	6:15	0.03142	0.785
6.50	6:30	0.03142	0.817
6.75	6:45	0.03142	0.848
7.00	7:00	0.03142	0.880
7.25	7:15	0.03142	0.911
7.50	7:30	0.03142	0.943
7.75	7:45	0.03142	0.974
8.00	8:00	0.03142	1.005
8.25	8:15	0.03142	1.037
8.50	8:30	0.03142	1.068
8.75	8:45	0.03142	1.100
9.00	9:00	0.03142	1.131
9.25	9:15	0.03142	1.162
9.50	9:30	0.03142	1.194
9.75	9:45	0.03142	1.225
10.00	10:00	0.08260	1.257
10.25	10:15	0.08260	1.339
10.50	10:30	0.08260	1.422
10.75	10:45	0.08260	1.505
11.00	11:00	0.14750	1.587
11.25	11:15	0.14750	1.735
11.50	11:30	0.88500	1.882

25-yr 72-hr storm = 14.5"

Time	Distribution
11:45	0.187000
12:00	0.037000
12:15	0.036000
12:30	0.019000
12:45	0.019000
13:00	0.014000
13:15	0.014000
13:30	0.012000
13:45	0.011000
14:00	0.009000
14:15	0.008000
14:30	0.008000
14:45	0.007000
15:00	0.008000
15:15	0.007000
15:30	0.008000
15:45	0.007000
16:00	0.004000
16:15	0.005000
16:30	0.005000
16:45	0.004000
17:00	0.005000
17:15	0.004000
17:30	0.005000
17:45	0.004000
18:00	0.005000
18:15	0.004000
18:30	0.005000
18:45	0.004000
19:00	0.005000
19:15	0.004000
19:30	0.005000
19:45	0.004000
20:00	0.003000
20:15	0.003000
20:30	0.003000
20:45	0.003000
21:00	0.003000
21:15	0.003000
21:30	0.003000
21:45	0.003000
22:00	0.003000
22:15	0.003000
22:30	0.003000
22:45	0.003000
23:00	0.003000
23:15	0.003000
23:30	0.003000
23:45	0.003000
0:00	0.000000

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
11.75	11:45	1.10330	2.767
12.00	12:00	0.21830	3.870
12.25	12:15	0.21240	4.089
12.50	12:30	0.11210	4.301
12.75	12:45	0.11210	4.413
13.00	13:00	0.08260	4.525
13.25	13:15	0.08260	4.608
13.50	13:30	0.07080	4.691
13.75	13:45	0.06490	4.761
14.00	14:00	0.05310	4.826
14.25	14:15	0.04720	4.879
14.50	14:30	0.04720	4.927
14.75	14:45	0.04130	4.974
15.00	15:00	0.04720	5.015
15.25	15:15	0.04130	5.062
15.50	15:30	0.04720	5.104
15.75	15:45	0.04130	5.151
16.00	16:00	0.02360	5.192
16.25	16:15	0.02950	5.216
16.50	16:30	0.02950	5.245
16.75	16:45	0.02360	5.275
17.00	17:00	0.02950	5.298
17.25	17:15	0.02360	5.328
17.50	17:30	0.02950	5.351
17.75	17:45	0.02360	5.381
18.00	18:00	0.02950	5.404
18.25	18:15	0.02360	5.434
18.50	18:30	0.02950	5.458
18.75	18:45	0.02360	5.487
19.00	19:00	0.02950	5.511
19.25	19:15	0.02360	5.540
19.50	19:30	0.02950	5.564
19.75	19:45	0.02360	5.593
20.00	20:00	0.01770	5.617
20.25	20:15	0.01770	5.635
20.50	20:30	0.01770	5.652
20.75	20:45	0.01770	5.670
21.00	21:00	0.01770	5.688
21.25	21:15	0.01770	5.705
21.50	21:30	0.01770	5.723
21.75	21:45	0.01770	5.741
22.00	22:00	0.01770	5.758
22.25	22:15	0.01770	5.776
22.50	22:30	0.01770	5.794
22.75	22:45	0.01770	5.811
23.00	23:00	0.01770	5.829
23.25	23:15	0.01770	5.847
23.50	23:30	0.01770	5.865
23.75	23:45	0.01770	5.882
24.00	0:00	0.00000	5.900

25-yr 72-hr storm = 14.5"

SFWMD Unit Hydrographs
24-Hour
Sum 1.0

Time	Distribution
0:00	0.005325
0:15	0.005325
0:30	0.005325
0:45	0.005325
1:00	0.005325
1:15	0.005325
1:30	0.005325
1:45	0.005325
2:00	0.005325
2:15	0.005325
2:30	0.005325
2:45	0.005325
3:00	0.005325
3:15	0.005325
3:30	0.005325
3:45	0.005325
4:00	0.005325
4:15	0.005325
4:30	0.005325
4:45	0.005325
5:00	0.005325
5:15	0.005325
5:30	0.005325
5:45	0.005325
6:00	0.005325
6:15	0.005325
6:30	0.005325
6:45	0.005325
7:00	0.005325
7:15	0.005325
7:30	0.005325
7:45	0.005325
8:00	0.005325
8:15	0.005325
8:30	0.005325
8:45	0.005325
9:00	0.005325
9:15	0.005325
9:30	0.005325
9:45	0.005325
10:00	0.014000
10:15	0.014000
10:30	0.014000
10:45	0.014000
11:00	0.025000
11:15	0.025000
11:30	0.150000

24-hour depth **7.5 in**
24 peak int **5.6 in/hr**

SFWMD Hydrographs
5- yr 24-Hour 7.5 inch
Sum = 7.5

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
0.00	0:00	0.03994	0.000
0.25	0:15	0.03994	0.040
0.50	0:30	0.03994	0.080
0.75	0:45	0.03994	0.120
1.00	1:00	0.03994	0.160
1.25	1:15	0.03994	0.200
1.50	1:30	0.03994	0.240
1.75	1:45	0.03994	0.280
2.00	2:00	0.03994	0.320
2.25	2:15	0.03994	0.359
2.50	2:30	0.03994	0.399
2.75	2:45	0.03994	0.439
3.00	3:00	0.03994	0.479
3.25	3:15	0.03994	0.519
3.50	3:30	0.03994	0.559
3.75	3:45	0.03994	0.599
4.00	4:00	0.03994	0.639
4.25	4:15	0.03994	0.679
4.50	4:30	0.03994	0.719
4.75	4:45	0.03994	0.759
5.00	5:00	0.03994	0.799
5.25	5:15	0.03994	0.839
5.50	5:30	0.03994	0.879
5.75	5:45	0.03994	0.919
6.00	6:00	0.03994	0.959
6.25	6:15	0.03994	0.998
6.50	6:30	0.03994	1.038
6.75	6:45	0.03994	1.078
7.00	7:00	0.03994	1.118
7.25	7:15	0.03994	1.158
7.50	7:30	0.03994	1.198
7.75	7:45	0.03994	1.238
8.00	8:00	0.03994	1.278
8.25	8:15	0.03994	1.318
8.50	8:30	0.03994	1.358
8.75	8:45	0.03994	1.398
9.00	9:00	0.03994	1.438
9.25	9:15	0.03994	1.478
9.50	9:30	0.03994	1.518
9.75	9:45	0.03994	1.558
10.00	10:00	0.10500	1.598
10.25	10:15	0.10500	1.703
10.50	10:30	0.10500	1.808
10.75	10:45	0.10500	1.913
11.00	11:00	0.18750	2.018
11.25	11:15	0.18750	2.205
11.50	11:30	1.12500	2.393

25-yr 72-hr storm = 14.5"

Time	Distribution
11:45	0.187000
12:00	0.037000
12:15	0.036000
12:30	0.019000
12:45	0.019000
13:00	0.014000
13:15	0.014000
13:30	0.012000
13:45	0.011000
14:00	0.009000
14:15	0.008000
14:30	0.008000
14:45	0.007000
15:00	0.008000
15:15	0.007000
15:30	0.008000
15:45	0.007000
16:00	0.004000
16:15	0.005000
16:30	0.005000
16:45	0.004000
17:00	0.005000
17:15	0.004000
17:30	0.005000
17:45	0.004000
18:00	0.005000
18:15	0.004000
18:30	0.005000
18:45	0.004000
19:00	0.005000
19:15	0.004000
19:30	0.005000
19:45	0.004000
20:00	0.003000
20:15	0.003000
20:30	0.003000
20:45	0.003000
21:00	0.003000
21:15	0.003000
21:30	0.003000
21:45	0.003000
22:00	0.003000
22:15	0.003000
22:30	0.003000
22:45	0.003000
23:00	0.003000
23:15	0.003000
23:30	0.003000
23:45	0.003000
0:00	0.000000

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
11.75	11:45	1.40250	3.518
12.00	12:00	0.27750	4.920
12.25	12:15	0.27000	5.198
12.50	12:30	0.14250	5.468
12.75	12:45	0.14250	5.610
13.00	13:00	0.10500	5.753
13.25	13:15	0.10500	5.858
13.50	13:30	0.09000	5.963
13.75	13:45	0.08250	6.053
14.00	14:00	0.06750	6.135
14.25	14:15	0.06000	6.203
14.50	14:30	0.06000	6.263
14.75	14:45	0.05250	6.323
15.00	15:00	0.06000	6.375
15.25	15:15	0.05250	6.435
15.50	15:30	0.06000	6.488
15.75	15:45	0.05250	6.548
16.00	16:00	0.03000	6.600
16.25	16:15	0.03750	6.630
16.50	16:30	0.03750	6.668
16.75	16:45	0.03000	6.705
17.00	17:00	0.03750	6.735
17.25	17:15	0.03000	6.773
17.50	17:30	0.03750	6.803
17.75	17:45	0.03000	6.840
18.00	18:00	0.03750	6.870
18.25	18:15	0.03000	6.908
18.50	18:30	0.03750	6.938
18.75	18:45	0.03000	6.975
19.00	19:00	0.03750	7.005
19.25	19:15	0.03000	7.043
19.50	19:30	0.03750	7.073
19.75	19:45	0.03000	7.110
20.00	20:00	0.02250	7.140
20.25	20:15	0.02250	7.163
20.50	20:30	0.02250	7.185
20.75	20:45	0.02250	7.208
21.00	21:00	0.02250	7.230
21.25	21:15	0.02250	7.253
21.50	21:30	0.02250	7.275
21.75	21:45	0.02250	7.298
22.00	22:00	0.02250	7.320
22.25	22:15	0.02250	7.343
22.50	22:30	0.02250	7.365
22.75	22:45	0.02250	7.388
23.00	23:00	0.02250	7.410
23.25	23:15	0.02250	7.433
23.50	23:30	0.02250	7.455
23.75	23:45	0.02250	7.478
24.00	0:00	0.00000	7.500

25-yr 72-hr storm = 14.5"

SFWMD Unit Hydrographs
72-Hour
Sum 1.359

Time	Distribution
0:00	0.001521
0:15	0.001521
0:30	0.001521
0:45	0.001521
1:00	0.001521
1:15	0.001521
1:30	0.001521
1:45	0.001521
2:00	0.001521
2:15	0.001521
2:30	0.001521
2:45	0.001521
3:00	0.001521
3:15	0.001521
3:30	0.001521
3:45	0.001521
4:00	0.001521
4:15	0.001521
4:30	0.001521
4:45	0.001521
5:00	0.001521
5:15	0.001521
5:30	0.001521
5:45	0.001521
6:00	0.001521
6:15	0.001521
6:30	0.001521
6:45	0.001521
7:00	0.001521
7:15	0.001521
7:30	0.001521
7:45	0.001521
8:00	0.001521
8:15	0.001521
8:30	0.001521
8:45	0.001521
9:00	0.001521
9:15	0.001521
9:30	0.001521
9:45	0.001521
10:00	0.001521
10:15	0.001521
10:30	0.001521
10:45	0.001521
11:00	0.001521
11:15	0.001521
11:30	0.001521

72-hour depth **9.9 in**
72 peak int **5.4 in/hr**

SFWMD Hydrographs
25 yr 72-Hour 14.5 inch
Sum = 9.9

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
0.00	0:00	0.011079	0.000
0.25	0:15	0.011079	0.011
0.50	0:30	0.011079	0.022
0.75	0:45	0.011079	0.033
1.00	1:00	0.011079	0.044
1.25	1:15	0.011079	0.055
1.50	1:30	0.011079	0.066
1.75	1:45	0.011079	0.078
2.00	2:00	0.011079	0.089
2.25	2:15	0.011079	0.100
2.50	2:30	0.011079	0.111
2.75	2:45	0.011079	0.122
3.00	3:00	0.011079	0.133
3.25	3:15	0.011079	0.144
3.50	3:30	0.011079	0.155
3.75	3:45	0.011079	0.166
4.00	4:00	0.011079	0.177
4.25	4:15	0.011079	0.188
4.50	4:30	0.011079	0.199
4.75	4:45	0.011079	0.210
5.00	5:00	0.011079	0.222
5.25	5:15	0.011079	0.233
5.50	5:30	0.011079	0.244
5.75	5:45	0.011079	0.255
6.00	6:00	0.011079	0.266
6.25	6:15	0.011079	0.277
6.50	6:30	0.011079	0.288
6.75	6:45	0.011079	0.299
7.00	7:00	0.011079	0.310
7.25	7:15	0.011079	0.321
7.50	7:30	0.011079	0.332
7.75	7:45	0.011079	0.343
8.00	8:00	0.011079	0.355
8.25	8:15	0.011079	0.366
8.50	8:30	0.011079	0.377
8.75	8:45	0.011079	0.388
9.00	9:00	0.011079	0.399
9.25	9:15	0.011079	0.410
9.50	9:30	0.011079	0.421
9.75	9:45	0.011079	0.432
10.00	10:00	0.011079	0.443
10.25	10:15	0.011079	0.454
10.50	10:30	0.011079	0.465
10.75	10:45	0.011079	0.476
11.00	11:00	0.011079	0.487
11.25	11:15	0.011079	0.499
11.50	11:30	0.011079	0.510

Time	Distribution
11:45	0.001521
12:00	0.001521
12:15	0.001521
12:30	0.001521
12:45	0.001521
13:00	0.001521
13:15	0.001521
13:30	0.001521
13:45	0.001521
14:00	0.001521
14:15	0.001521
14:30	0.001521
14:45	0.001521
15:00	0.001521
15:15	0.001521
15:30	0.001521
15:45	0.001521
16:00	0.001521
16:15	0.001521
16:30	0.001521
16:45	0.001521
17:00	0.001521
17:15	0.001521
17:30	0.001521
17:45	0.001521
18:00	0.001521
18:15	0.001521
18:30	0.001521
18:45	0.001521
19:00	0.001521
19:15	0.001521
19:30	0.001521
19:45	0.001521
20:00	0.001521
20:15	0.001521
20:30	0.001521
20:45	0.001521
21:00	0.001521
21:15	0.001521
21:30	0.001521
21:45	0.001521
22:00	0.001521
22:15	0.001521
22:30	0.001521
22:45	0.001521
23:00	0.001521
23:15	0.001521
23:30	0.001521
23:45	0.001521
0:00	0.002219

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
11.75	11:45	0.011079	0.521
12.00	12:00	0.011079	0.532
12.25	12:15	0.011079	0.543
12.50	12:30	0.011079	0.554
12.75	12:45	0.011079	0.565
13.00	13:00	0.011079	0.576
13.25	13:15	0.011079	0.587
13.50	13:30	0.011079	0.598
13.75	13:45	0.011079	0.609
14.00	14:00	0.011079	0.620
14.25	14:15	0.011079	0.631
14.50	14:30	0.011079	0.643
14.75	14:45	0.011079	0.654
15.00	15:00	0.011079	0.665
15.25	15:15	0.011079	0.676
15.50	15:30	0.011079	0.687
15.75	15:45	0.011079	0.698
16.00	16:00	0.011079	0.709
16.25	16:15	0.011079	0.720
16.50	16:30	0.011079	0.731
16.75	16:45	0.011079	0.742
17.00	17:00	0.011079	0.753
17.25	17:15	0.011079	0.764
17.50	17:30	0.011079	0.776
17.75	17:45	0.011079	0.787
18.00	18:00	0.011079	0.798
18.25	18:15	0.011079	0.809
18.50	18:30	0.011079	0.820
18.75	18:45	0.011079	0.831
19.00	19:00	0.011079	0.842
19.25	19:15	0.011079	0.853
19.50	19:30	0.011079	0.864
19.75	19:45	0.011079	0.875
20.00	20:00	0.011079	0.886
20.25	20:15	0.011079	0.897
20.50	20:30	0.011079	0.908
20.75	20:45	0.011079	0.920
21.00	21:00	0.011079	0.931
21.25	21:15	0.011079	0.942
21.50	21:30	0.011079	0.953
21.75	21:45	0.011079	0.964
22.00	22:00	0.011079	0.975
22.25	22:15	0.011079	0.986
22.50	22:30	0.011079	0.997
22.75	22:45	0.011079	1.008
23.00	23:00	0.011079	1.019
23.25	23:15	0.011079	1.030
23.50	23:30	0.011079	1.041
23.75	23:45	0.011079	1.052
24.00	0:00	0.016163	1.064

Time	Distribution
0:15	0.002219
0:30	0.002219
0:45	0.002219
1:00	0.002219
1:15	0.002219
1:30	0.002219
1:45	0.002219
2:00	0.002219
2:15	0.002219
2:30	0.002219
2:45	0.002219
3:00	0.002219
3:15	0.002219
3:30	0.002219
3:45	0.002219
4:00	0.002219
4:15	0.002219
4:30	0.002219
4:45	0.002219
5:00	0.002219
5:15	0.002219
5:30	0.002219
5:45	0.002219
6:00	0.002219
6:15	0.002219
6:30	0.002219
6:45	0.002219
7:00	0.002219
7:15	0.002219
7:30	0.002219
7:45	0.002219
8:00	0.002219
8:15	0.002219
8:30	0.002219
8:45	0.002219
9:00	0.002219
9:15	0.002219
9:30	0.002219
9:45	0.002219
10:00	0.002219
10:15	0.002219
10:30	0.002219
10:45	0.002219
11:00	0.002219
11:15	0.002219
11:30	0.002219
11:45	0.002219
12:00	0.002219
12:15	0.002219
12:30	0.002219

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
24.25	0:15	0.016163	1.080
24.50	0:30	0.016163	1.096
24.75	0:45	0.016163	1.112
25.00	1:00	0.016163	1.128
25.25	1:15	0.016163	1.144
25.50	1:30	0.016163	1.161
25.75	1:45	0.016163	1.177
26.00	2:00	0.016163	1.193
26.25	2:15	0.016163	1.209
26.50	2:30	0.016163	1.225
26.75	2:45	0.016163	1.241
27.00	3:00	0.016163	1.258
27.25	3:15	0.016163	1.274
27.50	3:30	0.016163	1.290
27.75	3:45	0.016163	1.306
28.00	4:00	0.016163	1.322
28.25	4:15	0.016163	1.338
28.50	4:30	0.016163	1.355
28.75	4:45	0.016163	1.371
29.00	5:00	0.016163	1.387
29.25	5:15	0.016163	1.403
29.50	5:30	0.016163	1.419
29.75	5:45	0.016163	1.435
30.00	6:00	0.016163	1.451
30.25	6:15	0.016163	1.468
30.50	6:30	0.016163	1.484
30.75	6:45	0.016163	1.500
31.00	7:00	0.016163	1.516
31.25	7:15	0.016163	1.532
31.50	7:30	0.016163	1.548
31.75	7:45	0.016163	1.565
32.00	8:00	0.016163	1.581
32.25	8:15	0.016163	1.597
32.50	8:30	0.016163	1.613
32.75	8:45	0.016163	1.629
33.00	9:00	0.016163	1.645
33.25	9:15	0.016163	1.662
33.50	9:30	0.016163	1.678
33.75	9:45	0.016163	1.694
34.00	10:00	0.016163	1.710
34.25	10:15	0.016163	1.726
34.50	10:30	0.016163	1.742
34.75	10:45	0.016163	1.759
35.00	11:00	0.016163	1.775
35.25	11:15	0.016163	1.791
35.50	11:30	0.016163	1.807
35.75	11:45	0.016163	1.823
36.00	12:00	0.016163	1.839
36.25	12:15	0.016163	1.856
36.50	12:30	0.016163	1.872

Time	Distribution
12:45	0.002219
13:00	0.002219
13:15	0.002219
13:30	0.002219
13:45	0.002219
14:00	0.002219
14:15	0.002219
14:30	0.002219
14:45	0.002219
15:00	0.002219
15:15	0.002219
15:30	0.002219
15:45	0.002219
16:00	0.002219
16:15	0.002219
16:30	0.002219
16:45	0.002219
17:00	0.002219
17:15	0.002219
17:30	0.002219
17:45	0.002219
18:00	0.002219
18:15	0.002219
18:30	0.002219
18:45	0.002219
19:00	0.002219
19:15	0.002219
19:30	0.002219
19:45	0.002219
20:00	0.002219
20:15	0.002219
20:30	0.002219
20:45	0.002219
21:00	0.002219
21:15	0.002219
21:30	0.002219
21:45	0.002219
22:00	0.002219
22:15	0.002219
22:30	0.002219
22:45	0.002219
23:00	0.002219
23:15	0.002219
23:30	0.002219
23:45	0.002219
0:00	0.005325
0:15	0.005325
0:30	0.005325
0:45	0.005325
1:00	0.005325

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
36.75	12:45	0.016163	1.888
37.00	13:00	0.016163	1.904
37.25	13:15	0.016163	1.920
37.50	13:30	0.016163	1.936
37.75	13:45	0.016163	1.953
38.00	14:00	0.016163	1.969
38.25	14:15	0.016163	1.985
38.50	14:30	0.016163	2.001
38.75	14:45	0.016163	2.017
39.00	15:00	0.016163	2.033
39.25	15:15	0.016163	2.050
39.50	15:30	0.016163	2.066
39.75	15:45	0.016163	2.082
40.00	16:00	0.016163	2.098
40.25	16:15	0.016163	2.114
40.50	16:30	0.016163	2.130
40.75	16:45	0.016163	2.147
41.00	17:00	0.016163	2.163
41.25	17:15	0.016163	2.179
41.50	17:30	0.016163	2.195
41.75	17:45	0.016163	2.211
42.00	18:00	0.016163	2.227
42.25	18:15	0.016163	2.243
42.50	18:30	0.016163	2.260
42.75	18:45	0.016163	2.276
43.00	19:00	0.016163	2.292
43.25	19:15	0.016163	2.308
43.50	19:30	0.016163	2.324
43.75	19:45	0.016163	2.340
44.00	20:00	0.016163	2.357
44.25	20:15	0.016163	2.373
44.50	20:30	0.016163	2.389
44.75	20:45	0.016163	2.405
45.00	21:00	0.016163	2.421
45.25	21:15	0.016163	2.437
45.50	21:30	0.016163	2.454
45.75	21:45	0.016163	2.470
46.00	22:00	0.016163	2.486
46.25	22:15	0.016163	2.502
46.50	22:30	0.016163	2.518
46.75	22:45	0.016163	2.534
47.00	23:00	0.016163	2.551
47.25	23:15	0.016163	2.567
47.50	23:30	0.016163	2.583
47.75	23:45	0.016163	2.599
48.00	0:00	0.038791	2.615
48.25	0:15	0.038791	2.654
48.50	0:30	0.038791	2.693
48.75	0:45	0.038791	2.732
49.00	1:00	0.038791	2.770

Time	Distribution
1:15	0.005325
1:30	0.005325
1:45	0.005325
2:00	0.005325
2:15	0.005325
2:30	0.005325
2:45	0.005325
3:00	0.005325
3:15	0.005325
3:30	0.005325
3:45	0.005325
4:00	0.005325
4:15	0.005325
4:30	0.005325
4:45	0.005325
5:00	0.005325
5:15	0.005325
5:30	0.005325
5:45	0.005325
6:00	0.005325
6:15	0.005325
6:30	0.005325
6:45	0.005325
7:00	0.005325
7:15	0.005325
7:30	0.005325
7:45	0.005325
8:00	0.005325
8:15	0.005325
8:30	0.005325
8:45	0.005325
9:00	0.005325
9:15	0.005325
9:30	0.005325
9:45	0.005325
10:00	0.014000
10:15	0.014000
10:30	0.014000
10:45	0.014000
11:00	0.025000
11:15	0.025000
11:30	0.150000
11:45	0.187000
12:00	0.036500
12:15	0.036500
12:30	0.019000
12:45	0.019000
13:00	0.012750
13:15	0.012750
13:30	0.012750

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
49.25	1:15	0.038791	2.809
49.50	1:30	0.038791	2.848
49.75	1:45	0.038791	2.887
50.00	2:00	0.038791	2.926
50.25	2:15	0.038791	2.964
50.50	2:30	0.038791	3.003
50.75	2:45	0.038791	3.042
51.00	3:00	0.038791	3.081
51.25	3:15	0.038791	3.120
51.50	3:30	0.038791	3.158
51.75	3:45	0.038791	3.197
52.00	4:00	0.038791	3.236
52.25	4:15	0.038791	3.275
52.50	4:30	0.038791	3.313
52.75	4:45	0.038791	3.352
53.00	5:00	0.038791	3.391
53.25	5:15	0.038791	3.430
53.50	5:30	0.038791	3.469
53.75	5:45	0.038791	3.507
54.00	6:00	0.038791	3.546
54.25	6:15	0.038791	3.585
54.50	6:30	0.038791	3.624
54.75	6:45	0.038791	3.663
55.00	7:00	0.038791	3.701
55.25	7:15	0.038791	3.740
55.50	7:30	0.038791	3.779
55.75	7:45	0.038791	3.818
56.00	8:00	0.038791	3.857
56.25	8:15	0.038791	3.895
56.50	8:30	0.038791	3.934
56.75	8:45	0.038791	3.973
57.00	9:00	0.038791	4.012
57.25	9:15	0.038791	4.051
57.50	9:30	0.038791	4.089
57.75	9:45	0.038791	4.128
58.00	10:00	0.101987	4.167
58.25	10:15	0.101987	4.269
58.50	10:30	0.101987	4.371
58.75	10:45	0.101987	4.473
59.00	11:00	0.182119	4.575
59.25	11:15	0.182119	4.757
59.50	11:30	1.092715	4.939
59.75	11:45	1.362252	6.032
60.00	12:00	0.265894	7.394
60.25	12:15	0.265894	7.660
60.50	12:30	0.138411	7.926
60.75	12:45	0.138411	8.064
61.00	13:00	0.092881	8.203
61.25	13:15	0.092881	8.296
61.50	13:30	0.092881	8.388

Time	Distribution
13:45	0.012750
14:00	0.004550
14:15	0.004550
14:30	0.004550
14:45	0.004550
15:00	0.004550
15:15	0.004550
15:30	0.004550
15:45	0.004550
16:00	0.004550
16:15	0.004550
16:30	0.004550
16:45	0.004550
17:00	0.004550
17:15	0.004550
17:30	0.004550
17:45	0.004550
18:00	0.004550
18:15	0.004550
18:30	0.004550
18:45	0.004550
19:00	0.004550
19:15	0.004550
19:30	0.004550
19:45	0.004550
20:00	0.004550
20:15	0.004550
20:30	0.004550
20:45	0.004550
21:00	0.004550
21:15	0.004550
21:30	0.004550
21:45	0.004550
22:00	0.004550
22:15	0.004550
22:30	0.004550
22:45	0.004550
23:00	0.004550
23:15	0.004550
23:30	0.004550
23:45	0.004550
0:00	0.000000

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
61.75	13:45	0.092881	8.481
62.00	14:00	0.033146	8.574
62.25	14:15	0.033146	8.607
62.50	14:30	0.033146	8.640
62.75	14:45	0.033146	8.674
63.00	15:00	0.033146	8.707
63.25	15:15	0.033146	8.740
63.50	15:30	0.033146	8.773
63.75	15:45	0.033146	8.806
64.00	16:00	0.033146	8.839
64.25	16:15	0.033146	8.872
64.50	16:30	0.033146	8.906
64.75	16:45	0.033146	8.939
65.00	17:00	0.033146	8.972
65.25	17:15	0.033146	9.005
65.50	17:30	0.033146	9.038
65.75	17:45	0.033146	9.071
66.00	18:00	0.033146	9.105
66.25	18:15	0.033146	9.138
66.50	18:30	0.033146	9.171
66.75	18:45	0.033146	9.204
67.00	19:00	0.033146	9.237
67.25	19:15	0.033146	9.270
67.50	19:30	0.033146	9.303
67.75	19:45	0.033146	9.337
68.00	20:00	0.033146	9.370
68.25	20:15	0.033146	9.403
68.50	20:30	0.033146	9.436
68.75	20:45	0.033146	9.469
69.00	21:00	0.033146	9.502
69.25	21:15	0.033146	9.535
69.50	21:30	0.033146	9.569
69.75	21:45	0.033146	9.602
70.00	22:00	0.033146	9.635
70.25	22:15	0.033146	9.668
70.50	22:30	0.033146	9.701
70.75	22:45	0.033146	9.734
71.00	23:00	0.033146	9.767
71.25	23:15	0.033146	9.801
71.50	23:30	0.033146	9.834
71.75	23:45	0.033146	9.867
72.00	0:00	0	9.9

SFWMD Unit Hydrographs
72-Hour
Sum 1.359

Time	Distribution
0:00	0.001521
0:15	0.001521
0:30	0.001521
0:45	0.001521
1:00	0.001521
1:15	0.001521
1:30	0.001521
1:45	0.001521
2:00	0.001521
2:15	0.001521
2:30	0.001521
2:45	0.001521
3:00	0.001521
3:15	0.001521
3:30	0.001521
3:45	0.001521
4:00	0.001521
4:15	0.001521
4:30	0.001521
4:45	0.001521
5:00	0.001521
5:15	0.001521
5:30	0.001521
5:45	0.001521
6:00	0.001521
6:15	0.001521
6:30	0.001521
6:45	0.001521
7:00	0.001521
7:15	0.001521
7:30	0.001521
7:45	0.001521
8:00	0.001521
8:15	0.001521
8:30	0.001521
8:45	0.001521
9:00	0.001521
9:15	0.001521
9:30	0.001521
9:45	0.001521
10:00	0.001521
10:15	0.001521
10:30	0.001521
10:45	0.001521
11:00	0.001521
11:15	0.001521
11:30	0.001521

72-hour depth **11.0 in**
72 peak int **6.1 in/hr**

SFWMD Hydrographs
25 yr 72-Hour 14.5 inch
Sum = 11

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
0.00	0:00	0.01231	0.000
0.25	0:15	0.01231	0.012
0.50	0:30	0.01231	0.025
0.75	0:45	0.01231	0.037
1.00	1:00	0.01231	0.049
1.25	1:15	0.01231	0.062
1.50	1:30	0.01231	0.074
1.75	1:45	0.01231	0.086
2.00	2:00	0.01231	0.098
2.25	2:15	0.01231	0.111
2.50	2:30	0.01231	0.123
2.75	2:45	0.01231	0.135
3.00	3:00	0.01231	0.148
3.25	3:15	0.01231	0.160
3.50	3:30	0.01231	0.172
3.75	3:45	0.01231	0.185
4.00	4:00	0.01231	0.197
4.25	4:15	0.01231	0.209
4.50	4:30	0.01231	0.222
4.75	4:45	0.01231	0.234
5.00	5:00	0.01231	0.246
5.25	5:15	0.01231	0.259
5.50	5:30	0.01231	0.271
5.75	5:45	0.01231	0.283
6.00	6:00	0.01231	0.295
6.25	6:15	0.01231	0.308
6.50	6:30	0.01231	0.320
6.75	6:45	0.01231	0.332
7.00	7:00	0.01231	0.345
7.25	7:15	0.01231	0.357
7.50	7:30	0.01231	0.369
7.75	7:45	0.01231	0.382
8.00	8:00	0.01231	0.394
8.25	8:15	0.01231	0.406
8.50	8:30	0.01231	0.419
8.75	8:45	0.01231	0.431
9.00	9:00	0.01231	0.443
9.25	9:15	0.01231	0.455
9.50	9:30	0.01231	0.468
9.75	9:45	0.01231	0.480
10.00	10:00	0.01231	0.492
10.25	10:15	0.01231	0.505
10.50	10:30	0.01231	0.517
10.75	10:45	0.01231	0.529
11.00	11:00	0.01231	0.542
11.25	11:15	0.01231	0.554
11.50	11:30	0.01231	0.566

Time	Distribution
11:45	0.001521
12:00	0.001521
12:15	0.001521
12:30	0.001521
12:45	0.001521
13:00	0.001521
13:15	0.001521
13:30	0.001521
13:45	0.001521
14:00	0.001521
14:15	0.001521
14:30	0.001521
14:45	0.001521
15:00	0.001521
15:15	0.001521
15:30	0.001521
15:45	0.001521
16:00	0.001521
16:15	0.001521
16:30	0.001521
16:45	0.001521
17:00	0.001521
17:15	0.001521
17:30	0.001521
17:45	0.001521
18:00	0.001521
18:15	0.001521
18:30	0.001521
18:45	0.001521
19:00	0.001521
19:15	0.001521
19:30	0.001521
19:45	0.001521
20:00	0.001521
20:15	0.001521
20:30	0.001521
20:45	0.001521
21:00	0.001521
21:15	0.001521
21:30	0.001521
21:45	0.001521
22:00	0.001521
22:15	0.001521
22:30	0.001521
22:45	0.001521
23:00	0.001521
23:15	0.001521
23:30	0.001521
23:45	0.001521
0:00	0.002219

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
11.75	11:45	0.01231	0.579
12.00	12:00	0.01231	0.591
12.25	12:15	0.01231	0.603
12.50	12:30	0.01231	0.615
12.75	12:45	0.01231	0.628
13.00	13:00	0.01231	0.640
13.25	13:15	0.01231	0.652
13.50	13:30	0.01231	0.665
13.75	13:45	0.01231	0.677
14.00	14:00	0.01231	0.689
14.25	14:15	0.01231	0.702
14.50	14:30	0.01231	0.714
14.75	14:45	0.01231	0.726
15.00	15:00	0.01231	0.739
15.25	15:15	0.01231	0.751
15.50	15:30	0.01231	0.763
15.75	15:45	0.01231	0.776
16.00	16:00	0.01231	0.788
16.25	16:15	0.01231	0.800
16.50	16:30	0.01231	0.812
16.75	16:45	0.01231	0.825
17.00	17:00	0.01231	0.837
17.25	17:15	0.01231	0.849
17.50	17:30	0.01231	0.862
17.75	17:45	0.01231	0.874
18.00	18:00	0.01231	0.886
18.25	18:15	0.01231	0.899
18.50	18:30	0.01231	0.911
18.75	18:45	0.01231	0.923
19.00	19:00	0.01231	0.936
19.25	19:15	0.01231	0.948
19.50	19:30	0.01231	0.960
19.75	19:45	0.01231	0.972
20.00	20:00	0.01231	0.985
20.25	20:15	0.01231	0.997
20.50	20:30	0.01231	1.009
20.75	20:45	0.01231	1.022
21.00	21:00	0.01231	1.034
21.25	21:15	0.01231	1.046
21.50	21:30	0.01231	1.059
21.75	21:45	0.01231	1.071
22.00	22:00	0.01231	1.083
22.25	22:15	0.01231	1.096
22.50	22:30	0.01231	1.108
22.75	22:45	0.01231	1.120
23.00	23:00	0.01231	1.133
23.25	23:15	0.01231	1.145
23.50	23:30	0.01231	1.157
23.75	23:45	0.01231	1.169
24.00	0:00	0.017959	1.182

Time	Distribution
0:15	0.002219
0:30	0.002219
0:45	0.002219
1:00	0.002219
1:15	0.002219
1:30	0.002219
1:45	0.002219
2:00	0.002219
2:15	0.002219
2:30	0.002219
2:45	0.002219
3:00	0.002219
3:15	0.002219
3:30	0.002219
3:45	0.002219
4:00	0.002219
4:15	0.002219
4:30	0.002219
4:45	0.002219
5:00	0.002219
5:15	0.002219
5:30	0.002219
5:45	0.002219
6:00	0.002219
6:15	0.002219
6:30	0.002219
6:45	0.002219
7:00	0.002219
7:15	0.002219
7:30	0.002219
7:45	0.002219
8:00	0.002219
8:15	0.002219
8:30	0.002219
8:45	0.002219
9:00	0.002219
9:15	0.002219
9:30	0.002219
9:45	0.002219
10:00	0.002219
10:15	0.002219
10:30	0.002219
10:45	0.002219
11:00	0.002219
11:15	0.002219
11:30	0.002219
11:45	0.002219
12:00	0.002219
12:15	0.002219
12:30	0.002219

	Time	Rainfall	Cumulative
Hours	(hrs)	(in)	(in)
24.25	0:15	0.017959	1.200
24.50	0:30	0.017959	1.218
24.75	0:45	0.017959	1.236
25.00	1:00	0.017959	1.254
25.25	1:15	0.017959	1.272
25.50	1:30	0.017959	1.290
25.75	1:45	0.017959	1.307
26.00	2:00	0.017959	1.325
26.25	2:15	0.017959	1.343
26.50	2:30	0.017959	1.361
26.75	2:45	0.017959	1.379
27.00	3:00	0.017959	1.397
27.25	3:15	0.017959	1.415
27.50	3:30	0.017959	1.433
27.75	3:45	0.017959	1.451
28.00	4:00	0.017959	1.469
28.25	4:15	0.017959	1.487
28.50	4:30	0.017959	1.505
28.75	4:45	0.017959	1.523
29.00	5:00	0.017959	1.541
29.25	5:15	0.017959	1.559
29.50	5:30	0.017959	1.577
29.75	5:45	0.017959	1.595
30.00	6:00	0.017959	1.613
30.25	6:15	0.017959	1.631
30.50	6:30	0.017959	1.649
30.75	6:45	0.017959	1.667
31.00	7:00	0.017959	1.685
31.25	7:15	0.017959	1.703
31.50	7:30	0.017959	1.721
31.75	7:45	0.017959	1.738
32.00	8:00	0.017959	1.756
32.25	8:15	0.017959	1.774
32.50	8:30	0.017959	1.792
32.75	8:45	0.017959	1.810
33.00	9:00	0.017959	1.828
33.25	9:15	0.017959	1.846
33.50	9:30	0.017959	1.864
33.75	9:45	0.017959	1.882
34.00	10:00	0.017959	1.900
34.25	10:15	0.017959	1.918
34.50	10:30	0.017959	1.936
34.75	10:45	0.017959	1.954
35.00	11:00	0.017959	1.972
35.25	11:15	0.017959	1.990
35.50	11:30	0.017959	2.008
35.75	11:45	0.017959	2.026
36.00	12:00	0.017959	2.044
36.25	12:15	0.017959	2.062
36.50	12:30	0.017959	2.080

Time	Distribution
12:45	0.002219
13:00	0.002219
13:15	0.002219
13:30	0.002219
13:45	0.002219
14:00	0.002219
14:15	0.002219
14:30	0.002219
14:45	0.002219
15:00	0.002219
15:15	0.002219
15:30	0.002219
15:45	0.002219
16:00	0.002219
16:15	0.002219
16:30	0.002219
16:45	0.002219
17:00	0.002219
17:15	0.002219
17:30	0.002219
17:45	0.002219
18:00	0.002219
18:15	0.002219
18:30	0.002219
18:45	0.002219
19:00	0.002219
19:15	0.002219
19:30	0.002219
19:45	0.002219
20:00	0.002219
20:15	0.002219
20:30	0.002219
20:45	0.002219
21:00	0.002219
21:15	0.002219
21:30	0.002219
21:45	0.002219
22:00	0.002219
22:15	0.002219
22:30	0.002219
22:45	0.002219
23:00	0.002219
23:15	0.002219
23:30	0.002219
23:45	0.002219
0:00	0.005325
0:15	0.005325
0:30	0.005325
0:45	0.005325
1:00	0.005325

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
36.75	12:45	0.017959	2.098
37.00	13:00	0.017959	2.116
37.25	13:15	0.017959	2.134
37.50	13:30	0.017959	2.152
37.75	13:45	0.017959	2.169
38.00	14:00	0.017959	2.187
38.25	14:15	0.017959	2.205
38.50	14:30	0.017959	2.223
38.75	14:45	0.017959	2.241
39.00	15:00	0.017959	2.259
39.25	15:15	0.017959	2.277
39.50	15:30	0.017959	2.295
39.75	15:45	0.017959	2.313
40.00	16:00	0.017959	2.331
40.25	16:15	0.017959	2.349
40.50	16:30	0.017959	2.367
40.75	16:45	0.017959	2.385
41.00	17:00	0.017959	2.403
41.25	17:15	0.017959	2.421
41.50	17:30	0.017959	2.439
41.75	17:45	0.017959	2.457
42.00	18:00	0.017959	2.475
42.25	18:15	0.017959	2.493
42.50	18:30	0.017959	2.511
42.75	18:45	0.017959	2.529
43.00	19:00	0.017959	2.547
43.25	19:15	0.017959	2.565
43.50	19:30	0.017959	2.583
43.75	19:45	0.017959	2.601
44.00	20:00	0.017959	2.618
44.25	20:15	0.017959	2.636
44.50	20:30	0.017959	2.654
44.75	20:45	0.017959	2.672
45.00	21:00	0.017959	2.690
45.25	21:15	0.017959	2.708
45.50	21:30	0.017959	2.726
45.75	21:45	0.017959	2.744
46.00	22:00	0.017959	2.762
46.25	22:15	0.017959	2.780
46.50	22:30	0.017959	2.798
46.75	22:45	0.017959	2.816
47.00	23:00	0.017959	2.834
47.25	23:15	0.017959	2.852
47.50	23:30	0.017959	2.870
47.75	23:45	0.017959	2.888
48.00	0:00	0.043102	2.906
48.25	0:15	0.043102	2.949
48.50	0:30	0.043102	2.992
48.75	0:45	0.043102	3.035
49.00	1:00	0.043102	3.078

Time	Distribution
1:15	0.005325
1:30	0.005325
1:45	0.005325
2:00	0.005325
2:15	0.005325
2:30	0.005325
2:45	0.005325
3:00	0.005325
3:15	0.005325
3:30	0.005325
3:45	0.005325
4:00	0.005325
4:15	0.005325
4:30	0.005325
4:45	0.005325
5:00	0.005325
5:15	0.005325
5:30	0.005325
5:45	0.005325
6:00	0.005325
6:15	0.005325
6:30	0.005325
6:45	0.005325
7:00	0.005325
7:15	0.005325
7:30	0.005325
7:45	0.005325
8:00	0.005325
8:15	0.005325
8:30	0.005325
8:45	0.005325
9:00	0.005325
9:15	0.005325
9:30	0.005325
9:45	0.005325
10:00	0.014000
10:15	0.014000
10:30	0.014000
10:45	0.014000
11:00	0.025000
11:15	0.025000
11:30	0.150000
11:45	0.187000
12:00	0.036500
12:15	0.036500
12:30	0.019000
12:45	0.019000
13:00	0.012750
13:15	0.012750
13:30	0.012750

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
49.25	1:15	0.043102	3.121
49.50	1:30	0.043102	3.164
49.75	1:45	0.043102	3.208
50.00	2:00	0.043102	3.251
50.25	2:15	0.043102	3.294
50.50	2:30	0.043102	3.337
50.75	2:45	0.043102	3.380
51.00	3:00	0.043102	3.423
51.25	3:15	0.043102	3.466
51.50	3:30	0.043102	3.509
51.75	3:45	0.043102	3.552
52.00	4:00	0.043102	3.595
52.25	4:15	0.043102	3.639
52.50	4:30	0.043102	3.682
52.75	4:45	0.043102	3.725
53.00	5:00	0.043102	3.768
53.25	5:15	0.043102	3.811
53.50	5:30	0.043102	3.854
53.75	5:45	0.043102	3.897
54.00	6:00	0.043102	3.940
54.25	6:15	0.043102	3.983
54.50	6:30	0.043102	4.026
54.75	6:45	0.043102	4.070
55.00	7:00	0.043102	4.113
55.25	7:15	0.043102	4.156
55.50	7:30	0.043102	4.199
55.75	7:45	0.043102	4.242
56.00	8:00	0.043102	4.285
56.25	8:15	0.043102	4.328
56.50	8:30	0.043102	4.371
56.75	8:45	0.043102	4.414
57.00	9:00	0.043102	4.457
57.25	9:15	0.043102	4.501
57.50	9:30	0.043102	4.544
57.75	9:45	0.043102	4.587
58.00	10:00	0.113319	4.630
58.25	10:15	0.113319	4.743
58.50	10:30	0.113319	4.857
58.75	10:45	0.113319	4.970
59.00	11:00	0.202355	5.083
59.25	11:15	0.202355	5.286
59.50	11:30	1.214128	5.488
59.75	11:45	1.513613	6.702
60.00	12:00	0.295438	8.216
60.25	12:15	0.295438	8.511
60.50	12:30	0.15379	8.806
60.75	12:45	0.15379	8.960
61.00	13:00	0.103201	9.114
61.25	13:15	0.103201	9.217
61.50	13:30	0.103201	9.320

Time	Distribution
13:45	0.012750
14:00	0.004550
14:15	0.004550
14:30	0.004550
14:45	0.004550
15:00	0.004550
15:15	0.004550
15:30	0.004550
15:45	0.004550
16:00	0.004550
16:15	0.004550
16:30	0.004550
16:45	0.004550
17:00	0.004550
17:15	0.004550
17:30	0.004550
17:45	0.004550
18:00	0.004550
18:15	0.004550
18:30	0.004550
18:45	0.004550
19:00	0.004550
19:15	0.004550
19:30	0.004550
19:45	0.004550
20:00	0.004550
20:15	0.004550
20:30	0.004550
20:45	0.004550
21:00	0.004550
21:15	0.004550
21:30	0.004550
21:45	0.004550
22:00	0.004550
22:15	0.004550
22:30	0.004550
22:45	0.004550
23:00	0.004550
23:15	0.004550
23:30	0.004550
23:45	0.004550
0:00	0.000000

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
61.75	13:45	0.103201	9.424
62.00	14:00	0.036829	9.527
62.25	14:15	0.036829	9.564
62.50	14:30	0.036829	9.601
62.75	14:45	0.036829	9.637
63.00	15:00	0.036829	9.674
63.25	15:15	0.036829	9.711
63.50	15:30	0.036829	9.748
63.75	15:45	0.036829	9.785
64.00	16:00	0.036829	9.821
64.25	16:15	0.036829	9.858
64.50	16:30	0.036829	9.895
64.75	16:45	0.036829	9.932
65.00	17:00	0.036829	9.969
65.25	17:15	0.036829	10.006
65.50	17:30	0.036829	10.042
65.75	17:45	0.036829	10.079
66.00	18:00	0.036829	10.116
66.25	18:15	0.036829	10.153
66.50	18:30	0.036829	10.190
66.75	18:45	0.036829	10.227
67.00	19:00	0.036829	10.263
67.25	19:15	0.036829	10.300
67.50	19:30	0.036829	10.337
67.75	19:45	0.036829	10.374
68.00	20:00	0.036829	10.411
68.25	20:15	0.036829	10.448
68.50	20:30	0.036829	10.484
68.75	20:45	0.036829	10.521
69.00	21:00	0.036829	10.558
69.25	21:15	0.036829	10.595
69.50	21:30	0.036829	10.632
69.75	21:45	0.036829	10.669
70.00	22:00	0.036829	10.705
70.25	22:15	0.036829	10.742
70.50	22:30	0.036829	10.779
70.75	22:45	0.036829	10.816
71.00	23:00	0.036829	10.853
71.25	23:15	0.036829	10.890
71.50	23:30	0.036829	10.926
71.75	23:45	0.036829	10.963
72.00	0:00	0	11

SFWMD Unit Hydrographs
72-Hour
Sum 1.359

Time	Distribution
0:00	0.001521
0:15	0.001521
0:30	0.001521
0:45	0.001521
1:00	0.001521
1:15	0.001521
1:30	0.001521
1:45	0.001521
2:00	0.001521
2:15	0.001521
2:30	0.001521
2:45	0.001521
3:00	0.001521
3:15	0.001521
3:30	0.001521
3:45	0.001521
4:00	0.001521
4:15	0.001521
4:30	0.001521
4:45	0.001521
5:00	0.001521
5:15	0.001521
5:30	0.001521
5:45	0.001521
6:00	0.001521
6:15	0.001521
6:30	0.001521
6:45	0.001521
7:00	0.001521
7:15	0.001521
7:30	0.001521
7:45	0.001521
8:00	0.001521
8:15	0.001521
8:30	0.001521
8:45	0.001521
9:00	0.001521
9:15	0.001521
9:30	0.001521
9:45	0.001521
10:00	0.001521
10:15	0.001521
10:30	0.001521
10:45	0.001521
11:00	0.001521
11:15	0.001521
11:30	0.001521

72-hour depth **14.0 in**
72 peak int **7.7 in/hr**

SFWMD Hydrographs
100 yr 72-Hour 18 inch

Sum = **14**

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
0.00	0:00	0.015667	0.000
0.25	0:15	0.015667	0.016
0.50	0:30	0.015667	0.031
0.75	0:45	0.015667	0.047
1.00	1:00	0.015667	0.063
1.25	1:15	0.015667	0.078
1.50	1:30	0.015667	0.094
1.75	1:45	0.015667	0.110
2.00	2:00	0.015667	0.125
2.25	2:15	0.015667	0.141
2.50	2:30	0.015667	0.157
2.75	2:45	0.015667	0.172
3.00	3:00	0.015667	0.188
3.25	3:15	0.015667	0.204
3.50	3:30	0.015667	0.219
3.75	3:45	0.015667	0.235
4.00	4:00	0.015667	0.251
4.25	4:15	0.015667	0.266
4.50	4:30	0.015667	0.282
4.75	4:45	0.015667	0.298
5.00	5:00	0.015667	0.313
5.25	5:15	0.015667	0.329
5.50	5:30	0.015667	0.345
5.75	5:45	0.015667	0.360
6.00	6:00	0.015667	0.376
6.25	6:15	0.015667	0.392
6.50	6:30	0.015667	0.407
6.75	6:45	0.015667	0.423
7.00	7:00	0.015667	0.439
7.25	7:15	0.015667	0.454
7.50	7:30	0.015667	0.470
7.75	7:45	0.015667	0.486
8.00	8:00	0.015667	0.501
8.25	8:15	0.015667	0.517
8.50	8:30	0.015667	0.533
8.75	8:45	0.015667	0.548
9.00	9:00	0.015667	0.564
9.25	9:15	0.015667	0.580
9.50	9:30	0.015667	0.595
9.75	9:45	0.015667	0.611
10.00	10:00	0.015667	0.627
10.25	10:15	0.015667	0.642
10.50	10:30	0.015667	0.658
10.75	10:45	0.015667	0.674
11.00	11:00	0.015667	0.689
11.25	11:15	0.015667	0.705
11.50	11:30	0.015667	0.721

25-yr 72-hr storm = 14.5"

Time	Distribution
11:45	0.001521
12:00	0.001521
12:15	0.001521
12:30	0.001521
12:45	0.001521
13:00	0.001521
13:15	0.001521
13:30	0.001521
13:45	0.001521
14:00	0.001521
14:15	0.001521
14:30	0.001521
14:45	0.001521
15:00	0.001521
15:15	0.001521
15:30	0.001521
15:45	0.001521
16:00	0.001521
16:15	0.001521
16:30	0.001521
16:45	0.001521
17:00	0.001521
17:15	0.001521
17:30	0.001521
17:45	0.001521
18:00	0.001521
18:15	0.001521
18:30	0.001521
18:45	0.001521
19:00	0.001521
19:15	0.001521
19:30	0.001521
19:45	0.001521
20:00	0.001521
20:15	0.001521
20:30	0.001521
20:45	0.001521
21:00	0.001521
21:15	0.001521
21:30	0.001521
21:45	0.001521
22:00	0.001521
22:15	0.001521
22:30	0.001521
22:45	0.001521
23:00	0.001521
23:15	0.001521
23:30	0.001521
23:45	0.001521
0:00	0.002219

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
11.75	11:45	0.015667	0.736
12.00	12:00	0.015667	0.752
12.25	12:15	0.015667	0.768
12.50	12:30	0.015667	0.783
12.75	12:45	0.015667	0.799
13.00	13:00	0.015667	0.815
13.25	13:15	0.015667	0.830
13.50	13:30	0.015667	0.846
13.75	13:45	0.015667	0.862
14.00	14:00	0.015667	0.877
14.25	14:15	0.015667	0.893
14.50	14:30	0.015667	0.909
14.75	14:45	0.015667	0.924
15.00	15:00	0.015667	0.940
15.25	15:15	0.015667	0.956
15.50	15:30	0.015667	0.971
15.75	15:45	0.015667	0.987
16.00	16:00	0.015667	1.003
16.25	16:15	0.015667	1.018
16.50	16:30	0.015667	1.034
16.75	16:45	0.015667	1.050
17.00	17:00	0.015667	1.065
17.25	17:15	0.015667	1.081
17.50	17:30	0.015667	1.097
17.75	17:45	0.015667	1.112
18.00	18:00	0.015667	1.128
18.25	18:15	0.015667	1.144
18.50	18:30	0.015667	1.159
18.75	18:45	0.015667	1.175
19.00	19:00	0.015667	1.191
19.25	19:15	0.015667	1.206
19.50	19:30	0.015667	1.222
19.75	19:45	0.015667	1.238
20.00	20:00	0.015667	1.253
20.25	20:15	0.015667	1.269
20.50	20:30	0.015667	1.285
20.75	20:45	0.015667	1.300
21.00	21:00	0.015667	1.316
21.25	21:15	0.015667	1.332
21.50	21:30	0.015667	1.347
21.75	21:45	0.015667	1.363
22.00	22:00	0.015667	1.379
22.25	22:15	0.015667	1.394
22.50	22:30	0.015667	1.410
22.75	22:45	0.015667	1.426
23.00	23:00	0.015667	1.441
23.25	23:15	0.015667	1.457
23.50	23:30	0.015667	1.473
23.75	23:45	0.015667	1.488
24.00	0:00	0.022857	1.504

Time	Distribution
0:15	0.002219
0:30	0.002219
0:45	0.002219
1:00	0.002219
1:15	0.002219
1:30	0.002219
1:45	0.002219
2:00	0.002219
2:15	0.002219
2:30	0.002219
2:45	0.002219
3:00	0.002219
3:15	0.002219
3:30	0.002219
3:45	0.002219
4:00	0.002219
4:15	0.002219
4:30	0.002219
4:45	0.002219
5:00	0.002219
5:15	0.002219
5:30	0.002219
5:45	0.002219
6:00	0.002219
6:15	0.002219
6:30	0.002219
6:45	0.002219
7:00	0.002219
7:15	0.002219
7:30	0.002219
7:45	0.002219
8:00	0.002219
8:15	0.002219
8:30	0.002219
8:45	0.002219
9:00	0.002219
9:15	0.002219
9:30	0.002219
9:45	0.002219
10:00	0.002219
10:15	0.002219
10:30	0.002219
10:45	0.002219
11:00	0.002219
11:15	0.002219
11:30	0.002219
11:45	0.002219
12:00	0.002219
12:15	0.002219
12:30	0.002219

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
24.25	0:15	0.022857	1.527
24.50	0:30	0.022857	1.550
24.75	0:45	0.022857	1.573
25.00	1:00	0.022857	1.595
25.25	1:15	0.022857	1.618
25.50	1:30	0.022857	1.641
25.75	1:45	0.022857	1.664
26.00	2:00	0.022857	1.687
26.25	2:15	0.022857	1.710
26.50	2:30	0.022857	1.733
26.75	2:45	0.022857	1.755
27.00	3:00	0.022857	1.778
27.25	3:15	0.022857	1.801
27.50	3:30	0.022857	1.824
27.75	3:45	0.022857	1.847
28.00	4:00	0.022857	1.870
28.25	4:15	0.022857	1.893
28.50	4:30	0.022857	1.915
28.75	4:45	0.022857	1.938
29.00	5:00	0.022857	1.961
29.25	5:15	0.022857	1.984
29.50	5:30	0.022857	2.007
29.75	5:45	0.022857	2.030
30.00	6:00	0.022857	2.053
30.25	6:15	0.022857	2.075
30.50	6:30	0.022857	2.098
30.75	6:45	0.022857	2.121
31.00	7:00	0.022857	2.144
31.25	7:15	0.022857	2.167
31.50	7:30	0.022857	2.190
31.75	7:45	0.022857	2.213
32.00	8:00	0.022857	2.235
32.25	8:15	0.022857	2.258
32.50	8:30	0.022857	2.281
32.75	8:45	0.022857	2.304
33.00	9:00	0.022857	2.327
33.25	9:15	0.022857	2.350
33.50	9:30	0.022857	2.373
33.75	9:45	0.022857	2.395
34.00	10:00	0.022857	2.418
34.25	10:15	0.022857	2.441
34.50	10:30	0.022857	2.464
34.75	10:45	0.022857	2.487
35.00	11:00	0.022857	2.510
35.25	11:15	0.022857	2.533
35.50	11:30	0.022857	2.555
35.75	11:45	0.022857	2.578
36.00	12:00	0.022857	2.601
36.25	12:15	0.022857	2.624
36.50	12:30	0.022857	2.647

Time	Distribution
12:45	0.002219
13:00	0.002219
13:15	0.002219
13:30	0.002219
13:45	0.002219
14:00	0.002219
14:15	0.002219
14:30	0.002219
14:45	0.002219
15:00	0.002219
15:15	0.002219
15:30	0.002219
15:45	0.002219
16:00	0.002219
16:15	0.002219
16:30	0.002219
16:45	0.002219
17:00	0.002219
17:15	0.002219
17:30	0.002219
17:45	0.002219
18:00	0.002219
18:15	0.002219
18:30	0.002219
18:45	0.002219
19:00	0.002219
19:15	0.002219
19:30	0.002219
19:45	0.002219
20:00	0.002219
20:15	0.002219
20:30	0.002219
20:45	0.002219
21:00	0.002219
21:15	0.002219
21:30	0.002219
21:45	0.002219
22:00	0.002219
22:15	0.002219
22:30	0.002219
22:45	0.002219
23:00	0.002219
23:15	0.002219
23:30	0.002219
23:45	0.002219
0:00	0.005325
0:15	0.005325
0:30	0.005325
0:45	0.005325
1:00	0.005325

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
36.75	12:45	0.022857	2.670
37.00	13:00	0.022857	2.693
37.25	13:15	0.022857	2.715
37.50	13:30	0.022857	2.738
37.75	13:45	0.022857	2.761
38.00	14:00	0.022857	2.784
38.25	14:15	0.022857	2.807
38.50	14:30	0.022857	2.830
38.75	14:45	0.022857	2.853
39.00	15:00	0.022857	2.875
39.25	15:15	0.022857	2.898
39.50	15:30	0.022857	2.921
39.75	15:45	0.022857	2.944
40.00	16:00	0.022857	2.967
40.25	16:15	0.022857	2.990
40.50	16:30	0.022857	3.013
40.75	16:45	0.022857	3.035
41.00	17:00	0.022857	3.058
41.25	17:15	0.022857	3.081
41.50	17:30	0.022857	3.104
41.75	17:45	0.022857	3.127
42.00	18:00	0.022857	3.150
42.25	18:15	0.022857	3.173
42.50	18:30	0.022857	3.195
42.75	18:45	0.022857	3.218
43.00	19:00	0.022857	3.241
43.25	19:15	0.022857	3.264
43.50	19:30	0.022857	3.287
43.75	19:45	0.022857	3.310
44.00	20:00	0.022857	3.333
44.25	20:15	0.022857	3.355
44.50	20:30	0.022857	3.378
44.75	20:45	0.022857	3.401
45.00	21:00	0.022857	3.424
45.25	21:15	0.022857	3.447
45.50	21:30	0.022857	3.470
45.75	21:45	0.022857	3.493
46.00	22:00	0.022857	3.515
46.25	22:15	0.022857	3.538
46.50	22:30	0.022857	3.561
46.75	22:45	0.022857	3.584
47.00	23:00	0.022857	3.607
47.25	23:15	0.022857	3.630
47.50	23:30	0.022857	3.653
47.75	23:45	0.022857	3.675
48.00	0:00	0.054857	3.698
48.25	0:15	0.054857	3.753
48.50	0:30	0.054857	3.808
48.75	0:45	0.054857	3.863
49.00	1:00	0.054857	3.918

Time	Distribution
1:15	0.005325
1:30	0.005325
1:45	0.005325
2:00	0.005325
2:15	0.005325
2:30	0.005325
2:45	0.005325
3:00	0.005325
3:15	0.005325
3:30	0.005325
3:45	0.005325
4:00	0.005325
4:15	0.005325
4:30	0.005325
4:45	0.005325
5:00	0.005325
5:15	0.005325
5:30	0.005325
5:45	0.005325
6:00	0.005325
6:15	0.005325
6:30	0.005325
6:45	0.005325
7:00	0.005325
7:15	0.005325
7:30	0.005325
7:45	0.005325
8:00	0.005325
8:15	0.005325
8:30	0.005325
8:45	0.005325
9:00	0.005325
9:15	0.005325
9:30	0.005325
9:45	0.005325
10:00	0.014000
10:15	0.014000
10:30	0.014000
10:45	0.014000
11:00	0.025000
11:15	0.025000
11:30	0.150000
11:45	0.187000
12:00	0.036500
12:15	0.036500
12:30	0.019000
12:45	0.019000
13:00	0.012750
13:15	0.012750
13:30	0.012750

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
49.25	1:15	0.054857	3.973
49.50	1:30	0.054857	4.027
49.75	1:45	0.054857	4.082
50.00	2:00	0.054857	4.137
50.25	2:15	0.054857	4.192
50.50	2:30	0.054857	4.247
50.75	2:45	0.054857	4.302
51.00	3:00	0.054857	4.357
51.25	3:15	0.054857	4.411
51.50	3:30	0.054857	4.466
51.75	3:45	0.054857	4.521
52.00	4:00	0.054857	4.576
52.25	4:15	0.054857	4.631
52.50	4:30	0.054857	4.686
52.75	4:45	0.054857	4.741
53.00	5:00	0.054857	4.795
53.25	5:15	0.054857	4.850
53.50	5:30	0.054857	4.905
53.75	5:45	0.054857	4.960
54.00	6:00	0.054857	5.015
54.25	6:15	0.054857	5.070
54.50	6:30	0.054857	5.125
54.75	6:45	0.054857	5.179
55.00	7:00	0.054857	5.234
55.25	7:15	0.054857	5.289
55.50	7:30	0.054857	5.344
55.75	7:45	0.054857	5.399
56.00	8:00	0.054857	5.454
56.25	8:15	0.054857	5.509
56.50	8:30	0.054857	5.563
56.75	8:45	0.054857	5.618
57.00	9:00	0.054857	5.673
57.25	9:15	0.054857	5.728
57.50	9:30	0.054857	5.783
57.75	9:45	0.054857	5.838
58.00	10:00	0.144224	5.893
58.25	10:15	0.144224	6.037
58.50	10:30	0.144224	6.181
58.75	10:45	0.144224	6.325
59.00	11:00	0.257542	6.469
59.25	11:15	0.257542	6.727
59.50	11:30	1.545254	6.985
59.75	11:45	1.926417	8.530
60.00	12:00	0.376012	10.456
60.25	12:15	0.376012	10.832
60.50	12:30	0.195732	11.208
60.75	12:45	0.195732	11.404
61.00	13:00	0.131347	11.600
61.25	13:15	0.131347	11.731
61.50	13:30	0.131347	11.862

Time	Distribution
13:45	0.012750
14:00	0.004550
14:15	0.004550
14:30	0.004550
14:45	0.004550
15:00	0.004550
15:15	0.004550
15:30	0.004550
15:45	0.004550
16:00	0.004550
16:15	0.004550
16:30	0.004550
16:45	0.004550
17:00	0.004550
17:15	0.004550
17:30	0.004550
17:45	0.004550
18:00	0.004550
18:15	0.004550
18:30	0.004550
18:45	0.004550
19:00	0.004550
19:15	0.004550
19:30	0.004550
19:45	0.004550
20:00	0.004550
20:15	0.004550
20:30	0.004550
20:45	0.004550
21:00	0.004550
21:15	0.004550
21:30	0.004550
21:45	0.004550
22:00	0.004550
22:15	0.004550
22:30	0.004550
22:45	0.004550
23:00	0.004550
23:15	0.004550
23:30	0.004550
23:45	0.004550
0:00	0.000000

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
61.75	13:45	0.131347	11.994
62.00	14:00	0.046873	12.125
62.25	14:15	0.046873	12.172
62.50	14:30	0.046873	12.219
62.75	14:45	0.046873	12.266
63.00	15:00	0.046873	12.313
63.25	15:15	0.046873	12.359
63.50	15:30	0.046873	12.406
63.75	15:45	0.046873	12.453
64.00	16:00	0.046873	12.500
64.25	16:15	0.046873	12.547
64.50	16:30	0.046873	12.594
64.75	16:45	0.046873	12.641
65.00	17:00	0.046873	12.688
65.25	17:15	0.046873	12.734
65.50	17:30	0.046873	12.781
65.75	17:45	0.046873	12.828
66.00	18:00	0.046873	12.875
66.25	18:15	0.046873	12.922
66.50	18:30	0.046873	12.969
66.75	18:45	0.046873	13.016
67.00	19:00	0.046873	13.063
67.25	19:15	0.046873	13.109
67.50	19:30	0.046873	13.156
67.75	19:45	0.046873	13.203
68.00	20:00	0.046873	13.250
68.25	20:15	0.046873	13.297
68.50	20:30	0.046873	13.344
68.75	20:45	0.046873	13.391
69.00	21:00	0.046873	13.438
69.25	21:15	0.046873	13.484
69.50	21:30	0.046873	13.531
69.75	21:45	0.046873	13.578
70.00	22:00	0.046873	13.625
70.25	22:15	0.046873	13.672
70.50	22:30	0.046873	13.719
70.75	22:45	0.046873	13.766
71.00	23:00	0.046873	13.813
71.25	23:15	0.046873	13.859
71.50	23:30	0.046873	13.906
71.75	23:45	0.046873	13.953
72.00	0:00	0	14

SFWMD Unit Hydrographs
72-Hour
Sum 7.138

Time	Distribution			
0:00	0	**72-hour depth**	**3.6**	**in**
0:05	0.018	**72 peak int**	**#REF!**	**in/hr**
0:10	0.057			
0:15	0.132			
0:20	0.263			
0:25	0.44			
0:30	0.63			
0:35	0.785			
0:40	0.88			
0:45	0.95			
0:50	0.988			
0:55	0.995			
1:00	1			

SFWMD Hydrographs
100 yr 72-Hour 20 inch
Sum = 3.6

Hours	Time (hrs)	Rainfall (in)	Cumulative (in)
0	0	0	0
5	5	0.009078	0.0648
10	10	0.028748	0.2052
15	15	0.066573	0.4752
20	20	0.132642	0.9468
25	25	0.221911	1.584
30	30	0.317736	2.268
35	35	0.395909	2.826
40	40	0.443822	3.168
45	45	0.479126	3.42
50	50	0.498291	3.5568
55	55	0.501821	3.582
60	60	0.504343	3.6

25-yr 72-hr storm = 14.5"

Appendix F

SWMM5 LOS Model Results

Table F-1: North Miami SWMM Peak Stage Results for 2-Year, 5-Year, and 10-Year Simulations

					Existing Condition 2-year, 24-hour (4.2-inch)			Existing Condition 5-year, 24-hour (5.9-inch)			Existing Condition 10-year, 72-hour (9.9-inch)		
Node	Road Crown Location	Road Class No.	Road Type	Road Crown Elev. (ft) NAVD	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?
ACN1-0	NE 151st St & NE 8th Ave *	3	Local	4.0	4.2	0.2	NO	4.5	0.5	NO	5.0	1.0	-
ACN1-1	NE 146th St & NE 8th Ave	3	Local	3.5	4.2	0.7	NO	4.5	1.0	NO	5.0	1.5	-
ACN1-2	NE 145th St W of NE 10th Ave	3	Local	3.5	1.4	-	YES	4.5	1.0	NO	5.0	1.5	-
ACN1-3	NE 144th St W of NE 10th Ave	3	Local	3.3	3.6	0.3	NO	4.5	1.2	NO	5.1	1.8	-
ACN1-4	NE 142nd St & NE 9th Ave	3	Local	7.2	6.3	-	YES	6.5	-	YES	6.7	-	-
ACN1-4A	NE 143rd St & NE 9th Ave	2	Arterial	3.7	4.3	0.6	NO	4.6	0.9	NO	5.1	1.4	NO
ACN1-5	NE 143rd St & NE 10th Ave	2	Arterial	3.1	3.7	0.6	NO	4.5	1.4	NO	5.1	2.0	NO
ACN1-6	NE 145th St & NE 10th Ave	2	Arterial	3.4	3.9	0.5	NO	4.5	1.1	NO	5.0	1.6	NO
ACN1-7	NE 147th St & NE 11th Ct	3	Local	3.9	3.0	-	YES	4.3	0.4	NO	5.0	1.1	-
ACN1-8	NE 143rd St & NE 12th Ave	2	Arterial	4.2	1.8	-	YES	4.3	0.0	NO	5.0	0.8	NO
ACN1-9	NE 144th St W of NE 14th Ave	4	NIC	2.5	4.2	1.7	-	4.4	1.9	-	5.1	2.6	-
ACN1-10	NE 146th St W of NE 14th Ave	4	NIC	2.5	4.2	1.7	-	4.4	1.9	-	5.1	2.6	-
ACN3-6	NE 127th St W of NE 12th Ave	3	Local	5.2	5.5	0.3	NO	6.0	0.8	NO	6.7	1.5	-
ACS1-1	NE 126th St W of NE 11th Ave	3	Local	5.7	5.8	0.1	NO	6.1	0.4	NO	6.7	1.0	-
ACS1-2	NE 123rd St W of NE 10th Ave	2	Arterial	5.8	6.0	0.2	NO	6.3	0.5	NO	6.5	0.7	NO
ACS1-3	NE 121st St W of NE 11th Ave *	3	Local	3.8	6.0	2.2	NO	6.3	2.5	NO	6.6	2.8	-
ACS1-3A	NE 125th St W of NE 11th Ave *	1	Emergency	7.2	5.8	-	-	6.1	-	-	6.6	-	-
ACS1-4	NE 12th Ave N of NE 124th St *	3	Local	6.1	6.6	0.5	NO	6.8	0.7	NO	7.0	0.9	-
ACS1-5	NE 13th Ave N of NE 125th St	3	Local	6.6	5.8	-	YES	6.1	-	YES	6.7	0.1	-
ACS1-6	NE 125th St E of NE 15th Ave	3	Local	1.7	2.7	1.0	NO	3.1	1.4	NO	3.4	1.7	-
ACS1-7	NE 121st St & NE 14th Ave *	2	Arterial	4.2	4.8	0.6	NO	5.1	0.9	NO	5.2	1.0	NO
ACS1-8	NE 124th St W of NE 17th Ave	3	Local	4.2	3.8	-	YES	4.0	-	YES	4.1	-	-
ACS1-9	NE 15th Ave S of NE 124th St *	1	Emergency	4.6	3.7	-	-	4.0	-	-	4.0	-	-
ACS2-1	NE 143rd St & NE 16th Ave	2	Arterial	4.8	4.7	-	YES	4.9	0.1	NO	5.2	0.4	NO
ACS2-2	NE 142nd St E of NE 17th Ave	2	Arterial	3.6	3.8	0.2	NO	4.3	0.7	NO	4.6	1.0	NO
ACS2-3	NE 144th St & NE 18th Ave	3	Local	4.0	4.7	0.7	NO	5.1	1.1	NO	5.4	1.4	-
ACS2-4	NE 149th St & NE 18th Ave *	3	Local	6.8	8.6	1.8	NO	9.3	2.5	NO	10.0	3.2	-

Table F-1: North Miami SWMM Peak Stage Results for 2-Year, 5-Year, and 10-Year Simulations

					Existing Condition 2-year, 24-hour (4.2-inch)			Existing Condition 5-year, 24-hour (5.9-inch)			Existing Condition 10-year, 72-hour (9.9-inch)		
Node	**Road Crown Location**	**Road Class No.**	**Road Type**	**Road Crown Elev. (ft) NAVD**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**
ACS2-5	NE 142nd St & NE 18th Ave *	3	Local	3.6	3.1	-	YES	3.4	-	YES	3.6	-	-
ACS2-6	NE 144th St & NE 18th Ave	4	NIC	3.9	4.1	0.2	-	4.3	0.4	-	4.6	0.7	-
ACS2-7	NE 144th St & NE 15th Ave *	4	NIC	4.0	5.1	1.1	-	5.5	1.5	-	5.6	1.6	-
ACS3-1	NE 137th St & NE 12th Ave	2	Arterial	6.8	7.4	0.6	NO	7.6	0.8	NO	7.9	1.1	NO
ACS3-10	NE 135th St E of NE 16th Ave *	1	Emergency	7.3	4.2	-	-	4.7	-	-	5.6	-	-
ACS3-2	NE 11th Ave S of NE 133rd St	3	Local	6.8	6.7	-	YES	7.0	0.2	NO	7.3	0.5	-
ACS3-3	NE 13th Ave N of NE 134th St	1	Local	5.7	6.0	0.3	NO	6.5	0.8	NO	6.8	1.1	-
ACS3-4	NE 138th St W of NE 16th Ave	3	Local	6.8	7.3	0.5	NO	7.5	0.7	NO	7.9	1.1	-
ACS3-5	NE 132nd St W of NE 14th Ave	3	Local	4.5	5.3	0.8	NO	6.0	1.5	NO	6.8	2.3	-
ACS3-6	NE 137th St E of NE 16th Ave	3	Local	3.5	3.4	-	YES	4.2	0.7	NO	4.5	1.0	-
ACS3-7	NE 16th Ave N of NE 135th St *	3	Local	6.7	3.8	-	YES	4.5	-	YES	5.2	-	-
ACS3-8	NE 136th St W of NE 15th Ave	3	Local	3.3	5.5	2.2	NO	6.1	2.8	NO	6.8	3.5	-
ACS3-8A	NE 137th St & NE 16th Ave	3	Local	7.2	4.7	-	YES	5.3	-	YES	5.9	-	-
ACS3-9	Unnamed *	3	Local	3.0	3.2	0.2	NO	3.4	0.4	NO	3.5	0.5	-
ACS4-1	Emerald NE of NE 16th Ave	3	Local	4.7	2.5	-	YES	3.1	-	YES	4.3	-	-
ACS4-2	17th Ave (Moefeld) N of NE 127th St	3	Local	3.8	4.3	0.5	NO	4.4	0.6	NO	4.5	0.7	-
ACS5-1	NE 127th St E of 17th Ave (Moefeld)	3	Local	3.2	3.6	0.4	NO	3.8	0.6	NO	4.0	0.8	-
BE1-1	NE 141st St & NE 4th Ave *	3	Local	2.3	2.6	0.3	NO	3.2	0.9	NO	3.6	1.3	-
BE1-2	NE 139th St & NE 4th Ave *	3	Local	2.4	2.5	0.1	NO	3.0	0.6	NO	3.6	1.2	-
BE1-3	NE 137th St & NE 4th Ave *	3	Local	3.3	2.9	-	YES	3.2	-	YES	3.4	0.1	-
BE1-4	NE 6th Ave S of NE 151st St *	1	Emergency	5.7	6.2	0.5	-	6.4	0.7	-	6.5	0.8	-
BE1-5	NE 6th Ave S of NE 140th St *	1	Emergency	9.5	8.8	-	-	8.9	-	-	9.0	-	-
BE1-6	NE 138th St & NE 6th Ave *	1	Emergency	7.9	7.2	-	-	7.4	-	-	7.7	-	-
BE1-7	NE 136th St & NE 6th Ave *	1	Emergency	7.6	5.8	-	-	7.0	-	-	7.7	0.1	-
BE1-8	NE 131st St & NE 6th Ave *	1	Emergency	7.2	6.8	-	-	7.0	-	-	7.3	0.1	-
BE1-9	NE 127th St & NE 6th Ave *	1	Emergency	7.6	5.0	-	-	5.5	-	-	6.1	-	-
BE1-10	NE 125th St & NE 3rd Ave *	1	Emergency	5.8	5.1	-	-	5.8	0.0	-	5.9	0.1	-

Table F-1: North Miami SWMM Peak Stage Results for 2-Year, 5-Year, and 10-Year Simulations

					Existing Condition 2-year, 24-hour (4.2-inch)			Existing Condition 5-year, 24-hour (5.9-inch)			Existing Condition 10-year, 72-hour (9.9-inch)		
Node	**Road Crown Location**	**Road Class No.**	**Road Type**	**Road Crown Elev. (ft) NAVD**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**
BE1-11	Dixie Hwy NE of Grieffing *	1	Emergency	6.1	2.1	-	-	2.5	-	-	2.8	-	-
BE1-12	NE 125th St & NE 9th Ave	1	Emergency	7.0	5.1	-	-	5.7	-	-	6.4	-	-
BE1-13	NE 125th St & NE 10th Ave *	1	Emergency	7.0	6.1	-	-	6.6	-	-	6.8	-	-
BE1-14	Dixie Hwy & NE 129th St *	1	Emergency	7.1	6.8	-	-	7.1	0.0	-	7.4	0.3	-
BE1-15	Dixie Hwy & NE 134th St *	1	Emergency	7.8	7.5	-	-	7.7	-	-	7.9	0.1	-
BE1-16	NE 135th St & NE 13th Ave *	1	Emergency	6.2	6.0	-	-	6.5	0.3	-	6.8	0.6	-
BE1-17	NE 135th St W of NE 16th Ave *	1	Emergency	5.1	5.5	0.4	-	6.1	1.0	-	6.8	1.7	-
BE1-18	Dixie Hwy & NE 136th St *	1	Emergency	8.7	8.7	-	-	8.9	0.2	-	9.0	0.3	-
BE1-19	Dixie Hwy & NE 141st St *	1	Emergency	9.6	8.4	-	-	8.6	-	-	8.7	-	-
BE1-20	Dixie Hwy & NE 145th St *	1	Emergency	6.7	5.7	-	-	5.8	-	-	5.8	-	-
BE2-1	NE 137th St W of NE 9th Ave	2	Arterial	8.3	8.3	-	YES	8.5	0.2	NO	8.7	0.4	NO
BE2-2	NE 137th St W of NE 9th Ave	2	Arterial	8.3	7.8	-	YES	8.1	-	YES	8.5	0.1	NO
BE2-3	NE 135th St & NE 7th Ave *	1	Emergency	7.3	6.4	-	-	7.4	0.1	-	7.9	0.6	-
BE2-4	NE 132nd St E of NE 8th Ave	3	Local	7.2	7.5	0.3	NO	7.7	0.5	NO	7.9	0.7	-
BE2-4A	NE 135th St & NE 8th Ave *	1	Emergency	7.8	6.7	-	-	7.6	-	-	8.0	0.2	-
BE2-5	NE 138th St & NE 7th Ave	3	Local	7.0	6.4	-	YES	7.4	0.4	NO	7.8	0.8	-
BE2-7	NE 132nd St W of NE 7th Ave	3	Local	7.1	7.2	0.1	NO	7.4	0.3	NO	7.9	0.8	-
BE2-8	NE 132nd St & NE 4th Ave *	3	Local	5.2	5.9	0.7	NO	6.5	1.3	NO	7.2	2.0	-
BE3-1	NE 129th St & NE 7th Ave	3	Local	6.0	6.8	0.8	NO	7.1	1.1	NO	7.4	1.4	-
BE3-2	NE 129th St & NE 8th Ave	3	Local	6.5	6.9	0.4	NO	7.2	0.7	NO	7.4	0.9	-
BE3-3	NE 129th St & NE 11th Ave	3	Local	6.7	6.9	0.2	NO	7.1	0.4	NO	7.4	0.7	-
BE4-1	NE 127th St W of NE 8th Ave	3	Local	5.7	6.4	0.7	NO	7.1	1.4	NO	7.3	1.6	-
BE4-2	NE 123rd St & of NE 9th Ave	3	Local	6.0	6.5	0.5	NO	6.6	0.6	NO	6.7	0.7	-
BE4-3	NE 8th Ave N of NE 121st St	3	Local	6.0	5.6	-	YES	6.1	0.1	NO	6.3	0.3	-
BE4-4	NE 7th Ave N of NE 125th St	3	Local	6.6	6.4	-	YES	6.9	0.3	NO	7.1	0.5	-
BE4-5	NE 124th St & NE 6th Ave	3	Local	6.0	6.1	0.0	NO	6.3	0.3	NO	6.4	0.4	-
BE4-6	NE 5th Ave N of NE 125th St	3	Local	6.1	6.3	0.2	NO	6.5	0.4	NO	6.7	0.6	-

Table F-1: North Miami SWMM Peak Stage Results for 2-Year, 5-Year, and 10-Year Simulations

					Existing Condition 2-year, 24-hour (4.2-inch)			Existing Condition 5-year, 24-hour (5.9-inch)			Existing Condition 10-year, 72-hour (9.9-inch)		
Node	Road Crown Location	Road Class No.	Road Type	Road Crown Elev. (ft) NAVD	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?
BE4-7	NE 4th Ave S of NE 129th St *	3	Local	6.4	6.4	-	YES	6.6	0.2	NO	6.7	0.3	-
BE4-8	NE 3rd Ave S of NE 126th St *	3	Local	5.7	5.6	-	YES	5.8	0.1	NO	6.0	0.3	-
BE4-9	NE 123rd St & Grieffing *	2	Arterial	4.9	4.7	-	YES	5.4	0.5	NO	5.8	0.9	NO
BE5-1	NE 129th St & Grieffiing *	2	Arterial	5.3	3.0	-	YES	3.8	-	YES	4.0	-	YES
BE6-1	NE 11th Ave S of NE 138th St	3	Local	8.4	8.2	-	YES	8.4	-	YES	8.7	0.3	-
BE6-2	NE 138th St E of NE 13th Ave	3	Local	7.2	8.2	1.0	NO	8.5	1.3	NO	8.8	1.6	-
BE6-3	NE 141st St & NE 14th Ave	1	Emergency	6.6	7.1	0.5	-	7.7	1.1	-	8.5	1.9	-
BE7-1	NE 3rd Ave S of NE 138th St	3	Local	2.7	2.8	0.1	NO	2.9	0.2	NO	3.1	0.4	-
BE7-2	NE 2nd Ct S of NE 141st St *	4	NIC	2.8	3.2	0.4	-	3.2	0.4	-	3.3	0.5	-
BE7-3	NE 4th Ave S of NE 135th St *	3	Local	2.5	3.4	0.9	NO	3.7	1.2	NO	4.1	1.6	-
BE7-4	NE 131st St E of Grieffiing *	3	Local	3.0	2.8	-	YES	3.1	0.1	NO	3.3	0.3	-
BE7-5	Grieffiing N of NE 135th St & *	4	NIC	4.2	2.2	-	-	2.7	-	-	3.1	-	-
BW1-1A	NW 12th Ave N of NW 133rd St	2	Arterial	9.7	9.0	-	YES	9.2	-	YES	10.1	0.4	NO
BW1-1B	NW 132nd St E of NW 16th Ave	3	Local	10.1	10.1	-	YES	10.2	0.1	NO	10.3	0.2	-
BW1-1C	NW 13th Ave N of NW 132nd St	3	Local	9.5	9.2	-	YES	9.4	-	YES	10.1	0.6	-
BW1-2	NW 13th Ave N of NW 128th St	3	Local	9.0	9.0	0.0	NO	9.3	0.3	NO	10.1	1.1	-
BW1-3	NW 130th St E of NW 13th Ave	3	Local	9.6	9.4	-	YES	9.5	-	YES	10.1	0.5	-
BW1-4	NW 16th Ave N of NW 123rd St	3	Local	9.6	9.1	-	YES	9.3	-	YES	10.1	0.5	-
BW1-5	NW 15th Ave N of NW 127th St	3	Local	9.2	8.9	-	YES	9.3	0.1	NO	10.1	0.9	-
BW1-6	NW 126th St E of NW 15th Ave	3	Local	8.7	8.8	0.1	NO	9.3	0.6	NO	10.1	1.4	-
BW1-7	NW 121st St & NW 16th Ave	3	Local	9.8	9.2	-	YES	9.4	-	YES	10.1	0.3	-
BW1-8	NW 121st St & NW 13th Ave	3	Local	9.7	9.3	-	YES	9.5	-	YES	10.1	0.4	-
BW1-9	NW 121st St E of NW 11th Ave	2	Arterial	9.0	9.1	0.1	NO	9.4	0.4	NO	10.1	1.1	NO
BW1-10	NW 125th St & NW 11th Ave	3	Local	9.6	9.1	-	YES	9.4	-	YES	10.1	0.5	-
BW1-10A	NW 12th Ave S of NW 125th St	2	Arterial	9.5	9.0	-	YES	9.4	-	YES	10.1	0.6	NO
BW1-11	NW 121st St E of NW 11th Ave	3	Local	9.3	9.2	-	YES	9.5	0.2	NO	10.1	0.8	-
BW1-12	NW 120th St W of NW 11th Ave	3	Local	9.0	9.3	0.3	NO	9.5	0.5	NO	10.1	1.1	-

Table F-1: North Miami SWMM Peak Stage Results for 2-Year, 5-Year, and 10-Year Simulations

					Existing Condition 2-year, 24-hour (4.2-inch)			Existing Condition 5-year, 24-hour (5.9-inch)			Existing Condition 10-year, 72-hour (9.9-inch)		
Node	Road Crown Location	Road Class No.	Road Type	Road Crown Elev. (ft) NAVD	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?
BW1-13	NW 126th St E of NW 8th Ave	3	Local	9.4	8.9	-	YES	9.4	-	YES	10.0	0.6	-
BW1-13A	NW 125th St E of NW 9th Ave	3	Local	9.4	9.0	-	YES	9.4	-	YES	10.0	0.6	-
BW1-14	NW 8th Ave S of NW 122nd St	3	Local	9.5	9.3	-	YES	9.5	-	YES	10.1	0.6	-
BW1-15A	NW 122nd St W of NW 7th Ave	3	Emergency	9.4	8.9	-	-	9.4	-	-	10.0	0.5	-
BW1-15B	NW 119th St W of NW 10th Ave	4	NIC	10.0	10.1	0.1	-	10.6	0.6	-	11.1	1.1	-
BW1-15C	NW 15th Ave S of NW 119th St	4	NIC	9.2	9.9	0.7	-	10.2	1.0	-	10.5	1.3	-
BW1-16	NW 4th Ave S of NW 127th St	3	Local	9.8	9.9	0.0	NO	9.9	0.1	NO	10.1	0.3	-
BW1-17	NW 4th Ave S of NW 121st St	3	Local	8.8	8.9	0.1	NO	9.1	0.3	NO	9.4	0.6	-
BW1-18	NW 4th Ave N of NW 124th St	3	Local	8.9	6.7	-	YES	7.9	-	YES	9.3	0.4	-
BW1-19	NW 125th St W of NW 1st Ave	1	Emergency	10.3	5.3	-	-	6.1	-	-	7.4	-	-
BW1-19A	NW 1st Ave N of NW 127th St	3	Local	10.8	10.1	-	YES	10.5	-	YES	11.2	0.4	-
BW1-20	NW 120th St E of NW 1st Ave	3	Local	7.6	8.4	0.8	NO	8.6	1.0	NO	9.2	1.6	-
BW1-21	NE 1st Ave S of NE 125th St	3	Local	3.8	3.0	-	YES	3.4	-	YES	4.1	0.3	-
BW1-22	NE 123rd Rd W of NE 2nd Ave	3	Local	3.8	2.7	-	YES	3.3	-	YES	4.3	0.5	-
BW1-23	Dixie Hwy NE of NE 119th St *	1	Emergency	6.1	1.1	-	-	1.1	-	-	1.2	-	-
BW2-1A	NW 134th St W of NW 11th Ave	3	Local	9.3	9.2	-	YES	9.4	0.1	NO	10.0	0.7	-
BW2-1B	NW 131st St W of NW 10th Ave	3	Local	9.2	9.1	-	YES	9.4	0.2	NO	10.0	0.8	-
BW2-2	NW 134th St E of NW 8th Ave	3	Local	9.0	9.1	0.1	NO	9.4	0.4	NO	10.0	1.0	-
BW2-3	NW 131st St W of NW 8th Ave	3	Local	9.0	9.0	0.0	NO	9.4	0.4	NO	10.0	1.0	-
BW2-4A	NW 8th Ave S of NW 128th St	3	Local	9.0	8.9	-	YES	9.4	0.4	NO	10.0	1.0	-
BW2-4B	NW 128th St W of NW 10th Ave	3	Local	8.9	9.0	0.1	NO	9.4	0.5	NO	10.0	1.1	-
BW2-4C	NW 129th St E of NW 11th Ave	3	Local	9.4	9.2	-	YES	9.4	0.0	NO	10.0	0.6	-
BW2-5	NW 6th Ave S of NW 130th St	2	Emergency	9.0	9.0	-	-	9.4	0.4	-	9.9	0.9	-
BW2-6	NW 131st St W of NW 5th Ave	3	Local	9.0	3.5	-	YES	5.4	-	YES	9.4	0.4	-
BW2-7	NW 5th Ave S of NW 129th St	3	Local	9.5	4.1	-	YES	7.0	-	YES	10.0	0.5	-
BW2-8	NW 133rd St W of NW 2nd Ave	3	Local	10.1	5.1	-	YES	10.1	0.0	NO	10.9	0.8	-
BW2-9	NW 130th St W of NW 2nd Ave	3	Local	9.7	6.2	-	YES	9.6	-	YES	10.3	0.6	-

Table F-1: North Miami SWMM Peak Stage Results for 2-Year, 5-Year, and 10-Year Simulations

					Existing Condition 2-year, 24-hour (4.2-inch)			Existing Condition 5-year, 24-hour (5.9-inch)			Existing Condition 10-year, 72-hour (9.9-inch)		
Node	**Road Crown Location**	**Road Class No.**	**Road Type**	**Road Crown Elev. (ft) NAVD**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**
BW2-10	NW 132nd St W of NW 2nd Ave	3	Local	9.8	2.9	-	YES	4.5	-	YES	7.9	-	-
BW2-11	NE 130th St W of NE 2nd Ave	3	Local	3.9	1.8	-	YES	2.6	-	YES	4.0	0.1	-
BW3-1A	NW 6th Ave S of NW 137th St *	2	Emergency	9.8	9.4	-	-	9.9	0.1	-	10.2	0.4	-
BW3-1B	NW 7th Ave S of NW 140th St *	2	Emergency	11.4	10.7	-	-	11.1	-	-	11.9	0.5	-
BW3-1C	NW 6th Ave S of NW 135th St	2	Emergency	8.9	9.0	0.1	-	9.5	0.6	-	9.9	1.0	-
BW3-1D	NW 135th St W of NW 8th Ave *	1	Emergency	9.4	9.3	-	-	9.4	0.0	-	10.0	0.6	-
BW3-1E	NW 135th St & NW 13th Ave *	1	Emergency	9.2	9.1	-	-	9.4	0.2	-	10.1	0.9	-
BW3-1F	NW 135th St W of NW 15th Ave *	1	Emergency	10.0	9.1	-	-	9.3	-	-	10.1	0.1	-
BW3-1G	NW 135th St W of NW 18th Ave *	4	NIC	9.5	2.5	-	-	4.3	-	-	7.8	-	-
BW3-1H	NW 17th Ave S of NW 130th St *	4	NIC	9.5	10.2	0.7	-	10.3	0.8	-	10.5	1.0	-
BW3-1I	NW 17th Ave S of NW 123rd St *	4	NIC	9.2	10.2	1.0	-	10.3	1.1	-	10.5	1.3	-
BW3-2	NW 5th Ave S of NW 137th St *	3	Local	10.4	8.6	-	YES	10.1	-	YES	10.5	0.1	-
BW3-2A	NW 135th St W of NW 5th Ave *	1	Emergency	10.3	4.0	-	-	5.8	-	-	9.5	-	-
BW3-3A	NE 2nd Ave S of NE 135th St	3	Local	2.7	1.9	-	YES	2.4	-	YES	3.4	0.7	-
BW3-3B	NE 139th St W of Biscayne Riv Dr *	4	NIC	2.7	3.1	0.4	-	3.3	0.6	-	3.5	0.8	-
BW3-4	Miami Ave S of NE 135th St	3	Local	5.5	4.7	-	YES	5.3	-	YES	5.7	0.2	-
BW3-4B	NE 1st Ave N of NE 135th St *	3	Local	2.5	2.2	-	YES	2.8	0.3	NO	3.6	1.1	-
BW4-1	NE 133rd St W of NE 2nd Ave	3	Local	3.5	3.2	-	YES	3.4	-	YES	3.5	0.0	-
BW5-1	NE 127th St & NE 1st Ave	3	Local	3.5	2.5	-	YES	3.3	-	YES	4.1	0.6	-
BW6-1	NE 2nd Ave N of NE 121st St	2	Arterial	4.5	4.0	-	YES	4.4	-	YES	4.9	0.4	NO

1) Where no survey was available and elevation was estimated from LIDAR *

2) NIC = Not in City of North Miami limits

3) Structural flooding of private property not included in this LOS analysis

Table F-1: North Miami SWMM Peak Stage Results for 2-Year, 5-Year, and 10-Year Simulations

					Existing Condition 2-year, 24-hour (4.2-inch)			Existing Condition 5-year, 24-hour (5.9-inch)			Existing Condition 10-year, 72-hour (9.9-inch)		
Node	**Road Crown Location**	**Road Class No.**	**Road Type**	**Road Crown Elev. (ft) NAVD**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**

Streets Evaluated	**Criteria**	**2-year**		**5-year**		**10-year**
Total	No. of CNM locations not meeting LOS =	49		72		
	No. of CNM locations evaluated for LOS =	109		109		
	% of CNM locations not meeting LOS =	45%		66%		
Local	No. of CNM locations not meeting LOS =	41		60		
	No. of CNM locations evaluated for LOS =	92		92		
	% of CNM locations not meeting LOS =	45%		65%		
Arterial	No. of CNM locations not meeting LOS =	8		12		16
	No. of CNM locations evaluated for LOS =	17		17		17
	% of CNM locations not meeting LOS =	47%		71%		94%
Emergency	No. of CNM locations not meeting LOS =					
	No. of CNM locations evaluated for LOS =					
	% of CNM locations not meeting LOS =					

Table F-2: North Miami SWMM Peak Stage Results for 25-Year and 100-Year Simulations

					Existing Condition 25-year, 72-hour (11.0-inch)			Existing Condition 100-year, 72-hour (14.0-inch)		
Node	**Road Crown Location**	**Road Class No.**	**Road Type**	**Road Crown Elev. (ft) NAVD**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**
ACN1-0	NE 151st St & NE 8th Ave *	3	Local	4.0	5.1	1.1	-	5.4	1.4	-
ACN1-1	NE 146th St & NE 8th Ave	3	Local	3.5	5.2	1.7	-	5.5	2.0	-
ACN1-2	NE 145th St W of NE 10th Ave	3	Local	3.5	5.2	1.7	-	5.5	2.0	-
ACN1-3	NE 144th St W of NE 10th Ave	3	Local	3.3	5.2	1.9	-	5.5	2.2	-
ACN1-4	NE 142nd St & NE 9th Ave	3	Local	7.2	6.8	-	-	7.1	-	-
ACN1-4A	NE 143rd St & NE 9th Ave	2	Arterial	3.7	5.2	1.5	-	7.1	3.4	-
ACN1-5	NE 143rd St & NE 10th Ave	2	Arterial	3.1	5.2	2.1	-	5.5	2.4	-
ACN1-6	NE 145th St & NE 10th Ave	2	Arterial	3.4	5.2	1.8	-	5.5	2.1	-
ACN1-7	NE 147th St & NE 11th Ct	3	Local	3.9	5.2	1.3	-	5.5	1.6	-
ACN1-8	NE 143rd St & NE 12th Ave	2	Arterial	4.2	5.2	1.0	-	5.5	1.3	-
ACN1-9	NE 144th St W of NE 14th Ave	4	NIC	2.5	5.2	2.7	-	5.5	3.0	-
ACN1-10	NE 146th St W of NE 14th Ave	4	NIC	2.5	5.2	2.7	-	5.5	3.0	-
ACN3-6	NE 127th St W of NE 12th Ave	3	Local	5.2	6.9	1.7	-	7.3	2.1	-
ACS1-1	NE 126th St W of NE 11th Ave	3	Local	5.7	6.9	1.2	-	7.2	1.5	-
ACS1-2	NE 123rd St W of NE 10th Ave	2	Arterial	5.8	6.6	0.8	-	6.9	1.1	-
ACS1-3	NE 121st St W of NE 11th Ave *	3	Local	3.8	6.6	2.8	-	6.9	3.1	-
ACS1-3A	NE 125th St W of NE 11th Ave *	1	Emergency	7.2	6.7	-	-	7.2	-	YES
ACS1-4	NE 12th Ave N of NE 124th St *	3	Local	6.1	7.1	1.0	-	7.2	1.1	-
ACS1-5	NE 13th Ave N of NE 125th St	3	Local	6.6	6.9	0.3	-	7.2	0.6	-
ACS1-6	NE 125th St E of NE 15th Ave	3	Local	1.7	3.5	1.8	-	3.7	2.0	-
ACS1-7	NE 121st St & NE 14th Ave *	2	Arterial	4.2	5.3	1.1	-	5.4	1.2	-
ACS1-8	NE 124th St W of NE 17th Ave	3	Local	4.2	4.2	0.0	-	4.4	0.2	-
ACS1-9	NE 15th Ave S of NE 124th St *	1	Emergency	4.6	4.1	-	-	4.2	-	YES
ACS2-1	NE 143rd St & NE 16th Ave	2	Arterial	4.8	5.2	0.4	-	5.4	0.6	-
ACS2-2	NE 142nd St E of NE 17th Ave	2	Arterial	3.6	4.7	1.1	-	4.9	1.3	-
ACS2-3	NE 144th St & NE 18th Ave	3	Local	4.0	5.8	1.8	-	6.7	2.7	-
ACS2-4	NE 149th St & NE 18th Ave *	3	Local	6.8	10.3	3.5	-	11.0	4.2	-

Table F-2: North Miami SWMM Peak Stage Results for 25-Year and 100-Year Simulations

					Existing Condition 25-year, 72-hour (11.0-inch)			Existing Condition 100-year, 72-hour (14.0-inch)		
Node	Road Crown Location	Road Class No.	Road Type	Road Crown Elev. (ft) NAVD	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?
ACS2-5	NE 142nd St & NE 18th Ave *	3	Local	3.6	3.7	0.0	-	4.1	0.5	-
ACS2-6	NE 144th St & NE 18th Ave	4	NIC	3.9	4.7	0.8	-	4.9	1.0	-
ACS2-7	NE 144th St & NE 15th Ave *	4	NIC	4.0	5.7	1.7	-	5.9	1.9	-
ACS3-1	NE 137th St & NE 12th Ave	2	Arterial	6.8	8.0	1.2	-	8.1	1.3	-
ACS3-10	NE 135th St E of NE 16th Ave *	1	Emergency	7.3	5.8	-	-	6.3	-	YES
ACS3-2	NE 11th Ave S of NE 133rd St	3	Local	6.8	7.4	0.6	-	7.5	0.7	-
ACS3-3	NE 13th Ave N of NE 134th St	1	Local	5.7	7.0	1.3	-	7.4	1.7	-
ACS3-4	NE 138th St W of NE 16th Ave	3	Local	6.8	8.0	1.2	-	8.1	1.3	-
ACS3-5	NE 132nd St W of NE 14th Ave	3	Local	4.5	6.9	2.4	-	7.3	2.8	-
ACS3-6	NE 137th St E of NE 16th Ave	3	Local	3.5	4.6	1.1	-	4.7	1.2	-
ACS3-7	NE 16th Ave N of NE 135th St *	3	Local	6.7	5.4	-	-	5.8	-	-
ACS3-8	NE 136th St W of NE 15th Ave	3	Local	3.3	7.0	3.7	-	7.3	4.0	-
ACS3-8A	NE 137th St & NE 16th Ave	3	Local	7.2	6.0	-	-	6.3	-	-
ACS3-9	Unnamed *	3	Local	3.0	3.5	0.5	-	3.9	0.9	-
ACS4-1	Emerald NE of NE 16th Ave	3	Local	4.7	4.4	-	-	4.7	-	-
ACS4-2	17th Ave (Moefeld) N of NE 127th St	3	Local	3.8	4.6	0.8	-	4.7	0.9	-
ACS5-1	NE 127th St E of 17th Ave (Moefeld)	3	Local	3.2	4.0	0.8	-	4.2	1.0	-
BE1-1	NE 141st St & NE 4th Ave *	3	Local	2.3	3.7	1.4	-	3.9	1.6	-
BE1-2	NE 139th St & NE 4th Ave *	3	Local	2.4	3.7	1.3	-	3.9	1.5	-
BE1-3	NE 137th St & NE 4th Ave *	3	Local	3.3	3.4	0.1	-	3.6	0.3	-
BE1-4	NE 6th Ave S of NE 151st St *	1	Emergency	5.7	6.5	0.8	-	6.7	1.0	NO
BE1-5	NE 6th Ave S of NE 140th St *	1	Emergency	9.5	9.1	-	-	9.1	-	YES
BE1-6	NE 138th St & NE 6th Ave *	1	Emergency	7.9	7.8	-	-	7.9	0.0	NO
BE1-7	NE 136th St & NE 6th Ave *	1	Emergency	7.6	7.8	0.2	-	8.0	0.4	NO
BE1-8	NE 131st St & NE 6th Ave *	1	Emergency	7.2	7.4	0.2	-	7.7	0.5	NO
BE1-9	NE 127th St & NE 6th Ave *	1	Emergency	7.6	6.4	-	-	7.0	-	YES
BE1-10	NE 125th St & NE 3rd Ave *	1	Emergency	5.8	6.0	0.2	-	6.2	0.4	NO

Table F-2: North Miami SWMM Peak Stage Results for 25-Year and 100-Year Simulations

					Existing Condition 25-year, 72-hour (11.0-inch)			Existing Condition 100-year, 72-hour (14.0-inch)		
Node	Road Crown Location	Road Class No.	Road Type	Road Crown Elev. (ft) NAVD	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?
BE1-11	Dixie Hwy NE of Grieffing *	1	Emergency	6.1	2.9	-	-	3.4	-	YES
BE1-12	NE 125th St & NE 9th Ave	1	Emergency	7.0	6.7	-	-	7.1	0.1	NO
BE1-13	NE 125th St & NE 10th Ave *	1	Emergency	7.0	6.9	-	-	7.2	0.2	NO
BE1-14	Dixie Hwy & NE 129th St *	1	Emergency	7.1	7.5	0.4	-	7.7	0.6	NO
BE1-15	Dixie Hwy & NE 134th St *	1	Emergency	7.8	7.9	0.1	-	8.1	0.3	NO
BE1-16	NE 135th St & NE 13th Ave *	1	Emergency	6.2	7.0	0.8	-	7.4	1.2	NO
BE1-17	NE 135th St W of NE 16th Ave *	1	Emergency	5.1	6.9	1.8	-	7.3	2.2	NO
BE1-18	Dixie Hwy & NE 136th St *	1	Emergency	8.7	9.0	0.3	-	9.1	0.4	NO
BE1-19	Dixie Hwy & NE 141st St *	1	Emergency	9.6	8.7	-	-	8.8	-	YES
BE1-20	Dixie Hwy & NE 145th St *	1	Emergency	6.7	5.8	-	-	5.9	-	YES
BE2-1	NE 137th St W of NE 9th Ave	2	Arterial	8.3	8.8	0.5	-	8.9	0.6	-
BE2-2	NE 137th St W of NE 9th Ave	2	Arterial	8.3	8.5	0.2	-	8.7	0.4	-
BE2-3	NE 135th St & NE 7th Ave *	1	Emergency	7.3	8.0	0.7	-	8.1	0.8	NO
BE2-4	NE 132nd St E of NE 8th Ave	3	Local	7.2	8.0	0.8	-	8.1	0.9	-
BE2-4A	NE 135th St & NE 8th Ave *	1	Emergency	7.8	8.1	0.3	-	8.2	0.4	NO
BE2-5	NE 138th St & NE 7th Ave	3	Local	7.0	7.9	0.9	-	8.1	1.1	-
BE2-7	NE 132nd St W of NE 7th Ave	3	Local	7.1	8.0	0.9	-	8.1	1.0	-
BE2-8	NE 132nd St & NE 4th Ave *	3	Local	5.2	7.3	2.1	-	7.6	2.4	-
BE3-1	NE 129th St & NE 7th Ave	3	Local	6.0	7.4	1.4	-	7.7	1.7	-
BE3-2	NE 129th St & NE 8th Ave	3	Local	6.5	7.5	1.0	-	7.7	1.2	-
BE3-3	NE 129th St & NE 11th Ave	3	Local	6.7	7.4	0.7	-	7.6	0.9	-
BE4-1	NE 127th St W of NE 8th Ave	3	Local	5.7	7.4	1.7	-	7.6	1.9	-
BE4-2	NE 123rd St & of NE 9th Ave	3	Local	6.0	6.7	0.7	-	6.9	0.9	-
BE4-3	NE 8th Ave N of NE 121st St	3	Local	6.0	6.4	0.4	-	6.7	0.7	-
BE4-4	NE 7th Ave N of NE 125th St	3	Local	6.6	7.1	0.5	-	7.2	0.6	-
BE4-5	NE 124th St & NE 6th Ave	3	Local	6.0	6.5	0.5	-	6.6	0.6	-
BE4-6	NE 5th Ave N of NE 125th St	3	Local	6.1	6.7	0.6	-	6.8	0.7	-

Table F-2: North Miami SWMM Peak Stage Results for 25-Year and 100-Year Simulations

					Existing Condition 25-year, 72-hour (11.0-inch)			Existing Condition 100-year, 72-hour (14.0-inch)		
Node	Road Crown Location	Road Class No.	Road Type	Road Crown Elev. (ft) NAVD	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?
BE4-7	NE 4th Ave S of NE 129th St *	3	Local	6.4	6.8	0.4	-	6.9	0.5	-
BE4-8	NE 3rd Ave S of NE 126th St *	3	Local	5.7	6.0	0.3	-	6.2	0.5	-
BE4-9	NE 123rd St & Grieffing *	2	Arterial	4.9	5.9	1.0	-	6.1	1.2	-
BE5-1	NE 129th St & Grieffiing *	2	Arterial	5.3	4.1	-	-	4.2	-	-
BE6-1	NE 11th Ave S of NE 138th St	3	Local	8.4	8.8	0.4	-	8.9	0.5	-
BE6-2	NE 138th St E of NE 13th Ave	3	Local	7.2	8.8	1.6	-	8.9	1.7	-
BE6-3	NE 141st St & NE 14th Ave	1	Emergency	6.6	8.6	2.0	-	8.8	2.2	NO
BE7-1	NE 3rd Ave S of NE 138th St	3	Local	2.7	3.2	0.5	-	3.3	0.6	-
BE7-2	NE 2nd Ct S of NE 141st St *	4	NIC	2.8	3.3	0.5	-	3.3	0.5	-
BE7-3	NE 4th Ave S of NE 135th St *	3	Local	2.5	4.1	1.6	-	4.3	1.8	-
BE7-4	NE 131st St E of Grieffiing *	3	Local	3.0	3.4	0.4	-	3.7	0.7	-
BE7-5	Grieffiing N of NE 135th St & *	4	NIC	4.2	3.2	-	-	3.6	-	-
BW1-1A	NW 12th Ave N of NW 133rd St	2	Arterial	9.7	10.2	0.5	-	10.5	0.8	-
BW1-1B	NW 132nd St E of NW 16th Ave	3	Local	10.1	10.4	0.3	-	10.6	0.5	-
BW1-1C	NW 13th Ave N of NW 132nd St	3	Local	9.5	10.2	0.7	-	10.5	1.0	-
BW1-2	NW 13th Ave N of NW 128th St	3	Local	9.0	10.3	1.3	-	10.6	1.6	-
BW1-3	NW 130th St E of NW 13th Ave	3	Local	9.6	10.2	0.6	-	10.6	1.0	-
BW1-4	NW 16th Ave N of NW 123rd St	3	Local	9.6	10.3	0.7	-	10.6	1.0	-
BW1-5	NW 15th Ave N of NW 127th St	3	Local	9.2	10.3	1.1	-	10.6	1.4	-
BW1-6	NW 126th St E of NW 15th Ave	3	Local	8.7	10.3	1.6	-	10.6	1.9	-
BW1-7	NW 121st St & NW 16th Ave	3	Local	9.8	10.3	0.5	-	10.6	0.8	-
BW1-8	NW 121st St & NW 13th Ave	3	Local	9.7	10.3	0.6	-	10.6	0.9	-
BW1-9	NW 121st St E of NW 11th Ave	2	Arterial	9.0	10.2	1.2	-	10.5	1.5	-
BW1-10	NW 125th St & NW 11th Ave	3	Local	9.6	10.2	0.6	-	10.5	0.9	-
BW1-10A	NW 12th Ave S of NW 125th St	2	Arterial	9.5	10.2	0.7	-	10.6	1.1	-
BW1-11	NW 121st St E of NW 11th Ave	3	Local	9.3	10.2	0.9	-	10.6	1.3	-
BW1-12	NW 120th St W of NW 11th Ave	3	Local	9.0	10.2	1.2	-	10.6	1.6	-

Table F-2: North Miami SWMM Peak Stage Results for 25-Year and 100-Year Simulations

					Existing Condition 25-year, 72-hour (11.0-inch)			Existing Condition 100-year, 72-hour (14.0-inch)		
Node	Road Crown Location	Road Class No.	Road Type	Road Crown Elev. (ft) NAVD	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?	Existing Peak Stage (ft) NAVD	Flood Depth (ft)	Meets LOS?
BW1-13	NW 126th St E of NW 8th Ave	3	Local	9.4	10.2	0.8	-	10.5	1.1	-
BW1-13A	NW 125th St E of NW 9th Ave	3	Local	9.4	10.2	0.8	-	10.5	1.1	-
BW1-14	NW 8th Ave S of NW 122nd St	3	Local	9.5	10.2	0.7	-	10.5	1.0	-
BW1-15A	NW 122nd St W of NW 7th Ave	3	Emergency	9.4	10.1	0.7	-	10.5	1.1	NO
BW1-15B	NW 119th St W of NW 10th Ave	4	NIC	10.0	11.2	1.2	-	11.7	1.7	-
BW1-15C	NW 15th Ave S of NW 119th St	4	NIC	9.2	10.6	1.4	-	10.8	1.6	-
BW1-16	NW 4th Ave S of NW 127th St	3	Local	9.8	10.2	0.4	-	10.4	0.6	-
BW1-17	NW 4th Ave S of NW 121st St	3	Local	8.8	9.5	0.7	-	10.2	1.4	-
BW1-18	NW 4th Ave N of NW 124th St	3	Local	8.9	9.5	0.6	-	10.1	1.2	-
BW1-19	NW 125th St W of NW 1st Ave	1	Emergency	10.3	7.9	-	-	9.0	-	YES
BW1-19A	NW 1st Ave N of NW 127th St	3	Local	10.8	11.6	0.8	-	12.1	1.3	-
BW1-20	NW 120th St E of NW 1st Ave	3	Local	7.6	9.3	1.7	-	9.6	2.0	-
BW1-21	NE 1st Ave S of NE 125th St	3	Local	3.8	4.3	0.5	-	4.7	0.9	-
BW1-22	NE 123rd Rd W of NE 2nd Ave	3	Local	3.8	4.5	0.7	-	4.8	1.0	-
BW1-23	Dixie Hwy NE of NE 119th St *	1	Emergency	6.1	1.2	-	-	1.4	-	YES
BW2-1A	NW 134th St W of NW 11th Ave	3	Local	9.3	10.2	0.9	-	10.5	1.2	-
BW2-1B	NW 131st St W of NW 10th Ave	3	Local	9.2	10.2	1.0	-	10.5	1.3	-
BW2-2	NW 134th St E of NW 8th Ave	3	Local	9.0	10.2	1.2	-	10.5	1.5	-
BW2-3	NW 131st St W of NW 8th Ave	3	Local	9.0	10.2	1.2	-	10.5	1.5	-
BW2-4A	NW 8th Ave S of NW 128th St	3	Local	9.0	10.2	1.2	-	10.5	1.5	-
BW2-4B	NW 128th St W of NW 10th Ave	3	Local	8.9	10.2	1.3	-	10.5	1.6	-
BW2-4C	NW 129th St E of NW 11th Ave	3	Local	9.4	10.2	0.8	-	10.5	1.1	-
BW2-5	NW 6th Ave S of NW 130th St	2	Emergency	9.0	10.1	1.1	-	10.4	1.4	NO
BW2-6	NW 131st St W of NW 5th Ave	3	Local	9.0	10.0	1.0	-	10.4	1.4	-
BW2-7	NW 5th Ave S of NW 129th St	3	Local	9.5	10.1	0.6	-	10.4	0.9	-
BW2-8	NW 133rd St W of NW 2nd Ave	3	Local	10.1	11.0	0.9	-	11.3	1.2	-
BW2-9	NW 130th St W of NW 2nd Ave	3	Local	9.7	10.4	0.7	-	10.6	0.9	-

Table F-2: North Miami SWMM Peak Stage Results for 25-Year and 100-Year Simulations

					Existing Condition 25-year, 72-hour (11.0-inch)			Existing Condition 100-year, 72-hour (14.0-inch)		
Node	**Road Crown Location**	**Road Class No.**	**Road Type**	**Road Crown Elev. (ft) NAVD**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**
BW2-10	NW 132nd St W of NW 2nd Ave	3	Local	9.8	8.6	-	-	9.9	0.1	-
BW2-11	NE 130th St W of NE 2nd Ave	3	Local	3.9	4.3	0.4	-	4.6	0.7	-
BW3-1A	NW 6th Ave S of NW 137th St *	2	Emergency	9.8	10.3	0.5	-	10.6	0.8	NO
BW3-1B	NW 7th Ave S of NW 140th St *	2	Emergency	11.4	12.1	0.7	-	12.6	1.2	NO
BW3-1C	NW 6th Ave S of NW 135th St	2	Emergency	8.9	10.1	1.2	-	10.5	1.6	NO
BW3-1D	NW 135th St W of NW 8th Ave *	1	Emergency	9.4	10.2	0.8	-	10.5	1.1	NO
BW3-1E	NW 135th St & NW 13th Ave *	1	Emergency	9.2	10.2	1.0	-	10.5	1.3	NO
BW3-1F	NW 135th St W of NW 15th Ave *	1	Emergency	10.0	10.2	0.2	-	10.6	0.6	NO
BW3-1G	NW 135th St W of NW 18th Ave *	4	NIC	9.5	8.6	-	-	10.1	0.6	-
BW3-1H	NW 17th Ave S of NW 130th St *	4	NIC	9.5	10.6	1.1	-	10.8	1.3	-
BW3-1I	NW 17th Ave S of NW 123rd St *	4	NIC	9.2	10.6	1.4	-	10.8	1.6	-
BW3-2	NW 5th Ave S of NW 137th St *	3	Local	10.4	10.6	0.2	-	10.9	0.4	-
BW3-2A	NW 135th St W of NW 5th Ave *	1	Emergency	10.3	10.0	-	-	10.8	0.5	NO
BW3-3A	NE 2nd Ave S of NE 135th St	3	Local	2.7	3.6	0.9	-	3.8	1.1	-
BW3-3B	NE 139th St W of Biscayne Riv Dr *	4	NIC	2.7	3.6	0.9	-	3.8	1.1	-
BW3-4	Miami Ave S of NE 135th St	3	Local	5.5	5.7	0.2	-	5.8	0.3	-
BW3-4B	NE 1st Ave N of NE 135th St *	3	Local	2.5	3.6	1.1	-	3.9	1.4	-
BW4-1	NE 133rd St W of NE 2nd Ave	3	Local	3.5	3.6	0.1	-	3.8	0.3	-
BW5-1	NE 127th St & NE 1st Ave	3	Local	3.5	4.3	0.8	-	4.6	1.1	-
BW6-1	NE 2nd Ave N of NE 121st St	2	Arterial	4.5	5.1	0.6	-	5.3	0.8	-

1) Where no survey was available and elevation was estimated from LIDAR *

2) NIC = Not in City of North Miami limits

3) Structural flooding of private property not included in this LOS analysis

Table F-2: North Miami SWMM Peak Stage Results for 25-Year and 100-Year Simulations

					Existing Condition 25-year, 72-hour (11.0-inch)			Existing Condition 100-year, 72-hour (14.0-inch)		
Node	**Road Crown Location**	**Road Class No.**	**Road Type**	**Road Crown Elev. (ft) NAVD**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**	**Existing Peak Stage (ft) NAVD**	**Flood Depth (ft)**	**Meets LOS?**

Streets Evaluated	Criteria	25-year		100-year
Total	No. of CNM locations not meeting LOS = No. of CNM locations evaluated for LOS = % of CNM locations not meeting LOS =	- - -		
Local	No. of CNM locations not meeting LOS = No. of CNM locations evaluated for LOS = % of CNM locations not meeting LOS =			
Arterial	No. of CNM locations not meeting LOS = No. of CNM locations evaluated for LOS = % of CNM locations not meeting LOS =			
Emergency	No. of CNM locations not meeting LOS = No. of CNM locations evaluated for LOS = % of CNM locations not meeting LOS =			24 34 71%

Appendix G

Rational Method Peak Runoff Results

Table G-1: Rational Method Calculation for Sansouci and Keystone Neighborhoods

$Q = C\ i_t\ A$ **Equation 1**

where:

Q = estimated peak rate of runoff (cfs) for some recurrence interval
C = runoff coefficient; fraction of runoff, expressed as a dimensionless decimal fraction, that appears as surface runoff from the contributing drainage area
i_t = average rainfall intensity (in/hr) for some recurrence interval, T during that period of time equal to Tc.
A = the contributing tributary drainage area in acres which produces the max. peak rate runoff
T_c = rainfall intensity averaging time in miuntes

Rational Formula Var.	**A**	**C**	**T_c**	**T_c**		**i_t**	**Q**		**i_t**	**Q**
Rainfall Return Period					2yr	2yr	2yr	5yr	5yr	5yr
Basin Name	**Area (ac)**	**Runoff # Coeff**	**Time of concen. (min)**	**Time of concen. (hr)**	**Rain Depth (in)**	**Rain Intensity (in/hr)**	**Peak Flow (cfs)**	**Rain Depth (in)**	**Rain Intensity (in/hr)**	**Peak Flow (cfs)**
117RDHU	32.1	0.65	26.0	0.43	4.2	1.8	38.0	5.9	2.6	53.4
119RDHU	18.4	0.65	21.0	0.35	4.2	1.5	17.6	5.9	2.1	24.7
121RDHU	16.1	0.65	21.0	0.35	4.2	1.5	15.4	5.9	2.1	21.7
18DRVHU	19.0	0.70	22.0	0.37	4.2	1.5	20.5	5.9	2.2	28.8
19AVEHU	35.6	0.70	30.0	0.50	4.2	2.1	52.3	5.9	3.0	73.5
ALMNDAHU	39.3	0.65	30.0	0.50	4.2	2.1	53.6	5.9	3.0	75.3
BAYVIEWHU	24.3	0.65	19.0	0.32	4.2	1.3	21.0	5.9	1.9	29.5
BISCAYNEBAYHU	32.4	0.65	22.0	0.37	4.2	1.5	32.4	5.9	2.2	45.6
CORONADOHU	22.4	0.65	21.0	0.35	4.2	1.5	21.4	5.9	2.1	30.0
HIBISCUSHU	29.6	0.65	24.0	0.40	4.2	1.7	32.3	5.9	2.4	45.4
IXORAHU	31.0	0.65	22.0	0.37	4.2	1.5	31.0	5.9	2.2	43.6
KEYSTONEDRHU	19.8	0.65	24.0	0.40	4.2	1.7	21.7	5.9	2.4	30.4
LAURELAHU	37.0	0.65	30.0	0.50	4.2	2.1	50.5	5.9	3.0	70.9
MAGNOLIAHU	13.9	0.65	22.0	0.37	4.2	1.5	13.9	5.9	2.2	19.5
NBAYSHRHU	39.7	0.60	26.0	0.43	4.2	1.8	43.4	5.9	2.6	60.9
SANSOUHU	17.4	0.70	26.0	0.43	4.2	1.8	22.1	5.9	2.6	31.1
W135STHU	14.3	0.60	26.0	0.43	4.2	1.8	15.6	5.9	2.6	21.9
E135STHU	18.9	0.60	30.0	0.50	4.2	2.1	23.9	5.9	3.0	33.5

Type D soils were estimated for soil group, A mixture of Residential with Paved roads were estimated for land type.

Table G-2: Time of Concentration Estimation for Sansouci and Keystone Neighborhoods

Hydrologic Unit	117RDHU	119RDHU	121RDHU	18DRVHU	19AVEHU	ALMNDAHU	BAYVIEWHU	BISCAYNEBAYHU	CORONADOHU
A. SHEET FLOW									
1 Segment ID	AB	AB	AB	AB	AB	AB	AB	AB	AB
2 Manning "n"	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3 Flow Length (<300 ft.)	75	75	75	75	75	75	75	75	75
4 Upstream Elevation (ft-NAVD)	5	5	5	6	6	5	5	4	4
5 Downstream Elevation (ft-NAVD)	4	4	4	5	5	4	4	3	3
6 Land Slope, s (ft./ft.)	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
7 Two Year Rainfall, p (in.)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
8 Travel Time, t (min.)	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32
B. SHALLOW CONCENTRATED FLOW									
1 Segment ID	BC	BC	BC	BC	BC	BC	BC	BC	BC
2 Paved or Unpaved (P/U)	P	P	P	P	P	P	P	P	P
3 Flow Length (ft.)	900	750	750	800	1000	1000	700	800	750
4 Upstream Elevation (ft-NAVD)	4	4	4	5	5	4	4	4	4
5 Downstream Elevation (ft-NAVD)	3	3	3	4	4	3	3	3	3
6 Watercourse Slope, s (ft./ft.)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
7 Average Velocity, v (ft./sec.)	0.7	0.7	0.7	0.7	0.6	0.6	0.8	0.7	0.7
8 Travel Time, t (min.)	22.14	16.84	16.84	18.55	25.93	25.93	15.18	18.55	16.84
Time of Concentration (min.)	26.00	21.00	21.00	22.00	30.00	30.00	19.00	22.00	21.00

Hydrologic Unit	HIBISCUSHU	IXORAHU	KEYSTONEDRHU	LAURELAHU	MAGNOLIAHU	NBAYSHRHU	SANSOUHU	W135STHU	E135STHU
A. SHEET FLOW									
1 Segment ID	AB	AB	AB	AB	AB	AB	AB	AB	AB
2 Manning "n"	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
3 Flow Length (<300 ft.)	75	75	75	75	75	75	75	75	75
4 Upstream Elevation (ft-NAVD)	5	5	5	5	5	4	5	4	4
5 Downstream Elevation (ft-NAVD)	4	4	4	4	4	3	4	3	3
6 Land Slope, s (ft./ft.)	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
7 Two Year Rainfall, p (in.)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
8 Travel Time, t (min.)	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32
B. SHALLOW CONCENTRATED FLOW									
1 Segment ID	BC	BC	BC	BC	BC	BC	BC	BC	BC
2 Paved or Unpaved (P/U)	P	P	P	P	P	P	P	P	P
3 Flow Length (ft.)	850	800	850	1000	800	900	900	900	1000
4 Upstream Elevation (ft-NAVD)	5	5	5	3	4	4	5	4	4
5 Downstream Elevation (ft-NAVD)	4	4	4	2	3	3	4	3	3
6 Watercourse Slope, s (ft./ft.)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
7 Average Velocity, v (ft./sec.)	0.7	0.7	0.7	0.6	0.7	0.7	0.7	0.7	0.6
8 Travel Time, t (min.)	20.32	18.55	20.32	25.93	18.55	22.14	22.14	22.14	25.93
Time of Concentration (min.)	24.00	22.00	24.00	30.00	22.00	26.00	26.00	26.00	30.00

Appendix H

BMP Inventory

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0001	FD-1
EXTR-0002	FD-1
EXTR-0003	15 inch hdpe
EXTR-0004	15 inch hdpe
EXTR-0005	15 inch rcp
EXTR-0006	18 inch hdpe
EXTR-0007	18 inch hdpe
EXTR-0008	18 inch hdpe
EXTR-0009	15 inch rcp
EXTR-0010	15 inch rcp
EXTR-0011	15 inch rcp
EXTR-0012	15 inch rcp
EXTR-0013	15 inch rcp
EXTR-0014	15 inch rcp
EXTR-0015	15 inch rcp
EXTR-0016	15 inch rcp
EXTR-0017	15 inch rcp
EXTR-0018	12 inch rcp
EXTR-0019	15 inch rcp
EXTR-0020	15 inch rcp
EXTR-0021	12 inch rcp
EXTR-0022	12 inch rcp
EXTR-0023	12 inch rcp
EXTR-0024	10 inch rcp
EXTR-0025	15 inch rcp
EXTR-0026	15 inch rcp
EXTR-0027	15 inch rcp
EXTR-0028	15 inch rcp
EXTR-0029	12 inch rcp
EXTR-0030	12 inch rcp
EXTR-0031	18 inch hdpe
EXTR-0032	15 inch rcp
EXTR-0033	12 inch rcp
EXTR-0034	15 inch rcp
EXTR-0035	18 inch hdpe
EXTR-0036	18 inch hdpe
EXTR-0037	18 inch hdpe
EXTR-0038	18 inch hdpe
EXTR-0039	18 inch hdpe
EXTR-0040	18 inch hdpe
EXTR-0041	18 inch hdpe
EXTR-0042	18 inch hdpe
EXTR-0043	18 inch hdpe

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0044	18 inch hdpe
EXTR-0045	18 inch hdpe
EXTR-0046	18 inch hdpe
EXTR-0047	18 inch hdpe
EXTR-0048	18 inch hdpe
EXTR-0049	18 inch hdpe
EXTR-0050	18 inch hdpe
EXTR-0051	18 inch hdpe
EXTR-0052	18 inch hdpe
EXTR-0053	18 inch hdpe
EXTR-0054	18 inch hdpe
EXTR-0055	18 inch hdpe
EXTR-0056	18 inch hdpe
EXTR-0057	18 inch hdpe
EXTR-0058	18 inch hdpe
EXTR-0059	18 inch hdpe
EXTR-0060	18 inch hdpe
EXTR-0061	18 inch hdpe
EXTR-0062	18 inch hdpe
EXTR-0063	18 inch hdpe
EXTR-0064	18 inch hdpe
EXTR-0065	18 inch hdpe
EXTR-0066	18 inch hdpe
EXTR-0067	18 inch hdpe
EXTR-0068	18 inch hdpe
EXTR-0069	18 inch hdpe
EXTR-0070	18 inch hdpe
EXTR-0071	18 inch hdpe
EXTR-0072	18 inch hdpe
EXTR-0073	18 inch hdpe
EXTR-0074	18 inch hdpe
EXTR-0075	18 inch hdpe
EXTR-0076	18 inch hdpe
EXTR-0077	18 inch hdpe
EXTR-0078	18 inch hdpe
EXTR-0079	18 inch hdpe
EXTR-0080	18 inch hdpe
EXTR-0081	18 inch hdpe
EXTR-0082	18 inch hdpe
EXTR-0083	18 inch hdpe
EXTR-0084	18 inch hdpe
EXTR-0085	18 inch hdpe
EXTR-0086	18 inch hdpe

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Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0087	18 inch hdpe
EXTR-0088	18 inch hdpe
EXTR-0089	18 inch hdpe
EXTR-0090	18 inch hdpe
EXTR-0091	18 inch hdpe
EXTR-0092	18 inch hdpe
EXTR-0093	18 inch hdpe
EXTR-0094	18 inch hdpe
EXTR-0095	18 inch hdpe
EXTR-0096	18 inch hdpe
EXTR-0097	18 inch hdpe
EXTR-0098	18 inch hdpe
EXTR-0099	18 inch hdpe
EXTR-0100	18 inch hdpe
EXTR-0101	18 inch hdpe
EXTR-0102	18 inch hdpe
EXTR-0103	18 inch hdpe
EXTR-0104	18 inch hdpe
EXTR-0105	18 inch hdpe
EXTR-0106	18 inch hdpe
EXTR-0107	18 inch hdpe
EXTR-0108	18 inch hdpe
EXTR-0109	18 inch hdpe
EXTR-0110	18 inch hdpe
EXTR-0111	18 inch hdpe
EXTR-0112	18 inch hdpe
EXTR-0113	18 inch hdpe
EXTR-0114	18 inch hdpe
EXTR-0115	15 inch hdpe
EXTR-0116	15 inch hdpe
EXTR-0117	15 inch hdpe
EXTR-0118	15 inch hdpe
EXTR-0119	15 inch hdpe
EXTR-0120	15 inch hdpe
EXTR-0121	15 inch hdpe
EXTR-0122	15 inch hdpe
EXTR-0123	15 inch hdpe
EXTR-0124	15 inch hdpe
EXTR-0125	15 inch hdpe
EXTR-0126	15 inch hdpe
EXTR-0127	15 inch hdpe
EXTR-0128	15 inch hdpe
EXTR-0129	15 inch hdpe

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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0130	15 inch hdpe
EXTR-0131	15 inch hdpe
EXTR-0132	15 inch hdpe
EXTR-0133	15 inch hdpe
EXTR-0134	15 inch hdpe
EXTR-0135	15 inch hdpe
EXTR-0136	15 inch hdpe
EXTR-0137	15 inch hdpe
EXTR-0138	15 inch hdpe
EXTR-0139	15 inch hdpe
EXTR-0140	15 inch hdpe
EXTR-0141	15 inch hdpe
EXTR-0142	15 inch hdpe
EXTR-0143	15 inch hdpe
EXTR-0144	15 inch hdpe
EXTR-0145	15 inch hdpe
EXTR-0146	15 inch hdpe
EXTR-0147	15 inch hdpe
EXTR-0148	15 inch hdpe
EXTR-0149	15 inch hdpe
EXTR-0150	15 inch hdpe
EXTR-0151	15 inch hdpe
EXTR-0152	15 inch hdpe
EXTR-0153	15 inch rcp
EXTR-0154	15 inch rcp
EXTR-0155	15 inch rcp
EXTR-0156	15 inch rcp
EXTR-0157	15 inch hdpe
EXTR-0158	15 inch hdpe
EXTR-0159	14 inch rcp
EXTR-0160	15 inch rcp
EXTR-0161	18 inch hdpe
EXTR-0162	15 inch rcp
EXTR-0163	15 inch rcp
EXTR-0164	15 inch rcp
EXTR-0165	15 inch rcp
EXTR-0166	15 inch rcp
EXTR-0167	15 inch rcp
EXTR-0168	15 inch rcp
EXTR-0169	15 inch rcp
EXTR-0170	15 inch rcp
EXTR-0171	15 inch rcp
EXTR-0172	15 inch rcp

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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0173	15 inch rcp
EXTR-0174	15 inch rcp
EXTR-0175	18 inch hdpe
EXTR-0176	18 inch hdpe
EXTR-0177	18 inch hdpe
EXTR-0178	18 inch hdpe
EXTR-0179	18 inch hdpe
EXTR-0180	18 inch hdpe
EXTR-0181	18 inch hdpe
EXTR-0182	18 inch hdpe
EXTR-0183	15 inch hdpe
EXTR-0184	18 inch hdpe
EXTR-0185	15 inch hdpe
EXTR-0186	18 inch hdpe
EXTR-0187	12 inch rcp
EXTR-0188	18 inch hdpe
EXTR-0189	FD-1
EXTR-0190	FD-1
EXTR-0191	FD-1
EXTR-0192	FD-1
EXTR-0193	18 HDPE FD
EXTR-0194	18 HDPE FD
EXTR-0195	FD-1
EXTR-0196	FD-1
EXTR-0197	FD-1
EXTR-0198	FD-1
EXTR-0199	18 HDPE FD
EXTR-0200	FD-1
EXTR-0201	FD-1
EXTR-0202	18 HDPE FD
EXTR-0203	18 HDPE FD
EXTR-0204	FD-1
EXTR-0205	FD-1
EXTR-0206	FD-1
EXTR-0207	FD-1
EXTR-0208	FD-1
EXTR-0209	FD-1
EXTR-0210	FD-1
EXTR-0211	FD-1
EXTR-0212	FD-1
EXTR-0213	FD-1
EXTR-0214	FD-1
EXTR-0215	FD-1

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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0216	FD-1
EXTR-0217	FD-1
EXTR-0218	FD-1
EXTR-0219	FD-1
EXTR-0220	FD-1
EXTR-0221	FD-1
EXTR-0222	FD-1
EXTR-0223	FD-1
EXTR-0224	FD-1
EXTR-0225	FD-1
EXTR-0226	FD-1
EXTR-0227	FD-1
EXTR-0228	FD-1
EXTR-0229	FD-1
EXTR-0230	FD-1
EXTR-0231	FD-1
EXTR-0232	FD-1
EXTR-0233	FD-1
EXTR-0234	FD-1
EXTR-0235	FD-1
EXTR-0236	FD-1
EXTR-0237	FD-1
EXTR-0238	FD-1
EXTR-0239	FD-1
EXTR-0240	FD-1
EXTR-0241	FD-1
EXTR-0242	FD-1
EXTR-0243	FD-1
EXTR-0244	FD-1
EXTR-0245	FD-1
EXTR-0246	FD-1
EXTR-0247	FD-1
EXTR-0248	18 HDPE FD
EXTR-0249	18 HDPE FD
EXTR-0250	18 HDPE FD
EXTR-0251	FD-1
EXTR-0252	FD-1
EXTR-0253	FD-1
EXTR-0254	18 HDPE FD
EXTR-0255	18 HDPE FD
EXTR-0256	FD-1
EXTR-0257	FD-1
EXTR-0258	18 HDPE FD

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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0259	18 HDPE FD
EXTR-0260	18 HDPE FD
EXTR-0261	18 HDPE FD
EXTR-0262	FD-1
EXTR-0263	FD-1
EXTR-0264	18 HDPE FD
EXTR-0265	18 HDPE FD
EXTR-0266	18 HDPE FD
EXTR-0267	18 HDPE FD
EXTR-0268	FD-1
EXTR-0269	FD-1
EXTR-0270	FD-1
EXTR-0271	FD-1
EXTR-0272	FD-1
EXTR-0273	FD-1
EXTR-0274	FD-1
EXTR-0275	FD-1
EXTR-0276	FD-1
EXTR-0277	FD-1
EXTR-0278	FD-1
EXTR-0279	18 HDPE FD
EXTR-0280	FD-1
EXTR-0281	FD-1
EXTR-0282	FD-1
EXTR-0283	FD-1
EXTR-0284	FD-1
EXTR-0285	FD-1
EXTR-0286	FD-1
EXTR-0287	FD-1
EXTR-0288	FD-1
EXTR-0289	18 HDPE FD
EXTR-0290	18 HDPE FD
EXTR-0291	18 HDPE FD
EXTR-0292	FD-1
EXTR-0293	18 HDPE FD
EXTR-0294	18 HDPE FD
EXTR-0295	18 HDPE FD
EXTR-0296	FD-1
EXTR-0297	FD-1
EXTR-0298	FD-1
EXTR-0299	FD-1
EXTR-0300	18 HDPE FD
EXTR-0301	18 HDPE FD

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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0302	18 HDPE FD
EXTR-0303	18 HDPE FD
EXTR-0304	FD-1
EXTR-0305	FD-1
EXTR-0306	FD-1
EXTR-0307	FD-1
EXTR-0308	FD-1
EXTR-0309	FD-1
EXTR-0310	FD-1
EXTR-0311	FD-1
EXTR-0312	FD-1
EXTR-0313	FD-1
EXTR-0314	FD-1
EXTR-0315	FD-1
EXTR-0316	FD-1
EXTR-0317	FD-1
EXTR-0318	FD-1
EXTR-0319	FD-1
EXTR-0320	FD-1
EXTR-0321	FD-1
EXTR-0322	FD-1
EXTR-0323	FD-1
EXTR-0324	FD-1
EXTR-0325	18 HDPE FD
EXTR-0326	18 HDPE FD
EXTR-0327	18 HDPE FD
EXTR-0328	18 HDPE FD
EXTR-0329	18 HDPE FD
EXTR-0330	18 HDPE FD
EXTR-0331	18 HDPE FD
EXTR-0332	18 HDPE FD
EXTR-0333	18 HDPE FD
EXTR-0334	18 HDPE FD
EXTR-0335	18 HDPE FD
EXTR-0336	18 HDPE FD
EXTR-0337	18 HDPE FD
EXTR-0338	18 HDPE FD
EXTR-0339	FD-1
EXTR-0340	18 HDPE FD
EXTR-0341	18 HDPE FD
EXTR-0342	18 HDPE FD
EXTR-0343	18 HDPE FD
EXTR-0344	18 HDPE FD

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HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0345	FD-1
EXTR-0346	FD-1
EXTR-0347	FD-1
EXTR-0348	FD-1
EXTR-0349	FD-1
EXTR-0350	FD-1
EXTR-0351	FD-1
EXTR-0352	FD-1
EXTR-0353	FD-1
EXTR-0354	FD-1
EXTR-0355	FD-1
EXTR-0356	FD-1
EXTR-0357	18 HDPE FD
EXTR-0358	18 HDPE FD
EXTR-0359	18 HDPE FD
EXTR-0360	18 HDPE FD
EXTR-0361	18 HDPE FD
EXTR-0362	18 HDPE FD
EXTR-0363	18 HDPE FD
EXTR-0364	18 HDPE FD
EXTR-0365	18 HDPE FD
EXTR-0366	18 HDPE FD
EXTR-0367	18 HDPE FD
EXTR-0368	18 HDPE FD
EXTR-0369	18 HDPE FD
EXTR-0370	18 HDPE FD
EXTR-0371	18 HDPE FD
EXTR-0372	18 HDPE FD
EXTR-0373	18 HDPE FD
EXTR-0374	18 HDPE FD
EXTR-0375	18 HDPE FD
EXTR-0376	18 HDPE FD
EXTR-0377	18 HDPE FD
EXTR-0378	FD-1
EXTR-0379	FD-1
EXTR-0380	FD-1
EXTR-0381	18 HDPE FD
EXTR-0382	FD-1
EXTR-0383	FD-1
EXTR-0384	FD-1
EXTR-0385	FD-1
EXTR-0386	18 HDPE FD
EXTR-0387	18 HDPE FD

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0388	18 HDPE FD
EXTR-0389	18 HDPE FD
EXTR-0390	FD-1
EXTR-0391	FD-1
EXTR-0392	FD-1
EXTR-0393	FD-1
EXTR-0394	FD-1
EXTR-0395	FD-1
EXTR-0396	FD-1
EXTR-0397	FD-1
EXTR-0398	FD-1
EXTR-0399	FD-1
EXTR-0400	FD-1
EXTR-0401	FD-1
EXTR-0402	FD-1
EXTR-0403	FD-1
EXTR-0404	FD-1
EXTR-0405	FD-1
EXTR-0406	FD-1
EXTR-0407	FD-1
EXTR-0408	FD-1
EXTR-0409	FD-1
EXTR-0410	FD-1
EXTR-0411	FD-1
EXTR-0412	FD-1
EXTR-0413	FD-1
EXTR-0414	FD-1
EXTR-0415	FD-1
EXTR-0416	FD-1
EXTR-0417	FD-1
EXTR-0418	FD-1
EXTR-0419	FD-1
EXTR-0420	FD-1
EXTR-0421	FD-1
EXTR-0422	FD-1
EXTR-0423	FD-1
EXTR-0424	FD-1
EXTR-0425	FD-1
EXTR-0426	FD-1
EXTR-0427	FD-1
EXTR-0428	FD-1
EXTR-0429	18 HDPE FD
EXTR-0430	18 HDPE FD

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0431	18 HDPE FD
EXTR-0432	18 HDPE FD
EXTR-0433	18 HDPE FD
EXTR-0434	18 HDPE FD
EXTR-0435	18 HDPE FD
EXTR-0436	18 HDPE FD
EXTR-0437	18 HDPE FD
EXTR-0438	18 HDPE FD
EXTR-0439	18 HDPE FD
EXTR-0440	18 HDPE FD
EXTR-0441	18 HDPE FD
EXTR-0442	18 HDPE FD
EXTR-0443	18 HDPE FD
EXTR-0444	18 HDPE FD
EXTR-0445	18 HDPE FD
EXTR-0446	18 HDPE FD
EXTR-0447	18 HDPE FD
EXTR-0448	18 HDPE FD
EXTR-0449	18 HDPE FD
EXTR-0450	18 HDPE FD
EXTR-0451	18 HDPE FD
EXTR-0452	18 HDPE FD
EXTR-0453	18 HDPE FD
EXTR-0454	18 HDPE FD
EXTR-0455	18 HDPE FD
EXTR-0456	18 HDPE FD
EXTR-0457	18 HDPE FD
EXTR-0458	18 HDPE FD
EXTR-0459	18 HDPE FD
EXTR-0460	18 HDPE FD
EXTR-0461	18 HDPE FD
EXTR-0462	18 HDPE FD
EXTR-0463	18 HDPE FD
EXTR-0464	18 HDPE FD
EXTR-0465	18 HDPE FD
EXTR-0466	18 HDPE FD
EXTR-0467	18 HDPE FD
EXTR-0468	18 HDPE FD
EXTR-0469	18 HDPE FD
EXTR-0470	18 HDPE FD
EXTR-0471	18 HDPE FD
EXTR-0472	18 HDPE FD
EXTR-0473	18 HDPE FD

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0474	18 HDPE FD
EXTR-0475	18 HDPE FD
EXTR-0476	18 HDPE FD
EXTR-0477	18 HDPE FD
EXTR-0478	18 HDPE FD
EXTR-0479	18 HDPE FD
EXTR-0480	18 HDPE FD
EXTR-0481	18 HDPE FD
EXTR-0482	18 HDPE FD
EXTR-0483	18 HDPE FD
EXTR-0484	18 HDPE FD
EXTR-0485	18 HDPE FD
EXTR-0486	12_RCP_FD
EXTR-0487	12_RCP_FD
EXTR-0488	12_RCP_FD
EXTR-0489	10_RCP_FD
EXTR-0490	15 RCP FD
EXTR-0491	15 RCP FD
EXTR-0492	15 HDPE FD
EXTR-0493	15 HDPE FD
EXTR-0494	15 HDPE FD
EXTR-0495	15 HDPE FD
EXTR-0496	15 HDPE FD
EXTR-0497	15 HDPE FD
EXTR-0498	15 HDPE FD
EXTR-0499	15 HDPE FD
EXTR-0500	15 HDPE FD
EXTR-0501	15 HDPE FD
EXTR-0502	15 HDPE FD
EXTR-0503	15 HDPE FD
EXTR-0504	15 HDPE FD
EXTR-0505	15 HDPE FD
EXTR-0506	15 HDPE FD
EXTR-0507	15 HDPE FD
EXTR-0508	15 HDPE FD
EXTR-0509	15 HDPE FD
EXTR-0510	15 HDPE FD
EXTR-0511	15 HDPE FD
EXTR-0512	15 HDPE FD
EXTR-0513	15 HDPE FD
EXTR-0514	15 HDPE FD
EXTR-0515	15 HDPE FD
EXTR-0516	15 HDPE FD

FD = French Drain
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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0517	15 HDPE FD
EXTR-0518	15 HDPE FD
EXTR-0519	15 HDPE FD
EXTR-0520	15 HDPE FD
EXTR-0521	15 HDPE FD
EXTR-0522	15 HDPE FD
EXTR-0523	15 HDPE FD
EXTR-0524	15 RCP FD
EXTR-0525	18 HDPE FD
EXTR-0526	18 HDPE FD
EXTR-0527	15 CMP FD
EXTR-0528	15 HDPE FD
EXTR-0529	15 HDPE FD
EXTR-0530	15 HDPE FD
EXTR-0531	15 HDPE FD
EXTR-0532	15 RCP FD
EXTR-0533	15 RCP FD
EXTR-0534	15 RCP FD
EXTR-0535	15 RCP FD
EXTR-0536	15 RCP FD
EXTR-0537	15 CMP FD
EXTR-0538	15 RCP FD
EXTR-0539	15 RCP FD
EXTR-0540	15 RCP FD
EXTR-0541	15 RCP FD
EXTR-0542	15 RCP FD
EXTR-0543	15 RCP FD
EXTR-0544	15 RCP FD
EXTR-0545	15 RCP FD
EXTR-0546	15 RCP FD
EXTR-0547	15 RCP FD
EXTR-0548	15 RCP FD
EXTR-0549	15 RCP FD
EXTR-0550	15 RCP FD
EXTR-0551	15 RCP FD
EXTR-0552	15 CMP FD
EXTR-0553	15 CMP FD
EXTR-0554	12_RCP_FD
EXTR-0555	15 RCP FD
EXTR-0556	12_RCP_FD
EXTR-0557	12_RCP_FD
EXTR-0558	15 RCP FD
EXTR-0559	15 RCP FD

FD = French Drain
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CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0560	15 RCP FD
EXTR-0561	15 RCP FD
EXTR-0562	15 HDPE FD
EXTR-0563	15 RCP FD
EXTR-0564	15 RCP FD
EXTR-0565	15 RCP FD
EXTR-0566	15 RCP FD
EXTR-0567	15 RCP FD
EXTR-0568	15 RCP FD
EXTR-0569	15 RCP FD
EXTR-0570	15 RCP FD
EXTR-0571	15 RCP FD
EXTR-0572	15 RCP FD
EXTR-0573	15 RCP FD
EXTR-0574	15 RCP FD
EXTR-0575	12_RCP_FD
EXTR-0576	12_RCP_FD
EXTR-0577	15 RCP FD
EXTR-0578	15 RCP FD
EXTR-0579	15 RCP FD
EXTR-0580	15 RCP FD
EXTR-0581	15 RCP FD
EXTR-0582	15 RCP FD
EXTR-0583	15 RCP FD
EXTR-0584	15 RCP FD
EXTR-0585	12_RCP_FD
EXTR-0586	15 RCP FD
EXTR-0587	24_HDPE_FD
EXTR-0588	24_HDPE_FD
EXTR-0589	24_HDPE_FD
EXTR-0590	24_HDPE_FD
EXTR-0591	18 HDPE FD
EXTR-0592	18 HDPE FD
EXTR-0593	18 HDPE FD
EXTR-0594	24_HDPE_FD
EXTR-0595	24_HDPE_FD
EXTR-0596	24_HDPE_FD
EXTR-0597	18 inch hdpe
EXTR-0598	18 inch hdpe
EXTR-0599	15 inch cmp
EXTR-0600	15 inch cmp
EXTR-0601	18 inch pipe
EXTR-0602	15 inch cmp

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0603	15 inch cmp
EXTR-0604	18 inch cmp
EXTR-0605	18 inch hdpe
EXTR-0606	15 inch cmp
EXTR-0607	15 inch cmp
EXTR-0608	15 inch rcp
EXTR-0609	15 inch rcp
EXTR-0610	12 inch rcp
EXTR-0611	12 inch rcp
EXTR-0612	12 inch clay
EXTR-0613	18 inch cmp
EXTR-0614	18 inch hdpe
EXTR-0615	18 inch hdpe
EXTR-0616	18 inch hdpe
EXTR-0617	18 inch rcp
EXTR-0618	18 inch hdpe
EXTR-0619	18 inch hdpe
EXTR-0620	18 inch hdpe
EXTR-0621	18 inch pipe
EXTR-0622	18 inch hdpe
EXTR-0623	18 inch pipe
EXTR-0624	18 inch pipe
EXTR-0625	18 inch pipe
EXTR-0626	18 inch pipe
EXTR-0627	18 inch hdpe
EXTR-0628	18 inch hdpe
EXTR-0629	18 inch hdpe
EXTR-0630	18 inch hdpe
EXTR-0631	18 inch hdpe
EXTR-0632	18 inch hdpe
EXTR-0633	18 inch hdpe
EXTR-0634	18 inch hdpe
EXTR-0635	18 inch hdpe
EXTR-0636	18 inch hdpe
EXTR-0637	18 inch pipe
EXTR-0638	18 inch hdpe
EXTR-0639	18 inch hdpe
EXTR-0640	18 inch hdpe
EXTR-0641	18 inch hdpe
EXTR-0642	18 inch cmp
EXTR-0643	18 inch pipe
EXTR-0644	15 inch cmp
EXTR-0645	15 inch cmp

FD = French Drain
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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0646	15 inch cmp
EXTR-0647	15 inch cmp
EXTR-0648	15 inch cmp
EXTR-0649	15 inch cmp
EXTR-0650	12 inch rcp
EXTR-0651	18 inch hdpe
EXTR-0652	18 inch hdpe
EXTR-0653	18 inch hdpe
EXTR-0654	unknown
EXTR-0655	20 inch hdpe
EXTR-0656	20 inch hdpe
EXTR-0657	18 inch hdpe
EXTR-0658	18 inch hdpe
EXTR-0659	18 inch hdpe
EXTR-0660	18 inch hdpe
EXTR-0661	18 inch hdpe
EXTR-0662	18 inch hdpe
EXTR-0663	18 inch hdpe
EXTR-0664	18 inch hdpe
EXTR-0665	18 inch hdpe
EXTR-0666	18 inch hdpe
EXTR-0667	18 inch hdpe
EXTR-0668	18 inch hdpe
EXTR-0669	18 inch hdpe
EXTR-0670	FD-1
EXTR-0671	FD-1
EXTR-0672	FD-1
EXTR-0673	FD-1
EXTR-0674	FD-1
EXTR-0675	FD-1
EXTR-0676	FD-1
EXTR-0677	FD-1
EXTR-0678	FD-1
EXTR-0679	FD-1
EXTR-0680	FD-1
EXTR-0681	FD-1
EXTR-0682	FD-1
EXTR-0683	FD-1
EXTR-0684	FD-1
EXTR-0685	FD-1
EXTR-0686	FD-1
EXTR-0687	FD-1
EXTR-0688	FD-1

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0689	FD-1
EXTR-0690	FD-1
EXTR-0691	FD-1
EXTR-0692	FD-1
EXTR-0693	FD-1
EXTR-0694	FD-1
EXTR-0695	FD-1
EXTR-0696	FD-1
EXTR-0697	FD-1
EXTR-0698	FD-1
EXTR-0699	FD-1
EXTR-0700	FD-1
EXTR-0701	FD-1
EXTR-0702	FD-1
EXTR-0703	FD-1
EXTR-0704	FD-1
EXTR-0705	FD-1
EXTR-0706	FD-1
EXTR-0707	FD-1
EXTR-0708	FD-1
EXTR-0709	18 HDPE FD
EXTR-0710	18 HDPE FD
EXTR-0711	FD-1
EXTR-0712	18 HDPE FD
EXTR-0713	18 HDPE FD
EXTR-0714	18 HDPE FD
EXTR-0715	18 HDPE FD
EXTR-0716	18 HDPE FD
EXTR-0717	18 HDPE FD
EXTR-0718	18 HDPE FD
EXTR-0719	18 HDPE FD
EXTR-0720	18 HDPE FD
EXTR-0721	18 HDPE FD
EXTR-0722	18 HDPE FD
EXTR-0723	18 HDPE FD
EXTR-0724	18 HDPE FD
EXTR-0725	18 HDPE FD
EXTR-0726	18 HDPE FD
EXTR-0727	18 HDPE FD
EXTR-0728	18 HDPE FD
EXTR-0729	18 HDPE FD
EXTR-0730	18 HDPE FD
EXTR-0731	18 HDPE FD

FD = French Drain
HDPE = High Density Polyethylene Pipe
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CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0732	18 HDPE FD
EXTR-0733	18 HDPE FD
EXTR-0734	18 HDPE FD
EXTR-0735	18 HDPE FD
EXTR-0736	18 HDPE FD
EXTR-0737	18 HDPE FD
EXTR-0738	18 HDPE FD
EXTR-0739	18 HDPE FD
EXTR-0740	18 HDPE FD
EXTR-0741	18 HDPE FD
EXTR-0742	18 HDPE FD
EXTR-0743	18 HDPE FD
EXTR-0744	18 HDPE FD
EXTR-0745	18 HDPE FD
EXTR-0746	18 HDPE FD
EXTR-0747	18 HDPE FD
EXTR-0748	FD-1
EXTR-0749	FD-1
EXTR-0750	18 HDPE FD
EXTR-0751	18 HDPE FD
EXTR-0752	18 HDPE FD
EXTR-0753	18 HDPE FD
EXTR-0754	18 HDPE FD
EXTR-0755	18 HDPE FD
EXTR-0756	18 HDPE FD
EXTR-0757	18 HDPE FD
EXTR-0758	18 HDPE FD
EXTR-0759	18 HDPE FD
EXTR-0760	18 HDPE FD
EXTR-0761	18 HDPE FD
EXTR-0762	18 HDPE FD
EXTR-0763	18 HDPE FD
EXTR-0764	18 HDPE FD
EXTR-0765	FD-1
EXTR-0766	FD-1
EXTR-0767	FD-1
EXTR-0768	18 HDPE FD
EXTR-0769	18 HDPE FD
EXTR-0770	FD-1
EXTR-0771	FD-1
EXTR-0772	FD-1
EXTR-0773	FD-1
EXTR-0774	FD-1

FD = French Drain
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RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0775	FD-1
EXTR-0776	18 HDPE FD
EXTR-0777	18 HDPE FD
EXTR-0778	FD-1
EXTR-0779	FD-1
EXTR-0780	FD-1
EXTR-0781	FD-1
EXTR-0782	18 HDPE FD
EXTR-0783	18 HDPE FD
EXTR-0784	18 HDPE FD
EXTR-0785	18 HDPE FD
EXTR-0786	FD-1
EXTR-0787	FD-1
EXTR-0788	FD-1
EXTR-0789	FD-1
EXTR-0790	FD-1
EXTR-0791	FD-1
EXTR-0792	FD-1
EXTR-0793	FD-1
EXTR-0794	18 HDPE FD
EXTR-0795	18 HDPE FD
EXTR-0796	18 HDPE FD
EXTR-0797	18 HDPE FD
EXTR-0798	18 HDPE FD
EXTR-0799	FD-1
EXTR-0800	FD-1
EXTR-0801	FD-1
EXTR-0802	FD-1
EXTR-0803	FD-1
EXTR-0804	FD-1
EXTR-0805	FD-1
EXTR-0806	FD-1
EXTR-0807	FD-1
EXTR-0808	FD-1
EXTR-0809	FD-1
EXTR-0810	18 HDPE FD
EXTR-0811	15 inch hdpe
EXTR-0812	FD-1
EXTR-0813	FD-1
EXTR-0814	FD-1
EXTR-0815	FD-1
EXTR-0816	FD-1
EXTR-0817	FD-1

FD = French Drain
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RCP = Reinforced Concrete Pipe
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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0818	FD-1
EXTR-0819	FD-1
EXTR-0820	18 inch hdpe
EXTR-0821	18 inch hdpe
EXTR-0822	18 inch hdpe
EXTR-0823	18 inch hdpe
EXTR-0824	18 inch hdpe
EXTR-0825	18 inch hdpe
EXTR-0826	18 HDPE FD
EXTR-0827	18 inch hdpe
EXTR-0828	18 inch hdpe
EXTR-0829	18 inch hdpe
EXTR-0830	18 inch hdpe
EXTR-0831	18 inch hdpe
EXTR-0832	FD-1
EXTR-0833	FD-1
EXTR-0834	FD-1
EXTR-0835	FD-1
EXTR-0836	FD-1
EXTR-0837	18 inch hdpe
EXTR-0838	18 HDPE FD
EXTR-0839	0
EXTR-0840	18 inch hdpe
EXTR-0841	18 HDPE FD
EXTR-0842	18 HDPE FD
EXTR-0843	18 HDPE FD
EXTR-0844	18 HDPE FD
EXTR-0845	18 HDPE FD
EXTR-0846	18 HDPE FD
EXTR-0847	18 HDPE FD
EXTR-0848	18 HDPE FD
EXTR-0849	18 HDPE FD
EXTR-0850	18 HDPE FD
EXTR-0851	18 HDPE FD
EXTR-0852	18 HDPE FD
EXTR-0853	18 HDPE FD
EXTR-0854	18 HDPE FD
EXTR-0855	18 HDPE FD
EXTR-0856	18 HDPE FD
EXTR-0857	18 HDPE FD
EXTR-0858	18 HDPE FD
EXTR-0859	18 HDPE FD
EXTR-0860	18 HDPE FD

FD = French Drain
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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0861	18 HDPE FD
EXTR-0862	18 HDPE FD
EXTR-0863	18 HDPE FD
EXTR-0864	18 HDPE FD
EXTR-0865	18 HDPE FD
EXTR-0866	18 HDPE FD
EXTR-0867	18 HDPE FD
EXTR-0868	18 HDPE FD
EXTR-0869	18 HDPE FD
EXTR-0870	18 HDPE FD
EXTR-0871	18 HDPE FD
EXTR-0872	18 HDPE FD
EXTR-0873	18 HDPE FD
EXTR-0874	18 HDPE FD
EXTR-0875	18 HDPE FD
EXTR-0876	18 HDPE FD
EXTR-0877	18 HDPE FD
EXTR-0878	18 HDPE FD
EXTR-0879	18 HDPE FD
EXTR-0880	18 HDPE FD
EXTR-0881	18 HDPE FD
EXTR-0882	18 HDPE FD
EXTR-0883	18 HDPE FD
EXTR-0884	18 HDPE FD
EXTR-0885	18 HDPE FD
EXTR-0886	18 HDPE FD
EXTR-0887	18 HDPE FD
EXTR-0888	18 HDPE FD
EXTR-0889	18 HDPE FD
EXTR-0890	18 HDPE FD
EXTR-0891	18 HDPE FD
EXTR-0892	18 HDPE FD
EXTR-0893	18 HDPE FD
EXTR-0894	18 HDPE FD
EXTR-0895	18 HDPE FD
EXTR-0896	18 HDPE FD
EXTR-0897	18 HDPE FD
EXTR-0898	15 CMP FD
EXTR-0899	15 RCP FD
EXTR-0900	15 RCP FD
EXTR-0901	18 HDPE FD
EXTR-0902	18 HDPE FD
EXTR-0903	18 HDPE FD

FD = French Drain
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Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0904	18 HDPE FD
EXTR-0905	18 HDPE FD
EXTR-0906	20_HDPE_FD
EXTR-0907	20_HDPE_FD
EXTR-0908	12_RCP_FD
EXTR-0909	12_RCP_FD
EXTR-0910	12_RCP_FD
EXTR-0911	15 HDPE FD
EXTR-0912	15 HDPE FD
EXTR-0913	15 CMP FD
EXTR-0914	15 CMP FD
EXTR-0915	15 CMP FD
EXTR-0916	15 CMP FD
EXTR-0917	15 CMP FD
EXTR-0918	15 CMP FD
EXTR-0919	15 CMP FD
EXTR-0920	15 CMP FD
EXTR-0921	18 HDPE FD
EXTR-0922	12_CLAY_FD
EXTR-0923	18 CMP FD
EXTR-0924	18 HDPE FD
EXTR-0925	18 HDPE FD
EXTR-0926	18 HDPE FD
EXTR-0927	15 CMP FD
EXTR-0928	15 CMP FD
EXTR-0929	12 inch cmp
EXTR-0930	24 inch cmp
EXTR-0931	15 inch rcp
EXTR-0932	15 inch rcp
EXTR-0933	FD-1
EXTR-0934	FD-1
EXTR-0935	15 inch rcp
EXTR-0936	FD-1
EXTR-0937	FD-1
EXTR-0938	15 RCP FD
EXTR-0939	15 RCP FD
EXTR-0940	24_CMP_FD
EXTR-0941	12_CMP_FD
EXTR-0942	18 inch hdpe
EXTR-0943	18 HDPE FD
EXTR-0944	18 inch hdpe
EXTR-0945	18 HDPE FD
EXTR-0946	18 inch hdpe

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0947	18 HDPE FD
EXTR-0948	18 HDPE FD
EXTR-0949	18 inch hdpe
EXTR-0950	18 HDPE FD
EXTR-0951	18 HDPE FD
EXTR-0952	18 HDPE FD
EXTR-0953	18 HDPE FD
EXTR-0954	18 HDPE FD
EXTR-0955	18 HDPE FD
EXTR-0956	18 HDPE FD
EXTR-0957	18 HDPE FD
EXTR-0958	18 HDPE FD
EXTR-0959	15 inch rcp
EXTR-0960	12 inch rcp
EXTR-0961	24 inch cmp
EXTR-0962	12 inch rcp
EXTR-0963	12 inch rcp
EXTR-0964	18 inch cmp
EXTR-0965	18 inch cmp
EXTR-0966	18 inch cmp
EXTR-0967	18 inch cmp
EXTR-0968	12 inch rcp
EXTR-0969	12 inch rcp
EXTR-0970	12 inch rcp
EXTR-0971	12 inch rcp
EXTR-0972	12 inch rcp
EXTR-0973	12 inch rcp
EXTR-0974	15 inch cmp
EXTR-0975	15 inch cmp
EXTR-0976	15 inch cmp
EXTR-0977	15 inch rcp
EXTR-0978	15 inch rcp
EXTR-0979	15 inch rcp
EXTR-0980	18 inch hdpe
EXTR-0981	15 inch rcp
EXTR-0982	15 inch rcp
EXTR-0983	15 inch rcp
EXTR-0984	15 inch rcp
EXTR-0985	10 inch rcp
EXTR-0986	15 inch rcp
EXTR-0987	18 inch hdpe
EXTR-0988	18 inch hdpe
EXTR-0989	18 inch hdpe

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-0990	18 inch hdpe
EXTR-0991	18 inch hdpe
EXTR-0992	18 inch hdpe
EXTR-0993	18 inch hdpe
EXTR-0994	18 inch hdpe
EXTR-0995	FD-1
EXTR-0996	FD-1
EXTR-0997	FD-1
EXTR-0998	FD-1
EXTR-0999	FD-1
EXTR-1000	FD-1
EXTR-1001	FD-1
EXTR-1002	FD-1
EXTR-1003	FD-1
EXTR-1004	FD-1
EXTR-1005	FD-1
EXTR-1006	FD-1
EXTR-1007	FD-1
EXTR-1008	FD-1
EXTR-1009	FD-1
EXTR-1010	FD-1
EXTR-1011	FD-1
EXTR-1012	FD-1
EXTR-1013	FD-1
EXTR-1014	FD-1
EXTR-1015	FD-1
EXTR-1016	FD-1
EXTR-1017	FD-1
EXTR-1018	FD-1
EXTR-1019	FD-1
EXTR-1020	FD-1
EXTR-1021	FD-1
EXTR-1022	FD-1
EXTR-1023	FD-1
EXTR-1024	FD-1
EXTR-1025	FD-1
EXTR-1026	FD-1
EXTR-1027	FD-1
EXTR-1028	FD-1
EXTR-1029	FD-1
EXTR-1030	FD-1
EXTR-1031	FD-1
EXTR-1032	FD-1

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-1033	FD-1
EXTR-1034	FD-1
EXTR-1035	FD-1
EXTR-1036	FD-1
EXTR-1037	FD-1
EXTR-1038	FD-1
EXTR-1039	FD-1
EXTR-1040	FD-1
EXTR-1041	FD-1
EXTR-1042	FD-1
EXTR-1043	FD-1
EXTR-1044	FD-1
EXTR-1045	FD-1
EXTR-1046	FD-1
EXTR-1047	FD-1
EXTR-1048	FD-1
EXTR-1049	FD-1
EXTR-1050	FD-1
EXTR-1051	FD-1
EXTR-1052	FD-1
EXTR-1053	FD-1
EXTR-1054	FD-1
EXTR-1055	36_HDPE_FD
EXTR-1056	36_HDPE_FD
EXTR-1057	18 HDPE FD
EXTR-1058	18 HDPE FD
EXTR-1059	18 HDPE FD
EXTR-1060	18 HDPE FD
EXTR-1061	18 HDPE FD
EXTR-1062	18 HDPE FD
EXTR-1063	18 HDPE FD
EXTR-1064	18 HDPE FD
EXTR-1065	18 HDPE FD
EXTR-1066	18 HDPE FD
EXTR-1067	10_RCP_FD
EXTR-1068	15 HDPE FD
EXTR-1069	18 HDPE FD
EXTR-1070	12_RCP_FD
EXTR-1071	12_RCP_FD
EXTR-1072	12_RCP_FD
EXTR-1073	15 RCP FD
EXTR-1074	15 RCP FD
EXTR-1075	15 RCP FD

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-1076	18 HDPE FD
EXTR-1077	18 HDPE FD
EXTR-1078	18 HDPE FD
EXTR-1079	18 HDPE FD
EXTR-1080	15 RCP FD
EXTR-1081	18 HDPE FD
EXTR-1082	18 HDPE FD
EXTR-1083	18 HDPE FD
EXTR-1084	18 HDPE FD
EXTR-1085	18 HDPE FD
EXTR-1086	18 HDPE FD
EXTR-1087	18 HDPE FD
EXTR-1088	15 CMP FD
EXTR-1089	15 CMP FD
EXTR-1090	18 HDPE FD
EXTR-1091	15 RCP FD
EXTR-1092	15 RCP FD
EXTR-1093	15 RCP FD
EXTR-1094	15 RCP FD
EXTR-1095	18 HDPE FD
EXTR-1096	18 HDPE FD
EXTR-1097	18 HDPE FD
EXTR-1098	18 CMP FD
EXTR-1099	18 CMP FD
EXTR-1100	18 CMP FD
EXTR-1101	18 CMP FD
EXTR-1102	12_RCP_FD
EXTR-1103	12_RCP_FD
EXTR-1104	18 HDPE FD
EXTR-1105	18 HDPE FD
EXTR-1106	24_CMP_FD
EXTR-1107	15 RCP FD
EXTR-1108	15 RCP FD
EXTR-1109	15 RCP FD
EXTR-1110	12_RCP_FD
EXTR-1111	12_RCP_FD
EXTR-1112	12_RCP_FD
EXTR-1113	12_RCP_FD
EXTR-1114	15 CMP FD
EXTR-1115	18 HDPE FD
EXTR-1116	18 HDPE FD
EXTR-1117	18 inch hdpe
EXTR-1118	18 HDPE FD

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Exfiltration Trench ID	Attribute Data
EXTR-1119	18 HDPE FD
EXTR-1120	18 HDPE FD
EXTR-1121	18 inch hdpe
EXTR-1122	18 inch hdpe
EXTR-1123	18 HDPE FD
EXTR-1124	18 HDPE FD
EXTR-1125	18 HDPE FD
EXTR-1126	18 HDPE FD
EXTR-1127	18 HDPE FD
EXTR-1128	18 HDPE FD
EXTR-1129	18 HDPE FD
EXTR-1130	18 HDPE FD
EXTR-1131	18 HDPE FD
EXTR-1132	18 HDPE FD
EXTR-1133	18 HDPE FD
EXTR-1134	18 HDPE FD
EXTR-1135	18 HDPE FD
EXTR-1136	18 HDPE FD
EXTR-1137	18 HDPE FD
EXTR-1138	12_HDPE_FD
EXTR-1139	18 HDPE FD
EXTR-1140	18 HDPE FD
EXTR-1141	18 HDPE FD
EXTR-1142	18 HDPE FD
EXTR-1143	18 HDPE FD
EXTR-1144	18 HDPE FD

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Recharge Well ID	ACAD Handle	ACAD Layer
RW-001	9F	AUGER_WELL
RW-002	A7	AUGER_WELL
RW-003	A8	AUGER_WELL
RW-004	A9	AUGER_WELL
RW-005	AA	AUGER_WELL
RW-006	AB	AUGER_WELL
RW-007	AC	AUGER_WELL
RW-008	AD	AUGER_WELL
RW-009	AE	AUGER_WELL
RW-010	AF	AUGER_WELL
RW-011	B0	AUGER_WELL
RW-012	B1	AUGER_WELL
RW-013	B2	AUGER_WELL
RW-014	B3	AUGER_WELL
RW-015	B4	AUGER_WELL
RW-016	B5	AUGER_WELL
RW-017	B6	AUGER_WELL
RW-018	B7	AUGER_WELL
RW-019	B8	AUGER_WELL
RW-020	B9	AUGER_WELL
RW-021	BA	AUGER_WELL
RW-022	BB	AUGER_WELL
RW-023	BC	AUGER_WELL
RW-024	BD	AUGER_WELL
RW-025	BE	AUGER_WELL
RW-026	BF	AUGER_WELL
RW-027	C0	AUGER_WELL
RW-028	C1	AUGER_WELL
RW-029	C2	AUGER_WELL
RW-030	C3	AUGER_WELL
RW-031	C4	AUGER_WELL
RW-032	C5	AUGER_WELL
RW-033	C6	AUGER_WELL
RW-034	C7	AUGER_WELL
RW-035	C8	AUGER_WELL
RW-036	C9	AUGER_WELL
RW-037	CA	AUGER_WELL
RW-038	CB	AUGER_WELL
RW-039	CC	AUGER_WELL
RW-040	CD	AUGER_WELL
RW-041	CE	AUGER_WELL
RW-042	CF	AUGER_WELL
RW-043	D0	AUGER_WELL

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Recharge Well ID	ACAD Handle	ACAD Layer
RW-044	D1	AUGER_WELL
RW-045	D2	AUGER_WELL
RW-046	D3	AUGER_WELL
RW-047	D4	AUGER_WELL
RW-048	D5	AUGER_WELL
RW-049	D6	AUGER_WELL
RW-050	D7	AUGER_WELL
RW-051	D8	AUGER_WELL
RW-052	D9	AUGER_WELL
RW-053	DA	AUGER_WELL
RW-054	DB	AUGER_WELL
RW-055	DC	AUGER_WELL
RW-056	DD	AUGER_WELL
RW-057	DE	AUGER_WELL
RW-058	DF	AUGER_WELL
RW-059	E0	AUGER_WELL
RW-060	E1	AUGER_WELL
RW-061	E2	AUGER_WELL
RW-062	E3	AUGER_WELL
RW-063	E4	AUGER_WELL
RW-064	E5	AUGER_WELL
RW-065	E6	AUGER_WELL
RW-066	E7	AUGER_WELL
RW-067	E8	AUGER_WELL
RW-068	E9	AUGER_WELL
RW-069	EA	AUGER_WELL
RW-070	EB	AUGER_WELL
RW-071	EC	AUGER_WELL
RW-072	ED	AUGER_WELL
RW-073	EE	AUGER_WELL
RW-074	EF	AUGER_WELL
RW-075	F0	AUGER_WELL
RW-076	F1	AUGER_WELL
RW-077	F2	AUGER_WELL
RW-078	F3	AUGER_WELL
RW-079	F4	AUGER_WELL
RW-080	F5	AUGER_WELL
RW-081	F6	AUGER_WELL
RW-082	F7	AUGER_WELL
RW-083	F8	AUGER_WELL
RW-084	F9	AUGER_WELL
RW-085	FA	AUGER_WELL
RW-086	FB	AUGER_WELL

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Table H-1
City of North Miami
Stormwater Master Plan Update
Exfiltration Trench Inventory

Recharge Well ID	ACAD Handle	ACAD Layer
RW-087	FC	AUGER_WELL
RW-088	FD	AUGER_WELL
RW-089	FE	AUGER_WELL
RW-090	FF	AUGER_WELL
RW-091	100	AUGER_WELL
RW-092	101	AUGER_WELL
RW-093	102	AUGER_WELL
RW-094	103	AUGER_WELL
RW-095	104	AUGER_WELL
RW-096	105	AUGER_WELL
RW-097	106	AUGER_WELL
RW-098	107	AUGER_WELL
RW-099	108	AUGER_WELL
RW-100	109	AUGER_WELL
RW-101	10A	AUGER_WELL
RW-102	10B	AUGER_WELL
RW-103	10C	AUGER_WELL
RW-104	10D	AUGER_WELL
RW-105	10E	AUGER_WELL
RW-106	10F	AUGER_WELL
RW-107	110	AUGER_WELL
RW-108	111	AUGER_WELL
RW-109	112	AUGER_WELL
RW-110	113	AUGER_WELL
RW-111	114	AUGER_WELL
RW-112	115	AUGER_WELL
RW-113	116	AUGER_WELL

FD = French Drain
HDPE = High Density Polyethylene Pipe
RCP = Reinforced Concrete Pipe
CMP = Corrugated Metal Pipe

Appendix I

Conceptual Cost Estimates

Table I-1: Preliminary Engineer's Estimate of Probable Cost
Biscayne Canal West Problem Area - Alternative 1
Within County Right-of-Way

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 13,000	$ 13,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 5,200	$ 5,200
3	18-in RCP, Class III	LF	180	$ 56	$ 10,080
4	Exfiltration Trench, 18"	LF	680	$ 115	$ 78,200
5	Ditch Bottom Inlet, Type J-bottom, <10'	EA	12	$ 5,000	$ 60,000
6	Milling Existing Asphalt Pavement, 2" Average Depth	SY	934	$ 4	$ 3,734
7	Optional Base Group 04 (Limerock)	SY	934	$ 12	$ 11,208
8	Asphaltic Concrete FC-12.5	TN	105	$ 115	$ 12,053
				Subtotal	**$ 194,000**
	Contingency:			30%	$58,200
	Legal, Engineering, and Adminstration:			20%	$38,800
	Overhead & Profit:			5%	$9,700

Total Preliminary Engineer's Estimate of Probable Cost **$ 301,000**

(Rounded to the nearest $1,000)

Table I-2: Preliminary Engineer's Estimate of Probable Cost
Biscayne Canal West Problem Area - Alternative 2
Within City Right-of-Way

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 18,000	$ 18,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 8,000	$ 8,000
3	Pipe Removal	LF	0	$ 30	$ -
4	15-in RCP, Class III	LF	0	$ 39	$ -
5	Exfiltration Trench, 18"	LF	1,800	$ 115	$ 207,000
6	Ditch Bottom Inlet, Type J-bottom, <10'	EA	6	$ 5,000	$ 30,000
7	Milling Existing Asphalt Pavement, 2" Average Depth	SY	1,954	$ 4	$ 7,816
8	Optional Base Group 04 (Limerock)	SY	0	$ 12	$ -
9	Asphaltic Concrete FC-12.5	TN	0	$ 115	$ -
10	Sodding	SY	2,000	$ 2	$ 4,000

Subtotal		**$ 275,000**
Contingency:	30%	$83,000
Legal, Engineering, and Adminstration:	20%	$55,000
Overhead & Profit:	5%	$14,000

Total Preliminary Engineer's Estimate of Probable Cost **$ 427,000**

(Rounded to the nearest $1,000)

Table I-3: Preliminary Engineer's Estimate of Probable Cost
Biscayne Canal East Problem Area 1 - Tier 1

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 119,000	$ 119,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 48,000	$ 48,000
3	Pipe Removal	LF	2,000	$ 30	$ 60,000
4	Exfiltration Trench, 18"	LF	12,500	$ 115	$ 1,437,500
5	18-in RCP, Class III	LF	450	$ 56	$ 25,200
6	Ditch Bottom Inlet, Type J-bottom, <10'	EA	45	$ 5,000	$ 225,000
7	Manhole, Type D-4 to D-6	EA	10	$ 6,000	$ 60,000
8	Milling Existing Asphalt Pavement, 2" Average Depth	SY	14,057	$ 4	$ 56,229
9	Optional Base Group 04 (Limerock)	SY	14,057	$ 12	$ 168,684
10	Asphaltic Concrete FC-12.5	TN	1,578	$ 115	$ 181,502
11	Sodding	SY	3,600	$ 2	$ 7,200
				Subtotal	**$ 2,389,000**

Contingency:	30%	$716,700
Legal, Engineering, and Adminstration:	20%	$477,800
Overhead & Profit:	5%	$119,500

Total Preliminary Engineer's Estimate of Probable Cost **$ 3,703,000**

(Rounded to the nearest $1,000)

Table I-4: Preliminary Engineer's Estimate of Probable Cost
Biscayne Canal East Problem Area 1 - Tier 2

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 211,000	$ 211,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 85,000	$ 85,000
3	Pipe Removal	LF	4,500	$ 30	$ 135,000
4	Exfiltration Trench, 18"	LF	12,500	$ 115	$ 1,437,500
5	18-in RCP, Class III	LF	450	$ 56	$ 25,200
6	24-in RCP, Class III	LF	1,500	$ 98	$ 146,880
7	48-in RCP, Class III	LF	1,178	$ 196	$ 230,888
8	5-ft x 10-ft RCBC	LF	1,040	$ 1,005	$ 1,045,200
9	Ditch Bottom Inlet, Type J-bottom, <10'	EA	55	$ 5,000	$ 275,000
10	Manhole, Type D-4 to D-6	EA	10	$ 6,000	$ 60,000
11	Milling Existing Asphalt Pavement, 2" Average Depth	SY	17,581	$ 4	$ 70,325
12	Optional Base Group 04 (Limerock)	SY	17,581	$ 12	$ 210,972
13	Asphaltic Concrete FC-12.5	TN	2,267	$ 115	$ 260,655
14	Sodding	SY	4,000	$ 2	$ 8,000

Subtotal		**$ 4,230,000**
Contingency:	30%	$1,269,000
Legal, Engineering, and Adminstration:	20%	$846,000
Overhead & Profit:	5%	$212,000

Total Preliminary Engineer's Estimate of Probable Cost **$ 6,600,000**
(Rounded to the nearest $1,000)

Table I-5: Preliminary Engineer's Estimate of Probable Cost
Biscayne Canal East Problem Area 1 - Tier 3

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 241,000	$ 241,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 96,000	$ 96,000
3	Pipe Removal	LF	4,500	$ 30	$ 135,000
4	Exfiltration Trench, 18"	LF	12,500	$ 115	$ 1,437,500
5	18-in RCP, Class III	LF	450	$ 56	$ 25,200
6	24-in RCP, Class III	LF	1,400	$ 98	$ 137,088
7	30-in RCP, Class III	LF	100	$ 120	$ 12,000
8	4-ft x 7-ft RCBC	LF	1,178	$ 599	$ 705,622
9	5-ft x 10-ft RCBC	LF	1,040	$ 1,005	$ 1,045,200
10	Ditch Bottom Inlet, Type J-bottom, <10'	EA	55	$ 5,000	$ 275,000
11	Manhole, Type D-4 to D-6	EA	10	$ 6,000	$ 60,000
12	Milling Existing Asphalt Pavement, 2" Average Depth	SY	18,795	$ 4	$ 75,180
13	Optional Base Group 04 (Limerock)	SY	18,795	$ 12	$ 225,540
14	Asphaltic Concrete FC-12.5	TN	2,403	$ 115	$ 276,341
15	Sodding	SY	4,000	$ 2	$ 8,000

Subtotal		**$ 4,814,000**
Contingency:	30%	$1,444,200
Legal, Engineering, and Adminstration:	30%	$1,444,200
Overhead & Profit:	5%	$240,700

Total Preliminary Engineer's Estimate of Probable Cost **$ 7,950,000**

(Rounded to the nearest $1,000)

Table I-6: Preliminary Engineer's Estimate of Probable Cost
Arch Creek South/Biscayne Canal East Problem Area - Tier 1

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 233,000	$ 233,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 93,000	$ 93,000
3	Pipe Removal	LF	2,000	$ 30	$ 60,000
4	Exfiltration Trench, 18"	LF	24,350	$ 115	$ 2,800,250
5	18-in RCP, Class III	LF	1,200	$ 56	$ 67,200
6	Ditch Bottom Inlet, Type J-bottom, <10'	EA	120	$ 5,000	$ 600,000
7	Milling Existing Asphalt Pavement, 2" Average Depth	SY	27,735	$ 4	$ 110,938
8	Optional Base Group 04 (Limerock)	SY	27,735	$ 12	$ 332,820
9	Asphaltic Concrete FC-12.5	TN	3,114	$ 115	$ 358,099
				Subtotal	**$ 4,656,000**

Contingency:	30%	$1,396,800
Legal, Engineering, and Adminstration:	20%	$931,200
Overhead & Profit:	5%	$232,800

Total Preliminary Engineer's Estimate of Probable Cost **$ 7,220,000**

(Rounded to the nearest $1,000)

Table I-7: Preliminary Engineer's Estimate of Probable Cost
Arch Creek South/Biscayne Canal East Problem Area - Tier 2

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 885,000	$ 885,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 354,000	$ 354,000
3	Pipe Removal	LF	6,000	$ 30	$ 180,000
4	Exfiltration Trench, 18"	LF	24,350	$ 115	$ 2,800,250
5	18-in RCP, Class III	LF	1,200	$ 56	$ 67,200
6	24-in RCP, Class III	LF	1,200	$ 96	$ 115,200
7	30-in RCP, Class III	LF	570	$ 120	$ 68,400
8	36-in RCP, Class III	LF	1,270	$ 147	$ 186,690
9	66-in RCP, Class III	LF	1,750	$ 210	$ 367,500
10	Ductile Iron Pipe Force Main	LF	5,170	$ 211	$ 1,090,870
11	Ditch Bottom Inlet, Type J-bottom, <10'	EA	140	$ 5,000	$ 700,000
12	Milling Existing Asphalt Pavement, 2" Average Depth	SY	31,548	$ 4	$ 126,193
13	Optional Base Group 04 (Limerock)	SY	31,548	$ 12	$ 378,576
14	Asphaltic Concrete FC-12.5	TN	4,808	$ 115	$ 552,920
15	Sodding	SY	5,000	$ 2	$ 10,000
16	Pump Station (40cfs)	EA	4	$ 477,425	$ 1,909,698
17	Griffing Park Underground Storage Vault (7 ac-ft)	LS	1	$ 4,800,000	$ 4,800,000
18	NE 125th St/NE 12th Ave Underground Storage Vault (4.5 ac-ft)	LS	1	$ 3,100,000	$ 3,100,000
				Subtotal	**$ 17,693,000**
			Contingency:	30%	$5,307,900
			Legal, Engineering, and Adminstration:	20%	$3,538,600
			Overhead & Profit:	5%	$884,700
	Total Preliminary Engineer's Estimate of Probable Cost				**$ 27,500,000**
	(Rounded to the nearest $1,000)				

Maintenance	Unit	Quantity	Unit Cost	Annual Cost
Storage Vaults clean-up (Labor)	Annual	2	$ 12,000	$ 24,000
Storage Vaults clean-up (Equipment)	Annual	2	$ 1,500	$ 3,000

Power Usage	Period	KWh	Cost KWh	Annual Cost
Pump Station Power Consumption	Annual	6,500	$ 0.28	$ 2,000.00

Table I-8: Preliminary Engineer's Estimate of Probable Cost
Arch Creek South Problem Area - Tier 1

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 48,000	$ 48,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 19,000	$ 19,000
3	Pipe Removal	LF	300	$ 30	$ 9,000
4	Exfiltration Trench, 18"	LF	4,790	$ 115	$ 550,850
5	18-in RCP, Class III	LF	390	$ 56	$ 21,840
6	Ditch Bottom Inlet, Type J-bottom, <10'	EA	30	$ 5,000	$ 150,000
7	Milling Existing Asphalt Pavement, 2" Average Depth	SY	5,623	$ 4	$ 22,492
8	Optional Base Group 04 (Limerock)	SY	5,623	$ 12	$ 67,476
9	Asphaltic Concrete FC-12.5	TN	631	$ 115	$ 72,601
				Subtotal	**$ 962,000**

Contingency:	30%	$289,000
Legal, Engineering, and Adminstration:	20%	$192,000
Overhead & Profit:	5%	$48,000

Total Preliminary Engineer's Estimate of Probable Cost **$ 1,500,000**

(Rounded to the nearest $1,000)

Table I-9: Preliminary Engineer's Estimate of Probable Cost
Arch Creek South Problem Area - Tier 2

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 209,000	$ 209,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 84,000	$ 84,000
3	Pipe Removal	LF	1,000	$ 30	$ 30,000
4	Exfiltration Trench, 18"	LF	4,790	$ 115	$ 550,850
5	18-in RCP, Class III	LF	390	$ 56	$ 21,840
6	30-in RCP, Class III	LF	1,440	$ 120	$ 172,800
7	36-in RCP, Class III	LF	600	$ 147	$ 88,200
8	42-in RCP, Class III	LF	0	$ 171	$ -
9	Ditch Bottom Inlet, Type J-bottom, <10'	EA	40	$ 5,000	$ 200,000
10	Milling Existing Asphalt Pavement, 2" Average Depth	SY	7,426	$ 4	$ 29,706
11	Optional Base Group 04 (Limerock)	SY	9,151	$ 12	$ 109,812
12	Asphaltic Concrete FC-12.5	TN	834	$ 115	$ 95,888
13	Sodding	SY	2,000	$ 2	$ 4,000
14	Pump Station (20cfs)	EA	1	$ 238,700	$ 238,700
15	Pump Station (15cfs)	EA	1	$ 200,000	$ 200,000
16	Underground Storage Vault (3 ac-ft)	LS	1	$ 2,000,000	$ 2,000,000
				Subtotal	**$ 4,035,000**

Contingency:	30%	$1,211,000
Legal, Engineering, and Adminstration:	20%	$807,000
Overhead & Profit:	5%	$202,000

Total Preliminary Engineer's Estimate of Probable Cost **$ 6,300,000**
(Rounded to the nearest $1,000)

Maintenance	Unit	Quantity	Unit Cost	Annual Cost
Storage Vaults clean-up (Labor)	Annual	1	$ 12,000	$ 12,000
Storage Vaults clean-up (Equipment)	Annual	1	$ 1,500	$ 1,500

Power Usage	Period	KWh	Cost KWh	Annual Cost
Pump Station Power Consumption	Annual	1,400	$ 0.28	$ 1,000.00

Table I-10: Preliminary Engineer's Estimate of Probable Cost
Arch Creek South Problem Area - Tier 3

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 209,000	$ 209,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 84,000	$ 84,000
3	Pipe Removal	LF	1,000	$ 30	$ 30,000
4	Exfiltration Trench, 18"	LF	4,790	$ 115	$ 550,850
5	18-in RCP, Class III	LF	390	$ 56	$ 21,840
6	30-in RCP, Class III	LF	1,100	$ 120	$ 132,000
7	42-in RCP, Class III	LF	990	$ 171	$ 169,290
8	Ditch Bottom Inlet, Type J-bottom, <10'	EA	40	$ 5,000	$ 200,000
9	Milling Existing Asphalt Pavement, 2" Average Depth	SY	8,406	$ 4	$ 33,624
10	Optional Base Group 04 (Limerock)	SY	9,258	$ 12	$ 111,096
11	Asphaltic Concrete FC-12.5	TN	944	$ 115	$ 108,535
12	Sodding	SY	2,000	$ 2	$ 4,000
13	Pump Station (20cfs)	EA	1	$ 238,700	$ 238,700
14	Pump Station (15cfs)	EA	1	$ 200,000	$ 200,000
15	Underground Storage Vault (3 ac-ft)	LS	1	$ 2,000,000	$ 2,000,000

Subtotal		**$ 4,093,000**
Contingency:	30%	$1,228,000
Legal, Engineering, and Adminstration:	30%	$1,228,000
Overhead & Profit:	5%	$205,000

Total Preliminary Engineer's Estimate of Probable Cost **$ 6,800,000**

(Rounded to the nearest $1,000)

Maintenance	Unit	Quantity	Unit Cost	Annual Cost
Storage Vaults clean-up (Labor)	Annual	1	$ 12,000	$ 12,000
Storage Vaults clean-up (Equipment)	Annual	1	$ 1,500	$ 1,500

Power Usage	Period	KWh	Cost KWh	Annual Cost
Pump Station Power Consumption	Annual	1,400	$ 0.28	$ 1,000.00

Table I-11: Preliminary Engineer's Estimate of Probable Cost
Arch Creek North/Arch Creek South Problem Area - Tier 1

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 266,000	$ 266,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 106,000	$ 106,000
3	Exfiltration Trench, 18"	LF	25,950	$ 115	$ 2,984,250
4	18-in RCP, Class III	LF	4,500	$ 56	$ 252,000
5	Ditch Bottom Inlet, Type J-bottom, <10'	EA	150	$ 5,000	$ 750,000
6	Milling Existing Asphalt Pavement, 2" Average Depth	SY	33,053	$ 4	$ 132,214
7	Optional Base Group 04 (Limerock)	SY	33,053	$ 12	$ 396,636
8	Asphaltic Concrete FC-12.5	TN	3,711	$ 115	$ 426,776
				Subtotal	**$ 5,314,000**
			Contingency:	30%	$1,594,200
			Legal, Engineering, and Adminstration:	20%	$1,062,800
			Overhead & Profit:	5%	$265,700

Total Preliminary Engineer's Estimate of Probable Cost **$ 8,300,000**
(Rounded to the nearest $1,000)

Table I-12: Preliminary Engineer's Estimate of Probable Cost
Arch Creek North/Arch Creek South Problem Area - Tier 2

Item No.	Item Description	Unit	Qty	Unit Cost		Capital Cost	
1	Mobilization (approx. 5 percent)	LS	1	$	480,000	$	480,000
2	Traffic Control (approx. 2 percent)	LS	1	$	192,000	$	192,000
3	Pipe Removal	LF	7,000	$	30	$	210,000
4	Exfiltration Trench, 18"	LF	25,950	$	115	$	2,984,250
5	18-in RCP, Class III	LF	390	$	56	$	21,840
6	36-in RCP, Class III	LF	1,825	$	147	$	268,275
7	48-in RCP, Class III	LF	3,100	$	196	$	607,600
8	60-in RCP, Class III	LF	400	$	205	$	82,000
9	5' x 5' Concrete Box Culvert	LF	1,970	$	530	$	1,044,100
10	Ductile Iron Pipe Force Main	LF	2,600	$	211	$	548,600
11	Ditch Bottom Inlet, Type J-bottom, <10'	EA	175	$	5,000	$	875,000
12	Milling Existing Asphalt Pavement, 2" Average Depth	SY	42,904	$	4	$	171,616
13	Optional Base Group 04 (Limerock)	SY	42,904	$	12	$	514,848
14	Asphaltic Concrete FC-12.5	TN	4,817	$	115	$	553,962
15	Sodding	SY	7,500	$	2	$	15,000
16	Pump Station (40cfs)	EA	2	$	477,425	$	954,849
17	Regular Excavation	CY	20500	$	4	$	82,000

Subtotal		**$ 9,606,000**
Contingency:	30%	$2,881,800
Legal, Engineering, and Adminstration:	20%	$1,921,200
Overhead & Profit:	5%	$480,300

Total Preliminary Engineer's Estimate of Probable Cost **$ 14,900,000**
(Rounded to the nearest $1,000)

Power Usage	Period	KWh	Cost KWh		Annual Cost	
Pump Station Power Consumption	Annual	3,300	$	0.28	$	1,000.00

Table I-13: Preliminary Engineer's Estimate of Probable Cost
Biscayne Canal East Problem Area 1 - Tier 1

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 13,000	$ 13,000
2	Traffic Control (approx. 2 percent)	LS	1	$ 5,200	$ 5,200
3	18-in RCP, Class III	LF	180	$ 56	$ 10,080
4	Exfiltration Trench, 18"	LF	900	$ 115	$ 103,500
5	Ditch Bottom Inlet, Type J-bottom, <10'	EA	12	$ 5,000	$ 60,000
6	Milling Existing Asphalt Pavement, 2" Average Depth	SY	1,172	$ 4	$ 4,689
7	Optional Base Group 04 (Limerock)	SY	1,172	$ 12	$ 14,064
8	Asphaltic Concrete FC-12.5	TN	132	$ 115	$ 15,137
				Subtotal	**$ 226,000**

Contingency:	30%	$67,800
Legal, Engineering, and Adminstration:	20%	$45,200
Overhead & Profit:	5%	$11,300

Total Preliminary Engineer's Estimate of Probable Cost **$ 360,000**

(Rounded to the nearest $1,000)

Appendix J

MS4 NPDES Inspection and Maintenance Schedule

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS

STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Dry Retention Systems New systems (i.e., those in operation after the effective date of the permit) → Existing systems without chronic problems → Existing systems with chronic problems that affect the permitted operation of the system →	 Annually the first two years of operation Once every three years Annually until the chronic problems are corrected	• Inspect the system for storage volume recovery within the permitted time, generally less than 72 hours. Dead or dying grass on the bottom and / or standing water following three or more days of dry weather is an indication of potential clogging and reduced infiltration capacity. • Inspect and monitor sediment accumulation on the bottom or inflow / outflow to prevent loss of storage volume, clogging of the system or the inflow / outflow pipes. • Inspect vegetation of bottom and side slopes to assure it is healthy, maintaining coverage, and that no erosion is occurring within the system. • Inspect inflow and outflow structures, trash racks, and other components for signs of undercutting or piping, settling, or damage, and for accumulation of debris and trash that would cause clogging and adversely impact operation of the system. • Inspect the system for potential mosquito breeding areas such as where standing water occurs after 72 hours or where cattails or other invasive vegetation becomes established. • Note any signs of excessive petroleum hydrocarbon contamination and handle appropriately (3).	As needed based on inspection to assure proper operation	• If needed, restore the infiltration capacity of the system by scraping, discing or otherwise aerating the bottom so that it meets the permitted recovery time for the required treatment volume. • Remove accumulated sediment from the bottom and inflow and outflow pipes and dispose of properly. If possible, sediment removal should be done when the system is dry and when the sediments are cracking. • Maintain healthy vegetative cover to prevent erosion in the bottom, side slopes or around inflow and outflow structures (4). Vegetation roots also help to maintain soil permeability. Mow as needed. • Conduct repairs to prevent undercutting or piping. Remove trash and debris from inflow and outflow structures, trash racks, and other system components to prevent clogging or impeding flow. • Eliminate mosquito breeding habitats.

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS

STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Exfiltration Trench / French Drains New systems (i.e., those in operation after the effective date of the permit) → Existing systems without chronic problems → Existing systems with chronic problems that affect the permitted operation of the system →	 Annually the first two years of operation Once every three years Annually until the chronic problems are corrected	• Inspect facility for sediment accumulation in the pipe (when used) and for storage volume recovery (i.e., drawdown capacity). If present, observation wells and inspection ports should be checked following 3 days minimum dry weather. Failure to percolate stored runoff to the design treatment volume level within 72 hours indicates binding of soil in the trench walls and / or clogging of geotextile wrap with fine solids. • Inspect appurtenances such as sedimentation and oil and grit separation traps or catch basins as well as diversion devices and overflow weirs when used. Diversion facilities and overflow weirs should be free of debris and ready for service. Sedimentation and oil / grit separators should be scheduled for cleaning when sediment depth approaches cleanout level. Cleanout levels should be established not less than 1 foot below the invert elevation of the chamber.	As needed based on inspection to assure proper operation	• Conduct minor maintenance measures to restore infiltration rates to acceptable levels. This may include removal of accumulated sediments by mechanical or manual means. • Major maintenance (total rehabilitation) is required to remove accumulated sediment in most cases or to restore recovery rate when minor measures are no longer effective or cannot be performed due to design configuration. • Remove trash and debris from diversion facilities and overflow weirs. Clean out sedimentation and oil / grit separators when sediment depth approaches cleanout level and dispose of properly (3, 5). • Remove debris from the outfall or "smart box" (diversion device in the case of off-line facilities).

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS

STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Grass Treatment Swales (Dry) New systems (i.e., those in operation after the effective date of the permit) → Existing systems without chronic problems → Existing systems with chronic problems that affect the permitted operation of the system →	 Annually the first two years of operation Once every three years Annually until the chronic problems are corrected	• Inspect the swale for storage volume recovery within the permitted time, generally less than 72 hours. Dead or dying grass, cattails / aquatic vegetation in the swale and / or standing water following three or more days of dry weather is an indication of potential clogging and reduced infiltration capacity. • Inspect the swales for debris or litter accumulation or damage to structures including diversion devices, inflow pipes, driveway culverts, and swale blocks. • Inspect and monitor sediment accumulation in the swale or at inflows to prevent clogging of the swale or the inflow pipes. • Inspect vegetation of bottom and side slopes to assure it is healthy, maintaining coverage, and that no erosion is occurring within the swale. • Inspect the swale for potential mosquito breeding areas such as where standing water occurs after 72 hours or where cattails or other invasive vegetation becomes established. • Inspect the swale to determine if parking, filling, excavation, construction of fences, or other objects are damaging or obstructing stormwater flow in the swales.	As needed based on inspection to assure proper operation	• If needed, restore the infiltration capacity of the swale system by scraping, discing or otherwise aerating the bottom so that it meets the permitted recovery time for the required treatment volume. • Remove trash and debris, especially from inflow or outflow structures, to prevent clogging or impeding flow. Repair any damages to structures within the swale system as needed to maintain proper operation. • Remove accumulated sediment from the swale and inflow or outflows and dispose of properly (3, 5). If possible, sediment removal should be done when the swale is dry and when the sediments are cracking. • Maintain healthy vegetative cover to prevent erosion of the swale bottom or side slopes (4). Mow grass as needed. • Eliminate mosquito breeding habitats. • Repair any damage to the swale system and remove fences or other obstructions that may have been built in the swale system.

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS

STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Dry Detention Systems New systems (i.e., those in operation after the effective date of the permit) → Existing systems without chronic problems → Existing systems with chronic problems that affect the permitted operation of the system →	 Annually the first two years of operation Once every three years Annually until the chronic problems are corrected	• Inspect the system for storage volume recovery within the permitted time, generally less than 72 hours. Dead or dying grass on the bottom and / or standing water following three or more days of dry weather is an indication of potential clogging and reduced infiltration capacity. • Inspect and monitor sediment accumulation on the bottom and at the inflow / outflow to prevent loss of storage volume, clogging of the system or the inflow / outfall pipes. • Inspect vegetation of bottom and side slopes to assure it is healthy and maintaining coverage, no erosion is occurring, and excessive seepage that may indicate excessive ground water inflow is not occurring. • Inspect inflow and outflow structures, trash racks, and other system components for signs of undercutting, piping, settling, or damage, and for accumulation of debris and trash that would cause clogging and adversely impact proper operation. • Inspect the system for potential mosquito breeding areas such as where standing water occurs after 72 hours or where cattails or other invasive vegetation becomes established. • Note any signs of excessive petroleum hydrocarbon contamination and handle appropriately (3).	As needed based on inspection to assure proper operation	• If needed, restore the infiltration capacity of the system by scraping, discing or otherwise aerating the bottom so that it meets the permitted recovery time for the required treatment volume. • Remove accumulated sediment from the system and inflow / outflow pipes and dispose of properly (3, 5). If possible, sediment removal should be done when the system is dry and when the sediments are cracking. • Maintain healthy vegetative cover to prevent erosion in the bottom, side slopes or around inflow and outflow structures (4). Mow as needed. Monitor seepage and repair if needed. • Conduct repairs to prevent undercutting, piping, or damage. Remove trash and debris from inflow and outflow structures, trash racks, and other system components to prevent clogging or impeding flow. • Eliminate mosquito breeding habitats.

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS

STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Wet Detention Systems New systems (i.e., those in operation after the effective date of the permit) → Existing systems without chronic problems → Existing systems with chronic problems that affect the permitted operation of the system →	 Annually the first two years of operation Once every three years Annually until the chronic problems are corrected	• Inspect the system for storage volume recovery within the permitted time frame. • Inspect the system for excessive sediment accumulations that cause a 20% or more decrease in the wet detention system's permitted storage volume. • Inspect inflow and outflow structures, trash racks, and other system components for signs of undercutting, piping, settling, or damage, and for accumulation of debris and trash that would cause clogging and adversely impact proper operation. • Inspect vegetation on side slopes to assure it is healthy and maintaining coverage, and that no erosion is occurring. • Inspect the wet detention system and, if applicable, littoral zone to assure that cattails or other invasive vegetation are not becoming established.	As needed based on inspection to assure proper operation	• If required, take actions to assure that storage volume is recovered within the permitted time frame. • Remove accumulated sediments to restore permitted storage volume and dispose of properly (3, 5). • Conduct repairs to prevent undercutting, piping, or damage. Remove trash and debris from inflow and outflow structures, trash racks, and other system components to prevent clogging or impeding flow. • Maintain healthy vegetative cover to prevent erosion of side slopes or around inflow and outflow structures (4). Remove any trees or shrubs that may have become established on the discharge structure embankment, if applicable. • Remove cattails and other exotic vegetation from the littoral zone, if applicable, and replant appropriate vegetation if needed to meet littoral zone requirements (4).

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS

STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Pollution Control Boxes (e.g., baffle boxes, CDS units, hydrodynamic separators, catch basin inserts, etc.)	Quarterly, unless historic clean out operation records demonstrate that a more or less frequent schedule is appropriate	• Inspect inlets, outlets, and other system components for damage that would prevent proper flow conditions and operation. • Inspect and monitor sediment accumulation in the pollution control box and at the inflow / outflow to prevent loss of storage volume, clogging of the inflow / outfall pipes. • If applicable, inspect and monitor vegetation and debris accumulation in the pollution control box screens to prevent loss of storage volume or clogging of the system. • If applicable, inspect absorbent materials used to trap hydrocarbons or bacteria to determine if they need replacement.	As needed based on inspection to assure proper operation	• Repair any damage to assure proper flow conditions and operation. • Remove accumulated sediment and dispose of properly. • Remove accumulated vegetation and debris and dispose of properly (3, 5). • Replace absorbent materials as required for proper operation. • Follow all manufacture's recommended maintenance schedule and activities.
Stormwater Pump Stations	Semi-annually and more frequently as needed	• Inspect pump for proper operation. • Inspect inlets, bar screens (if used) and other associated components for debris or litter to assure that pump operates properly.	As needed based on inspection to assure proper operation	• Maintain or repair pump as needed to assure proper operations. • Remove debris, litter, and sediments as needed to assure proper operations. Properly dispose of the litter and debris collected. Properly dispose of sediment collected (3, 5).

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS				
STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Major Stormwater Outfalls	Annually unless historic operation records demonstrate that a more or less frequent schedule is appropriate	• Inspect outfalls to assure they are not clogged with litter, debris, or sediment and they are flowing properly. • Inspect for damaged headwalls, seepage around pipe, erosion of bank around outfall, erosion or sedimentation at outfall discharge point, and damage or clogged riprap.	As needed based on inspection to assure proper operation	• Remove debris, litter, and sediments as needed to assure proper operations. Properly dispose of the litter and debris collected. Properly dispose of sediment collected (3, 5). • Repair any structural damage to assure proper operation. • Maintain healthy vegetative cover to prevent erosion of banks or areas near outfalls (4). • Assure that discharges from outfalls are not causing erosion and sedimentation.
Weirs or Other Control Structures Associated with Stormwater Structural Controls	Same as specified in this column for the type of stormwater control with which it is associated	• Inspect weirs / control structures for damage that would prevent proper flow conditions and operation. • Inspect and monitor sediment accumulation behind weirs / control structures to prevent loss of storage volume and adverse impacts on flow and operation. • Inspect and monitor litter / debris accumulation behind weirs / control structures to prevent loss of storage volume and adverse impacts on flow and operation.	As needed based on inspection to assure proper operation	• Repair any damages to weirs / control structures as needed to assure proper flow conditions and operation. • Remove accumulated sediments to restore permitted storage volume and dispose of properly (3, 5). • Remove litter / debris as needed to assure proper flow conditions and operation and dispose of properly.

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS				
STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Pipes / Culverts	Inspect a minimum of 10% of the total number of structures each year. All of the structures shall be inspected at least once over two consecutive permit cycles (every 10 years).	• Inspect pipes and culverts for structural deficiencies or damage that would prevent proper flow conditions and operation. • Inspect pipes and culverts to monitor sediment accumulation to prevent loss of storage volume and adverse impacts on flow and operation. • Inspect pipes and culverts to monitor vegetation and litter / debris accumulation to prevent loss of storage volume and adverse impacts on flow and operation. • Inspections of pipes and culverts can be done through a variety of methods, such as visual observations during normal operating conditions, TVing, mirroring, or other appropriate methods as set forth in the stormwater system operation and maintenance SOPs.	As needed based on inspection to assure proper operation	• Repair any damages to pipes or culverts as needed to assure proper flow conditions and operation. • Remove accumulated sediments as needed to assure proper flow conditions and operation. Dispose of collected sediments properly (3, 5). • Remove vegetation and litter / debris as needed to assure proper flow conditions and operation and dispose of properly.

TABLE II.A.1.a — INSPECTION AND MAINTENANCE SCHEDULE FOR STRUCTURAL CONTROLS AND ROADWAYS				
STRUCTURAL CONTROL (1)	FREQUENCY OF INSPECTION	POSSIBLE INSPECTION ACTIVITIES	FREQUENCY OF MAINTENANCE	POSSIBLE MAINTENANCE ACTIVITIES (2)
Storm Sewer Inlets, Catch Basins, Grates, Ditches, Conveyance Swales, and Other Stormwater Conveyances	Inspect a minimum of 10% of the total number of structures each year. All of the structures shall be inspected at least once over two consecutive permit cycles (every 10 years).	• Inspect for damage that would prevent proper flow conditions and operation. • Inspect and monitor sediment accumulation to prevent loss of storage volume and adverse impacts on flow and operation. • Inspect and monitor litter / debris accumulation to prevent loss of storage volume and adverse impacts on flow and operation. • Inspect vegetation on bottom and side slopes of conveyances to assure it is healthy, maintaining coverage, and that no erosion is occurring within the conveyance system.	As needed based on inspection to assure proper operation	• Repair any damages to weirs / control structures as needed to assure proper flow conditions and operation. • Remove accumulated sediments to restore permitted storage volume and dispose of properly (3, 5). • Remove litter / debris as needed to assure proper flow conditions and operation and dispose of properly. • Maintain healthy vegetative cover to prevent erosion of the conveyance bottom or side slopes (4).

Notes: (1) The structural controls listed herein are not intended to be a complete listing of all stormwater structures owned and operated by the permittee. The permittee is responsible to perform and record inspections and maintenance of all structures that comprise its municipal separate storm sewer system.

(2) The inspection and maintenance activities in the third and fifth columns of this table are not intended to address every possible inspection need or maintenance activity that may be required to assure that an existing structural control continues to function properly or as permitted.

(3) Excessive petroleum hydrocarbon contamination can present severe sediment disposal / cleanup problems. Evidence of such pollution includes very dark oily stains, particularly at inlet and outlet structures and strong odors of gasoline, etc. The source of such pollutant discharges to the MS4 should be determined and removed if possible. Otherwise,

pretreatment practices should be used as necessary to insure that stormwater runoff is not contaminated beyond levels normally observed in runoff from highways and parking lots.

(4) Use only pesticides approved by USEPA and FDACS for aquatic sites to control weed pests in and around treatment facilities. Use of pesticides and chemicals for the control of invasive species and common undesirable aquatic plants should be minimized. Careful herbicide selection and application is essential to minimize harm to desirable plants and animals. If done on a routine basis mechanical removal can help control unwanted aquatics and minimize the use of chemicals. However, experienced trained applicators can selectively control many undesirable plants with minimum harm to desirable vegetation and possible downstream contamination. The Florida Fish and Wildlife Conservation Commission's Bureau of Invasive Plant Management and / or the County Extension Office should be contacted for assistance.

Supplemental nutrients (fertilizer) should be used as needed to establish and maintain healthy and vigorous cover on the banks of treatment facilities. However, normal rates of fertilization should be lowered in the immediate vicinity of treatment facilities to avoid over-enrichment of the soil and adjacent waters. Apply supplemental nutrients only when grass shows signs of distress once ground cover is well established. Clippings should not go into the water and should be removed periodically to prevent the buildup of nutrients in vegetation subject to periodic or frequent inundation.

Problem areas susceptible to chronic erosion require more intense measures for protection and establishment of permanent vegetative cover. These special considerations may include the use of sod in lieu of seeding and / or the use of higher rates of soil amendments and supplemental moisture during dry weather conditions to insure more rapid establishment or vigorous growth in bank vegetation. Experts in soil conservation are available for assistance by contacting the Natural Resources Conservation Service with the USDA.

(5) Solids disposal. Stormwater system sediments including street sweepings, catch basin sediments, collected screenings, slurry, sludge, and other solids shall be handled and disposed of pursuant to Department rules and guidance, which is available at: www.dep.state.fl.us/waste/quick_topics/publications/shw/solid_waste/GuidanceForSt-Sweep050304Final.pdf.

Appendix K

2012 CRS Coordinator's Manual Changes

2012 *CRS Coordinator's Manual* Changes

NFIP/CRS

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Contents

Note on this paper: This document summarizes the non-editorial changes expected to be included in the 2012 *CRS Coordinator's Manual*. The actual language is being drafted and is subject to the approval of FEMA. The complete 2012 *Manual* is expected to be approved and available in the first quarter of 2012.

Section 200 – Procedures

211 Prerequisites

a. **Timing of Prerequisites:** A participating CRS community will need to meet the current and new prerequisites at the time of its cycle verification visit. No new requirements, including annual recertification requirements, will take effect until the ISO/CRS Specialist reviews them one-on-one with the community at the cycle visit.

b. Application/Participation (Class 9) Insurance Prerequisite:

Item 4 reads "The community must maintain all flood insurance policies that it has been required to carry on properties owned by the community." The following will be added to the statement signed by the CEO:

> "We understand that disaster assistance for any community-owned building located in the Special Flood Hazard Area is reduced by the amount of NFIP flood insurance coverage (structural and contents) that a community should be carrying on the building, regardless of whether the community is carrying a policy."

c. **Class 7 BCEGS Prerequisite:** The BCEGS prerequisite to be a CRS Class 7 or better will change to a Class 6 prerequisite. It will read:

> "In addition to having sufficient points, in order to be a Class ~~7~~ 6 or better, a community must have received a classification of ~~6/6~~ 5/5 or better under the Building Code Effectiveness Grading Schedule (BCEGS). Both BCEGS classifications (residential/personal and commercial) must be a class ~~6~~ 5 or better.
>
> "In accordance with Section 113, communities may propose alternative approaches to meet the objectives of a prerequisite. For example, communities that are prohibited by state law from adopting and enforcing building codes may submit comprehensive building construction regulations and administration and inspection procedures for review to determine the equivalent BCEGS classification. Such regulations must be enforced throughout the community, not just in the floodplain."

d. **Class 4 Prerequisites:**

1. The current Class 4 prerequisites related to credits under Activities 430 – Higher Regulatory Standards, 450 – Stormwater Management, and 510 – Floodplain Management Planning

2. The BCEGS prerequisite to be a CRS Class 4 or better will change from 5/5 to 4/4. As with the Class 6 prerequisite, a community may propose an alternative approach.

3. Class 4 or better communities will need to obtain a minimum total score of ___ points *[points to be determined soon]* (after the impact adjustment) from one or a combination of the following elements that credit protecting natural floodplain functions:

– 420 – Natural functions open space (NFOS)
– 420 – Natural shoreline protection (NSP)
– 430 – Prohibition of fill (DL 1)

- 444 – Additional map data (AMD) natural functions layer
- 450 − Low impact development (LID)
- 450 – Watershed management plan (WMP) items c, e, f, and g
- 450 − Erosion and Sediment Control (ESC)
- 450 − Water Quality (WQ)
- 510 − Natural floodplain functions plan (NFP)

3. Class 4 600 Series Prerequisite: A Class 4 or better community must document the following life safety measures:

   (a) Have an inventory of levees that would result in a flood of developed areas if they failed or were overtopped during a flood, including a map of the area(s) affected.

   (b) Have an inventory of dams that would result in a flood of developed areas if they failed, including a map of the area(s) affected.

   (c) Assess the impact of a flood caused by the failure of the levees and dams on life and property.

   (d) Obtain ____ points for Activity 610 – Flood Warning and Response. *[Points to be determined soon.]*

e. **Class 1 Prerequisites:**

1. Item 2.(c)(2), the requirement to receive credit under Activity 610 – Flood Warning and Response, will be replaced by the Class 4 prerequisite.

2. Item 2.(c)(5) states "At least 50% of the buildings in the community's SFHA must be covered by a flood insurance policy." A community may opt for an alternative: obtain at least 50% of the total points under the new Activity 370 − Flood Insurance Promotion.

3. Class 1 or better communities will need to obtain a minimum total score of ___ points *[points to be determined soon]* (after the impact adjustment) from one or a combination of the natural floodplain functions elements listed under the Class 4 prerequisite.

4. The rest of the Class 1 prerequisites will remain unchanged.

212 Application Documents

The current 50-page *CRS Application* will be replaced by a shorter "Quick Check" that will identify if the community is likely to receive at least 500 points for its activities. If so, a visit by an ISO/CRS Specialist will be scheduled. There will still be a need for the letter of full compliance from the FEMA Regional Office, which usually requires a Community Assistance Visit. The Quick Check will be available for completion on-line or downloading. It is hoped that states will help tailor the Quick Check for their state's conditions.

214 Recertification

No changes to recertification procedures or documentation will take effect until after the community's cycle verification visit. The only change planned is the following data table.

Data table: The table below will be in a new worksheet. It will need to be completed when a community joins the CRS and submitted with every annual recertification.

This new recertification requirement will take effect after the community's next cycle verification visit, not for all communities in 2012, as was originally proposed. At the cycle visit, the ISO/CRS Specialist will explain the requirement and provide guidance on how to obtain the data.

The data will help both FEMA and the community track floodplain development and mapping changes. It will be used by FEMA to help schedule assistance activities and set mapping priorities. Accurate building counts help determine insurance market penetration and can guide insurance promotional efforts (which can be credited under the new Activity 370 – Flood Insurance Promotion).

Application and Recertification Program Data	In the SFHA	In a regulated floodplain outside the SFHA	In the rest of the community
1. Number of buildings in the SFHA (bSF) as of last report			
2. Number of new buildings constructed in the SFHA since last report	+		
If available, the following data would be useful:			
a. Number of new manufactured homes installed since last report	+		
b. Number of other new 1 - 4 family structures constructed since last report	+		
c. Number of all other structures constructed/installed since last report	+		
3. Number of buildings removed/demolished since last report	-		
4. Number of buildings affected by map revisions since last report (+ or -)			
5. Number of buildings affected by corporate limits changes (+ or -)			
6. Current total number of buildings in the SFHA (bSF) (sum of lines 1 – 7)			
7. Number of substantial improvement/damage projects since last report			
8. Number of repetitive loss properties mitigated since last report			
9. Number of LOMRs and map revisions (not LOMAs) since last report			
10. Acreage of area(s) (aSFHA) as of the last report			
11. Acreage of area(s) affected by map revisions since last report (+ or -)			
12. Acreage of area(s) affected by corporate limits changes (+ or -)			
13. Current acreage of the SFHA (aSFHA) (sum of lines 12 − 14)			

215 Modifications

Modifications are requests to revise the scores for selected activities. If the modification is for only a one-class improvement, the 2007 *CRS Coordinator's Manual* policy has been to only verify the activities submitted in the modification. If the modification will result in a two-class improvement, the community's entire program is verified and the cycle schedule starts again.

Because of all the changes in the 2012 *CRS Coordinator's Manual*, this policy will change. If the non-modified activities are changed in the 2012 *Manual*, then they will be verified, too. In effect, if a community submits a modification and has unmodified activities and elements that are substantially changed, then the community's entire program will be verified and the cycle schedule will start over.

240 Community Flood Risk Assessment

A new tool will be explained in this new section. It is an on-line interactive assessment to help communities identify which CRS activities would be of most benefit to them. The Demo version is available for anyone to try at www.crs2012.org, under "Community Self-Assessment." Certified Floodplain Managers who complete the Demo version and provide comments on it can earn three continuing education credits (CECs) through the Association of State Floodplain Managers CFM program.

Doing the assessment is voluntary. It is a recommended tool for local officials who want to step back, look at their communities' flood problems, and identify programs and activities that best deal with those problems.

Selected sections of the Community Flood Risk Assessment, or a similar assessment that looks at the same concerns, such as a floodplain management plan, will be a prerequisite for:

- Developing a Program for Public Information under Activity 330 – Outreach Projects,
- The flood insurance coverage assessment under Activity 370 – Flood Insurance Promotion, and
- The documentation to support Activity 610 – Flood Warning and Response.
- The Class 4 prerequisite for a levee and dam failure assessment.

Activity 310 − Elevation Certificates

Objective: Maintain correct FEMA Elevation Certificates for new and substantially improved buildings in the SFHA

2007 *Manual*	Max Points		2012 *Manual*	Max Points
EC − ECs after joining CRS	56	⇒	Same	38
ECPO − Post-FIRM ECs	56	⇒	Same	48
ECPR − Pre-FIRM ECs	15	⇒	Same	30
ECCF − ECs in Computer Format	15	⇒	Dropped, new credit in 440 AMD	
ECWS − ECs on Website	20	⇒	Moved to 350 Website credit	
ORS − Off-site Record Storage	10	⇒	Moved to 430 Regulations Administration	
Max	172			116

EC − Elevation Certificates: The FEMA Floodproofing Certificate (FEMA Form 81-65) is required for floodproofed buildings. Communities will also need to provide a V Zone Certificate for new construction in the V Zone. An example form will be in the 2012 *Manual*. Communities that want to use a different form will need to show that it includes the same information that is needed for flood insurance rating for a new building in the V Zone.

ECPO − Elevation Certificates for post-FIRM buildings: Only the points are changing.

ECPR − Elevation Certificates for pre-FIRM buildings: Only the points are changing.

ECCF − Elevation Certificates in a computer format: The credit is being dropped from the CRS. The software was very expensive for FEMA to keep updated and the data were never used for its original purpose. However, a new, similar credit is being added to Activity 440 – Flood Data Maintenance, Additional Map Data (AMD), new item m.

ECWS − Elevation Certificates on the community's website: This element is being moved to Activity 350 − Flood Protection Information, with the rest of the CRS website credits.

ORS − Off-site record storage is being moved to a new element, Regulation Administration in Activity 430 − Higher Regulatory Standards. That element will also have credit for inspections and photographs at the time of the final Elevation Certificate.

Verification: Beginning with its next cycle verification visit, a community will need to provide (1) a list of all new buildings and substantial improvements in the SFHA since the last visit and (2) copies of all of the Certificates issued since the last visit. This can be done digitally.

The verification threshold for credit for EC, ECPO, and ECPR will be increased from 80% to 90%. This means that for any credit, at least 90% of the Elevation Certificates reviewed must contain no errors or omissions (also known as "gigs").

Recertification: After the next visit, (1) the list of new buildings and improvements and (2) copies of all of the previous year's certificates will need to be submitted annually, with each recertification. This can be done digitally. ISO will provide feedback on problems that are found.

Activity 320 − Map Information Service

Objective: Provide inquirers with flood hazard information

2007 *Manual*	Max Points		2012 *Manual*	Max Points
Read the FIRM for inquirers	140	⇒	MI 1− Same service	30
			MI 2 − LiMWA/floodway info/CBRS area	18
		new	MI 3 − Other flood problems not shown on FIRM	18
		new	MI 4 – Flood depth data (formerly in Activity 360)	18
		new	MI 5 − Special flood-related hazards	18
		new	MI 6 − Historical flood information/repetitive flood losses	18
		new	MI 7 − Natural floodplain functions	18
Max	140			90

The current credit is for reading the community's Flood Insurance Rate Map to inquirers and to provide basic information needed for rating an insurance policy (e.g., date of the FIRM). When the CRS was initiated in 1990, this was an important role, as most people did not have access to FIRMs and many had trouble reading them.

Things have changed since 1990. We now have a map determination industry that helps lenders. Insurance companies contract for centralized map information services for their agents. The public has direct access to FIRMs through FEMA's website. Accordingly, this credit will be reduced in the next *CRS Coordinator's Manual*. The remaining credit (MI 3 – 7) can be earned by providing additional flood hazard information from information sources other than the FIRM.

To receive the credit the community must

- Be receiving credit for reading the FIRM for inquirers (MI 1 is required);
- Have a map (or GIS layer) that shows the information provided;
- Volunteer the information to the inquirer (i.e., if the property is in an X Zone, but also in a repetitive loss area, the community does not wait for the inquirer to ask about any other hazards);
- Keep a log or other record of the service (no change from 2007); and
- Publicize the service (no change from 2007). There are three possible ways to do this:
  - An outreach project to the entire community, such as an article in a newsletter or a notice in a utility bill,
  - Notices sent to all local insurance agents, real estate agents, and lenders, or
  - Another approach as determined by a Program for Public Information (see Activity 330 – Outreach Projects)

The additional credit points add up to more than 100%, so the community can select what information it wants to provide and still receive the maximum credit.

Here are more details about the seven credited elements:

MI 1– Same service, i.e., provide all information found on a FIRM that is needed for rating a flood insurance policy.

MI 2 – LiMWA/floodway info/CBRS area: provide additional information found on a FIRM that is not related to rating the policy

MI 3 – Other flood problems not shown on FIRM. Examples include areas predicted to flood in the future because of climate change or sea level rise, local drainage problems, areas mapped outside the SFHA (e.g., in smaller watersheds), and a dam failure inundation zone.

MI 4 – Flood-depth data: the service would provide both the BFE and the ground or building elevation for a site or depths of flooding. The latter could be from flood depth maps that may be produced by RiskMAP.

MI 5 – Special flood-related hazards: advising inquirers about the property being subject to one of the special flood-related hazards recognized for CRS credit, such as coastal erosion, migrating channels, and ice jams. The affected area will need to be mapped, but not necessarily regulated.

MI 6 – Historical flood information/repetitive flood losses: areas flooded in the past (in or out of the SFHA), historic high water levels, mapped repetitive loss areas.

MI 7 – Natural floodplain functions: areas mapped in the National Wetlands Inventory, designated habitat areas, areas receiving natural floodplain functions credit in Activity 420 – Open Space Preservation, etc..

The 240 Community Flood Risk Assessment can help the community determine what additional information (MI 3 – 7) could and should be provided.

Activity 330 − Outreach Projects

Objective: Provide information needed to increase awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural floodplain functions

2007 *Manual*	Max Points		2012 *Manual*	Max Points
OPA − Additional Outreach Projects OPC − Outreach Projects to Community OPF − Projects to Floodplain properties	250	⇒	OP − Outreach Projects	175
OPS − Public information Program Strategy	125	⇒	PPI (OP) − Program for Public Information	55
		new	STK − Stakeholder delivery	40
		new	ACT − Action resulting from outreach	60
		new	FRP − Flood response preparations	50
		new	PPI (FRP) − Program for Public Information	20
PFI promotion of flood insurance	65		Moved to new Activity 370	
Max	380			350
Note that the community's points could add up to more than 350, but the credit for OP is capped at 175 points and the total credit is capped at 350 points.				

The changes are explained in a more detailed report, "Changes to CRS Activity 330 Outreach Projects." These pages only summarize the high points.

There will be two basic elements: Outreach projects (OP) and flood response preparations (FRP). In both elements, the community must identify the messages it wants to deliver and who they go to. For communities without a Program for Public Information (PPI), only messages that relate to the six priority CRS topics are credited:

1. Know your flood hazard (including the future flood hazard, e.g., sea level rise)
2. Insure your property for your flood hazard (at least one project must include this topic)
3. Protect people from the hazard
4. Protect your property from the hazard
5. Build responsibly
6. Protect natural floodplain functions

These six priority CRS topics replace the current 10 national topics. Communities with a PPI can add up to four more flood-related topics customized to local conditions.

A project disseminates a message. Certain projects are more effective at motivating change, so they are worth more points. For scoring purposes, there are three types of projects.

1. Informational materials: putting brochures and other materials out at public places; worth one point per message
2. General outreach: projects that reach out to people in general; worth two points per message
3. Targeted outreach: projects that reach out to 90% of the properties in the SFHA, the community's repetitive loss areas, or other target audiences identified in the PPI; six points per message

The credit points for OP are based on how many times the projects convey the same message each year. The credit for OP and FRP can be increased by 40% if the projects are designed as part of a Program for Public Information (PPI). A PPI is a plan, prepared by a committee in a similar manner as the current public information program strategy (OPS) or floodplain management plan (in Activity 510 – Floodplain Management Planning). Other activities' credits can be increased by a PPI, too. As with 510, the PPI will need to be updated at least every five years.

The credit for OP can be increased even more if there is a PPI and the projects are implemented by stakeholders (STK –30% bonus multiplier) and/or it can be shown that the messages have resulted in some desirable actions (ACT – 45% bonus multiplier). Because the maximum for OP is 175, OP plus the bonus credits could be greater than 350. However, the maximum possible score will be capped at 350.

FRP − Flood response preparations credits having a pre-flood plan of public information activities (news releases, handouts, templates, etc.), ready in advance of the next flood. The preparations must include proof copies of materials to be used, but they do not have to be copied or distributed until the flood occurs. FRP points are also increased if the projects are described in the PPI, but FRP is not eligible for the STK and ACT multiplier bonus points.

The scoring is based on the type of projects, the number of messages, the number of times the messages are repeated, plus the PPI, STK and ACT bonuses. This makes for a complicated scoring system that is best done on a spreadsheet. The following spreadsheet will be included with the 2012 *Manual* and will be available on-line as a Microsoft Excel file.

Outreach Project Worksheet

	Outreach Projects	Project Points	Number of times message is repeated										OP	Multipliers			
			Msg 1	Msg 2	Msg 3	M 4.a	M 4.b	Msg 5	Msg 6	Msg 7	Msg 8	Msg 9		PPI?	PPI	STK?	STK
OP 1	Insurance brochure	1		1									1	y	0.4	y	0.3
OP 2	Insurance agents	2		1									2	y	0.8	y	0.6
OP 3	Presentations	2	5	5		5		5		5			50	y	20.0	y	15.0
OP 4	Cable TV	2	1	1		1		1		1			10	y	4.0	y	3.0
OP 5	Mailing to SFHA	6	1	1	1		1	1		1			36	y	14.4		0.0
OP 6	Storm drain stencils	2							1				2	y	0.8		0.0
OP 7	Home builders meetings	6					2	2					24	y	9.6		0.0
OP 8													0		0.0		0.0
OP 9													0		0.0		0.0
OP 10													0		0.0		0.0
													0		0.0		0.0
	Messages												0		0.0		0.0
Msg 1	Is your house in the floodplain?												0		0.0		0.0
Msg 2	All residents in the SFHA should have flood insurance												0		0.0		0.0
Msg 3	Turn around, don't drown												0		0.0		0.0
M 4.a	Don't dump in our streams and ditches												0		0.0		0.0
M 4.b	Protect your house from flooding												0		0.0		0.0
Msg 5	Floodplain filling needs a permit												0		0.0		0.0
Msg 6	Don't dump in the storm drains, they drain to the bay												0		0.0		0.0
Msg 7	Know your evacuation route and have a family rendezvous point												0		0.0		0.0
												OP =	125				
	ACT?			y		y											
	ACT message points		0	21	0	12	0	0	0	0	0	0					
	ACT bonus		0.00	9.45	0.00	5.40	0.00	0.00	0.00	0.00	0.00	0.00	ACT =	14.85			
	FRP Projects	Points	Msg 1	Msg 2	Msg 3	Msg 4	Msg 5	Msg 6	Msg 7	Msg 8	Msg 9	Msg 10					
FRP 1	Media kits	2			1	1	1			1	1		10	y	4.0		
FRP 2	Pub svc announcemnts	2			1		1						4	y	1.6		
FRP 3	Door hangers	6			1	1	1			1	1		30	y	12.0		
FRP 4													0	y	0.0		
FRP 5													0		0.0		
												FRP =	44	PPI =	67.6	STK =	18.9
	c330 =			OP	125	+ PPI	67.60	+ STK	18.90	+ ACT	14.85	+ FRP	44	=	270.4		

Activity 340 − Hazard Disclosure

Objective: Disclose the flood hazard before the lender notifies prospective buyers of the need for flood insurance

2007 *Manual*	Max Points		2012 *Manual*	Max Points	Max W/PPI
DFH: Real estate agents' disclosure	46	⇒	Same	25	35
or State disclosure law	20	⇒	Dropped		
ODR: Other disclosure requirements	15	⇒	Same	25	25
REB: Real estate brochure	10	⇒	Same	8	12
DOH: Disclosing other hazards	10	⇒	Same	8	8
Max	81			66	80

Credit is given for disclosing the flood hazard before the mortgage lender has to notify prospective buyers of the hazard and of the need for flood insurance. Two elements (DFH and REB) receive a 42% bonus if they are designed in a Program for Public Information (element PPI under Activity 330) or if the community worked with real estate agents to design them. If the latter, there needs to be an annual meeting with the real estate representatives to evaluate and revise the program, similar to the PPI annual evaluation requirement.

DFH − Disclosure of flood hazard by real estate agents. This credit is keyed to disclosing the Special Flood Hazard shown on a Flood Insurance Rate Map. The minimum requirement for credit will also include a disclosure if the property is in a designated Coastal Barriers Resource System area, which is also shown on the FIRM.

The 20 point credit for a state disclosure law will be dropped, but still kept as creditable under ODR (5 points). This change is because upon closer review during the uniform minimum credit work, it was found that no state deserved the 20 points. If there is an effective state law, it would be reflected in a fully verified 46 points credit for DFH.

ODR − Other disclosure requirements, such as sellers must tell of known problems, the floodplain boundary must be shown on plats, or landlords must tell prospective tenants. Credit can be provided for state or local laws that require disclosure. A community can receive credit for up to five such requirements instead of three.

REB − Real estate disclosure brochure that advises the reader to check out if there's a hazard. As with DFH, full credit is only provided if the brochure was reviewed by the PPI committee or drafted with the involvement of real estate agents. It is recommended that real estate agents or communities provide the brochures to lenders as they would be valuable for people seeking pre-approval for a mortgage before they start house hunting.

DOH − Disclosure of other hazards by real estate agents, providing the community is already getting DFH credit. Creditable hazards must be flood-related, such as the coastal A Zone, erosion, subsidence, or wetlands. The 2012 *CRS Coordinator's Manual* will also include dam or levee failure flooding, coastal storm surge, and the seven CRS-credited special hazards as eligible for credit.

Activity 350 − Flood Protection Information

Objective: Provide the public with additional information

2007 *Manual*	Max Points		2012 *Manual*	Max Points	Max W/PPI
LIB − Flood protection library	25	⇒	Specific list of documents in library	16	16
LPD − Locally pertinent documents	5	⇒	Specific local documents	6	6
WEB – Website		⇒	Prerequisites revised		
WEB: 10 topics from 330	40	⇒	WEB 1 – 6 points per topic	36	60
WEB: Posting warning information	20	⇒	WEB 2 − Same	10	15
WEB: Posting real time gage links	10	⇒	WEB 3 − Same	10	10
WEB: noting where ECs are available	2	⇒	Part of WEB 4		
310 ECWS − Posting Elevation Certificates	20	⇒	WEB 4 − Posting ECs on the site	20	20
Max	102			98	127

The objective of this activity is to provide more detailed information on the messages that are introduced in the community's Activity 330 outreach projects and additional information that websites are very effective at disseminating, such as real time gage data. Full credit for two items is dependent on the community having a Program for Public Information (PPI) that includes these items as projects to be implemented and monitored.

There are three elements in the activity.

LIB − Keeping publications in a library. Full credit will be for having 12 specific FEMA publications (listed below) cataloged in the community's public library. All of them are available at no cost in hard or digital copy from FEMA.

If the state, region, community, or other entity has published documents that are more appropriate to the community's situation, then those may be substituted. References that are not relevant (e.g., the community has no coastal floodplain or manufactured homes) do not have to be included.

- Above the Flood: Elevating Your Floodprone House, FEMA-347
- Coastal Construction *Manual*, FEMA-55
- Elevated Residential Structures, FEMA-54
- Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings, FEMA-259
- Floodproofing Nonresidential Structures, FEMA-102
- Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding. FEMA-312
- Mandatory Purchase of Flood Insurance Guidelines, FEMA-186
- Manufactured Home Installation in Flood Hazard Areas, FEMA-85
- Mitigation of Flood and Erosion Damage to Residential Buildings in Coastal Areas, FEMA-257,
- Protecting Building Utilities From Flood Damage, FEMA-348
- Protecting Floodplain Resources, FEMA-268.
- Repairing Your Flooded Home, FEMA-234

LPD − Keeping locally pertinent documents available in the library. Examples of creditable documents include:

- Floodplain management ordinance
- Flood Insurance Rate Map
- Flood Insurance Study
- Floodplain management or hazard mitigation plan
- Other relevant plan, such a comprehensive plan or the beach management plan
- Others documents as identified in the community's PPI.

Documents for LIB or LPD credit may be hard copies or digital versions that one can view on a monitor in the library. Digital versions must be located in the library and not be dependent on links to an outside source.

WEB − Providing information via a website. The website must meet the following criteria:

1. There must be a flood information home page, with a directory of the site's flood information. For examples, see www.pbcgov.com/publicsafety/emergencymanagement/floodawareness, and www.floodhelp.uno.edu. There will be no credit for items that are not connected to this flood information home page.
2. The flood information home page must include information on the community's flood assistance services, such as the map information service and flood protection assistance credited under Activities 320 and 360.
3. For full credit, coverage of the topic must be more thorough than what is provided in an outreach project. Simply posting the written portions of an outreach project does not earn full credit. The objective is to provide more in-depth information.
4. There must be a link to FloodSmart or FEMA's flood insurance page
5. The community must check and fix the site's links at least monthly (there is free or low-cost software that can identify broken links automatically). It must review the content to ensure that it is still current and pertinent at least annually (e.g., make sure names, addresses, phone numbers, etc. are still correct, update any ordinance changes, etc.).

A community can receive credit for a county or regional site, provided there is a link from the community's website and the information is locally pertinent.

WEB 1 points are provided for website coverage of the six topics listed in Activity 330. A community with a Program for Public Information (PPI) credited in Activity 330 can add additional topics that are described in its PPI. WEB 1 and WEB 2 credit will be increased by 42% if the community has a Program for Public Information (PPI) that includes these topics as website projects to be implemented and monitored.

The Elevation Certificate website credit formerly in Activity 310 (ECWS) will be moved to WEB 4. Credit will be provided if the entire certificate is viewable on-line or if the site has a list of addresses that have Elevation Certificates and instructions on how the user can obtain them.

Documentation: No documentation will be required for WEB credit, as it will be verified on-line.

Activity 360 − Flood Protection Assistance

Objective: Provide one-on-one help in protecting property from flooding

2007 *Manual*	Max Points		2012 *Manual*	Max Points	Max W/PPI
Site-specific flood data	10	⇒	Moved to 320		
Names of qualified contractors	4	⇒	Dropped (can be in 330)		
Handouts on contractors	3	⇒	Dropped (can be in 330)		
Retrofitting advice	14	⇒	PPA − Property protection advice	25	40
Site visits	35	⇒	PPV − Advice after a site visit	30	47
		new	FAA − Financial assistance advice	10	15
School trained advisor	5	⇒	TNG − New credit for grants training	10	10
Max	71			75	112

Credit is given to communities that provide one-on-one advice and assistance to residents on protecting their property from flooding. As seen in the table above, some points previously available are being moved to Sections 320 or 330 and some items' points will be increased if the community has a Program for Public Information (PPI) that includes these items as projects to be implemented and monitored.

PPA − Property protection advice: This is for *face-to-face* advice and/or assistance about property protection, such as retrofitting techniques, local drainage improvements, and flood insurance.

PPV − Property protection site visit: If the community receives credit for PPA, additional points are available for making *site visits* to review flooding, drainage, and sewer problems and providing one-on-one advice to the property owner about protection of property. No credit is provided if the only purpose of the site visit is to verify compliance with a regulation or to see if drainage work is needed by the city.

FAA − Financial assistance advice: There is additional credit if the face-to-face property protection advice includes advice on financial assistance that may be available, including FEMA mitigation grants and Increased Cost of Compliance.

TNG − Training credit is provided if the person providing the advice and assistance has graduated from Emergency Management Institute courses on retrofitting or grants programs.

The prerequisites have not been changed: To qualify for this credit, the service must be publicized through an outreach project that reaches everyone in the community, a project that reaches everyone in the floodplain, or other project identified in the community's PPI.

Publicity: The service must be publicized through an outreach project that reaches everyone in the community, a project that reaches everyone in the floodplain, or via another approach as determined by a Program for Public Information (no change from 2007).

Documentation: Records must be kept of the advice given (no change from 2007).

Activity 370 − Flood Insurance Promotion

Objective: Improve flood insurance coverage in the community.

2012 *Manual*	Max Points
FIA − Assessment of Flood Insurance coverage: review of existing policies in various target areas	15
CP − Coverage improvement Plan: the community's plan to increase coverage in targeted areas	15
PI − Plan Implementation: more credit is provided for doing more projects	60
TA − Technical Assistance: offering flood insurance advice and assistance to residents	20
CI − Coverage Improvement: bonus points if the projects result in a measurable increase in coverage	30
	140

The changes are explained in a more detailed report, "CRS Activity 370 – Flood Insurance Promotion." This page only summarizes the high points.

This new activity credits communities that take an active role in encouraging residents and businesses to purchase and maintain adequate flood insurance coverage. Credit is for a four-step process that allows communities to assess their own needs and receive credit for improving their coverage. Credit for the four steps is provided incrementally.

Prerequisite: The community must prepare an inventory of all buildings owned by the community located in a floodprone area and note whether each building is insured for flood damage. See the more detailed report noted above for more information on this.

Step 1. FIA − Assessment of flood insurance coverage: the credit is provided for the assessment document. The assessment starts with the new Community Flood Risk Assessment that will be in Section 240 and policy data supplied to ISO every year. Errors found in the policy data (e.g., wrong community number) are reported to ISO.

Step 2. CP − Coverage improvement Plan: the plan is prepared by a committee that has representation from local insurance agents and lenders. The committee's recommended plan is submitted to the governing council. There is credit even if the plan is not adopted or implemented. The objective is to raise awareness of the current level of coverage and ways that it could be improved.

Step 3. PI − Plan Implementation: Projects are implemented pursuant to the plan. At least one of the projects must involve public support for flood insurance by one or more elected officials.

Step 4. CI − Coverage Improvement: Extra credit is provided if coverage goes up. A three-year running average is used to exclude short term variations in coverage.

TA − Technical assistance: Separate from the four planning steps, credit is available for having an expert advise people about flood insurance, similar to the credit for property protection advice under Activity 360. There will be more credit if the advisor is a licensed insurance agent and even more for an Associate in National Flood Insurance (ANFI™). See www.aicpcu.org/anfi for more information.

The planning process, adoption criteria, and scoring of projects is the same as for a Program for Public Information, credited in Activity 330. Having the same committee prepare one document that covers both activities is recommended, but not required.

Section 402 − Impact Adjustments for Areas

Changes in calculating the impact adjustment:

1. **aRF − The term "area of the regulatory floodplain,"** or aRF, will be replaced by the area of the Special Flood Hazard Area, or aSFHA. Communities that regulate an area larger than the SFHA shown on their Flood Insurance Rate Map will receive extra credit through the impact adjustment, up to a maximum of 150%.

   For example, if the community's SFHA is 1,000 acres and it regulates new development in an area that totals 1,200 acres, the impact adjustment formula will multiply the credit times 1.2.

2. **Coastal wetlands:** Areas with coastal wetlands or marshes had been excluded from the area of the regulatory floodplain. This previous exclusion was based on an understanding that Corps of Engineers Section 404 permits and other regulatory programs effectively prevented development in these areas. This exclusion will be dropped.

   This will likely increase the denominator used for the impact adjustment for many coastal communities, resulting in a reduction in credit. However, communities (and states) that prohibit development in their coastal wetlands will likely see an increase in credit in Activity 420 − Open Space Preservation.

3. **Default values:** Most activities have had an Option 2 default impact adjustment value. For example, communities that had at least five acres preserved as open space could use Option 2 and get 5% of the maximum credit (rOS = 0.05). The Option 2 default value will be dropped from Activity 420 − Open Space Preservation. For the credit for any element in Activity 420, the actual acreage of the open space and the SFHA will need to be calculated.

   In most cases, it is expected that communities will receive higher scores because most of those using Option 2 have more than 5% of their SFHA in parks and other creditable preserved open space. It is expected that large communities have GIS that can easily calculate these areas. The ISO/CRS Specialists will help small communities that may have to do this manually. Note also that the total area of the SFHA is part of the new data table required at recertification.

4. **Developed areas:** Certain elements, such as the new Open Space Incentives (OSI) in Activity 420 and Development Limitations (DL) in 430, are not credited in areas already developed. The impact adjustment sections will explain where this happens.

5. **Undevelopable areas:** It is has been noted that the CRS impact adjustment for areas treats all of the SFHA the same. Remote, "undevelopable" areas have equal weight with areas on the urban fringe that are prime for development. Rather than try to define, delineate, and eliminate such "undevelopable" areas from the impact adjustment formula, communities should zone them for little or low density development and receive LZ credit for those areas. LZ (low density zoning) will be moved from 430LD to 420.

Activity 410 − Floodplain Mapping

Objective: Regulate areas based on flood data not provided by FEMA, prepared to a higher study standard, and/or sharing in the cost of a Flood Insurance Study. The new name for this activity reflects this objective.

2007 *Manual*	Max Points		2012 *Manual*	Max Points
NS − New Study	410	⇒	Reduced credit for independent review	290
"with review"		⇒	SR – State Review	60
LEV – Leverage	1.0	⇒	Factor remains the same, 1.0	
HSS − Higher Study Standards	160	⇒	Up to 3 higher standards can be credited	160
FWS − More restrictive floodway standard	200	⇒	Same	110
CTP1 − Cooperating Technical Partners 1	20	⇒	Same	20
CTP2 − Cooperating Technical Partners 2	1.1	⇒	Multiplier increased to 1.18	112
AFDSH − Special Hazards credit	50	⇒	MAPSH – same credit, new acronym	TBA
Max	1386			* 752
* Higher points are possible if the impact adjustment is greater than 1.0				

NS − New study credit is for regulations based on flood elevations and other data not provided by FEMA. Credit is also for conducting restudies and assisting in FEMA funded flood insurance studies, subject to the leverage multiplier (LEV).

Credit under study scopes 3 or 4 will be provided for regulatory data based on high water marks that are higher than existing base flood elevations.

SR – State review is a new element that replaces the "with review" points in NS. It is provided where a study was given a detailed review by a qualifying state or regional agency. While a separate credit, the points are shown with NS in the table below.

	Original FIRM Zone					
	B, C, D, or X		A or V		AE, VE, A#	
Study scope	New Study	State review	New Study	State review	New Study	State review
1. Delineation of an approximate A Zone	70	−	60	−	−	−
2. Flood elevations for a site at time of development	100	20	80	20	45	10
3. New profile or length of shoreline, base flood elevations/depths in AH and AO zones.	225	45	175	35	110	20
4. New profile with floodway, length of shoreline with coastal velocity zone delineation, or converting coastal A Zones to V Zones or mapping the LiMWA.	290	60	230	45	140	25

HSS − Higher study standard credit is for conducting a study using future conditions, better topography, or other higher standard. "Future conditions" will be clarified to include sea level rise, subsidence, and climate change as well as watershed development, flood control projects, and new bridges. Up to three higher standards will be credited, instead of two.

Study scope	Original FIRM Zone			Max per Study
	B, C, D, or X	A or V	AE, VE, A#, V#	
1. Delineation of an approximate A Zone	20	15	–	60
2. Flood elevations for a site at time of development	30	20	15	90
3. New profile or length of shoreline	80	60	40	160

FWS − Floodway standard credit is for mapping the floodway using less than a 1 foot surcharge. Along with the reduction in points, the scoring is simplified:

1. FWS = 110, if the allowable rise was from 0 to 0.10 foot,
1. FWS = 90, if the allowable rise was from 0.11 to 0.25 foot,
2. FWS = 50, if the allowable rise was from 0.26 to 0.50 foot, or
3. FWS = 25, if the allowable rise was from 0.51 to 0.99 foot.

CTP − Cooperating Technical Partner. This is a bonus credit for being a CTP with FEMA. Studies completed pursuant to a CTP agreement will get a 18% credit bonus, up from 10%.

MAPSH − Special hazard credit is for mapping areas subject to one of the seven identified special flood-related hazards. Special hazards credits and points for all affected activities will be determined and published separately.

Activity 420 − Open Space Preservation

Objectives: (1) Prevent flood damage by keeping floodprone lands free of development and (2) Protect and enhance natural floodplain functions

2007 *Manual*	Max Points		2012 *Manual*	Max Points
OS − Open Space Preservation	725	⇒	Same (new acronym: OSP)	1,450
DR − Deed Restrictions	75	⇒	Same	50
NB − Natural and Beneficial functions	100	⇒	NFOS − Natural Functions Open Space	350
SHOS − Special Hazard Open Space	50	⇒	Same	TBA
430LD−LDC − Land Development Criteria *	100	⇒	OSI − Open Space Incentives *	250
430LD−LZ − Low density Zoning *	600	⇒	Same *	600
430−NBR − Natural functions Regulations	30	⇒	NSP − Natural Shoreline Protection	120
Max *	980		*	1,970
* These regulations are not credited in preserved open space areas that are credited under 420 – OSP. The impact adjustment accounts for this mutual exclusivity. Therefore, they are not included in the totals.				

OSP − Open space preservation credits keeping vacant lands vacant through ownership by a public agency, non-profit organization (such as a church camp), or restrictive regulations. To qualify, a property must be open, meaning there are no buildings, filling, or storage of materials. Note that OSP credit is limited to properties in the community's regulatory floodplain. If there are preserved open spaces outside this area that have a flood protection benefit, they may qualify for credit under watershed management plan credit (WMP) in Activity 450 – Stormwater Management.

DR − Deed restrictions: bonus credit for ensuring that parcels credited for OSP will never be developed. No change is proposed other than a reduction in the maximum points.

NFOS − Natural functions open space: This new element will replace Natural and Beneficial Functions Open Space (NB). It has credit for having parcels credited for OSP preserved in or restored to their natural state, with bonus credits for additional attributes. The area affected must be mapped and the natural function being preserved or protected must be documented.

Natural Functions Open Space Credit	Max Points
1. Parcel is credited as OSP and is preserved in its natural state (required for any NFOS credit).	170
2. Parcel is designated in a plan to protect natural functions, e.g., a habitat conservation plan	50
3. Parcel is designated as critical habitat for threatened or endangered species or the species is present	50
4. Parcel is in a designated open space corridor or connected network	60
5. There is educational material on the site's natural functions (10 points without a PPI)	20
Total	350

1. Parcel is credited as OSP and is preserved in its natural state: There is less credit if the area is preserved only for a set number of years. The property must be managed to stay in the natural state or otherwise managed to keep its designation. This will also credit areas restored

for a natural floodplain function, such as bioengineered channel stabilization projects, removal of seawalls to allow beach erosion, wetland or riparian habitat restoration, and moving levees back to allow channel meandering.

2. Parcel is designated in a plan to protect natural functions: The plan must meet the criteria for a Natural Floodplain Functions Plan (NFP) credit in 510.c.

3. Parcel is designated as critical habitat for threatened or endangered species or the species is present: "Threatened or endangered species" include those on a Federal or state list and those on an official Federal or state list as a species of concern or pending listing.

4. Parcel is in a designated open space corridor or connected network: This credits a designated open space corridor or connected network of wetlands, woodlands, wildlife habitats, wilderness and other areas that support native species, maintain natural ecological processes, and sustain air and water resources. "Designated open space corridor" means the property has been identified for its corridor or network value in an approved plan. In some areas, this is considered "green infrastructure."

5. There is educational material on the site's natural functions: Full credit is provided only if the information is covered in the community's Program for Public Information, credited in Activity 330. Such a program can be developed by a regional group.

SHOS − Special hazard open space: preserved open space in areas subject to a special flood-related hazard. Special hazards credits and points for all affected activities will be determined and published separately.

OSI − Open space incentives: This is a new element, but parts come from land development criteria (LDC) in 430LD. It will credit requirements and incentives that keep floodprone portions of developments open. OSI credit will not be provided in areas already developed or areas preserved as open space and credited under OSP.

Open Space Incentives Credit	Points
1. The regulations set aside all floodprone lands in a subdivision as open space, or otherwise keep them free from development. The credit can be prorated if smaller areas are set aside. *	250
2. Each lot in a new subdivision must provide a building site that is on natural high ground, out of the regulatory floodplain. *	150
3. *To the extent possible*, each lot in a new subdivision must provide a building site that is on natural high ground, out of the regulatory floodplain. If a lot does not have a buildable site out of the regulatory floodplain, all new structures, pavement, and other development must be sited on the highest land on the lot. *	65
4. The regulations include transfer of development rights language to encourage staying out of the floodplain. Fewer points are provided for a density bonus within the same development. *	70
5. The regulations allow cluster development or PUDs.	25
6. The community's land use plan recommends open space use or low density development of floodprone areas.	25
* These credits are mutually exclusive, so the points do not add up.	

LZ − Low density zoning provides credit for zoning districts that require lot sizes of one acre or larger. New in 2012: if the area is vacant, credit is only provided for minimum lot sizes of five acres or larger. LZ credit is not provided in areas preserved as open space and credited as OSP.

New language will be included for non-residential development and accounting for the number of units and lot coverage, rather than relying solely on the lot size to indicate low density zoning.

NSP − Natural shoreline protection: This new element credits programs that protect natural channels and shorelines, the area most valuable for protecting natural floodplain functions. The programs can be local policies followed on public lands and/or regulations that govern development on private lands. The credit will only be available for those channels or shorelines that are currently in their approximate natural state, i.e., there is no concrete, rip rap, levees, armoring, beach nourishment, dams, or other human intervention that constrains the natural processes of the river, stream, lake, or ocean shoreline.

While OSP and NFOS provide credit for open space and open areas with natural floodplain functions benefits, they treat all floodplain areas the same. NSP identifies the channel or shoreline, i.e., the area closest to the water, the first to flood, and the most important area to aquatic and riparian habitat, as worthy of special attention and additional credit. The credit is for allowing these areas to follow their natural processes, such as channel meandering and beach erosion, and to encourage natural shorelines that provide water quality benefits for runoff.

The credit is for a regulation or program that prohibits the following:

1. In channels and channel banks in riverine areas: rip rap or armoring, channel alterations, dredging, filling, or removal of vegetation.
2. On shorelines of lakes or oceans: filling or other alterations to a beach, including beach nourishment projects; alterations to sand dunes; or construction of seawalls, bulkheads, armoring, or other shoreline stabilization structures.

The regulation or program may allow human alterations that have a natural floodplain functions benefit, such as removing a levee, restoring habitat, reducing bank erosion with bio-engineering techniques, or planting to preserve sand dunes.

The following types of programs can be credited:

1. An ordinance or regulation that governs public and private activities, or
2. A written community policy that covers shorelines on the community's property, such as in city parks.

Programs to restore natural floodplain functions, such as re-establishing a wetland, are credited under NFOS. Regulations to require restoration activities, such as requiring a developer to set aside a habitat corridor, are credited under OSI.

There is only one score for the program. Unlike NFOS, there are no gradations of points. Therefore, the size of a buffer zone is irrelevant. However, a setback or buffer that prohibits buildings and filling can also qualify as preserved open space (OSP), subject to the OSP impact adjustment. The larger the buffer zone, the greater the OSP credit.

The impact adjustment for NSP will not be based on the area of the SFHA, but on the percentage of the length of affected shorelines divided by the total length of shorelines in the community.

The impact adjustment ratio is:

$$rNSP = \frac{aNSP}{aSL}$$

where aNSP = the length of shoreline affected by the program
and aSL = the total length of shoreline in the community's SFHA

Armored or concrete channels and ditches are counted toward aSL, but not toward aNSP. The option 2 default credit will be the same as for 430 elements, 0.25. Every channel that is counted towards CDR credit in Activity 540 − Drainage System Maintenance must be part of aSL. Therefore, the impact adjustment map will have to be in agreement with the impact adjustment map for Activity 540.

Credit for Natural Shoreline Protection can be provided in areas credited as preserved open space (OSP) to encourage communities to protect the shorelines on public lands.

Impact Adjustments

The table below summarizes what areas are included in the impact adjustment for the various elements in Activity 420. Credits for open space parcels (OSP, DR, NFOS, and SHOS) are only provided in areas that qualify for OSP. Credits for the regulatory elements (OSI, LZ, and all 430 elements except for BC and RA) are not provided in parcels that already qualify as preserved open space (OSP). Similarly, there is no 420 open space credit in areas already developed. The exception to these rules is that credit for protecting shorelines (NSP) will be available everywhere.

Activity 420 Impact Adjustment Criteria		
New Element	**Open Space (OSP)**	**Developed areas**
Open space preservation (OSP)	Included	Excluded
Deed restrictions (DR)	Included	Excluded
Natural functions open space (NFOS)	Included	Excluded
Special hazard open space (SHOS)	Included	Excluded
Open space incentives (OSI) *	Excluded	Excluded
Low density zoning (LZ) *	Excluded	Excluded
Natural shoreline protection (NSP)	Included	Included

Activity 430 − Higher Regulatory Standards

Objective: Require that new development be provided with more protection than is required by the NFIP's minimum criteria

2007 *Manual*	Max Points		2012 *Manual*	Max Points
		new	DL − Development Limitations *	1,330
FRB − Freeboard	300	⇒	More credit if fill prohibited * **	500
FDN − Foundation Protection	35	⇒	More credit if fill prohibited * **	80
CSI − Cumulative Substantial Improvement	110	⇒	Same *	90
LSI − Lower Subs. Improvement threshold	90	⇒	Same *	20
PCF − Protection of Critical Facilities	100	⇒	More flexible credit for partial protection *	80
PSC − Protection of Storage Capacity	80	⇒	Moved to new DL credit	
NBR − Natural/Beneficial Functions Regs	40	⇒	Moved to 420 Natural Shoreline Protection	
ENL − Enclosure Limits	300	⇒	Same * **	240
BC − Building Code	190	⇒	Same *	100
450−FRX − Freeboard in X Zones		⇒	LDP − Local Drainage Protection	120
STF − Staffing	50	⇒	Moved to new RA credit	
MHP − Manufactured Home Parks	50	⇒	Same *	15
CAZ − Coastal A Zones	650	⇒	Same * **	650
SHR − Special Hazards Regs		⇒	Same *	TBA
OHS − Other Higher Standards	100	⇒	Some credit incorporated in new DL credit *	20
SMS − State-Mandated Standards	45	⇒	Insurance agent training moved to new 370	20
		new	RA − Regulations Administration	67
430LD−LDC − Land Development Criteria	100	⇒	Moved to 420 Open Space Incentives	
430LD−LZ − Low density Zoning	600	⇒	Moved to 420 Low density Zoning	
Max	2840		**	1,862

* These regulations are not credited in preserved open space areas that are credited under 420 – OSP. The impact adjustment accounts for this mutual exclusivity.

** FRB, FDN, ENL, and CAZ are mutually exclusive from DL, so they are not included in the total points

Filling: The use of fill to elevate buildings has several advantages that make it very desirable for developers and homeowners. But, there are problems with using fill: it reduces floodplain storage capacity and it has an adverse impact on native vegetation, wetlands, drainage, and water quality. One method to offset the impacts of the use of fill is to require compensatory storage, but that does not compensate for the adverse impact on natural floodplain functions.

It was noted that all of the benefits of filling accrue to the development and the property owner while all of the problems accrue to neighbors, taxpayers, the community, the NFIP, or the environment. Therefore, the 2012 *Manual* is intended to show that filling is not a desirable floodplain management activity. This will be done by revising the credit criteria for three elements:

- 420 – Development Limitations (DL) will incorporate 430's Protection of floodplain Storage Capacity (PSC) and increase the credit,
- 430 − Freeboard (FRB) will tie bonus credit for freeboard to restrictions on filling,
- 430 − Foundation protection (FDN) will tie full credit for foundations on fill to compensatory storage.

In all three cases, the new credits will address the two major concerns with filling: in riverine areas it has adverse impacts on natural floodplain functions and it can increase flood heights elsewhere due to loss of storage. In coastal areas it has adverse impacts on natural floodplain functions (flood heights are not impacted by fill in coastal areas).

Full credit will be provided in riverine areas where both impacts are addressed with a fill prohibition. Half credit will be provided for a compensatory storage requirement in riverine areas because comp storage does not protect natural floodplain functions. Half the credit will be provided in coastal floodplains, because prohibiting fill only affects the adverse impacts on natural floodplain functions.

In all cases, filling will be allowed to support projects to protect or restore natural floodplain functions, such as a channel restoration project.

DL − Development Limitations. This is a new credit for prohibiting fill (from the old PSC), prohibiting buildings, and/or prohibiting storage of materials in the floodplain. If all three items are included in the community's regulations, the area affected probably qualifies for the higher credit for open space preservation (OSP in Activity 420). Note that there is no credit for DL and other higher regulatory standards in areas credited as OSP.

Development Limitations Credit	Points
1. Prohibit fill (including no CLOMR-Fs and LOMR-Fs) in riverine areas	280
1.a. Prohibit fill (including no CLOMR-Fs and LOMR-Fs) in coastal areas or require compensatory storage in riverine areas: 130	
2. Prohibit new buildings (pro-rated for prohibiting some types of buildings, e.g., residential)	1,000
3. Prohibit storage of materials	50
3.a. Prohibit storage of hazardous materials: 20	
3.b. Require hazardous materials to be stored above the base flood elevation: 10 points	
Total	1,330

In areas where the community prohibits new buildings under DL 2, there will be no credit for the following higher standards for new buildings: freeboard (FRB), foundation protection (FDN), enclosure limitations (ENL), and coastal A Zone regulations (CAZ).

Partial credit will be provided under DL 3 (prohibit storage of materials) for prohibiting the storage of hazardous materials. Somewhat less credit will be provided for requiring hazardous materials to be stored above the base flood elevation.

FRB − Freeboard: credit will be provided for up to three feet of freeboard. There will be additional credit if (1) the community prohibits construction of new buildings on fill or (2) requires compensatory storage where filling is allowed.

Freeboard Credit			
Freeboard	No filling restrictions	Riverine areas: Comp storage required Coastal areas: fill prohibited	Riverine areas: fill prohibited
1 foot	100	110	120
2 feet	225	250	280
3 feet	375	440	500

The table on the right shows the points. Separate credit may be developed to recognize more than three feet of freeboard where there are assurances that there is real growth potential, fill is prohibited, and the community does a thorough enforcement job.

The filling restrictions credit will be prorated if the community allows buildings on stem walls without compensatory storage. The current approach to providing more points for lower levels of freeboard in shallow flooding AO Zones will be kept. There will be additional credit if the freeboard requirement extends to properties outside the SFHA (e.g., all buildings on ground that is below the BFE + 2' must be elevated to two feet above the BFE, regardless of its FIRM Zone, up to the 150% limit on the impact adjustment).

There had been a proposal to provide credit for up to five feet of freeboard. That will still be possible, but it will be spelled out in a separate element, with additional provisions, such as a demonstrated expectation of new growth in the floodplain.

FDN – Foundation protection: requiring foundations to be engineered or constructed on compacted fill that is protected from erosion and scour. More emphasis will be placed on the engineering and less on filling.

Foundation Protection Credit	Points
1. Engineered foundations, no buildings on fill	80
2. Buildings on compacted fill, protected from erosion. In riverine areas, compensatory storage must be required	60
3. Buildings on compacted fill, protected from erosion and scour	35

This credit is not available in V Zones because an engineered foundation is a minimum NFIP requirement in V Zones.

The new credit is provided in more detail:

1. 80 points if ALL new buildings in the regulatory floodplain:
   (a) Must be constructed on foundations that are designed and sealed by a registered design professional as complying with the requirements of the International Building Code, the International Residential Code, or ASCE 24, and
   (b) New buildings are not allowed on fill.
2. 60 points if all new buildings built on fill in the regulatory floodplain must be
   (a) Constructed on properly designed and compacted fill (e.g., Section 1803.5.8 and Section 1804.4 of the International Building Code, Section 2.4 of ASCE 24, as specified or equivalent),
   (b) The fill has appropriate protection from erosion and scour, and
   (c) In riverine areas, the building and fill must meet a compensatory storage requirement that meets the credit criteria of Section 431.__. Development Limitations (DL1a).
3. 35 points if all new buildings built on fill in the regulatory floodplain must be
   (a) Constructed on properly designed and compacted fill (e.g., Section 1803.5.8 and Section 1804.4 of the International Building Code, Section 2.4 of ASCE 24, as specified or equivalent), and
   (b) The fill has appropriate protection from erosion and scour.

CSI – Cumulative substantial improvements: counting multiple improvements so when they add up to 50% of the building's value, the substantial improvement rule applies. No change is proposed, other than a change in the points.

LSI – Lower substantial improvements threshold: having the substantial improvement rule apply when a project is valued at less than 50% of the building's value (e.g., 40%). A recent ruling by FEMA that Increased Cost of Compliance (ICC) will be made available to buildings that are deemed by a higher local code standard to be substantially damaged should make CSI and LSI more attractive to communities.

PCF – Protection of critical facilities: The maximum credit will be for preventing new critical facilities from being located in the 500-year floodplain. It is not feasible for some communities to locate critical facilities outside the floodplain, but they may be able to take some steps towards reducing future risk to these facilities and partial credit will be considered. Therefore, there will be gradations of credit to lesser standards. This will provide more opportunities for partial credit for different levels of protection to different types of critical facilities.

The following list is taken from community ordinances and suggestions and shows the variations in protection standards that could be submitted:

- Prohibiting all new critical facilities from the 500-year floodplain.
- Requiring all new critical facilities to be protected to the 500-year flood level + 1 foot of freeboard either by elevation or dry floodproofing.
- Regulating only one type of critical facility, such as hazardous materials sites or critical facilities owned and managed by the community
- A substantial improvement shall require the entire facility to be protected to the required elevation
- All additions (including those not meeting the substantial improvement threshold) must be protected to the required elevation.
- All new critical facilities must have access unless it is determined by the permitting authority that access is not needed. Full credit for access would necessitate an engineering study to ensure that the road (1) can withstand a 500-year flood and (2) would not cause an obstruction to flows.

ENL – Enclosure limits: Credit is for prohibiting enclosing the bottom floor of elevated buildings or requiring a nonconversion agreement. There will be a change: to receive credit for limiting enclosures to less than 300 square feet, there must be a nonconversion agreement.

Enclosure Limits Credit	Points
1. Regulations prohibit any building enclosures, including breakaway walls, below the base flood elevation, OR	240
2. Regulations prohibit enclosures of areas of 300 square feet or greater, including breakaway walls, below the base flood elevation and a. There is a nonconversion agreement that meets the criteria of 3, below, OR	190
b. There is no nonconversion agreement – 95 points	
3. Regulations require that the owner of a building sign a nonconversion agreement, promising not to improve, finish, or otherwise convert the area below the lowest floor and a. The community will inspect the enclosed area at least once a year, OR	90
b. Granting the community the right to inspect the enclosed area at any time – 60 points. OR	
c. No mention is made of inspections – 30 points.	

This change resulted from FEMA's experiences with claim payments for flooded buildings that had small enclosures that were converted to living areas. Credit points are further prorated based on the community's ability to inspect the enclosed area.

Building Code Credit	Points	Points
Adoption of the International		
Building Code	20	
Residential Code	20	
Plumbing Code	3	
Mechanical Code	3	
Fuel Gas Code	2	
Private Sewage Disposal Code	2	
Total for code adoption		50
BCEGS classification of 5/5	10	
BCEGS classification of 4/4	20	
BCEGS classification of 3/3	30	
BCEGS classification of 2/2	40	
BCEGS classification of 1/1	50	
Max for BCEGS		50
Total		100

BC − Building code: credit is provided for adoption and enforcement of the International Codes or their equivalent. Enforcement of the codes will be verified. Where a community has two different BCEGS classes, the higher number will be used to calculate the credit.

The current approach of not having an impact adjustment for BC will be kept because (1) building codes help reduce flood and drainage problems outside the SFHA and (2) one of the main reasons for the credit is reduction of losses from other natural hazards.

Local Drainage Protection Credit	Points
1. Credit is based on how high the lowest floor (including basement) must be above the crown of the nearest street or the highest grade adjacent to the building); *[maximum is for 3 feet] OR*	120
2. if the regulations require that as a condition for a building permit, the applicant must prepare a site plan that accounts for street flooding, local drainage from and onto adjoining properties and that protects the building from local drainage flows; OR	40
3. if the regulations require that the applicant provide positive drainage away from the building site to an approved point of collection that does not create a hazard or problem on neighboring properties. OR	20
4. if the regulations require that the increased volume of runoff due to the development is kept on site, such as via a low impact development measure.	20

LDP − Local drainage protection: ensuring that new buildings are well above the street level or otherwise protected from shallow drainage flooding. This was moved from 450 – FRX. Items 3 and 4 in the table have new language.

MHP − Manufactured home parks: removing the elevation exemption for manufactured homes placed in existing manufactured home parks. The current exemption from having an impact adjustment will be kept because there won't be many points for this element and manufactured home parks comprise a small area of a floodplain. However, the community will need to provide (1) Elevation Certificates for recently installed manufactured homes and (2) documentation that the homes meet the required anchoring standards.

CAZ − Coastal A Zones: enforcing V Zone rules and ENL enclosure limits inland from the V Zone boundary. The credited regulations and the total points are not proposed for change, but the impact adjustment needs to be clarified:

- 1.0, if 100% of the community's SFHA is covered by CAZ regulations.
- 0.5, if the community has a LiMWA or has mapped an area using the same criteria and 100% of that area is covered by CAZ regulations. Option 3, the actual ratio, can be used where the area subject to CAZ regulations is larger than 50% of the SFHA.

– 0.1, if the regulations apply to a community-defined "coastal A Zone" that does not meet FEMA's LiMWA mapping criteria.

SHR − Special hazards regulations: enforcing appropriate construction standards in areas subject to a special flood-related hazard. Special hazards credits and points for all affected activities will be determined and published separately.

OHS − Other higher standards: credit for regulations not credited elsewhere. Some past credits, such as prohibiting certain types of buildings, will be in DL.

SMS − State-mandated regulatory standards: bonus credit if a regulatory standard is required by the state. The part of this element that credits state insurance training requirements will be dropped as no state has ever met the credit criteria.

RA − Regulations administration: This is a new element with five parts, as shown in the table.

Regulations Administration Credit	Points
1. Staff training	25
2. Building department is IAS accredited	5
3. Conducting 3 detailed inspections	16
4. Conducting reinspections	16
5. Off-site record storage (old ORS)	5
	67

1. Staff training: The current element for staffing (STF) will be put in this new element (although the credit points may be different). STF provides five points for each Certified Floodplain Manager and each graduate of several four day classes conducted or sponsored by FEMA's Emergency Management Institute.

2. IAS is the International Accreditation Service, an arm of the International Code Council. It has a new program that reviews and accredits building department. The program is explained at www.iasonline.org/Building_Department_ Program.

3. Conducting three detailed inspections: On the next page are specific criteria for when the inspections are conducted, what is inspected, and what documentation is needed.

4. Conducting reinspections, i.e., inspecting buildings when they are sold or rented to a new tenant or when a home improvement permit is applied for. For CRS credit, the regulations must clearly state that the community's inspector has a right to enter the building at the designated occurrences (e.g., sale of the property) and will inspect for compliance with the floodplain management permit that was previously issued. Documentation of the inspections will be needed at verification.

5. The off-site records storage credit is being moved from Activity 310 − Elevation Certificates. There will be more specific information on what qualifies as a "secure location" and how to credit off-site backups of digital data.

   Because all Elevation Certificates will be collected with each year's recertification (see Activity 310) there will be no credit for off-site storage of Elevation Certificates. All of the credit will based on backup storage of other permit records.

Regulations Administration Credit for Inspections

There will be a new credit for conducting three inspections as described below. There is no partial credit for two inspections or doing less than what is listed here.

For credit, the community must conduct at least three inspections for each permitted development project in the regulatory floodplain according to the following criteria:

1. The permit application records must include a site plan that shows:
   a. The site plan's scale and north orientation arrow
   b. The parcel boundaries and the location and names of adjacent streets
   c. All watercourses on the parcel
   d. All floodplain, V Zone, coastal A Zone, and floodway boundaries that run through the parcel
   e. All required buffer or setback lines from shorelines or channel banks
   f. All drainage and utility easements
   g. All areas to be cleared, cut, graded, or filled
   h. The location of all existing and proposed fences, walls, and other structures
2. If the permit includes a new building or an expansion to an existing building:
   a. The site plan must show the footprint of all existing and proposed buildings and building additions.
   b. The permit application papers must include:
   c. The elevation of the lowest floor of the building (or addition) and of an attached garage, including the elevation of the interior grade or floor of a crawlspace,
   d. The location and elevation of all mechanical and utility equipment servicing the building, and
   e. For buildings with solid foundation walls and buildings with enclosures below the BFE, the total area of each enclosed area (sq. ft.) measured on the outside, the location and specifications of all flood openings, and (a) the total net open area (sq. in) of flood openings below the BFE, accounting for screens, louvers, faceplates, and grilles; or (b) a statement of certification if engineered openings are specified (see NFIP Technical Bulletin #1).
3. The first inspection is conducted when the site is staked out or otherwise marked. The inspector checks that areas subject to special requirements are clearly marked on the ground. For example, if the floodway, coastal A Zone, or V Zone line goes through the parcel or there is a natural area that is not to be disturbed, it could be staked out. If there are no such areas, then this inspection does not need to be conducted for CRS credit (however, it is still a good idea to place stakes or other markings to show the building footprint in order to verify setbacks and other code requirements).
4. The second inspection is conducted when the project involves a building. The builder provides the community with documentation of the surveyed lowest floor elevation. The inspector checks that:
   a. The foundation or forms for the structure are correctly located on the site,
   b. Where buildings have foundation walls or other enclosures below the BFE, the location and size of the openings are as specified on the approved plans.

   The inspection records must include a record that the elevation of the lowest floor or the forms for the foundation walls were surveyed and found to be compliant. This could be, but does not have to be, a FEMA Elevation Certificate. At this point the inspector verifies that the lowest floor will be at or above the required elevation. This inspection is not needed if the project does not involve construction of a new building or a substantial improvement.

Regulations Administration Credit for Inspections (Continued)

5. The final inspection is conducted when the project is finished, the Elevation Certificate is submitted, and before a certificate of occupancy is issued. The inspector checks that:
   a. The foundation and floor elevation have not been altered since the second inspection,
   b. The building's lowest floor is at or above the required elevation and the correct information is recorded on the Elevation Certificate,
   c. All areas below the required elevation are constructed with materials resistant to flood damage,
   d. All required manufactured home tie downs are in place,
   e. Where buildings have foundation walls or other enclosures below the BFE, the location and size of the openings are as specified on the approved plans and recorded on the Elevation Certificate,
   f. All electrical, heating, ventilation, plumbing, air conditioning, ductwork, and other equipment is located, elevated or protected as specified on the approved plans and recorded on the Elevation Certificate.
   g. In coastal high hazard areas (Zone V) and coastal A Zones, slabs placed under the building are not connected to the foundation.
   h. The Elevation Certificate is complete and appears correct (e.g., the height of the lowest floor above the highest adjacent grade is accurate).
   i. V Zone and Breakaway Wall Certificates are obtained, as appropriate, for new and substantially improved buildings in V Zone and coastal A Zone areas.
   j. Buildings with enclosures in coastal A Zones meet the A Zone vent requirements.

   The inspection records must include:

   – Photographs of all sides of the structure,
   – Close up photographs of typical openings,
   – Photographs of all mechanical and utility equipment located outside the building, and
   – A completed FEMA Elevation or Floodproofing Certificate, as appropriate.

Documentation: The community must have records for each inspection available for the verification visit that show that show how each item was checked. The records must include copies of the photographs and elevation surveys.

Activity 440 − Flood Data Maintenance

Objective: Make the community's floodplain data more current, useful, or accurate to improve local regulations, planning, disclosures, and property appraisals

2007 *Manual*	Max Points		2012 *Manual*	Max Points
AMD − Additional Map Data	129	⇒	Two new credited attributes	160
BMM − Benchmark Maintenance	90	⇒	Alternative approaches to be credited	27
EDM − Erosion Data Maintenance	−	⇒	Same	TBA
FM − FIRM Maintenance	20	⇒	Same	15
Max	239			202

AMD − Additional map data credit is for incorporating FIRM data into the community's GIS and using the results in its regulatory and mitigation programs. The minimum requirement is for a layer that shows the items in the first line, below. Additional credit is provided for having layers for other attributes, as listed below, with the new points. Items l and m are new for 2012.

Additional Map Data	Points
a. Floodplain boundaries, corporate limits, streets, and parcel or lot boundaries	20
b. Buildings, building outlines, or building footprints	26
c. Floodways or coastal high hazard areas	12
d. Showing base flood elevations	12
e. FIRM zone attributes (e.g., A3, VE, etc.)	10
f. 500-year floodplain elevations or boundaries	10
g. Areas subject to other natural hazards	10
h. (2) Including contour lines at a smaller contour interval than on USGS quads	8
i. Floodplain data in the tax assessment data base	10
j. All FIRMs in effect after the date of the community's application to the CRS	6
k. Other data used for regulation or mitigation programs	8
l. Areas with natural floodplain functions (e.g., wetlands, designated riparian habitat)	14
m. Building elevation data	14
	160

BMM − Benchmark maintenance credit is for ensuring that benchmarks are accurate and maintained. The 2012 *Manual* will recognize more frequent re-surveying of benchmarks that don't have the stability ratings of A or B and CORS systems that support GPS surveying. The credit will be based on the number of qualifying benchmarks and CORS stations in floodplains with regulatory flood elevations, rather than all floodplains.

EDM − Erosion data maintenance is a special flood-related hazard. Special hazards credits and points for all affected activities will be determined and published separately.

FM − FIRM maintenance credit is for keeping copies of all old FIRMs, Flood Insurance Studies and Flood Hazard Boundary Maps. Digital or paper copies will be credited.

Activity 450 − Stormwater Management

Objective: Minimize the impact of new developments on surface water drainage and runoff.

2007 *Manual*	Max Points		2012 *Manual*		Max Points
SMR− Stormwater Mgmt. Regulations	225	⇒			380
SZ − Size of development regulated	25	⇒	Same	110	
DS − Design Storm	110	⇒	New credit for managing volume	225	
PUB − Public maintenance	90	⇒	Credit only for the requirement	20	
		new	LID – Low Impact Development	25	
WMP − Watershed Master Plan	225	⇒	Same		315
FRX − Freeboard in X Zones	150	⇒	Moved to activity 430, LDP		
ESC − Erosion and Sedimentation Control	45	⇒	Less credit for NPDES criteria		40
WQ − Water Quality regulations	25	⇒	Same		20
Max	520				755

SMR − Stormwater management regulations credits requiring all new developments to manage their excess stormwater runoff on site. It will have four sub elements, one more than in the past, the scores for which are summed to obtain the score for SMR.

1. **SZ − Size of development regulated:** minimum credit is for regulating developments of five acres or smaller, maximum credit is for regulating all development.
2. **DS − Design storm:** minimum credit is for managing the 10-year storm, maximum credit is for managing all storms up to the 100-year. This credit has previously been limited to managing peak flows, but there will be more points for also limiting increases in the volume of stormwater runoff leaving the site.
3. **PUB − Public maintenance:** requiring new stormwater management facilities to be maintained and subject to inspection. The credit in 450 will be limited to the regulatory requirement. There is a new credit in 540 − Drainage System Maintenance for the inspections and maintenance of storage facilities.
4. **LID − Low impact development:** This is a new element for requiring developers to use low impact development or similar "soft" techniques to minimize the size of on-site detention and to replicate natural stormwater characteristics.

WMP – **Watershed master plan** credit is for having a master plan to best determine how to manage stormwater, using open space, man-made, and natural approaches. There will be a new credit for having a dedicated source of funding for implementation, such as a stormwater utility.

ESC − Erosion and sedimentation control regulations credit is for management of sediment-laden runoff from construction sites. ESC will provide minimal credit for programs that do not regulate construction sites smaller than the national NPDES requirement, one acre. Credit for regulating agricultural lands will be dropped.

WQ − Water quality regulations: requiring stormwater management facilities to incorporate permanent best management practices (BMPs) for water quality. No change is proposed.

Activity 510 − Floodplain Management Planning

Objective: Produce a program of activities that will best tackle the community's vulnerability to the hazard and meet other community needs

2007 *Manual*	Max Points		2012 *Manual*	Max Points
FMP − Floodplain Management Planning	294	⇒	Refinements in the steps expected	417
RLAA − Repetitive Loss Area Analyses	50	⇒	Wider distribution of the analyses	140
HCP − Habitat Conservation Plan	15	⇒	NFP − Natural floodplain functions plan	100
Max	359			657

FMP − Floodplain management planning credits a 10-step process to prepare, adopt and implement a plan to mitigate the community's flood problems and protect natural floodplain functions. The major 2012 changes to the 10 steps are noted below.

Step 1. Organize to prepare the plan
Step 2. Involve the public
Step 3. Coordinate: This step will be simplified.
Step 4. Assess the hazard
Step 5. Assess the problem: Must cover all hazards identified in Step 4 and repetitive loss areas. Communities will get extra credit for assessing the impact of climate change, including sea level rise.
Step 6. Set goals: Must address all problems identified in Step 5.
Step 7. Review possible activities: The plan must describe the community's capability to implement the activities reviewed.
Step 8. Draft an action plan: Must address all problems identified in Step 5.
Step 9. Adopt the plan
Step 10. Implement, evaluate, and revise

The University of North Carolina reviewed 60 510 plans and found that many did not relate the problem to the recommended solutions. Therefore, plans will need to show how the problems described in Step 5 are addressed in steps 6 and 8. For example, if repetitive flood losses are a problem, the plan will need to show how the action plan relates to mitigating repetitive losses.

RLAA − Repetitive loss area analyses credits more detailed plans for identified repetitive loss areas, following a five step process. In 2012, the analysis reports must be made available to all the property owners in the repetitive loss areas and be submitted to and approved by the governing council. There must be annual progress reports. The National Flood Mitigation Data Collection Tool will be recommended, but no longer required.

NFP − Natural floodplain functions plan: HCP − Habitat Conservation plan will be replaced by credit for a natural floodplain functions plan that protects natural functions of the community's floodplain. Examples include a habitat conservation or restoration plan or a green infrastructure plan.

Activity 520 − Acquisition and Relocation

Objective: Acquire, relocate, or otherwise clear buildings out of the flood hazard area

2007 *Manual*	Max Points		2012 *Manual*	Max Points
520 − Acquisition/Relocation	3,200	⇒	Same	1,866

This activity has always been straightforward: the number of points is based on the number of buildings that have been cleared out of the floodplain. Credit is also for clearing repetitive loss properties in any location. With the change in the maximum points for this activity, credit for each building removed will be reduced

Double and triple points are provided for clearing out repetitive loss properties and severe repetitive loss properties, respectively. This credit will be dependent on the community submitting updated AW-501 repetitive loss worksheets.

The changes include:

1. Double credit will be provided for removing critical facilities from the floodplain. This will treat critical facilities and repetitive loss properties the same way in both 520 and 530.

2. There will be a 50% credit bonus for buildings that are removed from the V Zone, coastal A Zone, or coastal erosion area. If a building was moved, it would have to be moved to a site outside these zones.

3. For CRS credit purposes, FIRM zone boundaries shall be as shown on the current FIRM or on a published preliminary FIRM, whichever shows the larger floodplain.

4. There will be new environmental review criteria to ensure that the CRS is not rewarding projects that have a negative impact on environmental, historical and cultural resources. Depending on the type of project, the procedures will require a review in accordance with applicable sections of the Federal programs listed in the box and corresponding state rules.

Environmental Review Regulations
National Historic Preservation Act
Archeological & Historical Preservation Act
Endangered Species Act
Fish & Wildlife Coordination Act
Clean Water Act
Sec. 10 Rivers and Harbors Act
Farmlands Protection Policy Act
E.O. 11988 Floodplain Management
E.O. 11990 Wetlands Protection
E.O. 12898 Environmental Justice
Coastal Zone Management Act
Coastal Barriers Resources Act

Activity 530 – Flood Protection

Objective: Protect existing buildings from flood damage

2007 *Manual*	Max Points		2012 *Manual*	Max Points*
530 TU – Techniques Used				
Elevation	2,800	⇒	Same	1,540
Dry floodproofing		⇒	Same	635
Wet floodproofing		⇒	Same	675
Sewer backup protection	200	⇒	Same	455
Barriers, levees, floodwalls		⇒	Same	810
Reservoirs, detention, retention		⇒	Must account for future flood increases	1,300
Channel modifications	1,000	⇒	Must account for future flood increases	1,110

* The maximum points shown are the maximum points that a community can receive for that flood protection technique. The maximum credit a community can earn for Activity 530 for all protected buildings is 1,540 points.

Activity 530 credit is based on the flood protection technique used to protect buildings that remain in the floodplain. Credit is also provided for protecting repetitive loss properties in any location.

The credit in 530 is pro-rated based on the improvement in the flood protection level. In the 2007 *CRS Coordinator's Manual, t*he maximum 530 credit is for elevating a building to one foot above the base flood elevation or to the 500-year flood elevation. The maximum credit level will change to the flood protection level designated in ASCE 24-09. An excerpt is on the next page:

For example, for Category II buildings, full credit will be provided if the building is protected to the base flood elevation plus one foot in an A Zone, or the design flood elevation (the BFE plus the community's freeboard), whichever is higher. Partial credit will continue to be provided for lower levels of protection.

Full credit for Category IV buildings will be based on either the standard in the table or the standard in Activity 430 – Higher Regulatory Standards for protecting critical facilities (the 500-year flood elevation), whichever is higher. Note that the DFE is defined by the community. A community's DFE may be the BFE plus 2 or more feet of freeboard.

For CRS credit purposes, the base flood elevation shall be as shown on the current FIRM or on a current published preliminary FIRM, whichever is higher.

The new environmental review criteria discussed for 520 will also apply to 530.

		Category I	Category II	Category III	Category IV
Elevation of Lowest Floor (A Zone)	All A Zones not identified as Coastal A Zones: elevation of lowest floor	DFE	BFE +1 foot or DFE, whichever is higher	BFE +1 foot or DFE, whichever is higher	BFE +2 foot or DFE, whichever is higher
Elevation of Bottom of Lowest Horizontal Structural Member (V Zone)	All V Zones and Coastal A Zones: where the lowest horizontal structural member is parallel to direction of wave approach	DFE	DFE	BFE +1 foot or DFE, whichever is higher	BFE +1 foot or DFE, whichever is higher
	All V Zones and Coastal A Zones: where the lowest horizontal structural member is perpendicular to direction of wave approach	DFE	BFE +1 foot or DFE, whichever is higher	BFE +2 feet or DFE, whichever is higher	BFE +2 feet or DFE, whichever is higher

BFE: base flood elevation

DFE: design flood elevation, i.e., the BFE plus the locally required freeboard.

Category I: Structures that represent a low hazard to human life in the event of failure including, but not limited to agricultural facilities, certain temporary facilities, and minor storage facilities.

Category II: All structures except those listed in Categories I, III and IV

Category III: Structures that represent a substantial hazard to human life in the event of failure including, but not limited to schools, jails, health care facilities (see ASCE 24 for the full list)

Category IV: Structures designated as essential facilities including but not limited to hospitals, police stations, emergency shelters (see ASCE 24 for the full list)

For credit for structural flood control projects (reservoirs, detention, retention, pump stations, and channel modifications):

- The project must either have been designed to account for future changes in flood levels (including sea level rise expected over the next 100 years) or the community must regulate the watershed to ensure no increases in future flood levels .
- If the project depends on a non-accredited levee (e.g., an improvement to a pump station), the community must also qualify for credit under Activity 620 − Levees.
- If the project changes the base flood elevation shown on the FIRM, credit will be dependent on submittal of a request for a Letter of Map Revision (LOMR). This is required by 44 CFR Section 65.3 of the NFIP regulations.

Activity 540 − Drainage System Maintenance

Objective: Keep the channels and storage basins clear of debris in order to maintain their flood carrying and storage capacity

2007 *Manual*	Max Points		2012 *Manual*	Max Points
CDR − Channel and basin Debris Removal	200	⇒	CDR − Inspecting and maintaining channels	208
		new	SBM − Inspecting/maintaining storage basins	118
More attention to problem sites	50	⇒	PSM − Problem site maintenance	50
Capital improvement program	50	⇒	CIP − Capital improvements program	70
SDR − Stream Dumping Regulations	30	⇒	SDR w/o publicity: 15, w/publicity: 25, w/PPI:	32
EPM − Coastal Erosion Protection Maint.		⇒	Same	TBA
Max	330			

The original CDR − Channel and basin debris removal will be divided into four parts:

CDR − Channel debris removal: Inspecting channels and removing debris to maintain conveyance. This will cover all natural, private and publicly owned drainage channels to ensure flood elevations along a channel do not increase due to debris.

SBM − Storage basin maintenance: Inspecting retention and detention basins and maintaining them as needed. This will cover flow control facilities that retain, detain, or infiltrate stormwater runoff to prevent downstream increases in flow. Communities that received public maintenance credit (PUB) in Activity 450 − Stormwater Management should be able to qualify for this credit. The revised PUB regulation will be a prerequisite for this credit.

PSM − Problem site maintenance: Providing special attention to known problem sites, such as more frequent inspections

CIP − Capital improvements program: Having a capital improvements program, i.e., a long-term program to correct or replace drainage problem sites

There will be better guidance on the definition of the drainage system for full credit. To receive full credit for inspecting and maintaining storage basins, underground facilities will need to be included.

Annual inspections will continue to be required for credit. The new environmental review criteria discussed for 520 will also apply to 540.

SDR − Stream Dumping Regulations will continue, with half of the points provided for the regulations and half for publicizing the regulations. Publicity will be scored using the same approach as outreach projects in Activity 330 – Outreach Projects. This will mean more credit for more projects and extra credit if the outreach is designed by a Program for Public Information, up to the maximum points available in SDR.

Activity 610 − Flood Warning and Response

Objective: Provide timely identification of impending flood threats, disseminate warnings to appropriate people, and coordinate flood response activities

2007 *Manual*	Max Points		2012 *Manual*	Max Points
FTR − Flood threat recognition system	40	⇒	More credit for predicting areas affected	75
EWD − Emergency warning dissemination	60	⇒	More attention to prepared messages	75
ORE − Other response efforts	50	⇒	FRO − flood response operations	120
CFP − Critical facilities planning	50	⇒	Same	75
SRC − StormReady community	25	⇒	Same	20
TsunamiReady community	30	⇒	TRC − TsunamiReady Community	30
Max				395

There will be new names for the 600 Series and all three activities. The series name will change from Flood Preparedness to Warning and Response.

New prerequisite: The community must provide information to residents and businesses on safety measures people should take before, during, and after a flood.

- Communities with riverine flooding must meet this requirement by sending a notice to at least 90% of the community's properties annually. The notice will be eligible for credit as an outreach project (OP) under Activity 330 – Outreach Projects.
- Coastal jurisdictions with flooding only from tropical storms and hurricanes can meet this requirement by either (1) sending the annual notice described above or (2) providing repeated watch, warning and safety information, using written notices or mass media, and beginning at least 72 hours in advance of the storm. The second approach could be credited under Activity 330's new flood response preparations element (FRP).
- A community that has more than one source of flooding may need to do different types of outreach to different audiences.
- A community with a Program for Public Information may use a different approach, providing the PPI document explains how the approach meets the objective of this prerequisite.

FTR − Flood threat recognition system credit is for having a system that forecasts flood elevations and arrival times at specific locations within the community. The element will have two parts:

1. Data collection, i.e., receiving predicted flood levels (40% of the credit) and
2. Flood forecast, i.e., relating the predictions to the areas affected through real time models or flood stage forecast maps (60% of the credit).

EWD − Emergency warning dissemination credits disseminating the warning to the general public using a variety of means. Full credit for door-to-door warnings and using the Emergency Alert System will require more advance preparations and messaging. New credit will be provided for critical facilities having NOAA Weather Radios and having prepared public messages for different scenarios. This section will also remind readers that there is credit for pre- and post-flood outreach efforts under Activity 330's flood response preparations element (FRP).

FRO − Flood response operations credits a plan with specific tasks to be taken at various flood stages to reduce or prevent threats to health, safety, and property. New credits are provided for more detailed planning and for including mitigation actions in the emergency response plan.

CFP − Critical facilities planning provides credit for coordination of flood warning and response activities with the operators of critical facilities, such as hospitals, nursing homes, and hazardous materials storage sites.

SRC − StormReady community and TRC − TsunamiReady community: These designations are made by the National Weather Service. No change in the credit criteria is proposed.

Recertification: The community will need to provide after action reports evaluating plan implementation during each year's response plan exercise or after a flood. The type of drill or exercise a community uses must be related to its flood hazard. A table top exercise, a full scale drill, or an actual event where the community's emergency operations center is fully activated will meet this requirement.

Activity 620 − Levees

Objective: Reduce the threat of a levee failure, but prepare for the flood if a failure does occur

2007 *Manual*	Max Points		2012 *Manual*	Max Points
LPL − Level Protection Level	900	⇒	Dropped as the basis for credit	
Prerequisite: Levee built before 1991 and protects to the 25 – 100-year flood		⇒	Removed, but the structure must meet FEMA's criteria for a "levee"	
Levee maintenance		⇒	LM − Levee maintenance	97
Emergency plan		*new*	LFR − Levee failure recognition system	30
		new	LFW − Levee failure warning	30
		new	LFO − Levee failure operations plan	50
		new	LCF – Levee failure critical facilities planning	30
Max	900			237

Previously, this credit has only been provided for structures built before 1991 that are not recognized as 100-year levees on a Flood Insurance Rate Map. The points were based on the level of protection provided by the levee. All three of these prerequisites will be dropped. The credit points for a community with a 50-year levee will be the same as for a 200-year levee, because the credit will not be for the protection level − it will be for maintaining the levee in good shape and preparing for the flood that will occur when the levee fails or is overtopped.

There will be an outreach project prerequisite. It will not be a credited element in 620, but the project can receive credit under Activity 330 – Outreach Projects.

LM − Levee maintenance: All levees will need to have an operations and maintenance plan and conduct and pass annual maintenance inspections. This will be a prerequisite for all the other credits, but it will also be worth points for non-accredited levees. Credit points are not available for accredited levees because maintenance is a minimum requirement for accreditation (but accredited levees are eligible for the rest of the activity's credits).

LFR − Levee failure recognition system: This is similar to 610's FTR − Flood threat recognition system. It is for having a system to advise the emergency manager when a levee may be in danger of failure or overtopping. The system must be tested monthly with communication checks between the levee owner and the community's emergency manager. This is required for the following credits.

LFW − Levee failure warning: This is similar to 610's EWD − Emergency warning dissemination, credit for different ways to warn people threatened by a levee that may overtop or fail.

LFO − Levee failure operations plan: This is similar to 610's FRO − flood response operations, specified steps to be taken at different flood levels. LFR and LFW are prerequisites. There must be annual exercises or drills of the plan.

LCF – Levee failure critical facilities planning: This is similar to 610's CFP – critical facilities planning. There will be more credit for more detailed coordination with the facilities.

A separate paper is available on how the new credits relate to the National Levee Safety Committee's draft report to Congress.

Activity 630 − Dams

Objective: Reduce the threat of a dam failure, but prepare for the flood if a failure does occur

2007 *Manual*	Max Points		2012 *Manual*	Max Points
SDS − State Dam Safety Program		⇒	Revised criteria	
		new	Condition Assessment (CA)	15
Regs of Construction of New Dams (CND)	15			
Regs of Modifications to Existing Dams (MED)	15			
Emergency Action Planning (EAP)	6		Emergency Action Planning (EAP)	15
Dam Owner Responsibility (DOR)	3			
Public Information and Training (PIT)	6		Risk Communication/Public Awareness	15
Technical Staff (TSF)	24			
Staff Education and Training (SET)	6			
Total SDS	75			45
DFP − Dam Failure Response Plan				
Dam failure recognition	25	⇒	DFR − Dam failure recognition system	26
Dam failure warning dissemination	25	⇒	DFW − Dam failure warning	26
Evacuation/critical facilities coord/notification	50	⇒	DFO − Dam failure operations plan	35
		new	DCF – Dam failure critical facilities planning	26
Total DFP	100			113
Max	175			158

SDS − State Dam Safety Program credit has provided the state program's score to all communities in a state. In 2012, SDS credit will be limited to communities downstream of a dam that could be flooded if the dam failed. It will be up to the community to obtain the dam failure inundation map(s) (or other documentation from the state dam safety office) needed to document this prerequisite. This will encourage community officials to determine if they face such a threat.

The 2012 credit criteria for SDS will reflect FEMA's efforts to get state programs more involved in emergency planning for dam failures and to work more with communities and the public. There will be three parts to this credit, each worth up to 15 points for a maximum of 45 points:

a. Condition Assessment (CA) (maximum credit: 15 points) – *New criteria*

b. Risk Communication/Public Awareness (RC/PA) (maximum credit: 15 points) – *More points for current criteria*

c. Emergency Action Planning (EAP) (maximum credit: 15) – *New criteria*

The one credit for local dam failure preparedness will be expanded into three elements that mirror the elements in 610 and 620.

DFR − Dam failure recognition system: This is similar to 610's FTR − Flood threat recognition system. It is for having a system to advise the emergency manager when a dam may be in danger of failure. The system must be tested monthly with communication checks between the operator of the dam and the community's emergency manager.

DFW − Dam failure warning: This is similar to 610's EWD − Emergency warning dissemination credit for different ways to warn people threatened by a dam that may fail. There are two prerequisites: DFR and a targeted outreach project, credited in Activity 330. The project must be targeted to the residents in the affected area and must advise them of the dam failure threat, and warning, evacuation, and safety procedures. There is no extra credit for this prerequisite in 630, but the outreach project can receive credit in 330.

DFO − Dam failure operations plan: This is similar to 610's FRO − flood response operations, specified steps to be taken at different flood levels. DFR and DFW are prerequisites. There must be annual exercises or drills of the plan.

DCF –Dam failure critical facilities planning: This is similar to 610's CFP **–** critical facilities planning. There will be more credit for more detailed coordination with the facilities.

Special Hazard Credit

The CRS provides credit for mapping, preserving open space, and regulating new development in areas subject to seven designated special flood-related hazards:

1. Uncertain flow paths: alluvial fans, moveable bed streams, and other floodplains where the channel moves during a flood.
2. Closed basin lakes: lakes that have a small or no outlet that may stay above flood stage for weeks, months, or years.
3. Ice jams: flooding caused when warm weather and rain break up a frozen river. The broken ice floats downriver until it is blocked by an obstruction, such as a bridge, creating a dam.
4. Land subsidence: lowering of the land surface caused by withdrawal of subsurface water or minerals or by compaction of organic soils.
5. Mudflow hazards: a river, flow, or inundation of liquid mud down a hillside, usually as a result of a dual condition of loss of brush cover and the subsequent accumulation of water on the ground, preceded by a period of unusually heavy or sustained rain.
6. Coastal erosion: areas subject to the wearing away of land masses caused primarily by waves on the oceans, Gulf of Mexico, and the Great Lakes.
7. Tsunamis: large ocean waves caused by an underwater earthquake or volcano.

These special flood-related hazards are addressed in separate publications that discuss their credit points, impact adjustment, and documentation requirements. They will be available after the 2012 *CRS Coordinator's Manual* is completed. The following changes to the credit criteria are planned:

1. **Alluvial fans and ice jams:** 410 MAPSH credit will be provided for mapping alluvial fans and areas subject to ice jams. Because there are mapping criteria for these two hazards in FEMA's *Guidelines and Specification for Flood Hazard Mapping Partners*, the policy had been to treat mapping them as a minimum requirement of the NFIP. However, few, if any regular Flood Insurance Studies have mapped these hazards.

2. **Coastal erosion:**

   a. Include setbacks as eligible for open space preservation credit (420 – SHOS)

   b. Expand the open space preservation credit (420 – SHOS) to include all of the lands within the erosion setback area and the coastal VE and AE zone areas, not just areas forward of the frontal dune.

   c. Increase the maximum credit for coastal hazards open space (420 – SHOS).

   d. Increase the credit for prohibiting hardened structures (430 – SHR).

3. **Tsunami:** To receive any credit, a community must map and regulate the area affected by the special hazard. It is very difficult to regulate new construction for a tsunami hazard that may exceed the base flood elevation by 10 or more feet. Therefore, an alternative prerequisite for tsunamis will be that the community map the hazard and have an appropriate tsunami warning and response program.

Appendices

The 2007 *CRS Coordinator's Manual* has nine appendices, an Index, and the Activity Worksheets.

***2007 Manual* Appendices**
App A – FEMA Regional Offices
App B – Acronyms
App C – Classification Points
App D – Comparison with NFIP Regs
App E – CRS Publications
App F – Assistance Agencies
App G – ISO/CRS Specialists
App H – State Coordinators
App I – Application Procedures
Index
Activity Worksheets

– Appendices A, G, and H will be eliminated because this information can be better kept up to date and made available more widely on a website.

– Appendix C will be eliminated. This is a half page table that related points to classes and premium reductions. It was originally included as an appendix because it was thought that it might change. It has not changed in 15 years. It will be moved to the introductory section of the *Manual*.

– Appendix F will be eliminated because it is not needed any more. There have been no reports of anyone using it and the "For More Information" sections of each activity will have a list of relevant assistance agencies and links to their websites.

– Appendix I will be eliminated because of the move to a less formal Quick Check approach that will replace the formal application procedures. Application prequisites will still be covered in Sections 212 and 213.

– Most of the activity worksheets will be eliminated as a separate publication. We'll still keep those that a community needs to complete, such as the verification cover sheet that needs the CEO's signature and the 450 – Stormwater Management and 610 – Flood Warning and Response worksheets needed for the technical reviewers. The ISO Calculation Software will still be made available to communities, which is an automated version of the worksheets, but there is no requirement that a community fill them out.

These changes will leave us with three appendices – acronyms, comparison with NFIP regulations, and CRS publications – and the Index.

The acronyms will be changed substantially. These changes are shown here.

Section	Acronym	Description
B-1	XXX	element acronym or variable number
110	CRS	Community Rating System
111	NFIP	National Flood Insurance Program
113	FEMA	Federal Emergency Management Agency
113	FIRM	Flood Insurance Rate Map
113	ISO	The Insurance Services Office
130	BFE	base flood elevation
130	CEO	Chief Executive Officer of a community
130	NAVD	North American Vertical Datum
130	NGVD	National Geodetic Vertical Datum
130	SFHA	Special Flood Hazard Area
210	AW-nnn	activity worksheet number nnn
211	BCEGS	Building Code Effectiveness Grading Schedule
211	LiMWA	limit of moderate wave action

Section	**Acronym**	**Description**
220	rXXX	ratio of the buildings or area affected by XXX
222	XXXn	element number "n," e.g., OPAn = OPA1, OPA2, and OPA3
223	cXXX	credit points for element or activity XXX
302	bXXX	number of buildings affected by element XXX
303	bSF	number of buildings in the SFHA
310	CFR	Code of Federal Regulations (in the Federal Register)
311	EC	maintaining FEMA elevation certificates
~~311~~	~~ECCF~~	~~maintaining elevation certificates in computer format~~
311	ECPO	maintaining post-FIRM elevation certificates
311	ECPR	maintaining pre-FIRM elevation certificates
~~311~~	~~ECWS~~	~~posting elevation certificate data on a website~~
~~311~~	~~ORS~~	~~off-site records storage~~
312	bPO	number of post-FIRM buildings in the SFHA
312	bPR	number of pre-FIRM buildings in the SFHA
320	CBRA	Coastal Barrier Resources Act
321	LOMA	Letter of Map Amendment
321	LOMR	Letter of Map Revision
321	MI	providing map information and FIRM data
~~330~~	~~PFI~~	~~promotion of flood insurance~~
331	ACT	actions resulting from outreach projects
331	FRP	flood response preparations
331	OP	outreach projects
~~331~~	~~OPA~~	~~additional outreach projects~~
~~331~~	~~OPC~~	~~outreach project to the entire community~~
~~331~~	~~OPF~~	~~outreach project to floodplain residents~~
~~331~~	~~OPS~~	~~outreach project based on a strategy~~
331	PPI	Program for Public Information
331	STK	stakeholder implementation
340	MLS	Multiple Listing Service
341	DFH	disclosure of the flood hazard by real estate agents
341	DOH	disclosure of other hazards, such as subsidence
341	ODR	other disclosure requirements
341	REB	real estate agent brochure (explains flood hazards)
351	LIB	flood protection library
351	LPD	locally pertinent documents for a library
351	URL	universal resource locator
351	WEB	flood protection website
361	FAA	financial assistance advice
~~361~~	~~FPA~~	~~flood protection assistance~~
361	PPA	property protection advice
361	PPV	flood protection site visit
361	TNG	training credit
364	EMI	FEMA's Emergency Management Institute
371	CI	coverage improvement
371	CP	coverage improvement plan
371	FIA	assessment of flood insurance coverage
371	PI	plan implementation
371	SMT	state-mandated agent training
371	TA	technical assistance
401	SH	special flood-related hazard
~~402~~	~~aRF~~	~~area of the regulatory floodplain~~
402	aSFHA	area of the Special Flood Hazard Area
402	aXXX	area affected by element XXX
~~411~~	~~AFD~~	~~additional flood data~~
~~411~~	~~AFE~~	~~advisory flood elevations~~
411	CTP	Cooperating Technical Partner
~~411~~	~~DAYS~~	~~the number of days before adoption of advisory flood elevations~~
411	FWS	more restrictive floodway standard

Section	**Acronym**	**Description**
411	HSS	higher study standard
411	LEV	leverage
411	MAP	mapping credit (replaces AFD, the sum of all 410 elements)
411	NS	new flood study
411	SR	state review of a new flood study
421	DR	deed restrictions placed on open space properties
421	LZ	low density zoning
421	LZs	zoning: "s" = ~~maximum~~ minimum number of acres per building
~~421~~	~~NB~~	~~open space with natural and beneficial functions~~
421	NFOS	natural functions open space
421	NSP	natural Shoreline Protection
~~421~~	~~OS~~	~~floodplain lands preserved as open space~~
421	OSI	open space incentives
421	OSP	open space preservation
430	SHR	special hazard regulations
431	ASFPM	Association of State Floodplain Managers
431	BC	building code
431	CAZ	coastal A zone regulations
431	CFM	Certified Floodplain Manager
431	CSI	cumulative substantial improvement regulations
431	DL	development limitations
431	ENL	regulations limiting enclosures below elevated floors
~~431~~	~~FB~~	~~feet of freeboard above the base flood elevation~~
431	FDN	foundation protection regulations
431	FRB	floodplain regulations that require freeboard
431	ICC	increased cost of compliance
431	LDP	local drainage protection
431	LSI	lower substantial improvement threshold
431	MHP	manufactured home park regulations
~~431~~	~~NBR~~	~~regulations to protect natural and beneficial functions~~
431	OHS	other higher regulatory standards
431	PCF	regulations that protect critical facilities
~~431~~	~~PSC~~	~~regulations that protect floodplain storage capacity~~
431	RA	regulations administration
431	SFIP	Standard Flood Insurance Policy
431	SMS	state-mandated regulatory standards
~~431LD~~	~~LDC~~	~~land development criteria~~
441	AMD	additional map data
441	aRFM	area of the regulatory floodplain measured in square miles
441	BMM	benchmark maintenance
441	CAD	computer aided design (computer program)
441	EDM	erosion data maintenance
441	FHBM	Flood Hazard Boundary Map
441	FM	FIRM maintenance
441	GIS	geographic information system
441	NGS	National Geodetic Survey
441	NSRS	National Spatial Reference System
~~441~~	~~YCM~~	~~number of years between checks of reference marks~~
451	BMP	best management practices (for stormwater quality)
451	DS	design storms used in stormwater management regulations
451	ESC	erosion and sedimentation control regulations
~~451~~	~~FRX~~	~~freeboard for new buildings in B, C, D, and X Zones~~
451	LID	low impact development
451	PUB	stormwater facilities subject to public maintenance
451	SMR	stormwater management regulations
451	SZ	size of development subject to stormwater management
451	WMP	watershed master plan
451	WQ	stormwater management regulations for water quality

Section	**Acronym**	**Description**
452	aW	area of a community's watersheds
510	FMA	Flood Mitigation Assistance program
510	HMGP	Hazard Mitigation Grant Program
511	FMP	floodplain management planning
~~511~~	~~HCP~~	~~Habitat Conservation Plan~~
511	NFP	natural floodplain functions plan
521	AR	acquisition or relocation of floodprone buildings
521	bAR	number of buildings acquired or relocated, or otherwise removed
521	bRL	number of buildings on the repetitive loss list acquired or relocated, or otherwise removed
521	bSRL	number of Severe Repetitive Loss Properties acquired, relocated, or otherwise removed
531	FPB	flood protection level before the project was constructed
531	FPI	flood protection improvement
531	FPP	flood protection provided by the project
531	PB	protected buildings
531	PBi	protection credit for building "i"
531	TU_i	technique used to protect building "i"
541	CDR	channel and basin debris removal
541	CIP	capital improvements plan
541	EPM	coastal erosion protection maintenance
541	PSM	problem site maintenance
541	SBM	storage basin maintenance
541	SDR	stream dumping regulations
542	aDC	area of the developed portion of the community
611	CFP	critical facilities planning
611	EWD	emergency warning dissemination
611	FRO	flood response operations
611	FTR	flood threat recognition system
~~611~~	~~ORE~~	~~Other flood response efforts~~
611	SRC	StormReady community
611	TRC	TsunamiReady community
621	LCF	levee failure critical facilities planning
621	LFO	levee failure operations plan
621	LFR	levee failure recognition system
621	LFW	levee failure warning
621	LM	levee maintenance
621	LOP	levee outreach project
~~621~~	~~LP~~	~~levee protection~~
~~621~~	~~LPL~~	~~levee protection level~~
630	ASDSO	Association of State Dam Safety Officials
631	DF	Dam failure critical facilities planning
631	DFO	dam failure operations plan
~~631~~	~~DFP~~	~~dam failure emergency action response plan~~
631	DFR	dam failure recognition system
631	DFW	dam failure warning
631	EAP	dam failure emergency action plan
631	NOAA	National Oceanic and Atmospheric Administration
631	SDS	state dam safety program
635	NID	National Inventory of Dams
710	AGR	average growth rate
711	CGA	community growth adjustment
711	CMGR	community-supplied growth rate
711	USGR	U.S. Census growth rate
720	cT	community's total CRS credit points

Appendix L

Proposed Changes to CRS Activity 330

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Proposed Changes to CRS Activity 330 Outreach Projects

October 20, 2011

Notes:

1. All items listed in this document are proposed revisions for the 2012 *CRS Coordinator's Manual*.

2. Comments on these proposals are welcome Please submit them via the "Outreach and Feedback" page on www.CRS2012.org.

Proposed Changes to

CRS Activity 330

Contents

Introduction

> **Objective of Activity 330**
>
> Provide information needed to increase awareness and motivate actions to
>
> - o Reduce flood damage,
> - o Encourage flood insurance coverage, and
> - o Protect the natural functions of floodplains.

The proposed changes for Activity 330 − Outreach Projects are based on input from communities, NFIP stakeholders, behavioral science research, evaluations, recommendations from the CRS Task Force 330 evaluation committee, interviews with local CRS Coordinators, and other sources of information.

Based on this feedback, the elements in 330 were redesigned to provide more flexibility to localities, encourage better public information, and recognize communities that engage in more thorough, critical thinking about their public information needs—what they want people in their communities to know and do with regard to floodplain resources and the identified flood hazards.

One key to doing a good job is for a community to have its own, home-grown plan and program for public information. Along these lines, CRS communities have indicated that they would prefer more flexibility in what kinds of public information efforts they undertake.

Highlights of the Proposed Changes

- Credit is more dependent on repeating a message via different types of outreach projects.
- Communities are credited for innovative approaches and are no longer constrained by a prescriptive list of how much must be covered under each topic.
- The former elements OPC (outreach projects to the community), OPF (outreach projects to floodplain properties), and OPA (additional outreach projects) have been combined into a new element, OP (outreach projects) to emphasize the importance of tailoring the information provided to the topic, to the audience, and to the desired behavioral change.
- The former element OPS (outreach projects pursuant to a public information strategy) has been expanded to a new element, Program for Public Information (PPI), which is developed according to guidelines discussed on page 16. Projects carried out pursuant to the community's Program for Public Information (PPI) receive more points under Activity 330 and under several others in the 300 series of public information activities.
- Having a PPI (Program for Public Information) also makes the community eligible for bonus points for outreach messages that involve other stakeholders (STK) and for instances in which the community can show that its messages have been effective and have achieved results (ACT).
- A new element, Flood Response Preparations (FRP) is introduced. It provides credit for communities that design and prepare public information projects to be implemented when the next flood occurs.
- Promotion of Flood Insurance (PFI) was moved to a new Activity 370 − Flood Insurance Promotion. However, at least one Activity 330 project must include a message promoting flood insurance.

Credited Elements

Table 1 summarizes the changes for Activity 330 and introduces the proposed elements to be credited. This table is based on a total of 350 points for Activity 330.

Table 1. Credited Elements				
2007 Manual	**Max Points**		**2012 Manual**	**Max Points**
OPA − Additional Outreach Projects OPC − Outreach Projects to Community OPF − Projects to Floodplain properties	250	⇒	OP − Outreach Projects	175
OPS − Public information Program Strategy	125	⇒	PPI (OP) − Program for Public Information	55
		new	STK − Stakeholder delivery	40
		new	ACT − Action resulting from outreach	60
		new	FRP − Flood response preparations	50
		new	PPI(FRP) − Program for Public Information	20
PFI promotion of flood insurance	65		Moved to new Activity 370	
Max	380			350*
*Note that the points could add up to more than 350, but the credit for OP is capped at 175 points and the total credit is capped at 350 points.				

As seen in Table 1, it is proposed that the 2012 *CRS Coordinator's Manual* have two main elements:

- **OP − Outreach projects**, with a maximum of 175 points (and eligible for bonus points if the community has a Program for Public Information that identifies the community's outreach projects), and
- **FRP − Flood response preparations**, with a maximum of 50 points (and eligible for bonus points if the community has a Program for Public Information).

There are three bonus point elements.

1. Bonus points are available for a **PPI − Program for Public Information.** The points for OP and FRP can be increased if the community prepares and adopts a Program for Public Information. All projects implemented pursuant to the PPI can receive a 40% bonus. This applies to both OP and FRP projects.

Two additional types of bonus points are available only for OP projects:

2. Projects that are recommended by the PPI and implemented by an agency or organization other than the CRS community, can receive a 30% bonus. This is under the new element **STK − Stakeholder delivery**. For example, a CRS city can receive the STK bonus for messages that are delivered by a utility company, a homeowners association, or the county emergency manager.
3. Messages that can be shown to result in the desired actions identified in the PPI can receive the **ACT − Action results** bonus (45%). This is explained in more detail on page 11.

Messages and Projects

Credit for Activity 330 is based on the number of times an outreach message is repeated and on the types of projects that convey the message.

Messages

Messages are the heart of outreach projects. Messages are specific statements that the community considers important for its audiences. For communities without a PPI, Activity 330 only credits messages that relate to the six priority CRS topics. Communities with a PPI can add up to four more flood-related topics customized to local conditions. The six priority CRS topics and example messages appear in Table 2.

Table 2. Topics and Example Messages

Topic	Example Messages
1. Know your flood hazard	Your property is subject to flooding You are in a repetitively flooded area Floods kill: five people died in the 2002 flood
2. Insure your property for your flood hazard *Note: at least one project must include a message from this topic*	All residents in the SFHA should have flood insurance Renters should buy flood insurance for their contents Take advantage of a low-cost Preferred Risk Policy
3. Protect people from the hazard	Turn around, don't drown Know the flood warning signals Designate a place where your family can rendezvous after an evacuation order is issued
4. Protect your property from the hazard	Replace your flooded furnace with one elevated above the flood level Keep debris and trash out of the streams and ditches We can help you get a grant to elevate your home
5. Build responsibly	Get a permit before you build Know the substantial damage rules (and the ICC benefits) All projects should be at least 10 feet from the property line so you don't alter the drainage between homes
6. Protect natural floodplain functions	Don't dump in the storm drains, they drain to the bay Protect our turtle nesting areas Preserve our wetlands − they clean the water and protect us from flooding
Additional PPI topics (examples)	
7. Hurricane preparedness *	Know your evacuation route
8. General preparedness *	Inventory and photograph your home's contents and put important papers and insurance policies in a safe place
9. Basement flooding *	Check your downspout − drain away from the house
10. Flood education *	School children should learn about flooding as part of their science or geography classes

* Example topics 7 and 8 could also be listed under CRS topic 3 -- Protect people from the hazard. By listing them as separate topics in its PPI, the community can receive credit for covering three different topics in each project. Similarly, example topic 9 could be covered under CRS topic 4. All four additional topics need to be explained in the Program for Public Information.

Projects

A project disseminates a message. Certain projects are more effective at motivating change, so they are worth more points. For scoring purposes, there are three types of projects.

1. **Informational materials (worth 1 point per message),** such as brochures, flyers, and similar documents that are made available upon request or are placed in a static location, such as a city hall lobby. Because they do not "reach out" to the public, they receive only one point per message.

   Examples:

   – The building department has one-page handouts on permit requirements and substantial improvement/substantial damage which are available to people who come in to the permit office.

   – The department also has a brochure prepared by FEMA on flood insurance.

There are no extra points for putting the same document out on display in different locations. However, more points are available if the document is delivered to an identified audience via one of the next two types of projects.

2. **General outreach projects (worth 2 points per message),** such as newspaper articles, signs, and presentations that reach out an identified general audience. Since they do "reach out" to the public, they receive two points per message.

   Examples:

   – The regional newspaper has a flood preparedness supplement at the beginning of flood season.

   – A city employee gives a talk about floodplain construction rules to the annual meeting of the local homebuilders association. The handout on permit requirements is passed out.

3. **Targeted outreach projects (worth 6 points per message)** that are directed to a specific audience. Research has shown these to be the most effective way to reach people, provided they address the audience and focus on the audience's concerns. They receive six points per message.

   To qualify for this type of project, there must be an identified target audience. If a community does not have a PPI, the only target audiences recognized for credit are (1) floodplain residents and businesses, and (2) repetitive loss area residents and businesses. A PPI can identify additional target audiences. These can be people in a specific geographical area (e.g., floodplain or repetitive loss area residents, downtown businesses, etc.) or a functional group (e.g., insurance agents, building contractors, drivers, etc.). For credit, communities must demonstrate that the targeted outreach projects reach at least 90% of the targeted audience and the message must clearly explain that the recipient is receiving the message because he/she is part of the targeted audience.

   Examples:

   – The mayor sends a letter to all residents of the floodplain. (This is called an outreach project to floodplain properties (OPF) under the 2007 *CRS Coordinator's Manual*.)

   – A presentation is made to a neighborhood meeting attended by 90% of the repetitive loss area's residents.

Examples of Outreach Projects

Informational Materials (1 point per message): brochures, flyers, and similar documents that are made available upon request or are placed on display for people to take. These passive approaches are not sent out or disseminated to identified audiences. Examples include, but are not limited to:

- A brochure or flyer made available in public places
- Multiple-page booklet made available in public places

General Outreach (2 points per message): materials that are disseminated to people who did not ask for them, presentations made to groups, and similar activities that reach out to people. Examples include, but are not limited to:

- Newspaper supplements and articles
- Newsletter articles
- Utility bill stuffers
- Radio and television ads or public service announcements
- Staffed booth or display at public functions, shopping malls, etc.
- Flyers or booklets distributed throughout residential neighborhoods or given to visitors to a booth
- Billboards
- Letters, newsletters, or e-mail messages sent to subscribers
- Presentations to homeowners, civic, and business associations
- Short statements posted outdoors, such as “no dumping, drains to the river” and high water mark signs
- Local television shows
- Cable television news tickers or crawlers that display a message at the bottom of the screen
- Programs for school children
- Training for citizens, such as CERT teams and weather spotters

Targeted Outreach (6 points per message): materials that are delivered to at least 90% of a target audience. The project must clearly explain that the recipient’s property is subject to flooding or otherwise explain why the recipient is getting the notice. This is similar to the current requirement for OPF and repetitive loss outreach projects. These differ from general outreach projects in that almost everyone in an identified audience is expected to be reached and the message is tailored to that audience. Examples include, but are not limited to:

- Mailer or e-mail sent to all properties in the floodplain (OPF)
- Mailer or e-mail sent to all properties in a target area designated in a PPI (e.g. all downtown business owners or residents behind a levee)
- A presentation to all drivers’ education classes where the designated target audience is students learning to drive, as explained in a PPI

If a community does not have a PPI, the only targeted audiences that can be credited are the properties in the floodplain and the properties in repetitive loss areas, identified in accordance with Section 503 of the *Coordinator’s Manual*. To receive credit for a project targeted to any other audience, such as downtown businesses or drivers education students, the community must have a PPI that identifies both the target audience and the project..

Notes:
- *Providing information from a FIRM or other flood hazard map is credited in Activity 320.*
- *Real estate disclosure projects are credited in Activity 340.*
- *Use of a website or library is credited in Activity 350.*
- *One-on-one discussion and advice is credited in Activity 360.*
- *Additional credit for projects that promote flood insurance are credited in Activity 370.*

Training or projects directed at local government staff, elected officials, or members of advisory bodies do not qualify as outreach projects under this activity.

Audiences: Note that messages are directed at audiences and should be tailored accordingly. Targeted outreach projects must address the target audience. For example, if there are a lot of non-English speakers in the audience, the message needs to be in the appropriate language.

Messages and projects may be directed at audiences outside the community, provided they have a direct relationship to flooding in the community and the message explains why the recipient is being targeted. Examples:

- Messages to contractors or insurance agents that serve the metropolitan area,
- Advice to people upstream of the community to not dump waste in streams, or
- Projects distributed through the only home improvement stores in the county.

Note that each community on a multi-jurisdictional PPI committee will be scored separately, based on the messages and projects that affect that community. Multi-jurisdictional PPI committees are further explained on page 17.

Basic Scoring

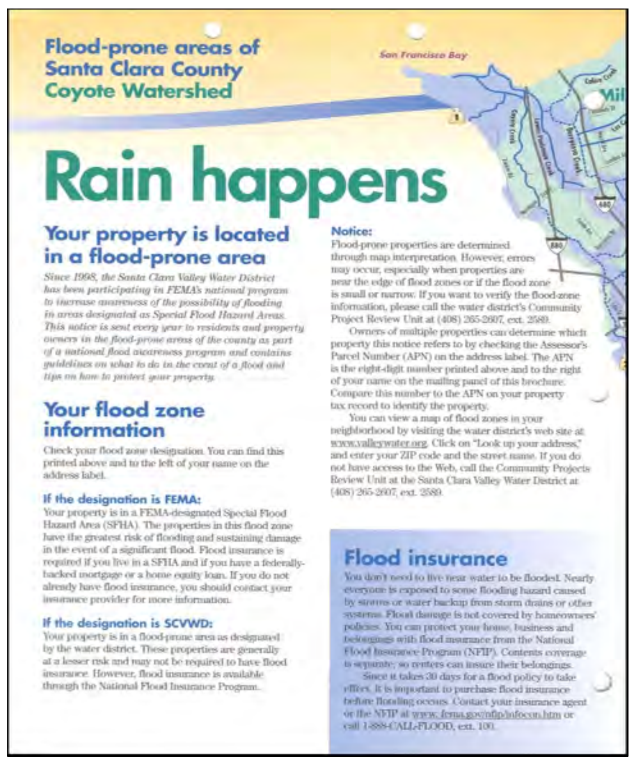
Researchers have found that the messages that are most effective in changing behavior are those that are repeated numerous times, sent through various means, and distributed from various sources. The 330 scoring system builds on this finding. As noted earlier, the score for Activity 330 is based on the types of projects and the number of times a message is repeated. Here are the basic scoring criteria:

- The same message can (and should) be conveyed via different projects and multiple methods.
- Only projects with messages tied to the six CRS priority topics (or the six topics plus the four determined by a PPI) are scored. The community may have to demonstrate to the CRS reviewer how a message is related to an approved topic.
- At least one project must convey a message that promotes flood insurance.
- Each project provides 1, 2, or 6 points for each message that is conveyed.
- A project can have up to six messages, one under each topic. If the community identifies four additional topics in its PPI, a project can be scored for up to 10 messages, one under each topic.
- Separate projects can disseminate different messages under the same topic. For example, one project could promote “Turn around, don’t drown,” and another project could explain the flood warning signals. Each different project would count toward disseminating a message under topic 3, Protect people from the hazard.
- With or without a PPI, a single project can only convey one message per topic. For example, a booklet for floodplain property owners will get credit for covering the topic of protecting people. It will not get credit for multiple messages by parsing the topic into smaller pieces, such as safety in cars, evacuation routes, warning signals, etc. If the community has a PPI that identifies safety in cars as a 7th topic deserving dissemination,

it could get credit for messages under two separate topics: CRS topic 3 − protecting people, and PPI topic 7 − safety in cars.

- Informational materials are counted as conveying their messages only once each year. For example, messages in a brochure that sits in City Hall for people to pick up as they pass by are counted as being delivered once each year.
- To be considered as disseminating a message more than once each year, a general outreach project must either (1) use different media or (2) involve two-way communication with the same audience. Examples:
    - Having the same message in newspaper articles, posted on billboards, and included in utility bills is counted as delivering the message three times each year. Each of these projects uses different media.
    - Making presentations each year to two different associations or groups (using the same messages) is counted as delivering the messages once to each audience. Looked at another way, each presentation would be counted as a separate project because it involves two-way communication.
    - Posting the same message on ten different signs around town is considered as disseminating the message once because the same medium is used and it does not involve two-way communication.
    - Repeating the same message on a cable TV crawler several times each week is considered as disseminating the message once because the same medium is used and it does not involve two-way communication.
- Targeted outreach projects that are repeated to 90% of the identified audience (e.g., more than one mailing to the same people each year) are counted as separate projects. Examples:
    - Making two presentations each year to the residents of the community's repetitive loss areas is counted as the same project delivering the messages twice.
    - Including the same messages in one presentation to the residents of the repetitive loss areas and in a mailing to the residents of the repetitive loss areas is counted as delivering the messages twice.

Scoring is based on the types of projects and the number of times messages are delivered, as shown in the examples in Table 3.



Flood-prone areas of Santa Clara County Coyote Watershed

San Francisco Bay

Rain happens

Your property is located in a flood-prone area

Since 1998, the Santa Clara Valley Water District has been participating in FEMA's national program to increase awareness of the possibility of flooding in areas designated as Special Flood Hazard Areas. This notice is sent every year to residents and property owners in the flood-prone areas of the county as part of a national flood awareness program and contains guidelines on what to do in the event of a flood and tips on how to protect your property.

Your flood zone information

Check your flood zone designation. You can find this printed above and to the left of your name on the address label.

If the designation is FEMA:
Your property is in a FEMA-designated Special Flood Hazard Area (SFHA). The properties in this flood zone have the greatest risk of flooding and sustaining damage in the event of a significant flood. Flood insurance is required if you live in a SFHA and if you have a federally-backed mortgage or a home equity loan. If you do not already have flood insurance, you should contact your insurance provider for more information.

If the designation is SCVWD:
Your property is in a flood-prone area as designated by the water district. These properties are generally at a lesser risk and may not be required to have flood insurance. However, flood insurance is available through the National Flood Insurance Program.

Notice:
Flood-prone properties are determined through map interpretation. However, errors may occur, especially when properties are near the edge of flood zones or if the flood zone is small or narrow. If you want to verify the flood-zone information, please call the water district's Community Project Review Unit at (408) 265-2607, ext. 2589.

Owners of multiple properties can determine which property this notice refers to by checking the Assessor's Parcel Number (APN) on the address label. The APN is the eight-digit number printed above and to the right of your name on the mailing panel of this brochure. Compare this number to the APN on your property tax record to identify the property.

You can view a map of flood zones in your neighborhood by visiting the water district's web site at www.valleywater.org. Click on "Look up your address," and enter your ZIP code and the street name. If you do not have access to the Web, call the Community Projects Review Unit at the Santa Clara Valley Water District at (408) 265-2607, ext. 2589.

Flood insurance

You don't need to live near water to be flooded. Nearly everyone is exposed to some flooding hazard caused by storms or water backup from storm drains or other systems. Flood damage is not covered by homeowners' policies. You can protect your home, business and belongings with flood insurance from the National Flood Insurance Program (NFIP). Contents coverage is separate, so renters can insure their belongings.

Since it takes 30 days for a flood policy to take effect, it is important to purchase flood insurance before flooding occurs. Contact your insurance agent or the NFIP at www.fema.gov/nfip/infocon.htm or call 1-888-CALL-FLOOD, ext. 100.

This is a project targeted to floodplain residents.
It clearly states that the recipient is in a floodprone area.

Table 3. Basic Scoring Example Projects (no PPI)				
Example Outreach Projects (OP)	**A Points per Message**	**B # of Flood-related Topics**	**C Times Delivered**	**Score (A x B x C)**
OP 1. Brochure on flood insurance produced by FEMA, which is set out in various public places (informational material—1 point per message)	1	1	1	1
OP 2. Local insurance agents have agreed to advise their clients that flood insurance is a good idea and give them the OP 1 brochure (general outreach—2 points per message)	2	1	1	2
OP 3. Presentations to five neighborhood associations with messages under CRS topics 1, 2, 4 and 5 (general outreach—2 points per message). The OP 1 brochure is handed out to everyone present.	2	4	5	40
OP 4. The neighborhood association presentation is taped and repeated twice a month on the public service cable TV channel (general outreach—2 points per message). This does not involve two-way communication, so it is counted as being delivered once a year.	2	4	1	8
OP 5. A mailing is sent each year to all residents of the SFHA (targeted outreach). It has messages under the first five CRS topics. (targeted outreach—6 points per message)	6	5	1	30
OP 6. "Do not dump" stencils are sprayed next to storm drain inlets (general outreach—2 points per message)	2	1	1	2
OP 7. The floodplain manager meets twice a year with the home builders association to discuss construction regulations and ways to incorporate flood mitigation into home improvement projects (general outreach—2 points per message, CRS topics 4 and 5).	2	2	2	8
Total				91 *
* There is a maximum credit of 175 points for projects without a PPI (see Table 1).				

Bonus Credits

There are three elements that provide additional credit to the outreach project scores. All three are provided only if the community prepares and adopts a Program for Public Information. The process for preparing a PPI is described starting on page 16.

PPI – Program for Public Information

To receive the bonus credit (an additional 40% of the project's score), the messages and the projects must be described in the PPI.

Messages: The PPI must identify the messages that are important to the community and the audience that should be reached. For each message, there must be a measurable desired outcome. Examples are shown in Table 4.

The PPI can identify up to four new topics, provided they are related to the goals of the CRS. Safety messages for tornadoes (e.g., go to the basement) would not qualify, but messages that apply to both floods and other hazards (e.g., develop a family disaster plan) would qualify.

Some outcomes can be objectively measured. For example, insurance policy information is sent to each CRS community once each year and can be used as a baseline and to measure improvement. Other outcomes are not as easy to measure. Topic 7 in Table 4 was added by the PPI committee and is a good example of this. The PPI committee needs to determine how to measure progress toward every desired outcome, keeping in mind that some outcomes may not lend themselves to numerical measurement.

Table 4. Example PPI Messages and their Desired Outcomes

Example Message	Example Desired Message Outcome
Topic 1. Know your flood hazard Message 1. Is your house in the floodplain?	Increase in the number of map information inquiries (tracked in Activity 320)
Topic 2. Insure your property for your flood hazard Message 2. All residents in floodprone areas should have flood insurance	The total number of SFHA policies increases
Topic 3. Protect people from the hazard Message 3. Turn around, don't drown	There are fewer reports of water rescues and police ticketing drivers who ignore barricades
Topic 4. Protect your property from the hazard Message 4.a. Don't dump in our streams and ditches Message 4.b. You can protect your house from flood damage	a. Drainage system inspectors report a decrease in the amount of trash removed b. Increase in the number of home improvement permits that include flood mitigation features
Topic 5. Build responsibly Message 5. Floodplain filling needs a permit	The number of citations for filling without a permit is reduced
Topic 6. Protect natural floodplain functions Message 6. Don't dump in the storm drains, they drain to the bay	Water quality is improved as measured by the Surface Water Management Office
PPI Message 7. Know your evacuation route and have a family rendezvous point	More families have prepared evacuation plans

Projects: After the PPI committee determines the audiences and the messages to be disseminated, it identifies what projects best do the job. For the PPI bonus, each project needs to be described, along with who will do it and when. Examples are shown in Table 5.

There is no limit to the number of projects a community can undertake, but there is a limit of 175 points for the projects' scores (OP), before the bonus points.

STK − Stakeholder Delivery

If a project is implemented by stakeholders, it receives more points via the STK bonus. (an additional 30% of the project's score). A stakeholder can be any agency, organization, or person (other than the community itself) that is actively involved in getting the message out to the audience.

Examples of stakeholders include

- FEMA, when a FEMA brochure is used as an informational material (as in the OP 1 example in the tables);
- An insurance company that published a brochure on flood insurance (with the company's name on the brochure), even if it is set out at City Hall;
- A local newspaper that publishes a flood or hurricane season supplement each year;

- A local newspaper that publishes articles and editorials (but advertisements paid for by the community do not qualify for STK credit, unless other sponsors or supporters are listed);
- A neighborhood or civic association that sponsors and hosts a presentation by a community employee (as in the OP 3 example in the tables;)
- Schools that implement outreach activities; and
- A utility company that runs pertinent articles in its newsletter.

This handbook clearly shows three sponsoring organizations (see red arrows) and would receive STK credit

Other examples are listed in Table 5.

The stakeholder does not have to be on the PPI committee, nor does the stakeholder have to write or prepare the project for the project to receive the STK bonus. What counts is that it is clear that the message is coming from someone other than the community or is sponsored or supported by the stakeholder. Therefore, stencils on city storm drains appear to come from the city, even if the stencils were applied by a volunteer organization. If the organization's name were in the message, then it would qualify for STK credit.

Note that STK is only available if the community has a PPI − Program for Public Information.

Table 5. Example PPI Projects

Project (Table 3)	Messages (Table 4)	Assignment	Schedule	Stakeholder
OP 1. FEMA's brochure on flood insurance	Msg 2	Floodplain manager	Printed and displayed by February 28	FEMA
OP 2. Local insurance agents advise their clients	Msg 2	Insurance agency representative on the PPI committee	Explain at the March insurance association meeting	Insurance agencies
OP 3. Presentations to five neighborhood associations	Messages 1, 2, 4.a, 5, 7	Floodplain manager	Set up the five presentations by January 31	Neighborhood associations
OP 4. Presentation on cable TV	Messages 1, 2, 4.a, 5, 7	Floodplain manager and public information officer	Tape the first two presentations and use the best scenes	Cable TV company
OP 5. Mailing sent each year to residents of the SFHA	Messages 1, 2, 3, 4.b, 5	Floodplain manager and public information officer	Disseminate in May, before hurricane season	
OP 6. Stencils on storm drains	Msg 6	Director of Public Works	Use summer help and complete by August 31	
OP 7. Meetings with home builders association	Messages 4.b and 5	Floodplain manager	Before and after construction season	

PPI and STK Scoring Example

Table 6 shows how the eight projects listed in Table 5 would score if they were all developed as part of the PPI − Program for Public Information with stakeholder support. See the notes, below, for explanations of how the scoring changed from Table 3.

Table 6. PPI and STK Scoring Examples

Project	A Points per Message	B # of Flood-related Topics	C Times Delivered	OP Score (A x B x C)	PPI 40%	STK 30%	Total (OP + PPI + STK)
OP 1. FEMA's brochure on flood insurance	1	1	1	1	0.40	0.30	1.70
OP 2. Local insurance agents advise their clients	2	1	1	2	0.80	0.60	3.40
OP 3. Presentations to five neighborhood associations	2	5 [a]	5	50	20.00	15.00	85.00
OP 4. The neighborhood association presentation on cable TV	2	5 [a]	1	10	4.00	3.00	17.00
OP 5. Mailing sent each year to residents of the SFHA	6	6 [a]	1	36	14.4		50.4
OP 6. Stencils on storm drains	2	1	1	2	0.80		2.80
OP 7. Meetings with home builders association.	6[b]	2	2	24	9.60		33.60
Total				125	50.00	18.90	193.90

Notes to Table 6.

a. When the PPI added a 7th message, projects 3, 4, and 5 receive more points than shown in Table 3.

b. The PPI also identified building contractors as a target audience, so the semi-annual meetings in OP 7 are now considered targeted outreach projects. This is not a simple change of numbers. To continue to receive this higher credit, the PPI committee must track progress towards the desired outcomes and evaluate and revise the project each year as needed.

ACT − Action results

If the projects are successful in getting people to change their ways (e.g., more people have insurance, there are fewer water rescues for people driving in flooded streets, or there are fewer citations of people building without a permit), then the credit for the messages is increased by 45% by the ACT − Action results bonus.

For each message, the PPI must list a desired outcome. This is explained on page 20, and examples are provided in Table 4 on page 9. The PPI committee must review the implementation of each project every year. It should also check to see how well the messages are getting across by seeing whether the outcomes are being met. If they are, ACT credit can be provided. ACT credit is a 45% bonus added to the credit for every message that showed progress.

Note that this adjusts the credit for the messages, not the projects. If a project conveys three messages, but only one message shows progress, the bonus will be limited to the points for that message.

Scoring example: After two years, the PPI committee documented progress on two messages:

- Message 2: All residents in the SFHA should have flood insurance. There was an increase in the number of flood insurance policies on existing buildings (it was not due to new construction or a new FIRM showing a larger SFHA). This message was disseminated via projects OP 1, OP 2, OP 5, and OP 7.
- Message 4.a: Don't dump in our streams and ditches. The drainage maintenance crews report that instead of the usual five truckloads of debris removed during an average year, only three truckloads of debris were removed since the projects were implemented. Message 4 was disseminated by projects OP 3 and OP 4.

Table 6 follows the format of Table 3, but adds the bonus point for PPI and STK. Table 7 adds the bonus for ACT. This can be confusing because ACT is a bonus for the messages, not the projects. Since the scores are based on the projects *and* the messages, a spreadsheet (Table 7) can show the scoring (projects in rows, messages in columns) and calculate the credit points. Instead of just 91 OP points for the seven projects, the community receives 208.75 points for the projects because of the additional credit for the PPI (and credit for the additional topics), stakeholder delivery (STK), and progress toward the messages' desired outcomes (ACT).

Table 7. ACT Scoring Examples

Outreach Project Worksheet

	Outreach Projects	Project Points	Number of times message is repeated										OP	Multipliers			
			Msg 1	Msg 2	Msg 3	M 4.a	M 4.b	Msg 5	Msg 6	Msg 7	Msg 8	Msg 9		PPI?	PPI	STK?	STK
OP 1	Insurance brochure	1		1									1	y	0.40	y	0.30
OP 2	Insurance agents	2		1									2	y	0.80	y	0.60
OP 3	Presentations	2	5	5		5		5		5			50	y	20.00	y	15.00
OP 4	Cable TV	2	1	1		1		1		1			10	y	4.00	y	3.00
OP 5	Mailing to SFHA	6	1	1	1		1	1		1			36	y	14.40		0.00
OP 6	Storm drain stencils	2							1				2	y	0.80		0.00
OP 7	Home builders meeting:	6					2	2					24	y	9.60		0.00
OP 8													0		0.00		0.00
OP 9													0		0.00		0.00
OP 10													0		0.00		0.00
													0		0.00		0.00
	Messages												0		0.00		0.00
Msg 1	Is your house in the floodplain?												0		0.00		0.00
Msg 2	All residents in the SFHA should have flood insurance												0		0.00		0.00
Msg 3	Turn around, don't drown												0		0.00		0.00
M 4.a	Don't dump in our streams and ditches												0		0.00		0.00
M 4.b	Protect your house from flooding												0		0.00		0.00
Msg 5	Floodplain filling needs a permit												0		0.00		0.00
Msg 6	Don't dump in the storm drains, they drain to the bay												0		0.00		0.00
Msg 7	Know your evacuation route and have a family rendezvous point												0		0.00		0.00
												OP =	125	PPI =	50.00	STK =	18.90
	ACT?			y		y											
	ACT message points		0	21	0	12	0	0	0	0	0	0					
	ACT bonus		0.00	9.45	0.00	5.40	0.00	0.00	0.00	0.00	0.00	0.00	ACT =	14.85			
	c330 =					OP	125	+ PPI	50.00	+ STK	18.90	+ ACT	14.85	=	208.75		

Comparison to 2007 CRS Scoring

The proposed changes are based on two objectives:

1. Give more points to projects that are shown to be more effective, and
2. Give flexibility to communities who strive to find creative and innovative ways to implement public outreach projects. The new approach is far less prescriptive than previous approaches, but it requires communities to engage in a planning process in order to achieve the same number of points as before.

Communities that do not develop a Public Information Plan (PPI) and continue to implement OPA, OPF, and OPC projects as before (under the 2007 *Manual*) will receive considerably fewer points under the proposed scoring system. A community could implement more projects to increase its score under the new system, but the score will be capped at 175 points if there is no PPI.

It is impossible to automatically convert a community's outreach projects scored under the 2007 *CRS Coordinator's Manual* directly to the proposed system. The ISO/CRS Specialist or the community's CRS Coordinator can do this manually.

However, we can score the seven example projects to show what they would have received under the 2007 *Manual*. This is done in Table 8. The seven example projects would receive 130 points under the 2007 *CRS Coordinator's Manual*. Under the proposed scoring, a community would receive 209 points for these projects, more points because the use of a PPI committee and stakeholders has been shown to be more effective and two of the messages have been shown to have an impact on people.

Table 8. 2007 Scoring Examples

Project	Project Type	Points per topic	Number of topics	Total
OP 1. Brochure on flood insurance	OPA	2	1	2
OP 2. Local insurance agents advise their clients	OPA	2	1	2
OP 3. Presentations to five neighborhood associations	OPA	2	5	10
OP 4. The neighborhood association presentation on cable TV	OPA	2	4 *	8
OP 5. Mailing sent each year to residents of the SFHA	OPF	13	8	104**
OP 6. Stencils on storm drains	OPA	2	1	2
OP 7. Meetings with home builders association	OPA	2	1	2
Total				130

* While this project covers more topics, the maximum score under the 2007 *CRS Coordinator's Manual* is for three OPA projects, so no topic can be counted more than three times under OPA.

** The average score for OPF in 2011 is 88 points.

This comparison also shows how the 2007 system discourages a variety of projects beyond three OPAs. Under the 2012 proposal, there is no limit to the number of projects, only to the total score for the projects.

FRP – Flood Response Preparations

This new element credits having a pre-flood plan for public information activities, news releases, handouts, etc., ready in advance of the next flood. FRP credit is provided for developing outreach projects to be implemented before, during and after a flood. FRP projects are scored the same as OP outreach projects, but they are not eligible to receive STK (stakeholder involvement) or ACT (actions or results) credit. More credit is available if the FRP projects are part of the PPI and reviewed annually.

A Flood Response Preparations (FRP) package would be a collection of documents and materials prepared in advance, such as templates and master copies. The preparations must include master copies of materials to be used, but they do not have to be copied until the flood occurs. The materials would cover key messages that need to be disseminated before, during, and after a flood.

Example messages:

- Evacuation routes (CRS Topic 3)
- Shelter locations (CRS Topic 3)
- "Turn Around Don't Drown" (CRS Topic 3)
- When it's safe to go back (CRS Topic 3)
- Don't enter a flooded building until it's been cleared by an inspector (CRS Topic 3)
- Get a permit for repairs (CRS Topic 5)
- Substantial damage rules (CRS Topic 5)
- Mitigation opportunities during repairs (CRS Topic 4)
- Information on mitigation grants (CRS Topic 4)

FRP projects only have to be prepared to receive credit. The projects are implemented when a flood is imminent − materials are reproduced and distributed, messages are disseminated, notices are posted on doors, etc. To receive the credit each year, the community must either use the FRP in response to a flood or review it and update it as needed. If there isn't a flood, the review and update could be conducted as a part of an annual flood response drill or exercise (required for credit under Activity 610 − Flood Warning Program). If the community has a PPI, the evaluation could also be part of the annual evaluation of the OP outreach projects.

The community will not lose OP credit during the year of the flood if implementing the FRP projects diverts resources needed to implement other OP projects. The community will lose its FRP credit if it does not implement its FRP projects when there is a flood or if it does not evaluate the FRP projects each year.

Example FRP

As with a PPI, the first part of preparing an FRP package is determining the key messages. As with OP, there can be one message per topic per project. If the community has a PPI, additional messages can be identified for credit (as in the PPI Topics 8 and 9 examples, below).

Communities should develop messages keyed to the flood and post-flood situation, which are not necessarily the same messages that are needed for OP projects in a pre-flood situation.

Example FRP messages:

- Topic 3. Protect people from the hazard – Message 3: Don't enter a flooded building until it's been cleared by an inspector
- Topic 4. Protect your property from the hazard – Message 4: Mitigation while you repair
- Topic 5. Build responsibly – Message 5: Get a permit for repairs
- PPI Topic 8: Message 8: ICC can help pay to mitigate substantially damaged buildings
- PPI Topic 9: Message 9: Apply for a mitigation grant

Example FRP projects:

- FRP 1: A media kit with backgrounder information for reporters on all five FRP messages
- FRP 2: Public service announcements that cover FRP messages 3 and 5
- FRP 3: Door hangers that explain all five FRP messages

All three projects are in the PPI.

The scoring for these projects is shown in Table 9, with the expanded spreadsheet used in Table 7. These projects total 44 points, plus 40% more (17.60 points) for having the messages and projects in the PPI. The total additional credit is 61.60 points.

Table 9. FRP Scoring Example

Outreach Project Worksheet

	Outreach Projects	Project Points	Number of times message is repeated										OP	Multipliers			
			Msg 1	Msg 2	Msg 3	M 4.a	M 4.b	Msg 5	Msg 6	Msg 7	Msg 8	Msg 9		PPI?	PPI	STK?	STK
OP 1	Insurance brochure	1		1									1	y	0.40	y	0.30
OP 2	Insurance agents	2		1									2	y	0.80	y	0.60
OP 3	Presentations	2	5	5		5		5		5			50	y	20.00	y	15.00
OP 4	Cable TV	2	1	1		1		1		1			10	y	4.00	y	3.00
OP 5	Mailing to SFHA	6	1	1	1		1	1		1			36	y	14.40		0.00
OP 6	Storm drain stencils	2							1				2	y	0.80		0.00
OP 7	Home builders meetings	6					2	2					24	y	9.60		0.00
OP 8													0		0.00		0.00
OP 9													0		0.00		0.00
OP 10													0		0.00		0.00
													0		0.00		0.00
	Messages												0		0.00		0.00
Msg 1	Is your house in the floodplain?												0		0.00		0.00
Msg 2	All residents in the SFHA should have flood insurance												0		0.00		0.00
Msg 3	Turn around, don't drown												0		0.00		0.00
M 4.a	Don't dump in our streams and ditches												0		0.00		0.00
M 4.b	Protect your house from flooding												0		0.00		0.00
Msg 5	Floodplain filling needs a permit												0		0.00		0.00
Msg 6	Don't dump in the storm drains, they drain to the bay												0		0.00		0.00
Msg 7	Know your evacuation route and have a family rendezvous point												0		0.00		0.00
												OP =	125	PPI =	50.00	STK =	18.90
	ACT?			y		y											
	ACT message points		0	21	0	12	0	0	0	0	0	0					
	ACT bonus		0.00	9.45	0.00	5.40	0.00	0.00	0.00	0.00	0.00	0.00	ACT =	14.85			
	FRP Projects	Points	Msg 1	Msg 2	Msg 3	Msg 4	Msg 5	Msg 6	Msg 7	Msg 8	Msg 9	Msg 10					
FRP 1	Media kits	2			1	1	1			1	1		10	y	4.00		
FRP 2	Pub svc announcemnts	2			1		1						4	y	1.60		
FRP 3	Door hangers	6			1	1	1			1	1		30	y	12.00		
FRP 4													0	y	0.00		
FRP 5													0		0.00		
												FRP =	44	PPI(FRP) =	17.60		
	c330 =			OP	125	+ PPI	67.60	+ STK	18.90	+ ACT	14.85	+ FRP	44	=	270.35		

Developing a Program for Public Information

The Program for Public Information is an ongoing public information effort to design and transmit the messages determined to be most important to the community. To develop a PPI, the community establishes a committee that assesses the local public information needs, designs the program based on those needs, monitors implementation of outreach projects, and performs an annual evaluation of their effectiveness. There are seven parts to preparing a PPI.

1. The PPI Committee

The community's Program for Public Information must be developed by a committee. The PPI committee is responsible for:

- Assessing the community's public information needs,
- Determining the appropriate messages to meet those needs,
- Planning the ways in which the community and its stakeholders can implement outreach projects to convey the messages, and
- Evaluating progress and making revisions as needed.

This process resembles the floodplain management planning process that is described and credited under CRS Activity 510. The PPI Committee and the 510 planning team could be the same. The PPI committee could also be an existing committee, such as a mitigation planning committee or advisory board, or a subcommittee of an existing group, as long as it meets the membership criteria

The community should also review Activity 370 − Flood Insurance Promotion which credits a similar planning committee. If the community is interested in either 510 or 370 credit, then the committee should be designed so that it will qualify for the other activities as well.

Membership: The committee must have members from both inside and outside the local government. The number of participants and their identities are determined by the community, but there must be at least five people. At least half of the members must be from outside the local government, especially stakeholders and other organizations that conduct their own public information activities. Note that there is no proration of the PPI bonus credit if fewer than half the members are from outside the community's government. If it is difficult to find non-governmental volunteers, it is suggested that the number of government members be reduced so that the public, stakeholders, and other non-governmental representatives have a major influence on the design of the PPI.

Example local government participants (note that any of these participants can be a contractor if the person has been regularly involved with the community in the past):

- Floodplain manager
- Emergency manager
- Public information officer
- Planning department representative
- Code enforcement or building department representative
- Public works, drainage maintenance, regional flood district representative.

Stakeholders: The more often a message is received from different sources, the more likely it is that the desired action or behavior will take place. For this reason, the CRS encourages the education and engagement of groups and people outside the local government (stakeholders) in planning and conducting outreach projects.

At least one-half of the members of the PPI committee must be representatives from outside the local government. These could be members of the public, representatives of key community organizations, and/or agencies and organizations that will likely implement recommended outreach projects.

Example stakeholder participants:

- Floodplain resident(s)
- Emergency/disaster responders, e.g., Red Cross, Salvation Army
- Utility companies
- Chamber of commerce/business organization
- Builders/developers/contractors trade association
- Environmental organizations, "Friends of the River," etc.
- Real estate agents
- Insurance agencies
- Major employer(s)

Bonus points are provided for outreach projects that are carried out in whole or in part by stakeholders, under element STK, described on page 9.

Multi-jurisdictional committees: There are occasions when CRS communities in a metropolitan area or members of a CRS users group would like to develop a joint or coordinated PPI. This approach has the advantage of sharing resources, avoiding duplication of effort, and capitalizing on regional media, such as a newspaper, television station, or a metropolitan organization like a county chapter of the American Red Cross or a council of governments.

This approach can also have a disadvantage if an individual community's needs are lost in the bigger operation. Accordingly, in order to avoid this, if a community wants to participate in a multi-jurisdictional PPI committee:

1. The community must send at least two representatives to the regional committee,
2. At least half of the representatives must be from outside the local government, and
3. At least half of the representatives must attend all the meetings of the regional committee. In effect, there must be a quorum from each community. Remote attendance, e.g., via a webinar that allows for everyone to talk, is permissible.

There is no separate score for the PPI document. Each CRS community's score is calculated separately, depending on which messages and projects apply to it. For example, an inland community would not benefit from projects oriented to beachfront target audiences, nor would a community benefit from a project conducted at a shopping mall 25 miles away from the community. Therefore a regional Plan should detail the projects not only by audience and method, but also by communities reached. A separate section for each participating community is recommended for this purpose.

Activity 370 – Flood Insurance Promotion: Activity 370 calls for a planning committee to develop a flood insurance coverage improvement plan. It is recommended that the PPI committee serve both functions and the PPI document include the projects designed to promote insurance coverage. To do this, the PPI committee needs to include representatives from:

- The community's floodplain management office,
- The community's public information office or someone else from the local government experienced and involved with public information or education (a representative of the local schools would qualify where there is no public information staff),
- Local insurance agencies, and
- Local lending institutions.

2. Needs Assessment

Before it can develop a local program for raising public awareness about flood related issues,, the committee must identify the community's characteristics and public information needs. This assessment identifies and catalogs what populations, neighborhoods, floodplain areas, etc., need information about the flood hazard and floodplain resources and functions. The PPI committee should use this information and consider what information is already being conveyed to its residents and whether that information is effectively informing people and fostering appropriate action.

The needs assessment can be prepared by staff, but the committee as a whole needs to review it.

Self-Assessment: The first step in the needs assessment is to complete the CRS Self-Assessment described in Section 240 of the *CRS Coordinator's Manual*. This is an on-line tool that guides the user through a series of questions to identify the characteristics of the community and the population as they relate to the community's flood hazard. This exercise will help the PPI committee by compiling the necessary information in the context of a flood hazard related public outreach effort.

The on-line CRS Self-Assessment tool can be skipped if the community has a floodplain management or hazard mitigation plan that identifies target areas and target audiences or if it has another documented process that meets these criteria.

Target Areas: Target areas are neighborhoods, districts, or other areas of the community with similar flooding, building, and population characteristics. It may be useful to assign names or labels to the areas, and some of them may be grouped together if they overlap or have the same characteristics.

Example target areas

- Developed parts of the Special Flood Hazard Area
- The downtown business district
- Repetitive loss areas
- An area subject to an unmapped special hazard, such as sinkholes or ice jams
- An area protected by a levee
- Beachfront hotels and rental units

Target audiences: A target audience is one that has specific public information needs based either on its geographic location (e.g. floodplain, rep loss areas, upstream communities with a direct impact on natural floodplain functions downstream) or its community function (e.g. building contractors, real estate agents, downtown business owners). For each Target Area, the PPI committee should consider who lives, works, or visits there or who/what has a direct impact on the community's flood hazard resiliency. This is the "target audience" for public information needs in that area. See also the discussion on audiences on page 6.

The characteristics of those people will influence the type of public information they need and how it should be delivered. The list below gives some examples of demographic and other characteristics that may be pertinent.

Example geographical target audiences:

- Residential neighborhoods
- Repetitive loss areas
- Renters
- Downtown businesses
- Properties protected by a levee
- Upstream polluters
- Areas outside the SFHA with historical flooding

Example functional target audiences

- Tourists and part-time residents
- Contractors
- Elderly or infirm
- Non-English-speakers
- Student drivers

Note that for the increased credit for a targeted outreach project, at least 90% of the target audience needs to be reached. There may be more than one target audience in each area. The self-assessment needs to identify whether there are non-English speaking audiences who will need translated outreach messages, elderly populations who may not be reached by social media, downtown businesses who are closed on weekends and would not benefit from a door-to-door campaign, etc.. Each area needs to be examined and the target audiences selected accordingly.

Current projects: For each target audience, the committee should identify any public information activities that are currently discussing the flood hazard or the value of the local natural floodplain functions. Who else is conveying similar messages to these people?

Examples of organizations and agencies to check:

- The community's public information officer
- The public works or drainage maintenance office
- The parks and recreation office
- The county emergency manager
- The office responsible for the National Pollutant Discharge Elimination System permit
- Regional planning agency or council of governments
- Regional or metropolitan sewer or flood control district
- State NFIP Coordinator
- Local businesses, especially insurance agencies and banks
- Utility companies
- Environmental and recreational organizations (e.g., Isaac Walton League, Audubon Society)
- Homeowner/Neighborhood associations
- Area newspapers
- Area radio and television stations

The committee needs to list the organizations or agencies that are sending the messages and what the messages are. This job can be easier if these kinds of organizations are invited to be on the PPI committee and if members share the workload.

Activity 370 – Flood Insurance Promotion: If the community wants the PPI to include the assessment need for Activity 370 credit, the assessment must include:

- The number of insurable buildings in each target area,
- The number of policies in force and past claims (provided by ISO to CRS communities at least once each year), and
- An executive summary that discusses the current level of coverage by target area.

3. Messages

For each target audience, the PPI committee should determine what public information message is needed, considering the hazards and/or floodplain functions/resources present in the target area, the characteristics of the audience, and other factors as appropriate.

Six broad messages are particularly important to the CRS (see Table 2 on page 3). At least one message must be on flood insurance. The PPI committee may develop others as appropriate for its target audiences. The additional messages designated by the PPI committee must be related to flooding, drainage, stormwater, natural floodplain functions, or flood-related hazards.

Or, the committee may decide to devote more attention to a particular aspect of one or more of the six listed CRS messages. For example, if the community's assessment indicates that there is habitat suitable for endangered species within a target area, then the committee may elect to send additional, more detailed messages about that issue, pursuant to CRS topic #6 (protect natural floodplain functions).

Examples of messages are shown in Table 4 on page 9. In designing each outreach project, the PPI committee will want to convert these broad messages into more specific language, as appropriate.

Outcomes: For each message, the committee needs to determine what outcome it would like to see. Some guidance on outcomes:

- Outcomes are what you'd like to see happen, such as a reduction in flood deaths or an increase in the number of people who know they live in a hazard area.
- Outcomes determine whether you are making progress, whether people are doing the right thing. They are the basis for the bonus credit ACT − Action results, and they should be used by the committee to determine which projects to continue and which ones to modify or stop because the messages are not producing the desired outcome.

Outcomes need to be objective, observable and measurable.

- Outcomes are not "outputs," like "distribute 10,000 flyers" or talk to "100 homeowners."
- Examples of outcomes are in Table 4, page 9.

Activity 370 – Flood Insurance Promotion: If the community wants the PPI to qualify for 370 credit, there needs to be at least one flood insurance message for at least one target audience. The message(s) need to include increasing the appropriate type of coverage as an outcome.

4. Projects

Once the needed messages and desired outcomes have been agreed upon, the PPI committee should consider what media, disseminated through what specific projects, would best convey the message(s) to the target audience(s). For each message, the PPI document lists the projects, who will do them and when. The projects are then implemented over the following year.

Examples of projects are listed in Table 5 on page 10.

5. Coordination

A Program for Public Information should not address only outreach projects. It should look at all the activities a community should pursue to inform people and motivate them to protect life and property , buy insurance, and protect natural floodplain functions. The CRS credits other public information work besides 330 – Outreach Projects. It has been proposed that the 2012 *CRS Coordinator's Manual* provide extra credit in some activities, if they are included in the PPI:

- Activity 320 – Map Information Service: The priority messages identified in the PPI should be conveyed when inquiries are made. The step 2 Needs Assessment may identify areas that should be mapped and included in the map information service.
- Activity 340 – Hazard Disclosure: If real estate agencies are represented on the PPI committee and their disclosure practice(s) and informational brochures are reviewed in the PPI, then extra credit is provided.
- Activity 350 – Flood Protection Information: As with outreach projects, credit for the website (WEB) is based on the number of topics covered. If there is a PPI, the community can receive additional credit for covering up to ten topics, instead of just six. The WEB credit for information on flood warning is also increased if it is coordinated with other warning messages in the PPI.

> Note that to receive the extra PPI credit, these activities would need to be based on appropriate messages, which have desired outcomes discussed in the PPI. The activities would also need to be evaluated by the committee and reviewed in the annual report (see section 7).

- Activity 360 – Flood Protection Assistance: The credits for the first three elements, property protection advice (PPA), advice after a site visit (PPV), and financial assistance advice (FAA) can all be increased if the services are included in the PPI.
- Activity 370 – Flood Insurance Promotion: It is recommended that the plan to improve insurance coverage be part of the PPI and be prepared by the same committee, provided that the committee includes the prerequisites for 370 credit. Notes on how to do this have been included in this section.
- Activity 510 – Floodplain Management Planning: Some communities have prepared public information program strategies (OPS) as part of their floodplain management or hazard mitigation plans. Both PPI and floodplain management planning (FMP) provide credit for having committees and the same committee can fulfill both activities' credit criteria.

- Activity 540 – Drainage System Maintenance provides extra credit for publicizing dumping regulations. The PPI could include this message (CRS topic 4) and determine the best way to disseminate it.
- Activities 610 – Flood Warning and Response, 620 – Levees, and 630 – Dams each have an outreach project prerequisite for any credit. The PPI could include the needed messages and determine the best way to disseminate them. The project(s) would be credited under Activity 330, as outreach projects (OP) eligible for the PPI, STK, and ACT bonus points.

6. The PPI Document

The committee's work needs to be recorded in a formal written document and adopted by the community's governing body. The PPI and the annual report can be stand-alone documents or they can be sections or chapters in a credited floodplain management plan and its annual report.

The PPI document need not be long and complicated. It could be fewer than 10 pages, as long as each of the items listed below is summarized. After the community completes the assessment of its public information needs, the PPI and its descriptive document could be completed in one or two meetings of the PPI committee.

The document must show that the community has incorporated the procedures and considerations described above in preparing its PPI. The PPI document that is submitted the first time the community requests PPI credit must include

1. A list of the members of the PPI committee and their affiliations. The committee must include stakeholders from outside the local government and the community.
2. A summary of the CRS Self-Assessment (Activity 240 or a similar summary from the community hazard mitigation plan) of the local flood hazard and the community's natural floodplain and coastal functions and resources. [Note: This may be a report generated by the self-assessment − this is still under development.]
3. A summary of the public information needs assessment, including the other public information activities currently being implemented within the community.
4. A list of the target audiences, the messages selected for each audience, and their desired outcomes.
5. A description of each outreach project intended to be carried out, who will do it, and when it will be done (see Table 5 on page 10).
6. If the community is applying for the PPI bonus credit for its flood response preparations credit, the FRP projects need to be listed, too.
7. If the community is requesting the PPI bonus credit for Activities 320, 340, 350, or 360, a discussion of how those activities are coordinated with the PPI and its projects. As discussed in Section 5. Coordination, if the committee identifies homeowners as a target audience and retrofitting their homes as a message, the PPI should describe how the library and website (Activity 350) will provide appropriate materials and information and what kind of advice staff should provide (Activity 360).
8. If the community is using the PPI to qualify for credit under Activity 370, the 370 criteria need to be included.

9. The process that will be followed to monitor and evaluate the public information projects, including a reporting procedure or other technique by which the PPI committee will make sure the projects are done (see section 7).

Items 4 and 5 can be done graphically. An example is Table 10. The pilot test PPI committees found this kind of approach helpful in determining which messages were appropriate for which audiences and which projects were best for which message.

Communities will be scored based on the impact of the projects on each community. Therefore, if the PPI document is prepared by a multi-jurisdictional committee, it needs to identify how each project affects each community. This can be a list by projects by community or an additional column in a matrix like Table 10.

Adoption: The document must achieve formal (official) status within the community, so that local government departments and offices will be aware of the public information efforts and cooperate. Ways to achieve official status could include

- Formal adoption by the community's governing board;
- Written acceptance as policy by the community's CEO;
- A letter from the community's counsel stating that the document is community policy; or
- Having the PPI Committee and process formally recognized in the community's floodplain management or hazard mitigation plan.

7. Monitoring and Evaluation

As with all planning efforts, completion of the document is just the beginning. The projects need to be implemented, monitored, evaluated, and revised as needed. The PPI document needs to describe how the monitoring, evaluation and revision will be conducted (item 9 in the previous section).

The monitoring and evaluation must be conducted by the PPI committee. Staff can collect data and make recommendations, but for CRS credit, the committee must review progress and agree on any changes. The committee also needs to review and approve the annual evaluation report that is submitted to the governing body and to FEMA via the annual CRS recertification.

This work will be more effective if the committee meets several times during the year and monitors the implementation of each outreach project.

Evaluation report: There is no required report format, but the annual report must include the following items:

1. The target audiences and the messages and desired outcomes for each.
2. The projects in the PPI that were to convey the messages
3. Which projects were implemented
4. Why some projects were not implemented (if any)
5. Which desired outcomes were met
6. What should be changed (including what messages, outcomes, and projects should be dropped, and what new ones should be initiated)

Note that the community may use any 12-month period for its “public information year.” If there is a defined hurricane or flood season, for example, the public information schedule may be tied to that. At the end of that year, the committee would conduct its annual evaluation of the PPI, produce the annual report of that evaluation, and then submit the report along with its next annual CRS recertification package.

If this annual evaluation shows that a project has brought about desirable results or actions, then the CRS credit for the project is increased under element ACT.

The annual report could use the spreadsheet in Table 10, with added columns after each message, outcome, and project to note the status and recommendations for change.

Table 10. Spreadsheet for Planning PPI (Program for Public Information) Projects

PPI Worksheet						
Target Audience	**Message**	**Outcome**	**Project(s)**	**Assignment**	**Schedule**	**Stakeholder**
Floodplain residents	Msg 1. Is your house in the floodplain?	Increase in the number of map information inquiries	OP 3. Presentations to five neighborhood associations	Floodplain manager	Set up the five presentations by January 31	Neighborhood associations
			OP 4. Presentation on cable TV	Floodplain manager and public information officer	Tape the first two presentations and use the best scenes	Cable TV company
			OP 5. Mailing sent each year to residents of the SFHA	Floodplain manager and public information officer	Disseminate in May, before hurricane season	
	Msg 2. All residents in floodprone areas should have flood insurance	The total number of SFHA policies increases	OP 1. Brochure on flood insurance	Floodplain manager	Printed and displayed by Feb. 28	
			OP 2. Local insurance agents advise their clients	Insurance agency representative on the PPI committee	Explain at the March insurance association meeting	Insurance agencies
			OP 3. Presentations to five neighborhood associations	See OP 3 above	See OP 3 above	See OP 3 above
			OP 4. Presentation on cable TV	See OP 4 above	See OP 4 above	See OP 4 above
			OP 5. Mailing sent each year to residents of the SFHA	See OP 5 above	See OP 5 above	
	Msg 3. Turn around, don't drown	Fewer reports of water rescues and police ticketing drivers who ignore barricades	OP 5. Mailing sent each year to residents of the SFHA	See OP 5 above	See OP 5 above	
	Msg 4.a. Don't dump in our streams and ditches	Drainage inspectors report a decrease in the amount of trash removed	OP 3. Presentations to five neighborhood associations	See OP 3 above	See OP 3 above	See OP 3 above
			OP 4. Presentation on cable TV	See OP 4 above	See OP 4 above	See OP 4 above

Appendix M

Standard Operating Procedures

Catch Basins

Description: This section contains information on the cleaning of catch basins in the storm drain system. This includes the processes of disposal of excess waste and the record keeping of the amounts of waste collected.

Applicability: Cleaning catch basins or storm drains.

1. Preparation:
   a. Clean off sediment and trash off grate.
   b. Do visual inspection on outside of grate.
   c. Make sure nothing needs to be replaced.
   d. Do inside visual inspection to see what needs to be cleaned.

2. Process
   a. Clean catch basin using manual or mechanical means.
   b. For manual means, place removed material in a location protected from potential runoff.
   c. Place spoils in vehicle for transport to disposal area.
   d. Dispose of spoils in an approved location for dewatering if necessary.
   e. For mechanical cleaning use a high powered vac truck to removed sediment. When sediment is removed use a high pressure washer to clean any other sediment out of catch basin.
   f. After catch basin is clean, send the rodder of the vac truck downstream to clean pipe and pull back sediment that might have moved down stream of the catch basin.

3. Clean-up
   a. When vehicle is full of spoils take them to a contained area for drying.
   b. After drying, put it into a dump truck and take it to the landfill.

4. Documentation
   a. Keep logs of the date and number of catch basins cleaned. Record employees involved with the activity.
   b. Record the estimated amount of waste collected from each catch basin.
   c. Keep any notes or comments of any problems.

Chemical Application Pesticides, Herbicides, Fertilizers

In accordance with our MS4 permit, the City of North Miami continues to endeavor to minimize its use of pesticides, herbicides, and fertilizers on public property. The procedures used to achieve this are as follows:

Description: This section contains information on the application of Pesticides, Herbicides and Fertilizers. Including how to prepare, take care, and disposal of chemical products.

Applicability: Using chemicals in city parks.

1. Preparation

   a. Calibrate fertilizer and pesticide application equipment to avoid excessive application.
   b. Use pesticides only if there is an actual pest problem
   c. Time and apply the application of fertilizers, herbicides or pesticides to coincide with the manufacturer's recommendation for best results ("Read the Label").
   d. Know the weather conditions. Do not use pesticides if rain is expected. Apply pesticides or herbicides only when wind speeds are low(less than 5 mph).

2. Process

   a. Always follow the manufacturer's recommendations for mixing, application and disposal. ("Read the Label").
   b. Do not mix or prepare pesticides for application near storm drains.
   c. Employ techniques to minimize off-target application (e.g. spray drift, over broadcasting.) of pesticides and fertilizers.

3. Clean-up

   a. Sweep pavements or sidewalks where fertilizers or other solid chemicals have fallen, back onto grassy areas before applying irrigation water.
   b. Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
   c. Always follow all federal and state regulations governing use, storage and disposal of fertilizers, herbicides or pesticides and their containers. ("Read the Label")

4. Documentation

   a. Keep copies of MSD sheets for all pesticides, fertilizers and other hazardous products used.
   b. Record fertilizing and pesticide application activities, including date, individual who did the application, amount of product used and approximate area covered.

Pesticides & Herbicides

Only personnel and contractors who have proof of certification and licensing by the Florida Department of Agriculture and Consumer Services (FDACS) for the application of pesticides and herbicides, are allowed to apply these products.

Fertilizers

(By January 1, 2014), All personnel and contractors who apply fertilizers must demonstrate proof of training through the Green Industry BMP Program. In addition, contracted applicators are required to prove certification for "urban landscape commercial fertilizer application."

Until January 1, 2014, personnel will continue to receive annual training on the proper application practices for fertilizers.

Annually, or more often, training on the proper storage and handling of these products is provided to all relevant personnel.

A list is maintained of all personnel and contractors who have received training, licensing, certification, and annual refresher training.

NORTH MIAMI
FLORIDA

CONSTRUCTION – During and Post Construction Site Inspection

Description: This section contains information and guidelines for protecting a construction site with BMPs and a SWPPP during and after the construction of a project.

Applicability: Protecting construction sites and surrounding runoff areas.

1. Preparation
   a. Incorporate a SWPPP in any construction project containing more than one acre in area.

2. Process
   a. Inspect construction site and surrounding area regularly for possible storm drain contamination.
   b. Follow SWPPP guidelines and checklists to verify that standards are met.

3. Clean-up
   a. Remove inlet protection.
   b. Clean flow paths.

4. Documentation
   a. Keep any notes or comments of any problems.

CONSTRUCTION – Pre-Construction SWPPP

Description: This section contains information and guidelines for protecting and preparing a construction site with BMPs and a SWPPP.

Applicability: Protecting construction sites and surrounding runoff areas prior to construction.

1. Preparation
   a. Conduct a pre-construction review of site and planed operations.

2. Process
   a. Plan which BMPs to implement during construction to manage runoff created from site.
   b. Incorporate in the SWPPP a set of procedures that will protect potential water quality impacts.
   c. Incorporate into the SWPPP opportunities for use of low impact design (LID) and green infrastructure when opportunities exist.

3. Clean-up
   a. None.

4. Documentation
   a. Record all construction sites that disturb greater than or equal to one acre.
   b. Keep any notes or comments of any problems.

NORTH MIAMI
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Construction Site Inspection Plan and Inspection Form

Construction site inspections are conducted for land-disturbing projects which have the potential to discharge stormwater runoff into our MS4.

Timing

Construction site inspections are conducted:

- Before the start of construction, after the placement of temporary BMPs
- During construction (one or more inspections, based on the project's potential for discharge to our MS4)
- At the end of the construction

Site Priority

All construction sites are considered priority if they have the potential to discharge into water bodies or our MS4. Sites will be inspected with a frequency deemed appropriate during the site plan review process and with consideration to rainfall events. In addition, any sites where compliance is a concern, will be inspected more frequently.

Inspection Procedure

Inspections are the responsibility of the building department and are conducted using the attached construction site inspection form. The intent of the inspection is to verify that BMPs are performing and to document the inspections. All completed inspection forms are kept on file.

Enforcement

Instances of non-compliance will be handled with successively more rigorous enforcement measures.

1. Notice of Violation
2. Stop work order
3. Fines

The construction site inspector will issue notices of violation or stop work orders as deemed necessary. Fines will be issued for repeated non-compliance issues.

Site: ______________________________ Date of Inspection: __________

Address: ____

Lat/Long of discharge point: ______________ Receiving water body: ________________

Project owner: ☐ Private ☐ City of North Miami

YES	NO	N/A	
☐	☐	☐	Erosion & Sedimentation Controls are installed as shown on plan.
☐	☐	☐	Erosion is being controlled on site.
☐	☐	☐	Sedimentation is being contained on site.
☐	☐	☐	No indication of sedimentation leaving the site.
☐	☐	☐	SWPP & completed inspection forms are on site & available.
☐	☐	☐	Copy of SFWMD or FDEP Permit (if applicable) is on-site.
☐	☐	☐	Coverage under the GCP has been obtained.
☐	☐	☐	Prior non-compliance issues have been addressed.
☐	☐	☐	All other sources of pollution are being controlled.

Comments:

____

____

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____

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Dumpsters/Garbage Storage & Management of Trash Containers

Description: This section contains information and guidelines for management of dumpster, trash containers and storage areas.

Applicability: Maintenance of garbage storage areas

1. Preparation
   a. Train employees on proper trash disposal.
   b. Locate dumpsters and trash cans in convenient, easily observable areas.
   c. Provide properly-labeled recycling bins to reduce the amount of garbage disposed.
   d. Install berms, curbing, or vegetation strips around storage areas to control water entering/ leaving storage areas.
   e. Whenever possible store garbage containers beneath a covered structure or inside to prevent contact with storm water.

2. Process
   a. Inspect garbage bins for leaks regularly, and have repairs made immediately by responsible party.
   b. Request/use dumpsters, and trash cans with lids and without drain holes.
   c. Locate dumpsters on a flat, hard surface that does not slope or drain directly into the storm drain system.

3. Clean-up
   a. Keep areas around dumpsters clean of all garbage.
   b. Have garbage bins emptied regularly to keep from overfilling.
   c. Wash out bins or dumpsters as needed to keep odors from becoming a problem.

4. Documentation
   a. Document training of employees

IDDE – Illicit Discharge Hotline Reporting

Description: This section includes procedures for initiating spill response through the use of a hotline and collection of documentation for an illicit discharge.

Applicability: Illicit discharges or hazardous spills.

1. Preparation
   a. Publicize Miami-Dade County emergency response phone numbers on the city website.
   b. Include the emergency response numbers for the Health Department on the city website.
   c. Provide city contact person to Miami-Dade County for contact when illicit discharges are reported.

2. Process
   a. Determine the nature of the spill.
   b. If the spill is hazardous in nature or significant in size report the spill immediately to 911.
   c. If the spill is hazardous in nature and may impact human life report the spill immediately to 911.
   d. For small spills requiring investigation by a professional during working hours call the City of North Miami at (305) 895-9871 to report the complaint. They will investigate the situation and prepare a report of the incident.
   e. For small spills requiring investigation after hours call the "After Hours" hotline at (305) 953-2854 to report complaints.

3. Clean-up
   a. If the spill is significant or toxic, cleanup crews will be dispatched immediately.
   b. Miami-Dade County will contact the City representative when a complaint is issued so the City may provide assistance with the cleanup.
   c. If spills are small or non-critical the City may conduct the cleanup effort.

4. Documentation
    a. Miami-Dade County will document incident reports received by their personnel.
    b. The City requests information from Miami-Dade County periodically in order to compile documentation.

IDDE - Outfall Inspections

Description: This section contains information and guidelines for inspection and detection of problems within outfall areas.

Applicability: Inspecting outfall locations

1. Preparation
   a. Know the past and present weather conditions. Conduct inspections during dry weather periods.
   b. Gather all necessary equipment including: tape measure, clear container, clipboard with necessary forms, flashlight, and camera (optional).
   c. Obtain maps showing outfall locations and identifiers.
   d. Obtain outfall description and observations from previous inspections, so the outfall can be accurately identified and observations compared.

2. Process
   a. Perform an inspection of each outfall at least once per year. Whenever possible use the same personnel for consistency in observations.
   b. Identify each outfall with a consistent and unique identifier. For example "Keystone #1". Use maps and previous inspection reports to confirm the outfall identity and location.
   c. Document and evaluate any discharge by completing the following steps:
      1. Collect field samples for visual observations in a clean, clear container and in a manner that avoids stirring up sediment that might distort the observation.
      2. Characterize and record observations on basic sensory and physical indicators (e.g., outfall condition, flow, odor, color, oil sheen) on the Outfall Inspection Form.
      3. Compare observations to previous inspections.
      4. If the flow does not appear to be an obvious illicit discharge (e.g., flow is clear, odorless, etc.), attempt to identify the source of the flow (groundwater, etc.)
      d. If an illicit discharge (such as raw sewage, petroleum products, paint, etc.) is encountered or suspected, follow the procedure of SOP IDDE - Tracing Illicit Discharges.

3. Clean-up

4. Documentation
    a. File completed outfall inspection forms.
    b. Update maps if new outfalls are observed and inspected.

NORTH MIAMI
FLORIDA

ILLICIT DISCHARGE – Removing Illicit Connections and Discharges

Description: This section contains information and guidelines for stopping illicit discharges into storm drain system. This also includes characterizing the nature of, and potential public/environmental threat posed by the illicit discharge.

Applicability: Removal/Ceasing of Illicit Discharges.

1. Preparation
    a. Follow IDDE inspection schedule to check for any illicit discharges in the community.
    b. Log inspections on the IDDE inspection checklist.
    c. Locate illicit discharge.

2. Process
    a. Contact City of North Miami Public Works Department ~~Department~~ at 305-895-9871 during working hours, or 305-953-2854 after working hours for hazardous or unknown spills.
    b. Notify violator of offending discharge and give direction to correct the problem.
    c. Work with violator by providing technical assistance.
    d. Perform follow-up inspections and enforce legal actions if discharge is not eliminated.
    e. Elevate the enforcement action as necessary to obtain results.

3. Clean-up
    a. Stabilize all disturbed soils and surfaces.
    b. Haul all debris, sediment or contaminated soil removed from area to approved dumping site.

4. Documentation
    a. Document beginning of work, completion of work and any cleanup items performed on site.
    b. Keep logs of past and existing illicit discharges.
    c. Record the area and amount of illicit discharge.
    d. Keep any notes or comments of any problems.

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ILLICIT DISCHARGE – Tracing the Source of Illicit Discharge

Description: This section contains information and guidelines for identifying the source of illicit discharge into storm drain system. This also includes characterizing the nature of, and potential public/environmental threat posed by the illicit discharge.

Applicability: Identifying the source of Illicit Discharge.

1. Preparation
   a. Become familiar with the surrounding water bodies and watersheds that could become contaminated.
   b. Look for areas that might have potential to have illicit discharge.(industrial areas or older neighborhoods)

2. Process
   a. Smoke test, TV, or dye test storm drain system to trace potential or difficult to detect illicit discharges.
   b. Determine the type of illicit discharge by collecting and analyzing samples of the water.
   c. Characterize the type of illicit discharge from analyzed samples or from source.
   d. Control possible discharge during dry weather with the use of sandbags or dams.

3. Clean-up
   a. Clean any equipment used in performing detection of illicit discharge.

4. Documentation
   a. Document beginning of work, completion of work and any cleanup items performed on site.
   b. Keep logs of past and existing illicit discharges.
   c. Record the area and amount of illicit discharge.
   d. Keep any notes or comments of any problems.

Reactive Inspection Program

Section III.A.7.c – Illicit Discharges and Improper Disposal – Inspection and Investigation of Suspected Illicit Discharges and/or Improper Disposal
This permit element requires a written **reactive investigation program** for suspected illicit discharges that are reported by others.

Reporting Illicit Discharges

Illicit discharges may be reported through the City of North Miami Public works Department at 305-895-9874 or 305-953-2854 after working hours or verbally while inspectors in field or at the office.

After receiving a report of a suspected illicit discharge City staff will fill out the below form, determine the location and zone of the site, and refer the report to the inspector for that zone. Inspection and enforcement procedures will follow the Proactive Inspection Program 5-10.

Reactive Investigation of Reported Illicit Discharge/Illegal Connection/Illegal Dumping

Date suspected illicit was reported: __________________

Date of investigation: __________________

MS4 potential Receiving system: ____

If not within MS4, date and to whom referral made: __________________

Verification of problem: __________________

Type of discharge/connection/dumping: ____

Determined Source: ____

Type of enforcement action taken: ____

Date to verify elimination: __________________

Date of Referral to FDEP of facility that may require MSGP: __________________

Litter Control Program

Description: The Litter Control Program for North Miami consists of 6 miles of litter collection along public streets, roadways, and rights-of-way within our jurisdiction. (3 miles of these streets, roadways, and rights-of-way are maintained by contract services.)

Applicability: Along all public streets, medians, parks and canals.

1. Preparation
   a. Prioritize cleaning routes in areas with the highest vehicle traffic.
   b. Review standard operating procedure with contractor if performing work.

2. Process
   a. The frequency of collection is Daily/weekly/monthly as shown on the map (because it varies by location)
   b. All collected litter is properly disposed of at the Motorpool.
   c. There is not an "Adopt-a-Road" program in place.

3. Documentation
   a. Documentation of volume of litter collected is kept and is summarized for each reporting each year.

NORTH MIAMI FLORIDA

Maintenance/Equipment Yard Practices And Inspections

The attached map depicts the location of the City-owned (or operated) equipment yard(s) and maintenance shops (that support road maintenance activities). Below or the standard practices in place at those facilities.

General Housekeeping:

Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date, and implement accordingly.

Place adequate stockpiles of spill cleanup materials where they are readily accessible.

Keep work sites clean and orderly. Remove debris in a timely fashion.

Spot clean leaks and drips routinely. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.

Clean leaks, drips, and other spills with as little water as possible. Use rags for small spills, a damp mop for general cleanup, and dry absorbent material for larger spills. Use the following three-step method for cleaning floors:

- Clean spills with rags or other absorbent materials
- Sweep floor using dry absorbent material
- Mop the floor. Mop water may be discharged to the sanitary sewer via a toilet or sink.

Sweep the maintenance area weekly, if it is paved, to collect loose particles. Do not hose down the area to a storm drain.

Report leaking vehicles to fleet maintenance.

Vehicle/Equipment Fueling:

Design fueling area to prevent stormwater runoff and spills.

Apply a suitable sealant that protects the asphalt from spilled fuels in areas where covering is infeasible and the fuel island is surrounded by pavement.

Use secondary containment when transferring fuel from the tank truck to the fuel tank. Cover storm drains in the vicinity during transfer.

Maintain clean fuel-dispensing areas using dry cleanup methods such as sweeping for removal of litter and debris, or use of rags and absorbents for leaks and spills. Do not wash down areas with water.

Post signs at the fuel dispenser or fuel island warning vehicle owners/operators against "topping off" of vehicle fuel tanks.

Vehicle/Equipment Washing:

If possible, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. These businesses are better equipped to handle and properly dispose of the wash waters.

Consider washing vehicles and equipment inside the building if washing/cleaning must occur on-site. This will help to control the targeted constituents by directing them to the sanitary sewer.

Design wash areas to properly collect and dispose of wash water when engine cleaning is conducted and when chemical additives, solvents, or degreasers are used. This may include installation of sumps or drain lines to collect wash water or construction of a berm around the designated area and grading of the area to collect wash water as well as prevent stormwater run-on.

Post signs stating that only washing is allowed in wash area and that discharges to the storm drain are prohibited.

Use biodegradable, phosphate-free detergents for washing vehicles as appropriate.

Use hoses with nozzles that automatically turn off when left unattended.

Discharge equipment wash water to the sanitary sewer, a holding tank, or a process treatment system, regardless of the washing method used. Discharge vehicle wash water to (1) the sanitary sewer, a holding tank, or process treatment system or (2) an enclosed recycling system.

Vehicle/Equipment Repair:

Move maintenance and repair activities indoors whenever feasible.

If outside, use a vehicle maintenance area designed to prevent stormwater pollution - minimize contact of stormwater with outside operations through berming and appropriate drainage routing.

If temporary work is being conducted outside, use a tarp, ground cloth, or drip pans beneath the vehicle or equipment to capture all spills and drips.

Designate a special area to drain and replace motor oil, coolant, and other fluids. This area should not have any connections to the storm drain or the sanitary sewer and should allow for easy clean up of drips and spills.

Drain all fluids from wrecked vehicles immediately. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).

Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.

Dispose of all waste materials according to applicable laws and regulations.

Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate. Promptly transfer used fluids to the proper waste or recycling drums and store in an appropriately designed area that can contain spills. Don't leave drip pans or other open containers lying around.

Do not dispose of oil filters in trash cans or dumpsters, which may leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Most municipalities prohibit or discourage disposal of these items in solid waste facilities. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

Avoid hosing down your work areas. If work areas are washed, collect and direct wash water to sanitary sewer.

Storage:

If possible, store materials and wastes under cover whenever possible.

Minimize stormwater runon by enclosing the area or building a berm around it.

Cover the containers where they are stored.

Raise the containers off the ground by use of pallet or similar method, with provisions for spill control and secondary containment.

Use covered dumpsters for waste product containers.

Contain the material in such a manner that if the container leaks or spills, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters or groundwater.

Store cracked and/or dead batteries in a non-leaking covered secondary container and dispose of properly at recycling or household hazardous waste facilities.

If equipment (e.g., radiators, axles) is to be stored outdoors, oil and other fluids should be drained first. This is also applicable to vehicles being stored and not used on a regular basis.

Try to keep chemicals in their original containers, and keep them well labeled.

Store idle equipment containing fluids under cover.

Inspections:

The attached form is used for the inspection of each site on an annual/monthly/weekly/ daily basis.

Equipment Yard/Maintenance Shop Inspection Form

Facility: ______________________________________ Date of Inspection: _____________

Address: ____

If site discharges to MS4, provide: Latitude/Longitude of discharge point: ___________________________

and receiving water body: ____________________________________

YES	NO	N/A	
☐	☐	☐	Materials/chemicals are stored, handled, and discarded in a manner to reduce the potential risk of spills entering the MS4
☐	☐	☐	A spill kit is on site
☐	☐	☐	Outfalls, inlets, and outlets of stormwater treatment systems are free of debris/pollutants
☐	☐	☐	Storage tanks are clearly marked, properly contained, and protected from potential damage
☐	☐	☐	Loading, unloading, and transfer areas are neat and free of spills/debris/pollutants
☐	☐	☐	Vehicle maintenance areas are properly maintained and draining to the treatment system or sanitary sewer line
☐	☐	☐	Outdoor manufacturing areas are properly maintained and free of spills or debris
☐	☐	☐	Outdoor stockpile/material handling areas are properly maintained and the materials are properly contained (i.e., no potential to leak or leach pollutants)
☐	☐	☐	Trash and debris areas are conspicuous and properly protected from stormwater runoff
☐	☐	☐	Fueling stations are free of petroleum product spills/leaks
☐	☐	☐	Vehicle wash and rinse areas are draining to the treatment system or sanitary sewer line
☐	☐	☐	The site was free of any visual indication of potential illicit connection/illicit discharge to the MS4. If no, note type of indication:
			Odor ☐ Color ☐ Foam ☐ Sheen ☐ Surface Scum ☐ Solids ☐ Turbidity ☐

INDUSTRIAL SITES ONLY

YES	NO	N/A	
☐	☐	☐	MSGP Notice of Intent (FDEP Form 62-621.300(5)(b)) was submitted to DEP
☐	☐	☐	Stormwater Pollution Prevention Plan was on site and implemented, per the MSGP
☐	☐	☐	Required SWPPP inspection and maintenance report forms completed, per the MSGP

Use reverse side of form for comments.

NORTH MIAMI
FLORIDA

Major Stormwater Outfalls – Structural Control Inspection
Standard Operational/Maintenance/Documentation Protocol

There are 7 major stormwater outfalls (MSWOs) that are part of our MS4. A MSWO is defined as:

- an outfall pipe larger than 36-inch inside diameter (or its equivalent), OR
- discharge from a single conveyance other than a pipe that serves a drainage area of 50 acres or more, OR
- an outfall pipe larger than 12-inches inside diameter (or its equivalent) that serves a drainage area containing industrial land uses, OR
- discharge from a single conveyance other than a pipe that serves a drainage area of 2 acres or more that include industrial land uses.

The MSOWs within our MS4 are located on the following map.

Inspections:
MSWOs are inspected annually or more frequently if historic operations indicate that it's needed for a particular MSWO. Inspections are conducted in accordance with the following Structural Control Inspection Form.

Maintenance:
There are several maintenance activities that may be associated with MSWOs. The appropriate activity is chosen to correspond to the reported condition. The following activities may be required:

1. Remove trash and debris and dispose of properly.
2. Remove accumulated vegetative matter and dispose of properly.
3. Remove accumulated sediment and dispose of properly.
4. Maintain earthen bank adjacent to the discharge pipe or headwall.
5. Maintain the headwall at the outfall, if applicable.
6. Repair/replace pipe if needed.

Documentation:
The documentation for the inspection and maintenance activities related to major stormwater outfalls is kept on file

NORTH MIAMI
FLORIDA

Major Stormwater Outfalls – Structural Control Inspection

Facility ID: ______________________ Date: ______________

FUNCTION:

Debris or sediment accumulation in pipe? *YES* *NO*

Barnacle accumulation in pipe? *YES* *NO*

Sediment accumulation in receiving water? *YES* *NO*

Pipe in need of repair/replacement ? *YES* *NO*

If *YES*, report to supervisor for further investigation or schedule for maintenance.

GENERAL:

Any indications of illicit discharge or illegal dumping? *YES* *NO*

If *YES*, describe and report to supervisor for proper response:

____

Signs of erosion on bank near outfall? *YES* *NO*

Rip-rap in need of maintenance? *YES* *NO*

Headwall in need of repair/replacement? *YES* *NO*

If *YES*, schedule for maintenance.

Plan to Eliminate Wastewater Contamination in Stormwater

The North Miami operates the wastewater collection and transmission system within our jurisdiction.

<Coordinate with the utility department to obtain a copy of the plan or program they use to eliminate wastewater spills and leaks within your jurisdiction.>

Identified indications of wastewater contamination are documented in the Illicit Discharge log. Follow-up with the Public Works Department is conducted so that documentation of the response and resolution can also be made in the log. In addition, the Public Works Department provides information on other reported wastewater spills for inclusion in the log.

Proactive Inspection Program

1. **Procedure and Criteria for identifying priority areas/facilities**

   For consistency with the Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) permit, the following areas are considered a priority in the inspection program:

   - Areas with older infrastructure
   - Industrial, commercial, or mixed use areas
   - Areas with history of past illicit discharges and/or illegal dumping
   - Areas with on-site sewage disposal systems
   - Areas upstream of sensitive or impaired water bodies

   The attached map depicts the areas zoned as industrial or commercial, that lie within our MS4 contributing area or in an area that discharges from an outfall for which we are responsible. The map is updated each year, typically in the month of October, by the Public Works department and saved as a PDF format file for use by all. “Older infrastructure” is not indicative of an increased potential to contain incidences of illicit discharges/connections/dumping.

2. **List of identified priority areas/facilities**

   Each year, a list of addresses is created from an overlay of the map created above and the County's current parcel map and associated database. This list is cross-referenced with the Florida Department of Environmental Protection (FDEP) list of facilities that have coverage under the Multi-Sector Generic Permit (MSGP). If any facilities that appear to require an MSGP are not on the FDEP list, the names and addresses of those businesses are referred to FDEP. The annual creation of the list of addresses and cross-referencing with the FDEP MSGP database is typically done in the month of October each year.

3. **Annual schedule for inspections**

   All priority areas/facilities are inspected at least once within the current five-year permit term. The inspection area has been divided into three zones. One zone will be inspected during each year of the permit term. If an area is found to have illicit discharges/connections/dumping, it is re-inspected for compliance and if warranted, specific facilities within that area are considered for placement on the high risk facility list for more frequent inspection.

   In addition, inspections for signs of illicit discharges are part of the Standard Operating Procedure for all structural control inspections and maintenance. A "checkbox" for this activity is included on the inspection forms for those activities. If a suspected illicit is identified, it is reported to Public Works for investigation under Reactive Investigations program.

Finally, all appropriate field personnel receive illicit discharge and illegal dumping identification and notification training. If a suspected illicit is identified during the course of performing their regular activities, it is reported to Public Works for investigation under the Reactive Investigations program.

4. **Procedure for conducting inspections**

   The inspector(s) patrols the prioritized area searching for indications of illicit discharges/connections/dumping into the City's MS4, in accordance with the training received. If any are identified, the inspector makes a cursory attempt at identifying the source of the illicit. If the source is identified, the inspector makes the decision to either approach the facility owner or refer the finding to his supervisor for further action. In speaking with the facility owner or operator, the inspector advises of the findings and cites the ordinance which prohibits such discharges. The inspector may use photo documentation to support the inspection. The inspector indicates his/her intention to return to verify that the problem has been corrected. If no source is identified, the findings are reported to the inspector's supervisor for further investigation.

Pro-active inspections also take place during the inspection of structural controls and other MS4 components by stormwater personnel that are trained in illicit discharge identification and reporting.

5. Procedure for tracing source of discovered illicit discharge

Visual observation, investigation, and testing if necessary, are used to identify the source of an illicit discharges/connections/dumping.

6. Procedure for eliminating the discharge

If an illicit connection to the MS4 through a pipe is identified, it is immediately terminated (plugged or removed). If the illicit is traced back to a property owner/operator, the owner of the property is contacted by the city engineer. The owner is notified of the problem and asked to address the situation immediately. The owner is also notified of the re-inspection date, typically one week.

7. Procedure for documenting the inspections and enforcement activities

The MSGP coverage research and reporting is documented by the copies of the lists generated during each step (list of facilities within MS4 that are commercial/industrial), list of facilities in the City with MSGP coverage, list of facilities that appear to need MSGP coverage but appear not to have it). These lists will be maintained with other back-up documentation to support the annual permit activities conducted by the City. The list of facilities that appear to need MSGP coverage will be sent to FDEP for follow-up.

8. Procedures for enforcement actions (or referrals to appropriate jurisdictional authority)

For cases within North Miami's MS4 contributing area, an unresolved matter is handled by the Public Works department. For cases outside North Miami's MS4, the appropriate entity is notified (FDOT, Miami-Dade County, etc.) by the Public Works department.

9. Identification of staff /department/outside entity responsible for inspections and for enforcement

Inspection activities are carried out by Miami-Dade County. Follow-up and management are provided by Miami-Dade County. Documentation is handled by the IW-5 section.

Proactive Illicit Discharge/Illegal Connection Inspection Form

Date of Inspection: _________________

Address of Facility OR General Description of Area Inspected:

____

Identification of MS4 component that could receive discharge from this site/area: _________________

If Facility inspection, does type of business require an MSGP? Yes___ No___

If yes, does this facility have one? Yes___ No___

Findings:

Evidence of illicit connections to storm sewer? Yes___ No___

Evidence of dumping/spills to storm sewer? Yes___ No___

Evidence of wash water going to storm sewer? Yes___ No___

Storage tanks leaking or improperly contained? Yes___ No___

Stockpiles/debris piles uncontained? Yes___ No___

If "yes," to any above, describe:

____

____

____

____

____

____

Type of Enforcement Action Taken: ____

Date to verify elimination: __________________

Date of referral to FDEP of Facility that may require MSGP: ___________________________________

Roadway Maintenance Practices
To Reduce Pollutants

Roadway repairs and maintenance may take place anywhere throughout the City's jurisdictional area, and is conducted on an as-needed basis.

Major repair work is typically done as a construction project by a contractor. These projects most often required a Notice of Intent under the State's Generic Construction Permit, which requires a Stormwater Pollution Protection Plan. Routine inspections are done as part of the construction site inspection program.

Minor repairs, completed by municipal staff, are performed using the following practices:

- Painting, striping, marking, and asphalt and concrete cutting or repair activities are done in dry weather.
- Nearby storm drain inlets are protected by covers, straw bales, sand bags, filter fabric or plastic to reduce the possible entry of wastes, dusts, overspray and/or slurry.
- All waste and debris remaining after the work is swept up and removed
- Water use is minimized when saw cutting concrete. The waste slurry is allowed to dry and then swept up or a wet vacuum is used to pick up the waste slurry during or immediately after cutting.
- Maintenance supplies (e.g., cement bags, sealants and tars) are stored under cover and away from drainage areas.
- Waste, scraps, rust and paint from any sandblasting or painting projects is collected and disposed of properly

Site Plan Review Procedures

Site Plan Reviews are required for all projects within the City of North Miami

Application packages for building/construction/grading permits include brochures presenting the need for obtaining an *Environmental Resource Permit* (ERP) and/or coverage under the *NPDES Generic Permit for Stormwater Discharge from Large and Small Construction Activities* (CGP).

Site Plan Reviews are typically conducted prior to a permit being issued. Personnel in the Engineering Services/ Stormwater Management Department conduct the reviews. Current local/state criteria are used as the guideline for review of the temporary and permanent stormwater treatment practices that are being proposed by the site plan.

Applicants for a building/construction/grading permit are advised that coverage under the Construction Generic Permit may be required. Applicants are further advised that proof of a SFWMD or FDEP Permit and/or coverage under the CGP, if applicable, will be required during the first construction site inspection.

The following checklist is used when performing site plan reviews:

YES	NO	N/A	
☐	☐	☐	Proposed work requires coverage under CGP.
☐	☐	☐	Proposed work appears to require an ERP.
☐	☐	☐	Proposed temporary stormwater sedimentation & erosion control BMPs appear to be appropriate for the project.
☐	☐	☐	Proposed permanent stormwater BMPs meet local requirements.

Spill Prevention & Response Training Plan

Following is the City of North Miami plan for training the appropriate personnel in preventing and responding to spills within our jurisdictional area.

Who

The following personnel shall receive annual training:

Topics

The information covered by the training includes:

- Practices to prevent spills
- How to recognize & assess the nature of a spill
- How to contain a spill
- How to report a spill that is hazardous, too large to manage, or threatens a water body

Method

The training is presented via EXCAL employee training videos. The primary videos for spill prevention & response are “Spills & Skills” and “Controlling Oil: Spill Prevention, Control & Countermeasure.” A question and answer period follows the training video. *<This is an example; describe what is appropriate for your entity. Remember that “all appropriate personnel” are to be trained, not just the stormwater department and the fire department.>*

Presenter

The training is presented by ________________________.

Schedule

The training is presented annually, usually in __*<month?>*_____.

Training Documentation

Attendance at the training session is documented by sign-in sheets.

776 NE 125 Street | North Miami | Florida | 33161 305.893.6511

Spill Prevention & Response Procedures

Following is the City of North Miami procedures for preventing and responding to spills within our jurisdictional area.

Procedure

1. Based on training received, identify whether or not the spill requires that a call be made to a supervisor or the Fire Department. If it does, do so immediately and follow any instructions given.
2. Take appropriate steps to contain the spill in order to eliminate or minimize the possibility of the spilled substance entering the storm drain system.
3. If within your authority, clean up the spill. Rely on training to determine the appropriate method for spill clean-up.
4. Follow up with documentation on any spill incident.

Documentation

Spills and the follow-up responses are documented in the IDDE log.

776 NE 125 Street | North Miami | Florida | 33161 305.893.6511

NORTH MIAMI
FLORIDA

STORMWATER POLLUTION PREVENTION PLAN
FOR STORMWATER DISCHARGES ASSOCIATED WITH SMALL CONSTRUCTION ACTIVITIES – ONE TO FIVE ACRES

SITE DESCRIPTION

Project Name and Location: ____

____

Owner Name and Address: ____

____

Description: Construction project involving the construction of ____________________

____

Soil disturbing activities will include: clearing and grubbing; installing stabilized construction entrances; excavation of water management facilities, storm sewer installation; utilities installation; grading; construction of curb and gutters; building pad and foundation placement; and preparation of landscaping and sodding.

Site Area: The site is ________ acres. __________ acres are expected to be disturbed by construction activities.

Site Map: Paving, Grading and Drainage Plans are attached.

Discharge points: Latitude __________ Longitude _______ Drainage Area __________

Name of Receiving Waters: ____

CONTROLS

Sequence and Timing of Erosion and Sediment Controls Measures

1. Excavation of water management facilities should occur immediately after clearing and grubbing to serve as a sediment trap or catchment for stormwater runoff from exposed soils.

2. Construction of perimeter berm or site grading to prevent off-site discharge of stormwater runoff.

3. Placement of silt fences and or hay bales, properly anchored, to contain erosion in areas prone to stormwater runoff erosive velocities.

4. Permanent stabilization will be provided to portions of the site where construction activities have ceased by laying sod.

5. Inlet protection will be provided for each inlet either by silt fence/filter fabric staked in place or hay bales.

6. Outlet protection will be provided by turbidity screens within the receiving body.

Other Controls
Material Management Practices

Waste Materials: All waste materials will be collected and stored in a securely covered metal dumpster provided by a licensed solid waste management company in Palm Beach County. The dumpster will meet all Palm Beach County and State solid waste management regulations. All trash and construction debris from the site will be deposited in the dumpster. The dumpster will be emptied as needed so there is no overflow. Trash will be hauled to an authorized/permitted landfill facility. All personnel will be instructed regarding the correct procedure of waste disposal.

Hazardous Waste: All hazardous waste material will be disposed of in a manner specified by local or State regulations. Site personnel will be instructed in these practices.

Sanitary Waste: All sanitary waste will be collected from the portable units a minimum of twice per week by the licensed Sanitary Company, as required by local regulations.

Petroleum Products: All on-site vehicles and tanks will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers, which are clearly labeled. Any asphalt substances used on-site will be applied accordingly to the manufacturer's recommendations. All above ground tanks for fueling will be secondarily contained.

Pesticides and Herbicides: Any pesticide and herbicide usage will be by State licensed applicators.

Fertilizers: Fertilizers used will be applied only in the minimum amount recommended by the manufacturer. If stored on-site, covered storage will be provided. The contents of any partially used bags of fertilizers will be transferred to a sealable container to avoid spills.

Paints: All containers will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm sewer system but will be properly disposed of according to manufacturers' instructions or State or local regulations.

Offsite Vehicle Tracking: A stabilized construction entrance will be provided to reduce vehicle tracking of sediments. Dump trucks hauling material from the construction site will be covered with a tarpaulin, as required by State law.

Stormwater Management

The stormwater management system will consist of conveyance system including inlets and culverts directing stormwater runoff into the detention facility for treatment and attenuation, prior to discharge to off-site receiving bodies. When all disturbed areas have been stabilized, the accumulated sediment will be removed from in and around all inlets and catch basins.

MAINTENANCE/INSPECTIONS PROCEDURES

Erosion and Sediment Control and Maintenance Practices

These are the inspection and maintenance practices that will be used to maintain erosion and sediment control.

- All control measures will be inspected at least once each week and following any storm event of 0.5 inches or greater. Rainfall amount should be based on an onsite rain gauge.
- All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of onsite inspection report.
- Built up sediment will be removed from silt fence when it has reached one-third the height of the fence.
- Silt fence will be inspected for depth of sediment, tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground.
- A maintenance inspection report will be made after each inspection. A copy of the report form to be completed by the inspector is attached.
- The site superintendent will designate a qualified employee who will be responsible for inspections, maintenance and repair activities, and completing the inspection and maintenance reports.

Non-Stormwater Discharges

Non-stormwater discharges are permissible provided that discharge does not cause erosion or create turbidity within the receiving body and are in compliance with regulatory requirements. These discharges may include water line flushing, fire fighting activities, fire hydrant flushing, dust control, irrigation drainage and air conditioning condensate and water used to spray off loose solids from vehicles (Wastewater from a more thorough cleaning, including the use of detergents or other cleaners is not permitted).

CERTIFICATION OF COMPLIANCE WITH STATE REGULATIONS

The Stormwater Pollution Prevention Plan shall reflect South Florida Department of Environmental Protection Generic Permit for Stormwater Discharge from Large and Small Construction Activities. DEP Document 62-621.300(4)(a) of the Florida Administrative Code (F.A.C.).

POLLUTION PREVENTION PLAN CERTIFICATION

"I certify under penalty of law that I understand, and shall comply with, the terms and conditions of the State of Florida Generic Permit for Stormwater Discharge from Large and Small Construction Activities and this Stormwater Pollution Prevention Plan prepared thereunder."

Contractor/Site Operator

Name: ______________________________ Telephone Number: ____________________

Signed: _____________________________ Address: ___________________________

Title: ______________________________ Date: ______________________________

NORTH MIAMI
FLORIDA

STORMWATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT FORM

TO BE COMPLETED EVERY 7 DAYS AND WITHIN 24 HOURS OF A RAINFALL EVENT OF 0.5 INCHES OR MORE

INSPECTOR: ____________________ **QUALIFICATION:** ________________

DAYS SINCE LAST RAINFALL: **AMOUNT:** ______________________

SEDIMENT AND EROSION CONTROLS:

Temporary Stabilization: ____

Permanent Stabilization: ____

Note: May be impractical for this construction project. If so, use N/A for response:

Inlet Protection: ____

Outlet Protection: ____

Silt Fences: ____

Stabilized Construction Entrances: ______________________________________

Maintenance Required for Sediment and Erosion Controls: ______________________

____

To be performed by: ____________________ **On or before:** ____________________

MATERIALS MANAGEMENT PRACTICES:

Evidence of Spills: ____

Maintenance Required for Materials Management Areas: ___________________________

To be performed by: ____________________ **On or before:** ____________________

CHANGES REQUIRED TO THE POLLUTION PREVENTION PLAN: ________

____

REASONS FOR CHANGE: ____

____

____

____

I certify that this facility is in compliance or not in compliance (circle one) with the Stormwater Pollution Prevention Plan and the State of Florida Generic Permit for Stormwater Discharge from Small Construction Activities.

Signed: ____________________________________ Date: ______________________

Street Sweeping

A map of the street sweeping routes is attached. _____ miles of public roadway are in the program. Roadways without curb and gutter, and roadways not owned/maintained by City of North Miami, are not included in the program.

The frequency of sweeping is:

Daily/weekly/monthly

As shown on the map (because it varies by location)

Frequency has been established based on historical information about collected amounts over the past ___ years. The areas swept most frequently are the priority areas.

Documentation of volume of street sweeping collection is kept in a log book by date and is summarized for reporting each year.

An estimate of the total phosphorus and total nitrogen collected by the street sweeping is performed based on the Florida Stormwater Association's determinations of street sweeping removal rates project.

All street sweeping collection is properly disposed of in accordance with DEP's "Guidance For The Management Of Street Sweepings, Catch Basin Sediments and Stormwater System Sediments."

Florida Stormwater Association
Street Sweeping Nutrient Removal Rates

Based on the May 31, 2011 Final Report "Quantifying Nutrient Loads Associated with Urban Particulate Matter (PM), and Biogenic/Litter Recovery Through Current MS4 Source Control and Maintenance Practices" and Table 8 in the report (pg.41), the following values may be used to estimate nutrient removal values from street sweeping activity:

Median Value of Nutrient Removal per Unit of Material Collected	
Total Phosphorus	**Total Nitrogen**
0.000361	0.000563

Example Calculations:

In fiscal year 2010, Palm Beach County collected 1,915 cubic yards of material with the street sweeping program. Assuming the average density of the street sweeping material is 2,295 pounds per cubic yard,* then 4,394,925 pounds were collected. Using the table above, the total phosphorus removed would be estimated at (4,394,925)(0.000361) = 1,587 pounds. The total nitrogen removed would be estimated at (4,394,925)(0.000563) = 2,474 pounds.

Last year the Town of Jupiter collected 35.8 dry tons (71,600 pounds) of street sweeping material from residential areas. The estimated nutrient removal rates for total phosphorous and total nitrogen would be (71,600 pounds)(0.000361) = 26 pounds, and (71,600)(0.000563) = 40 pounds, respectively.

Alternatively, the State has provided a spreadsheet tool, wherein the user has only to enter the cubic feet OR wet or dry pounds of street sweepings collected, in order to determine the pounds of TP and TN removed by the activity. This spreadsheet is available on the Palm Beach County MS4 NPDES website.

* *This assumption is based on information from the Study referenced above.*

Exfiltration Trench – Structural Control Inspection
Standard Operational/Maintenance/Documentation Protocol

There are 9.5 linear feet (or **miles**) of exfiltration trench that are part of our MS4; the systems are located as shown on the following map.

Inspections:

Established exfiltration trench is inspected once every three years, using the following Structural Control Inspection Form.

New exfiltration trench is inspected annually for the first two years of operation.

If chronic problems are identified with a run of exfiltration trench, it is inspected annually until the problem is resolved (two consecutive annual inspections without an issue).

The inspection to check for proper function is conducted close to the recovery time of that exfiltration trench system (generally 72 hours after a significant rainfall event) to verify that the system still functions as intended. The inspection for sediment accumulation in the system is conducted in dry weather.

Inspections are conducted in accordance with the following Structural Control Inspection Form.

Maintenance:

There are several maintenance activities that may be associated with exfiltration trench. The appropriate activity is chosen to correspond to the reported condition. The following activities may be required:

1. Remove sediment in pipe(s) and/or upstream and downstream structures. This may be done by flushing or vacuuming.

2. Remove trash and debris from the system and dispose of properly.

3. Total rehabilitation (removal and replacement) of the exfiltration trench system may be required when the system fails to function at the design capacity.

Documentation:

The documentation for the inspection and maintenance activities related to exfiltration trench is kept on file.

Exfiltration Trench – Structural Control Inspection

Facility/Segment ID: ________________________ Date: _________________

Inspection conducted _______ days/hours after significant rainfall event.

FUNCTION:

Standing water in observation well, inspection port, or inlet? *YES* *NO*

Standing water above inlet grates? *YES* *NO*

If *YES*, report to supervisor for further investigation or schedule for maintenance.

GENERAL:

Sediment amount less than one foot below pipe invert in up or downstream structure? *YES* *NO*

Sediment visible in pipe? *YES* *NO*

Debris accumulation at weir? *YES* *NO*

If *YES*, describe and schedule for maintenance: ____

Any indications of illicit discharge or illegal dumping? YES NO

If YES, describe and report to supervisor for proper response: ____

Major Stormwater Outfalls – Structural Control Inspection
Standard Operational/Maintenance/Documentation Protocol

There are two (2) major stormwater outfalls (MSWOs) that are part of our MS4. A MSWO is defined as:

- an outfall pipe larger than 36-inch inside diameter (or its equivalent), OR
- discharge from a single conveyance other than a pipe that serves a drainage area of 50 acres or more, OR
- an outfall pipe larger than 12-inches inside diameter (or its equivalent) that serves a drainage area containing industrial land uses, OR
- discharge from a single conveyance other than a pipe that serves a drainage area of 2 acres or more than include industrial land uses.

The MSOWs within our MS4 are located on the following map.

Inspections:

MSWOs are inspected annually, or more frequently if historic operations indicate that it's needed for a particular MSWO. Inspections are conducted in accordance with the following Structural Control Inspection Form.

The anticipated inspection schedule follows.

[List the Major Stormwater Outfalls and provide inspection dates]

Maintenance:

There are several maintenance activities that may be associated with MSWOs. The appropriate activity is chosen to correspond to the reported condition. The following activities may be required:

1. Remove trash and debris and dispose of properly.
2. Remove accumulated vegetative matter and dispose of properly.
3. Remove accumulated sediment and dispose of properly.
4. Maintain earthen bank adjacent to the discharge pipe or headwall.
5. Maintain the headwall at the outfall, if applicable.
6. Repair/replace pipe if needed.

Documentation:

The documentation for the inspection and maintenance activities related to major stormwater outfalls is kept on file.

Major Stormwater Outfalls – Structural Control Inspection

Facility ID: ________________________ Date: _________________

FUNCTION:

Debris or sediment accumulation in pipe? *YES* *NO*

Barnacle accumulation in pipe? *YES* *NO*

Sediment accumulation in receiving water? *YES* *NO*

Pipe in need of repair/replacement ? *YES* *NO*

If *YES*, report to supervisor for further investigation or schedule for maintenance.

GENERAL:

Any indications of illicit discharge or illegal dumping? *YES* *NO*

If *YES*, describe and report to supervisor for proper response: ____

Signs of erosion on bank near outfall? *YES* *NO*

Rip-rap in need of maintenance? *YES* *NO*

Headwall in need of repair/replacement? *YES* *NO*

If *YES*, schedule for maintenance.

Pollution Control Device – Structural Control Inspection
Standard Operational/Maintenance/Documentation Protocol

There are ______ pollution control devices (PCDs) that are part of our MS4; they are located as shown on the following map.

The purpose of PCDs is the removal of debris, sediment, oils, and/or other materials from the stormwater stream before it discharges into a receiving water body. Thus, the more material removed by these devices, the better. Frequent inspection and maintenance is the key to the proper function of these units.

Inspections:

PCDs are inspected quarterly, unless historic operations indicate that a less or more frequent inspection schedule is needed for particular PCDs. Inspections are conducted in accordance with the PCD manufacturer's recommendations. In general, inspections will include the items listed on the following Structural Control Inspection Form.

Inspections are conducted in accordance with the following inspection form.

Maintenance:

There are several maintenance activities that may be associated with PCDs. The appropriate activity is chosen to correspond to the reported condition. The following activities may be required:

1. Remove trash and debris from system and dispose of properly.

2. Remove accumulated vegetative matter and dispose of properly.

3. Remove accumulated sediment and dispose of properly.

4. Replace absorbent materials as required.

5. Repair damage to structure, inflow or outflow pipes.

Documentation:

The documentation for the inspection and maintenance activities related to pollution control devices is *[describe documentation system or procedures. This could be paper file copies or inspection forms and/or maintenance work orders, or an electronic database, or any other method used by your MS4 to manage field work performed]*.

PCD – Structural Control Inspection

Facility ID: ________________________ Date: _________________

FUNCTION:

Sediment accumulation? *YES* *NO*

Debris accumulation? *YES* *NO*

Absorbent materials need replacement? *YES* *NO*

If *YES*, report to supervisor for further investigation or schedule for maintenance.

GENERAL:

Any indications of illicit discharge or illegal dumping? *YES* *NO*

If *YES*, describe and report to supervisor for proper response: ____

Inlets/Outlets damaged or obstructed? *YES* *NO*

If *YES*, schedule for maintenance.

Pipes/Culverts and Inlets/Manholes – Structural Control Inspection Standard Operational/Maintenance/Documentation Protocol

There are 38.8 linear feet/**miles** of pipe/culvert that are part of our MS4. The locations are shown on the following map. This value and the locations on the map do NOT include exfiltration trench, which is catalogued separately. Each pipe segment (between two structures or between a structure and an outfall) has a unique identification. This information is stored in a geographic information system (GIS).

There are 2,659 inlets/catch basins/manholes that are part of our MS4. Their locations are also shown on the following map. Each structure has a unique identification. This information is stored in a geographic information system (GIS).

Inspections:

At least 10% of the total number of linear feet of pipe/culvert is inspected each year. The inlets, catchbasins, and manholes associated with a pipe/culvert system are inspected concurrently. Visual inspections are conducted in accordance with the checklist/procedure that follows. Inspection forms are not used. The GIS is coded to identify the last inspection date for each facility. If warranted, as a result of the visual inspection, a work order for maintenance, repair, or a more detailed pipe or structure investigation is generated. A more detailed investigation may include televising the pipe, or using mirrors or other devices, as appropriate, to determine the condition of the pipe/culvert. As a result of the more detailed investigation, a work order for maintenance or repair may be generated.

Maintenance:

There are several maintenance activities that may be associated with stormwater networks . The appropriate activity is chosen to correspond to the reported condition. The following activities may be required:

1. Remove trash and debris and dispose of properly.
2. Remove accumulated vegetative matter and dispose of properly.
3. Remove accumulated sediment and dispose of properly.
4. Remove barnacles and/or other marine life and dispose of properly.
5. Repair/replace the headwall at the end of the pipe, if applicable.
6. Repair/replace pipe or structure, if needed.

Documentation:

The documentation for the inspection and maintenance activities related to the pipes/culverts and inlets/manholes is kept on file.

Pipes/Culverts – Structural Control Inspection

VISUAL INSPECTION:

Evidence of settling above the pipe alignment? *YES* *NO*

Sediment accumulation in pipe (viewed from inlets, manholes, etc.)? *YES* *NO*

Barnacle accumulation in pipe (viewed from inlets, manholes, and/or outfall)? *YES* *NO*

If *YES*, schedule for maintenance and report to supervisor for further investigation.

Stormwater Pump Station – Structural Control Inspection
Standard Operational/Maintenance/Documentation Protocol

There are 4 stormwater pump stations (SWPSs) that are part of our MS4; they are located as shown on the following map.

Inspections:

SWPSs are inspected semi-annually, or more frequently if historic operations indicate that it's needed for a particular SWPS. Because these structures are each unique, their inspection protocol is specific to each structure.

The anticipated inspection schedule follows.

[List the Stormwater Pump Stations and provide inspection dates]

Maintenance:

There are several maintenance activities that may be associated with SWPSs. The appropriate activity is chosen to correspond to the reported condition. The following activities may be required:

1. Remove trash and debris and dispose of properly.
2. Remove accumulated vegetative matter and dispose of properly.
3. Remove accumulated sediment and dispose of properly.
4. Maintain pump in accordance with pump manufacturer's recommendations.
5. See Sumps and Injection Wells SOP for more information/

Documentation:

The documentation for the inspection and maintenance activities related to stormwater pump stations is kept on file.

Stormwater Pump Station #_______
Inspection Procedure/Checklist/Form

Facility ID: ________________________ Date: _________________

FUNCTION:

[develop one for each unique pump station] *YES* *NO*

GENERAL:

Any indications of illicit discharge or illegal dumping? *YES* *NO*

If *YES*, describe and report to supervisor for proper response: ____

Debris accumulation upstream or downstream of structure? *YES* *NO*

Sediment accumulation upstream or downstream of structure? *YES* *NO*

Headwall in need of repair/replacement? *YES* *NO*

If *YES*, schedule for maintenance.

Vehicle Maintenance and Repair Activities

Description: This section is about the protection of storm drain system from vehicles or equipment that may leak or drip petroleum products and that may also collect large amounts of dirt.

Applicability: Storing and washing of vehicles and equipment.

1. Preparation

   a. Store vehicles indoors where possible and in an area with no floor drains that lead to storm water system.
   b. Watch for leaking equipment and vehicles.

2. Process

   a. Use drip pans to collect leaking fluids from equipment or vehicles.
   b. Repair leaking vehicles as soon as possible to protect storm drain system.
   c. Wash vehicles and equipment in dedicated areas.

3. Clean-up

   a. Properly clean any areas that have been polluted by leaking vehicles.
   b. Discharge all wash water containing contaminates (degreasers, acids, and oil bases) to a treatment facility or sanitary sewer if it meets treatment plan standards.
   c. Do not store or wash vehicles over storm drain inlets.

4. Documentation

   a. Record location where vehicles and equipment were leaking.
   b. Keep any notes or comments of any problems.

Washing

Description: This section contains information and guidelines for washing off equipment and vehicles.

Applicability: Washing vehicles and equipment

1. Preparation
   a. Provide wash areas for small vehicles inside the maintenance building that has a drain system which is attached to the sanitary sewer system.
   b. Provide wash areas for large vehicles on an approved outside wash pad that has a drain system which is attached to the sanitary sewer system.
   c. No vehicle washing will be done where the drain system is connected to the storm sewer system.

2. Process
   a. Minimize water and soap use when washing vehicles.
   c. Use hoses with automatic shut off nozzles to minimize water usage.
   d. When washing outside the building, it is the operators' responsibility to make sure all wash water is contained on the wash pad and does not have access to the storm drain.
   e. Never wash vehicles over or a storm drain.

3. Clean Up
   a. Sweep wash areas after every washing to collect what solids can be collected to prevent them from washing down the drain system.
   b. Clean solids from the settling pits on an as needed basis.

Waterline Flushing after Construction/System Disinfection with Discharge to Storm Drain

Description: This section contains information for proper waterline flushing, protection of inlet structures, and maintaining a clean flow path for waterway after a construction project or system disinfection with discharge to storm drain.

Applicability: Waterline flushing after construction projects or after system disinfection.

1. Preparation
    a. Determine chlorine content of discharged water. Utilize de-chlorination equipment if necessary.
    b. Determine flow path of discharge.
    c. Obtain discharge permit if necessary.

2. Process
    a. Protect inlets in flow path.
    b. Sweep and clean flow path.
    c. Use diffuser to reduce velocities.

3. Clean-up
    a. Remove inlet protection.
    b. Clean flow paths.
    c. Remove equipment from flush point.

4. Documentation
    a. Document beginning of work, completion of work and any cleanup items performed on site.
    b. Residual test of discharged water.

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