95 EXPRESS PHASE 3B-2

Palm Beach County
From Glades Road to Linton Boulevard

Drainage Report

June 2020

Prepared for:
Florida Department of Transportation-District Four (D4)

Prepared by:
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Palm Beach County
From Glades Road to Linton Boulevard

FDOT

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1. INTRODUCTION

1.1 Project Overview

I-95 (SR-9) is the primary interstate facility used to travel south-north along the east coast of Florida. Along with I-75 and Florida's Turnpike, I-95 is one of only three south-north major highway systems used to carry people and goods into and out of south Florida. Rapid population growth over the past two decades has resulted in additional traffic on I-95 and congestion on local crossroads. Over the next 20 years I-95 is expected to have a significant traffic demand exceeding its current capacity.

Accordingly, the Florida Department of Transportation (FDOT) is proposing to extend its regional managed lanes network northward, as part of the I-95 Express Lanes Phase 3B-2 Project, north of Segment 3A previously submitted. The project extends from south of Glades to south of Linton Boulevard in Palm Beach County, with approximately 6.5 miles traversing the Cities of Delray Beach and Boca Raton. The project involves the conversion of existing High Occupancy Vehicle lanes (HOV lanes) to High Occupancy Toll lanes (HOT lanes) and widening to accommodate one additional HOT lane in each direction, bridge widening, toll and gantry improvements, ITS, signing and pavement markings improvements, and drainage improvements. The drainage improvements include the expansion of linear dry detention ponds and infield ponds. The project will be procured by FDOT under the design-build delivery method.

Phase 3B-2 has been separated into three segments. Segment 1 encompasses proposed works on Peninsula Corp Drive. Segment 2 extends from south of Glades Road to south of Linton Boulevard. Segment 3 includes construction of the Diverging Diamond Interchange (DDI) at Glades Road as well as proposed works on Glades Road itself, east and west of the proposed DDI. This report will be limited to the work associated with Phase 3B-2, Segment 2.

The project corridor is located within the jurisdictional boundary of the South Florida Water Management District (SFWMD). The regulations of SFWMD will govern the stormwater management design criteria for the project; however, the proposed stormwater management system will also conform to any additional design requirements of the Florida Department of Environmental Protection (FDEP) and United States Army Corps of Engineers (USACE).

The project limits have been differentiated into eight main drainage systems based on existing geographical, topographical and waterbody discharge divides. In order to accurately evaluate the project based on pre-development and post-development flows to the various receiving waterbodies along the corridor, several sub-basins have been delineated within each drainage system.

1.2 Scope

This Drainage Report describes the existing drainage conditions and addresses the proposed drainage improvements for the I-95 corridor from south of Glades to Linton Boulevard in Palm Beach County. It has been prepared as part of the conceptual Environmental Resource Permit (ERP) package to be submitted to SFWMD for review and approval. Please refer to the separate Concept Cross Drain Report and Bridge Hydraulics Reports for documentation on the existing traversing culverts and bridges, and their proposed improvements within the project limits.

The scope of this Drainage Report consists of addressing the permitting water quality and water quantity requirements, as well as the establishment of a detailed hydrologic and hydraulic model to evaluate the existing and proposed drainage conditions (flood stages and discharges) within the limits of the project. The analysis demonstrates that the proposed improvements will have no negative drainage impacts to the surrounding areas; the proposed stormwater management facilities will have the capacity to adequately treat and attenuate roadway runoff within the project limits.

The proposed stormwater management facilities have been designed to conform to SFWMD water quality and water quantity criteria, with consideration of several design constraints including avoidance of right-of-way acquisition, avoidance and minimization of wetland impacts.

2. SURVEY AND DATA COLLECTION

Field and record data collected for this project includes previously issued plans and permits, as-built plans, field reviews, topographic survey, geotechnical testing, and aerial image evaluation.

Topographic survey was performed by aerial planimetrics for the entire I-95 Express Lanes Phase 3 corridor limits, with supplemental ground survey performed for bridge obscured areas and select locations obscured by landscape or walls. The topographic survey was used to develop base maps and assist in establishing the pre-development hydrologic and hydraulic conditions.

An existing drainage survey was also performed. In addition, the major components of the existing drainage system were compiled based on review of existing plans, permits, and engineering evaluation, in order to develop general nodal- link connectivity for the hydrologic and hydraulic models. Existing SFWMD permits and FDOT as-built plans were obtained and used to establish the existing drainage conditions for the conceptual drainage design and permit application submittal.

All geotechnical investigations and soil information used were obtained from previous PD&E studies.

In addition to topographical survey and geotechnical investigations, an inventory of existing I-95 drainage outfalls was performed to gather information regarding type and condition of the outfall end treatments. The purpose for the inventory was to determine where manatee exclusion devices should be installed on drainage outfalls to District waterbodies and to determine the most appropriate type of manatee exclusion device given the existing end treatments.

3. DESIGN CRITERIA AND PARAMETERS

3.1 Datum Conversion

The vertical datum used in this report and calculations is NAVD 88. The datum shift was determined using the National Geodetic Survey VERTCON online tool. The datum shift used to convert NGVD 29 to NAVD 88 within the study area is summarized in Table 1 below.

Table 1-Datum Conversion from NGVD 29 to NAVD 88

Location	Shift (ft.)
At BC/PBC line	(-)1.56
At Linton Rd	(-)1.53

3.2 Stormwater Quality Criteria

3.2.1 South Florida Water Management District (SFWMD)

The SFWMD has the lead jurisdiction over the stormwater quality criteria for the project and generally requires that all projects meet state water quality standards as set forth in Chapter 17-302, Florida Administrative Code (FAC). According to the SFWMD Permit Volume IV, all projects must meet the following volumetric retention/detention requirements:

1. For wet detention systems, the first inch of runoff from the project or the total runoff from 2.5 inches times the percent of imperviousness, whichever is greater, must be detained on site. A wet detention system is a system that maintains the control elevation at the seasonal high groundwater elevation and does not bleed down more than one-half inch of detention volume in 24 hours;

2. Dry detention systems must provide 75 percent (75%) of the required wet detention volume. Dry detention systems must maintain the control elevation at or above one foot above the seasonal high groundwater elevation;

3. Retention systems must provide 50 percent (50%) of the wet detention volume; and

4. For projects with more than 50 percent (50%) of imperviousness, discharge to the receiving water bodies must be made thorough baffles, skimmers, or other mechanisms suitable from preventing oil and grease from discharging to or from the retention/detention areas.

3.3 Stormwater Quantity Criteria

3.3.1 South Florida Water Management District (SFWMD)

SFWMD requires that offsite discharge rates be limited to rates not causing adverse impacts to existing off-site properties, and:

1. Historic discharge rates,
2. Rates determined in previous SFWMD permit action, or
3. Basin allowable discharge rates.

The receiving waterbodies that are within the vicinity of the project include the SFWMD Canals: El Rio Canal and C-15 Canal, and Lake Worth Drainage District (LWDD) L-46 and L-40 Canals.

SFWMD requires that the post-development peak discharge rate for the 25-year 72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year 72-hour rainfall event. Since flood routing was not completed for the original I-95 project(s), the pre-development peak discharge rates have been determined by modeling the existing conditions as per the as-built and/or permitted plans. The preliminary flood routing results indicate that pre- versus post-development peak discharge criteria is met with the proposed stormwater management facilities.

SFWMD also requires that provisions be made to replace or otherwise mitigate the loss of historical basin storage provided by the project. In addition, SFWMD requires flood protection within the project as follows: 1) Building finished floor elevation must be set at or above the 100-year flood elevation, as determined from the Federal Flood Insurance Rate Maps (FIRM) or 100-year-72-hour rainfall event peak stages; and 2) Centerline of roadways must be set at or above the 10-year-24-hour rainfall event peak stages or two feet above the seasonal high groundwater elevation, whichever is greater.

3.3.2 FEMA Floodplain Impacts

The project corridor lies within Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) Panel Nos. 12099C1176F, 12099C0988F, 12099C0989F, 12099C0987F. South of Glades Road, the corridor is predominantly located within the 100-year floodplain, within Zones AE and AH with base flood elevations (BFE) varying between 9.50 and 12 ft. NAVD. The portion of the corridor between Glades Road and Yamato Road is predominantly located within the 100-year floodplain, within Zones AE and AH with base flood elevations (BFE) varying between 10.00 and 11 ft. NAVD. The portion of he corridor north of Yamato Road to the End Project is located outside of the 100-year floodplain in Zone X. Refer to **Appendix B** for the FEMA Maps covering the project limits.

Floodplains must be protected in accordance with Executive Order 11988m “Floodplain Management”, USDOT Order 5650.2, “Floodplain Management Protection”, and Federal-Aid Policy Guide 23 CFR 650A. The intent of these regulations is to avoid or minimize highway encroachments within the base floodplains, and to avoid supporting land use development incompatible with floodplain values.

Given the significant increase in storage for stormwater management within the corridor, there is no change in flood “risk” or adverse floodplain impacts associated with this project. The following floodplain statement is a slightly modified version of Statement Number 3 in the FDOT PD&E Manual, tailored for this project: (See Chapter 24, PD&E Manual).

The modifications to drainage structures included in this project will result in an insignificant change in their capacity to carry floodwater. This change will cause minimal increases in flood heights and flood limits. These minimal increases will not result in any significant change in flood risks or damage. There will not be a significant change in the potential for interruption or termination of emergency services or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant.

3.3.3 Florida Department of Transportation (FDOT)

Design High Water (DHW) and Allowable High Water (AHW) are hydraulic parameters based on FDOT drainage design criteria for roadway base clearance and various design water elevations, as described in the FDOT Drainage Manual. DHW consists of the maximum flooding level standing over a period of 24-hours. DHW values are typically established for a 10-year design storm frequency and for roadway base protection purposes. DHW values are typically determined by simulating the FDOT 10year-24-hour storm. A stage hydrograph for a 48-hour duration is used to determine the maximum standing water level for a 24-hour time period. However, per the FDOT District Four Drainage Practices and Guidance, the DHW values are determined by selecting a long-term stage (i.e. 3-7 days) or the seasonal high groundwater table elevation (SHGWT), whichever is greater. Since the existing roadway base for I-95 is well above the three feet clearance that is required from SHGWT and the proposed roadway design will not lower the roadway base elevation, no base clearance issues are anticipated for the project.

3.4 Stormwater Management System Design Criteria

The conceptual drainage design for the I-95 project has been developed based upon the stormwater quality and quantity criteria of the agencies with jurisdiction over the corridor. The following subsections describe the design criteria for the available best management practices (BMP's) to meet the required stormwater quality and quantity criteria:

3.4.1 Detention Ponds

The detention ponds must be designed in accordance with the following design criteria and parameters established by SFWMD:

Size Requirements:

- No minimum area requirement for dry ponds. The bottom elevation of the pond must be set at least one foot above the control elevation.

Maintenance Berms:

- Per FDOT criteria, at least 15 feet adjacent to the pond shall be a slope of 8:1 (horizontal: vertical) or flatter. The berm area shall be sodded.
- SFWMD requires a minimum width of 20 feet for all perimeter maintenance berms. However, per previous agreements between FDOT and SFWMD, a minimum perimeter maintenance berm for ponds of 15 feet with slopes no steeper than 4:1 beyond the control elevation is permissible.

Side Slopes and Littoral Zones:

- Per SFWMD, side slopes cannot be steeper than 1:4 (vertical: horizontal) from the top of bank out to a minimum depth of two feet below the control elevation. Side slopes shall be topsoiled and stabilized through seeding or planting from the top of bank to a depth of two feet below the control elevation.

- Per SFWMD, shallow, littoral areas shall be provided at a minimum of 20 percent of the wet detention area or 2.5 percent of the total detention area (including side slopes plus the basin contributing area).

Discharge Structures:

- Per SFWMD, control structures shall include baffle system to encourage discharge from the center of the water column rather than the top or bottom. Baffle design shall be per FDOT Design Standard 240 or 241.
- Per SFWMD, control structures shall be designed so that the gravity control devices are sized based upon a maximum design discharge of one half inch of the detention volume in 24 hours. The devices shall incorporate dimensions no smaller than six square inches, three inches minimum dimension, and/or 20 degrees for "V" notches.

3.4.2 French Drain

French drains are feasible when in-situ soil hydraulic conductivity is sufficient to promote exfiltration of the required stormwater quality volumes. However, French drains have not been proposed for Phase 3B-2, Segment 2.

3.4.3 Conveyance Systems

Conveyance systems collect and carry stormwater runoff to receiving water bodies, other conveyance systems, detention ponds, retention ponds, and French drains. The two main conveyance systems used in roadway projects are storm sewer systems and roadway and median ditches or swales. The design of both storm sewer systems and conveyance ditches/swales shall be based on FDOT drainage design criteria. The criteria are summarized as follows:

- For major expressways, a 10-year recurrence interval shall be used in the design of storm sewer systems.
- For major expressways within a sag vertical curve with no outlet other than the storm sewer, a 50-year recurrence shall be used in the design of the storm sewer system. Also, for depressed expressway stretches where storm sewer is the only possible outfall, a 50-year recurrence shall be used for the design of the storm sewer system.
- Design of storm sewer systems shall maintain hydraulic grade line (HGL) a minimum of one foot below gutter line when minor losses are not computed in the design. When minor losses are considered, HGL may be maintained at or below the gutter line.
- Design of storm sewer system shall maintain a minimum velocity of 2.5 feet per second flowing full and a maximum velocity of 15 feet per second.
- Roadway and median ditches shall be designed to convey the 10-year frequency storm. Outfall ditches shall be designed to convey the 25-year frequency storm.
- The maximum allowed velocity in grassed ditches shall be 4.0 feet per second. For velocities higher than 5.5 feet per second, linings other than grass shall be used such as paved concrete, flexible, riprap, geo-grid or interlocking concrete blocks.

- Two feet sumps shall be provided at all drainage structures when downstream pipe is relatively flat or when the structure has more than one pipe connection (to/from), to minimize entrance of sediments into drainage pipes.

3.5 Total Maximum Daily Load (TMDLs) and Nutrient Impaired Water Bodies

The Florida Department of Environmental Protection developed a Basin Management Action Plan (BMAP) which implements certain measures in order to restore and protect state waters and addresses Total Maximum Daily Load (TMDLs) requirements for impaired waterbodies. TMDLs represent the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards.

Section 303(d) of the federal Clean Water Act requires states to submit to the EPA lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters. The Florida Department of Environmental Protection has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], Florida Statutes [F.S.]); the state's 303(d) list is amended annually to include basin updates.

For assessment purposes, the Florida Department of Environmental Protection has divided the Southeast Coast–Biscayne Bay Basin into water assessment polygons with a unique waterbody identification (WBID) number for each watershed or stream reach. For the WBID identified with TMDL for Fecal coliform within the project, no additional performance measures or nutrient loading reductions can be made since the existing and proposed Roadway land-use has no contribution to such impairment. However, based on the limits of the I-95 Express Lanes Phase 3B-2 project, and FDEP Impaired Water Verified List 2014, there are four WBID within Segment: 3262, 3264D, 3226F and 3264. In addition, based on Permit 50-02713-S Application 140828-14 (2014) drainage report, the LWDD E-4/El Rio Canal confirm this water body as impaired. As such, Nutrient Load analysis and evaluation of the proposed water treatment facilities has been made to the I-95 Express Phase 3B-2 project to estimate the nutrient loading reductions.

The ERP Applicants Handbook Volume I establish general water quality requirements, but no specific instructions or methods to evaluate nutrient load. Mr. Lee Marchman, PE the DEP State Stormwater Engineer provided the following clarifications on October 28, 2014:

"In current Environmental Resource Permitting (ERP) circumstances, an evaluation of the Nutrient load isn't necessary; as Florida's permitting approach is "BMP-based", using "Presumptive criteria." ... If a stormwater management system is designed in accordance with the stormwater treatment requirements and criteria adopted by the department or a water management district under this part (Chapter 62-330, F.A.C.), the system design is presumed not to cause or contribute to violations of applicable state water quality standards ... On the other hand, if a stormwater system discharges to an impaired water body, it is required that the discharge must make a "net improvement" of the constituent in the receiving water body. Discharges in BMAP areas may also impose additional limits to discharges of certain constituents. In cases like this, an evaluation of the pollutant load is helpful. "

The nutrient load evaluation for the project areas contributing to the Hillsboro and C-15 Canal based on the ERP Stormwater Quality Handbook 2010 shows that the total water quality treatment provided in the contributing areas as summarized in the following table, substantially exceeded the required volume to achieve the proper reduction:

WATER TREATMENT STORAGE SUMMARY FOR NUTRIENT LOAD REDUCTION					
SYSTEM	**RECEIVING WATER BODY**	**SFWMD BASIN**	**TYPE OF TREATMENT**	**REQUIRED TREATMENT FOR POLLUTANT REMOVAL (Ac-ft)**	**TREATMENT PROVIDED* (Ac-ft)**
34	LWDD L-46 Canal	Hillsboro Canal	Dry Ret	0.05	29.97
35	Airport Canal	Hillsboro Canal	Dry Ret	0.99	49.95
36	E-4 Canal/El Rio Canal	Hillsboro Canal	Dry & Wet Ret	0.43	21.76
37	E-4 Canal/El Rio Canal	Hillsboro Canal	Dry & Wet Ret	0.76	40.31
Hillsboro Basin Totals				**2.23**	**141.99**
38	LWDD L-40 Canal	C-15 Canal	Dry Ret	0.41	4.69
39	C-15 Canal	C-15 Canal	Dry Ret	0.60	13.95
40	C-15 Canal	C-15 Canal	Dry Ret	0.03	6.58
41	C-15 Canal	C-15 Canal	Dry Ret	0.14	1.21
C-15 Canal Basin Totals				**1.18**	**26.43**
Total				3.41	168.42

*Provided Storage. Refers to the minimum storage provided on I-95 CDC segment 3B as required by SFWMD.

3.6 Design Storms and Rainfall Depths

Rainfall contour maps provided by SFWMD in the Permit Information Manual Vol. IV were used along with the rainfall volume assumptions from previous I-95 projects to estimate the rainfall volumes associated with various design storm events for this study. The rainfall volumes for the various design storms simulated in the pre-development and post-development ICPR models developed for this study include:

For Systems 34 thorough 41:

- 10-year-24-hour: 10.5-inch
- 25-year-72-hour: 16.00-inch
- 100-year-24-hour: 20.0-inch

3.7 Drainage Analysis Methodology

3.7.1 Basin Delineation and Parameters

Basin boundaries were delineated using a combination of topographic survey, field assessments, and previous permit documentation. Refer to Appendices C and D for pre-development and post-development drainage maps respectively. Curve Numbers (CN) values for each basin were calculated using methods developed by the United States Department of Agriculture, Soil Conservation Services (SCS) in conjunction with basin specific S-values as required by SFWMD. All basins are relatively small and were assigned the minimum recommended time of concentration of 10 minutes.

3.7.2 Drainage System Modeling

The pre-development and post-development models of the I-95 drainage systems were developed using the software Advanced Integrated Channel and Pond Routing (AdICPR) version 4.03.02. The majority of the input used to model existing features was acquired from topographic survey and existing drainage information obtained by existing plans and permits. In areas where topographic survey data was insufficient, other sources such as existing plans and permits were used to generate the input.

For the pre-development and post-development models, swales and ponds were modeled as separate stage-area nodes in AdICPR, with assigned sub-basins delineated for each node based on their direct contributing runoff area. Elevation contours were created for the swales and ponds in Microstation using the DTM feature of Geopack. These areas were measured at one-foot to half-foot contours and input into AdICPR as stage-area nodes. Boundary conditions were modeled as constant time-stage nodes with elevations set at the mean high water for tidal waterbodies and established canal maintained water surface elevations for controlled canals. In scenarios in which basins are directly connected to these receiving waterbodies without any existing control or attenuation, the basins have been assigned directly to the boundary node.

Nodes are generally interconnected by links consisting of pipes or culverts, weirs and drop structures. Pipe and culvert links have been input based on information from existing plans and permits. Weirs and drop

structures have also been modeled based on existing plans and permits, depending on intended type of flow simulation and downstream conveyance and node type.

The calculations, AdICPR flood routing input, and results for each drainage system are included in **Appendices F** thorough M.

The following design storm events were simulated in AdICPR for each of the respective criteria:

- 10-year 24-hour: Roadway and open swale drainage design storm event
- 25-year 72-hour: Pre-versus–post discharge and flooding stages design storm event
- 100-year 24-hour: Floodplain and minimum finished floor elevation design storm event

4. PERMITTING REQUIREMENTS

The following is a guideline of the environmental permitting requirements for the project and it is not intended to be all-inclusive.

- **Florida Department of Environmental Protection (FDEP):** A Generic Permit for Stormwater Discharge from Large and Small Construction Activities (National Pollutant Discharge Elimination System (NPDES)) Permit will ultimately be required by the subsequent Design-Build Firm prior to construction. As part of the conceptual permit application, the Permit Plans include a Stormwater Pollution Prevention Plan (SWPPP) and Erosion Control Plan. The subsequent Design-Build Firm will be responsible for submittal of the Notice of Intent (NOI) and any required modifications to the SWPPP and Erosion Control Plan based on the final design and construction sequence.

- **South Florida Water Management District (SFWMD):** The following permits will be required from the SFWMD:

    - A SFWMD Conceptual ERP has been issued for the proposed improvements and SMFs required for the I-95 Express Lanes Phase 3B project. For Phase 3B-2, a minor modification was requested for specific early works associated with Segments 1, 2 and 3 while a major modification will be required for each segment. The minor modification for combined Segments was approved on December 23, 2019 .

    - A SFWMD Water Use Permit for Dewatering is required for projects with proposed dewatering activities. Since a Master Dewatering Permit has already been approved by SFWMD for FDOT projects in Broward County, the Design-Build Firm shall conform to the special conditions of the existing permit and submit documentation during the final design and construction permitting phase of the project. The major concerns to be addressed in the documentation will be the proximity to sources of contaminants, drawdown impacts, and dewatering effluent discharge location(s)

- **United States Army Corps of Engineers (USACE):** Due to unavoidable wetland, surface water, and/or foraging habitat impacts associated with the proposed roadway widening and required swale and pond expansions, a USACE Section 404 Dredge and Fill Permit will be required. This permit will be applied for under the Joint ERP application submittal. In addition, a USACE Section 408 Approval will be required for modifications to the SFWMD canal crossings that were constructed under previous USACE civil works projects. The Section 408 review will be coordinated concurrent with the SFWMD Right-of-Way Occupancy Permit application review.

- **United States Coast Guard (USCG)** The Coast Guard approves the location and plans of bridges and causeways and imposes any necessary conditions relating to the construction, maintenance, and operation of these bridges in the interest of public navigation. A bridge permit is the written approval of the location and plans of the bridge or causeway to be constructed or modified across a navigable waterway of the United States. Any individual, partnership, corporation, local, state, or federal legislative body, agency, or authority planning to construct or modify a bridge or causeway across a navigable waterway of the U.S. must apply for a Coast Guard bridge permit in accordance with 33 CFR 115.50. A USCG permit application is not required for this section.

5. DRAINAGE SYSTEM 33

5.1 Overview

The I-95 Express Phase 3B System 33 is defined as the segment of the I-95 corridor from NW 13th Street to the L-46 Canal. The existing system consists of a dry swale that ultimately discharges to the LWDD L-46 Canal. The system is located within the Hillsboro Drainage Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. System 33 serves a proposed total onsite area of 6.49 acres, 3.02 acres of which is impervious area and 3.47 acres of which is pervious area.

For System 33, the existing dry detention swale on the east side will be modified to accommodate the new widening of the corridor, and to provide the required water quality treatment volume and peak discharge rate attenuation in accordance with SFWMD criteria.

The proposed stormwater plan will not only enhance water quality treatment within this section of the I-95 corridor, but will also provide sufficient storage capacity to attenuate the 25-year-72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The proposed stormwater plan will limit the 10-year-24-hour maximum stages to proposed travel lane edge of pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages.

There are approximately 200 SY of wetland impacts at the downstream end of the existing 8'x4' CBC which will need to be extended for proposed Ramp C to Glades Road.

No contaminated sites are located within the system limits, based on a site review conducted by environmental scientists within the design team.

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.56 pertaining to the Broward County/Palm Beach County Line on I-95.

5.2 Proposed Modifications from Concept Design

- PrDitch 33-2 has been removed
- Seasonal Highwater Table has been revised

5.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 33. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and South Florida Water Management District (SFWMD) permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3423, Year - 1973
- State Project No.: 93220-3478, Year - 1987

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Permit No. 88-00061-S, Year - 1988

Lake Worth Drainage District (LWDD)

- Project No. 8800763R.01

5.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was determined to be at El. 3.01 ft NAVD (4.57 ft NGVD) based on existing survey and field observation.

The water surface elevation for the L-46 Canal is 1.24 ft. NAVD (2.8 ft. NGVD), as per drainage structure S-57 on the as-built plans for State Project No.: 93220-3478. Field observations also confirm normal water surface elevations for the L-46 Canal.

5.5 Floodplain

The study limits include areas within FEMA floodplain Zone AH adjacent to the east side of the I-95 corridor. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRM 12099C1176F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevation was identified as 9.50 feet (NAVD).

5.6 Pre-Development Conditions Stormwater Management System

5.6.1 General Pre-Development Drainage Conditions

The following system description includes only system information shown in the permit and as-builts plans mentioned above. Current conditions of this system are different due to siltation and weathering over time.

System 33 is located within the SFWMD Hillsboro Canal Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map.

Runoff from the NB lanes sheet-flows to an existing swale on the eastern side of I-95. Runoff from the SB lanes is collected and conveyed by an existing network of median barrier wall inlets which in turn discharges into the existing swale on the east side of I-95. This existing swale ultimately discharges into the LWDD L-46 Canal.

No permitted allowable discharge has been found. Therefore, for System 33, the pre-development model will be utilized to establish the pre-development peak discharge rates.

5.6.2 Pre-Development Modeling Results

Given that both System 33 and System 34 discharge directly into the LWDD L-46 Canal, the pre-development model includes both Systems combined.

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix F**. AdlCPR model results are also included in **Appendix F**.

5.7 Post-Development Conditions Stormwater Management System

5.7.1 General Post-Development Drainage Conditions

In the post-development conditions, the proposed improvements along Glades Road includes the reconfiguration of the on-off ramps to I-95. The stormwater runoff collected within System 33 will be treated and attenuated within two proposed interconnected dry retention ponds, PrPond 33-1 and PrPond 33-2, which will discharge into the L-46 Canal via a proposed control structure. This control structure will

limit the peak discharge rate into the L-46 Canal and provide the necessary water quality treatment volume prior outfall in the Canal in accordance with SFWMD requirements. Refer to **Appendix E** for the Post-Development Drainage Maps.

The boundary condition tailwater elevation for this system is the same tailwater elevation used in the pre- development condition.

Please refer to the Post-Development Land-Use Table included in **Appendix F** for curve number calculations and area breakdowns.

5.7.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inches over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 34 for all onsite contributing basins. Refer to Water Quality Tables included in **Appendix F** for water quality treatment summary and supplemental water quality calculations.

5.7.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. All AdICPR flood routing results indicate that pre-versus post-development peak discharge criteria is met with the proposed stormwater management facilities. Refer to AdICPR flood routing reports (included in **Appendix F**) for a complete summary of results.

5.7.4 Post-Development Modeling Results

Given that both System 33 and System 34 discharge directly into the LWDD L-46 Canal, the post-development model includes both Systems combined.

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix F**. The post-development discharge rates are less than the pre-development discharge rates for all design storm events. Refer to AdICPR Node Maximum Conditions (included in **Appendix F**) for a complete summary of maximum stages and discharge rates.

5.8 Conclusions and Recommendations

In general, the proposed System 34 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The drainage design for System 33 meets both the water quality and water quantity requirements set by the SFWMD. System 33 will provide 0.86 ac-ft. of water quality treatment volume within the proposed dry retention ponds. The required water quality treatment volume for System 33 is 0.76 ac-ft. Therefore, a surplus of 0.10 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.

- The pre-development peak discharge rate from System 33 and System 34 into the LWDD L-46 Canal for the 25-year-72-hour design storm event is 140.68 cfs and the post-development peak discharge rate from System 33 and System 34 is 67.93 cfs. Therefore, the total 25-year-72-hour pre-development discharge is reduced by 72.75 cfs. Peak discharge values correspond to the maximum inflow into the L-46 Canal.

- All proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.

- All proposed ponds contain the 25-year-72-hour and 100-year-24-hour maximum stages.

6. DRAINAGE SYSTEM 34

6.1 Overview

The I-95 Express Phase 3B System 34 is defined as the segment of the I-95 corridor from the L-46 Canal to the Glades Road Interchange. The existing system consists of several dry swales/ponds and dry retention ponds within the infield areas south of Glades Road that ultimately discharge to the LWDD L-46 Canal. The system is located within the Hillsboro Drainage Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. System 34 serves a proposed total onsite area of 27.23 acres, 12.45 acres of which is impervious area and 14.78 acres of which is pervious area.

For System 34, three inter-connected retention ponds will be provided within the proposed Glades Road interchange (one in the SW quadrant and two in the SE quadrant) to accommodate the new widening of the corridor, and to provide the required water quality treatment volume and peak discharge rate attenuation in accordance with SFWMD criteria.

The proposed stormwater plan will not only enhance water quality treatment within this section of the I-95 corridor, but will also provide sufficient storage capacity to attenuate the 25-year-72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The proposed stormwater plan will limit the 10-year-24-hour maximum stages to proposed travel lane edge of pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages.

There are 200 SY of wetland impacts at the downstream end of the existing 8'x4' CBC which will need to be extended for proposed Ramp C to Glades Road. There is also an additional 385 SY of wetland impacts located in the southeast quadrant of the Glades Road interchange.

No contaminated sites are located within the system limits, based on a site review conducted by environmental scientists within the design team.

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.56 pertaining to the Broward County/Palm Beach County Line on I-95.

6.2 Proposed Modifications from Concept Design

- Design of Diverging Diamond Interchange at Glades Road in place of typical interchange
- PrPond 34-2A has been removed
- Seasonal Highwater Table has been revised

6.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 34. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and South Florida Water Management District (SFWMD) permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3423, Year - 1973
- State Project No.: 93220-3478, Year - 1987

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Permit No. 88-00061-S, Year - 1988

Lake Worth Drainage District (LWDD)

- Project No. 8800763R.01

6.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was determined to be at El. 3.01 ft NAVD (4.57 ft NGVD) based on existing survey and field observation.

The water surface elevation for the L-46 Canal is 1.24 ft. NAVD (2.8 ft. NGVD), as per drainage structure S-57 on the as-built plans for State Project No.: 93220-3478. Field observations also confirm normal water surface elevations for the L-46 Canal.

6.5 Floodplain

The study limits include areas within FEMA floodplain Zone AH adjacent to the east and west sides of the I-95 corridor. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRM 12099C1176F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevations on the east side of I-95 vary from 9.50 to 10 feet (NAVD) and is 12 feet (NAVD) to the west of the project corridor.

6.6 Pre-Development Conditions Stormwater Management System

6.6.1 General Pre-Development Drainage Conditions

The following system description includes only system information shown in the permit and as-builts plans mentioned above. Current conditions of this system are different due to siltation and weathering over time.

System 34 is located within the SFWMD Hillsboro Canal Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. Runoff from part of the I-95 southbound travel lanes in the southwest quadrant of the Glades Road Interchange flows into a dry retention pond located in the infield area between the I-95 mainline and the southbound on-ramp from Glades Road. Based on permit documentation, this pond provides a water quality treatment volume of 113,256 cu-ft (2.6 Ac-ft.). Permit documentation shows a ditch block that operates as a control structure, where stormwater overflows from the retention pond are conveyed over the ditch block and via a 24-inch pipe into a roadside swale/ditch prior to ultimately draining into the L-46 Canal. The control elevation at the ditch block is at elevation 10.74 ft. NAVD (12.3 ft. NGVD). However, field and aerial reviews revealed that the permitted ditch block no longer exists at the location specified on the as-built plans. Additionally, not enough details could be found in the permit documentation to model the pond associated to this structure as per permit conditions; therefore the pond was modeled using the existing topographic conditions and no control structure was modeled downstream of this pond.

Runoff from the northbound travel lanes and entrance/exit ramps in the southeast quadrant of the interchange drains into the infield areas and appears to be conveyed via a stormwater collection and conveyance system that discharges into a conveyance swale east of the northbound off-ramp to Glades Road. Runoff from this quadrant of the interchange ultimately drains into the L-46 Canal without any water quality treatment, according to permit documents.

No permitted allowable discharge has been found. Therefore, for System 34, the pre-development model will be utilized to establish the pre-development peak discharge rates.

6.6.2 Pre-Development Modeling Results

Given that both System 33 and System 34 discharge directly into the LWDD L-46 Canal, the pre-development model includes both Systems combined.

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix F**. AdICPR model results are also included in **Appendix F**.

6.7 Post-Development Conditions Stormwater Management System

6.7.1 General Post-Development Drainage Conditions

In the post-development conditions, the proposed improvements along Glades Road includes the reconfiguration of the on-off ramps to I-95. The stormwater runoff collected within System 34 will be treated and attenuated within three inter-connected dry retention ponds, PrPond 34-2 within

the southwest quadrant of Glades Road Interchange and PrPond 34-1 and PrPond 34-1A within the southeast quadrant. A drop structure located at the south end of Pond 34-1A will limit the peak discharge rate into the L-46 Canal and provide the necessary water quality treatment volume prior to outfall to the Canal in accordance with SFWMD requirements. Refer to **Appendix E** for the Post-Development Drainage Maps.

The boundary condition tailwater elevation for this system is the same tailwater elevation used in the pre- development condition.

Please refer to the Post-Development Land-Use Table included in **Appendix F** for curve number calculations and area breakdowns.

6.7.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inches over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 34 for all onsite contributing basins. Refer to Water Quality Tables included in **Appendix F** for water quality treatment summary and supplemental water quality calculations.

6.7.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. All AdICPR flood routing results indicate that pre-versus post-development peak discharge criteria is met with the proposed stormwater management facilities. Refer to AdICPR flood routing reports (included in **Appendix F**) for a complete summary of results.

6.7.4 Post-Development Modeling Results

Given that both System 33 and System 34 discharge directly into the LWDD L-46 Canal, the pre-development model includes both Systems combined.

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix F**. The post-development discharge rates are less than the pre-development discharge rates for all design storm events. Refer to AdICPR Node Maximum Conditions (included in **Appendix F**) for a complete summary of maximum stages and discharge rates.

6.8 Conclusions and Recommendations

In general, the proposed System 34 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The drainage design for System 34 meets both the water quality and water quantity requirements set by the SFWMD. System 34 will provide 29.97 ac-ft. of water quality treatment volume within the proposed dry retention ponds. The required water quality treatment volume for System 34 is 2.67 ac-ft. Therefore, a surplus of 27.30 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.

- The pre-development peak discharge rate from System 34 into the LWDD L-46 Canal for the 25-year-72-hour design storm event is 84.77 cfs and the post-development peak discharge rate from System 34 is 25.28 cfs. Therefore, the total 25-year-72-hour pre-development discharge is reduced by 59.49 cfs. Peak discharge values correspond to the maximum inflow into the L-46 Canal.

- All proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.

- All proposed ponds contain the 25-year-72-hour and 100-year-24-hour maximum stages.

7. DRAINAGE SYSTEM 35

7.1 Overview

The I-95 Express Phase 3B System 35 can be defined as the segment of the I-95 corridor from the Glades Road Interchange to Spanish River Boulevard/SW 40th Street. This System contains the northern quadrants of the Glades Road Interchange, Basins B-1, B-100 and the offsite area from Airport Road. Basin nomenclature from the SFWMD ERP No.50- 02713-S, Application No. 140828-14 has been used in this section to be consistent with the documentation on the permit.

In this system, the runoff from the ramps and main line within the north portion of the Glades Road Interchange flows into the infield areas. An existing dry retention pond located at the northeast quadrant of the Interchange provides water treatment for the system by using a ditch block as a control structure. Overflow from this pond ultimately discharges into an outfall ditch located on the east side of the on-ramp from Glades to NB I-95. This ditch flows north to Airport Canal (reference Drainage Maps), please refer to **Appendix D and E** of this report.

Within the northwest section of the interchange runoff does not appear to have any kind of formal treatment or control structure. Based on the permit plans and drainage maps it appears to flow into the infield areas, conveyed toward the adjacent roadside swale by an existing pipe and ultimately discharge into the Airport Canal. Aerial and field observation indicate that most of the runoff from the interchange is currently flowing into an off-site storage area west of the off-ramp to Glades Road which is interconnected to the Airport Canal via a 60” cross drain approximately 2200 ft. north of Glades Road.

The remaining portion of the System correspond to the mainline of the corridor, and runoff is flowing toward a sequence of interconnected roadside ponds with a series of ditch blocks that, basically, are providing water quality and attenuation along the east and west sides of I-95 within this System.

The ultimate discharge for these treatment facilities is also the Airport Canal. The existing treatment facilities will be modified to accommodate the proposed corridor widening and to provide additional treatment required because of increased impervious area within the project limits.

Refer to **Appendix A** for the SFWMD Drainage Basin Map.

System 35 serves a proposed total onsite area of 83.74 acres, 49.06 acres of which is impervious area and 34.68 acres of which is pervious area.

There are no wetlands or contaminated sites within the system limits, based on a site review conducted by Environmental Scientists within the design team.

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.56 pertaining to the Broward County/Palm Beach County Line on I-95. However, for those elevations taken from the plans for project 412420-3-52-01 the vertical datum shift is identified on the key sheet and is set at (-) 1.55 to convert between NGVD 29 to NAVD 88.

7.2 Proposed Modifications from Concept Design

- Design of Diverging Diamond Interchange at Glades Road in place of typical interchange
- Majority of Drainage Basin B-1 (14.89 acres) is now being treated and attenuated
- PrPond 1 has been extended
- Revised limits of PrPond 2 to include PrPond 4 and PrPond6
- Revised limits of PrPond 3 to include PrPond 5

7.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 35. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and South Florida Water Management district (SFWMD) permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3432, Year. 1970
- State Project No.: 93220-3422, Year. 1970
- State Project No.: 93220-3478 52, Year. 1987

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Permit No.50-02713-S (Application No. 140828-14), Year. 2014
- Permit No. 50-2713-S (Application No. 130227-11), Year. 2014
- Permit No. 50-2713-S (Application No. 910403-6), Year. 1991

Lake Worth Drainage District (LWDD)

- Project No. 8800763R.01

7.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was determined to be at El. 4.5 ft NAVD (6.00 ft NGVD) from (SFWMD) Permit 50-027-13-S.

7.5 Floodplain

The project limits include areas within FEMA floodplain Zone AH adjacent to the east and west sides of the I-95 corridor. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRMs 12099C1176F and 12099C0988F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevations on the east side of I-95 vary from 10.0 to 10.5 feet (NAVD) and varies from 10.5 to 12 feet (NAVD) to the west of the project corridor.

7.6 Pre-Development Conditions Stormwater Management System

7.6.1 General Pre-Development Drainage Conditions

The following system description includes only system information shown in the permit and as-built plans mentioned above. This system is included in a design-build project currently being constructed which contains Spanish River Boulevard and Yamato Road. The post development condition for this design-build project will be the existing condition for this I-95 project.

The analysis and calculations for this system follow the same nomenclature for ponds and control structures used in the permit documentation.

For this system, the runoff from the northeast segment of the Glades Road Interchange flows into a dry retention pond located in the east infield area. Based on permit this pond provides a water treatment volume of 181,209.60 cft (4.2 Ac-ft.) for the system using a ditch block as a control structure; flow is then conveyed into a swale east of I-95 and ultimately into the Airport Canal.

In the northwest portion of the interchange, runoff from the northwest loop of the Glades Road Interchange, including the off-ramp and southbound travel lanes, does not appear to have any kind of formal treatment. Runoff flows into the infield areas. Based on the permit drainage maps, the infields, the existing storage area to the west and adjacent swales to the west of I-95, are interconnected and the runoff ultimately drains the Airport Canal.

Field visits and aerial examination indicate that most of the runoff within this area is flowing toward the off-site storage area west of the off-ramp to Glades Road before discharging into the Airport Canal via a 60" cross drain approximately 2200 ft. north of Glades Road.

Approximately 700 ft of the southbound lanes of I-95 are treated utilizing French Drain within the median
along a super-elevated segment.

Stormwater runoff from the remainder of the mainline corridor within this system drains to 8 roadside swales, currently under construction, that as described in the permit documentation, should provide the required water quality volume and attenuation.

Also there is an area of 5.55 acres that corresponds to the Airport Road that is considered off-site area, currently flowing toward ExPonds 1, 2, 4, 6 and 8; this area was not incorporated into the required water quality volume, however it was included in the water quantity analysis in the AdICPR model.

7.6.2 Pre-Development Modeling Results

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix G**. AdICPR model results are also included in **Appendix G**.

7.7 Post-Development Conditions Stormwater Management System

7.7.1 General Post-Development Drainage Conditions

Proposed improvements along Glades Road includes the reconfiguration of the on-off ramps to I-95, consequently, all the infield ponds are proposed to be modified and regraded to provide additional water quality and attenuation.

In the post-development condition, the stormwater runoff collected within the infields north of Glades Road will be treated and attenuated within the proposed east and west dry retention ponds, before the ultimately discharging into the Airport Canal. All three ponds are interconnected by equalizer pipes, with two separate control structures. The weir in PrPond 35-3 (west of I-95)

discharges offsite to the existing storage area, then on to the Airport Canal via an existing 60" RCP. While PrPond 35-1 (east of I-95) discharges, via drop structure, to a dry detention roadside swale flowing north to the Airport Canal.

SFWMD ERP No. 50-02713-S, Application No. 910403-6 states that the I-95 improvements were permitted with treatment provided within roadside swales along the mainline and that areas along I-95 that did not directly discharge into the treatment swales were not being treated, instead, these areas were compensated for within the proposed treatment swales by treating existing lanes.

However, the proposed design will provide treatment and attenuation of the directly connected impervious areas along the mainline. Stormwater runoff from the mainline is conveyed to five interconnected dry detention roadside swales located to the east and west of I-95 which ultimately drain to Airport Canal.

Refer to **Appendix G** for Water Quality Calculation and **Appendix E** for the Post-Development Drainage Maps.

Same as in pre-development conditions, the 5.55 acres that corresponds to the Airport Road considered offsite area, will not be treated and will remain as existing conditions. But it will be accounted for in the water quantity calculations and AdICPR routing.

The boundary condition tailwater elevation for this system will be the same tailwater used in the pre- development condition.

In conclusion, the existing dry ponds/swales adjacent to I-95 NB and SB will be re-configured and their capacity maximized, they will be strategically located at various elevations along the roadside areas. The existing french drain along the inside shoulder of I-95 was maintained as part of future improvements.

Please refer to the Post-Development Land-Use Table included in **Appendix G** for curve number calculations and area breakdowns.

7.7.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inch over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 35 for all onsite contributing basins. Refer to Water Quality Tables included in **Appendix G** for water quality treatment summary and supplemental water quality calculations.

7.7.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. All AdICPR flood routing results indicate that pre- versus post-development peak discharge criteria is met with the proposed stormwater management facilities. Refer to AdICPR flood routing reports (included in **Appendix G**) for a complete summary of results.

7.7.4 Post-Development Modeling Results

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix G**. The post-development discharge rates are less than the pre-development discharge rates for all design storm events. Refer to AdICPR Node Maximum Conditions (included in **Appendix G**) for a complete summary of maximum stages and discharge rates.

7.8 Conclusions and Recommendations

In general, the proposed System 35 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The drainage design for System 35 meets both the water quality and water quantity requirements set by the SFWMD. System 35 will provide 49.55 ac-ft. of water quality treatment volume within the dry retention ponds and roadside ditches. The required water quality treatment volume for System 35 is 10.69 ac-ft. Therefore, a surplus of 38.86 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.

- The pre-development peak discharge rate from System 35 into the Airport Canal for the 25-year-72-hour design storm event is 330.78 cfs and the post-development peak discharge rate from System 35 is 266.25 cfs. Therefore, the total 25-year-72-hour pre-development discharge is reduced by 64.53 cfs. Peak discharge values correspond to the maximum inflow into the Airport Canal.

- All proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.

8. DRAINAGE SYSTEM 36

8.1 Overview

The I-95 Express Phase 3B System 36 can be defined as the segment of the I-95 corridor from south of Spanish River Boulevard/SW 40th Street to north of El Rio Canal and it corresponds to Basins 200, construction segments 2 and 3 depicted on the ERP 50-02713-S documentation submitted to SFWMD for the ongoing construction of the Spanish River Interchange. Basin's nomenclature from the permit has been used on this section of the report.

Basin 200 contains a series of wet detention ponds all located within the infield areas between Spanish River Blvd. and El Rio Canal. The existing system consists of a series of barrier wall inlets, shoulder gutter inlets, and multiple linear dry detention swales along I-95, and dry detention ponds within the existing infield areas in the interchange ramps. The ponds and swales along I-95 and within the Ramps are interconnected to provide required attenuation and treatment. This system discharges into LWDD E-4/El Rio Canal.

Refer to **Appendix A** for the SFWMD Drainage Basin Map. System 36 serves a proposed total onsite area of 44.60 acres, 23.16 acres of which is impervious area and 21.44 acres of which is pervious area.

No modified or proposed treatment ponds along I-95 and ramps will be necessary to treat and attenuate for the proposed project improvements. Widening of the I-95 corridor will have no impact on the existing water treatment and attenuation facilities. The existing stormwater plan will provide sufficient storage capacity to attenuate the 25-year-72-hour and 100-year –24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The existing stormwater plan will keep the 10-year-24-hour maximum stages to proposed travel lane Edge of Pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages, with some exceptions noted in Section 8.7 and approved by SFWMD since post-development maximum stages are less than pre-development maximum stages.

There are no wetlands or contaminated sites within the system limits, based on a site review conducted by Environmental Scientist within the design team. This is also stated in Permit 50-02713-S (1991).

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.56 pertaining to the Broward County/Palm Beach County Line on I-95. However, for those elevations taken from the plans for project 412420-3-52-01 the vertical datum shift is identified on the key sheet and is set at (-) 1.55 to convert between NGVD 29 to NAVD 88.

8.2 Proposed Modifications from Concept Design

- Seasonal Highwater Table has been revised

8.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 36. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and South Florida Water Management District (SFWMD) permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3432, Year. 1970
- State Project No.: 93220-3422, Year. 1970
- State Project No.: 93220-3478 52, Year. 1987

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:
- Permit No. 50-02713-S Application 140828-14 (2014)
- Permit No. 50-02713-S Application 130227-11 (2014)
- Permit No. 50-02713-S Application 910403-6 (1991)

  Permit No. 88-00061-S, Year. 1988

Lake Worth Drainage District (LWDD)

- Project No. 8800763R.01

8.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was determined to be at 4.2 ft. NAVD (5.76 ft. NGVD) based on Geotechnical Data Report for Roadway and Ponds. SR-9/I-95 and Spanish River Boulevard and Yamato Road Interchange (Project no. H5105042) prepared by Terracon on August 2, 2012. For calculations purposes, SHGWT is estimated at 4.5 ft. NAVD (6.06 ft. NGVD) for this basin.

Tailwater elevation for the E-4 (El Rio) Canal is set at 2.75 ft NAVD (4.3 ft NGVD), this is the maintenance elevation taken from SFWMD Permit 50-02713-S (2013).

8.5 Floodplain

The project limits include areas within FEMA floodplain Zone AH adjacent to the east and west sides of the I-95 corridor. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRM 12099C0988F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevations vary from 9 to 10.5 feet (NAVD).

8.6 Pre-Development Conditions Stormwater Management System

8.6.1 General Pre-Development Drainage Conditions

Existing conditions correspond to the ongoing construction project for I-95 and Spanish River Boulevard Interchange improvements. The post development condition for this design-build project will be the existing condition for this project on I-95.

Within this system, the Yamato Road Interchange will be greatly changed for the proposed design-build project mentioned above. Drainage patterns will remain the same as this system will ultimately discharge into the LWDD E-4 (El Rio) Canal.

Runoff for the new interchange is collected via a series of barrier wall inlets, shoulder gutter inlets, overland. A series of roadside treatment swales/ponds collect runoff from the I-95 mainline improvements and proposed ramps providing the required water quality and attenuation as per SFWMD.

Same ponds and control structures names from the permit were used in the analysis and calculations for this system.

This system outfall into the El Rio Canal using two control outfalls control structures located at the Ponds adjacent to the canal. Same ponds and control structures names from the permit were used in the analysis and calculations for this system.

For this system, the pre-development discharge into the El Rio Canal/E-4 Canal of 1.17 cfs for Pond 13, has been obtained from the Post- development conditions on the permit.

No modified or proposed treatment ponds along I-95 and ramps will be necessary to treat and attenuate for the proposed project improvements. Widening of the I-95 corridor will have no impact on the existing water treatment and attenuation facilities. The existing stormwater plan will provide sufficient storage capacity to attenuate the 25-year-72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The existing stormwater plan will keep the 10-year-24-hour maximum stages to proposed travel lane Edge of Pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages, with some exceptions noted in Section 5.7 and approved by SFWMD since post-development maximum stages are less than pre-development maximum stages.

There are not wetlands or contaminated sites within the system limits, based on a site review conducted by Environmental Scientist within the design team. This is also stated in Permit 50-02713-S (1991).

8.6.2 Pre-Development Modeling Results

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix H**. AdlCPR model results are also included in **Appendix H**.

8.7 Post-Development Conditions Stormwater Management System

8.7.1 General Post-Development Drainage Conditions

In the post-development conditions, the stormwater runoff collected within System 36 will be treated and attenuated within the existing interconnected stormwater treatment facilities. The existing interconnections between the ponds and swales will be the same as the pre-development condition, and no addition or modifications will be necessary within this system. The existing swales will provide stormwater collection and conveyance, water quality treatment and discharge attenuation prior to outfall into the El Rio Canal. System 36 will discharge to the El Rio Canal via 2 outfalls. The proposed stormwater

management facilities will provide the necessary water quality treatment volume. Refer to **Appendix H** for the Post-Development Drainage Maps.

The boundary condition tailwater elevation for this system will be the same tailwater used in the pre-development condition.

Please refer to the Post-Development Land-Use Table included in **Appendix H** for curve number calculations and area breakdowns.

8.7.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inches over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 36 for all onsite contributing basins. Refer to Water Quality Tables included in **Appendix H** for water quality treatment summary and supplemental water quality calculations.

8.7.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. The AdICPR flood routing results indicate that the post-development discharge rate is equal to the pre-development discharge rate for the 10 Yr and the 100 Yr storm events, however the 25 Yr storm event post development discharge rate is slightly higher (by 0.03 cfs) than the pre-development discharge rate. This deficiency is made up for within Drainage System 37, see discussion in Section 8.7 below. Refer to AdICPR flood routing reports (included in **Appendix H**) for a complete summary of results.

8.7.4 Post-Development Modeling Results

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix H**. The post-development discharge rates are slightly higher during the 25 Yr design storm evet as described in Section 8.6.3 and Section 8.7. Refer to AdICPR Node Maximum Conditions (included in **Appendix H**) for a complete summary of maximum stages and discharge rates.

8.8 Conclusions and Recommendations

In general, the proposed System 36 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The conceptual drainage design for System 36 meets the water quality requirements set by the SFWMD. System 36 will provide 21.76 ac-ft. of water quality treatment volume within the dry detention ponds and roadside ditches. The required water quality treatment volume for System 36 is 6.14 ac-ft. Therefore, a surplus of 15.62 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.

- The total pre-development peak discharge rate from System 36 into the El Rio Canal/E-4 Canal for the 25-year-72-hour design storm event is 38.03 cfs and the total post-development peak discharge rate from System 36 is 38.06 cfs. Therefore, the post-development discharge rate is 0.03 cfs higher than the pre-development discharge rate. This additional discharge rate is offset by Drainage System 37 which also discharges into the El Rio Canal/E-4 Canal with a post-development discharge rate that is 0.85 cfs less than the pre-development rate as described in Section 9.

- All proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.

- All proposed swales/ponds either contain the 25-year-72-hour and 100-year-24-hour maximum stages, the exceptions, which do not contain the maximum stages, still result in a reduction (improvement) compared with the existing 25-year-72-hour maximum stages.

9. DRAINAGE SYSTEM 37

9.1 Overview

The I-95 Express Phase 3B System 37 can be defined as the segment of the I-95 corridor from south of El Rio Canal to North of the Yamato Interchange and it corresponds to Basins 300 on Segment 2, and Basin 300 on Segment 3. The nomenclature used on the SFWMD ERP No.50-02713-S, Application No. 140828-14 has been used on this report section. (Refer to Back-up Documentation on **Appendix I**).

The existing system consists of multiple linear dry detention and conveyance swales and dry detention ponds within the infield areas within the Yamato Road Interchange that ultimately discharges to the LWDD E-4 (El Rio) Canal via several existing outfall structures. The system is located within the LWDD and SFWMD jurisdiction. Refer to **Appendix A** for the SFWMD Drainage Basin Map. System 37 serves a proposed total onsite area of 89.75 acres, 46.89 acres of which is impervious area and 42.86 acres of which is pervious area.

For System 37, no modification of the existing stormwater management system is required to accommodate the new widening of the corridor. The existing stormwater plan will provide water quality treatment within this section of the I-95 corridor and sufficient storage capacity to attenuate the 25-year-72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The existing stormwater plan will still limit the 10-year-24-hour maximum stages to proposed travel lane Edge of Pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages.

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system, the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.56 pertaining to the Broward County/Palm Beach County Line on I-95. However, for those elevations taken from the plans for project 412420-3-52-01 the vertical datum shift is identified on the key sheet and is set at (-) 1.55 to convert between NGVD 29 to NAVD 88.

9.2 Proposed Modifications from Concept Design

- Seasonal Highwater Table has been revised

9.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 37. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and South Florida Water Management District (SFWMD) permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3432, Year. 1970
- State Project No.:93220-3422, Year. 1970
- State Project No.: 93220-3478 52, Year. 1987

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Permit No. 50-02713-S Application 140828-14 (2014)
- Permit No. 50-02713-S Application 130227-11 (2014)
- Permit No. 50-02713-S Application 910403-6 (1991)
- Permit No. 88-00061-S, Year. 1988

Lake Worth Drainage District (LWDD)

- Project No. 8800763R.01

9.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was determined to be at 4.2 ft. NAVD (5.76 ft. NGVD) based on Geotechnical Data Report for Roadway and Ponds. SR/I-95 and Spanish River Boulevard and Yamato Road Interchange (Project no. H5105042) prepared by Terracon on August 2, 2012. For calculations purposes, SHGWT is estimated at 4.5 ft. NAVD (6.06 ft. NGVD) for this basin.

Tailwater elevation for the E-4 (El Rio) Canal is set at 2.75 ft NAVD (4.3 ft NGVD), this is the maintenance elevation taken from SFWMD Permit 50-02713-S (2013).

9.5 Floodplain

The project limits include areas within FEMA floodplain Zone AH adjacent to the east and west sides of the I-95 corridor. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRM 12099C0988F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevations vary from 9 to 10.5 feet (NAVD).

9.6 Pre-Development Conditions Stormwater Management System

9.6.1 General Pre-Development Drainage Conditions

This system is included in a design-build project currently being constructed which contains Spanish River Boulevard and Yamato Road. The post development condition for this design-build project will be the existing condition for this project on I-95.

Within this system, the Yamato Road Interchange will be greatly changed for the proposed design-build project mentioned above. Drainage patterns will remain the same as this system will ultimately discharge into the LWDD E-4 (El Rio) Canal.

Most the treatment for the new interchange and I-95 will take place in new infield ponds, mainly collecting runoff from the proposed off-ramp and northbound lanes.

Runoff for the new interchange is collected via a series of barrier wall inlets, shoulder gutter inlets, overland. A series of roadside treatment swales/ponds collect runoff from the I-95 mainline improvements and proposed ramps providing the required water quality and attenuation as per SFWMD.

Same ponds and control structures names from the permit were used in the analysis and calculations for this system.

This system outfalls into the El Rio Canal using several control structures. Ponds treating runoff from the corridor outfall to the canal via control structures located at the ponds adjacent to the canal. Same ponds and control structures names from the permit were used in the analysis and calculations for this system.

Proposed treatment ponds along I-95 will not be modified, only the front slope of swale I-95 Ramp D and Pond 16B shall have to be slightly regraded to accommodate proposed project improvements, still, the pond/swales capacities won't be affected, therefore widening of the I-95 corridor will have no impact on

the existing water treatment and attenuation facilities. The existing stormwater plan will provide sufficient storage capacity to attenuate the 25-year-72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The existing stormwater plan will keep the 10-year-24-hour maximum stages to proposed travel lane Edge of Pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages.

9.6.2 Pre-Development Modeling Results

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix I**. AdICPR model results are also included in **Appendix I**.

9.7 Post-Development Conditions Stormwater Management System

9.7.1 General Post-Development Drainage Conditions

In the post-development conditions, the stormwater runoff collected within System 37 will be treated and attenuated within the existing interconnected stormwater treatment facilities. The existing interconnections between the ponds and swales will be the same as the pre-development condition, and no addition or modifications except for some front slope minor regrading will be necessary within this system. The boundary condition tailwater elevation for this system will be the same tailwater used in the pre-development condition. The existing swales will provide stormwater collection and conveyance, water quality treatment and discharge attenuation prior to outfall into the El Rio Canal. System 37 will discharge to the El Rio Canal via 2 outfalls. The proposed stormwater management facilities will provide the necessary water quality treatment volume and limit the peak discharge rate into the El Rio Canal to the pre-development peak discharge rate. Refer to **Appendix E** for the Post-Development Drainage Maps.

Please refer to the Post-Development Land-Use Table included in **Appendix I** for curve number calculations and area breakdowns.

9.7.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inches over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 37 for all onsite contributing basins. Refer to Water Quality Tables included in **Appendix I** for water quality treatment summary and supplemental water quality calculations.

9.7.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. All AdICPR flood routing results indicate that pre- versus post-development peak discharge criteria is met with the proposed stormwater management facilities. Refer to AdICPR flood routing reports (included in **Appendix I**) for a complete summary of results.

9.7.4 Post-Development Modeling Results

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix I**. The post-development discharge rates are less than the pre-development discharge rates for all design storm events. Refer to AdICPR Node Maximum Conditions (included in **Appendix I**) for a complete summary of maximum stages and discharge rates.

9.8 Conclusions and Recommendations

In general, the proposed System 37 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The conceptual drainage design for System 37 meets both the water quality and water quantity requirements set by the SFWMD. System 37 will provide 40.31 ac-ft. of water quality treatment volume within the dry detention ponds/swales within the area impacted by the new widening of I-95. The required water quality treatment volume for System 37 is 9.77 ac-ft. Therefore, a surplus of -30.54 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.
- The total pre-development peak discharge rate from System 37 into the El Rio Canal/E-4 Canal for the 25-year-72-hour design storm event is 63.05 cfs and the post-development peak discharge rate from system 37 is 62.20 cfs. Therefore, the total 25-year-72-hour pre-development discharge is reduced by 0.85 cfs.
- All proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.
- All proposed swales/ponds either contain the 25-year-72-hour and 100-year-24-hour maximum stages

10. DRAINAGE SYSTEM 38

10.1 Overview

The I-95 Express Phase 3B System 38 can be defined as the segment of the I-95 corridor from north of the Yamato Interchange to north of the L-40 Canal and additional 1700 ft on the southbound side north of the L-40. This System corresponds to Basins 400 on Segment 4. The nomenclature used on the SFWMD ERP No.50-02713-S, Application No. 140828-14 used on this report section (Refer to Back-up Documentation on **Appendix J**).

The existing system consists of multiple linear dry detention swales along both sides of the I-95. The system is located within the C-15 Canal Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. System 38 serves a proposed total onsite area of 38.55 acres, 28.92 acres of which is impervious area and 9.63 acres of which is pervious area. 2.83 acres will not be treated in Basin 38 (0.33 acres of impervious and 2.50 acres of pervious).

For System 38, the existing dry detention swales along both sides of the I-95 will be modified to accommodate the new widening of the corridor and provide the required water quality treatment and water quantity discharge attenuation in accordance with SFWMD criteria.

The proposed stormwater plan will not only enhance water quality treatment within this section of the I-95 corridor, but will also provide sufficient storage capacity to attenuate the 25-year-72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The proposed stormwater plan will limit the 10-year-24-hour maximum stages to proposed travel lane Edge of Pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages, with some exceptions noted in Section 5.7 and approved by SFWMD since post-development maximum stages are less than pre-development maximum stages.

There are not wetlands or contaminated sites within the system limits, based on a site review conducted by Environmental Scientist within the design team. This is also stated in Permit 50-02713-S (1991).

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.56 pertaining to the Broward County/Palm Beach County Line on I-95. However, for those elevations taken from the plans for project 412420-3-52-01 the vertical datum shift is identified on the key sheet and is set at (-) 1.55 to convert between NGVD 29 to NAVD 88.

10.2 Proposed Modifications from Concept Design

- Seasonal Highwater Table has been revised
- Revised berm elevations for all three ponds
- Proposed ponds no longer inter-connected
- Replacement of Clint Moore Bridge included in design

10.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 38. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and SFWMD permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3460/3445, Year. 1990
- State Project No.: 93220-3460/1445, Year. 1988

- Construction Plans – Exhibits- Application No 140828-14

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Permit No. 50-02713-S, Application 140828-14, Year. 2014
- Permit No. 50-02713-S, Application 130227-11, Year. 2014
- Permit No. 50-02713-S, Application 910403-6, Year. 1991
- Permit No. 50-04369-P, Year. 2003, Year. 1991

10.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was determined to be at EL 5.5 ft. NAVD (7.05 ft. NGVD) based on the Drainage Design Documentation for I-95 and Spanish River Boulevard Interchange Improvements prepared by FDOT D4 on July 2015. For the calculations the SHGWT was taken at 6.0 ft. NAVD (7.55 ft. NGVD).

Tailwater elevation for the L-40 canal varies from 6.95 ft. NAVD (8.50 ft. NGVD) to 7.45 ft. NAVD (9.00 ft. NGVD) based on DBHYDRO Station S40_H. This information was also provided on ICPR models for I-95 and Spanish River Boulevard Interchange Improvements (I-95-Segment 4) prepared on July 2015 by FDOT D4.

10.5 Floodplain

The project limits include areas within FEMA floodplain Zone AH adjacent where the I-95 corridor crosses the L-40 Canal. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRMs 12099C0987F and 12099C0989F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevation is 11 feet (NAVD).

10.6 Clint Moore Bridge System

Clint Moore bridge is proposed to be replaced as part of the 3B-2 project. The total drainage area at the bridge is 11.85 acres (8.88 acres impervious and 2.96 acres pervious). The existing drainage system discharges, without treatment, into adjacent pervious areas within the right-of-way.

The proposed improvements do not add additional impervious area to Clint Moore bridge. Therefore, the proposed drainage system will also discharge, without treatment, into adjacent pervious areas within the right-of-way.

10.7 Pre-Development Conditions Stormwater Management System

10.7.1 General Pre-Development Drainage Conditions

This system is included in a design-build project currently being constructed which contains Spanish River Boulevard and Yamato Road. The pre-development condition for this design-build project will be the existing condition for this project on I-95. The following outlines the expected treatment from that design build project.

Within this system, the runoff ultimately makes its way to the L-40 Canal under the jurisdiction of the Lake Worth Drainage District (LWDD).

System 38 is located within the SFWMD Hillsboro Canal Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. Runoff from the northbound travel lanes of I-95, south of Clint Moore Road, flow into an existing conveyance roadside swale located along the east side of I-95. About 500 ft. south of Clint Moore Road, a cross-drain pipe, moves the water from the east side to the west side of I-95. North of Clint Moore Road and west of I-95, runoff continues through a dry retention swale, to the L-40 Canal. Runoff, from the southbound travel lanes, flow into this swale mixing with the water from the east side. A control structure located west of the canal controls the overflow from the retention swale into the L-40 Canal.

Runoff from the I-95 northbound lanes, north of Clint Moore Road, flow into a dry retention swale, on the east side of I-95. A second control structure OCS-18, at the north end of the swale controls the outfall from the retention swale into the L-40 Canal.

In addition, to the area from north of the Yamato Interchange to the L-40 Canal there is a segment about 1700 ft north of the L-40 Canal where southbound travel lanes also discharge into the L-40 Canal. This segment flows into a retention swale with a third control structure, also outfalling into the L-40 Canal.

Details for the outfall control Structures were obtained from the latest set of plans released for construction for Segment 4 (Refer to Backup documentation on **Appendix J**).

10.7.2 Pre-Development Modeling Results

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix J**. AdICPR model results are also included in **Appendix J**.

10.8 Post-Development Conditions Stormwater Management System

10.8.1 General Post-Development Drainage Conditions

In the post-development conditions, the stormwater runoff collected within System 38 will be treated and attenuated within three proposed dry retention swale system. The swales will provide stormwater collection and conveyance, water quality treatment and discharge attenuation prior to outfall into the L-40 Canal. System 38 will discharge to the L-40 Canal via 3 outfalls. The proposed stormwater management facilities will provide the necessary water quality treatment volume and limit the peak discharge rate into the L-40 Canal to the pre-development peak discharge rate. Refer to **Appendix E** for the Post-Development Drainage Maps.

A series of 3 control structures are proposed within System 38 to regulate discharge to the L-40 Canal. The proposed control structures consist of three raised ditch bottom inlets type D with 24-inch RCP outfall pipes. The boundary condition tailwater elevation for this system will be the same tailwater used in the pre-development condition.

Please refer to the Post-Development Land-Use Table included in **Appendix J** for curve number calculations and area breakdowns.

10.8.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inches over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 38 for onsite contributing basins. Refer to Water Quality Tables included in **Appendix J** for water quality treatment summary and supplemental water quality calculations.

10.8.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. All AdICPR flood routing results indicate that pre-versus post-development peak discharge criteria is met with the proposed stormwater management facilities. Refer to AdICPR flood routing reports (included in **Appendix J**) for a complete summary of results.

10.8.4 Post-Development Modeling Results

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix J**. The post-development discharge rates are less than the pre-development discharge rates for all design storm events. Refer to AdICPR Node Maximum Conditions (included in **Appendix J**) for a complete summary of maximum stages and discharge rates.

10.9 Conclusions and Recommendations

In general, the proposed System 38 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The conceptual drainage design for System 38 meets both the water quality and water quantity requirements set by the SFWMD. System 38 will provide 4.69 ac-ft. of water quality treatment volume within the dry retention ponds and roadside ditches. The required water quality treatment volume for System 38 with credits applied is 2.74 ac-ft. Therefore, a surplus of 1.95 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.
- The total pre-development peak discharge rate from System 38 into the L-40 Canal for the 25- year-72-hour design storm event is 76.95 cfs and the total post-development peak discharge rate from System 38 is 57.63 cfs. Therefore, the total 25-year-72-hour pre-development discharge is reduced by 19.32 cfs.

- All proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.

- All proposed ponds either contain the 25-year-72-hour and 100-year-24-hour maximum stages.

11. DRAINAGE SYSTEM 39

11.1 Overview

The I-95 Express Phase 3B System 39 is defined as the segment of the I-95 corridor from the L-40 Canal to the C-15 Canal and west to Access Road, and west of I-95 along Peninsula Corp. Drive to Congress Avenue and the Park and Ride parking lot. The existing system consists of linear dry detention swales along the east side of I-95 and offsite wet detention ponds north and south of Peninsula Corp. Drive. The system ultimately discharges to the C-15 Canal via an existing control structure. The system is located within the C-15 Drainage Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. System 39 serves a proposed total onsite area of 33.52 acres, 23.35 acres of which is impervious area and 10.17 acres of which is pervious area.

For System 39, the existing dry detention swales on the east side of I-95 will remain as existing and the downstream control structure weir elevation will be modified in order to provide the required water quality treatment volume and peak discharge rate attenuation in accordance with SFWMD criteria.

The proposed stormwater plan will not only enhance water quality treatment within this section of the I-95 corridor but will also provide sufficient storage capacity to attenuate the 25-year72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The proposed stormwater plan will limit the 10-year-24-hour maximum stages to proposed travel lane edge of pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages.

There are approximately 78 SY of wetland impacts located at the upstream end of 24” cross-drain at L-40 Canal and approximately 208 SY of wetland impacts due to the widening of the SB side of the C-15 Canal Bridge.

No contaminated sites within the system limits, based on a site review conducted by environmental scientists within the design team. This statement is also supported in SFWMD ERP No. 50-02713-S.

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.56 pertaining to the Broward County/Palm Beach County Line on I-95.

11.2 Proposed Modifications from Concept Design

- Seasonal Highwater Table has been revised
- Reduced offsite area draining from Peninsula Corp Drive
- Lowered proposed weir elevation

11.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 39. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and South Florida Water Management District SFWMD permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3460/3445, Year - 1990
- State Project No.: 93220-3460/1445, Year - 1988
- Drainage design documentation for Segment 4, FPN 412420-3-52-01, FAP# 0951-64-1-I, July 2015

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Permit 50-02713-S, Application 140828-14, Year - 2014
- Permit 50-02713-S, Application 130227-11, Year - 2014
- Permit 50-02713-S, Application 910403-6, Year - 1991
- Permit 50-04369-P, Year - 2003

11.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was set at EL 6.94 ft NAVD (8.5 ft NGVD) to match the water surface elevation for the C-15 Canal.

The water surface elevation for the C-15 Canal is 6.94 ft. NAVD (8.5 ft. NGVD), which the maintained elevation of the canal shown in SFWMD Permit No. 50-02713-S.

11.5 Floodplain

The project limits include areas within FEMA floodplain Zone AH adjacent to where the I-95 corridor crosses the L-40 Canal and the C-15 Canal. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRM

12099C0987F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevation at L-40 Canal is 11 feet (NAVD). The approximate Zone AH, 100- year base flood elevation at C-15 Canal is 9 feet (NAVD).

11.6 Pre-Development Conditions Stormwater Management System

11.6.1 General Pre-Development Drainage Conditions

The following system description includes only system information shown in the permit and as-builts plans mentioned above. Current conditions of this system are different due to siltation and weathering over time.

System 39 is located within the SFWMD C-15 Canal Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. Within this system, stormwater runoff ultimately drains to the SFWMD C-15 Canal. Runoff is collected and conveyed via a closed stormwater collection system and routed into two existing interconnected wet detention ponds named ExPond 39-4 and ExPond 39-6 (Pond A and B respectively, based on documentation for Permit No. 50- 02713-S). These existing ponds provide water quality treatment of runoff prior to discharge into the C-15 Canal. This System also includes the area west of I-95 comprised of the access road along Peninsula Corp. Drive up to Congress Avenue and the Park and Ride parking lot. A 60-inch pipe crossing underneath I-95 conveys the stormwater from this section of the system and discharges it into ExPond 39-6, south of the C-15 Canal.

ExPond 39-4 and ExPond 39-6 are wet detention ponds and both are located on the east side of I-95, south of the C-15. The ponds are connected via a 72-inch pipe and have a control structure at the north end of Pond B comprised of a type K inlet with a control elevation at elevation 7.57 ft. NAVD (9.1 ft. NGVD) and two 48-inch RCP outfalls that discharge stormwater into the C-15 Canal. The pond bottoms are at elevation 4.47 ft. NAVD (6 ft. NGVD), and the tops of bank elevations are at 12.47 ft. NAVD (14 ft. NGVD). Based on the permit, the ponds provide a total water quality volume of 4.62 ac-ft. and the existing discharge is 387.86 cfs.

11.6.2 Pre-Development Modeling Results

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix K**. AdlCPR model results are also included in **Appendix K**.

11.7 Post-Development Conditions Stormwater Management System

11.7.1 General Post-Development Drainage Conditions

In the post-development condition, the stormwater runoff collected within System 39 will be treated and attenuated within the existing interconnected wet detention ponds, ExPond-4 and ExPond 39-6, south of the C- 15 Canal. The existing interconnections between the ponds and swales will be similar to the pre-

development condition. The ponds will provide water quality treatment and discharge attenuation prior to outfall into the C-15 Canal. System 39 will discharge to the C-15 Canal via the existing outfall; however,

the control structure will be modified to have an elevation at the inlet grate of 9.0 ft. NAVD (10.56 ft. NGVD) and a v-notch bleeder with an invert elevation set at the C-15 Canal water surface elevation as per original condition. This modification will provide the required water quality treatment volume and peak discharge rate attenuation for the proposed improvements within the system. Refer to **Appendix E** for the Post-Development Drainage Maps.

The boundary condition tailwater elevation for this system is the same tailwater used in the pre-development condition.

Please refer to the Post-Development Land-Use Table included in **Appendix K** for curve number calculations and area breakdowns.

11.7.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inch over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 39 for all onsite contributing basins. Refer to Water Quality Tables included in **Appendix K** for water quality treatment summary and supplemental water quality calculations.

11.7.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. All AdICPR flood routing results indicate that pre- versus post-development peak discharge criteria is met with the proposed stormwater management facilities. Refer to AdICPR flood routing reports (included in **Appendix K**) for a complete summary of results.

11.7.4 Post-Development Modeling Results

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix K**. The post-development discharge rates are less than the pre-development discharge rates for all design storm events. Refer to AdICPR Node Maximum Conditions (included in **Appendix K**) for a complete summary of maximum stages and discharge rates.

11.8 Conclusions and Recommendations

In general, the proposed System 39 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The conceptual drainage design for System 39 meets both the water quality and water quantity requirements set by the SFWMD. System 39 will provide 13.95 ac-ft. of water quality treatment volume within the dry detention ponds and roadside ditches. The required water quality treatment volume for System 39 is 4.86 ac-ft. Therefore, a surplus of 9.09 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.

- The pre-development peak discharge rate from System 39 into the C-15 Canal for the 25-year-72-hour design storm event is 174.39 cfs and the post-development peak discharge rate from System 39 is 166.97 cfs. Therefore, the total 25-year-72-hour pre-development discharge reduction amounts to 7.42 cfs.

- All proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.

- All proposed ponds either contain the 25-year-72-hour and 100-year-24-hour maximum stages.

12. DRAINAGE SYSTEM 40

12.1 Overview

The I-95 Express Phase 3B System 40 is defined as the segment of the I-95 corridor from the C-15 Canal to approximately 3000 ft. north of the C-15 Canal. The existing system consists of a closed storm sewer system collecting and conveying runoff from the roadway toward the grassed areas at both sides of I-95. There is one existing dry retention pond adjacent to the northbound travel lanes which outfalls to the C-15 Canal. The system is located within the C-15 Canal Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map.

System 40 serves a proposed total onsite area of 30.89 acres, 13.76 acres of which is impervious area and 17.13 acres of which is pervious area.

For System 40, the existing swale on the west side of I-95 will be modified to a new dry retention ditch that will complement the existing dry retention pond on the east side and provide additional water quality treatment and peak discharge rate attenuation.

The proposed stormwater plan will not only enhance water quality treatment within this section of the I-95 corridor, but will also provide sufficient storage capacity to attenuate the 25-year-72-hour and 100-year-24-hour design storm events and maintain or reduce pre-development discharges to offsite waterbodies. The proposed stormwater plan will limit the 10-year-24-hour maximum stages to proposed travel lane edge of pavement (EOP) elevations, as well as contain the 25-year-72-hour and 100-year-24-hour maximum stages.

There is approximately 208 SY of wetland impacts due to the widening of the SB side of the C-15 Canal Bridge.

No contaminated sites within the system limits, based on a site review conducted by environmental scientists within the design team.

The datum shift was identified by using the National Geodetic Survey VERTCON online tool. For this system the datum shift used to convert NGVD 29 to NAVD 88 is (-) 1.53 pertaining to the I-95 at Linton Boulevard.

12.2 Proposed Modifications from Concept Design

- Seasonal Highwater Table has been revised
- ExPond 40-3 (now PrPond 40-3) proposed to be enlarged
- PrDitch 40-1 (now PrPond 40-1) proposed to be interconnected with PrPond 40-3

12.3 Background

Various regulatory agencies were contacted to identify readily available data for the segment of the I-95 corridor within System 40. This data, in addition to the topographic survey, was used to develop base maps and assist in establishing the pre-development and post-development hydrologic and hydraulic conditions. The data collection process includes obtaining information regarding existing drainage features within the I-95 corridor and the adjacent areas from survey, record drawings, and SFWMD permits. The agencies contacted and the information obtained is summarized below:

Florida Department of Transportation (FDOT)

FDOT existing plans, as-builts, and available drainage reports were obtained and used to establish existing drainage conditions within this segment of I-95. The data collected from FDOT includes the following plans/record drawings:

- State Project No.: 93220-3503, Year - 2002
- State Project No.: 93220-3424, Year - 1970
- State Project No.: 93220-3406-3445, Year - 1990

South Florida Water Management District (SFWMD)

Existing SFWMD permits were obtained and used to establish existing drainage conditions within this section of the I-95 corridor. Data collected from SFWMD includes:

- Permit 50-02713-S, Year - 1991
- Permit 50-04369-P, Year - 2003

12.4 Seasonal High Groundwater Table and Tailwater Elevations

The Seasonal High Groundwater Table (SHGWT) was set at EL 6.94 ft NAVD (8.5 ft NGVD) to match the water surface elevation for the C-15 Canal.

The water surface elevation for the C-15 Canal is 6.94 ft. NAVD (8.5 ft. NGVD), which the maintained elevation of the canal shown in SFWMD Permit No. 50-02713-S.

12.5 Floodplain

The project limits include areas within FEMA floodplain Zone AH adjacent to where the I-95 corridor crosses the Canal. Zone AH designates flood hazard areas inundated by 100-year flood. Specific information about the Flood Insurance Rate maps (FIRMs) can be found on FIRM 12099C0987F included in **Appendix B** of this report. The approximate Zone AH, 100- year base flood elevation at C-15 Canal is 9 feet (NAVD).

12.6 Pre-Development Conditions Stormwater Management System

12.6.1 General Pre-Development Drainage Conditions

The following system description includes only system information shown in the permit and as-builts plans mentioned above. Current conditions of this system are different due to siltation and weathering over time.

System 40 is located within the SFWMD C-15 Canal Basin. Refer to **Appendix A** for the SFWMD Drainage Basin Map. In this system, the runoff ultimately drains to the SFWMD C-15 Canal. The stormwater runoff from the outer northbound travel lanes and from the median is collected and conveyed via a closed stormwater system that discharges into an existing dry pond east of the roadway. The pond has a control structure located north of the C-15 Canal with a weir elevation of 8.70 ft. NAVD (10.26 ft. NGVD) and a 36-inch RCP. The pond provides a water quality treatment volume of 3.63 Ac-ft. Similarly, runoff from the southbound I-95 travel lanes is collected and conveyed via a closed stormwater system that discharges into the roadside swale/ditch adjacent to the southbound travel lanes.

An existing 48-inch cross-drain located approximately 2000 ft. north of the C-15 Canal connects a west off-site area (5.35 Ac) and the west swales to a ditch that runs parallel to the dry pond adjacent to the northbound travel lanes; runoff from the ditch is discharged into the C-15 Canal without any water quality treatment.

Permit also shows that the allowable discharge to the C-15 is 119.49 cfs.

12.6.2 Pre-Development Modeling Results

The flood routing results for all simulated design storm events are summarized in the Drainage System Summary Tables included in **Appendix L**. AdlCPR model results are also included in **Appendix L**.

12.7 Post-Development Conditions Stormwater Management System

12.7.1 General Post-Development Drainage Conditions

In the post-development conditions, the stormwater runoff collected within System 40 will be treated and attenuated within the existing dry retention pond on the east side of I-95 and a proposed roadside dry detention ditch on the west side. The existing interconnections between the ponds and swales will be similar to the pre-development condition. The proposed ditch and existing pond will provide water quality treatment and attenuation prior to outfall into the C-15 Canal. System 40 will discharge to the C-15 Canal via a proposed control structure consisting of a raised ditch bottom inlet Type D with a 36-inch diameter

outfall pipe. The proposed stormwater management facilities will provide the necessary water quality treatment volume and limit the peak discharge rate into the C-15 Canal to the pre-development peak discharge rate. Refer to **Appendix E** for the Post-Development Drainage Maps.

The boundary condition tailwater elevation for this system is the same tailwater used in the pre-development condition.

Please refer to the Post-Development Land-Use Table included in **Appendix L** for curve number calculations and area breakdowns.

12.7.2 Post-Development Conditions Stormwater Quality Analysis

SFWMD criteria require the water quality treatment to be provided for 2.5-inches over the total onsite impervious area or 1-inch over the total onsite area, whichever is greater. Water quality treatment is proposed within System 40 for all onsite contributing basins. Refer to Water Quality Tables included in **Appendix L** for water quality treatment summary and supplemental water quality calculations.

12.7.3 Post-Development Conditions Stormwater Quantity Analysis

SFWMD requires that the post-development peak discharge rate for the 25-year-72-hour rainfall event does not exceed the pre-development peak discharge rate for the 25-year-72-hour rainfall event. All AdICPR flood routing results indicate that pre-versus post-development peak discharge criteria is met with the proposed stormwater management facilities. Refer to AdICPR flood routing reports (included in **Appendix L**) for a complete summary of results.

12.7.4 Post-Development Modeling Results

The peak discharge rates for the 10-year-24-hour, 25-year-72-hour and 100-year-24-hour storm events are shown in the Drainage System Summary Tables, included in **Appendix L.** The post-development discharge rates are less than the pre-development discharge rates for all design storm events. Refer to AdICPR Node Maximum Conditions (included in **Appendix L**) for a complete summary of maximum stages and discharge rates.

12.8 Conclusions and Recommendations

In general, the proposed System 40 stormwater management facilities meet SFWMD water quality and water quantity permit criteria. The main drainage and permitting issues, conclusions, and/or recommendations are summarized as follows:

- The conceptual drainage design for System 40 meets both the water quality and water quantity requirements set by the SFWMD. System 40 will provide 6.58 ac-ft. of water quality treatment volume within the dry detention ponds and roadside ditches. The required water quality treatment volume for System 40 is 3.46 ac-ft. Therefore, a surplus of 3.13 ac-ft. of water quality treatment volume is provided within the proposed stormwater management system.

- The pre-development peak discharge rate from System 40 into the C-15 Canal for the 25-year-72-hour design storm event is 120.65 cfs and the post-development peak discharge rate from System 40 is 100.32 cfs. Therefore, the total 25-year-72-hour pre-development discharge reduction amounts to 20.33 cfs.

- Proposed travel lane Edge of Pavement (EOP) elevations are equal to or higher than the 10-year-24-hour maximum stages.

13. PROJECT SUMMARY TABLES

Table 2A-Pre-Development Project Area Breakdown and Land Use Summary

PRE-DEVELOPMENT				
System	Impervious Area (ac)		Pervious Area (ac)	Total Area (ac)
	Roadway / Sidewalk, etc.	Wet Storage		
System 33	5.04	0.00	4.35	9.39
System 34	9.20	0.00	16.90	26.10
System 35	43.75	0.00	47.64	91.39
System 36	23.16	0.00	21.44	44.60
System 37	39.23	0.00	50.52	89.75
System 38	26.26	0.00	9.46	35.72
System 39	29.23	0.00	22.13	57.79
System 40	12.47	0.00	18.27	30.74
TOTAL	**188.34**	**0.00**	**191.40**	**385.48**

Table 2B-Post-Development Project Area Breakdown and Land Use Summary

POST-DEVELOPMENT				
System	Impervious Area (ac)		Pervious Area (ac)	Total Area (ac)
	Roadway / Sidewalk, etc.	Wet Storage		
System 33	3.02	0.00	3.47	6.49
System 34	12.45	0.00	16.92	29.37
System 35	52.77	0.00	40.49	93.26
System 36	28.07	0.00	17.89	45.96
System 37	46.89	0.00	42.86	89.75
System 38	26.26	0.00	9.46	35.72
System 39	30.84	0.00	20.51	57.78
System 40	13.76	0.00	17.13	30.89
TOTAL	**214.06**	**0.00**	**168.73**	**389.22**

Table 3-Water Quality Summary

System	Impervious Area (ac)		Pervious Area (ac)	Total Area (ac)	Water Quality Required (ac·ft)	Water Quality Provided (ac·ft)	Surplus Water Quality Provided (ac·ft)
	Roadway / Sidewalk, etc.	Wet Storage					
System 33	3.02	0.00	3.47	6.49	0.76	0.86	0.10
System 34	12.45	0.00	16.92	29.37	2.67	29.97	27.30
System 35	52.77	0.00	40.49	93.26	10.69	49.95	38.86
System 36	28.07	0.00	17.89	45.96	6.14	21.76	15.62
System 37	46.89	0.00	42.86	89.75	9.77	40.31	30.54
System 38	26.26	0.00	9.46	35.72	2.74	4.69	1.95
System 39	30.84	6.43	20.51	57.78	4.86	13.95	9.08
System 40	13.76	0.00	17.13	30.89	3.46	6.58	3.13
TOTAL	**214.06**	**6.43**	**168.73**	**389.22**	**41.09**	**168.07**	**126.58**

Table 4-Project Peak Discharges Reduction Summary*[1]

System	Receiving Water Body	PRE-DEVELOPMENT	POST-DEVELOPMENT	REDUCTION
		25-year-72-hour Peak Discharge (cfs)	25-year-72-hour Peak Discharge (cfs)	25-year-72-hour Peak Discharge (cfs)
System 33	LWDD L-46 Canal	140.68	67.93	72.75
System 34				
System 35	Airport Canal	330.78	270.64	60.14
System 36	El Rio Canal/E-4 Canal	36.89	36.89	0.00
System 37	El Rio Canal/E-4 Canal	29.99	29.17	0.82
System 38	LWDD L-40 Canal	76.95	57.63	19.32
System 39	C-15 Canal	174.39	113.27	61.12
System 40	C-15 Canal	120.65	100.32	20.33

*[1] Maximum inflow including bleeders.