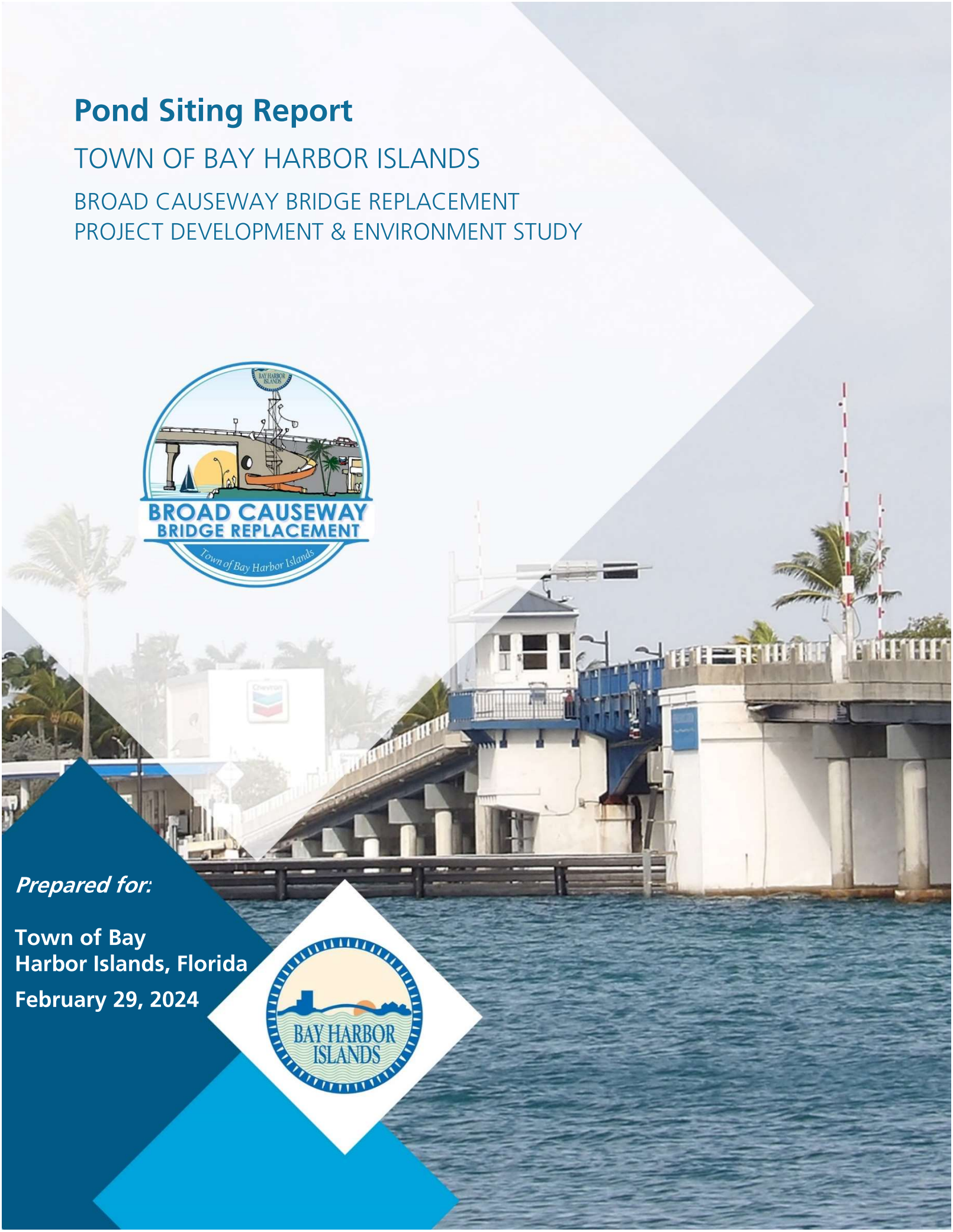
Pond Siting Report

TOWN OF BAY HARBOR ISLANDS

BROAD CAUSEWAY BRIDGE REPLACEMENT
PROJECT DEVELOPMENT & ENVIRONMENT STUDY



Prepared for:

Town of Bay Harbor Islands, Florida

February 29, 2024

Financial Project Identification Number:	452428-1-21-01
Federal-Aid Project Number:	N/A
FDOT Efficient Transportation Decision Making (ETDM) Number:	14520
Town of Bay Harbor Islands Project Number:	BC-160

Pond Siting Report

February 29, 2024

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being or have been carried out by Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. §327 and a Memorandum of Understanding dated May 26, 2022, and executed by Federal Highway Administration (FHWA) and FDOT.

Prepared for:

Town of Bay Harbor Islands

Prepared by:

AtkinsRéalis

DRAFT

POND SITING REPORT

Town of Bay Harbor Islands

In cooperation with the Florida Department of Transportation

and US Coast Guard

Financial Management Number: 452428-1-21-01

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Broad Causeway Bridge Replacement Project Development and Environment (PD&E) Study

Broad Causeway Bridge from Broad Causeway Island to East of West Broadview Drive

Miami-Dade County, Florida

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022, and executed by the Federal Highway Administration and FDOT.

For additional information, contact:

Rodney Carrero-Santana, PE, CFM, LEED AP
Town Engineer
Town of Bay Harbor Islands
9665 Bay Harbor Terrace
Bay Harbor Islands, Florida 33154
Phone: (305) 866-6241
rcarrerosantana@bayharborislands-fl.gov

Robert McMullen
Environmental Scientist
Florida Department of Transportation
1000 NW 111th Avenue
Miami, Florida 33172
Phone: (305) 470-5149
Robert.McMullen@dot.state.fl.us

PROFESSIONAL ENGINEER CERTIFICATE

I hereby certify that I am a registered professional engineer in the State of Florida practicing with AtkinsRéalis, and that I have supervised the preparation of, and approved the evaluation, findings, opinions, conclusions, and technical advice reported in:

REPORT:	Draft Pond Siting Report
PROJECT:	Broad Causeway Bridge Replacement PD&E Study
LOCATION:	Miami-Dade County, Florida
FINANCIAL MANAGEMENT NO.:	452428-1-21-01
FEDERAL PROJECT NO.:	N/A
FDOT ETDM NO.:	14520

This Pond Siting Report (PSR) contains engineering information that fulfills the purpose and need for the Broad Causeway Bridge Replacement PD&E Study from Broad Causeway Island to East of West Broadview Drive in Miami-Dade County, Florida. I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of transportation engineering as applied through professional judgment and experience.

I hereby certify that I am a registered professional engineer in the State of Florida practicing with AtkinsRéalis, and that I have prepared or approved the evaluation, findings, opinions, conclusions, or technical advice for this project.

This item has been digitally signed and sealed by *Rick Renna* on the date adjacent to the seal.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

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EXECUTIVE SUMMARY

This project will replace the aging Broad Causeway Bridge over the Intercoastal Waterway (ICWW), connecting the Town of Bay Harbor Islands (Town) with the City of North Miami, within Miami-Dade County. No additional lanes are proposed but a high-level, fixed bridge will be constructed where opposing traffic will be separated, with shoulders and a wider shared use path will be provided, as shown in the figure below:

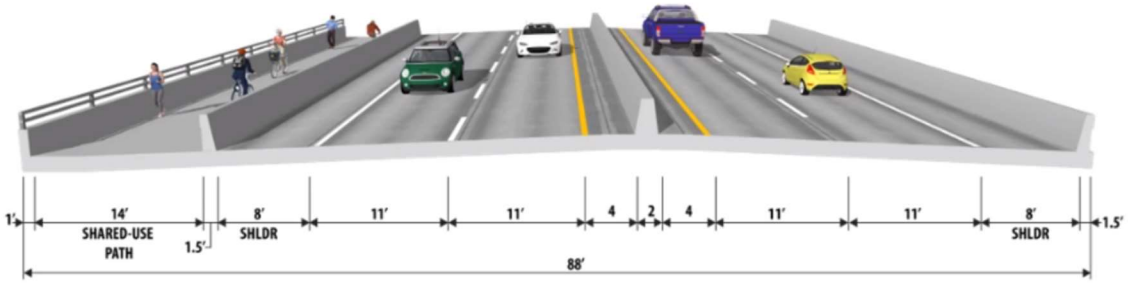

Figure ES- 1: Typical Section of the Proposed Broad Causeway Bridge

The bridge is part of Broad Causeway, a roadway classified as "Urban Minor Arterial". The existing bridge consists of four 10 ft travel lanes, undivided (two in each direction), without a raised median. The outside travel lanes include shared-use markings to denote the accommodation of bicycles. In addition, a raised sidewalk is present on each side of the bridge, with a width that varies from 22 to 36 inches.

Figure ES- 2: Project Location Map

The purpose of this Pond Siting Report is to establish preferred drainage concepts and general stormwater pond site sizes within the three areas of the project.

The project discharges to the Biscayne Bay Aquatic Preserve, within the South Florida Water Management District (SFWMD) jurisdiction, the regional water management district. Biscayne Bay Aquatic Preserve is designated as an Outstanding Florida Water (OFW). It is designated by the Florida Department of Environmental Protection (FDEP) as "Waters Not Attaining Standards" and is therefore considered a verified impaired waterbody.

Based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), the project area has no FEMA Floodways. The entire project lies within the 100-year

floodplain. Because the FEMA floodplains on this project are driven entirely by storm surge through Biscayne Bay, fill placed as part of this project will have no impact on the floodplain elevations. If the SFWMD requires demonstration of this relationship between project fill and the floodplain elevation, pre- and post-development storm surge modeling will be presented to verify this concept.

In an interview with Jason Atkinson, former Director of Public Works, Town of Bay Harbor Islands, on December 14, 2023, Mr. Atkinson stated that (1) flooding from king tides is not highly significant at the project site but gets worse further north of the Broad Causeway Bridge east touch down, and (2) the Town is not having problems in the project area though problems occur further northward on the West Island. However, the drainage systems on the island are occasionally inundated by tidal backflow from Biscayne Bay. Future seal level rise is expected to exacerbate "sunny day" flooding events.

The proposed project will require securing an Environmental Resource Permit (ERP) through the SWFWMD to meet requirements in Chapter 62-346, F.A.C. Construction activities will also require the development of a Stormwater Pollution Prevention Plan (SWPPP) and proper coordination for National Pollutant Discharge Elimination System (NPDES) requirements.

Additionally, a parallel permit will be required from the Miami-Dade County Department of Environmental Management (DERM).

Because the entire project is in tidal water where peak stages are controlled by storm surge, no attenuation of the peak discharge is required.

Since the entire project lies within the Biscayne Bay Aquatic Preserve, an OFW, treatment volumes are increased by 150%. Since the Biscayne Bay Aquatic Preserve is impaired, a pre/post nutrient analysis was developed using BMPTRAINS.

There are no regional cross drains on this project, and the hydraulics of the Broad Causeway Bridge over the ICWW, will be evaluated in the BHR during the design phase.

All green areas within the Causeway Island, except for proposed recreational areas in the northeastern portion of the Causeway Island, will be used for retention ponds. The final details of the recreational usage are being resolved with the Town. Since the spatial area of the island is fixed, available pond storage will be determined by the elevations of the island's roadways and perimeter overflow elevations, as shown in the figure below:

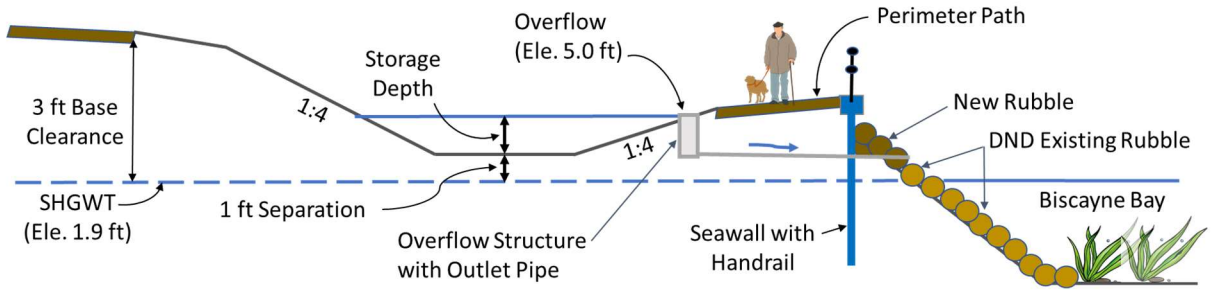

Figure ES- 3: Vertical Storage Controls on the Causeway Island

In addition to the retention ponds located on the Causeway Island, a small retention pond will be constructed, at the southeast corner of the bridge, on land currently owned by the Town. The roadway east of the bridge, west of the existing W. Broadview Drive intersection, is too low to store runoff in this retention pond or in French drains and will therefore be directly discharged in the proposed condition, even as occurs currently.

Water quality treatment volumes required, and volumes provided in the retention ponds are tabulated below:

Table ES- 1: Summary of Treatment Volumes Required and Provided

Project Treatment Volumes (ac-ft)			
Location	**Required (ac-ft)**	**Provided (ac-ft)**	**Provided (in)**
Causeway Island	1.35	4.83	4.10
West Island	0.51	0.14	0.50
Total Project	1.85	4.97	3.40

The annual predevelopment nutrient loadings, and post development loadings with the retention ponds in place, were compared using BMPTRAINS, with results tabulated below:

Table ES- 2: Existing and Proposed Annual Nutrient Loadings

Project Annual Loadings (kg/yr)						
Location	**TN**			**TP**		
	Existing	**Proposed**	**Reduction**	**Existing**	**Proposed**	**Reduction**
Causeway Island	24.17	2.44	90%	3.18	0.32	90%
West Island	20.86	8.53	59%	2.75	1.12	59%
Total Project Treatment Volume:	45.03	10.97	76%	5.93	1.44	76%

Water quality storage on the island may be reduced by a historical underground contamination plume associated with the aged gas station on the island. Future discussions with the SFWMD and DERM will resolve any required separation between the pond storage areas and the underground contamination plume. If the Causeway Island's water quality storage is reduced below that which is required by the SFWMD, compensatory water quality treatment will be sought within the Biscayne Bay watershed.

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ACRONYMS AND ABBREVIATIONS

A	AADT	Average Annual Daily Traffic
	AASHTO	American Association of State Highway and Transportation Officials
	ACM	Asbestos Containing Materials
	ADA	Americans with Disabilities Act
	AET	All-Electric Tolling
	ALPR	Automated License Plate Reader
	APE	Area of Potential Effect
B	BBAP	Biscayne Bay Aquatic Preserve
	BEBR	Bureau of Economic and Business Research
	BMPs	Best Management Practices
C	CCTV	Closed-Circuit Television
	CEQ	Council on Environmental Quality
	CH	Critical Habitat
	CFR	Code of Federal Regulations
	CIDR	Comprehensive Inventory Data Report
	CIP	Capital Improvements Program
	CCTV	Closed-Circuit Television
	CO	Carbon Monoxide
D	3D	Three Dimensional
	D	Directional
	DERM	Miami-Dade County Division of Environmental Resource Management
	DHT	Design Hour Truck
	DMS	Dynamic Message Sign
	DTPW	Department of Transportation and Public Works
	DRER	Department of Regulatory Environmental Resources
E	EA	Environmental Assessment
	EAA	Expedited Administrative Authorization
	EFH	Essential Fish Habitat

	EL	Elevation
	ERP	Environmental Resource Permit
	EST	Environmental Screening Tool
	ETAT	Environmental Technical Advisory Team
	ETDM	Efficient Transportation Decision Making
F	F.A.C.	Florida Administrative Code
	FEMA	Federal Emergency Management Agency
	FDACS	Florida Department of Agriculture and Consumer Services
	FDEM	Florida Department of Emergency Management
	FDEO	Florida Department of Economic Opportunity
	FDEP	Florida Department of Environmental Protection
	FDM	FDOT Design Manual
	FDOS	Florida Department of State
	FDOT	Florida Department of Transportation
	FHWA	Federal Highway Administration
	FIRM(s)	Flood Insurance Rate Map(s)
	FLHSMV	Florida Department of Highway Safety and Motor Vehicle
	FONSI	Finding of No Significant Impact
	FS	Florida Statutes
	FTO	Florida Traffic Online
	FWC	Florida Fish and Wildlife Conservation Commission
	FY	Fiscal Year
G	GIS	Geographic Information System
H	HAPC	Habitat Area of Particular Concern
	HCM	Highway Capacity Manual
	HSM	Highway Safety Manual
I	ICWW	Intracoastal Waterway
	ID	Identification
	ITS	Intelligent Transportation Systems
J		
K	K	Standard Peak Hour

L	LCCA	Life-Cycle Cost Comparison Analysis
	LED(s)	Light-Emitting Diode(s)
	LEP	Limited English Proficiency
	LiDAR	Light Detection and Ranging
	LRTP	Long Range Transportation Plan
	LRFD	Load & Resistance Factor Design
	LTS	Level of Traffic Stress
M	MBC	Metal Based Coatings
	MDT	Miami-Dade Transit
	MHW	Mean High Water
	MLW	Mean Low Water
	MOT	Maintenance of Traffic
	MOU	Memorandum of Understanding
	MP	Milepost
	Mph	Miles Per Hour
	MSAT	Mobile Source Air Toxics
	MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
	MSL	Mean Sea Level
	MVMT	Million Vehicle Miles Traveled
N	NAVD	North American Vertical Datum of 1988
	NBI	National Bridge Inventory
	NEPA	National Environmental Policy Act
	NGVD	National Geodetic Vertical Datum of 1929
	NIS	Navigation Impact Study
	NMFS	National Marine Fisheries Service
	No(s).	Number(s)
	NOAA	National Oceanic and Atmospheric Administration
	NPDES	National Pollutant Discharge Elimination System
	NPS	National Park Service
	NRCS	National Resources Conservation Service
	NRE	Natural Resources Evaluation
	NRHP	National Register of Historic Places

O	OEM	Office of Environmental Management
	OFW	Outstanding Florida Waters
	OSW	Other Surface Waters
P	P2P	Point-to-Point
	PCB	Polychlorinated Biphenyls
	PD&E	Project Development and Environment
	PER	Preliminary Engineering Report
	PI	Public Information
	PIP	Public Involvement Plan
	PTAR	Project Traffic Analysis Report
Q	Q&A	Question and Answer
R	RCP	Reinforced Concrete Pipe
	ROW	Right-of-Way
	RSU	Roadside Unit
	RWIS	Roadway Weather Information Systems
S	SAFMC	South Atlantic Fisheries Management Council
	SAV	Submerged Aquatic Vegetation
	SERPM	Southeast Florida Regional Planning Model
	SFWMD	South Florida Water Management District
	SHGWT	Seasonal High Groundwater Table
	SHPO	State Historic Preservation Office(r)
	SIS	Strategic Intermodal System
	SLD	Straight Line Diagram
	SMF(s)	Stormwater Management Facility(ies)
	SPF	Safety Performance Function
	SR	State Road
	Sta.	Station
	SUP	Shared Use Path
T	Town	Town of Bay Harbor Islands
	TBP	Toll-By-Plate
	TDP	Transit Development Plan

	TIP	Transportation Improvement Program
	TMC	Turning Movement Counts
	TMP	Transportation Management Plan
	TNM	Traffic Noise Model
	TO	Transportation Operations
	TSM&O	Transportation Systems Management and Operations
	TTCP	Temporary Traffic Control Plan
	TPO	Transportation Planning Organization
U	USACE	United States Army Corps of Engineers
	USCG	United States Coast Guard
	USDOT	United States Department of Transportation
	USEPA	United States Environmental Protection Agency
	USFWS	United States Fish and Wildlife Service
V	V/C	Volume to Capacity
W		
X		
Y		
Z		

1. INTRODUCTION

1.1. Project Description

The project involves the replacement of the Broad Causeway Bridge connecting the Town of Bay Harbor Islands (Town) with the City of North Miami, within Miami-Dade County. The bridge is part of Broad Causeway, a roadway classified as "Urban Minor Arterial". This arterial begins in Bal Harbour/Surfside and connects those commuters to the mainland. The specific limits of the project extend from the Broad Causeway Island (25°53'19.41"N, 80° 8'54.52"W) on the west side to east of West Broadview Drive (25°53'11.30"N, 80° 8'18.93"W). The Florida Department of Transportation (FDOT) Bridge Identification (ID) Number (No.) is 875101. A graphic depicting the location of the bridge is provided as **Figure 1-1**Error! Reference source not found., below. The project is approximately 0.77 miles in length.

The existing bridge consists of four lanes, undivided (two in each direction), the four travel lanes are 10 ft. wide, without a raised median. The outside travel lanes also include shared use markings also referred to as sharro's to accommodate bicycles. In addition, a raised sidewalk is present on each side of the bridge, with a width that varies from 22 to 36 inches. There are no guardrails separating the sidewalk from the travel lane. Crossing over the Intracoastal Waterway (ICWW), the bridge channel has a horizontal clearance between bridge fenders of 84.0 ft., a maximum vertical clearance of 18.0 ft. at Mean Low Water (MLW) and a minimum vertical clearance of 15.7 ft. at Mean High Water (MHW) at the Bascule crossing. The ICWW at the bridge crossings is deemed a navigable waterway by the United States Coast Guard (USCG). The bridge bascule is required by the USCG to open twice per hour on the quarter and three-quarter hour but only opens if vessels are waiting.

The existing bridge, constructed in 1951, has been determined to be functionally obsolete, and contains fracture critical components based on a Bridge Inspection Report prepared in January 2023 by FDOT. In 2017, major structural repairs were performed to the bridge at a construction cost of approximately $17 million. As a result of a 2020 inspection carried out by FDOT, a design to address additional repairs has been completed and it has been determined that the cost to perform these repairs will amount to $3.0 million. As a result of the 2024 inspection, temporary emergency repairs will be completed. One lane of the bridge is closed until repairs are complete. It is expected that major costly repairs will be needed more frequently as the bridge ages to prevent closure or severe damages. Because of the structure type, the number of

structural deficiencies, and high maintenance costs, the Town is considering replacement of the bridge.

Figure 1-1: Project Location Map

This Project Development and Environment (PD&E) Study has been conducted to address the structural and functional deficiencies of the existing Broad Causeway Bridge. The feasibility of continued rehabilitation and repair versus replacement of the bridge.

Bridge concepts will include provisions for new pedestrian and bicycle accommodations to comply with Americans with Disabilities Act (ADA) requirements and guardrails for the safety of pedestrians.

Existing right-of way (ROW), owned by the Town, is anticipated to accommodate the replacement bridge and approaches. Included in the Town Charter by the 1953 Senate Bill No. 865, the State of Florida surrendered and granted to the Town any claim or control over all tidewaters and other lands, and all bayous and bay bottoms, beaches, waters, waterways and water bottoms, and all riparian rights within and adjacent to the Town limits for municipal purposes only, a strip of 300 ft. wide from Kane Concourse, westwardly across Biscayne Bay to approximately 123rd Street in the City of North Miami. Therefore, the replacement bridge will be built within the 300 ft. strip over Biscayne Bay under claim or control by the Town.

For the discussion within this report, the project may be divided into three areas, as shown in **Figure 1-1**, above:

- Causeway Island
- Intracoastal Waterway (ICWW) Bridge
- West Island

For the purposes of the analyses in this report, the ICWW bridges will be accounted as divided at the crest of the existing and proposed bridges, with the west slope of the bridges included in the Causeway Island and the east slope of the bridges included in the West Island.

1.2. PURPOSE OF REPORT

The purpose of this Pond Siting Report is to establish preferred drainage concepts and general stormwater pond site sizes and locations within the three areas of the project.

Please note that the vertical datum used for this project is NAVD 88, unless otherwise specified. The datum conversion from NGVD 29 to NAVD 88 for the project area is -1.55 ft. according to the NOAA NCAT Tool, shown in **Appendix B: .**

2. POLICY AND DATA COLLECTION

Policy for this Pond Siting Report was obtained from the following sources:

- FDOT Drainage Manual, October 30, 2023
- FDOT Drainage Design Guide, October 30, 2023
- FDOT PD&E Manual, Part 2, Chapter 11 – Water Resources, July 1, 2023

Data for this Pond Siting Report was collected and reviewed from the following sources:

- Federal Emergency Management Agency (FEMA), FIRMettes)
  - 120655: City of North Miami
  - 120635: Miami Dade County, Florida, and Incorporated Areas
  - 120637: Town of Bay Harbor Islands Revised
- Custom Soil Resource Report for Miami Dade County, Florida, published by the USDA NRCS

3. EXISTING CONDITIONS

3.1. EXISTING ALIGNMENT AND TYPICAL SECTION

The existing bridge consists of four lanes, undivided (two in each direction), the four travel lanes are 10-foot wide, without a raised median.

3.2. TOPOGRAPHY AND HYDROLOGIC FEATURES

The Broad Causeway Bridge project is located entirely within the Biscayne Bay Aquatic Preserve Basin in Miami-Dade County, within the Southwest Florida Water Management District (SWFWMD).

The average elevation on the Causeway Island is elevation 5 to 6 ft., NAVD, and the average elevation east of the ICWW bridge is about 3.5 ft., NAVD, varying between 3 to 4 ft., NAVD. An existing drainage map is shown in **Appendix A:**

3.3. EXISTING CROSS DRAINS AND BRIDGES

There are no cross drains within the project limits.

Crossing over the Intracoastal Waterway (ICWW), the existing bridge has a maximum vertical clearance of 18.0 feet at Mean Low Water and a minimum vertical clearance of 15.7 feet at Mean High Water at the Bascule crossing. The ICWW at the bridge crossings is deemed a navigable waterway by the United States Coast Guard (USCG). The bridge bascule is required by the USCG to open at :15 and :45 minutes of each hour to allow boat traffic. A picture of the existing bascule span is included as **Figure 3-1**, below:

Figure 3-1: Bascule Span of Existing Bridge

3.4. RECEIVING WATERBODIES (AND DEGREE OF IMPAIRMENT)

The project discharges to the Biscayne Bay Aquatic Preserve, within the South Florida Water Management District (SFWMD) jurisdiction, the regional water management district. Biscayne Bay Aquatic Preserve is designated as an Outstanding Florida Water (OFW). It is designated by the Florida Department of Environmental Protection as "Waters Not Attaining Standards" and is therefore considered a verified impaired waterbody. WBID 3226H2 is on the north side of the bridge and WBID 3226H on the south side.

3.5. Soils

The USDA Natural Resources Conservation Service Web Soil Survey was used to obtain general soil characteristics of the natural soils within the project. Most of the land within the project area is developed and is classified as "Urban Land" with no distinct soil properties. **Table 3-1** provides a summary of the predominant soils and their hydrologic characteristics. See **Appendix C:** for Soil Survey information.

A *Preliminary Report of Geotechnical Exploration - Roadway*, dated 11-17-23, conducted as a part of this PD&E study, recommended "performing a detailed geotechnical exploration in accordance with FDOT Soil and Foundation Handbook and Structures Design Guidelines once a final design option is selected".

Table 3-1: USDA NRCS Web Soil Survey - Predominant Soils

Soil Name	Map No.	Percent of Corridor	Hydrologic Soil Group	Drainage
Udorthents-Water-Urban Land Complex	9	1.0%	A	Well drained
Urban Land	15	52.2%	-	-
Baggs Cape fine sand	47	3.2%	A	Well drained
Beach Complex	51	0.8%	-	-
Water	99	41.0%	N/A	N/A
Waters of the Atlantic Ocean	100	1.7%	N/A	N/A

3.6. ENVIRONMENTAL CHARACTERISTICS

The study area reviewed for the environmental resources assessed in this section are within the limits shown in **Figure 1-1**.

3.6.1. Land Use Data

Existing land use is shown below in **Figure 3-2.** The project area is fully developed and land use is not expected to change in the future.

Figure 3-2: Generalized Existing Land Use Map

3.6.2. Cultural Features

A separate Cultural Resource Assessment Survey (CRAS) has been prepared as part of the PD&E study. Information regarding features at any of the proposed pond sites on the Causeway Island that are eligible for consideration as culturally significant can be found within the CRAS.

3.6.3. Natural and Biological Features

A separate Natural Resources Evaluation (NRE) report has been prepared as part of the PD&E study. Information regarding natural and biological features within the project area, including wetlands and threatened and endangered species and their habitats, can be found within the NRE report.

3.6.4. Contamination Assessment

A separate Level I Contamination Assessment Report (Contamination Screening Evaluation Report) has been prepared as part of the PD&E study. Information regarding contamination issues and hazardous waste sites within the project area can be found within the Level I report.

3.6.5. Public Water Wells

There are no public water wells within or adjacent to the project.

3.7. Floodplains and Floodways

Based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), the project area has no FEMA Floodways. The entire project lies within the 100-year floodplain as shown in **Figure 3-3**, below:

Figure 3-3: Flood Insurance Rate Maps (FIRMs) within the Project Area

Table 3-2: Flood Insurance Rate Map (FIRM) Summary

Panel Name and Number	Flood Zone	Elevation (ft-NGVD 29)	Elevation (ft-NAVD 88)
City of North Miami 120655	VE	10	8.45
Miami-Dade Unincorporated Areas 120635	AE	10	8.45
Town of Bay Harbor Island 120637	AE	8	6.45

NGVD 29 Elevations – 1.55-ft. = NAVD 88 Elevations

The applicable FEMA FIRM is included in **Appendix B:** . The impacted floodplains in Miami-Dade County are classified as Zone VE and AE, as shown above in **Table 3-2**. Zone VE and AE on the FIRM maps are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood.

3.8. Flooding History and Maintenance Concerns

In an interview with Jason Atkinson, Director of Public Works, TBHI, on 12/14/23, Mr. Atkinson stated that (1) King tides are not that significant at the project site but get worse further north of the BCB east touch down, and (2) the Town is not having problems in the project area though problems occur further northward.

Future seal level rise is expected to exacerbate these "sunny day" flooding events. 1.24 ft. of sea level rise is expected over the life of the structure, per the FDOT Drainage Manual, Section 3.4.1, sea level rise methodology.

The nearby Biscayne Creek tidal datum information is shown below:

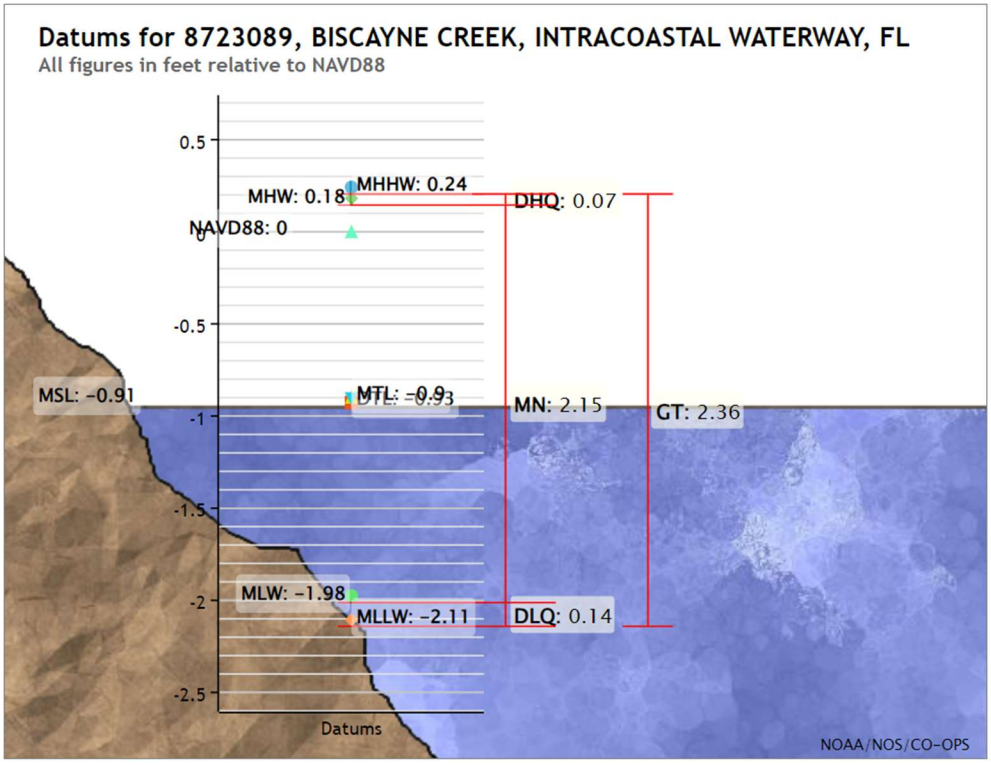


Figure 3-4: Tidal Datum for Broad Causeway Bridge

4. PROPOSED CONDITIONS

4.1. Overview

This project will replace the aging Broad Causeway Bridge over the Intercoastal Waterway. No additional lanes are proposed but a high-level, fixed bridge will be constructed where opposing traffic will be separated, with shoulders and a wider shared use path will be provided, as shown in the figure below:

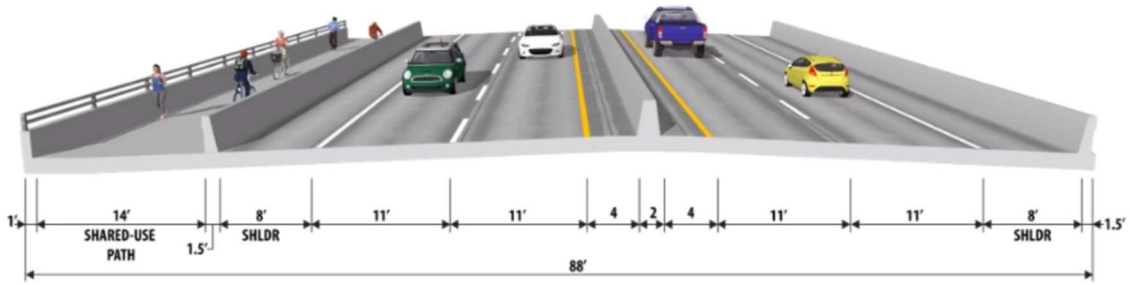


Figure 4-1: Typical Section and Elevation Rendering of the Proposed Bridge

The proposed stormwater management facilities will be dry retention ponds on the Causeway Island and a small dry retention pond east of the bridge West Island within the Town. For the proposed stormwater management condition, the Broad Causeway Bridge over the ICWW, from **Figure 1-1**, is absorbed into the Causeway Island and the West Island, divided at the crest of the proposed bridge.

4.2. PERMITTING

The proposed project will require securing an Environmental Resource Permit (ERP) through the South Florida Water Management District (SFWMD) to meet requirements in Chapter 62-346, F.A.C. Construction activities will also require the development of a Stormwater Pollution Prevention Plan (SWPPP) and proper coordination for National Pollutant Discharge Elimination System (NPDES) requirements.

Additionally, a parallel permit will be required from the Miami-Dade County Department of Environmental Management.

4.3. DESIGN CRITERIA

The stormwater design criteria for this roadway widening project must meet the Florida Department of Transportation and Chapter 62-346, F.A.C. of the ERP requirements, as applicable. The following list of design criteria, in Section 4.3.1, has been used in the methodology for the preliminary pond siting and serves as the minimum standards in

determining the property requirements and types of stormwater ponds needed. Retention and French drain criteria are listed below:

4.3.1. Water Quality

a) **South Florida Water Management District, Environmental Resource Permit Applicant's Handbook (SFWMD ERP AH) Volume II, May 22, 2016, Section 4.2.1, Retention Systems:**

- Retention of 50% of (1) the first inch of runoff from the developed project, or (2) the total runoff of 2.5 inches times the percentage of imperviousness, whichever is greater.

b) **SFWMD ERP AH Volume II, May 22, 2016, Section 4.1.3, Direct Discharges to Outstanding Florida Waters (OFW):**

- Systems which have a direct discharge to an OFW, must provide an additional fifty percent of the required treatment volume.

c) **SFWMD ERP AH Volume II, May 22, 2016, Section 4.1.4, Projects Discharging to Impaired Waters or to Outstanding Florida Waters:**

- Systems discharging to a waterbody that has been identified as impaired by the Florida Department of Environmental Protection pursuant to 403.067, F.S., or to an OFW, shall be designed in accordance with the procedures in Appendix E (Procedure for Environmental Resource Permit Water Quality Evaluations for Applications Involving Discharges to Outstanding Florida Waters and Water Bodies that Do Not Meet State Water Quality Standards).
- From Appendix E, **Existing ERP Water Quality Requirements and Evaluation**, "The additional protective measures shall include a site-specific pollutant loading analysis and an additional 50% water quality treatment volume above the amounts required pursuant to Section 4.2.1, Volume II."
- Minimum seawall cap elevation is 6 ft above Mean Sea Level (MSL), which is 6.33 ft NAVD, per Town of Bay Harbors Islands Municode Chapter 23 / Article I / Section 23.12(10)(c).

4.3.2. Water Quantity

Because the entire project is in tidal water where peak stages are controlled by storm surge, no attenuation of the peak discharge is required.

4.3.3. Floodplain Compensation

There are no regional cross drains on this project, and the hydraulics of the Broad Causeway Bridge over the ICWW, will be evaluated in the Bridge Hydraulics Report during the design phase.

This project and its surrounding lands are fully within mapped FEMA floodplains. Because the FEMA floodplains on this project are driven entirely by storm surge through Biscayne Bay, fill placed as part of this project will have no impact on the floodplain elevations. If the SFWMD requires demonstration of this relationship between project fill and the floodplain elevation, pre- and post-development storm surge modeling will be presented to verify this concept.

No future floodplain development is expected on this project since it is already fully built out.

4.4. GENERAL DESIGN APPROACH

4.4.1. Procedure

As previously noted in **Figure 1-1**, the project is divided into three areas:

- Causeway Island
- Intracoastal Waterway (ICWW) Bridge
- West Island

With the elimination of scuppers discharging directly to the Bay from the proposed bridge, the ICWW bridge is divided at its crest and discharges westward to the Causeway Island and eastward to the West Island in the proposed condition. Therefore, stormwater discussions in the proposed condition will refer to the Causeway Island or the West Island. Interconnected retention ponds will be used on the Causeway Island and a small retention pond on the West Island. Since these two basins discharge to the same waterbody, they will be computed as separate subbasins, but will be available to compensate for one another in satisfying water quality treatment requirements. The entire Broad Causeway Bridge deck runoff will flow on the proposed bridge shoulders and be directed into the stormwater ponds on the Causeway Island and on the West Island.

Since the entire project lies within the Biscayne Bay Aquatic Preserve, an OFW, treatment volumes are increased by 150%. Since the Biscayne Bay Aquatic Preserve is impaired, a pre/post nutrient analysis was developed using BMPTRAINS.

Soils, groundwater, and topography at the pond sites, were determined from desktop evaluation as described in this section.

4.4.2. Topographic Data

LiDAR information was used for topography within the project area.

4.4.3. Resilience and Nature-based Solutions

All water levels within the proposed drainage design consider future sea level rise per the FDOT Drainage Manual, Section 3.4.1. These include the MHW and Seasonal High Groundwater Table (SHGWT) elevations, discussed in this subsection. Additionally, to account for future sea level rise, the minimum seawall cap elevation is 6 ft above MSL, which is 6.33 ft NAVD, per Town of Bay Harbors Islands Municode Chapter 23 / Article I / Section 23.12(10)(c).

The Town proposes to integrate nature-based environmental treatment into the shallow dry detention ponds on the Causeway Island. Bio-swales, rain gardens, and bio-retention, will be employed, both under bridges and interspersed in open areas, with appropriate vegetation for the expected level of shading. These nature-based solutions will increase pollutant uptake within the detention ponds and provide a pleasant environment for recreation on the island.

4.4.3.1. Sea Level Rise (SLR) Analysis for MHW

The FDOT Drainage Manual, Section 3.4.1, calls for a SLR analysis to be performed for designs with tidal tailwater conditions. The Drainage Manual also requires that tidal outfall tailwaters use the MHW elevation. The future MHW is calculated below, using the procedure in Section 3.4.1.

The nearest tidal station with SLR trend analysis is 8723214, Virginia Key, Biscayne Bay FL:

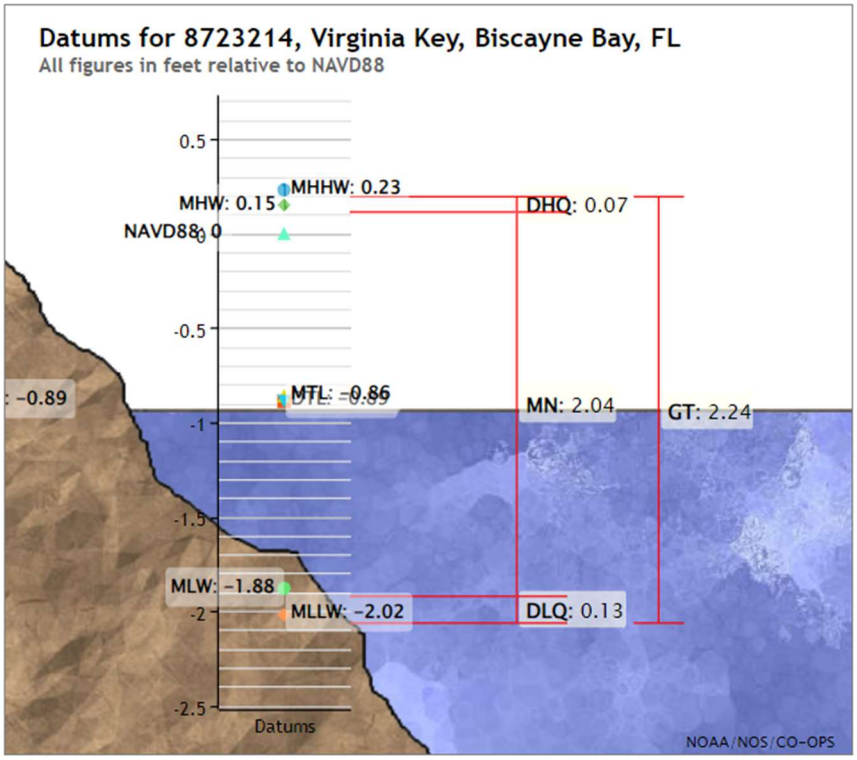


Figure 4-2: Datums for 8723214, Virginia Key, Biscayne Bay FL

The SLR trend at this station is, with 95% upper confidence, 3.32 mm/yr (0.131 in/yr), as shown in the figure below:

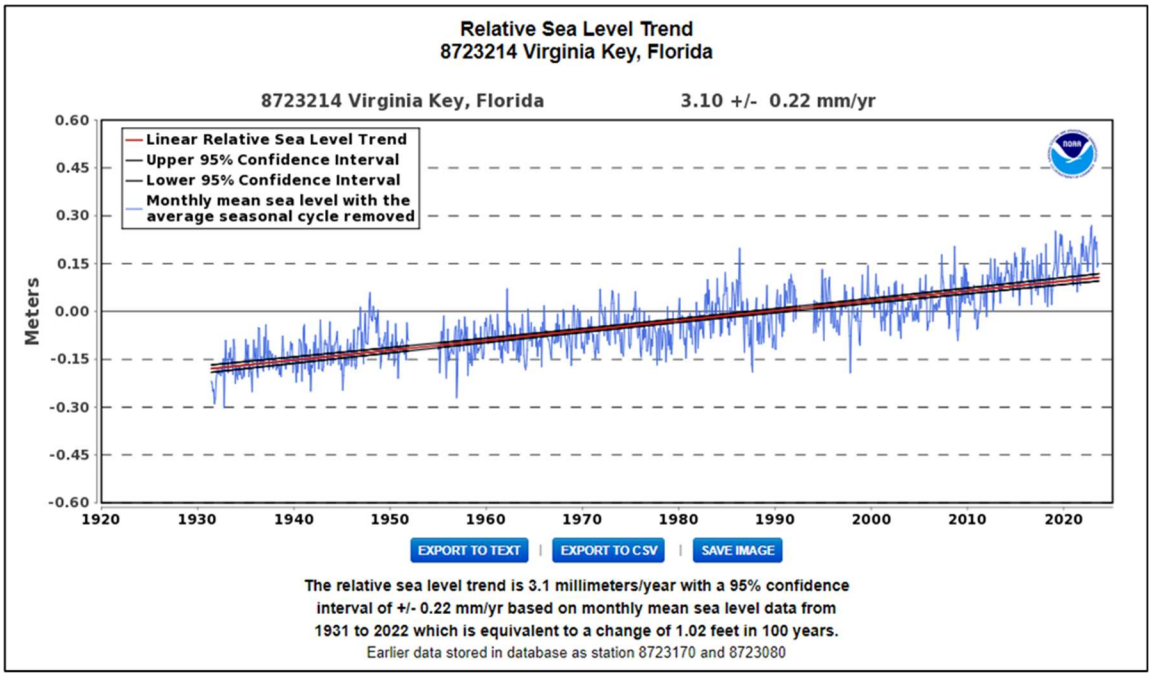


Figure 4-3: Sea Level Rise Trend for 8723214 Virginia Key, FL

The bridge service life will be adopted for the drainage system as well. With an expected project completion date of 2031 and a 75 year expected bridge life, the target SLR year becomes 2106. The mid-year of the tidal epoch (1983 – 2001) is 1992. Thus, the anticipated SLR through the service life of the bridge is 1.24 ft.

4.4.3.2. Sea Level Rise (SLR) Analysis for SHGWT

Because the SHGWT within the project is driven by tidal fluctuations, the anticipated SHGWT will include SLR. Instead of calculating SLR from the midyear of the tidal epoch, SLR for SHGWT will be calculated from the SHGWT estimate in the *Preliminary Report of Geotechnical Exploration – Roadway*, published in 2023. From the discussion above, the target SLR year is once again 2106. Thus, with a target SLR rate of 3.32 mm/yr (0.131 in/yr), as shown in **Figure 4-3** above, the design SLR for the SHGWT becomes 0.90 ft.

4.4.3.3. Seasonal High Groundwater Table Estimate

The *Preliminary Report of Geotechnical Exploration – Roadway*, Section 3.6, states that,

> *"Based on the groundwater table encountered within the borings, the Miami-Dade County NRCS Soil Survey and USGS well information, the preliminary SHWT is estimated to be at approximately 3 to 4 feet below the existing ground surface and/or approximately elevation +1 foot, NAVD and will be heavily tidally influenced."*

Adjusting for expected SLR of 0.90 ft. per **Section 4.4.3.2**, above, results in a SHGWT elevation of 1.90 ft. NAVD. Therefore, a SHGWT elevation of 1.90 ft NAVD will be adopted for this project, both on the Causeway Island and the land east of the bridge.

4.4.3.4. MHW Estimate

Though the closest tidal station showing the rate of SLR is 8723214 Virginia Key, FL, the closest station for tidal benchmarks is 8723089 Biscayne Creek, ICWW, FL, shown below:

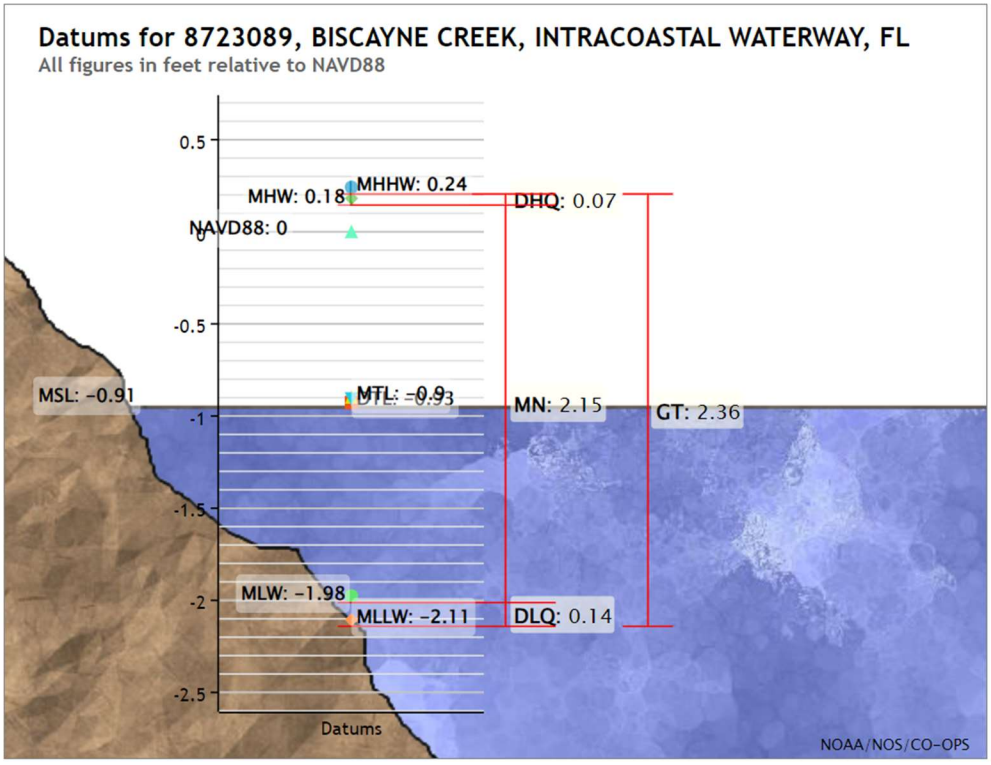


Figure 4-4: Tidal Benchmarks, 8723089 Biscayne Creek, ICWW, FL

Adding the expected SLR of 1.24 ft., from **Figure 4-3**, to the MHW elevation of 0.18 ft NAVD from **Figure 4-4**: Tidal Benchmarks, 8723089 Biscayne Creek, ICWW, FL, yields an expected MHW of 1.42 ft NAVD at the end of the service life of the bridge.

4.4.4. Estimating Attenuation Volumes

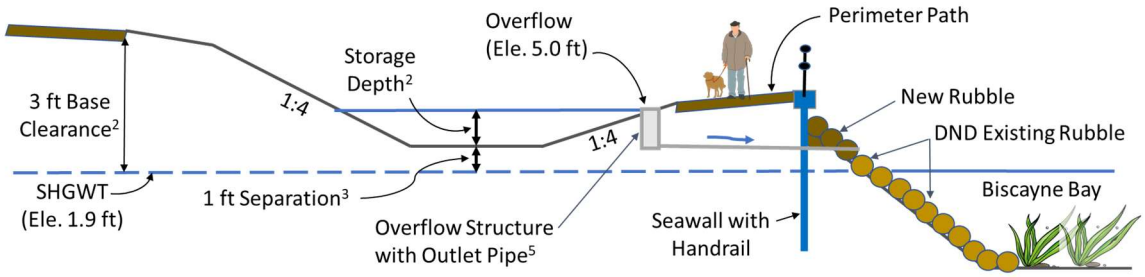
Since the entire project discharges to a tidal waterbody, attenuation is not considered.

4.4.5. Estimating Right-of-Way Requirements

The entire project, including stormwater management facilities, will be constructed within existing right-of-way.

4.4.6. Pond Locations and Design on the Causeway Island

All green areas within the Causeway Island will be developed for retention ponds, using 1:4 side slopes down to a minimum of 1 ft. above the SHGWT, to allow for mowing without scarring the pond bottom. Since the spatial area of the island is fixed, available pond storage will be determined by the elevations of the island's roadways and perimeter overflow elevations, as shown in the figure below:



Notes

1. All elevations are in NAVD.
2. Base clearance set by FDOT 2024 Flexible Pavement Design Manual, Section 5.2.2
3. Maximum storage depth controlled by recovery through percolation per SFWMD Applicant's HB, Volume 2, Section 5.3.3 (a) – assumed maximum of 3 ft.
4. 1 ft. minimum separation per SFWMD and to allow for mowing without scarring pond bottom
5. Outfall pipe above MHW to deter barnacle growth
6. SHGWT, with sea level rise over the service life of the structure, is 1.9 ft. NAVD.
7. Minimum seawall cap elevation is 6 ft above MSL, which is 6.33 ft NAVD, per Town of Bay Harbors Islands Municode Chapter 23 / Article I / Section 23.12(10)(c).

Figure 4-5: Vertical Storage Controls on the Causeway Island

Using the SFWMD Constant Head Open Hole Test Method, the preliminary geotechnical investigation estimated the hydraulic conductivity of the top 10 ft of the existing soil as 2.74E-04 cfs/ft2 – ft of head, which is 24 ft/day. This is excellent horizontal percolation. Using a safety factor of 2 for geotechnical uncertainties and dividing by 2 to convert from horizontal to vertical permeability, an expected vertical permeability of 6 ft/day will be assumed for this report. Given the excellent percolation, a maximum storage depth of 3 feet will be assumed within retention basins. This permeability will be confirmed with a double ring infiltration test during design.

Preliminary pond locations are identified in **Appendix D:**

4.4.7. Pond Locations and Design East of the Bridge

A small retention pond will be constructed, at the southeast corner of the bridge, on land currently owned by the Town, as shown in **Appendix D:** . The roadway east of the bridge, west of the existing W. Broadview Drive intersection, is too low to store runoff in

either the planned retention pond or in French drains and will therefore be directly discharged in the proposed condition, as occurs currently.

4.5. Water Quality Calculations

4.5.1. Required and Provided Treatment Volumes

Since all treatment systems involve retention and discharge to the same waterbody, water quality requirements will be estimated separately for both the Causeway Island and the West Island, and then summarized on an entire project basis, where retention ponds capture on the island are added to treatment east of the bridge.

Water quality treatment volumes, required and provided, are tabulated below, with available pond storage tabulation in **Error! Reference source not found.**.

Table 4-1: Summary of Treatment Volumes Required and Provided

Project Treatment Volumes (ac-ft)			
Location	**Required (ac-ft)**	**Provided (ac-ft)**	**Provided (in)**
Causeway Island	1.35	4.83	4.10
West Island	0.51	0.14	0.50
Total Project	1.85	4.97	3.40

4.5.2. Potential Reductions in Available Causeway Island Pond Areas

Two possible reductions in the land available for pond storage on the island are discussed below. If the island's water quality storage is reduced below that which is required by the SFWMD, compensatory water quality treatment will be sought within the Biscayne Bay watershed.

4.5.2.1. Contamination Plume on the Causeway Island

A historical underground contamination plume is associated with the gas station on the island. The site is identified as Sunshine #08 in the contamination assessment report, and limits of the contamination plume are estimated in the figure below:

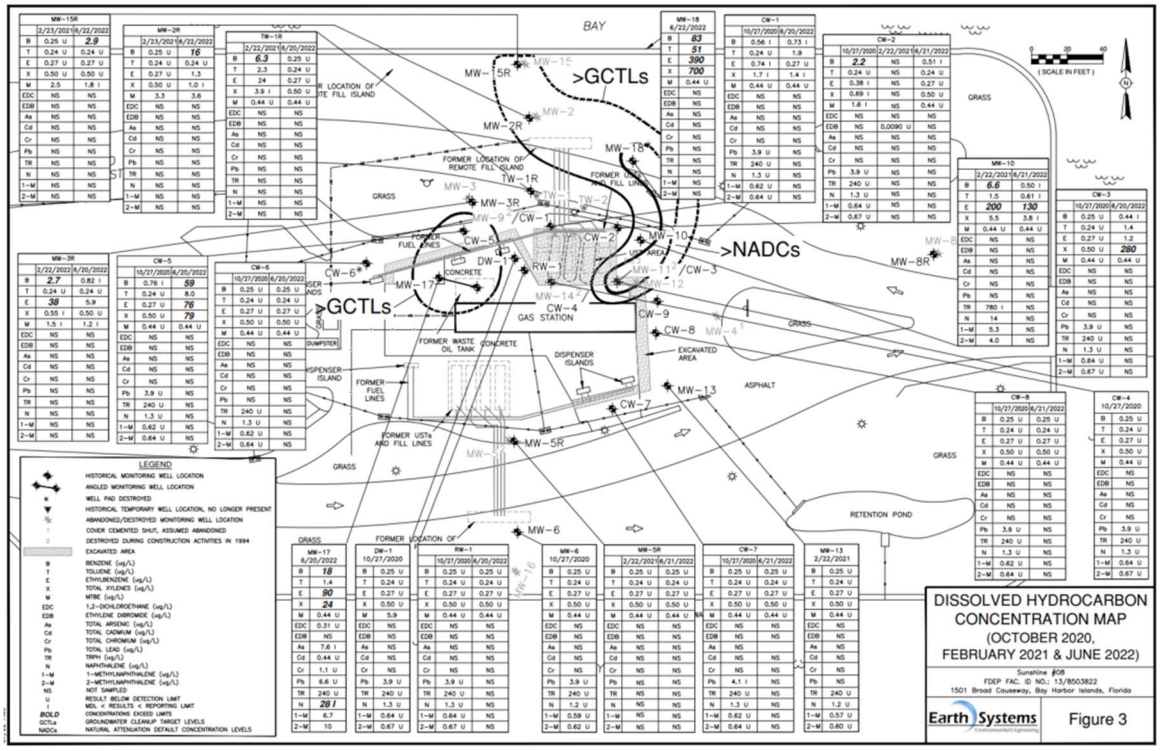


Figure 4-6: Contamination Plume at Island Service Station (Earth Systems Environmental Engineering, Interim Assessment Report)

Future discussions with the SFWMD and DERM will resolve any required separation between the pond storage areas and the underground contamination plume.

4.5.2.2. Island Recreational Usage

The Town of Bay Harbor Island has expressed a desire to use parts of the island for recreational activities beyond constructing a shared use path along the island's perimeter. The final details of the recreational usage are yet to be resolved with the Town, but an initial allowance for recreation is included in the pond layout shown in **Appendix D:** .

4.5.3. Pre/Post Development Nutrient Analyses

The annual predevelopment and post development nutrient loadings were compared using BMPTRAINS, with results tabulated below:

Table 4-2: Existing and Proposed Annual Nutrient Loadings

Project Annual Loadings (kg/yr)						
Location	TN			TP		
	Existing	Proposed	Reduction	Existing	Proposed	Reduction
Causeway Island	24.17	2.44	90%	3.18	0.32	90%
West Island	20.86	8.53	59%	2.75	1.12	59%
Total Project Treatment Volume:	45.03	10.97	76%	5.93	1.44	76%

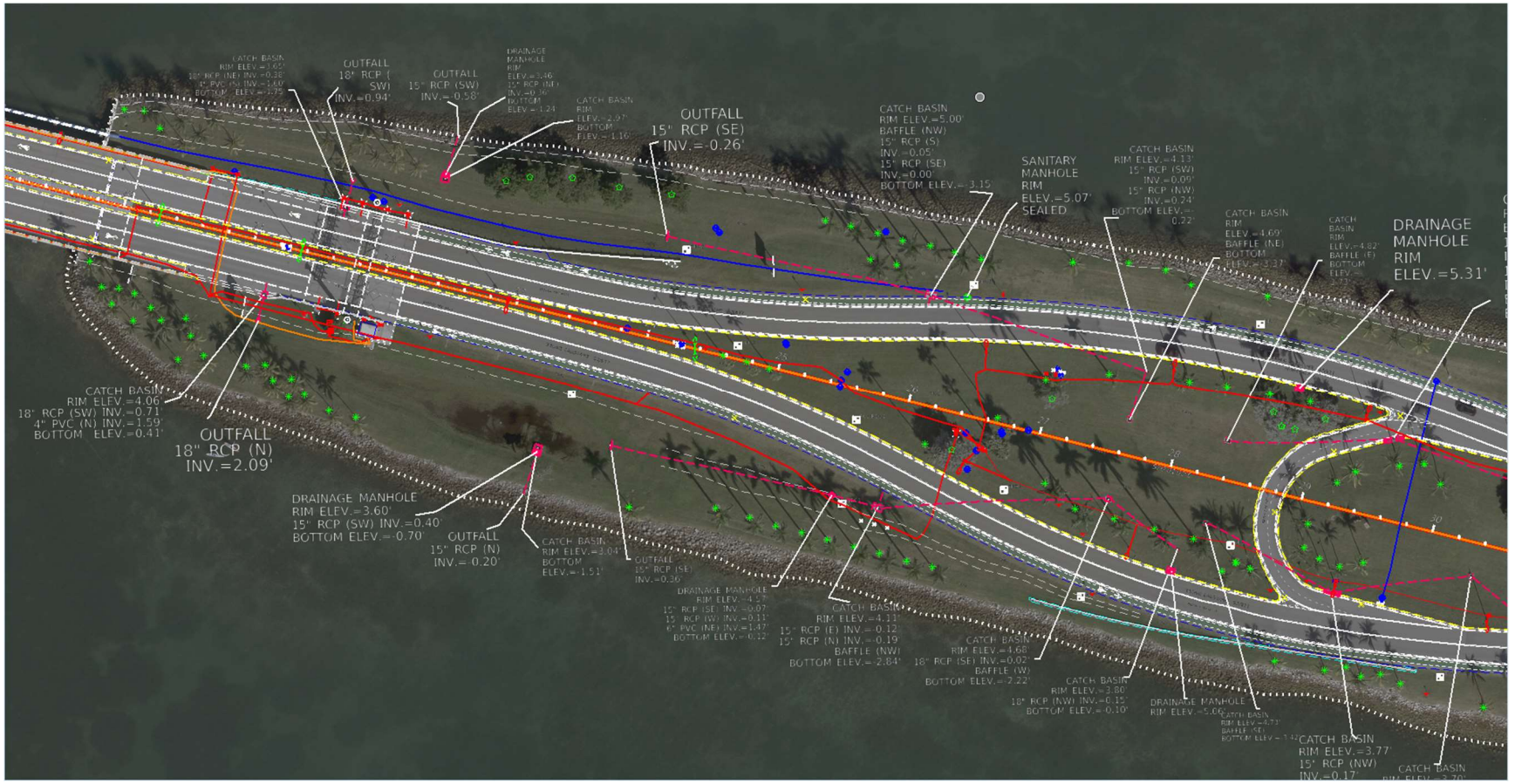
Pre-development and post-development nutrient analyses Reports are included in **Appendix E**.

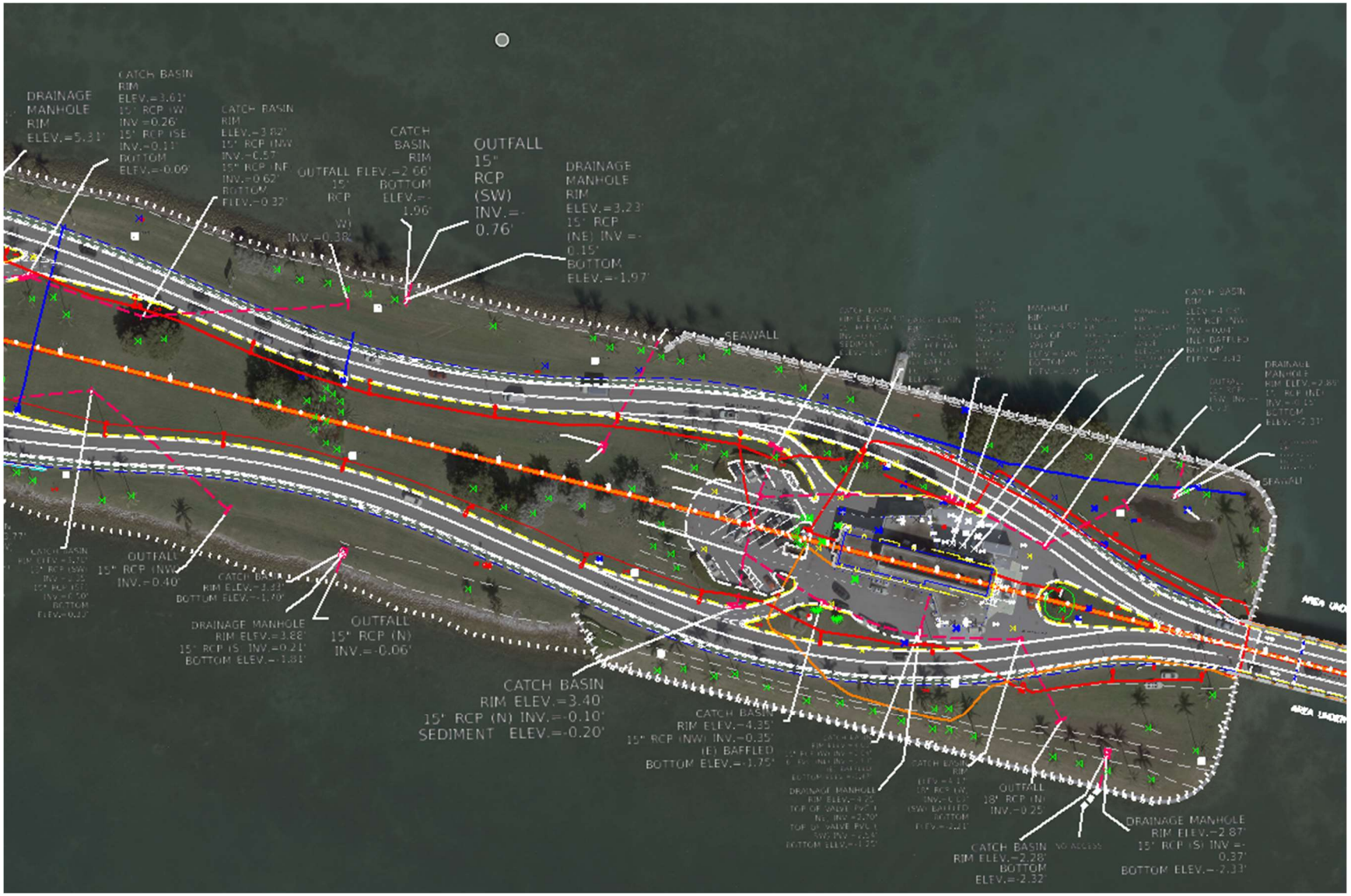
5. CONCLUSIONS

This Pond Siting Report presents a conceptual drainage analysis to determine and satisfy SFWMD water quality treatment needs to serve the Broad Causeway Bridge replacement project.

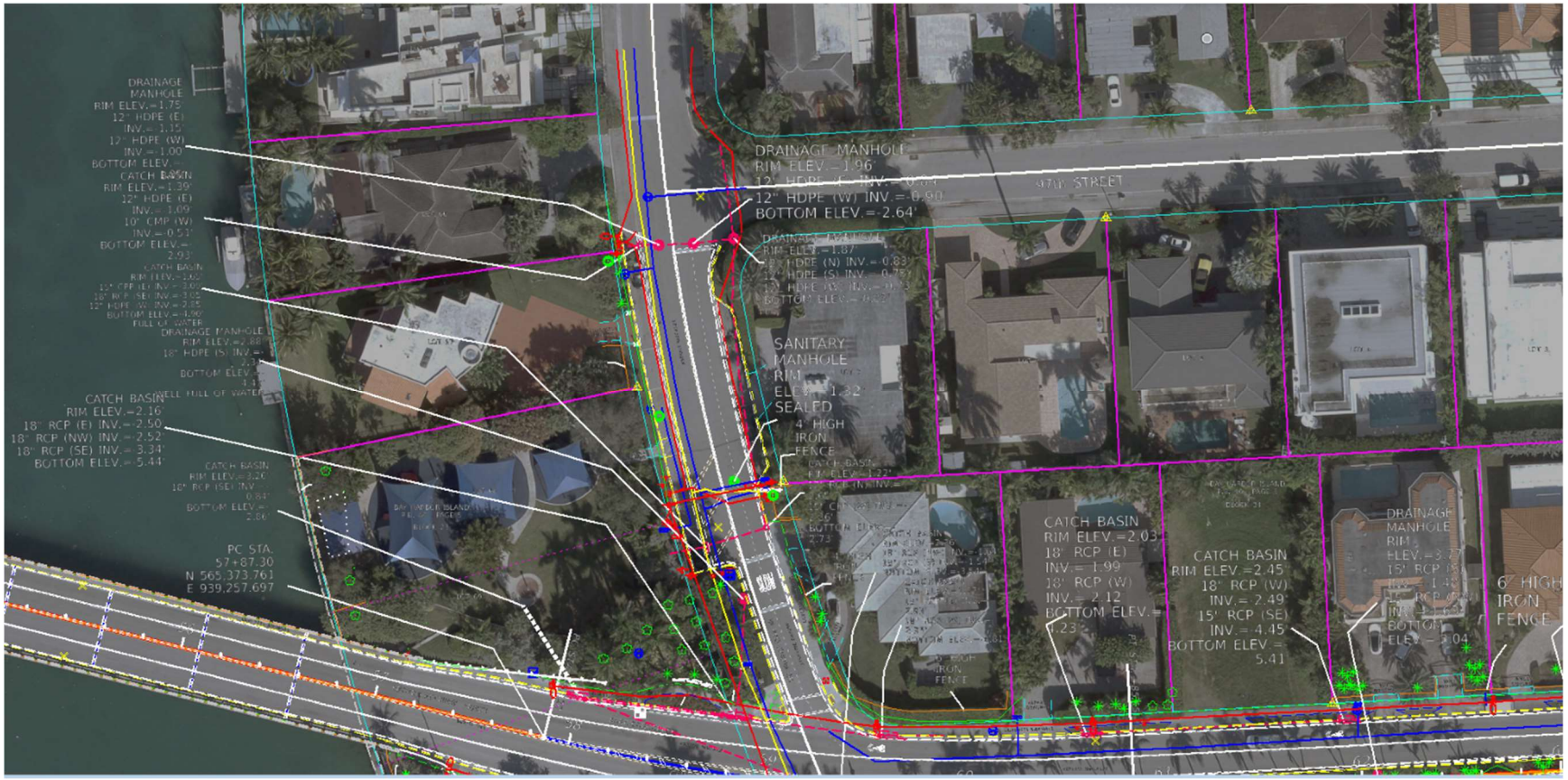
Sufficient right of way is available to satisfy regulatory stormwater management requirements, including an initial allowance for island recreational usage. The relaxation of attenuation and floodplain compensation requirements due to tidal conditions, will be confirmed with the regulatory agencies.

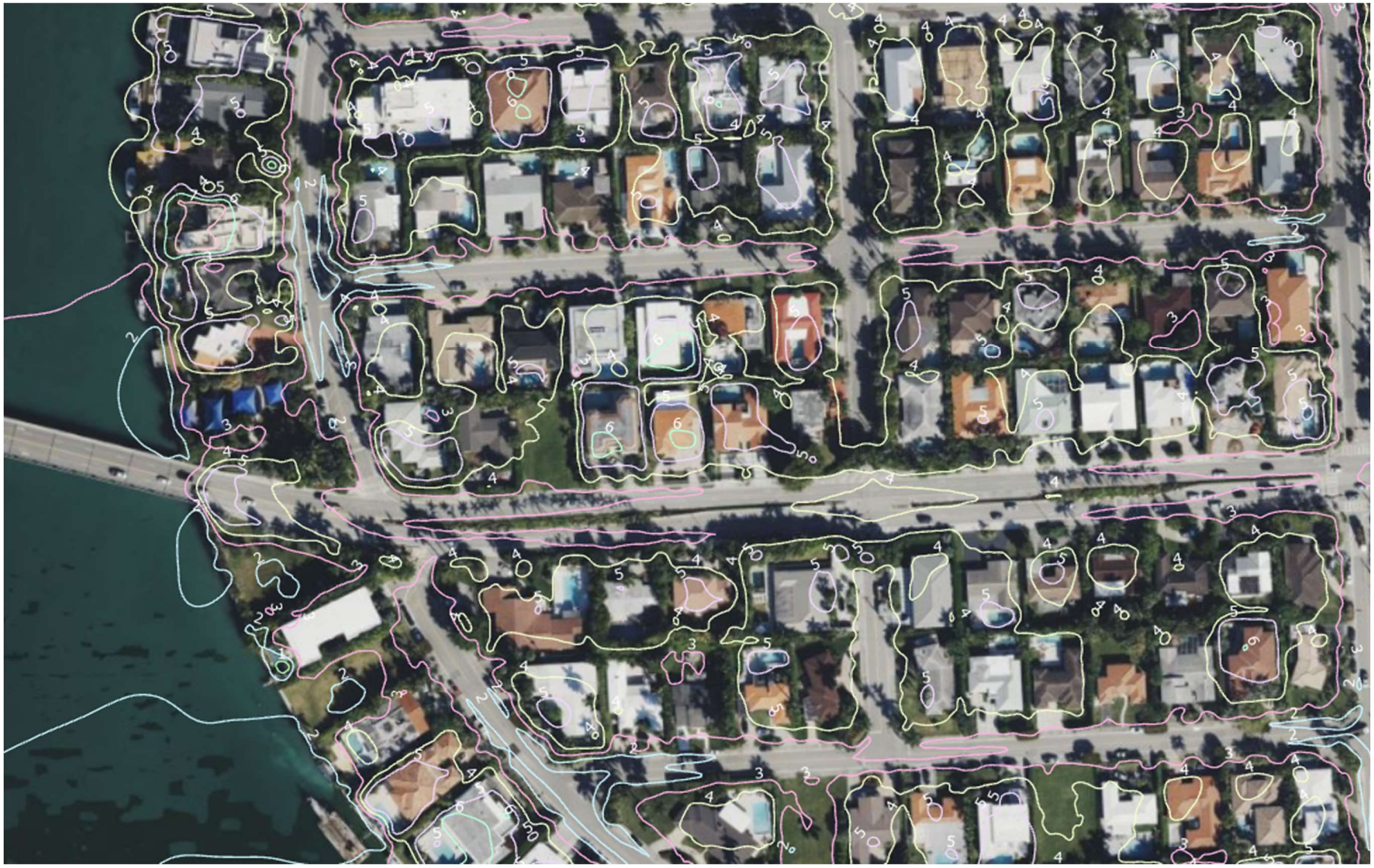
Appendix A: Existing Drainage Maps and Contours


OUTFALL
15" RCP (SE)
INV.=0.26'
SANITARY
MANHOLE
RIM
ELEV.=5.07'
SEALED
DRAINAGE
MANHOLE
RIM
ELEV.=5.31'
CATCH BASIN
RIM ELEV.=4.06'
18" RCP (SW) INV.=0.71'
4" PVC (N) INV.=1.59'
BOTTOM ELEV.=0.41'
OUTFALL
18" RCP (N)
INV.=2.09'
DRAINAGE MANHOLE
RIM ELEV.=3.60'
15" RCP (SW) INV.=0.40'
BOTTOM ELEV.=-0.70'
OUTFALL
15" RCP (N)
INV.=-0.20'
CATCH BASIN
RIM ELEV.=3.04'
BOTTOM
ELEV.=1.51'
CATCH BASIN
RIM ELEV.=4.11'
15" RCP (E) INV.=-0.12'
15" RCP (N) INV.=-0.19'
BAFFLE (NW)
BOTTOM ELEV.=-2.84'
CATCH BASIN
RIM ELEV.=4.68'
18" RCP (SE) INV.=0.02'
BAFFLE (W)
BOTTOM ELEV.=-2.22'
CATCH BASIN
RIM ELEV.=3.80'
18" RCP (NW) INV.=-0.15'
BOTTOM ELEV.=-0.10'
CATCH BASIN
RIM ELEV.=3.77'
15" RCP (NW)
INV.=-0.17'

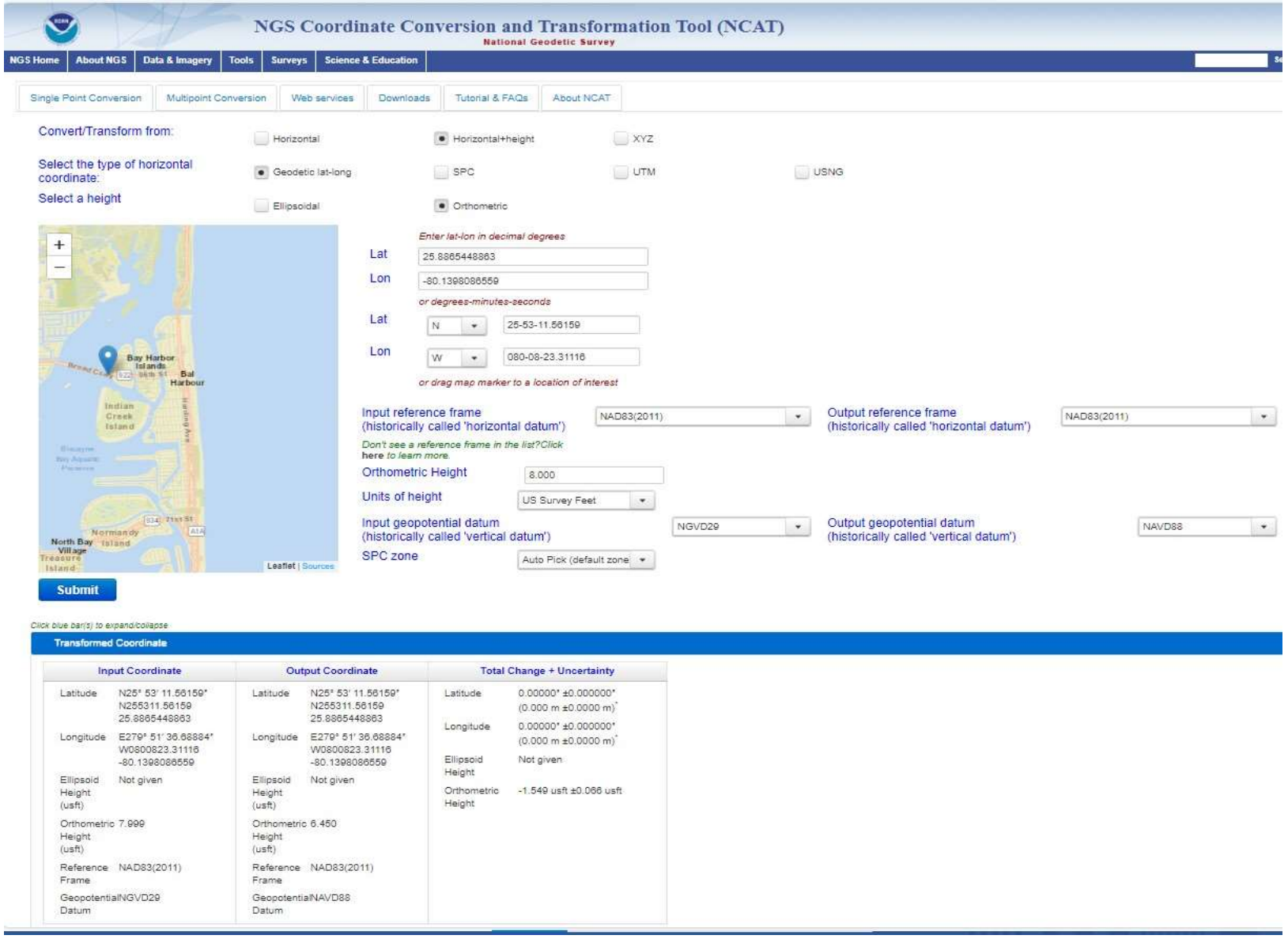

DRAINAGE MANHOLE RIM ELEV.=5.31'
CATCH BASIN RIM ELEV.=3.61' 15" RCP (W) INV.=0.26' 15" RCP (SE) INV.=-0.11' BOTTOM ELEV.=-0.09'
CATCH BASIN RIM ELEV.=3.82' 15" RCP (NW) INV.=-0.57' 15" RCP (NE) INV.=-0.62' BOTTOM ELEV.=-0.32'
OUTFALL ELEV.=2.66' 15" RCP (W) INV.=-0.38'
CATCH BASIN RIM ELEV.=4.35' BOTTOM ELEV.=-1.96'
OUTFALL 15" RCP (SW) INV.=-0.76'
DRAINAGE MANHOLE RIM ELEV.=3.23' 15" RCP (NE) INV.=-0.15' BOTTOM ELEV.=-1.97'
SEAWALL
OUTFALL 15" RCP (NW) INV.=-0.40'
CATCH BASIN RIM ELEV.=3.33' BOTTOM ELEV.=-1.70'
DRAINAGE MANHOLE RIM ELEV.=3.88' 15" RCP (S) INV.=-0.21' BOTTOM ELEV.=-1.81'
OUTFALL 15" RCP (N) INV.=-0.06'
CATCH BASIN RIM ELEV.=3.40' 15" RCP (N) INV.=-0.10' SEDIMENT ELEV.=-0.20'
CATCH BASIN RIM ELEV.=4.35' 15" RCP (NW) INV.=-0.35' (E) BAFFLED BOTTOM ELEV.=-1.75'
OUTFALL 18" RCP (N) INV.=-0.25'
CATCH BASIN RIM ELEV.=2.26' BOTTOM ELEV.=-2.32'
DRAINAGE MANHOLE RIM ELEV.=2.87' 15" RCP (S) INV.=-0.37' BOTTOM ELEV.=-2.33'


CATCH BASIN
RIM ELEV.=2.03'
18" RCP (E)
INV.= 1.99'
18" RCP (W)
INV.= 2.12'
BOTTOM ELEV.=
-2.23'
CATCH BASIN
RIM ELEV.=2.45'
18" RCP (W)
INV.= 2.49'
15" RCP (SE)
INV.= -4.45'
BOTTOM ELEV.=
5.41
DRAINAGE MANHOLE
RIM ELEV.=3.77'
15" RCP (S
INV.= 1.43'
BOTTOM
ELEV.= 2.04'
6' HIGH
IRON
FENCE
PT STA.
60+85.65
N
565,345.538
E
939,553.593
4' HIGH
WOOD
FENCE
DRAINAGE MANHOLE
RIM ELEV.=2.65'
BOTTOM ELEV.=-2.64'
SANITARY MANHOLE
RIM ELEV.=2.88'
8" PVC (SE) INV.=
0.99'

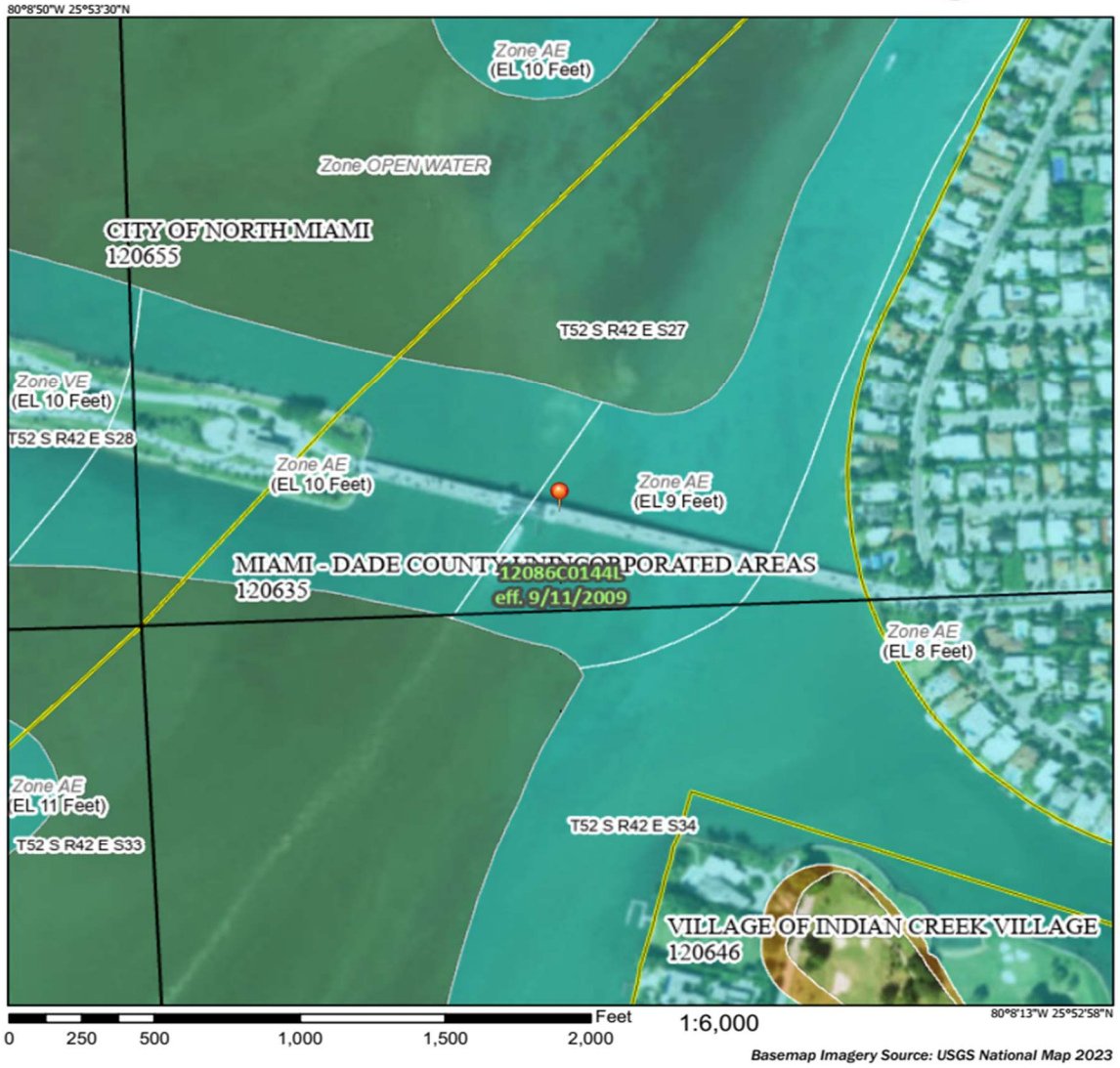

DRAINAGE MANHOLE
RIM ELEV.=1.75'
12" HDPE (E) INV.=-1.15'
12" HDPE (W) INV.=-1.00'
BOTTOM ELEV.=
CATCH BASIN
RIM ELEV.=1.39'
12" HDPE (E) INV.=-1.09'
10" CMP (W) INV.=-0.51'
BOTTOM ELEV.=-2.93'
CATCH BASIN
RIM ELEV.=2.16'
18" RCP (E) INV.=-2.50'
18" RCP (NW) INV.=-2.52'
18" RCP (SE) INV.=-3.34'
BOTTOM ELEV.=-5.44'
PC STA.
57+87.30
N 565,373.761
E 939,257.697
DRAINAGE MANHOLE
RIM ELEV.=1.96'
12" HDPE (W) INV.=-0.90'
BOTTOM ELEV.=-2.64'
SANITARY MANHOLE
RIM ELEV.=1.32'
SEALED
4' HIGH IRON FENCE
CATCH BASIN
RIM ELEV.=2.03'
18" RCP (E) INV.=-1.99'
18" RCP (W) INV.=-2.12'
BOTTOM ELEV.=-4.23'
CATCH BASIN
RIM ELEV.=2.45'
18" RCP (W) INV.=-2.49'
15" RCP (SE) INV.=-4.45'
BOTTOM ELEV.=-5.41'
DRAINAGE MANHOLE
6' HIGH IRON FENCE



Appendix B: FEMA FIRMettes


NGS Coordinate Conversion and Transformation Tool (NCAT)
National Geodetic Survey
NGS Home
About NGS
Data & Imagery
Tools
Surveys
Science & Education
Single Point Conversion
Multipoint Conversion
Web services
Downloads
Tutorial & FAQs
About NCAT
Convert/Transform from:
Horizontal
Horizontal+height
XYZ
Select the type of horizontal coordinate:
Geodetic lat-long
SPC
UTM
USNG
Select a height
Ellipsoidal
Orthometric
Enter lat-lon in decimal degrees
Lat
25.8865448863
Lon
-80.1398086559
or degrees-minutes-seconds
Lat
N
25-53-11.56159
Lon
W
080-08-23.31116
or drag map marker to a location of interest
Input reference frame (historically called 'horizontal datum')
NAD83(2011)
Output reference frame (historically called 'horizontal datum')
NAD83(2011)
Don't see a reference frame in the list?Click here to learn more.
Orthometric Height
8.000
Units of height
US Survey Feet
Input geopotential datum (historically called 'vertical datum')
NGVD29
Output geopotential datum (historically called 'vertical datum')
NAVD88
SPC zone
Auto Pick (default zone
Submit
Bay Harbor Islands
Bal Harbour
Indian Creek Island
Normandy Island
North Bay Village
Treasure Island
Leaflet | Sources
Click blue bar(s) to expand/collapse
Transformed Coordinate
Input Coordinate
Output Coordinate
Total Change + Uncertainty
Latitude N25° 53' 11.56159" N255311.56159 25.8865448863
Longitude E279° 51' 36.68884" W0800823.31116 -80.1398086559
Ellipsoid Height (usft) Not given
Orthometric Height (usft) 7.999
Reference Frame NAD83(2011)
GeopotentialDatum NGVD29
Latitude N25° 53' 11.56159" N255311.56159 25.8865448863
Longitude E279° 51' 36.68884" W0800823.31116 -80.1398086559
Ellipsoid Height (usft) Not given
Orthometric Height (usft) 6.450
Reference Frame NAD83(2011)
GeopotentialDatum NAVD88
Latitude 0.00000" ±0.000000" (0.000 m ±0.0000 m)
Longitude 0.00000" ±0.000000" (0.000 m ±0.0000 m)
Ellipsoid Height Not given
Orthometric Height -1.549 usft ±0.066 usft

National Flood Hazard Layer FIRMette



Basemap Imagery Source: USGS National Map 2023

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

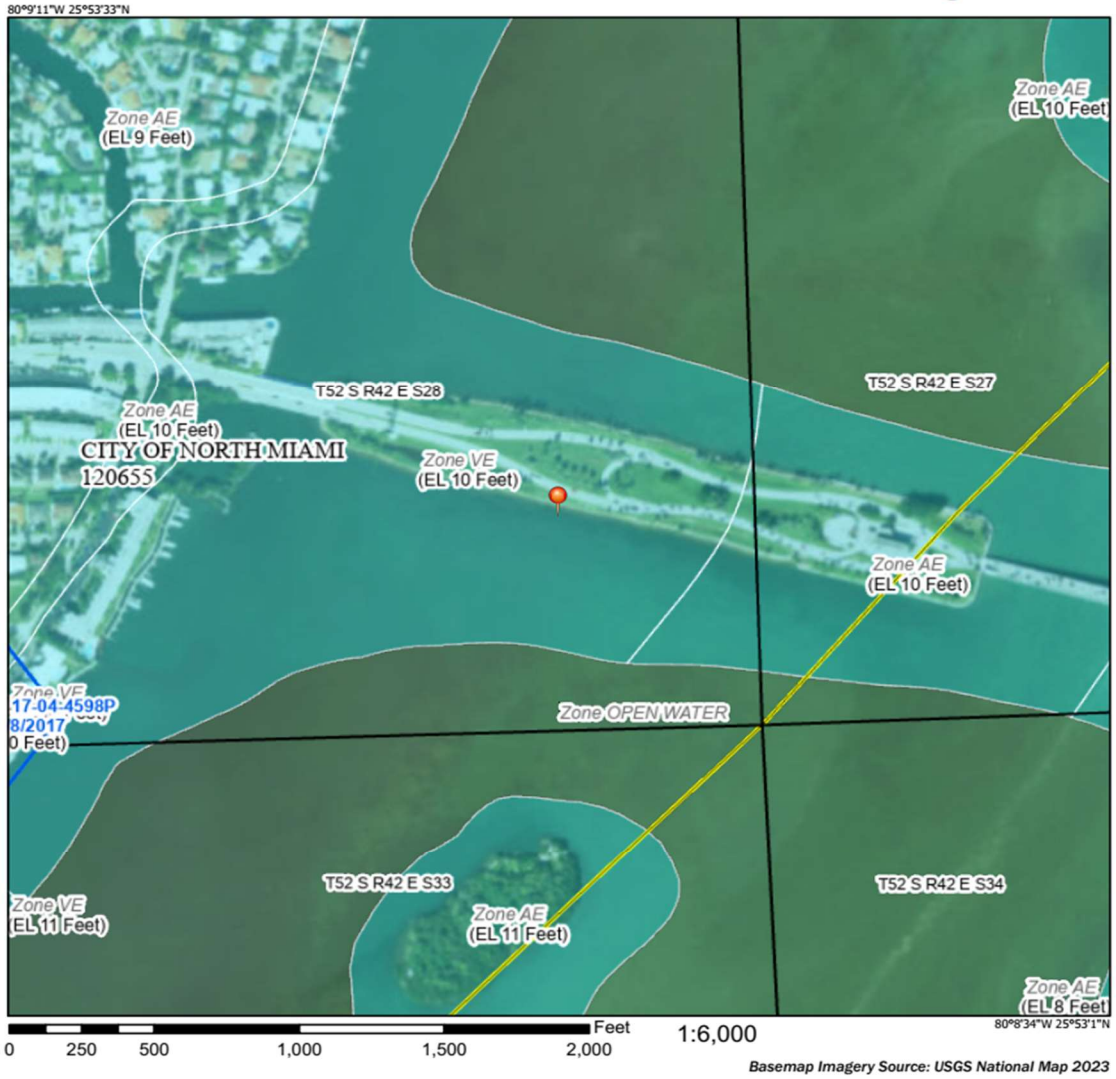
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/19/2023 at 5:05 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette



Basemap Imagery Source: USGS National Map 2023

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/19/2023 at 5:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/19/2023 at 5:02 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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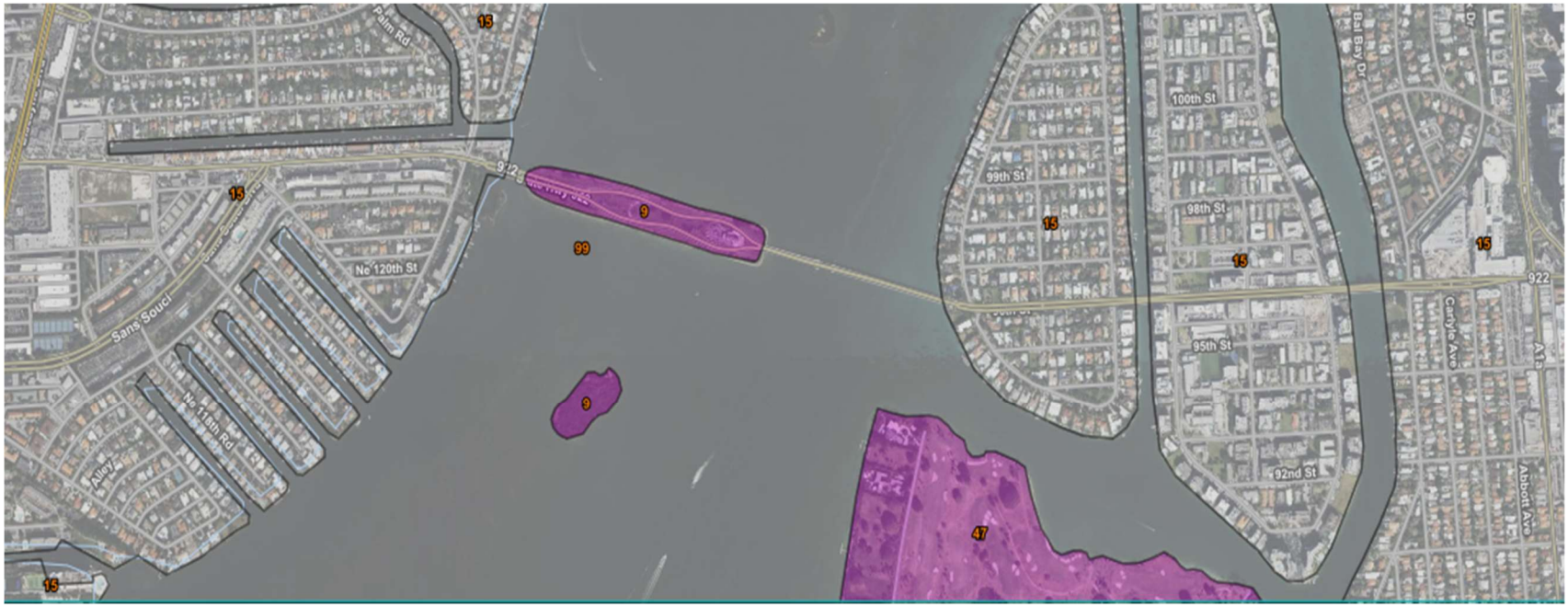
Appendix C: NRCS Soils Map


Palm Rd
15
15
99
9
Ne 120th St
Sans Souci
Ne 118th Rd
Alley
9
15
99th St
98th St
100th St
15
15
15
922
95th St
92nd St
Carlyle Ave
Abbott Ave
47

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Miami-Dade County Area, Florida (FL686)

Summary by Map Unit — Miami-Dade County Area, Florida (FL686)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9	Udorthents-Water-Urban land complex, 0 to 60 percent slopes	A	22.8	0.5%
15	Urban land, 0 to 2 percent slopes		1,565.2	36.2%
39	Beach complex, tidal, 0 to 3 percent slopes		10.0	0.2%
41	Dade fine sand-Urban land complex, 0 to 2 percent slopes	A	4.5	0.1%
47	Baggs Cape fine sand-Urban land complex, 0 to 2 percent slopes	A	274.5	6.3%
51	Beach complex, tidal-Urban land complex, 0 to 3 percent slopes		22.4	0.5%
53	Biscayne marly silt loam, drained-Urban land complexx, 0 to 1 percent slopes	C/D	8.9	0.2%
99	Water		1,584.6	36.6%
100	Waters of the Atlantic Ocean		662.3	15.3%
Totals for Area of Interest			**4,325.5**	**100.0%**

Appendix D: Required and Provided Treatment Volume

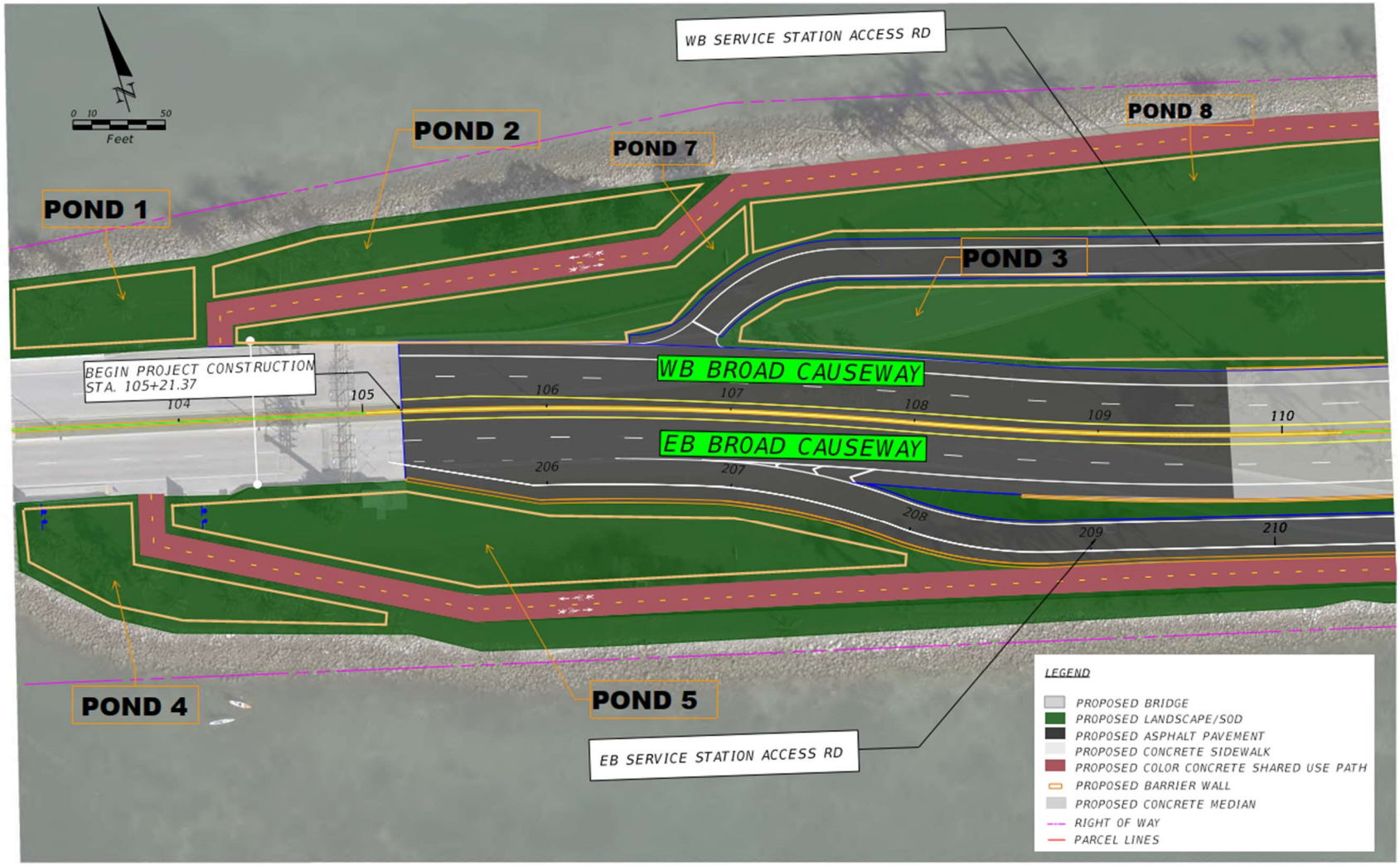


Figure D- 1: Layout of Retention Ponds on the Causeway Island (1 of 3)

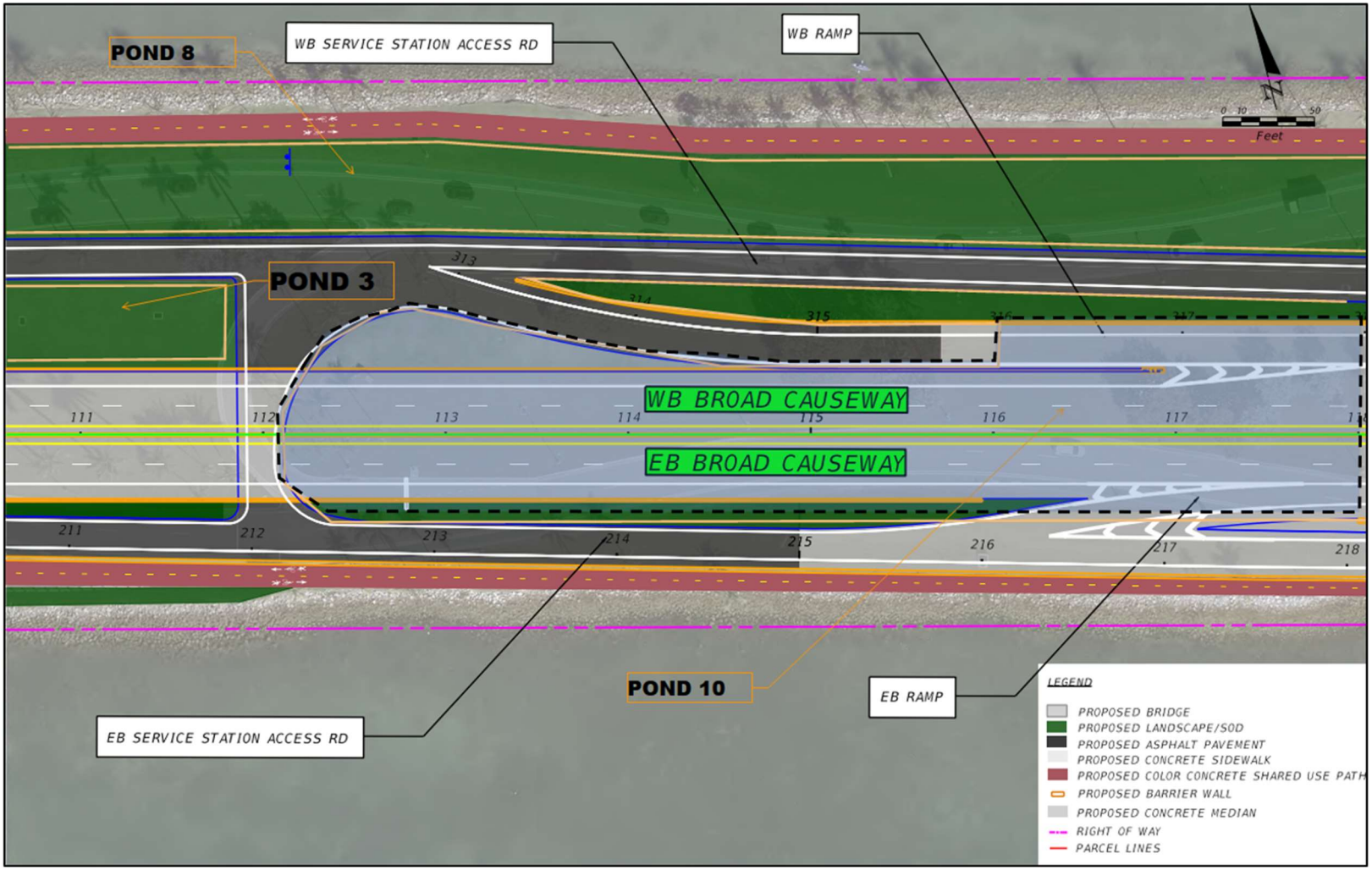


Figure D- 2: Layout of Retention Ponds on the Causeway Island (2 of 3)

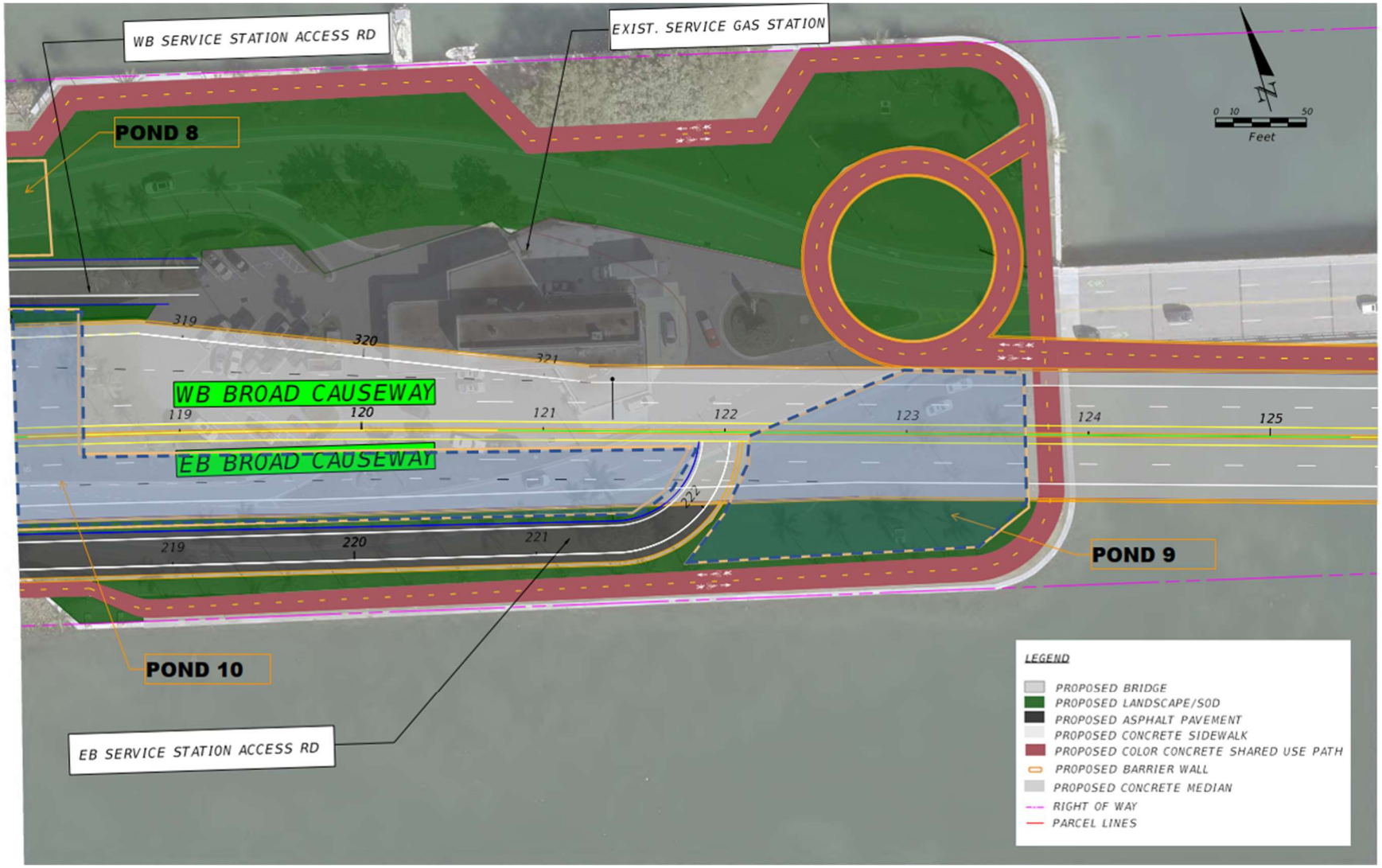


Figure D- 3: Layout of Retention Ponds on the Causeway Island (3 of 3)

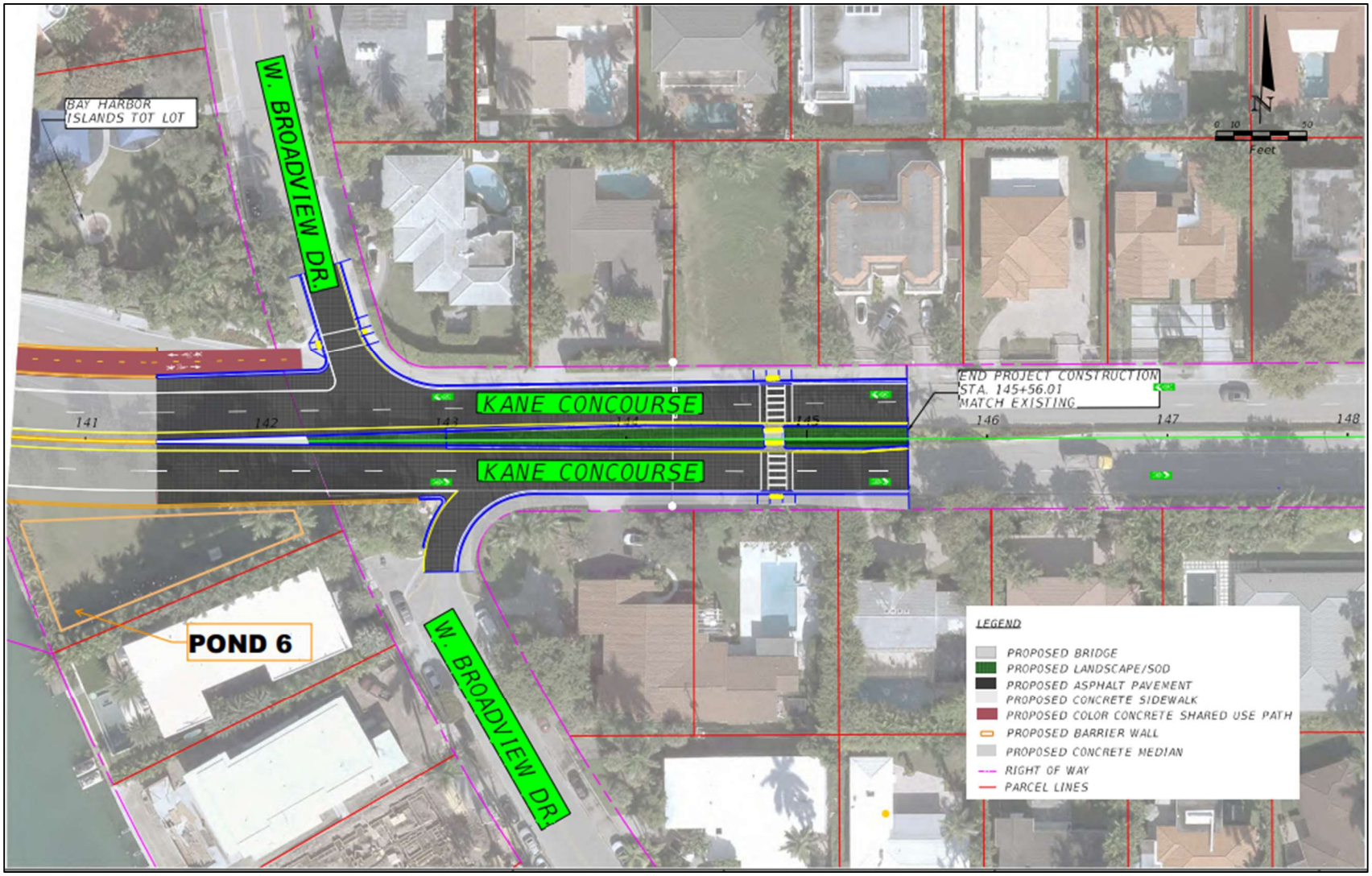


Figure D- 4: Layout of Retention Pond on the West Island

BCB Impervious-Pervious Areas (ac)												
Area	Existing						Proposed					
	Causeway Island	% of Total Area	West Island	% of Total Area	Total Project	% of Total Area	Causeway Island	% of Total Area	West Island	% of Total Area	Total Project	% of Total Area
DCIA	0.60	4%	2.90	100%	3.50	21%	0.00	0%	0.75	22%	0.75	4%
N-DCIA	3.92	29%	0.00	0%	3.92	24%	8.63	61%	2.49	74%	11.12	64%
Pervious	9.14	67%	0.00	0%	9.14	55%	5.50	39%	0.14	4%	5.63	32%
Total Area	13.67	100%	2.90	100%	16.57	100%	14.12	100%	3.38	100%	17.50	100%

Table D- 1: DCIA, N-DCIA, and Pervious Areas for Pre- and Post-development Conditions

Available Pond Storage				
Pond No.	**Location**	**Bottom Ele. (ft-NAVD)**	**Top Ele. (ft-NAVD)**	**Storage (ac-ft)**
1	Causeway Island	3	5	0.10
2		3	5	0.06
3		3	6	0.91
4		3	5	0.14
5		3	5	0.21
7		3	5	0.13
8		3	5	1.22
9		3	4	0.27
10		3	5	1.81
Total Causeway Island Storage:				**4.83**
6	West Island	3	5	0.14
Total West Island Storage:				**0.14**
Total Project Storage:				**4.97**

Table D- 2: Available Post-development Pond Storage

Appendix E: Pre/Post Development Nutrient Analysis

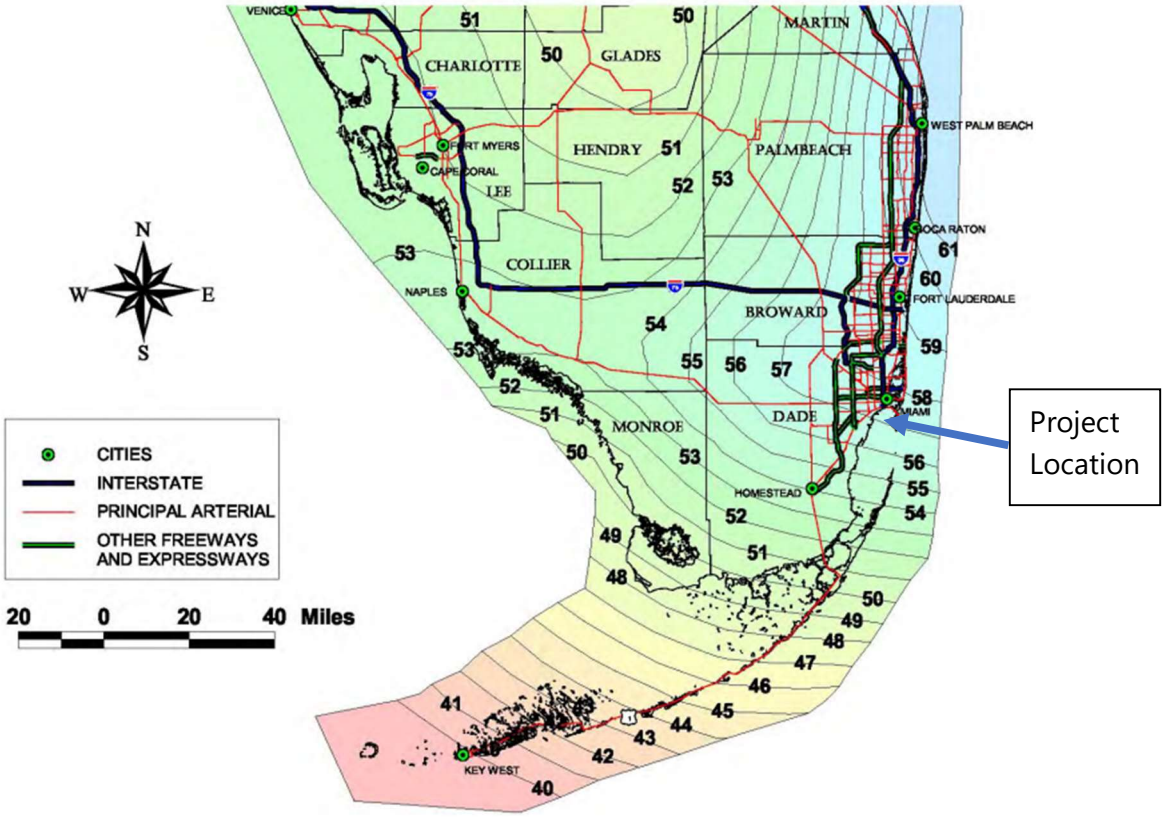


Figure E- 1: Stormwater Quality Handbook, ** Draft 3-17-2010**, Figure 3.6 Rainfall Isopleth Map for South Florida

Complete Report (not including cost) Ver 4.3.5

Project: Broad Causeway Bridge: Causeway Island
Date: 12/29/2023 1:34:54 PM

Site and Catchment Information

Analysis: Net Improvement

Catchment Name	Causeway Island
Rainfall Zone	Florida Zone 5
Annual Mean Rainfall	57.00

Pre-Condition Landuse Information

Landuse	Highway: TN=1.520 TP=0.200
Area (acres)	13.67
Rational Coefficient (0-1)	0.20
Non DCIA Curve Number	81.59
DCIA Percent (0-100)	4.00
Nitrogen EMC (mg/l)	1.520
Phosphorus EMC (mg/l)	0.200
Runoff Volume (ac-ft/yr)	12.897
Groundwater N (kg/yr)	0.000
Groundwater P (kg/yr)	0.000
Nitrogen Loading (kg/yr)	24.172
Phosphorus Loading (kg/yr)	3.180

Post-Condition Landuse Information

Landuse	Highway: TN=1.520 TP=0.200
Area (acres)	14.12
Rational Coefficient (0-1)	0.29
Non DCIA Curve Number	90.06
DCIA Percent (0-100)	0.00
Wet Pond Area (ac)	0.00
Nitrogen EMC (mg/l)	1.520
Phosphorus EMC (mg/l)	0.200
Runoff Volume (ac-ft/yr)	19.708
Groundwater N (kg/yr)	0.000
Groundwater P (kg/yr)	0.000
Nitrogen Loading (kg/yr)	36.935
Phosphorus Loading (kg/yr)	4.860

Catchment Number: 1 Name: Causeway Island

Project: Broad Causeway Bridge: Causeway Island
Date: 12/29/2023

Retention Design

Retention Depth (in)	4.100
Retention Volume (ac-ft)	4.824

Watershed Characteristics

Catchment Area (acres)	14.12
Contributing Area (acres)	14.120
Non-DCIA Curve Number	90.06
DCIA Percent	0.00
Rainfall Zone	Florida Zone 5
Rainfall (in)	57.00

Surface Water Discharge

Required TN Treatment Efficiency (%)	35
Provided TN Treatment Efficiency (%)	93
Required TP Treatment Efficiency (%)	35
Provided TP Treatment Efficiency (%)	93

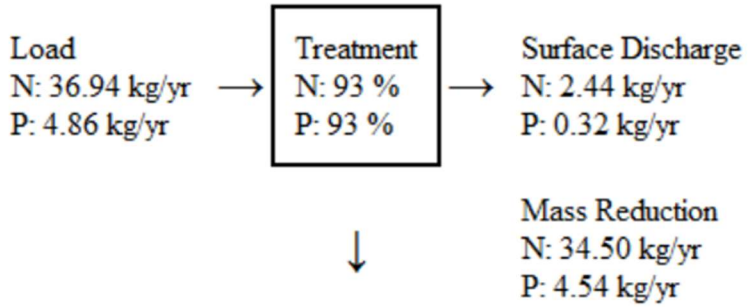
Media Mix Information

Type of Media Mix	Not Specified
Media N Reduction (%)	
Media P Reduction (%)	

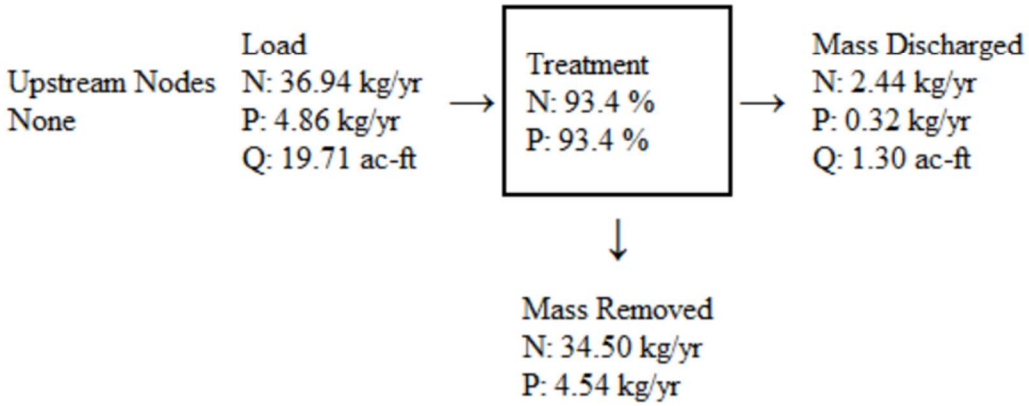
Groundwater Discharge (Stand-Alone)

Treatment Rate (MG/yr)	0.000
TN Mass Load (kg/yr)	34.499
TN Concentration (mg/L)	0.000
TP Mass Load (kg/yr)	4.539
TP Concentration (mg/L)	0.000

Load Diagram for Retention (stand-alone)



Load Diagram for Retention (As Used In Routing)



Summary Treatment Report Version: 4.3.5

Project: Broad Causeway Bridge: Causeway Island

Analysis Type: Net Improvement
BMP Types:
Catchment 1 - (Causeway Island) Retention
Based on % removal values to the nearest percent
Total nitrogen target removal met? **Yes**
Total phosphorus target removal met? **Yes**

Routing Summary
Catchment 1 Routed to Outlet

Summary Report

Nitrogen

Surface Water Discharge

Total N pre load	24.17 kg/yr	
Total N post load	36.94 kg/yr	
Target N load reduction	35 %	
Target N discharge load	24.17 kg/yr	
Percent N load reduction	93 %	
Provided N discharge load	2.44 kg/yr	5.37 lb/yr
Provided N load removed	34.5 kg/yr	76.07 lb/yr

Phosphorus

Surface Water Discharge

Total P pre load	3.18 kg/yr	
Total P post load	4.86 kg/yr	
Target P load reduction	35 %	
Target P discharge load	3.18 kg/yr	
Percent P load reduction	93 %	
Provided P discharge load	.321 kg/yr	.71 lb/yr
Provided P load removed	4.539 kg/yr	10.009 lb/yr

Figure E- 2: BMPTRAINS Report for the Nutrient Analysis of the Causeway Island

Complete Report (not including cost) Ver 4.3.5

Project: Broad Causeway Bridge: West Island
Date: 12/25/2023 1:04:05 PM

Site and Catchment Information

Analysis: Net Improvement

Catchment Name	BCB - West Island
Rainfall Zone	Florida Zone 5
Annual Mean Rainfall	57.00

Pre-Condition Landuse Information

Landuse	Highway: TN=1.520 TP=0.200
Area (acres)	2.90
Rational Coefficient (0-1)	0.81
Non DCIA Curve Number	95.00
DCIA Percent (0-100)	100.00
Nitrogen EMC (mg/l)	1.520
Phosphorus EMC (mg/l)	0.200
Runoff Volume (ac-ft/yr)	11.130
Groundwater N (kg/yr)	0.000
Groundwater P (kg/yr)	0.000
Nitrogen Loading (kg/yr)	20.860
Phosphorus Loading (kg/yr)	2.745

Post-Condition Landuse Information

Landuse	Highway: TN=1.520 TP=0.200
Area (acres)	3.38
Rational Coefficient (0-1)	0.51
Non DCIA Curve Number	94.33
DCIA Percent (0-100)	22.00
Wet Pond Area (ac)	0.00
Nitrogen EMC (mg/l)	1.520
Phosphorus EMC (mg/l)	0.200
Runoff Volume (ac-ft/yr)	8.174
Groundwater N (kg/yr)	0.000
Groundwater P (kg/yr)	0.000
Nitrogen Loading (kg/yr)	15.320
Phosphorus Loading (kg/yr)	2.016

Catchment Number: 1 Name: BCB - West Island

Project: Broad Causeway Bridge: West Island
Date: 12/25/2023

Retention Design

Retention Depth (in)	0.500
Retention Volume (ac-ft)	0.141

Watershed Characteristics

Catchment Area (acres)	3.38
Contributing Area (acres)	3.380
Non-DCIA Curve Number	94.33
DCIA Percent	22.00
Rainfall Zone	Florida Zone 5
Rainfall (in)	57.00

Surface Water Discharge

Required TN Treatment Efficiency (%)	
Provided TN Treatment Efficiency (%)	44
Required TP Treatment Efficiency (%)	
Provided TP Treatment Efficiency (%)	44

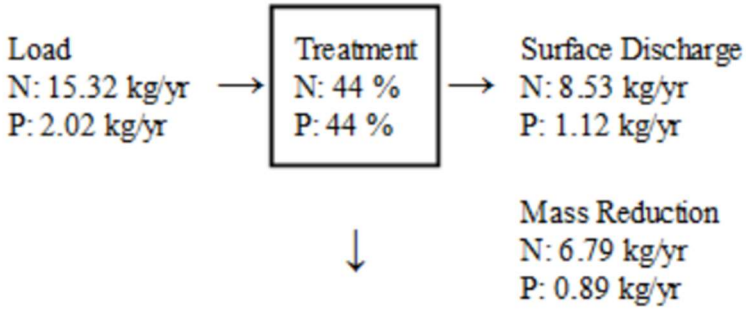
Media Mix Information

Type of Media Mix	Not Specified
Media N Reduction (%)	
Media P Reduction (%)	

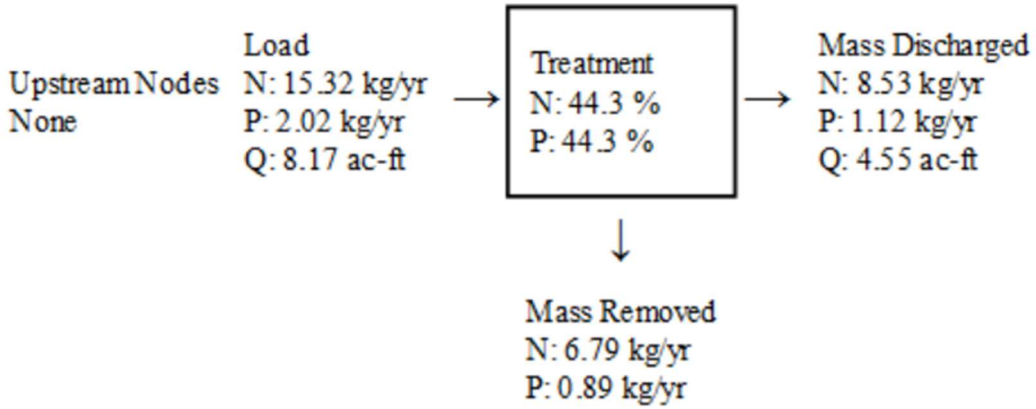
Groundwater Discharge (Stand-Alone)

Treatment Rate (MG/yr)	0.000
TN Mass Load (kg/yr)	6.786
TN Concentration (mg/L)	0.000
TP Mass Load (kg/yr)	0.893
TP Concentration (mg/L)	0.000

Load Diagram for Retention (stand-alone)



Load Diagram for Retention (As Used In Routing)



Summary Treatment Report Version: 4.3.5

Project: Broad Causeway Bridge: West Island

Analysis Type: Net Improvement
BMP Types:
Catchment 1 - (BCB - West Island) Retention
Based on % removal values to the nearest percent
Total nitrogen target removal met? **Yes**
Total phosphorus target removal met? **Yes**

Routing Summary
Catchment 1 Routed to Outlet

Summary Report

Nitrogen

Surface Water Discharge

Total N pre load	20.86 kg/yr	
Total N post load	15.32 kg/yr	
Target N load reduction	%	
Target N discharge load	20.86 kg/yr	
Percent N load reduction	44 %	
Provided N discharge load	8.53 kg/yr	18.82 lb/yr
Provided N load removed	6.79 kg/yr	14.96 lb/yr

Phosphorus

Surface Water Discharge

Total P pre load	2.745 kg/yr	
Total P post load	2.016 kg/yr	
Target P load reduction	%	
Target P discharge load	2.745 kg/yr	
Percent P load reduction	44 %	
Provided P discharge load	1.123 kg/yr	2.48 lb/yr
Provided P load removed	.893 kg/yr	1.969 lb/yr

Figure E- 3: BMPTRAINS Report for the Nutrient Analysis of the West Island

Town of Bay Harbor Islands
9665 Bay Harbor Terrace
Bay Harbor Islands, FL 33154
(305) 866-6241