Surfside

TOWNWIDE DRAINAGE IMPROVEMENT AND FLOOD HAZARD MITIGATION PLAN

DECEMBER 2023

Kimley»Horn

MATTHEW P. BROSMAN LICENSE No. 85460 ★ STATE OF FLORIDA PROFESSIONAL ENGINEER

Digitally signed by Matthew P Brosman
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Executive Summary

The Town of Surfside (Town) is a community incorporated on May 18, 1935, of approximately 1 square mile located along Biscayne Bay in northern Miami-Dade County. In January 2022, the Town entered into a funding agreement with the Florida Department of Economic Opportunity to administer mitigation disaster recovery funds through the U.S. Department of Housing and Urban Development Community Development Block Grant (CDBG-MIT). The priority for the awarded grant funding was to evaluate alternative drainage improvements throughout the Town. In June 2022, the Town selected Kimley-Horn and Associates, Inc. (Kimley-Horn) to provide the Townwide Drainage Improvement and Flood Hazard Mitigation Plan, also referred to in this report as the Town's Stormwater Master Plan (SWMP).

The purpose of this Stormwater Master Plan is to identify opportunities promote flood hazard mitigation by reducing flooding duration and maximum flood depths within the limits of the Town of Surfside, Florida. This Stormwater Master Plan includes the following components:

- A review of existing stormwater and drainage data, reports, and plans available through the South Florida Water Management District (SFWMD), Miami-Dade County, and Town sources.
- An assessment of the existing drainage system and flood hazard conditions within the Town of Surfside.
- A drainage deficiency map depicting existing problem areas, identifying locations where roadway flooding extends above the crown of road or to the finished floor of adjacent building.
- A stormwater hydrologic and hydraulic model of the existing system and its capacity to handle the 10-year, 24-hour and 100-year, 72-hour storm events.
- Identification and analysis of proposed improvement alternatives, conceptually designed to alleviate deficiencies identified in the hydrologic and hydraulic analysis.
- An Opinion of Probable Construction Cost (OPC) for proposed improvements and a Capital Improvement Plan (CIP) to provide the Town with a framework for implementing the recommended improvements.

Based on an extensive review of existing data and modeling of the existing condition of the Town stormwater system, Kimley-Horn and Town Staff identified five focus areas for detailed analysis through additional hydrologic and hydraulic modeling. The analysis proceeded to identify alternative solutions to achieve the following performance goals:

- During the 10-year return design storm event, flooding in roadway travel lanes should be below the crown of the roadway. This standard matches the current Miami-Dade County standard for arterial roadways.
- During the 100-year return storm event, flooding should be below the building finish floor elevations. This standard matches the current Miami-Dade County standard.

In addition, water quality and quantity requirements from state and county regulation were considered in the proposed improvements to prepare the Town for future design and construction permitting processes.

The project team identified solutions to improve performance in each focus area and developed opinions of probable construction cost to develop a Capital Improvement Plan (CIP). The total opinion of probable construction cost for the improvements proposed is $11,412,500.

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List of Abbreviations

BMP	Best Management Practice
CIP	Capital Improvement Plan
CRS	Community Rating System
DCA	Department of Community Affairs
FAC	Florida Administrative Code
EPA	Environmental Protection Agency
ERP	Environmental Resource Permitting
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FFE	Finished Floor Elevation
FIND	Florida Inland Navigation District
FS	Florida Statutes
GIS	Geographic Information System
HDPE	High Density Polyethylene
ICPR	Interconnected Channel and Pond Routing Model
Kimley-Horn	Kimley-Horn & Associates, Inc.
MHHW	Mean Higher-High Water
MLLW	Mean Lower-Low Water
MS4	Municipal Separate Storm Sewer System
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
OPC	Opinion of Probable Cost
SFWMD	South Florida Water Management District
SWMP	Stormwater Master Plan
SLR	Sea Level Rise
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USGS	United States Geological Survey

I. INTRODUCTION

The Town of Surfside (Town) was incorporated in 1935 and is approximately one square mile in area, located along Biscayne Bay in northern Miami-Dade County (County). See **Figure 1** for a location map of the Town.

Stormwater management and operation within the Town are managed by the Town Public Works Department. Outside of the Town's limits, the Florida Inland Navigation District (FIND) maintains and operates the Intracoastal Waterway in partnership with the U.S. Army Corps of Engineers (USACE). Stormwater management regulations, including those with respect to the discharge of stormwater and water quality standards, are determined by State regulation through the South Florida Water Management District (SFWMD).

In January 2022, the Town of Surfside entered into a funding agreement with the Florida Department of Economic Opportunity to administer mitigation disaster recovery funds through the U.S. Department of Housing and Urban Development Community Development Block Grant (CDBG-MIT). The priority for the awarded grant funding was to evaluate alternative drainage improvements throughout the Town, and in June 2022 the Town selected Kimley-Horn and Associates, Inc. (Kimley-Horn) to provide the Townwide Drainage Improvement and Flood Hazard Mitigation Plan, referred to in this report as the Town's Stormwater Master Plan (SWMP).

The purpose of this Stormwater Master Plan is to identify opportunities to protect surface water quality and reduce flooding within the Town limits. In addition, the intent is to enable the Town to examine the performance of the existing stormwater infrastructure, the effectiveness of its current Operation and Maintenance Program, and to identify prioritized capital improvement projects that will increase flood hazard mitigation.

This Stormwater Master Plan includes the following components:

- A review of existing stormwater and drainage data, reports, and plans available through SFWMD, Miami-Dade County, and Town sources.
- An assessment of the existing drainage system and flood hazard conditions with the Town of Surfside.
- A drainage deficiency map depicting existing stormwater problem areas, identifying locations where roadway flooding extends above the crown of road or to the finished floor of adjacent building.
- A stormwater hydrologic and hydraulic model of the existing system and their capacity to handle the 10-year, 24-hour and 100-year, 72-hour storm events.
- Identification and analysis of proposed improvement alternatives, conceptually designed to alleviate deficiencies identified in the hydrologic and hydraulic analysis.
- An Opinion of Probable Construction Cost (OPC) for proposed improvements and Capital Improvement Plan (CIP) to provide the Town with a framework for implementing the recommended improvements.

Figure 1. Location Map

II. DATA COLLECTION

Kimley-Horn collected available data on the existing stormwater management system and stormwater management requirements within the Town. Information was sourced from Miami-Dade County, the SFWMD, the Florida Department of Environmental Protection (FDEP), and the Town of Surfside. The datasets considered include local and regional planning efforts, stormwater regulations, existing studies, existing permits, existing plans and as-built drawings, field data collection, and resident reports.

A. Data Collection Summary

To begin the data collection phase, Kimley-Horn requested and reviewed the following data from the Town:

- Existing reports/studies
- Roadway drainage plans (past and planned)
- Resident Complaints and Town Reports of Flooding
- Available stormwater system GIS files

Kimley-Horn also collected the following data:

- FDOT pump station As-builts
- Existing land use data
- Natural Resources Conservation Service (NRCS) soils data
- Topographic data
- Tidal water level records from Virginia Key, Biscayne Bay, FL Station 8723214

All data was reviewed, filed, and recorded in a data collection log. A summary of the data collected is provided in **Table 1**.

Table 1. Data Collection Information

Data Type	Name	Provided By	Description
Field Measurements	Kimley Horn – Field Visits	Kimley-Horn	Field measurements of pipe sizes and inverts
Field Measurements	Town of Surfside- Field Visits	Town of Surfside	Field measurements of pipe sizes and inverts
GIS Data	Town of Surfside	Town of Surfside	Stormwater pipe, structure, and outfall size and invert information
GIS Data	Existing Land Use	Miami Dade County	Existing conditions land use, last updated November, 2022
GIS Data	Soils Resource Report	NRCS	Hydrologic soils information
Paving, Grading and Drainage Plans	Surfside 96th Street Park	SFWMD	Right of way and outfall drainage improvements at 96th Street Park
Permits	Environmental Resource Permits	SFWMD	Three Environmental Resource Permits (ERPs) of permitted developments within the Town

Data Type	Name	Provided By	Description
Precipitation Data	Precipitation Frequency Estimates	NOAA Atlas 14	Design precipitation frequency estimates
Precipitation Data	Precipitation Frequency Estimates	SFWMD	Design precipitation frequency estimates
Reports	Town Resident Flood Reports and Complaints	Town of Surfside	Resident-reported flooding reports and complaints
Roadway Drainage Plans	Abbott Avenue Drainage Improvements	Town of Surfside	Proposed Abbott Avenue stormwater and pump station improvements
Roadway Drainage Plans	Storm Drainage and Street Improvement Program	Town of Surfside	Roadway drainage construction plans
Roadway Drainage Plans	Bay Drive Drainage Improvements	Town of Surfside	Roadway drainage construction plans of Bay Drive
Roadway Drainage Plans	NE 96th Street Roadway Plans	Town of Surfside	Roadway drainage construction plans of 96th Street Pump Station
Roadway Drainage Plans	Biscaya Drainage Improvements	SFWMD	Gravity storm sewer drainage improvements
Topographic Data	2018 Miami Dade County lidar	Miami Dade County	Lidar data converted to NGVD 29 vertical datum
Topographic Survey	Abbott Avenue Drainage Improvements	Town of Surfside	Existing conditions survey for Abbott Avenue, 92nd Street, and 91st Street
Utility As-Builts	Pump Station at 88th Street & 94th Street	FDOT	88th Street, 94th Street pump station as-built plans
Utility As-Builts	Pump Station at 96th Street	Town of Bal Harbor	96th Street pump station as-built plans
Utility As-Builts	Town-Wide Stormwater Plan As-Builts	Town of Surfside	Town of Surfside roadway drainage as-builts

The following Sections provide a brief overview of each relevant data source.

B. Local and Regional Planning Efforts

A Unified Approach to Recovery for a Healthy & Resilient Biscayne Bay (2020)

The Biscayne Bay Task Force was established in 2019 by the Miami-Dade County Commission. The Task Force reviews studies related to the health of Biscayne Bay and makes recommendations for the health of the bay to the County. It set the stage for the establishment of the Biscayne Bay Watershed Management Advisory Board in 2021 which is tasked with advising the County Mayor and Commission, working with stakeholders to develop a watershed management plan, coordinating projects in priority areas, and expanding public outreach. The watershed management plan is in development but will likely include new pollutant load reduction goals to support the goal of restoring the health of the Bay. This local effort is included in this SWMP to notify the Town of potential future changes to stormwater treatment requirements prior to discharge.

Unified Sea Level Rise Projection Southeast Florida (2019)

The Southeast Florida Regional Climate Change Compact (SEFLCC) was developed among Broward, Miami-Dade, Monroe, and Palm Beach Counties to work collaboratively to reduce regional greenhouse gas emissions, implement adaptation strategies, and build climate resilience within their own communities and across the Southeast Florida region. The Compact's Regionally Unified Sea Level Rise Projection (USLRP) and accompanying guidance report are accepted or adopted by each of the four-counties' Boards of County Commissioners. This SWMP adopts the recommendations of the 2019 USLRP. The *Hydrologic and Hydraulic Analysis* Section of this SWMP details the sea level rise projection used in the analysis.

Miami-Dade County Local Mitigation Strategy

The Miami-Dade County Local Mitigation Strategy (LMS) is a whole community initiative designed to reduce or eliminate the long-term risk to human life and property from hazards. The LMS identifies projects that improve County resiliency with the goal of helping those projects secure funding. The Town of Surfside, The Village of Bal Harbour and the City of Miami Beach participate in the LMS. All three municipalities and the Miami-Dade County Department of Parks are administering LMS projects near or within the Town.

The Town coordinated with the County to have their projects included in the LMS as listed in **Table 2**. The LMS helps to minimize rework within the same location by identifying cases where two projects were planned within the same area, simultaneous construction should be considered. The LMS projects within the Town were considered in this SWMP, and recommended alternatives were reviewed for consistency with LMS projects. LMS projects outside of the Town in the table below are included for flood-mitigation reference, but do not impact the proposed alternatives in this SWMP.

Table 2. LMS Projects Within and Adjacent to the Town

Project Title	Agency	Project Status	Project Description
Vulnerability Assessment	Town of Surfside	Funding Applied For	Assessment of the Town's vulnerability to storm surge and flooding.
Drainage Station Generators	Town of Surfside	Future Project	Procurement of three generators to provide backup to drainage stations in the event of a wind or water induced power outage.
Beach Dune Restoration Project	Town of Surfside	Design and Permitting	Restoration of the sand dune system to increase elevation, remove invasive species, and plant native plants.
Collins Avenue Water Main Replacement	Town of Surfside	Funding Applied For	Replacement of a 70-year old water main that has experienced numerous leaks and major calcification, as well as corrosion from saltwater.
Sea Wall Replacement and Repair – Haulover Marina	Miami-Dade County Department of Parks	Future Project	Restoration or replacement 575 linear feet of seawall at Haulover Marina, in Baker's Haulover Cut, connecting the Intra Coastal Waterway and the Atlantic Ocean.
Village Hall	Village of Bal Harbour	Project in Planning Stage	Construction of a new Village Hall.
Village Seawall and Dock Renovation	Village of Bal Harbour	Project Complete	Reparation of seawall and dock at Bal Harbour Village Park.

Project Title	Agency	Project Status	Project Description
City Hall Hurricane Upgrade	Village of Bal Harbour	Project Complete	Installation of impact windows at the City Hall,new HVAC, new generator, structural termite repair, electrical upgrades, and security system installation and upgrades.
Biscayne Point - Neighborhood Improvements	City of Miami Beach	Project in Planning Stage	Provide a higher level of service for flood protection and control of pollutant loading into the stormwater system.
North Shore – Neighborhood Improvements (North Beach Town Center)	City of Miami Beach	Project in Planning Stage	Provide a higher level of service for flood protection and control of pollutant loading into the stormwater system.

C. Stormwater Regulations

Stormwater management practices in the Town of Surfside are influenced by the local and regional planning efforts described in the *Local and Regional Planning Efforts* Section, as well as by local, state, and federal regulations. More information on the programs and regulations that affect stormwater management practices in the Town are provided below.

National Pollution Discharge Elimination System (NPDES)

The NPDES is managed by the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP). FDEP issues NPDES permits for discharge from point sources, including municipal separate storm sewer systems (MS4s) outfall points. The Town of Surfside is a co-permittee of Miami-Dade County's MS4 permit, along with many other municipalities within the County, and is required to report annually on the following actions:

- Contribution to MS4 SWMP including implementation, inspection, and maintenance of structural controls and roadways
- Control and management of stormwater pollutants from areas of new development and significant redevelopment
- Control and management of stormwater pollutants from roadways
- Assurance that flood management projects and retrofitting of existing structural flood control devices consider water quality treatment
- Control and management of stormwater pollutants from municipal waste treatment
- Control and management of stormwater pollutants from application and storage of pesticides, herbicides, and fertilizers
- Control and detection of illicit discharges and improper disposal into MS4
- Control and management of stormwater pollutants from industrial and high risk runoff areas

- Control and management of stormwater pollutants from construction site runoff

The latest annual report from the Town details the maintenance, inspections, public outreach, and other actions taken by the Town during the 2021 cycle. Included in the report is a summary of water quality monitoring conducted in conjunction with the County per an Interlocal Agreement since 1994. The monitoring tests the waters of Biscayne Bay against numeric criterion for Total Nitrogen, Total Phosphorous, and Chlorophyll-A based on State standards for the nine Estuarine Regions in the area.

The MS4 permit requires the Town to conduct activities related to operation and maintenance of their MS4 system including public outreach, inspection, and maintenance. For more information on these activities refer to the *Operation and Maintenance Plan* section of this SWMP

U.S. Army Corps of Engineers (USACE) Regulatory Program

Major modifications to the stormwater system outfalls of the Town may trigger additional permitting requirements. Although the proposed alternatives in this SFWMD are not anticipated to require specific USACE permitting Kimley-Horn recommends that the Town or the Town's contractor, review state and federal regulations prior to design and construction for stormwater projects that outfall to Biscayne Bay.

The U.S. Army Corps of Engineers' (USACE) Regulatory Program involves the regulating of discharges of dredged or fill material into waters of the United States and structures or work in navigable waters of the United States, under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act of 1899. A proposed project's impacts to these areas will determine what permit type is required. Permit types are briefly summarized below:

- An individual, or standard permit, is issued when projects have more than minimal individual or cumulative impacts, are evaluated using additional environmental criteria, and involve a more comprehensive public interest review.
- A general permit is issued for structures, work or discharges that will result in only minimal adverse effects.
- Nationwide permits are issued by USACE on a national basis and are designed to streamline Department of the Army authorization of projects such as commercial developments, utility lines, or road improvements that produce minimal impact the nation's aquatic environment. More information on nationwide permits can be found here.
- A regional general permit is issued for a specific geographic area by an individual USACE District.
- The USACE operates a State Programmatic General Permit (SPGP VI) with the State of Florida that authorizes the state agencies of Florida to issue verification concurrently with their other state authorizations without requirement of applying separately for a Corps permit. SPGP VI authorizes shoreline stabilization (e.g., seawalls or riprap), boat ramps, docks, derelict vessel removal, and scientific devices.

National Flood Insurance Program (NFIP)

The NFIP is managed by the Federal Emergency Management Agency (FEMA) and the Florida Department of Community Affairs (DCA). The Town of Surfside joined the NFIP Community Rating System (CRS) program in October of 2016 and has a class rating of 6 as of April 2023. The Town's Floodplain Manager is responsible for managing the Town's involvement with the NFIP. The Town improved its score from Class 7 to Class 6 in 2021. CRS class ratings determine the discount applied to the full-risk premium for all NFIP policies in the Town, including policies outside of the SFHA. The Town achieved this improvement by increasing its scores in several key areas of the CRS outlined in **Table 3**.

Table 3. CRS Areas of Greatest Improvement

CRS Activity	2017 Score	2021 Score	Difference
Outreach Projects	300	350	50
Flood Protection Assistance	55	100	45
Flood Insurance Promotion	0	90	90
Open Space Preservation	47	94	47
Higher Regulatory Standards	241	411	170

The Town achieved the maximum possible score for the **Elevation Certificates**, and **Map Information Service** activities. Maximum scores for **Outreach Projects** and **Flood Response Preparations** subsections were also achieved. Strengthening of the Town's regulatory standards resulted in the greatest improvement from 2017 to 2021. The upgrade from Class 7 to Class 6 resulted in an increased premium reduction from 15% to 20%.

Maintaining or improving the Town's CRS rating requires inter-departmental teamwork. The Town can increase its CRS class rating, which affects the flood insurance discount residents in the community are eligible for, by following activities outlined in the current version of the FEMA CRS Coordinator's Manual.

The 2021 CRS Verification Report identified two areas where the Town can improve their scores. The Town can further improve its score in the **Floodplain Management** activity by adopting at least a 10-year design storm event. The Town has currently adopted a 5-year design storm event, and the CRS does not credit design storms lower than a 10-year event.

The **Stormwater Management** activity also has room for improvement. The primary means for improving the Town's score in this activity is to adopt a watershed master plan or a stormwater master plan that complies with CRS requirements. Adopting this SWMP will improve the Town's Stormwater Management score, contributing to improving the Town's overall CRS score.

Environmental Resource Permit (ERP) Program

The Environmental Resource Permit (ERP) Program is regulated through the FDEP and SFWMD. The program regulates development involving the alteration of surface water flows. The ERP program reviews qualifying projects to prevent flooding, protect water quality of lakes, streams, and other surface waters from stormwater pollution. SFWMD reviews ERPs for residential and commercial developments, roadway construction and agriculture. FDEP reviews ERPs for power plants, ports, wastewater treatment plants, and single family home projects. The *Environmental Resource Permit Applicant's Handbook Volume I* defines each permit type.

The ERP review process verifies that a project will not negatively impact water quality, public health, safety, and welfare, navigation or surface water flows, fishing or recreational uses, increase flooding, or impact wetlands, fish or wildlife. Active ERPs are subject to periodic compliance inspections to ensure continued compliance with the terms of the permit.

The proposed alternatives in this SWMP will require an ERP permit or revisions to existing permits.

Miami-Dade County Stormwater Permitting Program

Miami Dade County issues One-Time Environmental Permits (OTEP) prior to construction or modification of a building structure or property. Of the nine OTEPs, Kimley-Horn identified six OTEPS that regulate stormwater in the County.

The Class I OTEP is required for projects performing work in, on, over or upon tidal water or coastal wetlands in the County or any municipalities located within the County. In cases where environmental impacts are unavoidable, mitigation is required.

The Class II OTEP controls stormwater discharge to any surface water in the County. The Class II Permit is needed to control the pollution inherent in stormwater runoff.

The Class III OTEP authorizes construction within non-tidal canals or areas under the direct control of Miami-Dade County, such as canal rights-of-way, canal maintenance easements and reservations.

The Class IV OTEP is required for construction within areas dominated by wetland plant species as defined by Chapter 24-5 of the Miami-Dade County Code (reference Section 373.019, Florida Statutes), areas subject to prolonged periods of inundation or saturation and/or areas where hydric soils are present. Class IV permits determine whether a proposed project avoids or minimizes wetland impacts. Projects that do not avoid impacts must provide mitigation for any proposed impacts.

The Class V OTEP authorizes temporary dewatering or whenever water is removed from an excavation, from the ground or existing structure to ensure that sediment, turbidity, and contaminants are removed before it is later discharged.

The Class VI OTEP authorizes the installation of a drainage system for any project that has known soil or groundwater contamination; or that uses, generates, handles, disposes of, discharges, or stores hazardous materials.

The projects identified in this SWMP will require OTEPs belonging to one or more of the categories discussed above.

Town Ordinances and Regulations

Local ordinances represent the Town's adoption of regional requirements and are a representation of the Town's attention to achieving a level of service. The following ordinances are relevant to stormwater system design and flood protection.

Code 1960, § 6B-27(b); Ord. No. 1442, §§ 1, 2, 9-9-03 – Stormwater Management Requirements sets requirements for proposed stormwater management systems in private development. The performance standards consist of maintaining the rate, volume, quality and timing of stormwater runoff equivalent or below existing conditions, treating the first inch of stormwater runoff in an off-line retention system, and complying with all water quality standards set forth in chapter 17-3 of the Florida Administrative Code.

Ord. No. 1392, § 2, 12-8-98 – Stormwater Utility System established the Town-wide stormwater utility and fee collection mechanism to plan, construct, operate and maintain the stormwater management system.

Ord. No. 2023-1734, § 2, 3-14-23 – The ordinance amends section 90-60 "Construction Next to Sea Walls" and 90-63 "Miscellaneous Elevations for Sea Walls, and Groins" to establish a minimum elevation for new sea walls equal to or greater than the Base Flood Elevation (BFE) as set forth in the applicable Flood Insurance Rate Map (FIRM). The maximum elevation of a sea wall shall not exceed the Town's minimum Design Flood Elevation (DFE) of 8.5 feet, NAVD88.

Ord. No. 2023-1743, § 2, 5-9-23 – the ordinance amends sections 34-26, 34-37, 34-30, and 34-31. The ordinance also adds section 34-25 and sections 34-32 through 34-40. The ordinance regulates non-stormwater discharges into the Town's MS4 and establishes criteria for enforcement and penalties for violations of Chapter 34 Article 2 "Stormwater Drainage Management". The ordinance establishes the use of BMPs, Sediment Erosion and Control Plans (SECPs), and responsibility to report illicit discharges.

D. Existing Studies

The Town has not completed a comprehensive Stormwater Master Plan to date. Key studies of the Town's stormwater network and flooding risk available at the time of this SWMP are highlighted below in chronological order:

Drainage Report for Town of Surfside Drainage Improvements (2008)

Calvin, Giordano, and Associates Inc. (CGA) developed a drainage report for the Town per NPDES permit requirements. The drainage report provided a framework for implementing water quality improvements within the Town. See the *National Pollution Discharge Elimination System (NPDES)* Section of this SWMP for more information on the NPDES program.

The drainage report modeled nine sub-basins representing the Town, in existing and proposed conditions. The model determined peak stages for each sub-basin and peak discharge rates at Town outfalls. CGA also developed water quality volume and pollutant loading calculations for stormwater entering the Town's system.

The drainage report recommended the installation of drainage wells to reduce pollutants discharged into Biscayne Bay. The drainage report also recommended routine street cleaning, inspection of commercial properties to ensure proper storage of hazardous material, inspect functionality of wastewater and stormwater systems, and inspection and maintenance of sediment removal devices, drainage wells, and the Town stormwater system. Many of these activities are specifically covered by the NPDES permit requirements.

This SWMP reviewed the drainage study for consistency with current as-built information provided by the Town, and for an understanding of the Town's water quality protection efforts.

FEMA Flood Hazards

The Town is susceptible to coastal flooding from two sources, Biscayne Bay and the Atlantic Ocean. The Atlantic Ocean borders the Town to the east. Wave energy in the area is low relative to other portions of Florida, primarily due to the proximity of the Bahamas Banks, which provide a sheltering effect from oceanic storm waves. Biscayne Bay is located west of the Town and separates the Town from the mainland Florida peninsula.

FEMA Flood Insurance Rate Maps (FIRM) are used to depict how likely it is for an area to flood. Areas within a FIRM are classified under different flood zones, the flood zones present in the Town are described in **Table 4**. In the Town of Surfside they represent flooding risk from the two coastal flooding sources discussed above. Current effective FEMA FIRM Panels 12086C0144L, 12086C0163L, 12086C0307L, and 12086C0326L with an effective date of September 11, 2009, show that the area west of Collins Avenue is located within Flood Zone AE with Base Flood Elevation (BFE) values ranging from 8 to 9 feet, NAVD88. Developed areas east of Collins Avenue are designated as Flood Zone X Unshaded. The beach on the east coast of the Town encompasses various flood zones: Flood Zone X Shaded, Flood Zone AE with BFE values ranging from 8 to 10 feet, NAVD 88, and Flood Zone VE with BFE values ranging from 8 to 11 feet, NAVD88.

Table 4. Flood Zone Descriptions

Flood Zone	Description
VE	Coastal areas subject to inundation by the 1% annual chance flood event and have an additional hazard associated with storm waves.
AE	Areas subject to inundation by the 1% annual chance flood event.
AO	Areas subject to inundation by the 1% annual chance flood event, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet.
X Shaded	Areas subject to inundation by the 0.2% annual chance flood event.
X Unshaded	Areas of minimal flood hazard.

Preliminary FEMA FIRM Panels 12086C0144M, 12086C0163M, 12086C0307M, and 12086C0326M were issued on February 25th, 2021. These panels show the Town west of Collins Avenue within Flood Zone AE with a BFE of 7 feet, NAVD 88, with small portions of Flood Zone X Shaded. East of Collins Avenue the Town is within Flood Zone AO depth 3 feet, Zone AE with BFE values ranging from 7 to 10 feet NAVD 88, and Flood Zone VE with BFE values ranging from 9 to 11 feet, NAVD 88. Some portions of the seawall on the west side of the Town, along Biscayne Bay, are within the Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between Zone VE and the LiMWA (or between the shoreline and the LiMWA for areas where Zone VE is not identified) will be similar to, but less severe than, those in the Zone VE. These panels are not effective as of December 2023.

The proposed alternatives in this SWMP consider rainfall-induced flooding from two storm events, influenced by tidal cycles. However, the proposed alternatives do not consider flooding mitigation due to coastal flooding.

American Flood Coalition Flood Adaptation Assessment Pilot (2021)

The American Flood Coalition (AFC) partnered with Atkins in 2021 to conduct a vulnerability analysis using the Atkins City Simulator tool. The City Simulator tool combines federal, state, and local datasets to model resiliency of a desired municipality between 2019 and 2050. The tool also tests adaptation strategies and their effectiveness against the same datasets. Comparing the results of the baseline scenario against different adaptation strategies helps determine the most effective steps municipalities can take to improve resiliency.

The City Simulator tool determined that the most effective adaptation strategy for the Town of Surfside is to convert select lots within the Town into stormwater retention areas with injection wells. The study states that the added retention capacity will reduce flood depths in the 500-year flooding event.

This SWMP reviewed and considered this analysis to further identify the Town's at-risk infrastructure.

Abbott Avenue Proposed Drainage Improvements (2022)

Keith and Associates, Inc. (KEITH) conducted a study of the Town's stormwater management system and provided drainage improvement alternatives centered around Abbott Avenue. The study found that Abbott Avenue currently experiences greater flooding than surrounding areas due to its distance from existing outfalls and low existing elevations relative to adjacent roadways. The study determined that designing and constructing pump stations and drainage wells along Abbott Avenue at 91st and 92nd Street resulted in reduction of peak flood stages in the area.

The original approved design of these stormwater improvements consisted of two stormwater pumps, one on 91st Street and one on 92nd Street. Further efforts by the Town and KEITH to value engineer the project resulted in splitting the project into two phases. The Town has moved forward with plans to construct drainage improvements at 91st Street and will construct drainage improvements along 92nd Street at a later date. As of December 2023, construction has not begun on this project.

This SWMP adopts both phases of the KEITH improvements into the existing conditions of the Town.

E. Existing Permits

Kimley-Horn collected existing permit information from SFWMD and Miami-Dade County Stormwater Management. Review of existing permits collected generally indicate permitted areas consist of private stormwater management systems associated with commercial, retail, or multifamily developments. Private permitted areas generally manage stormwater entirely onsite and do not discharge to the Town stormwater system. Therefore, private stormwater management systems were not considered in this SWMP.

Review of existing permits provided only a few permits with municipal ownership. Those that were found related to authorization of construction and operation of elements of the Town stormwater system.

FDEP MS4 Permit

The Town of Surfside is a co-permittee of Miami-Dade County's MS4 permit, the Town's requirements under that permit are detailed in the *National Pollution Discharge Elimination System (NPDES)* section of this SWMP. The Town provided the 2021 NPDES MS-4 Annual Report for review in this SWMP, which provided a summary of the Town's stormwater management performance against the permit's goals. The Annual Report assessed elements of the Town's Stormwater Management Program and deemed that the Town met the standards of all applicable portions of the Stormwater Management Program Summary Table.

Environmental Resource Permits (ERPs)

The Town applied for an ERP in April, 2022 for drainage of a proposed park at 9572 Bay Drive, Surfside, Florida. The proposed drainage system collects and treats all rainwater with a seepage system. Kimley-Horn determined that this permit application and proposed project do not significantly impact the Town's stormwater system.

Miami-Dade County Permits

DERM operates a Class II permit, last renewed in 2012, for drainage improvements identified in the *Drainage Report for Town of Surfside Drainage Improvements (2008)*. The permit authorized construction of improvements throughout the Town that improved water quality of discharge to Biscayne Bay. Existing Plans and As-Built Drawings

F. Existing Plans and As-Built Drawings

Kimley-Horn compiled as-built drawings and existing plans of the Town stormwater system. Existing plans and as-builts detailed drainage layouts, inverts, pipe sizes, pipe material, and pump station data. All relevant pump data can be found in the *Pump Station Data* Section of this SWMP. Modeling efforts to develop the proposed alternatives in this SWMP incorporated the most up to date information of the Town stormwater system.

FDOT Plans

The FDOT provided As-built plans for pump stations along 96th Street, 94th Street, and 88th Street. All relevant pump data can be found in the *Pump Station Data* Section of this SWMP.

Town Record Drawings

The Town provided Kimley-Horn with record drawings including plans of the entire existing Town stormwater system, stormwater improvements along Biscaya Drive and Bay Drive, maps of major outfalls and monitoring sites, the most recent stormwater atlas, and pump data for Town and FDOT pump stations. The complete stormwater system as-built set is from 2008 and was supplemented by more recent plan sets.

Roadway Drainage Plans - Abbott Avenue Drainage Improvements (2022)

Keith and Associates, Inc. (KEITH) was hired by the Town to develop hydrologic and hydraulic modeling and engineering design for drainage improvements on Abbott Avenue. The report was provided to Kimley-Horn for implementation of the proposed pump station and associated infrastructure into the existing conditions modeling analysis. A summary of the KEITH report is included in the *Abbott Avenue Proposed Drainage Improvements (2022)* section of this SWMP. KEITH documentation included surveys of Abbott Avenue, 92nd Street, and 91st Street, and drainage design plans along 91st Street.

This SWMP adopts the KEITH design improvements into the existing conditions of the Town. All models, identified projects, and analysis treat the KEITH improvements as completed. However, as of December 2023, construction has not begun on this project.

Pump Station Data

Eight pump stations influence the Town stormwater system: four existing pump stations maintained and operated by the Town, two pump stations from the Abbott Avenue project designed by KEITH and to be maintained and operated by the Town, and three existing FDOT pump stations. **Figure 3** shows the location of all nine pump stations.

Kimley-Horn compiled data from As-builts, SCADA information, and design plans into **Table 5**. Pump elevation on and elevation off data for Town pumps was determined from existing SCADA information. Elevations for FDOT pumps and the designed Abbott Avenue pump were determined from As-builts and design plans, respectively.

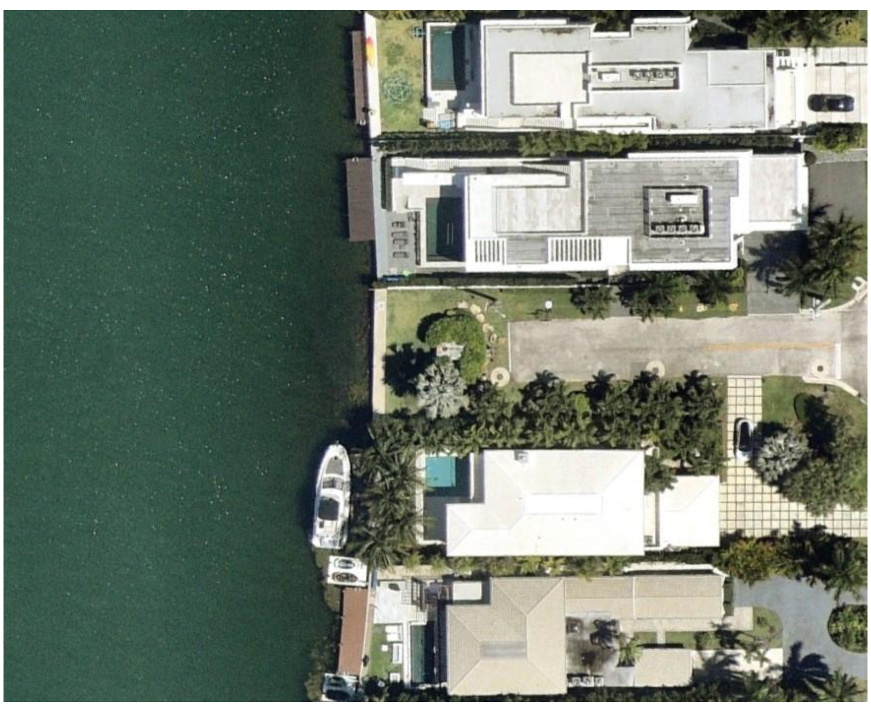

Figure 2. Pump Station at 94th Street and Bay Drive

Figure 3. Pump Location Map

Table 5. Pump Data Summary

Pump Location	Pump Owner	GIS Label	Status	Pump Capacity (cfs)	Drainage Well Capacity (GPM)	Elevation On (ft NAVD88)	Elevation Off (ft NAVD88)
94th Street and Bay Drive	Town	PS-1	Active	20	1-620 2-800	4.51	-10.99
92nd Street and Bay Drive	Town	PS-2	Active	20	N/A	-0.99	-5.99
89th Street and Hawthorne Avenue	Town	PS-3	Active	20	1-500 1-550 1-800	-0.99	-5.99
92nd Street and Abbott Avenue [2]	Town	PS-4	Designed, Not Constructed	Lead: 4.75 Lag: 24.5	3-500	Lead: 0.5 Lag: 1.0	Lead: -8.0 Lag: -8.0
91st Street and Abbott Avenue [1]	Town	PS-5	Designed, Not Constructed	Lead: 4.75 Lag: 24.5	3-500	Lead: 0.5 Lag: 1.0	Lead: -8.0 Lag: -8.0
88th Street and Carlyle Avenue	Town	PS-6	Active	20	1-400 1-500 1-650	-0.99	-5.99
88th Street and Byron Avenue	FDOT	PS-7	Active	Lead: 26.84 Lag: 26.84	4-600	Lead: -2.5 Lag: -1.5	Lead: -3.82 Lag: -3.82

Pump Location	Pump Owner	GIS Label	Status	Pump Capacity (cfs)	Drainage Well Capacity (GPM)	Elevation On (ft NAVD88)	Elevation Off (ft NAVD88)
94th Street and Abbott Avenue	FDOT	PS-8	Active	Lead: 26.84 Lag: 26.84	4-600	Lead: -2.5 Lag: -1.5	Lead: -3.82 Lag: -3.82
96th Street and Bay Drive	FDOT	PS-9	Active	Lead: 26.84 Lag: 26.84	4-600	Lead: 0.57 Lag: 0.76	Lead: -2.98 Lag: -3.96

[1] **Abbott Avenue Revision Drawings, Phase 1**

[2] **Abbott Avenue Revision Drawings, Phase 2**

This SWMP adopts the listed pump information as part of the Town's existing stormwater system and assumes that all pumps are operating at design capacity. The pumps along Abbott Avenue at 92nd Street and 91st Street were designed by KEITH but have not been constructed as of December 2023. The construction of the two Abbott Avenue pumps will happen in two phases, the Phase 1 will build the 91st Street pump and Phase 2 will build the 92nd Street pump. Bringing these pumps to operational status is not included in the SWMP's recommendations, capital improvement plan, or opinion of probable cost. Refer to the *Improvements Outside of Focus Areas* Section of this report for recommendations to improve Town pump station efficiency.

G. Geographic Information System (GIS) Data

The Town provided Kimley-Horn with a series of stormwater atlas GIS files. The stormwater atlas includes locations and names for all inlets, outfalls, manholes, pumps, and other stormwater structures within the Town. The atlas also includes stormwater pipe locations, sizes, materials, and inverts when available. The Town's atlas had locations with missing invert data, and some locations contained no available data. See **Figure 4** for locations in the Town atlas with no data.

Figure 4. Locations with No Data

Kimley-Horn revised the existing stormwater atlas using data collected from the field (Refer to *Field Data Collection* Section below). Field data superseded existing data where appropriate, and field data was added to the atlas in areas with missing data. the stormwater atlas was also updated with data from the *Existing Plans and As-Built Drawings* Section of this SWMP.

H. Field Data Collection

Kimley-Horn performed stormwater system data collection over two weeks in August 2022. Invert elevations for inlets and manholes missing from GIS data provided by the Town were recorded and verified in the field. The current condition of these areas was also evaluated and documented to identify any obstructions such as sand/sediment accumulation. **Figure 5** shows locations within the Town where Kimley-Horn collected data in yellow.

Figure 5. Field Visit Data Points

Kimley-Horn worked closely with Town staff to collect this data. Kimley-Horn collected photos, structure type, depth of pipe inverts below manholes or grates, pipe direction, and recorded comments on the conditions of the structures. This field data was then uploaded to a feature layer in ArcGIS Pro. After correcting for sedimentation where necessary, Kimley-Horn subtracted recorded invert depths of observed pipes from lidar-determined ground elevations to finalize invert elevations.

Sediment was present in 34 of the 89 inlets and manholes that Kimley-Horn observed. **Figure 7** shows all locations in the Town's existing stormwater system where these observations were recorded.

The revised invert elevations, pipe directions and sizes, were compiled into new GIS shapefiles and used in the existing and proposed conditions models to provide an accurate simulation of conveyance through the stormwater network.

Figure 6. Example of sediment at Collins Avenue and 95th Street

Figure 7. Observed Sediment

I. Resident Reports

Kimley-Horn reviewed drainage complaints submitted by residents and documented by staff, including photos during and after storm events and King Tides. See the *Tidal Data Analysis* Section of this report for more information on King Tides. **Figure 8** shows the locations of areas that received resident complaints of flooding and **Figure 9** shows locations where Kimley-Horn received photos from residents of flooding within the Town.

Figure 8. Resident Complaint Locations

Figure 9. Resident Flood Photos

Two hybrid (in-person and virtual) meetings were held at the Community Center in October 2022 and July 2023. The initial meeting in October 2022 focused on sharing project goals, educating the community on sea level rise science and resilience, and soliciting early feedback on perceived flood risk, concerns, flooding hot spots, and solutions. This meeting facilitated the collection of resident data by providing a forum for residents to submit their complaints. Residents were asked to place points where they observed flooding on a map of the Town. Residents also had access to a digital comment card and flood map reporting tool.

Figure 10. Town of Surfside Community Center

The July 2023 meeting's main purpose was to inform residents about the purpose, plan, and results of the SWMP. Residents had the opportunity to ask questions and provide comments to the panel, consisting of the Kimley-Horn Team, the Mayor, Town Manager, Public Works Director, and Assistant Public Works Director. Input from Town Staff and Residents formed the basis for improvement recommendations found in the *Improvements Outside of Focus Areas* Section of this SWMP. Resident complaint data and photos were mapped by Kimley-Horn and factored into selecting focus areas for proposed projects. See the *Focus Area* Identification Section of this SWMP for more information on how focus areas were selected.

Figure 11. King-Tide Event in November 2022 at 89th Street and Bay Drive

III. HYDROLOGIC AND HYDRAULIC ANALYSIS

A hydrologic and hydraulic analysis of the entire Town was conducted as the main vehicle for identifying and recommending stormwater system improvements. Kimley-Horn developed a 1-D ICPR model of the Town, divided into sub-basins, to evaluate the existing flooding conditions within the Town during two design storm events: the 10-year, 24-hour storm and the 100-year, 72-hour storm.

Kimley-Horn utilized the existing results to identify areas experiencing high inundation depths or long flooding durations during these storm events. Existing conditions results factored into the selection of focus areas detailed in the *Focus Area Identification*.

Once the existing model was deemed complete and focus areas were chosen, the projects identified in this report (refer to the *Proposed Improvements* Section) were added to the model to quantify the potential flood hazard mitigation through reduction in flood stage and flood duration. Each identified project was implemented individually in the model to understand its impact without interference from other project impacts. Proposed conditions results factored into the selection of preferred alternatives in the *Proposed Improvements* Section of this SWMP.

Modeling of the Town stormwater system was important to developing this SWMP due to the following benefits:

- It allows for analyzing the interconnectivity of the sub-basins. Improvements in one sub-basin may have far reaching effects across the Town, especially when located in sub-basins hydraulically connected to Biscayne Bay, relieving bottlenecks at the outfalls. Hydraulic capacity increases in one area of the Town, therefore allow other areas to drain more effectively. See **Appendix E** for flood duration reduction heatmaps showing this effect.
- It holds the capacity to be perpetually revised to include new projects and new scenarios. The goal of this SWMP is to serve as a planning document for the Town. Although the written recommendations are limited to the projects analyzed, the model can be updated as needed to include future scenarios of interest to the town.

A. Town Performance Goals

Kimley-Horn identified performance goals through various meetings with Town Staff. These performance goals represent the minimum standards for sub-basin performance.

Water Quantity Performance Goals

- During the 10-year return design storm event, flooding in roadway travel lanes should be below the crown of the roadway. This standard is the same as the current Miami-Dade County standard for arterial roadways.
- During the 100-year return storm event, flooding should be below the building finish floor elevations. This standard is the same as the current Miami-Dade County standard.

Water Quality Treatment Performance Goals

All waters of Miami-Dade County are Class III with designated uses of Fish Consumption, Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife, and have corresponding water quality criteria per the State. In addition, Biscayne Bay encompasses two state aquatic preserves, one of which borders the Town. It is an Outstanding Florida Waters, and no degradation is permitted.

As noted by the participation of the Town in various local efforts for water quality protection and the various local, regional, and state regulations in the *Stormwater Regulations* Section of this report, the Town and its residents are committed to maintaining the health of Biscayne Bay. This SWMP considers stormwater quality measures and documents anticipated changes to water quality requirements to help the Town plan for implementation of proposed improvements.

Flood Hazard Mitigation Goals

Flood hazard mitigation encompasses all actions that reduce property damage and threat to life and public health from flooding. Two ways to mitigate flood hazards are to reduce peak flood stages and flood duration. The Town is committed to flood hazard mitigation through the construction of drainage improvements that will achieve either peak stage reduction or flood duration reduction. For more information on drainage improvements to improve flood hazard mitigation, see the *Proposed Improvements* section of this SWMP.

B. Study Area

The study area of the Townwide Drainage Improvement and Flood Hazard Mitigation Plan encompasses all drainage basins west of Collins Avenue. Private properties east of Collins Avenue are assumed to discharge to permitted stormwater injection wells without interconnection to the model area (Refer to *Existing Permits* Section of this report).

For the purposes of this SWMP, the study area is divided into 73 drainage sub-basins, interconnected by a system of pipes, catch basins, and pumps. Sub-basins also interact via overland flooding across connecting roads. See **Figure 12**.

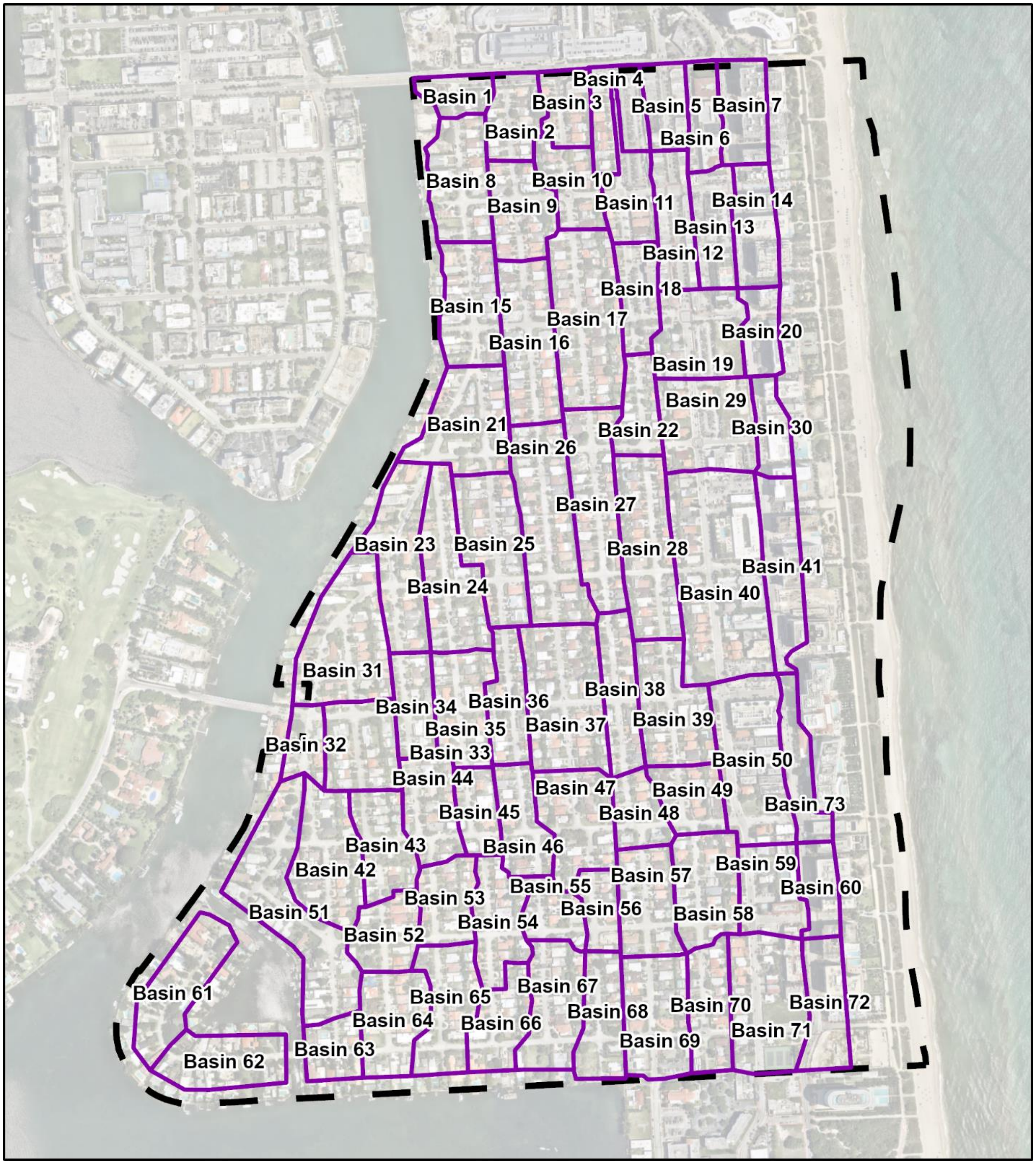

Figure 12. Sub-Basins

C. Model Inputs

The hydrologic and hydraulic modeling utilized to evaluate each priority project against existing conditions and the Town performance goals (refer to the *Town Performance Goals* Section of this report), is based on the data collected and described in previous Sections of this SWMP. A separate 1D hydrologic and hydraulic model was prepared using Interconnected Channel and Pond Routing Model (ICPR) v. 4.07 modeling software for each priority area with hydrologic parameters and inputs as described below.

Design Storm Intensities

To define design storms, the rainfall data for the 10-year, 24-hour and 100-year, 72-hour storm events were obtained from the South Florida Water Management District (SFWMD) isohyetal maps and from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14. The more conservative NOAA values were chosen. Change factors for rainfall intensities in future conditions are not included in the model.

The modeled design storm intensities were chosen based on the recommended Levels of Service which coincide with the Town's performance goals. Modeling the 10-year, 24-hour storm event is based on the Miami-Dade County Public Works Manual degree of protection standard. It states that 4-Lane roads in high density, high traffic areas should be designed with drainage facilities capable of conveying the 10-year, 24-hour storm event, to prevent the peak flood stage from overtopping the crown of road.

The 100-year, 72-hour storm event is based on Chapter 11C of the Miami-Dade County Municipal Code which states that the finished floor elevation of a building "for all uses and whether the property is located in a Special Flood Hazard Area, or outside" shall be the higher of the base flood elevation shown in the Flood Insurance Rate Maps or 4 to 8 inches (depending on the designated use of the building) above the elevation established by the County Flood Criteria (CFC) Map.

The 10-year, 24-hour, and 100-year, 72-hour rainfall totals from the SFWMD Isoheytal maps are 8.52, and 17.60 inches, respectively. These rainfalls were distributed across a 24-hour or 72-hour period using the FLMOD 24-hour rainfall and SFWMD 72-hour rainfall distributions, as appropriate.

Table 6. Rainfall Depths per Storm Event

Storm Event	Rainfall Depth (inches)
10-year, 24-hour	8.52
100-year, 72-hour	17.60

Topographic Data

The Digital Elevation Model (DEM) that covers the study area was acquired from Miami-Dade County. The DEM was available with a 5-foot grid cell size and was developed with lidar data collected in 2018. The DEM is the basis for development of many model features and parameters including basin boundaries, stage-area, and overland weir elevation data. The DEM was reviewed to determine if there were any voids or "noise" in the topographic data that would impact model features or model parameters. No significant voids to the topographic data were observed that would cause issues during the modeling process.

Land Use

The Curve Number (CN) method is an empirical surface runoff method developed by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (formerly the Soil Conservation Service) to estimate runoff and infiltration. The TR-55 Urban Hydrology for Small Watersheds document provides runoff curve numbers for different land use and soil types.

Within ICPR, percent impervious and the percent of directly connected impervious area (DCIA) can be assigned. Percent impervious is defined as the total percentage of impervious area for the corresponding land cover zone. When DCIA is used impervious areas should be excluded from the curve numbers and curve numbers would be representative of the pervious areas only. DCIA encompasses those impervious areas that are directly connected to a basin's outfall. Runoff flows along DCIAs without passing over any pervious areas (e.g. roof to driveway to curb and gutter to storm sewer to detention pond).

Percent impervious, DCIA, and pervious area curve numbers were assigned within the model. The percent impervious and DCIA was set per land use category. Pervious curve numbers were be set based on the soil hydrologic group and "good condition" land cover as defined in the TR-55 document.

As discussed above, soils and land use are the basis of infiltration and runoff calculations. Soils are assumed to remain the same into the future. As such, changes in land use are what is most impactful to future infiltration and runoff calculations. Existing land use was determined based on aerial imagery. Future land use was compared to existing land use to determine if there were changes that modeling percent impervious and DCIA in the future conditions.

Since the land use between existing conditions and future conditions is not anticipated to differ significantly, the future conditions model will not consider changes in stage area calculations or infiltration due to land use.

Existing Infrastructure Condition

The existing condition model was constructed assuming that all known and mapped stormwater system infrastructure is maintained to function as designed, regardless of condition noted during field visits. Seepage into or out of the stormwater system was not considered for the purpose of this analysis.

Groundwater Levels

There are multiple ways groundwater elevations affect stormwater calculations. First, groundwater elevations indicate the amount of available soil storage and therefore affect the amount of runoff versus infiltration that will occur. Additionally, they indicate the water surface elevation during normal wet season conditions. In a model, that translates to infiltration calculations and initial basin stages.

As it relates to infiltration calculations, NRCS soils data was used as the basis of the pervious curve number calculations. To consider groundwater effects, areas classified as "Water" or areas with soils classified with a dual hydrologic group that includes a "D" soil, such as "A/D", were conservatively inputted in the model with the curve number corresponding to Type D soils. No changes to the assigned infiltration values under future conditions are considered due to the assumption that future land use does not differ significantly from existing conditions. See the *Land Use* Section for more information.

Groundwater also impacts basin initial stages. Since the Town does not have groundwater monitoring wells, the groundwater elevation is not available through the SFWMD DBHydro database. Therefore, the existing and future condition tailwater elevations, based on tidal data, were applied to the entire stormwater network (Refer to the *Tidal Data Analysis* Section). Seepage into or out of the stormwater system was not modeled and the infiltration in pervious areas is considered a loss from the system.

Pump Stations

The existing and future conditions models were constructed to include six Town pump stations and three FDOT pump stations as discussed in the *Existing Plans and As-Built Drawings* Section of this report. The Town pump stations consist of the four in service as of December 2022, and two that will be added to the system as part of Phase 1 and Phase 2 of the Abbott Avenue project.

The operational set points for each of the Town pump stations are based on active SCADA configuration provided by the Town, and design set points for those planned Abbott Avenue stations. The set points for the FDOT pump stations are based on as-built drawings.

Drainage Wells

Only the drainage wells associated with the Town or FDOT pump stations were included in the existing and future conditions models. Therefore, dewatering and drainage wells related to any separately permitted stormwater systems were excluded. In addition, the drainage wells were assumed to have a decreased capacity in the future conditions models, represented in the model by raised groundwater levels influenced by higher average tailwater conditions (See *Future Tailwater Condition*).

D. Tidal Data Analysis

All assessment areas outfall to Biscayne Bay and are tidally influenced. As such, it is important to understand the impact of the downstream boundary condition within the model. The subsections below present the tailwater values based on tidal data. These values were applied to the model where the stormwater network outfalls into Biscayne Bay and within groundwater nodes linked to drainage wells. They were not applied to the entire perimeter of the Town, as private sea walls are assumed to prevent overland flow into or out of the Town.

In addition, tidal conditions were modeled dynamically to represent diurnal tidal fluctuations.

Existing Tailwater Condition

The tidal gauge located in Virginia Key, Biscayne Bay was used for this analysis (NOAA Station 8723214). Verified high tide and low tide elevations available between February 1, 1995 and December 31, 2022 were considered.

The higher high tide, or the daily maximum tidal elevations, from the dataset were graphed as seen in **Figure 13.** Daily maximum tidal elevations 1994-2022. Outliers corresponding to storm surges due to hurricanes and known “King Tide” events were included in the dataset. The linear trendline in black represents an increase in daily maximum tidal elevations through the years studied.

The daily maximum data was also ranked to determine tidal elevation percentiles. It was determined that data from the past five years is representative of current conditions and sufficient basis for tailwater determination. The results of this analysis for the entire dataset reviewed and past five years are shown in **Table 7**.

Figure 13. Daily maximum tidal elevations 1994-2022

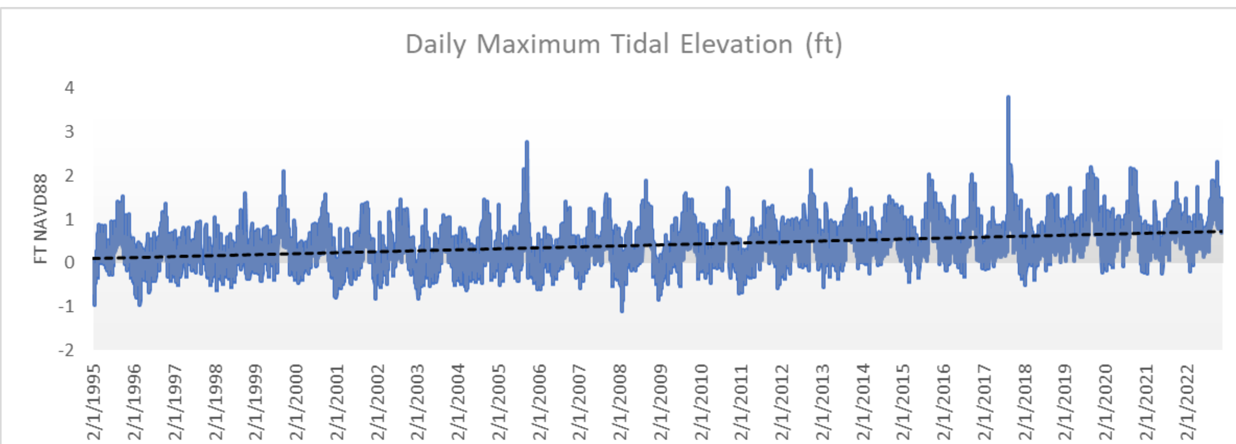

Table 7. Tidal elevation percentiles

Percentile	Percent Chance	Tidal Elevation (ft, NAVD 88)	
		All Data (1994-2022)	Last 5 years (2018-2022)
50%	50%	0.38	0.66
80%	20%	0.84	1.07
90%	10%	1.15	1.38
95%	5%	1.54	1.60
99%	1%	2.54	1.92
99.5%	0.5%	2.82	2.02
99.9%	0.1%	3.22	2.19

Through discussion with the Town, it was determined that nuisance tidal flooding, such as so-called "King Tide" effects, should be considered in the analysis. Based on the data above, the 90th percentile value for the past five years, 1.38 feet NAVD 88, was used as the existing tailwater condition.

Since daily data was used in the tidal analysis, a tidal elevation of greater than or equal value to 1.38 feet has a 10 percent chance of occurring on any given day within a representative year, or approximately 36 days per year.

Table 8. Design tailwater boundary condition for existing conditions model

Boundary Condition	Water Surface Elevation (ft NAVD88)
90th Percentile Tidal Tailwater for 2018-2022	1.38

Future Tailwater Condition

The Southeast Florida Climate Compact (SEFLCC) publishes a Sea Level Rise Projection and Guidance Report every 5 years to ensure a regionally unified projection of sea level rise for adaptation planning. The latest version was published in 2019, following NOAA's 2017 projection updates. In previous Guidance Reports the SEFLCC had used the IPCC AR5 Median Curve, the USACE High Curve, and the NOAA High Curve for their Unified Sea Level Rise Projections, and planning horizons of 2030, 2060, and 2100. In 2019 they used the IPCC Median Curve, the NOAA Intermediate-High Curve, and the NOAA High Curve, and shifted the planning horizons to 2040, 2070 and 2120.

This SWMP is based on the recommendations included in the 2019 publication and listed below:

- For non-critical infrastructure in service during or after 2070, the NOAA Intermediate-High Curve is recommended
- 50-year planning horizon for infrastructure

It is assumed that infrastructure improvements identified as part of the recommended alternatives in this SWMP will be constructed over the next 10 years. Considering the estimated 50-year lifespan of pipes and stormwater structures and the 10-year implementation phase, a 2070 planning horizon aligns with the recommendations of the SEFLCC.

However, a review of the NOAA Intermediate-High sea level rise projections published by the SEFLCC indicate a proposed sea level rise of 2.75 feet by 2070. As described above, an existing conditions tailwater of 1.38 feet NAVD88 was used. Applying the 2070 projected sea level rise results in a tailwater condition of 4.13 feet NAVD88. A review of available topographic data of the Town indicates approximately 60% of the Town has ground elevations lower than this condition, as shown in **Figure 15**. Designing and planning stormwater system upgrades for a tailwater condition of that magnitude is not conducive to the planning process for the Town. Therefore, Kimley-Horn recommended utilizing a 2050 planning horizon to evaluate future tailwater conditions. Thirty years reflects a common planning horizon for private structures and residential homes, of which most of the Town consists of west of Collins Avenue.

The 2050 projected sea level rise from 2020 is 1.38 feet. Therefore, the future tailwater condition used for future conditions is 2.76 feet.

Figure 14. King-Tide event November 2022 at Biscaya Drive

Figure 15. Areas inundated by 2050 future tailwater condition within the Town of Surfside

Table 9. Design tailwater for future conditions model

Boundary Condition	Water Surface Elevation (ft NAVD88)
Existing Condition Tidal Boundary + SLR to 2050	2.76

E. Existing Conditions Results

The Town experiences inundation greater than 0.5 feet in several areas in the existing conditions 100-year, 72-hour storm event, primarily concentrated around depressional areas. **Figure 17** shows flood depths in the existing conditions model from the 100-year, 72-hour storm event where blue represents shallow flooding and orange represents deeper flooding.

The Town generally decreases in elevation from east to west, with the exception of a depressional area centered at 91st Street and Abbott Avenue. Other major depressional areas exist along 96th Street, Bay Drive from 93rd Street to 90th Street, Hawthorne Avenue, Irving Avenue, and Garland Avenue from 90th Street to 88th Street, and along Biscaya Drive. See **Figure 18** for the topographic conditions of the Town, where white areas represent the highest elevations and blue areas represents the lowest elevations. Flooding is worse in the previously identified depressional areas, with flood depths exceeding 1 foot.

Figure 16. King-Tide event November 2022 at 89th Street and Hawthorne Avenue

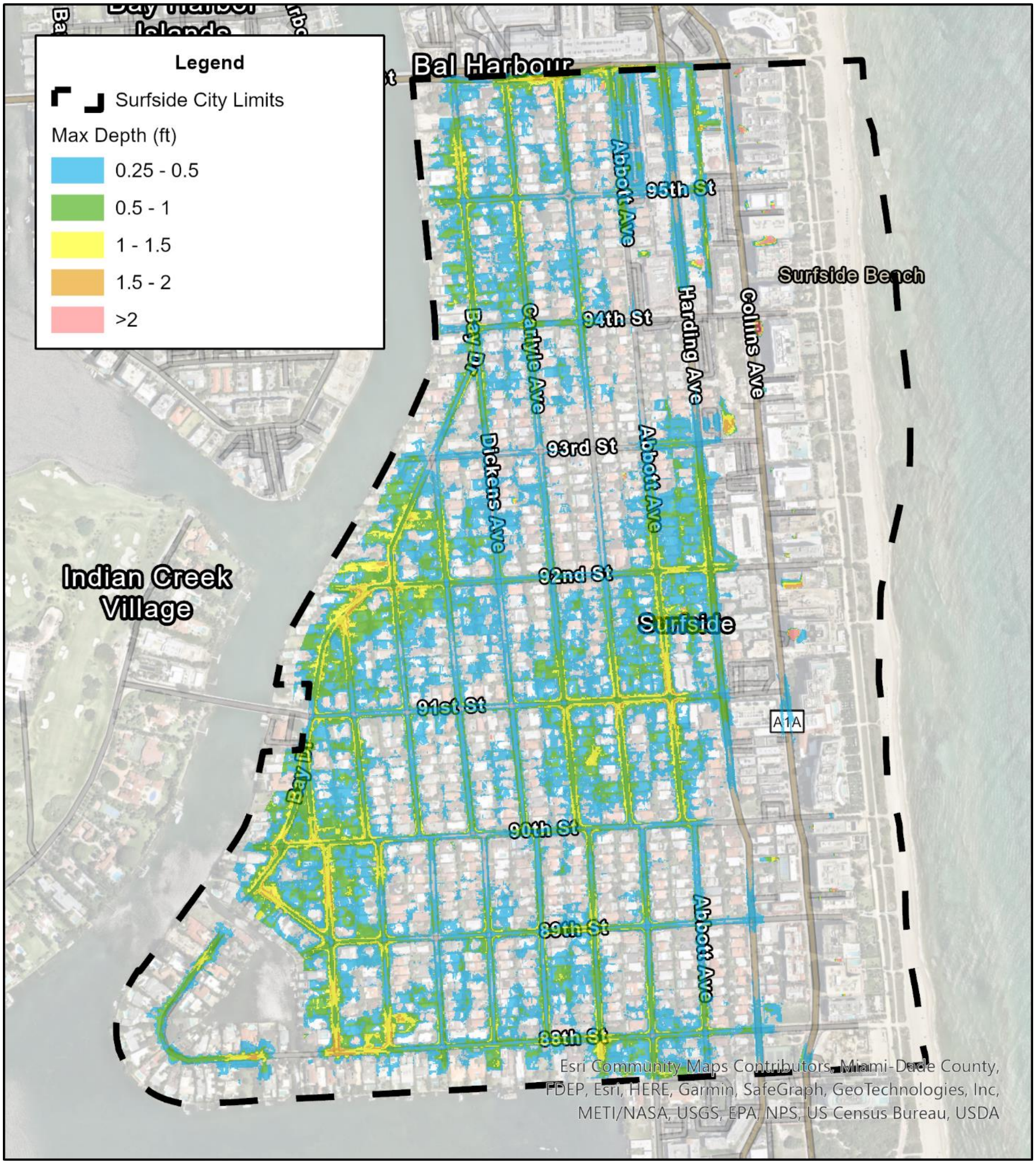

Figure 17. Existing 100-year, 72-hour Flood Depths.

Figure 18. Existing Topography

Undersized stormwater infrastructure further hinders floodwater conveyance in out of these depressional areas. The existing Town stormwater system does not have the hydraulic capacity necessary to quickly convey peak flows generated by the modeled design storms. Runoff that the Town's system cannot convey continues to pond throughout the storm duration and increases flood depth. The existing conditions model also noted long drawdown times, which are a direct result of a lack of hydraulic capacity.

F. Future Conditions Analysis

The Town of Surfside is 99.5% developed according to the Town of Surfside Comprehensive Plan, Future Land Use Element. Only 1.89 acres of vacant land remain within the Town, and most development expected over the planning horizon is redevelopment. Redevelopment is not expected to change infiltration or stage storage capacity in the Town and therefore are not considered to impact. the Town's stormwater system.

Future conditions analysis of the Town focused on the impact of sea level rise. See the *Future Tailwater Condition* of this report for more information on how sea level rise affects tidal water surface elevations, used to determine tailwater and groundwater boundary conditions in the model.

G. Focus Area Identification

Based on a review of the drainage deficiencies identified and input from Town staff, 5 focus areas consisting of 12 drainage sub-basins were selected as a priority for more detailed analysis (See **Figure 19**). The development of the priority sub-basin list was based on several factors including observed flooding, modeled existing conditions flooding, resident complaint records and feedback, Town Staff input, roadway conditions, stormwater system conditions, proximity to other focus areas, and evaluation against Town performance goals.

Observed flooding data came from resident and Town Staff input. Resident feedback was also collected through two Town hall meetings. See the *Resident Reports* Section for more information on how observed flood data was collected.

The existing conditions model of the Townwide stormwater system provided flood depths and drawdown times for two design storms, detailed in the *Design Storm Intensities* Section. Evaluation of achieving performance goals in these areas was based on flooding results from the existing conditions model. Six major depressional areas with low roadways experienced the greatest flooding depths and durations in the model. Further analysis of the existing stormwater system identified deficiencies in these depressional areas. These depressional areas overlapped with resident complaints and poor performance in several locations, forming the basis for focus area selection.

The *Proposed Improvements* Section of this SWMP details the hydraulic and hydrologic analysis of these focus areas and makes recommendations for flood hazard mitigation. The projects consist of one or more of the following:

- Increasing drainage capacity by increasing the size of existing pipes.
- Increasing drainage capacity by increasing the size of existing outfalls, as well as adding additional outfalls.
- Improving pump capacity at certain deficient pump stations.
- Increasing maintenance within the sub-basin. This is a recommendation for all areas where field visit documentation showed sedimentation.

IV. PROPOSED IMPROVEMENTS

Five focus areas were identified based on the *Focus Area Identification* Section of this SWMP. The following Sections describe the two alternative drainage improvements per focus area with corresponding comparisons to existing conditions for flooding duration and peak stage. **Figure 19** shows the five focus areas considered in this SWMP and **Table 10** below summarizes the proposed alternative improvements.

Table 10. Summary of Proposed Focus Area Alternatives

Focus Area	Location	Summary of Proposed Alternative 1	Summary of Proposed Alternative 2
3	92nd Street and Bay Drive	Upsize the existing pipes along 92nd Street from Bay Drive to Biscayne Bay to 2-24" pipes. The existing pump will be replaced with a new 40 cfs pump.	Upsize the existing pipes and outfall along 92nd Street from Bay Drive to Biscayne Bay to 24" pipes. The existing pump station will be replaced with a new 40 cfs. A second gravity system outfall will be constructed.
2	92nd Street and Emerson Avenue	Upsize the existing pipes along 92nd Street from Emerson Avenue to Bay Drive to 24" pipes and from Bay Drive to Biscayne Bay to 2-24" pipes.	Connect the existing stormwater system along 92nd Street to 94th Street by installing new pipes and upsizing existing pipes to 24". A segment upstream of the outfall will be upsized to 2-24" pipes.
1	91st Street and Abbott Avenue	Upsize the existing outfall to Biscayne Bay on the north side of 91st Street to 2-30" pipes.	Upsize the existing pipes running west along 91st Street from Abbott to the outfall (on both sides of the street) to 30" pipes.
4	Hawthorne Avenue and Irving Avenue	Upsize the existing pipes along 89th Steet from Hawthorne Avenue to Biscayne Bay to 2-24" pipes.	Upsize the existing pipes along 89th Street from Hawthorne Avenue to Biscayne Bay to 2-24" pipes. A second gravity system outfall will be constructed.
5	Biscaya Drive	Upsize both existing outfalls to Biscayne Bay to 36" pipes.	Upsize pipes along 88th Street east to Biscayne Bay to 24" pipes. A new 10 cfs pump station and corresponding force main outfall will be constructed adjacent to the existing outfall.

Note: Proposed alternatives in the above table are organized by magnitude of flood hazard mitigation relative to existing conditions.

Proposed alternatives identified in this Section were developed with the intent of flood hazard mitigation. Proposed alternatives achieve flood hazard mitigation by reducing flood depth and flood duration time with respect to Town performance goals. Drainage wells throughout the Town system provide water quality, and all proposed alternatives include pollutant retardant baffles upstream of outfalls to further improve water quality.

Figure 19. Focus Areas

A. Focus Area 1

Location

Focus Area 1 encompasses Carlyle, Byron, and Abbott Avenues, between 92nd street and 89th street, centered on 91st street (**Figure 20**). The area consists of approximately 16 acres of existing detached single-family development with approximately 3,300 linear feet of roadway.

Figure 20. Focus Area 1

Existing Drainage Conditions

The drainage system in this area is a hybrid system consisting of interconnected catch basins with pipe connections to outfalls into the Biscayne Bay, as well as a not yet constructed pump system.

A pump station at the corner of 91st Street and Abbot Avenue has been designed and permitted but not constructed. For the purposes of this SWMP the pump station project is assumed to be completed and will not be included in recommendations, the capital improvement plan, or opinion of probable cost. The KEITH design consists of a 5 cfs lead pump and a 25 cfs lag pump. The lead pump switches on when its wet well stages to 0.5 feet NAVD88 and switches off at -8.0 feet NAVD88. The lag pump switches on when its wet well stages to 1.0 foot NAVD88 and switches off at -8.0 feet NAVD88. The pumps discharge to a force main connected to a series of drainage wells for water quality, and ultimately outfalls into Biscayne Bay at 91st Street. More information on the proposed pump station is located in the *Pump Station Data* Section.

The Town of Surfside has received complaints regarding drainage conditions within the area. The focus area was modeled together with the other sub-basins within the Town based on data collected as part of the stormwater master plan process.

Based on available GIS and as-built information, elevations range from a low of approximately 1.0 feet to a high of approximately 4.9 feet NAVD88.

Performance Goal Analysis

Based on the existing conditions model, the majority of the focus area does not meet the Town's performance goals. **Figure 21** depicts flooding depths during the 10-year, 24-hour storm and the corresponding streets that would be inundated. **Figure 22** depicts flooding depths during the 100-year, 72-hour storm and the corresponding buildings that would be affected.

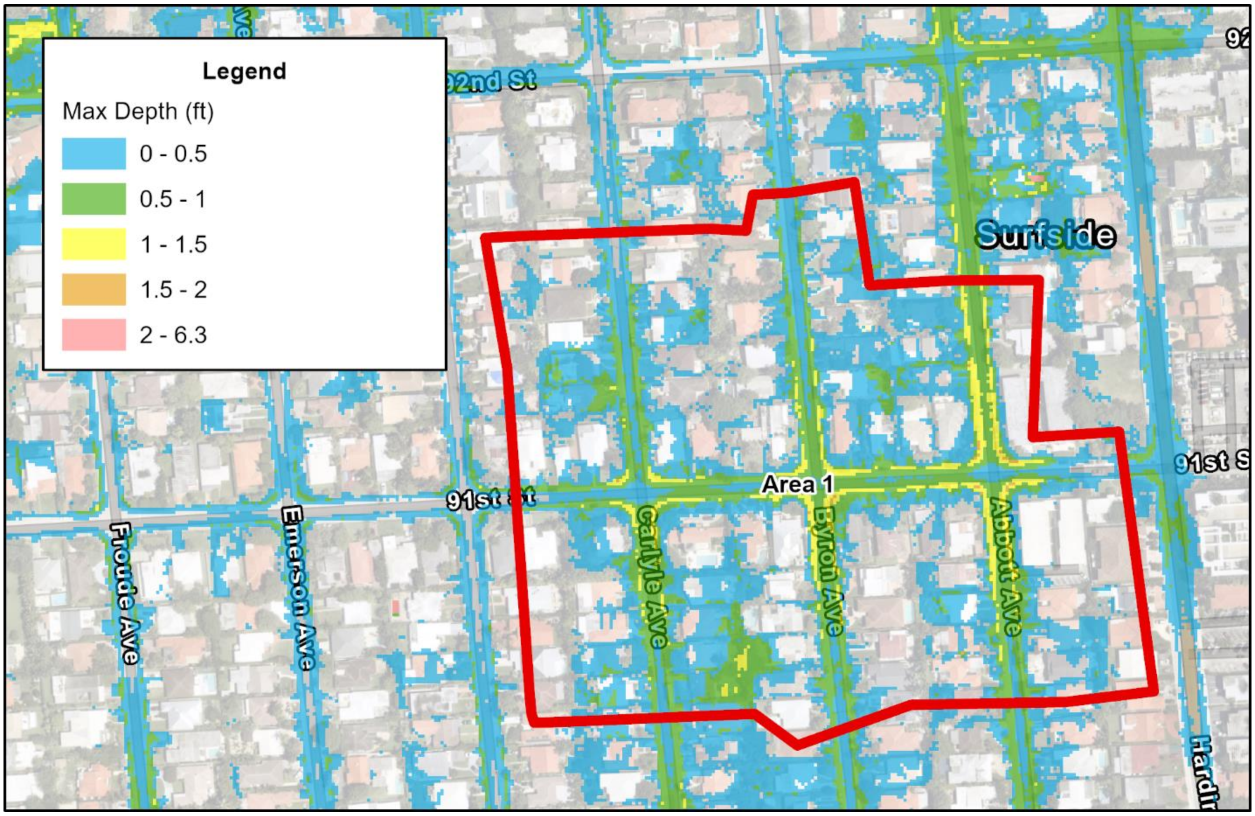

Figure 21. Focus Area 1, Existing Conditions 10-year, 24-hour Storm Event

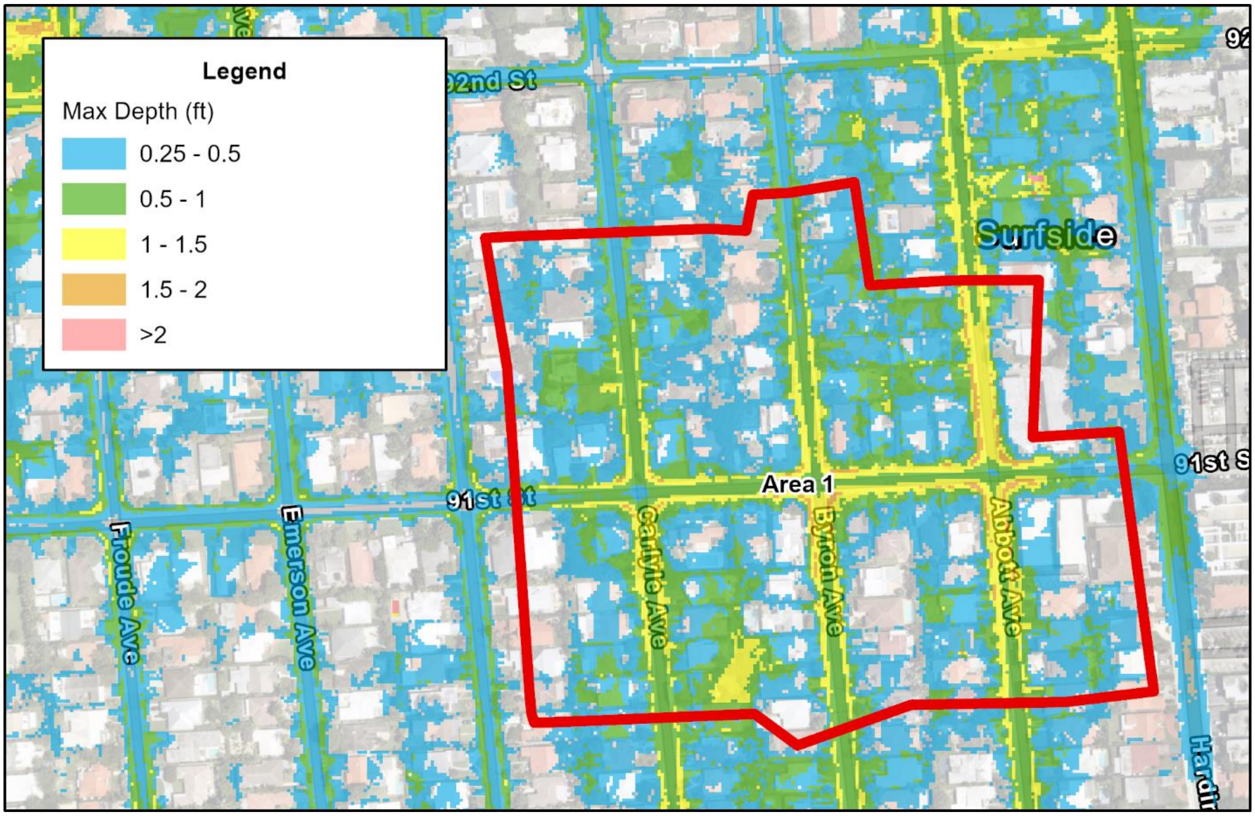

Figure 22. Focus Area 1, Existing Conditions 100-year, 72-hour Storm Event

Drainage Improvement Alternative 1

The first modeled drainage alternative for Focus Area 1 is to upsize the existing outfall to Biscayne Bay on the north side of 91st Street. The outfall would be upsized to 2-30" RCP. See **Figure 23** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 6.25 hours to 4.50 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 3.75 hours to 2.75 hours in the 10-year, 24-hour storm.

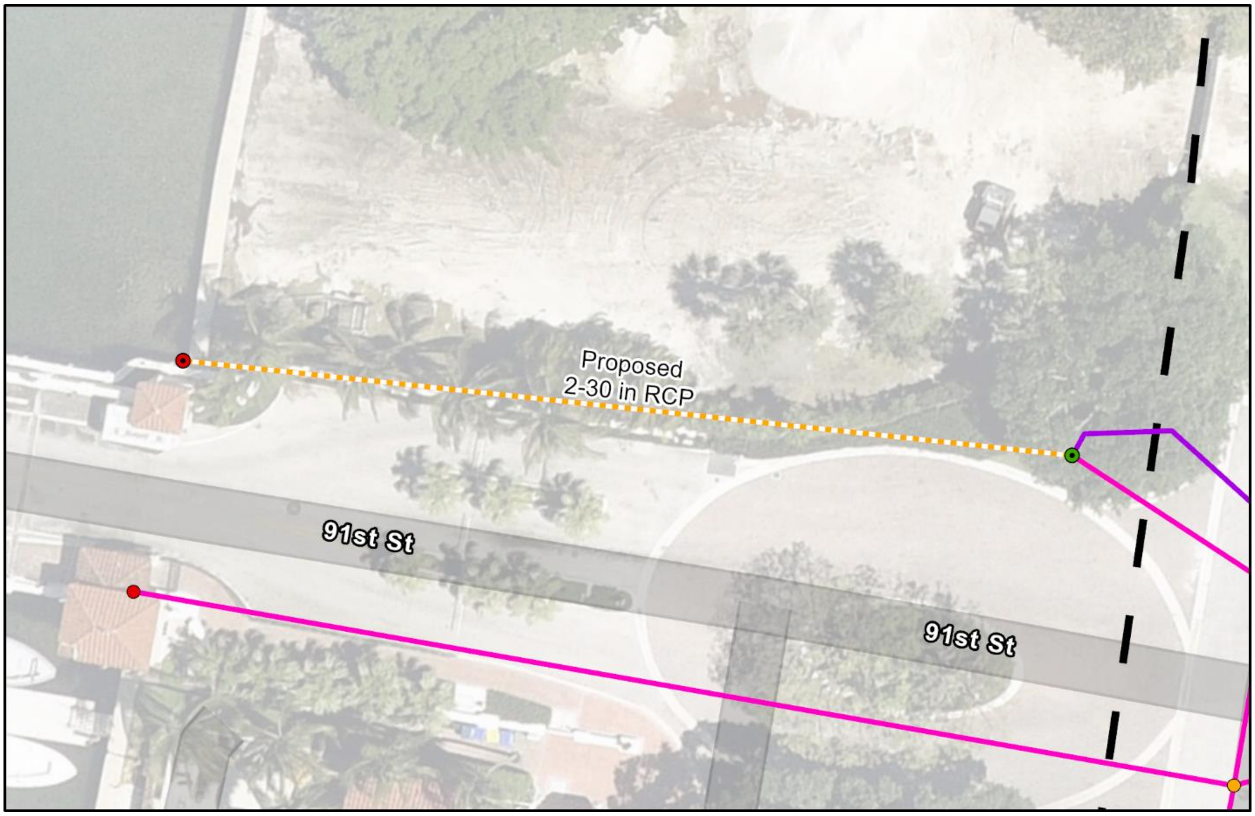

Figure 23. Focus Area 1, Alternative 1 Schematic

Table 11. Focus Area 1, Alternative 1 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$59,850	$60,000
2	Stormwater Pollution Prevention	1	L.S.	$19,950	$20,000
3	Asphalt Restoration	1,105	S.Y.	$35	$39,000
4	Curbing Restoration	170	L.F.	$35	$6,000
5	Remove existing 30" pipe	170	L.F.	$55	$10,000
6	Storm Pipe, Double 30" RCP	170	L.F.	$600	$102,000
7	Concrete End wall	1	EA.	$6,500	$7,000
8	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
9	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
10	Remove existing structure	1	EA.	$1,000	$1,000
11	Inlet Apron	1	EA.	$500	$500
12	Catch Basin	1	EA.	$18,000	$18,000
13	Pollution Retardant Baffle	1	EA.	$500	$500
14	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
15	Professional Services	1	L.S.	$75,600	$76,000
16	Contingency (30%)	1	L.S.	$151,200	$152,000
TOTAL				**$732,000**	

Drainage Improvement Alternative 2

The second modeled drainage alternative for Focus Area 1 is to upsize the existing pipes running west down 91st Street to the outfall at Biscayne Bay on both sides of 91st Street. The pipes and outfall would be upsized to 30” RCP. See **Figure 24** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 6.25 hours to 4.75 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 3.75 hours to 3.00 hours in the 10-year, 24-hour storm.

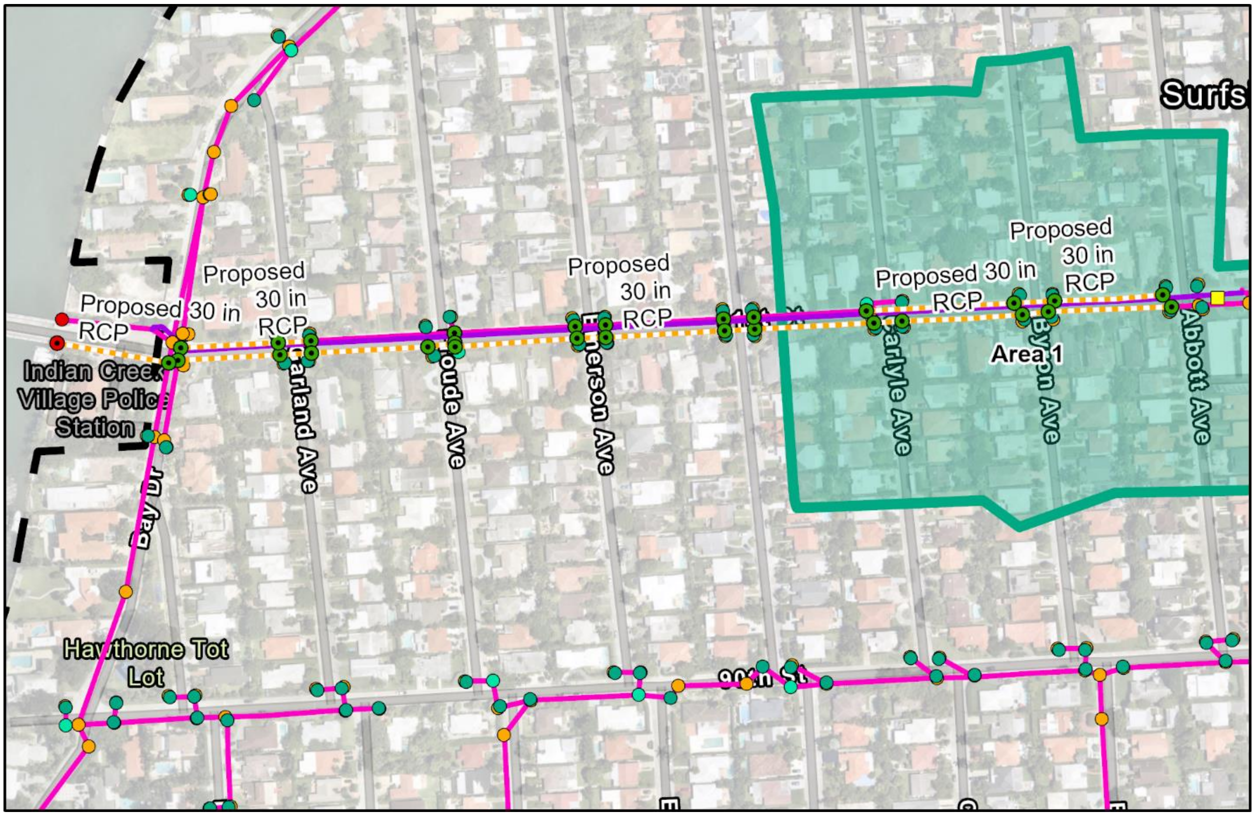

Figure 24. Focus Area 1, Alternative 2 Schematic

Table 12. Focus Area 1, Alternative 2 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$528,000	$528,000
2	Stormwater Pollution Prevention	1	L.S.	$176,000	$176,000
3	Asphalt Restoration	19,500	S.Y.	$35	$683,000
4	Curbing Restoration	3,000	L.F.	$35	$105,000
5	Remove existing 10" pipe	50	L.F.	$20	$2,000
6	Remove existing 12" pipe	341	L.F.	$20	$7,000
7	Remove existing 15" pipe	762	L.F.	$20	$16,000
8	Remove existing 18" pipe	1,378	L.F.	$48	$67,000
9	Remove existing 24" pipe	930	L.F.	$48	$45,000
10	Remove existing concrete end wall	1	EA.	$1,000	$1,000
11	Remove existing structure	28	EA.	$1,000	$28,000
12	Storm Pipe, 30" RCP	3,000	L.F.	$600	$1,800,000
13	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
14	Concrete End wall	1	EA.	$6,500	$7,000
15	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
16	Inlet Apron	28	EA.	$500	$14,000
17	Catch Basin	28	EA.	$18,000	$504,000
18	Pollution Retardant Baffle	1	EA.	$500	$1,000
19	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
20	Professional Services	1	L.S.	$633,600	$634,000
21	Contingency (30%)	1	L.S.	$1,267,200	$1,268,000
TOTAL					**$6,126,000**

The table below summarizes the effect of the proposed improvements. **This SWMP recommends Drainage Improvement Alternative 1**.

Table 13. Focus Area 1 Summary of Proposed Alternatives

	10-Year Storm			100-Year Storm		
Parameter	**Existing**	**Alternative 1**	**Alternative 2**	**Existing**	**Alternative 1**	**Alternative 2**
Peak Stage (ft, NAVD88)	2.86	2.86	2.86	3.15	3.15	3.15
Flooding Duration (hrs)	3.75	2.75	3.00	6.25	4.50	4.75

B. Focus Area 2

Location

Focus Area 2 encompasses Emerson Avenue, between 93rd street and 91st street, centered on 92nd street (**Figure 25**). The area consists of approximately 5 acres of existing detached single-family development with approximately 1,300 linear feet of roadway.

Figure 25. Focus Area 2

Existing Drainage Conditions

The drainage system in this area is a hybrid system consisting of interconnected catch basins with pipe connections to outfalls into the Biscayne Bay.

The area is served by an existing pump, more information on the existing pump station is located in the *Pump Stations* Section.

The Town of Surfside has received complaints regarding drainage conditions within the area.

Based on available GIS and as-built information, elevations range from a low of approximately 1.1 feet to a high of approximately 4.3 feet NAVD.

Performance Goal Analysis

Based on the existing conditions model, the majority of the focus area does not meet the Town's performance goals. **Figure 26** depicts flooding depths during the 10-year, 24-hour storm in Focus Area 1 and the corresponding streets that would be inundated. **Figure 27** depicts flooding depths during the 100-year, 72-hour storm in Focus Area 1 and the corresponding buildings that would be affected.

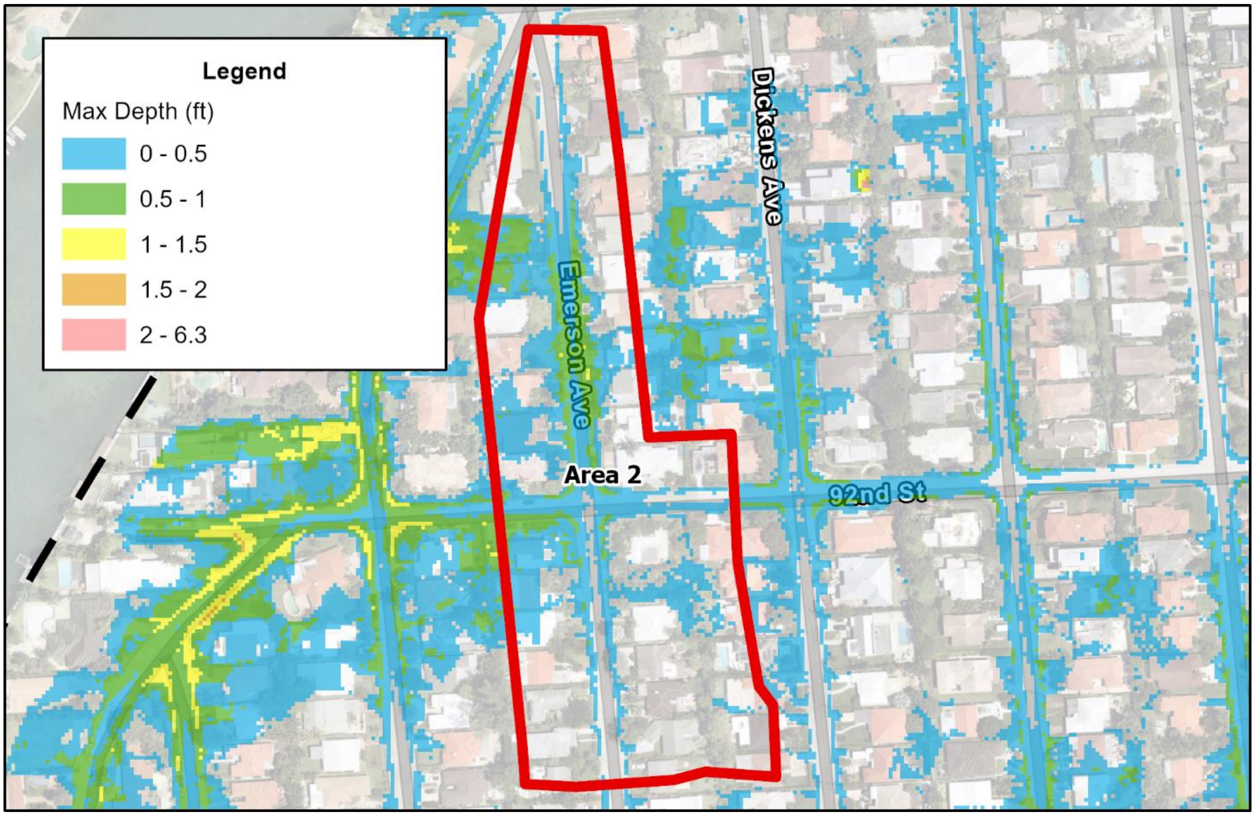

Figure 26. Focus Area 2, Existing Conditions 10-year, 24-hour Storm Event

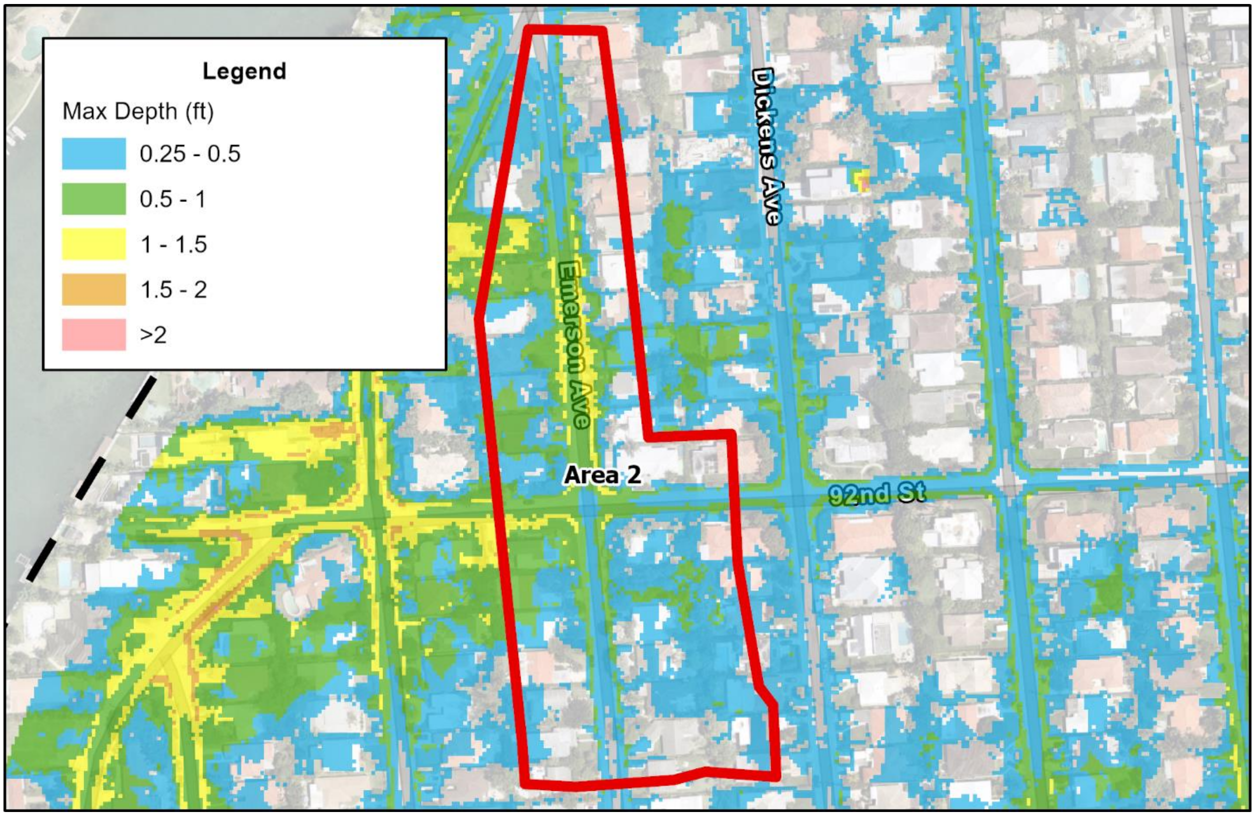

Figure 27. Focus Area 2, Existing Conditions 100-year, 72-hour Storm Event

Drainage Improvement Alternative 1

The first modeled drainage alternative for Focus Area 2 is to upsize the existing pipe run through the outfall to Biscayne Bay starting at the intersection of Emerson Avenue and 92nd Street. The outfall and the pipe run starting at the intersection of Bay Drive and 92nd Street would be upsized to 2-24” RCP. See **Figure 28** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 9.25 hours to 5.00 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 5.50 hours to 3 hours in the 10-year, 24-hour storm.

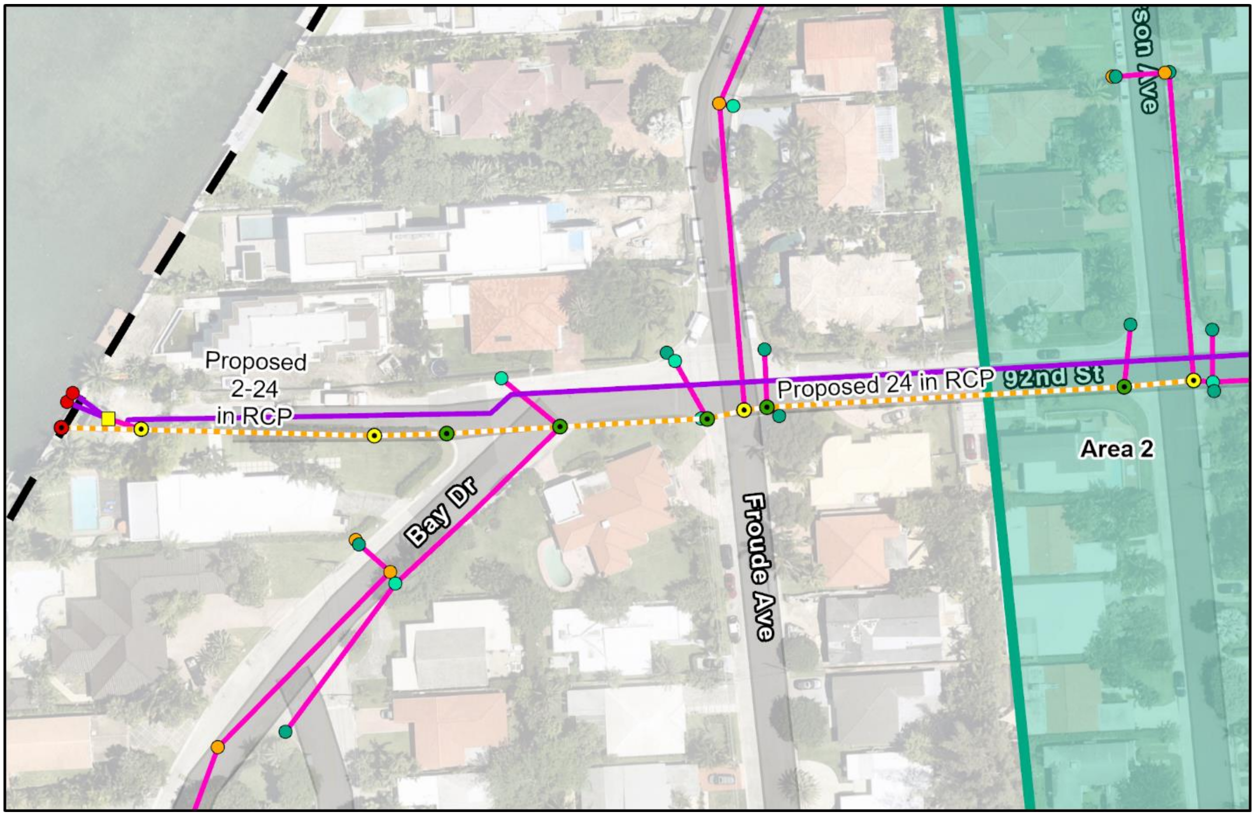

Figure 28. Focus Area 2, Alternative 1 Schematic

Table 14. Focus Area 2, Alternative 1 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$185,925	$186,000
2	Stormwater Pollution Prevention	1	L.S.	$61,975	$62,000
3	Driveway/Sidewalk Restoration	200	S.Y.	$50	$10,000
4	Asphalt Restoration	4,272	S.Y.	$35	$150,000
5	Curbing Restoration	712	L.F.	$35	$25,000
6	Remove existing 10" pipe	88	L.F.	$20	$2,000
7	Remove existing 18" pipe	624	L.F.	$48	$30,000
8	Storm Pipe, 24" RCP	955	L.F.	$650	$621,000
9	Concrete End wall	1	EA.	$6,500	$7,000
10	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
11	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
12	Remove existing structure	9	EA.	$1,000	$9,000
13	Stormwater Manhole	4	EA.	$18,000	$72,000
14	Catch Basin	5	EA.	$18,000	$90,000
15	Inlet Apron	5	EA.	$500	$3,000
16	Install new cast-in-place Junction Box	1	L.S.	$4,223	$5,000
17	Pollution Retardant Baffle	1	EA.	$500	$500
18	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
19	Professional Services	1	L.S.	$226,875	$227,000
20	Contingency (30%)	1	L.S.	$453,750	$454,000
TOTAL					**$2,193,500**

Drainage Improvement Alternative 2

The second modeled drainage alternative for Focus Area 2 is to connect the existing stormwater system along 92nd Street to the outfall along 94th Street. This connection would be achieved by upsizing the pipes running north along Emerson Avenue and installing new pipes to connect to the existing system on Bay Drive with 24" RCP. The pipes running from Bay Drive up to 94th Street would be upsized through to the outfall. 40 feet of pipe upstream of the outfall would be upsized to 2-24" RCP. See **Figure 29** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 9.25 hours to 7.00 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 5.50 hours to 4.5 hours in the 10-year, 24-hour storm.

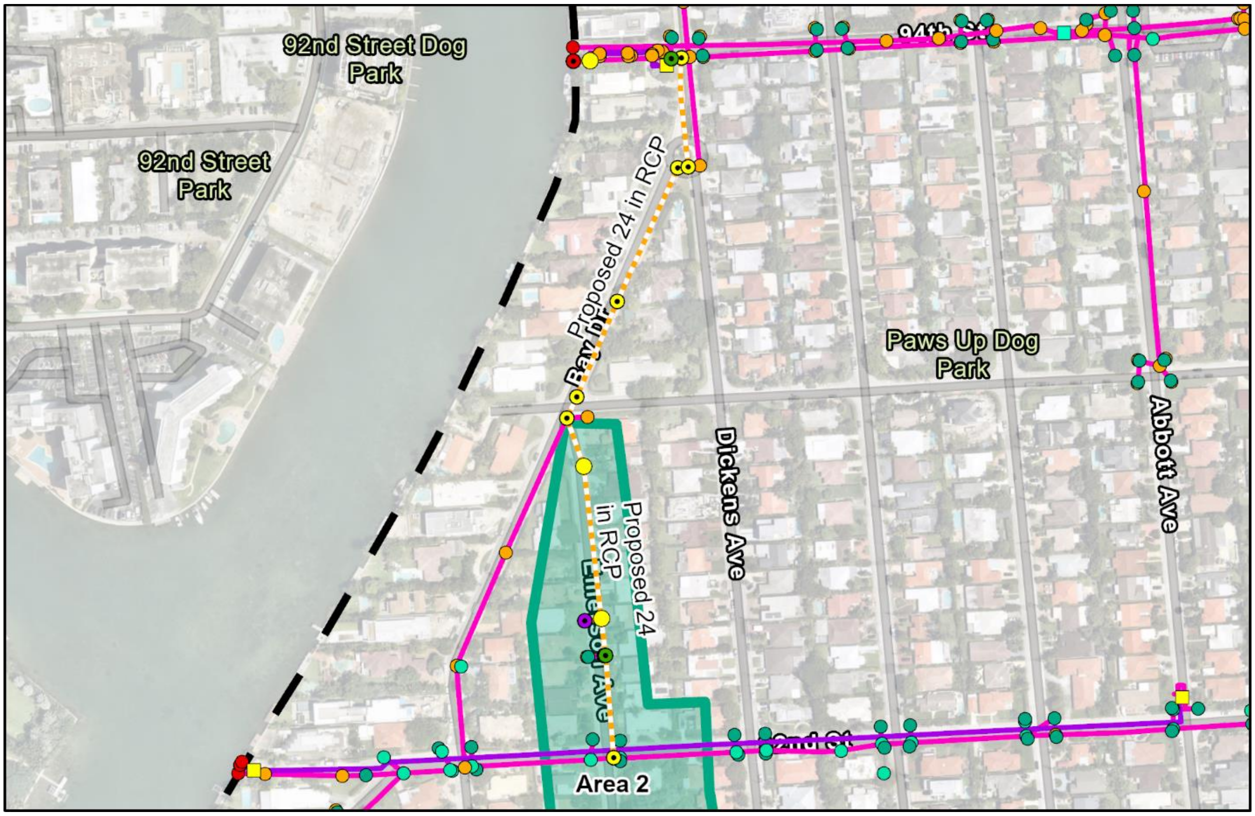

Figure 29. Focus Area 2, Alternative 2 Schematic

Table 15. Focus Area 2, Alternative 2 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$287,400	$288,000
2	Stormwater Pollution Prevention	1	L.S.	$95,800	$96,000
3	Driveway/Sidewalk Restoration	1,900	S.Y.	$50	$95,000
4	Asphalt Restoration	9,042	S.Y.	$35	$317,000
5	Curbing Restoration	1,507	L.F.	$35	$53,000
6	Remove existing 10" pipe	206	L.F.	$20	$5,000
7	Remove existing 18" pipe	766	L.F.	$48	$37,000
8	Remove existing concrete end wall	1	EA.	$1,000	$1,000
9	Remove existing structure	6	EA.	$1,000	$6,000
10	Storm Pipe, 24" RCP	1,507	L.F.	$650	$980,000
11	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
12	Concrete End wall	1	EA.	$6,500	$7,000
13	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
14	Stormwater Manhole	9	EA.	$18,000	$162,000
15	Catch Basin	2	EA.	$18,000	$36,000
16	Inlet Apron	2	EA.	$500	$1,000
17	Pollution Retardant Baffle	1	EA.	$500	$1,000
18	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
19	Professional Services	1	L.S.	$697,500	$698,000
20	Contingency (30%)	1	L.S.	$697,500	$698,000
TOTAL					**$3,721,000**

The table below summarizes the effect of the proposed improvements. **This SWMP recommends Drainage Improvement Alternative 1**.

Table 16. Focus Area 2, Summary of Proposed Alternatives

	10-Year Storm			100-Year Storm		
Parameter	**Existing**	**Alternative 1**	**Alternative 2**	**Existing**	**Alternative 1**	**Alternative 2**
Peak Stage (ft, NAVD88)	2.67	2.54	2.67	3.07	3.02	3.06
Flooding Duration (hrs)	5.50	3.00	4.50	9.25	5.00	7.00

C. Focus Area 3

Location

Focus Area 3 encompasses Froude Avenue and Bay Drive, between 93rd street and 91st street, centered on 92nd street (**Figure 30**). The area consists of approximately 12 acres of existing detached single-family development with approximately 2,300 linear feet of roadway.

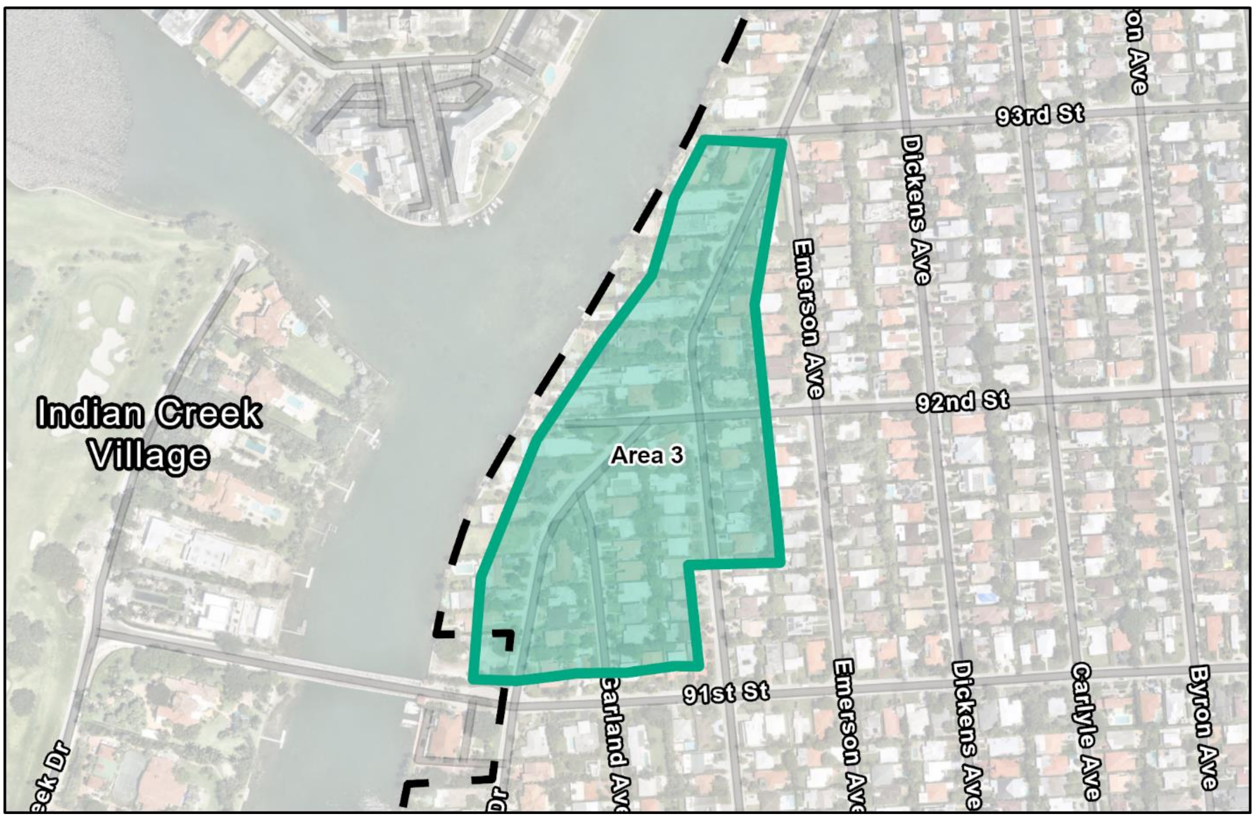

Figure 30. Focus Area 3

Existing Drainage Conditions

The drainage system in this area is a hybrid system consisting of interconnected catch basins with pipe connections to outfalls into the Biscayne Bay.

A pump system at the end of 92nd Street outfalls to Biscayne Bay and pulls water from the adjacent gravity system. The pump station does not route to drainage wells for water quality before reaching its outfall. The existing pump station has a maximum capacity of approximately 20 cfs. More information on the existing pump station is located in the *Pump Stations* Section.

The Town of Surfside has received complaints regarding drainage conditions within the area.

Based on available GIS and as-built information, elevations range from a low of approximately 1.0 feet to a high of approximately 5.9 feet NAVD.

Performance Goal Analysis

Based on the existing conditions model, the majority of the focus area does not meet the Town's performance goals. **Figure 31** depicts flooding depths during the 10-year, 24-hour storm in Focus Area 1 and the corresponding streets that would be inundated. **Figure 32** depicts flooding depths during the 100-year, 72-hour storm in Focus Area 1 and the corresponding buildings that would be affected.

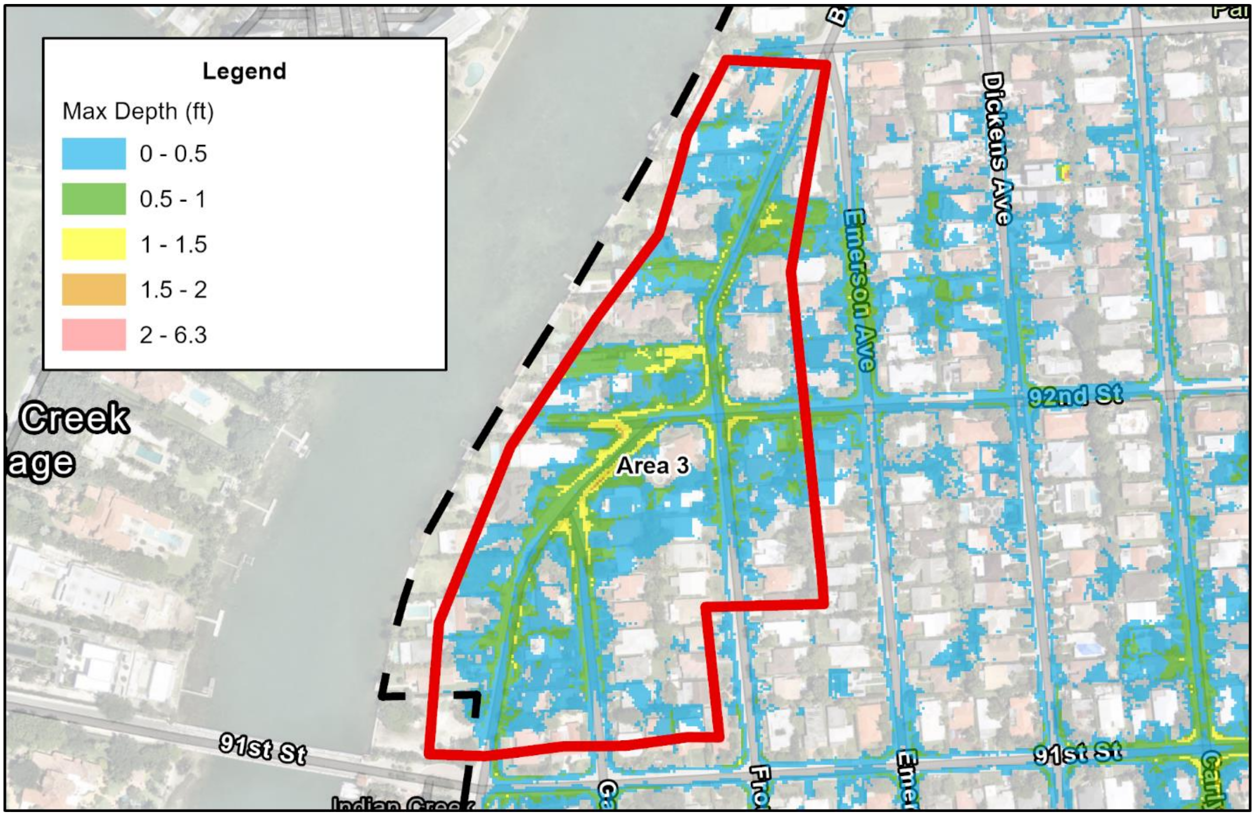

Figure 31. Focus Area 3, Existing Conditions 10-year, 24-hour Storm Event

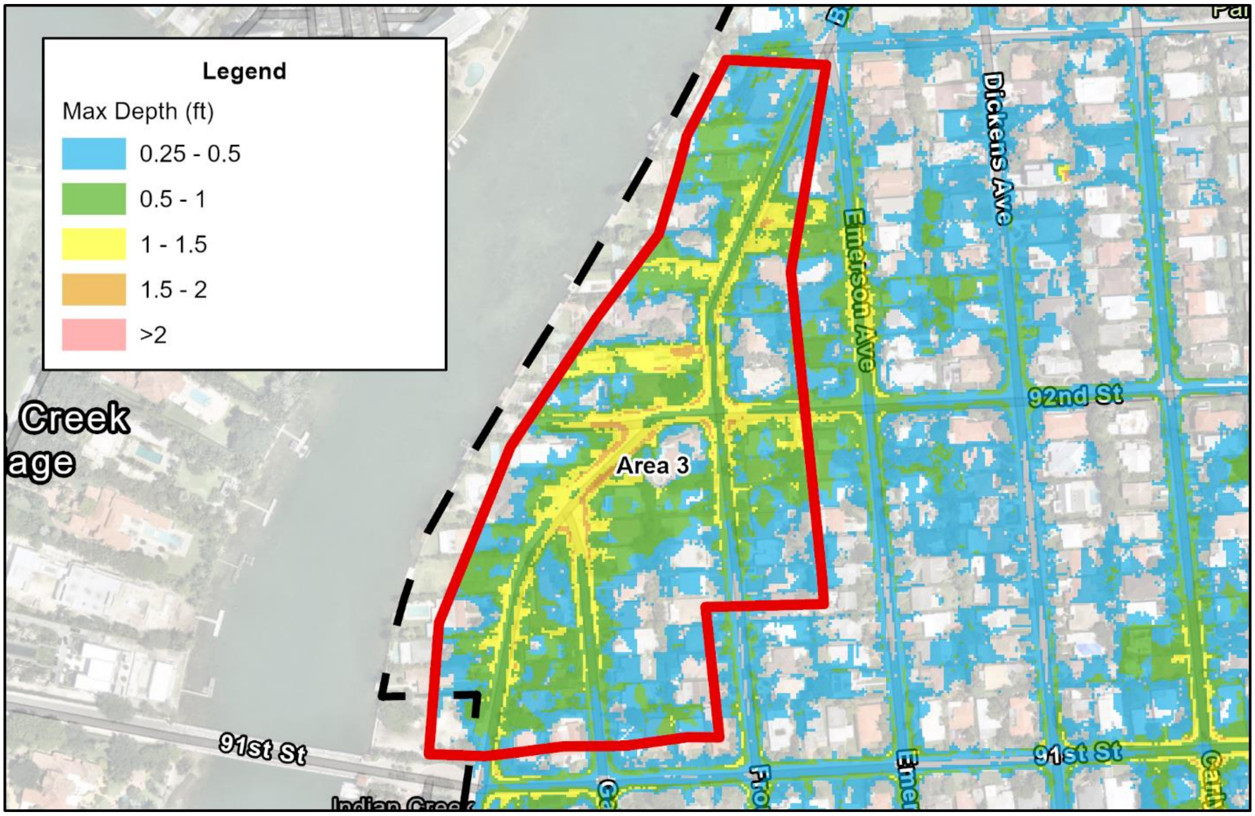

Figure 32. Focus Area 3, Existing Conditions 100-year, 72-hour Storm Event

Drainage Improvement Alternative 1

The first modeled drainage alternative for Focus Area 3 is to upsize the existing pipes and outfall to Biscayne Bay, starting at the intersection of Bay Drive and 92nd Street, to 2-24" RCP. The existing pump would be replaced with a new 40 cfs pump. See **Figure 33** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 8.75 hours to 4.25 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 5.50 hours to 2.00 hours in the 10-year, 24-hour storm.

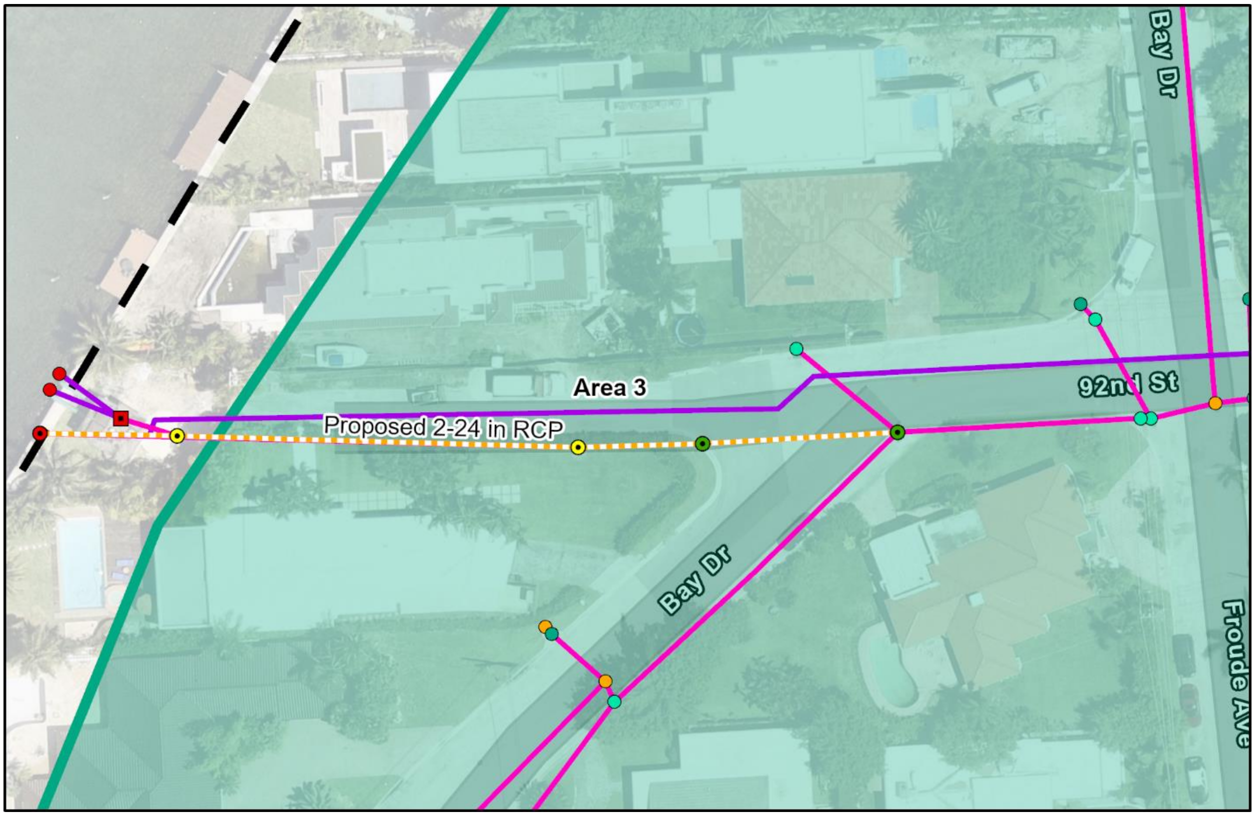

Figure 33. Focus Area 3, Alternative 1 Schematic

Table 17. Focus Area 3, Alternative 1 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$468,225	$469,000
2	Stormwater Pollution Prevention	1	L.S.	$156,075	$157,000
3	Asphalt Restoration	2,520	S.Y.	$35	$89,000
4	Curbing Restoration	315	L.F.	$35	$12,000
5	Remove existing 18" pipe	315	L.F.	$48	$16,000
6	Remove existing structure	4	EA.	$1,000	$4,000
7	Storm Pipe, Double 24" RCP	315	L.F.	$650	$205,000
8	Concrete End wall	1	EA.	$6,500	$7,000
9	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
10	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
11	Stormwater Manhole	2	EA.	$18,000	$36,000
12	Catch Basin	2	EA.	$18,000	$36,000
13	Inlet Apron	2	EA.	$500	$1,000
14	Pollution Retardant Baffle	1	EA.	$500	$500
15	40 cfs pump	1	L.S.	$2,500,000	$2,500,000
16	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
17	Professional Services	1	L.S.	$565,875	$566,000
18	Contingency (30%)	1	L.S.	$1,131,750	$1,132,000
TOTAL					**$5,470,500**

Drainage Improvement Alternative 2

The second modeled drainage alternative for Focus Area 3 is to upsize the existing pipes and outfall to Biscayne Bay starting at the intersection of Bay Drive and 92nd Street. All upsized pipes including the outfall would be 24” RCP. The existing pump station would be replaced with a new 40 cfs pump station. Additionally, a second outfall would be constructed independently of the pump influenced outfall. This system would branch from the existing stormwater system at the intersection of Bay Drive and 92nd Street. From there it would utilize 2 new manholes on its way to a new outlet into Biscayne Bay. The new system would be 24” RCP. See **Figure 34** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 8.75 hours to 6.00 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 5.50 hours to 4.00 hours in the 10-year, 24-hour storm.

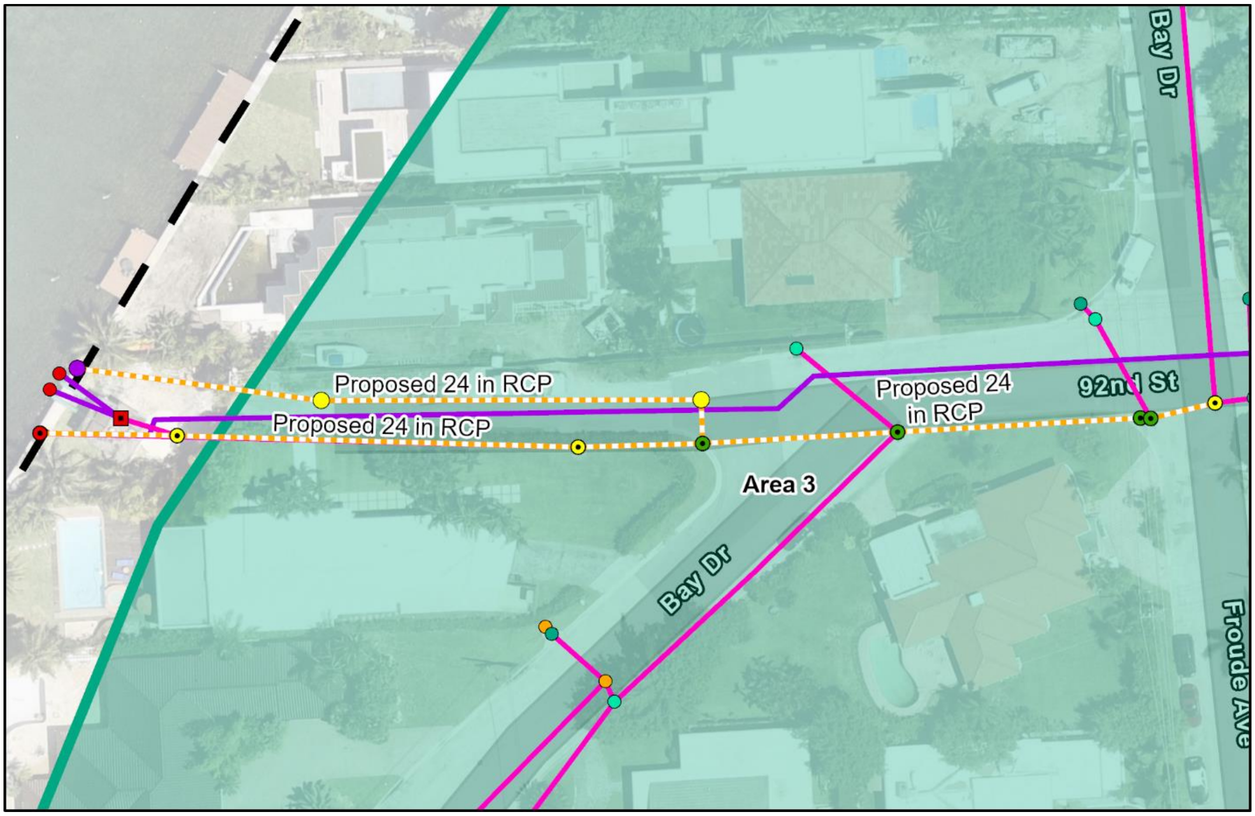

Figure 34. Focus Area 3, Alternative 2 Schematic

Table 18. Focus Area 3, Alternative 2 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$535,500	$536,000
2	Stormwater Pollution Prevention	1	L.S.	$178,500	$179,000
3	Asphalt Restoration	3,936	S.Y.	$35	$138,000
4	Curbing Restoration	656	L.F.	$35	$23,000
5	Remove existing outfall	40	L.F.	$100	$4,000
6	Remove existing 10" pipe	89	L.F.	$20	$2,000
7	Remove existing 18" pipe	337	L.F.	$48	$17,000
8	Remove existing structure	7	EA.	$1,000	$7,000
9	Storm Pipe, 24" RCP	656	L.F.	$650	$427,000
10	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
11	Catch Basin	4	EA.	$18,000	$72,000
12	Inlet Apron	4	EA.	$500	$2,000
13	Stormwater Manhole	5	EA.	$18,000	$90,000
14	Concrete End wall	1	EA.	$6,500	$7,000
15	Seawall Outfall Restoration	2	EA.	$15,000	$30,000
16	Pollution Retardant Baffle	2	EA.	$500	$1,000
17	Obtain Easement Access for New Outfall	1	L.S.	$25,000	$25,000
18	40 cfs pump	1	EA.	$2,500,000	$2,500,000
19	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
20	Professional Services	1	L.S.	$642,750	$643,000
21	Contingency (30%)	1	L.S.	$1,285,500	$1,286,000
TOTAL					**$6,214,000**

The table below summarizes the effect of the proposed improvements. **This SWMP recommends Drainage Improvement Alternative 1**.

Table 19. Focus Area 3, Summary of Proposed Alternatives

	10-Year Storm			100-Year Storm		
Parameter	**Existing**	**Alternative 1**	**Alternative 2**	**Existing**	**Alternative 1**	**Alternative 2**
Peak Stage (ft, NAVD88)	2.87	2.48	2.55	3.05	2.99	3.01
Flooding Duration (hrs)	*5.50*	*2.00*	*4.00*	*8.75*	*4.25*	*6.00*

D. Focus Area 4

Location

Focus Area 4 encompasses Irving Avenue and Hawthorne Avenue, between 90th street and 89th street, centered on Hawthorne Avenue (**Figure 35**). The area consists of approximately 16 acres of existing detached single-family development with approximately 3,100 linear feet of roadway.

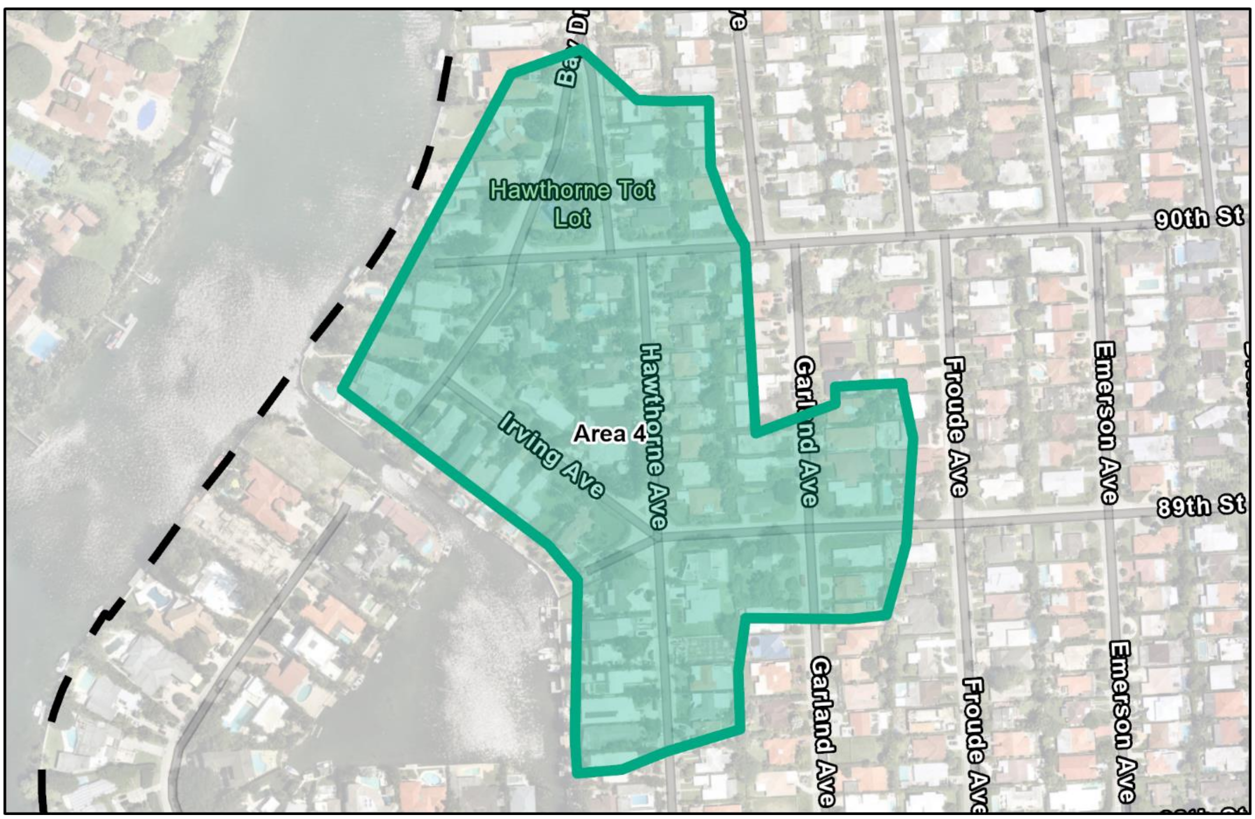

Figure 35. Focus Area 4

Existing Drainage Conditions

The drainage system in this area is a hybrid system consisting of interconnected catch basins with pipe connections to outfalls into the Biscayne Bay.

The area is served by an existing pump owned and operated by the Town. This pump has a capacity of approximately 20 cfs, an on elevation of -0.99 feet NAVD, and an off elevation of -5.99 feet NAVD. The pump outfalls to Biscayne Bay at the west end of 89th Street. More information on the existing pump station is located in the *Pump Stations* Section.

The Town of Surfside has received complaints regarding drainage conditions within the area. In addition, the Town of Surfside has received complaints regarding drainage conditions within the area.

Based on available GIS and as-built information, the elevations range from a low of approximately 0.6 feet to a high of approximately 5.1 feet NAVD.

Performance Goal Analysis

Based on the existing conditions model, the majority of the focus area does not meet the Town's performance goals. **Figure 36** depicts flooding depths during the 10-year, 24-hour storm in Focus Area 1 and the corresponding streets that would be inundated. **Figure 37** depicts flooding depths during the 100-year, 72-hour storm in Focus Area 1 and the corresponding buildings that would be affected.

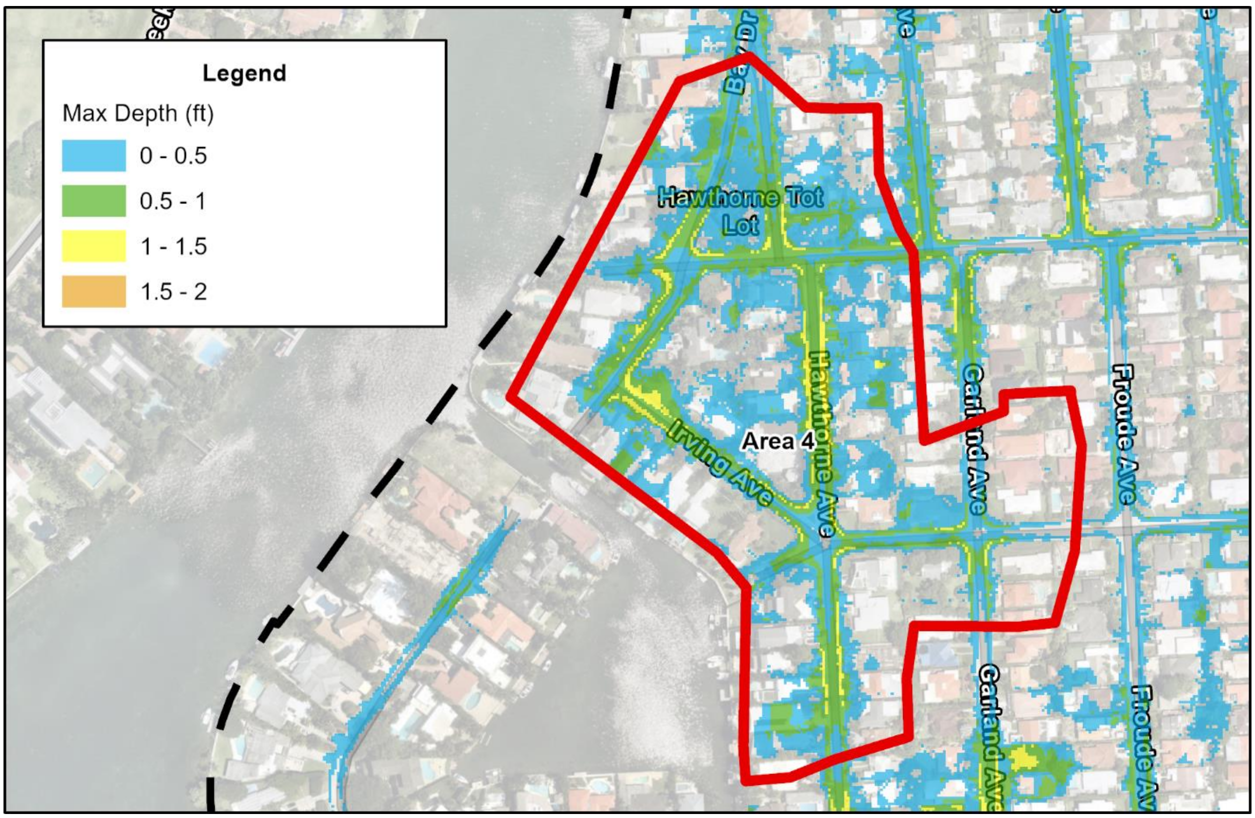

Figure 36. Focus Area 4, Existing Conditions 10-year, 24-hour Storm Event

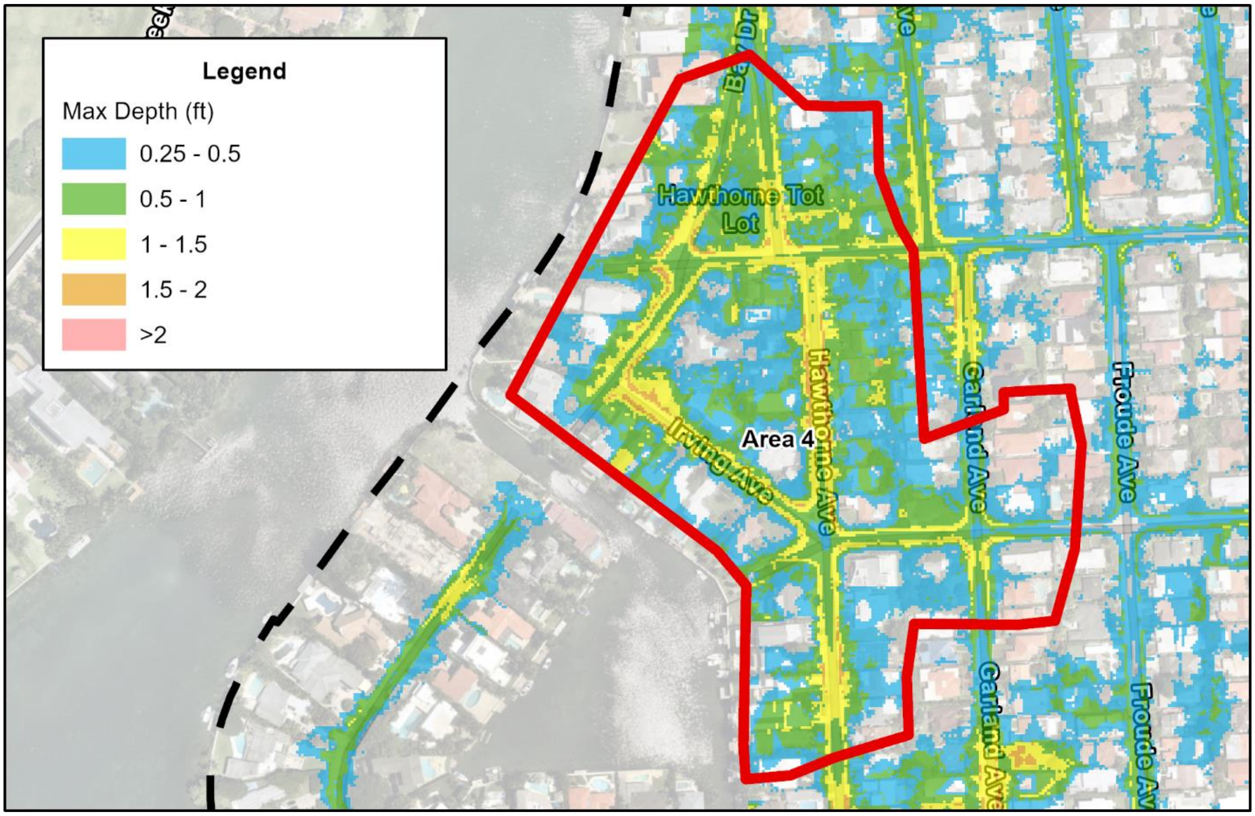

Figure 37. Focus Area 4, Existing Conditions 100-year, 72-hour Storm Event

Drainage Improvement Alternative 1

The first modeled drainage alternative for Focus Area 4 is to upsize the existing pipes and outfall to Biscayne Bay starting at the intersection of Hawthorne Avenue and 89th Street. All upsized pipes including the outfall would be 2-24" RCP. See **Figure 38** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 6.25 hours to 5.50 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 4.25 hours to 3.50 hours in the 10-year, 24-hour storm.

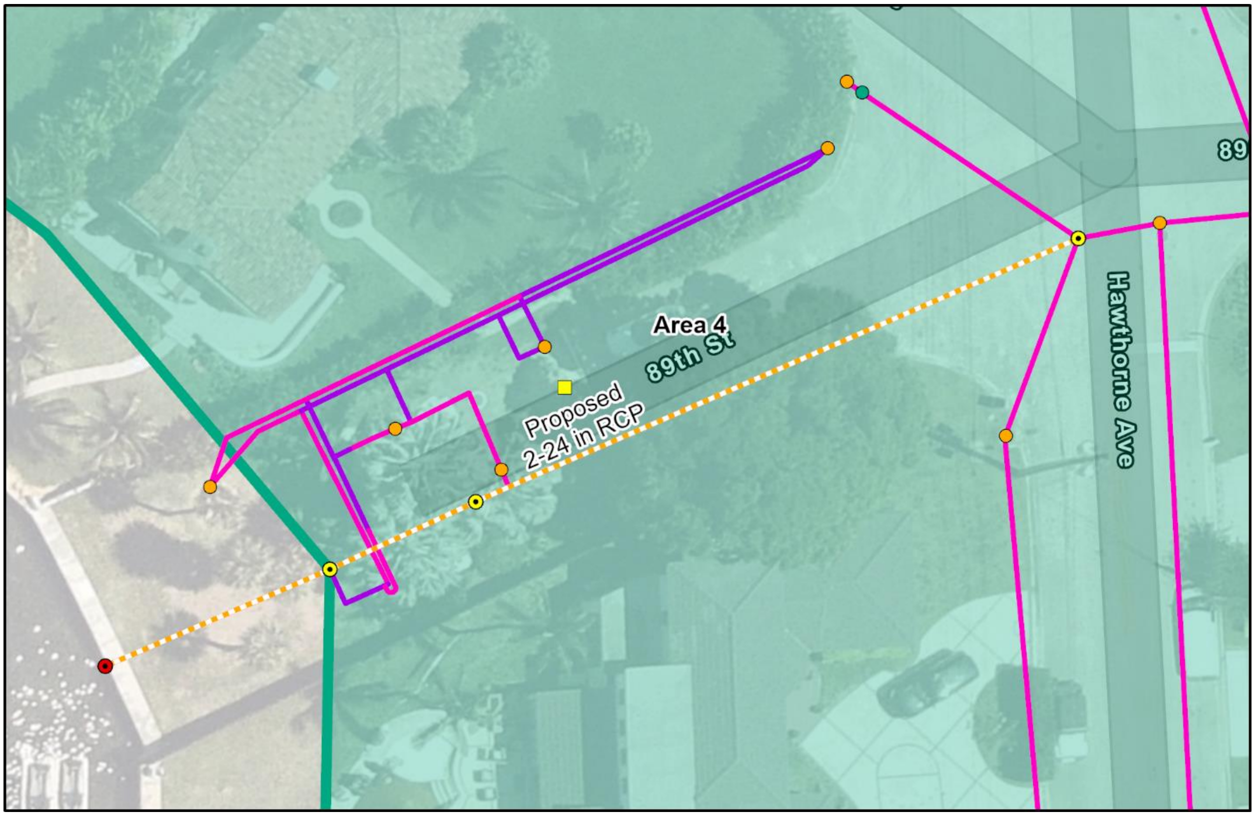

Figure 38. Focus Area 4, Alternative 1 Schematic

Table 20. Focus Area 4, Alternative 1 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$66,225	$67,000
2	Stormwater Pollution Prevention	1	L.S.	$22,075	$23,000
3	Asphalt Restoration	400	S.Y.	$35	$14,000
4	Curbing Restoration	50	L.F.	$35	$2,000
5	Remove existing 30" pipe	30	L.F.	$55	$2,000
6	Remove existing 24" pipe	175	L.F.	$48	$9,000
7	Remove existing concrete end wall	1	EA.	$1,000	$1,000
8	Remove existing structure	3	EA.	$1,000	$3,000
9	2x24" RCP	205	L.F.	$650	$134,000
10	Concrete End wall	1	EA.	$6,500	$7,000
11	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
12	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
13	Stormwater Manhole	3	EA.	$18,000	$54,000
14	Pollution Retardant Baffle	1	EA.	$500	$500
15	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
16	Professional Services	1	L.S.	$83,475	$84,000
17	Contingency (30%)	1	L.S.	$159,450	$160,000
TOTAL					**$800,500**

Drainage Improvement Alternative 2

The second modeled drainage alternative for Focus Area 4 is to upsize the existing pipes and outfall to Biscayne Bay starting at the intersection of Hawthorne Avenue and 89th Street. All upsized pipes including the outfall would be 30" RCP. Additionally, a second outfall would be constructed independently of the pump influenced outfall. This system would branch from the existing stormwater system at the intersection of Hawthorne Avenue and 89th Street. From there it would utilize 1 new manhole on its way to a new outlet into Biscayne Bay. The new system would be 24" RCP. See **Figure 39** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 6.25 hours to 5.00 hours in the 100-year, 72-hour storm and an estimated reduction in residence time in the focus area from 4.25 hours to 3.00 hours in the 10-year, 24-hour storm.

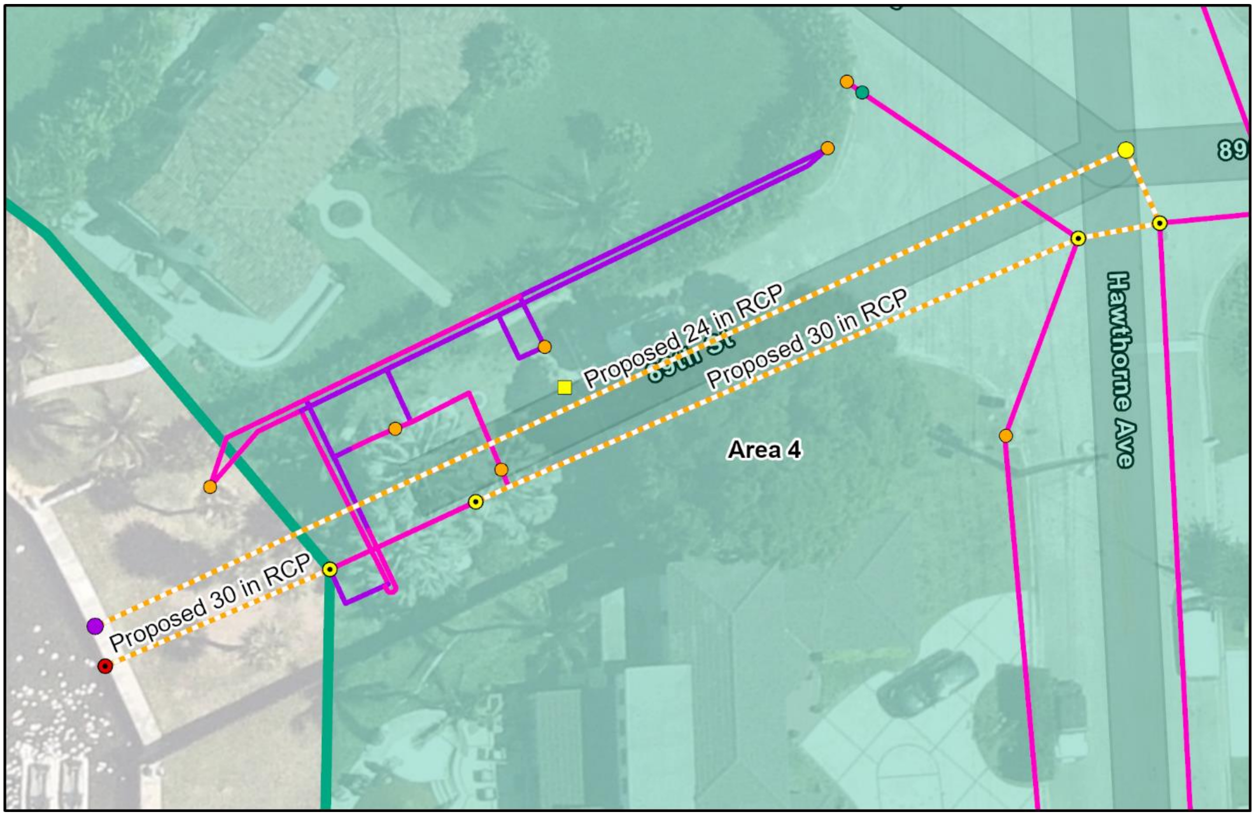

Figure 39. Focus Area 4, Alternative 2 Schematic

Table 21. Focus Area 4, Alternative 2 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$102,000	$102,000
2	Stormwater Pollution Prevention	1	L.S.	$34,000	$34,000
3	Asphalt Restoration	265	S.Y.	$35	$10,000
4	Curbing Restoration	70	L.F.	$35	$3,000
5	Remove existing outfall	50	L.F.	$100	$5,000
6	Remove existing 24" pipe	170	L.F.	$48	$9,000
7	Remove existing concrete end wall	1	EA.	$1,000	$1,000
8	Remove existing structure	7	EA.	$1,000	$7,000
9	Storm Pipe, 24" RCP	220	L.F.	$650	$143,000
10	Storm Pipe, 30" RCP	190	L.F.	$600	$114,000
11	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
12	Concrete End wall	2	EA.	$6,500	$13,000
13	Seawall Outfall Restoration	2	EA.	$15,000	$30,000
14	Stormwater Manhole	5	EA.	$18,000	$90,000
15	Pollution Retardant Baffle	2	EA.	$500	$1,000
16	Inlet Apron	7	EA.	$500	$4,000
17	Obtain Easement Access for New Outfall	1	L.S.	$25,000	$25,000
18	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
19	Professional Services	1	L.S.	$122,400	$123,000
20	Contingency (30%)	1	L.S.	$229,800	$230,000
TOTAL					**$1,169,000**

Table 22 below summarizes the effect of the proposed improvements. **This SWMP recommends Drainage Improvement Alternative 2**.

Table 22. Focus Area 4, Summary of Proposed Alternatives

	10-Year Storm			100-Year Storm		
Parameter	**Existing**	**Alternative 1**	**Alternative 2**	**Existing**	**Alternative 1**	**Alternative 2**
Peak Stage (ft, NAVD88)	2.61	2.56	2.51	3.05	3.02	3.00
Flooding Duration (hrs)	4.25	3.50	3.00	6.25	5.50	5.00

E. Focus Area 5

Location

Focus Area 5 encompasses Biscaya Drive (**Figure 40**). The area consists of approximately 8 acres of existing detached single-family development with approximately 1,900 linear feet of roadway.

Figure 40. Focus Area 5

Existing Drainage Conditions

The drainage system in this area is a hybrid system consisting of interconnected catch basins with pipe connections to outfalls into the Biscayne Bay.

The Town of Surfside has received complaints regarding drainage conditions within the area.

Based on available GIS and as-built information, the elevations range from a low of approximately 1.1 feet to a high of approximately 6.2 feet NAVD.

Performance Goal Analysis

Based on the existing conditions model, the majority of the focus area does not meet the Town's performance goals. **Figure 41** depicts flooding depths during the 10-year, 24-hour storm in Focus Area 1 and the corresponding streets that would be inundated. **Figure 42** depicts flooding depths during the 100-year, 72-hour storm in Focus Area 1 and the corresponding buildings that would be affected.

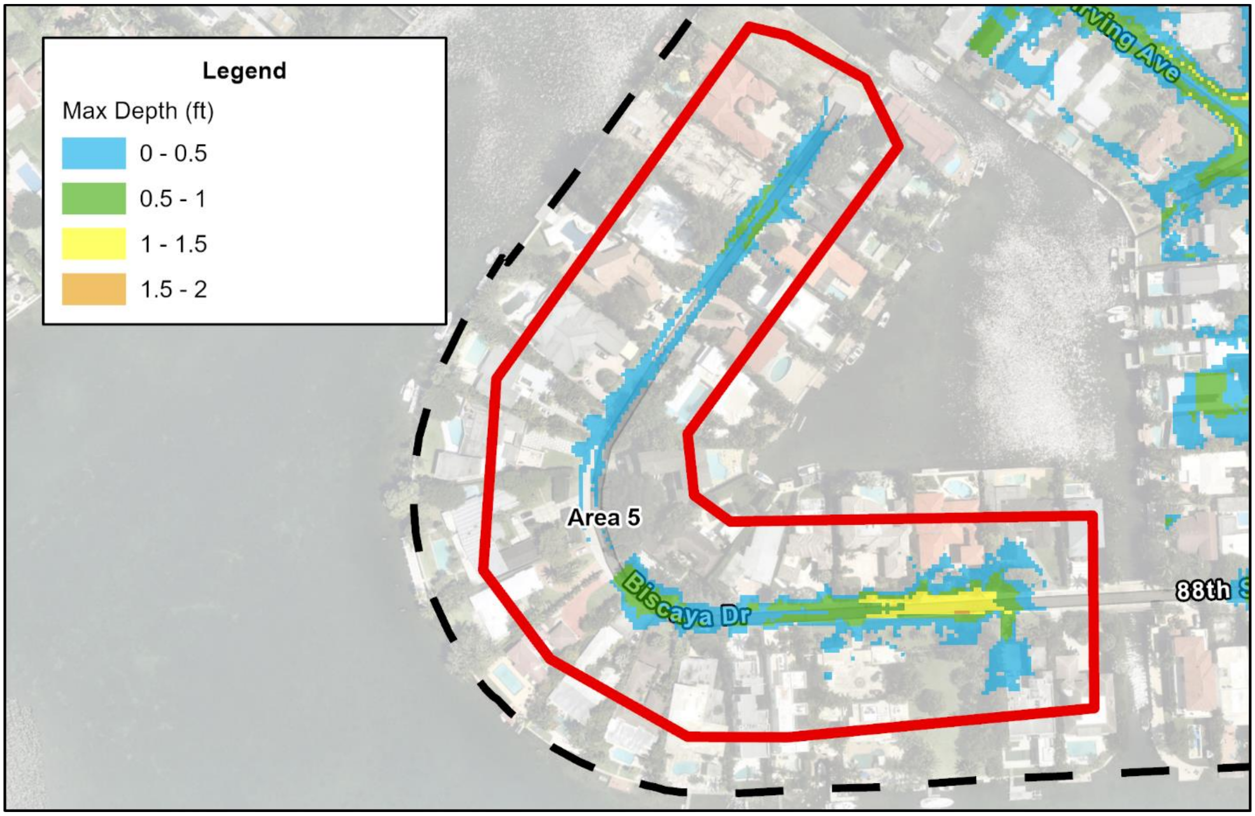

Figure 41. Focus Area 5, Existing Conditions 10-year, 24-hour Storm Event

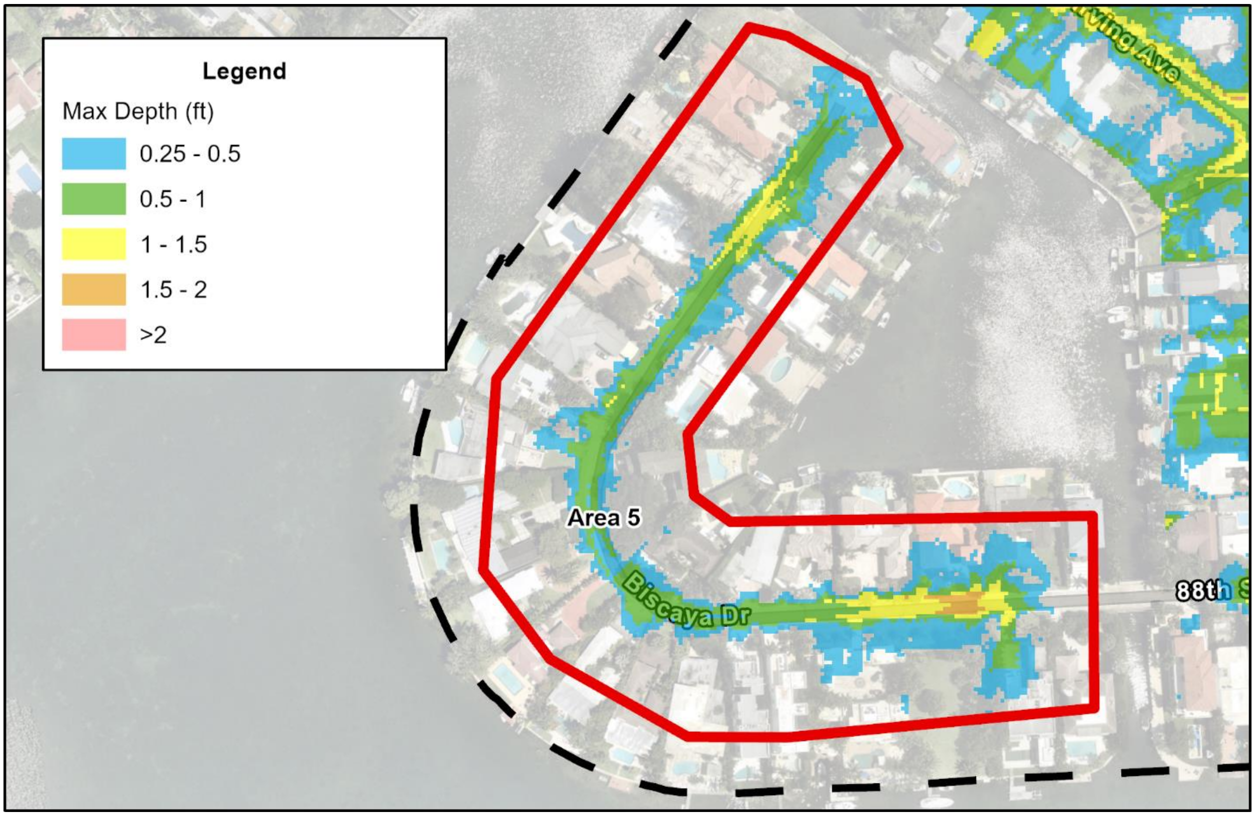

Figure 42. Focus Area 5, Existing Conditions 100-year, 72-hour Storm Event

Drainage Improvement Alternative 1

The first modeled drainage alternative for Focus Area 5 is to upsize both existing outfalls to Biscayne Bay along Biscaya Drive. The outfall would be upgraded to 36" RCP. See **Figure 43** for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 11.75 hours to 10.50 hours in the 100-year, 72-hour storm. Peak stages in the 100-year, 72-hour storm had an estimated reduction from 2.66 feet to 1.83 feet and an estimated reduction in residence time in the focus area from 4.50 hours to 3.50 hours in the 10-year, 24-hour storm. Peak stages in the 10-year, 24-hour storm had an estimated reduction from 2.34 feet to 1.47 feet.

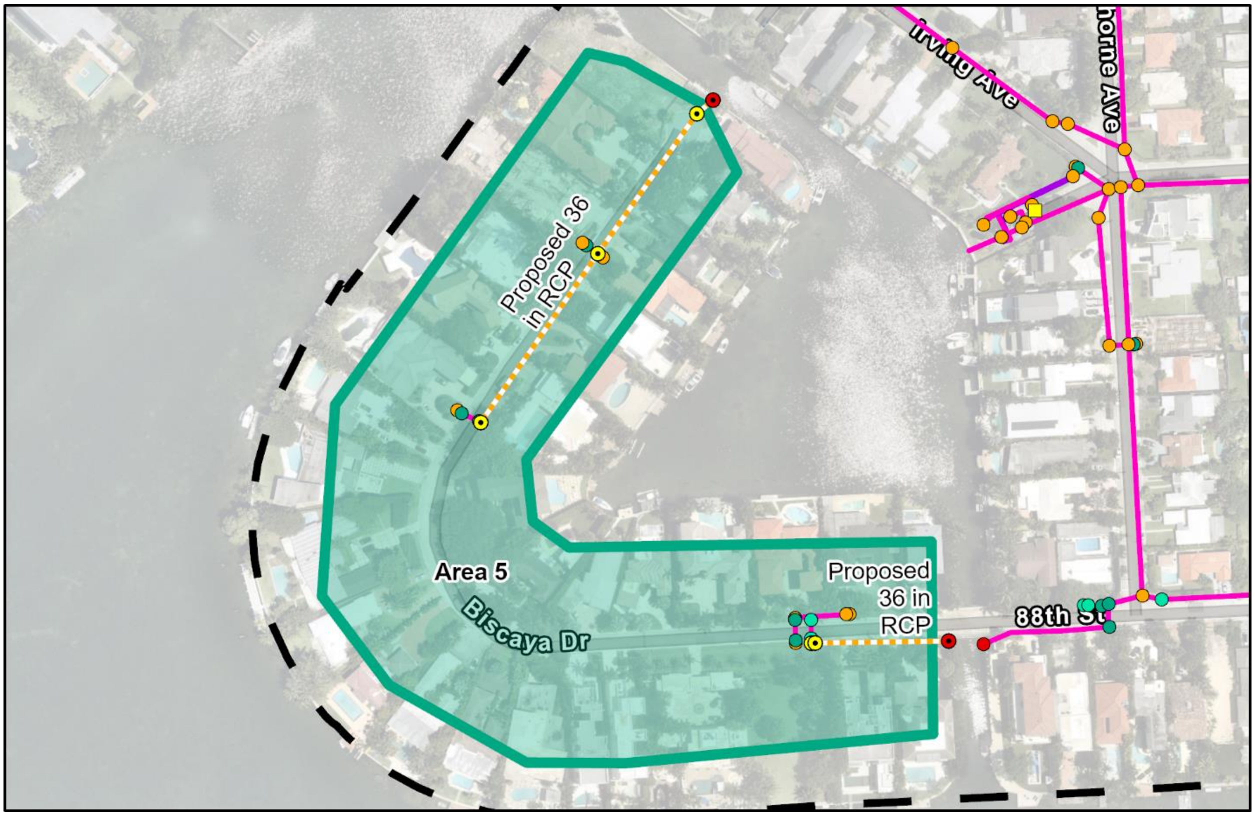

Figure 43. Focus Area 5, Alternative 1 Schematic

Table 23. Focus Area 5, Alternative 1 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$156,525	$157,000
2	Stormwater Pollution Prevention	1	L.S.	$52,175	$53,000
3	Driveway/Sidewalk Restoration	1,525	S.Y.	$50	$77,000
4	Asphalt Restoration	450	S.Y.	$35	$16,000
5	Curbing Restoration	650	L.F.	$35	$23,000
6	Remove existing 15" pipe	180	L.F.	$20	$4,000
7	Remove existing 24" pipe	525	L.F.	$48	$26,000
8	Remove existing concrete end wall	2	EA.	$1,000	$2,000
9	Remove existing structure	5	EA.	$1,000	$5,000
10	Storm Pipe, 36" RCP	705	L.F.	$790	$557,000
11	Concrete End wall	2	EA.	$6,500	$13,000
12	Seawall Outfall Restoration	2	EA.	$15,000	$30,000
13	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
14	Stormwater Manhole	4	EA.	$18,000	$72,000
15	Catch Basin	1	EA.	$18,000	$18,000
16	Inlet Apron	1	EA.	$500	$500
17	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
18	Professional Services	1	L.S.	$191,775	$192,000
19	Contingency (30%)	1	L.S.	$376,050	$377,000
TOTAL					**$1,847,500**

Drainage Improvement Alternative 2

The second modeled drainage improvement in Focus Area 5 included upgrading existing pipes as well as installing a new outfall and pump station. The existing outfall on the south end of Biscaya Drive would be upgraded to 24” RCP to match the existing outfall to the north, while a new 24” force main would be installed to discharge a new 10 cfs pump station. See Figure 44 for a schematic of this improvement.

The modeled effect of this improvement was an estimated reduction in residence time in the focus area from 11.75 hours to 0.75 hours in the 100-year, 72-hour storm. Peak stages in the 100-year, 72-hour storm had an estimated reduction from 2.66 feet to 2.20 feet and an estimated reduction in residence time in the focus area from 4.50 hours to 0.25 hours in the 10-year, 24-hour storm. Peak stages in the 10-year, 24-hour storm had an estimated reduction from 2.34 feet to 1.84 feet.

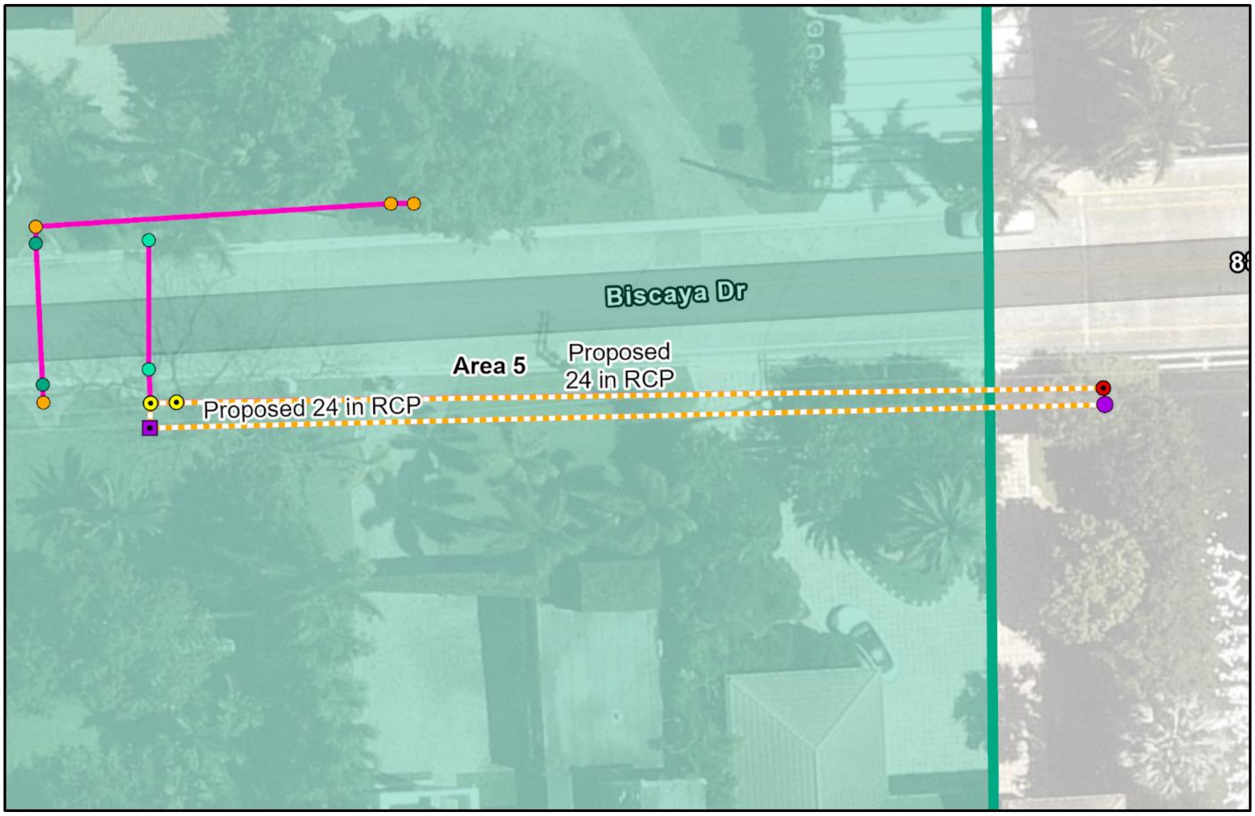

Figure 44. Focus Area 5, Alternative 2 Schematic

Table 24. Focus Area 5, Alternative 2 Capital Improvements Estimated Cost

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$409,050	$410,000
2	Stormwater Pollution Prevention	1	L.S.	$136,350	$137,000
3	Driveway/Sidewalk Restoration	365	S.Y.	$50	$19,000
4	Asphalt Restoration	15	S.Y.	$35	$1,000
5	Curbing Restoration	190	L.F.	$35	$7,000
6	Remove existing 15" pipe	180	L.F.	$20	$4,000
7	Remove existing structure	2	EA.	$1,000	$2,000
8	Remove existing concrete end wall	1	EA.	$1,000	$1,000
9	Storm Pipe, 24" RCP	560	L.F.	$650	$364,000
10	Outfall, 24" RCP	50	L.F.	$500	$25,000
11	Catch Basin	2	EA.	$18,000	$36,000
12	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
13	Concrete End wall	2	EA.	$6,500	$13,000
14	Seawall Outfall Restoration	2	EA.	$15,000	$30,000
15	Obtain Easement Access for New Outfall	1	L.S.	$25,000	$25,000
16	10 cfs pump	1	L.S.	$2,000,000	$2,000,000
17	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
18	Professional Services	1	L.S.	$494,850	$495,000
19	Contingency (30%)	1	L.S.	$982,200	$983,000
TOTAL					**$4,777,000**

Table 25 below summarizes the effect of the proposed improvements. **This SWMP recommends Drainage Improvement Alternative 1**.

Table 25. Focus Area 5, Summary of Proposed Alternatives

	10-Year Storm			100-Year Storm		
Parameter	**Existing**	**Alternative 1**	**Alternative 2**	**Existing**	**Alternative 1**	**Alternative 2**
Peak Stage (ft, NAVD88)	2.34	1.47	1.84	2.66	1.83	2.2
Flooding Duration (hrs)	4.50	3.50	0.25	11.75	10.50	0.75

F. Improvements Outside of Focus Areas

The *Hydrologic and Hydraulic Analysis* Section of this SWMP addressed large scale issues seen through modeling results at the five focus areas. However, Kimley-Horn compiled three main improvements the Town can make to their existing stormwater system, in addition to the those within the focus areas, to mitigate flood hazards within various Town basins: *Stormwater Capacity Upgrades*, *Local Drainage Improvements*, and *Pump Performance Optimization*. These improvements are largely encompassed by the Town's ongoing maintenance and repair schedule or address specific, smaller scale concerns.

These improvements did not undergo the same level of proposed condition modeling analysis and are not included in the CIP. However, they arose from initial existing condition modeling as well as documented problem areas.

For additional recommended actions the Town can take in addition to these improvements refer to the *Operation and Maintenance Plan* Section.

Stormwater Capacity Upgrades

It is Kimley-Horn's recommendation that the Town consider upsizing all pipes in the Town stormwater system that are less than 18" in diameter, as time and budget allows. Pipes that are less than 18" in diameter have significantly less hydraulic capacity than larger pipes in addition to being more susceptible to blockages and sediment build up. The hydraulic capacity of a pipe dramatically decreases as pipe diameter decreases. See **Table 26** summarizing calculated maximum flowrate for RCP pipes with a 1% slope. Flow increases to nearly twice the rate when comparing a 15" pipe to an 18" pipe. In addition to the lower hydraulic capacity within smaller diameter pipes, the network capacity is reduced is as a whole when small pipes interconnect larger pipes.

Table 26. Flowrate by Pipe Size

Pipe Diameter (in)	Maximum Flowrate (cfs)
6	0.56
8	1.21
10	2.19
12	3.56

Pipe Diameter (in)	Maximum Flowrate (cfs)
15	6.46
18	10.50
24	22.62

Figure 45. Stormwater Pipe along Abbott Avenue

Figure 46. Pipe Segments within the Town with Diameter Less than or Equal to 15"

As shown in **Figure 46**, the Town has large segments of its stormwater network connected by pipes with a diameter less than or equal to 15" and stands to gain capacity by upsizing these pipes.

When looking to upsize small pipes, the Town should prioritize upsizing small pipes located between larger pipes, and small pipes that restrict a larger pipe run from conveying stormwater to an outfall or other critical infrastructure. These smaller pipes are more heavily impacted by sediment build up as well as barnacle growth in the case of pipes near outfalls. Opportunities to upsize existing pipes may also occur during routine inspections and maintenance when broken or blocked pipes are replaced. Increasing pipe sizes to at least 18” reduces the impact of sediment build up in the periods between pipe flushes and the reduces the need for maintenance.

Local Drainage Improvements

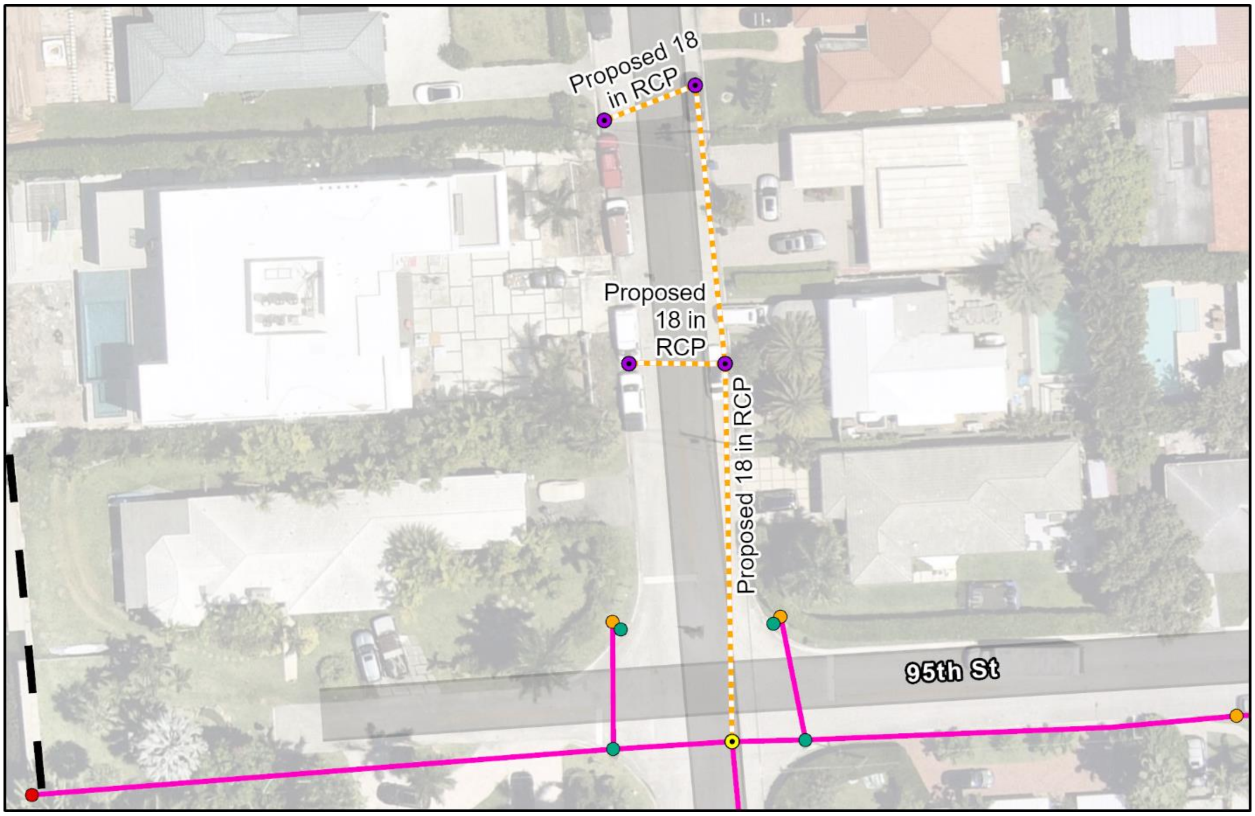

Figure 47. Additional Inlets at Bay Drive

It is Kimley-Horn’s recommendation that the Town add inlets along Bay Drive between 96th Street and 95th Street. The lack of drainage structure along the road has led to resident complaints of flooding. Kimley-Horn recommends adding inlets to direct rainfall off the street and through the existing outfall at 95th street. Currently runoff must travel to the inlets at the corner of Bay Drive and 95th Street before being collected, leading to increased flooding along Bay Drive during high intensity storms. These improvements would reduce flood depth and flooding duration by conveying water into the Town’s stormwater system through the proposed inlets. **Figure 47** above shows a potential layout of proposed drainage infrastructure along this Section of Bay Drive.

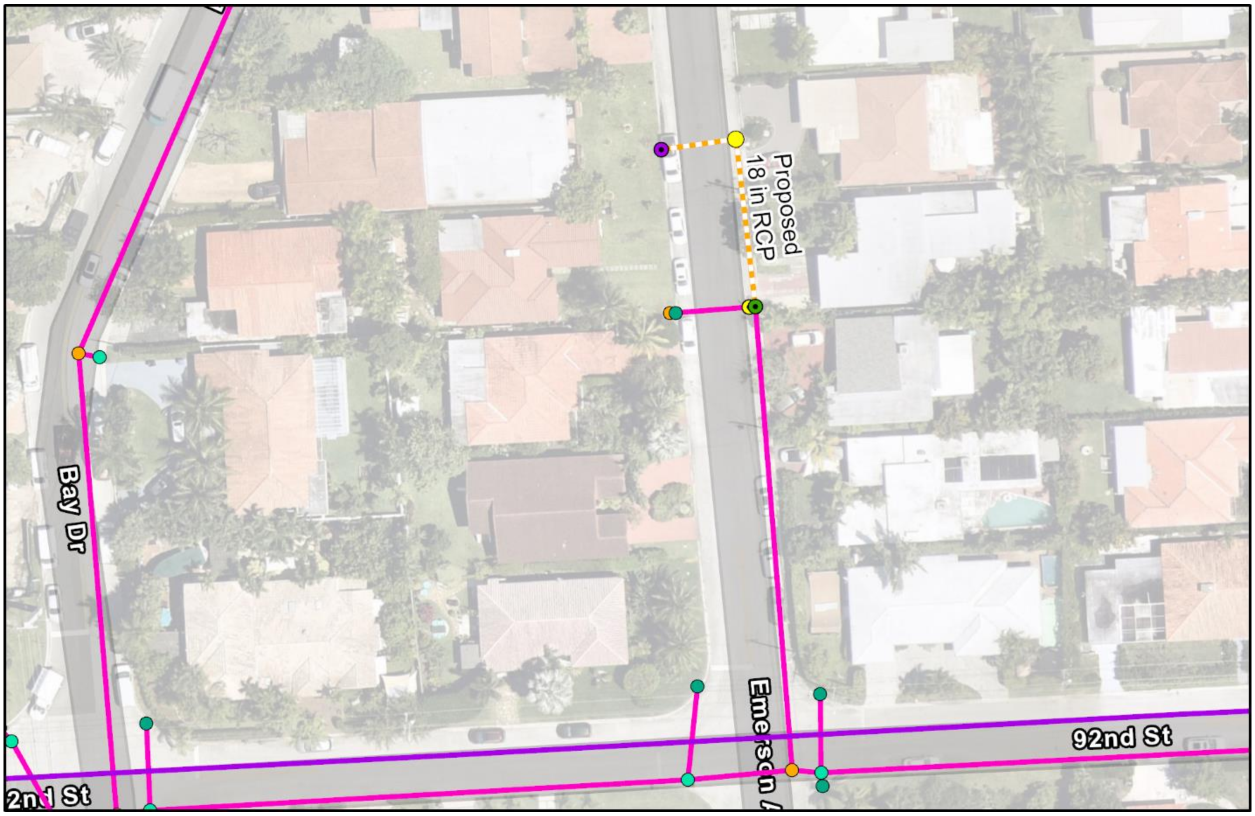

Figure 48. Additional Inlet at Emerson Avenue

Kimley-Horn also recommends adding inlets along Emerson Avenue between 93rd and 92nd Street. While Focus Area 2 Drainage Alternative 2 proposes similar improvements, as seen in **Figure 29**, Kimley-Horn recommends the improvements shown in **Figure 48** above if the Town does not implement Drainage Alternative 2. Constructing an additional inlet at the proposed location would allow runoff to enter the Town system earlier in the storm, reducing flood depths on the road. The proposed inlet is allocated at a low point in the road and would directly contribute to reducing ponding at that location.

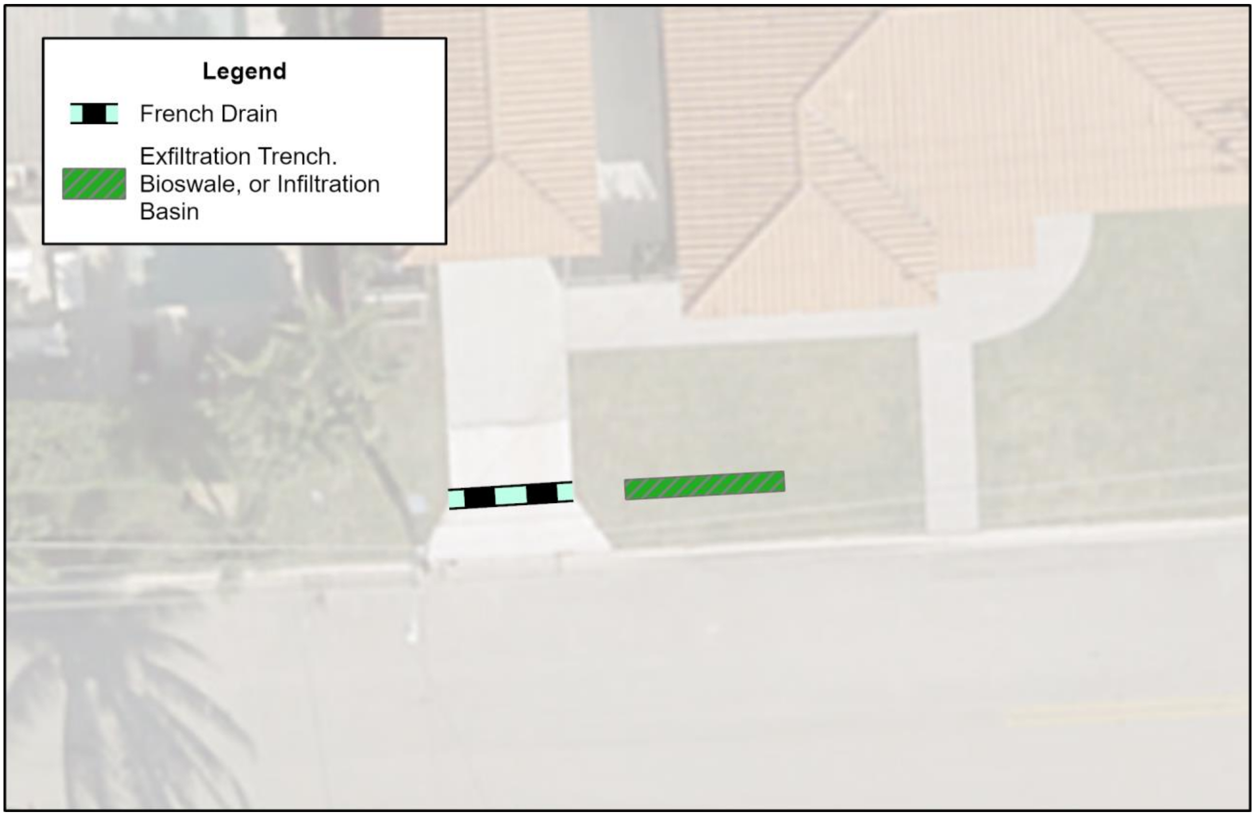

Figure 49. Private Drainage Schematic

The Town stormwater system currently receives runoff from private properties, increasing the load on the Town's stormwater system. Kimley-Horn recommends that the Town consider encouraging the installation of private property drainage systems to reduce the amount of runoff that reaches the Town stormwater system.

The use of French drains, infiltration basins, and bioswales, as seen in **Figure 49**, are feasible for private property drainage systems. These stormwater best management practices (BMPs) can increase the volume and rate of percolation of stormwater runoff into the groundwater table. The Town may consider strengthening their Code of Ordinances to require private drainage systems be installed in the case of new construction or substantial improvements of existing structures. This recommendation is consistent with the Town's goal to promote flood hazard mitigation, by reducing the amount of runoff that reaches the Town stormwater system.

Pump Performance Optimization

The Town provided Kimley-Horn viewing access to the Town SCADA system and a brief overview showed that the Town may be able to operate their pumps more efficiently. Kimley-Horn recommends that the Town hire a consultant that specializes in SCADA analysis to evaluate the Town's pump station operation. In a suboptimal pump operating design, the wet wells that feed the pumps do not fill to their design capacity before pumps are switched on. This leads to the pump switching on and off rapidly, which shortens the pump's operating life and necessitates more frequent maintenance. A consultant specializing in SCADA analysis can propose potential improvements to pump operation set points to extend pump operating life and improve efficiency.

V. CAPITAL IMPROVEMENT PROGRAM

A. Background

Kimley-Horn prepared this Capital Improvement Program (CIP) to prioritize and set budgets required to plan, construct, operate and maintain the Town's Storm Water Management Program. The CIP is a tool intended to provide an order of magnitude for the Town's yearly funding for the implementation of the recommended projects in this Townwide Drainage Improvement and Flood Hazard Mitigation Plan.

The proposed CIP is based on the findings of the assessment of existing drainage improvements in each of the priority project areas. The two major components of the CIP are: the Operation and Maintenance Plan and the Budget/Prioritization recommendations.

The Operation and Maintenance Plan is based on the general assessment of the existing drainage conditions within the Town limits. The recommended operation and maintenance procedures are identified in the subsequent Section.

The Budget/Prioritization component is based on the findings of the analysis of the five focus areas. Preliminary opinions of probable costs (budgets) were prepared for each project area. The following is a detailed explanation and summary of each component of the CIP.

B. Operation and Maintenance Plan

The Town's Operation and Maintenance plan maintains the integrity of its stormwater management system and ensures that it continues to operate at design capacity. The operation and maintenance plan also assists the Town in complying with the National Pollutant Discharge Elimination System (NPDES) as required by state and federal regulations. The majority of the MS4 permit requirements are directly related to operation and maintenance of the stormwater infrastructure with particular emphasis on water quality pre-treatment. More information on the MS4 permit is contained in the *FDEP MS4 Permit* section of this SWMP. Periodic observations, routine maintenance, and general improvements are also required. This Section of the Townwide Drainage Improvement and Flood Hazard Mitigation Plan is not intended to serve as a complete operation and maintenance manual, but to provide enough information to allocate sufficient budget to stormwater infrastructure operations and maintenance costs. The Town Public Works Department oversees the Standard Operating Procedures (SOPs) that make up the Town Operation and Maintenance Plan.

Inspecting and Maintaining Catch Basins and Pipe Systems

Even with regular removal of sediment from the catch basins, over time sediment will build up in drainage pipes. Therefore, pipes should be cleaned and flushed on a regular basis. Pipe flushing is typically performed in conjunction with catch basin cleaning and can be contracted out on an as-needed basis. During this activity, a high-pressure water hose is inserted into the pipe network. This process flushes debris into the catch basin where it can then be removed. If inspections yield unsatisfactory results, maintenance activities such as sediment removal from catch basins and pipe flushing will be required. The large amount of sand that enters Town stormwater system requires consistent maintenance to ensure function of the Town system. Consider implementing monitoring the frequency that manholes and inlets are being cleaned using a GIS data management system.

The Town's current Structure Control Inspection and Maintenance SOP requires regular inspection and maintenance of all Town Stormwater Management System structures and facilities. The inspection and maintenance schedule for Town structures is provided in **Table 27**. The maintenance schedule detailed in the SOP meets the requirements of the MS4 permit and is comprehensive enough to meet the maintenance needs of the Town.

Table 27. Town Inspection and Maintenance Frequency

Structure Class	Inspection Frequency
Pollution Control Boxes	Quarterly
Inlets and Catch Basins	Annually
Manholes	Annually
Facilities (Pump Stations)	Quarterly
Pipes	Annually

Updating Maps and Inventories of Stormwater Management Infrastructure

As part of this Townwide Drainage Improvement and Flood Hazard Mitigation Plan, an updated GIS map of the drainage infrastructure located within the Town was created using information obtained from the Town and field data. Field data was used to update invert elevations where appropriate, and to add invert and rim elevation data to areas with missing information. See the *Data Collection* Section of this SWMP for more information on the development of the updated GIS map. It is recommended that this map be updated regularly to reflect the installation of new drainage infrastructure. An updated map of drainage outfalls is required to be submitted annually under the MS4 permit. Dye tests have also been discussed to confirm whether the FDOT system connects to the Town system at 92nd Street and 93rd Street.

Figure 50. Invert measurement at 94th Street

Roadway Litter Control and Street Sweeping Programs

Street sweeping and litter control programs are recommended to reduce the amount of debris entering the stormwater management system. This activity cleans intake structures, reduces debris deposition within the pipe network, and enhances the aesthetics of the Town. Generally, street sweeping is a positive maintenance activity that provides measurable benefits. Because pollutants such as hydrocarbons and metals adhere to dirt particles, removing this dirt from the street system will remove these pollutants before they are allowed to discharge into the Town's drainage system, improving water quality.

The Town's current Street Sweeping and Litter SOP details the Town's procedures in detail. All streets in the Town are swept weekly. Public right of way and parking areas are cleaned five to six days a week. The Town SOP meets all requirements under the MS4 permit.

Public Outreach and Education Requirements

The Town maintains a Comprehensive Stormwater Education/Outreach Program (Outreach Program) that highlights the following issues:

- Illicit Discharge and Proper De-watering Planning
- Florida Friendly Landscaping Practices
- Hazardous Waste Disposal
- Pet Waste and Water Pollution Control
- Litter Control and Street Sweeping
- Pesticides, Herbicides, and Fertilizers

This Outreach Program addresses key areas as required by the MS4 permit.

Kimley-Horn recommends strengthening the Outreach Program by adding education material or programs targeting construction erosion and sediment control for contractors that operate within the Town.

Conducting Inspections and Monitoring Activities

Under the MS4 permit, the Town is required to conduct inspections of the following activities:

- Evaluating, monitoring, and inspecting waste treatment, storage, and disposal facilities
- Implementing an inspection program to detect illicit discharges and illegal connections to the stormwater management system
- Maintaining a citizen complaint log documenting illicit discharges
- Identifying and maintaining a GIS database of areas served by septic systems and advising the local health department of potential violations if constituents common to wastewater contamination due to malfunctioning septic tank systems are discovered
- Advising the appropriate utility owner of potential violation if constituents common to wastewater contamination are found in areas served by sanitary sewer systems
- Inspecting industrial and high risk facilities for illegal discharges into the MS4
- Requiring new construction sites to obtain NPDES permits from Department of Environmental Protection (DEP) prior to land clearing
- Monitoring water quality in canals

The Town has adopted several SOPs related to inspection and monitoring of the Town MS4 system including the following:

- Maintenance Shop and Equipment Yard Inspection
- Pesticides Herbicide Fertilizer Application and Inspection
- Pre-Construction and Construction Site Inspection
- Proactive Inspection and Reactive Investigation

This collection of SOPs forms a comprehensive program for handling inspection and monitoring requirements under the MS4 permit.

Minor Repairs and Improvements

The final task conducted to maintain the stormwater collection system is routine improvements and repairs. This task covers a significant spectrum of activities ranging from the repair of collapsed pipes and manholes to the replacement of catch basin grates. Maintenance activities are performed in response to an immediate problem using the best methods available. These tasks often cannot be foreseen or scheduled.

Operation and Maintenance Costs

Based on previous budgets, the Town's operating expenses are approximately $300,000 a year, but this value fluctuates from year to year. Kimley-Horn estimates that maintenance costs will total approximately $100,000 a year in 2023 dollars, and that this cost will increase by approximately 5% each year. As the maintenance activities are initiated, Kimley-Horn recommend utilizing the database of GIS information to track and schedule the maintenance and inspection activities. This process will identify the date and time that a system was last maintained and will also provide a tool to identify the next scheduled maintenance.

C. Considerations for Budget and Prioritization

The Capital Improvement Program is based on the results of the analysis of the 5 focus areas. Recommended improvements to achieve the stated performance goals were identified for each area. The recommended improvements were quantified based on the available data and preliminary opinions of probable costs (preliminary budgets) were prepared for each basin. Prior to each individual project being implemented, professional services such as surveying, engineering, and permitting will be required and are included within the budgets. The budget figures were developed by reviewing recent costs from similar projects. The CIP budgets are based on 2023 dollars.

The following assumptions have been made in the formulation of the budgets for the drainage improvements:

- The budgets include the recommended improvements identified in the analysis of the 5 focus areas.
- Projects were grouped by focus area.
- The budgets include restoration of the roadway impacted by the proposed trenching, but do not include any additional roadway resurfacing. It is assumed that roadway resurfacing will be completed concurrently with the proposed drainage projects, but that the Town will have a separate roadway resurfacing budget.
- The budgets do not include any costs of obtaining construction easements. A budget of $25,000 is included for obtaining easements when a new outfall is proposed.
- The budgets include a 15 % allowance for mobilization and maintenance of traffic.
- The budgets include a 30 % contingency for each project. A relatively high contingency value is used, due to the age and level of coverage of the survey and geotechnical data available to prepare the conceptual design for the projects.
- The budgets include a 15 % of construction cost allowance for surveying, engineering, permitting, and construction phase assistance (site observations during construction).
- The budgets include landscape costs to replace sod only. No budget for additional landscape improvements or restoration is included.

The budgetary numbers are an opinion of probable construction costs in the current marketplace. Unit pricing for similar projects constructed in Miami-Dade County and the region, was used as the basis for the construction budget. FDOT 6-month rolling averages for unit items were also referenced. Based on the preliminary budgets, the proposed priority sub-basin improvements were grouped and phased to provide the alternative five-year and ten-year capital improvement programs.

Resilient Florida Grant Program

The development of this SWMP sets the Town on a path towards identification and prioritization of stormwater infrastructure improvements that serve as the basis for flood hazard mitigation. However, it is also an important step in jump starting the Town's evaluation of future vulnerabilities and planning for resiliency.

Future condition flooding scenarios are being studied by the State through The Resilient Florida Program (§ 380.093, Fla. Stat.). This effort encompasses a grant mechanism for eligible municipalities to receive funding for resiliency planning of their critical infrastructure, including stormwater systems. The grants are geared towards both planning and implementation but require a Vulnerability Assessment (VA) as the first step since the completion of a VA renders the Town eligible for additional State funding to implement identified projects from this SWMP. The requirements for the VA are laid out by the same Statute and offer a sequential process to identify areas and assets of the Town that are impacted by five different types of flooding, as applicable. The VA may also include other non-flooding related threats chosen for evaluation by the Town.

In addition to the benefit of eligibility for additional funding, a VA would expand on the findings of this SWMP to include additional flooding scenarios and vulnerable critical infrastructure. Likewise, the development of this SWMP supports the VA by providing priority areas, vulnerable to flooding in future conditions as they are in existing conditions, as well as localized models capable of addressing rainfall-induced flooding, one of the required analyses of the VA. The projects identified in this SWMP can be included in the VA to earn grant money for proposed projects. With completion of the SWMP and VA, as well as continued collaboration with the County and neighboring municipalities, the Town will have a robust list of threats, vulnerabilities, and most importantly resiliency solutions that will benefit the community for years to come.

APPENDIX A – HYDROLOGIC AND HYDRAULIC MODEL INPUTS

Appendix A Included Separately

APPENDIX B – EXISTING MODEL RESULTS EXHIBITS

DATE:	AUGUST 2023
DESIGN:	AFS
DRAWN:	AFS
CHECKED:	MPB
KH NO.:	143332002

10-YEAR 24-HOUR EXISTING CONDITIONS PEAK INUNDATION MAP

Broward County, FL

TOWN OF SURFSIDE
STORMWATER MASTER PLAN

N

Kimley»Horn
8201 Peters Road
Suite 2200
Plantation, FL 33324
(954) 535-5100 Phone

SHEET
1

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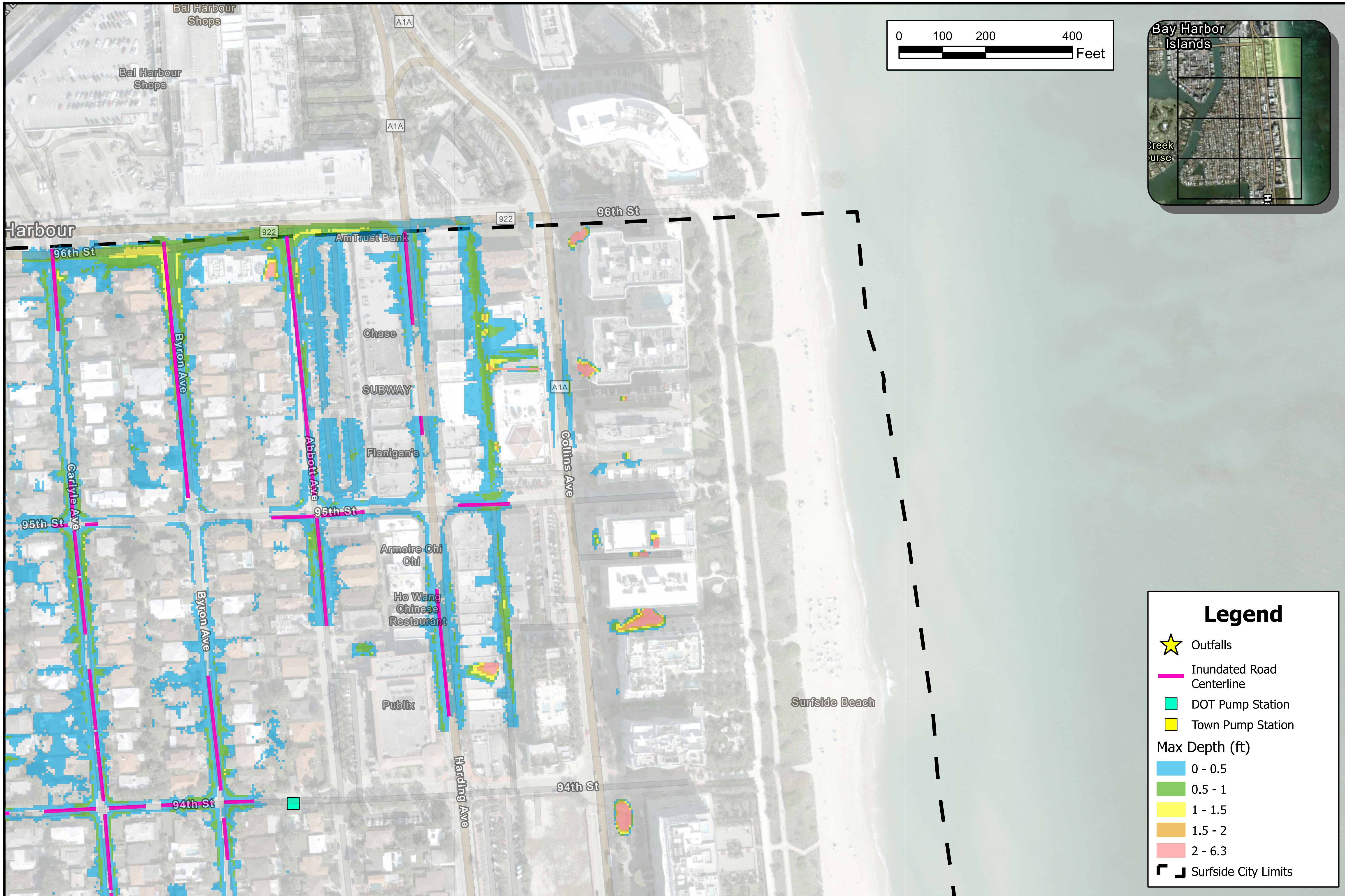
Town of Surfside, FL
TOWN OF SURFSIDE
STORMWATER MASTER PLAN

10-YEAR 24-HOUR
PEAK INUNDATION MAP

DATE:	AUGUST 2023
DESIGN:	KT
DRAWN:	KT
CHECKED:	MB
KH NO.:	143332002

SHEET
1-1



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Town of Surfside, FL

TOWN OF SURFSIDE
STORMWATER MASTER PLAN

10-YEAR 24-HOUR
PEAK INUNDATION MAP

DATE: AUGUST 2023
DESIGN: KT
DRAWN: KT
CHECKED: MB
KH NO.: 143332002

SHEET
1-2

Legend

- Outfalls
- DOT Pump Station
- Town Pump Station
- Inundated Road Centerline

Max Depth (ft)

- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 6.3
- Surfside City Limits

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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

10-YEAR 24-HOUR PEAK INUNDATION MAP

DATE:	AUGUST 2023
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KH NO.:	143332002

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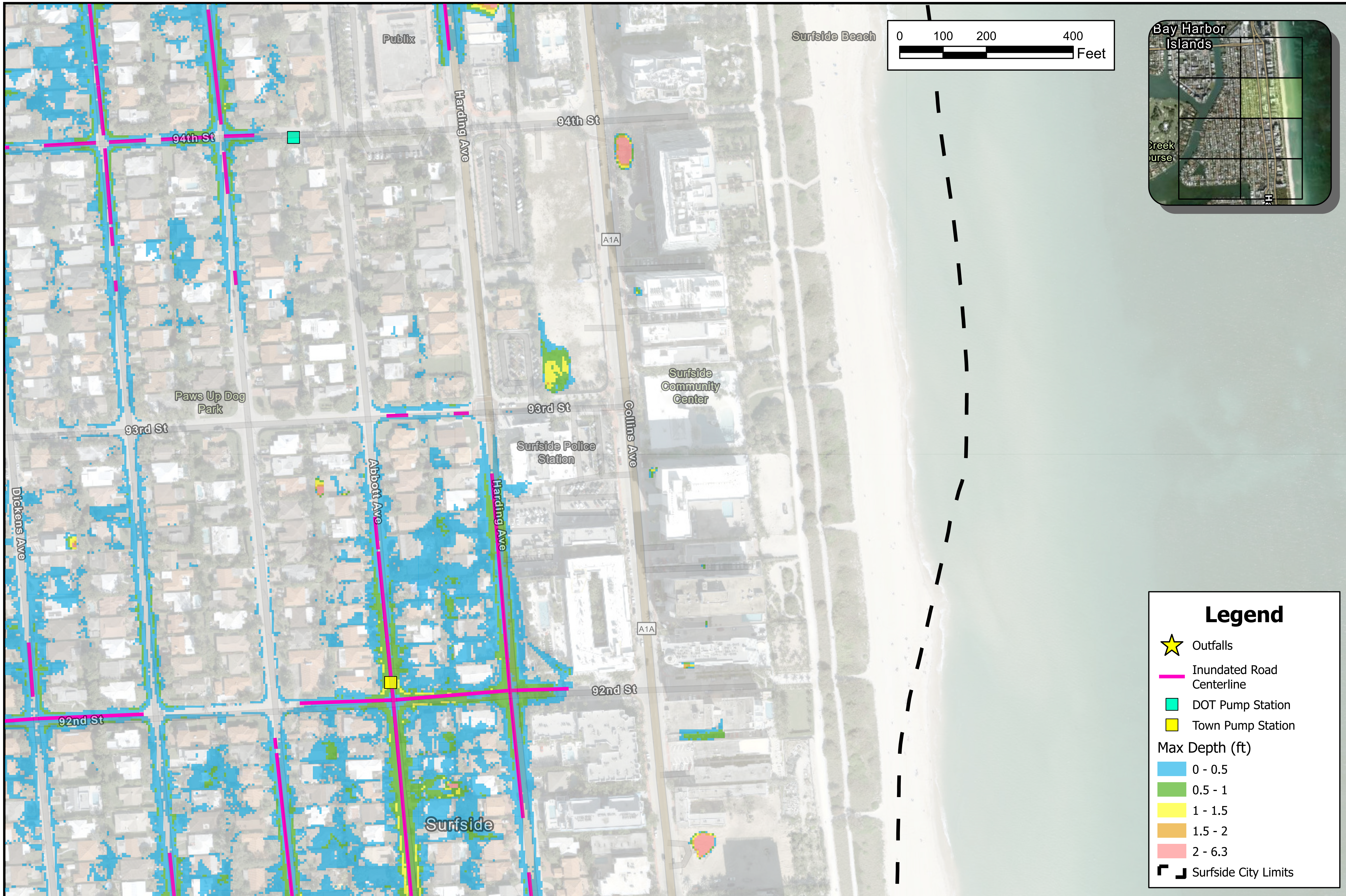

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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

10-YEAR 24-HOUR PEAK INUNDATION MAP

DATE:	AUGUST 2023
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1-4

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Town of Surfside, FL
TOWN OF SURFSIDE
STORMWATER MASTER PLAN

10-YEAR 24-HOUR
PEAK INUNDATION MAP

DATE:	AUGUST 2023
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SHEET
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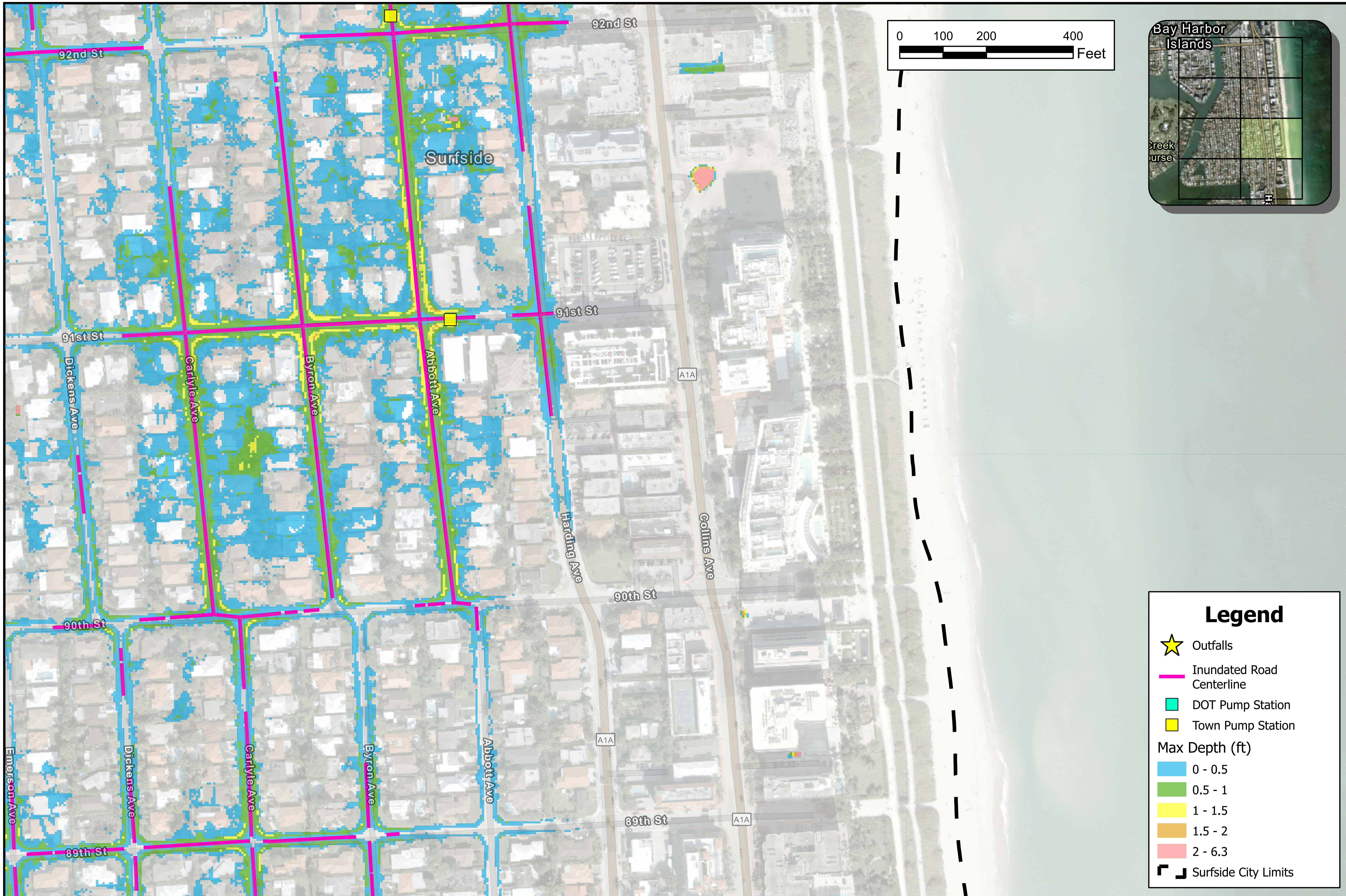

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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

10-YEAR 24-HOUR PEAK INUNDATION MAP

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Town of Surfside, FL

TOWN OF SURFSIDE
STORMWATER MASTER PLAN

10-YEAR 24-HOUR
PEAK INUNDATION MAP

DATE:	AUGUST 2023
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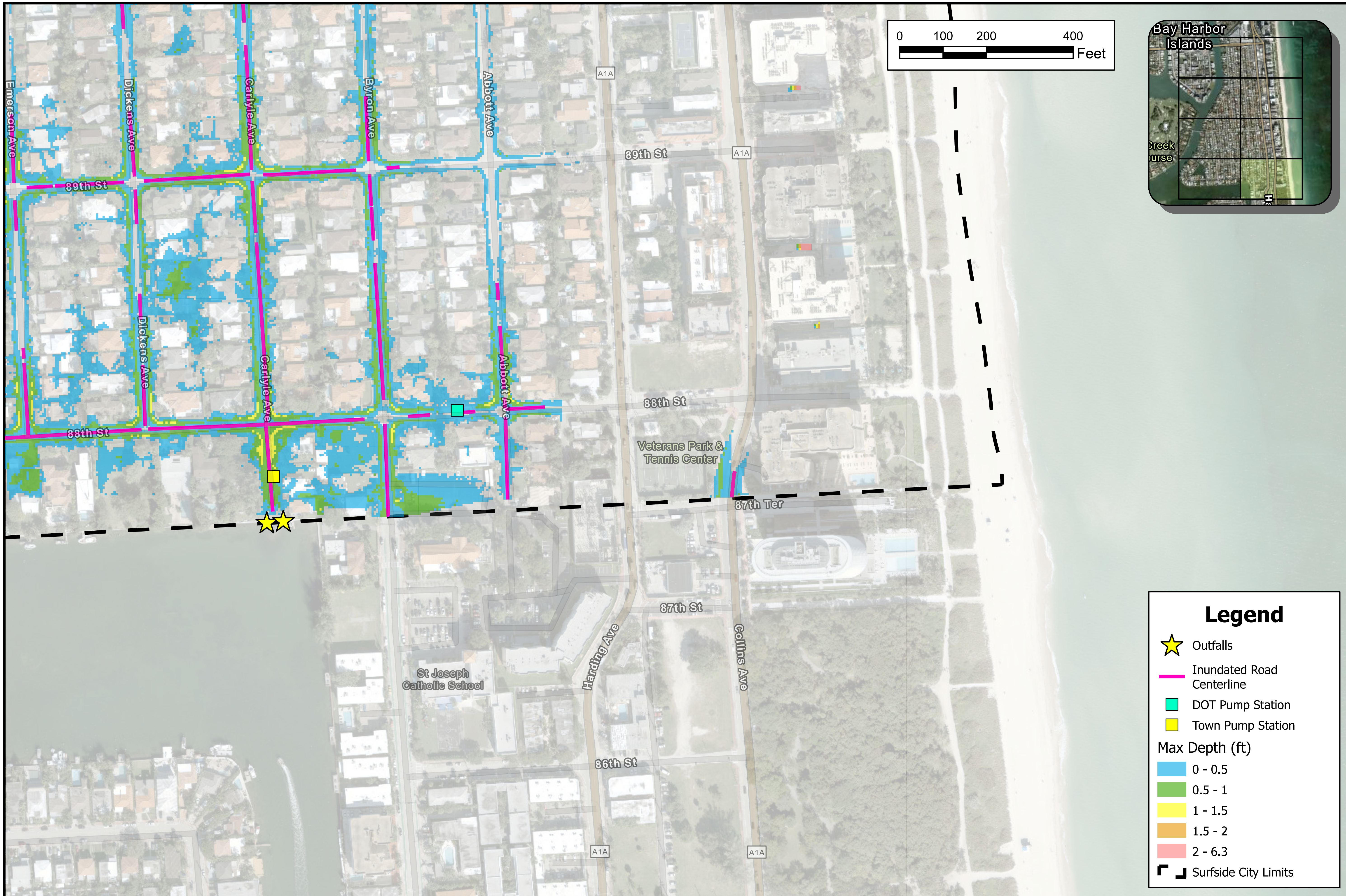
SHEET

1-7



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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

10-YEAR 24-HOUR PEAK INUNDATION MAP

DATE:	AUGUST 2023
DESIGN:	KT
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1-8

DATE:	AUGUST 2023
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100-YEAR 72-HOUR EXISTING CONDITIONS PEAK INUNDATION MAP

Broward County, FL

TOWN OF SURFSIDE
STORMWATER MASTER PLAN

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2

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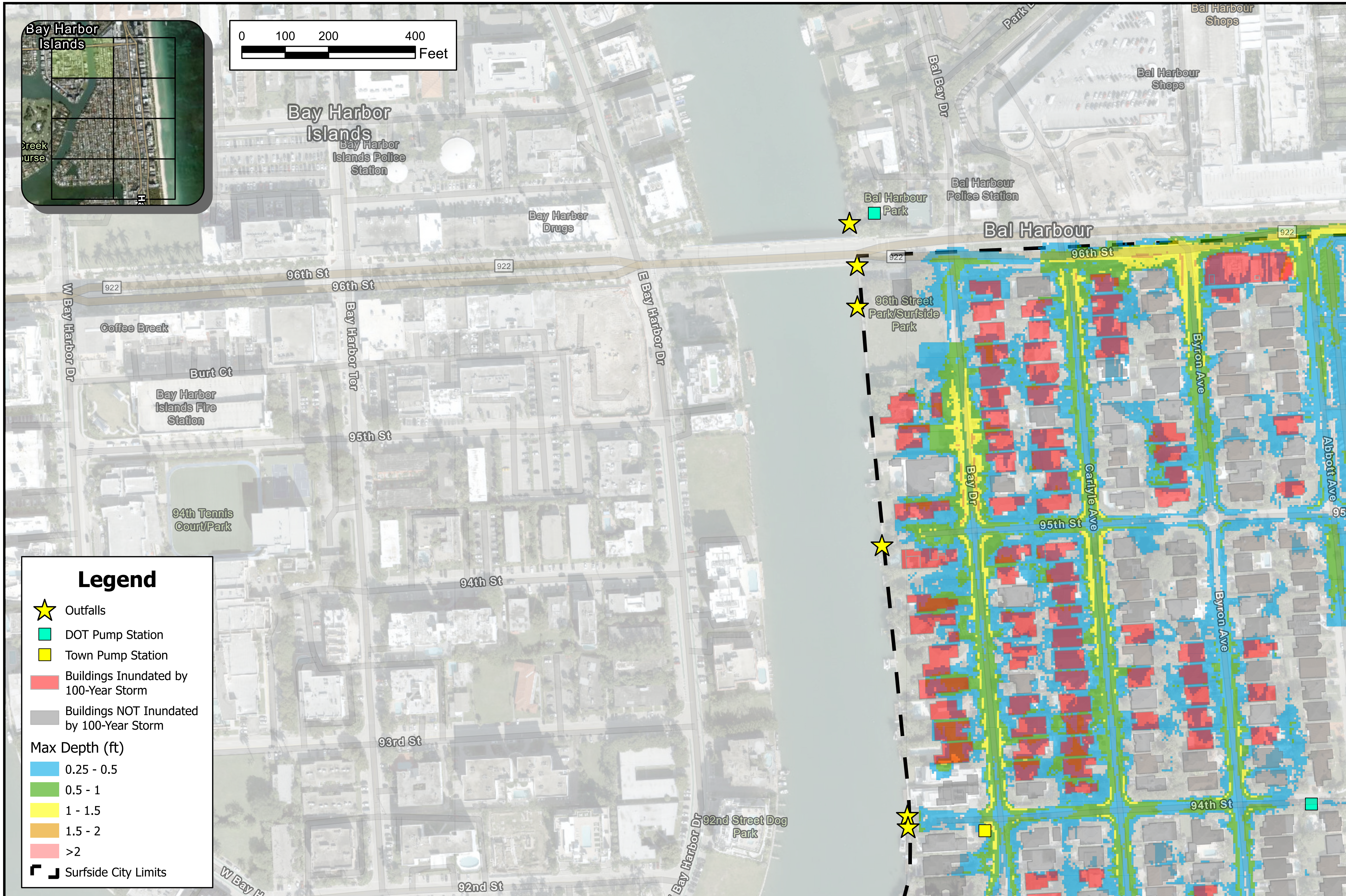

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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

10-YEAR 24-HOUR PEAK INUNDATION MAP

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2-1

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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

10-YEAR 24-HOUR PEAK INUNDATION MAP

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KH NO.:	143332002

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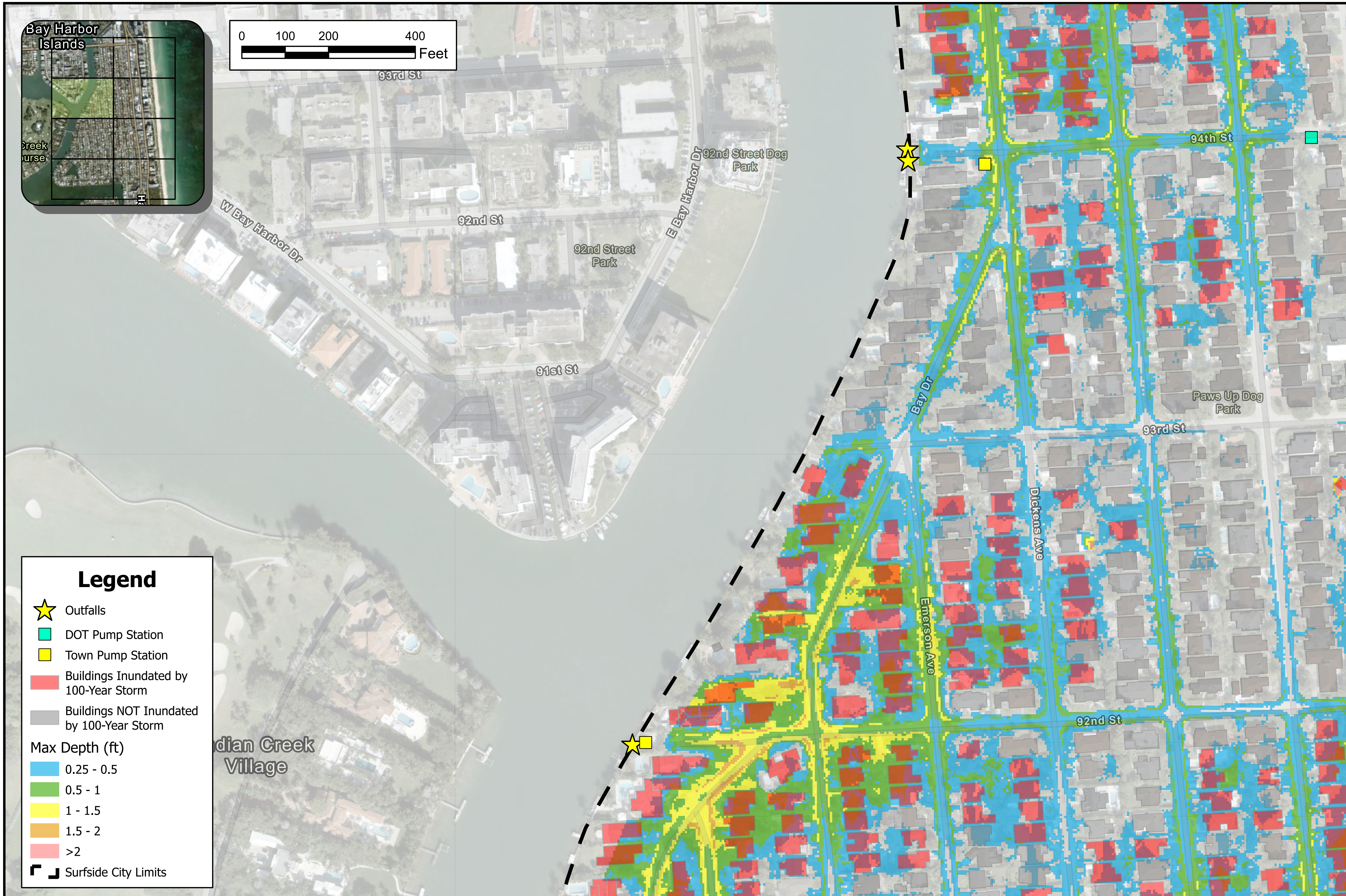
2-2



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Town of Surfside, FL

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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

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Town of Surfside, FL
TOWN OF SURFSIDE
STORMWATER MASTER PLAN

10-YEAR 24-HOUR
PEAK INUNDATION MAP

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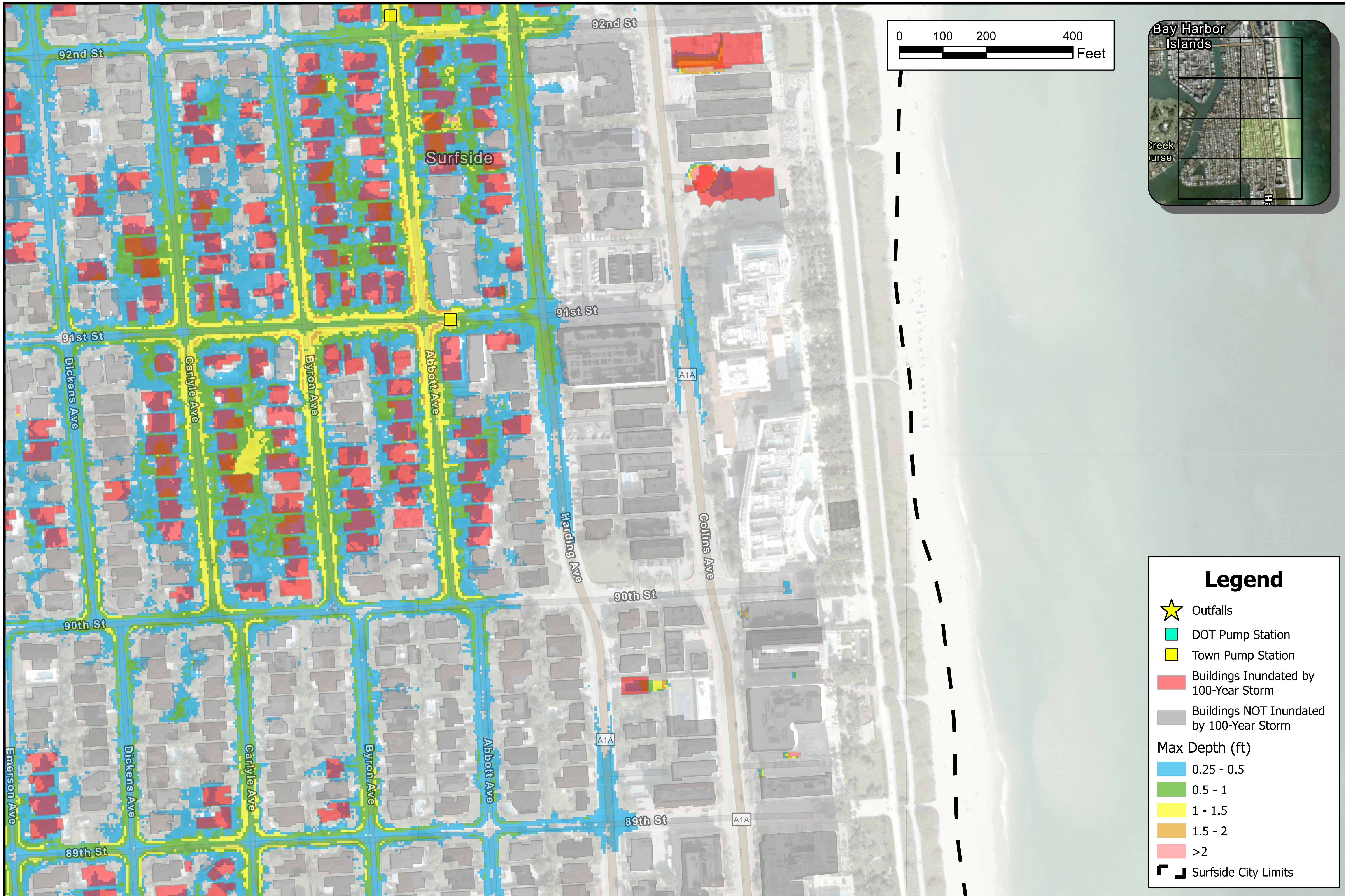

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Town of Surfside, FL
TOWN OF SURFSIDE
STORMWATER MASTER PLAN

10-YEAR 24-HOUR
PEAK INUNDATION MAP

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Town of Surfside, FL
TOWN OF SURFSIDE
STORMWATER MASTER PLAN

10-YEAR 24-HOUR
PEAK INUNDATION MAP

DATE:	AUGUST 2023
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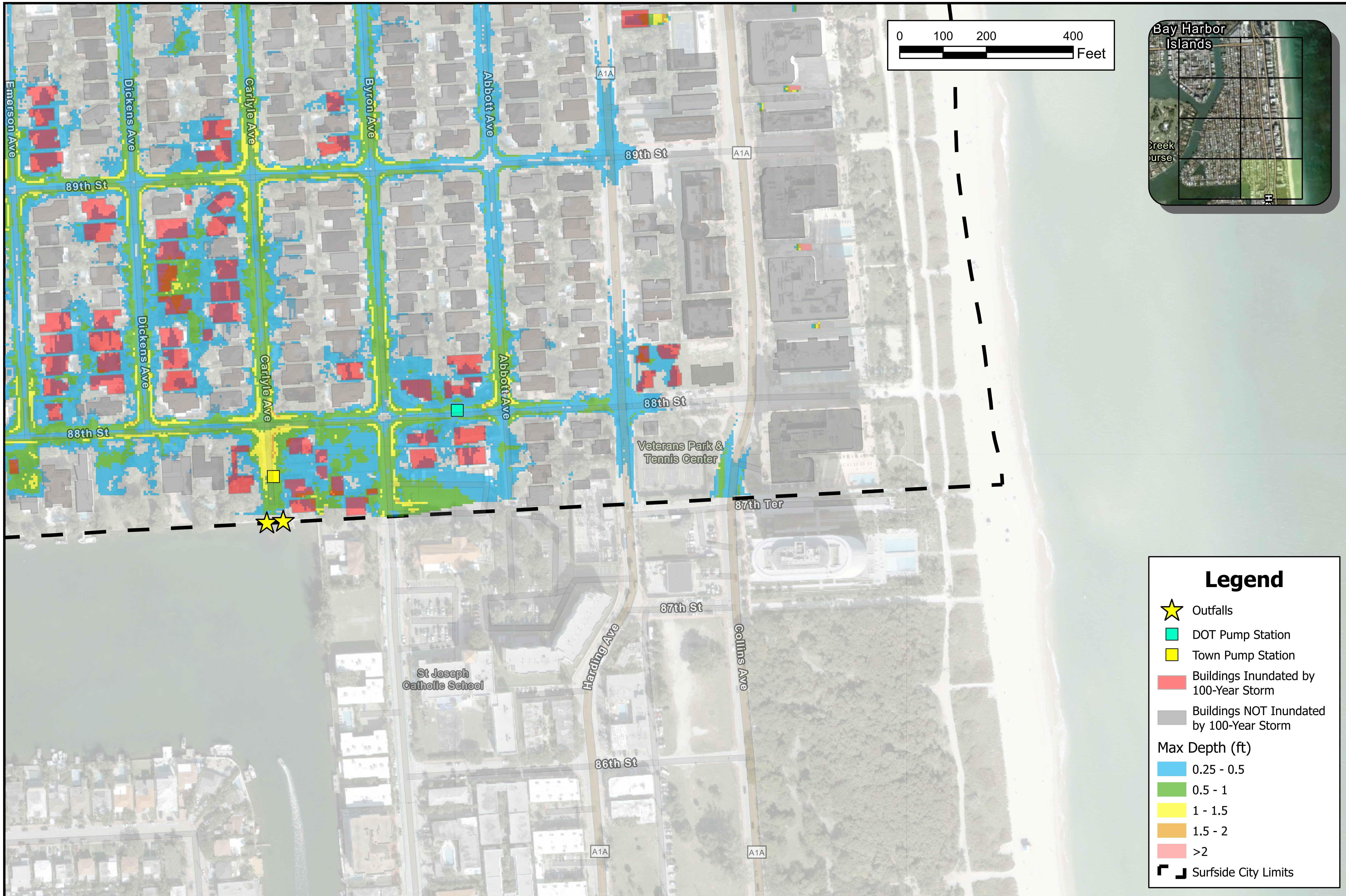
2-7



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TOWN OF SURFSIDE STORMWATER MASTER PLAN

10-YEAR 24-HOUR PEAK INUNDATION MAP

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2-8

APPENDIX C – PROPOSED IMPROVEMENTS SUMMARY

Proposed Alternative Peak Stage and Flooding Duration Summary

Focus Area	Summary of Proposed Alternative 1	Summary of Proposed Alternative 2	10-year, 24-hour Storm Event: Peak Stage (ft, NAVD88) Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference	Flooding Duration (hrs) Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference
1	Upsize the existing outfall to Biscayne Bay on the north side of 91st Street to 2-30" pipes.	Upsize the existing pipes running west along 91st Street from Abbott to the outfall (on both sides of the street) to 30" pipes.	2.86	2.86	*0.00*	2.86	*0.00*	3.75	2.75	*1.00*	3.00	*0.75*
2	Upsize the existing pipes along 92nd Street from Emerson Avenue to Bay Drive to 24" pipes and from Bay Drive to Biscayne Bay to 2-24" pipes.	Connect the existing stormwater system along 92nd Street to 94th Street by installing new pipes and upsizing existing pipes to 24". A segment upstream of the outfall will be upsized to 2-24" pipes.	2.67	2.54	*0.13*	2.67	*0.00*	5.50	3.00	*2.50*	4.50	*1.00*
3	Upsize the existing pipes along 92nd Street from Bay Drive to Biscayne Bay to 2-24" pipes. The existing pump will be replaced with a new 40 cfs pump.	Upsize the existing pipes and outfall along 92nd Street from Bay Drive to Biscayne Bay to 24" pipes. The existing pump station will be replaced with a new 40 cfs. A second gravity system outfall willl be constructed.	2.87	2.48	*0.39*	2.55	*0.32*	5.50	2.00	*3.50*	4.00	*1.50*
4	Upsize the existing pipes along 89th Steet from Hawthorne Avenue to Biscayne Bay to 2-24" pipes.	Upsize the existing pipes along 89th Street from Hawthorne Avenue to Biscayne Bay to 2-24" pipes. A second gravity system outfall willl be constructed.	2.61	2.56	*0.05*	2.51	*0.10*	4.25	3.50	*0.75*	3.00	*1.25*
5	Upsize both existing outfalls to Biscayne Bay to 36" pipes.	Upsize pipes along 88th Street east to Biscayne Bay to 24" pipes. A new 10 cfs pump station and corresponding force main outfall will be constructed adjacent to the existing outfall.	2.34	1.47	*0.87*	1.84	*0.50*	4.50	3.50	*1.00*	0.25	*4.25*

Proposed Alternative Peak Stage and Flooding Duration Summary

Focus Area	Summary of Proposed Alternative 1	Summary of Proposed Alternative 2	100-year, 72-hour Storm Event									
			Peak Stage (ft, NAVD88)					Flooding Duration (hrs)				
			Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference	Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference
1	Upsize the existing outfall to Biscayne Bay on the north side of 91st Street to 2-30" pipes.	Upsize the existing pipes running west along 91st Street from Abbott to the outfall (on both sides of the street) to 30" pipes.	3.15	3.15	*0.00*	3.15	*0.00*	6.25	4.50	*1.75*	4.75	*1.50*
2	Upsize the existing pipes along 92nd Street from Emerson Avenue to Bay Drive to 24" pipes and from Bay Drive to Biscayne Bay to 2-24" pipes.	Connect the existing stormwater system along 92nd Street to 94th Street by installing new pipes and upsizing existing pipes to 24". A segment upstream of the outfall will be upsized to 2-24" pipes.	3.07	3.02	*0.05*	3.06	*0.01*	9.25	5.00	*4.25*	7.00	*2.25*
3	Upsize the existing pipes along 92nd Street from Bay Drive to Biscayne Bay to 2-24" pipes. The existing pump will be replaced with a new 40 cfs pump.	Upsize the existing pipes and outfall along 92nd Street from Bay Drive to Biscayne Bay to 24" pipes. The existing pump station will be replaced with a new 40 cfs. A second gravity system outfall willl be constructed.	3.05	2.99	*0.06*	3.01	*0.04*	8.75	4.25	*4.50*	6.00	*2.75*
4	Upsize the existing pipes along 89th Steet from Hawthorne Avenue to Biscayne Bay to 2-24" pipes.	Upsize the existing pipes along 89th Street from Hawthorne Avenue to Biscayne Bay to 2-24" pipes. A second gravity system outfall willl be constructed.	3.05	3.02	*0.03*	3.00	*0.05*	6.25	5.50	*0.75*	5.00	*1.25*
5	Upsize both existing outfalls to Biscayne Bay to 36" pipes.	Upsize pipes along 88th Street east to Biscayne Bay to 24" pipes. A new 10 cfs pump station and corresponding force main outfall will be constructed adjacent to the existing outfall.	2.66	1.83	*0.83*	2.20	*0.46*	11.75	10.50	*1.25*	0.75	*11.00*

Proposed Alternative Peak Stage and Flooding Duration Summary

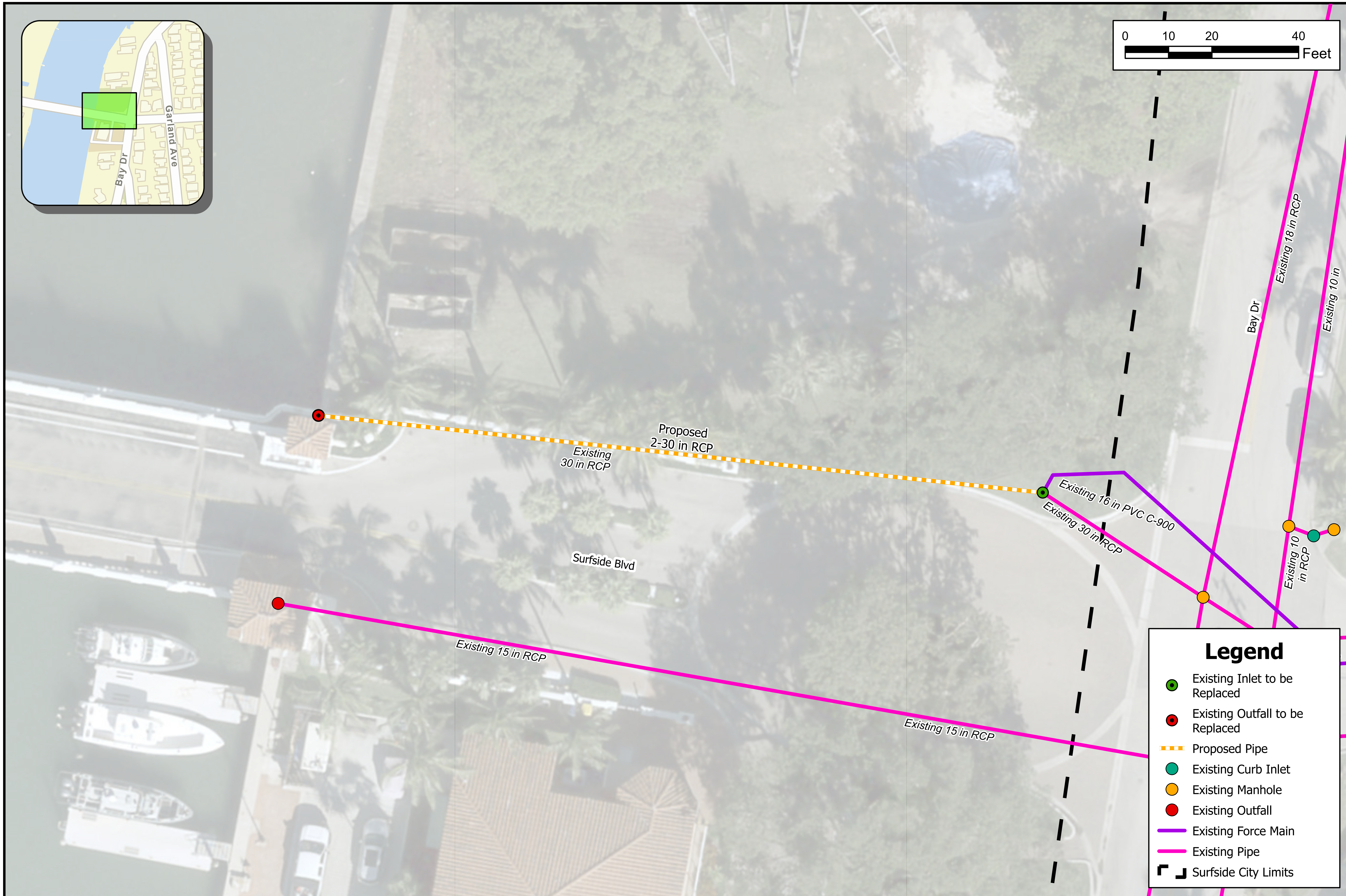
			Future Conditions with Sea Level Rise - 10-year, 24-hour Storm Event									
			Peak Stage (ft, NAVD88)					Flooding Duration (hrs)				
Focus Area	Summary of Proposed Alternative 1	Summary of Proposed Alternative 2	Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference	Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference
1	Upsize the existing outfall to Biscayne Bay on the north side of 91st Street to 2-30" pipes.	Upsize the existing pipes running west along 91st Street from Abbott to the outfall (on both sides of the street) to 30" pipes.	2.89	2.89	*0.00*	2.89	*0.00*	5.25	4.00	*1.25*	4.00	*1.25*
2	Upsize the existing pipes along 92nd Street from Emerson Avenue to Bay Drive to 24" pipes and from Bay Drive to Biscayne Bay to 2-24" pipes.	Connect the existing stormwater system along 92nd Street to 94th Street by installing new pipes and upsizing existing pipes to 24". A segment upstream of the outfall will be upsized to 2-24" pipes.	2.78	2.72	*0.06*	2.78	*0.00*	6.50	4.25	*2.25*	6.00	*0.50*
3	Upsize the existing pipes along 92nd Street from Bay Drive to Biscayne Bay to 2-24" pipes. The existing pump will be replaced with a new 40 cfs pump.	Upsize the existing pipes and outfall along 92nd Street from Bay Drive to Biscayne Bay to 24" pipes. The existing pump station will be replaced with a new 40 cfs. A second gravity system outfall willl be constructed.	2.90	2.58	*0.32*	2.73	*0.17*	6.00	3.00	*3.00*	5.75	*0.25*
4	Upsize the existing pipes along 89th Steet from Hawthorne Avenue to Biscayne Bay to 2-24" pipes.	Upsize the existing pipes along 89th Street from Hawthorne Avenue to Biscayne Bay to 2-24" pipes. A second gravity system outfall willl be constructed.	2.90	2.75	*0.15*	2.73	*0.17*	5.50	5.25	*0.25*	4.75	*0.75*
5	Upsize both existing outfalls to Biscayne Bay to 36" pipes.	Upsize pipes along 88th Street east to Biscayne Bay to 24" pipes. A new 10 cfs pump station and corresponding force main outfall will be constructed adjacent to the existing outfall.	2.90	2.76	*0.14*	2.62	*0.28*	18.75	18.50	*0.25*	1.75	*17.00*

Proposed Alternative Peak Stage and Flooding Duration Summary

Focus Area	Summary of Proposed Alternative 1	Summary of Proposed Alternative 2	Future Conditions with Sea Level Rise - 100-year, 72-hour									
			Peak Stage (ft, NAVD88)					Flooding Duration (hrs)				
			Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference	Pre-Project	Post-Alternative 1	Difference	Post-Alternative 2	Difference
1	Upsize the existing outfall to Biscayne Bay on the north side of 91st Street to 2-30" pipes.	Upsize the existing pipes running west along 91st Street from Abbott to the outfall (on both sides of the street) to 30" pipes.	3.18	3.18	*0.00*	3.18	*0.00*	8.25	5.50	*2.75*	6.00	*2.25*
2	Upsize the existing pipes along 92nd Street from Emerson Avenue to Bay Drive to 24" pipes and from Bay Drive to Biscayne Bay to 2-24" pipes.	Connect the existing stormwater system along 92nd Street to 94th Street by installing new pipes and upsizing existing pipes to 24". A segment upstream of the outfall will be upsized to 2-24" pipes.	3.16	3.13	*0.03*	3.16	*0.00*	11.00	6.75	*4.25*	10.50	*0.50*
3	Upsize the existing pipes along 92nd Street from Bay Drive to Biscayne Bay to 2-24" pipes. The existing pump will be replaced with a new 40 cfs pump.	Upsize the existing pipes and outfall along 92nd Street from Bay Drive to Biscayne Bay to 24" pipes. The existing pump station will be replaced with a new 40 cfs. A second gravity system outfall willl be constructed.	3.15	3.09	*0.06*	3.13	*0.02*	9.75	5.25	*4.50*	9.50	*0.25*
4	Upsize the existing pipes along 89th Steet from Hawthorne Avenue to Biscayne Bay to 2-24" pipes.	Upsize the existing pipes along 89th Street from Hawthorne Avenue to Biscayne Bay to 2-24" pipes. A second gravity system outfall willl be constructed.	3.14	3.14	*0.00*	3.13	*0.01*	8.00	7.00	*1.00*	6.75	*1.25*
5	Upsize both existing outfalls to Biscayne Bay to 36" pipes.	Upsize pipes along 88th Street east to Biscayne Bay to 24" pipes. A new 10 cfs pump station and corresponding force main outfall will be constructed adjacent to the existing outfall.	3.22	2.94	*0.28*	2.92	*0.30*	56.50	55.50	*1.00*	2.25	*54.25*

APPENDIX D – PROPOSED IMPROVEMENTS EXHIBITS

A. Focus Area 1



Kimley»Horn
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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 1 ALTERNATIVE 1

DATE:	AUGUST 2023
DESIGN:	KT
DRAWN:	KT
CHECKED:	MB
KH NO.:	143332002

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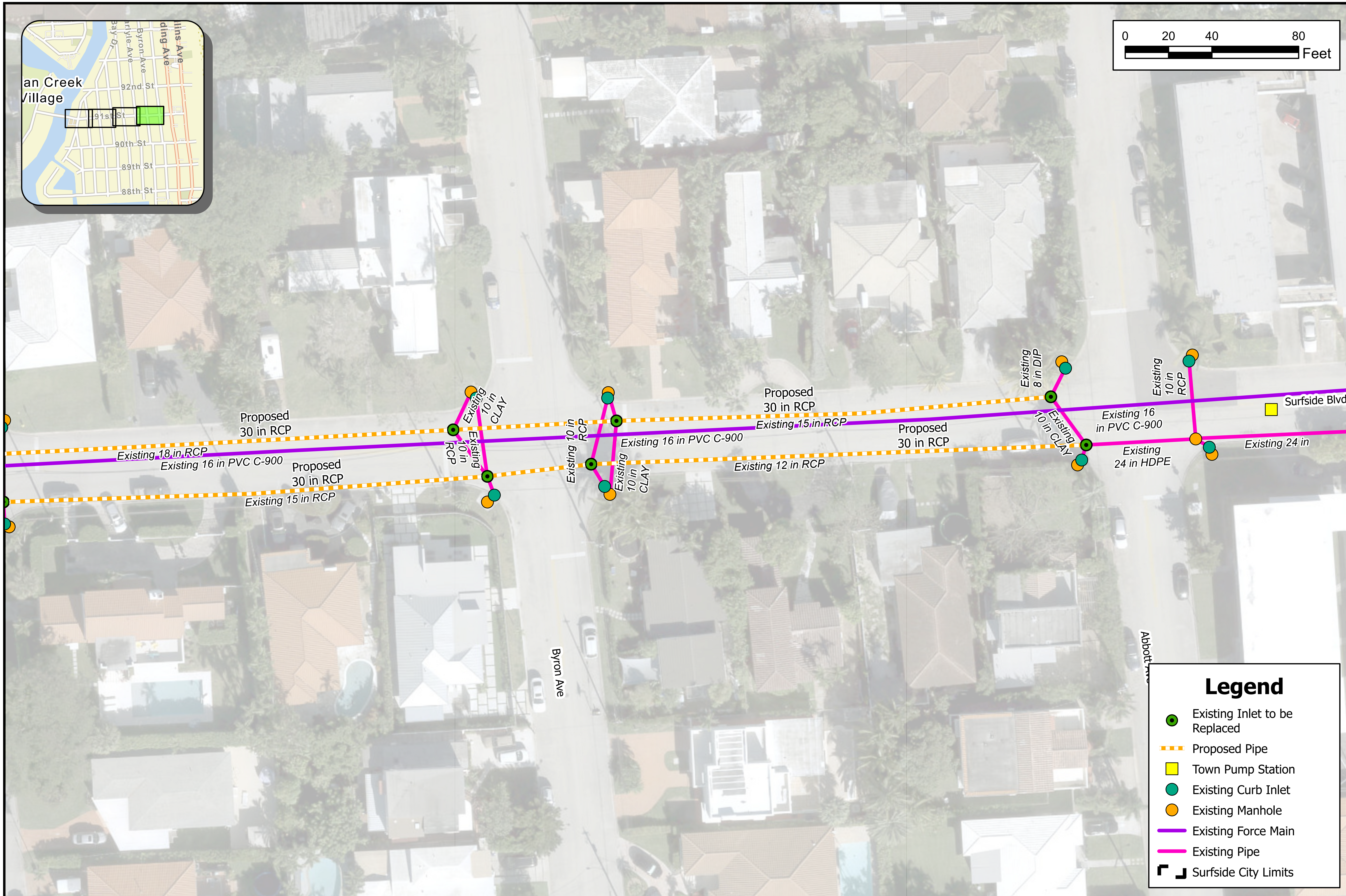

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TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 1 ALTERNATIVE 2

DATE:	AUGUST 2023
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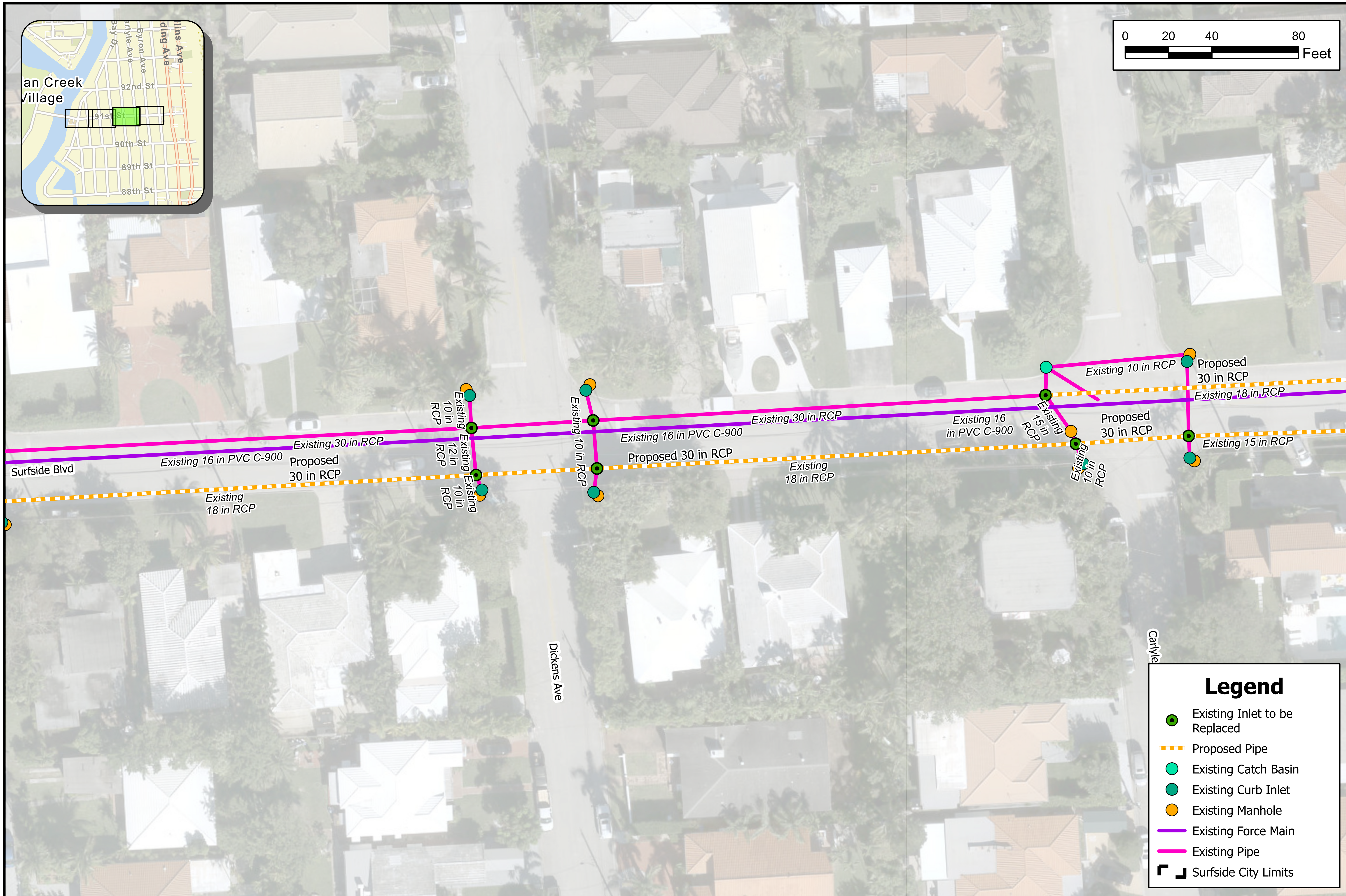

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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 1 ALTERNATIVE 2

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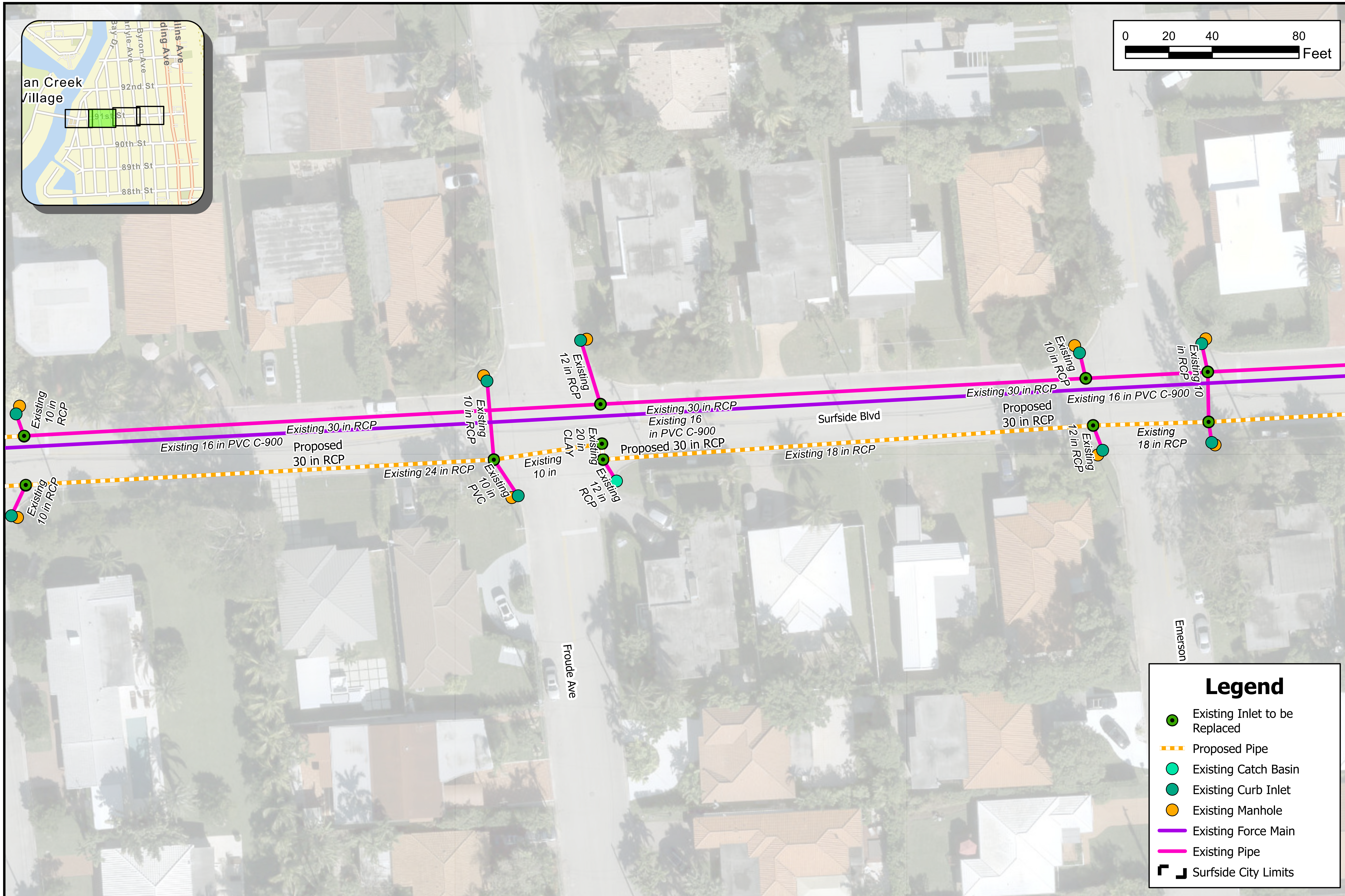

Legend

- Existing Inlet to be Replaced
- Proposed Pipe
- Existing Catch Basin
- Existing Curb Inlet
- Existing Manhole
- Existing Force Main
- Existing Pipe
- Surfside City Limits

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Town of Surfside, FL

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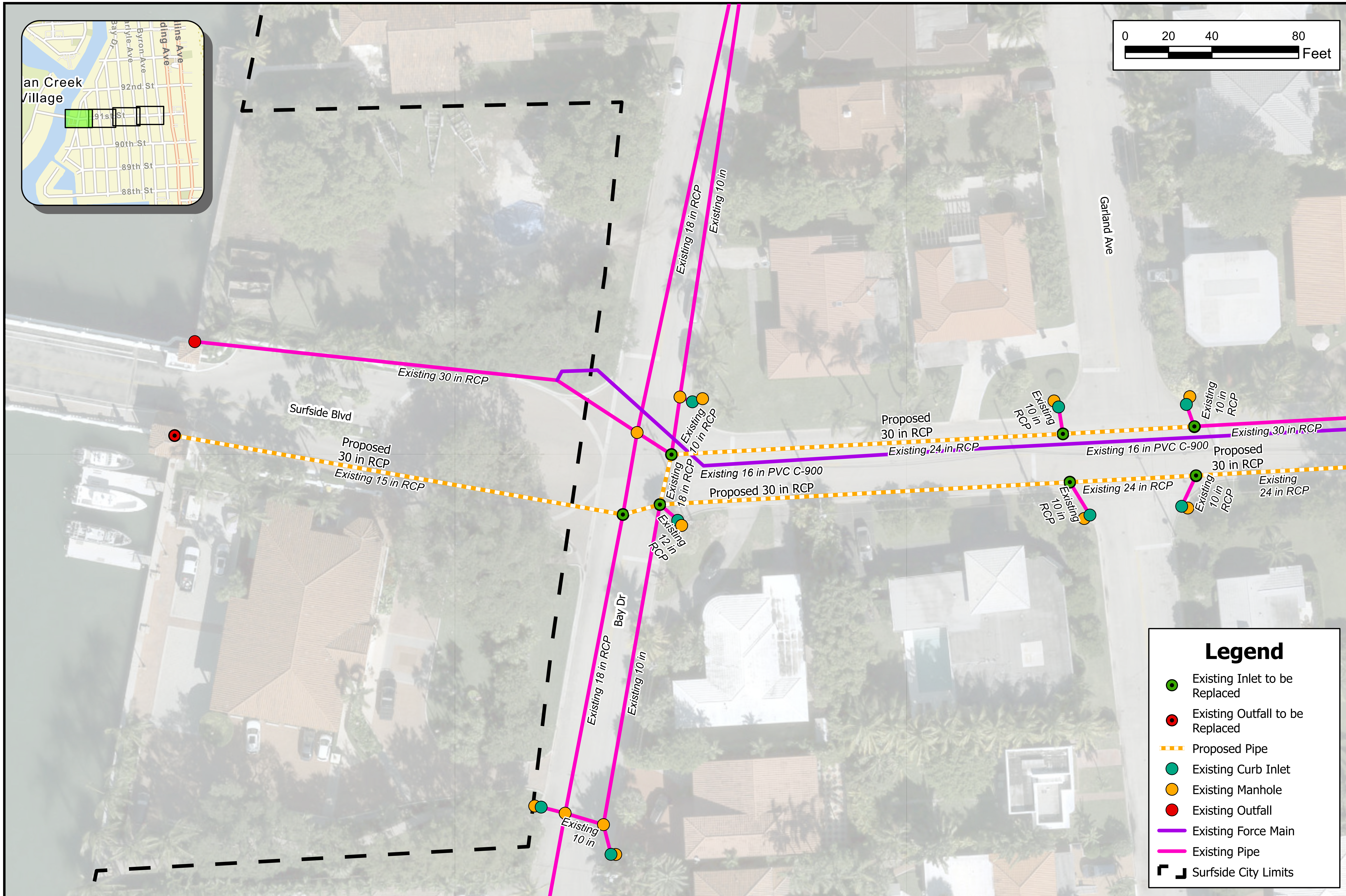
1-2-3



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Town of Surfside, FL

TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 1 ALTERNATIVE 2

DATE:	AUGUST 2023
DESIGN:	KT
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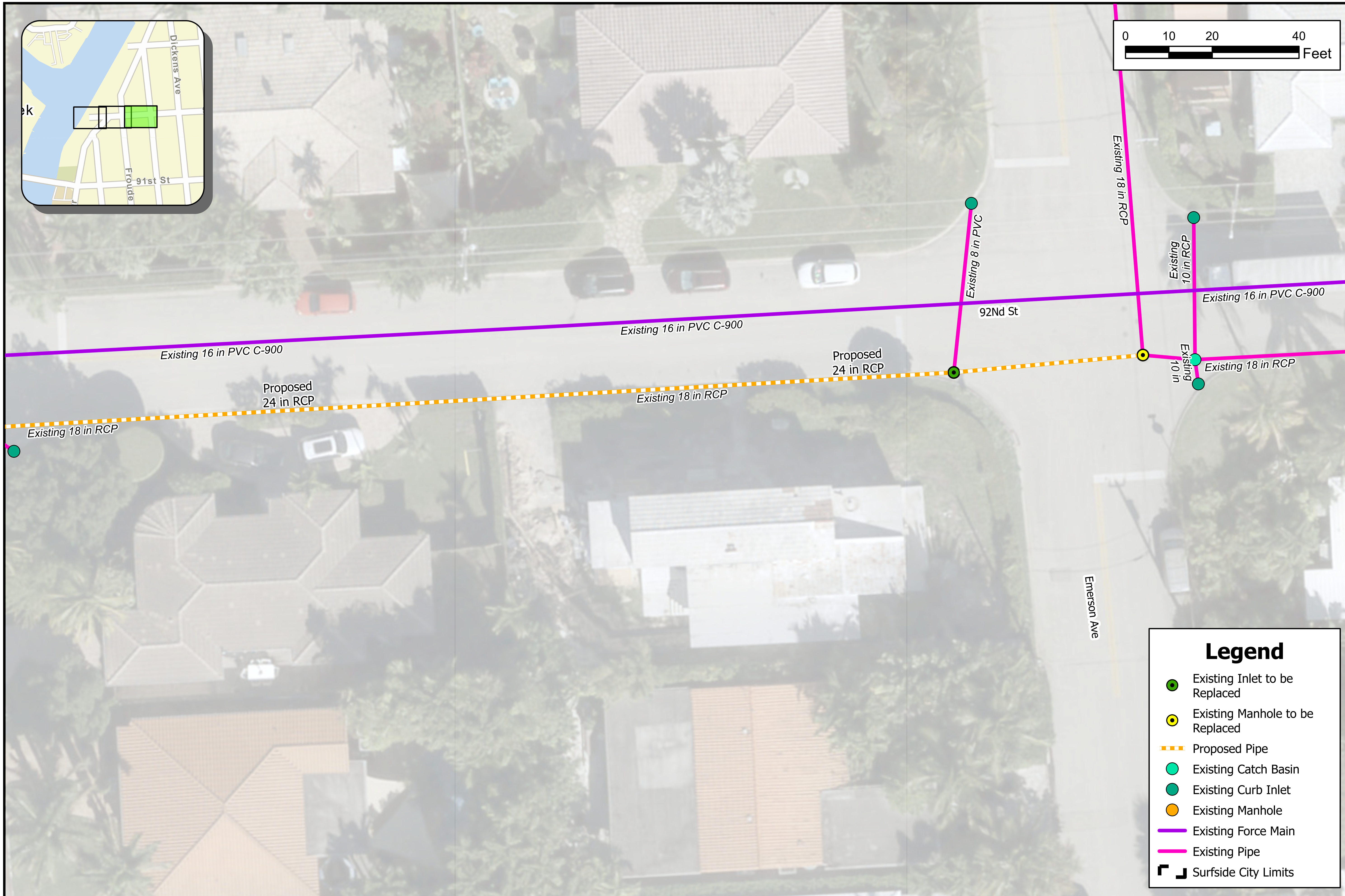
KH NO.:	143332002

SHEET
1-2-4

B. Focus Area 2



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TOWN OF SURFSIDE
STORMWATER MASTER PLAN

FOCUS AREA 2
ALTERNATIVE 1

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KH NO.:	143332002

SHEET
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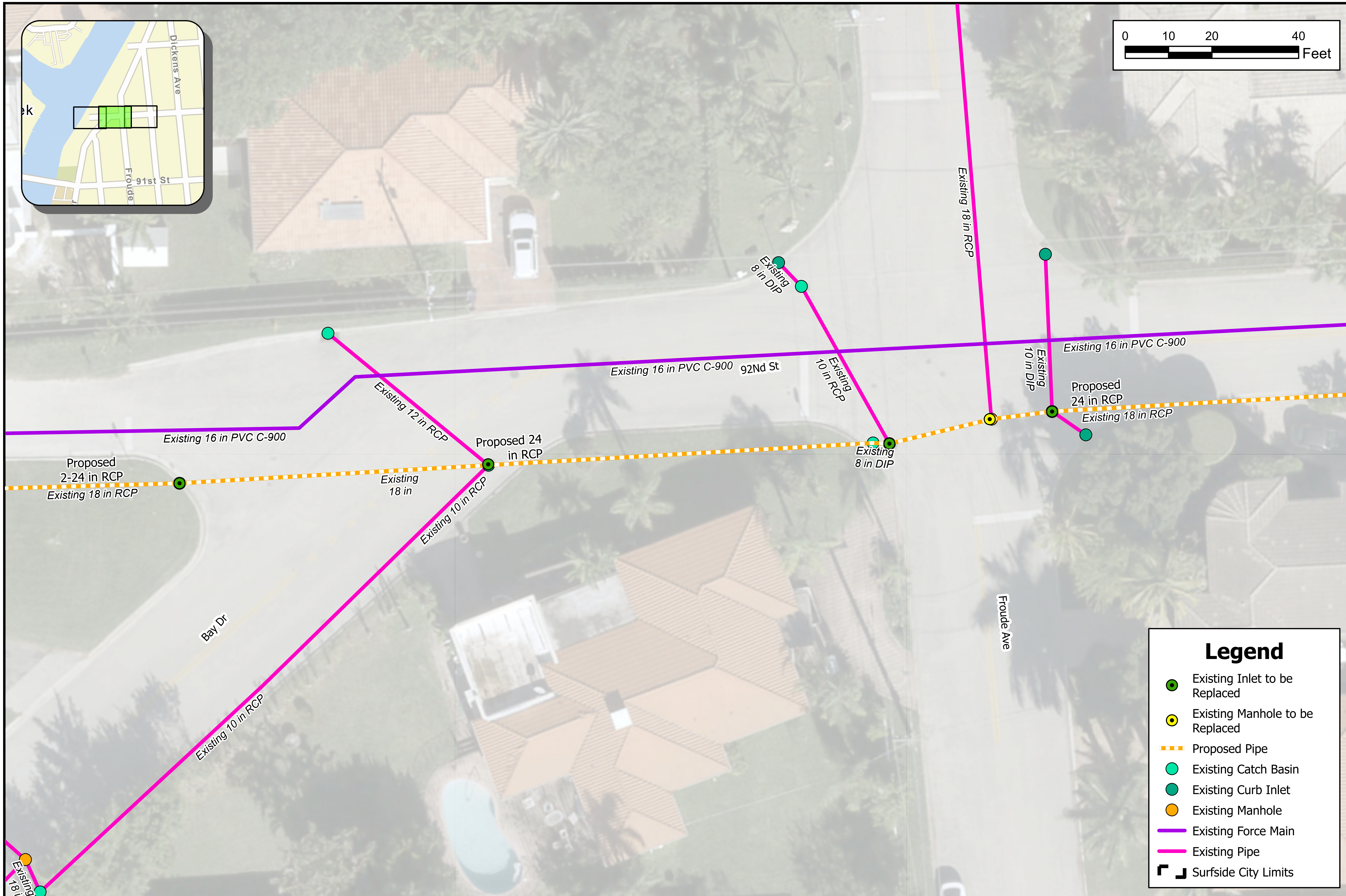

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TOWN OF SURFSIDE
STORMWATER MASTER PLAN

FOCUS AREA 2
ALTERNATIVE 1

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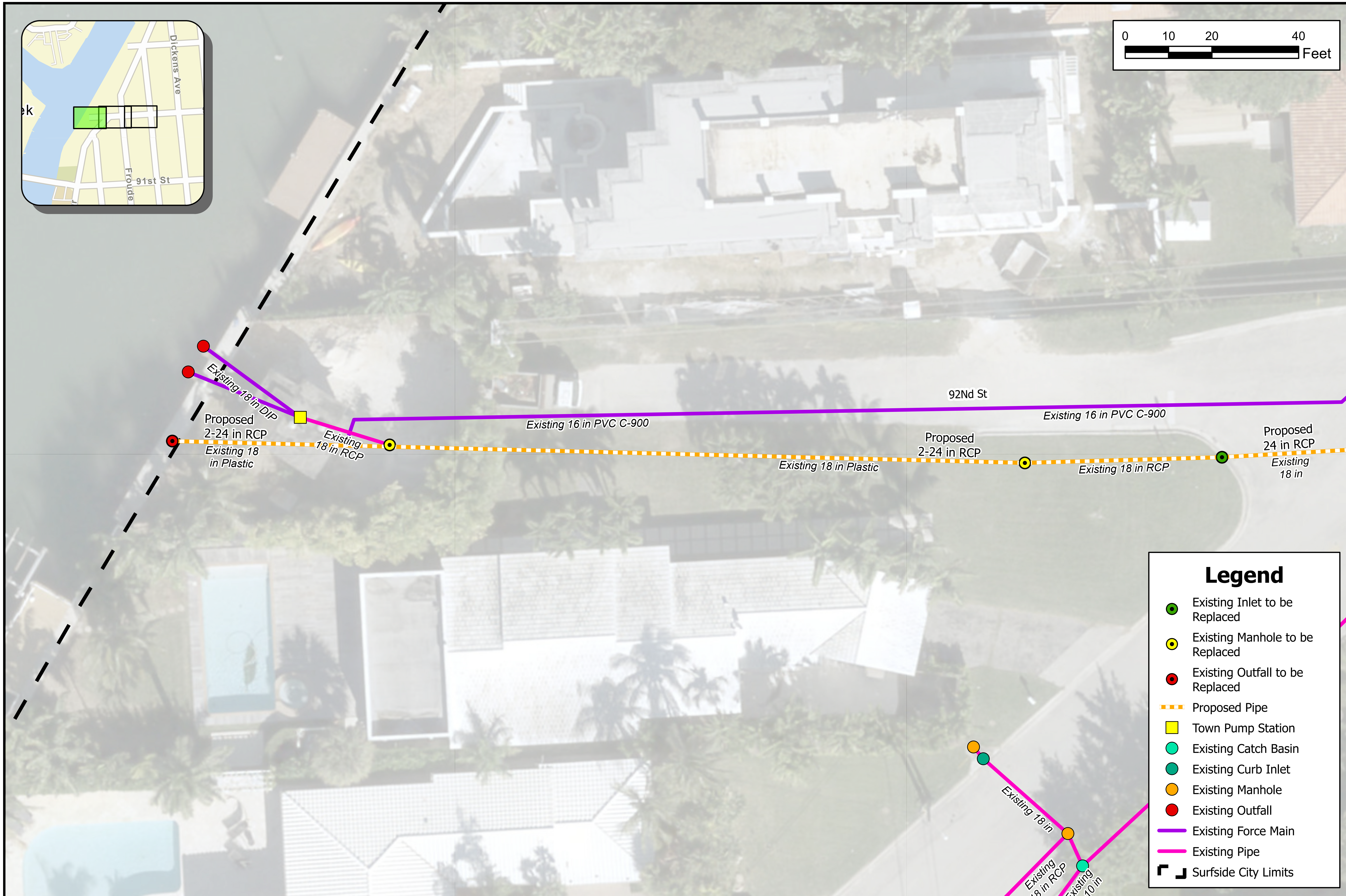
SHEET
2-1-2



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TOWN OF SURFSIDE STORMWATER MASTER PLAN

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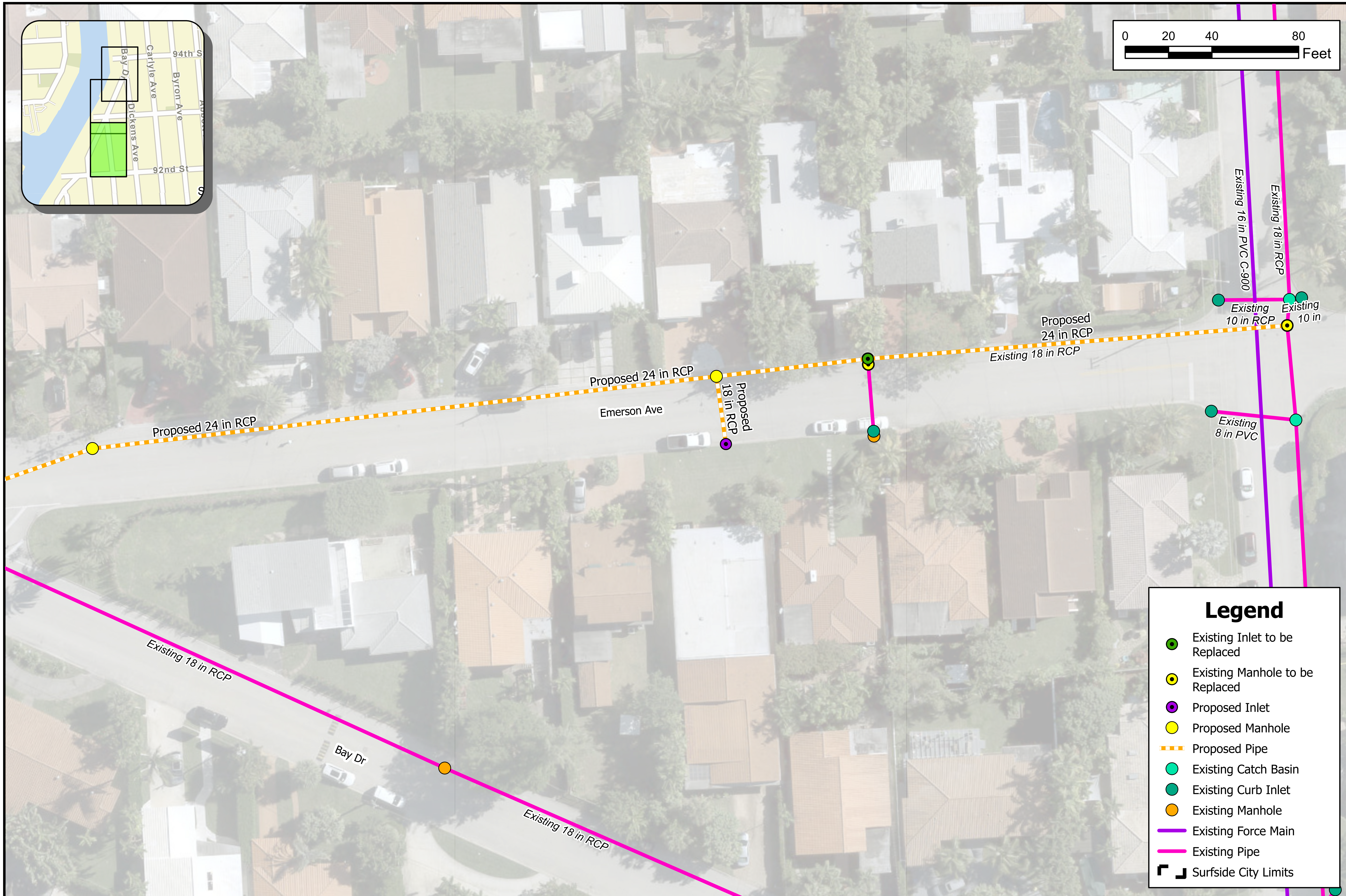
SHEET

2-1-3



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FOCUS AREA 2
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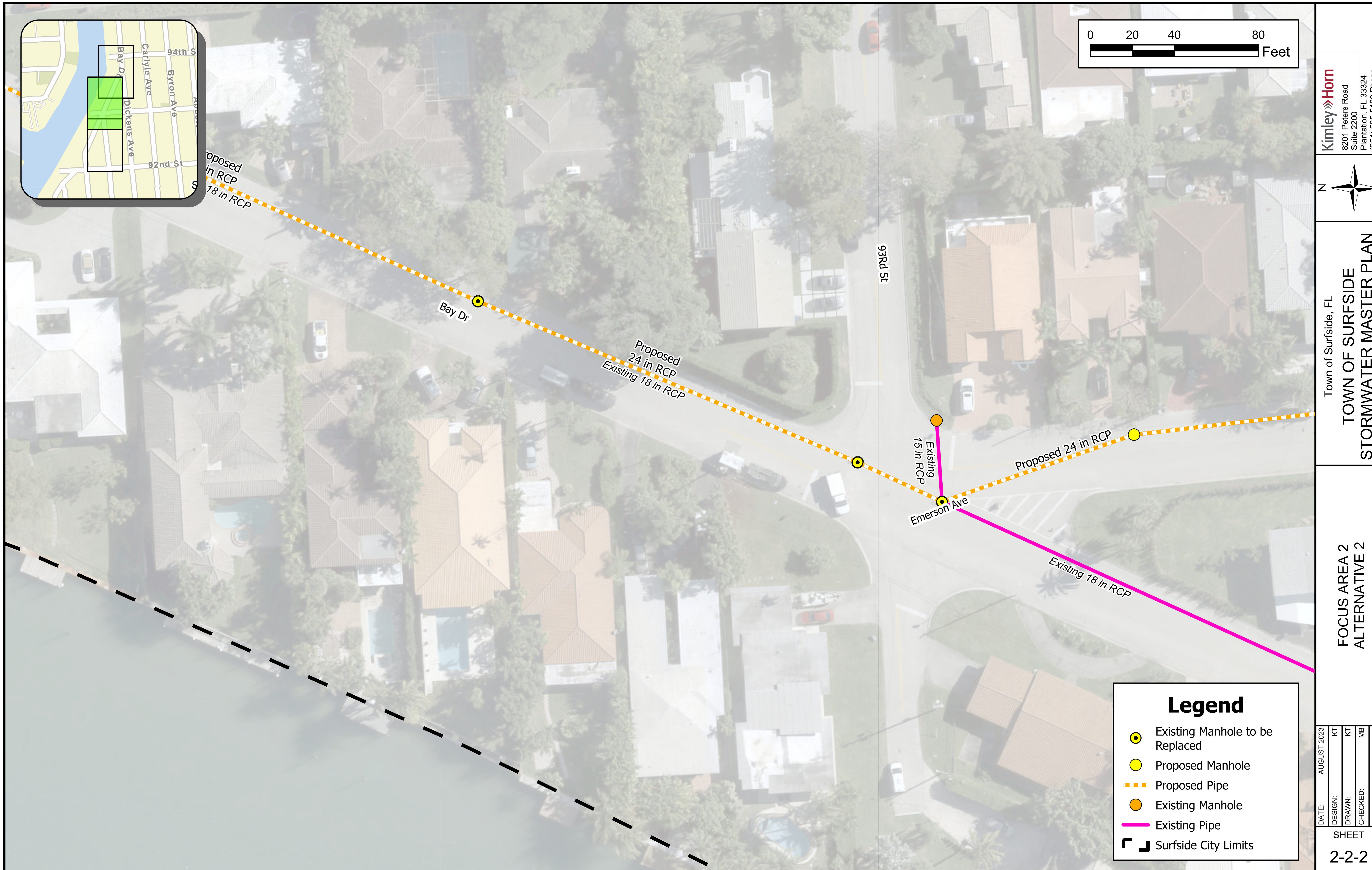
SHEET
2-2-1



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Bay Dr
Carlyle Ave
Byron Ave
Dickens Ave
92nd St
0 20 40 80 Feet
Proposed 18 in RCP
Existing 18 in RCP
Bay Dr
Proposed 24 in RCP
Existing 18 in RCP
93Rd St
Existing 15 in RCP
Proposed 24 in RCP
Emerson Ave
Existing 18 in RCP
Legend
Existing Manhole to be Replaced
Proposed Manhole
Proposed Pipe
Existing Manhole
Existing Pipe
Surfside City Limits
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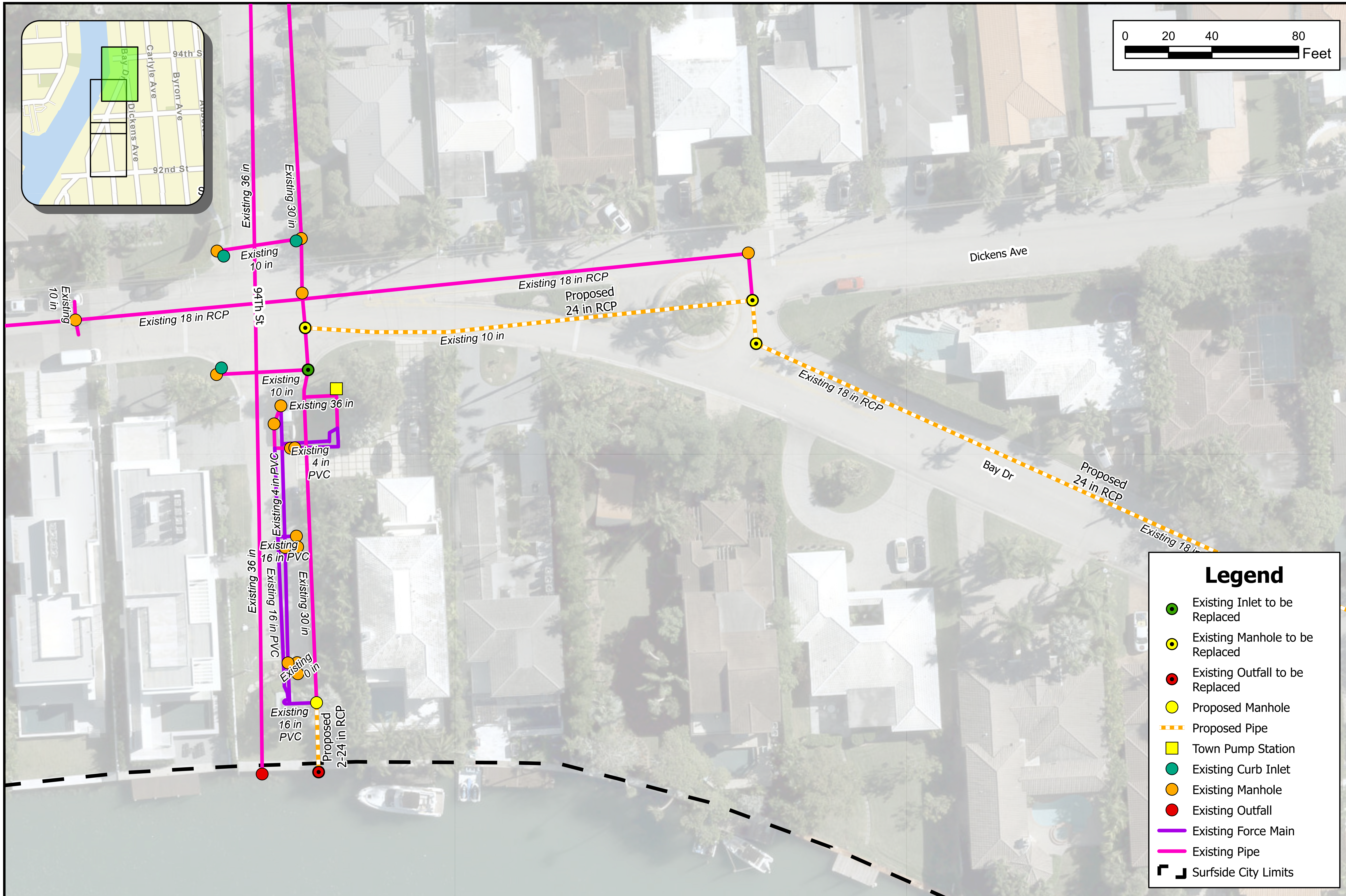
TOWN OF SURFSIDE
STORMWATER MASTER PLAN
FOCUS AREA 2
ALTERNATIVE 2
DATE: AUGUST 2023
DESIGN: KT
DRAWN: KT
CHECKED: MB
KH NO.: 143332002
SHEET
2-2-2



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FOCUS AREA 2
ALTERNATIVE 2

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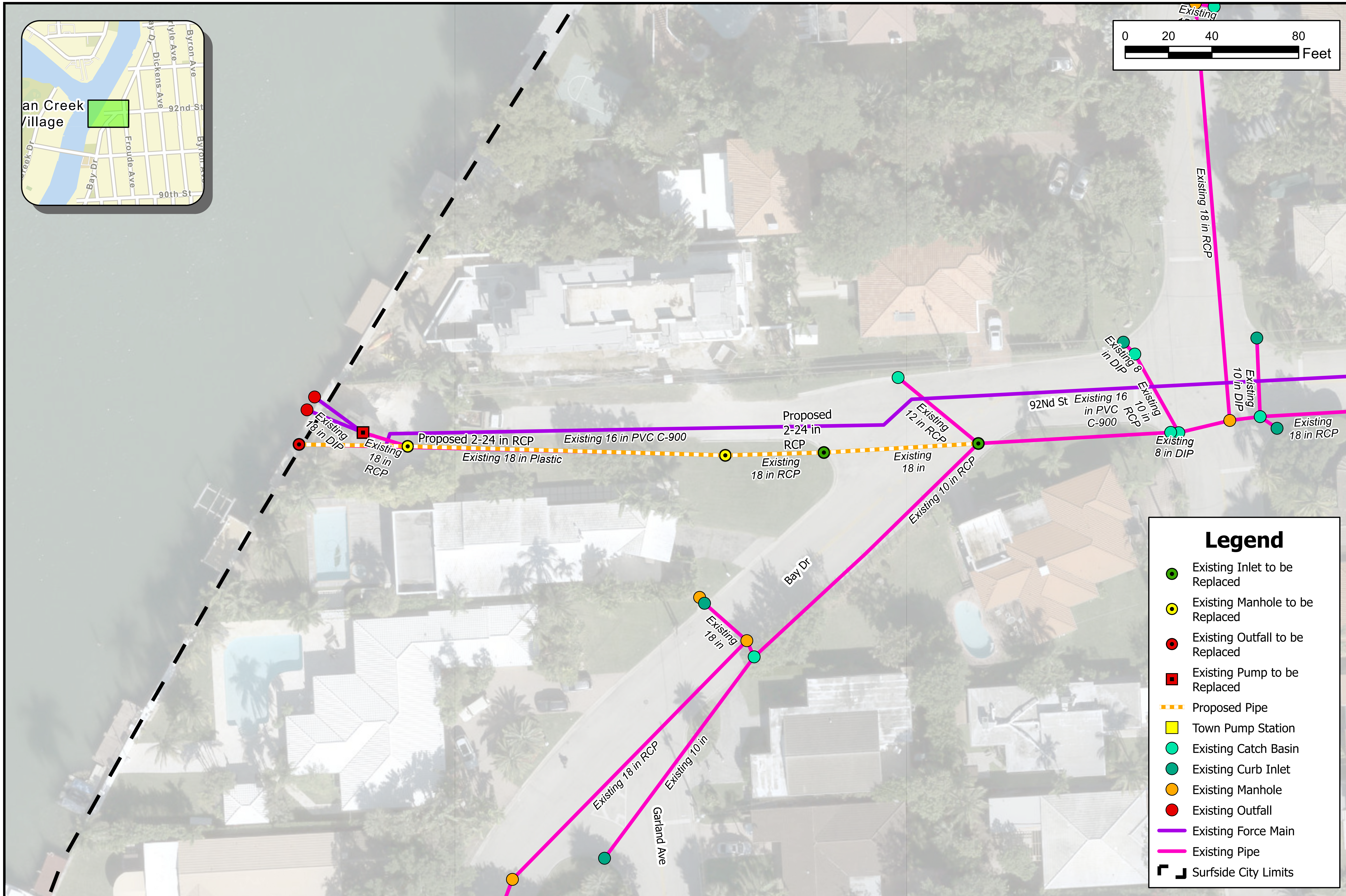
SHEET
2-2-3

C. Focus Area 3



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TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 3 ALTERNATIVE 1

DATE:	AUGUST 2023
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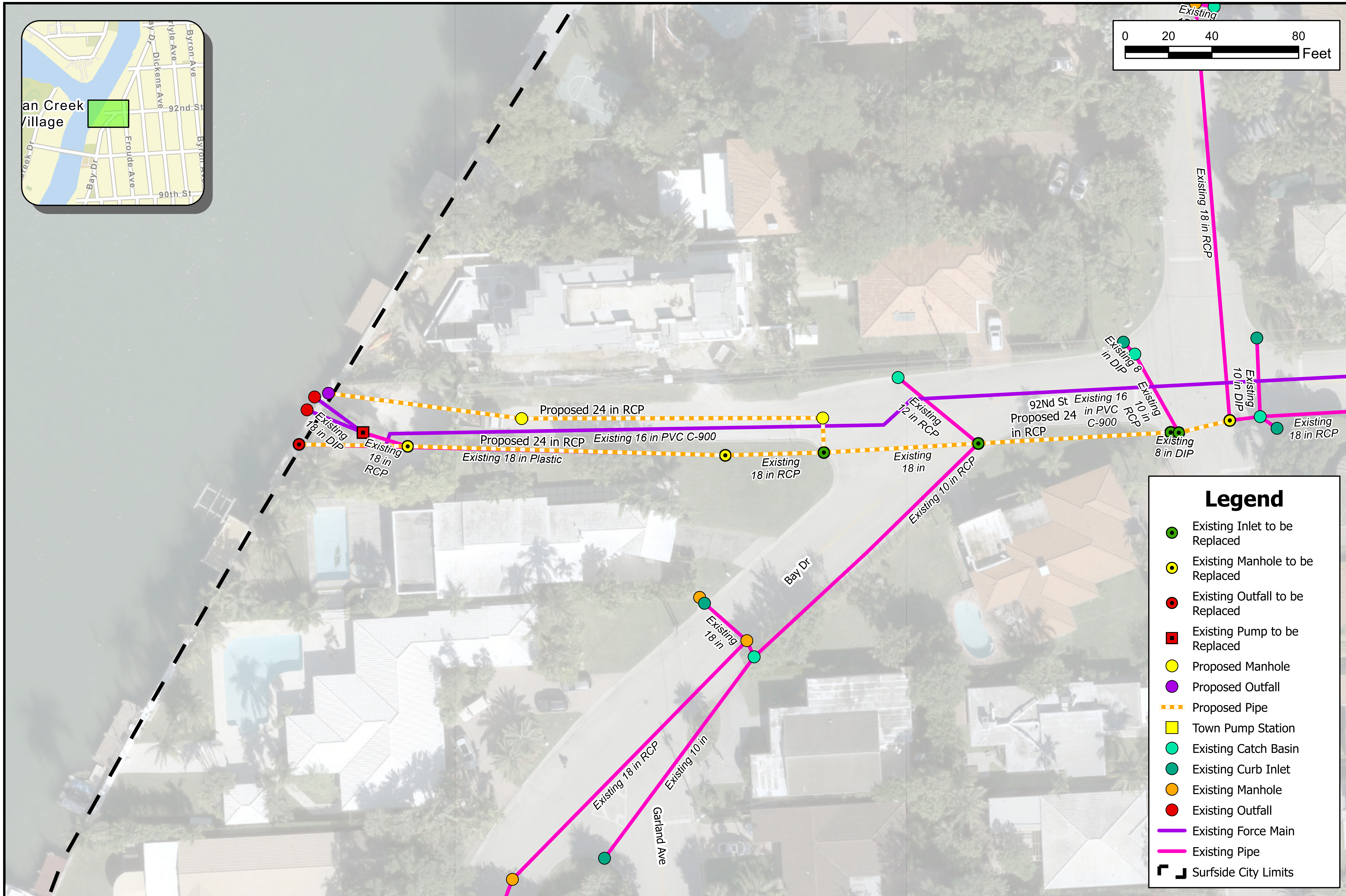
SHEET

3-1-1



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TOWN OF SURFSIDE
STORMWATER MASTER PLAN

FOCUS AREA 3
ALTERNATIVE 2

DATE:	AUGUST 2023
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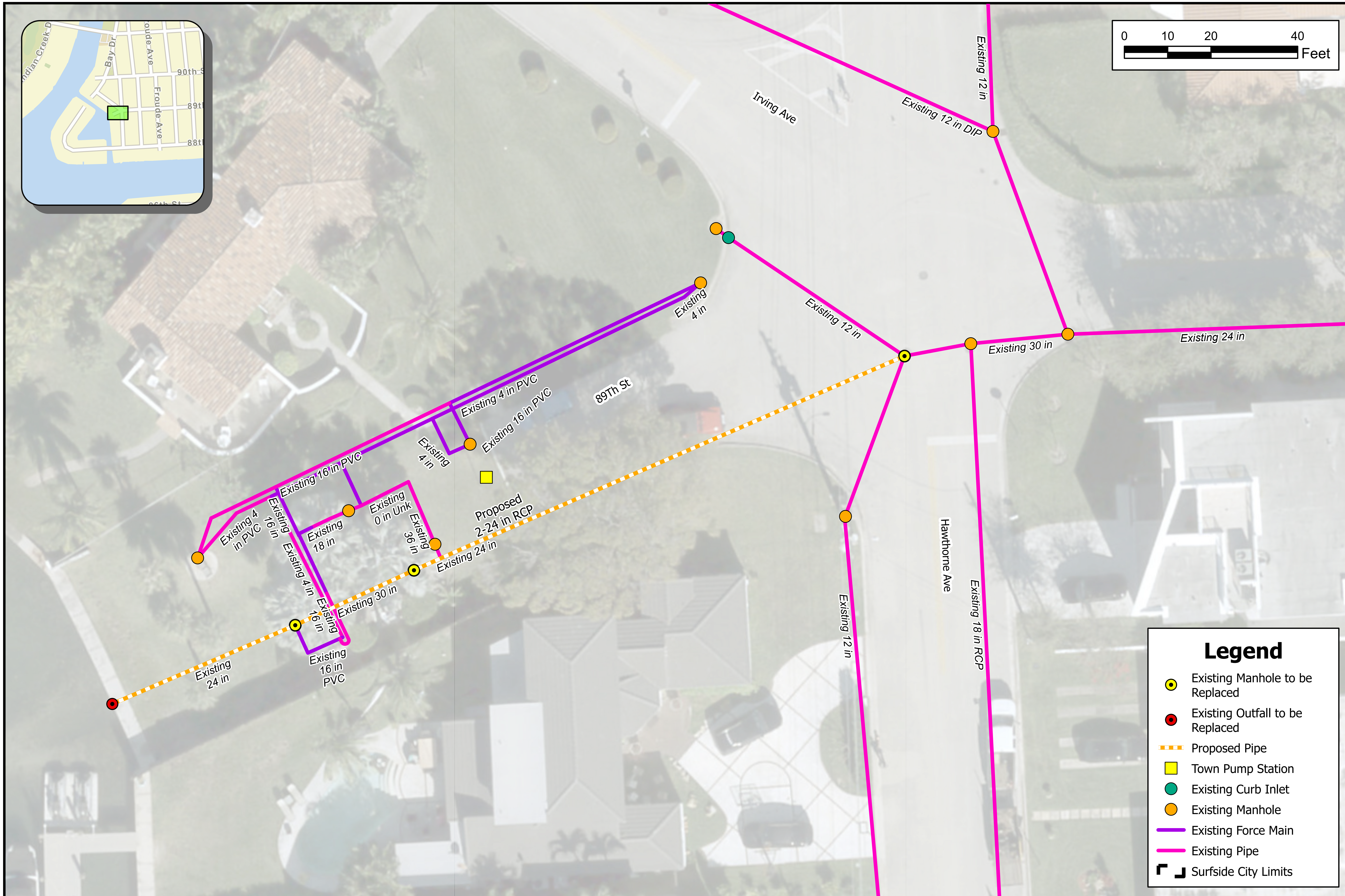
SHEET
3-2-1

D. Focus Area 4



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TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 4 ALTERNATIVE 1

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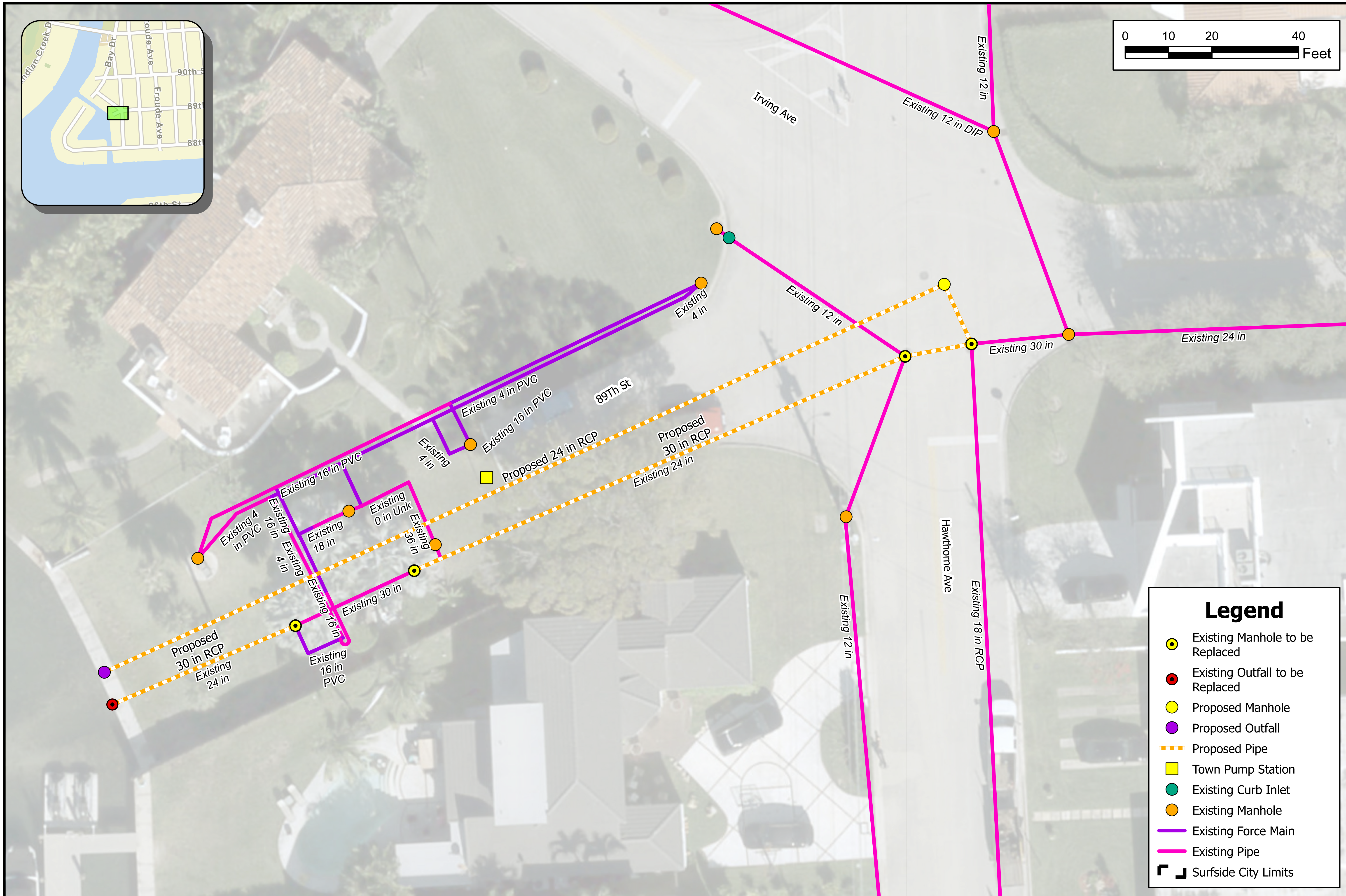
SHEET

4-1-1



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FOCUS AREA 4 ALTERNATIVE 2

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SHEET

4-2-1

E. Focus Area 5

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TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 5 ALTERNATIVE 1

DATE:	AUGUST 2023
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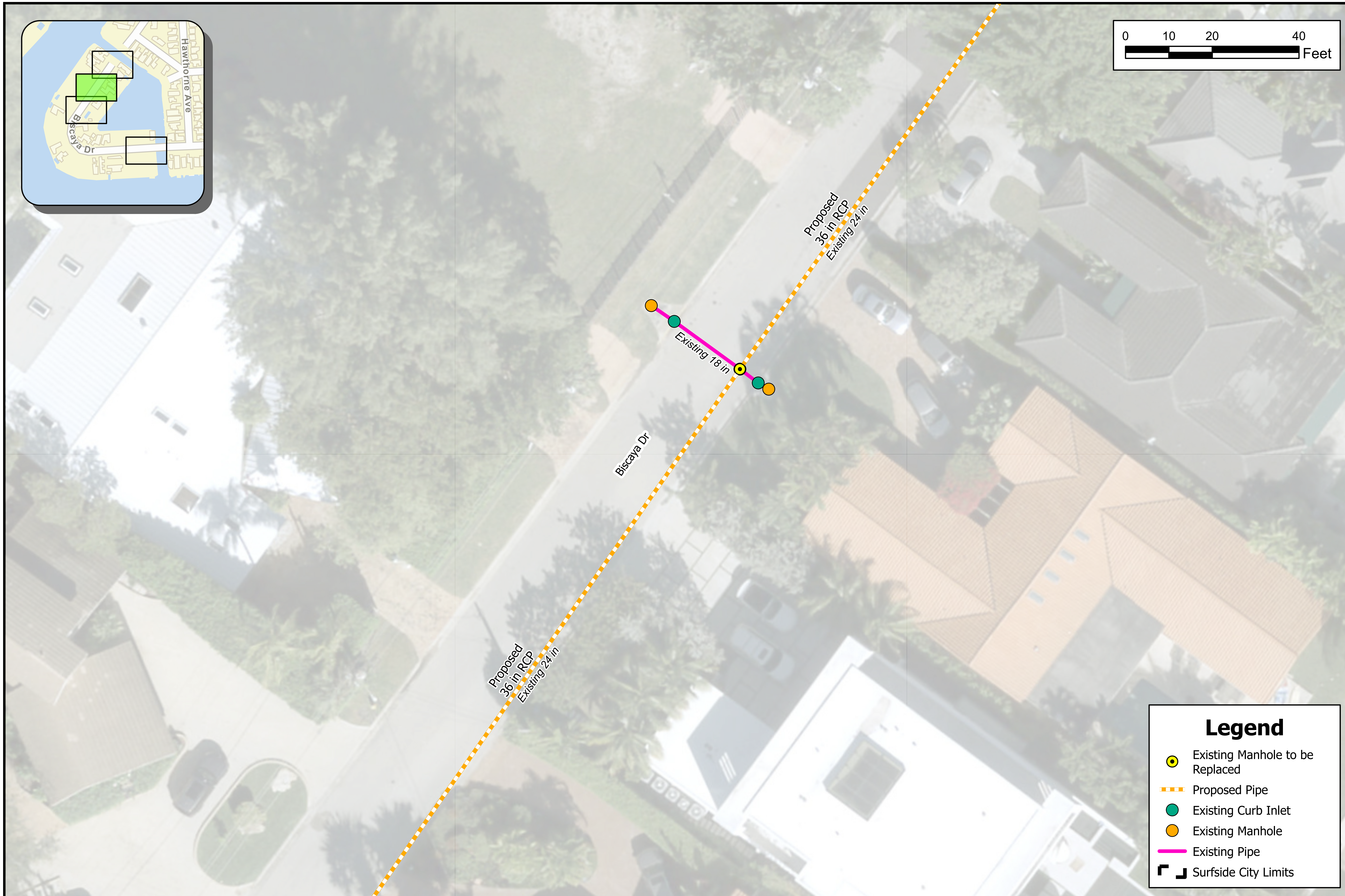
SHEET

5-1-1



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STORMWATER MASTER PLAN

FOCUS AREA 5
ALTERNATIVE 1

DATE:	AUGUST 2023
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SHEET
5-1-2

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TOWN OF SURFSIDE STORMWATER MASTER PLAN

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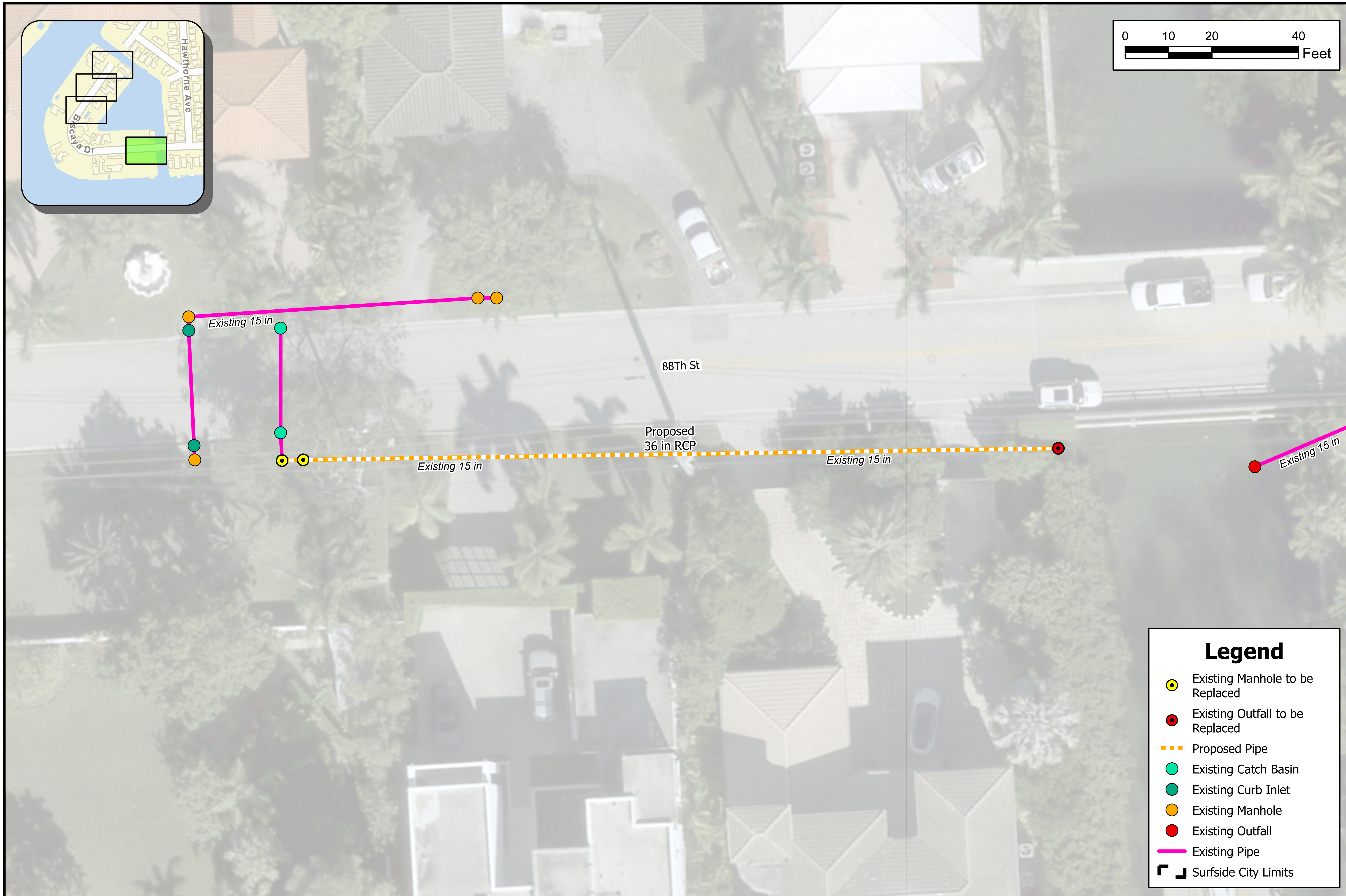
5-1-3



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FOCUS AREA 5 ALTERNATIVE 1

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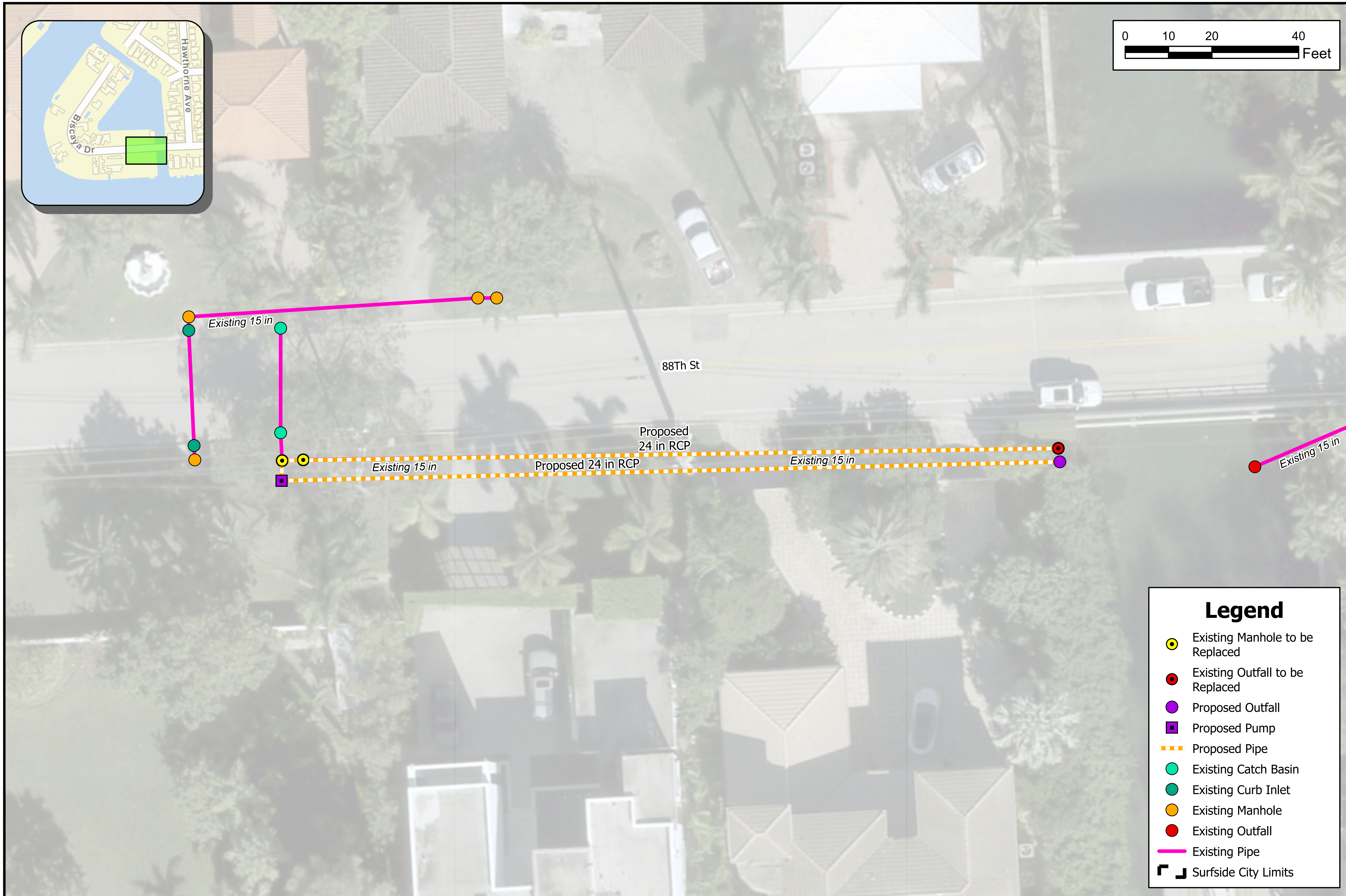
5-1-4



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TOWN OF SURFSIDE STORMWATER MASTER PLAN

FOCUS AREA 5 ALTERNATIVE 2

DATE:	AUGUST 2023
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KH NO.:	143332002

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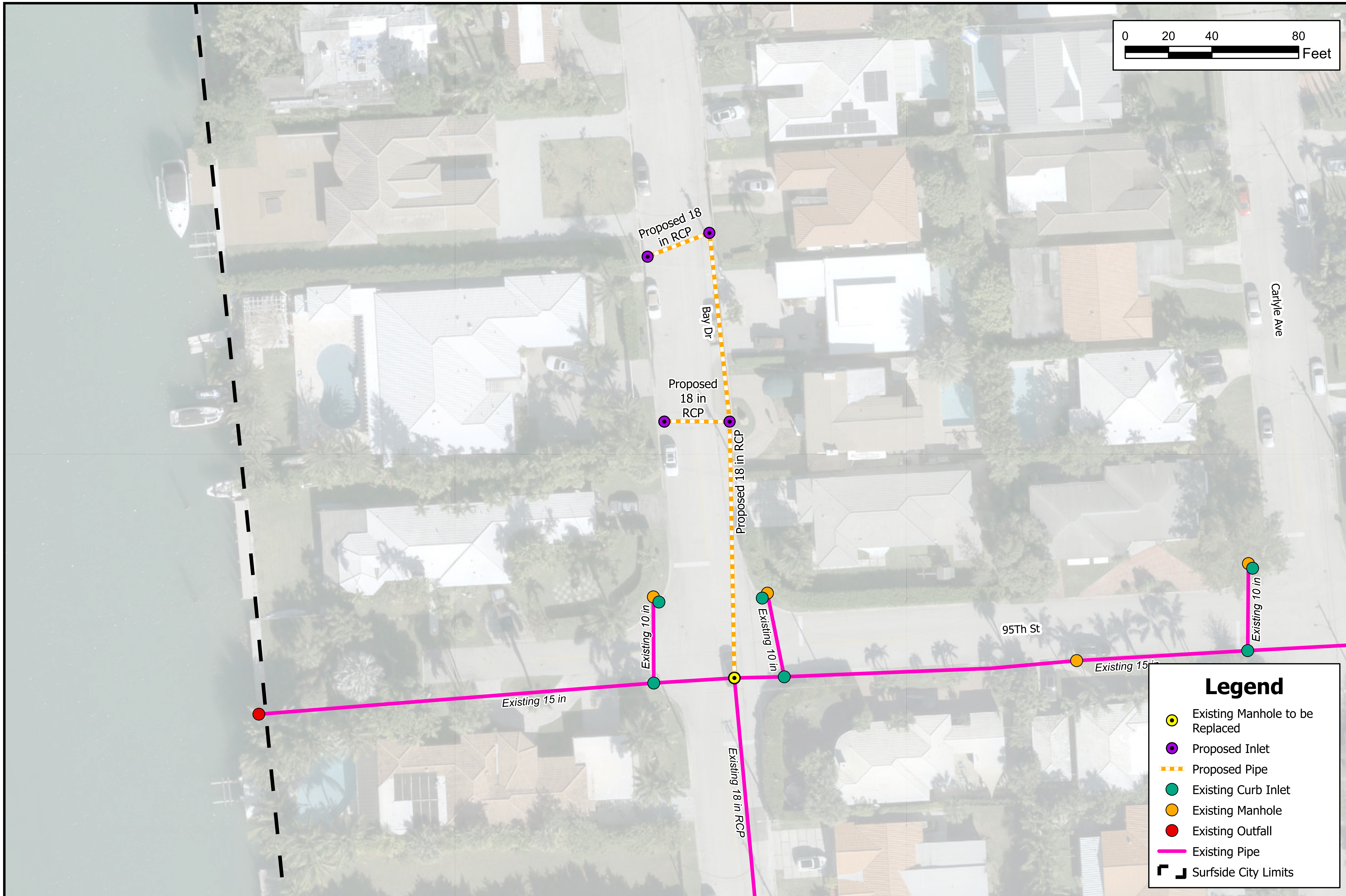
5-2-1

F. Bay Drive



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TOWN OF SURFSIDE
STORMWATER MASTER PLAN

BAY DRIVE
DRAINAGE IMPROVEMENTS

DATE:	AUGUST 2023
DESIGN:	KT
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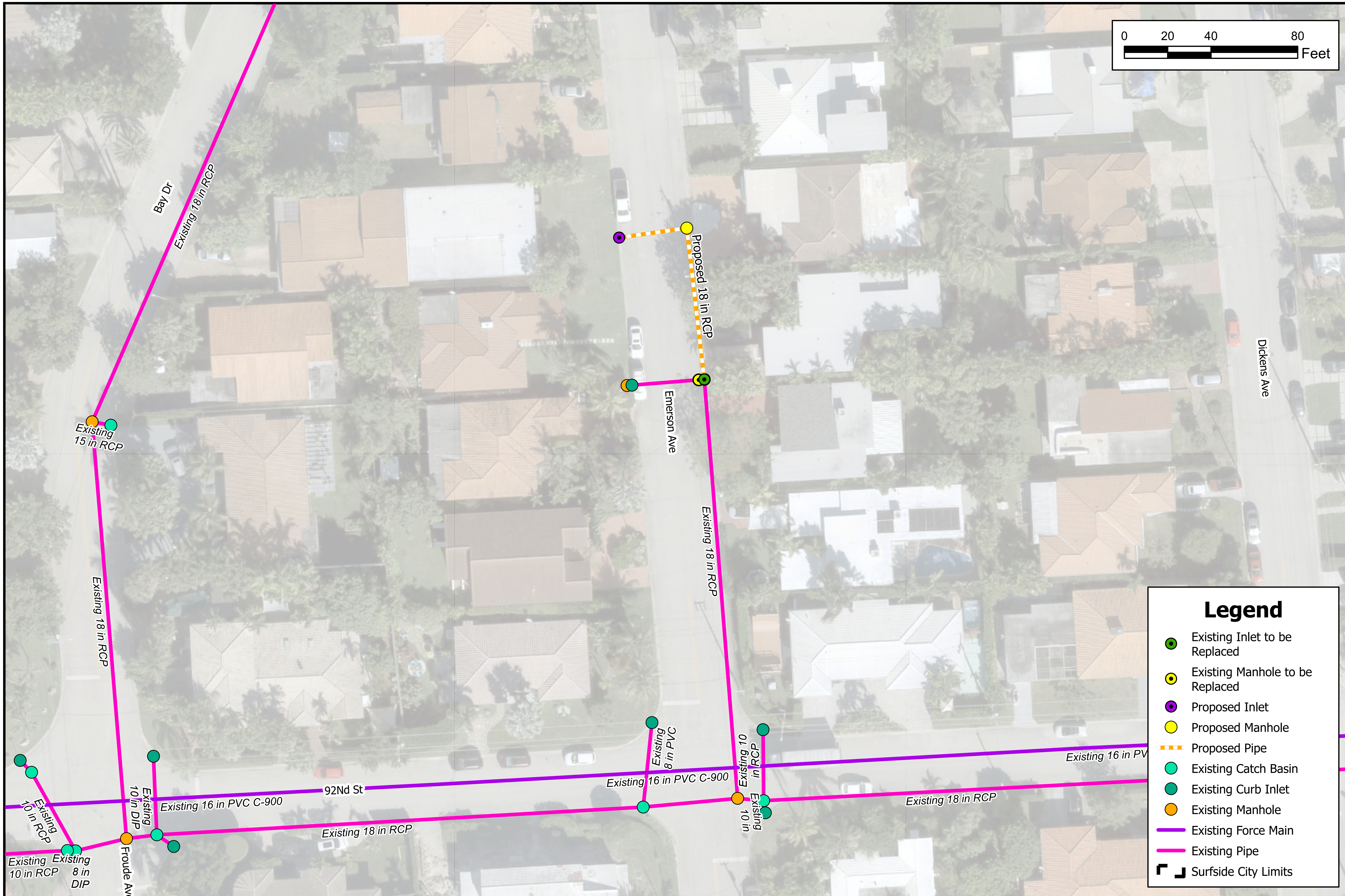
G. Emerson Avenue



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STORMWATER MASTER PLAN

EMERSON AVENUE
DRAINAGE IMPROVEMENTS

DATE:	AUGUST 2023
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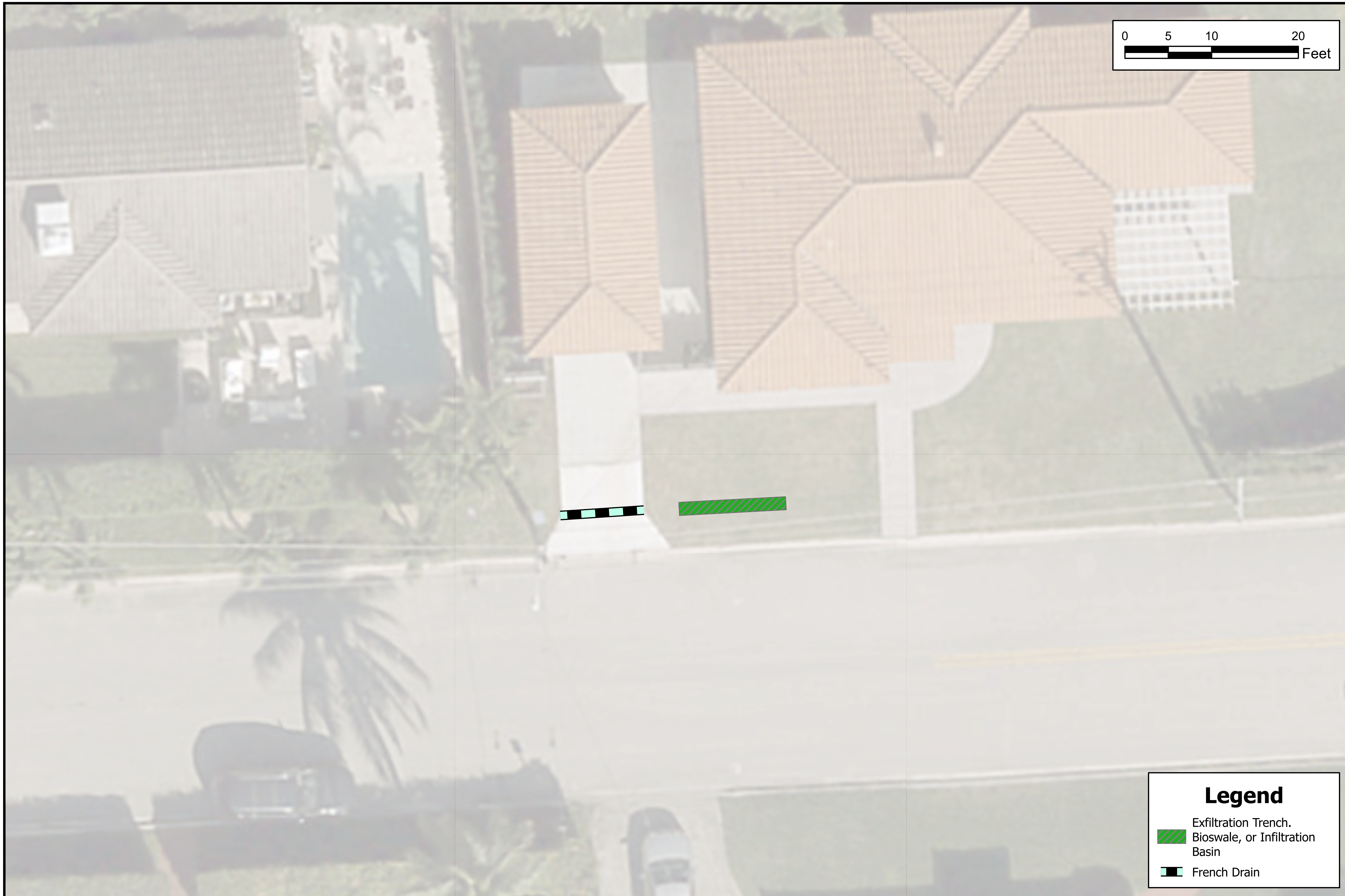
H. Private Drainage Schematic



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TOWN OF SURFSIDE STORMWATER MASTER PLAN

PRIVATE DRAINAGE IMPROVEMENTS EXAMPLE SCHEMATIC

DATE:	DECEMBER 2023
DESIGN:	KT
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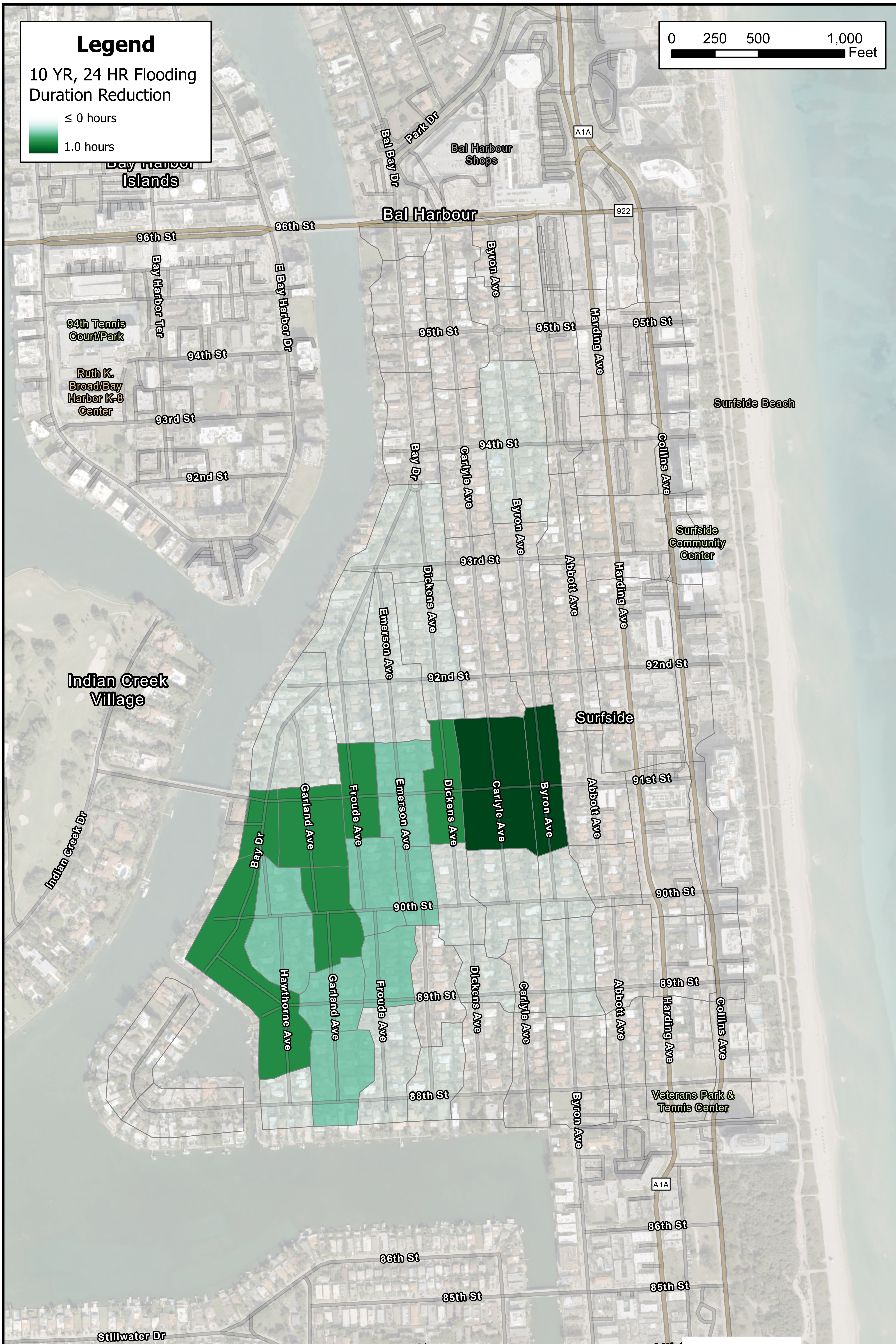
APPENDIX E – PROPOSED IMPROVEMENT HEATMAPS



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FOCUS AREA 1
RECOMMENDED ALTERNATIVE
FLOODING DURATION REDUCTION

Town of Surfside, FL
SURFSIDE
STORMWATER MASTER PLAN

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DATE:	OCTOBER 2023	
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FOCUS AREA 1
RECOMMENDED ALTERNATIVE
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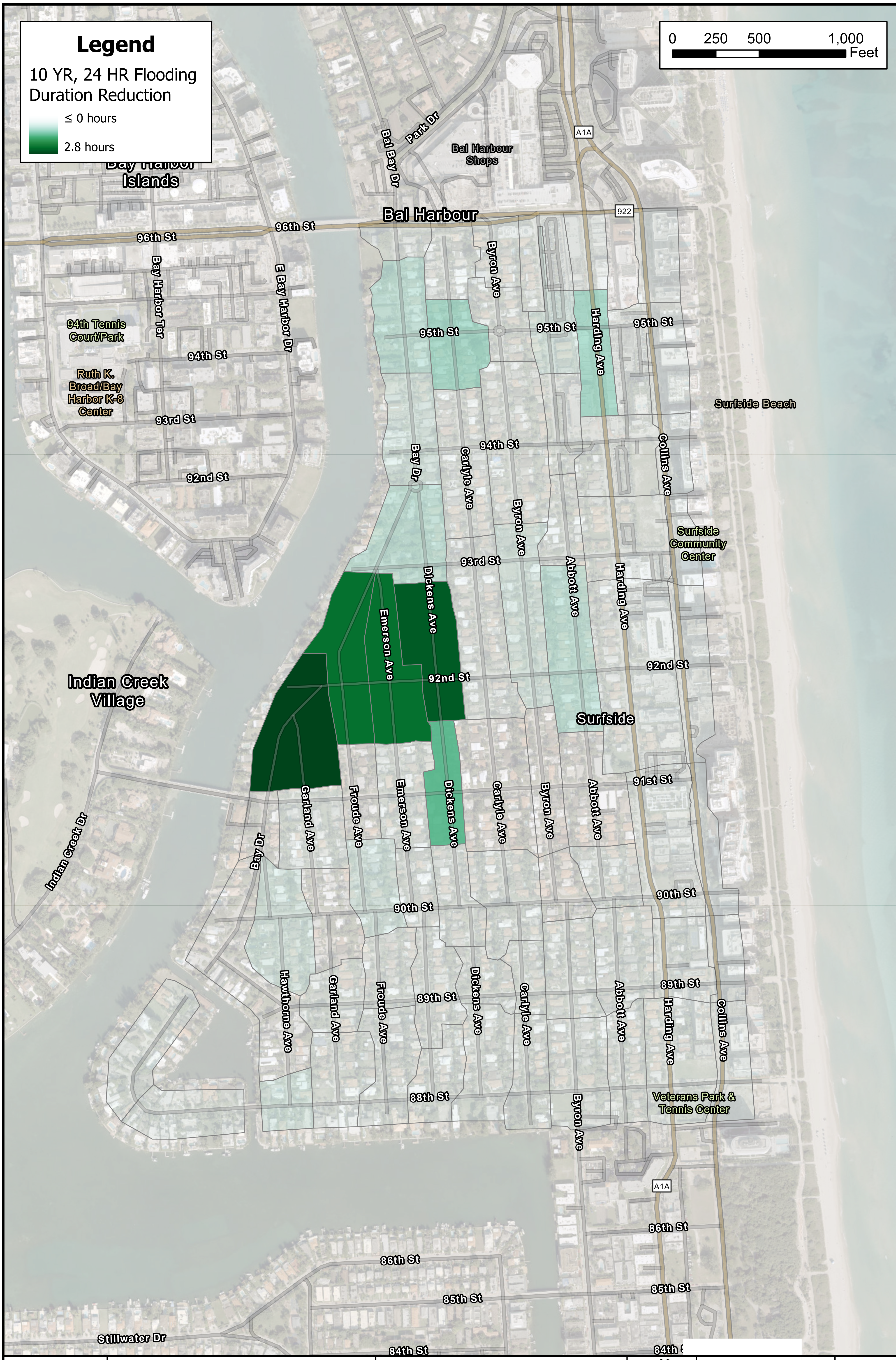

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FOCUS AREA 2
RECOMMENDED ALTERNATIVE
FLOODING DURATION REDUCTION

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FOCUS AREA 2
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FOCUS AREA 3
RECOMMENDED ALTERNATIVE
FLOODING DURATION REDUCTION

Town of Surfside, FL
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STORMWATER MASTER PLAN

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FOCUS AREA 3
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FOCUS AREA 4
RECOMMENDED ALTERNATIVE
FLOODING DURATION REDUCTION

Town of Surfside, FL
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FOCUS AREA 4
RECOMMENDED ALTERNATIVE
FLOODING DURATION REDUCTION

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STORMWATER MASTER PLAN

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FOCUS AREA 5
RECOMMENDED ALTERNATIVE
FLOODING DURATION REDUCTION

Town of Surfside, FL
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STORMWATER MASTER PLAN

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FOCUS AREA 5
RECOMMENDED ALTERNATIVE
FLOODING DURATION REDUCTION

Town of Surfside, FL
SURFSIDE
STORMWATER MASTER PLAN

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APPENDIX F – CAPITAL IMPROVEMENT PLAN

Focus Area 1 Drainage Alternative 1

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$59,850	$60,000
2	Stormwater Pollution Prevention	1	L.S.	$19,950	$20,000
3	Asphalt Restoration	1,105	S.Y.	$35	$39,000
4	Curbing Restoration	170	L.F.	$35	$6,000
5	Remove existing 30" pipe	170	L.F.	$55	$10,000
6	Storm Pipe, Double 30" RCP	170	L.F.	$600	$102,000
7	Concrete End wall	1	EA.	$6,500	$7,000
8	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
9	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
10	Remove existing structure	1	EA.	$1,000	$1,000
11	Inlet Apron	1	EA.	$500	$500
12	Catch Basin	1	EA.	$18,000	$18,000
13	Pollution Retardant Baffle	1	EA.	$500	$500
14	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
15	Professional Services	1	L.S.	$75,600	$76,000
16	Contingency (30%)	1	L.S.	$151,200	$152,000
				TOTAL	$732,000

Focus Area 2 Drainage Alternative 1

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$185,925	$186,000
2	Stormwater Pollution Prevention	1	L.S.	$61,975	$62,000
3	Driveway/Sidewalk Restoration	200	S.Y.	$50	$10,000
4	Asphalt Restoration	4,272	S.Y.	$35	$150,000
5	Curbing Restoration	712	L.F.	$35	$25,000
6	Remove existing 10" pipe	88	L.F.	$20	$2,000
7	Remove existing 18" pipe	624	L.F.	$48	$30,000
8	Storm Pipe, 24" RCP	955	L.F.	$650	$621,000
9	Concrete End wall	1	EA.	$6,500	$7,000
10	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
11	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
12	Remove existing structure	9	EA.	$1,000	$9,000
13	Stormwater Manhole	4	EA.	$18,000	$72,000
14	Catch Basin	5	EA.	$18,000	$90,000
15	Inlet Apron	5	EA.	$500	$3,000
16	Install new cast-in-place Junction Box	1	L.S.	$4,223	$5,000
17	Pollution Retardant Baffle	1	EA.	$500	$500
18	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
19	Professional Services	1	L.S.	$226,875	$227,000
20	Contingency (30%)	1	L.S.	$453,750	$454,000
				TOTAL	$2,193,500

Focus Area 3 Drainage Alternative 1

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$468,225	$469,000
2	Stormwater Pollution Prevention	1	L.S.	$156,075	$157,000
3	Asphalt Restoration	2,520	S.Y.	$35	$89,000
4	Curbing Restoration	315	L.F.	$35	$12,000
5	Remove existing 18" pipe	315	L.F.	$48	$16,000
6	Remove existing structure	4	EA.	$1,000	$4,000
7	Storm Pipe, Double 24" RCP	315	L.F.	$650	$205,000
8	Concrete End wall	1	EA.	$6,500	$7,000
9	Seawall Outfall Restoration	1	EA.	$15,000	$15,000
10	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
11	Stormwater Manhole	2	EA.	$18,000	$36,000
12	Catch Basin	2	EA.	$18,000	$36,000
13	Inlet Apron	2	EA.	$500	$1,000
14	Pollution Retardant Baffle	1	EA.	$500	$500
15	40 cfs pump	1	L.S.	$2,500,000	$2,500,000
16	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
17	Professional Services	1	L.S.	$565,875	$566,000
18	Contingency (30%)	1	L.S.	$1,131,750	$1,132,000
				TOTAL	$5,470,500

<u>Focus Area 4 Drainage Alternative 2</u>

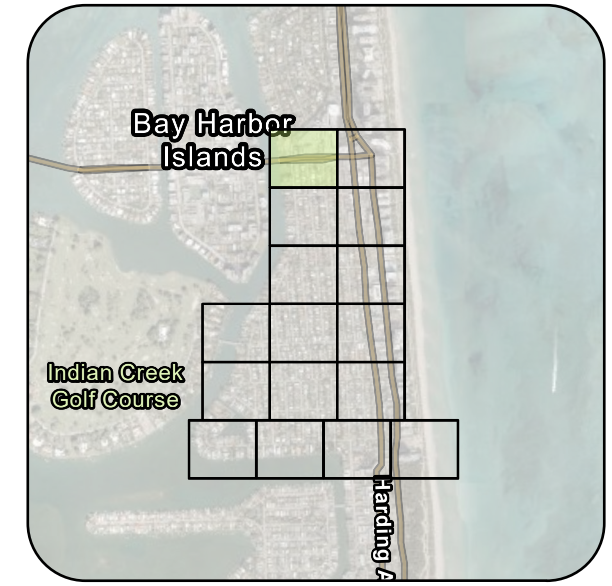
Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$102,000	$102,000
2	Stormwater Pollution Prevention	1	L.S.	$34,000	$34,000
3	Asphalt Restoration	265	S.Y.	$35	$10,000
4	Curbing Restoration	70	L.F.	$35	$3,000
5	Remove existing outfall	50	L.F.	$100	$5,000
6	Remove existing 24" pipe	170	L.F.	$48	$9,000
7	Remove existing concrete end wall	1	EA.	$1,000	$1,000
8	Remove existing structure	7	EA.	$1,000	$7,000
9	Storm Pipe, 24" RCP	220	L.F.	$650	$143,000
10	Storm Pipe, 30" RCP	190	L.F.	$600	$114,000
11	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
12	Concrete End wall	2	EA.	$6,500	$13,000
13	Seawall Outfall Restoration	2	EA.	$15,000	$30,000
14	Stormwater Manhole	5	EA.	$18,000	$90,000
15	Pollution Retardant Baffle	2	EA.	$500	$1,000
16	Inlet Apron	7	EA.	$500	$4,000
17	Obtain Easement Access for New Outfall	1	L.S.	$25,000	$25,000
18	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
19	Professional Services	1	L.S.	$122,400	$123,000
20	Contingency (30%)	1	L.S.	$229,800	$230,000
				TOTAL	$1,169,000

Focus Area 5 Drainage Alternative 1

Item	Description	Qty.	Units	Unit Price	Sub-total
1	Mobilization/ MOT/ Clearing & Grubbing	1	L.S.	$156,525	$157,000
2	Stormwater Pollution Prevention	1	L.S.	$52,175	$53,000
3	Driveway/Sidewalk Restoration	1,525	S.Y.	$50	$77,000
4	Asphalt Restoration	450	S.Y.	$35	$16,000
5	Curbing Restoration	650	L.F.	$35	$23,000
6	Remove existing 15" pipe	180	L.F.	$20	$4,000
7	Remove existing 24" pipe	525	L.F.	$48	$26,000
8	Remove existing concrete end wall	2	EA.	$1,000	$2,000
9	Remove existing structure	5	EA.	$1,000	$5,000
10	Storm Pipe, 36" RCP	705	L.F.	$790	$557,000
11	Concrete End wall	2	EA.	$6,500	$13,000
12	Seawall Outfall Restoration	2	EA.	$15,000	$30,000
13	Tideflex Inline Check Valve	2	EA.	$100,000	$200,000
14	Stormwater Manhole	4	EA.	$18,000	$72,000
15	Catch Basin	1	EA.	$18,000	$18,000
16	Inlet Apron	1	EA.	$500	$500
17	Utility Sleeves and Adjustments	1	L.S.	$25,000	$25,000
18	Professional Services	1	L.S.	$191,775	$192,000
19	Contingency (30%)	1	L.S.	$376,050	$377,000
				TOTAL	$1,847,500

APPENDIX G – UPDATED STORMWATER ATLAS

0 50 100 200 Feet



Legend

- Unknown
- Inlet
- Manhole
- Outfall
- Pump Station
- Existing Force Main
- Existing Pipe

Kimley»Horn
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Town of Surfside, FL

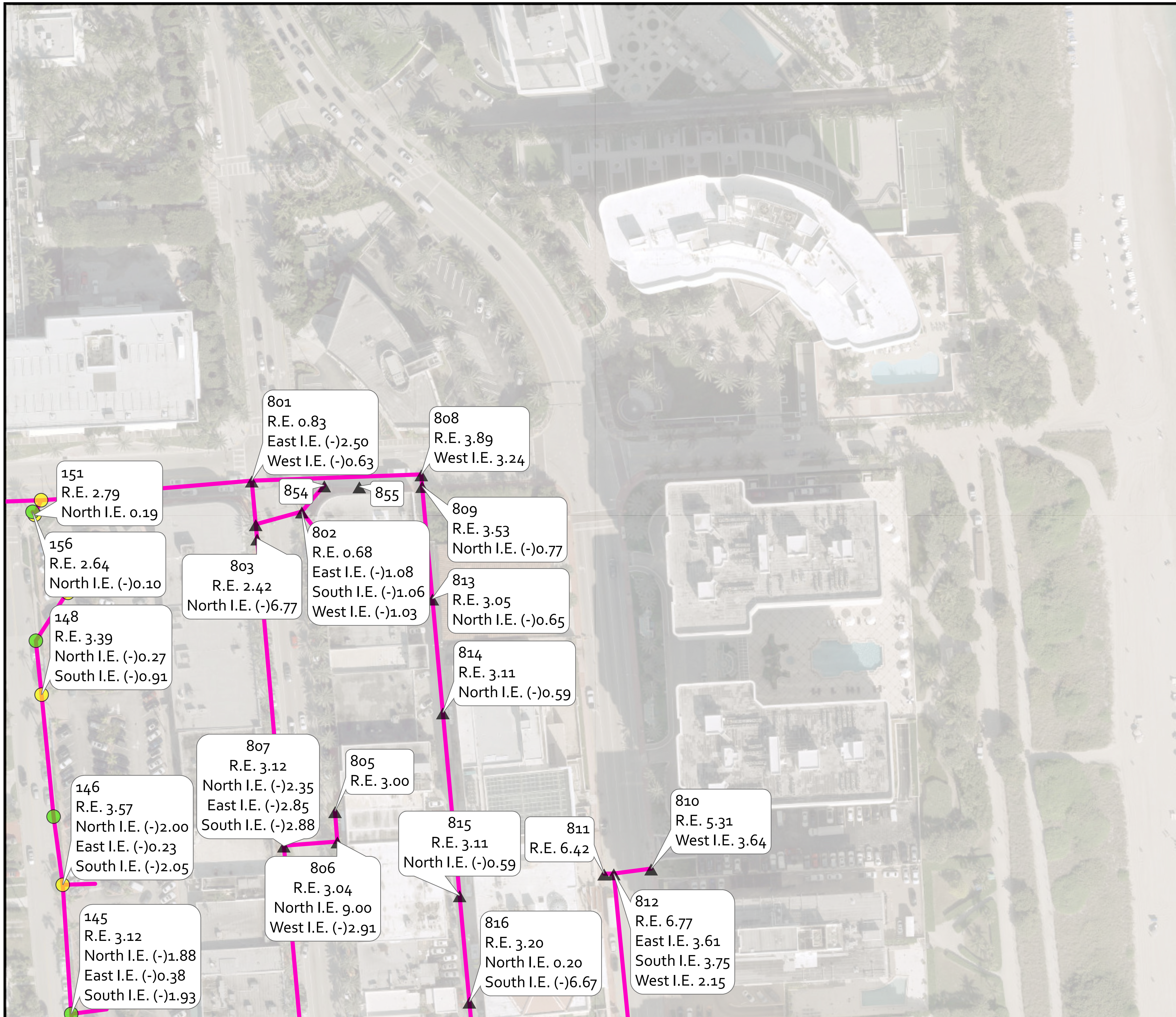
TOWN OF SURFSIDE STORMWATER MASTER PLAN

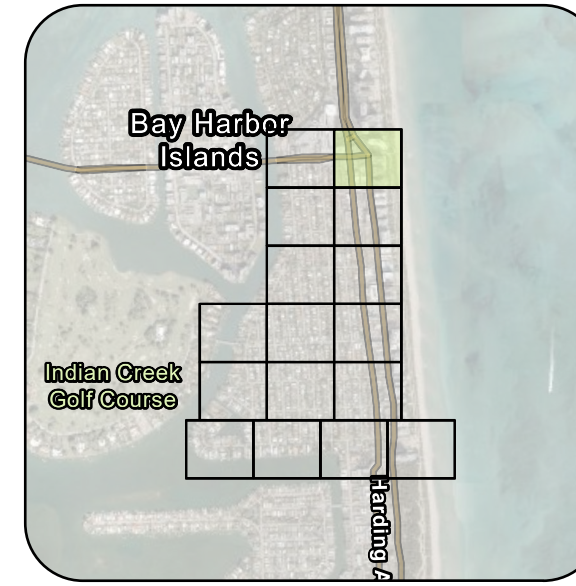
TOWN OF SURFSIDE DRAINAGE ATLAS

DATE:	DECEMBER 2023
DESIGN:	KT
DRAWN:	KT
CHECKED:	MB
KH NO.:	143332002

SHEET

1-1





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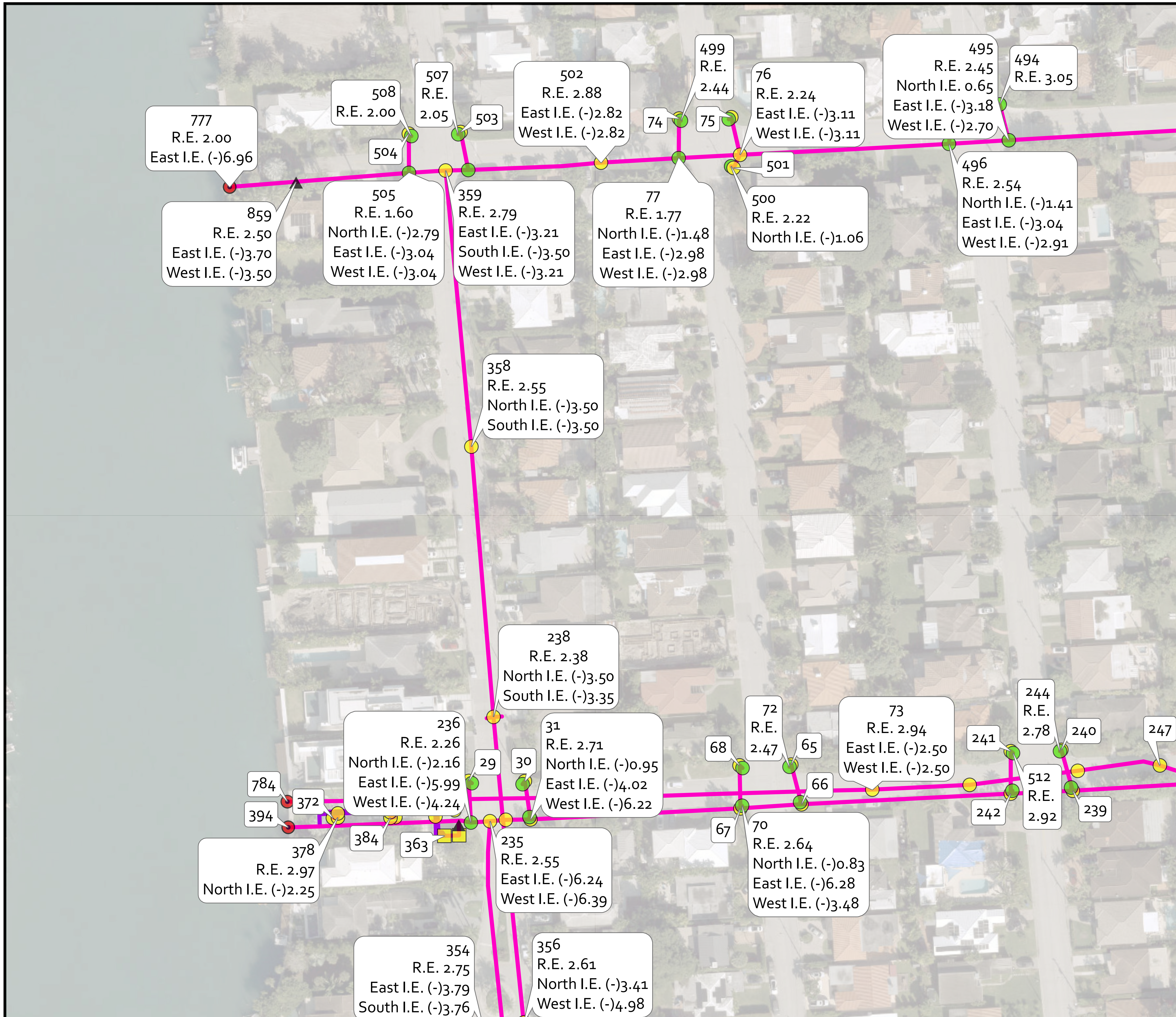
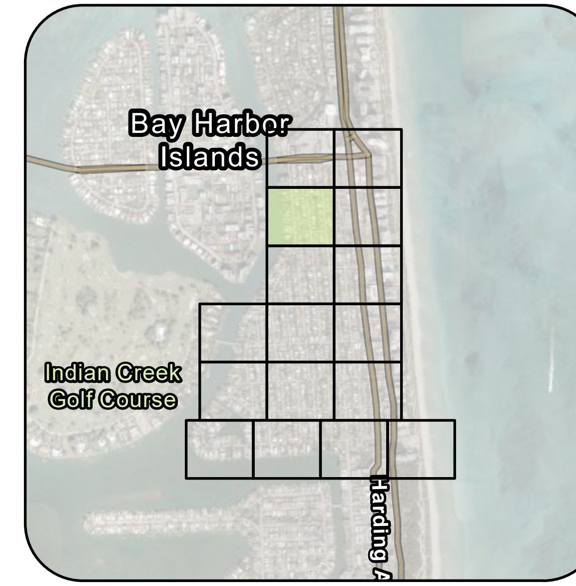
SHEET

1-2



0 50 100 200 Feet



N

Legend

- Unknown
- Inlet
- Manhole
- Outfall
- Pump Station
- Existing Force Main
- Existing Pipe

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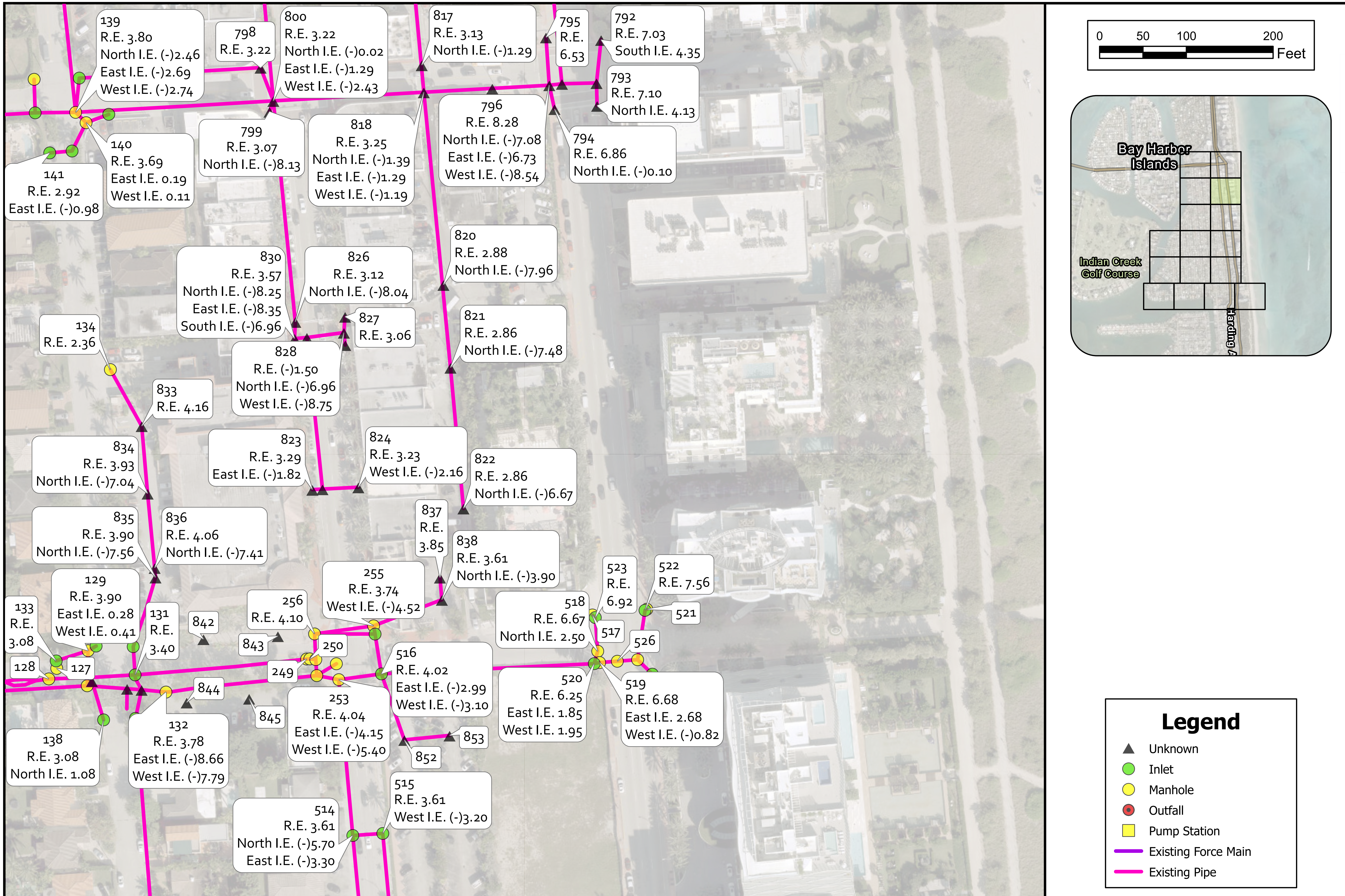
SHEET
1-3



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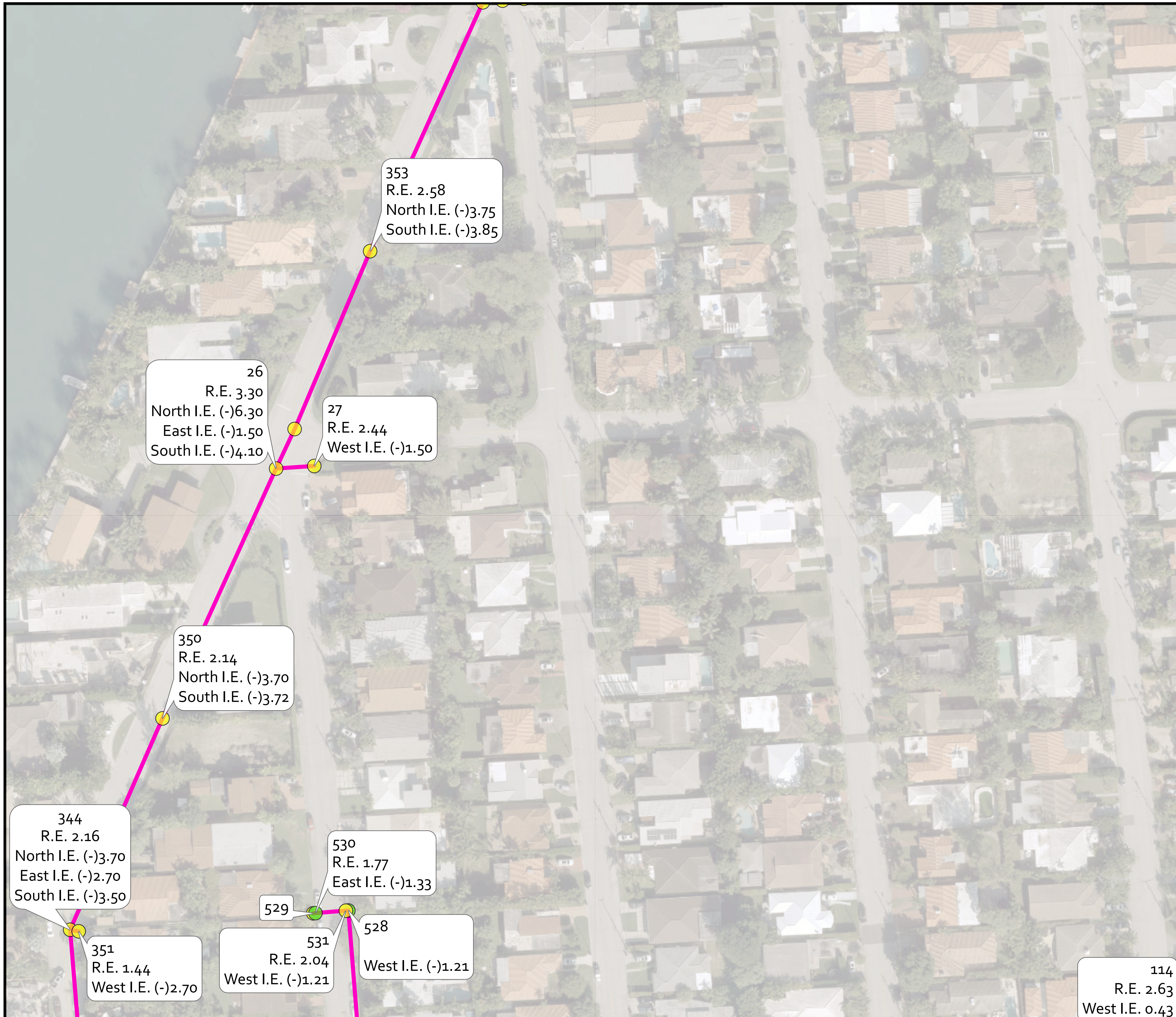
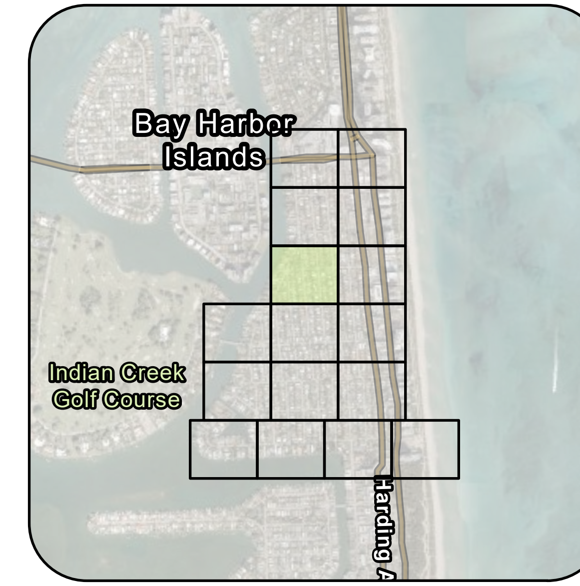
SHEET
1-4





Legend

- Unknown
- Inlet
- Manhole
- Outfall
- Pump Station
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DRAINAGE ATLAS

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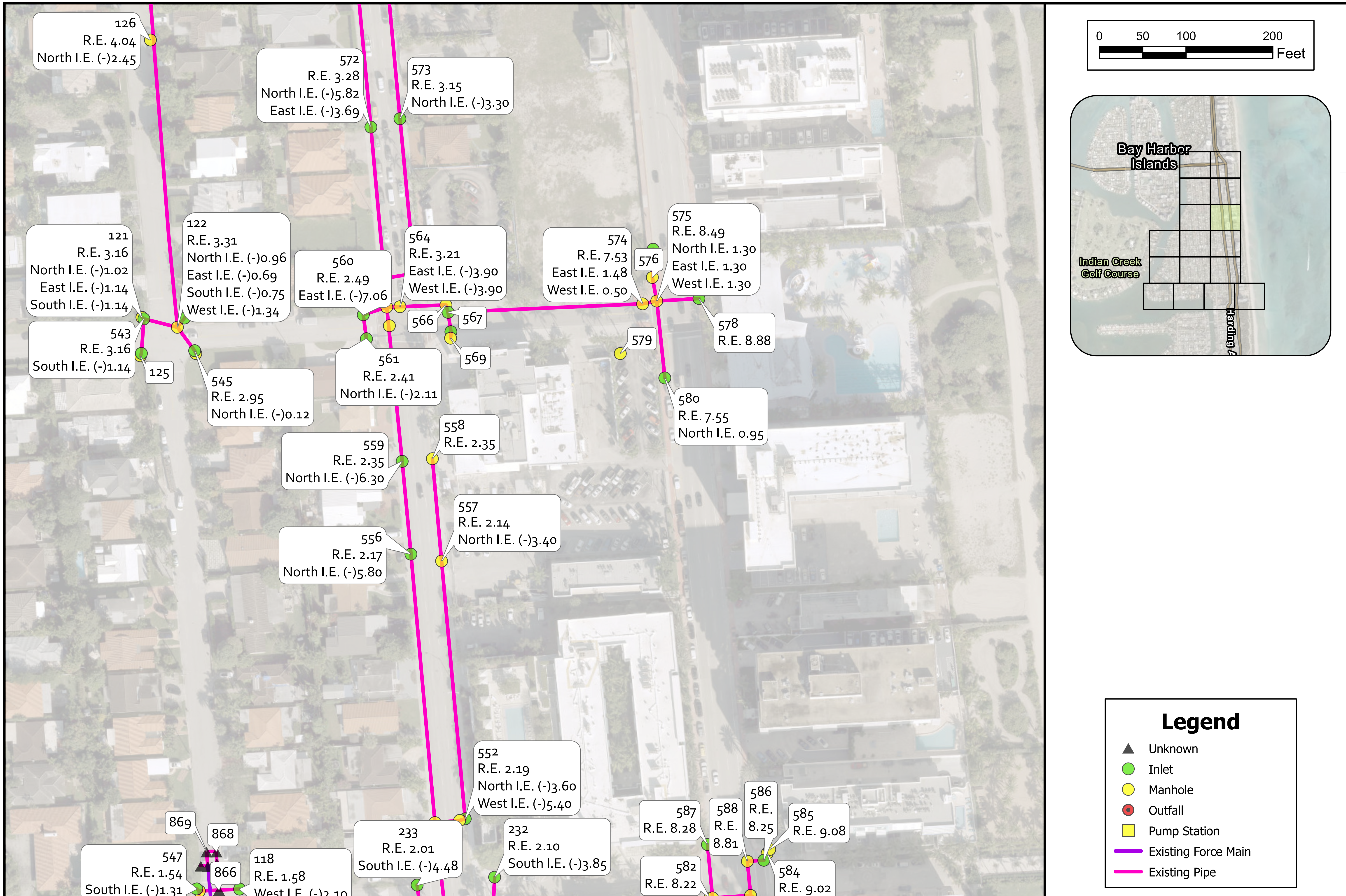
SHEET

1-5



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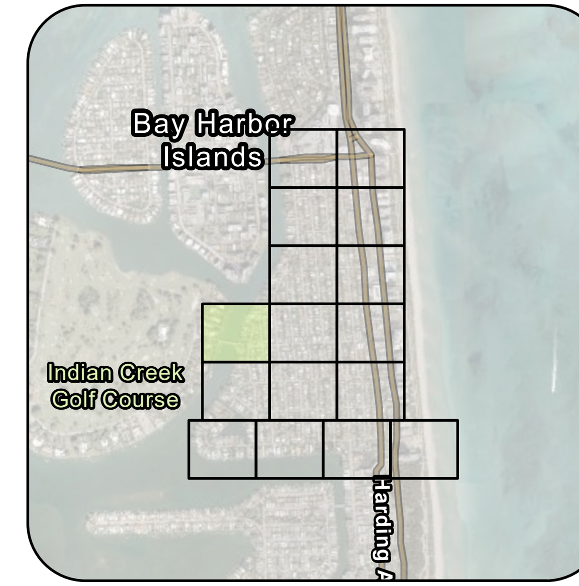
KH NO.:	143332002

SHEET
1-6

0 50 100 200 Feet



Legend

- Unknown
- Inlet
- Manhole
- Outfall
- Pump Station
- Existing Force Main
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TOWN OF SURFSIDE STORMWATER MASTER PLAN

TOWN OF SURFSIDE DRAINAGE ATLAS

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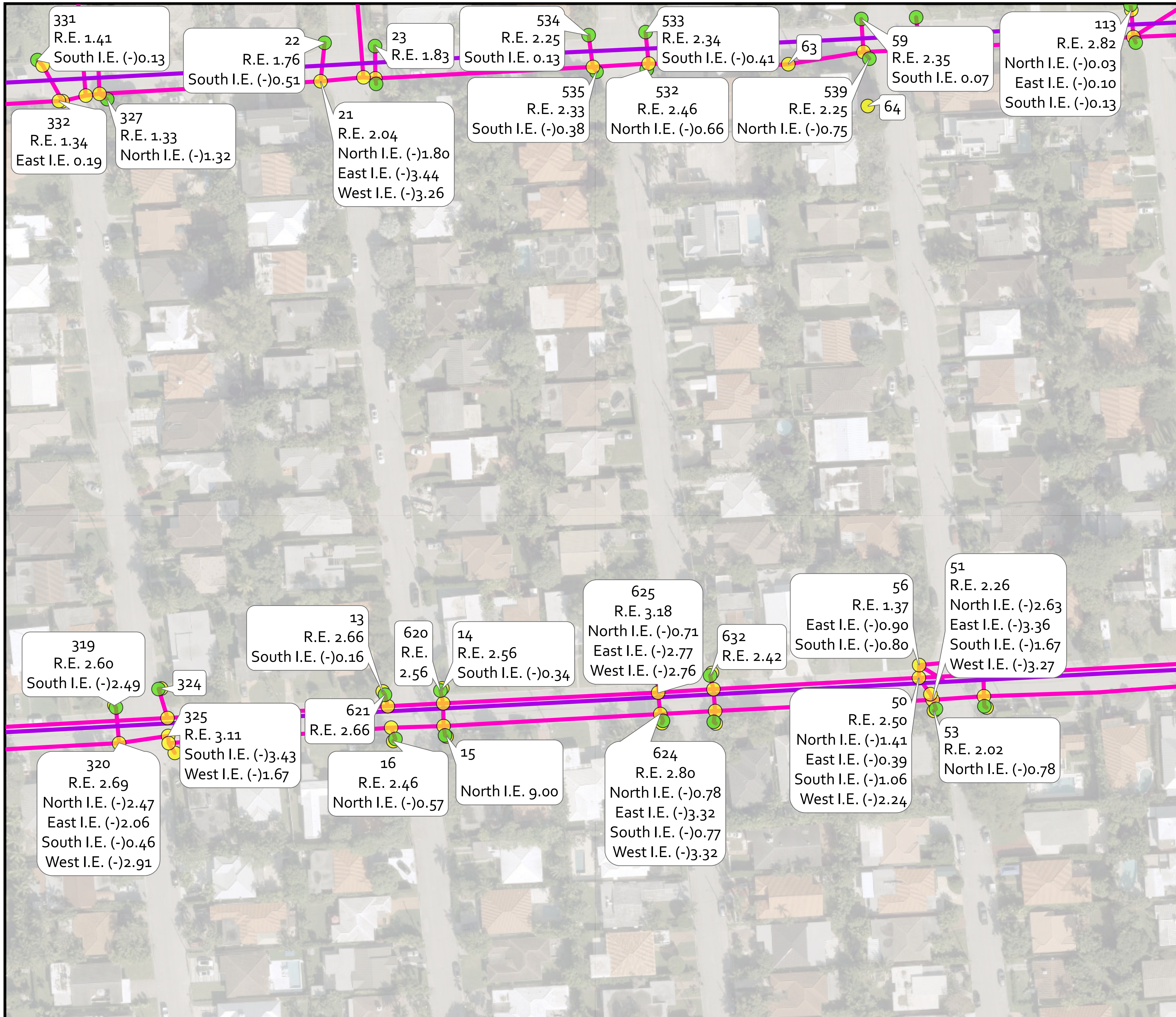
KH NO.:	143332002

SHEET

1-7



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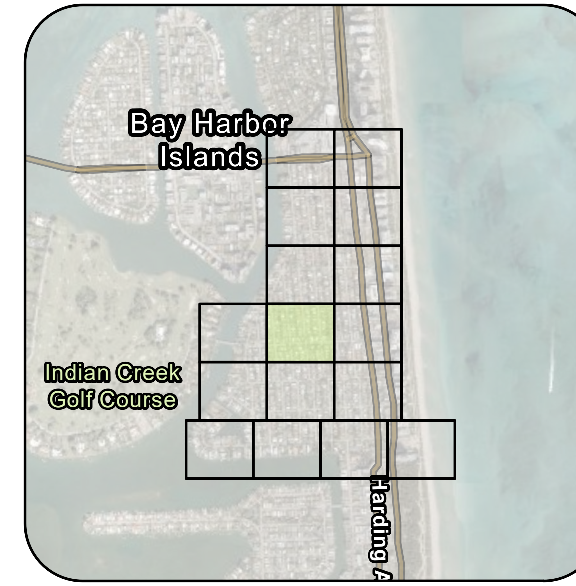

Legend

- Unknown
- Inlet
- Manhole
- Outfall
- Pump Station
- Existing Force Main
- Existing Pipe

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DRAINAGE ATLAS

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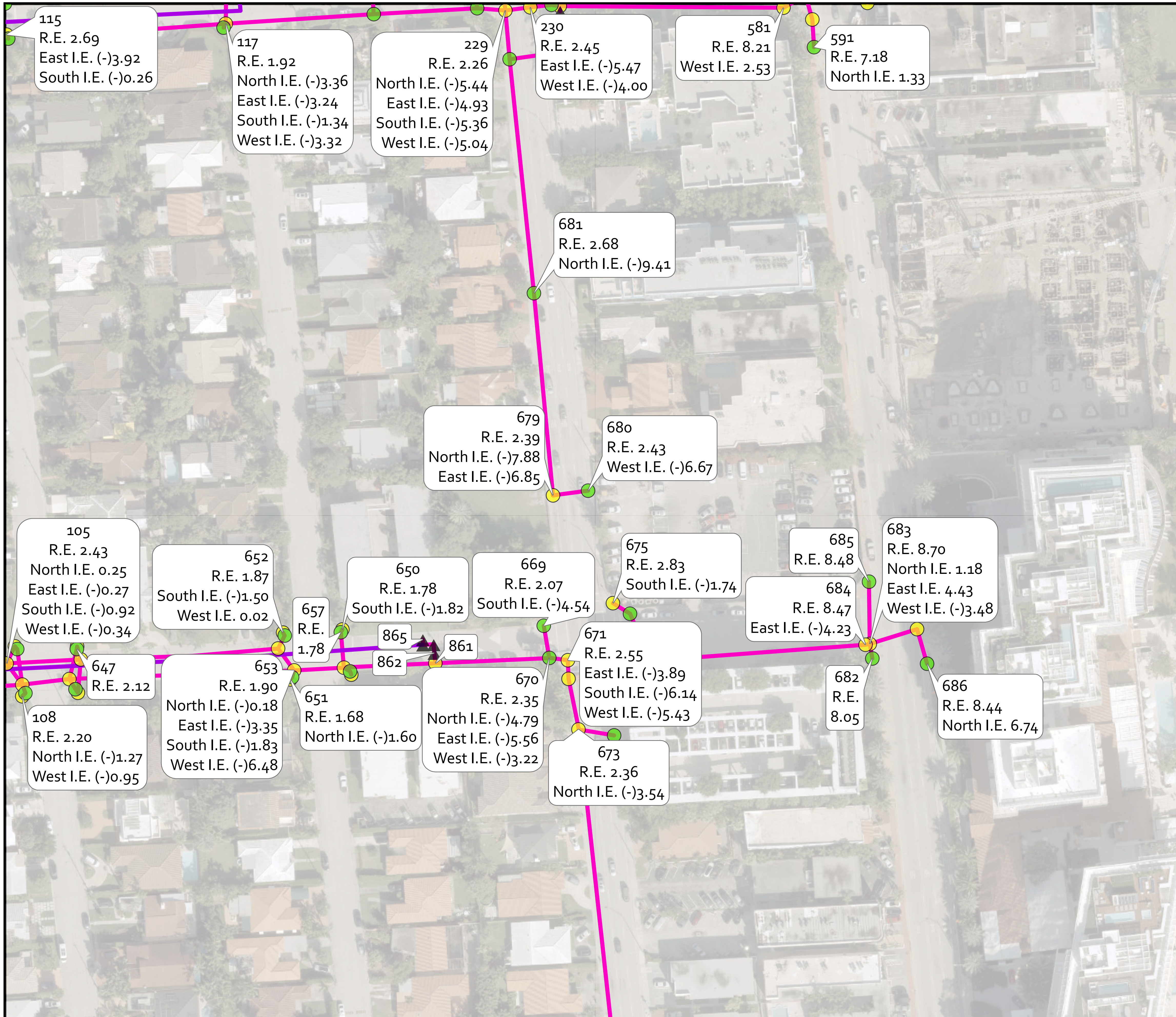
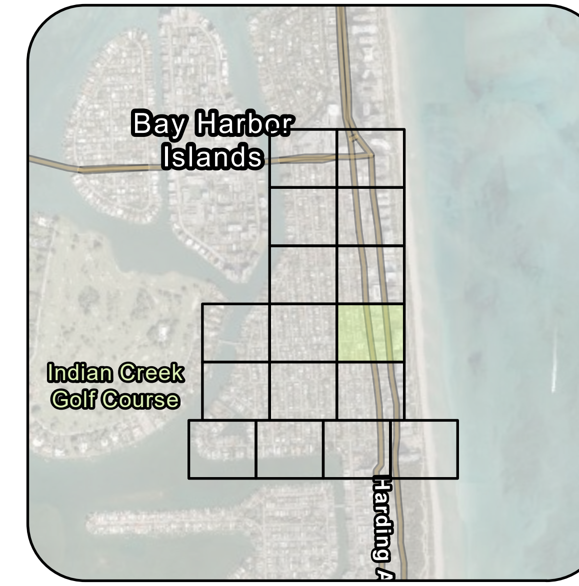
SHEET
1-8





Legend

- Unknown
- Inlet
- Manhole
- Outfall
- Pump Station
- Existing Force Main
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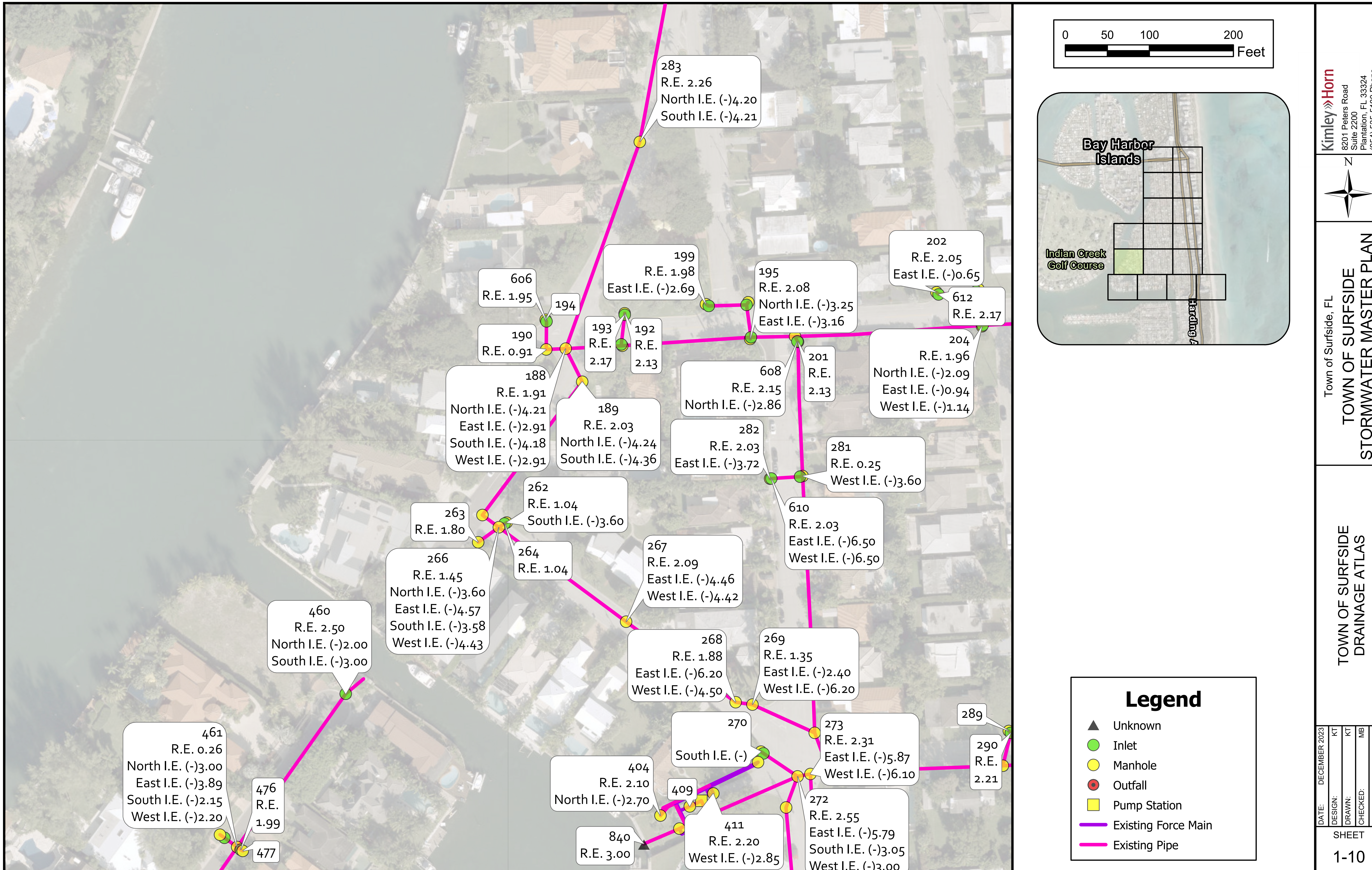
SHEET
1-9



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South I.E. (-)4.21
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R.E. 1.98
East I.E. (-)2.69
195
R.E. 2.08
North I.E. (-)3.25
East I.E. (-)3.16
202
R.E. 2.05
East I.E. (-)0.65
612
R.E. 2.17
606
R.E. 1.95
194
193
R.E. 2.17
192
R.E. 2.13
190
R.E. 0.91
188
R.E. 1.91
North I.E. (-)4.21
East I.E. (-)2.91
South I.E. (-)4.18
West I.E. (-)2.91
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North I.E. (-)4.24
South I.E. (-)4.36
608
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North I.E. (-)2.86
201
R.E. 2.13
204
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East I.E. (-)0.94
West I.E. (-)1.14
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East I.E. (-)3.72
281
R.E. 0.25
West I.E. (-)3.60
262
R.E. 1.04
South I.E. (-)3.60
263
R.E. 1.80
610
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East I.E. (-)6.50
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West I.E. (-)4.42
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South I.E. (-)
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East I.E. (-)5.87
West I.E. (-)6.10
290
R.E. 2.21
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East I.E. (-)3.89
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West I.E. (-)2.20
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R.E. 2.10
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409
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West I.E. (-)3.00
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R.E. 2.20
West I.E. (-)2.85
840
R.E. 3.00
477
0
50
100
200
Feet
Bay Harbor Islands
Indian Creek Golf Course
Harding A
N
Legend
Unknown
Inlet
Manhole
Outfall
Pump Station
Existing Force Main
Existing Pipe
Kimley»Horn
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Town of Surfside, FL
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TOWN OF SURFSIDE
DRAINAGE ATLAS
DATE: DECEMBER 2023
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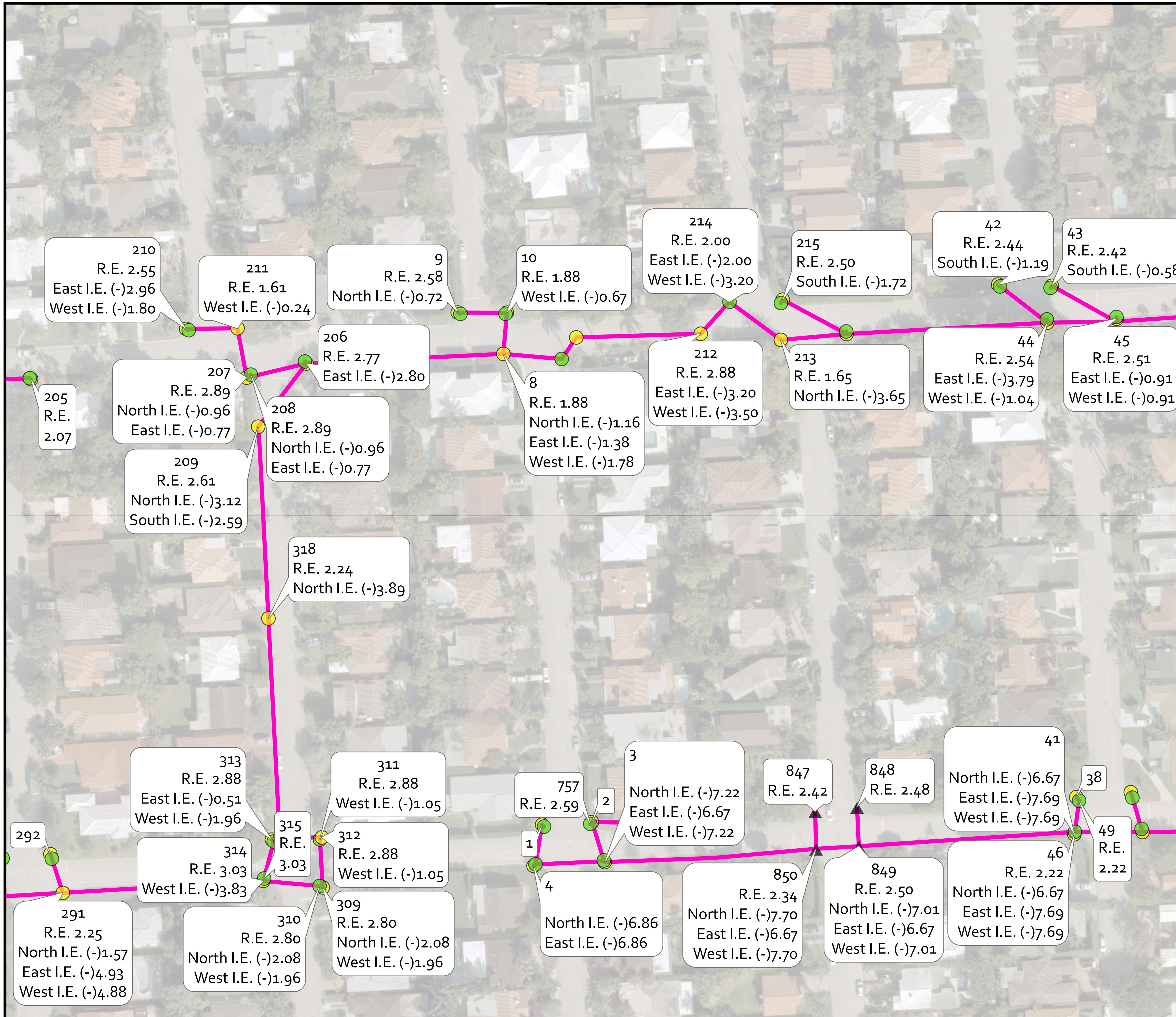
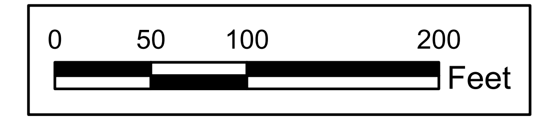
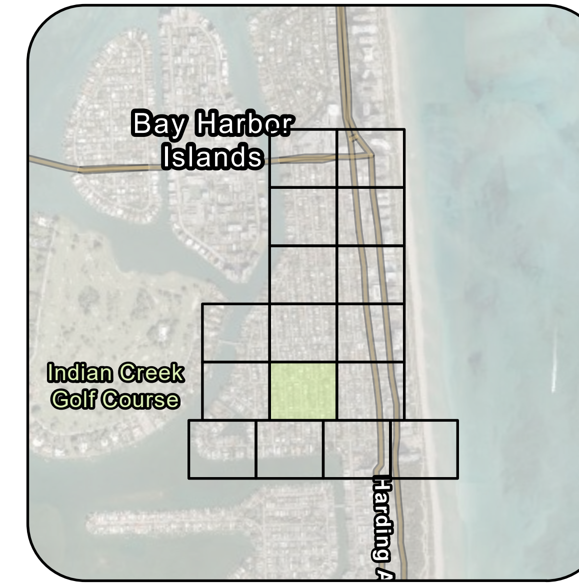
CHECKED: MB
KH NO.: 143332002
SHEET
1-10







Legend

- ▲ Unknown
- Inlet
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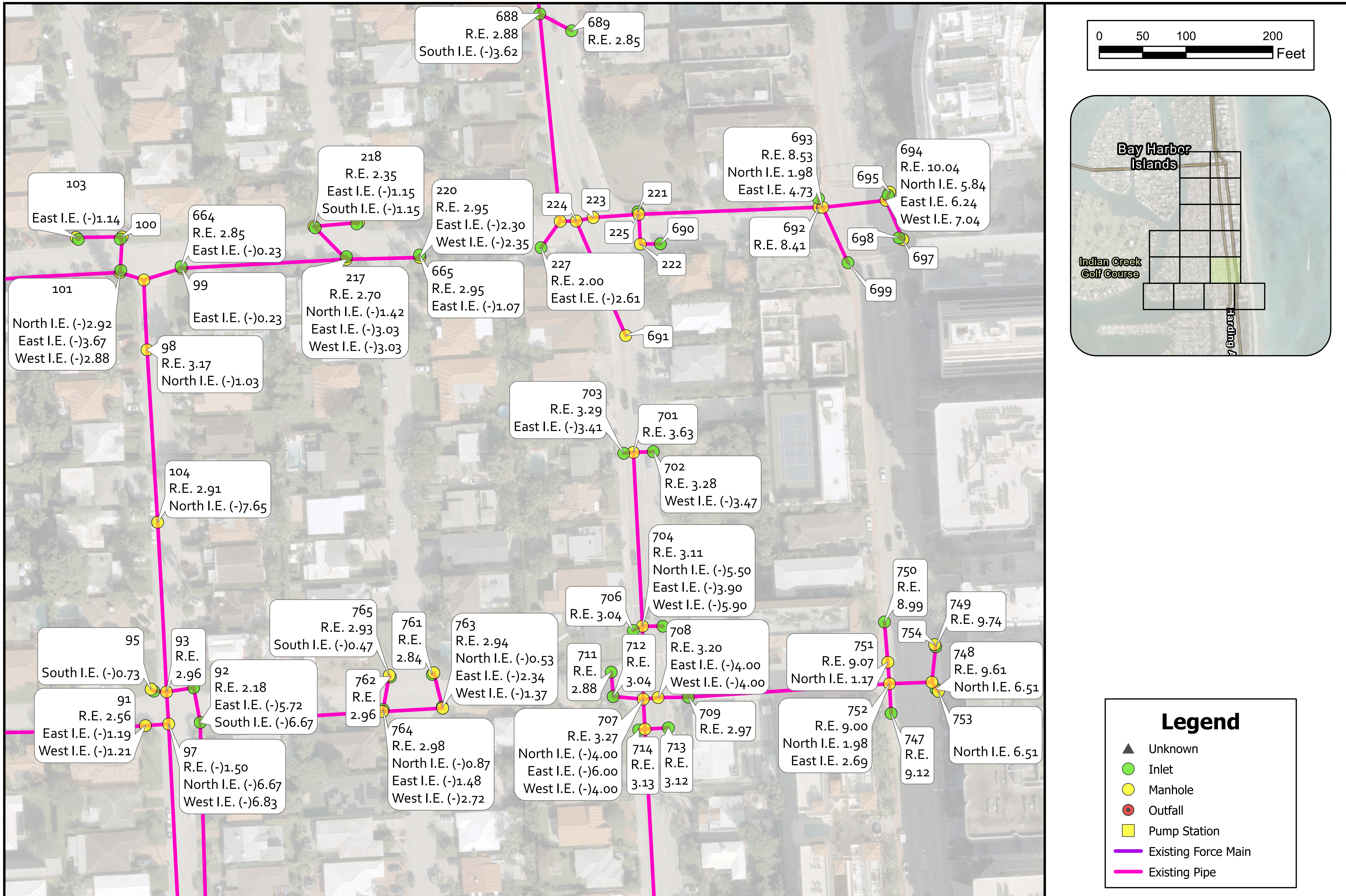
SHEET
1-11



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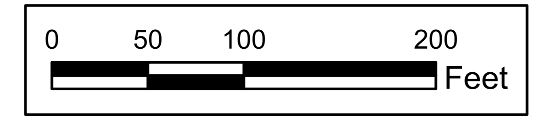
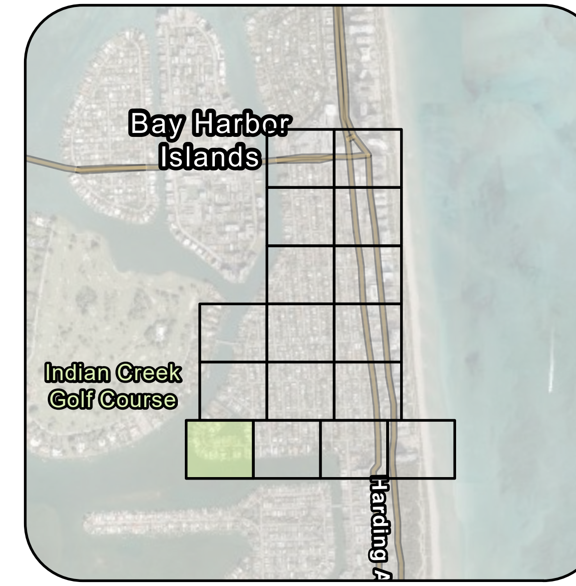
SHEET
1-12





Legend

- Unknown
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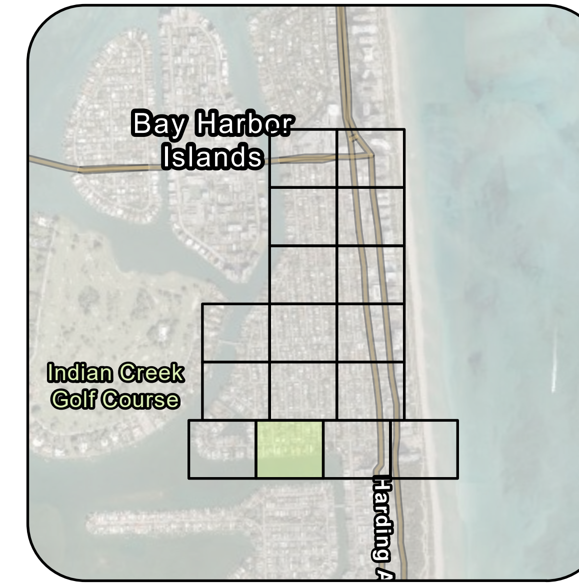
SHEET
1-13

0 50 100 200 Feet



Legend

- Unknown
- Inlet
- Manhole
- Outfall
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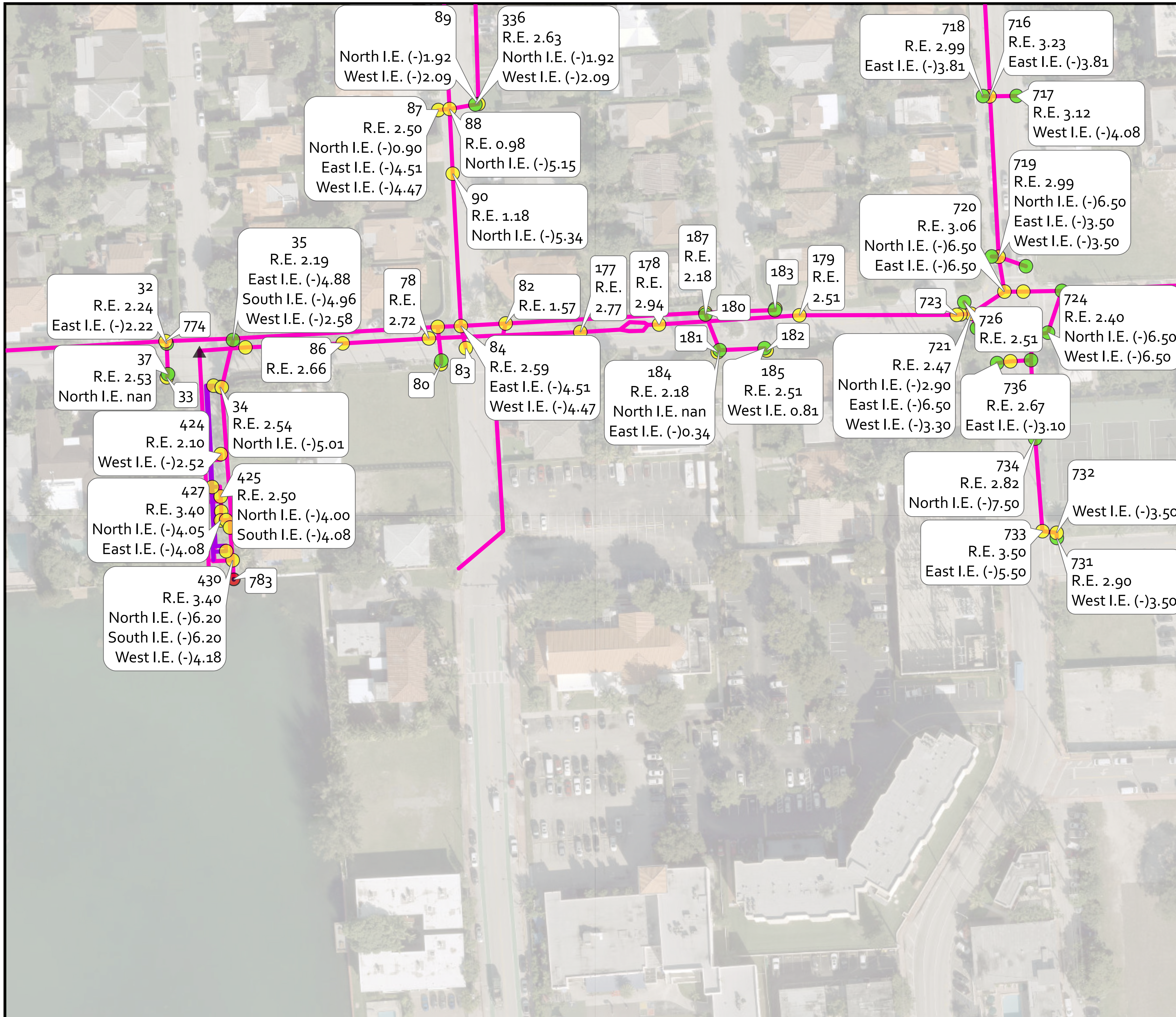
SHEET
1-14



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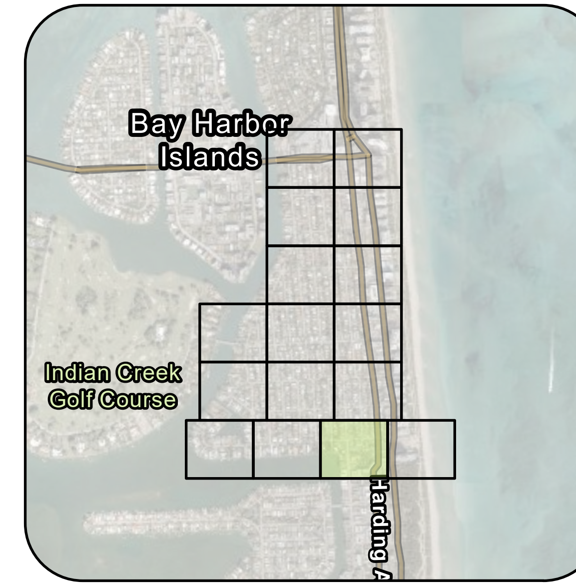

Legend

- Unknown
- Inlet
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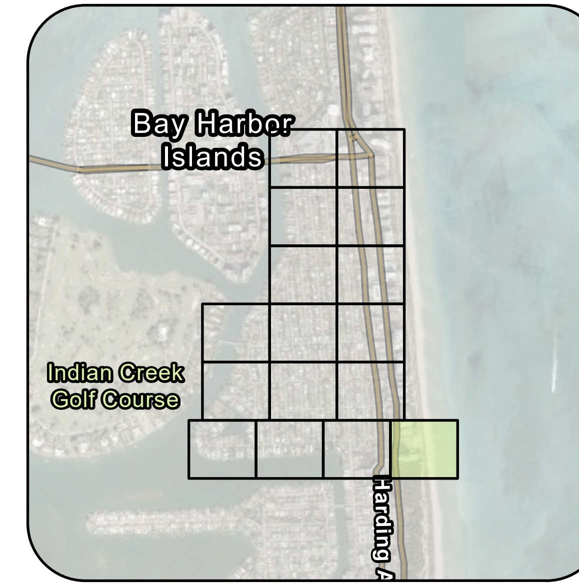
SHEET
1-15

0 50 100 200 Feet



Legend

- Unknown
- Inlet
- Manhole
- Outfall
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SHEET
1-16