

# CITY OF DELRAY BEACH

## INTRACOASTAL WATERWAY WATER LEVEL & INFRASTRUCTURE VULNERABILITY STUDY

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February 12, 2019  
City of Delray Beach



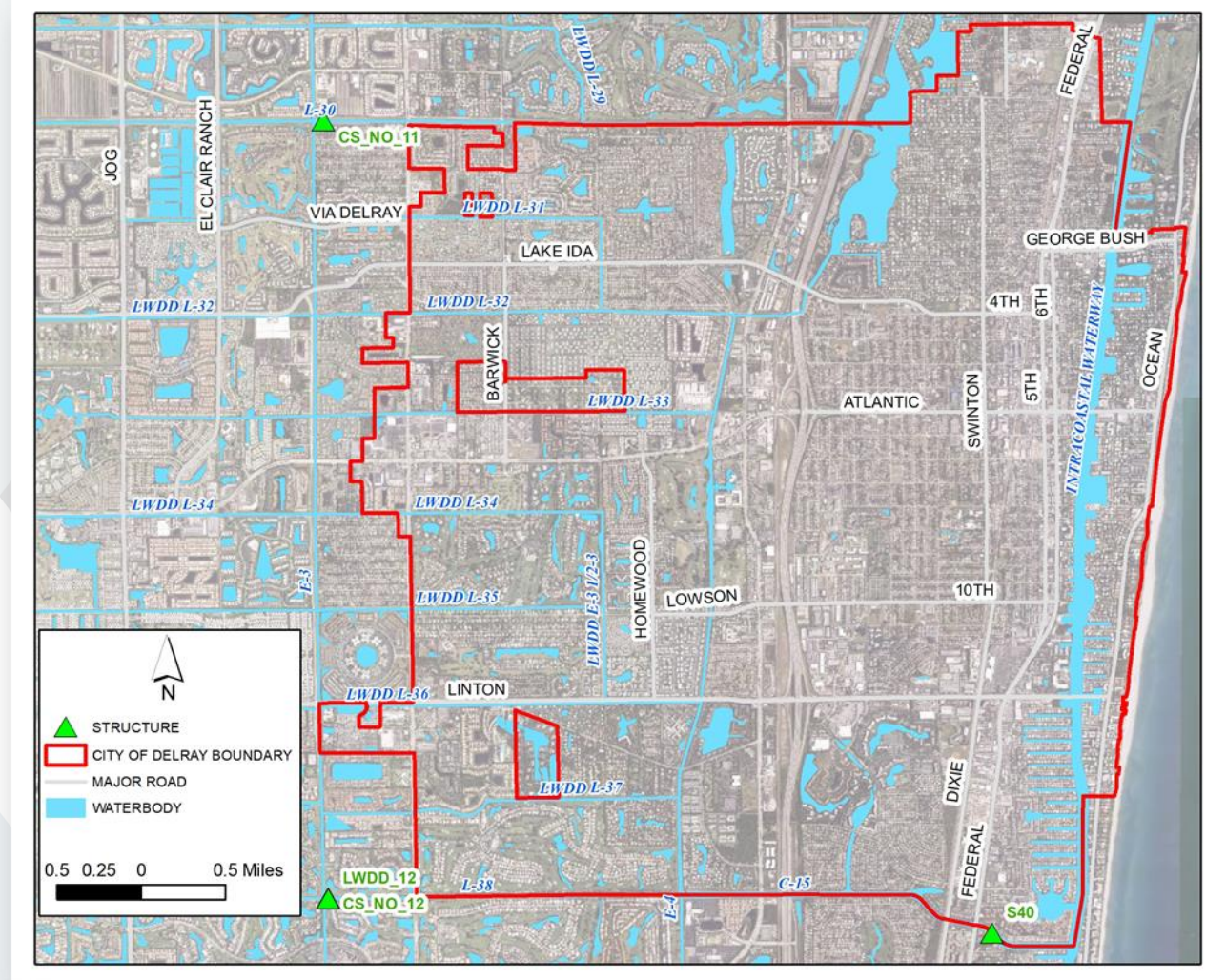
# City of Delray Beach

4 Miles of Intracoastal Waterway

Under 1 Mile of Public Seawall

Over 20 miles of Private Seawalls

City Limits (16 Square Miles)



# TIDAL FLOODING



# TOPICS

## Seawall Vulnerability Analysis

- ▶ Interim Solutions
  - Seawall Repairs and Backflow Preventers

## Stormwater Master Plan Update

- ▶ Long Term Solutions
  - Increase Size and Number of Stormwater Pump Stations
  - Raise Roads, Increase Pipe Sizes

## Commission Direction

- ▶ Funding Priorities
- ▶ CRS Rating
- ▶ Seawall Ordinance Discussion

# GOALS & OBJECTIVES

## **Assess Future Seasonal Flooding along IntraCoastal Waterway (ICW)**

- Develop water level predictions for 30 and 75 year planning horizons
- Inventory current conditions - seawalls and stormwater connections

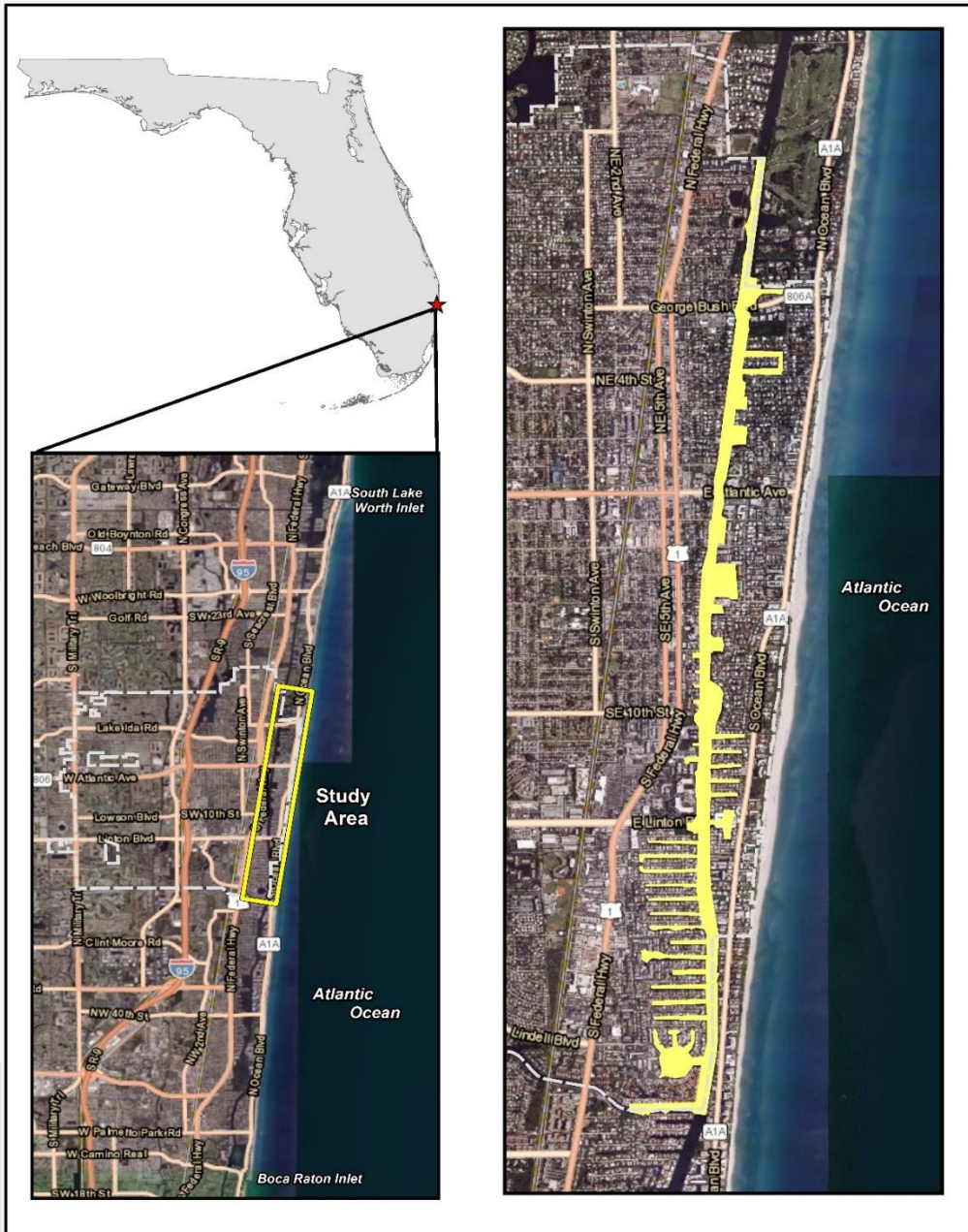
## **Identify Options to Protect Infrastructure and Property**

- Assess current conditions given water level predictions
- Prioritize improvement projects

## **Address Stormwater System Infrastructure Needs into the Future**

- Implementation Strategies
- Funding Strategies
- Commission Actions required

# COMPONENTS OF THE TOTAL WATER LEVEL



- Astronomical Tides
- Ocean Storm Surge
- Stormwater Discharge from Inland Rain
- Sea Level Rise

## SFWMD S40-T (DELRAY BEACH ICW) TOP 10 RECORDED WATER LEVELS

| Rank | Date       | Feet NAVD88 | Associated Storm Event |
|------|------------|-------------|------------------------|
| 1    | 9/10/2017  | 3.14        | Hurricane Irma         |
| 2    | 11/16/1996 | 3.10        |                        |
| 3    | 10/13/1996 | 2.98        |                        |
| 4    | 10/28/2012 | 2.97        | Hurricane Sandy        |
| 5    | 9/25/2004  | 2.84        | Hurricane Jeane        |
| 6    | 9/29/2015  | 2.66        | Hurricane Joaquin      |
| 7    | 9/4/2004   | 2.64        | Hurricane Frances      |
| 8    | 10/17/2016 | 2.61        |                        |
| 9    | 10/5/2017  | 2.60        |                        |
| 10   | 10/15/1999 | 2.59        | Hurricane Irene        |

# SEA LEVEL RISE

South Florida Regional Compact on Climate Change guidance references :

- Intergovernmental Panel on Climate Change (IPCC) AR5 Medium Rate
- U.S. Army Corps of Engineers (USACE) High Rate (NRC Curve III)

| Year | Increase in MSL Relative to 2018 |      |            |      |
|------|----------------------------------|------|------------|------|
|      | USACE High Curve                 |      | IPCC Curve |      |
|      | Inches                           | Feet | Inches     | Feet |
| 2048 | 12.5                             | 1.1  | 7.1        | 0.6  |
| 2093 | 48.9                             | 4.1  | 24.0       | 2.0  |

# 30-YEAR PLANNING ELEVATION

3.9 to 4.4 ft. NAVD

Freeboard

0.5 ft.

5-year Return Period Event

1.8 ft.

30 years of SLR

0.6-1.1 ft.

Average Daily Maximum  
Water Level 2017

1.0 ft.

*2018 Veteran's Park Seawall Improvement*



# CURRENT CONDITION SURVEYS

## Public & Private Seawalls

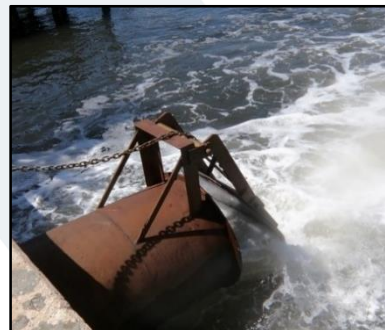
- Seawall Elevations
- Seawall Structural Assessments
  - Public top-side inspections
  - Private rapid structural assessments
  - Video inventory



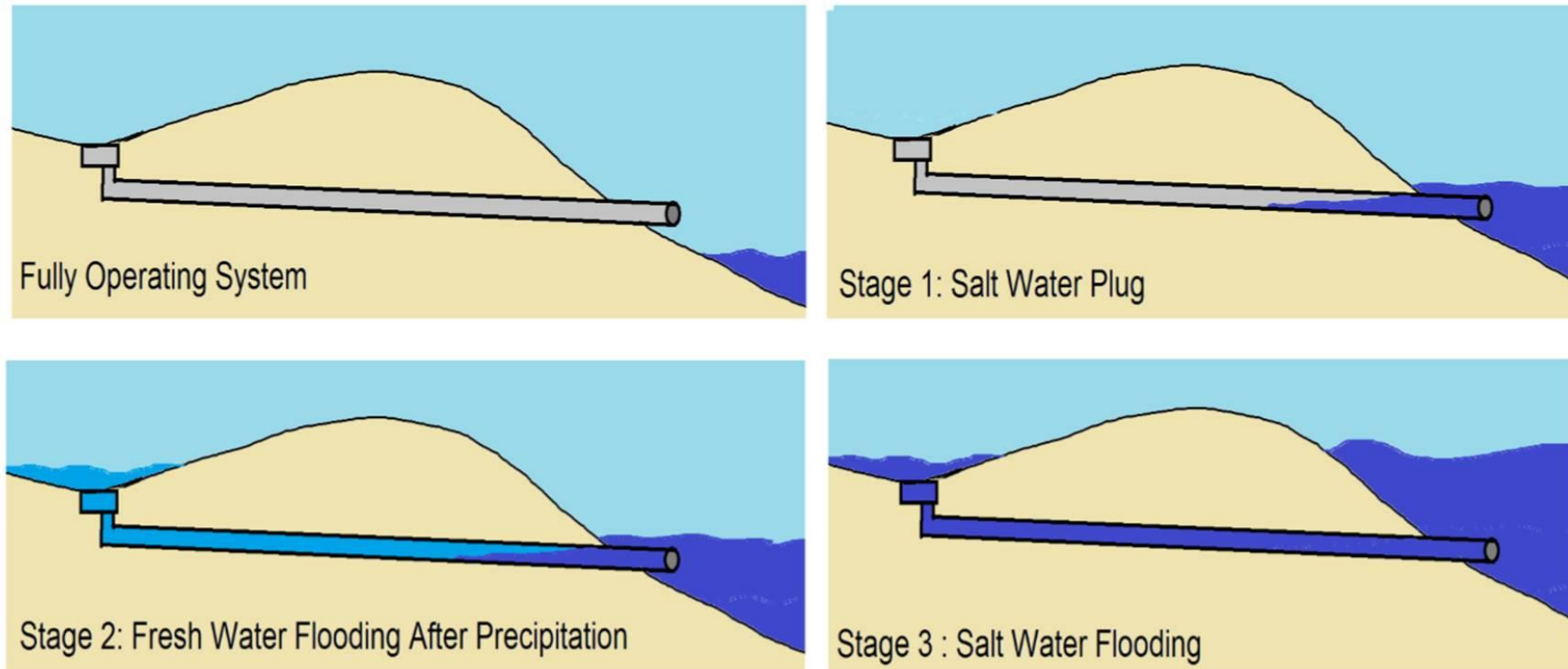
# CURRENT CONDITION SURVEYS

## Stormwater System

- Stormwater Inlet & Outfall Elevations
- Stormwater Outfall Inspections
- Backflow Prevention Device Inventory



## Stages of Stormwater Infrastructure Failure due to Sea Level Rise

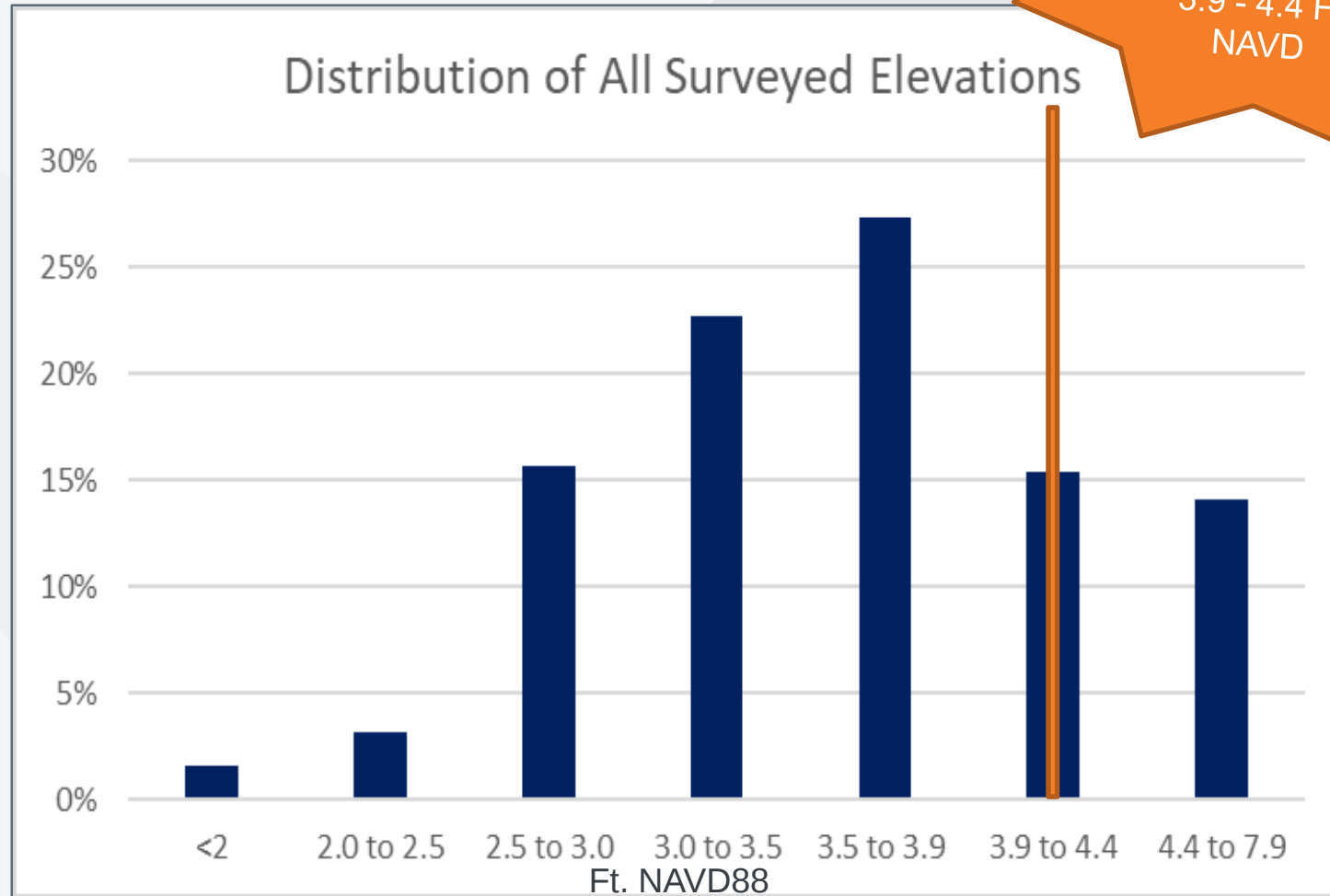


### Legend

Ground Sky Fresh Water Salt Water Stormwater Drainage Infrastructure

Figure by Emily Niederman, Stetson University (Class of 2017)

# SEAWALL ELEVATION ANALYSIS



30-Yr Planning  
Elevation  
Range =  
3.9 - 4.4 Ft  
NAVD

# SEAWALL STRUCTURAL ANALYSIS

- Seawall Structural Assessments
  - Public top-side inspections
  - Private rapid structural assessments
  - Video inventory

|         | Good | Satisfactory | Fair | Poor | Serious | Critical |
|---------|------|--------------|------|------|---------|----------|
| Public  | 1    | 16           | 9    | 3    | 0       | 0        |
| Private | 48   | 170          | 450  | 152  | 41      | 7        |
| Total % | 4%   | 19%          | 53%  | 18%  | 5%      | 1%       |

# PUBLIC SEAWALL ANALYSIS

- Top-side structural assessments of 29 public seawalls
- Observation reports developed
- Ranked based on condition and need for repair/replacement

|         |    |                                      |
|---------|----|--------------------------------------|
| Highest | SF | Structural Seawall Failures          |
|         | LK | Water and Soil Leaks                 |
|         | SD | Structural Seawall Decay and Repairs |
|         | CE | Cap Elevation Issues                 |
| Lowest  | NA | No Action                            |

*NE 1<sup>st</sup> Court*



*Beach Drive*



# STORMWATER SYSTEM ANALYSIS

- Surveyed 103 inlets and their associated outfalls along ICW
- 86 inlets below 4.4 ft.
- 28 protected by current or planned back flow prevention devices
  - Some are in need of maintenance
- 58 remain unprotected and below 4.4 ft.
- Ranked based on inlet elevation for prioritizing future backflow prevention installations
- Potential to provide protection within 10 years by installing ~6 backflow prevention devices per year



Spanish Trail E 1.  
Oysters prevent closure of the duckbill.



Waterway Lane



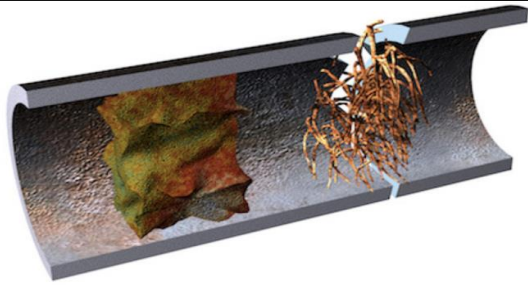
# Capital Improvement Projects (TM5) – Cont.

## ➤ Backflow preventers (In-line Valves)

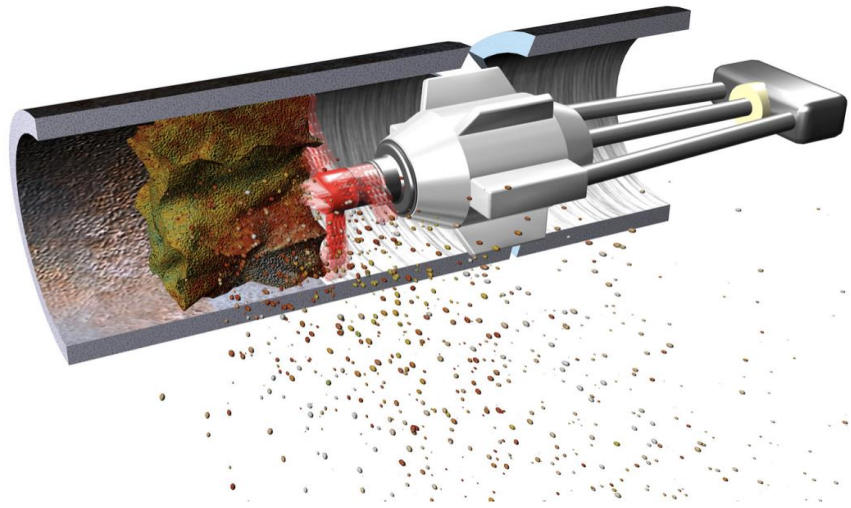


# Capital Improvement Projects (TM5) – Cont.

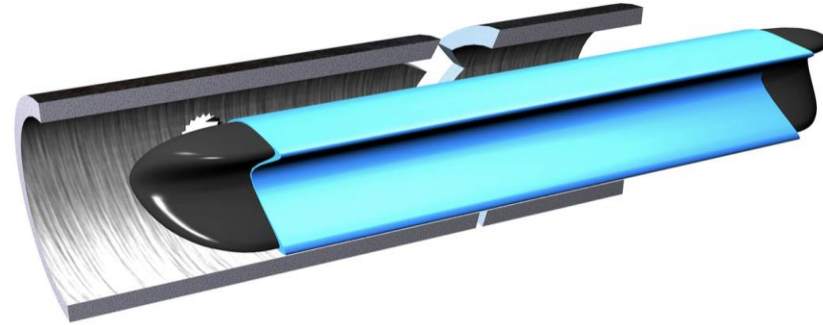
## ➤ Pipe lining (Slip Lining):



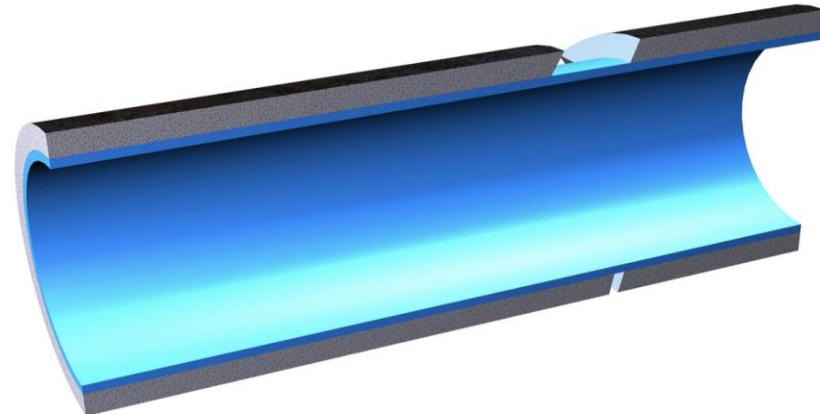
First, a SPT sewer camera reveals the waste buildup, breach, or possible root intrusion.



Then, a pneumatic cleaning tool cleans the pipe internally.



Next, a CIPP liner is pulled into place and the bladder is inflated.



After curing, the CIPP lining product is a structural "pipe within the original pipe."



**City of Delray Beach**  
**STORMWATER MANAGEMENT**  
**MASTER PLAN UPDATE**

**City Commission**  
**Workshop**

**February 12, 2019**

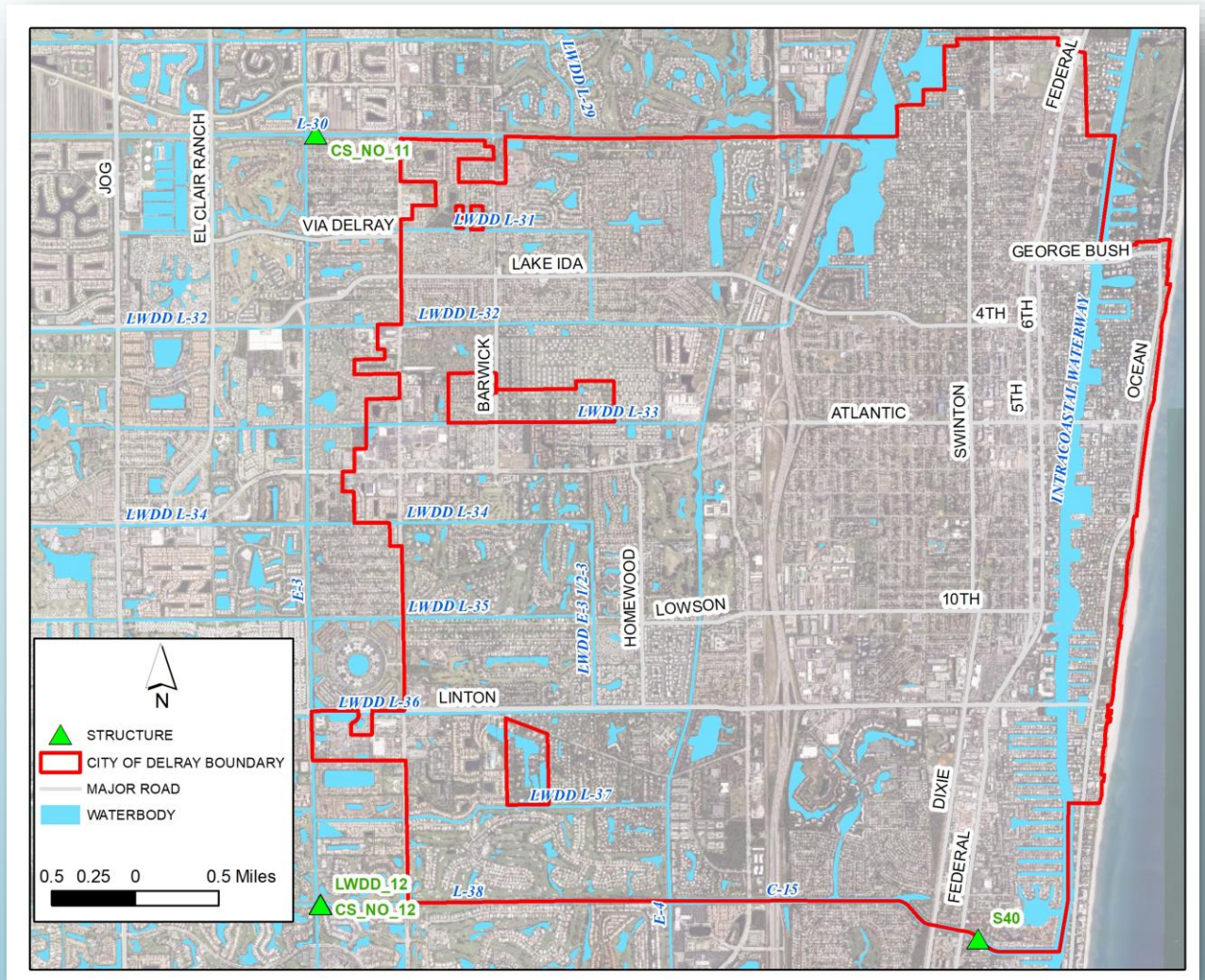


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# Stormwater Master Plan Update Purpose and Benefits

1. Provide the City with a 5-year stormwater Capital Improvement Plan to implement high priority projects in a systematic, objective and cost-effective manner
2. Assist the City in developing and Adaptive Management Plan for Climate Change, and mitigating projected sea-level and groundwater rise
3. Help the City secure grants for flood protection, sea-level and groundwater rise, and water quality improvement projects
4. Help improve the City's FEMA Community Rating Score (CRS) that will help reduce resident flood insurance rates
5. Allow evaluation of existing Stormwater Utility Rates based on projected needed improvements and costs

## City Limits (16 Square Miles)



# Stormwater Master Plan Update Scope of Work

- Task 1 – Kickoff Meeting
- Task 2 – Data Acquisition and Evaluation
- Task 3 – Existing Conditions Hydrologic/Hydraulic Modeling (TM1)
- Task 4 – Existing Conditions Flood Protection Level of Service (TM2)
- Task 5 – Projected Sea Level Rise and Groundwater Rise Impacts (TM3)
- Task 6 – Water Quality Assessment (TM4)
- Task 7 – Capital Improvement Projects (TM5)
- Task 8 – Stormwater Ordinance Review – (Provided as separate deliverable)
- Task 9 – Utility Rate Structure Review Assistance (Optional Task)
- Task 10 – NPDES Review (TM6)

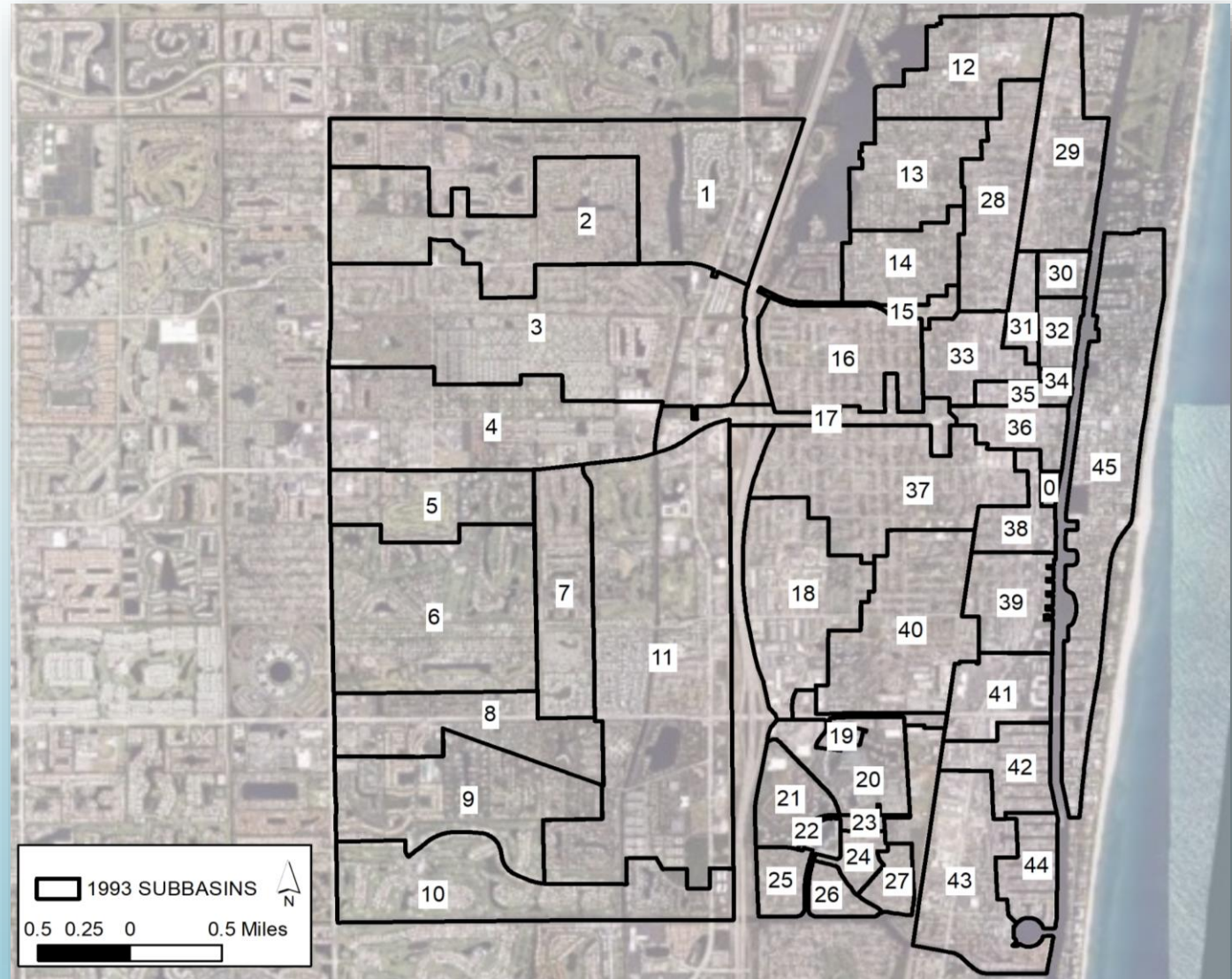


Task 3  
Existing Conditions  
Hydrologic/Hydraulic Modeling (TM1)

# Existing Conditions Hydrologic/Hydraulic Modeling (TM1)

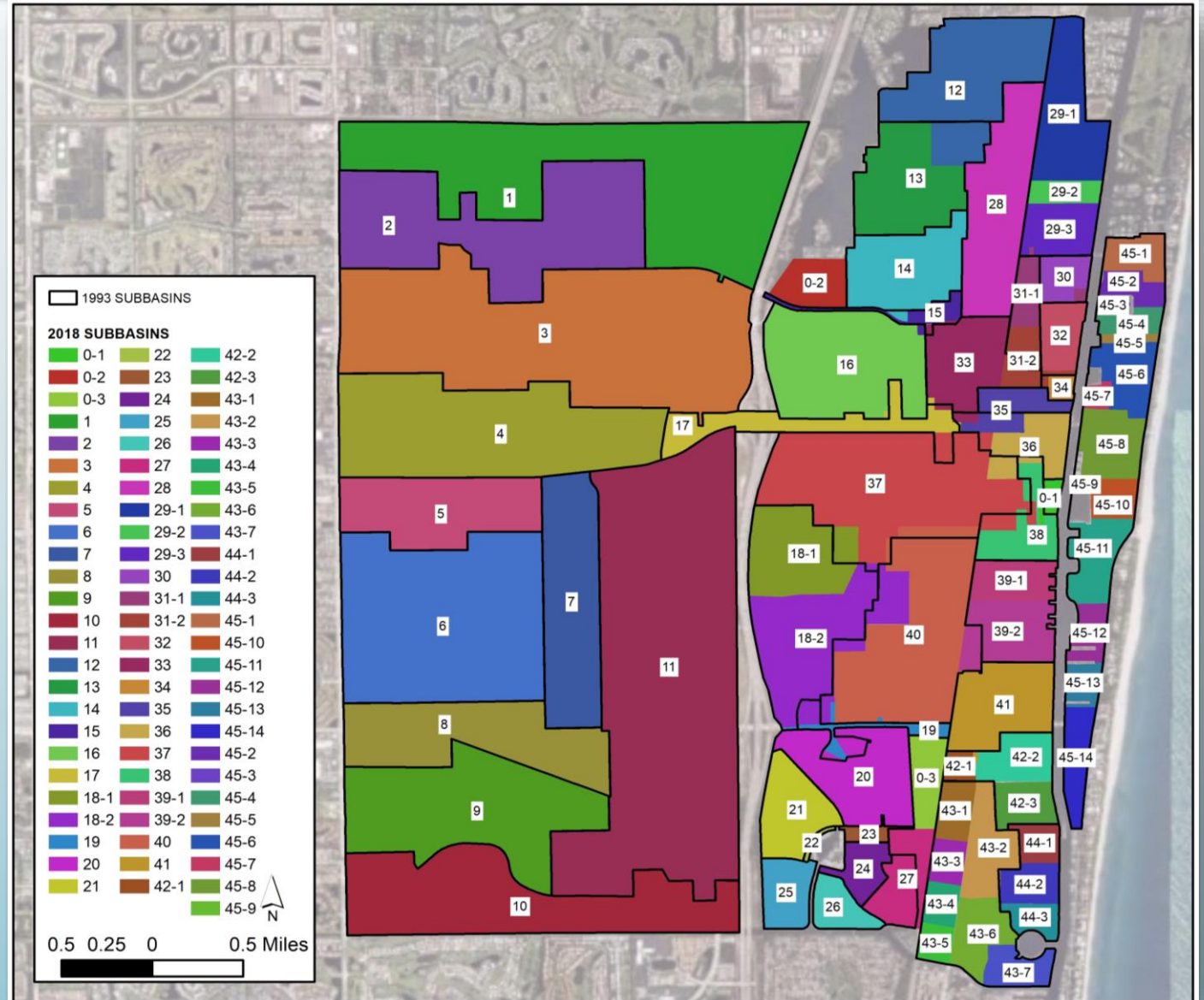
## ➤ Sub-basin Delineations:

- 1993 Stormwater Master Plan subdivided City in to 45 sub-basins
- Sub-basin delineations were refined based on (total of 76 sub-basins) :
  - ✓ Better available topography
  - ✓ New infrastructure information
  - ✓ Most up to date permit files

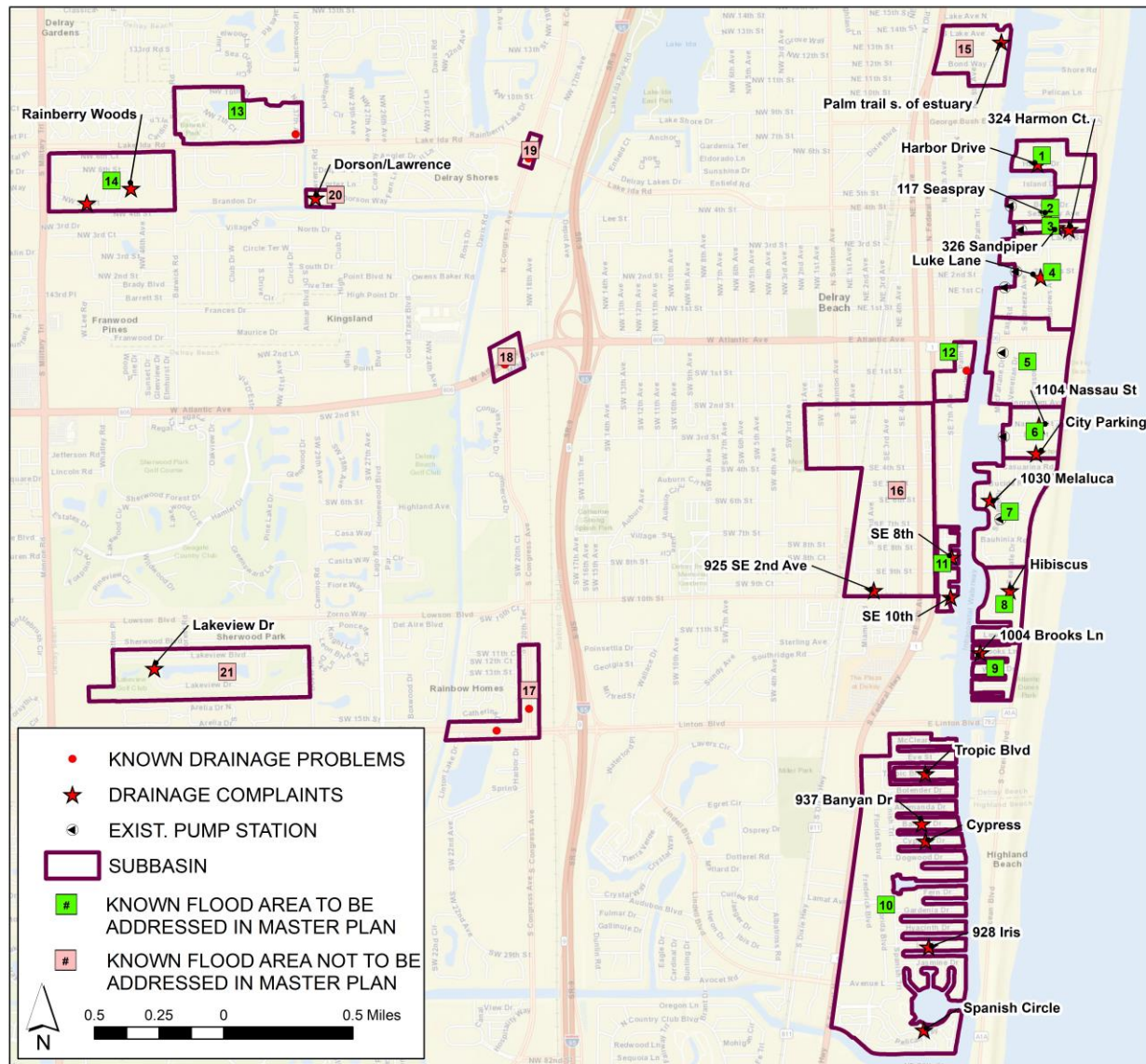


# Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.

## ➤ Refined Sub-basin Delineations:



## Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.



### ➤ Problem Area Identification:

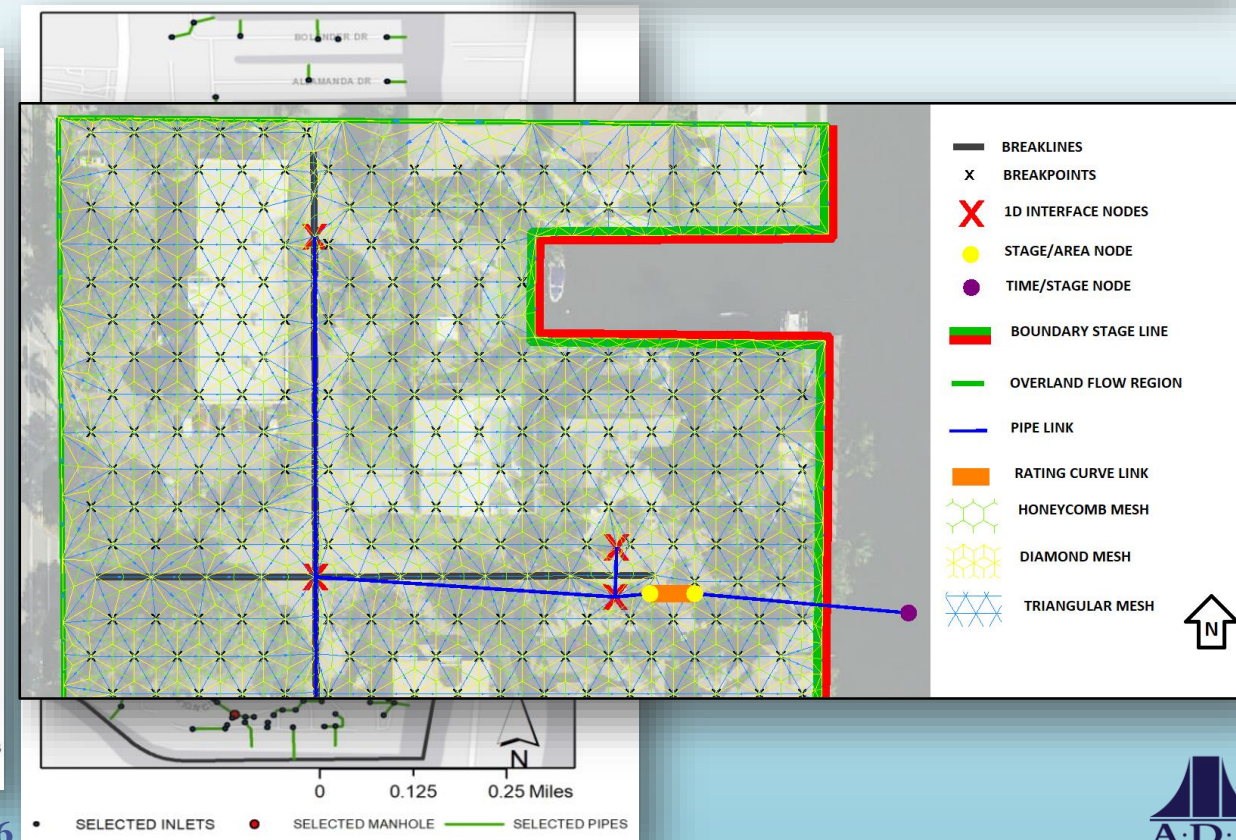
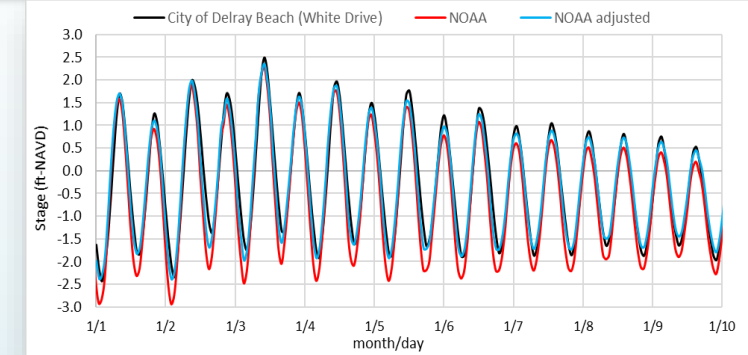
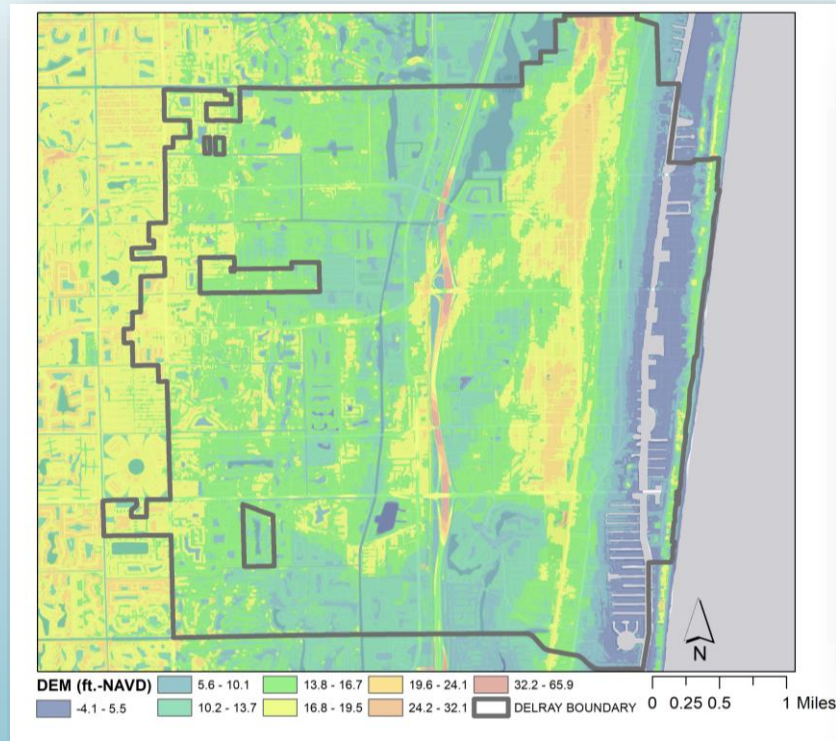
- ✓ Known areas of flooding
- ✓ Know areas or tidal flooding
- ✓ Repetitive flooding complaints

| Problem Area | Area (Ac) | Associated Drainage Basin(s)                   |
|--------------|-----------|------------------------------------------------|
| 1            | 26.2      | 45-2                                           |
| 2            | 22.8      | 45-4                                           |
| 3            | 7.8       | 45-5                                           |
| 4            | 67.3      | 45-6, 45-7                                     |
| 5            | 64.8      | 45-8                                           |
| 6            | 27.4      | 45-10                                          |
| 7            | 61.2      | 45-11                                          |
| 8            | 28.5      | 45-12                                          |
| 9            | 19.5      | 45-13                                          |
| 10           | 281.5     | 42-2, 42-3, 43-2, 43-6, 43-7, 44-1, 44-2, 44-3 |
| 11           | 14.6      | 39-1, 39-2                                     |
| 12           | 15.3      | 36                                             |
| 13           | 59.9      | 2, 3                                           |
| 14           | 71.0      | 3                                              |

# Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.

## ➤ Hydrologic/Hydraulic Model Setup:

- Used available data to develop an integrated one (1D) / two (2D) dimensional hydrologic/hydraulic model using the ICPRV4 Pro model:
  - ✓ Topography (5' LiDar data from Palm Beach County)
  - ✓ Available stormwater system infrastructure GIS database recently developed by the City
  - ✓ Soils maps
  - ✓ Tidal data
  - ✓ Rainfall data

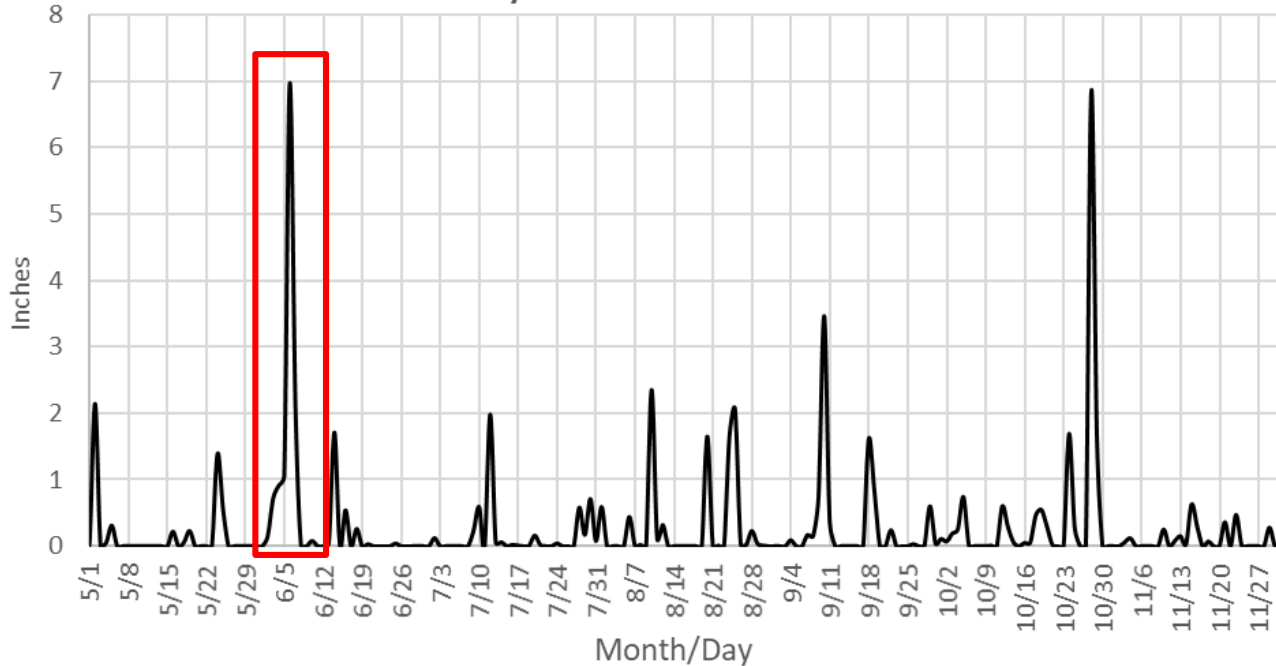


# Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.

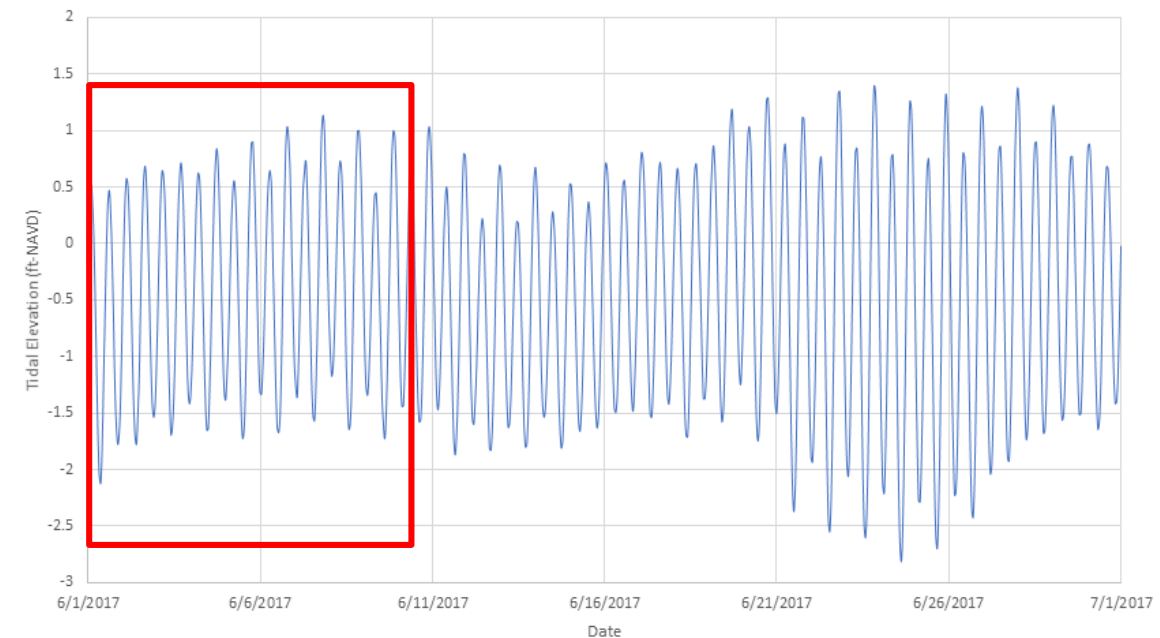
## ➤ Hydrologic/Hydraulic Model Validation:

- ✓ Model was validated with a documented high-intensity 9-day rainfall event from June 1 to June 10, 2018

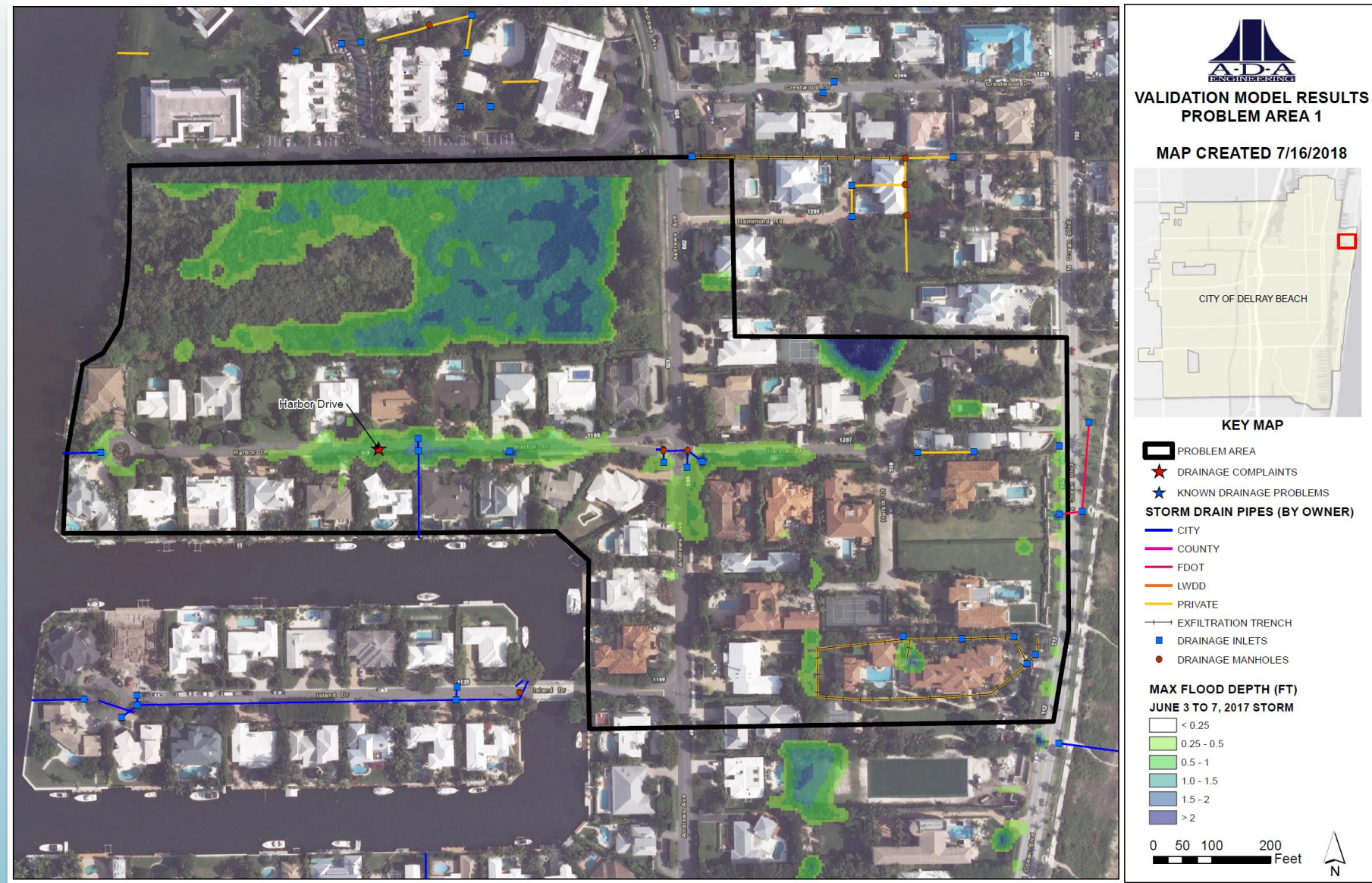
S40 Daily Rainfall - Summer 2017



Validation Model Tidal Values



# Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.



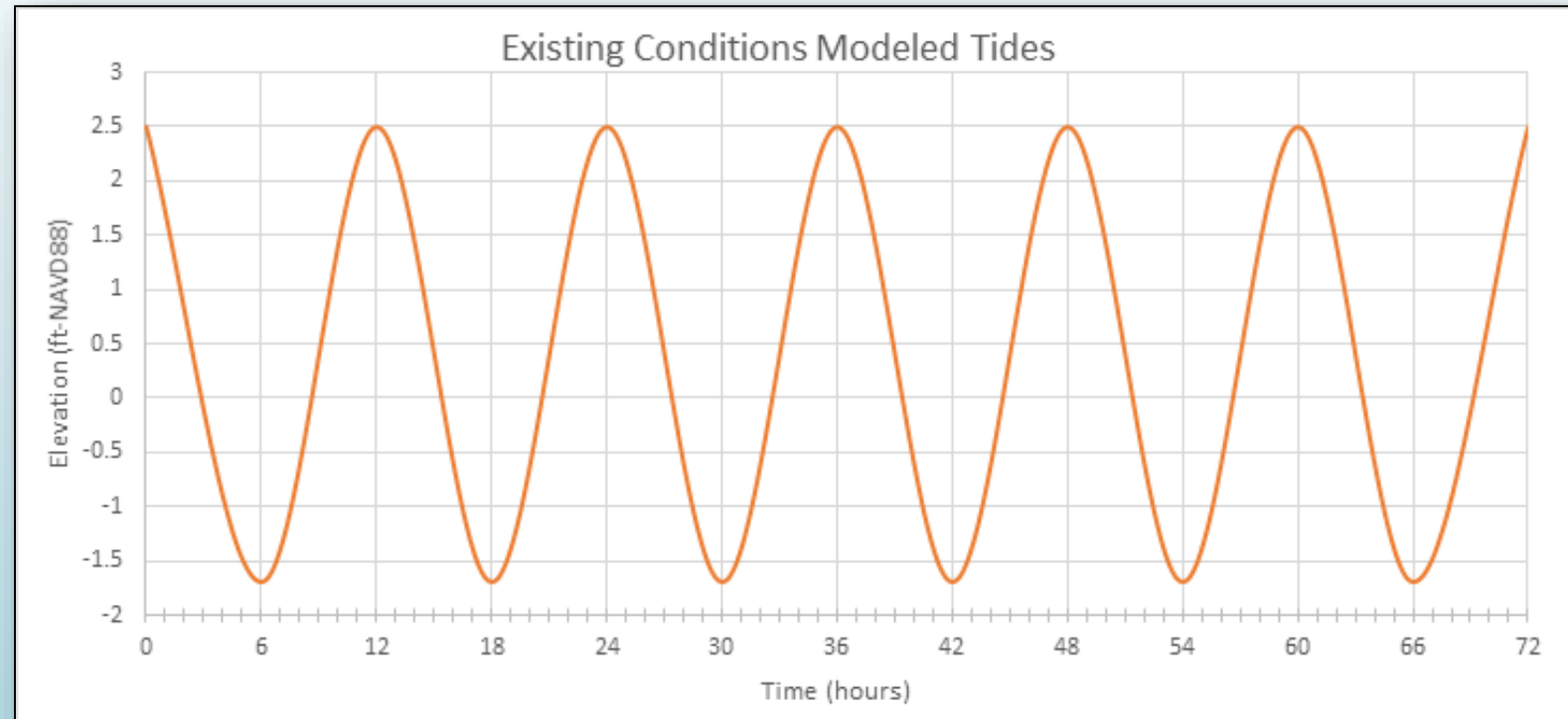
# Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.



# Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.

## ➤ Used validated model to simulate design storm events to determine the existing flood protection level of service (LOS) during current King-tide events:

- Design storm events simulated:
  - ✓ 5-year, 24-hour (8 to 8.5 inches)
  - ✓ 10-year, 24-hour (10.5 to 11 inches)
  - ✓ 25-year, 72-hour (14.3 to 15.6 inches)
  - ✓ 100-year, 72-hour (17 to 18.5 inches)
- Tidal condition simulated (3-year King-tide average):



# Existing Conditions Hydrologic/Hydraulic Modeling (TM1) – Cont.

## ➤ Problem Area 12 sample Design Storm Event flood maps:

**Problem Area 12: 5-year, 24-hour Storm Flooding**



**Problem Area 12: 100-year, 72-hour Storm Flooding**

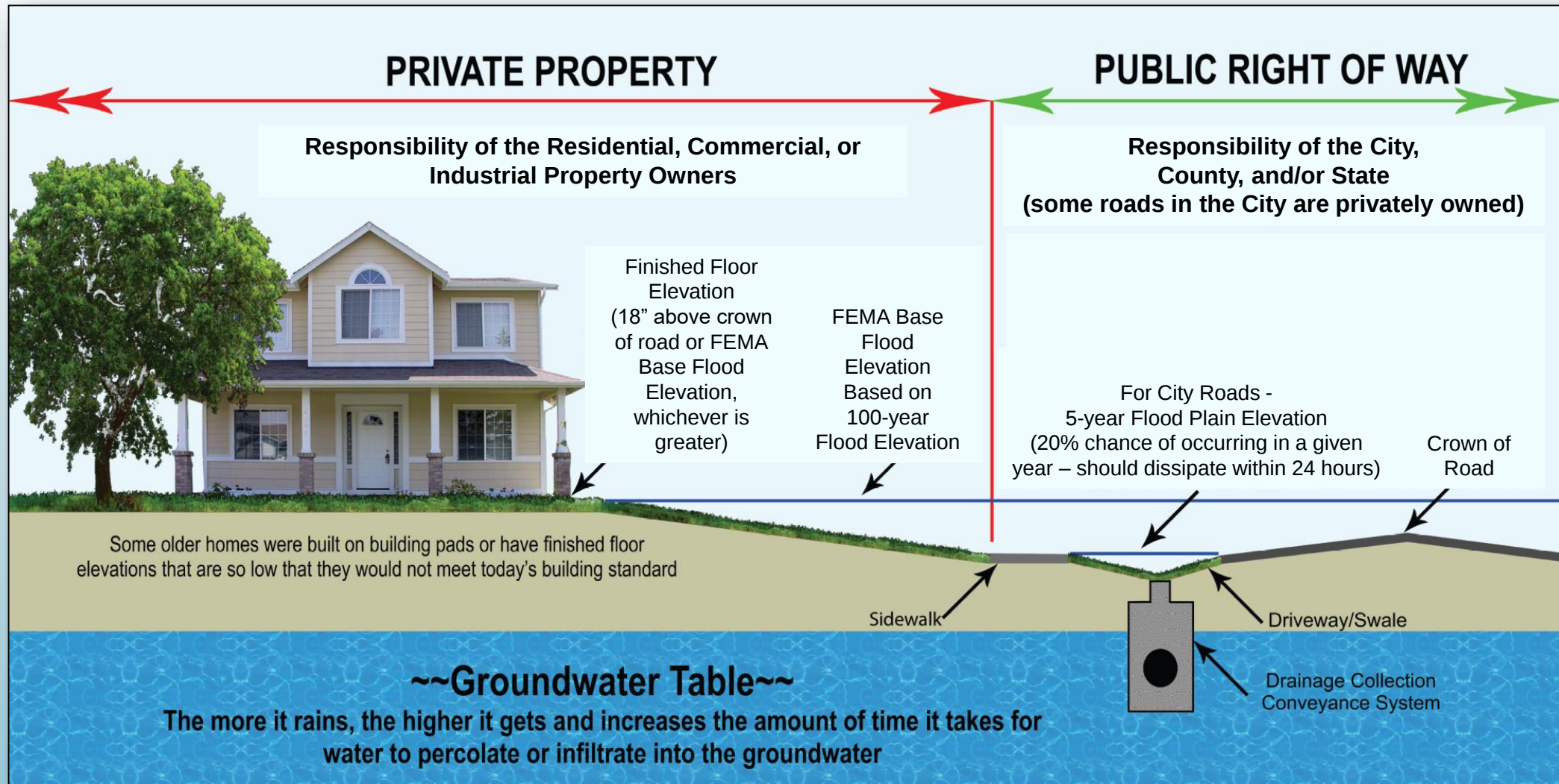




Task 4  
Existing Conditions Flood Protection  
Level of Service (TM2)

# Existing Conditions Flood Protection Level of Service (TM2)

## ➤ Flood Protection Level of Service (LOS) Criteria:



# Existing Conditions Flood Protection Level of Service (TM2) – Cont.

- **Established flood protection level of service (LOS) based on a Flood Protection Severity Score (FPSS):**
- **FPSS based on two (2) Flood Severity Indicators and Weighting Factors (WF):**
  1. **NS: Number of structures** anticipated to flood by a 100-year, 3-day design storm event, which can include commercial, residential, and public buildings. All structures and/or buildings are considered equivalent, regardless of their size or value. **(WF = 4)**
  2. **MCLRS: Miles of collector and local residential streets** anticipated to be impassable during 5-year, 1-day design storm event. All collector and local residential streets are considered impassable if the depth of flooding exceeds the crown of the road during the 5-year, 1-day design storm event. **(WF = 2)**

## Existing Conditions Flood Protection Level of Service (TM2) – Cont.

- In addition to the Flood Severity Indicators and Weighting Factor, implemented a Flooding Exceedance (E) Factor:

| <u>Depth of Flooding Above Flooding Severity Indicator</u> | <u>(E)</u> |
|------------------------------------------------------------|------------|
|------------------------------------------------------------|------------|

|                                                            |   |
|------------------------------------------------------------|---|
| Less than or equal to 6 inches:                            | 1 |
| Greater than 6 inches and less than or equal to 12 inches: | 2 |
| Greater than 12 inches                                     | 3 |

- The FPSS is computed as:

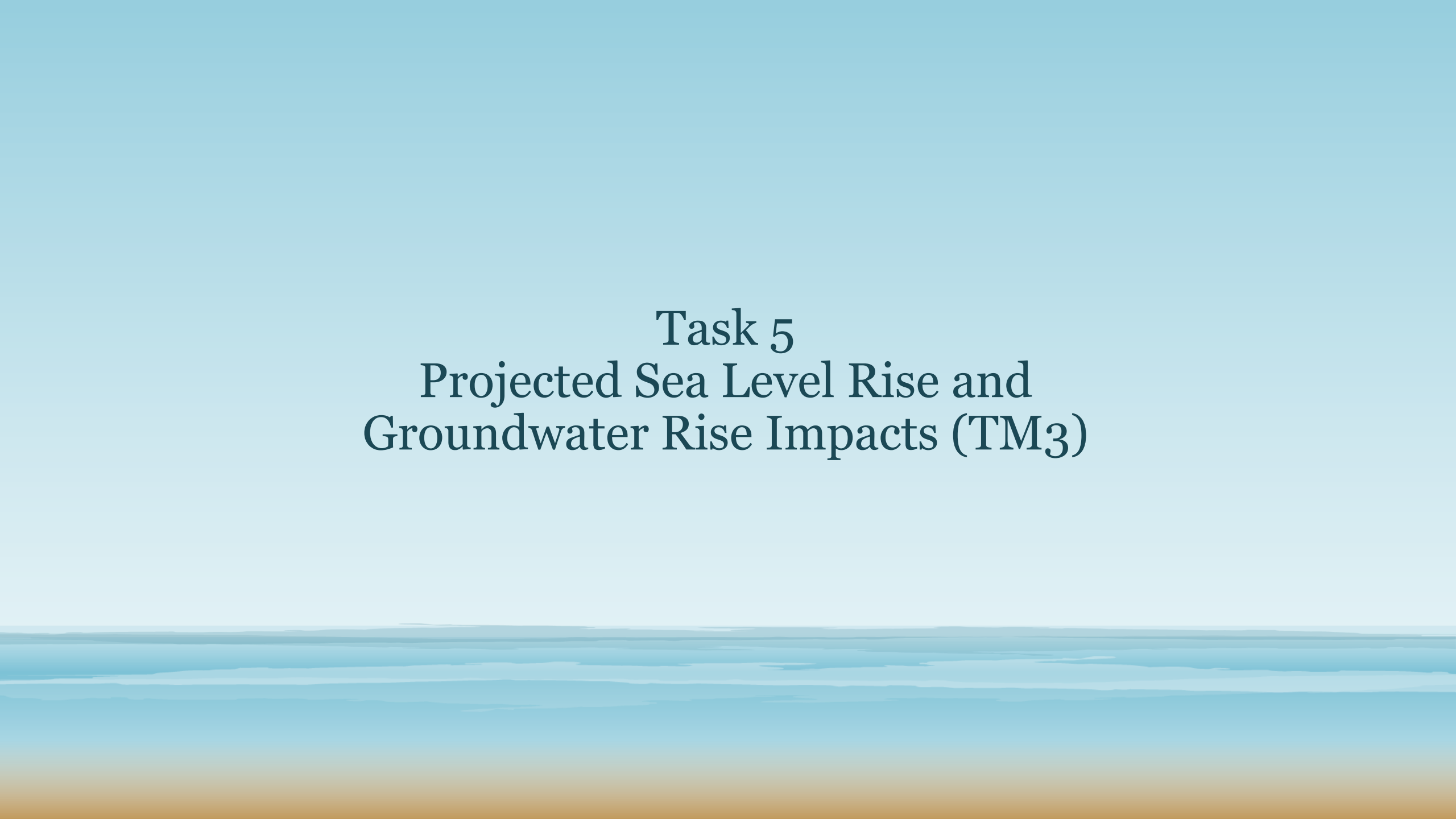
$$FPSS = \sum 4E_i * NS + \sum 2E_i * MCLRS$$

- The FPSS is then divided by the Problem Area drainage area to normalize the score.

# Existing Conditions Flood Protection Level of Service (TM2) – Cont.

## ➤ Summary of Problem Area Ranking based on FPSS:

| Rank | Problem Area Name               | Sub-Basin Area<br>(Acres) | FPSS  | Weighted<br>FPSS |
|------|---------------------------------|---------------------------|-------|------------------|
| 1    | Beach Drive (2)                 | 22.84                     | 105.7 | 4.63             |
| 2    | Thomas Street & Basin Drive (4) | 67.34                     | 234.4 | 3.48             |
| 3    | Rainberry Woods (14)            | 71.02                     | 190.3 | 2.68             |
| 4    | Hibiscus (8)                    | 28.53                     | 63.4  | 2.22             |
| 5    | Bay Street (6)                  | 27.42                     | 55.2  | 2.01             |
| 6    | Seasage Drive (7)               | 61.22                     | 63.4  | 1.04             |
| 7    | Waterway Lane (3)               | 7.85                      | 4.6   | 0.59             |
| 8    | Atlantic Ave (5)                | 64.79                     | 33.7  | 0.52             |
| 9    | Tropic Isles (10)               | 281.49                    | 144.6 | 0.51             |
| 10   | Beach Drive (1)                 | 26.22                     | 9.2   | 0.35             |
| 11   | Barwick Park (13)               | 59.92                     | 17.9  | 0.3              |
| 12   | 7 <sup>th</sup> Ave (11)        | 14.65                     | 1.6   | 0.11             |
| 13   | Brooks Lane (9)                 | 19.54                     | 1.4   | 0.07             |
| 14   | Marine Way (12)                 | 15.28                     | 0.8   | 0.05             |



# Task 5

## Projected Sea Level Rise and Groundwater Rise Impacts (TM3)

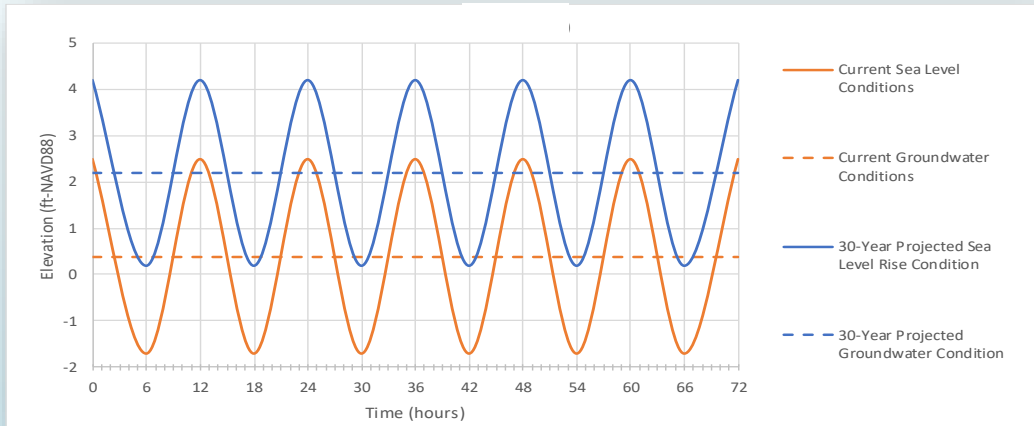
# Projected Sea Level and Groundwater Rise Impacts (TM3)

## ➤ Implemented recommendations from Seawall Vulnerability Study:

### ✓ 30- and 75-year Planning Horizons for Sea Level and Groundwater Rise:

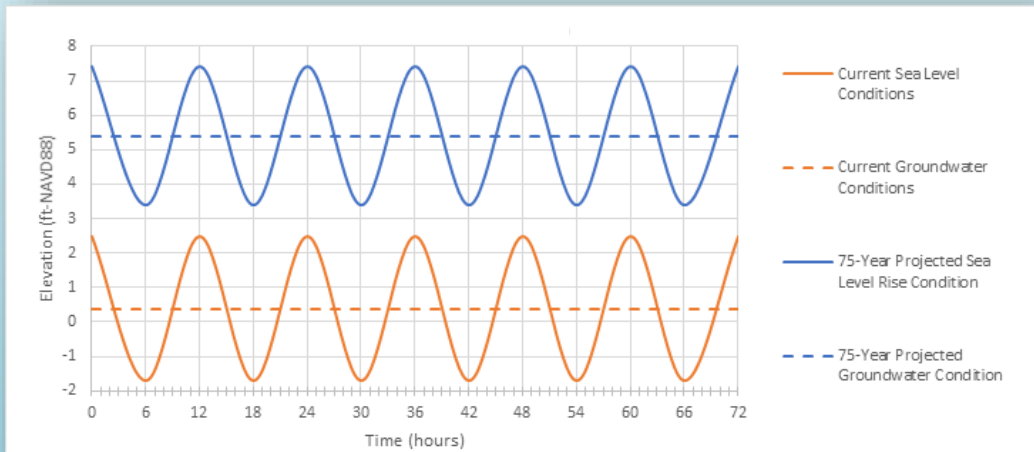
#### ■ 30-year Planning Horizon:

| 30-Year Planning Horizon Model Parameter       | Elevation (ft-NAVD) |
|------------------------------------------------|---------------------|
| High Tide Elevation (ft-NAVD)                  | 4.2                 |
| Low Tide Elevation (ft-NAVD)                   | 0.2                 |
| Avg Wet Season Groundwater Elevation (ft-NAVD) | 2.2                 |



#### ■ 75-year Planning Horizon:

| 75-Year Planning Horizon Model Parameter        | Elevation (ft-NAVD) |
|-------------------------------------------------|---------------------|
| High Tide Elevation (ft-NAVD)                   | 7.4                 |
| Low Tide Elevation (ft-NAVD)                    | 3.4                 |
| Avg West Season Groundwater Elevation (ft-NAVD) | 5.4                 |



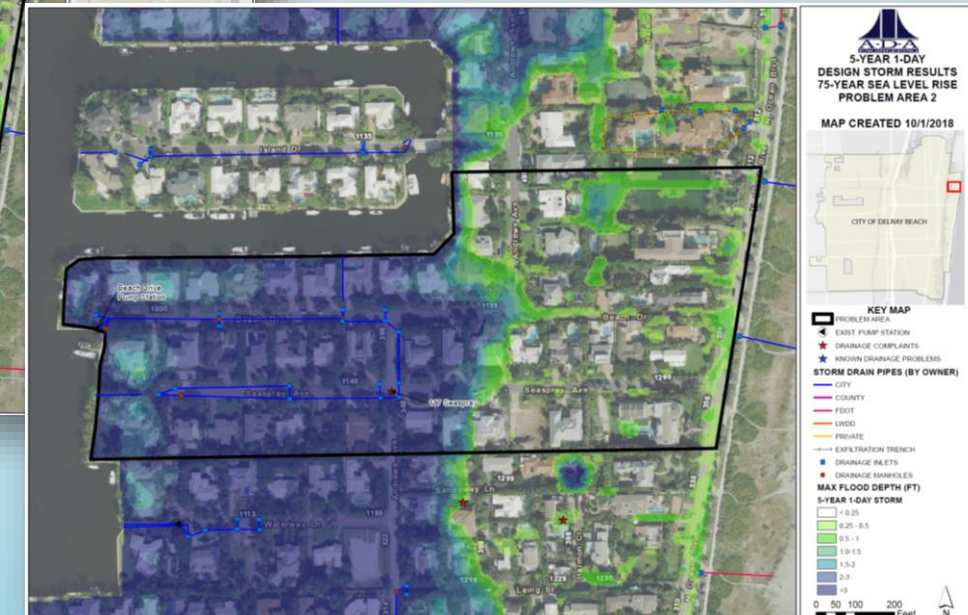
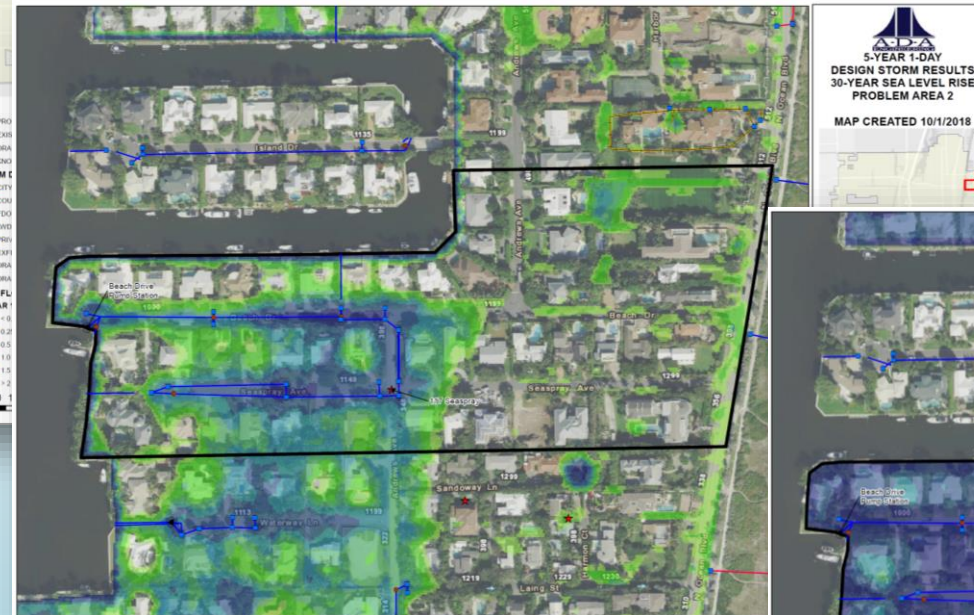
# Projected Sea Level and Groundwater Rise Impacts (TM3) – Cont.

## Existing Conditions: 5-yr, 24hr Storm

## ➤ Problem Area 2 sample Sea Level Rise Impact:

### 30-year: 5-yr, 24hr Storm

### 75-year: 5-yr, 24hr Storm



# Projected Sea Level and Groundwater Rise Impacts (TM3) – Cont.

## ➤ 30-Year Planning Horizon degradation in FPSS:

| Problem Area | Problem Area Description | Existing Conditions FPSS | 30-Year Sea Level Rise FPSS | Percent Increase of FPSS |
|--------------|--------------------------|--------------------------|-----------------------------|--------------------------|
| 1            | Harbor Drive             | 9.2                      | 57.4                        | 524%                     |
| 2            | Beach Drive              | 105.7                    | 246.4                       | 133%                     |
| 3            | Waterway Lane            | 4.6                      | 61                          | 1226%                    |
| 4            | Basin Drive              | 234.4                    | 1181.8                      | 404%                     |
| 5            | Atlantic Avenue          | 33.7                     | 872                         | 2488%                    |
| 6            | Bay Street               | 55.2                     | 388.3                       | 603%                     |
| 7            | Seasage Drive            | 63.40                    | 535.6                       | 745%                     |
| 8            | Hibiscus Road            | 63.4                     | 368.7                       | 482%                     |
| 9            | Brooks Lane              | 1.4                      | 382.7                       | 27236%                   |
| 10           | Tropic Isles             | 144.6                    | 673.2                       | 366%                     |
| 11           | 7 <sup>th</sup> Avenue   | 1.6                      | 50.2                        | 3038%                    |
| 12           | Marine Way               | 0.8                      | 142.2                       | 17675%                   |
| 13           | Barwick Park             | 17.9                     | 41.9                        | 134%                     |
| 14           | Rainberry Woods          | 190.3                    | 294.5                       | 55%                      |

# Task 7

## Capital Improvement Projects (TM5)

# Capital Improvement Projects (TM5)

## ➤ **Key assumptions and criteria for proposed Capital Improvement Projects:**

- ✓ Projects conceptually designed to mitigate 30-year Planning Horizon sea level and groundwater rise to meet desired flood protection LOS.

**(Achieve FPSS of 0 to the maximum extent practical)**

- ✓ All seawalls (private or public) or access to the intracoastal must be elevated to the recommend minimum elevation of 4.2 ft-NAVD88.
- ✓ All existing gravity outfalls (private or public) to remain must be protected with backflow preventers.
- ✓ Known existing gravity pipes (private or public) to remain that show signs of infiltration must be slipped lined to prevent groundwater intrusion through cracks or non-watertight joints.

# Capital Improvement Projects (TM5) – Cont.

## ➤ **Key structural elements for formulating Capital Improvement Projects:**

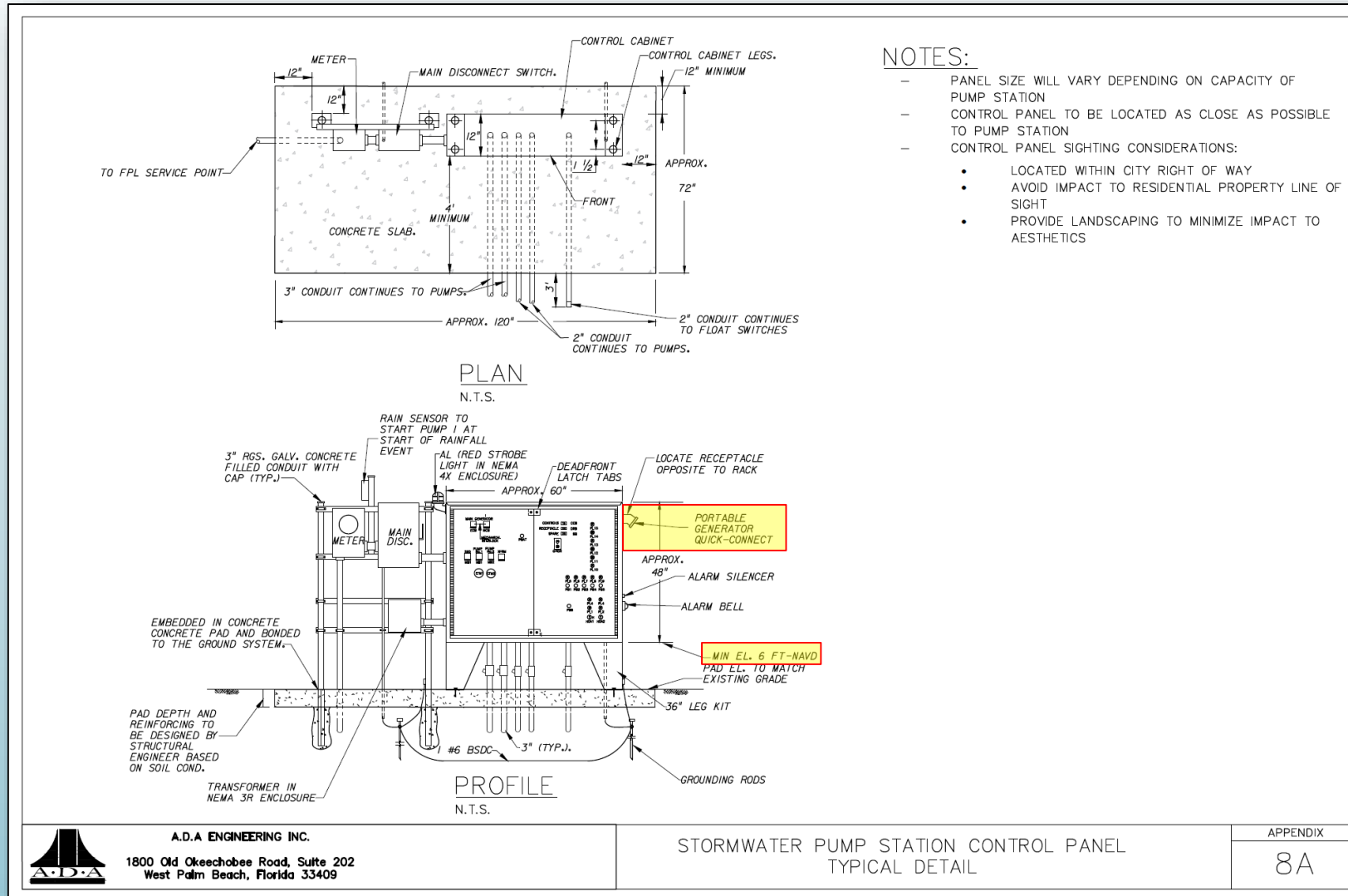
- ✓ Constructing Stormwater pump stations with pollution control devices
- ✓ Raising roads and low-laying areas
- ✓ Implementing backflow preventers for gravity outfalls to remain
- ✓ Lining gravity pipes to remain
- ✓ Constructing exfiltration trenches

➤ **Stormwater pump stations with pollution control devices:**



# Capital Improvement Projects (TM5) – Cont.

## ➤ Stormwater pump stations electrical panel:

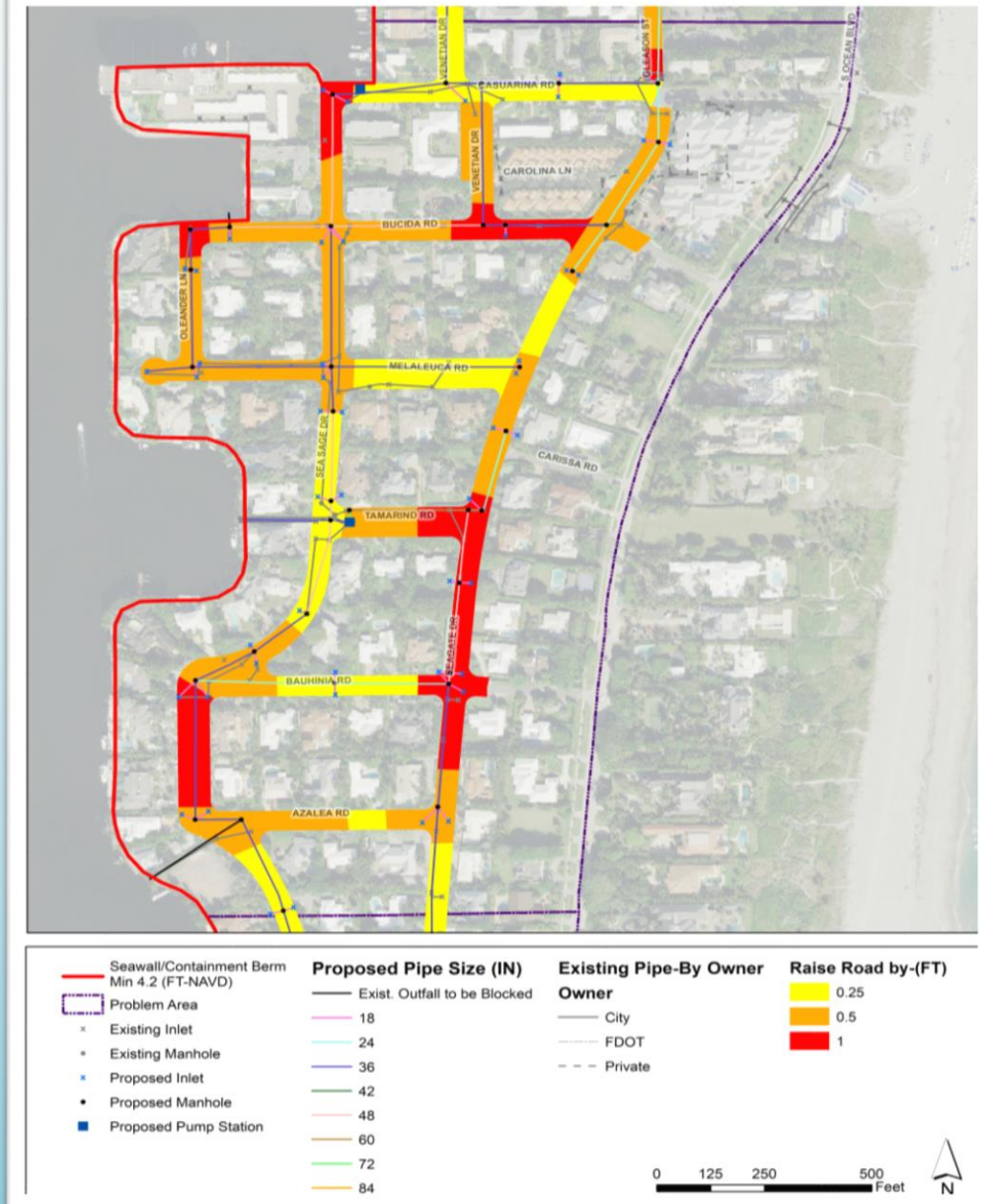


➤ **Raising of roads and low-laying areas:**



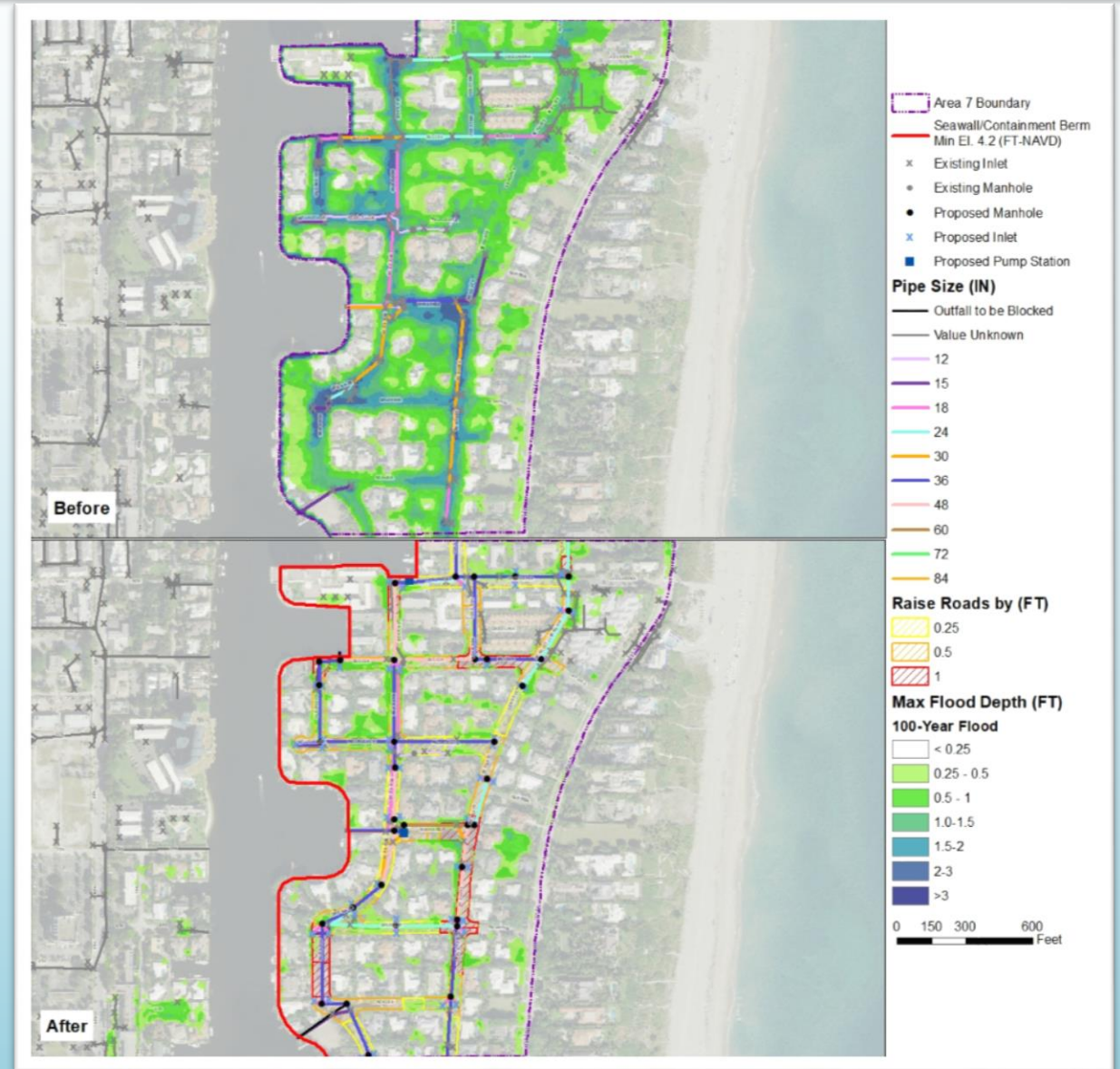
# Capital Improvement Projects (TM5) – Cont.

- **Sample Capital Improvement Project for Problem Area 7 (61 acres)**
- **FPSS = 0**
  - **Existing FPSS = 63.4**
  - **30-year FPSS = 535.6**



# Capital Improvement Projects (TM5) – Cont.

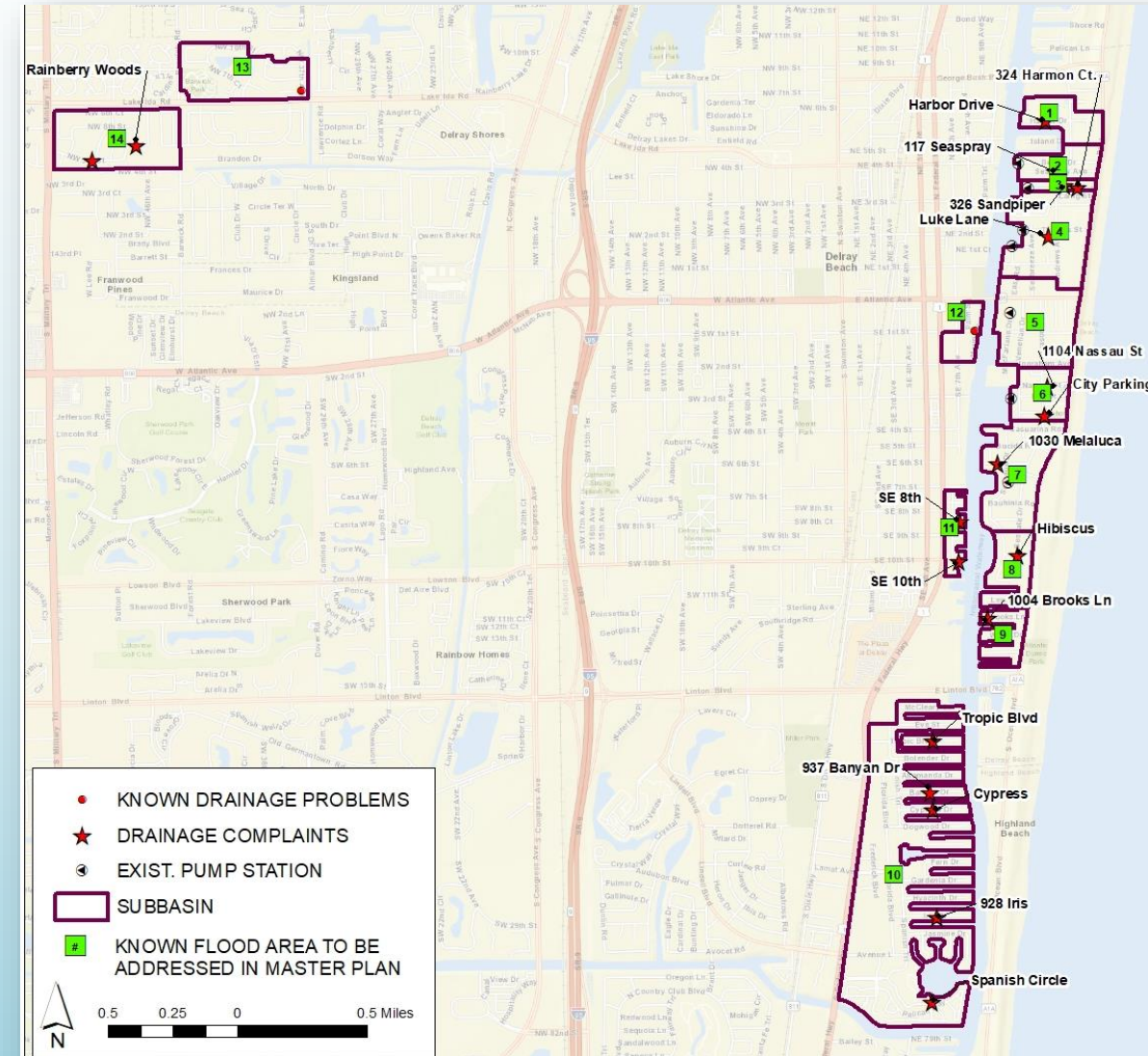
- Problem Area 7 improvements for 100-year, 72-hour event:
- Planning-level cost approx. \$33 Million



# Capital Improvement Projects (TM5) – Cont.

## ➤ Planning-Level costs for all Problem Areas (2019 Dollars):

| Problem Area Name      | Problem Area | Project Cost Estimate |
|------------------------|--------------|-----------------------|
| Harbor Drive           | 1            | \$10,340,000          |
| Beach Drive            | 2            | \$10,620,000          |
| Waterway Lane          | 3            | \$19,400,000          |
| Basin Drive            | 4            | \$42,090,000          |
| Atlantic Avenue        | 5            | \$27,980,000          |
| Bay Street             | 6            | \$21,090,000          |
| Seasage Drive          | 7            | \$32,940,000          |
| Hibiscus Road          | 8            | \$25,470,000          |
| Brooks Lane            | 9            | \$15,900,000          |
| Tropic Isles           | 10           | \$157,190,000         |
| 7 <sup>th</sup> Avenue | 11           | \$6,400,000           |
| Barwick Park           | 13           | \$3,740,000           |
| Rainberry Woods        | 14           | \$5,200,000           |
| <b>TOTAL</b>           |              | <b>\$378,360,000</b>  |



# Capital Improvement Projects (TM5) – Cont.

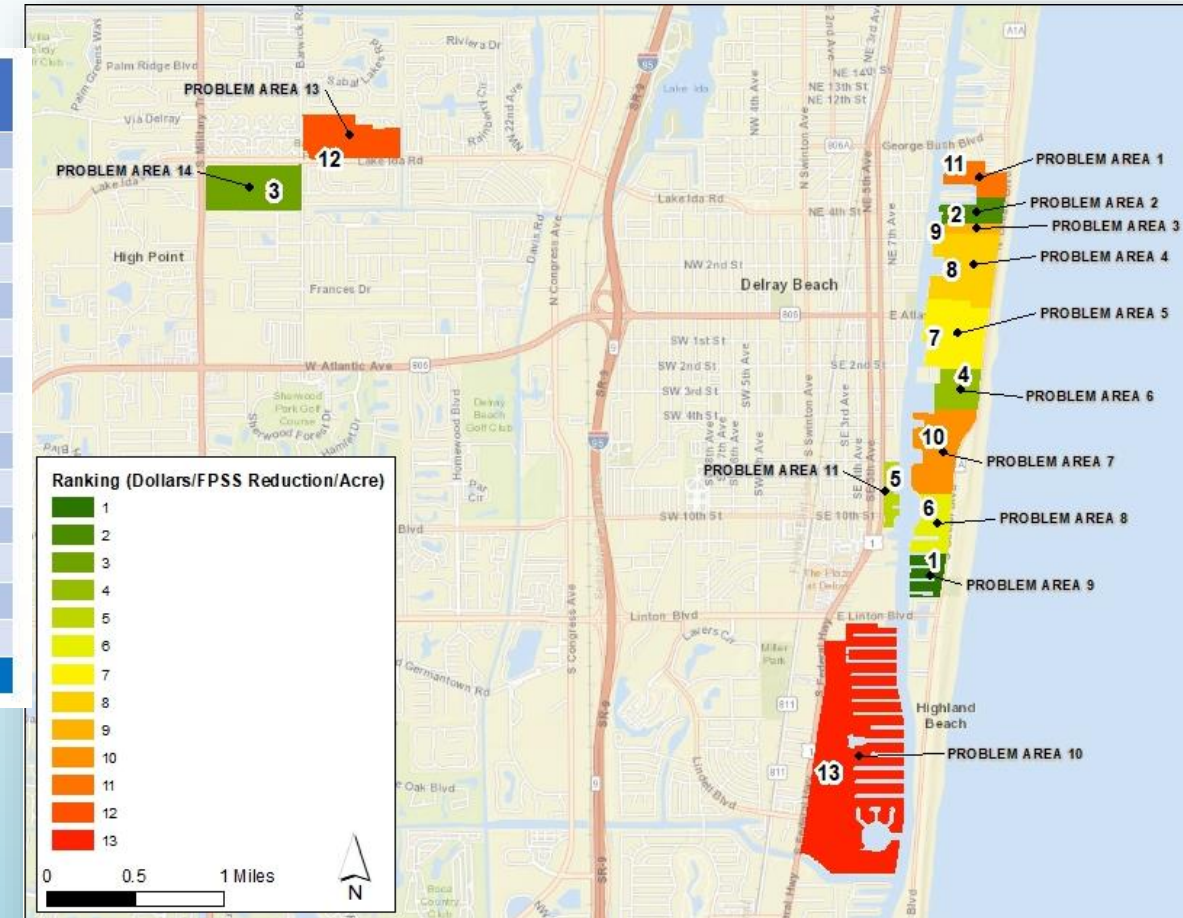
## ➤ Approach for ranking Capital Improvement Projects based on cost effectiveness:

| Problem Area Name | Problem Area (Acres) | Flood Protection Severity Score (FPSS) |                         |                        | FPSS Difference (30-Year Sea Level Rise FPSS minus Capital Improvements FPSS) | Percent Reduction of FPSS with Capital Improvements | Area-Weighted FPSS Difference (points reduced per acre) | Dollars per FPSS Point Reduced per Acre |
|-------------------|----------------------|----------------------------------------|-------------------------|------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------|-----------------------------------------|
|                   |                      | Current Tidal Conditions               | 30-Year Sea Level Rise  | 30-Year Sea Level Rise |                                                                               |                                                     |                                                         |                                         |
|                   |                      | Existing Infrastructure                | Existing Infrastructure | Capital Improvements   |                                                                               |                                                     |                                                         |                                         |
| 1                 | 26.22                | 9.20                                   | 57.40                   | 0.00                   | 57.40                                                                         | 100%                                                | 2.19                                                    | \$ 4,724,911.97                         |
| 2                 | 22.84                | 105.70                                 | 246.40                  | 0.00                   | 246.40                                                                        | 100%                                                | 10.79                                                   | \$ 984,601.29                           |
| 3                 | 7.85                 | 4.60                                   | 61.00                   | 0.00                   | 61.00                                                                         | 100%                                                | 7.77                                                    | \$ 2,496,610.67                         |
| 4                 | 67.34                | 234.40                                 | 1181.80                 | 12.00                  | 1169.80                                                                       | 99%                                                 | 17.37                                                   | \$ 2,422,680.30                         |
| 5                 | 64.79                | 33.70                                  | 872.00                  | 12.00                  | 860.00                                                                        | 99%                                                 | 13.27                                                   | \$ 2,107,566.94                         |
| 6                 | 27.42                | 55.20                                  | 388.30                  | 24.10                  | 364.20                                                                        | 94%                                                 | 13.28                                                   | \$ 1,587,647.76                         |
| 7                 | 61.22                | 63.40                                  | 535.60                  | 0.00                   | 535.60                                                                        | 100%                                                | 8.75                                                    | \$ 3,765,521.55                         |
| 8                 | 28.53                | 63.40                                  | 368.70                  | 0.00                   | 368.70                                                                        | 100%                                                | 12.92                                                   | \$ 1,970,932.61                         |
| 9                 | 19.54                | 1.40                                   | 382.70                  | 0.00                   | 382.70                                                                        | 100%                                                | 19.59                                                   | \$ 811,928.70                           |
| 10                | 281.49               | 144.60                                 | 673.20                  | 64.00                  | 609.20                                                                        | 90%                                                 | 2.16                                                    | \$ 72,632,902.33                        |
| 11                | 14.65                | 1.60                                   | 50.20                   | 0.00                   | 50.20                                                                         | 100%                                                | 3.43                                                    | \$ 1,866,769.80                         |
| 12                | -                    | 0.80                                   | 142.20                  | -                      | -                                                                             | -                                                   | -                                                       | -                                       |
| 13                | 59.92                | 17.90                                  | 41.90                   | 0.00                   | 41.90                                                                         | 100%                                                | 0.70                                                    | \$ 5,352,915.99                         |
| 14                | 71.02                | 190.30                                 | 294.50                  | 8.00                   | 286.50                                                                        | 97%                                                 | 4.03                                                    | \$ 1,289,087.95                         |

# Capital Improvement Projects (TM5) – Cont.

## ➤ Ranking of Capital Improvement Projects based on cost effectiveness:

| Rank | Problem Area | Problem Area Name           | Dollars per Weighted FPSS Point Reduced per Acre | Project Cost Estimate |
|------|--------------|-----------------------------|--------------------------------------------------|-----------------------|
| 1    | 9            | Brooks Lane                 | \$810,000                                        | \$15,900,000          |
| 2    | 2            | Beach Drive                 | \$980,000                                        | \$10,620,000          |
| 3    | 14           | Rainberry Woods             | \$1,290,000                                      | \$5,200,000           |
| 4    | 6            | Bay Street                  | \$1,590,000                                      | \$21,090,000          |
| 5    | 11           | 7 <sup>th</sup> Avenue      | \$1,870,000                                      | \$6,400,000           |
| 6    | 8            | Hibiscus Road               | \$1,970,000                                      | \$25,470,000          |
| 7    | 5            | Atlantic Avenue             | \$2,110,000                                      | \$27,980,000          |
| 8    | 4            | Basin Drive / Thomas Street | \$2,420,000                                      | \$42,090,000          |
| 9    | 3            | Waterway Lane               | \$2,500,000                                      | \$19,400,000          |
| 10   | 7            | Seasage Drive               | \$3,770,000                                      | \$32,940,000          |
| 11   | 1            | Harbor Drive                | \$4,720,000                                      | \$10,340,000          |
| 12   | 13           | Barwick Park                | \$5,350,000                                      | \$3,740,000           |
| 13   | 10           | Tropic Isles                | \$72,630,000                                     | \$157,190,000         |
| -    | 12           | Marine Way                  | -                                                | -                     |
|      |              | <b>TOTAL COST</b>           |                                                  | <b>\$378,360,000</b>  |



Questions?

# Conclusions and Recommendations

## Current Efforts:

### 1. Public Seawalls and Pipe Connections to ICW

- Establish Minimum Seawall Height (30-year Planning Horizon is 4.2 ft-NAVD88)
- Repair and Elevate City Owned Seawalls
- Install Check Valves at City Owned Pipes
- Line or Replace City Owned Pipes

### 2. Private Seawalls and Pipes Connections to ICW

- Seawall Study Evaluated Implementation Strategies (other South Florida Coastal Communities)
- Ordinances Options to Protect City and Residents from Projected Sea Level Rise:
  - ✓ 1) Public/Private Partnership – Uses Existing Comp Plan Requirements
  - ✓ 2) Ordinance with Minimum Elevation and Timeline Requirement
  - ✓ 3) Ordinance with Elevation Requirement only
  - ✓ 4) City Implementation – Assess Significant Fees, Take Ownership (Not Recommended)

# Conclusions and Recommendations

## Next Steps:

1. The Stormwater Master Plan provides a roadmap to implement projects as part of the Capital Improvement Plan (CIP).
  - Prioritize Projects
    - Based on available funding
    - Coordination with other projects
    - Input from residents
2. City should adopt the Final Stormwater Master Plan to obtain credit for CRS improvements.
3. Fund through Bonds or Federal Grants for addressing sea level rise and Climate Change and Revising Stormwater Utility Fee (currently underway)

# Conclusions and Recommendations – Cont.

1. Update Stormwater Master Plan every 5-years as required by FEMA:
  1. Maximize Community Rating Score (CRS)
  2. Re-assess sea-level and groundwater rise trends
  3. Re-prioritize projects based on projects previously implemented
2. City to adopt a policy on how to move forward to implement change in line with goals of the Comprehensive Plan

# THANK YOU FOR YOUR ATTENTION - DISCUSSION -

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