



STORMWATER MASTER PLAN UPDATE

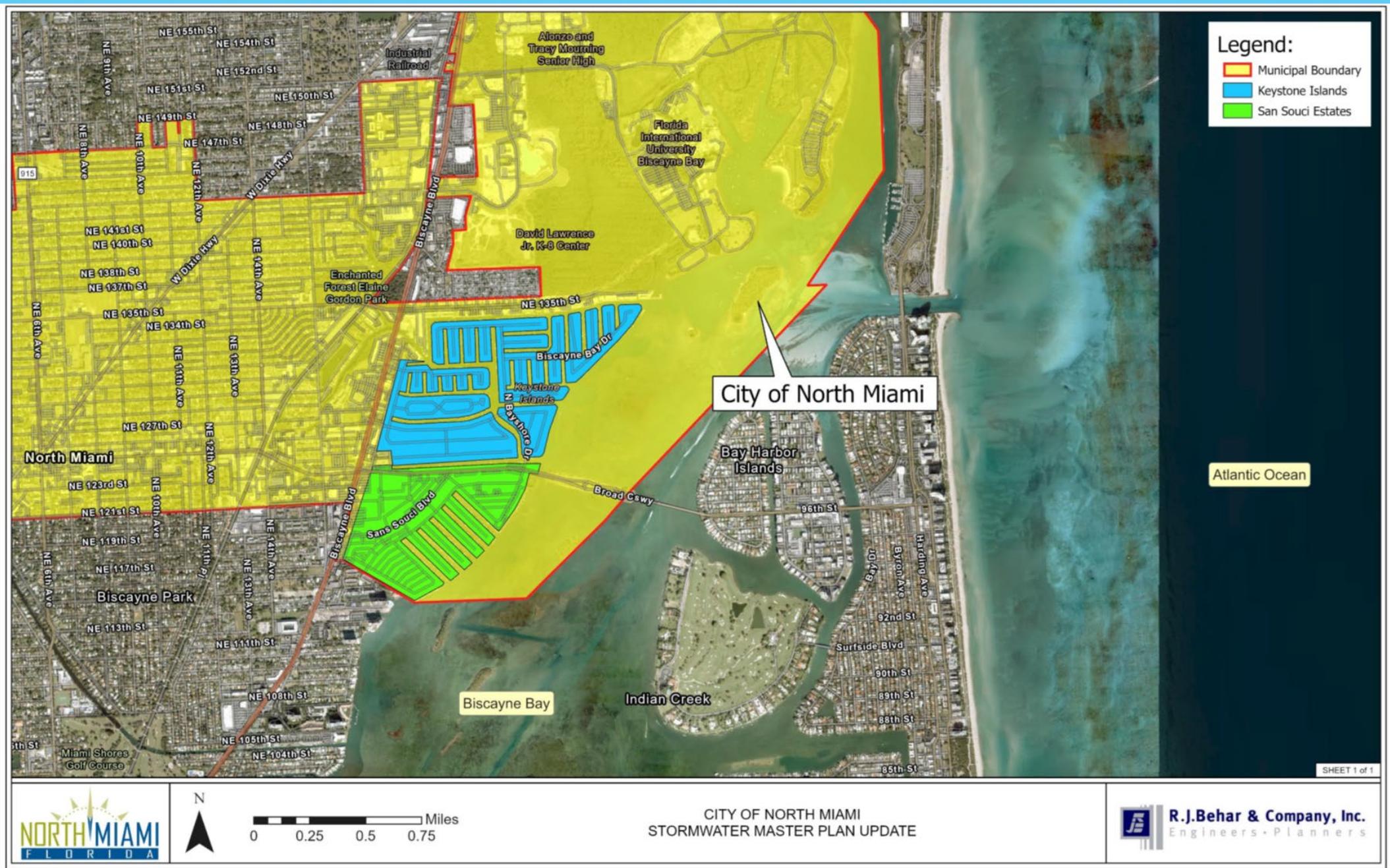
PREPARED BY:

 R.J. Behar & Company, Inc.
Engineers • Planners

May 7, 2025

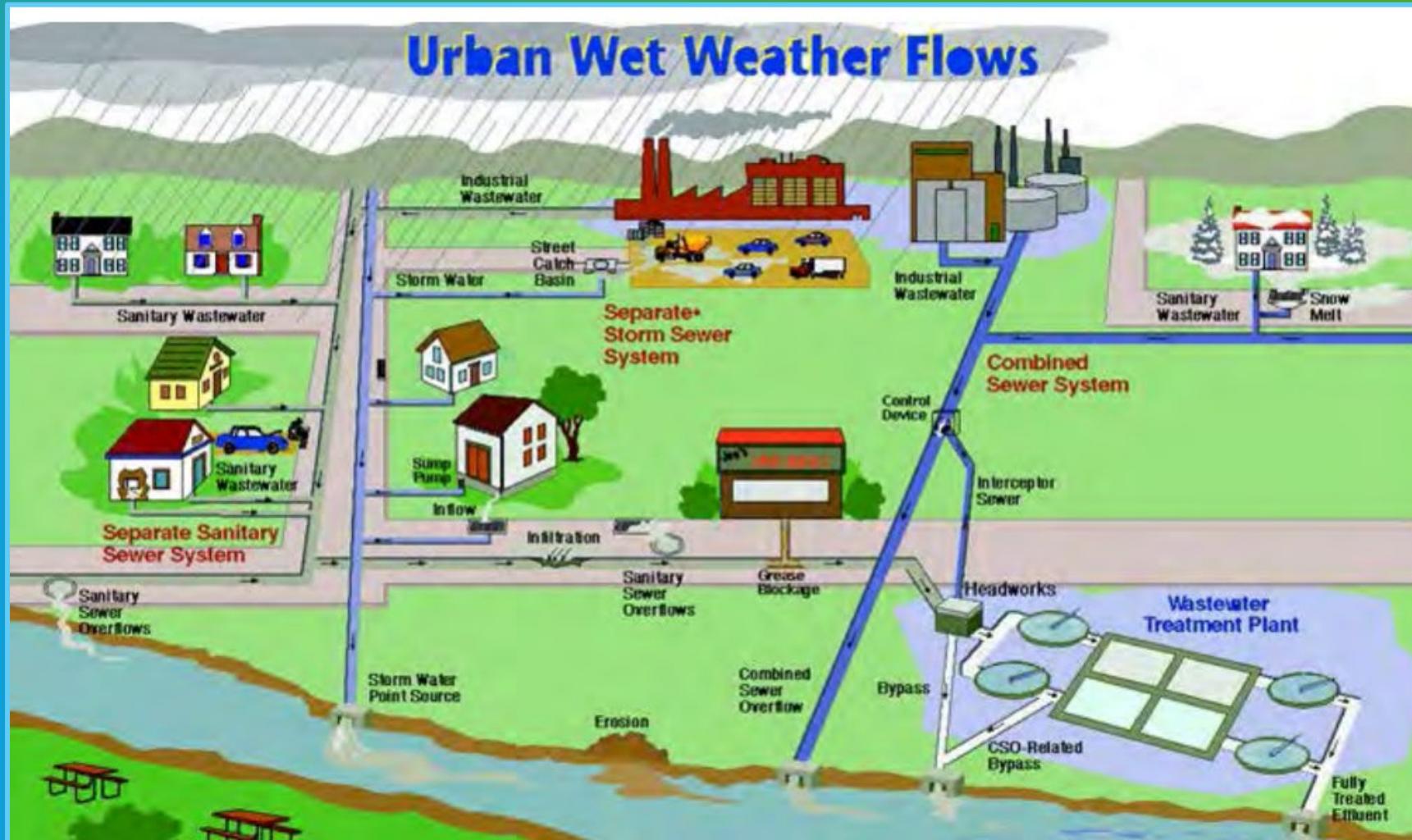


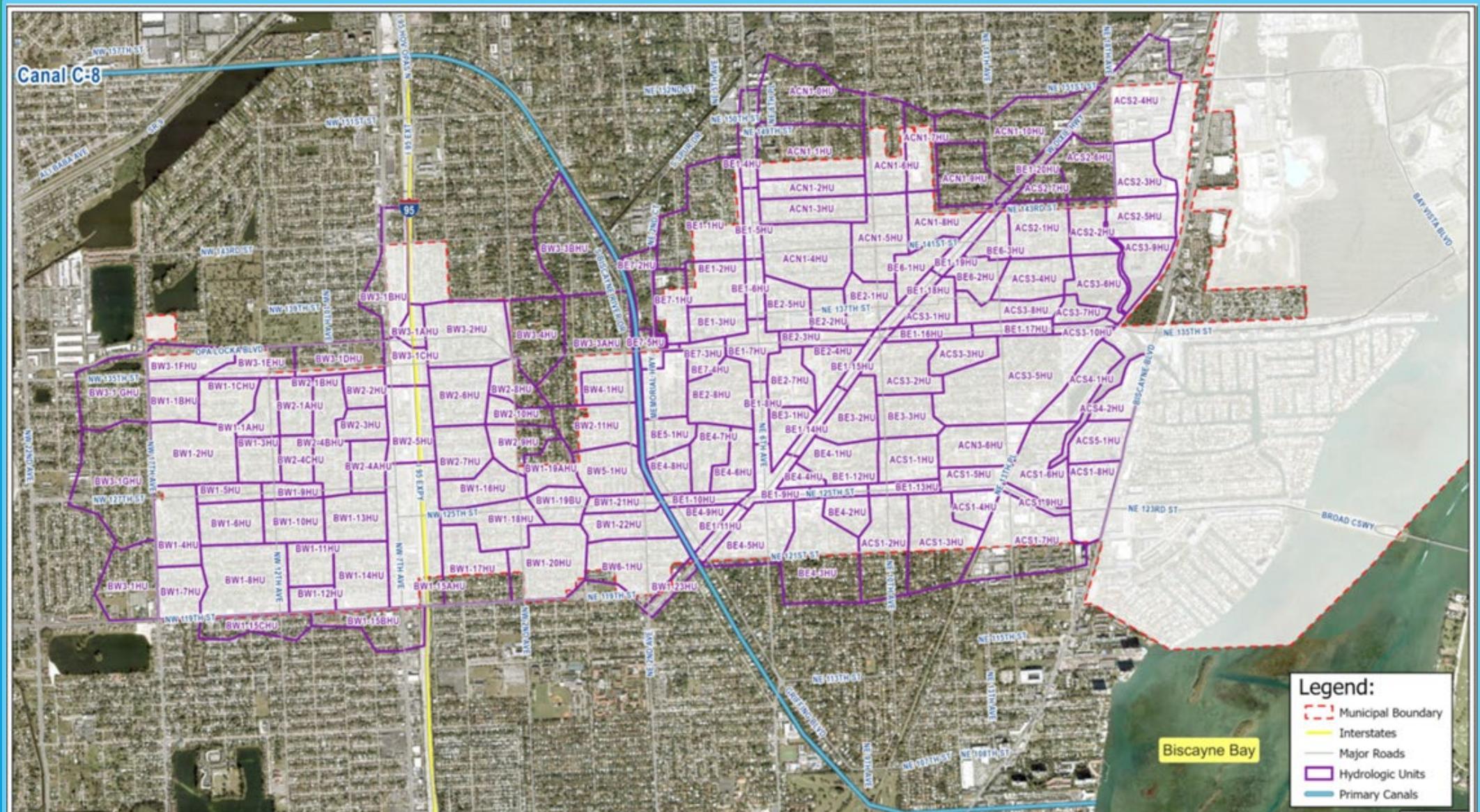
CITY OF NORTH MIAMI BOUNDARY



U.S. EPA STORMWATER MANAGEMENT MODEL (SWMM)

- The U.S. EPA Stormwater Management Model (SWMM) is a widely used simulation tool for urban and non-urban drainage systems. It's used for analyzing and designing drainage systems, managing stormwater runoff, and modeling both quantity and quality aspects of the water flow. SWMM is available in the public domain.



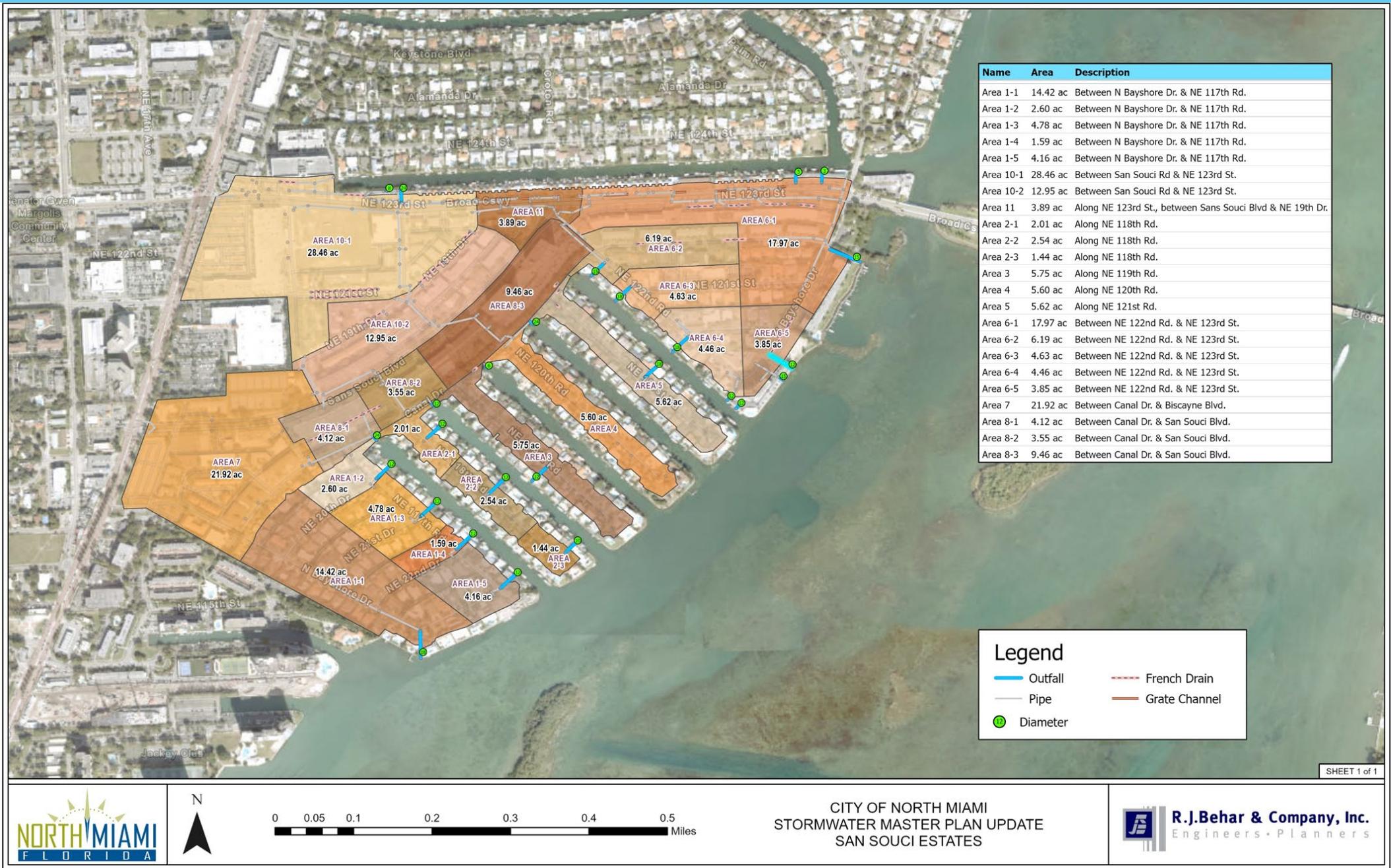


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CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SUB-BASIN (HU) MAP



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0 0.05 0.1 0.2 0.3 0.4 0.5 Miles

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SAN SOUCI ESTATES



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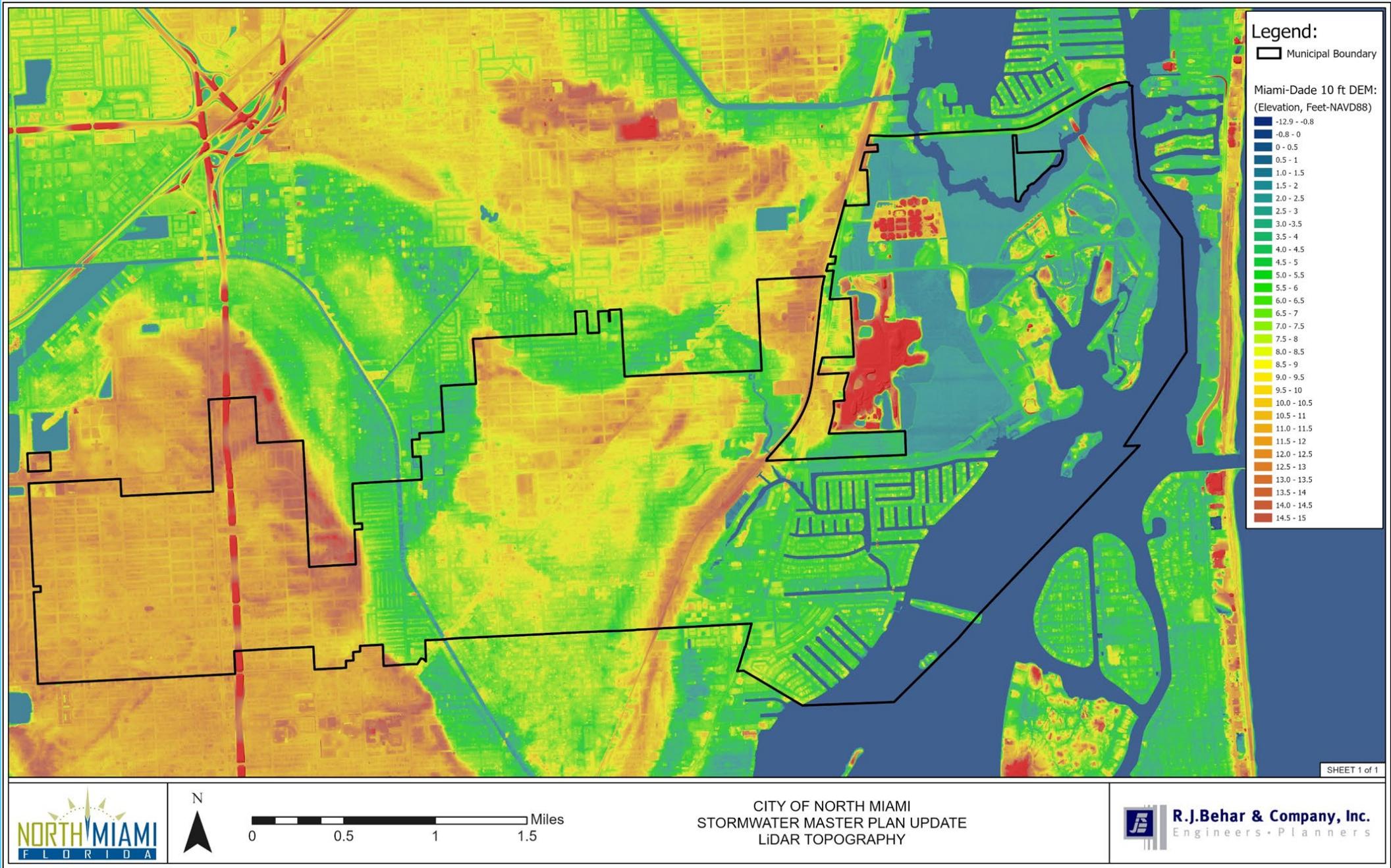
0 0.05 0.1 0.2 0.3 0.4 0.5 Miles

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
KEYSTONE ISLANDS



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SHEET 1 of 1



CITY'S DRAINAGE INFRASTRUCTURE

- 2,293 City-owned stormwater catch basins and approximately 605 catch basins owned by others, such as State and County;
- 366 stormwater manholes;
- 174 stormwater outfalls,
- 113 recharge wells;
- 4 pump stations;
- 9.5 miles of exfiltration trench; and,
- 38.8 miles of stormwater pipe.

Miami-Dade County DRER Level of Service Definition

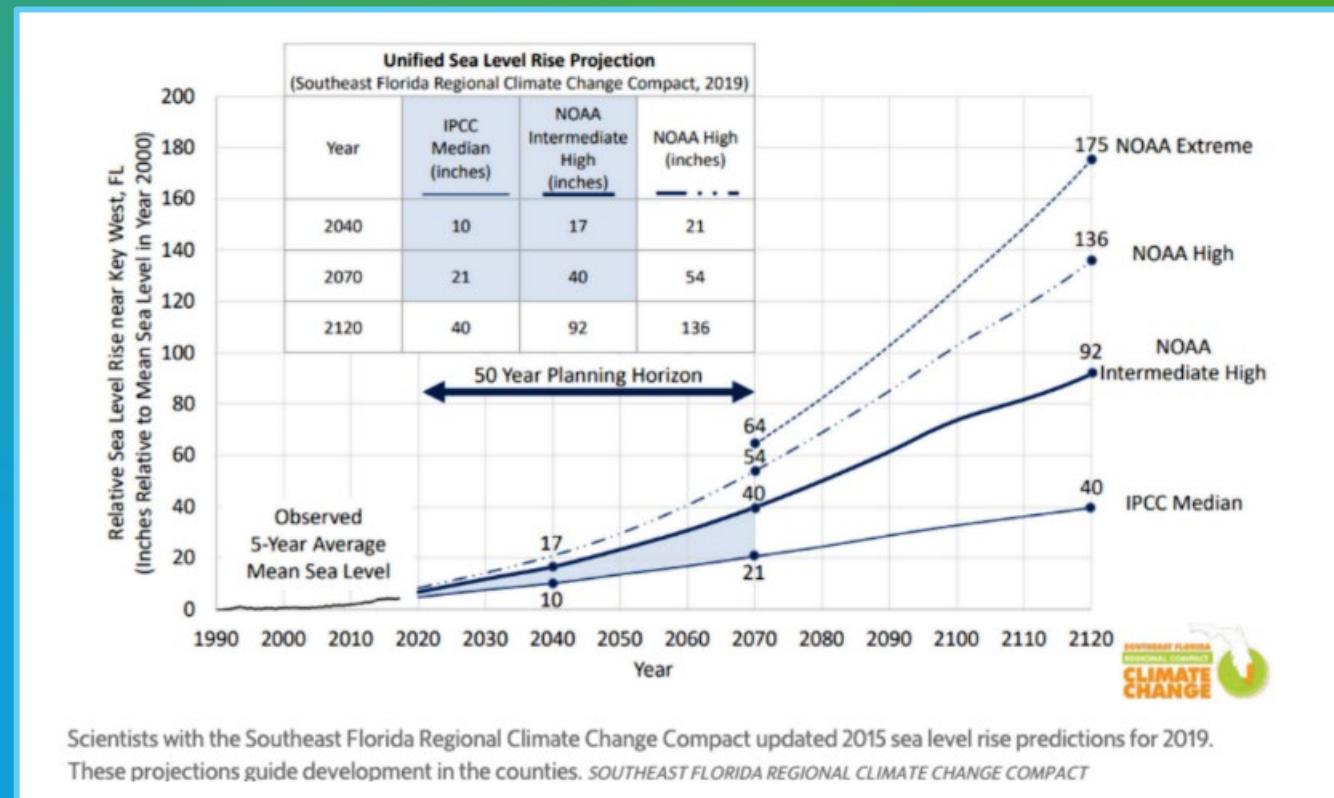
| TYPE OF INFRASTRUCTURE | DESIGN STORM EVENT | FLOODING LIMITS |
|--|---|--|
| Biscayne Canal (Primary) | 100-Year | Top of Bank |
| Miami-Dade County canals | 25-Year | Top of Bank |
| Residential, commercial and public structures | 100-Year | 15 feet away from step |
| Principal Arterial (Evacuation Routes) | 100-Year | Impassable 8 inches above top of crown |
| Minor Arterial (4-lane roads in high traffic areas) | 10-Year | To the outer edges of traffic lanes |
| Collector Roads (2-lane roads on residential and commercial areas) | 5-Year (except 10-year for a bridge or culvert in the canal system) | To crown of the street |
| Local Roads (residential roads) | 5-Year | To crown of street or within 15 feet of occupied structure, whichever is lower |

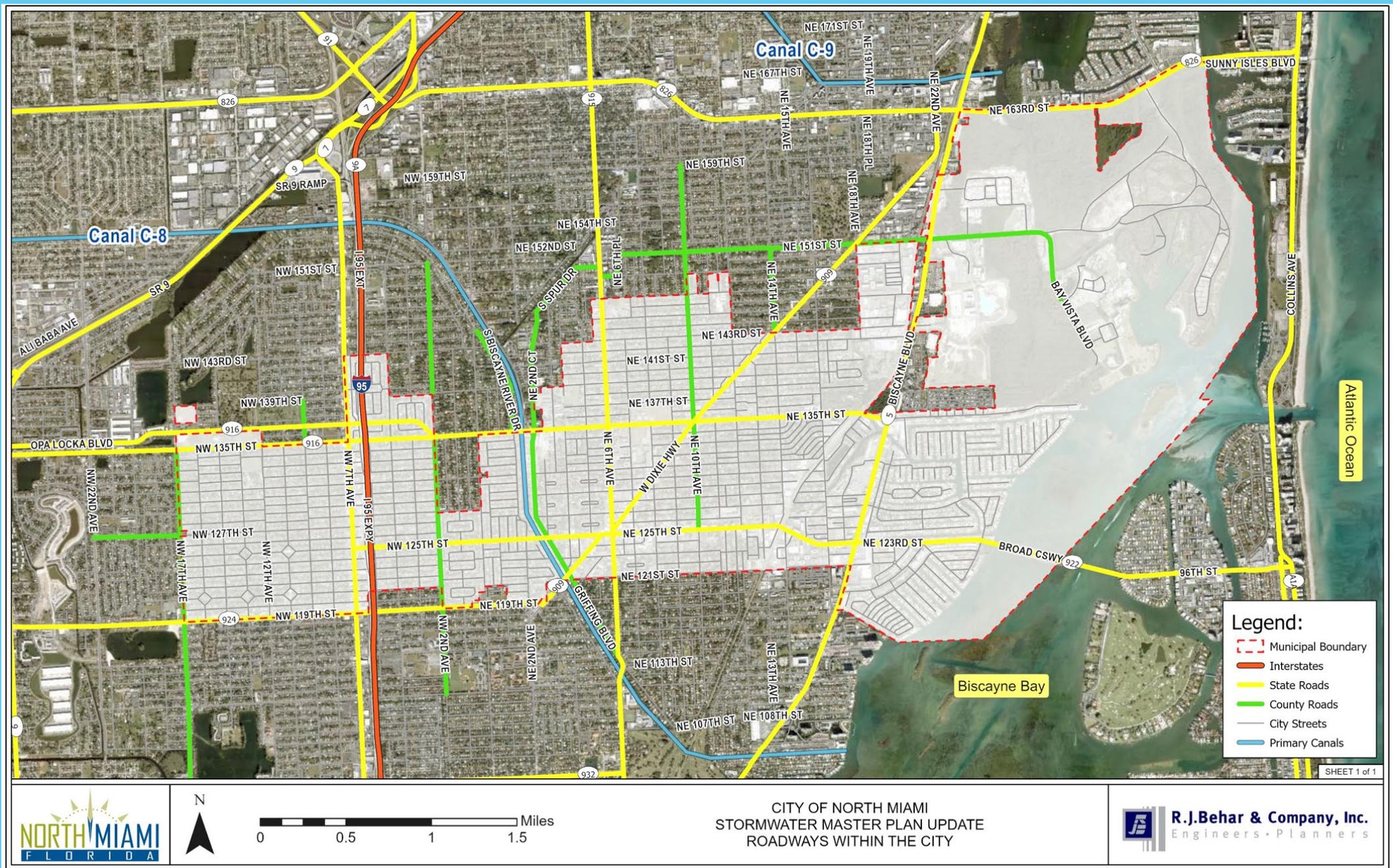
- Road Class No. 1: Emergency (LOS for these locations will only be evaluated for the 100-year simulation);
- Road Class No. 2: Arterial (LOS for these locations will be evaluated at the road crown for the 5-year 24-hour simulation and 10-year 72-hour simulations); and,
- Road Class No. 3: Local (LOS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

THE SEA LEVEL RISE (SLR)

- SLR information was extracted from the Miami-Dade County Stormwater Management Program Master Plan Update (FY2021).

Unified Sea Level Rise Projections from 2019





STORM SIMULATIONS

The SWMM 5.1 model for the existing conditions (2024) was run for the following design storm simulations:

- 2-yr, 24-hour;
- 5-yr, 24-hour;
- 10-yr, 72-hour;
- 25-yr, 72-hour and
- 100-yr, 72-hour events.

| DESIGN STORM EVENT | RAINFALL VOLUME (IN) |
|--------------------|----------------------|
| 5-year, 24-hour | 6.0 |
| 10-year, 72-hour | 9.9 |
| 25-year, 72-hour | 11.0 |
| 100-year, 72-hour | 14.0 |

PROBLEM AREAS IDENTIFIED BY THE CITY IN PREVIOUS STUDIES

- NE 3rd Court is a historical flooding problem area, it is a low-lying area that discharges into a canal. The area is currently serviced by a Miami-Dade County pump station.
- The NE 143rd Street and NE 12th Avenue pump station experienced clogging.
- Problems at NE 131st and NE 123rd Streets where manatees were found in the City's stormwater infrastructure.

Current critical flood prone areas provided by the City:

- Location 1: NE 141st Street from NE 5th Avenue to 3rd Court
- Location 2: NE 135th Street and NE 3rd Court
- Location 3: NE 121st Street and NE 11th Court
- Location 4: NE 2nd Avenue from 135th Street to 119th Street
- Location 5: NE 125th Street and NE 15th Avenue
- Location 6: NE 124th Street east of Croton Road (Laurel Lane, Keystone)

PROBLEM AREAS IDENTIFIED BY THE CITY

Heavy flooding during a storm event in June of 2024

- Location 3: NE 121st Street and NE 11th Court (alley gate) – 24”
- 1115 NE 121st Street (house) – 15”
- 1125 NE 123rd Street (wall) – 12”
- 1305 NE 129th Street (house – 11”, stop sign – 5”)
- 1300 NE 130th Street (gate) – 10”
- 1305 NE 130th Street (gate) – 15”
- 1271 NE 130th Street (utility box) – 15”
- NE 131 Street and NE 13th Avenue (hydrant) – 10”
- 1395 NE 132nd Street (house) – 20”
- 1495 NE 136th Street (house) – 11”
- 1195 NE 143rd Street (building) – 14”
- NE 143 Street and NE 10th Avenue (stop sign) – 11”
- 795 NE 146th Street (gate) – 12”
- 14705 NE 11th Court (gate) – 10”
- 495 NE 141st Street (house) – 17”



CITY OF NORTH MIAMI

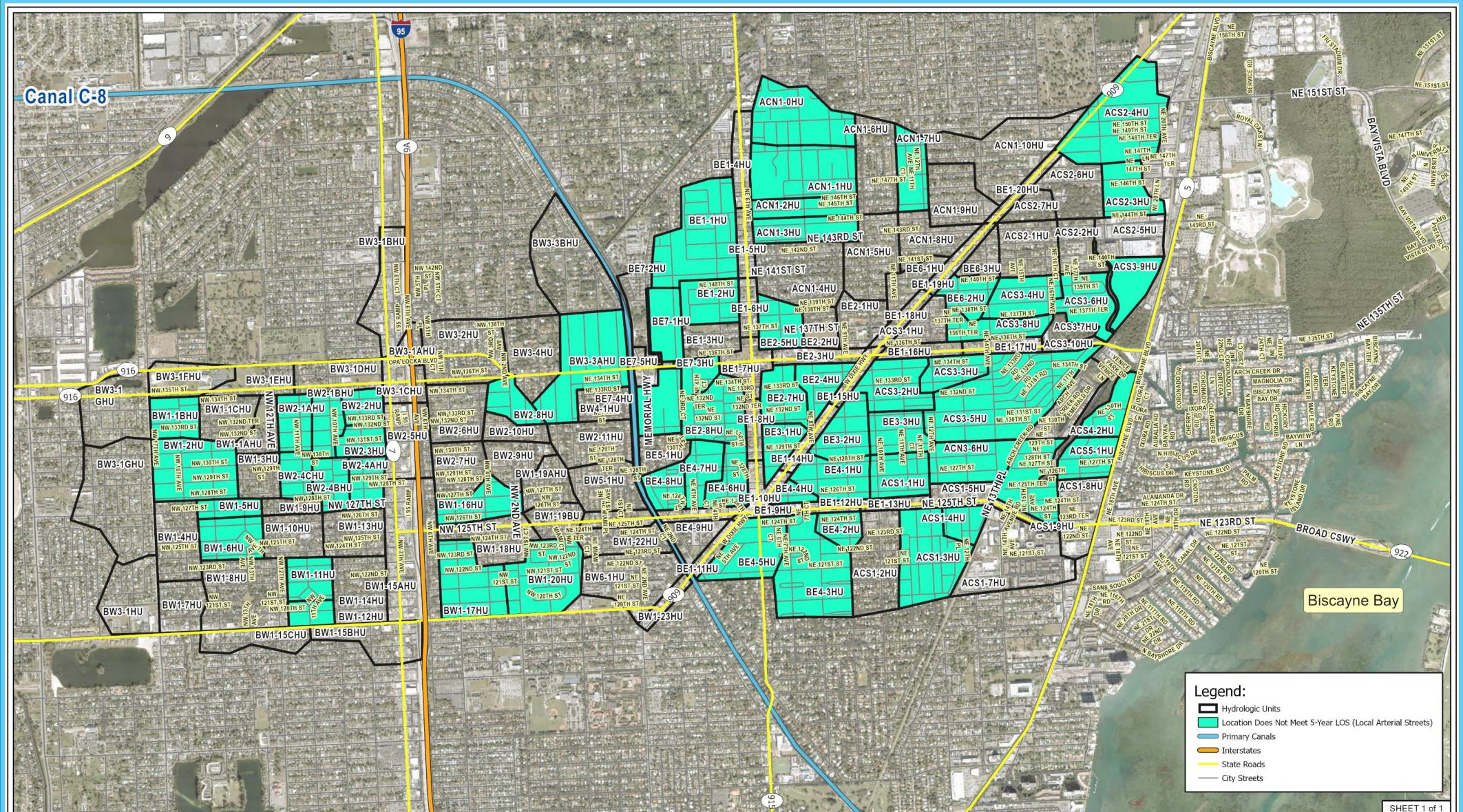
Legend

 Flood Prone Areas
 Municipal Boundary

**CITY OF NORTH MIAMI
PUBLIC WORKS DEPARTMENT
JUNE 2024**

FLOOD PRONE AREAS



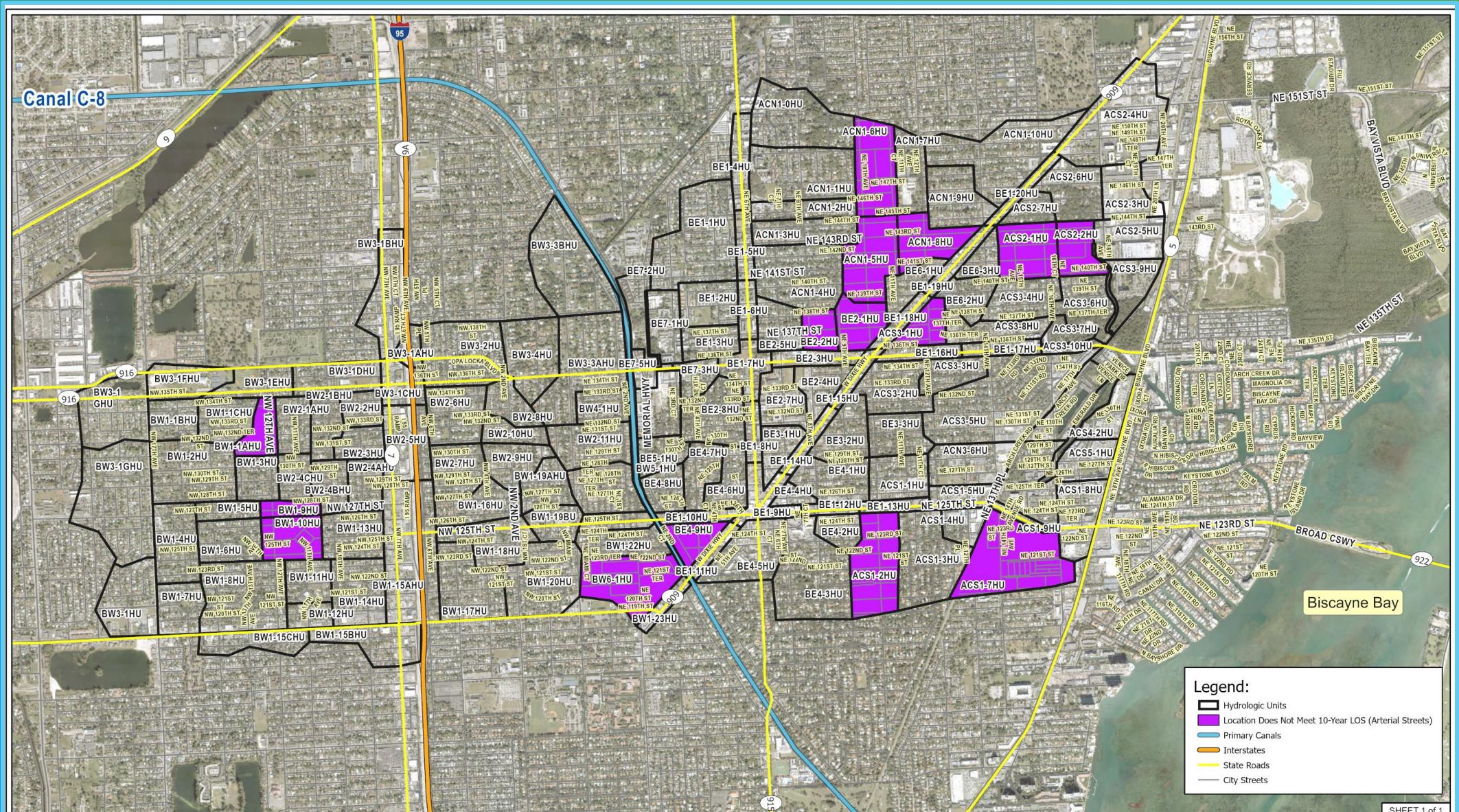


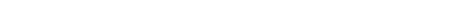
0 0.5 1 1.5 Miles

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
LOS RESULTS FOR THE 5-YEAR STORM EVENT
(LOCAL AND ARTERIAL STREETS)



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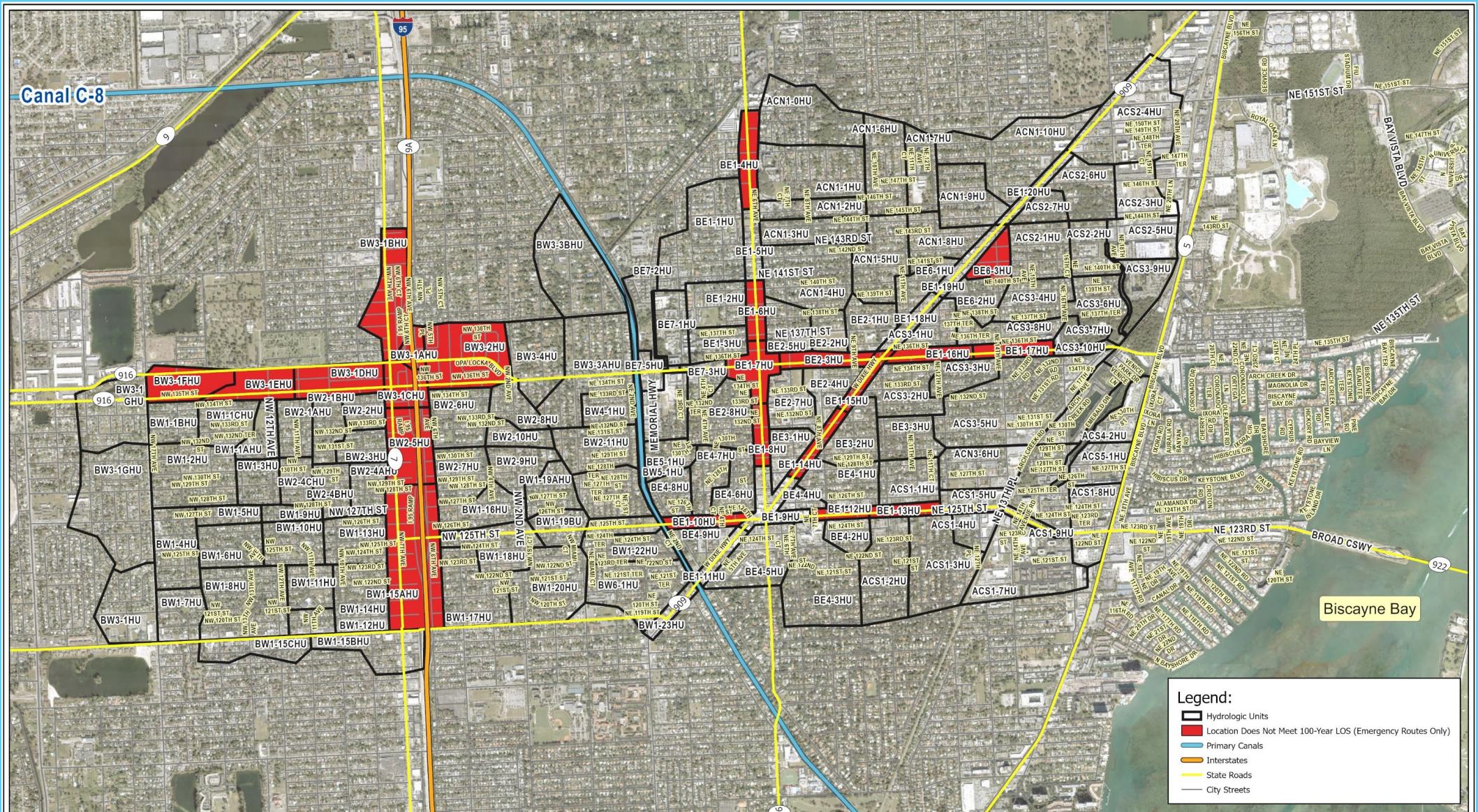


0 0.5 1 1.5 Miles

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
LOS RESULTS FOR THE 10-YEAR STORM EVENT
(ARTERIAL STREETS)



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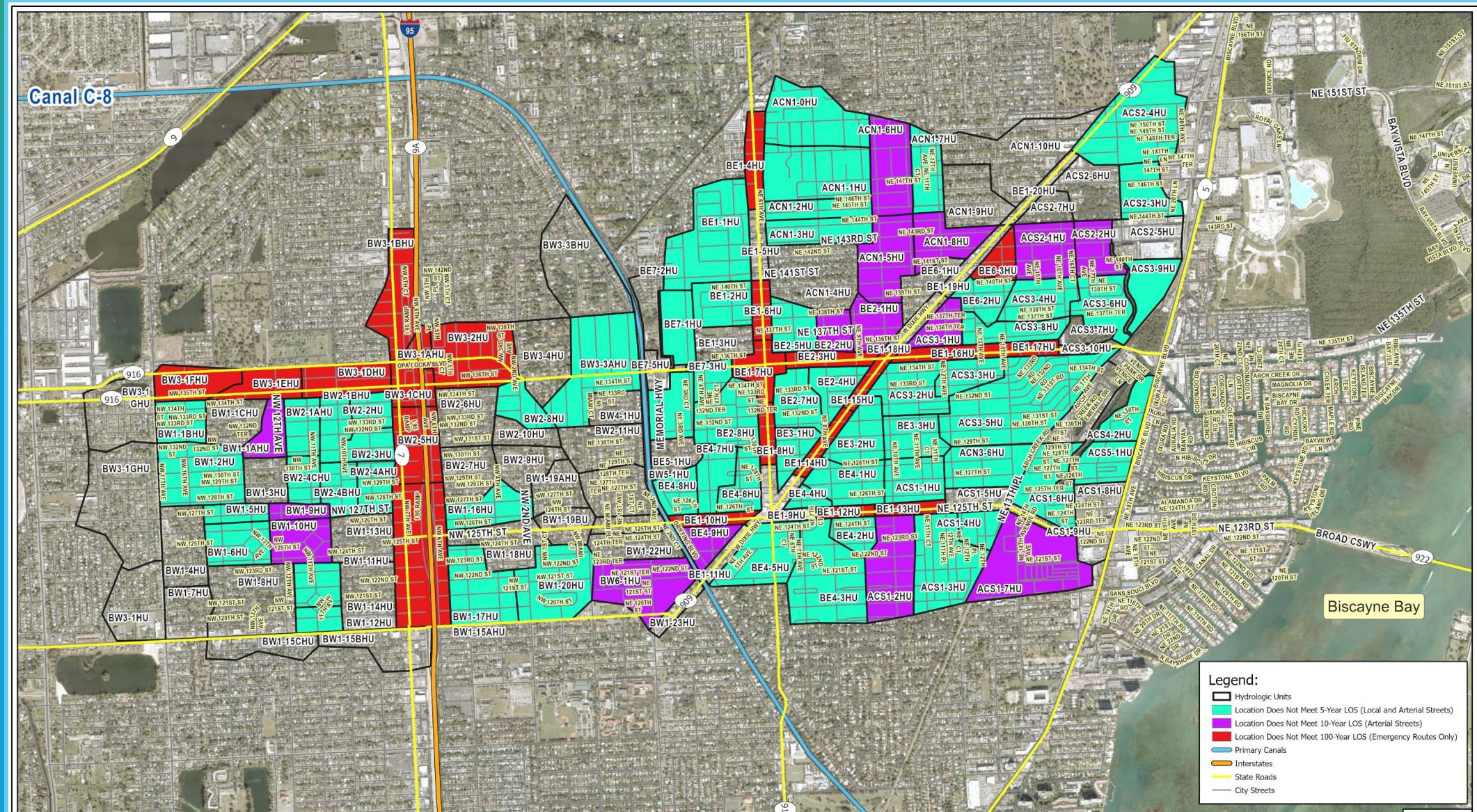


0 0.5 1 1.5 Miles

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
LOS RESULTS FOR THE 100-YEAR STORM EVENT
(EMERGENCY ROUTES ONLY)



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Legend:

- Hydrologic Units
- Location Does Not Meet 5-Year LOS (Local and Arterial Streets)
- Location Does Not Meet 10-Year LOS (Arterial Streets)
- Location Does Not Meet 100-Year LOS (Emergency Routes Only)
- Primary Canals
- Interstates
- State Roads
- City Streets

SHEET 1 of 1



0 0.5 1 1.5 Miles

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
LOS RESULTS FOR THE 5-YEAR, 10-YEAR
AND 100-YEAR STORM EVENTS



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IMPLEMENTATION PLAN

- ✓ The recommended stormwater improvements have been divided into short-term and long-term stormwater improvements.
- ✓ The short-term recommendations are intended for the critical flood prone areas identified by the model and the City. The recommended short-term improvements can be implemented within approximately the next 5 years, depending on funding.
- ✓ These improvements typically consist of constructing new exfiltration trenches, which is the City's currently preferred and historically most effective BMP and demonstrate the hydraulic benefits that can be anticipated through the installation of networks of exfiltration trenches in the problem areas.
- ✓ The total conceptual cost estimate to implement all short-term drainage improvements is approximately \$11 Million.
- ✓ The long-term stormwater improvements presented in this master plan represents a compilation of actions to be implemented over a long planning period, estimated to be 15 to 20 years.

IMPLEMENTATION PLAN

✓ The long-term improvements are divided into Group 1 and Group 2:

Group 1 recommendations consist of primarily a new exfiltration trench and installation of flap gates for areas connected to the canals.

Group 2 recommendations are built upon the exfiltration benefits through the addition of underground storage vaults, in-system storage, wet detention, stormwater pump stations, and upgrades of existing outfalls to address LOS deficiencies within a problem area.

RECOMMENDED SHORT-TERM IMPROVEMENTS FOR CRITICAL FLOOD PRONE AREAS

ASSUMPTIONS:

The trench width is 5 feet for the 18-inch and 24-inch French drains and 6 feet for the 36-inch French drains.

The total depth from the surface to the bottom of the French drain is 15 feet.

The minimum safety factor in the French drains preliminary design is 2.

Inlets shall provide a vertical sump to minimize entrance of trash and sediments into drainage pipes.

Skimmers are required in parking areas and in signalized intersections. Skimmers should also be provided in the locations where an outfall is recommended.

Regrading of the existing swales to provide extra storage and water quality is recommended when feasible.

RECOMMENDED STORMWATER SHORT-TERM IMPROVEMENTS

| PROBLEM AREA | PROPOSED IMPROVEMENTS |
|---|--|
| Location 1: NE 141 st St. from NE 5 th Ave. to 3 rd Ct. | Construct 1,270 Linear feet (LF) of 24-inch exfiltration trench along NE 141 st St. and connect to the existing drainage system. |
| Location: 495 NE 141 st Street (house) | This residence is located within location 1, to mitigate the flooding issues, 280 LF of 18-inch exfiltration trench is recommended at this location. |
| Location2: NE 135 th St. and north of NE 3 rd Ct. | Construct 1,400 LF of 18-inch exfiltration trench along NE 3 rd Ct., and a flap gate in the existing 15-inch outfall located on the NE corner of NE 135 th St. and NE 3 rd Ct. |
| Location 3: NE 121 st St. and NE 11 th Ct. | Install 300 LF of 24-inch exfiltration trench along NE 121 st St. |
| Location 4: NE 2 nd Ave. from 135 th St. to 119 th St. | The recommendation is to provide periodic maintenance to remove debris blocking the existing drainage inlets and swales, and to install flap gates at all existing outfalls to prevent back flow during high tide. |
| Location 5: NE 125 th St. and NE 15 th Ave. – | Construct 300 LF of 24-inch exfiltration trench along NE 15 th Ave. |
| Location 6: NE 124 th St. east of Croton Rd. (Laurel Lane, Keystone) | A new drainage system, providing solid pipes, new inlets, three pump stations and seven injection wells, is recommended at this location. |
| Location 7: NE 135 th St. near the preserve area. | Construct 600 LF of 36-inch exfiltration trench. |
| LOCATIONS: NE 133 rd St. from 14 th Ave. to approximately 1470, NE 132 nd St. from NE 14 th Ave. to approximately 1520, 1395 NE 132 nd St., and 131 st St. NE 13 th Ave. | Construct a total of 1530 of 18-inch exfiltration trench. |
| NE 143 rd St. and NE 10 th Ave. | 300 LF of 36-inch exfiltration trench is proposed at this location |
| NE 146 th St., west of NE 8 th Ave. | A new drainage system with 250 LF of 18-inch exfiltration trench is proposed. |
| 1125 NE 123 rd St. | 100 LF of 18-inch exfiltration trench is recommended. |
| 1195 NE 143 rd St | 200 LF of 18-inch exfiltration trench is recommended. |
| LOCATIONS 1271 NE 130 th St., 1300 NE 130 th St., and 1305 NE 130 th St. | 280 LF of 18-inch exfiltration trench is recommended. |
| 1405 NE 129 th St. | 300 LF of 18-inch exfiltration trench is recommended. |
| 1495 NE 136 th St. | 340 LF of 18-inch exfiltration trench is recommended. |
| 14705 NE 11 th Ct. | 200 LF of 18-inch exfiltration trench is recommended. |

PRELIMINARY ENGINEERS ESTIMATE OF PROBABLE COST

| SHORT-TERM DRAINAGE IMPROVEMENTS | | |
|---|--|---------------|
| NO | DESCRIPTION | COST |
| 1 | LOCATION NO.1 | \$ 1,316,000 |
| 2 | LOCATION NO.2 | \$ 834,000 |
| 3 | LOCATION NO.3 | \$ 325,000 |
| 4 | LOCATION NO.4 | \$ 470,000 |
| 5 | LOCATION NO.5 | \$ 356,000 |
| 6 | LOCATION NO.6 | \$ 4,117,000 |
| 7 | LOCATION NO.7 | \$ 726,000 |
| 8 | LOCATION NE 133 ST FROM 14 AVE TO APPROX. 1470 | \$ 502,000 |
| 9 | LOCATION 1395 NE 132 ST | \$ 99,000 |
| 10 | LOCATION 131 NE 13 AVE | \$ 82,000 |
| 11 | LOCATION NE 132 ST FROM 14 AVE TO APPROX. 1520 | \$ 306,000 |
| 12 | LOCATION 1125 NE 123 ST | \$ 210,000 |
| 13 | LOCATION 1495 NE 136 ST | \$ 195,000 |
| 14 | LOCATION 1305 NE 130 ST | \$ 114,000 |
| 15 | LOCATION 1271 NE 130 ST | \$ 66,000 |
| 16 | LOCATION 1300 NE 130 ST | \$ 64,000 |
| 17 | LOCATION 1195 NE 143 ST | \$ 109,000 |
| 18 | LOCATION 14705 NE 143 CT | \$ 102,000 |
| 19 | LOCATION 495 NE 141 ST | \$ 177,000 |
| 20 | LOCATION 795 NE 146 ST | \$ 145,000 |
| 21 | LOCATION 1405 NE 129 ST | \$ 180,000 |
| 22 | LOCATION 143 ST NE 10 AVE | \$ 435,000 |
| SUB TOTAL 100% ENGINEER'S ESTIMATE OF CONSTRUCTION COST | | \$ 10,930,000 |



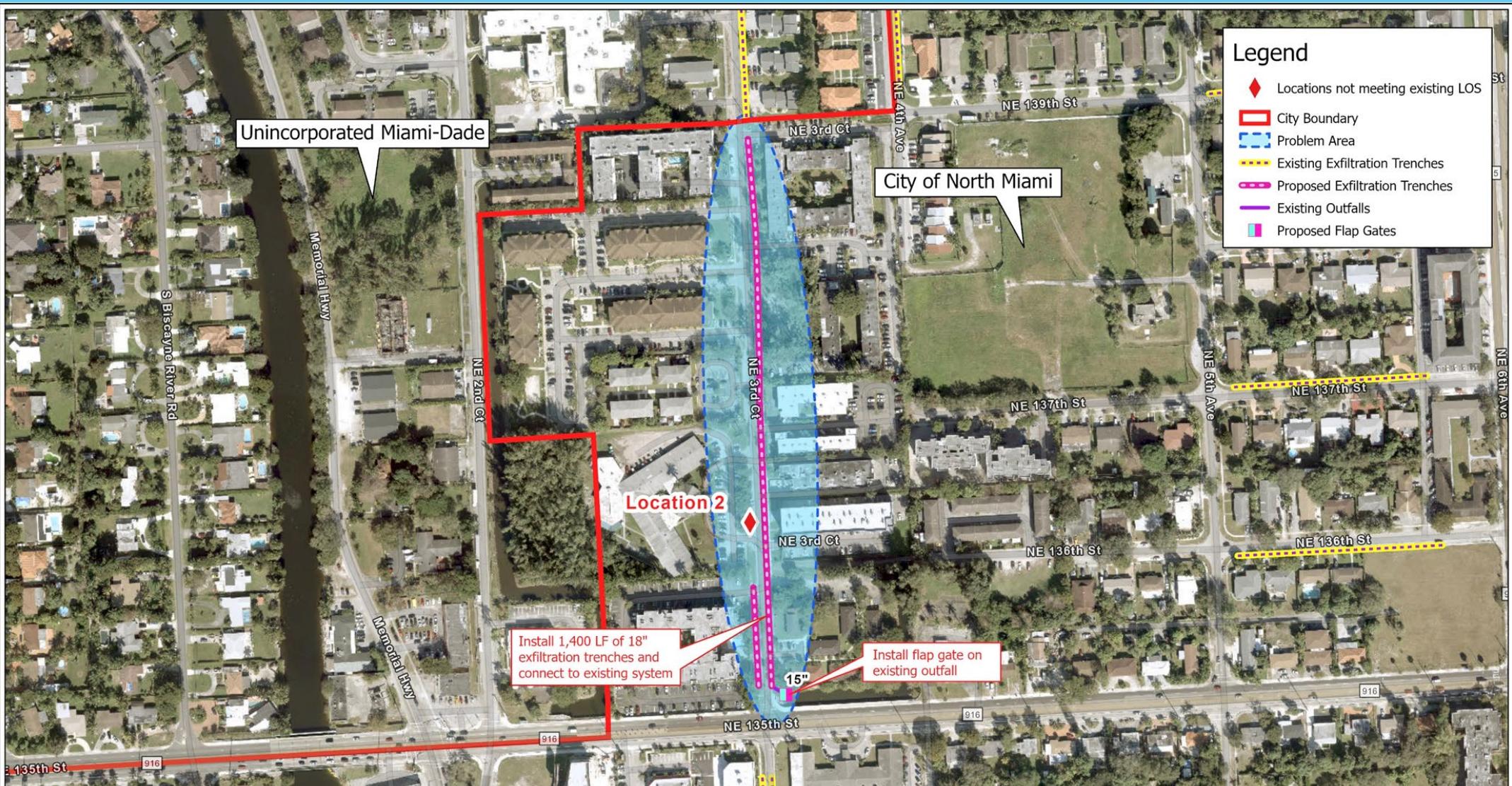
0 125 250 500 750 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION NO. 1 AND 495 NE 141 ST

SHEET 1 of 1



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CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION NO. 2



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SHEET 1 of 1

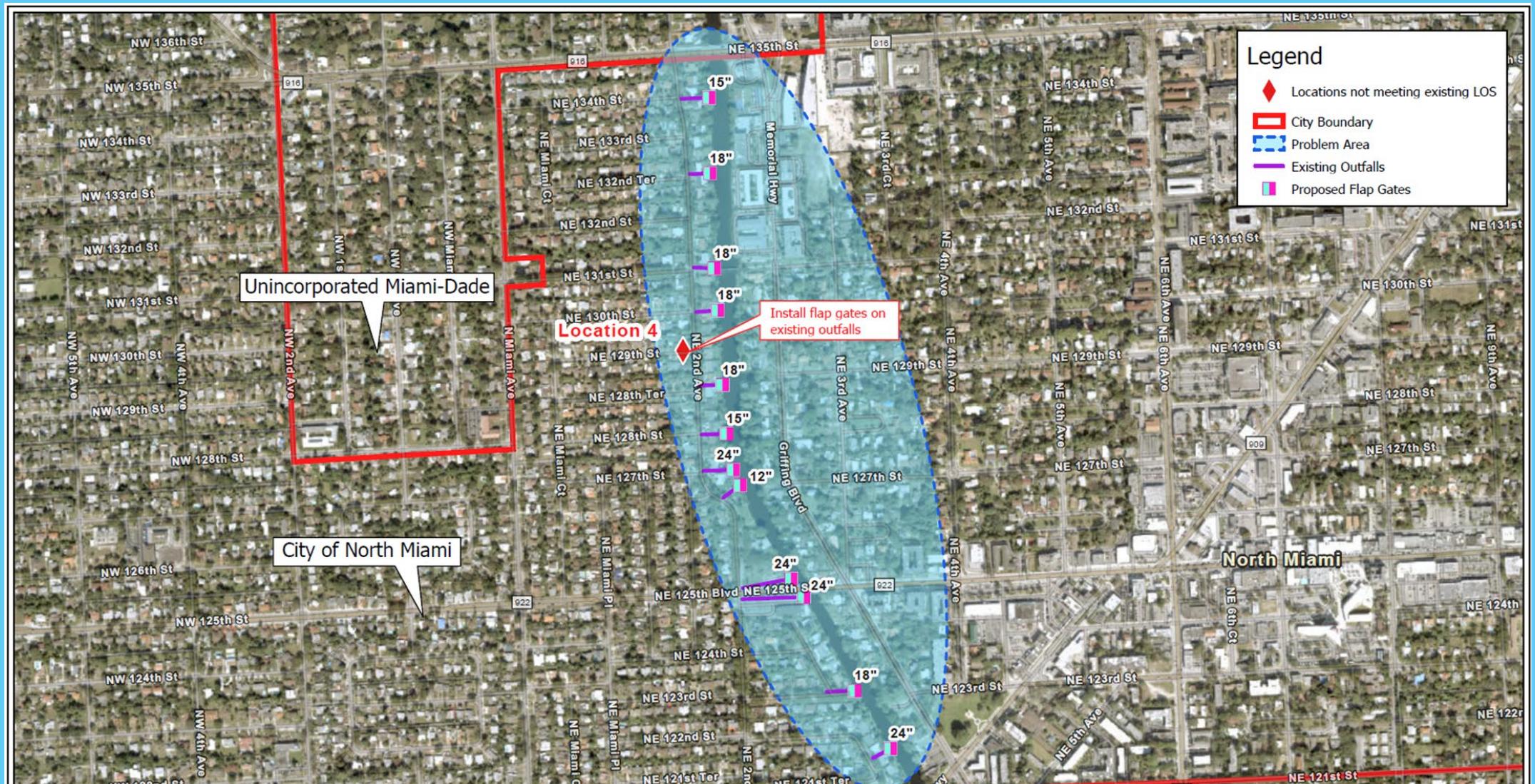


0 125 250
Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION NO. 3



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0 250 500 1,000 1,500 2,000 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION NO. 4



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SHEET 1 of 1

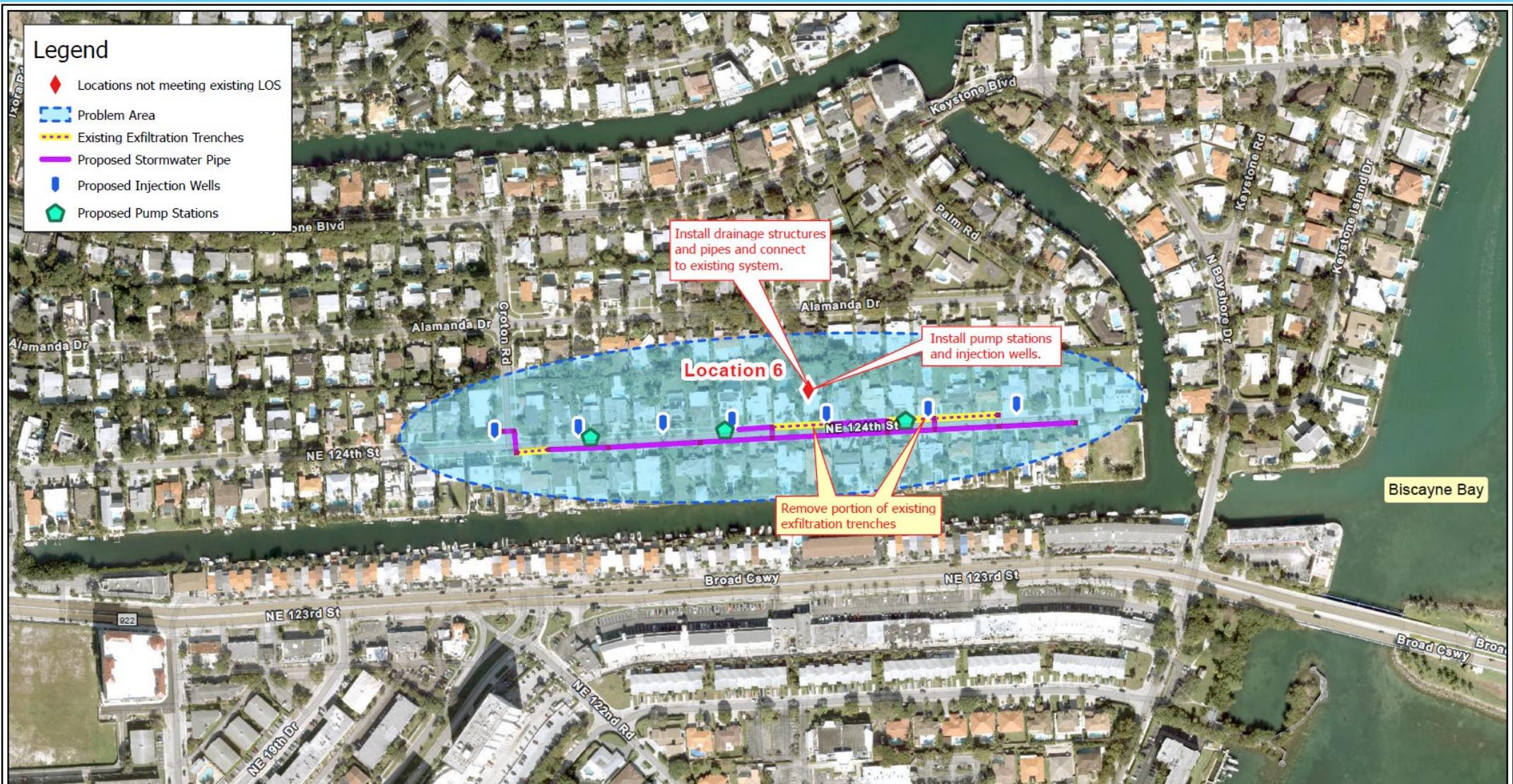


0 125 250 375 500 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION NO. 5



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SHEET 1 of 1



0 125 250 500 750 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION NO. 6



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**CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION NO. 7**



SHEET 1 of 1



0 125 250 500
Feet

CITY OF NORTH MIAMI STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS

LOCATIONS: NE 133 ST FROM 14 AVE TO APPROX. 1470,
NE 132 ST FROM 14 AVE TO APPROX. 1520, 1395 NE 132 ST, 131 ST NE 13 AVE



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SHEET 1 of 1



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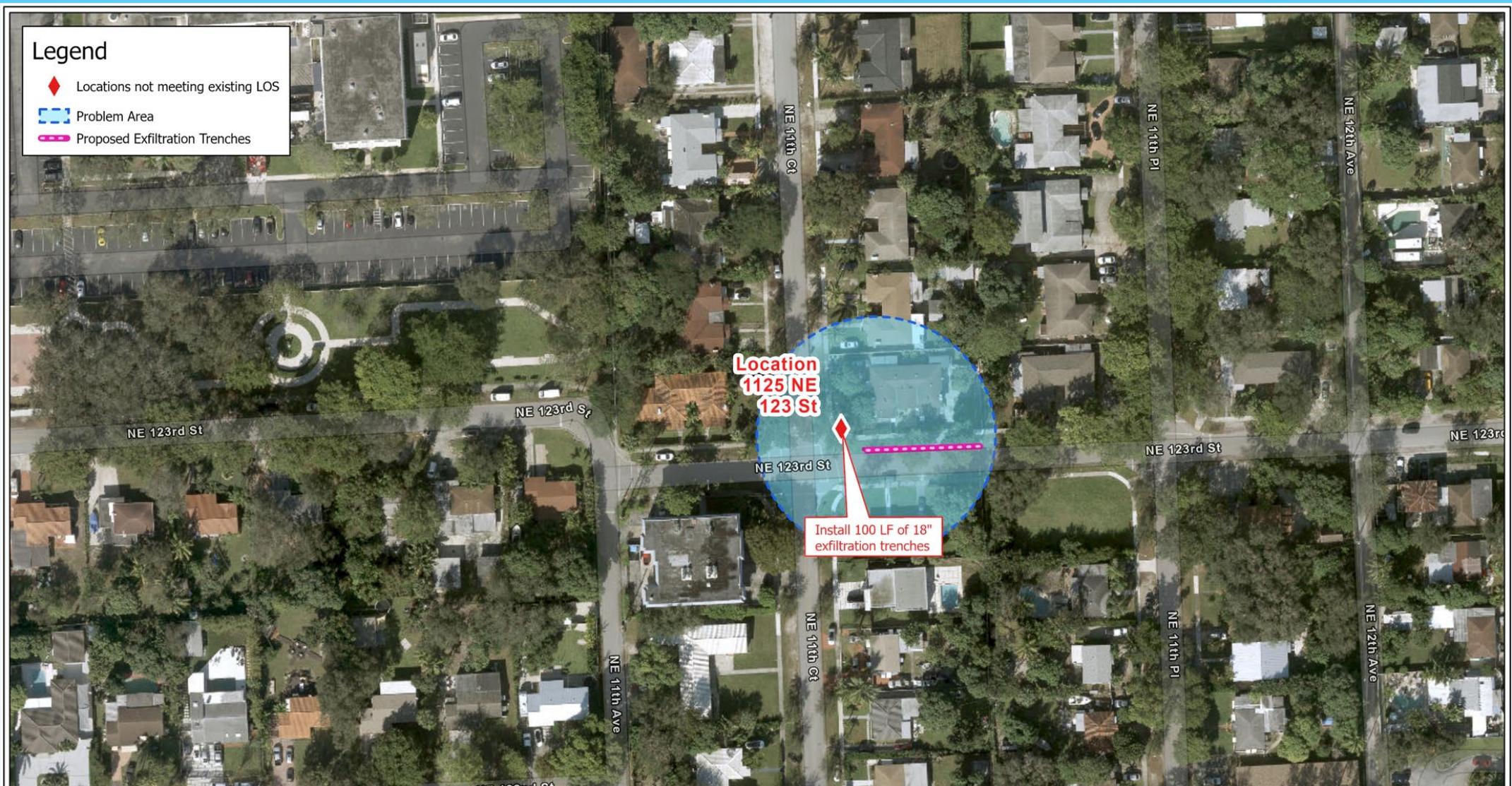
125

Feet
250

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION 143 ST NE 10 AVE



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SHEET 1 of 1



10

0

125

— Feet
250

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION 1125 NE 123 ST



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SHEET 1 of 1



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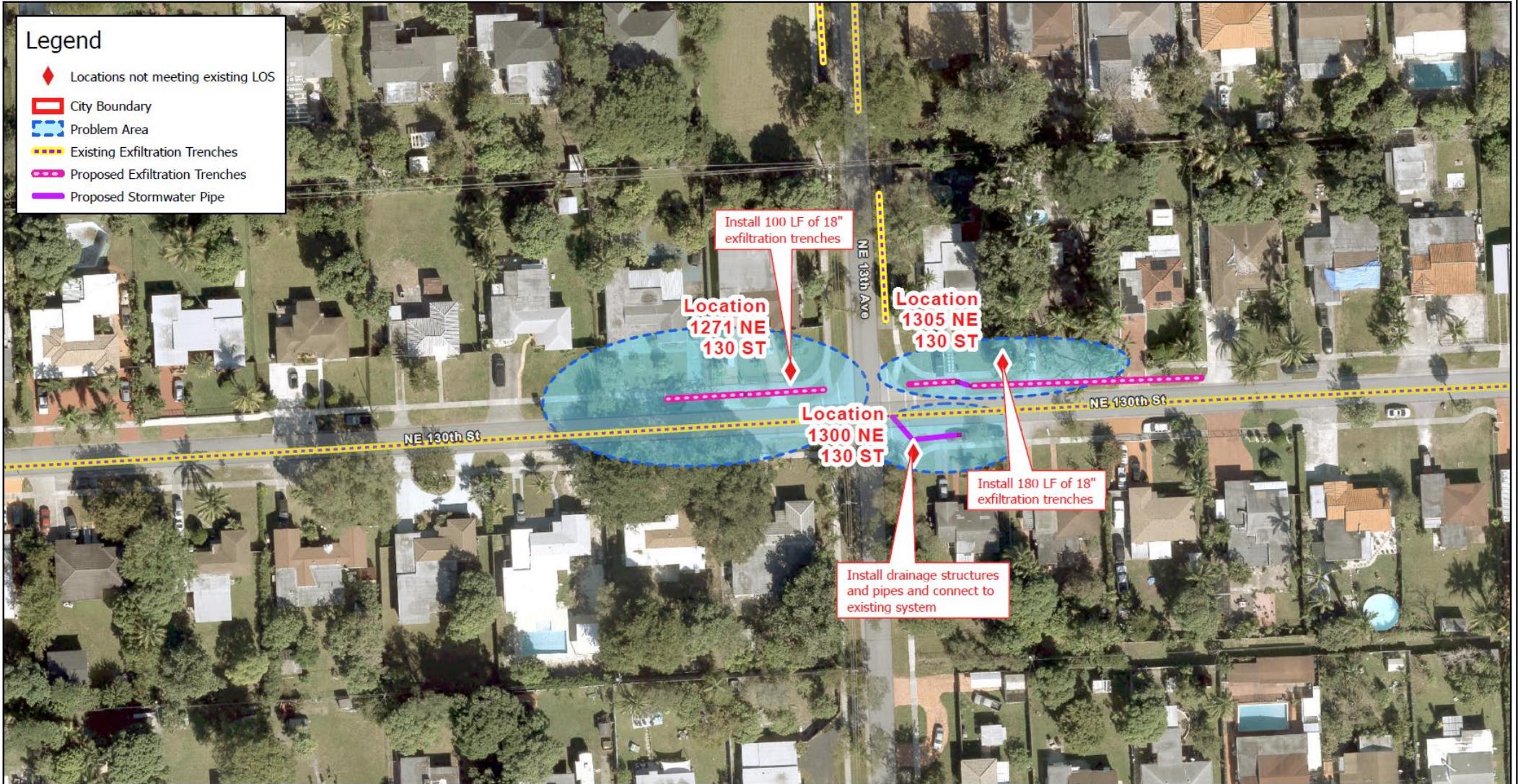
13

—Feel
250

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION 1195 NE 143 ST



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SHEET 1 of 1



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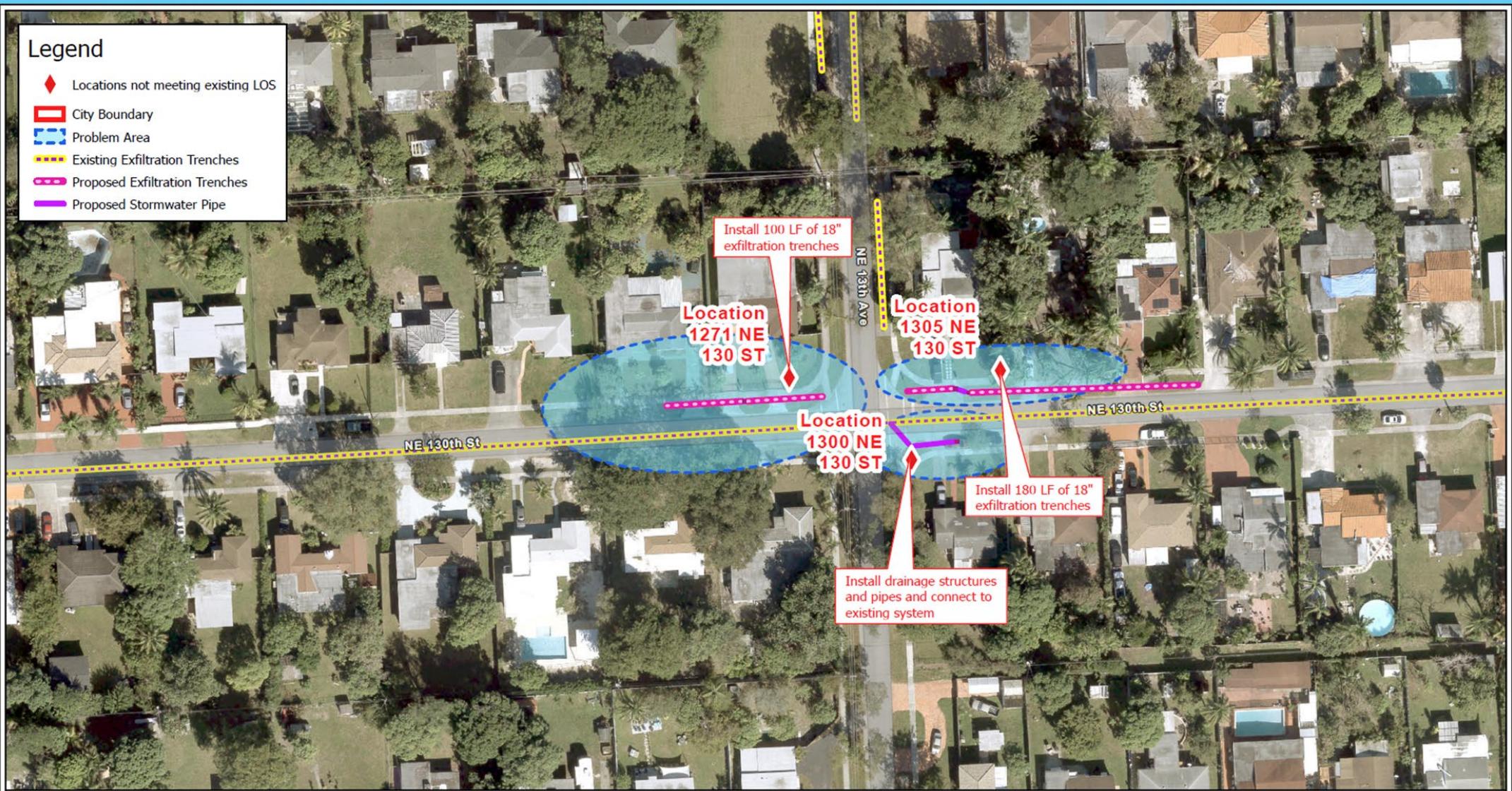
125

Feet
250

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATIONS 1271 NE 130 ST, 1300 NE 130 ST, 1305 NE 130 ST



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50

1

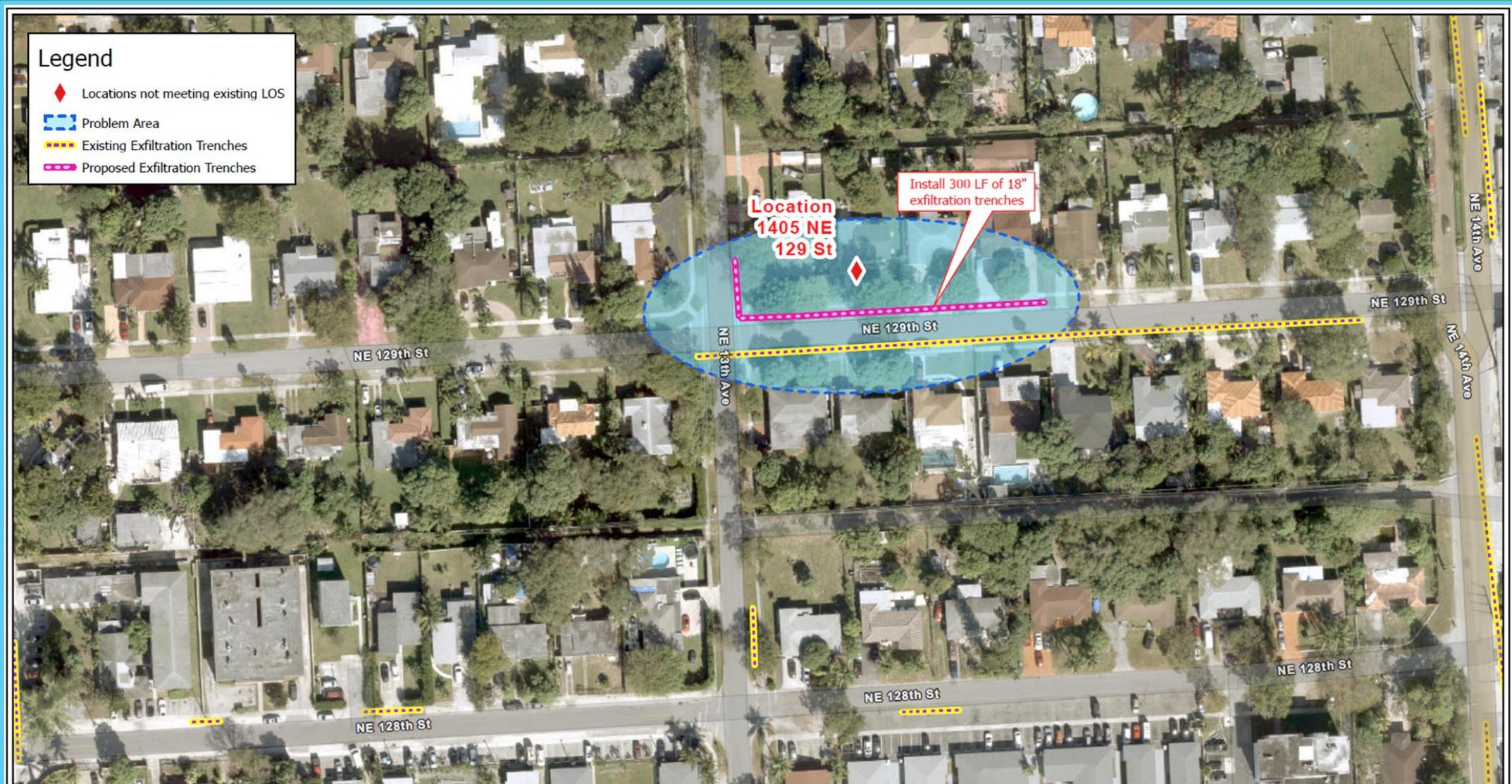
125

— Feet
250

**CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATIONS 1271 NE 130 ST, 1300 NE 130 ST, 1305 NE 130 ST**



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SHEET 1 of 1



0 125 250
Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION 1405 NE 129 ST



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SHEET 1 of 1



0 125 250 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION 1495 NE 136 ST



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SHEET 1 of 1



0

125

250 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
SHORT-TERM DRAINAGE IMPROVEMENTS
LOCATION 14705 NE 11 CT



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RECOMMENDED LONG-TERM IMPROVEMENTS FOR FLOOD PRONE AREAS

- ✓ Additional French drains are recommended in all major basins and most of the sub-basins within the City.
- ✓ The proposed long-term improvements do not have to be built at the same time, they can be separated into several smaller projects based on available funding and Citizen's flooding complaints among other factors.

BISCAYNE CANAL WEST PROBLEM AREA

- ✓ The Biscayne Canal West Problem Area lies in the northwest corner of the City and is bounded by NW 135th St. (north), NW 132nd St. (south), NW 17th Ave. (west), and NW 15th Ave. (east).
- ✓ An option to improve the drainage level of service in this area is to construct 2,000 LF of exfiltration under the Ben Franklin Park and connected to the existing drainage in the adjacent neighborhood. The exfiltration trenches should be located and placed in such a manner as to avoid disturbance of the sports fields in the park.
- ✓ This alternative provides reduction in flood stages for other nodes in the region. The alternative will provide improved regional water quality benefit as well as aquifer recharge.

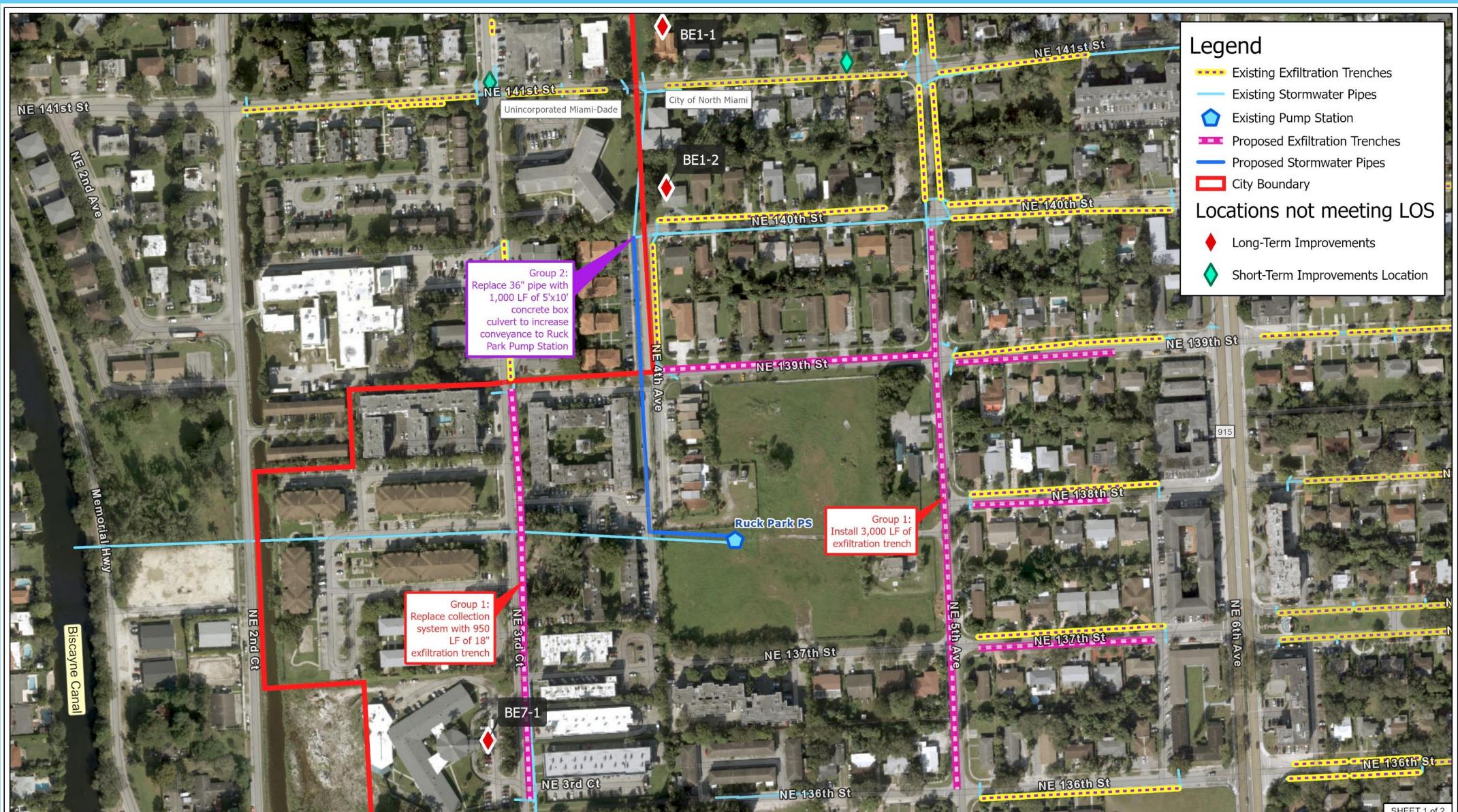


BISCAYNE CANAL EAST PROBLEM AREA 1

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

- ✓ The City has identified this area as one of the historic flooding concerns. Model results indicate several locations within the area with 5-year LOS deficiencies:
- ❖ It is recommended to install 12,500 LF of exfiltration trenches and a collection system in the problem area.

The proposed improvements will reduce flood stages for several deficient nodes, exfiltration trenches alone are expected to provide flood reduction during the 5-year/24-hour design storm. However, model results indicate that exfiltration alone will not correct any of the deficient nodes in the problem area for larger storm events, such as the 25- and 100-year, 3-day storms. Additional Improvements such as increasing the capacity of the pipe feeding the existing pump station at Ruck Park and several outfall upgrades are proposed.

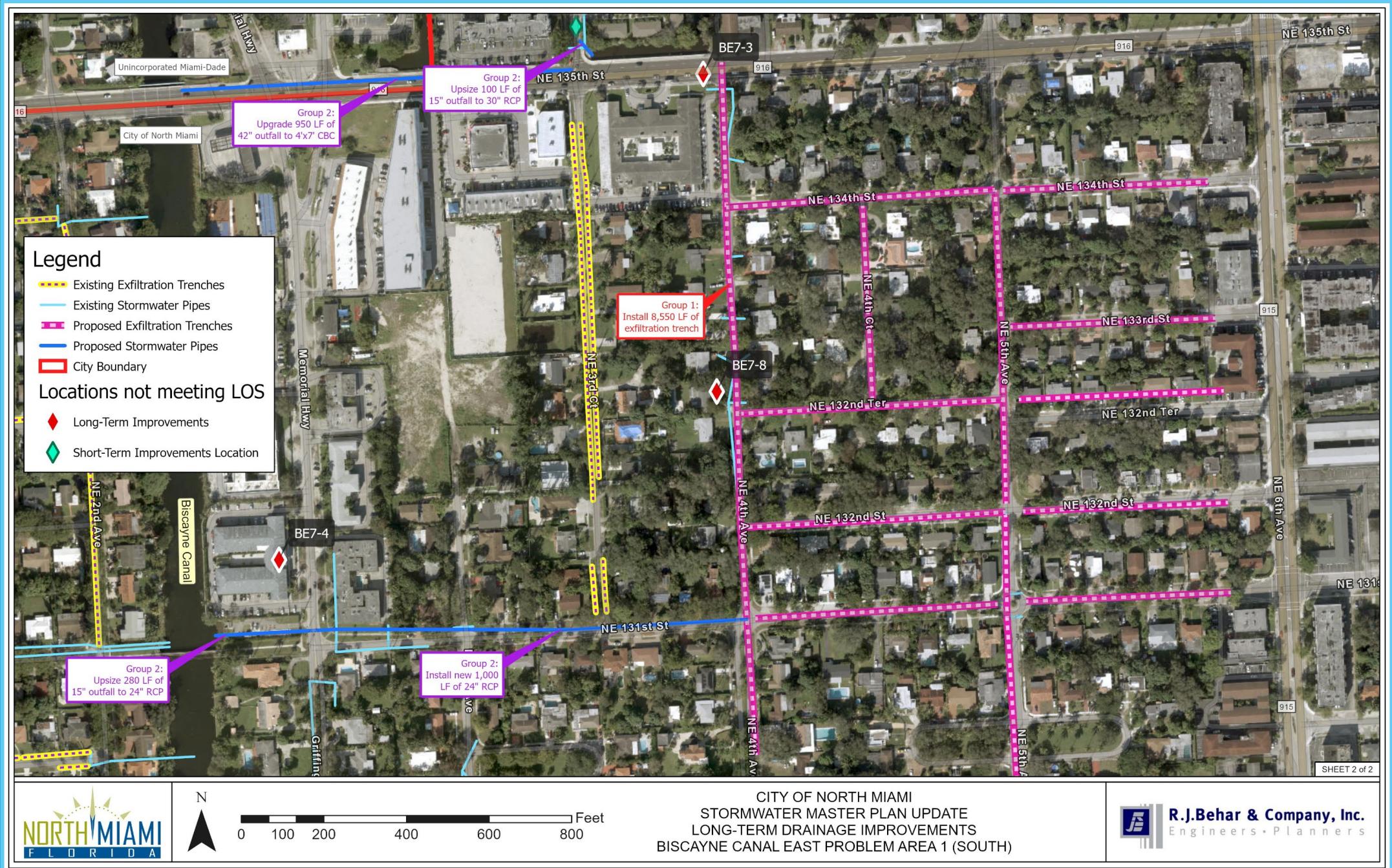


0 100 200 400 600 800 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
LONG-TERM DRAINAGE IMPROVEMENTS
BISCAYNE CANAL EAST PROBLEM AREA 1 (NORTH)



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ARCH CREEK SOUTH/BISCAYNE CANAL EAST PROBLEM AREA

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

- ✓ The City has identified this area as a historic flooding concern. Model results indicate several locations within the area with 5-year LOS deficiencies:
- ✓ It is recommended to install 25,000 LF of exfiltration trenches in the problem area.



0 250 500 1,000 1,500 2,000 Feet

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
LONG-TERM DRAINAGE IMPROVEMENTS
ARCH CREEK SOUTH/BISCAYNE CANAL EAST PROBLEM AREA



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ARCH CREEK SOUTH PROBLEM AREA

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

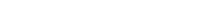
- ✓ The City has identified this area as one of concern. Model results indicate two locations within the area with 10-year LOS deficiencies:
 - ❖ The recommendation is to install 4,900 LF of exfiltration trenches in the problem area. Additional piping and inlets to collect and route runoff to the exfiltration trenches will be necessary to ensure the optimal utilization of the exfiltration trenches.

The proposed improvements provide minimal hydraulic and flood control benefits. Therefore, the additional improvements listed below are proposed:

- Upsize the existing NE 142nd and NE 143rd St. outfall into Arch Creek from 30-inch to 36-inch RCP. Upsizing this outfall will require coordination with FDOT, as NE 143rd St. is FDOT right-of-way.
- Upsize the existing outfall along NE 140th St. into Arch Creek from 24-inch to 30-inch RCP.
- A new 30-inch trunkline is proposed to convey runoff from areas to the west to the upgraded outfall.
- A 3 ac-ft underground storage facility at a vacant lot at NE 17th Ct. A 35 cfs pump station in the facility will drain the facility to the upgraded 142nd St. outfall into Arch Creek. The facility will be fed by a series of collection systems and a 42-inch trunkline along NE 141st St.
- Upsize of the existing outfall at NE 142nd St. from 30-inch to 42-inch RCP and an upsizing of the existing outfall along NE 140th St. from 24-inch RCP to 42-inch RCP.

These improvements will reduce the 10-year flood stages up to 0.5-feet and correct the LOS deficiency.





Locations not meeting LOS

Long-Term Improvements

Legend

- Yellow dotted line: Existing Exfiltration Trenches
- Light blue line: Existing Stormwater Pipes
- Blue pentagon: Existing Pump Station
- Pink line: Proposed Exfiltration Trenches
- Dark blue line: Proposed Stormwater Pipes
- Green hexagon: Proposed Pump Station
- Dark blue square with dots: Proposed Underground Storage
- Red square: City Boundary

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
LONG-TERM DRAINAGE IMPROVEMENTS
ARCH CREEK SOUTH PROBLEM AREA



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ARCH CREEK NORTH/ARCH CREEK SOUTH PROBLEM AREA

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

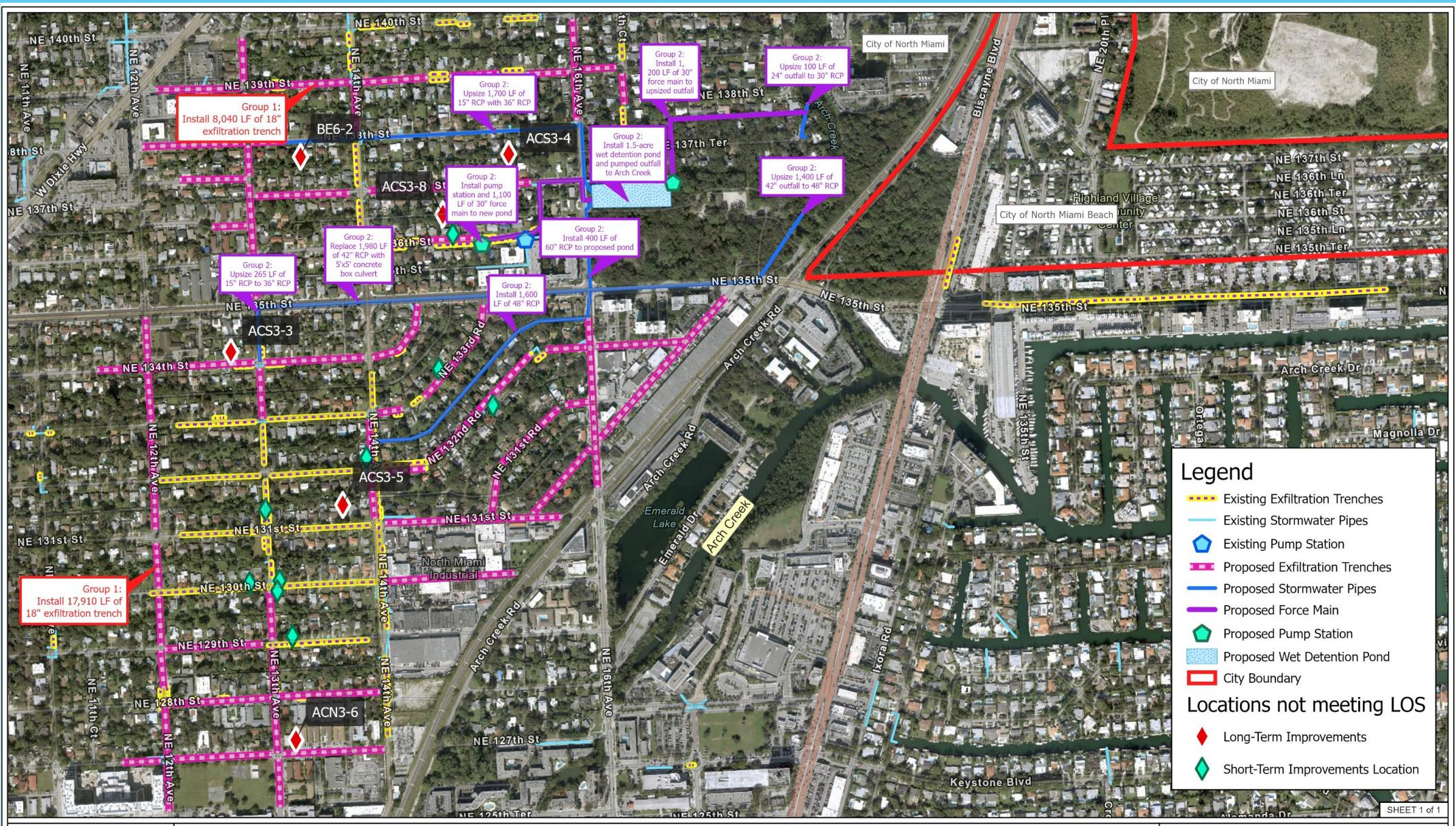
Model results indicate several locations within the area with 5-year LOS deficiencies:

- ❖ It is recommended to install 25,950 LF of exfiltration trenches in the problem area. Additional piping and inlets to collect and route runoff to the exfiltration trenches will be necessary to ensure the optimal utilization of the exfiltration trenches.

The proposed improvements significantly reduce flood stages for several deficient nodes; exfiltration alone is expected to provide sufficient flood stage reduction to alleviate the 5-year LOS.

To meet the LOS, additional storage and conveyance upgrades are proposed below:

- ✓ Upsizing the existing outfall along NE 135th St. from 42-inch to 48-inch RCP. Upsizing this outfall will require coordination with FDOT, as NE 135th St. is FDOT right-of-way.
- ✓ Installing various conveyance upgrades connecting to the upgraded outfall, which include: - 1,700 LF of 48-inch RCP from NE 132nd St. and NE 14th Ave., connecting to the upgraded outfall at NE 135th St. and NE 16th Ave.
- ✓ Replacing 1,970 LF of 42-inch pipe along 135th St. with 5' x 5' CBC, providing in-system storage and low-head loss conveyance.
- ✓ Upgrading the existing 18-inch RCP from NE 13th Ave. and NE 134th St. to 36-inch RCP.
- ✓ Upsizing the existing outfall at NE 137th Ter. from 24-inch to 30-inch RCP.
- ✓ Installing a 1.5-acre wet detention pond in Elaine Gordon Park. The water level in the pond will be controlled by a 40 cfs pump station, which will pump treated runoff through a 30-inch force main to the upgraded outfall at NE 137th Ter. The pond will treat runoff from the south by means of a 5' x 5' CBC pipe from NE 135th St. and NE 16th Ave. and will treat runoff from the north and west by means of an incoming 36-inch RCP trunkline.
- ✓ Installing a 40 cfs pump station on NE 136th St. This is a low-lying area for which a gravity drainage solution is not feasible to achieve LOS. The facility will pump runoff through a 30-inch force main to the proposed wet detention pond at Elaine Gordon Park.



CITY OF NORTH MIAMI
PROPOSED DRAINAGE IMPROVEMENTS
PRELIMINARY ENGINEER'S ESTIMATE OF PROBABLE COST

LONG-TERM IMPROVEMENTS ESTIMATED FRENCH DRAIN COST PER LINEAR FOOT

| COST ESTIMATION FOR INSTALLATION OF 200 LF OF 24" FRENCH DRAIN AND ASSOCIATED STRUCTURES | | | | |
|--|------|-----------|----------|-----------|
| ITEM | UNIT | UNIT COST | QUANTITY | COST |
| DEMOLITION (PAVEMENT REMOVAL, REMOVAL OF EXISTING PIPES) | LS | \$ 7,359 | 1 | \$ 7,359 |
| INSTALL NEW CATCH BASINS | EA | \$ 8,020 | 2 | \$ 16,039 |
| INSTALL NEW MANHOLE | EA | \$ 10,092 | 1 | \$ 10,092 |
| INSTALL NEW 24" FRENCH DRAIN | LF | \$ 384 | 200 | \$ 76,719 |
| INSTALL NEW 24" DRAINAGE PIPE | LF | \$ 263 | 30 | \$ 7,887 |
| SIDEWALK AND DRIVEWAY RESTORATION | SY | \$ 100 | 69.3 | \$ 6,958 |
| SOD RESTORATION/SWALES | SY | \$ 12 | 222.2 | \$ 2,600 |
| EXISTING CATCH BASIN REMOVAL | EA | \$ 1,755 | 1 | \$ 1,755 |
| CONTINGENCY (30%) | LS | \$ 38,823 | 1 | \$ 38,823 |
| ENGINEERING COST | LS | \$ 12,941 | 1 | \$ 12,941 |
| MOBILIZATION | LS | \$ 9,059 | 1 | \$ 9,059 |
| MAINTENANCE OF TRAFFIC | LS | \$ 9,059 | 1 | \$ 9,059 |

COST PER 200 LF OF INSTALLED FRENCH DRAIN \$ 199,291

COST PER LF OF INSTALLED FRENCH DRAIN \$ 996

Assumptions:

*Excavation size will be 4-ft wide and 15-ft deep. Restoration will include sodding and replacement of pavement, sidewalks, and driveways.

* The French drain systems will require some removal of pavement, sidewalks, and driveways.

* Each 200-ft of installed French drain will require (2) inlet structures and 30-ft of connecting 24" RCP or HDPE.

RECOMMENDATIONS

- This report identifies potential deficiencies of the stormwater infrastructure within the City and a list of short-term improvements projects was provided to mitigate all the critical flooding areas.
- The long-term recommendations are meant to improve even further the drainage level of service, but due to the size of the improvements and cost, they are considered for the long-term.
- The following factors were taken into consideration when developing the recommendation:
 - **Interconnectivity of Improvements:** Interconnectivity is recommended for areas which are currently disconnected to the primary canal stormwater system, with no outfalls. Also, interconnectivity between new and existing systems is recommended.
 - **Backflow for high tides:** The effects of installing backflow preventers at selected outfalls were evaluated to analyze the elimination of flooding caused by backflow in canals and at coastal areas caused by high tides.
 - **Upgrades in capacity:** Group 2 for long-term improvements provides upgrades to existing infrastructure for conveyance capacities to provide flood mitigation where the existing system is undersized.
 - **Additional pumping to storage:** Group 2 for long-term improvements includes pump stations.

While large-scale infrastructure projects are crucial, the City can take the following smaller, immediate steps to improve flood preparation:

- ✓ **Routine Maintenance Programs:** Preventative maintenance, including regular CCTV inspections, enables the City to identify and address problems before they become larger and more expensive breakdowns.
- ✓ **Compliant Tracking Systems:** Centralized complaint tracking systems that collect, log and analyze stormwater-related issues can identify patterns and prioritize solutions for vulnerable areas. One key feature consists of a geographic/location tracker so that, over time, reoccurring issues in certain areas of the system can be identified and strategies developed to alleviate them.
- ✓ **Post-construction Stormwater Management:** Integrating strong management programs during new and re-development ensures systems are equipped to handle increased demands and avoid strained systems.
- ✓ **Community Engagement:** Educating the community on practical measures strengthens community resilience and ensures residents know what they can do to stay safe. Communicating the importance of not polluting, since this will end up clogging or reducing the capacity of the stormwater system.

GREEN ALTERNATIVES BENEFITS

- Green infrastructure reduces and treats stormwater at its source while delivering environmental, social, and economic benefits.
- Stormwater runoff is a major cause of water pollution in urban areas.
- When rain falls in natural, undeveloped areas, the water is absorbed and filtered by soil and plants. Stormwater runoff is cleaner and less problematic.
- Green infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments.

GREEN ALTERNATIVES



Permeable Pavement/Interlocking Pavers



Bioswales



Planter Boxes

GREEN ALTERNATIVES



Green Parking

Green Streets

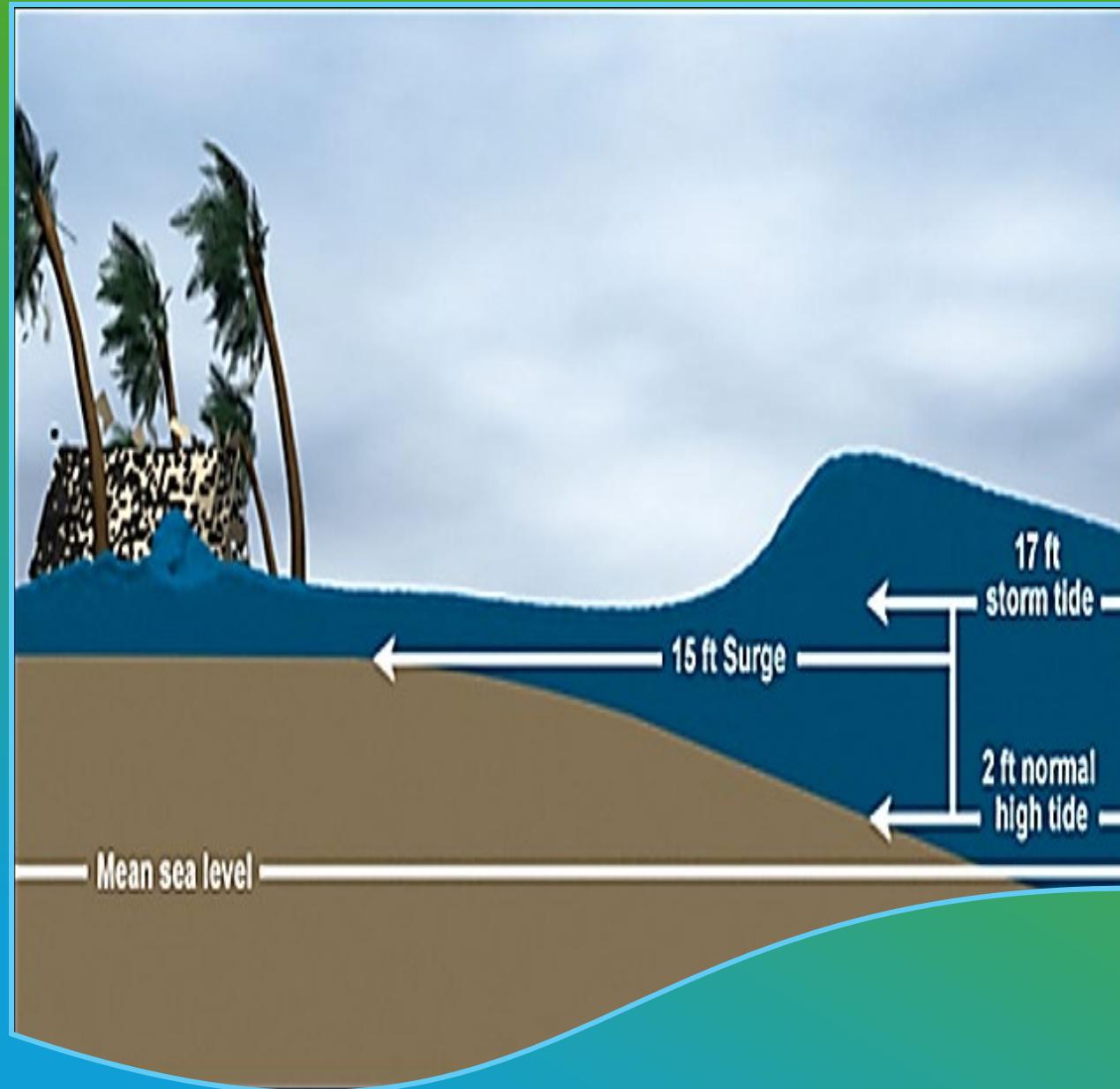


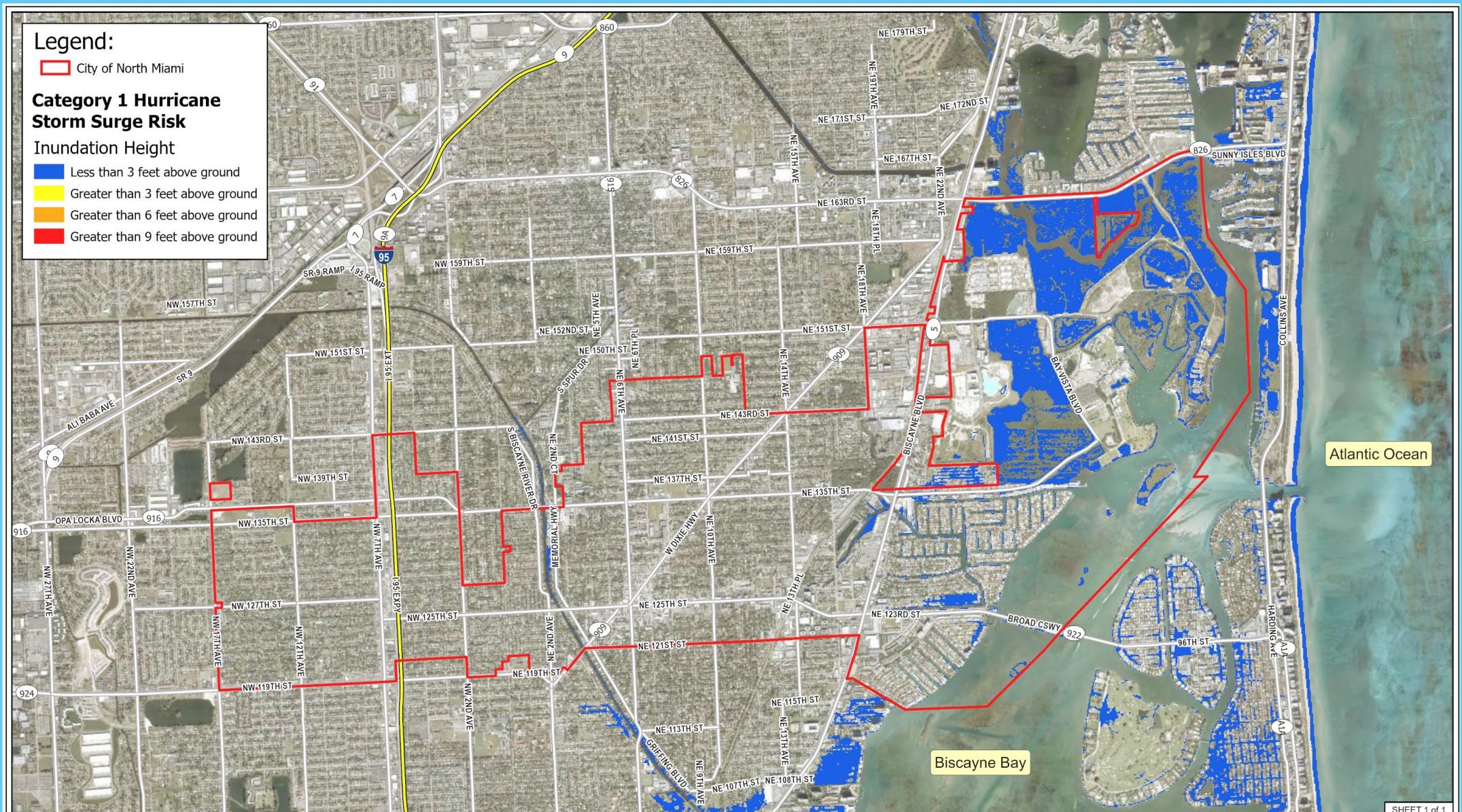
| CATEGORY | SUSTAINED WINDS | TYPES OF DAMAGE DUE TO HURRICANE WINDS |
|--------------|-------------------|--|
| 1 | 74-95 mph | Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days. |
| 2 | 96-110 mph | Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-Total power loss is expected with outages that could last from several days to weeks. |
| 3 (major) | 111-129 mph | Devastating damage will occur: Well-Built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes. |
| 4 (major) | 130-156 mph | Catastrophic damage will occur: Well-Built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted, and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |
| 5 (major) | 157 mph or higher | Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months. |

STORM SURGE FLOODING

MAPS

- Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides.
- Storm surge should not be confused with storm tide, which is defined as the water level rise due to the combination of storm surge and the astronomical tide.
- This rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide, resulting in storm tides reaching up to 20 feet or more in some cases.





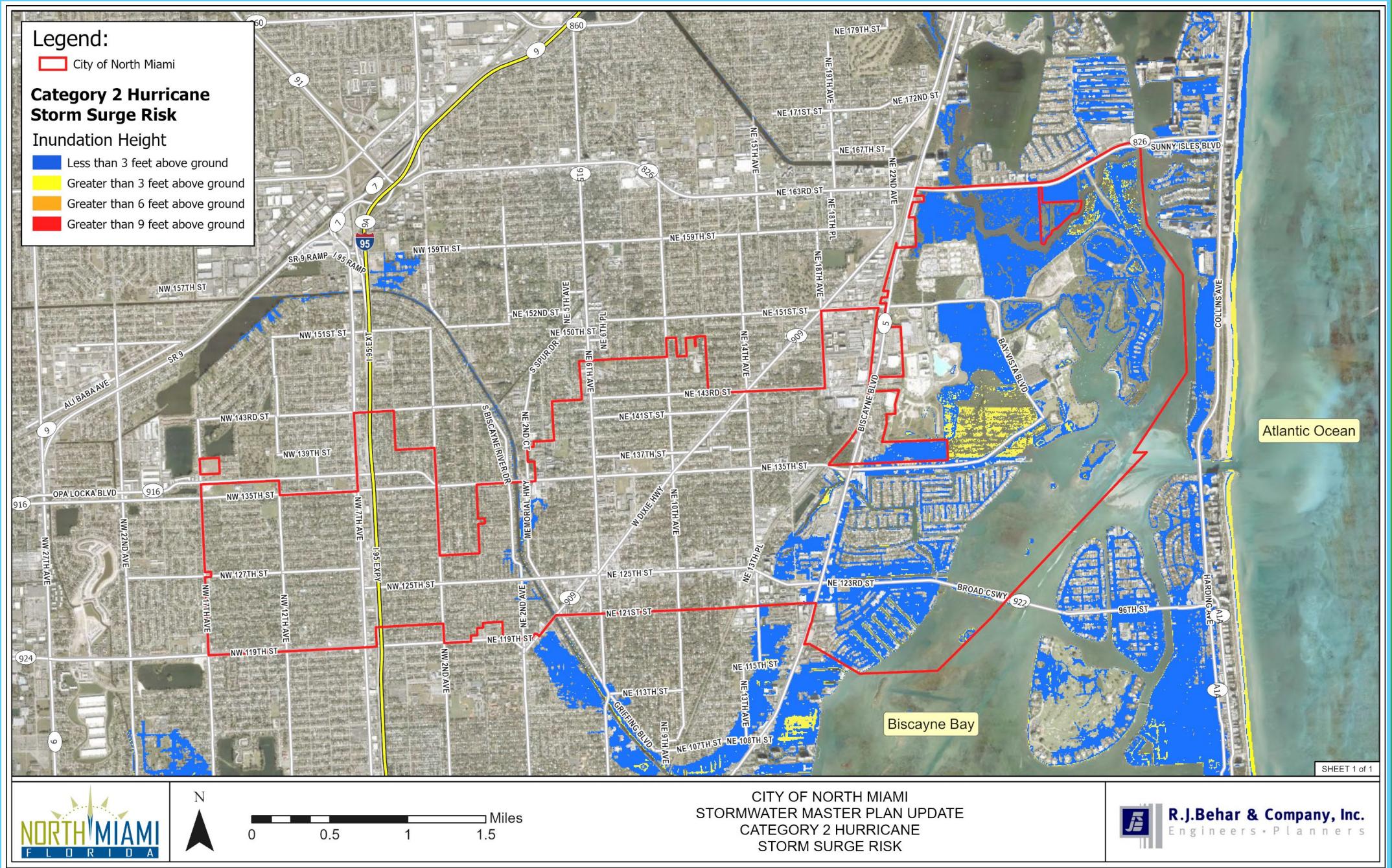


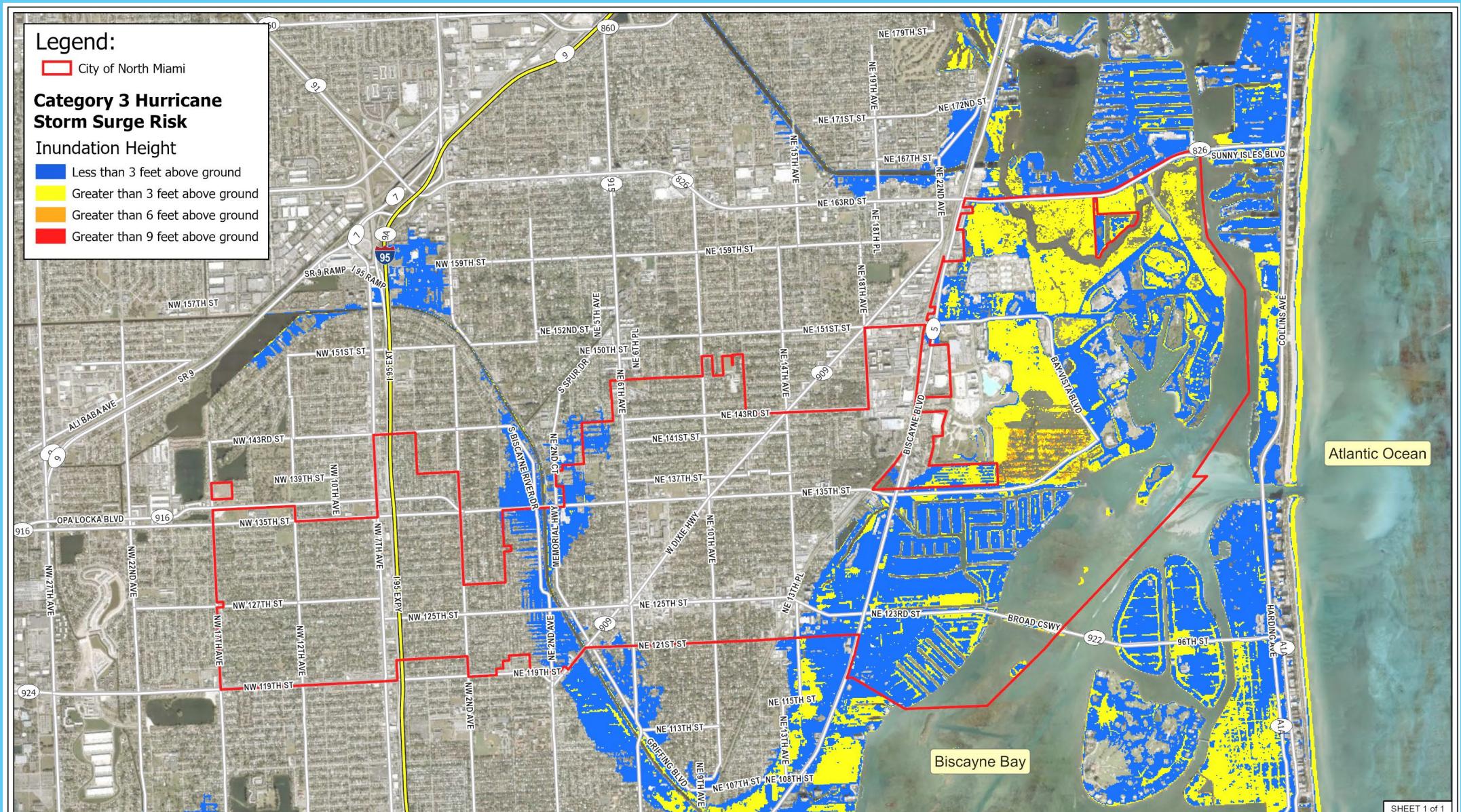
A scale bar representing distance in miles. It features a horizontal line with tick marks at 0, 0.5, 1, and 1.5 miles. The segment from 0 to 1 is shaded black, while the segments from 1 to 0.5 and 0.5 to 1.5 are white. The word "Miles" is written at the end of the bar.

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
CATEGORY 1 HURRICANE
STORM SURGE RISK



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SHEET 1 of 1

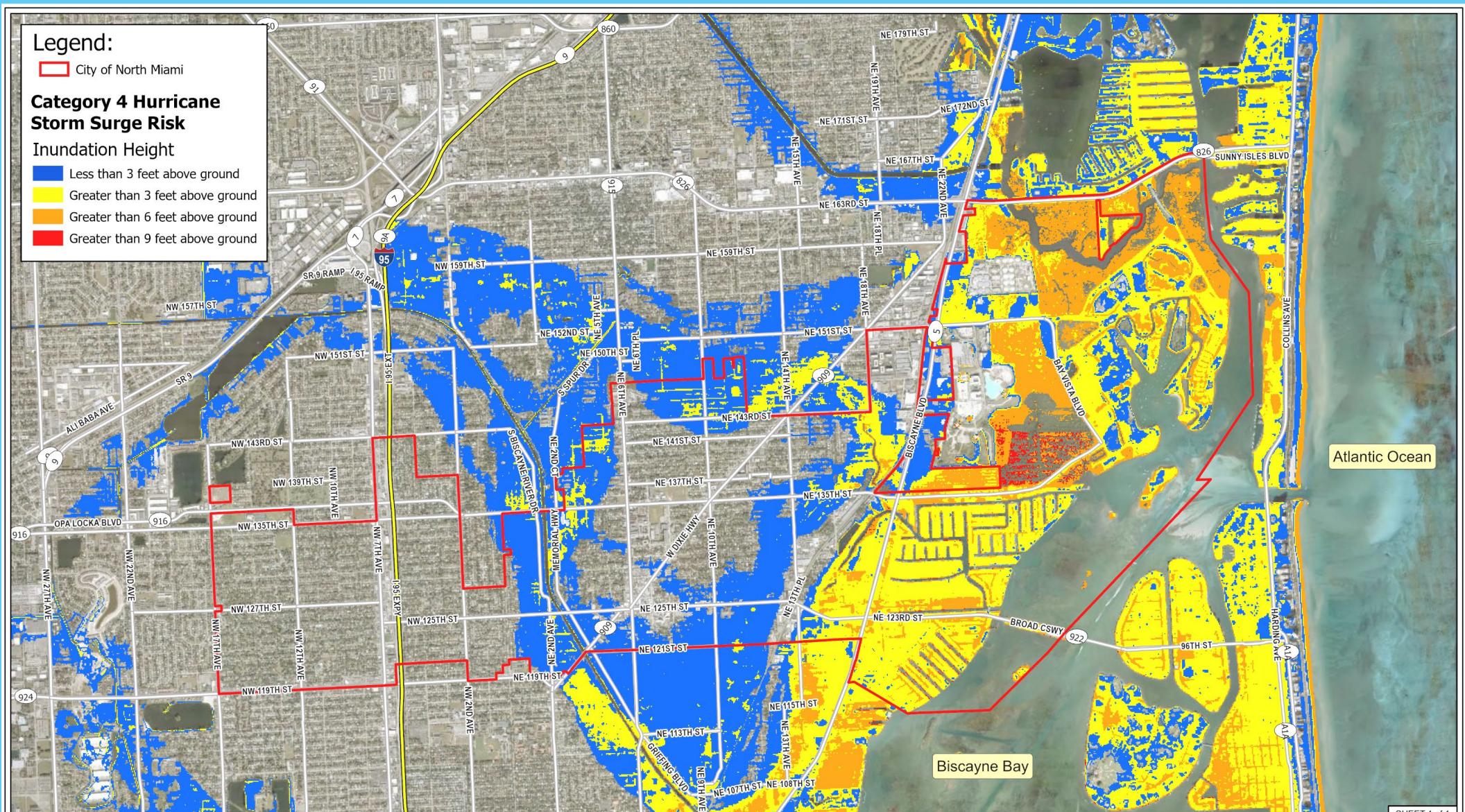


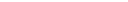
0 0.5 1 1.5 Miles

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
CATEGORY 3 HURRICANE
STORM SURGE RISK



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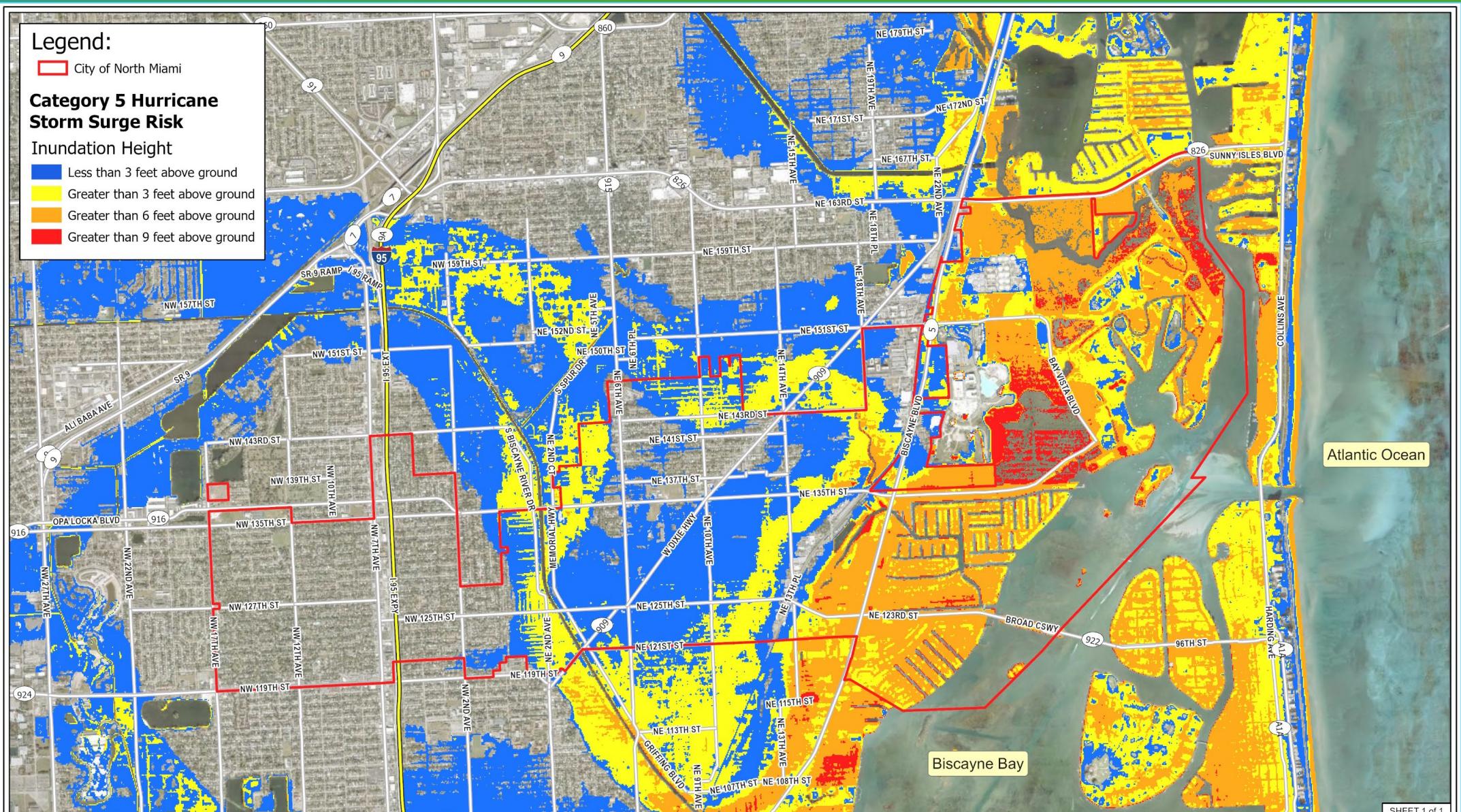


A scale bar representing 1 mile. It consists of a horizontal line with tick marks. The first tick mark is at 0, the second is at 0.5, the third is at 1, and the fourth is at 1.5. The segment from 0 to 1 is filled with a dark gray color, while the segments from 0.5 to 1 and 1 to 1.5 are white. The word "Miles" is written in black text to the right of the scale bar.

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
CATEGORY 4 HURRICANE
STORM SURGE RISK



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A horizontal scale bar representing 1 mile. The bar is divided into four segments: a black segment from 0 to 0.5, a white segment from 0.5 to 1, a black segment from 1 to 1.5, and a white segment from 1.5 to the end. The text "Miles" is written at the end of the bar.

CITY OF NORTH MIAMI
STORMWATER MASTER PLAN UPDATE
CATEGORY 5 HURRICANE
STORM SURGE RISK



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SHEET 1 of 1

**THANK
YOU!**