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Water and Sewer System Master Plans

September 25, 2019

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Master Plan Development

Methodology
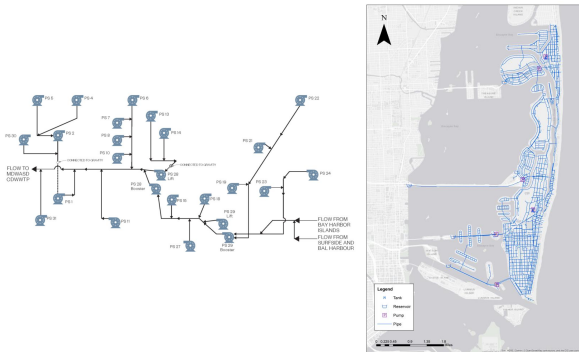
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Population, Water Demand and Sewer Flows Forecast
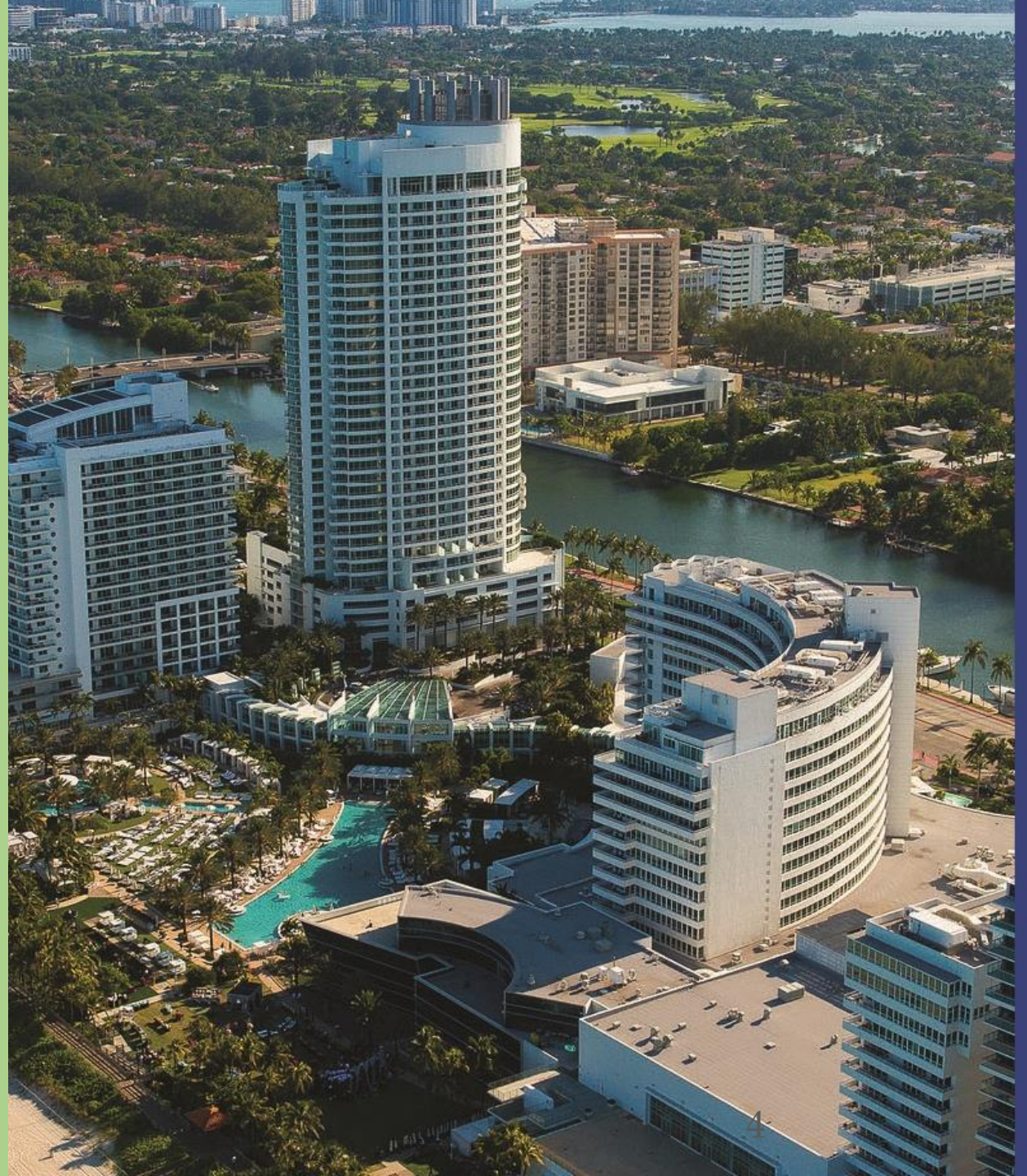
Population Projections

Residents

Source: Traffic Analysis Zones (TAZ) Projections by Miami-Dade RER

2019	2045
96,000	121,000

+

Employees

Source: Traffic Analysis Zones (TAZ) Projections by Miami-Dade RER

2019	2045
70,000	96,000

+

Hotel Guests

Source: Current: Greater Miami Convention and Visitors Bureau, Future : Hazen

2019	2045
25,000	43,000

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Population and Water Demand Projections

Equivalent Population

Residents (x 1)

+

Employees (x 0.5)

+

Hotel Guests (x 1)

Historical Water Demand   Projected Water Demand

Finished Water Demand (mgd)

Year	Annual Finished Water Demand
2015	23.2
2016	23.2
2017	23.6
2018	23.0
2020	24.7
2025	26.7
2030	28.2
2035	29.8
2040	31.4
2045	33.0

Equivalent Population

■ Annual Finished Water Demand   ●— Equivalent Population
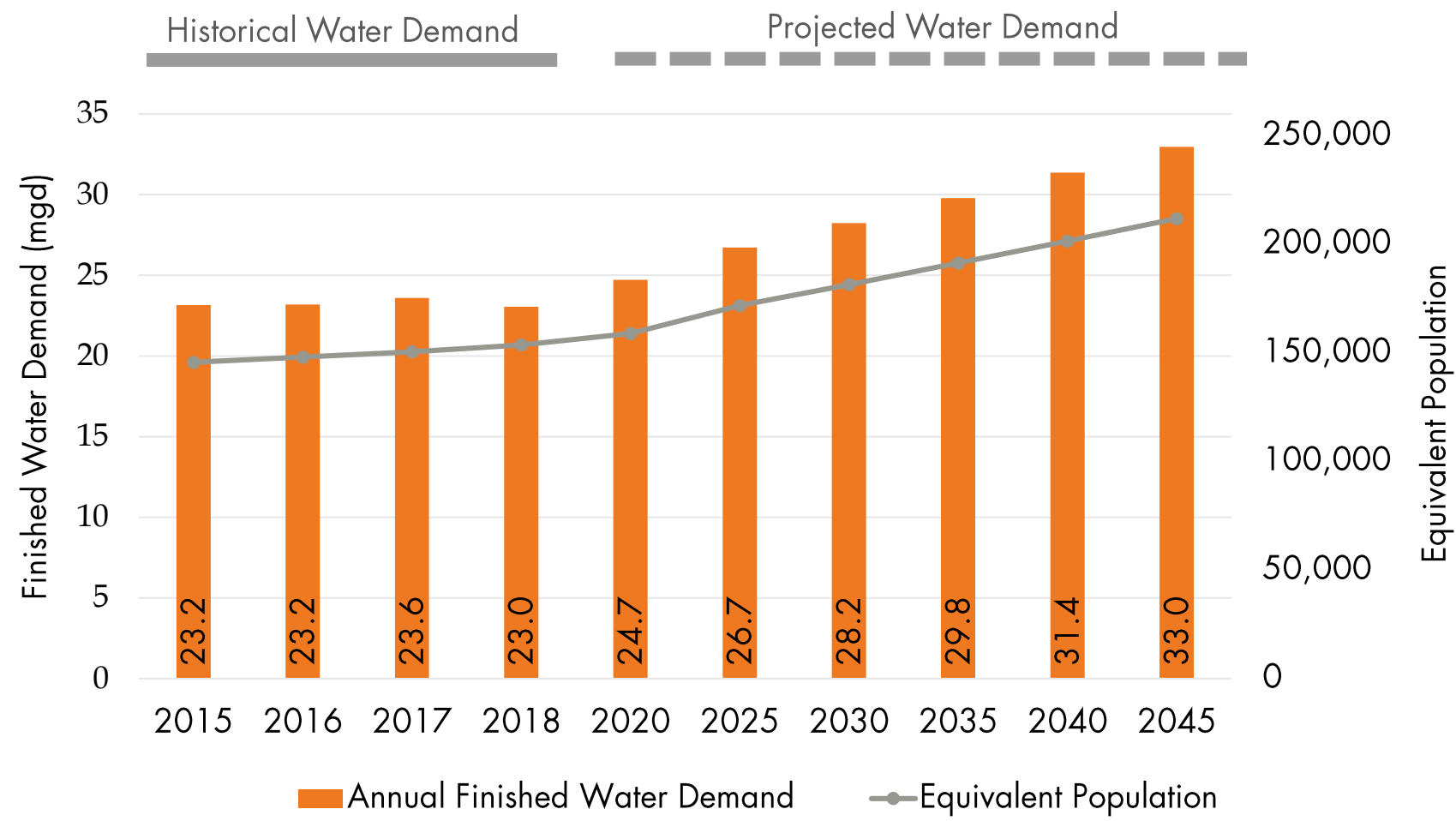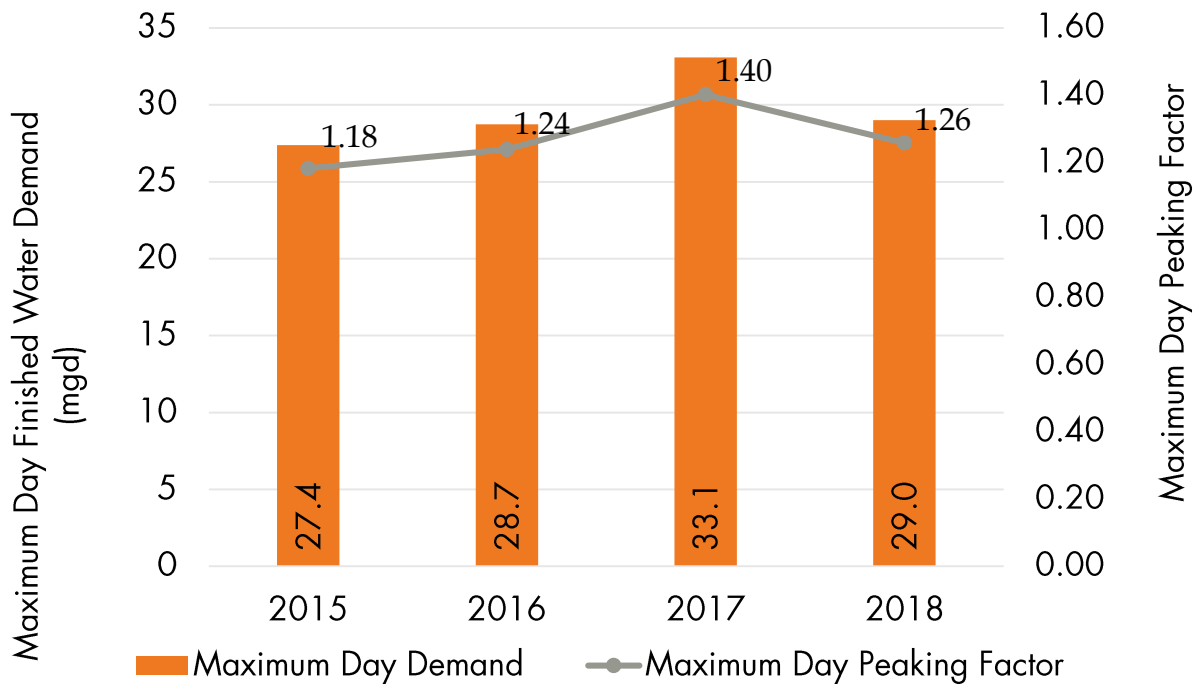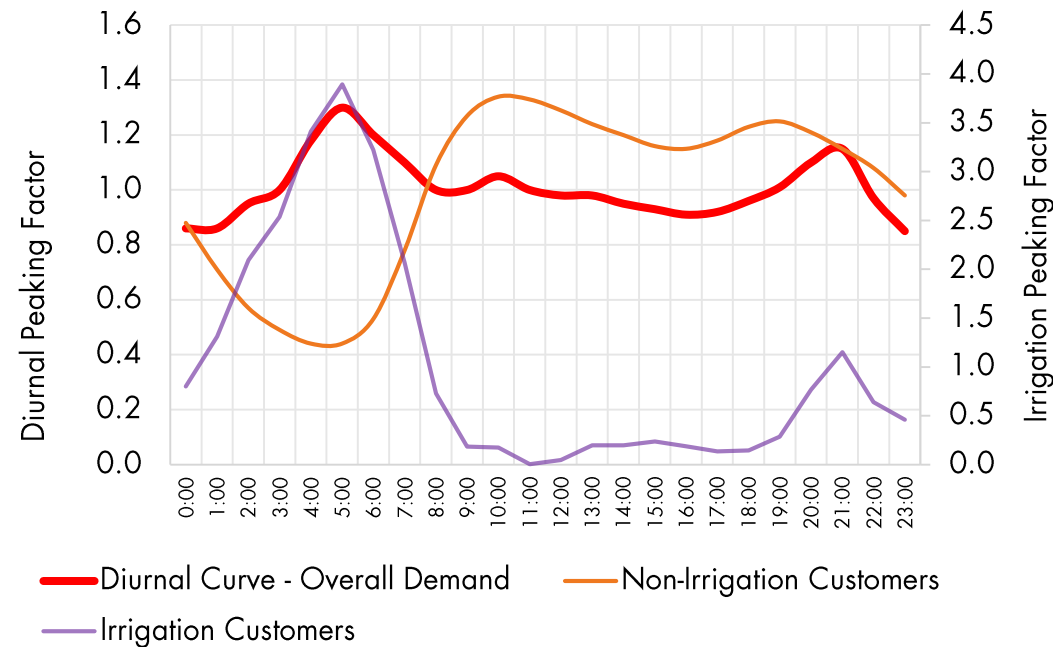
Seasonal and Diurnal Water Demand Fluctuations

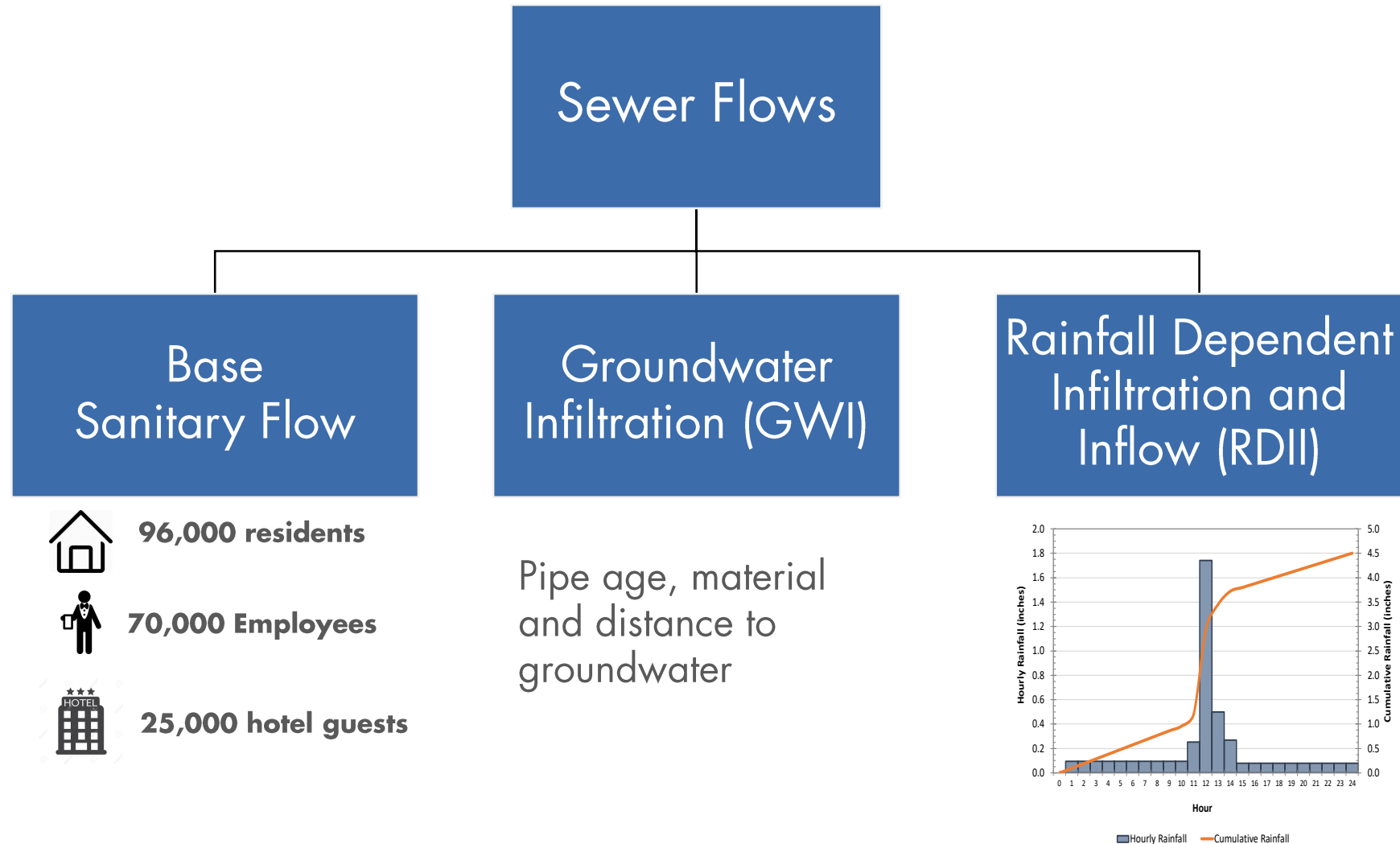## The evaluation takes into account the day-to-day and hourly variations

Average maximum day peaking factor = 1.27

Overall diurnal peaking factor = 1.30

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Estimation of Sewer Flows

Sewer Flows

Base Sanitary Flow

Groundwater Infiltration (GWI)

Rainfall Dependent Infiltration and Inflow (RDII)

96,000 residents

70,000 Employees

25,000 hotel guests

Pipe age, material and distance to groundwater

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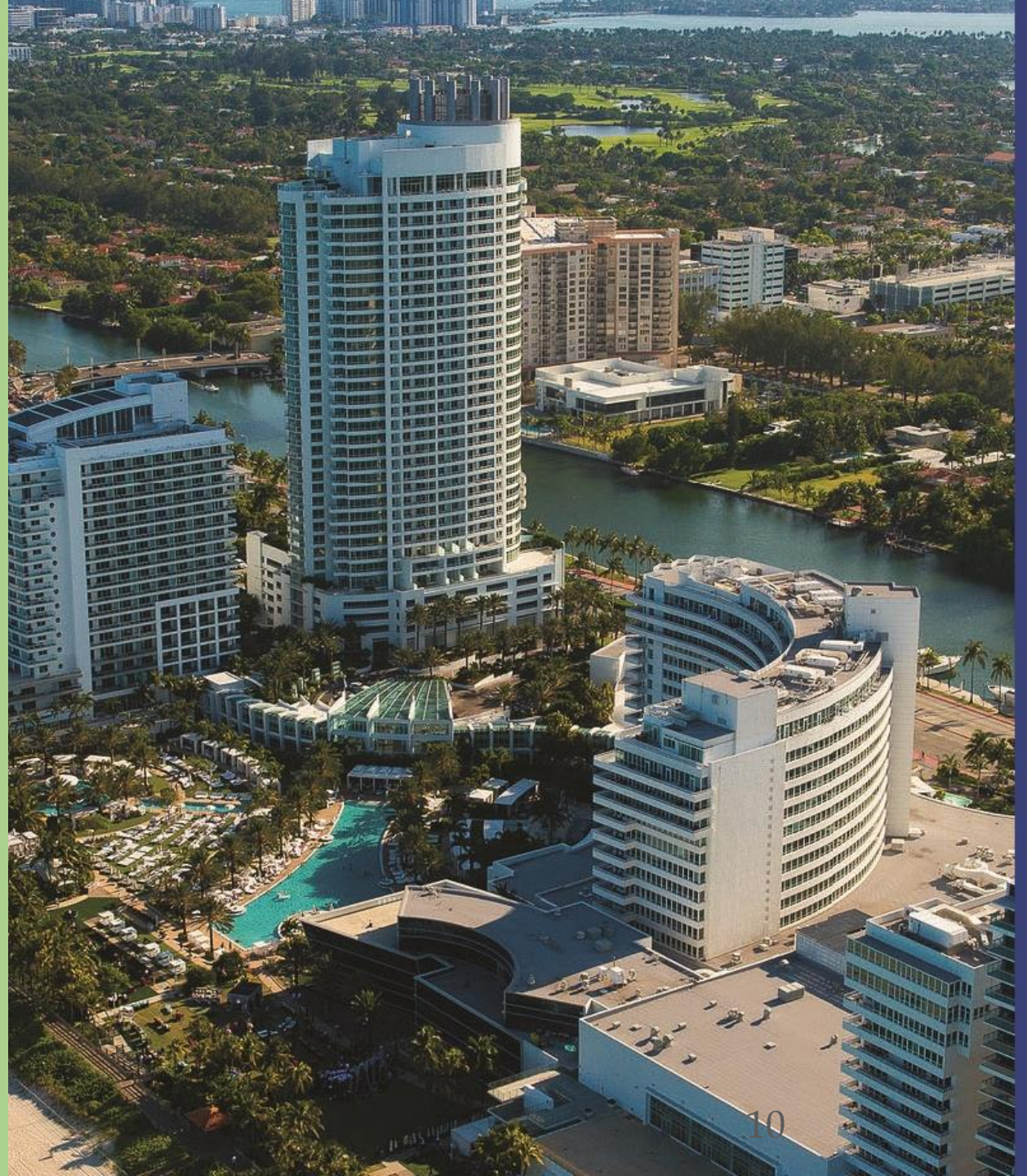**Water System
Master Plan**

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Summary of Existing Water Facilities

Miami Beach is a wholesale water customer of MDWASD

- Interconnects with MDWASD

1: 20-Inch water main on Watson Island (Mac Arthur Causeway)

2: 30-Inch water main on San Marco Island (Venetian Causeway)

3: 36-Inch water main on Julia Tuttle Causeway (Norwood)

4: 36-Inch water main on Normandy Isle (79th Street Causeway)

5: 24-Inch water main on Byron Avenue (Emergency Interconnect)

Existing Water Facilities
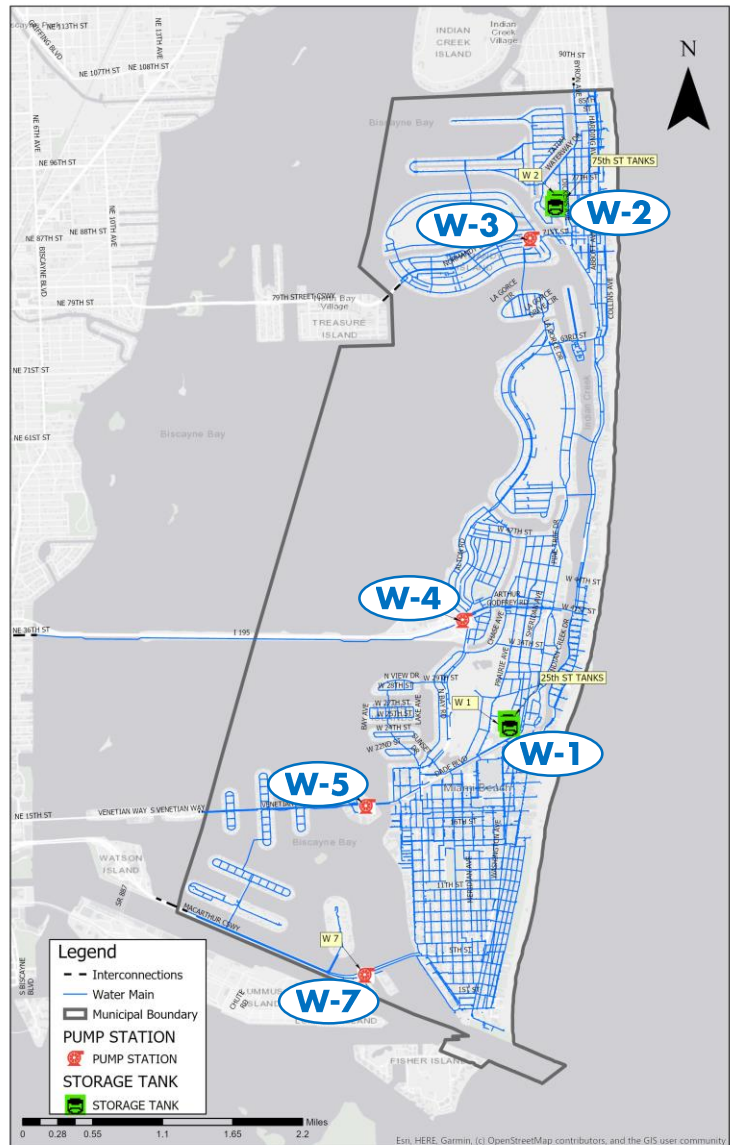
The water pressure is boosted from the MDWASD Interconnects

- Main Facilities

W-1: 45th Street Booster Station and 2 3MG Storage Tanks

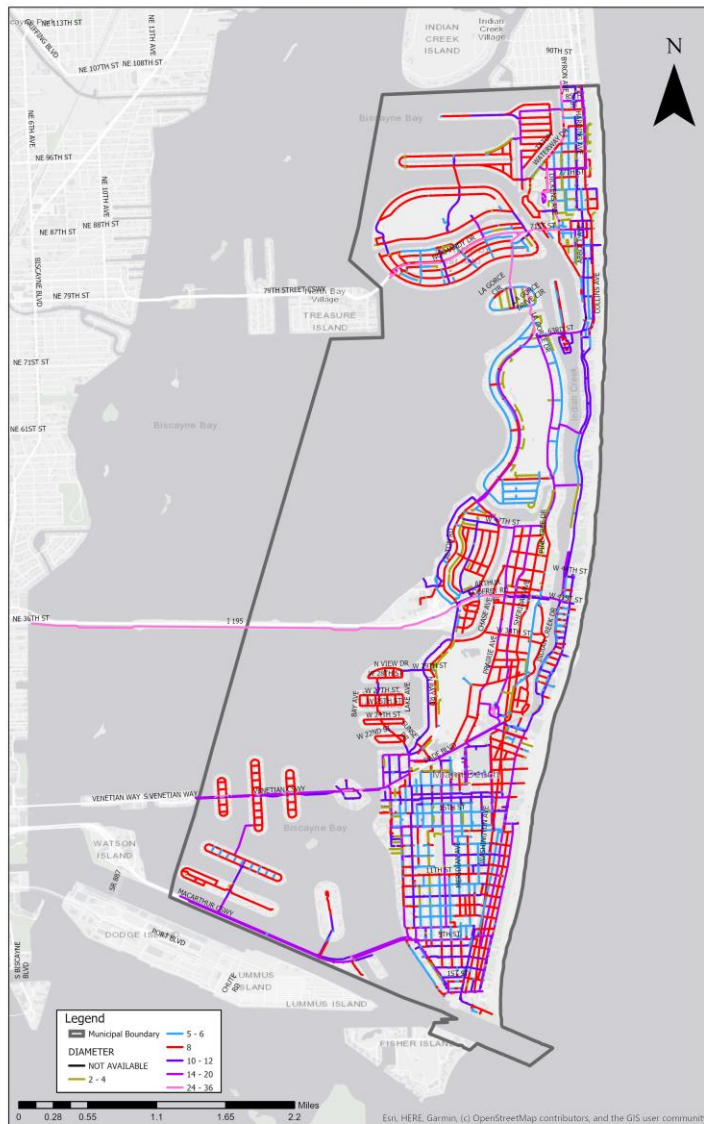W-2: 75th Street Booster Station and 2 4MG Storage Tanks

W-3: Normandy Isle Booster Station
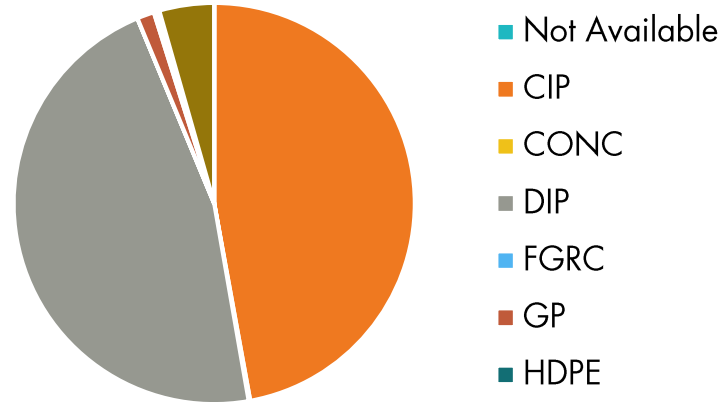
W-4: 41st Street Booster Station

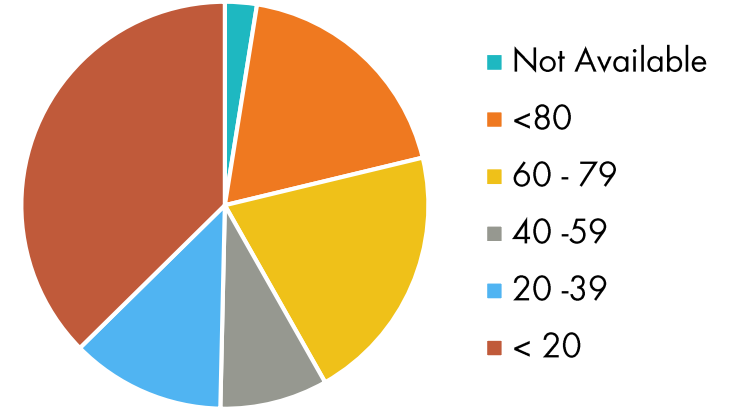W-5: Belle Isle Booster Station

W-7: Terminal Island Booster Station

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Water Distribution Network

Pipe Material

Legend:
- Not Available
- CIP
- CONC
- DIP
- FGRC
- GP
- HDPE

Pipe Age (years)
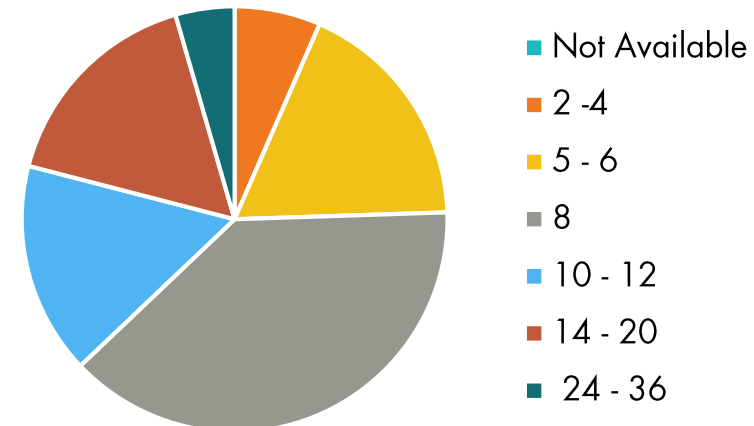
Legend:
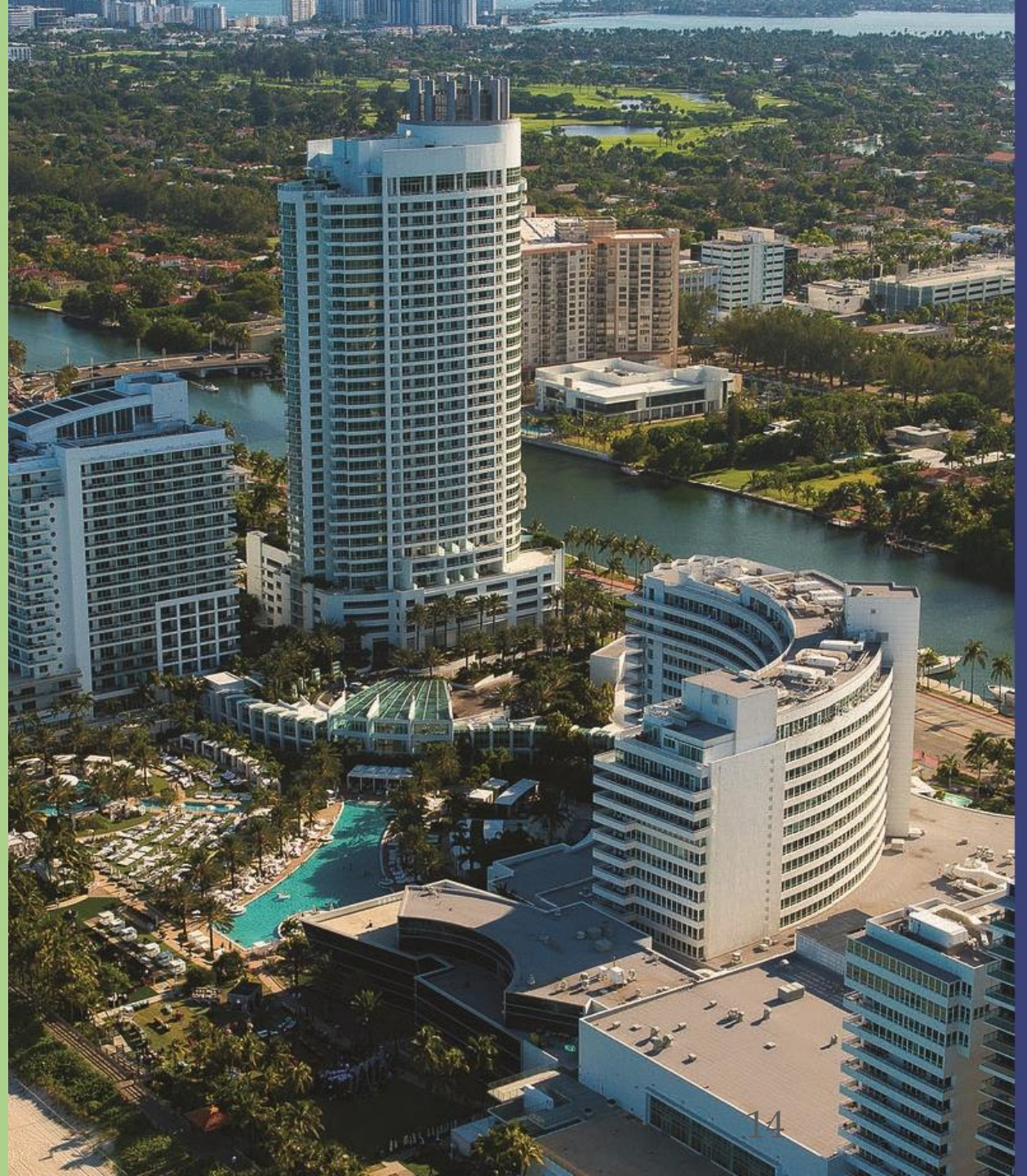- Not Available
- <80
- 60 - 79
- 40 -59
- 20 -39
- < 20

Notes:
FGRC = fiberglass reinforced pipe
GP = galvanized pipe
HDPE = high-density polyethylene
RCP = reinforced concrete pipe

Pipe Diameter (inches)

Legend:
- Not Available
- 2 -4
- 5 - 6
- 8
- 10 - 12
- 14 - 20
- 24 - 36

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# Water Distribution System Hydraulic Model

A dynamic computer model of the City's water system was created using Innovyze InfoWater

- Represents the components of the water system **starting at the points of connection with the MDWASD** system and the downstream pipe network

- **Developed using information from City's GIS database**, as-built records, pump curves, data collected during field visits, and other documentation provided by the City

- **Calibration** was conducted to obtain agreement between observed and model predicted flows and
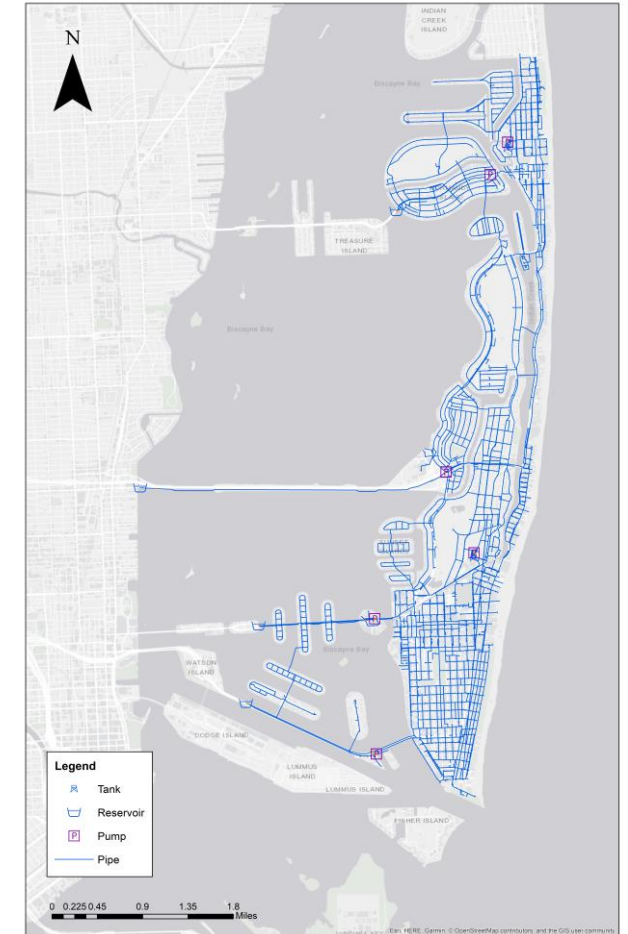
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Water Supply System Evaluation
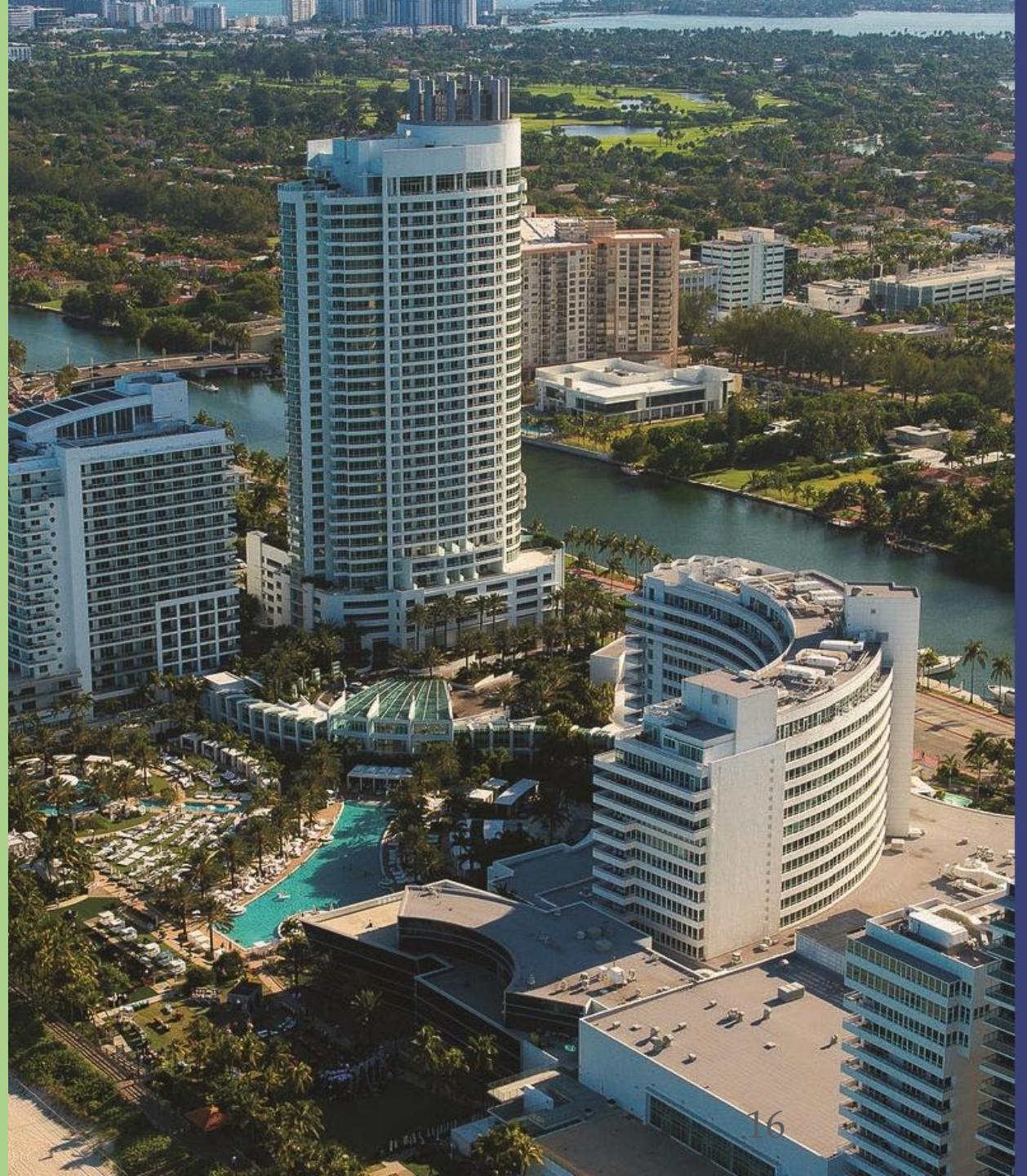
System evaluation conducted using the hydraulic model

Adequate Pressure

- During Maximum Day – Peak Hour Flows
- Pressures >= 35 psi

Fire Flow Adequacy

- Assessed based on land-use
- Assessed large fire events in different parts of the network

Water Age Analysis

- Storage Tank Turnover
- System wide and localized water age evaluation

What-if Scenarios

- 20" pipe from Terminal Island to the Beach Offline
- Alternate supply from Byron Ave

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# The required water flow for fire suppression purposes from fire hydrants based on land use

Land Use Classification	Needed Fire Flow (gpm)
Business and Office	3,000
High Density Residential	3,000
Industrial and Office	3,000
Institutions, Utilities, and Communication	1,000
Low Density Residential	1,000
Low-Medium Density Residential	1,500
Medium Density Residential	2,000
Medium-High Density Residential	2,500
Parks and Recreation	750

A second step in evaluating fire flow availability was carried out evaluating the performance of the water system during a large concentrated fire events at specific locations within the distribution system.
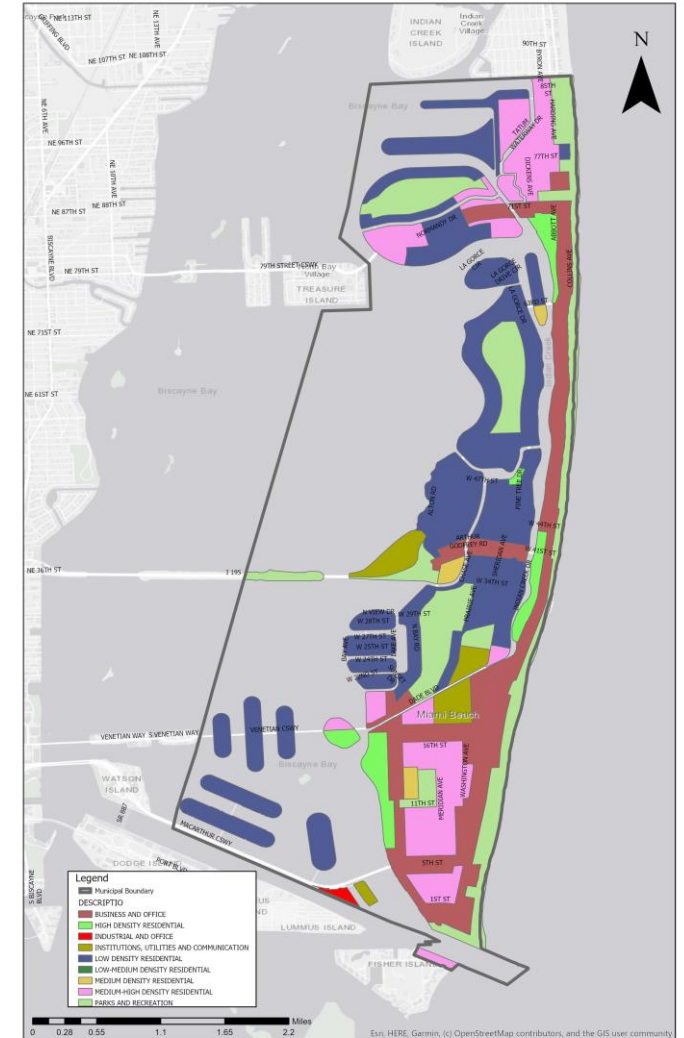
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Risk Assessment and Rehabilitation and Repair (R&R) Projects for Water System Aboveground Assets
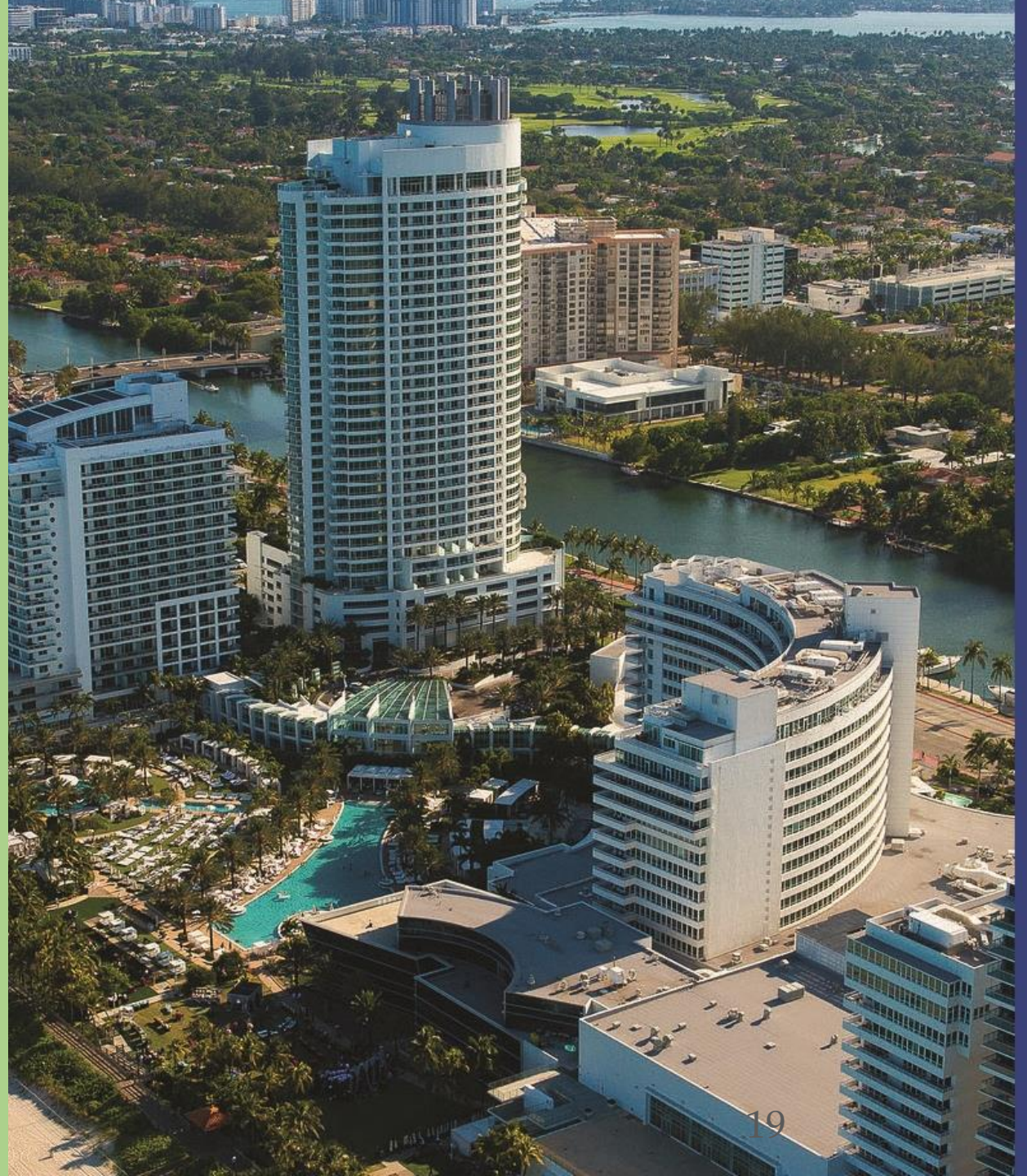
CIP Projects Identified as part of Condition Assessment of Water System Aboveground Assets

- Hazen performed a condition assessment of the major above-ground water and sewer assets

- Pump stations, storage tanks, and aerial crossings were evaluated

- Medium and high critically projects identified:
  - Two aerial crossing replacements : Venetian MacArthur Causeway
 - Six pump station rehabilitations

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Risk Assessment and Rehabilitation and Repair (R&R) Projects for Water System Underground Assets
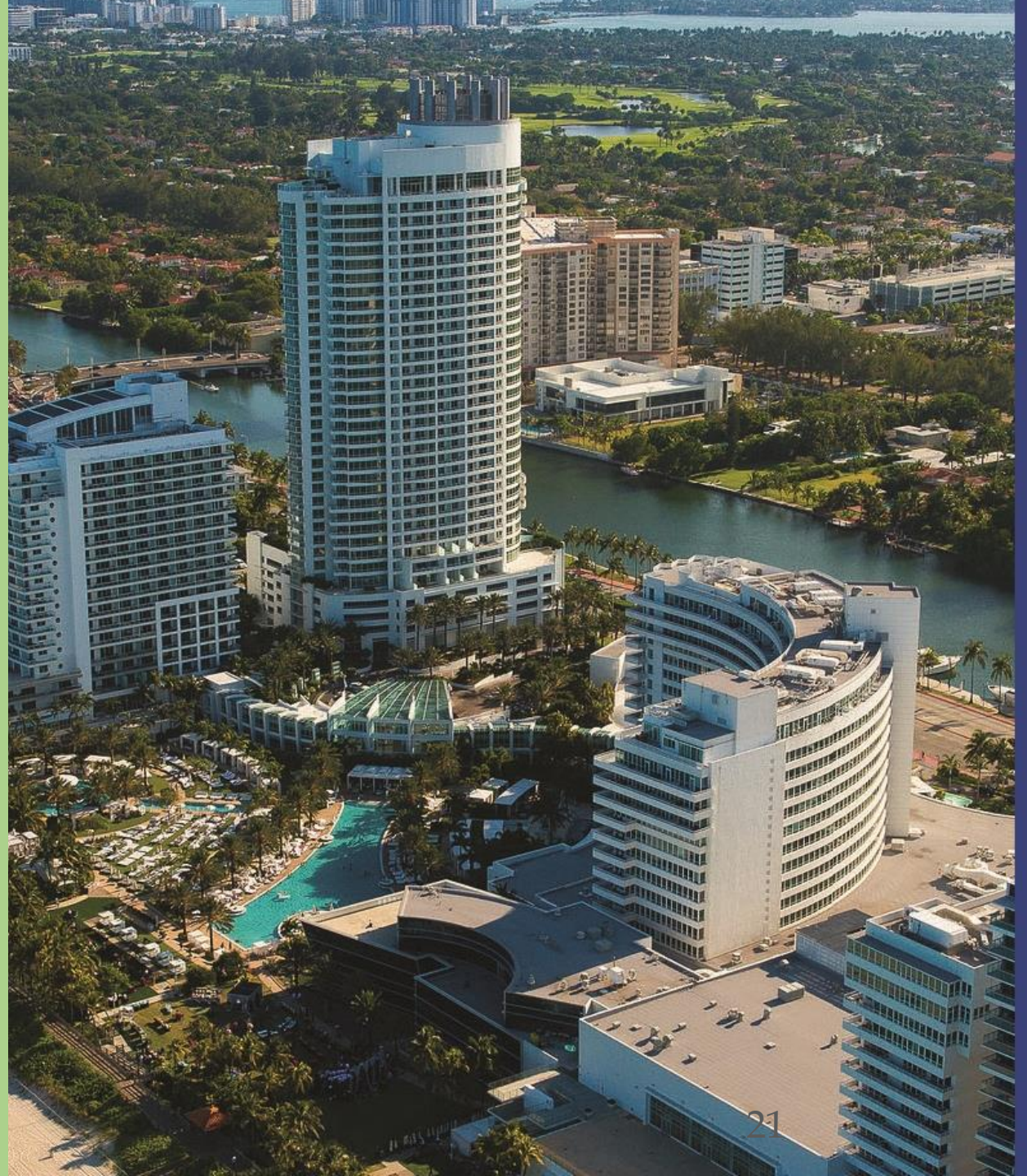
Risk Analysis Project Prioritization for Underground Assets

- R & R Project Prioritization was developed based on a Risk Analysis that combined Consequence of Failure (CoF) and Probability of Failure (PoF) to obtained a combined scored use to rank each project.

- Three levels (Low, Medium and High) were developed for CoF and PoF

Consequence of Failure (CoF)	Low
	Medium
	High

Probability of Failure (PoF)	Low
	Medium
	High

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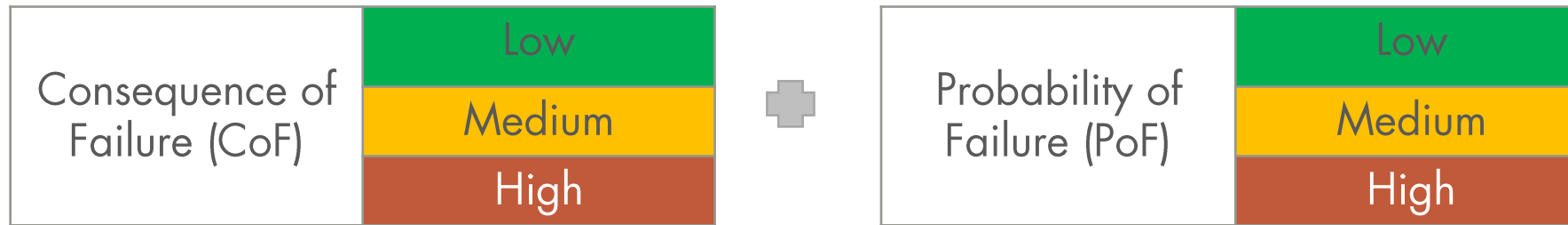
CoF relates to factors such as the cost of repair, social/health impacts, and environmental impacts.

Consequence of Failure Criteria (Weight)	Range or Value	Score
Flow [a] (40%)	< 10 gpm	1
	10 – 50 gpm	2
	50 – 150 gpm	3
	150 – 500 gpm	4
	> 500 gpm	5
Land Use (40%)	Any other Land Use	1
	Business and Offices	5
Proximity to Major Roads (20%)	Other	1
	Collector Roads	2
	Federal / State Roads	3
	Divided Access / Major Roads	4
	Limited Access Roads	5

Note:
[a] 2019 DWF from hydraulic model.

A composite CoF was calculated for each water main segment based on the scores and relative weights presented in the Table.

Consequence of Failure	Composite Score	Total Water Main Length (ft)
Low	< 1.8	452,190
Medium	1.8 – 2.6	198.200
High	> 2.6	323,640

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Water Main Risk Matrix by Length (Feet)

		Probability of Failure (PoF)		
		Low	**Medium**	**High**
Consequence of Failure (CoF)	**High**	158,770 (16%)	46,780 (5%)	118,090 (12%)
	Medium	82,230 (8%)	42,780 (4%)	73,190 (8%)
	Low	222,190 (23%)	28,170 (3%)	201,830 (21%)

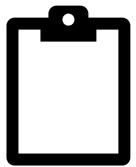|		Probability of Failure (PoF)		
		Low	**Medium**	**High**
Consequence of Failure (CoF)	**High**	Future	2037-2038	2020-2025
	Medium	Future	2039-2042	2026-2032
	Low	Future	2043-2044	2033-2036
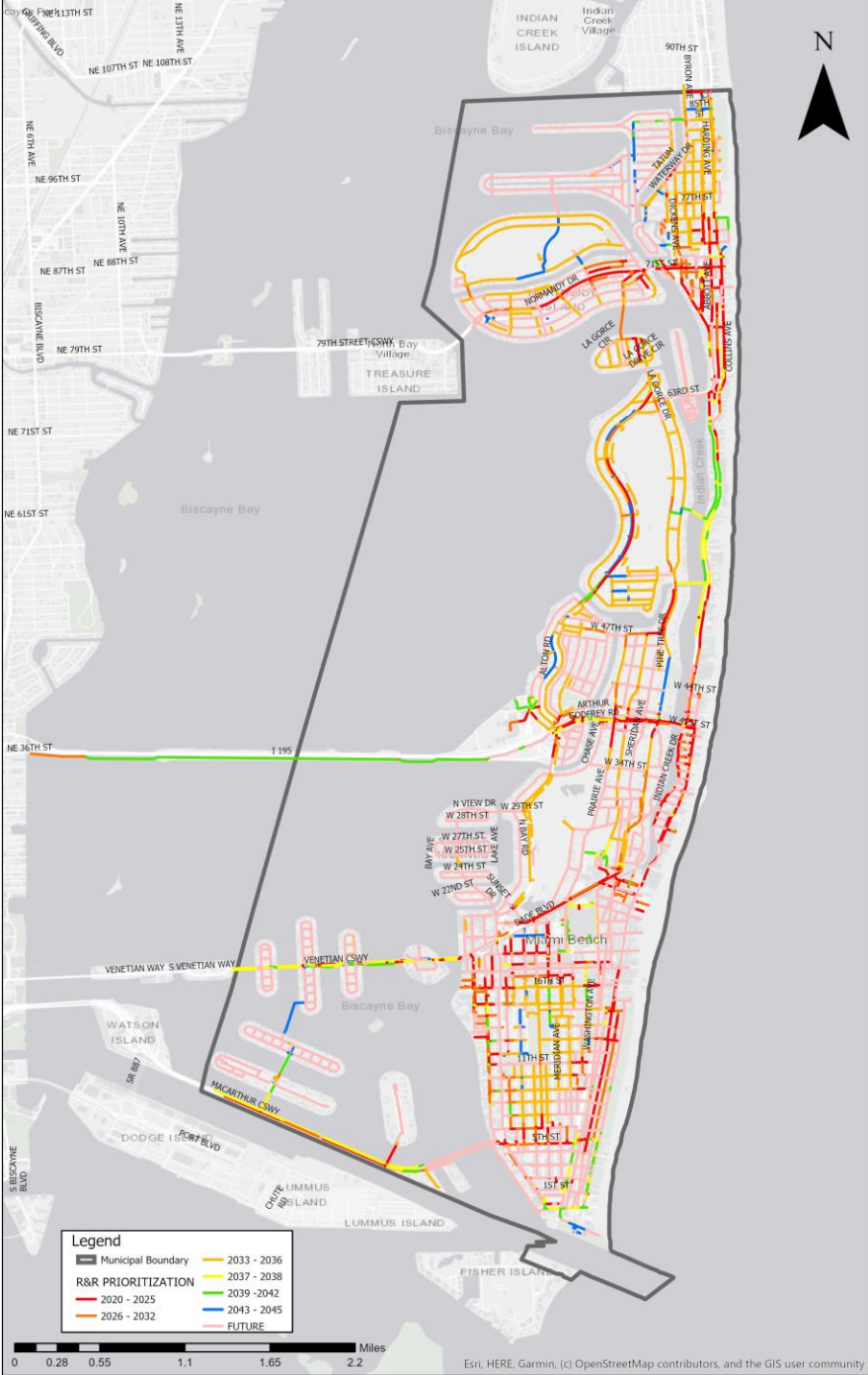
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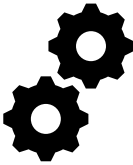# ABOVE

Water System Capital Improvement Program
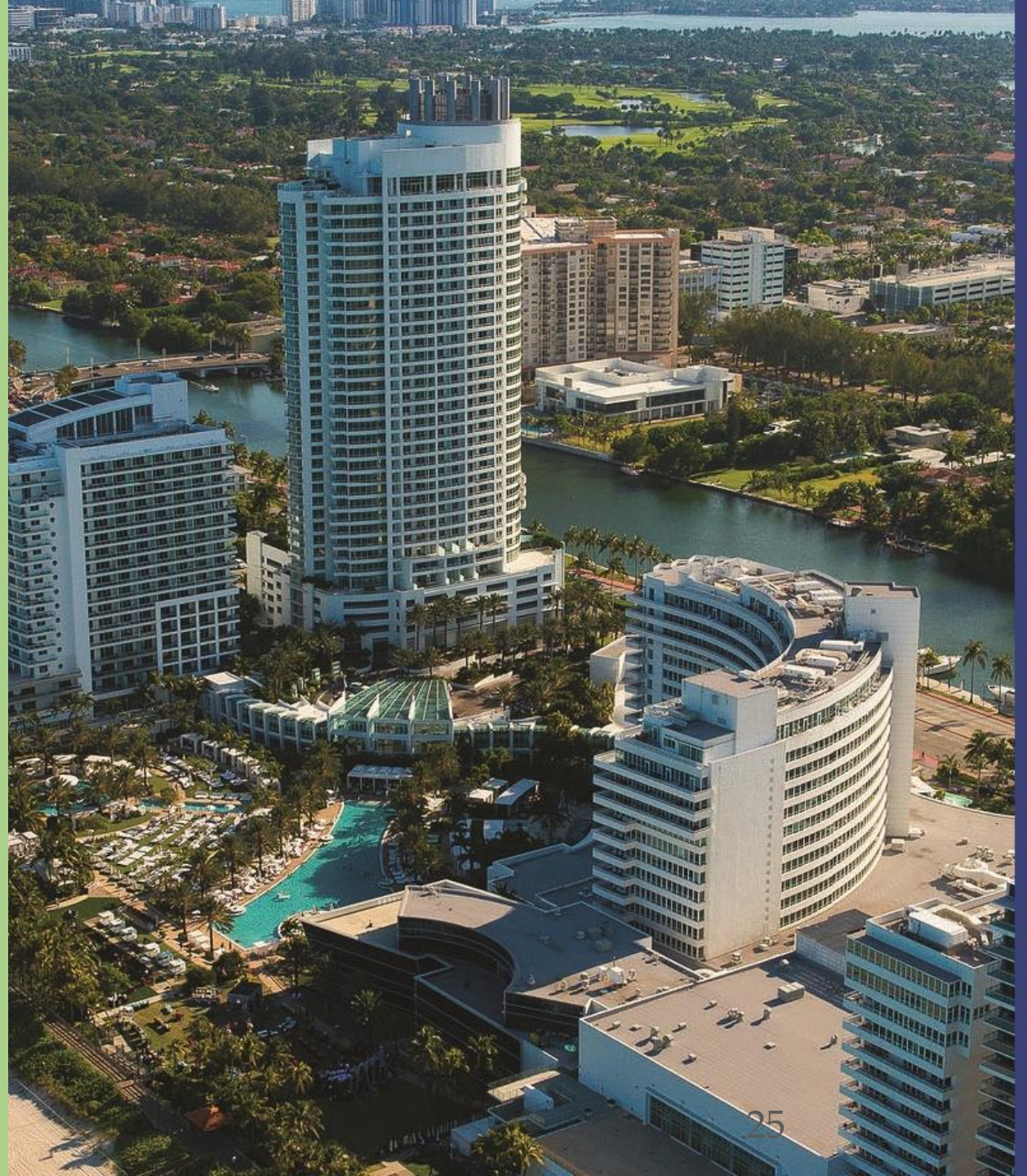
Identified Water System Improvements Based on Evaluation of the Distribution System

48 CIP Projects Identified

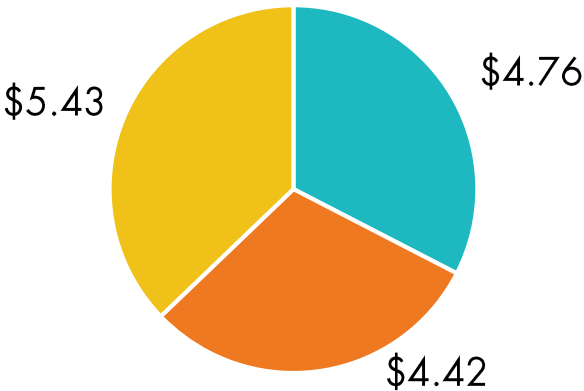**17** Capacity Based Improvements Identified (including improvements for fire flow)
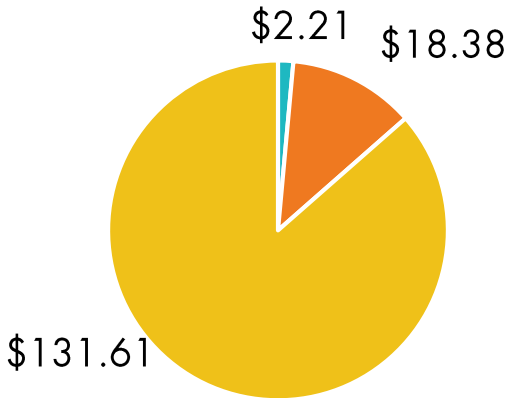
48 R&R Based Improvements Identified

Total CIP Cost Through 2045 = **$167 M**

Capacity Based Improvement Projects
(Total Cost = $ 14.6 M)

$4.76

$5.43

$4.42

- Water Distribution System Projects - Capacity
- Water Supply Projects - Capacity
- Pumping and Storage Facility Projects - Capacity

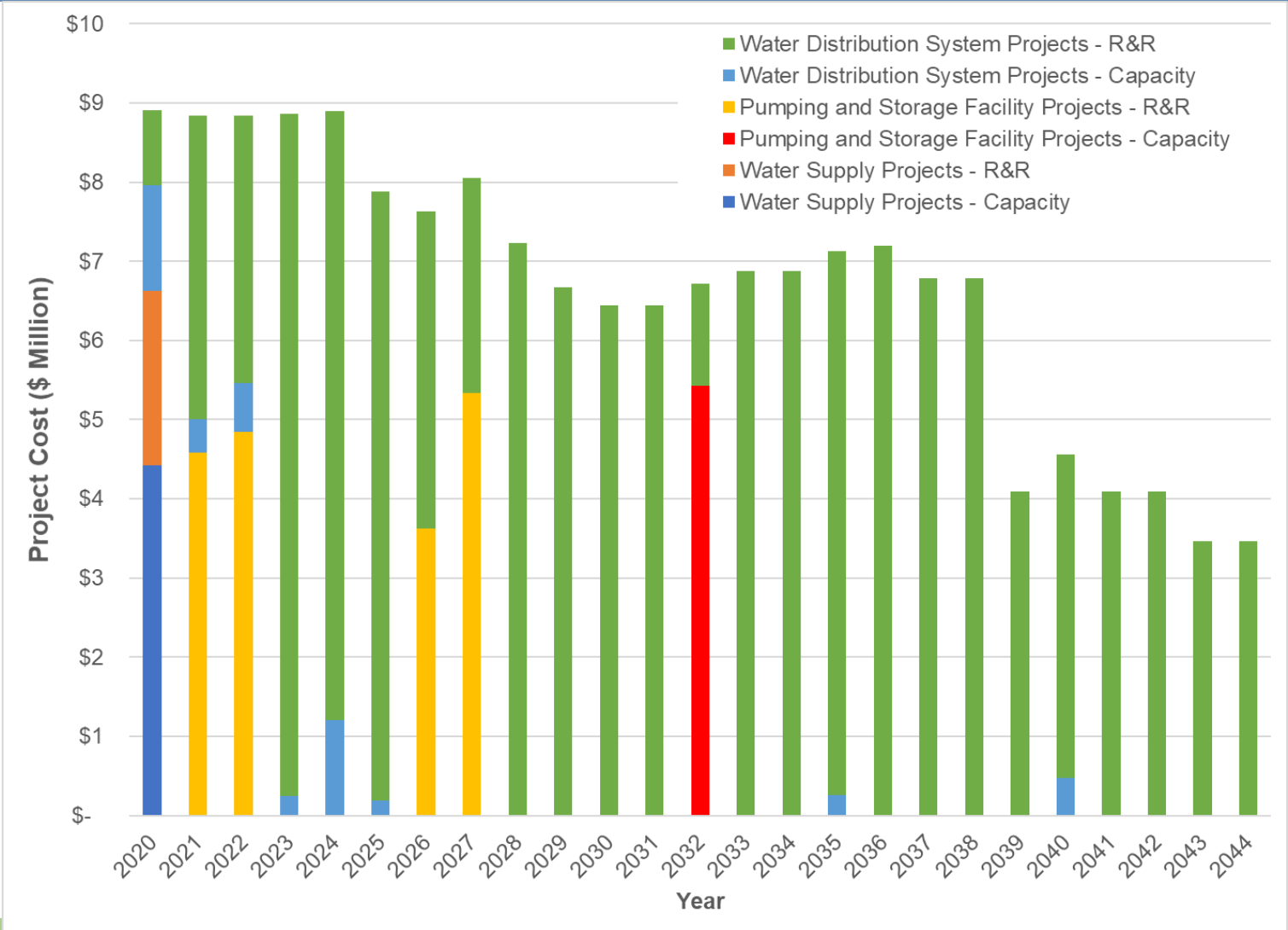## R&R Based Improvement Projects
(Total Cost = $ 152.2 M)

$2.21 $18.38

$131.61

- Water Supply Projects - R&R
- Pumping and Storage Facility Projects - R&R
- Water Distribution System Projects - R&R

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The total cost of the recommended projects in the Water Master Plan is $167 million (2018 dollars):
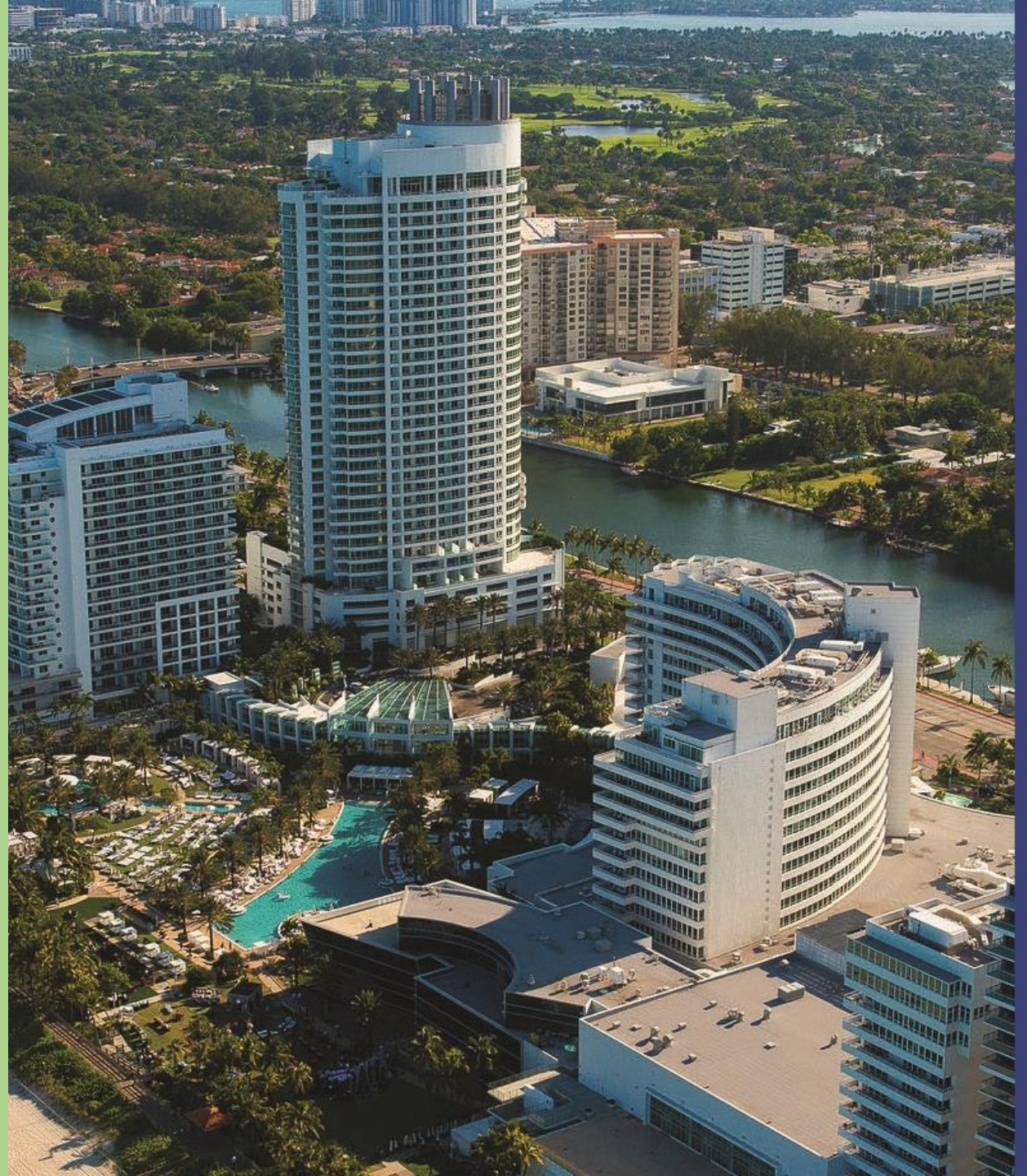
Water System $167M

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Sewer System Master Plan

September 25, 2019

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Summary of Existing Sewer System

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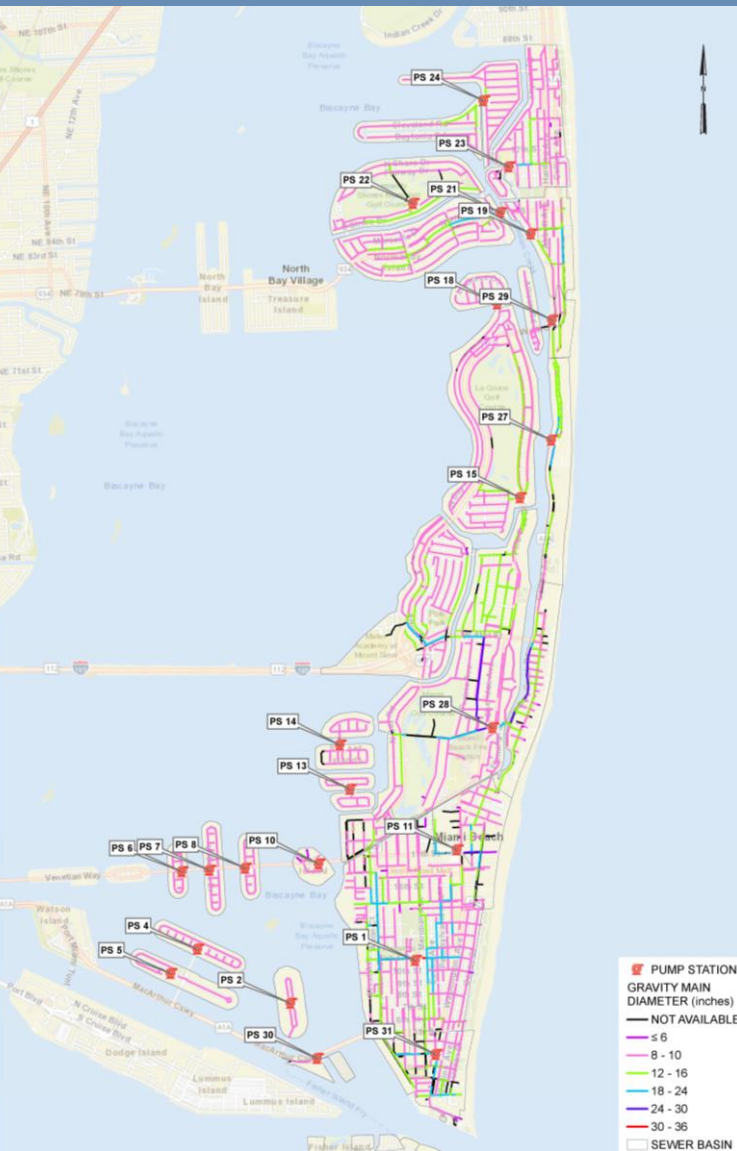
3,100 manholes

117 miles gravity sewer mains

24 miles active force mains

23 pump station service areas (basins)

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Sewer Force Main Network

Pipe Material

- Not Available
- DIP
- HDPE
- CIP
- PCCP
- PVC
- RCP
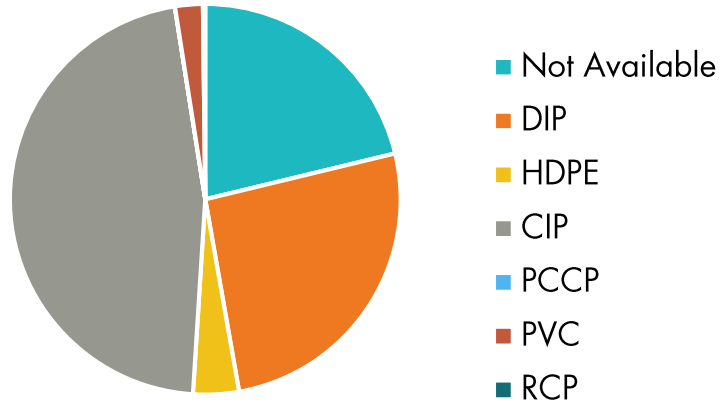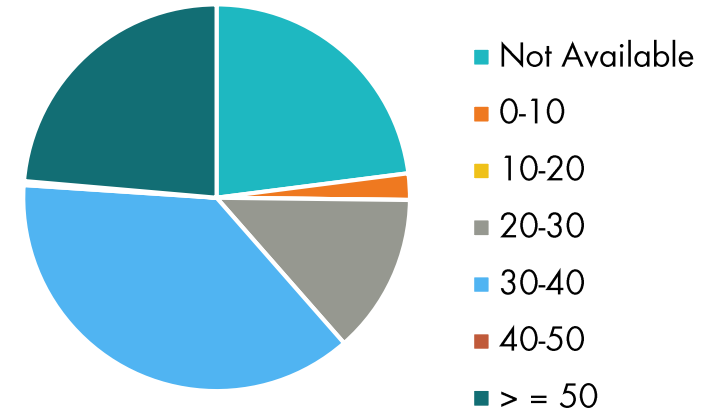
Notes:
CIP = Cast Iron Pipe
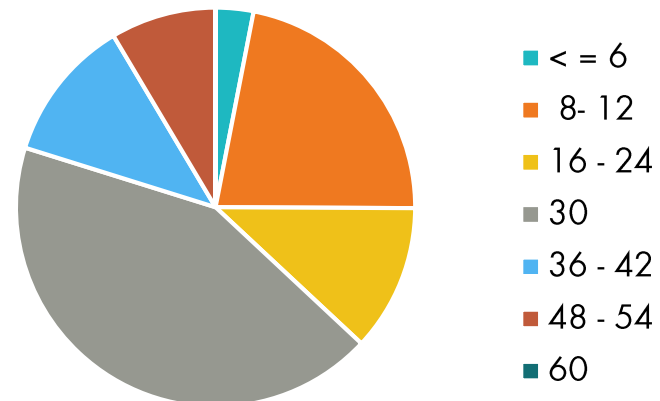DIP = Ductile Iron Pipe
FRP = fiberglass reinforced pipe
HDPE = high-density polyethylene
PCCP = Prestressed Concrete Cylinder Pipe
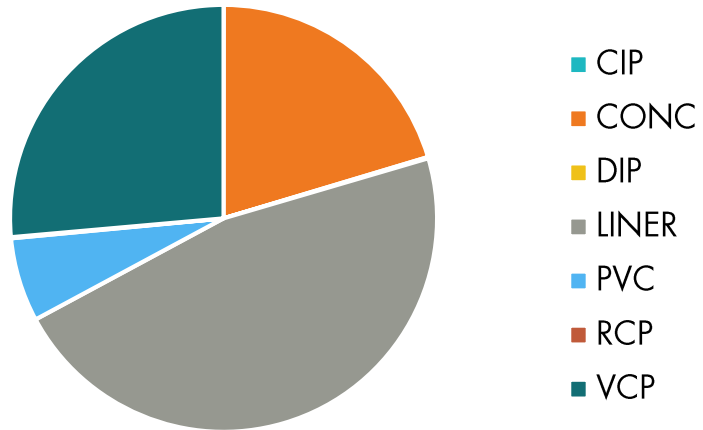PVC = Polychloride Vinyl Pipe
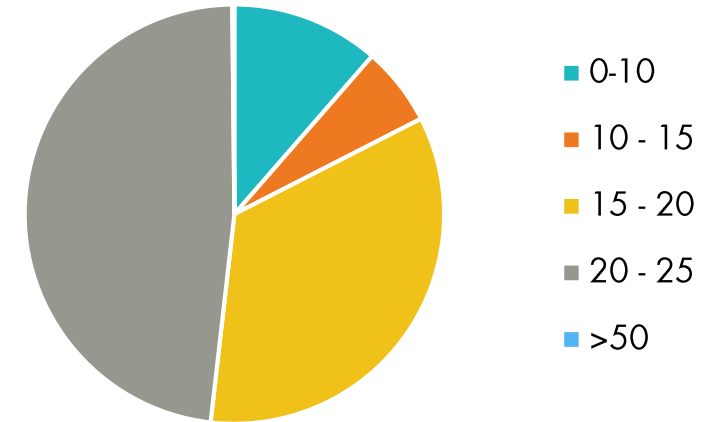RCP = reinforced concrete pipe

Pipe Age (years)

- Not Available
- 0-10
- 10-20
- 20-30
- 30-40
- 40-50
- > = 50

Pipe Diameter (inches)

- < = 6
- 8- 12
- 16 - 24
- 30
- 36 - 42
- 48 - 54
- 60

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Sewer Gravity Main Network

Pipe Material

- CIP
- CONC
- DIP
- LINER
- PVC
- RCP
- VCP

Pipe Age (years)

- 0-10
- 10 - 15
- 15 - 20
- 20 - 25
- >50
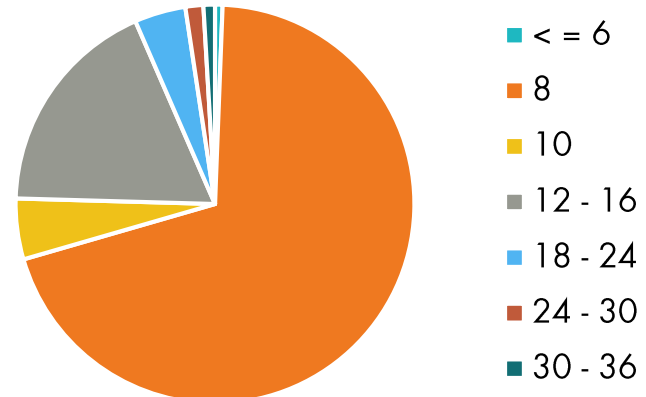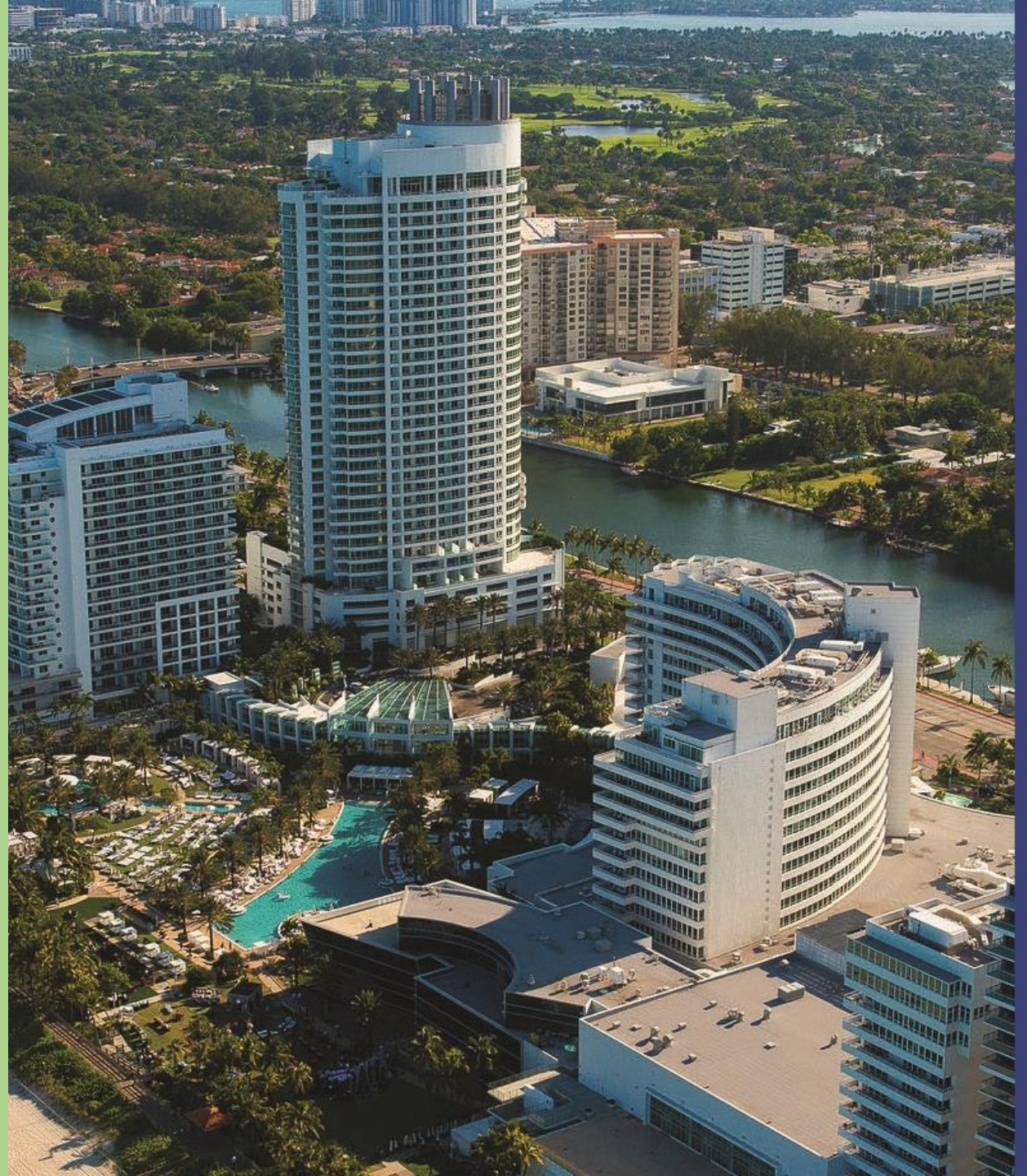
Notes:
CIP = Cast Iron Pipe
CONC = Concrete
DIP = Ductile Iron Pipe
PVC = Polychloride Vinyl Pipe
RCP = reinforced concrete pipe
VCP = Vitrified Clay Pipe

Pipe Diameter (inches)

- < = 6
- 8
- 10
- 12 - 16
- 18 - 24
- 24 - 30
- 30 - 36

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Force Main Hydraulic Model

The hydraulic model was used to perform extended period simulations to predict the following:

- Sanitary flow through all infrastructure components in network

- Hydraulic pressures at any point in the force main system

- Pumping capacity of each pump station

- Pumping capacity with standby pump out of service

- Pump station operating wet well levels

- Likelihood and location of SSOs
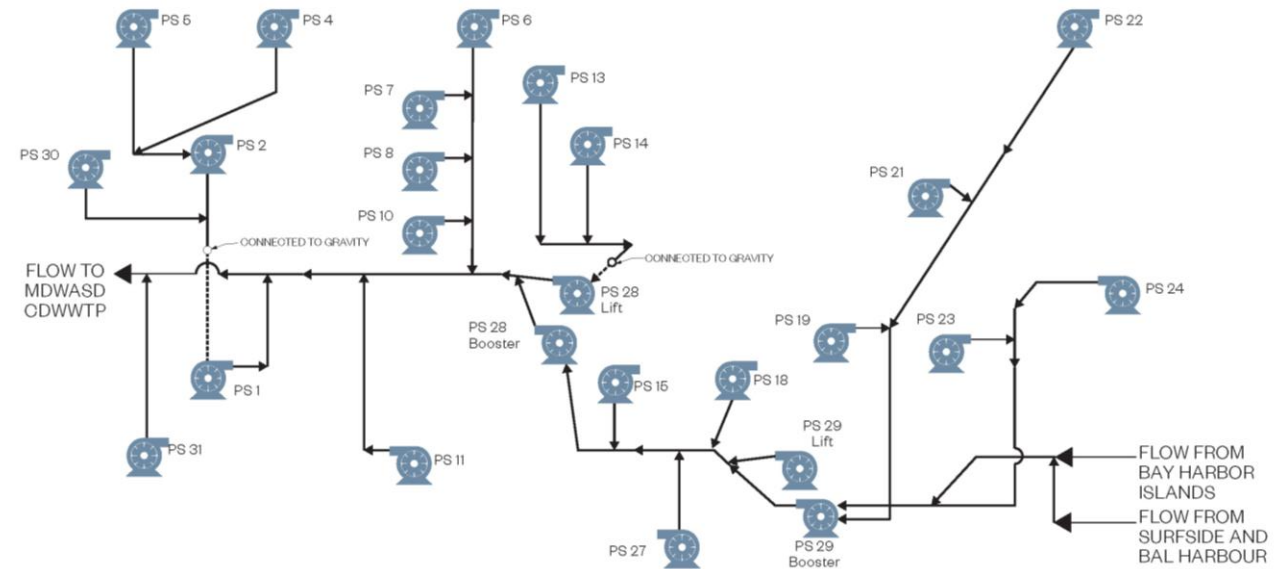
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Evaluation of Sewer System Improvement Needs

|	Recommended Capacity Improvement Projects		
ID	Project Name	Recommended Project Description	Timeframe
4	Pump Station 2 parallel force main	Install parallel 10-inch force main (subaqueous crossing).	2020 - 2024
5	Pump Station 4 parallel force main	Install parallel 6-inch force main.	2020 - 2024
6	Pump Stations 4 and 5 parallel force main	Install parallel 8-inch force main.	2020 - 2024
7	Pump Station 14 parallel force main	Install parallel 8-inch force main.	2020 - 2024
8	Pump Station 18 parallel force main	Install parallel 8-inch force main.	2020 - 2024
9	Pump Station 23 parallel force main	Install parallel 16-inch force main.	2020 - 2024
10	Pump Station 27 parallel force main	Install parallel 10-inch force main.	2020 - 2024
11	North Beach parallel force main and interconnect	Install parallel 16-inch force main and interconnect from interconnection with Bal Harbour to 16-inch force main on Harding Avenue at 85th Street. (Add interconnection between 16-inch parallel force mains.)	2030-2034
12	Pump Stations 6, 7, and 8 flow rerouting	Reroute flow so that the flow from Pump Stations 6, 7, and 8 is repumped by Pump Station 10.	2020 - 2024 [a]

Note:
[a] Pump Station 6 wet well level set points are not exceeded until 2025, but Pump Stations 6, 7 and 8 all discharge to the same force main, so Pump Station 6 will be rerouted at the same time as Pump Stations 7 and 8.

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Risk Assessment and Rehabilitation and Repair (R&R) Projects for Sewer Aboveground Assets
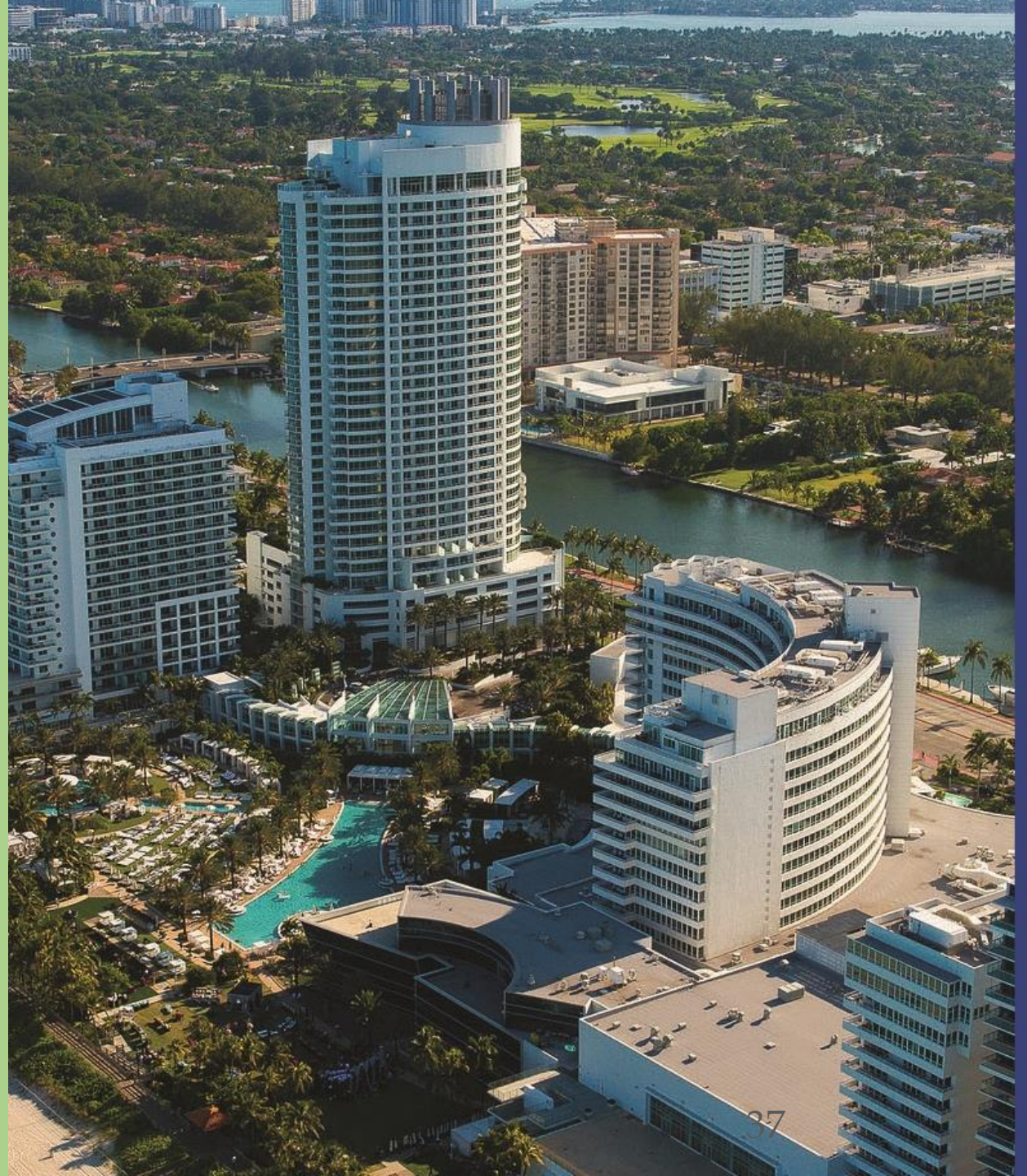
CIP Projects Identified as part of Condition Assessment of Sewer System Aboveground Assets

The *Water and Sewer Renewal and Replacement Report* (Hazen, 2018) evaluated the aboveground assets (pump stations and aerial crossings) based on criticality
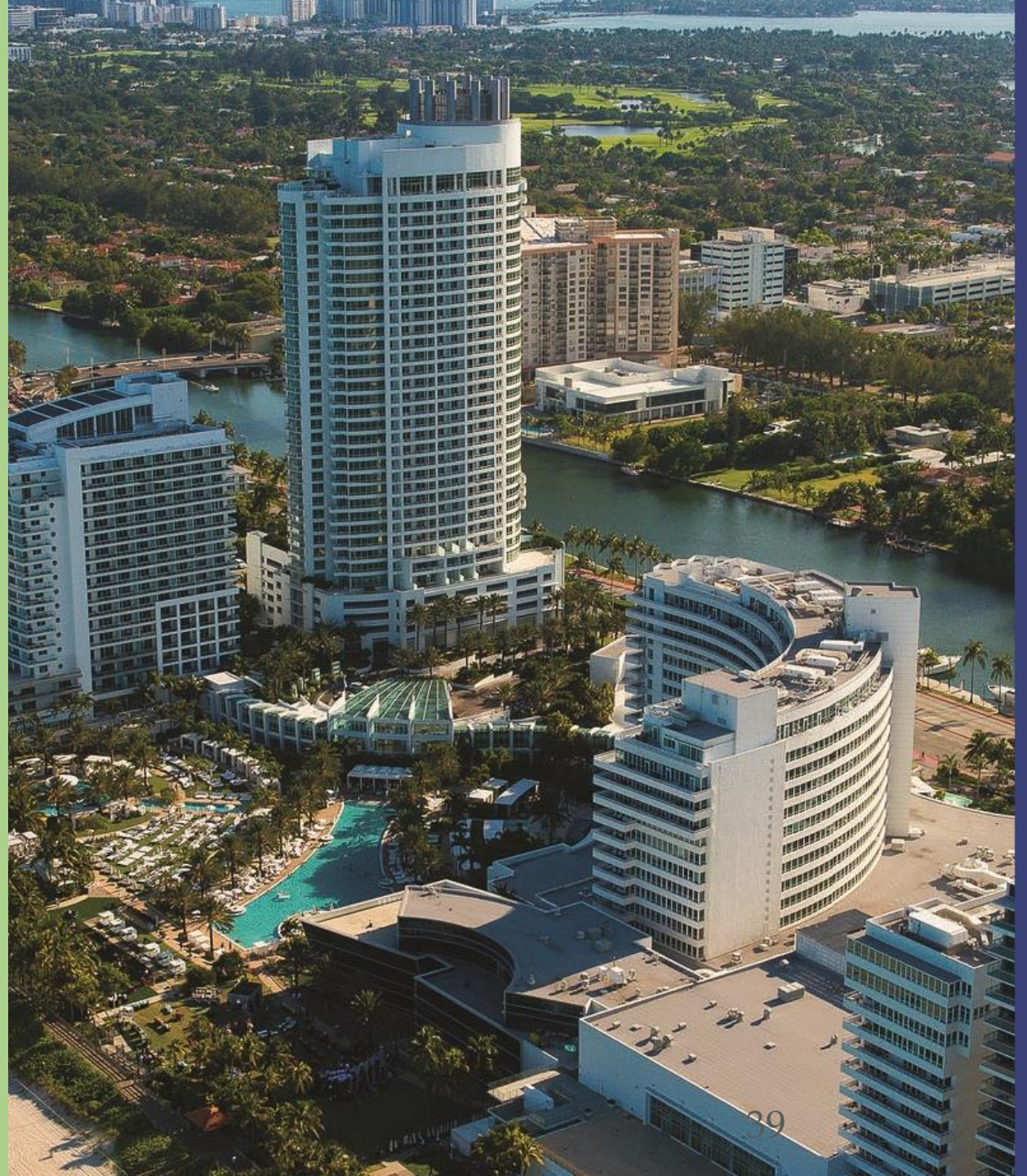
Six (6) High Criticality Projects identified

Eight (8) Medium Criticality Projects identified

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Risk Assessment and Rehabilitation and Repair (R&R) Projects for Sewer Underground Assets
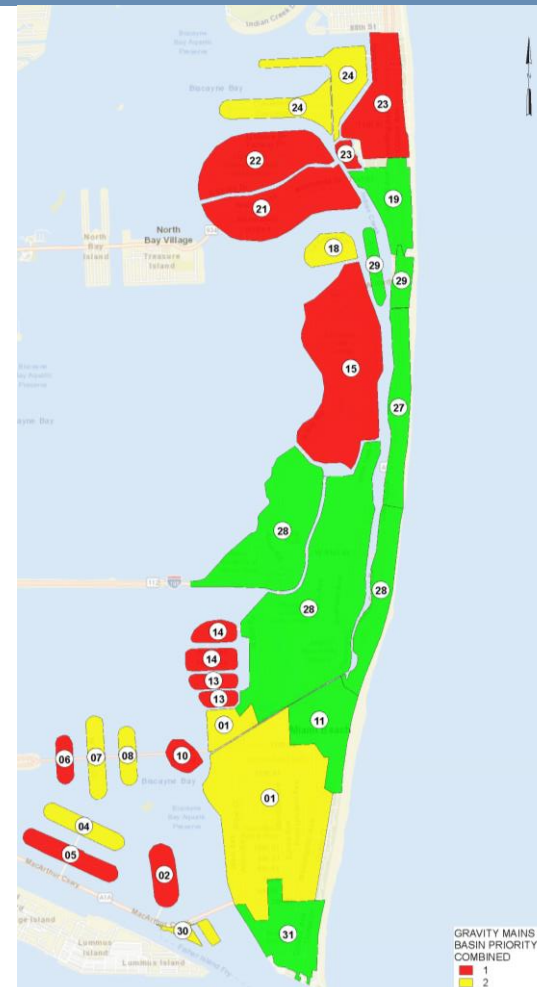
a) Basins selected based on GPDIM

+

b) Basins selected based on RUL

=

c) Basins selected for I/I improvements in the Master Plan

- The Collection System was evaluated using GIS and historical flow data available.

- Basins selected based on Gallons per Day per Inch-Mile (GPDIM) greater than 5,000 were combined with basins selected based on the remaining useful life (RUL) to obtain the recommended basin prioritization in the Master Plan.

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Evaluation of Sewer Underground Assets - Risk Analysis Project Prioritization
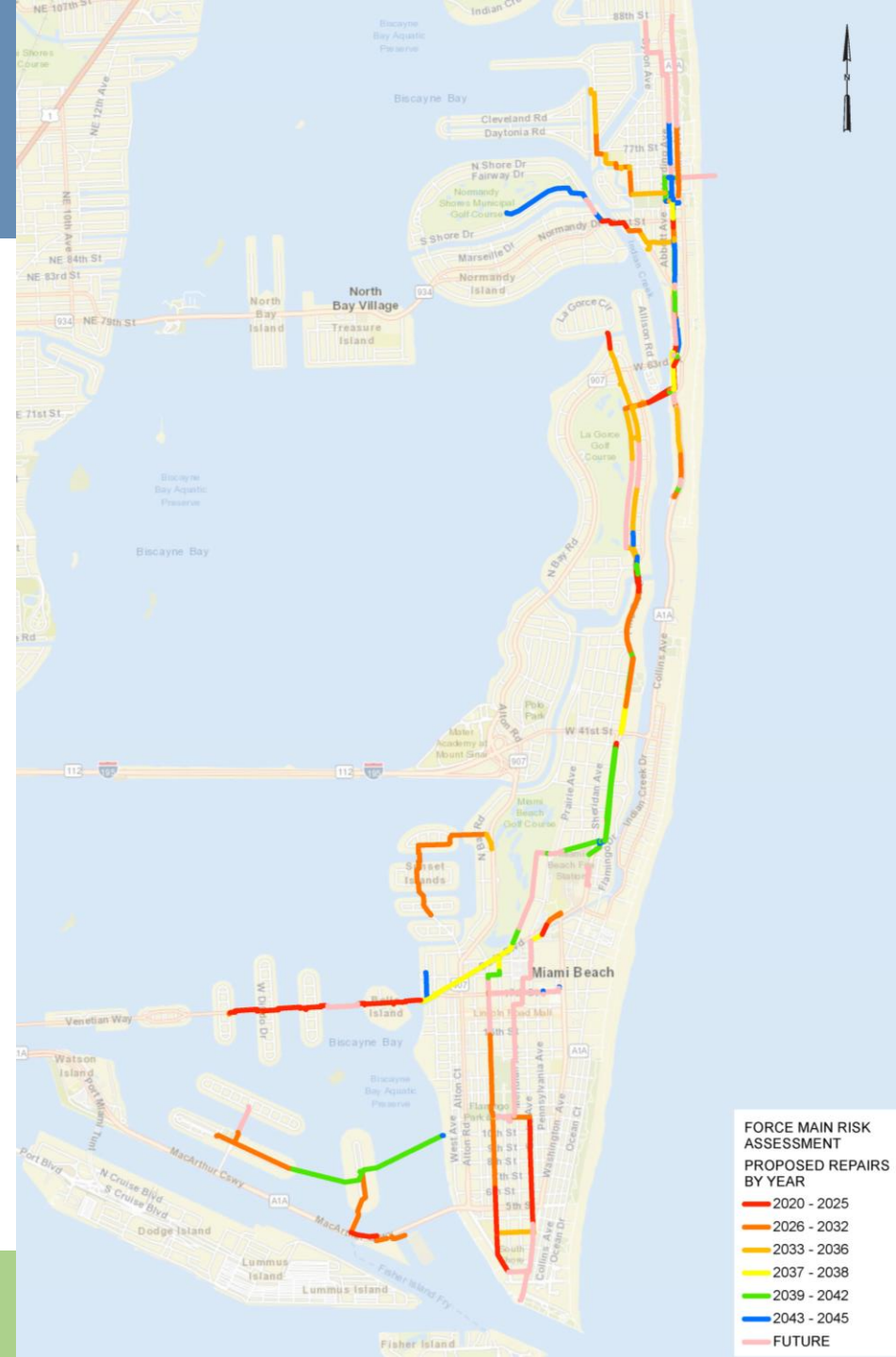
- R & R Project Prioritization was developed based on a Risk Analysis that combined Consequence of Failure (CoF) and Probability of Failure (PoF) to obtained a combined scored use to rank each project.

- Three levels (Low, Medium and High) were developed for CoF and PoF

Consequence of Failure (CoF)	Low
	Medium
	High

Probability of Failure (PoF)	Low
	Medium
	High

MIAMIBEACH
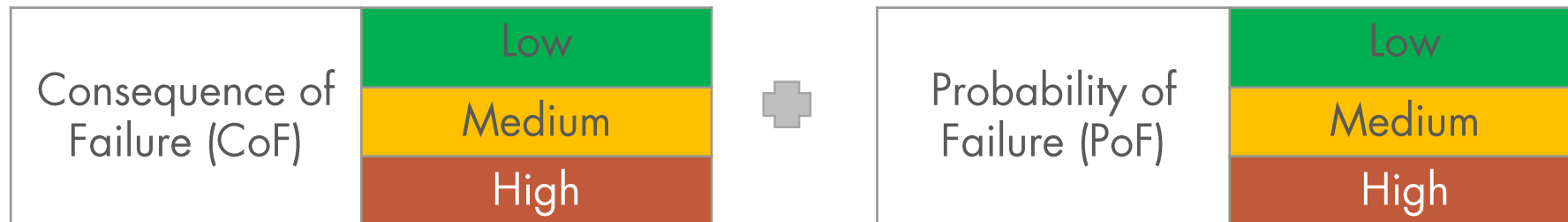
After both Sewer System PoF and CoF ratings were combined in 3x3 matrix

Probability of Failure (PoF)

Consequence of Failure (CoF)		Low	Medium	High
	High	5,000 (4%)	10,000 (8%)	18,000 (14%)
	Medium	12,000 (10%)	18,000 (14%)	28,000 (22%)
	Low	10,000 (8%)	9,000 (7%)	16,000 (13%)

Probability of Failure (PoF)

Consequence of Failure (CoF)		Low	Medium	High
	High	Future	2037-2038	2020-2025
	Medium	Future	2039-2042	2026-2032
	Low	Future	2043-2044	2033-2036

FORCE MAIN RISK ASSESSMENT
PROPOSED REPAIRS BY YEAR
- 2020 - 2025
- 2026 - 2032
- 2033 - 2036
- 2037 - 2038
- 2039 - 2042
- 2043 - 2045
- FUTURE

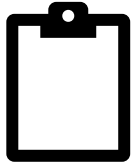MIAMIBEACH
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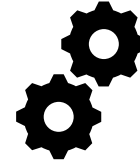# Sewer System Capital Improvement Program

Summary of Sewer System Recommended Improvements

64 CIP Projects Identified

9 Capacity Based Improvements Identified

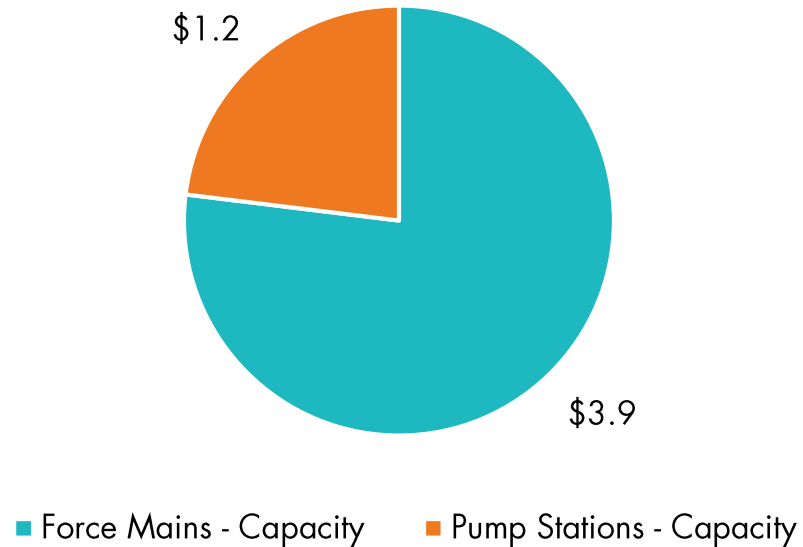**55** R&R Based Improvements Identified
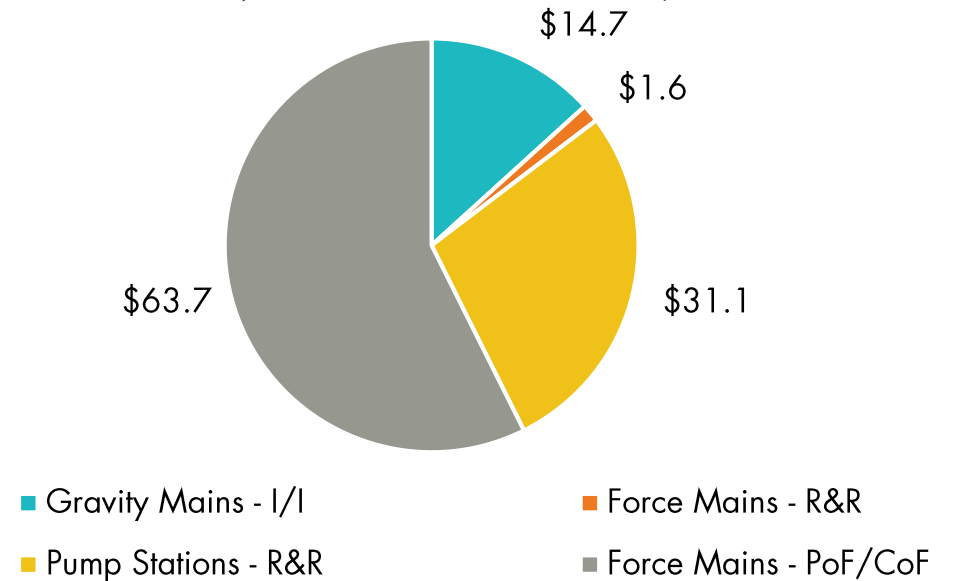
Total CIP Cost Through 2045 = **$116 M**

## Capacity Based Improvement Projects
(Total Costs = $ 5 M)

$1.2

$3.9

- Force Mains - Capacity
- Pump Stations - Capacity

R&R Based Improvement Projects
(Total Costs = $ 111.1 M)

$14.7

$1.6

$63.7

$31.1

- Gravity Mains - I/I
- Force Mains - R&R
- Pump Stations - R&R
- Force Mains - PoF/CoF

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The total cost of the Sewer System recommended projects in the Master Plan is $116 million (2018 dollars):

Sewer System $116M
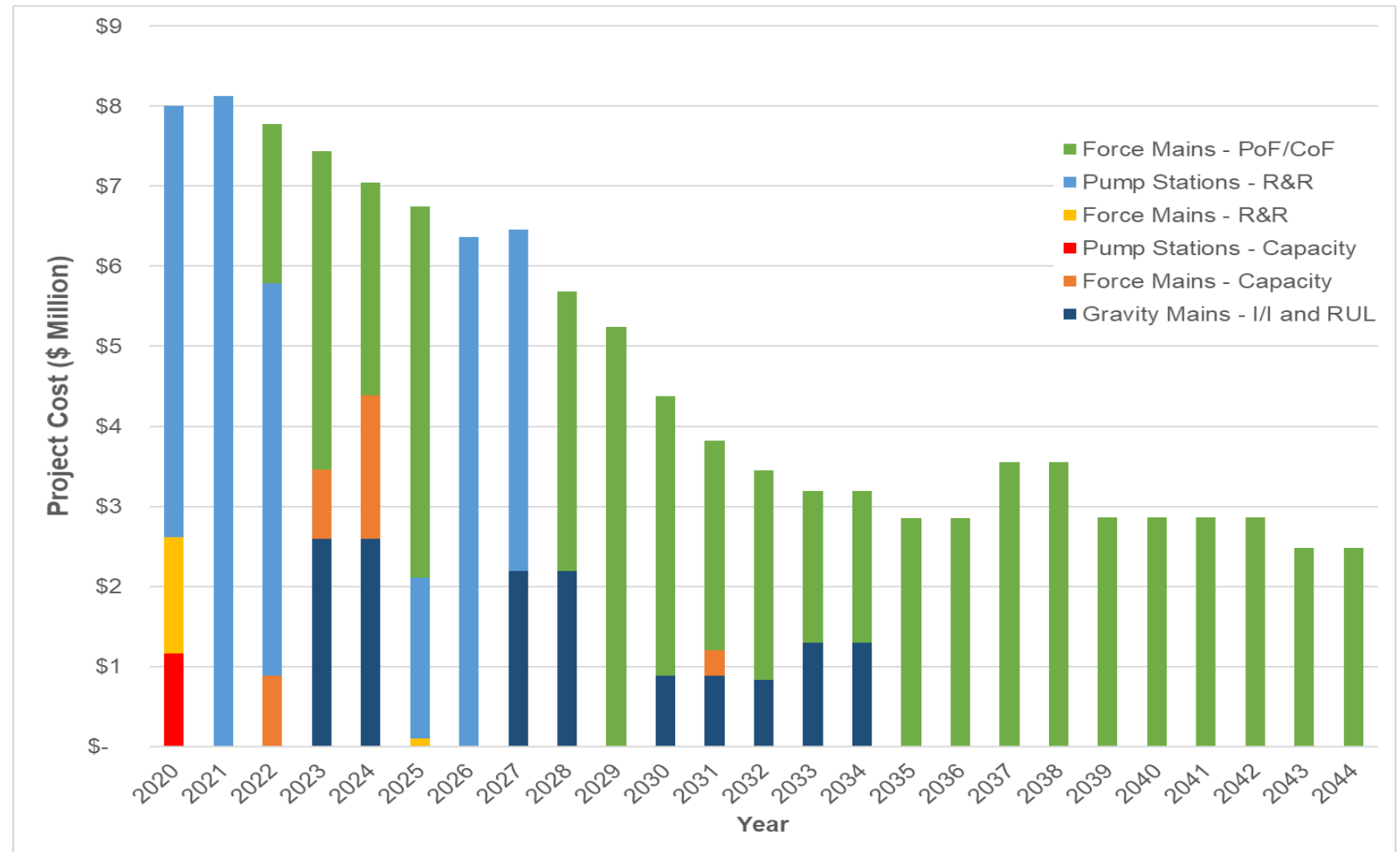
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RISING ABOVE

Questions/Comments