Water Infrastructure Investments: Strategies to Improve Your County's Resilience

National Association of Counties
December 19, 2016

Stronger Counties. **Stronger America.**

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- This box can collapse so that you can better view the presentation. To unhide the box, click the arrows on the top left corner of the panel.
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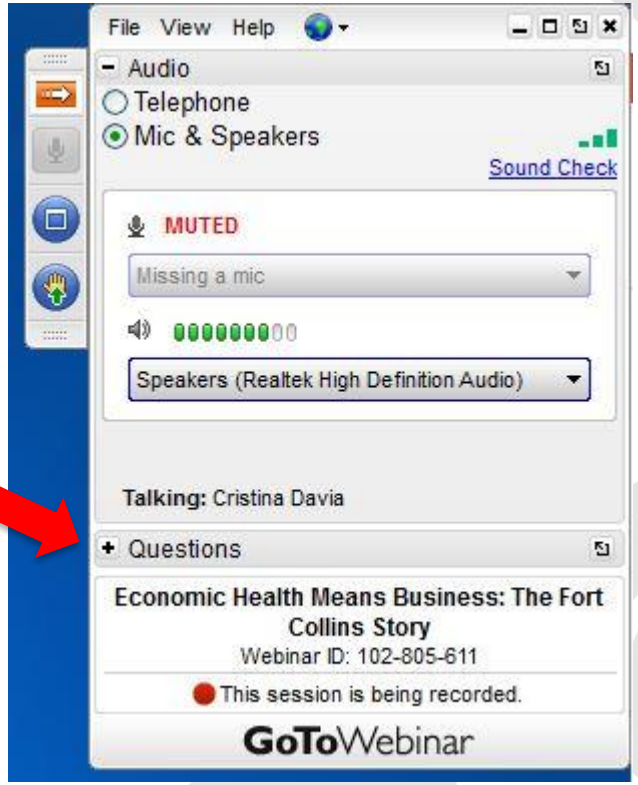

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Water Infrastructure Investments: Strategies to Improve Your County's Resilience

National Association of Counties
December 19, 2016

Stronger Counties. **Stronger America.**

Today's Speakers

Adam Ortiz
Director
Department of the Environmental for Prince George's County

Hardeep Anand, P.E.
Deputy Director
Miami Dade Water & Sewer Department

Laurens Vander Tak
VP and Technology Fellow
CH2M, Water Resources and Ecosystems Management

Today's Moderator

Terry Martin
Senior Water Accounts Manager
Esri

Green Infrastructure and Green Stormwater Infrastructure

GIS Tools:

Context, Analysis, Connectivity, Understanding, Site Suitability, Planning, Implementation, Management, and Evaluation

Terry Martin (tmartin@esri.com) & Ryan Perkl (rperkl@esri.com)

Green Infrastructure Definitions:

Florida: Corridors of Green Infrastructure as ecosystem services for water quantity and quality

EPA: Green Infrastructure as constructed features that mimic the ecosystem services with regard to water, stormwater, and waste water infrastructure

Mind The Gap:

Connectivity

Context

Localization

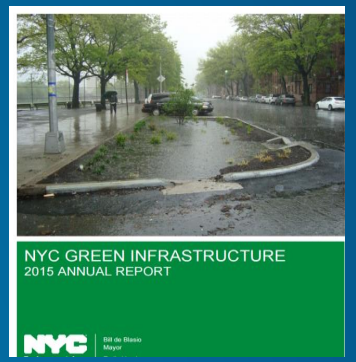
Prioritization

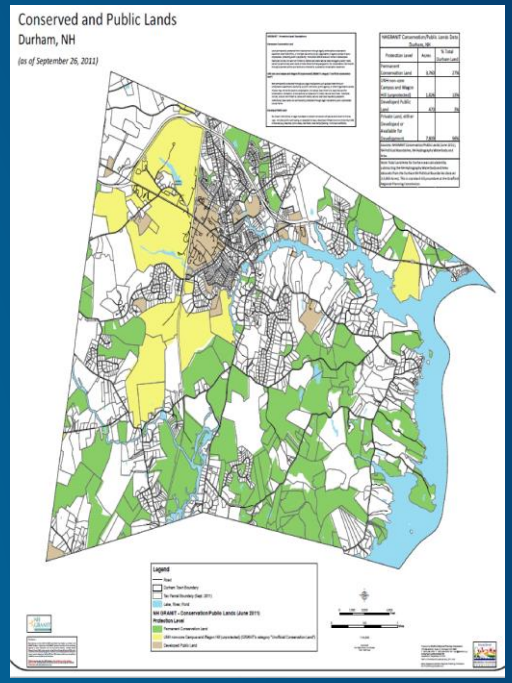
Site Suitability

Management

Evaluation

Standardization





Planning and Engineering Brought Together

Natural Systems

Regional Scale

Two Scales Green Infrastructure

When rain falls in natural, undeveloped areas, the water is absorbed and filtered by soil and plants. Stormwater runoff is cleaner and less of a problem than in cities.

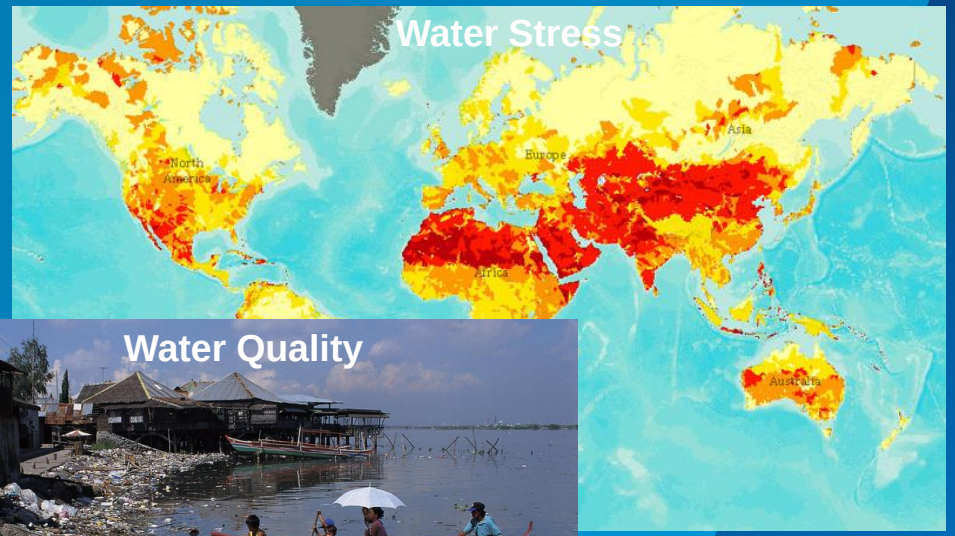
Green infrastructure uses vegetation, soils, and other elements and practices to manage water quality naturally. At the large scale, green infrastructure is a patchwork of natural areas that provide habitat, flood protection, cleaner air, and cleaner water.

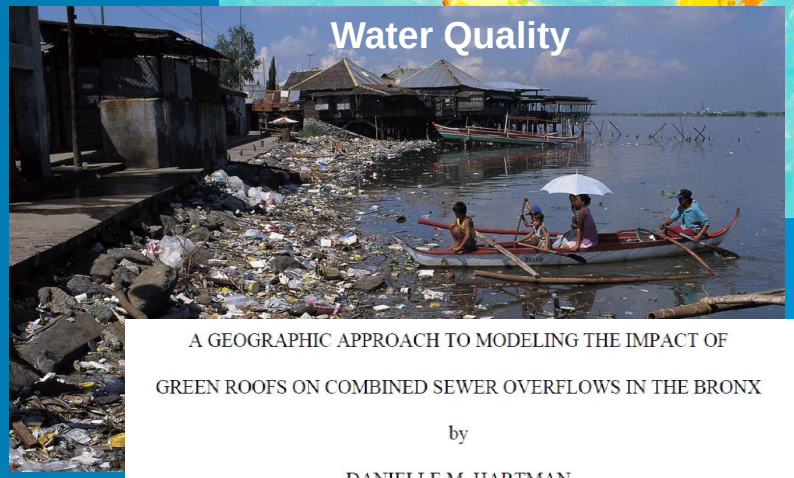
At the neighborhood or site scale, **Green Stormwater Infrastructure** systems mimic natural processes.

Built systems that mimic natural systems

Local Scale

GIS for Green Infrastructure





A GEOGRAPHIC APPROACH TO MODELING THE IMPACT OF

GREEN ROOFS ON COMBINED SEWER OVERFLOWS IN THE BRONX

by

DANIELLE M. HARTMAN

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Water Stress, Water Quality, Water Security…”*The Arrows are all going in the wrong direction*”…

“Be inspired, grasp the methodologies and tools and alter the course of what’s going on.”

Jack Dangermond
GeoDesign Conference 2016

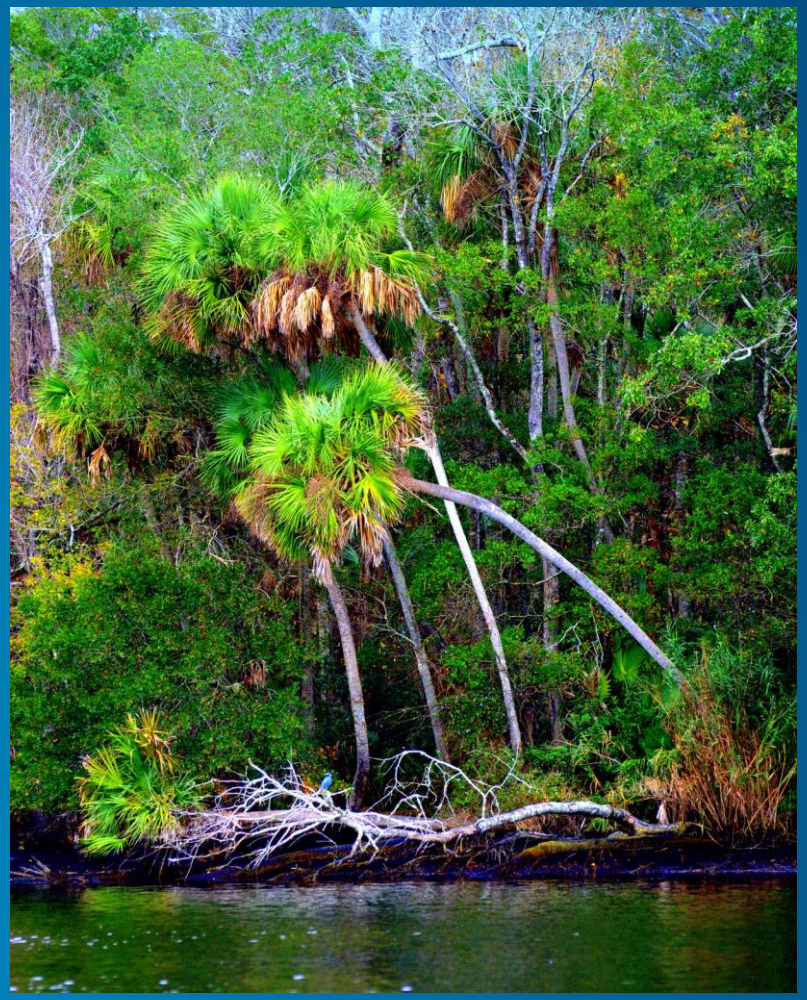
It’s a geographic problem

It needs a geographic approach

It needs a GIS Platform to solve it

Green Infrastructure

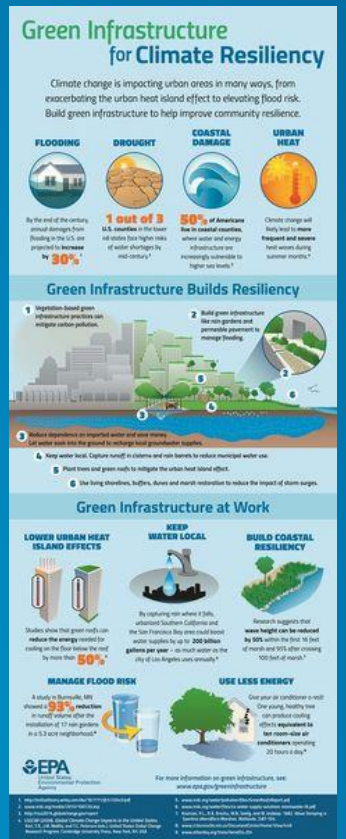
- **Green Infrastructure: intact tracts of natural ecosystems providing ecosystem services that benefit us all.**
- **Preserve and protect**
- **Enhance**
- **Restore**
- **Connect**

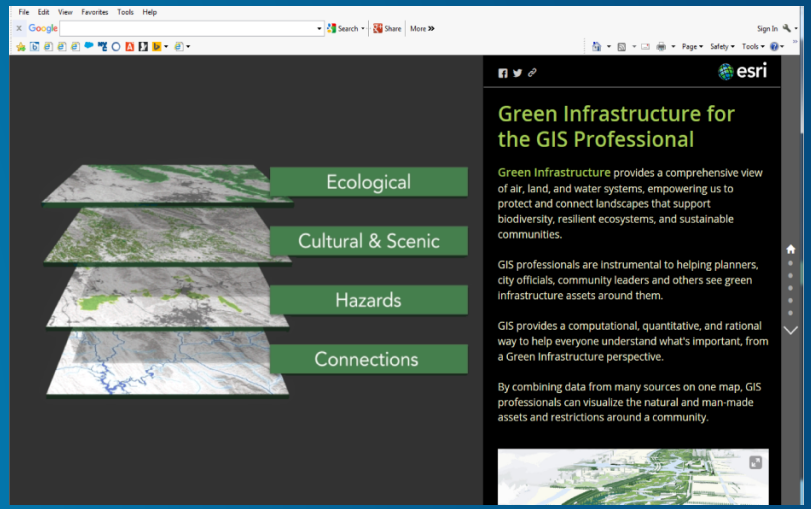


Preserve, enhance, connectt

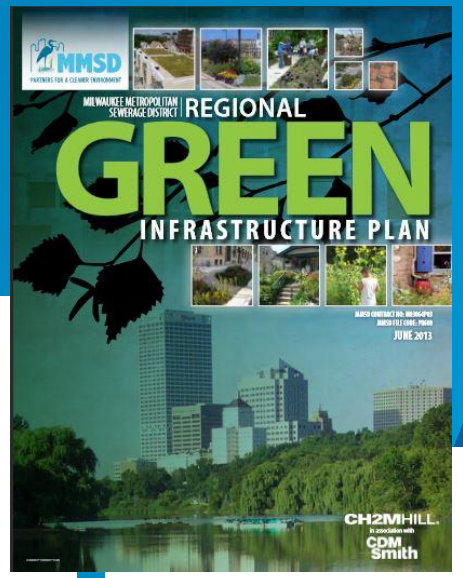
Green Stormwater Infrastructure

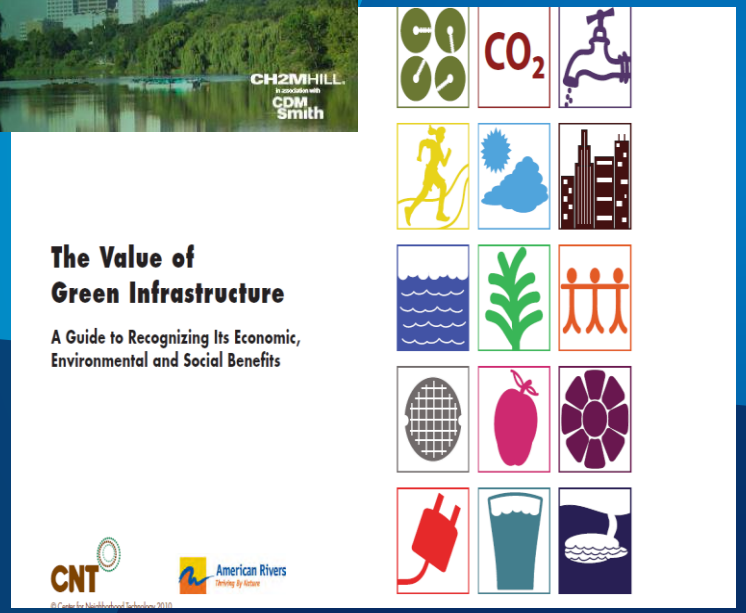
- **Green Infrastructure is an approach to water management that protects, restores, or mimics the natural water cycle.**
- **Context**
- **Connectivity**
- **Site Suitability**
- **Sustainability**

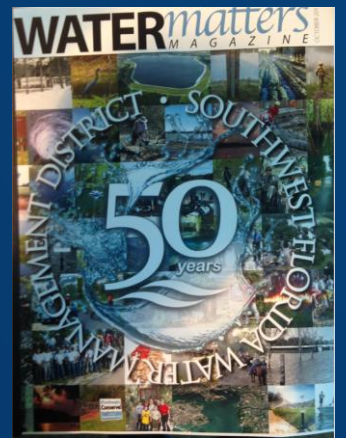




Context, create, connect







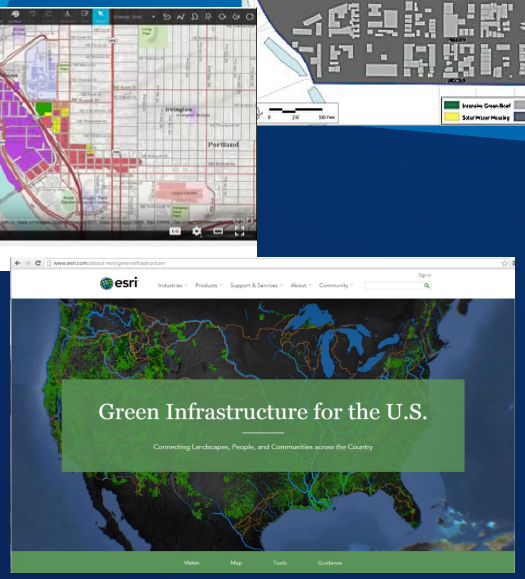
Why Green Infrastructure?

Reduce Runoff
Conserve water resources
Improve water quality
Reduce CO2
Urban Agriculture
Energy Savings
CSO Requirements
Increase green space
Better than Gray Infrastructure
Less Expensive
Habitat improvement
Wildlife corridor
Aesthetics
It’s the right thing to do

GIS Use Case

Siting a green infrastructure project is a geographic problem, GIS software, helps solve this problem by identifying optimal green infrastructure sites. It allows us to demonstrate how organizations can integrate green initiatives into their business. It has also helps to bring attention to the problems and solutions.

Most of the tools already exist. GeoPlanner, Model Builder, GeoDesign, City Engine, Green Infrastructure, StoryMaps, even 22 of the Water Utility Solutions fit with no changes (except the name).



Benefits

Every place can benefit from the cost effective application of green infrastructure because it saves money, reduces energy consumption, is more aesthetically pleasing and provides additional benefits such as carbon reduction and wildlife habitat.

Every water organization can benefit.

Every community, city, and county can benefit.

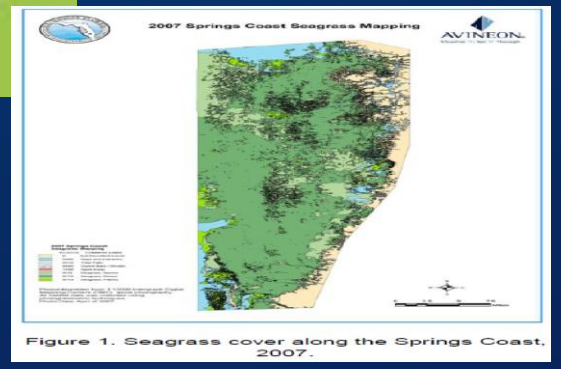
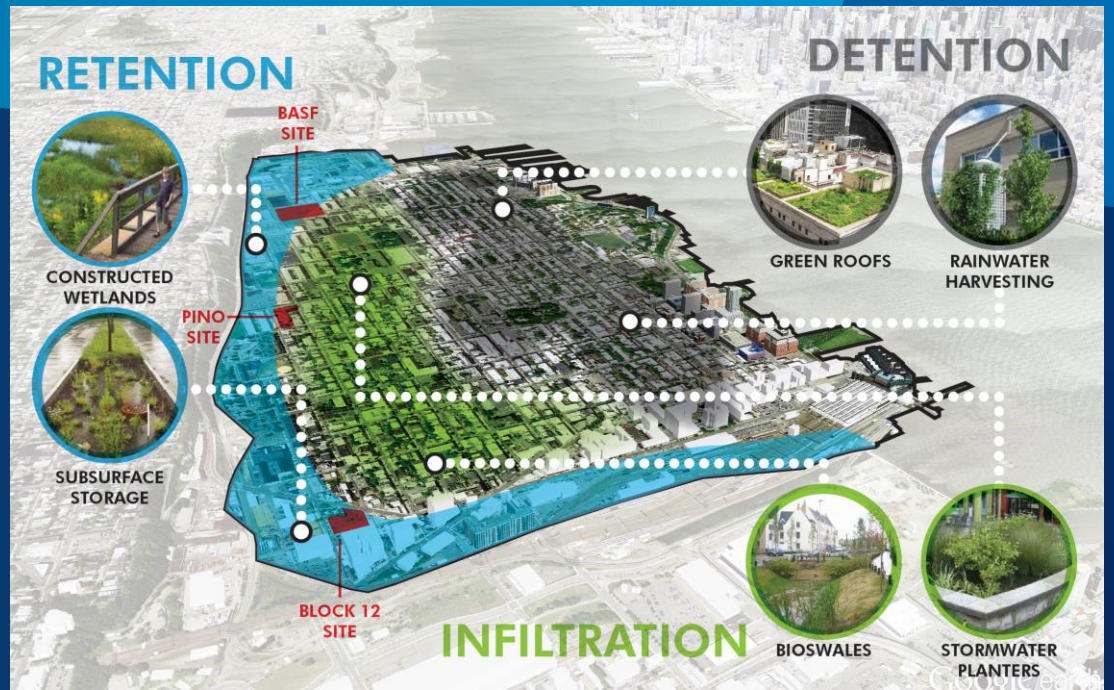


Figure 1. Seagrass cover along the Springs Coast, 2007.

Types of Built Green Infrastructure

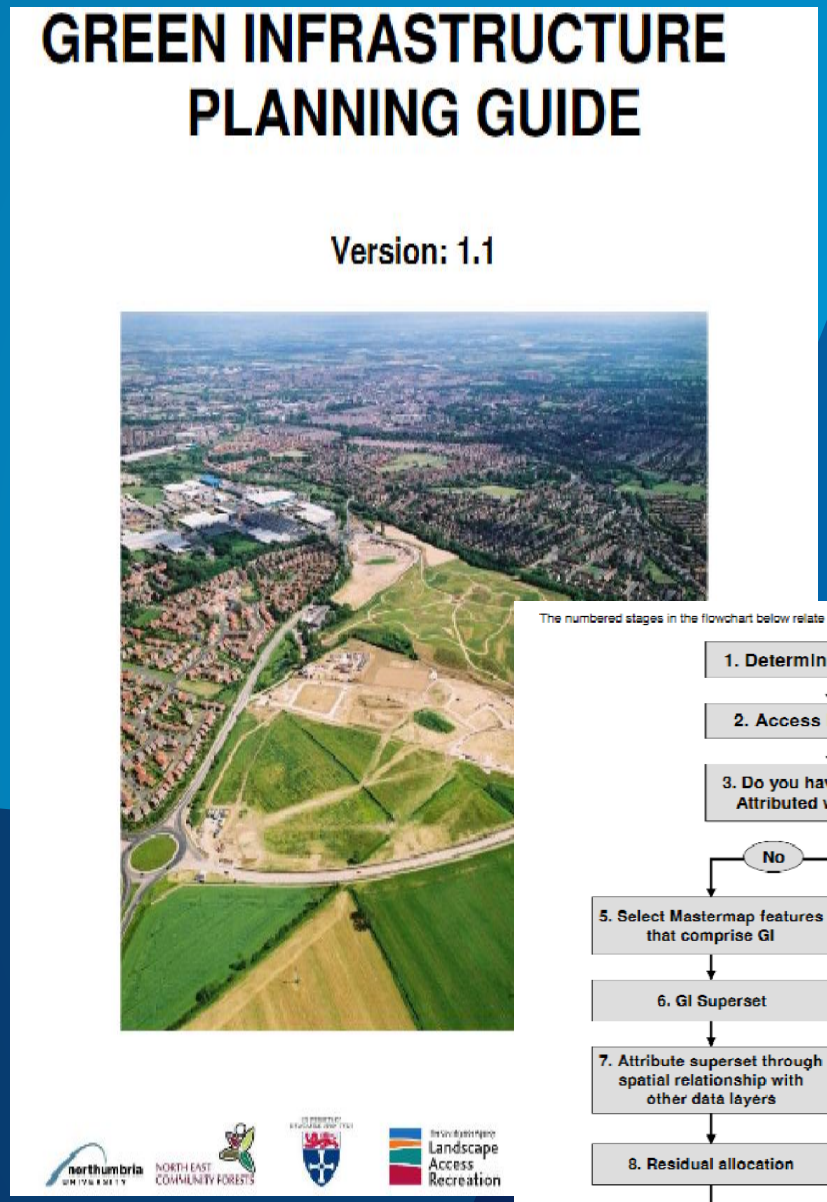
By Type

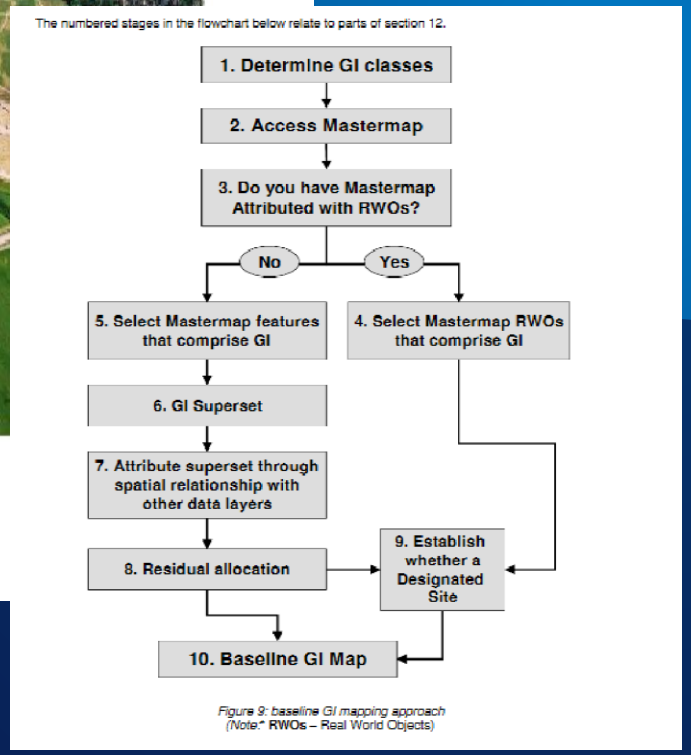


By Function

By Location:

- Inverts
- Drainage
- Outfalls
- Constructed Wetlands
- Right of way
- Green Street (permeable paving)
- Zoos
- Botanical Gardens
- Parks
- Schools
- Public Land
- Private Land
- New Development
- Retrofit





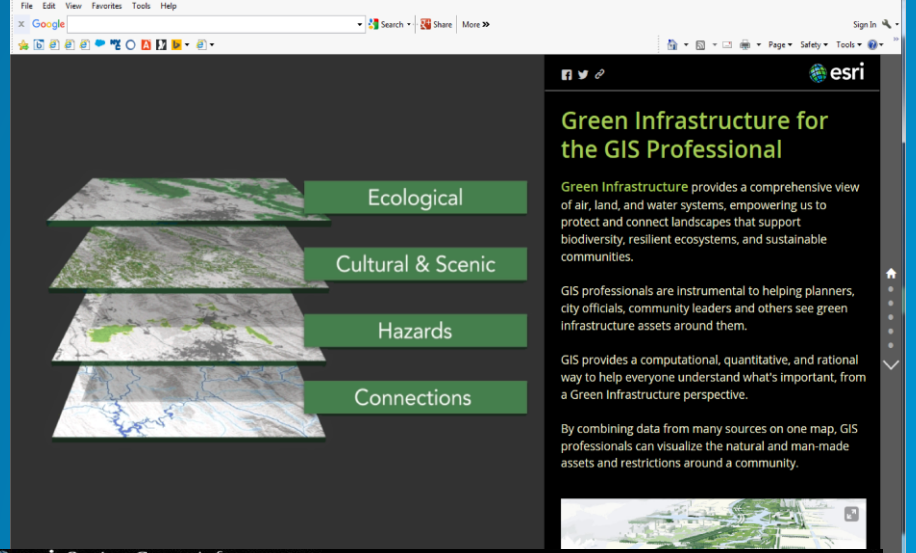
How it's done

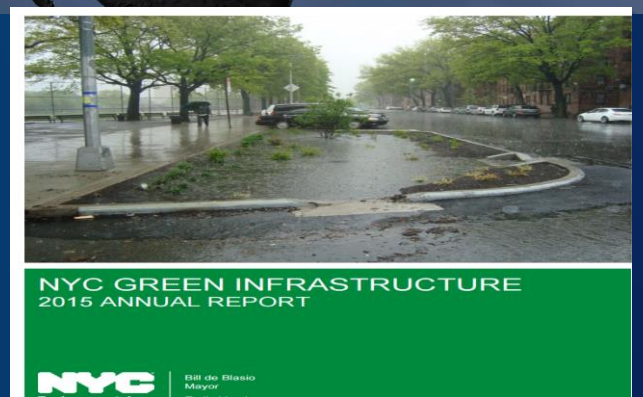
Consent agreement
Master Plan
Grant Proposal
Site Selection (public, private, agency)
Planning
Design
Construction
Operations and Maintenance
Public Awareness and outreach

What we observed

It is a geographic problem.
It is only *sometimes* a geographic workflow

1. Geographic Approach offers:
2. Data Management (Portal/AGOL, versioning, QA/QC Data Reviewer)
3. Site Suitability Tools (Green Infrastructure web tools, Model Builder, ArcPy)
4. Site Selection (decision support tools, LiDAR, 3D, ArcGIS Earth, City Engine, GeoPlanner)
5. Data Export for Design (ArcGIS for AutoCAD, Portal (group), Import (data reviewer)
6. Construction (GeoEvent, Drone2Map)
7. Operations and Maintenance (Workforce Manager, Navigator, Collector, Survey 123)
8. Public Engagement (Story Maps, Crowdsourcing apps, public facing AGOL, Publisher)



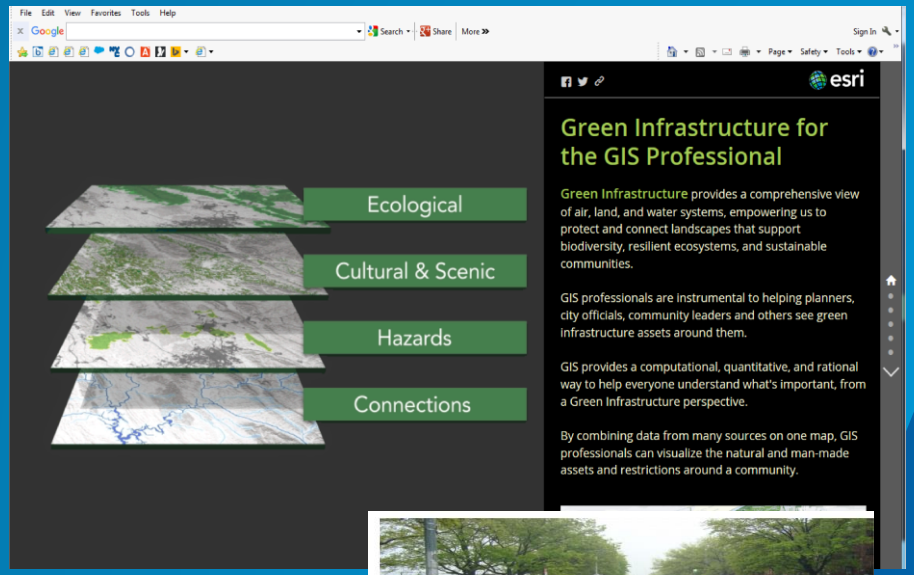


Esri Green Infrastructure Initiative: Context and Connectivity

The Esri Green Infrastructure Initiative provides Data and Tools that give you a regional Context for natural and constructed green infrastructure projects.

The tools provide a method to localize the regional data and develop local data and plans to support green infrastructure projects and green stormwater infrastructure projects.

This allows you to connect your local projects to the bigger picture.



Green Infrastructure Two Applications One Reason

Green Infrastructure Initiative provides context and connectivity for planning and managing GI projects.

Can be applied to GI restoration, stormwater management, and resilient adaptation to the effects of climate change.

Improving chances for sustainability

http://www.esri.com/about-esri/greeninfrastructure

Understanding our world.

Prince George's County, Maryland

Adam Ortiz
Director
Department of the Environmental
for Prince George's County

PRINCE GEORGE'S COUNTY | CORVIAS SOLUTIONS

CLEAN WATER PARTNERSHIP

STORMWATER MANAGEMENT DIVISION

PRINCE GEORGE'S COUNTY MARYLAND

Corvias®

CLEAN WATER MANDATE

Mandate for Prince George's County

- Build filters to treat 15,000 impervious acres by 2025
  - Approximately 46,000 stormwater filtration devices
  - Will cost approximately $1.2 billion
- Pay for this with a dedicated funding source (Clean Water Act Fee)

The Prince George's Model: *Make work for us*

- Clean our waters
- Revitalize older communities
- Lead with innovation
- Grow local economy
- Partner as much as possible

STORMWATER MANAGEMENT DIVISION

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OUR PERSPECTIVE

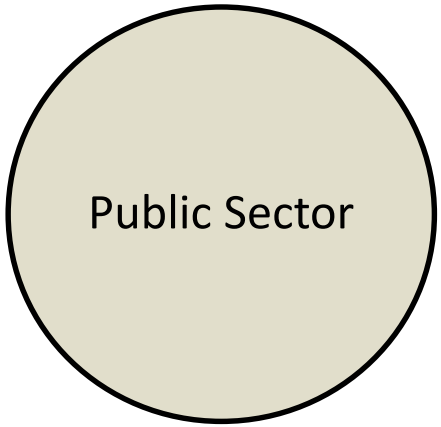
1. Have a lot of catching up to do
2. Need to be humble, we don't have all the answers
3. Embrace culture of innovation
4. Transcend stereotypes with a can-do mindset
5. "Lets things happen to us" vs.

   "Make things happen for us"
6. Leverage opportunity for interconnected issues

   (County Executive Baker)
7. Role of Government?

   To align outside forces for the public good

WE ARE NOT ENOUGH



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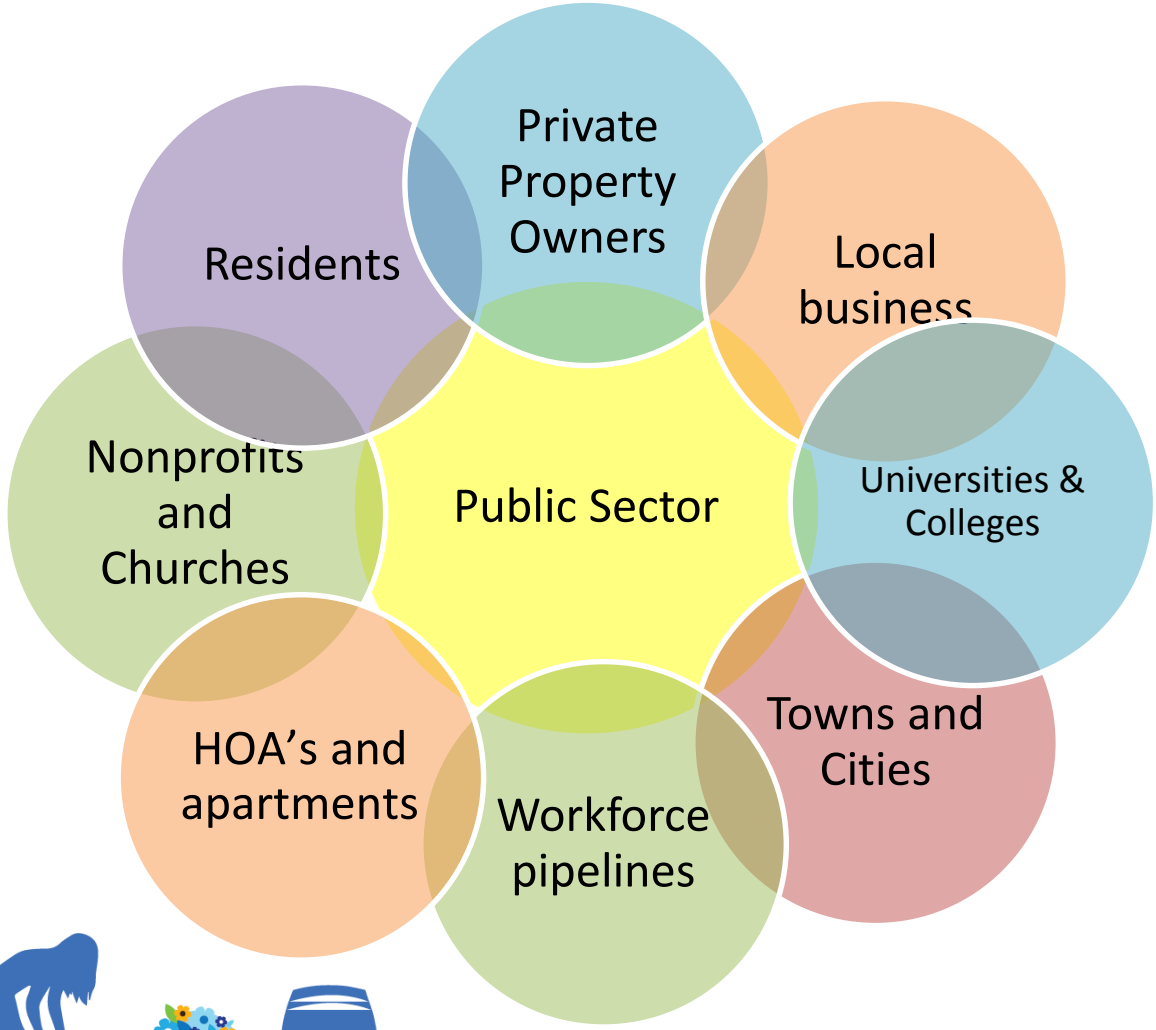
WE MUST PARTNER



STORMWATER MANAGEMENT DIVISION

PARTNERSHIP:
PRIVATE PROPERTY OWNERS

Our **Rain Check** Program provides up to **$3 Million** for private property owners to address polluted runoff.

STORMWATER MANAGEMENT DIVISION

PARTNERSHIP: SCHOOLS

Our 200 school properties can help us meet our retrofit acreage goals while we help them meet their environmental literacy goals, turning raingardens into outdoor classrooms.

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PARTNERSHIP:
CHURCHES AND NONPROFITS

Alternative Compliance Program

1. **Easements**: Up to 50% reduction in fee
2. **Green Teams and Green Ministries**: Up to 25% reduction
3. **Green Housekeeping**: Up to 25% reduction

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PARTNERSHIP: WORKFORCE TRAINERS

STORMWATER MANAGEMENT DIVISION

PARTNERSHIP: PRIVATE SECTOR

Public Private Partnership (P3)

- Enhance strengths and mitigate weaknesses of the other
- Use market forces to achieve goals, bring down pricing, and nurture a ‘Stormwater Silicon Valley’

STORMWATER MANAGEMENT DIVISION

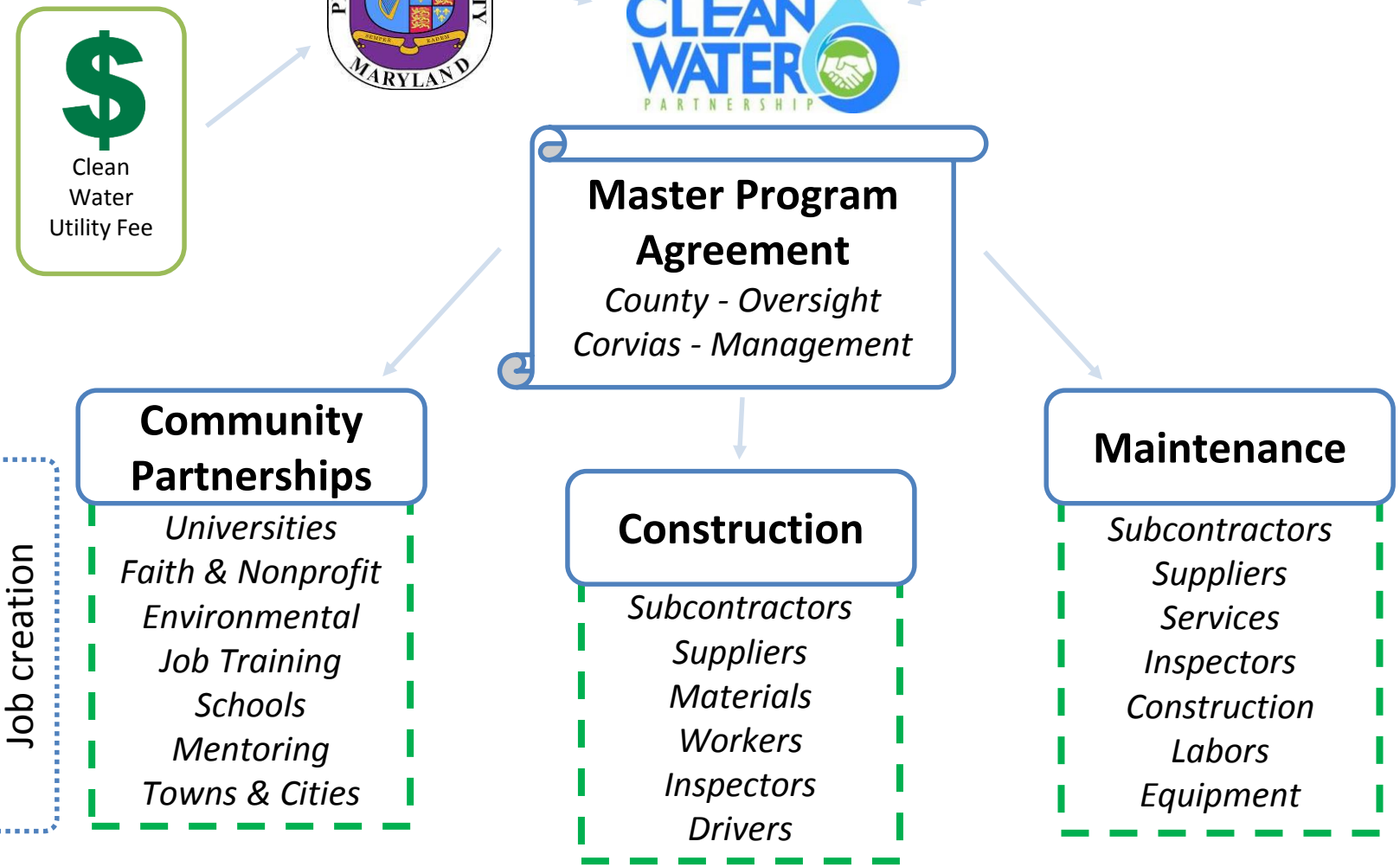
CLEAN WATER PARTNERSHIP

THE AGREEMENT

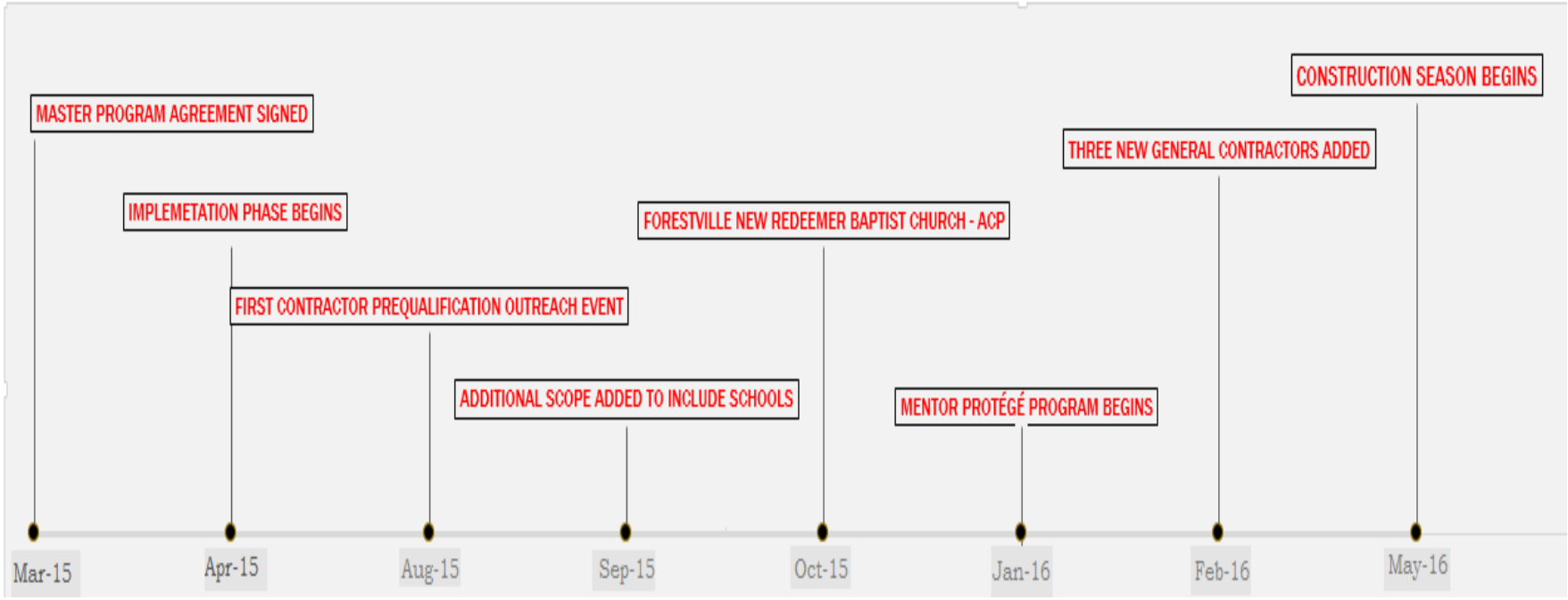
- Construction: 3 years to retrofit 2,000 acres
- Maintenance: 30 years
- Manage $100M in contracting
  - Pay for performance:
    - Time & budget
    - Socio Economic –
      - 40% County business
        - Small and minority business targets
        - Local hiring (51%)
      - Local business mentor-protoge development

THE CLEAN WATER PARTNERSHIP

STUCTURE



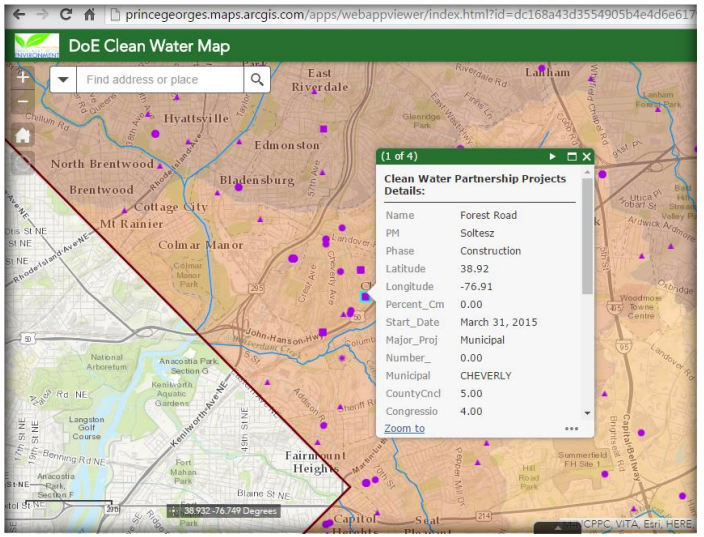
THE CLEAN WATER PARTNERSHIP TIMELINE



PERFORMANCE METRICS & TRANSPARENCY

CWP Dashboard
Cleanwaterpartnership.com

DoE Clean Water Map
Princegeorges.maps.arcgis.com



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PERFORMANCE METRICS & TRANSPARENCY

PUBLIC SCHOOLS	MUNICIPAL SITES	PONDS	PRIVATE PROPERTY	OUTFALLS
39	372.54	460.19	24.27	50
ACRES	ACRES	ACRES	ACRES	ACRES
ESTIMATED 18 PROJECTS	ESTIMATED 180 PROJECTS	ESTIMATED 4 PROJECTS	ESTIMATED 50 PROJECTS	ESTIMATED 50 PROJECTS

WORKFORCE DEVELOPMENT

11,285.55

TOTAL HOURS WORKED BY COUNTY RESIDENTS (15.32%)

55,988.05

TOTAL HOURS WORKED

Year 1	Year 2	Year 3
15%	30%	51%

COMMUNITY IMPACT

125,000

INVESTMENT IN STUDENT INTERNSHIPS

MORE THAN **50 OUTREACH EVENTS**

IN THE BUSINESS COMMUNITY

SMALL CHURCHES

CONNECTING WITH CONGREGATIONS AS PART OF OUR CWP PARTNERSHIP WITH FAITH-BASED AND 501(c) NON-PROFIT GROUPS

STORMWATER MANAGEMENT DIVISION

PERFORMANCE METRICS & TRANSPARENCY

DISTRICT 1 (10 BUSINESSES)
Assedo Consulting, LLC B
Audio Video Solutions, Inc.
CelSue Construction Services, Inc. A MP A
CSI Engineering, PC B
Eden Team, LLC B
GeoTech Engineers, Inc.
L.E. Blue & Associates, Inc.
NZI Construction Corporation
Olney Masonry Corporation
Sandy Audio Visual, LLC

DISTRICT 2 (2 BUSINESSES)
Advanced Engineering Design, Inc. B
DMV Solutions, LLC

DISTRICT 3 (2 BUSINESSES)
AB Consultants, Inc.
BizyBee Professional Staffing & Biz' Ness Solutions, LLC

DISTRICT 4 (10 BUSINESSES)
Angarai International, Inc. B
BCV Solutions, Inc.
Bourn Environmental, LLC B
Hopper Grass Lawn Care, LLC
Kambiance, LLC
LK Enterprise General Construction, Inc.
Nudawn Marketing Group, Inc. B
Pivotal Practices Consulting, LLC
Sage Services Group, LLC
SherAl Consulting Services, LLC B

DISTRICT 5 (15 BUSINESSES)
Braxton Educational Services and Training, LLC B
Brewington Management Co., LLC
City Ornamental Iron Inc
Corenic Construction Group, LLC
CSA Central, Inc. B
Engineering Design Technologies, Inc.
Estime Enterprises, Inc. B
Exceed Corporation B
Garcete Construction Co., Inc.
HCD International, Inc. B
Helix Enterprises, Inc. B
MK Catering, Inc. A
SanDow Construction, Inc.
The Sutter Group B
Systems Integration, Inc.

DISTRICT 6 (16 BUSINESSES)
Business Strategy Consultants, LLC
Clean Sweep Trucking, LLC MP
Denang's Trucking LLC
Dirt Plus, Inc. B
D & F Construction, Inc.
The ELOCEN Group, LLC
Erimax, Inc.
Monumental Building, LLC
Printing Express & Designs, LLC B A A
Strativia, LLC
M & G Services, Inc.
McElroy Enterprises, LLC
McJordan Consulting Services & Facilities Solutions Group, LLC
Neil General Contractor, Inc.
Shipley & Horne, P.A.
Tri-Logistic, LLC

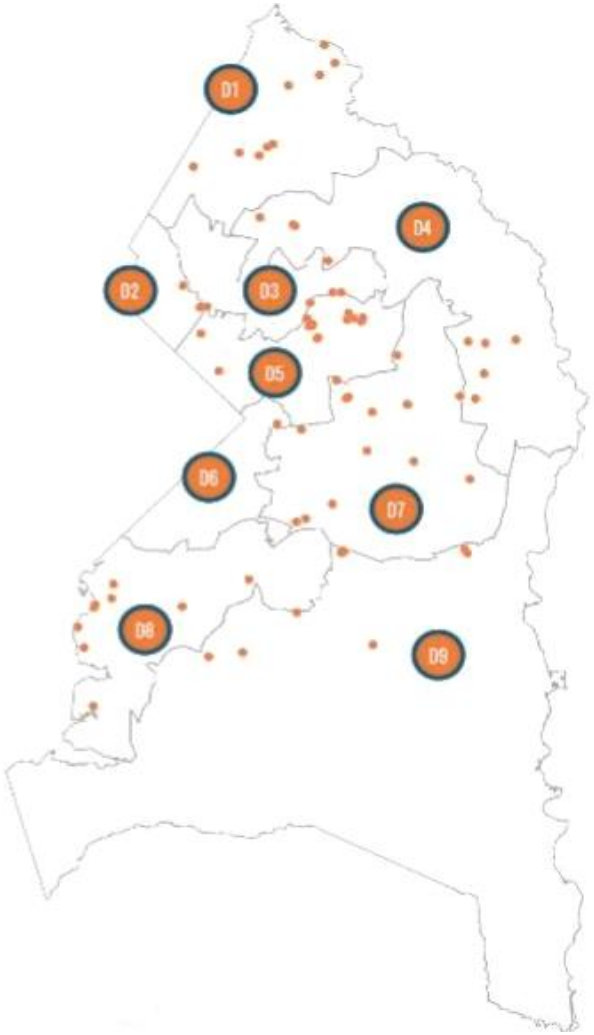
DISTRICT 7 (1 BUSINESSS)
Jordon Lawn & Maintenance

DISTRICT 8 (9 BUSINESSES)
Arel Architects, Inc. B
BluPrint, LLC
Construction Management & Technology, Inc.
Faulkner Lawn Care & Landscaping B A MP A
Global Executive Staffing, LLC
Leuterio Thomas, LLC
Lord & Mitchell, Inc.
TreKnot Organization LLC
Ubiquity Marketing & Management Consulting Inc.

DISTRICT 9 (9 BUSINESSES)
Capitol City Associates, Inc. B
Century Fence Construction, LLC
Conscious Planet, L3C
Essex Construction, LLC B A
Grace Management & Construction, LLC B MP
Manuel Luis Construction Co.,Inc.
Philip Aaron Lacy Architects
Proctor Landscaping & Masonry
Warren Brothers Construction , LLC B

OUTSIDE COUNTY (62 BUSINESSES)

B *Bid*
A *Award*
MP *Mentor Protégé*
A *Assisted*



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Nudawn Marketing Group, Inc. B
Pivotal Practices Consulting, LLC
Sage Services Group, LLC
SherAl Consulting Services, LLC B

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Grace Management & Construction, LLC B MP
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OUTSIDE COUNTY (62 BUSINESSES)

B *Bid*
A *Award*
MP *Mentor Protégé*
A *Assisted*

STORMWATER MANAGEMENT DIVISION

PROCESS TRANFORMATION

Before	Now
Silo'd design, build, and maintenance	Integrated project development
James Brown: "Hit it and quit it"	Long term investment in product
Focus on individual projects	Focus on effective system
Narrow Control	Broad Empowerment
Costly duplication	Aggregation and standardization
Input preoccupation	Outcome preoccupation
Start over from scratch	Scalable resources
Change orders	No change orders
Missed deadlines, extensions	Timeliness

INDUSTRY TRANFORMATION

Before	Now
Uncertain price and schedule	Fixed price, fixed payment process
Unpredictable payments to subs	Timely payment
Cost per acre +-$130k	Cost per acre +-$50k
Community disengagement	Broad socio-economic engagement
Same ol’ contractors	New contracting participants
Limited financing options	Additional financing options
Subordination to market	Driving the market

STORMWATER MANAGEMENT DIVISION

LESSONS LEARNED

1. Negotiation Process

- Hold negotiations early and anticipate adequate time
- Establish clear and defined roles for oversight of different disciplines

2. Duration of Agreement

- It must correspond with the scope and scale of deliverables
- Consider increases in production or product demand

3. Project Inventories and Distribution

- Discuss and develop clear planning guidelines for the partnership
- Create and maintain a transparent, alternate system to handle viable projects that may be more conducive to an enhanced CIP program

LESSONS LEARNED

4. Quality Assurance/Quality Control

- Create specific and detailed performance measures

5. Completion Certifier Agreement

- Respond to inquires from outside entities that may be watching
- Have an independent third party entity certifying the execution and completion of the program's work

6. Permitting

- Anticipate and adjust local permitting processes to address pace of individual project loads
- Develop and implement expedited permitting relationships with local agencies (i.e. the County Permitting Agency, MNCPPC, SCD, etc).
- Make permitting processes geared toward restoration oriented projects vs. a typical development track.

LESSONS LEARNED

7. Procurement

- Resources and capacity
- Evaluate and adjust the procurement process to help facilitate prompt payments for partnership workforce and vendors

8. Maintenance

- Have a long term maintenance plan in place

9. Private Property Access

- Ensure that the Agreement allows for project participation on private property
- Ensure that local governing laws/regulations authorize local stormwater fund revenue expenditures on private property
- Anticipate the need for project implementation on private property

LESSONS LEARNED

10. Diversification

- Evaluate and look for opportunities that will diversify the program (i.e. developing a programmatic approach w/the school system or faith based communities)

11. Partnerships

- Engage stakeholders up front
  - Executive and Legislative Branches
  - Other Public Agencies (local, State, and Federal)
  - Schools and Universities
  - NPOs/NGOs
  - Communities
  - Municipalities
  - Environmental Groups

12. Be Adaptive

- Anticipate and plan for change
- Be flexible with the program

THANK YOU.

STORMWATER MANAGEMENT DIVISION

Miami-Dade County, Florida

Hardeep Anand, P.E.
Deputy Director
Miami Dade Water & Sewer Department

Laurens Vander Tak
VP and Technology Fellow
CH2M, Water Resources and Ecosystems Management

M-D WASD

Water Infrastructure Investments: **Becoming a Resilient Utility**

Introduction

01 System Overview

02 A Resilience Framework for Action

03 Implementation

04 Resilient Utility Coalition

Water System

- 3 large regional and 5 small water treatment plants (WTP), plus new Hialeah Reverse Osmosis WTP
- Supplying an average of 314 million gallons per day (MGD)
- Per capita water use 137 GPCD

- 15 wholesale customers
- 432,000 retail customers
- 100 water supply wells
- 8,206 miles of pipes
- 38,381 fire hydrants
- 126,306 valves

Wastewater System

- 3 wastewater treatment plants
- 2 ocean outfalls and 21 deep injection wells
- Collecting, treating, and disposing 308 MGD
- 350,000 retail customers
- 13 wholesale customers
- 6,309 miles of mains and laterals
- 1,047 sewer pumps stations
- Reusing 13 MGD

CIP & REGULATORY COMPLAINCE

Programs

PSIP: Design/construct 119 pump station & forcemain projects totaling approximately $200M over a 3-year period

Consent Decree: Design/construct 82 capital improvement projects totaling approximately $2.2B over a 15-year period

OOL: Complete system-wide wastewater infrastructure improvements over 60 projects totaling approximately $5.4B

Planning and Compliance

Integrated Master Plan: Comprehensive plan encompassing water, wastewater, climate adaptation, integration of technologies

I/I Program: Implementation of an overall program and scorecard

Resiliency Program: Climate change and sea level rise adaptation

Utility Development: Utility coordination, roadway projects and system betterment for new service areas

CIP

UPEC: Program and construction management for CIP pipeline projects (water and sewer)

Pumps: program and construction management for CIP pipeline projects (water and sewer)

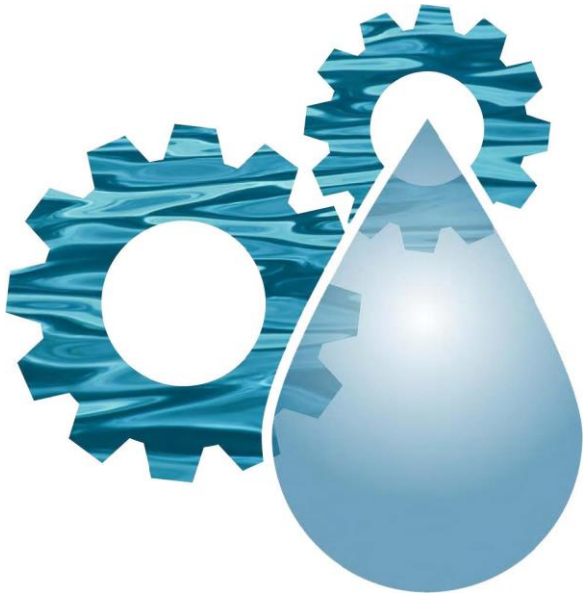
Plants: Design/construct new 50 MGD Northwest Wellfield WTP; new 20 MGD South Miami Heights WTP; and CIP/R&R Plant projects

SECTION 02

A Resilience Framework

Resilience Vision

Guiding Framework



Effective Utility Management (EUM)

- 10 attributes of effectively managed utilities
- 5 keys to management success
- Lean six sigma

EPA Climate Ready Utilities

- Adaptive response framework

Envision Sustainable Infrastructure Rating System

Institute for Sustainable Infrastructure

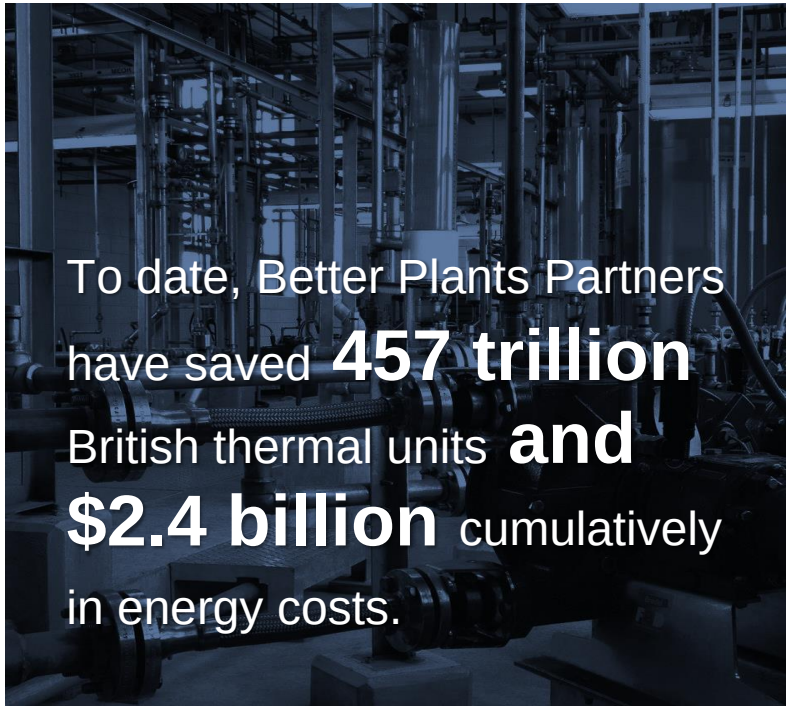
INSTITUTE FOR SUSTAINABLE INFRASTRUCTURE
I S I
envision™
ASCE
APWA
ACEC

Department of Energy Partnership

- Better Plants Program
- CHP Accelerator
- Wastewater Plants Accelerator

Better Plants®
U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY
CHP Deployment Program

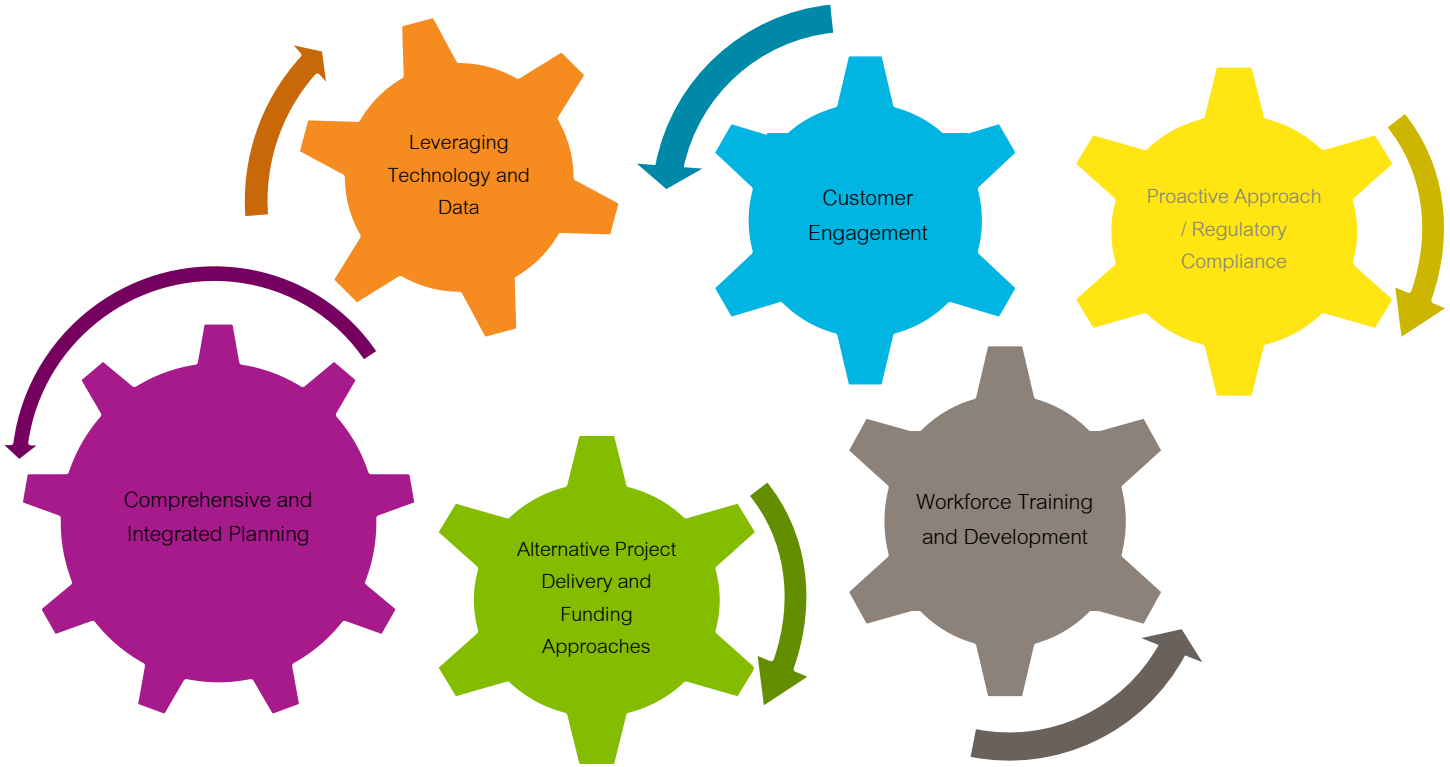


Utility of the Future Today

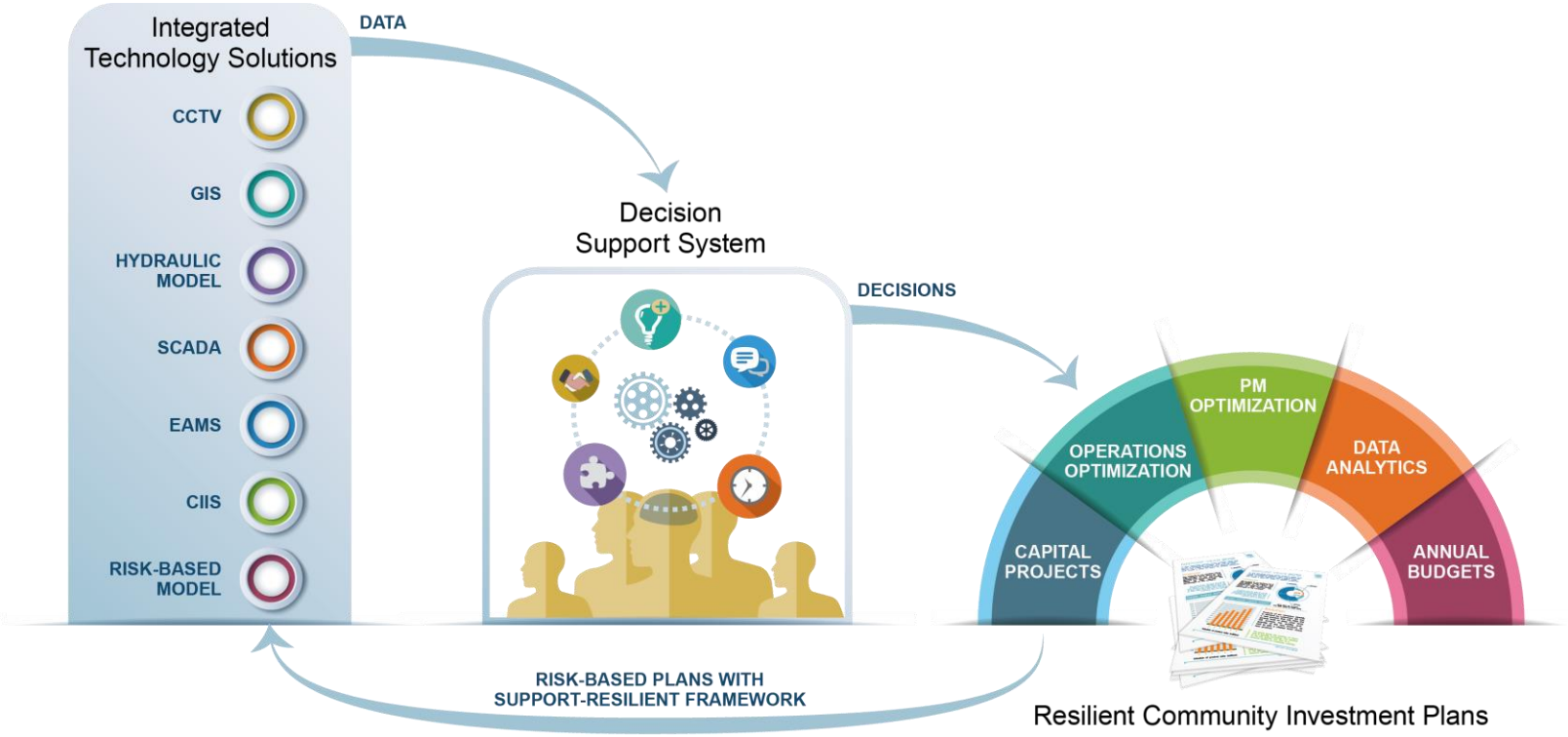
2016 Recognition at WEFTEC

WATER RESOURCES UTILITY OF THE FUTURE TODAY

Changing the Culture



Embracing Technology



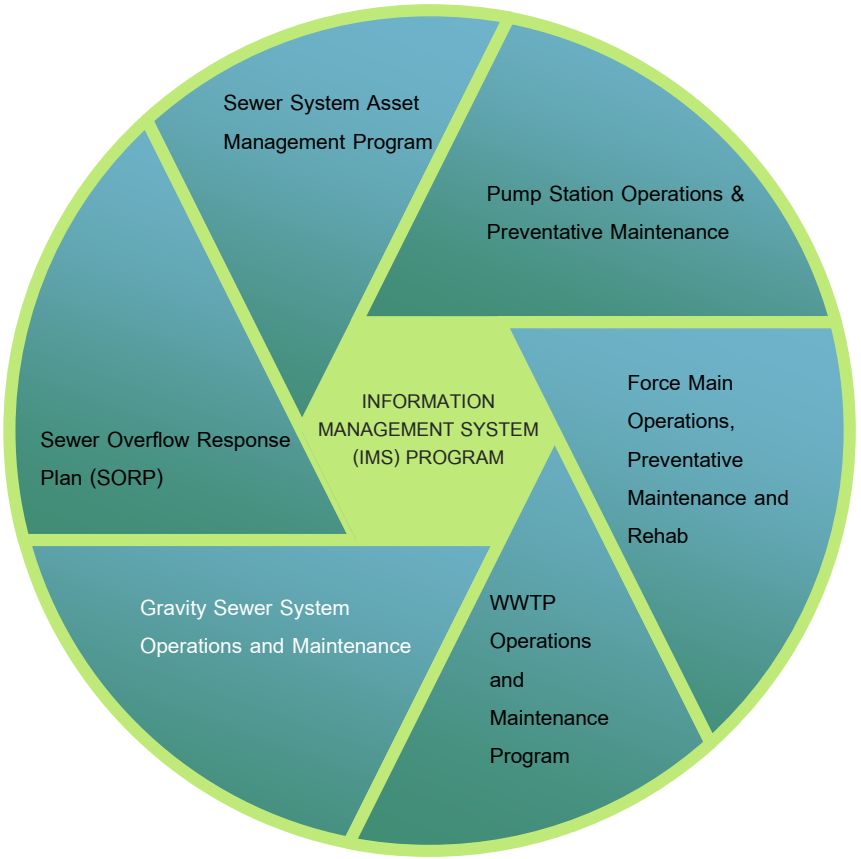
Resilience Vision

SECTION 03

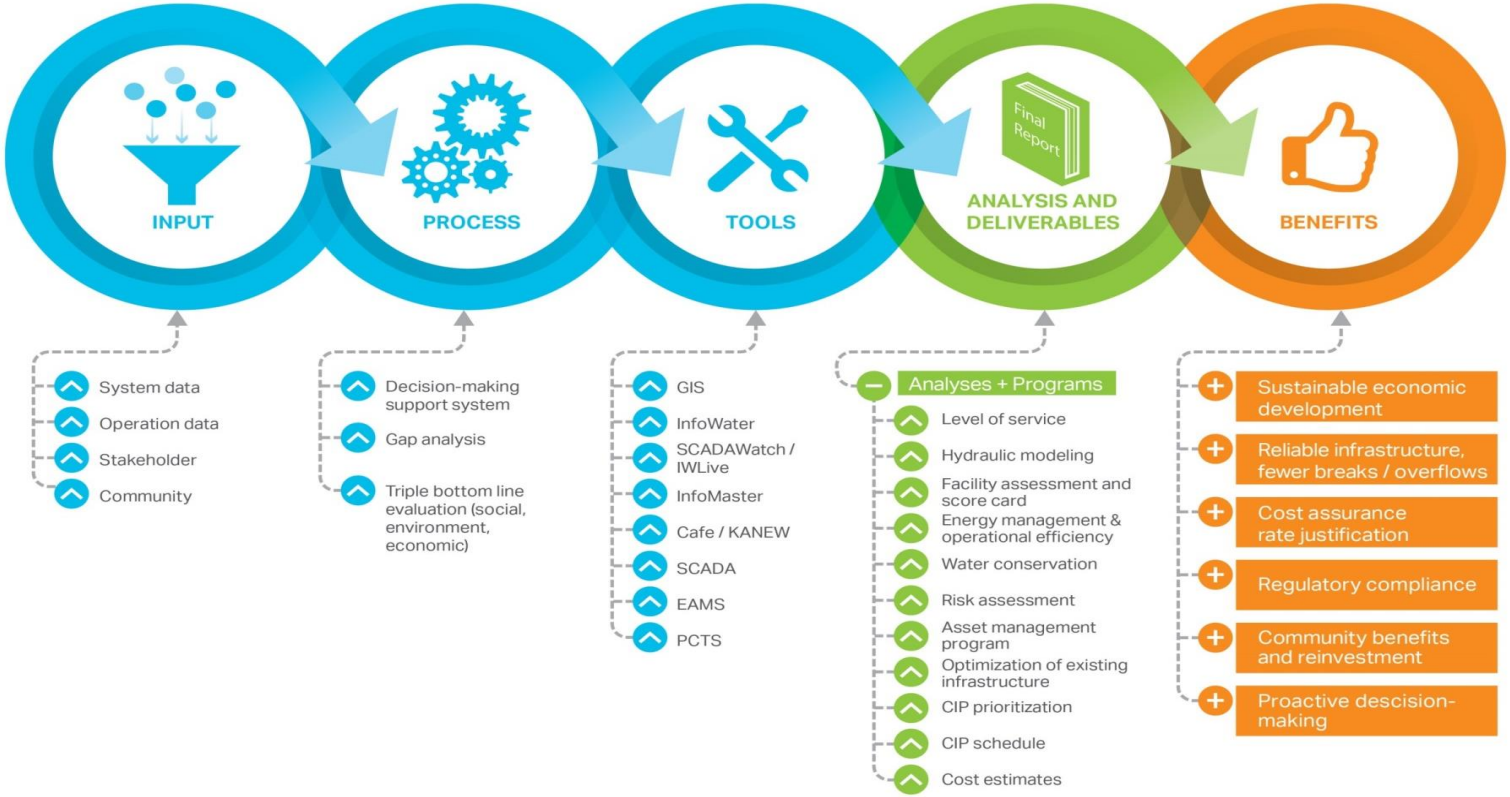
Implementation

CMOM


New CMOM Program Requirements
Defined purpose
Defined goal
Documented with specific detail
Implemented by trained personnel
Established performance measures
Written procedures for periodic review


Sewer System Asset Management Program
Pump Station Operations & Preventative Maintenance
Force Main Operations, Preventative Maintenance and Rehab
WWTP Operations and Maintenance Program
Gravity Sewer System Operations and Maintenance
Sewer Overflow Response Plan (SORP)
INFORMATION MANAGEMENT SYSTEM (IMS) PROGRAM

Hydraulic Modeling



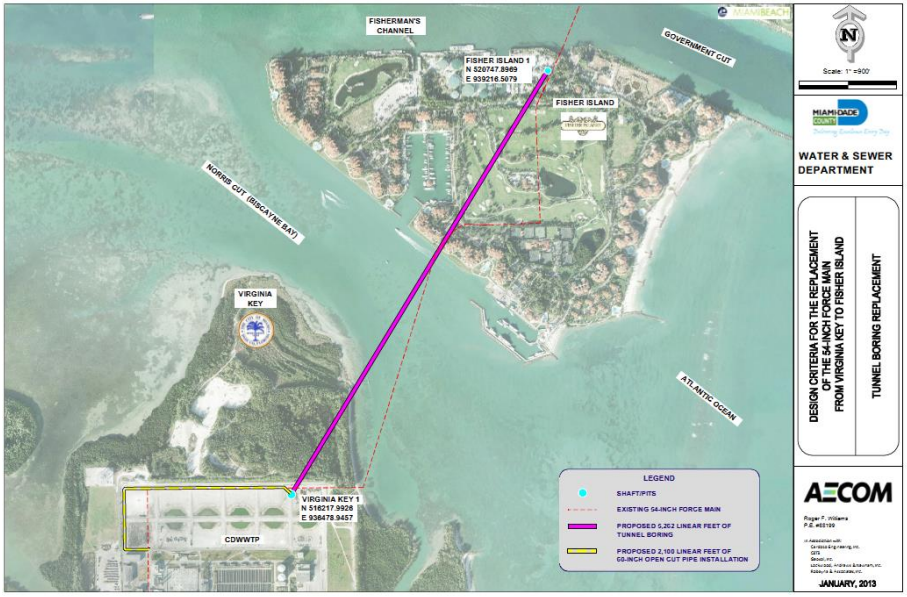
Pipeline Improvements

Norris Cut Force Main Replacement

- 5,300 LF of 10’ Dia. Tunnel under Norris Cut from Fisher Island to Virginia Key
- 2,700 LF of 60” Dia. Open Cut Pipeline Installation in WWTP
- 1,000 LF of 10” Dia. Horizontal Directional Drill

Results

- **Increased reliability/redundancy**
- **Renewal of aging infrastructure**
- Customer satisfaction
- Enhanced infrastructure stability
- Staff training on alternative technologies



Pipeline Improvements

Rehab of 72” Sanitary Sewer Force Main

- 15,300 LF of 63” HDPE Slip-lined Pipe
- Fittings, Connections and Thrust Restraints
- 180 Days (Dry-Season)

Results

- **Preventative replacement** successfully mitigated potential for failures and property damage
- Maximization of existing infrastructure
- **Enhancement in operational resilience**
- Financially viable solution

Energy Initiatives

South District WWTP Cogeneration Facility Improvements

- Upgrade of existing cogeneration facility constructed in early 1990's
- Capacity expanded to process methane gas from adjacent municipal landfill
- Four 2,000 kw cogeneration units
- Upgrades to digester and landfill gas conditioning systems

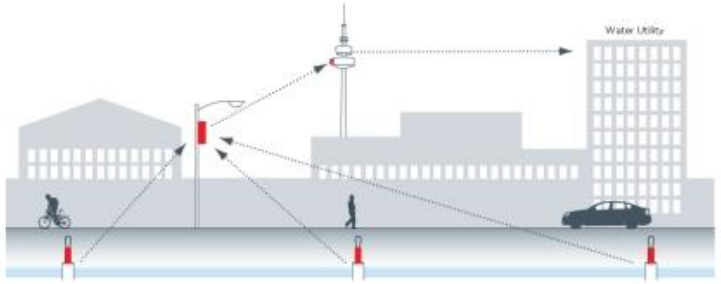
Results

- **Increased energy output and system efficiency**
- Reduction in carbon emissions
- **Improved redundancy and WWTP resilience**

Water System Initiatives

Enhanced Leak Detection System

- Deployment of fixed network in densely populated area with aging infrastructu
- Piloted over 109 miles of transmission and distribution system piping
  - 50 Leaks identified in first four months
  - 459 Millions of Gallons of Water Saved
  - Significant savings in non-revenue water



2016 NACO Achievement Award in Water Loss Management and Accountability

Water System Initiatives

Acoustic Fiber Optic Emergency Response System

- Real time monitoring of wire strands in vulnerable PCCP pipe
- Installed on high criticality/high risk assets
- Automatic alerts upon wire breaks
- AFO allows for preventative action prior to critical failures

Water System Initiatives

Advanced Metering Infrastructure (AMI)

- MDWASD preparing to deploy AMI throughout service area (450,000 accounts)
- Improvements in customer service and engagement
- Water conservation and improved efficiencies
- Leveraging of data for planning
  - Real-time consumption
  - Pressure monitoring
  - Leak detection
  - Other network applications

SECTION 04

Resilient Utility Coalition

RUC Vision

How do we operationalize?

How do we reduce & mitigate risks & enhance resilience?

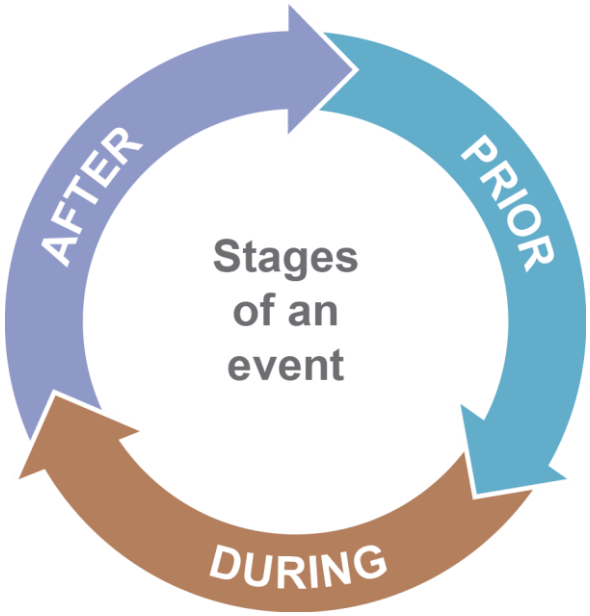
Members And Roles

Academia	Professional Organizations	Water Industry	Utilities
• Innovation, research and development • Opportunity to collaboratively engage in labscale studies, pilots, pursue research grants	• Best management practices and industry standards • Training and education of workforce • Advocacy and policy development • Networking and engagement	• Innovative & comprehensive solutions • Holistic approach to incorporate resiliency from planning to operations • Tech talks	• Regional scorecard • Quarterly roundtable meetings • Exchange of resources and materials • Preparedness Drills • Share best practices and lessons learnt • Interlocal Agreements

Continuous Process

Rapid Recovery

Ability to adapt and learn from an event. Better preparedness.



Robust & Flexible

Able to rebound back from small, daily disruptors. This is part of the operational stability. Ability to keep absorbing shocks and keep responding.

Resourceful & Actionable

Ability to manage an event as it unfolds. Sound action plans / alternatives to put in action.

CARDS Aligned

C Comprehensive and Collaborative

A Actionable and Adaptive

R Robust and Resiliency

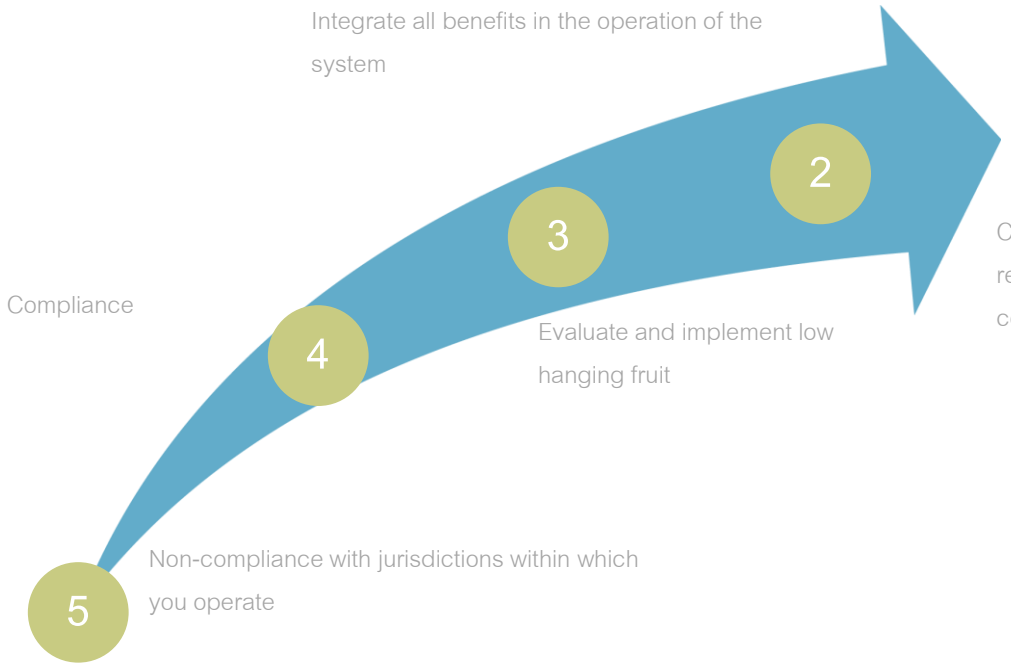
D Dynamic and Diligent

S Sustainable and Strategic

Changing the organizational culture

Overarching planning that aligns the CARDS

The Resilience Path



CARDS aligned. A recognized leader; continuous improvement

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Capital Improvement Program

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786-552-8571

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MIAMI-DADE WATER AND SEWER DEPARTMENT

Storm Surge, Sea-Level Rise and Flood Modeling for Climate Risk and Resilience Planning for Wastewater Infrastructure

Ocean Outfall Legislation Program

NACo Water Infrastructure Webinar

December 19, 2016

ch2m SM

Acknowledgements

- Bertha M. Goldenberg, Miami-Dade Water and Sewer Department, FL
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- Matt Alvarez, CH2M, FL
- Dr. Jennifer Baldwin, CH2M, TN
- Dr. Say-Chong Lee, CH2M, FL
- Paul Robinson, CH2M, CA
- Dr. Swamy Pati, CH2M, FL
- Dr. Peter B. Urich, CLIMsystems Ltd, NZ

Agenda

- Background
- Climate Projections
- Flood Inundation Modeling with Climate Change
- Draft Design Guidelines for Facility Hardening with Climate Change
- Next Steps

Climate Resilience/Facility Hardening- Objectives and General Approach

- Assess projected climate change for key climate variables (sea level rise, precipitation, wind, inundation due to surge)
- Define critical wastewater assets and risk due to climate change
- Define design criteria to minimize risk
- Develop facility hardening plans and design guidelines for OOL and PMCM design teams

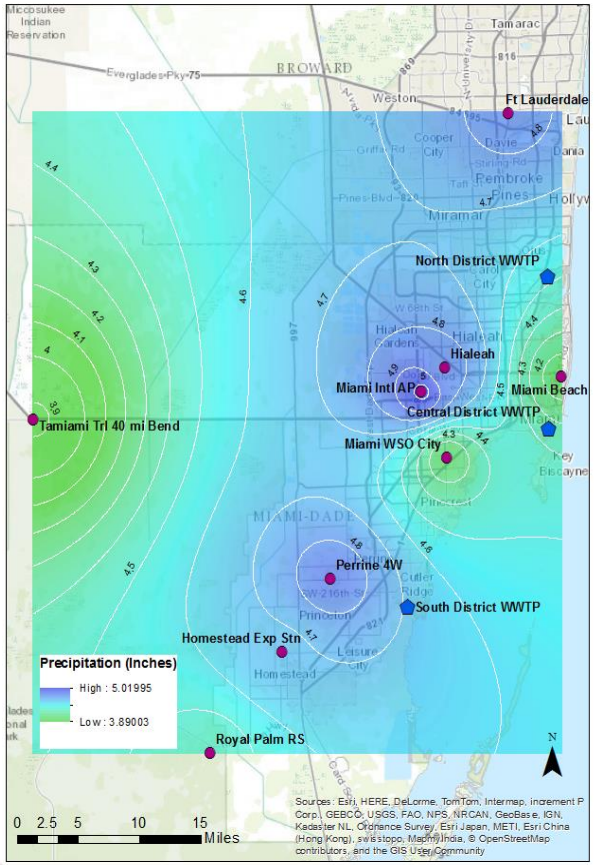
Background

- In 2015, CH2M completed
  - Storm surge modeling
  - Determined 2075 flood elevations at 142 pump stations accounting for 3.1 and 4.0 feet of Sea Level Rise
  - Developed draft design guidelines for facility hardening at WWTPs and at pump stations
- Design guidelines for pump station facility hardening updates ongoing:
  - Update modeling scenarios
  - Develop criticality levels for pump station design
  - Develop decision flow chart for levels of protection and hardening alternatives based on risk and criticality

Climate Projections

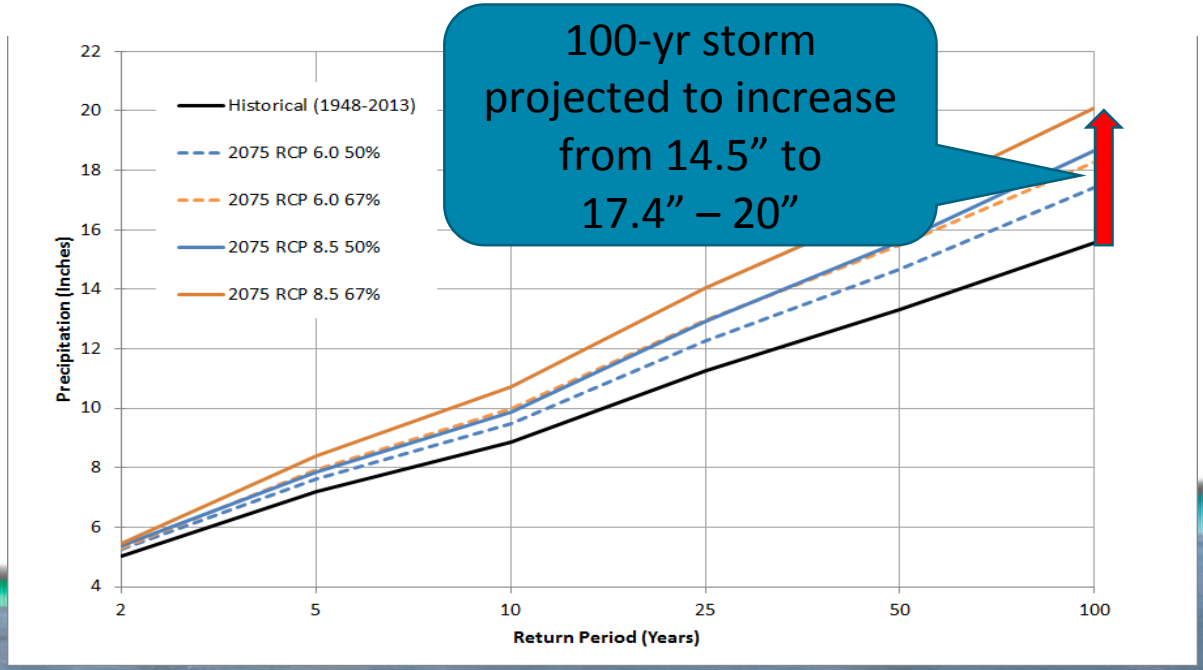
Precipitation Intensity-Duration-Frequency (IDF) Projections: Peak Flow and Flood Impacts

Station Locations with Historical 2-yr, 24-hr Precipitation (Inches)



Pump Station Peak Flows Are Based on 2 yr Storm:

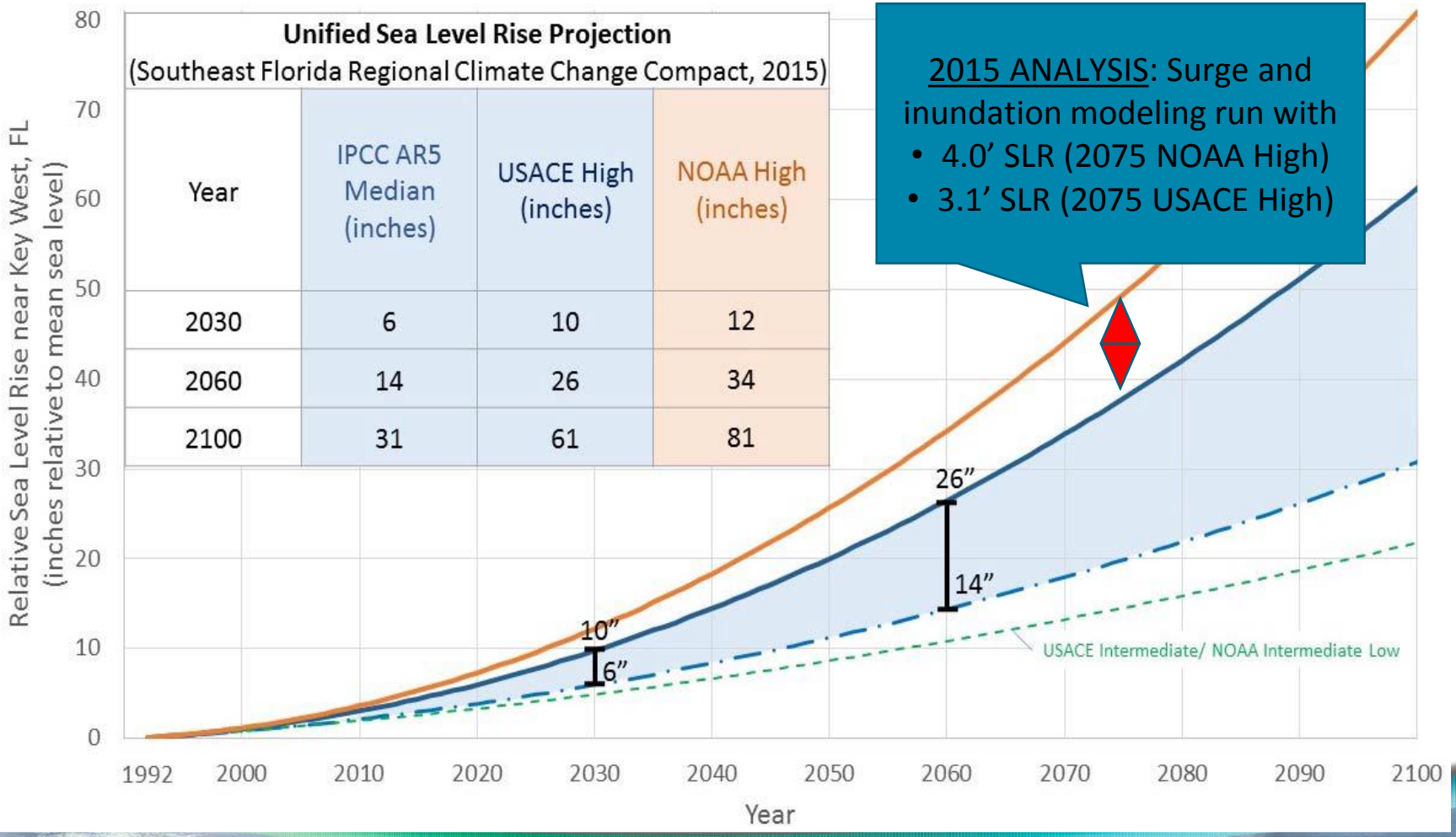
- Historically: 4.5” (SFWMD, 2001)
- Updated: 4.9” (2014)
- Projected: 5.4” to 6” (2040 to 2100)



Sea Level Rise Impacts: Coastal Flooding and Increased Wastewater Infiltration/Inflow (due to higher groundwater and rainfall)

Unified Sea Level Rise Projection
(Southeast Florida Regional Climate Change Compact, 2015)

Year	IPCC AR5 Median (inches)	USACE High (inches)	NOAA High (inches)
2030	6	10	12
2060	14	26	34
2100	31	61	81



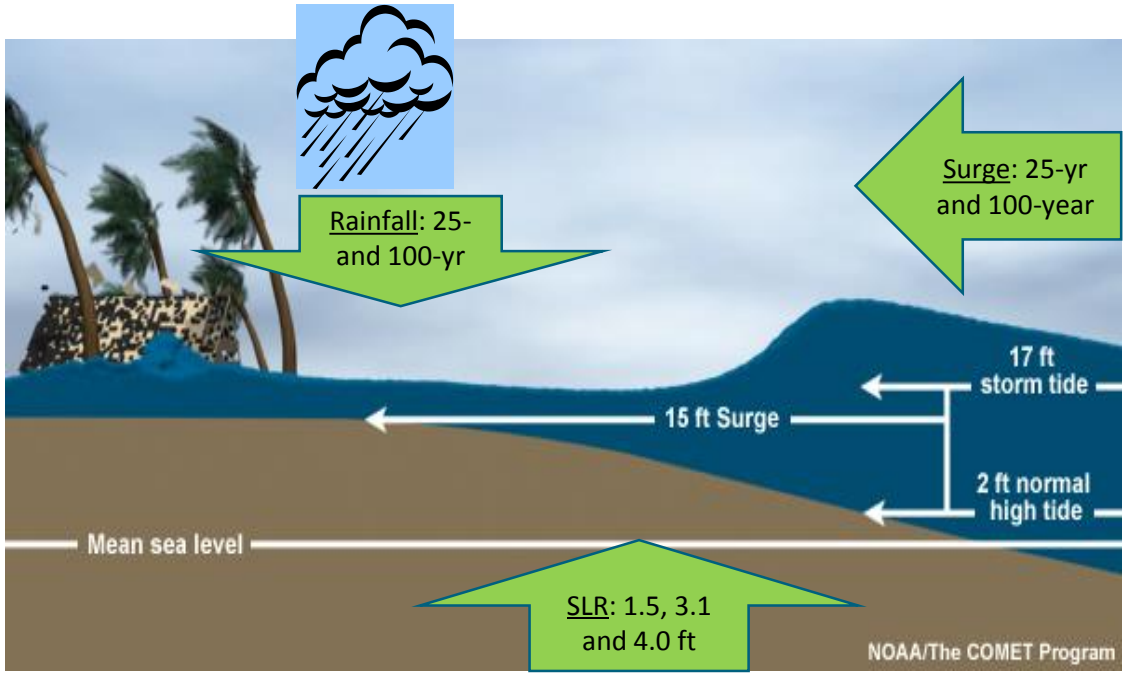
2015 ANALYSIS: Surge and inundation modeling run with
- 4.0' SLR (2075 NOAA High)
- 3.1' SLR (2075 USACE High)

Flood Modeling with Climate Change

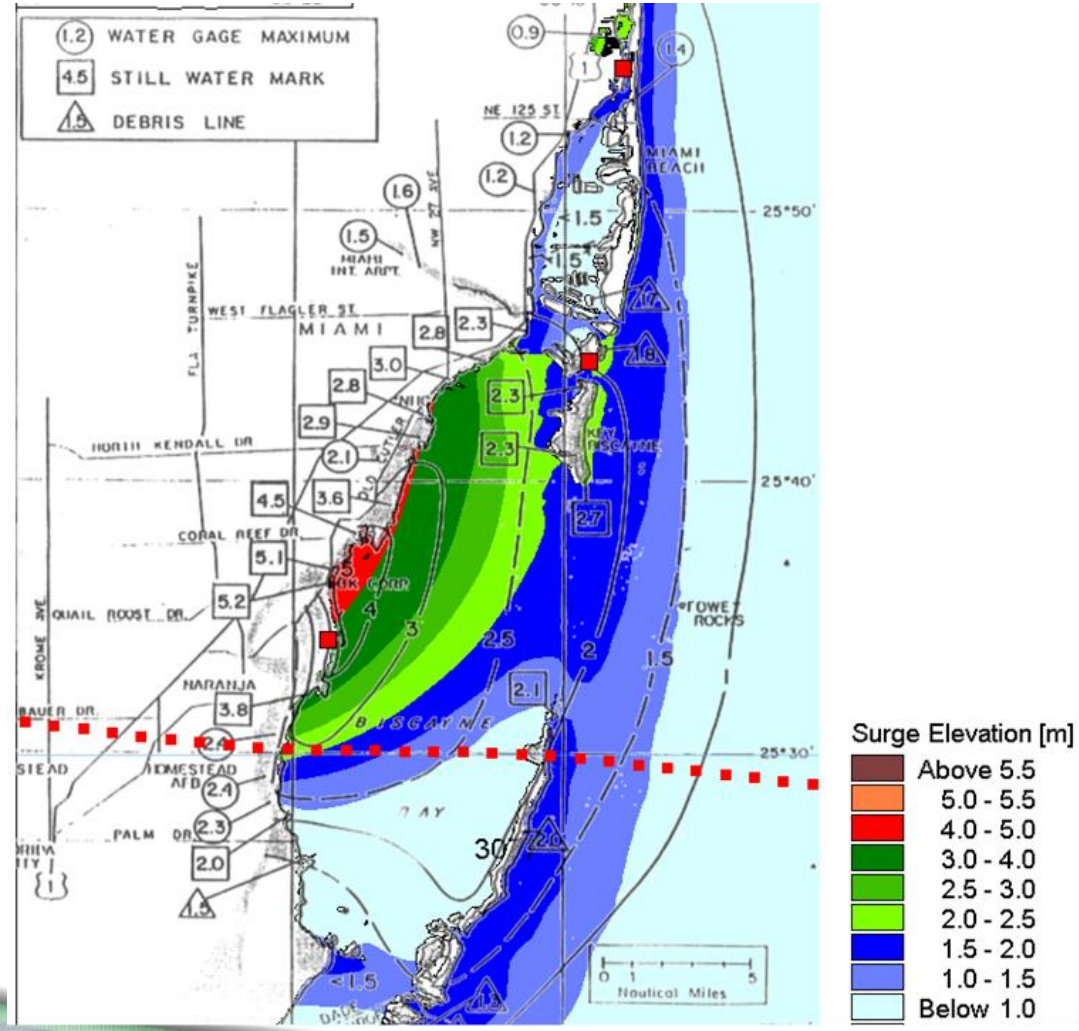
Relationship of Modeling Tasks Reflects Flooding Source: SLR, Storm Surge with Future SLR and Rainfall, Wave Effects

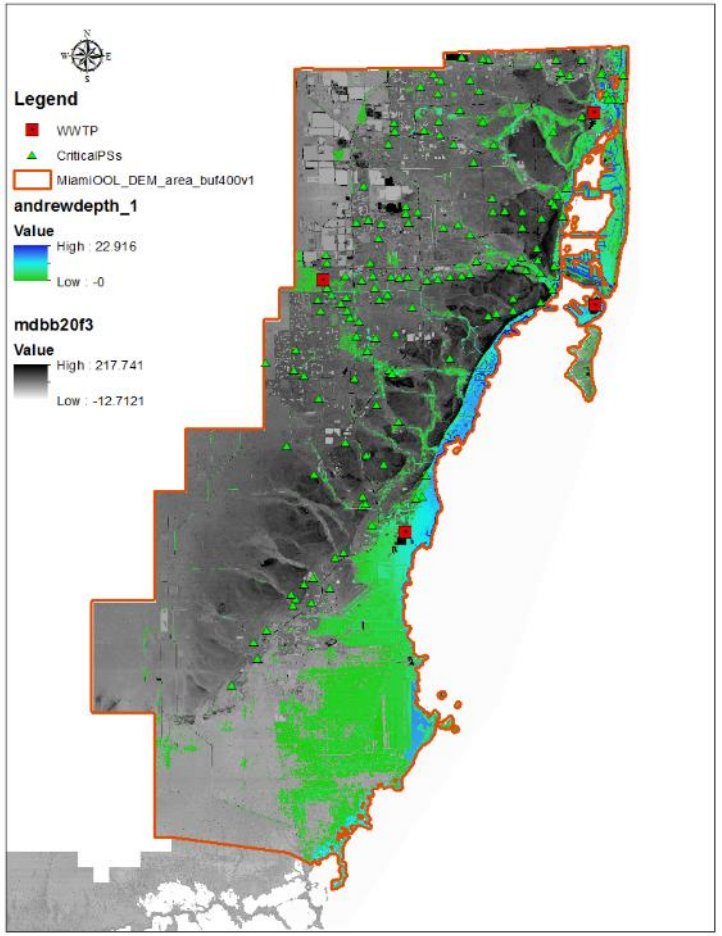
Key Variables:

- Wind driven storm surge: 100-yr and 25-yr storms
- SLR: 1.5 ft (2040), 3.1 ft and 4.0 ft (2075)
- Impacts of storm tracks and coastal bathymetry on storm surge and SLR
- Flood Propagation of SLR, Surge, and Rainfall inland
- Wave effects at shoreline and propagation inland

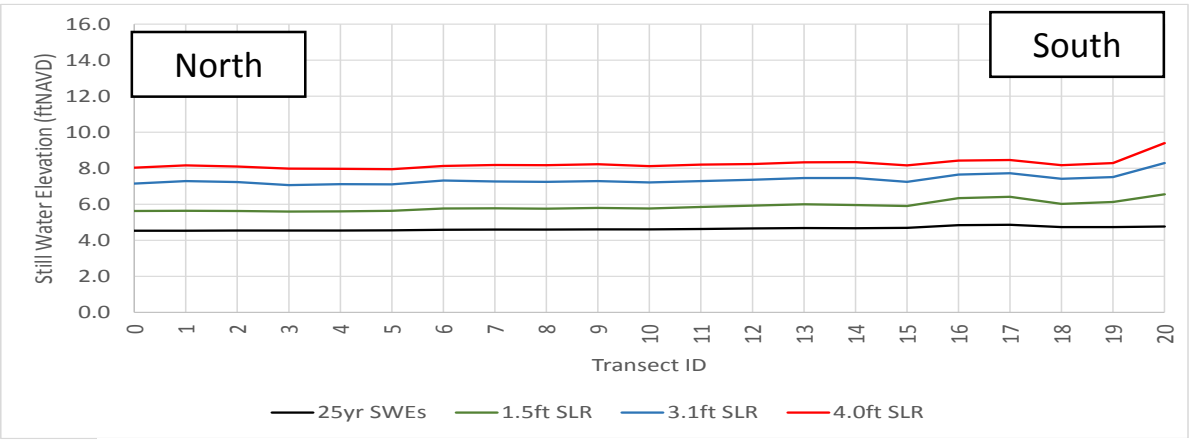


Surge Modeling: Comparison of Peak Surge Elevation: modeled with MIKE21 vs observations for Hurricane Andrew

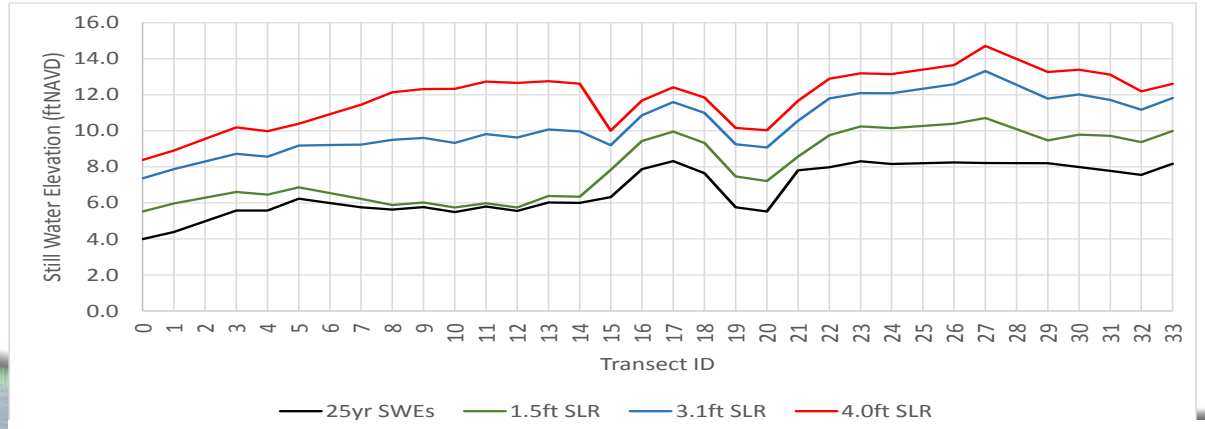




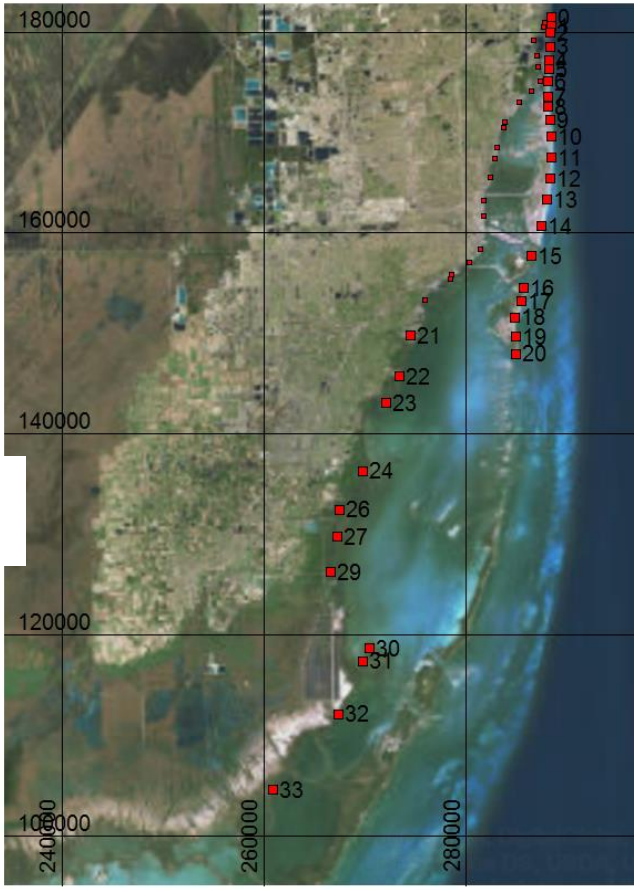
Additional Storm Surge Modeling Scenarios (MIKE21): 25-year storm surge with 1.5, 3.1 and 4.0 ft SLR



Spatial variation of the 25-year SWEs and each SLR scenario along transects, Ocean points

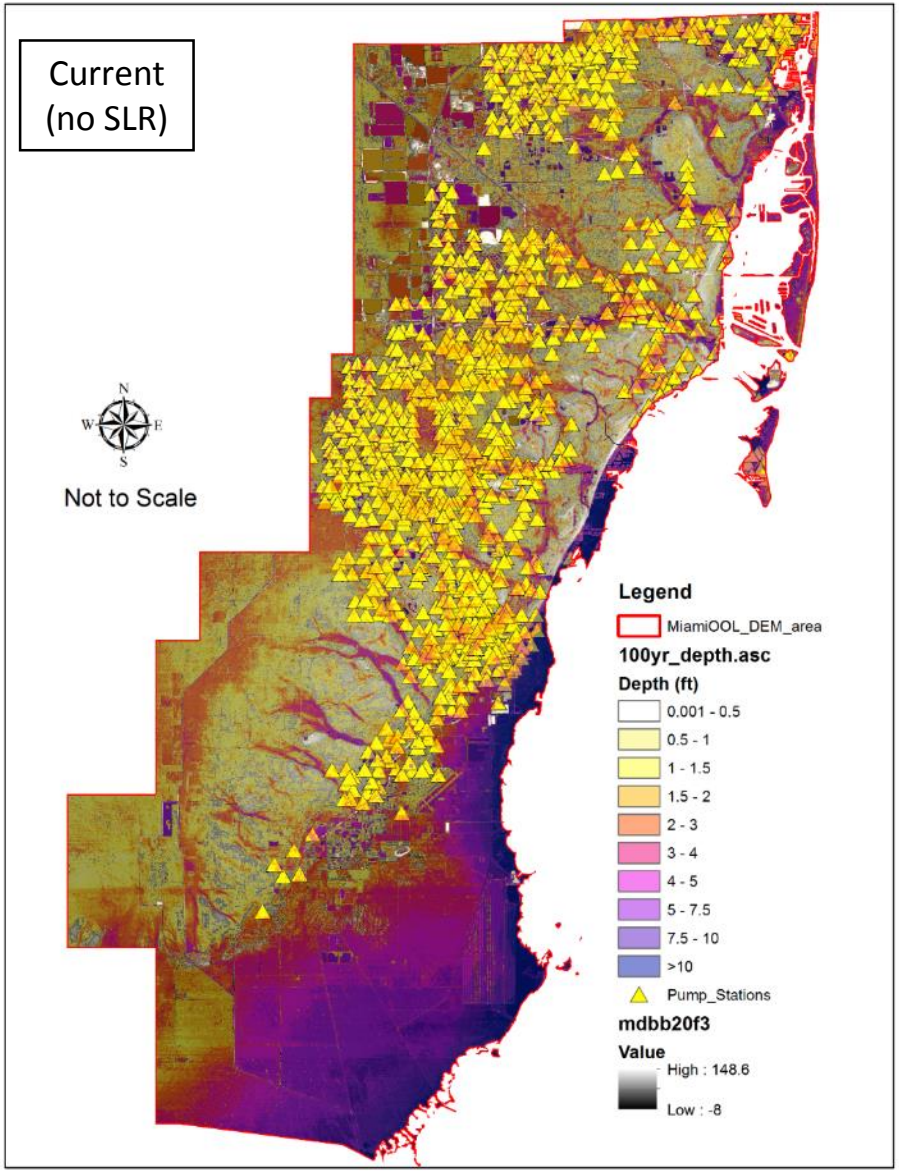


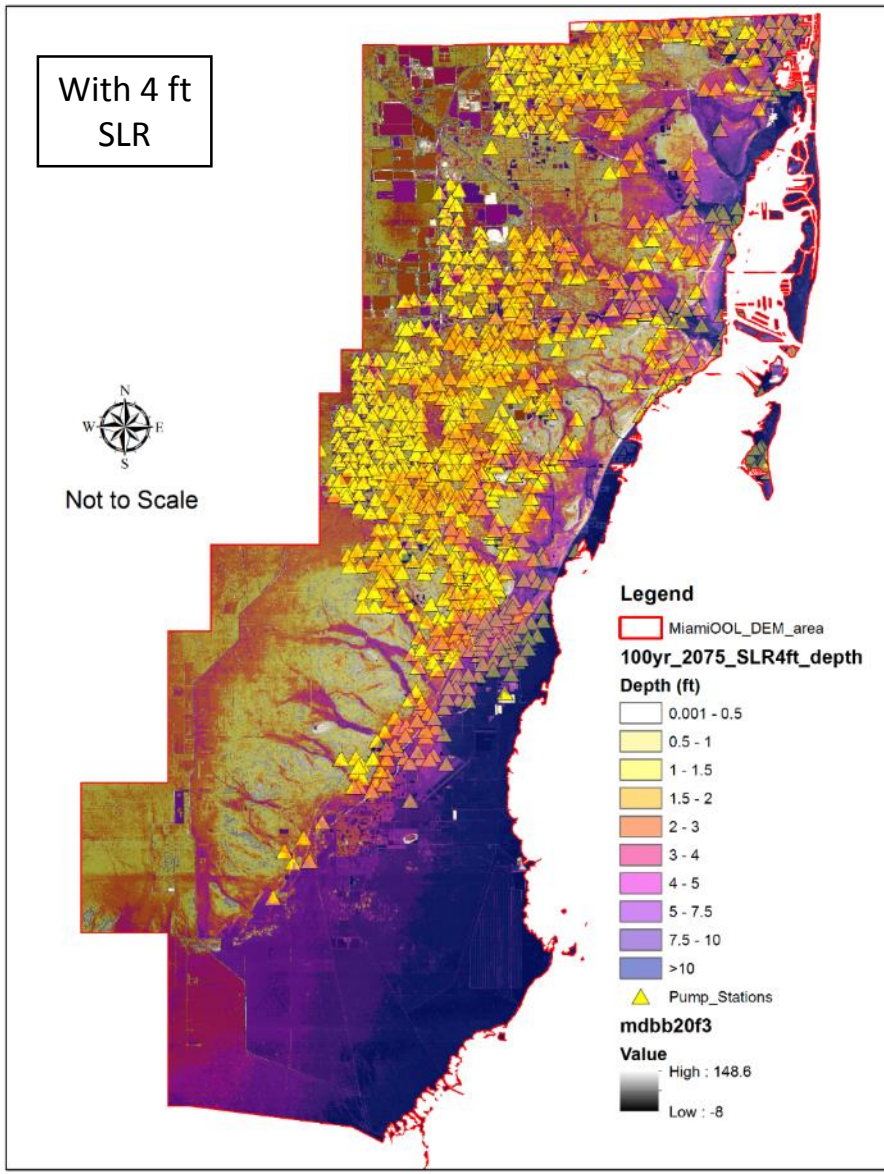
Spatial variation of the 25-year SWEs and each SLR scenario along transects, Bay points



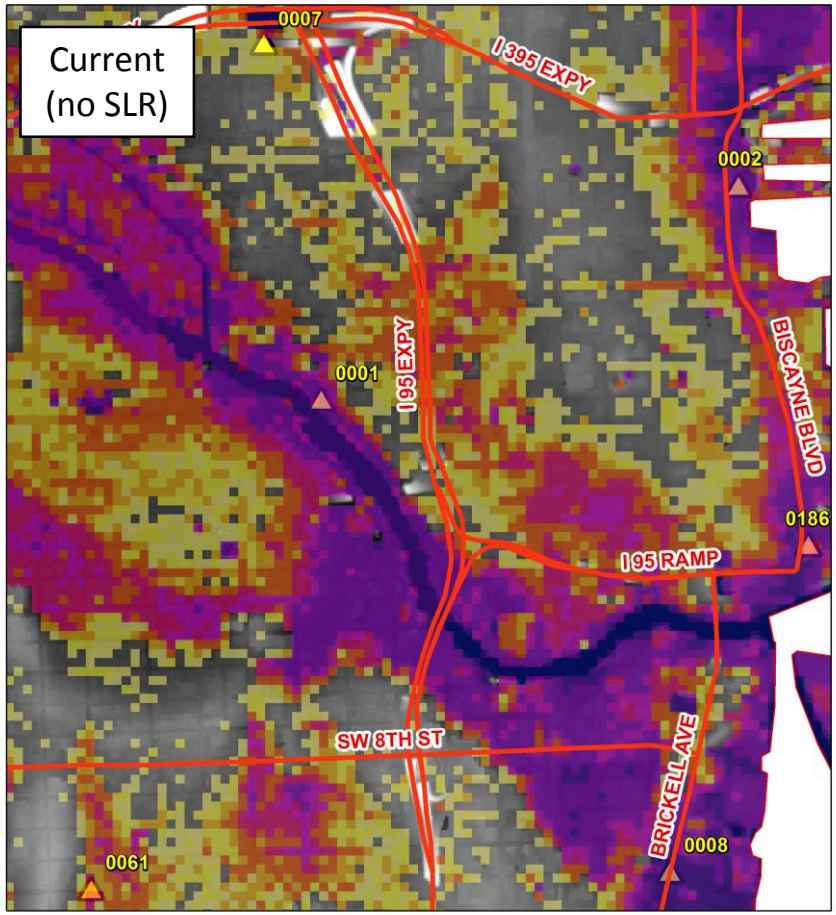
Location of model transects

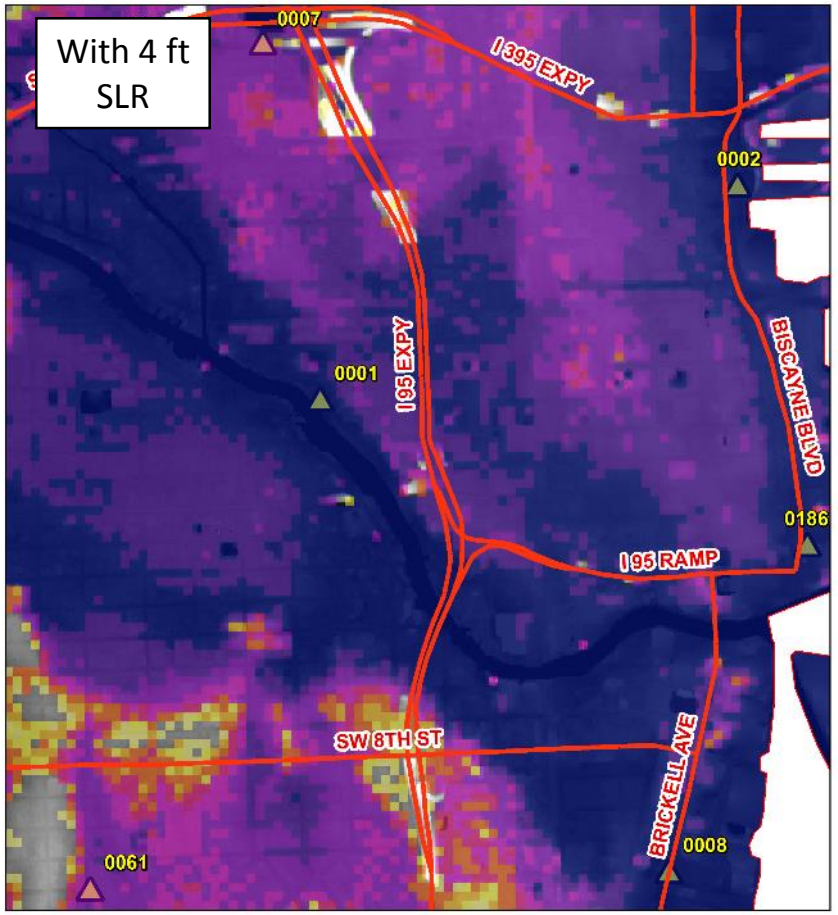
Inland Flooding: 100-year Depth

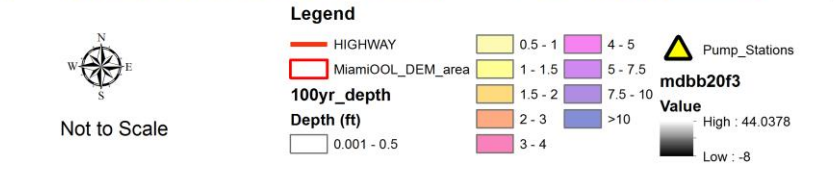


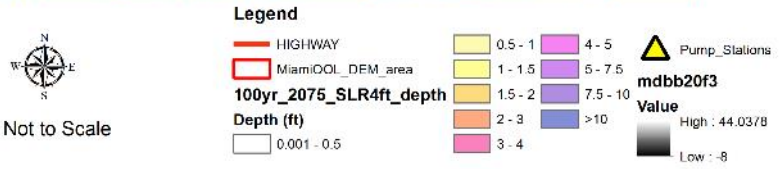


Refined Inland Flooding: 100-year Depth (zoomed in at PS #1)

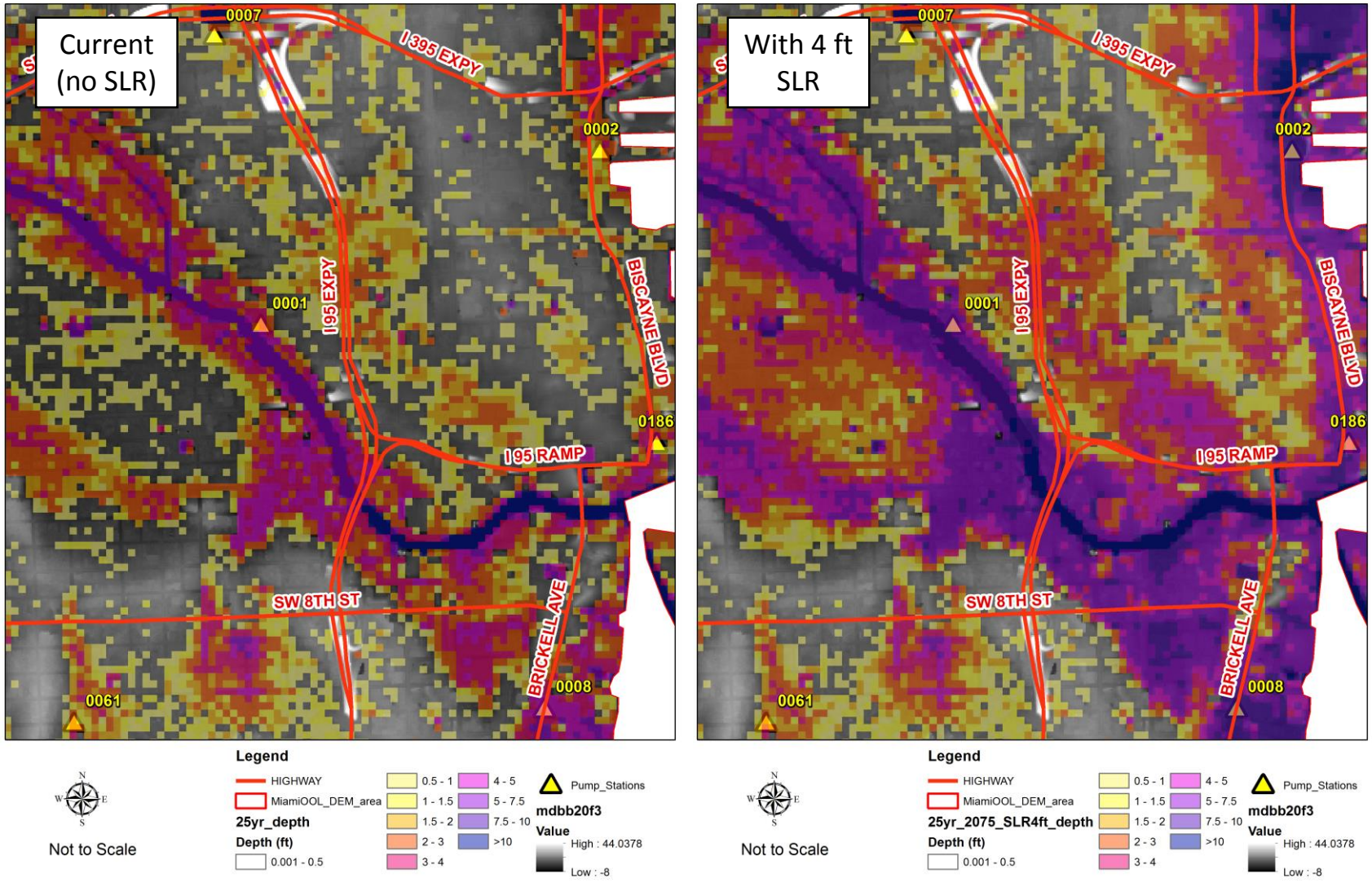








Refined Inland Flooding: 25-year Depth (zoomed in at PS #1)

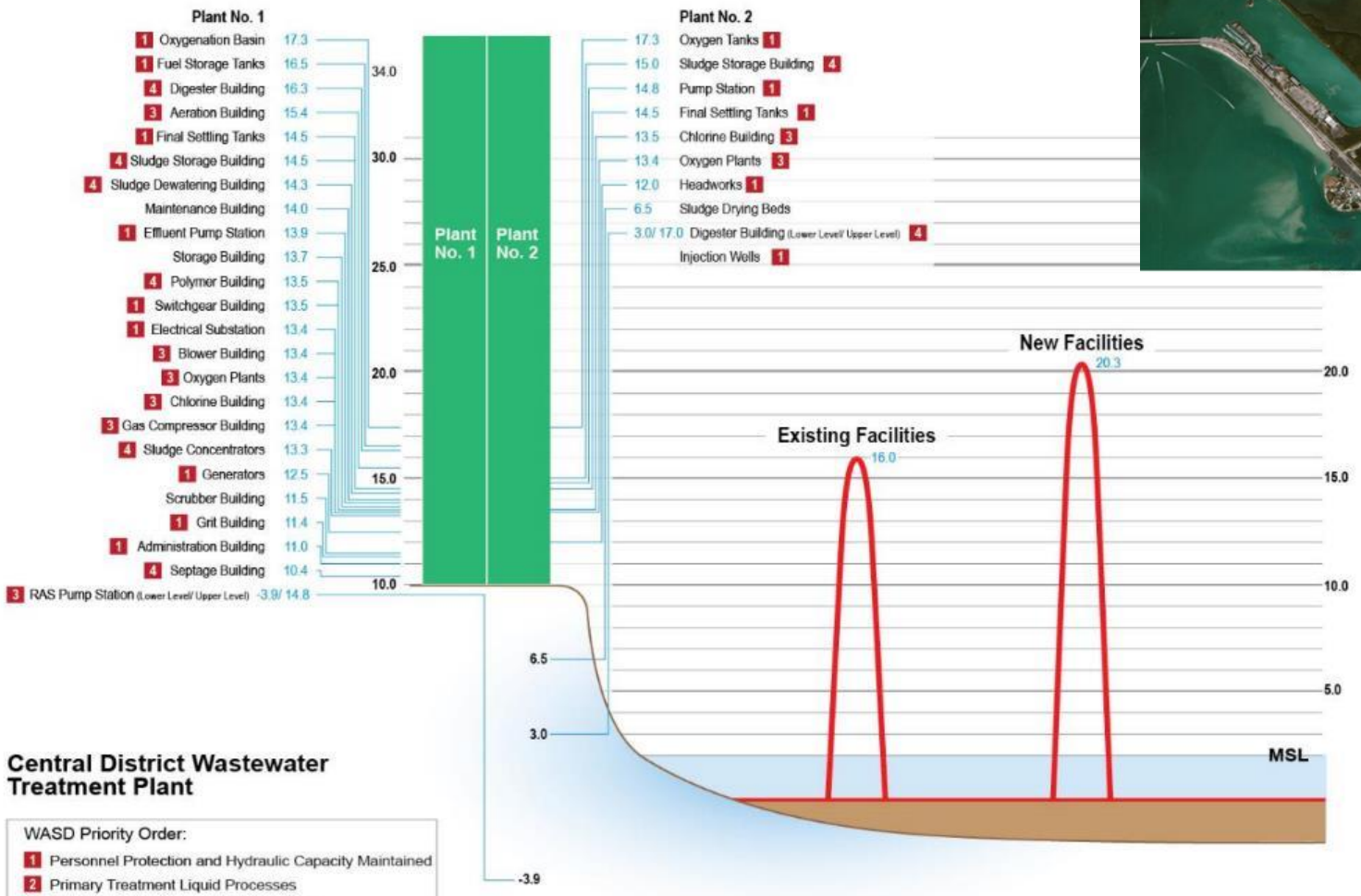


Miami-Dade Design Guidance on Facility Hardening with Climate Change

Factors in Setting Risk-based Design Criteria Used to Evaluate Cost/Benefit of Facility Hardening

- **Planning Horizon to establish the service life:**
  - 2075 for Critical Long-Term Facilities (e.g. WWTPs)
  - 2040 selected for pump station flows (e.g. PS-1)
- **Criticality, based on wastewater or pumping facility function, such as:**
  - Maintenance of facility hydraulics
  - Maintenance of equivalent primary treatment, liquid train
  - Maintenance of secondary treatment, liquid train
  - Maintenance of solids treatment

Facility Hardening Costs were Developed for Critical Facilities above Design Flood Elevation



Central District Wastewater Treatment Plant

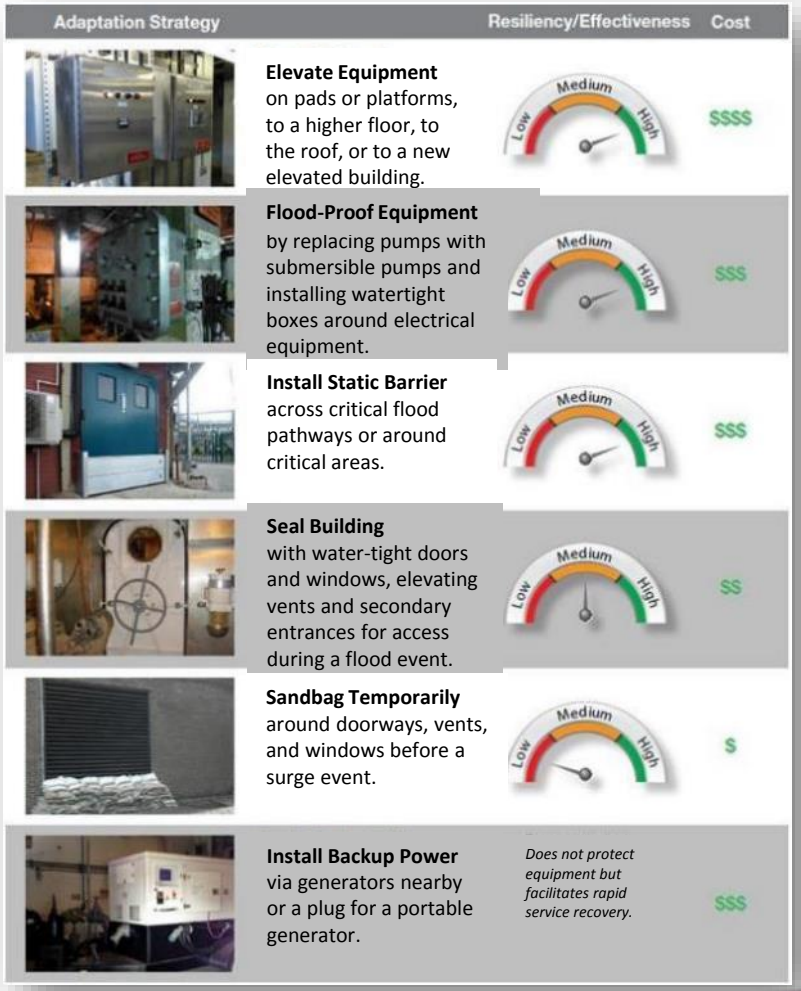
WASD Priority Order:

1. Personnel Protection and Hydraulic Capacity Maintained
2. Primary Treatment Liquid Processes
3. Secondary Treatment Liquid Processes
4. Solids Treatment Processes

** All elevations are in 1929 NGVD*

Adaptation Strategies / Protective Measures

- Identified site-specific protective measures to minimize prolonged service interruption and flood risk, while balancing feasibility, resiliency, and cost.
- Establish robust design guidelines for future wastewater infrastructure upgrades/designs that assist in mitigating flood risk.



Source: NYCDEP

Facility Hardening Costs - WWTPs

	Scenario 1 (Design Elevation 16.0 ft)			Scenario 2 (2075 SLR + FB + SF)		
	CD	OOL (Existing	Total	CD	OOL (Existing Facilities)	Total
CDWWTP	$ 4,576,200		$ 4,576,200	$ 39,947,600		$ 39,947,600
SDWWTP	$ 1,533,000	$ 3,980,000	$ 5,513,000	$ 16,053,000	$ 7,650,000	$ 23,703,000
NDWWTP	$ 9,213,000		$ 9,213,000	$ 14,578,000		$ 14,578,000
Note:			**$ 19,302,200**			**$ 78,228,600**
OOL Facility hardening was only estimated for retrofitting existing facilities.						
New OOL facilities would be hardened to same design criteria.						

Facility Hardening Design Guidelines for Existing and New WWTP Assets: Draft issued Aug.2015, revision planned early 2017

	Existing WWTP Facility Assets		New WWTP Facility Assets	
	ft NGVD29	Basis	ft NGVD29	Basis
CDWWTP	16.0	FEMA BFE + 3ft SLR from SEFLCC(2011) +FB +SF	20.3	2075 Surge+1.23m(48")SLR + FB +SF+21"(100-yr, 72-hr rainfall)
SDWWTP	16.0	FEMA BFE + 3ft SLR from SEFLCC(2011) +FB +SF	19.0	2075 Surge+1.23m(48")SLR + FB +SF+21"(100-yr, 72-hr rainfall)
NDWWTP	16.0	Same as CDWWTP and SDWWTP	17.1	2075 Surge+1.23m(48")SLR + FB +SF+21"(100-yr, 72-hr rainfall)

FB= Freeboard = 2.0 ft per ASCE Standard 24-05/2010 FBC Category IV

SF= Safety Factor = 1.0 ft per 2014 MWH study at CDWWTP

SLR = 1.23m = 48" per NOAA High projection for 2075 (USACE High projection is 0.93m)

Next Steps (2016-2017 Update): Prioritizing Pump Stations based on Criticality

- Criticality Factors
  - Flow
    - Based on population served
  - Priority 1 critical facilities served
    - Hospitals, shelters, first responders, emergency centers, city hall, homeland security, potable water facilities, prisons
    - Booster stations
    - Re-pump stations
  - Priority 2 critical facilities served
    - Other government buildings, schools, care service centers, fleet vehicle stations

Next Steps

- Prioritize Critical Pump Stations based on Flooding Risk
- Refine facility hardening approaches of priority pump stations based on feasibility, cost/benefit
- Cost estimates for categories of pump stations based on selected facility hardening approaches
- Update design guidelines for both pump stations and WWTPS
  - Flood protection elevations
  - Decision flow chart based on:
    - Criticality and Risk
    - Cost benefit (feasibility)
    - Service life
  - Case studies
- Develop GIS mapping tool for current and projected flood elevations

Question & Answer session

- Type your question into the “Questions” box and the moderator will read the question on your behalf.

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THANK YOU!

Additional questions or feedback?

Contact Jenna Moran at jmoran@naco.org