Adaptation Actions To Reduce Impairment of Indian River Lagoon Water Quality Caused by Climate Change
Funding provided by the IRL NEP

Presented to:
UF Water Institute Symposium
February 25, 2020
Gainesville, Florida

By:
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Institute of Environment
Florida International University
Miami, Florida

Overall Project Goal

1. Conduct a risk assessment of IRL NEP mission to climate change
2. Prioritize risks
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Looking Ahead to 2030:
A 10-Year Comprehensive Conservation and Management Plan for the Indian River Lagoon, Florida

To help organize and communicate its conservation and management goals the IRL NEP created a 'Vital Signs' wheel

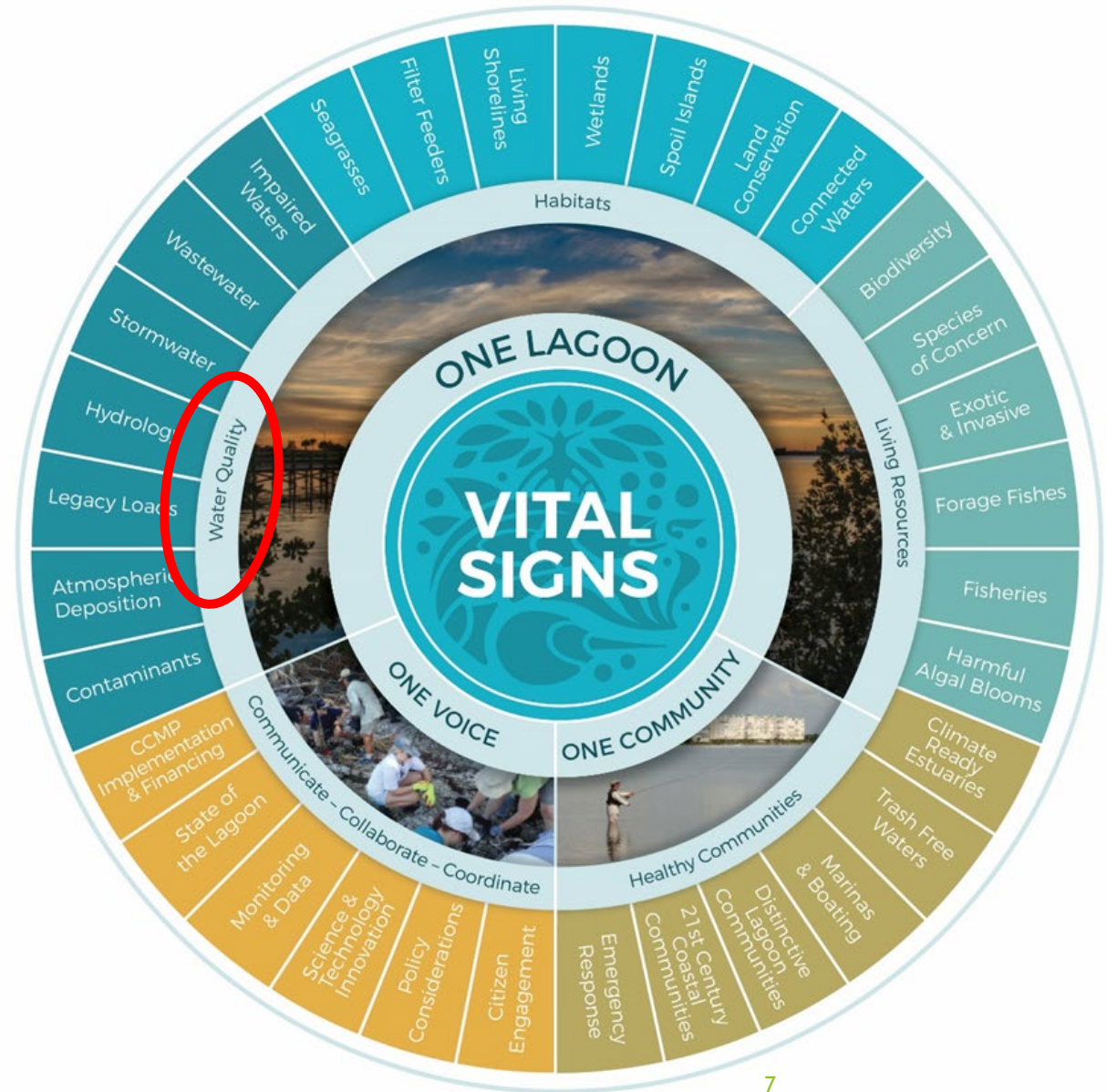

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Five vital sign categories

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1. Water quality

Five vital sign categories
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2. Habitats

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1. Water quality
2. Habitats
3. Living resources

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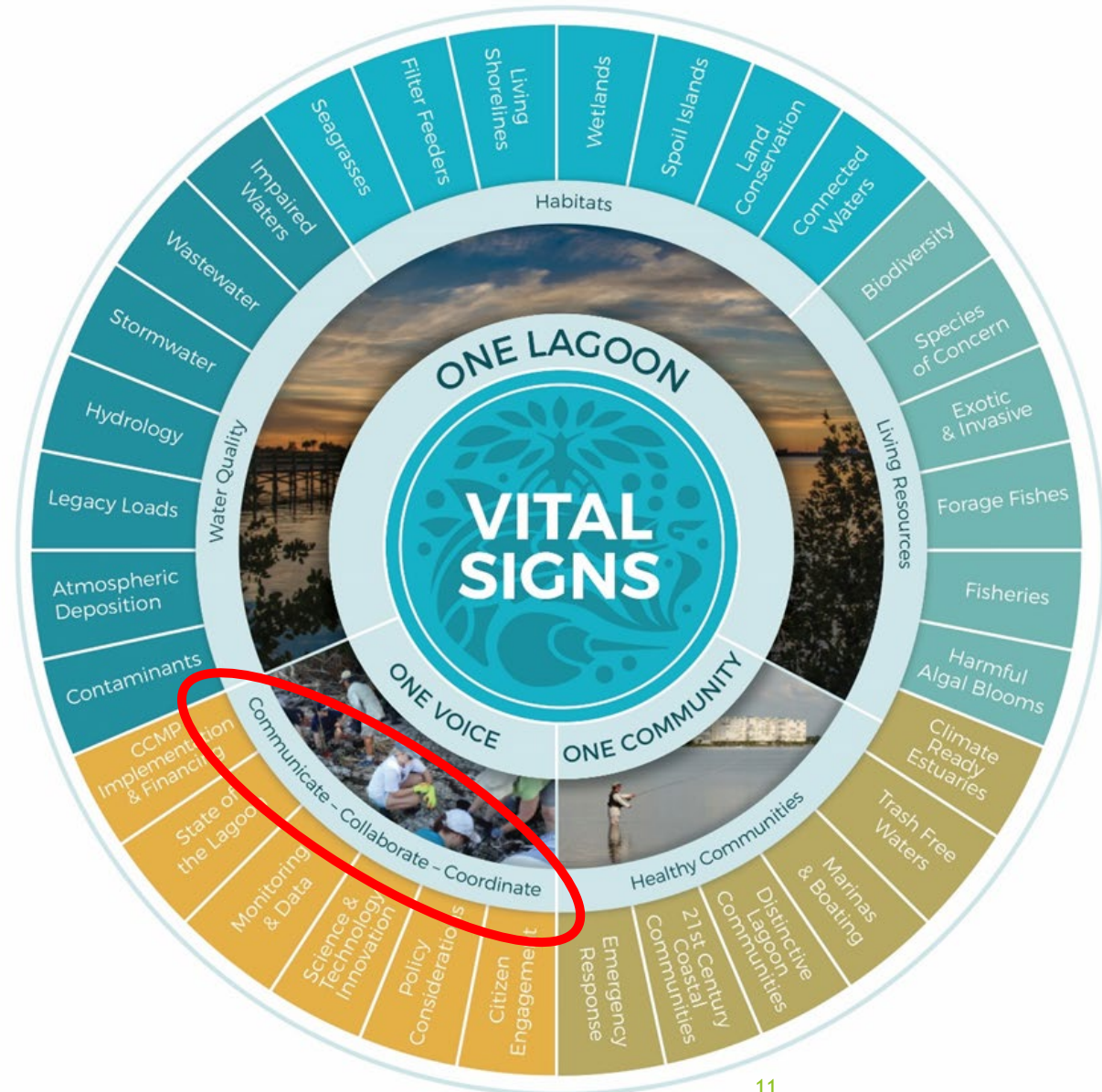1. Water quality
2. Habitats
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4. Healthy communities

Five vital sign categories

1. Water quality
2. Habitats
3. Living resources
4. Healthy communities
5. Communicate, collaborate, coordinate

11

32 vital signs were developed to provide guidance towards achieving the goals of each category

7 vital signs were identified in the water quality category

n = 7
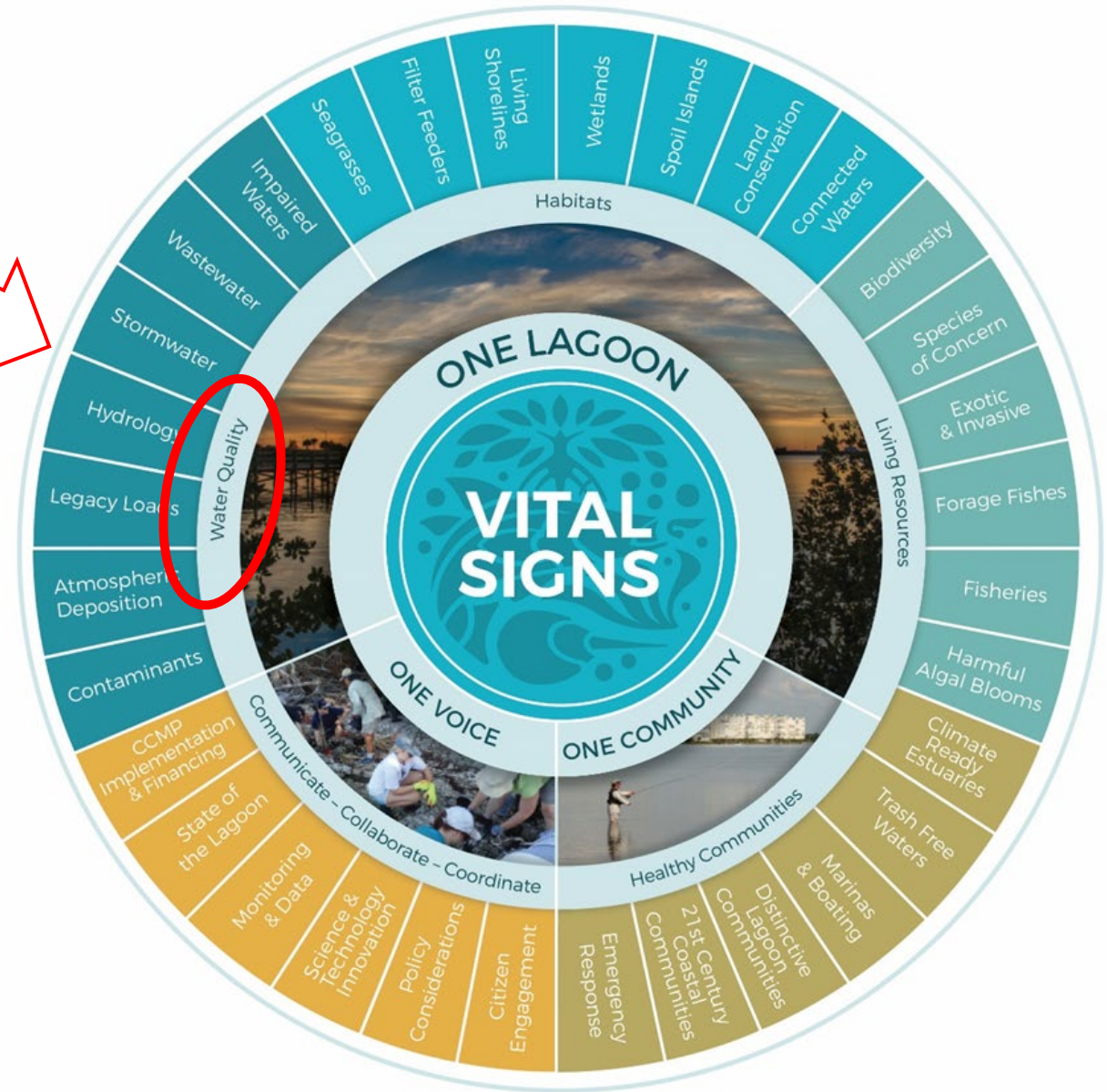
Impaired Waters focus = track progress in reducing pollutants that cause impairment:
- Total phosphorus
- Total nitrogen
- Chlorophyll-a
- fecal coliform
- metals

Wastewater focus = reduce
principle <u>source</u> of pollutants:
- Septic (OSTDS)
- Wastewater treatment plants (WWTP)

Stormwater Focus = reduce principle <u>source</u> of pollutants:
- Surface water storage and conveyance systems

Climate change will introduce new challenges towards reducing impairment and improving water quality and of course towards the successful completion of the other 25 vital sign goals designed to restore habitat value and ecosystem function.

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Risk Identification – Water Quality

Vital Sign: Surface water (storm and fresh)				
Climate Stressor/Risk				
Warmer temperature	Changes in precipitation	Increasing storminess	Acidification	Sea level rise
Increased pollutant loadings **(urban, rural)** due to changes in solubility and/or toxicity caused by warmer temperature	Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events	Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events	Increased pollutant loadings due to changes in solubility and/or toxicity caused by acidification	Increased pollutant loadings due to higher water table caused by sea level rise

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Scoring magnitude of risk caused by climate change

Consequence	Spatial extent of impact
1. Low (could adjust, life will go on)	1. Site (bridge, stormwater outflow)
2. Medium	2. Place (wildlife refuge)
3. High (catastrophic, major disruption)	3. Region (watershed)

Likelihood	Time horizon
1. Low	1. > 10 years
2. Medium	2. 5-10 years
3. High (very likely, predictable)	3. Already occurring or < 5 years

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Scoring magnitude of risk caused by climate change

Minimum = 4 Maximum = 12

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Risk Analysis - Water Quality

Vital Sign	Climate Stressor	Risk	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Wastewater	Warmer temperature	Increased pollutant loadings due to changes in solubility and/or toxicity caused by warmer temperature	1	1	2	2	6	Medium

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	Temp	PPt	Storms	pH	SLR	Sum		Highest	Higher	High	Sum
Water Quality											
Impaired waters (IW)	5	54	57	0	55	171	5	162	4	0	166
Wastewater (WW)	1	10	10	1	10	32	2	30		0	30
Stormwater and surface water (SW)	5	8	8	1	9	31	3	24	2	2	28
Hydrology and hydrodynamics (HH)	3	3	0	0	3	9	0	3	6	0	9
Legacy loads and healthy sediments (LL)	0	0	1	0	0	1	0	0	1	0	1
Atmospheric deposition (AD)	1	1	1	0	0	3	3	0	0	0	0
Sum	15	76	77	2	77	247	13	219	13	2	234
Habitats											
Seagrass (S)	6	16	15	1	14	52	5	47	0	0	47
Living shorelines (LS)	1	1	2	1	2	7	3	0	4	0	4
Wetlands and impounded/altered marshes (W)	3	1	0	0	2	6	5	1	0	0	1
Sum	10	18	17	2	18	65	13	48	4	0	52
Living Resources											
Biodiversity (B)	3	16	11	1	17	48	5	33	10	0	43
Species of concern (SoC)	10	15	18	1	19	63	4	47	12	0	59
Invasive species (InS)	2	15	14	0	14	45	3	14	28	0	42
Commercial and recreational fisheries (CRF)	3	15	19	1	14	52	4	42	6	0	48
Sum	15	45	51	2	47	160	11	103	46	0	149
Grand Total	40	139	145	6	142	472	37	370	63	2	435

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Biodiversity (B)	3	16	11	1	17	48	5	33	10	0	43
Species of concern (SoC)	10	15	18	1	19	63	4	47	12	0	59
Invasive species (InS)	2	15	14	0	14	45	3	14	28	0	42
Commercial and recreational fisheries (CRF)	3	15	19	1	14	52	4	42	6	0	48
Sum	15	45	51	2	47	160	11	103	46	0	149
Grand Total	**40**	**139**	**145**	**6**	**142**	**472**	**37**	**370**	**63**	**2**	**435**

51

Category and Vital Sign	Stressor						Accept	Level of Risk			
	Temp	PPt	Storms	pH	SLR	Sum		Highest	Higher	High	Sum
Water Quality											
Impaired waters (IW)	5	54	57	0	55	**171**	5	162	4	0	166
Wastewater (WW)	1	10	10			**32**	2	30		0	30
Stormwater and surface water (SW)	5	8	8	1	9	**31**	3	24	2	2	28
Hydrology and hydrodynamics (HH)	3	3	0	0	3	**9**	0	3	6	0	9
Legacy loads and healthy sediments (LL)	0	0	1	0	0	**1**	0	0	1	0	1
Atmospheric deposition (AD)	1	1	1	0	0	**3**	3	0	0	0	**0**
Sum	15	76	77	2	77	**247**	13	219	13	2	234
Habitats											
Seagrass (S)	6	16	15	1	14	**52**	5	47	0	0	47
Living shorelines (LS)	1	1	2	1	2	**7**	3	0	4	0	4
Wetlands and impounded/altered marshes (W)	3	1	0	0	2	**6**	5	1	0	0	1
Sum	10	18	17	2	18	**65**	13	48	4	0	52
Living Resources											
Biodiversity (B)	3	16	11	1	17	**48**	5	33	10	0	43
Species of concern (SoC)	10	15	18	1	19	63	4	47	12	0	59
Invasive species (InS)	2	15	14	0	14	45	3	14	28	0	42
Commercial and recreational fisheries (CRF)	3	15	19	1	14	**52**	4	42	6	0	48
Sum	15	45	51	2	47	**160**	11	103	46	0	149
Grand Total	**40**	**139**	**145**	**6**	**142**	**472**	**37**	**370**	**63**	**2**	**435**

50%

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Category and Vital Sign	Stressor						Accept	Level of Risk			
	Temp	PPt	Storms	pH	SLR	Sum		Highest	Higher	High	Sum
Water Quality											
Impaired waters (IW)	5	54	57	0	55	**171**	5	162	4	0	166
Wastewater (WW)	1	10	10	50%		**32**	2	30	58%	0	30
Stormwater and surface water (SW)	5	8	8	1	9	**31**	3	24	2	2	28
Hydrology and hydrodynamics (HH)	3	3	0	0	3	**9**	0	3	6	0	9
Legacy loads and healthy sediments (LL)	0	0	1	0	0	**1**	0	0	1	0	1
Atmospheric deposition (AD)	1	1	1	0	0	**3**	3	0	0	0	**0**
Sum	15	76	77	2	77	**247**	13	219	13	2	234
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53

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	Temp	PPt	Storms	pH	SLR	Sum		Highest	Higher	High	Sum
Water Quality											
Impaired waters (IW)	5	54	57	0	55	171	97%	162	4	0	166
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Stormwater and surface water (SW)	5	8	8	1	9	31	3	24	2	2	28
Hydrology and hydrodynamics (HH)	3	3	0	0	3	9	0	3	6	0	9
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Grand Total	40	139	145	6	142	472	37	370	63	2	435

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Overall Project Goal

1. Conduct a risk assessment of IRL NEP mission to climate change
2. Prioritize risks

3. Formulate action plans to reduce risks

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Adaptation Actions to reduce risks to Water Quality caused by the most significant climate change stressors.

Stressor	Adaptation Action
PPt	Reduce pollutant loadings from WWTP durng high rainfall events
	Reduce pollutant loadings from OSTDS during high rainfall events
	Reduce pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events
Storms	Reduce pollutant loadings from WWTP due to more frequent and intense storms
	Reduce pollutant loadings from OSTDS due to more frequent and intense storms
	Reduce pollutant loadings from surface water storage and conveyance infrastructure due to more frequent and intense storms
SLR	Reduce pollutant loadings from WWTP caused by rising water table and sea level (inundation, erosion)
	Reduce pollutant loadings from OSTDS caused by rising water table and sea level (inundation, erosion)
	Reduce pollutant loadings from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)

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Adaptation Actions to reduce risks to Water Quality caused by the most significant climate change stressors.

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Adaptation Actions to reduce risks to Water Quality caused by the most significant climate change stressors.

Stressor	Adaptation Action
PPt ✱	Reduce pollutant loadings from WWTP durng high rainfall events
	Reduce pollutant loadings from OSTDS during high rainfall events
	Reduce pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events
Storms	Reduce pollutant loadings from WWTP due to more frequent and intense storms
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To achieve the goals of the nine Adaptation Actions, nine Action Plans are recommended, each consisting of the following five tasks to be completed at the appropriate level of organizational governance

1. Construct a georeferenced map of all systems, including (invert)elevations, proximity to groundwater table and IRL shoreline.
2. Evaluate integrity of systems (age, service history, present and future investment).
3. Evaluate system vulnerability associated with three most significant climate change stressors (i.e., ppt, storms, SLR).
4. Prioritize risks to WWTP, OSTDS, SWSC systems based upon 2 and 3.
5. Prepare a Climate Change Adaptation Strategy (CCAS) containing a comprehensive set of prioritized goals and objectives to mitigate the risks to each system.

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Final Step: Implementation and monitoring strategy

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Hence, it appears logical to incorporate the nine actions plans and associated Climate Change Adaptation Strategies described herein into existing BMAP/TMDL programs operating within the IRL watershed.

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Elevated pollutant loadings caused climate change will likely complicate the ability of existing BMAPs to meet their respective TMDL targets.

Hence, it appears logical to incorporate the nine actions plans and associated Climate Change Adaptation Strategies described herein into existing BMAP/TMDL programs operating within the IRL watershed.

The program already has an established leadership hierarchy, partnership network, funding stream, and reporting / monitoring protocol.

The Bottom Line

To reduce IRL water quality impairment caused by both historical land use changes and future land use and climate change, we must reduce the input of nutrient pollution (i.e., nitrogen and phosphorous) from OSTDS, WWTP, and SWSC infrastructure.

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To reduce IRL water quality impairment caused by both historical land use changes and future land use and climate change, we must reduce the input of nutrient pollution (i.e., nitrogen and phosphorous) from OSTDS, WWTP, and SWSC infrastructure.

This will improve water quality, reduce impairment, and stimulate the recovery of a more resilient, climate-ready estuary.

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Adaptation Actions To Reduce Impairment of Indian River Lagoon Water Quality Caused by Climate Change

Presented to:
UF Water Institute Symposium
February 25, 2020
Gainesville, Florida

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