

LOW IMPACT DEVELOPMENT COUPLED WITH FLOOD MITIGATION

**CDM
Smith**

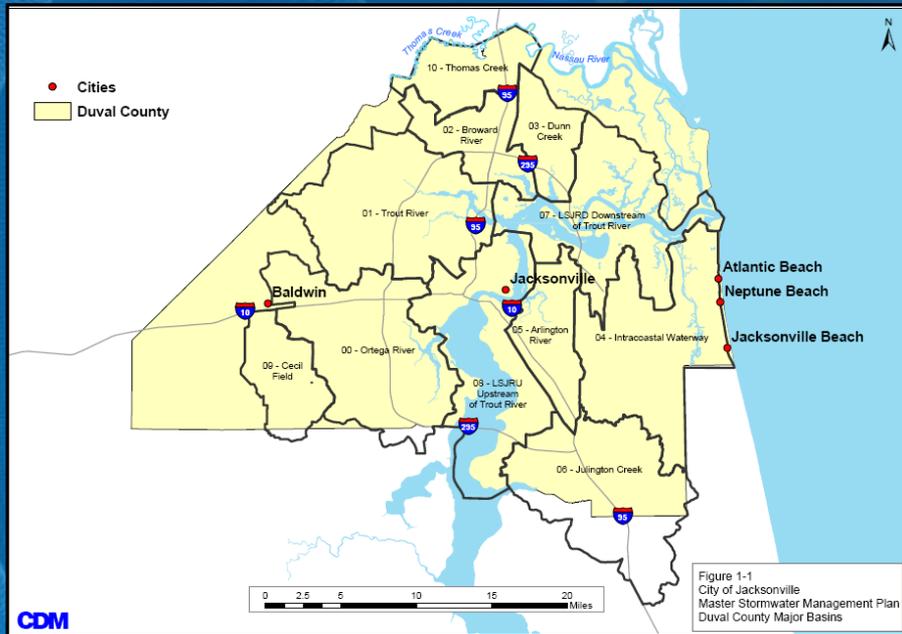


Figure 1-1
City of Jacksonville
Master Stormwater Management Plan
Duval County Major Basins



Richard Wagner, P.E.,
D.WRE

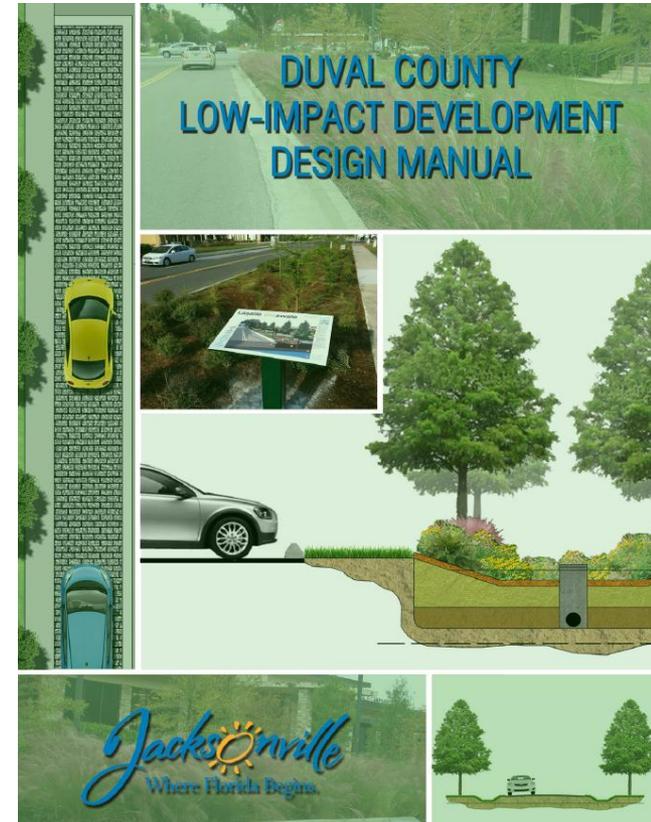
Seth Nehrke, P.E., D.WRE

2013 Jacksonville
Environmental Symposium



Examples of Low Impact Development (LID) Considerations in Jacksonville

- Master Stormwater Management Plan (MSMP) 1992
 - Floodplain and floodway protection
 - Volume-time detention
 - Stormwater project components
- City of Jacksonville LID Manual
- Wurn and Fletcher Morgan Parks study
- Valens Drive study



City of Jacksonville Preliminary LID Manual Focuses on Right-of-Way LID Applications

- Conveyance and landscape swales
- Bioretention
- Pervious pavement



Benefits of LID Practices

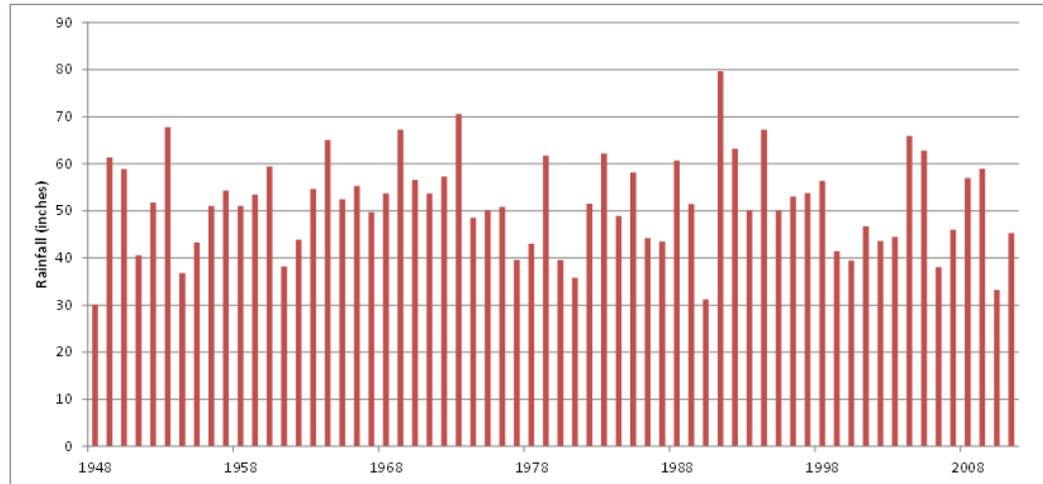
- Water quality
 - Pollutant loads are reduced in proportion to runoff volume reduction
 - Reduced size requirement for ponds with LID in tributary area
 - Improved water quality and lower temperature discharges
- Water quantity
 - Increased groundwater infiltration, recharge, and baseflow
 - May result in reduced pipe sizes and storage volume requirement for pond with LID in tributary area
 - Reduced discharge volumes
 - Reductions in potable water supply use by landscape irrigation

Evaluation of Runoff Control Practices

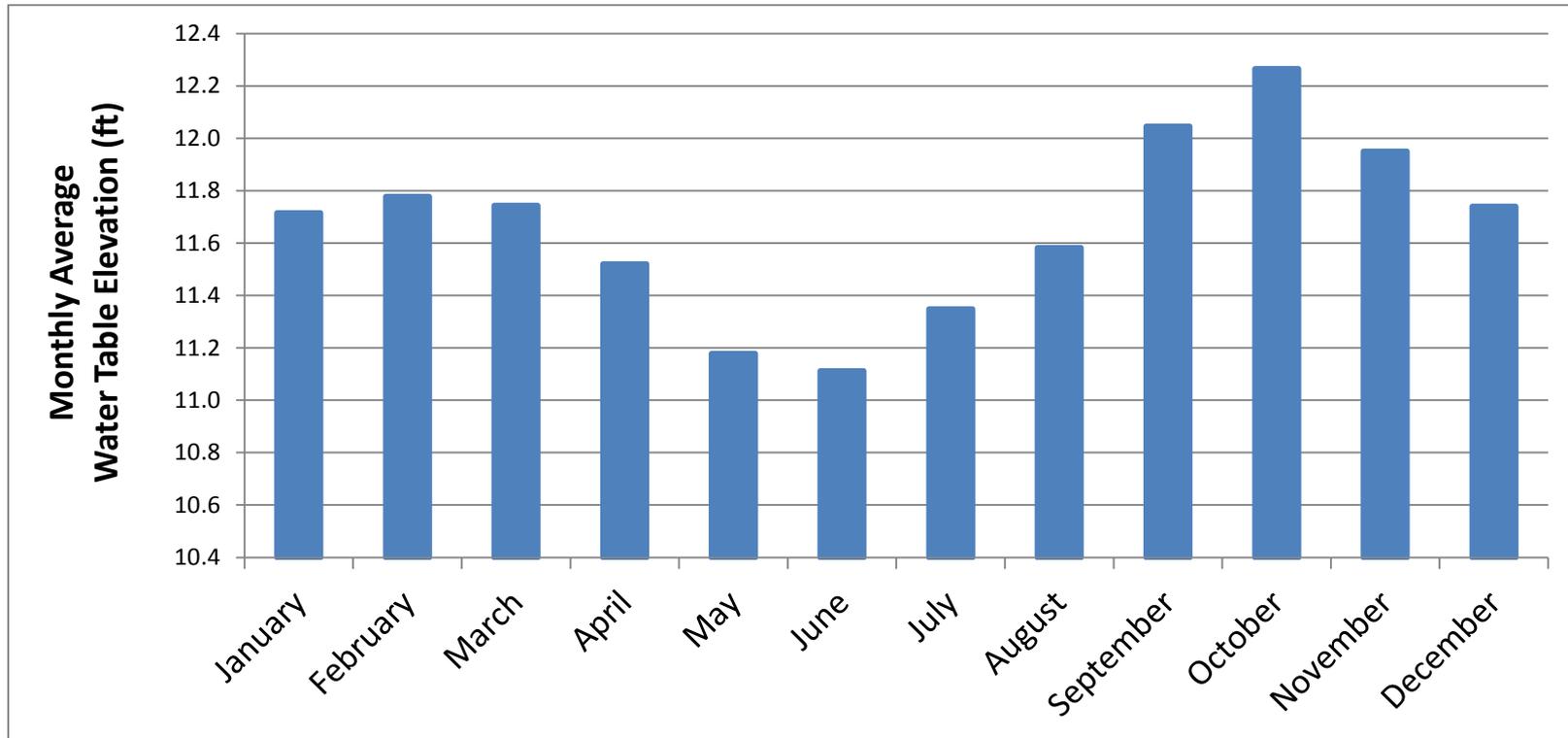
- Goal: reasonable water budget and seasonal water table representation
- Long-term H&H and water quality simulations using SWMM5
 - Pre-development (runoff, groundwater) for undeveloped (pervious) land
 - Post-development: impervious land (e.g., roadway, parking lot) routed to LID feature
 - Determine average annual % runoff capture

SWMM5 – Undeveloped Area

- Long-term simulations using SWMM5
 - Surface runoff hydrologic parameters based on MSMP modeling
 - Added groundwater parameter values for calculation of baseflow
 - Target: Rainfall converted to roughly 30% streamflow, 70% ET



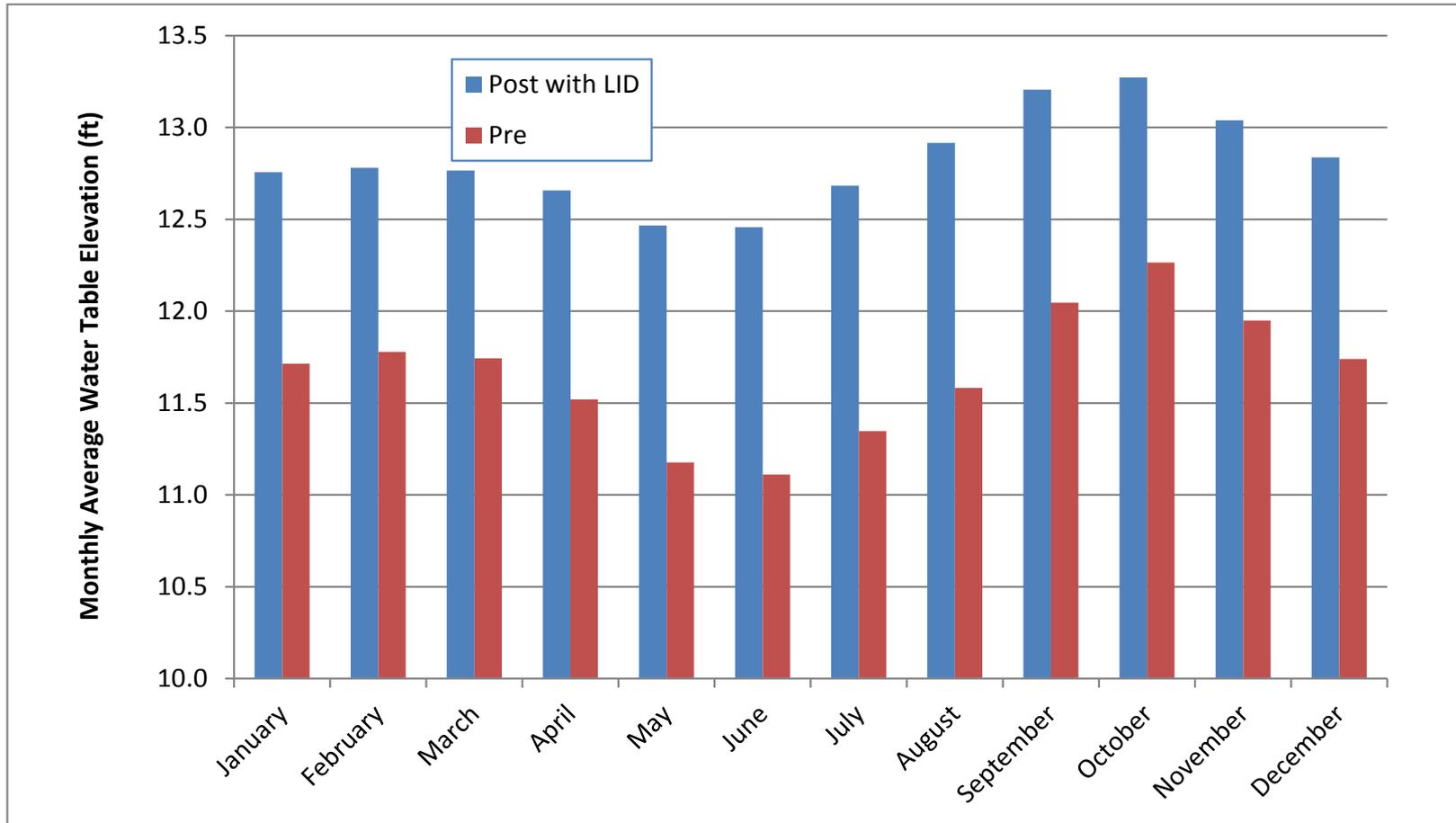
SWMM5 – Undeveloped Area: Simulated Seasonal Water Table



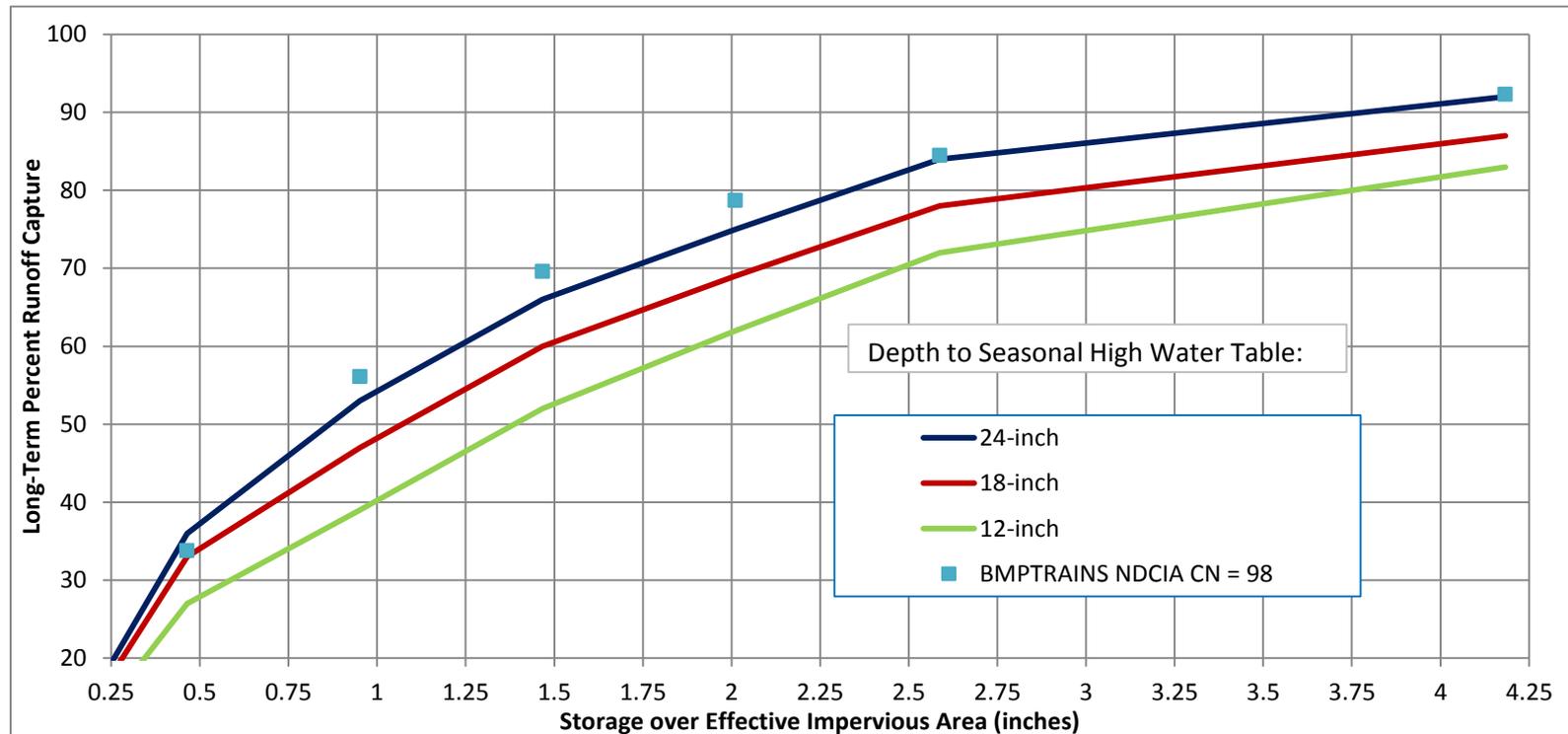
SWMM5 – Developed Area

- Long-term simulation with impervious area runoff routed to LID feature
 - Various ratios of impervious tributary area to LID surface area
 - Typical design characteristics for LID feature (e.g., bioretention ponding depth and planting media depth)
- Goal: determine runoff capture efficiency based on LID storage/treatment volume

SWMM5 – Model Shows Higher Local Water Table Elevation After Development with LID

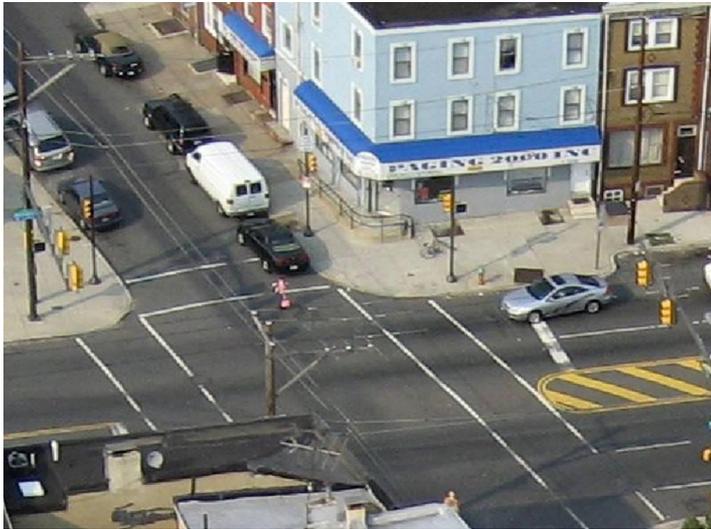


Results Based on Storage Volume and Depth to Seasonal High Water Table



Other Potential LID Practices

- Reduced roadway widths
- Filter strips
- Curb extensions
- Landscaping planter boxes



Example Studies in Jacksonville

- Wurn and Fletcher Morgan Parks
 - Opportunity for stormwater irrigation from existing ponds
 - In tributary area to impaired waters (Pottsburg Creek, Lower St. Johns River)
- Valens Drive
 - Known area of nuisance flooding
 - In tributary area to impaired waters (Pottsburg Creek, Lower St. Johns River)
- Evaluation Aspects
 - Benefits (e.g., increased infiltration and recharge, volume and load reduction, peak stages reduced, potable water use reduction)
 - Costs

Recreational LID Demonstration Projects



LID Retrofit Opportunities: Public Facilities



Horizontal
Irrigation Well

LID Retrofit Opportunities: Public Facilities



SOURCE: KEVIN ROBERT PERRY - CITY OF PORTLAND



SOURCE: NEVUE NGAN ASSOCIATES

Stormwater Irrigation Evaluation

- Define irrigation and tributary areas
- Determine irrigation demand
- Quantify savings

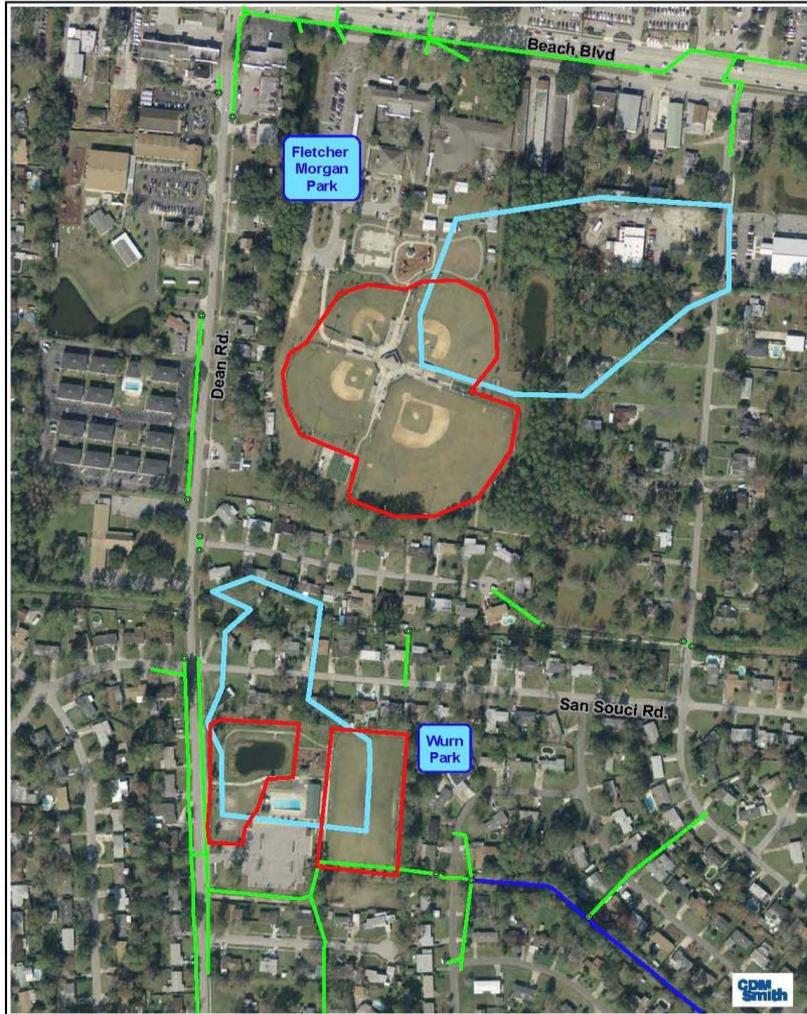


Figure 1-1
City of Jacksonville
Wurn and Fletcher Morgan Park
Stormwater Harvesting Pilot Study
Location Map

Stormwater Irrigation Evaluation

Define Irrigation & Tributary Areas

Analyze Supply and Demand



- ▭ Irrigation Areas
- ▭ Tributary Area for Harvesting
- Piped Conveyance
- End Walls

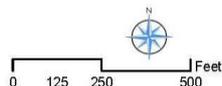


Figure 1-1
City of Jacksonville
Wurn and Fletcher Morgan Park
Stormwater Harvesting Pilot Study
Location Map

Location: Fletcher Morgan
Season: Summer
Watering Days: 4 days/wk (typical)

Zone No.	GPM	Zone Flow (gal/day)*	Zone Flow (gal/wk)*
1	78.1	4,700	18,800
2	75.7	4,600	18,200
3	76.9	4,700	18,500
4	61	3,700	14,700
5	72.6	4,400	17,500
6	72.4		
7	61		
8	61		
9	73.2		
10	76.3		
11	67.1		
12	54.9		
13	54.9		
14	0		
15	0		
16	30.4		
17	63		
18	63		
19	60		
Total	1,102		

Fletcher Morgan Park Irrigation	
Watershed	8.63 Acres
Impervious	1.75 Acres
Percent Impervious	20.3%
Runoff Coeff Perv.	0.12
Runoff Coeff Imp.	0.85
Re-Use Volume in pond	15,700 ft ³
Irrigation Area	7.2 acres
Reuse efficiency	84%
Yearly Rainfall	52 in/yr NE FL
Weekly Rainfall Runoff (equivalent)	0.32 in/wk Watershed
C	0.27
Effective Impervious Area (EIA)	2.31 Acres
Reuse Volume [V] (In. over EIA)	1.87 in
Reuse Rate [R] (In./day over EIA)	0.21 in/day (from REV Chart; Figure 31-1 SIRMWD Applicant's Handbook)
Reuse Rate [R] over irrigated area	1,008 ft ³ /day
Required	5,062 ft ³ /day
Percentage of Demand Met	19.9%

Pond Depth: 8 feet
Pond Area: 0.36 Acres
Bott. Area: 0.09 Acres
Pond Volume: 1.8 ac-ft
Pond Volume: 78,408 ft³

Re-use Depth: 1 ft
Re-use Volume: 15,700 ft³

20%

Location: Wurn Park
Season: Summer
Watering Days: 5 days/wk (typical)
Std. Head Flow: 14.2 gpm

Zone No.	Heads/ Zone
1	6
2	9
3	7
4	7
5	7
6	7
Total	43

Wurn Park Irrigation	
Watershed	4.5 Acres
Impervious	1.35 Acres
Percent Impervious	30.0%
Runoff Coeff Perv.	0.12
Runoff Coeff Imp.	0.85
Re-Use Volume in pond	14,810 ft ³
Irrigation Area	3.3 Acres
Reuse efficiency	85%
Yearly Rainfall	52 in/yr NE FL
Weekly Rainfall Runoff (equivalent)	0.46 in/wk Watershed
C	0.34
Effective Impervious Area (EIA)	1.53 Acres
Reuse Volume [V] (In. over EIA)	2.67 in
Reuse Rate [R] (In./day over EIA)	0.18 in/day (from REV Chart; Figure 31-1 SIRMWD Applicant's Handbook)
Reuse Rate [R] over irrigated area	672 ft ³ /day
Required	1,765 ft ³ /day
Percentage of Demand Met	38.1%

Pond Depth: 7 feet
Pond Area: 0.34 Acres
Bott. Area: 0.07 Acres
Pond Volume: 1,435 Ac-ft
Pond Volume: 62,509 ft³

Re-use Depth: 1 ft
Re-use Volume: 14,810 ft³

38%

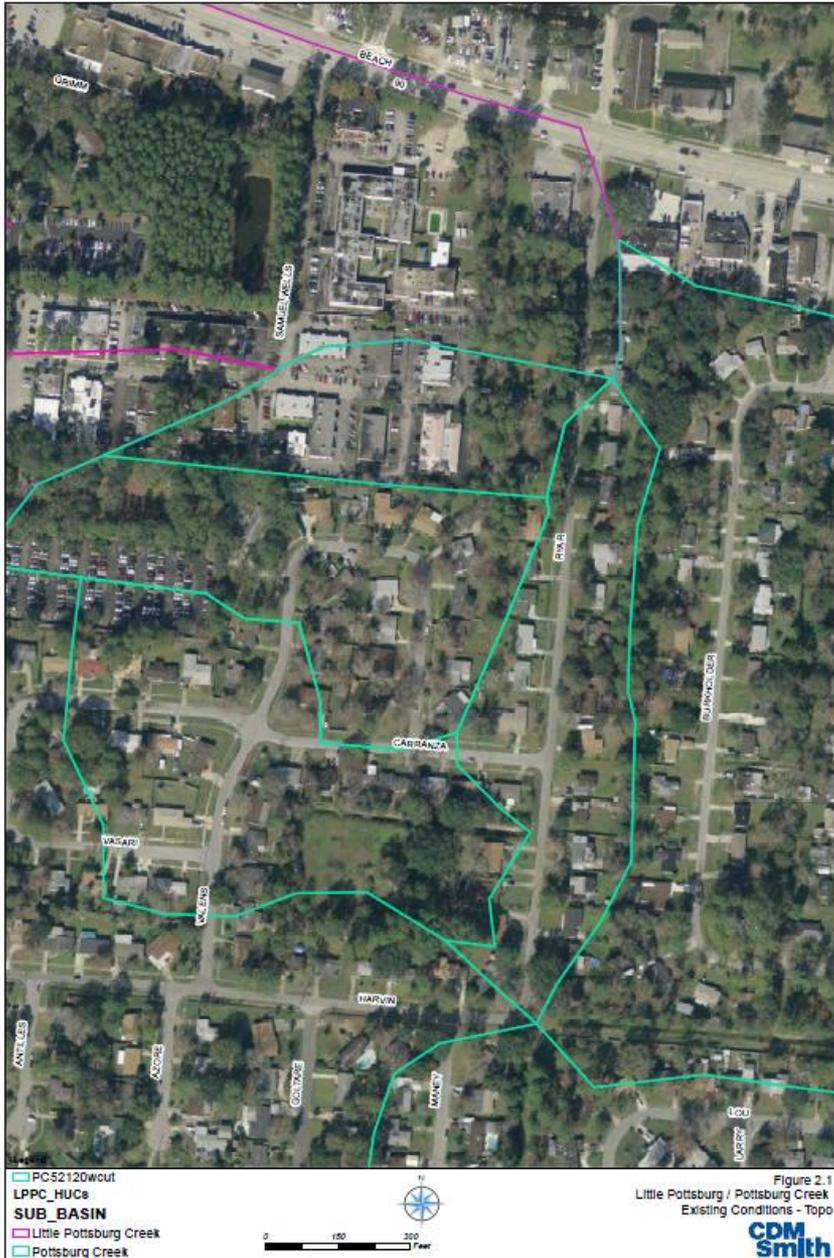
* Typical daily irrigation values provided by the City. Minutes of irrigation per day.

Stormwater Irrigation ROI

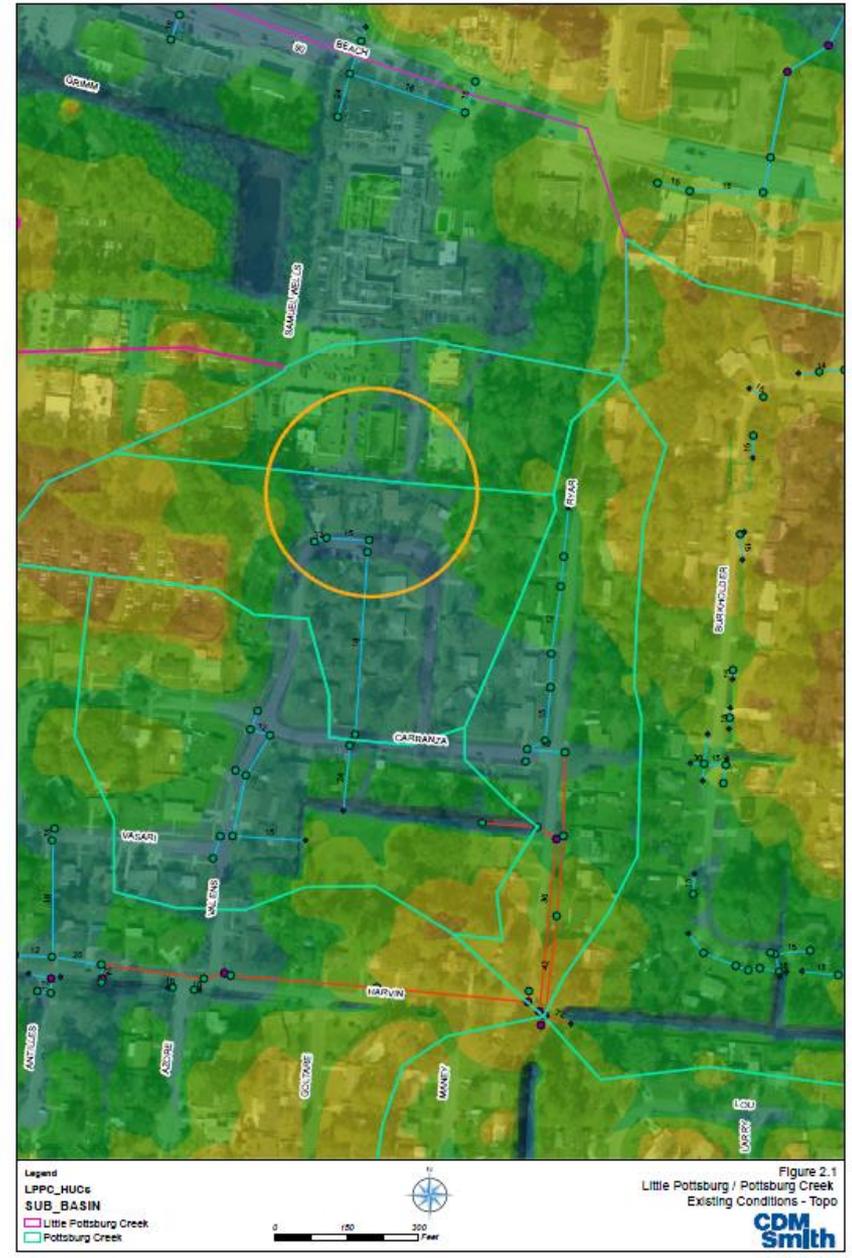
Item	Units	Unit Cost	Quantity	Total Cost
Capital Costs				
1. Horizontal Well				
1a. Mobilization and Site Prep. (5% of construction cost, 1b - 4)	EA	\$ 4,347	2	\$ 8,693
1b. Dewatering	EA	\$ 9,000	2	\$ 18,000
1c. Excavation	CY	\$ 7	1,040	\$ 7,280
1d. 6" Perforated PVC Pipe	LF	\$ 10	300	\$ 3,000
1e. Gravel	TN	\$ 80	80	\$ 6,400
1f. Geotextile	SY	\$ 3	272	\$ 816
1f. Sod	SY	\$ 4	800	\$ 3,200
2. Pond Reshaping ¹	CY	\$ 7	3,748	\$ 26,236
3. Covered Pump Station	EA	\$ 8,000	2	\$ 16,000
4. Irrigation Automated Control System	EA	\$ 3,000	2	\$ 6,000
Subtotal 1 - Capital Costs				\$ 95,625
Contingency (30%)				\$ 28,688
Subtotal 2 - (Capital Costs + 30% Contingency)				\$ 124,313
Design Services				
Feasibility Study				\$ 9,630
Data Development				\$ 29,394
Design and Permitting				\$ 64,504
Construction Services				\$ 10,699
Subtotal 3 - Development Cost (Subtotal 2 + Design Services)				\$ 238,540
Annual Operations & Maintenance Cost				
5. Horizontal Well	LS	\$ 1,500	2	\$ 3,000
6. Pump Station	LS	\$ 2,500	2	\$ 5,000
Annual Potable Water Savings				
7. Annual Water Savings (deducted) ²	kgal	\$ (4.33)	1,936	\$ (8,385)
Annual Water Quality Value Savings				
8. Annual Total Nitrogen Worth (deducted) ³	MT	\$ (1,000,000)	0.026	\$ (26,000)
Subtotal 4 - Total Annual Savings (5, 6, 7 & 8 in 2013 dollars)				\$ (26,385)
Years to Recover Investment (subtotal 3 / subtotal 4, in 2013 dollars)				9.0
<p>1. Assume 4 feet of excavation required for each pond (i.e., wet excavation).</p> <p>2. JEA rates are \$3.86/kgal for commercial irrigation + \$0.37/kgal environmental fee = \$4.33/kgal; quantity based on weekly irrigation schedules provided by COJ Parks and Recreation Department for an assumed 5 month irrigation season, and calculated irrigation demand met through harvesting of 35% for Fletcher Park and 57% for Wurn Park.</p> <p>3. Based on conceptual worth of total nitrogen (TN) for water quality trading planning (\$1M/metric ton TN)</p>				

9 years

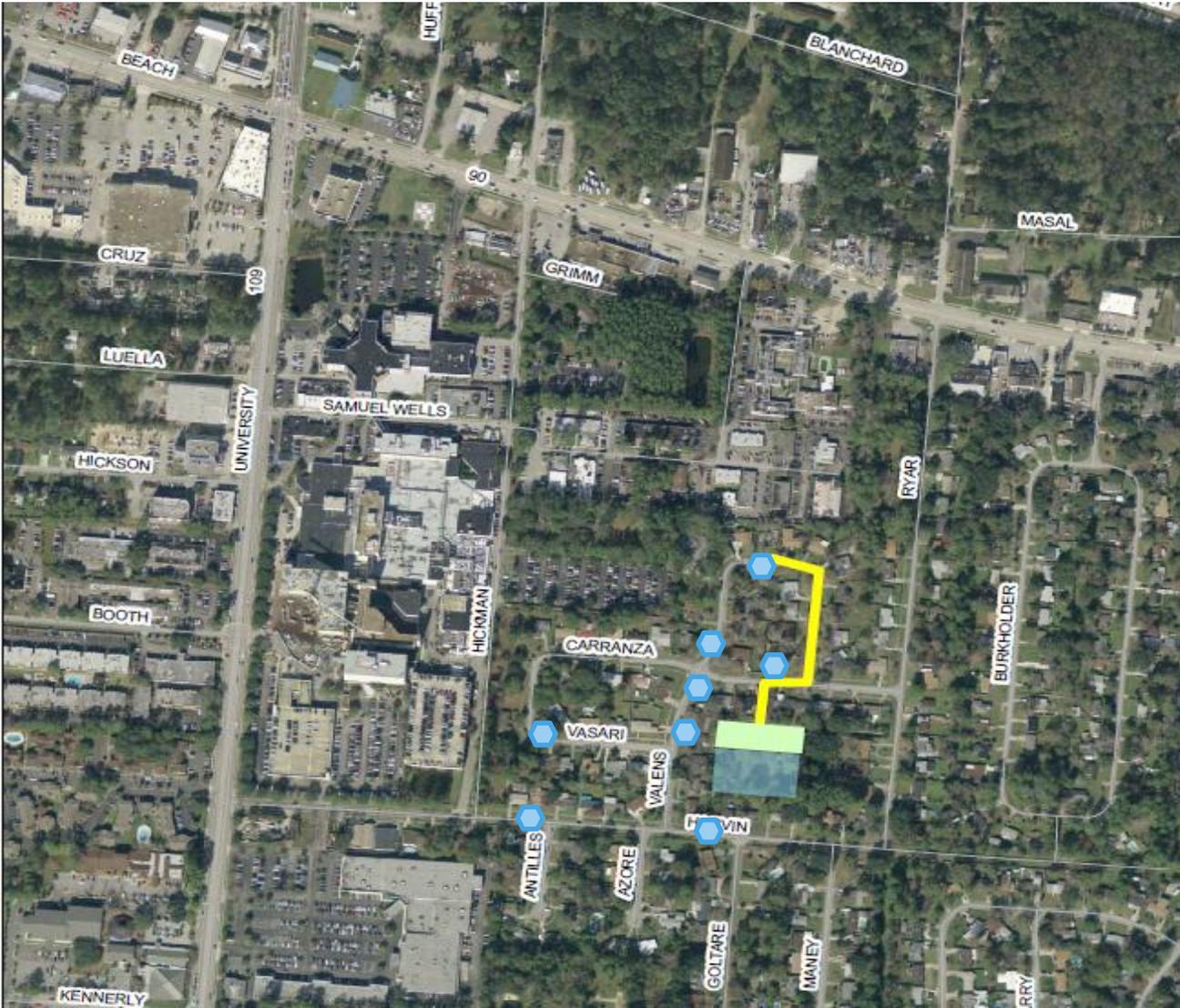
Project Area



Project Topography



LID Retrofit Opportunities: Flood Control



SOURCE: KEVIN ROBERT PERRY - CITY OF PORTLAND



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Educational Components

Underground Exfiltration Trench

How It Works

Below is a cross-sectional (vertical) depiction of the exfiltration system.

What's Under Your Feet?
To increase the amount of usable open space in the Park, an under-ground exfiltration system known as an underground exfiltration trench (see above). This system provides fast-flow for a portion of the stormwater from the Police Station parking lot (see above). It consists of a row of perforated pipes that are perforated every 8 inches of the pipe, and surrounds the open area in the parking lot (see above). These pipes allow collected stormwater to slowly percolate into the surrounding soils.

Water flows out of the perforated pipe, through the gravel bed and filter fabric envelope, and then enters (infiltrates) into surrounding native soils, where it recharges the natural groundwater supply. This entire process is often called exfiltration.

Underground exfiltration systems help increase the amount of usable land in urban areas while providing effective treatment for stormwater runoff. Want to learn more? Visit casselberry.org/lakes

Lake Concord Park
...an interactive water quality experience
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Rain Gardens

Plants for rain gardens are chosen for their ability to take up nutrients and survive in alternating wet and dry conditions. Below are some of the plants featured in Lake Concord Park's rain gardens.

Golden Canna
(Scientific name: *Canna flaccida*)
Golden Canna, also called the Yellow Florida Canna Lily, is a Florida native and Florida-friendly flower that produces showy yellow flowers. Golden Canna attracts butterflies and prefers full sun and moist soils. It is often found along shorelines of lakes and ponds.

Lily of the Nile
(Scientific name: *Agapanthus africanus*)
Lily of the Nile is also known as African Lily or Ageranthus. It is a Florida-friendly flower that prefers full sun and dry to moist soil conditions, and it features showy flowers.

African Iris
(Scientific name: *Iris sibirica*, also known as: *Iris versicolor*)
African Iris, also known as Forsyth Iris or Butterfly Iris, is a Florida-friendly flower that prefers full sun but can tolerate partial shade, as well as a variety of soil moisture conditions.

Holly Fern
(Scientific name: *Cytomium falcatum*)
Holly Fern is a slow growing Florida-friendly groundcover that prefers moist, shady areas but is drought tolerant and can survive in full sun.

Bald Cypress
(Scientific name: *Taxodium distichum*)
Bald Cypress is a Florida native and Florida-friendly tree often found in wetlands and lake shorelines. It prefers full sun and is highly drought tolerant, and so it is well suited to the wet-shorelines. It prefers full sun and is highly drought tolerant, and so it is well suited to the wet-shorelines. It prefers full sun and is highly drought tolerant, and so it is well suited to the wet-shorelines. It prefers full sun and is highly drought tolerant, and so it is well suited to the wet-shorelines. It prefers full sun and is highly drought tolerant, and so it is well suited to the wet-shorelines.

Runoff enters the rain garden, and the plants and soils help absorb pollutants and excess nutrients, allowing the cleaned stormwater to percolate naturally into the ground and replenish groundwater and natural aquifers.

Rain gardens take advantage of depressional areas in the landscape. They reduce the need for artificial irrigation and help reduce the pollutants in stormwater. Lake Concord Park features multiple rain gardens located adjacent to the main parking lot.

Rain gardens help conserve water and protect our watershed. To find out more about rain gardens, including tips on how to construct one at your own home, visit casselberry.org/lakes

Lake Concord Park

Nutrient Separating Baffle Box

- This structure is designed to help reduce the amount of sediment and polluted stormwater runoff that enters Lake Concord.
- The nutrient separating screen system in the center of the box filters out large debris, such as leaves, sticks and trash.
- By slowing the flow through the stormwater pipe, the baffle box provides time for sediment to settle out of the water, collecting it in the bottom of the box.
- This baffle box is being used to treat runoff from the parking lot and Quail Pond Circle, west of US 1792.
- The result is cleaner water entering Lake Concord, which in turn flows into Gee Creek and eventually Lake Jesup.

The sign was funded by Summit Technologies, Inc., manufacturer of the baffle boxes installed in the park.

Lake Concord Park
...an interactive water quality experience
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Summit Technologies

Stormwater BMP educational signage installed throughout the park

Educational Components (cont.)



Baffle box with viewing cover allows visitors to see the mechanics behind an otherwise invisible technology

Educational Components (cont.)

- Host field trips and events
- NPDES MS4 permit education credits

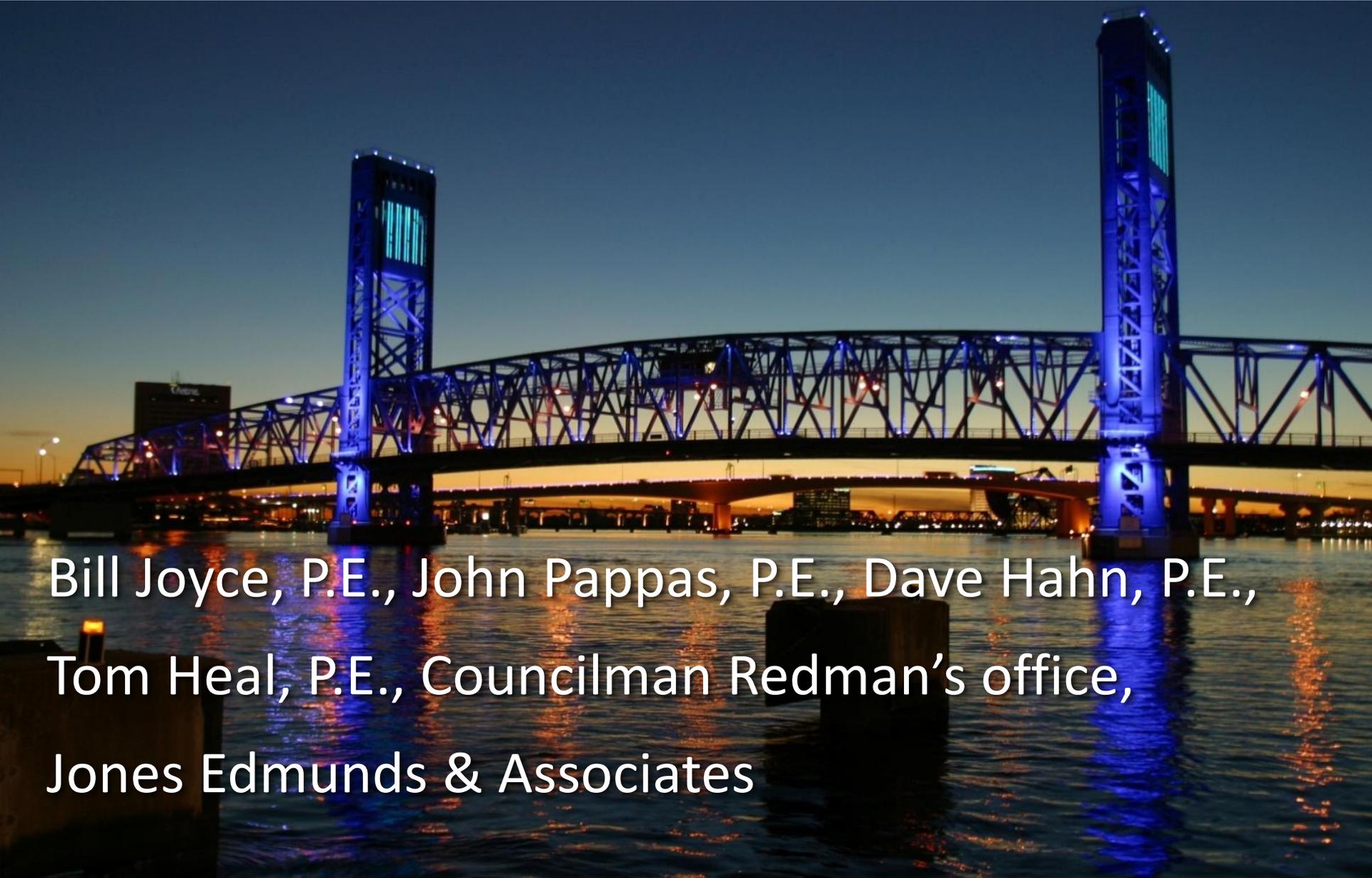


City of Jacksonville – LID Next Steps

- Identify additional locations to employ stormwater irrigation
- Move forward with design and implementation of Valens Drive Low Impact Development Demonstration Project
- Implement LID Manual into design requirements



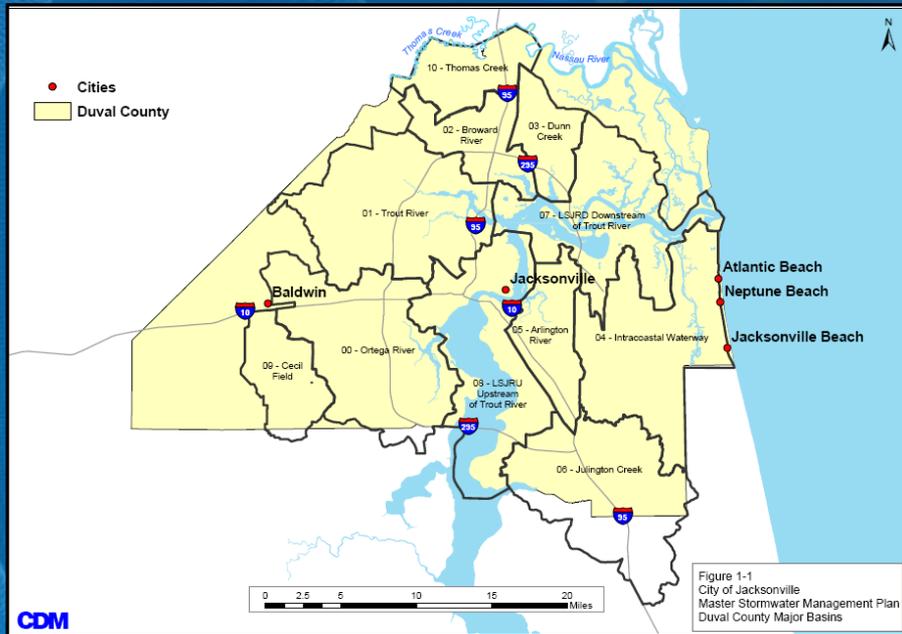
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