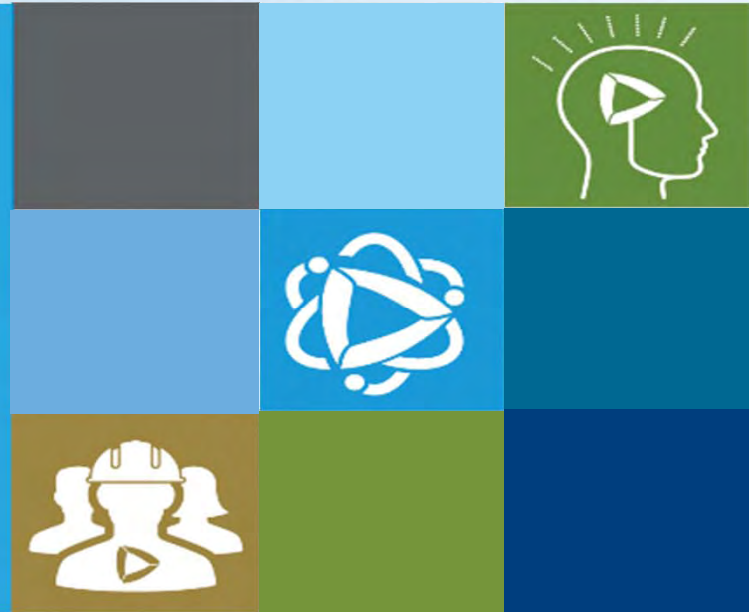




Investigation of Fecal Sources Impacting an Urban Creek



By: Mike Hardin, PhD, PE, CFM – Geosyntec Consultants, Inc.
Lisa Lotti – City of Orlando, Stormwater Compliance Manager



Presentation Outline

- Introduction
- Background of Issue
- Project Purpose
- Data Collection Design
- Results
- Conclusions
- Recommendations



Acknowledgements



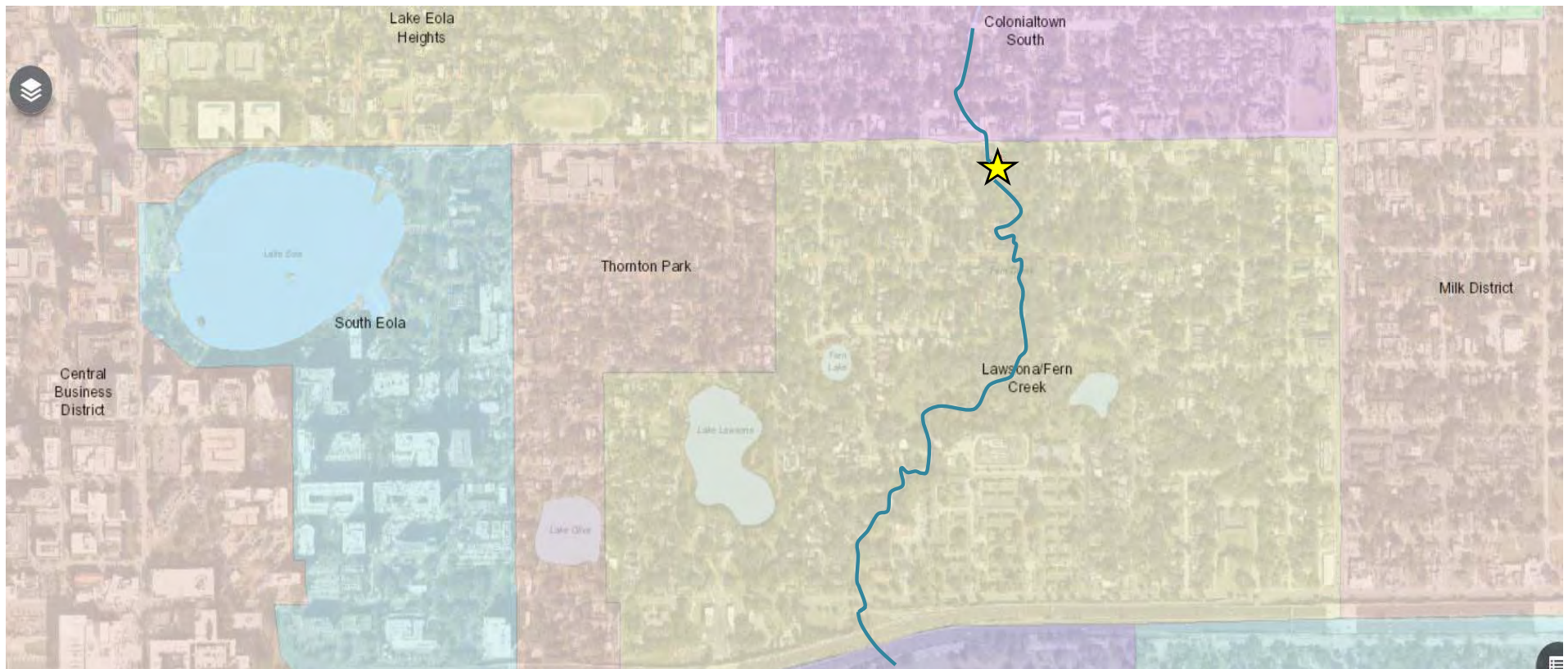
- **City of Orlando**
 - Jim Hunt, PE – Deputy Public Works Director, City Engineer
 - Lisa Henry, PE – Streets and Stormwater Division Manager
 - Nicki Wesson, PE – Project Manager II
 - Jessica Goodstein – Environmental Specialist II
- **Geosyntec project team**
 - Nick Hartshorn, EI – project engineer
 - Mark Ellard, PE, CFM, D.WRI, ENV. SP – project director
 - Jared Ervin, PhD – project engineer
- **Field sampling subconsultant – Barnes, Ferland and Associates, Inc. (BFA)**
 - John Watson – field sampling
 - Benjamin Stormont, PG – field sampling
 - Katie Ballew – field sampling
- **Source Molecular**
 - Performed DNA marker analysis
- **Southern Research Laboratories**
 - Performed fecal coliform analysis

Introduction

Introduction - Location



- Fern Creek located in Downtown Orlando



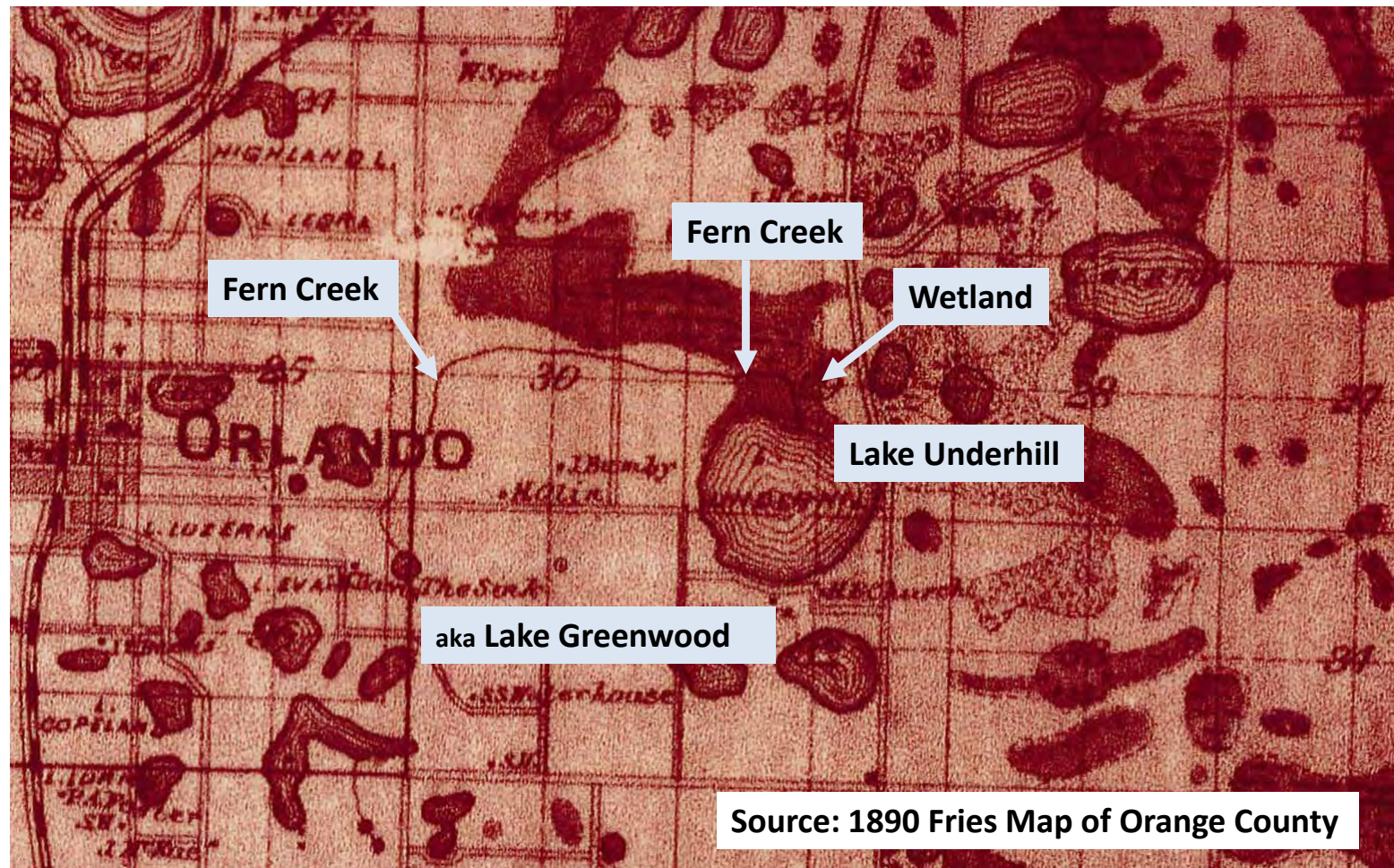


Nearby Landmarks





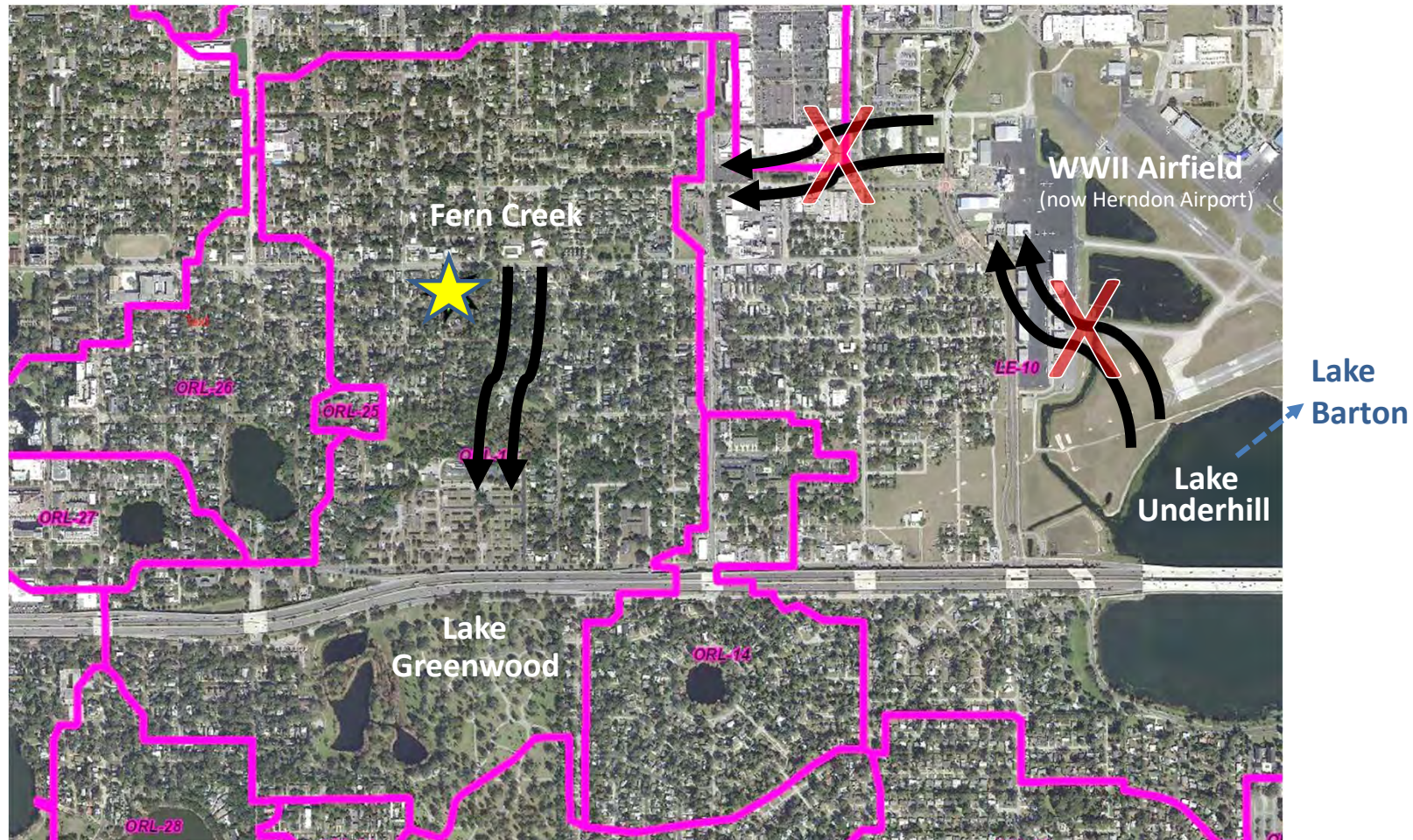
Historic Drainage Pattern



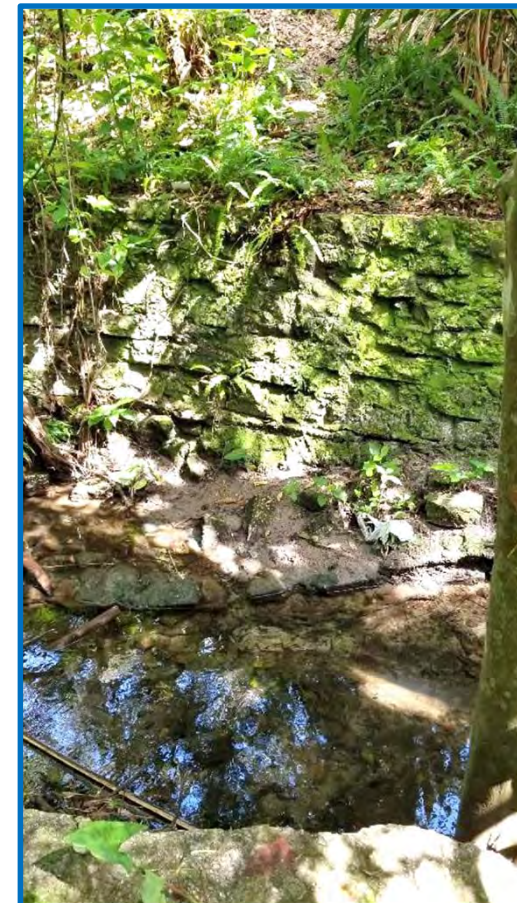
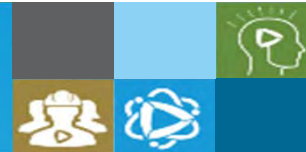
Introduction - Conditions



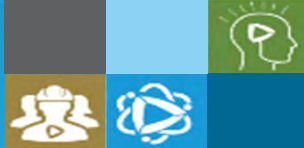
- **Historic Drainage Altered**
 - During WWII wetland removed to build airfield
 - Wetland/Lake Underhill hydraulic connection to fern creek eliminated
 - Baseflow to Fern Creek minimized



Introduction - Conditions



Introduction - Conditions



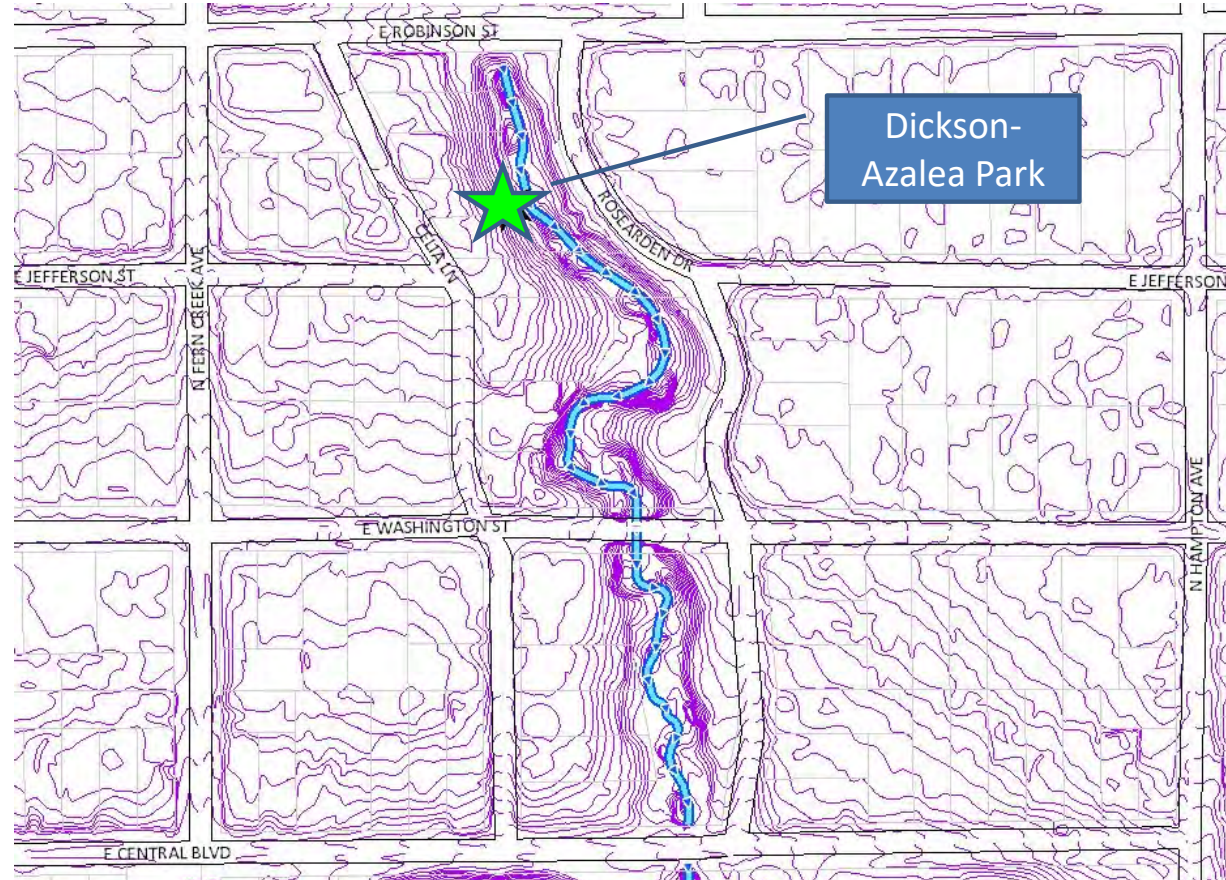
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Background of Issue

Background of Issue – Study Area

- Receiving area for this portion of Fern Creek basin = 203 acres
- 54" RCP upstream in creek
- DRMP 1996 report*:
 - Avg velocities = 4.8 fps
 - Modeled peak flow = 128 cfs
- Contours display steep banks which also meander
- Elevation changes within 1000 feet
 - Ground: 104 feet to 84 feet MSL
 - Pipe invert: 84 feet to 76 feet MSL
- Some tree roots present, but not as much vegetation to stabilize banks

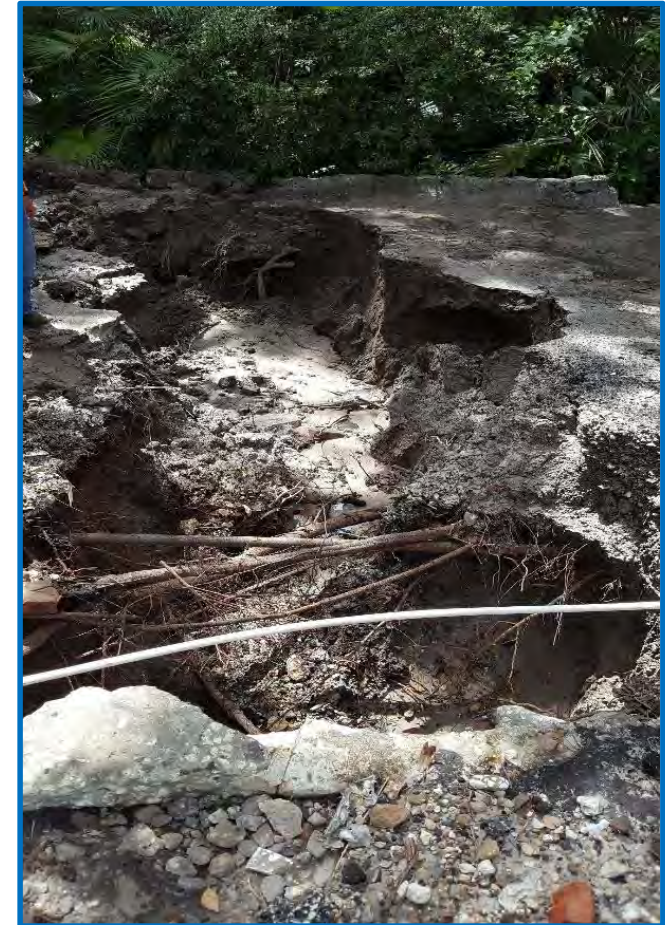
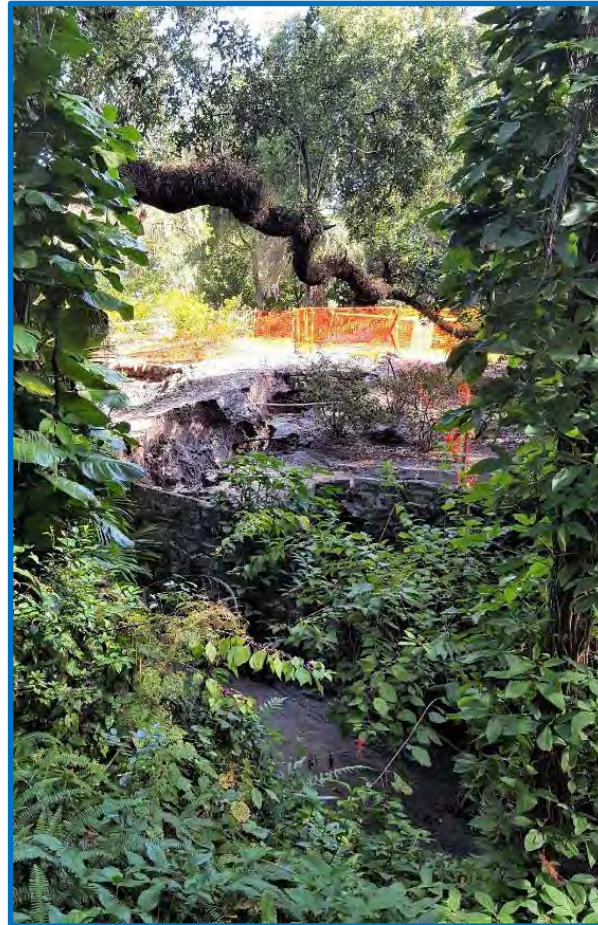
* "Fern Creek Flood Protection & Erosion Control" report for City of Orlando; Dyer, Riddle, Mills & Precourt, inc., December 1996



Background of Issue – Collapsed Wall

- Rainfall Prior to Wall Collapse:

- Dec 9 = 1.16"
- Dec 15 = 0.83"
- Dec 20 = 2.83"
over 10 hours



Background of Issue – Collapsed Wall



Sediment deposition into creek



Background of Issue – Collapsed Wall Surrounding Area

- Steep terrain
- Terraced, but stabilization still an issue
- Wall present in immediate area, but overland flow caused undermining behind wall

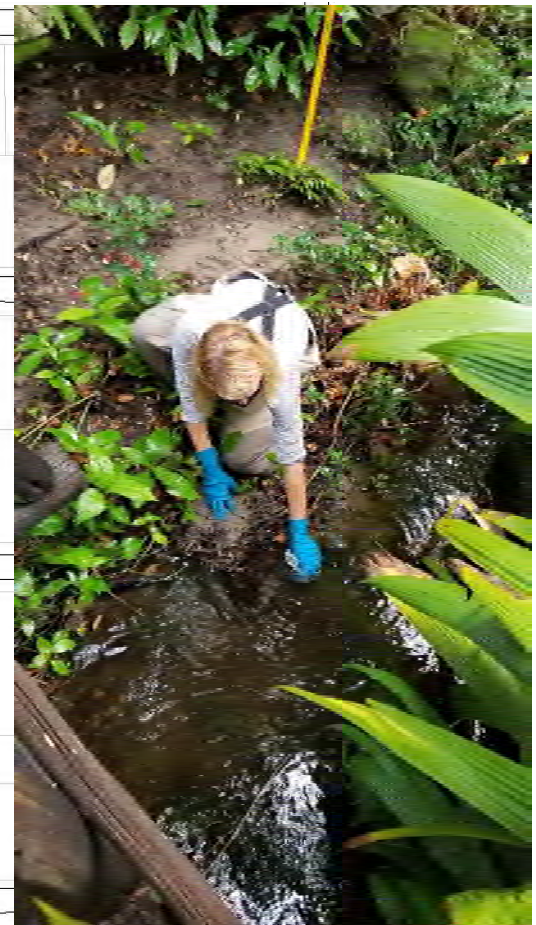
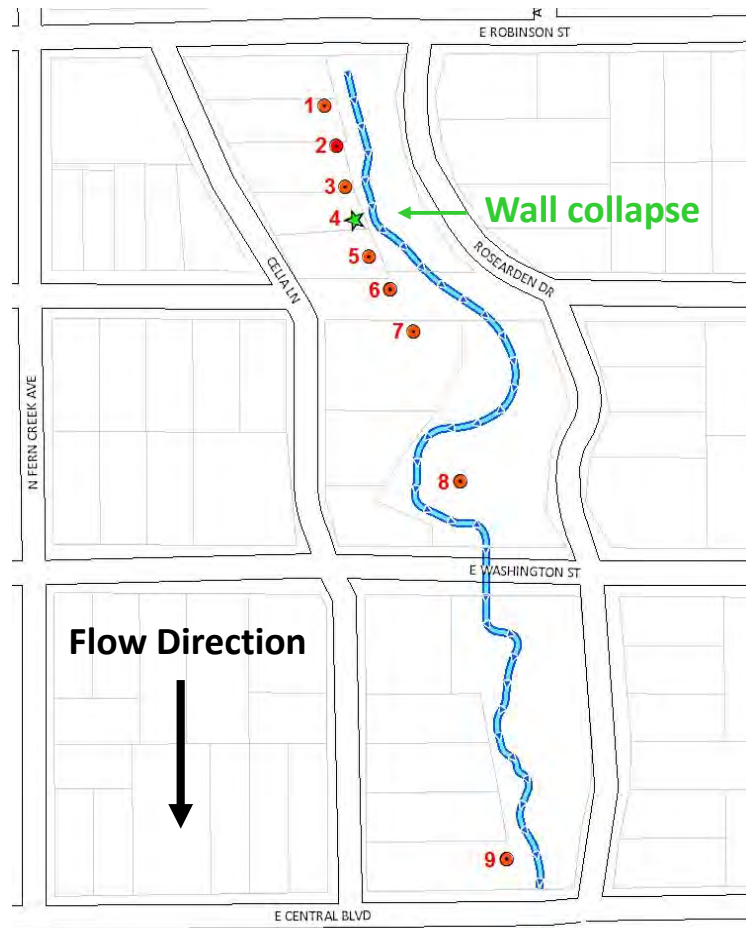


Background of Issue – Collapsed Wall



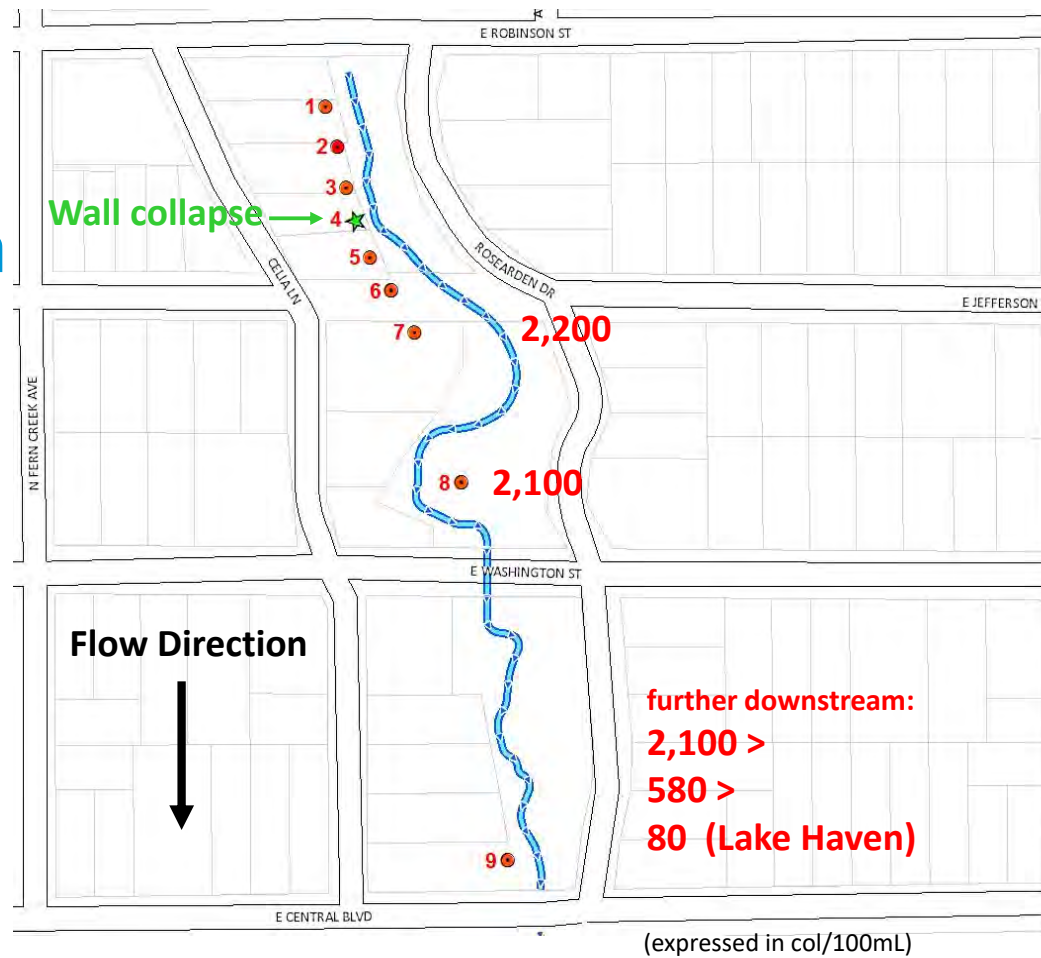
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Background of Issue – City Bacteria Sampling



Background of Issue – City Bacteria Sampling

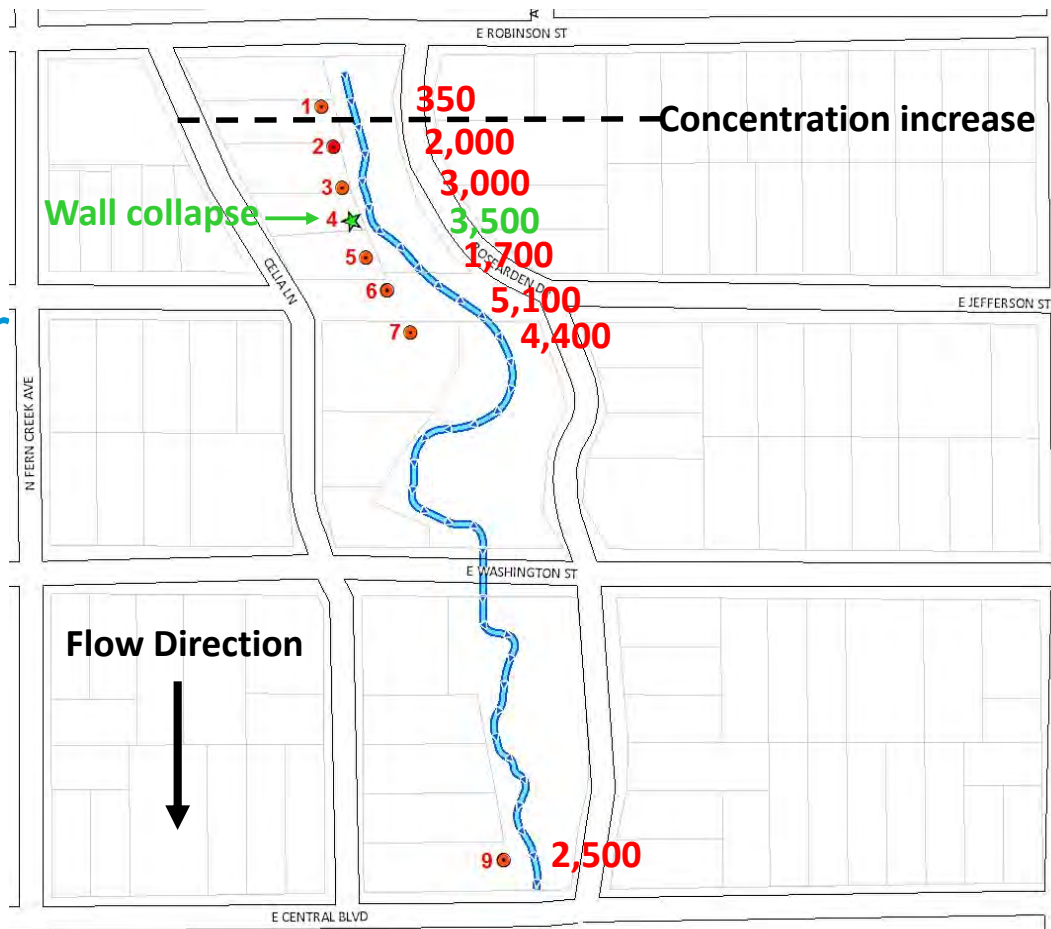
- Fecal Coliform Sampling on 12/27/2018
- 7 Days after collapse
 - No rain within last 7 days



Background of Issue – City Bacteria Sampling

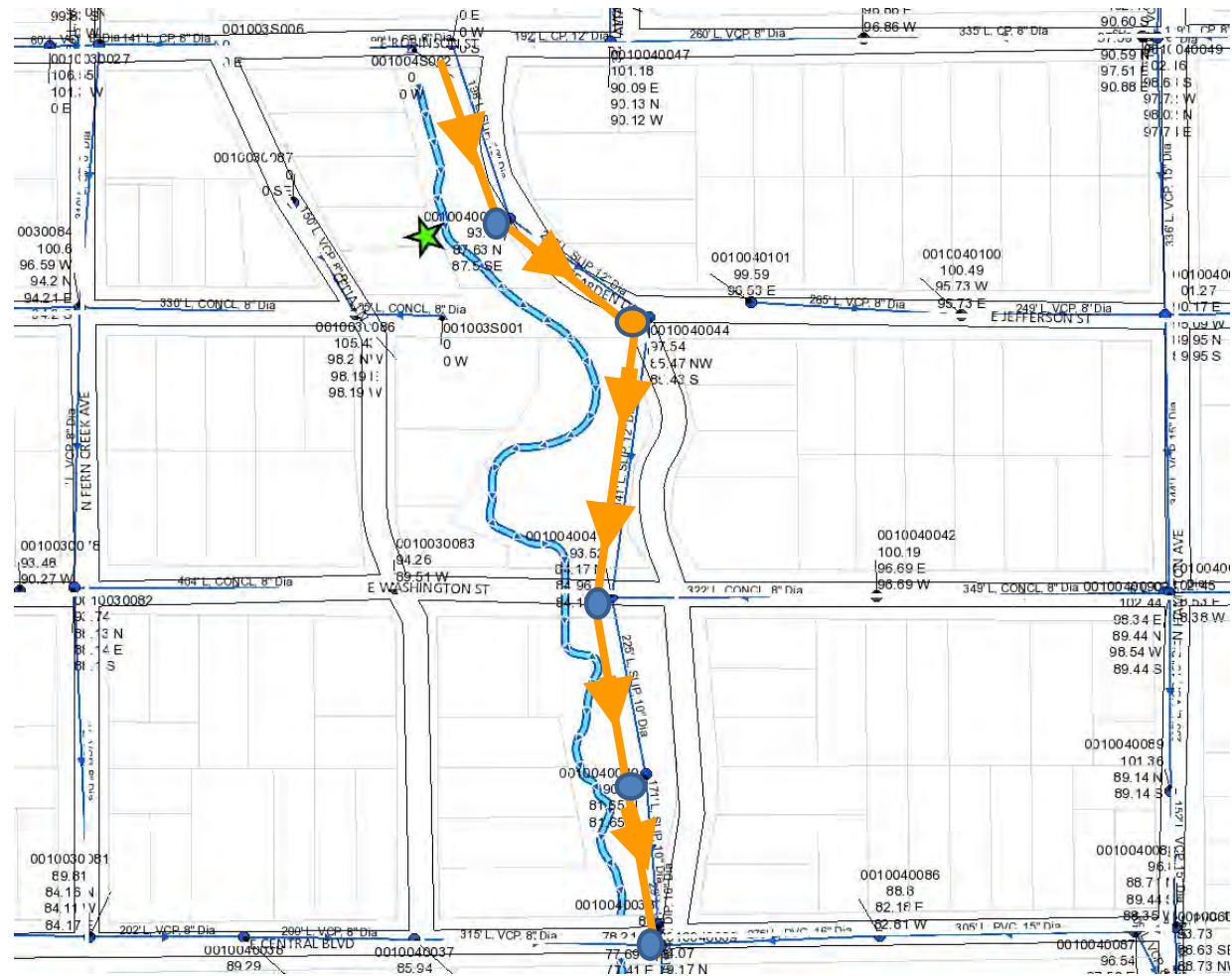
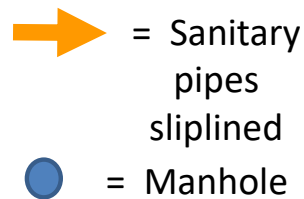


- Fecal Coliform Sampling on 1/04/2019
- 15 Days after collapse
 - No rain within last 15 days
 - Assistance requested by Water Reclamation



Background of Issue – City Bacteria Sampling

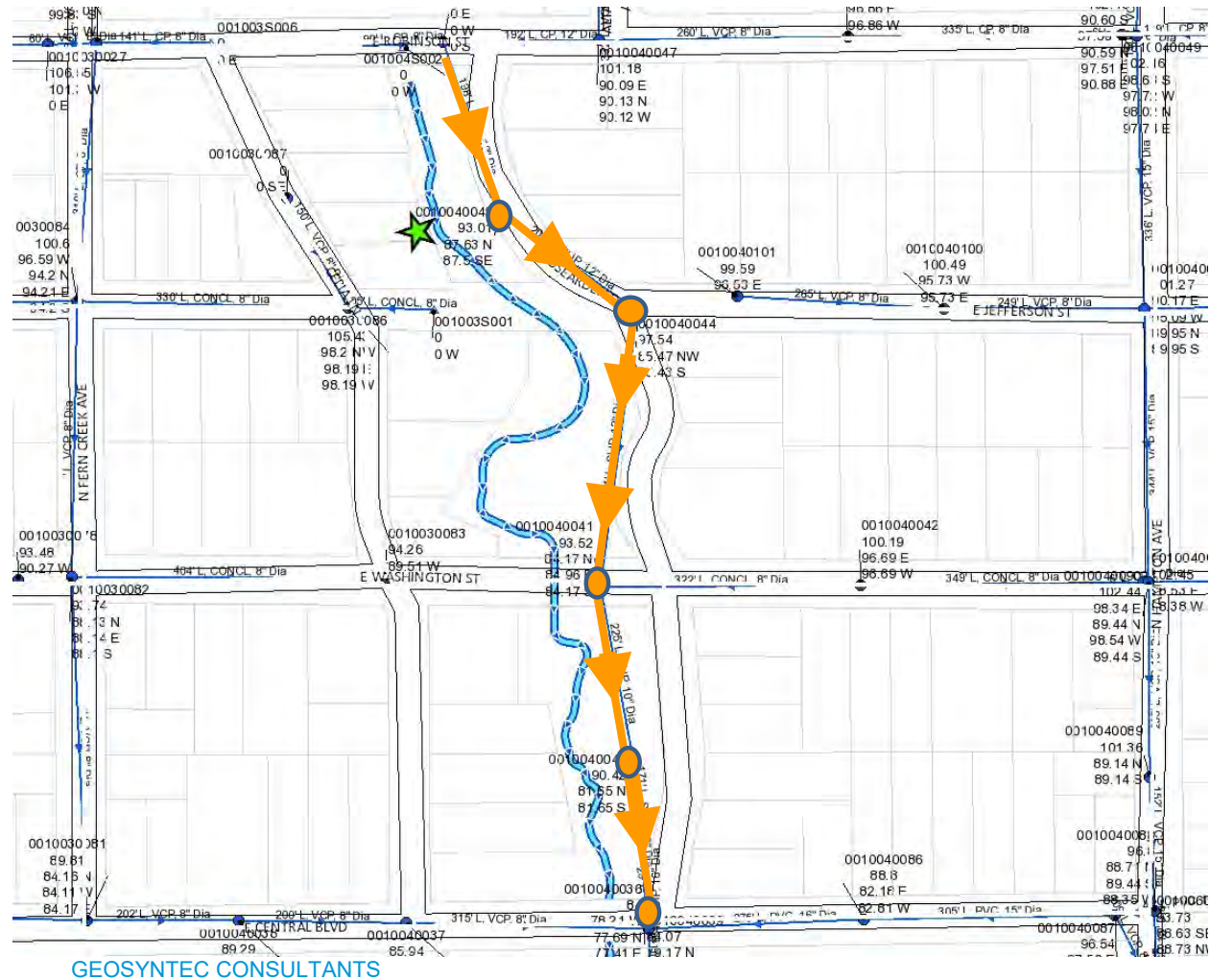
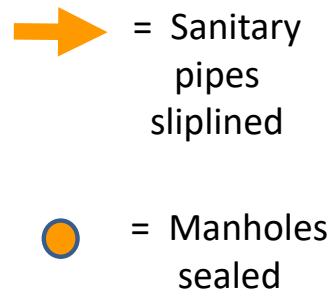
- Nearby sanitary system impacts to the creek
 - Performed slip lining of pipes and manholes
 - Occurred prior to wall collapse



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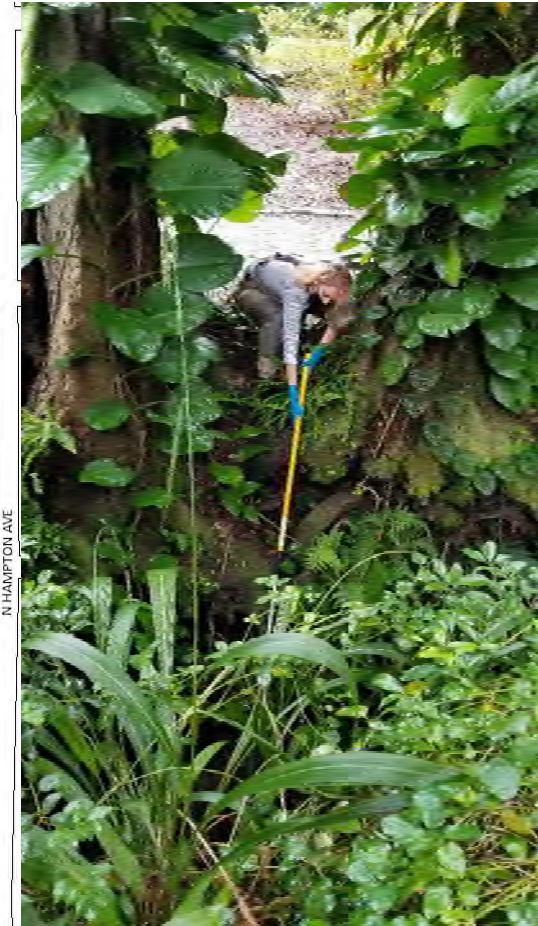
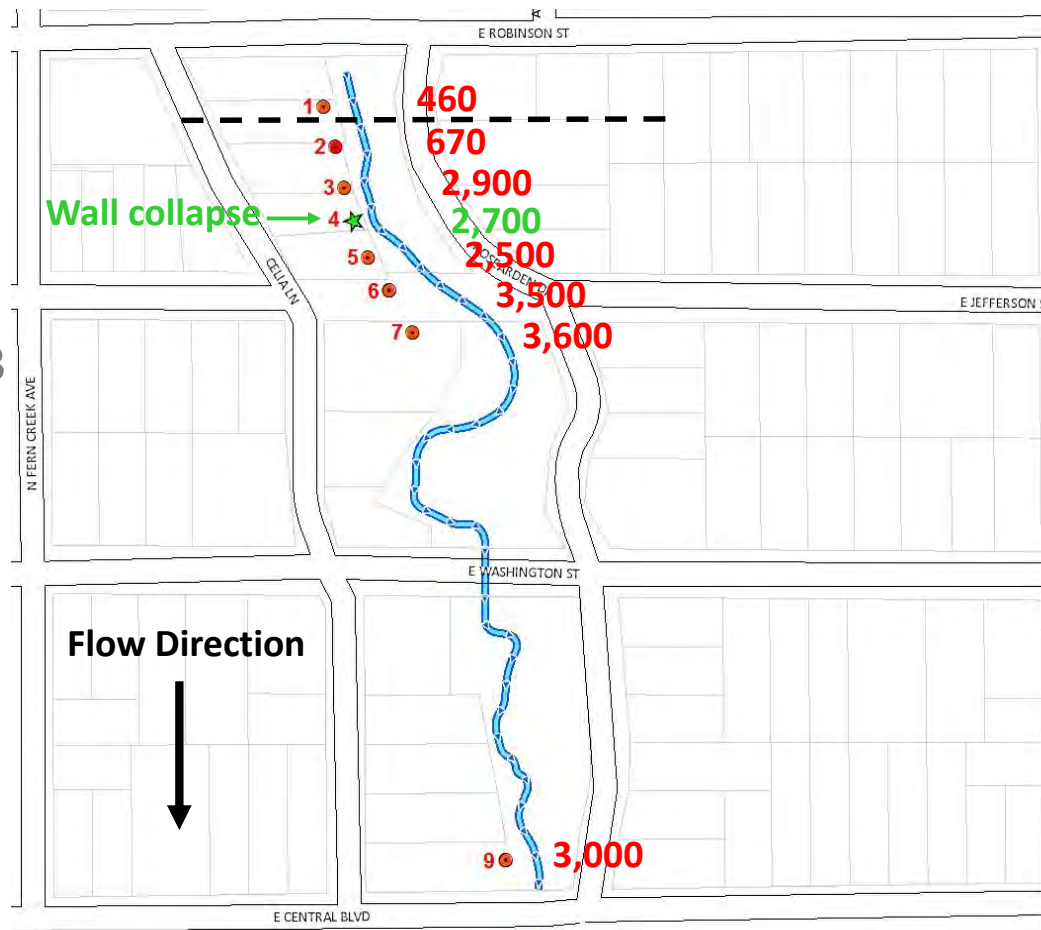
Background of Issue – City Bacteria Sampling

- Nearby sanitary system impacts to the creek
 - Finished sliplining the manholes after wall collapse



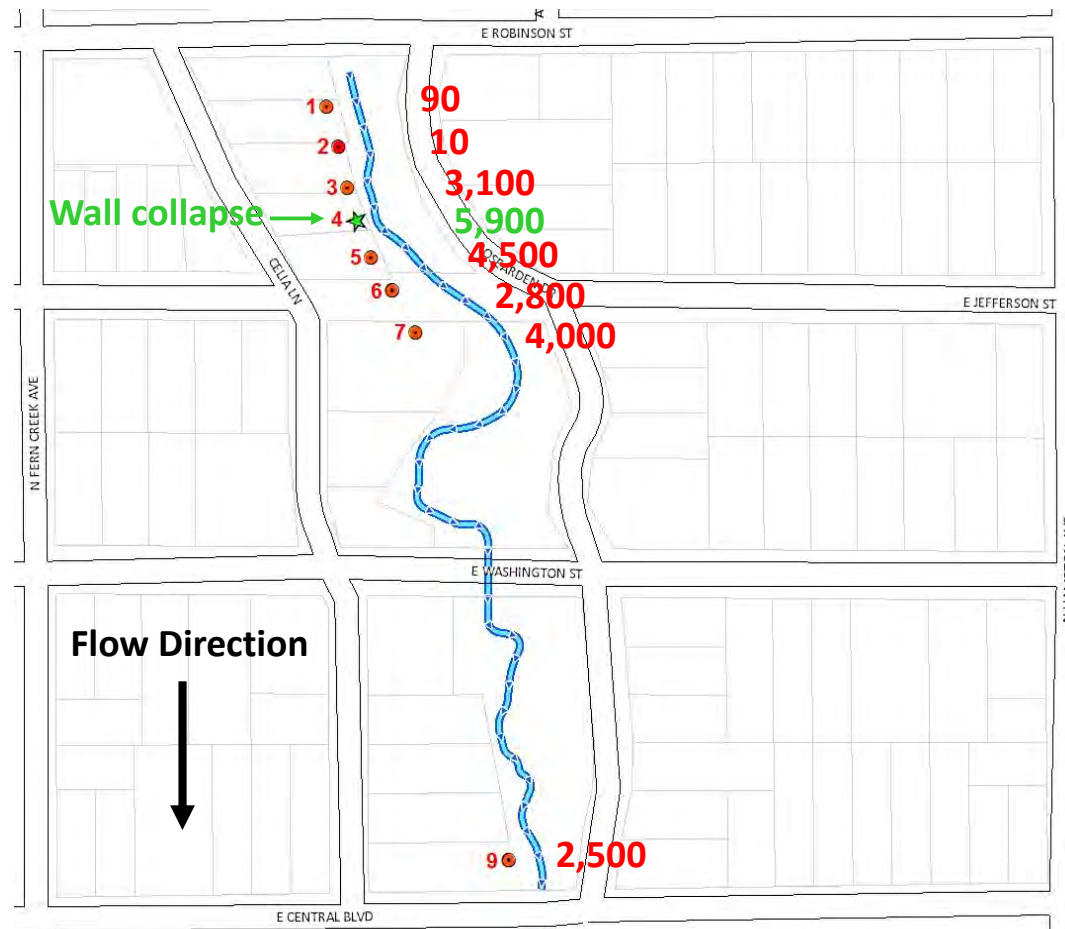
Background of Issue – City Bacteria Sampling

- Fecal Coliform Sampling on 1/30/2019
- 40 Days after collapse
 - 2.14 inches of rain within last 3 days
 - Dredging efforts ongoing for three weeks
 - Sanitary manholes lined one week prior to sampling
 - 26 days since previous sampling event



Background of Issue – City Bacteria Sampling

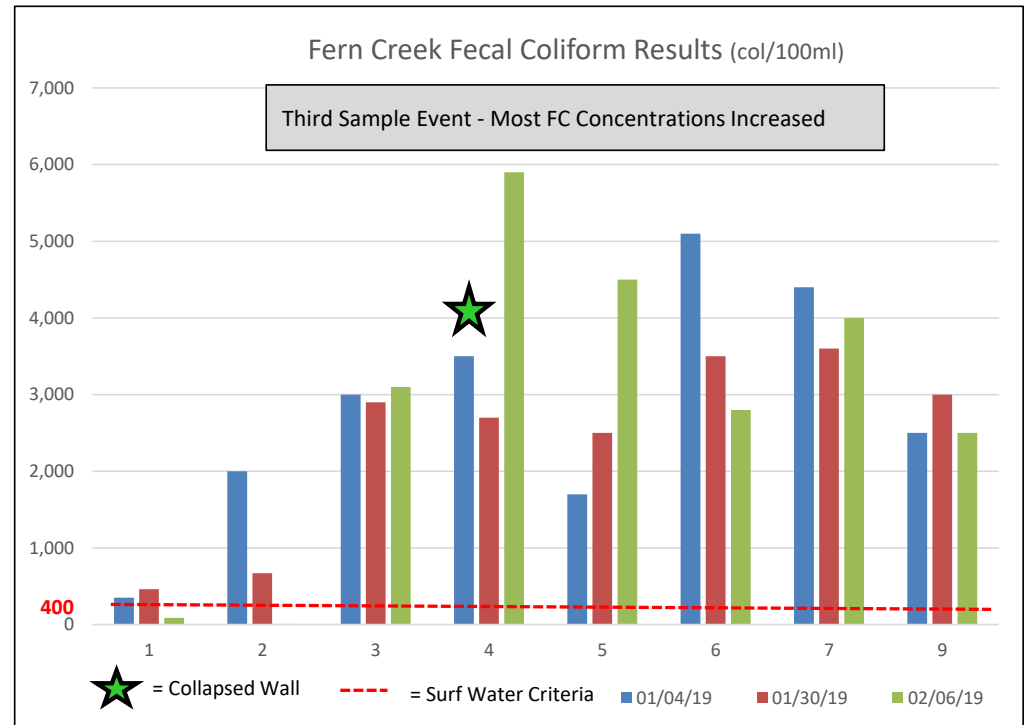
- Fecal Coliform Sampling on 2/6/2019
- 47 Days after collapse
 - No rain within last 7 days
 - Dredging efforts completed
 - Additional assistance requested by Water Reclamation



Background of Issue – City Bacteria Sampling



Station	01/04/19	01/30/19	02/06/19
1	350	460	90
2	2,000	670	10
3	3,000	2,900	3,100
4	3,500	2,700	5,900
5	1,700	2,500	4,500
6	5,100	3,500	2,800
7	4,400	3,600	4,000
9	2,500	3,000	2,500



Upstream



Downstream


* Fecal coliform must remain less than 400 colonies/100ml per *Surface Water Quality Standards*, Rule 62-302.530, F.A.C., for predominately fresh waters to maintain a healthy, well-balanced population of fish and wildlife


Background of Issue – City Bacteria Sampling



- Nearby sanitary system impacts to the creek

– Checked lateral lines along creek for integrity

 = Lateral lines checked for integrity

 = Direction of flow for sanitary gravity line






Background of Issue – City Bacteria Sampling



- Nearby sanitary system impacts to the creek

– Performed dye testing to identify illicit connections

– **None observed**

-  = Dye test performed
-  = Lateral lines checked for integrity
-  = Direction of flow for sanitary gravity line



Project Purpose

Project Purpose

- **Help determine the origins of elevated bacterial concentrations measured in the creek**
 - Appears to be a source of fecal bacteria within the park area
- **Several potential sources**
 - Leaky sanitary sewer from unlined or improperly lined mains
 - Legacy bacteria loads from prior unlined sanitary conditions
 - Potentially significant release with wall collapse
 - Direct human waste into the creek
 - Direct dog waste into the creek
 - Direct wildlife waste into the creek
 - Stormwater transporting bacteria from other parts of the watershed

Project Purpose

- Assess the origin and spatial locations of fecal contamination
- Develop recommendations to address the fecal contamination based on origin / source



Source: <https://www.wrcbtv.com/story/42167966/florida-wildlife-park-introduces-social-distancing-skunk-ape-mascot>



Source: <https://theconversation.com/brexit-wisdom-of-crowds-proves-effective-predictor-of-britains-chaotic-eu-departure-119906>



Source: <https://nbc-2.com/news/science/2020/09/24/opossums-squirrels-and-more-taken-into-florida-wildlife-refuge-after-hurricane/>

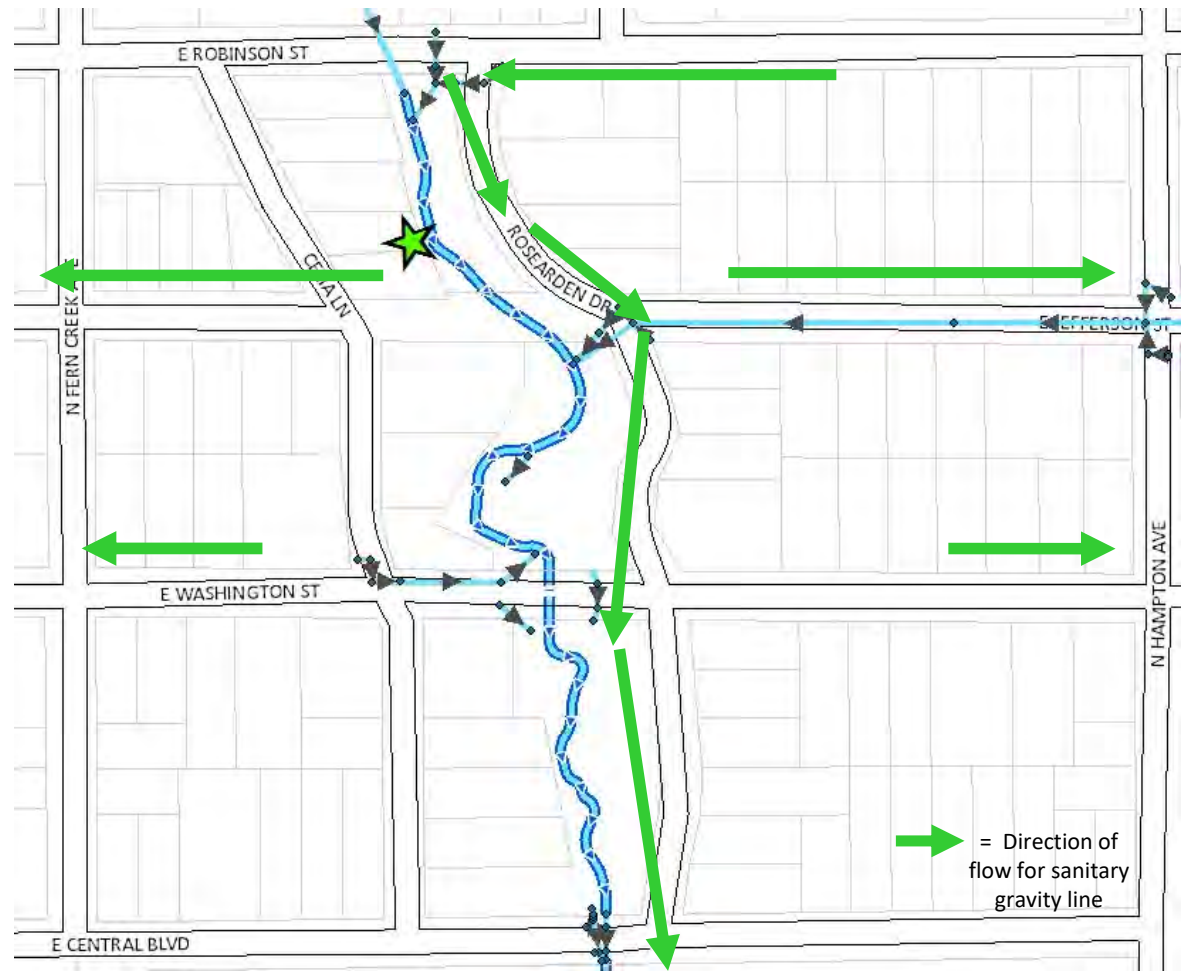


Source: <https://www.familyhandyman.com/article/should-you-pick-up-your-dogs-poop/>

Data Collection Design

Data Collection Design

- Based on City sampling, bacteria source appears to be persistent
 - Not dependent on rainfall events
 - Appears to be generated within the creek
 - Most upstream locations lower concentrations
 - Downstream locations consistently high concentrations
- Interested in dry stormwater inflows due to potential sanitary impacts
 - Proximity to sanitary
 - Older infrastructure
 - Stormwater infrastructure could transport to creek



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Data Collection Design

- Design sampling approach to use data-driven approach to identify sources of fecal contamination
 - Human marker (HF183)
 - Dog marker (BacCan)
- Develop a Quality Assurance Plan (QAP)
 - Most important document for sampling projects
 - Identifies all responsible parties
 - Clearly identifies responsibilities for each party
 - Defines project sampling protocols and procedures
 - Identify and get buy-in on non-standard testing procedures
 - Acts as project sampling plan

GEOSYNTEC CONSULTANTS



Prepared for




**CITY OF
ORLANDO**

**Fern Creek Bacterial Source Tracking
Quality Assurance Plan**

Orlando, Florida

Prepared by



Geosyntec
consultants
engineers | scientists | innovators

1511 East State Road 434, Suite 1005
Winter Springs, FL 32708

Geosyntec Project #: FW3594
October 2019

Data Collection Design

- **Sampling followed FDEP sampling procedures**
 - FC1000 Cleaning / Decontamination Procedures
 - FD1000 Documentation Procedures
 - FQ1000 Field Quality Control Requirements
 - FS1000 General Sampling Procedures
 - FS2000 General Aqueous Sampling
 - FS2100 Surface Water Sampling
 - FS4000 Sediment Sampling
- **DNA sampling required specific SOP**
 - Need to be extra careful to not contaminate the sample
 - Requires sterilized sample bottles (no intermediate bottles unless sterile)
 - Samples stored on ice in the dark and shipped overnight to analysis laboratory
 - Make observations during sampling
 - Color
 - Odor
 - Fecal sources observed during sampling (dogs, wildlife, etc.)

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Department of Environmental Protection Standard Operating Procedures for Field Activities

DEP-SOP-001/01



FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
2600 BLAIR STONE ROAD
TALLAHASSEE, FL 32399-2400

January 2017

Data Collection Design

- Sampling plan with hypothesis driven approach

- Interested in identifying the source

- Location of contamination
- Human
- Dog
- Sediments
- Other

- 4 Hypotheses were developed

- H1 Human waste is a significant source of bacteria to Fern Creek
- H2 Human waste is a significant source of bacteria to storm drain outfalls in Fern Creek
- H3 Dog waste is a significant source of bacteria to Fern Creek
- H4 Creek sediments contain a reservoir of bacteria that are a significant source to the water flowing in Fern Creek

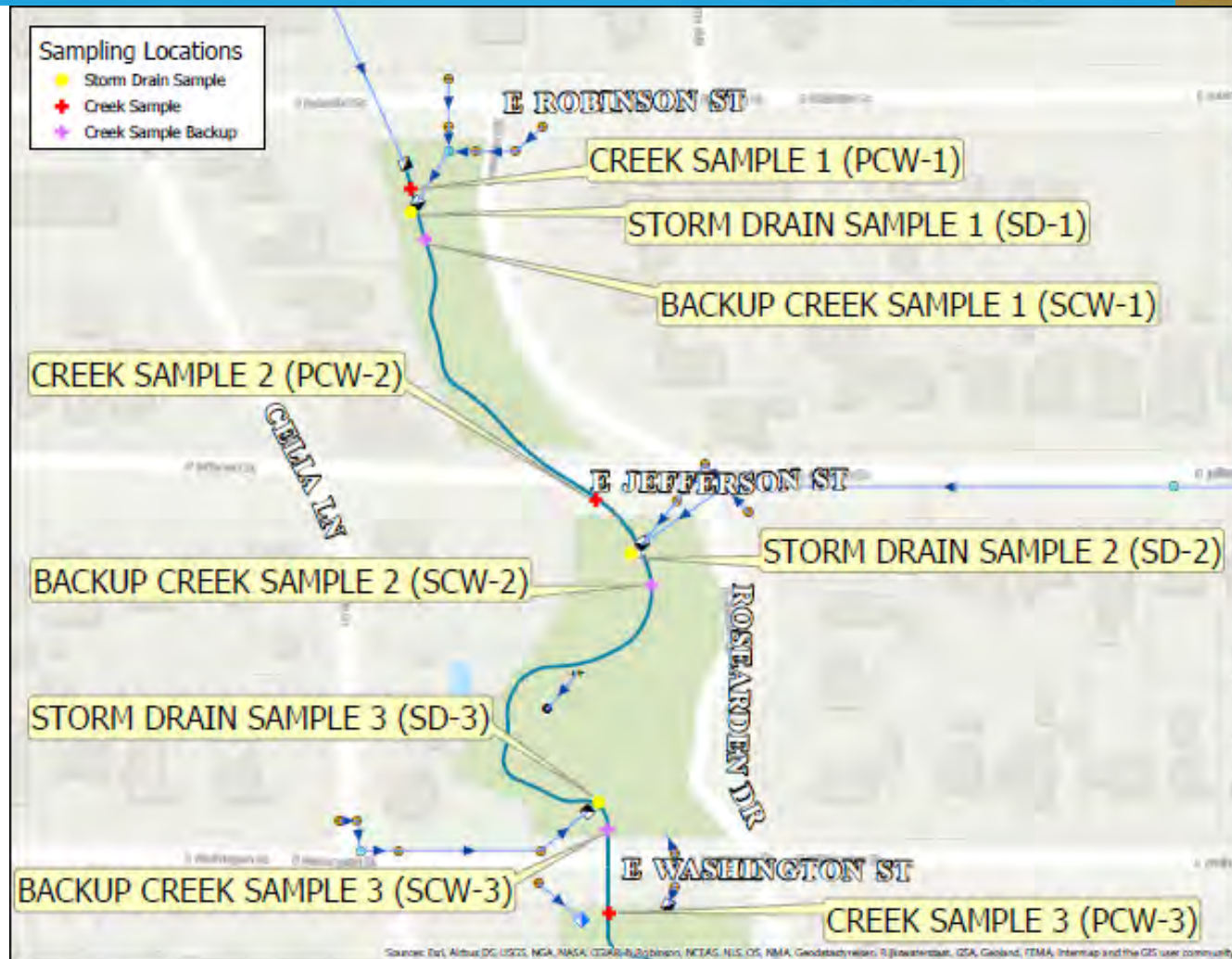


Source:

<https://www.freepik.com/search?dates=any&format=search&page=1&query=Scientist%20magnifying%20glass%20dna&sort=popular>

Data Collection Design

- 3 creek sample locations
- 3 storm drain sample locations
- 3 backup creek sample locations
- Sampled
 - Creek water
 - Dry flow from storm drains
 - Creek sediments



Results

Results



- Performed 3 dry sampling events
- H1: Human waste was a significant source of bacteria to Fern Creek during dry weather
 - Only one location / event showed human marker present
 - Very low levels (MDL = 20 copies/100mL)
 - Detected in most upstream sample location
 - **Not significant**
- H2: Human waste is a significant source of bacteria to dry weather storm drain discharges in Fern Creek
 - No storm drain samples collected
 - **Not significant**

Event (Date)	Location	Human Marker (copies/100mL)	Dog Marker (copies/100mL)	Fecal Coliform (CFU/100mL)	TSS (mg/L)
Event 1 (10/24/2019)	PCW-1	36	ND	200	< 2.5
	SCW-1	ND	ND	77	< 2.5
	PCW-2	ND	1,620	290	< 2.5
	SCW-2	ND	1,040	520	< 2.5
	SCW-3	ND	1,860	34	< 2.5
	PCW-3	ND	627	55	< 2.5
Event 2 (11/19/2019)	PCW-1	ND	ND	8,100	< 2.5
	SCW-1	ND	526	740	< 2.5
	PCW-2	ND	2,720	370	< 2.5
	SCW-2	ND	992	570	< 2.5
	SCW-3	ND	712	250	< 2.5
	PCW-3	ND	817	210	< 2.5
Event 3 (1/2/2020)	PCW-1	ND	506	39	< 2.5
	SCW-1	ND	DNQ	24	< 2.5
	PCW-2	ND	DNQ	88	< 2.5
	SCW-2	ND	DNQ	52	2.6
	SCW-3	ND	ND	27	< 2.5
	PCW-3	ND	ND	1,100	< 2.5

ND = Not Detected, DNQ = Detected Not Quantified (detected below the quantification limit)

Results

- H3: Dog waste was a significant source of bacteria to Fern Creek during dry weather
 - Frequently detected at elevated concentrations
 - Present in 13 of 18 samples
 - Detected above 500 copes/100 mL in 10 samples
 - Higher at mid and downstream locations
 - Highest at PCW-2
 - **Significant**

Event (Date)	Location	Human Marker (copies/100mL)	Dog Marker (copies/100mL)	Fecal Coliform (CFU/100mL)	TSS (mg/L)
Event 1 (10/24/2019)	PCW-1	36	ND	200	< 2.5
	SCW-1	ND	ND	77	< 2.5
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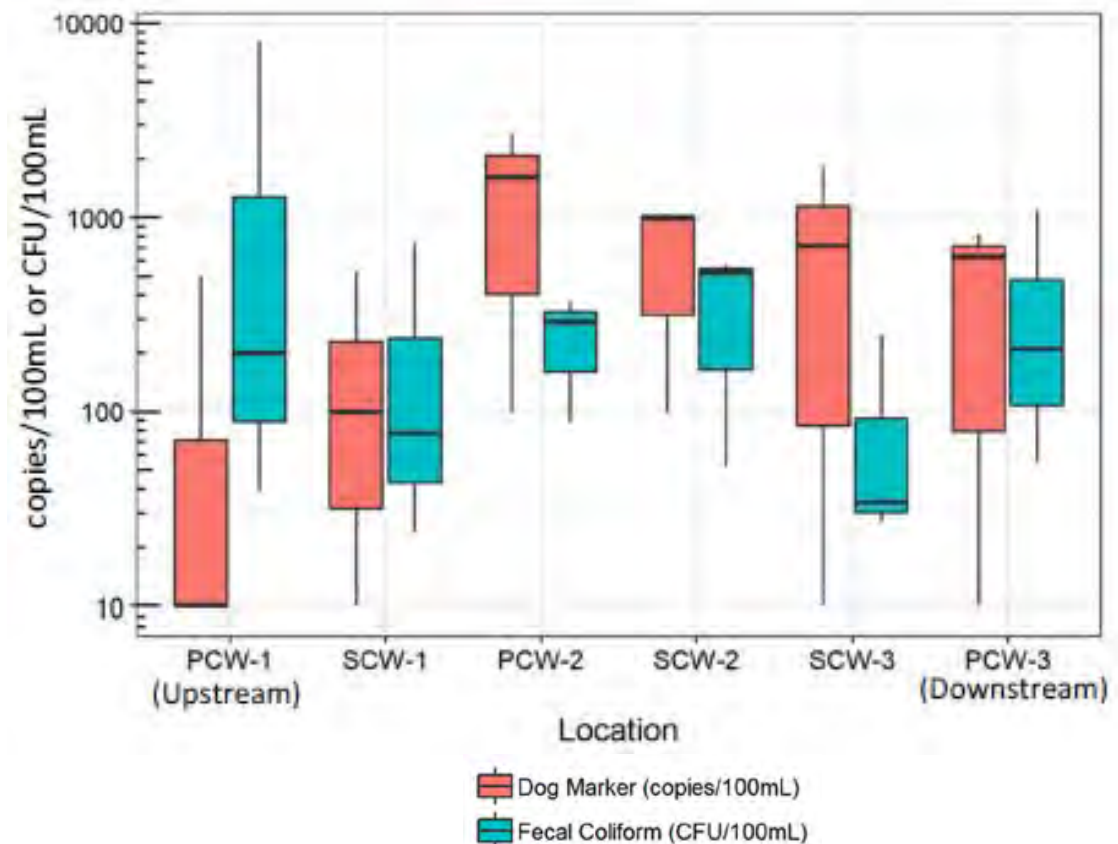
ND = Not Detected, DNQ = Detected Not Quantified (detected below the quantification limit)

- H4: Creek sediments contain a reservoir of bacteria that are a significant source to the water flowing in Fern Creek during dry weather
 - Relatively low concentrations
 - TSS concentrations very low (typically at or below laboratory detection limits)
 - **Not significant**

Event (Date)	Location	Fecal Coliform (CFU/g)	% Moisture
Event 1 (10/24/2019)	CS-1	30	19.1
	CS-2	145	21.1
	CS-3	110	18.2

Results

- Compared dog marker to fecal coliform concentrations
 - No significant correlation observed
 - Other non-human sources likely contributing fecal bacteria
 - Birds
 - Racoons
 - Other



Conclusions and Recommendations

Conclusions

- **Fern Creek an urban creek**
 - Project area is public park
- **Wall collapsed in Fern Creek**
 - Complaints of odor prompted fecal bacteria sampling
 - Older sanitary system in area
 - Was due to be sliplined
 - Significant amount of sediments discharged into creek
 - Since been repaired and sediments removed
- **City performed extensive sampling during dry weather conditions**
 - Extremely elevated fecal bacteria concentrations observed
 - Appeared to be a source within Fern Creek
 - South of East Robinson Street and north of East Jefferson street
- **Developed a detailed QAP which also acted as the sampling plan**

Conclusions

- Performed targeted dry weather bacterial sampling
 - Creek baseflow
 - Creek sediments
 - Dry storm drain flows (non observed during sampling)
- DNA marker sampling to identify source of fecal bacteria
 - Dog marker (BacCan)
 - Human marker (HF183)
- Source of fecal bacteria to Fern Creek based on the sampling and analysis conducted
 - Human waste ruled out
 - Storm drain discharges during dry events ruled out (non observed during sampling)
 - Sediments ruled out
 - **Dog waste identified as significant contributor**
- Lack of correlation between dog marker and fecal coliform concentration indicated other non-human sources contributing to fecal bacteria
 - Cats
 - Birds
 - Racoons
 - Other

Recommendations

- Implement dog waste outreach program / expand current program
 - Additional signage
 - Additional pet waste stations
 - Enforcement of local ordinances
 - Targeted door to door outreach campaign
 - Mail flyers
 - Radio adds
 - TV adds
- Perform additional dry weather sampling to assess effectiveness of program
- Perform additional wet weather sampling to examine stormwater impacts



Source: <https://www.petwasteeliminator.com/e802pc.html>



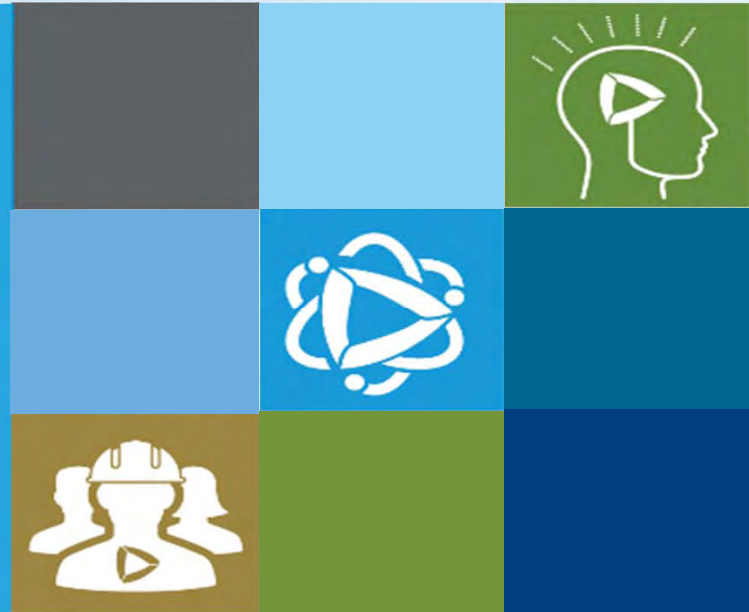
Source: <https://www.alachuacounty.us/depts/epd/waterresources/stormwaterpollutionandsolutions/pages/pet-waste.aspx>



Source: <https://cooperator.com/article/the-artful-dodger/full>



Thank You!
Questions?



Mike Hardin, PhD., PE, CFM – Senior Engineer
mhardin@geosyntec.com

3504 Lake Lynda Drive, Suite 155
Orlando, FL 32817
(407)321-7030

Lisa Lotti – Stormwater Compliance Program Manager

Lisa.lotti@cityoforlando.net

Streets and Stormwater Division
(407)246-2037

