Riverside County Stormwater Monitoring Program

Magnolia Center Storm Drain Follow-up Investigation

Outcomes of a Collaborative Investigation

Middle Santa Ana River Watershed

TMDL Task Force Meeting

February 3, 2021

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City of Riverside & Watershed Protection Division
Riverside County Flood Control and Water Conservation District

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CITY OF RIVERSIDE

WESTON SOLUTIONS
an employee-owned company

ESB
BABCOCK Laboratories, Inc.

Overview

- Background - 2019 TMDL Synoptic Study
- Special Investigation Purpose
- Study Design
- Monitoring Results
- Key Findings
- Conclusions & Next Steps

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Background

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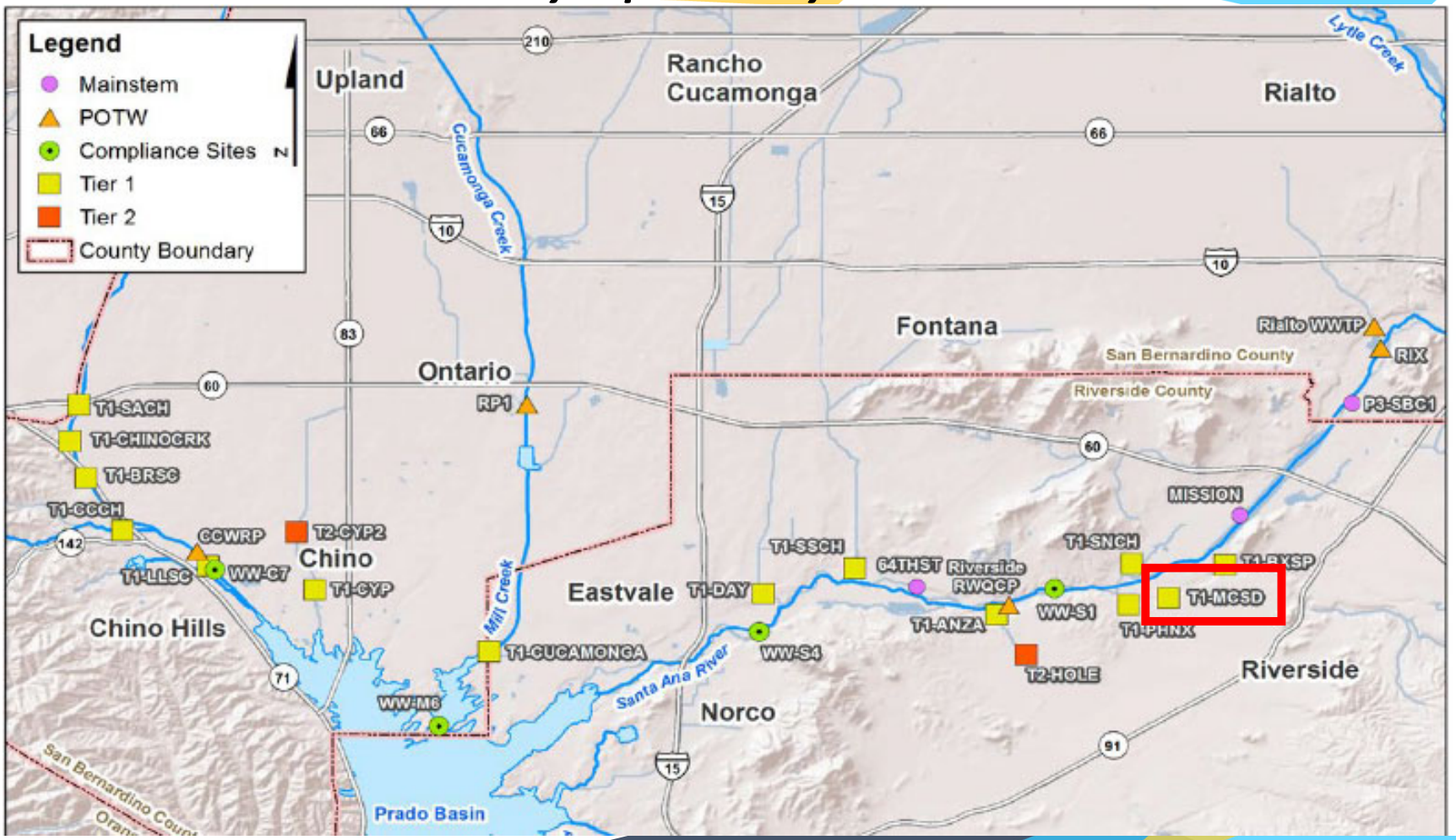
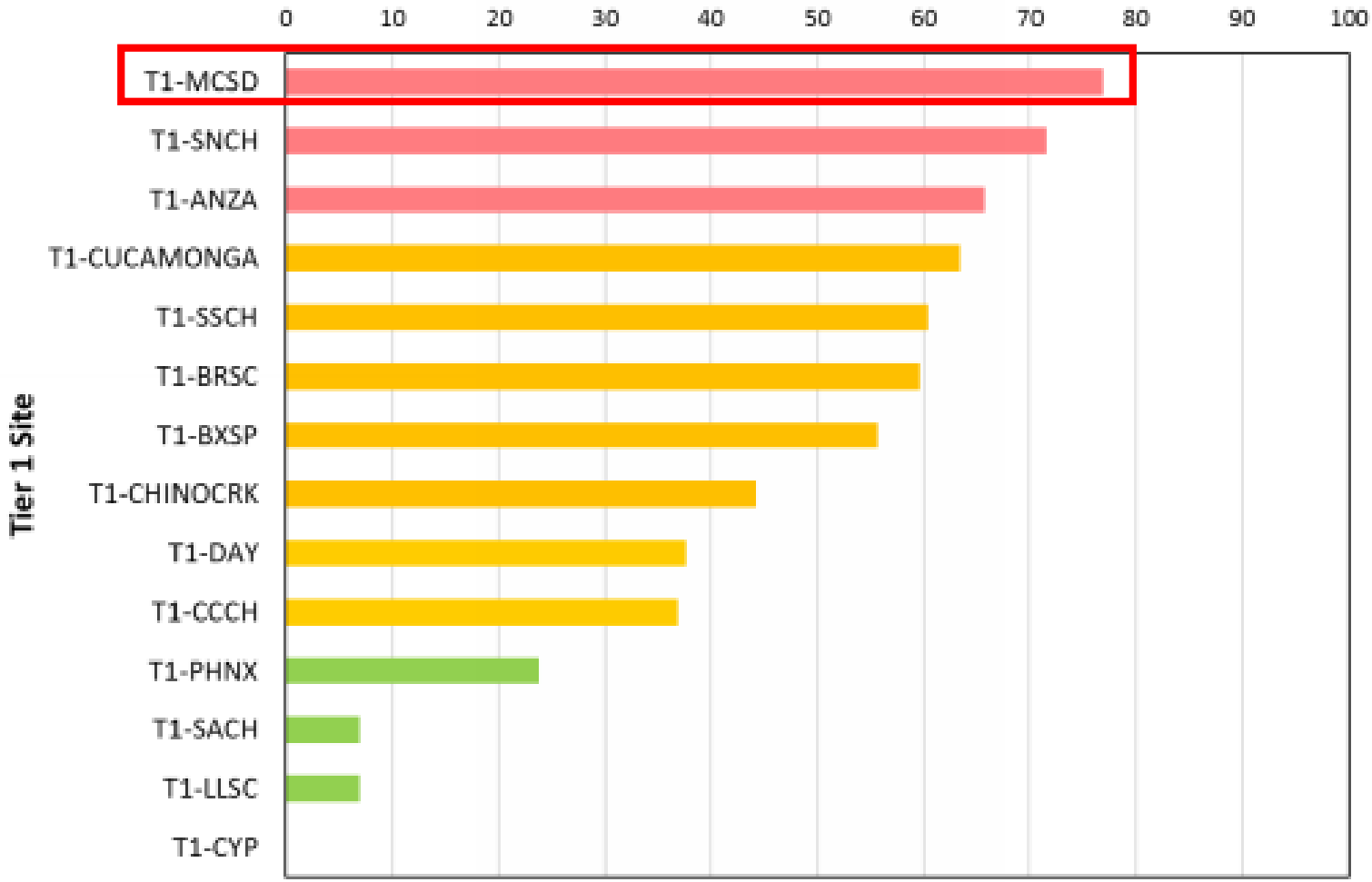
Background

MSAR TMDL 2019 Synoptic Study



Background

MSAR TMDL 2019 Synoptic Study



Special Investigation Purpose

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Purpose

To investigate the presence of human sources of bacteria in discharge from the Outfall (as identified in the Synoptic Study).

Study Questions

Within the Magnolia Center Storm Drain drainage area:

1. Where is dry weather flow present?
2. Where are the greatest concentrations of *E. coli* and greatest copies of the human DNA marker HF183?
3. Can we decrease the investigation area to focus on controllable human sources of fecal indicator bacteria?

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Study Design

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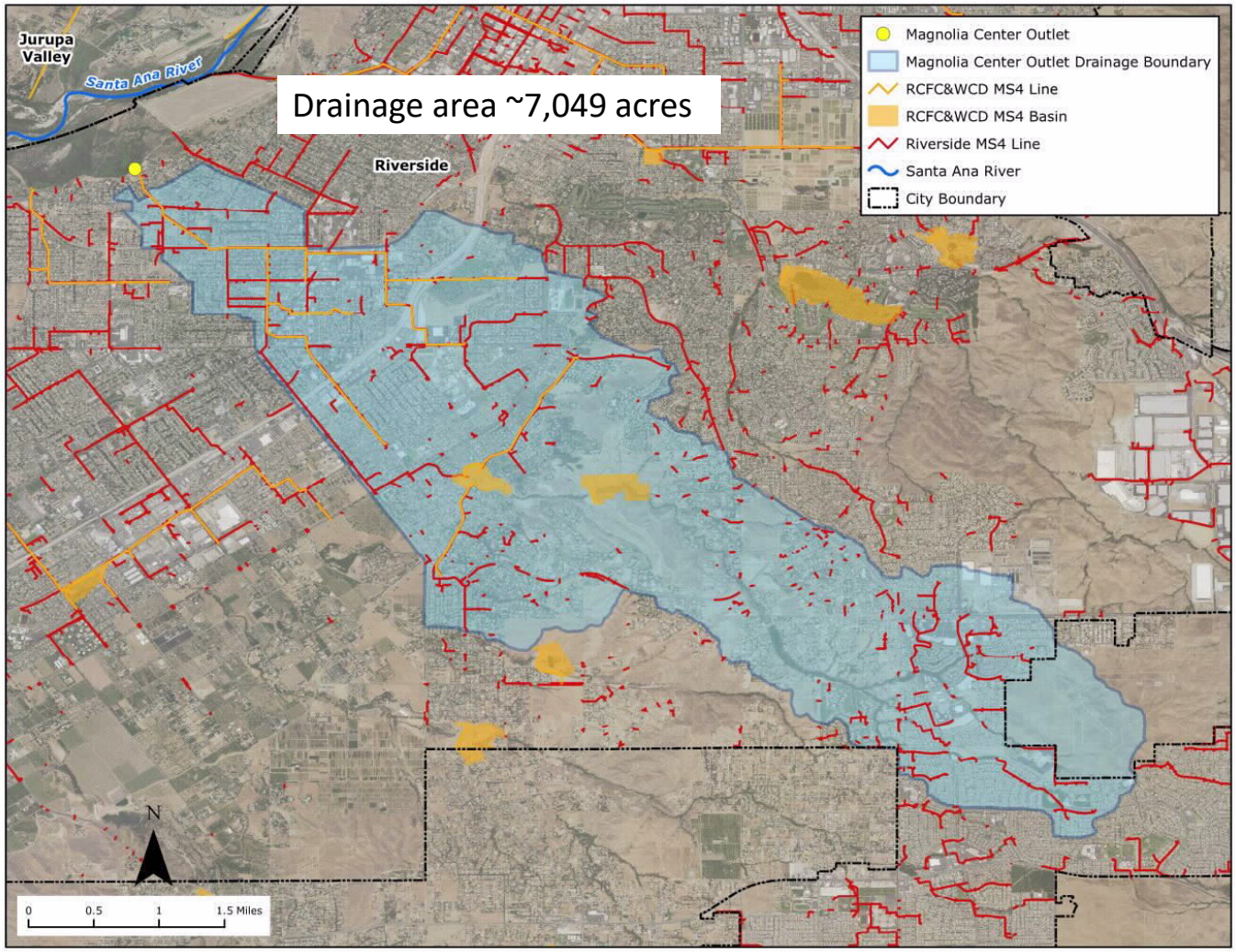
Study Design



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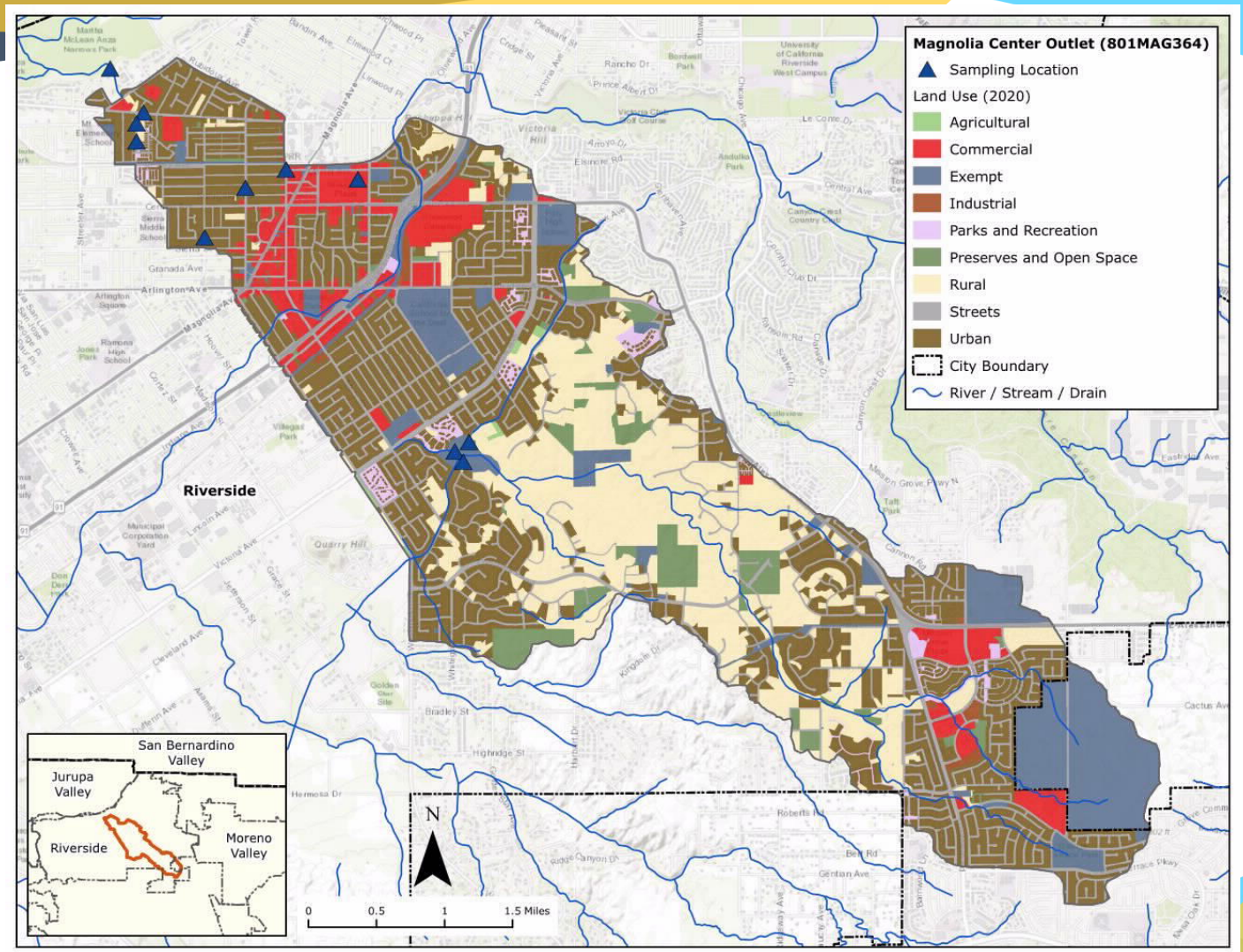

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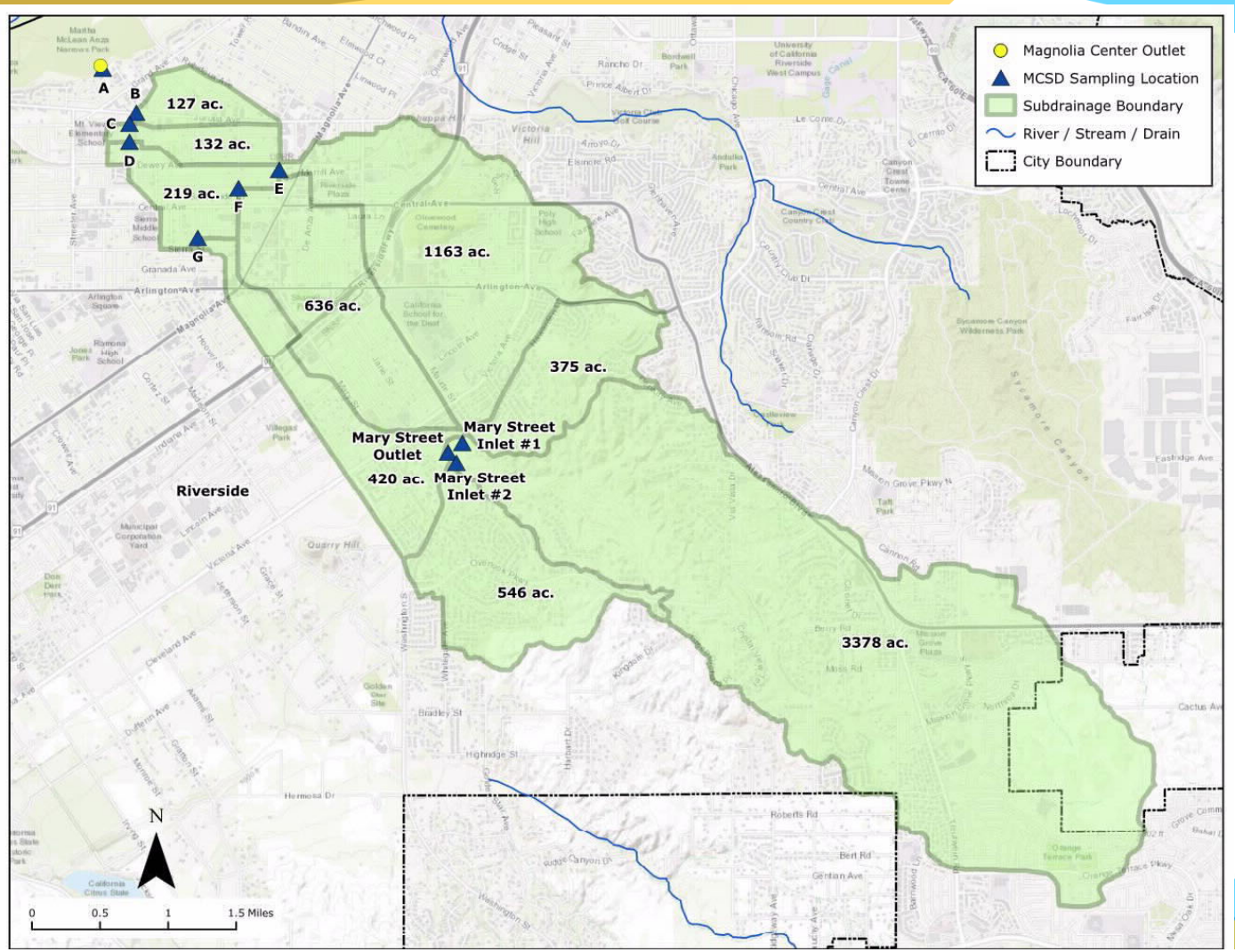
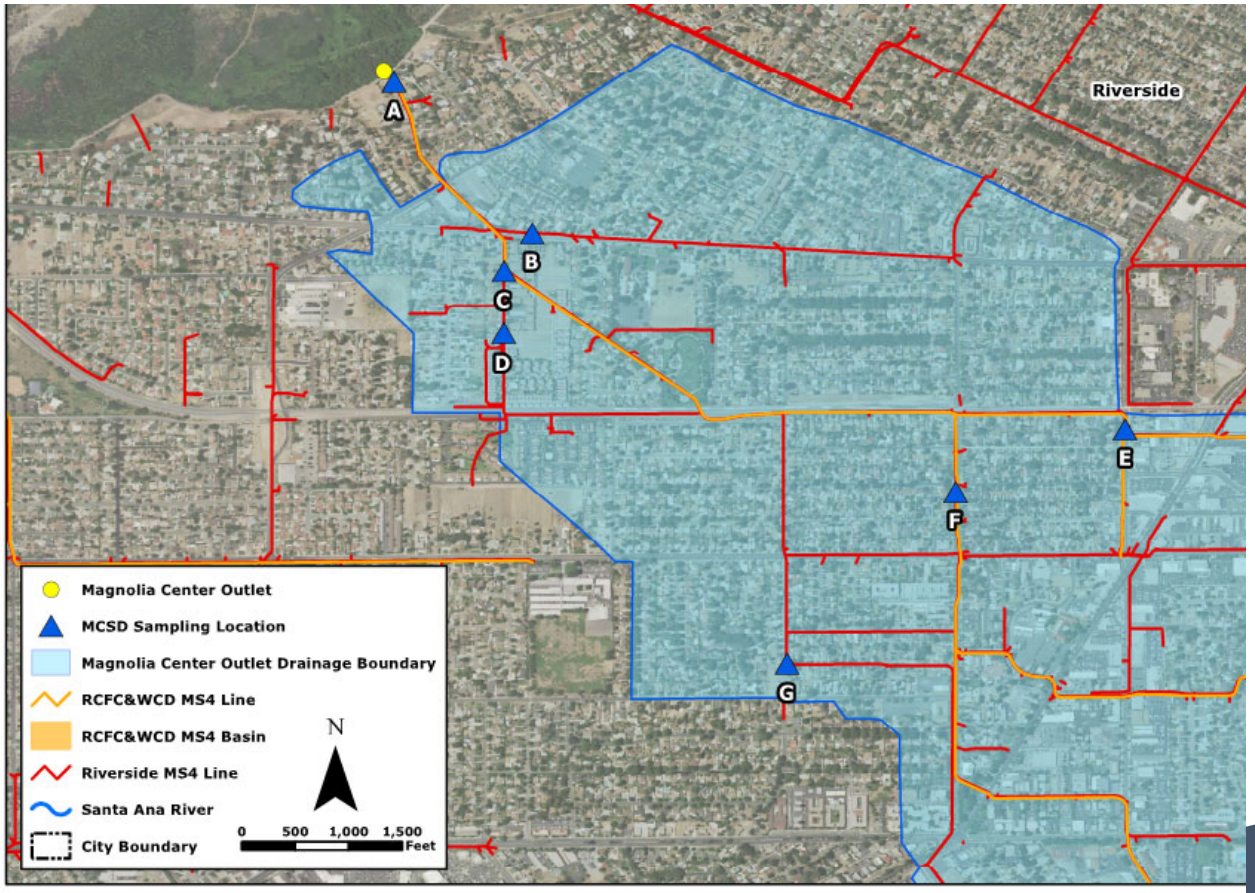
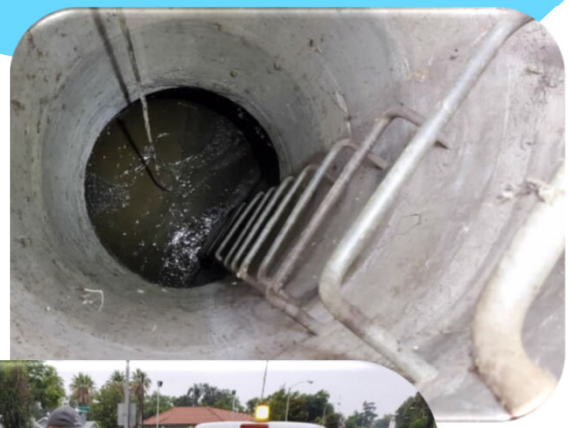


Study Design

Underground MS4 Network





Study Design

Mary Street Dam

Study Design
Monitoring Locations and Analyses

Site Description	Site ID	Approx. Sub-drainage area (acres)
A. Magnolia Center Storm Drain	364a	NA[1]
B. Jurupa Ave. near Grapevine Way	364b	127
C. Correll St. near Jurupa Ave.	364c	132
D. Correll St. near Arborwood Ln.	364d	219
E. Brockton Ave. near Merrill Ave.	364e	1163
F. Palm Ave. near Beatty Dr.	364f	636
G. Arch Way near Orange Vista Way	364g	420
H. Riverside Plaza[2]	364h	42
Mary St. Inlet 1	MI1	375
Mary St. Inlet 2	MI2	546
Mary St. Outlet	MO	3,378

Field Parameters

- pH
- Temperature
- Dissolved oxygen
- Conductivity
- Turbidity (District)

Laboratory Analysis

- *E. coli*
- HF 183
- MBAS
- Turbidity (City)

Study Design
HF183 Analysis Decision Matrix

Weeks 1-3: HF183 collected and analyzed at all sites* **Weeks 4-5 dependent on matrix**

*Additional sites may be added during the study dictated by field conditions. These may be subject to a further modified approach dependent upon the study schedule.

E. Coli Concentration	HF183 Signal: High	HF183 Signal: Low	Dry (No Flow)
High	**Human source identified and sub-drainage area will be further investigated.** Week 4 & Week 5 - Samples will be collected, filtered and frozen, but not analyzed at this time.	**Human source not identified.** Week 4 & Week 5 - Samples will be collected and analyzed to confirm results and continue to look for intermittent or transitory sources.	**Non-stormwater flows not observed.** Week 4 & Week 5 - Sites will continue to be monitored to look for intermittent or transitory sources. Samples will be collected and analyzed if water observed.
Low	**Human source identified and sub-drainage area will be further investigated.** Week 4 & Week 5 - Samples will be collected and analyzed to confirm results and continue to look for intermittent or transitory sources.	**Human source not identified.** Week 4 & Week 5 - Samples will be collected, filtered and frozen, but not analyzed at this time.	**Non-stormwater flows not observed.** Week 4 & Week 5 - Sites will continue to be monitored to look for intermittent or transitory sources. Samples will be collected and analyzed if water observed.

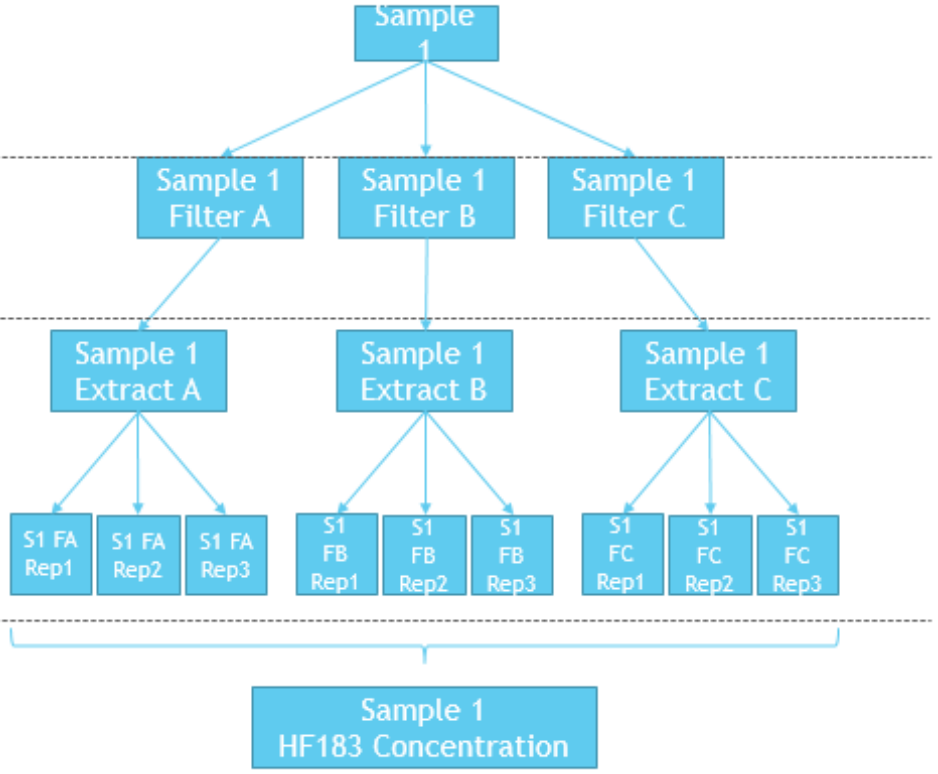
Study Design
EPA Method 1696 Flow Chart

Filtration
- 100 mL per filter
- 3 filters per sample

DNA Extraction
- Entire filter
- 100 µL DNA extract

qPCR Analysis
- 3 measurements (reactions) per filter
- 2 µL DNA extract per reaction

Data Analysis
- Assay: HF183/BacR287
- QA/QC samples: Method Blanks, No template controls, internal amplification control, sample processing control
- Only positive replicates are used to calculate average
- Results in copies per reaction



Monitoring Results

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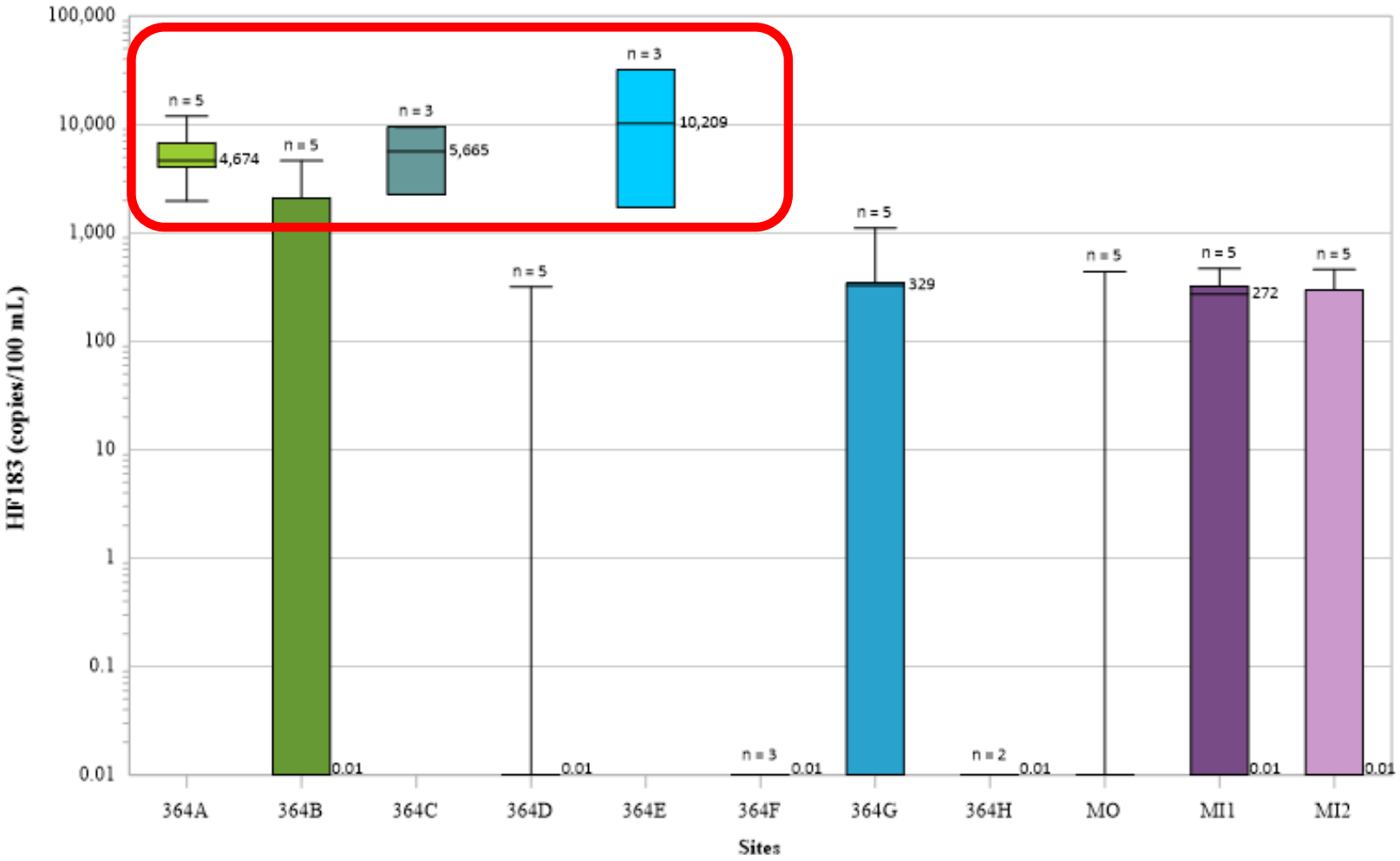
Monitoring Results

Site	Average Flow (cfs)	*E. coli* Geometric mean *(MPN/100 mL)*	*E. coli* Load (MPN/ day)	Average HF183 Concentration (copies/ 100 mL)	HF183 Load (copies/ day)
364A	1.052	2,269	$5.84 \cdot 10^{10}$	5,884	$1.51 \cdot 10^{11}$
364B	0.055[1]	1,656	$2.22 \cdot 10^{9}$	1,495	$2 \cdot 10^{9}$
364C	0.466[1]	2,224	$5.01 \cdot 10^{10}$	5,816	$1.31 \cdot 10^{11}$
364D	0.072[1]	3,609	$6.34 \cdot 10^{9}$	280	$4.92 \cdot 10^{8}$
364E	0.460	2,565	$2.89 \cdot 10^{10}$	14,678	$1.65 \cdot 10^{11}$
364F	0.176[1]	72	$3.10 \cdot 10^{8}$	264	$1.14 \cdot 10^{9}$
364G	0.512	2,895	$3.63 \cdot 10^{10}$	400	$5.01 \cdot 10^{9}$
364H	0.115	12,200	$3.43 \cdot 10^{10}$	401	$1.13 \cdot 10^{9}$
MI1	0.094	443	$1.02 \cdot 10^{9}$	324	$7.46 \cdot 10^{8}$
MI2	0.292	2,023	$1.45 \cdot 10^{10}$	323	$2.31 \cdot 10^{9}$
MO	0.280	43[2]	$2.95 \cdot 10^{8}$	299	$2.05 \cdot 10^{9}$

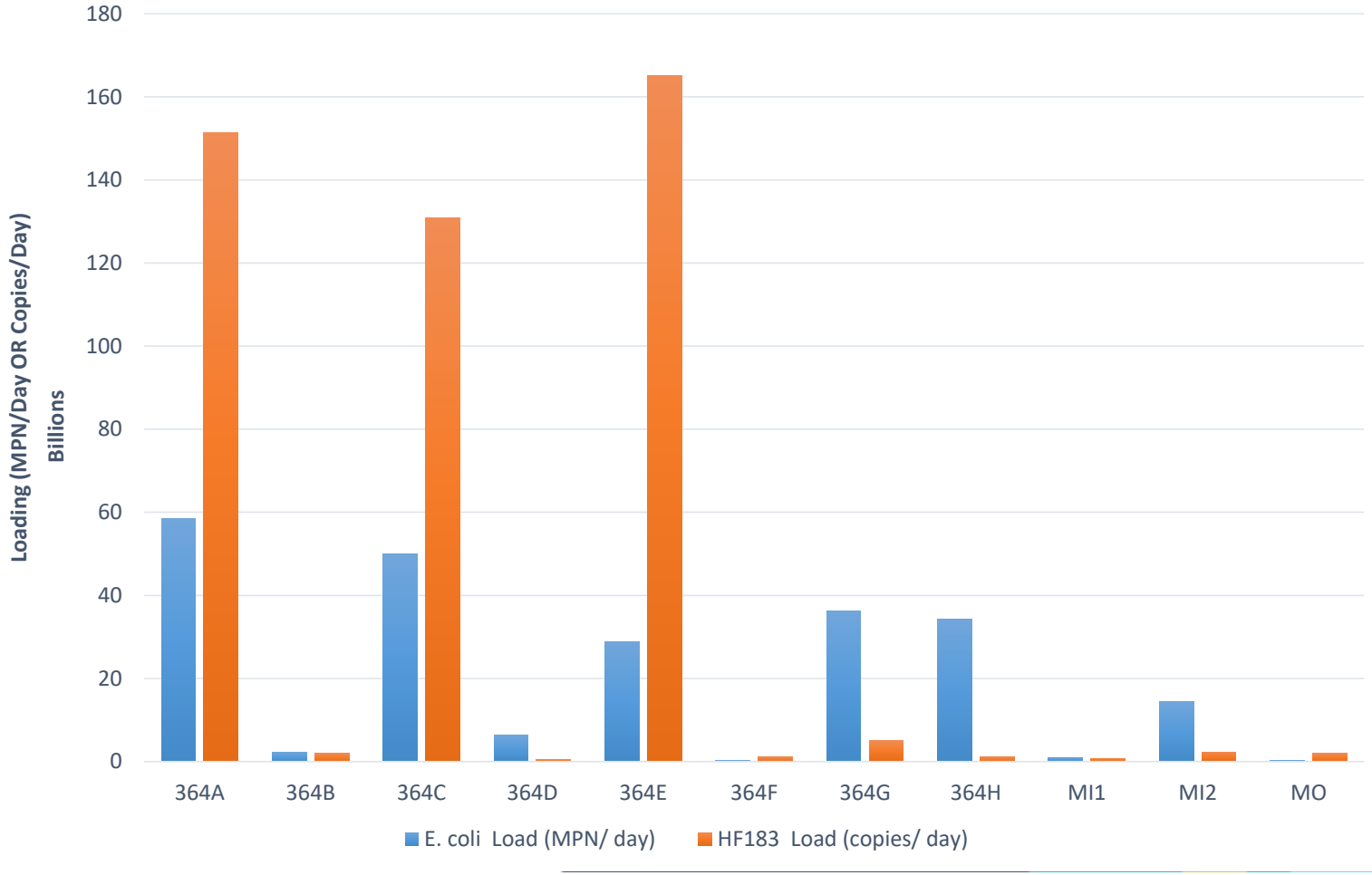
1- flowrates adjusted due to incorrect recording of field measurements
2- geomean calculated using RL of 10 for ND results

Monitoring Results
HF183 Concentrations



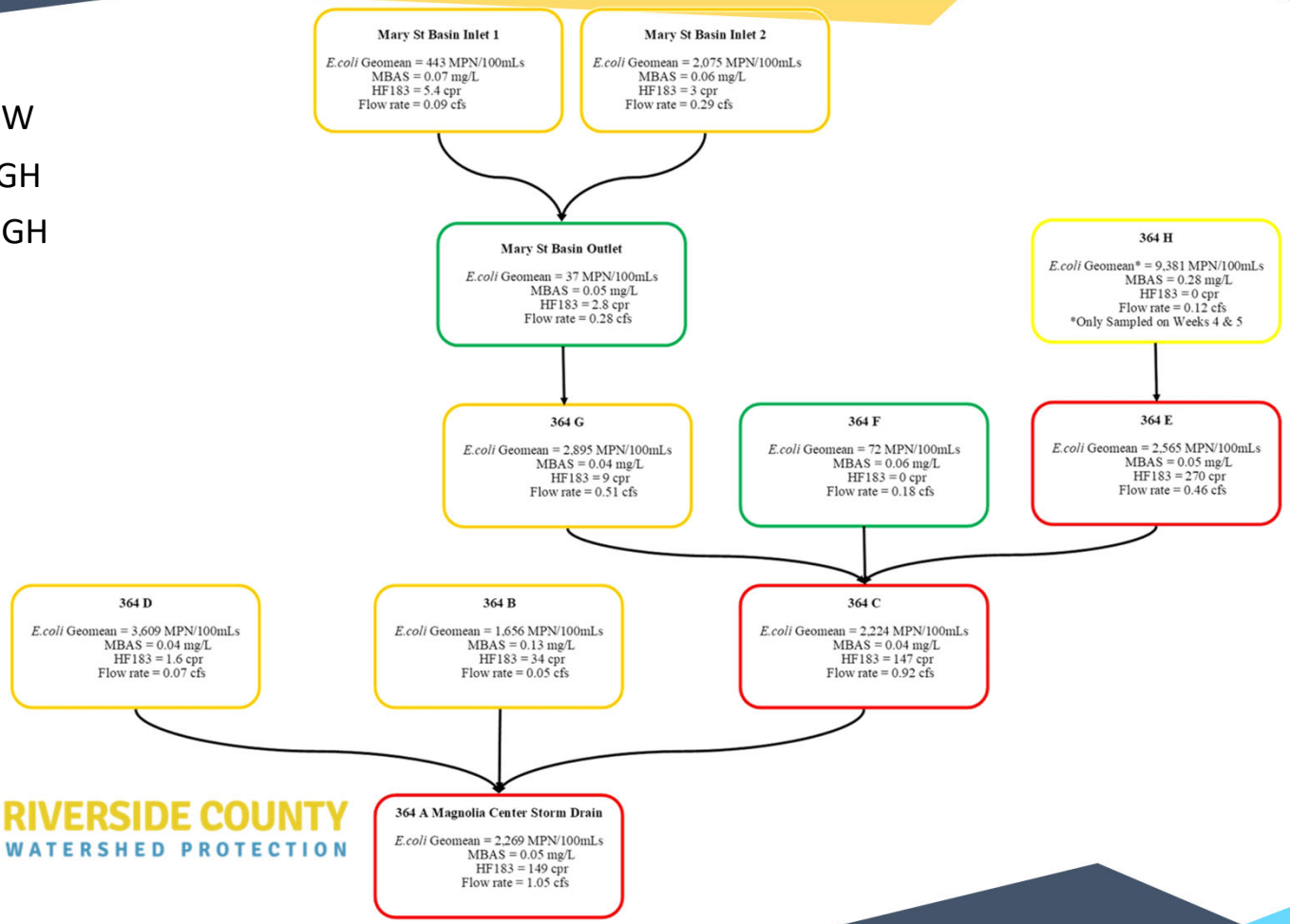
Monitoring Results

Calculated *E. coli* and HF183 Loads



Monitoring Results

- LOW/ LOW
- LOW/ HIGH
- HIGH/ HIGH



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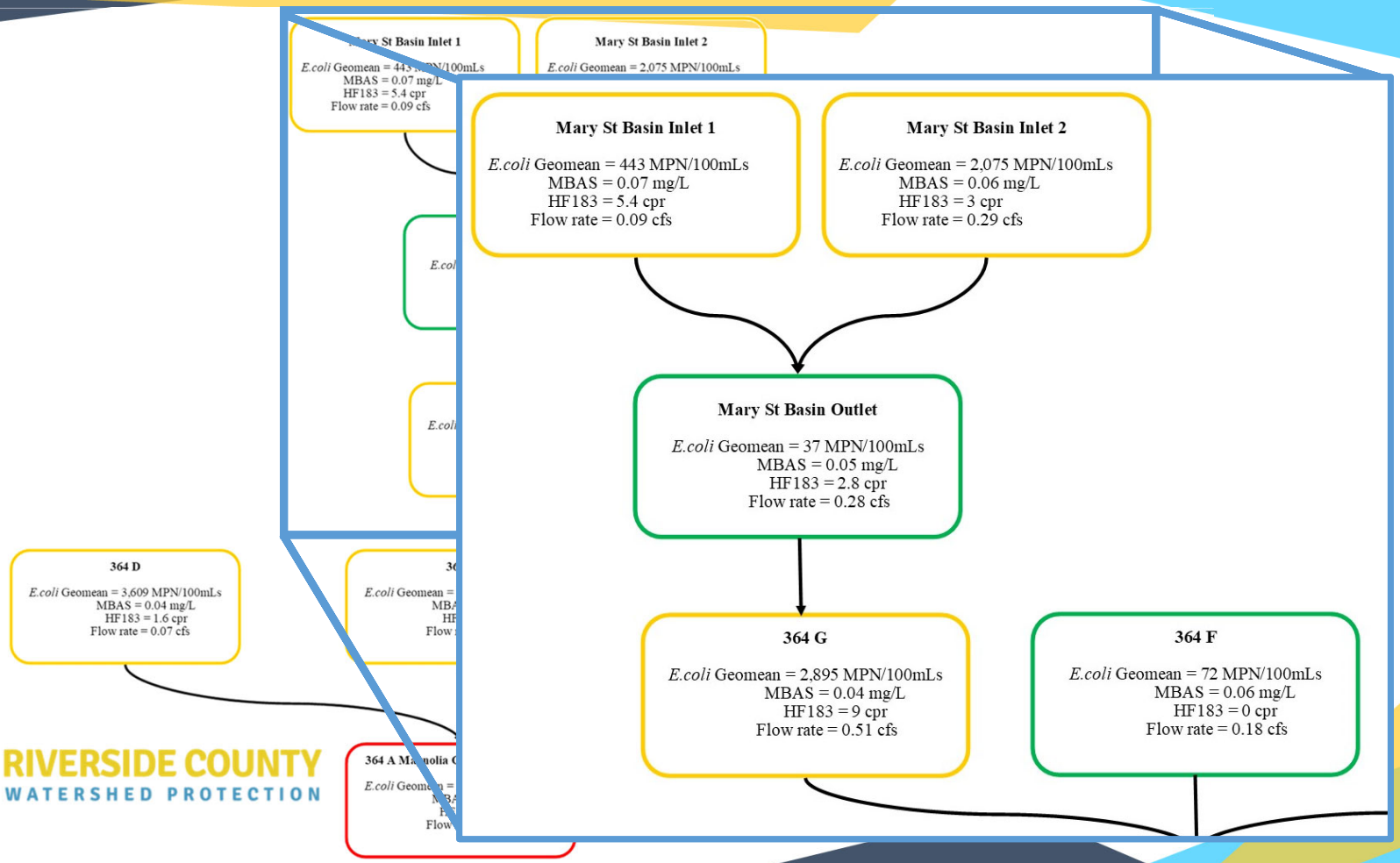
Monitoring Results



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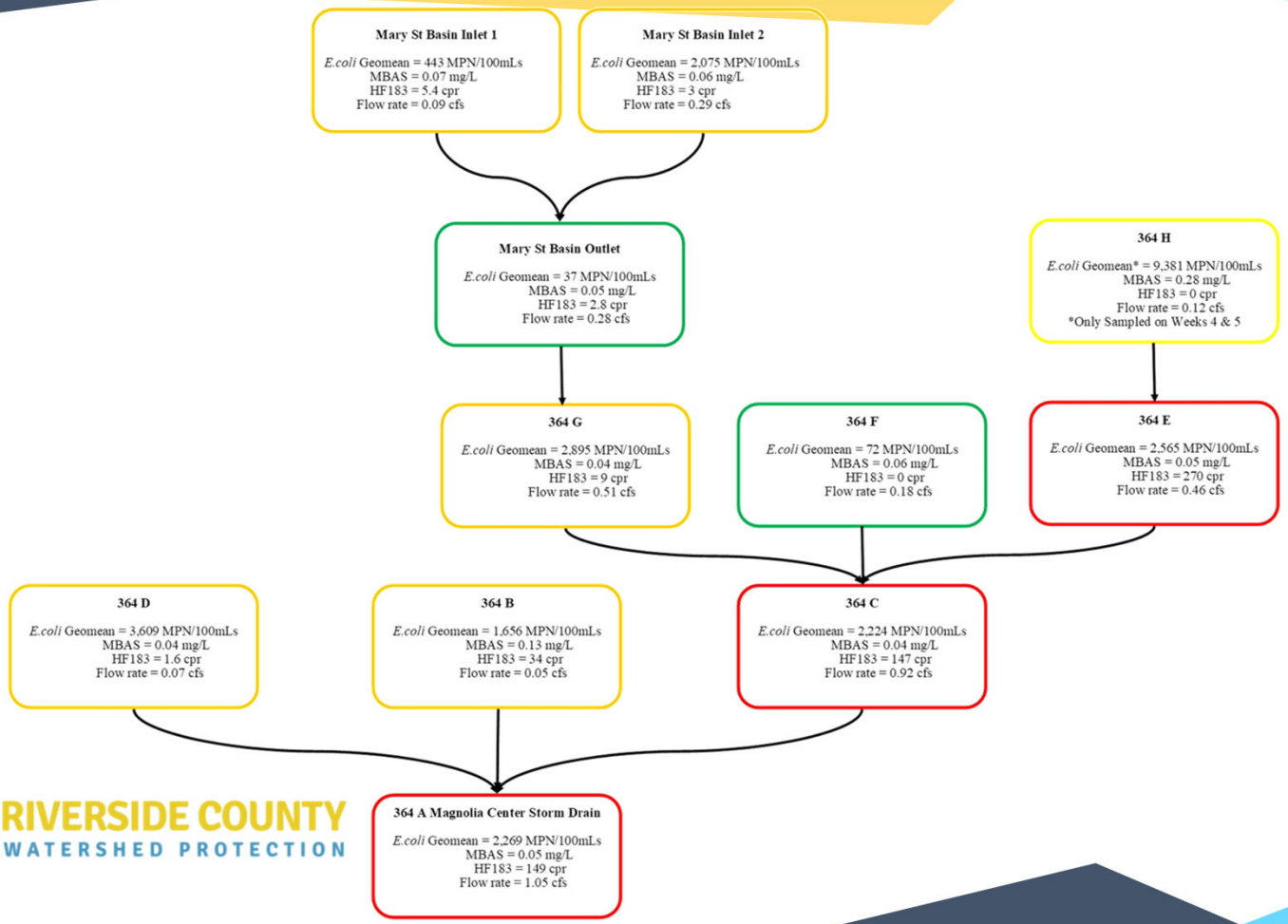

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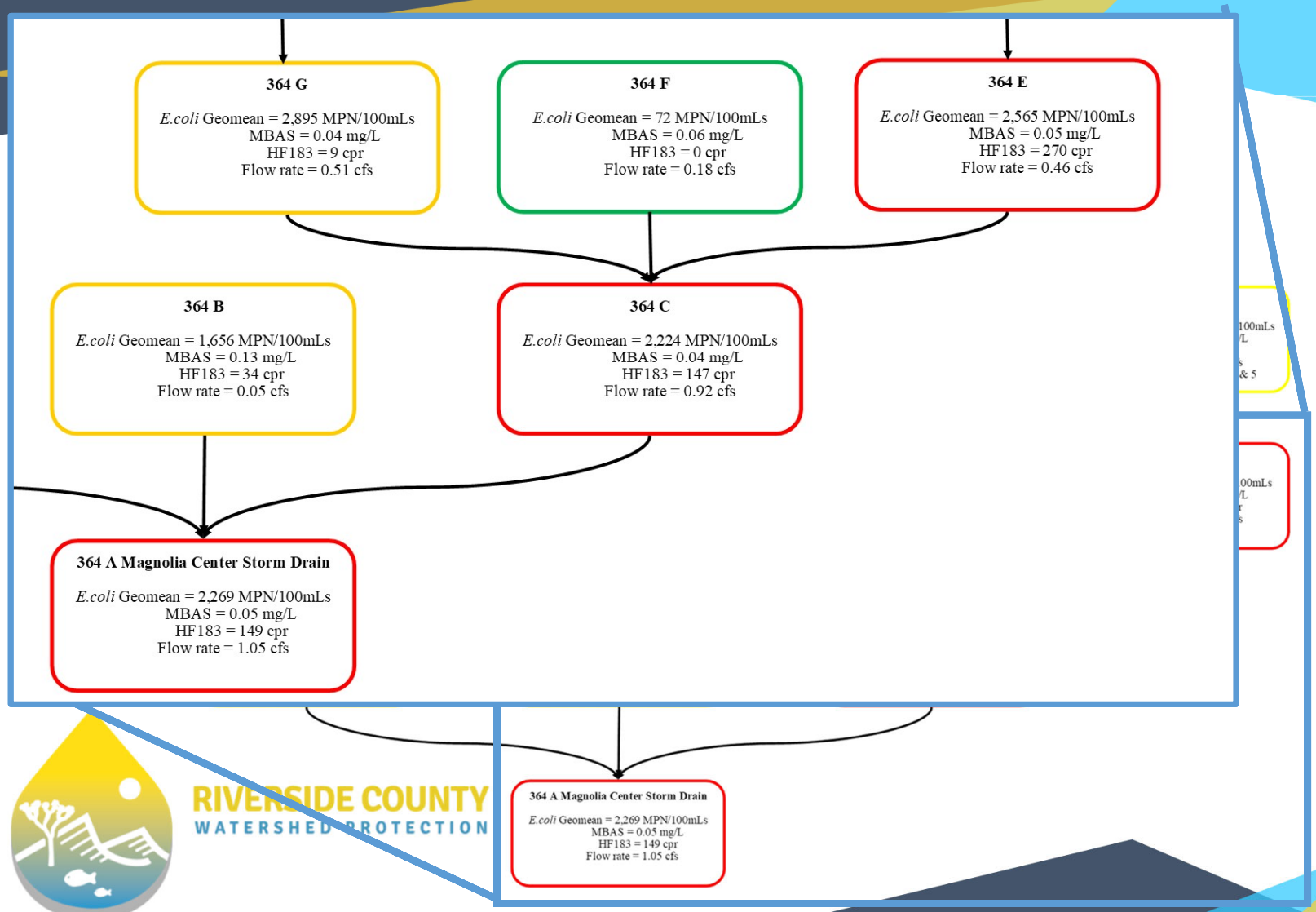

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Key Findings

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Key Findings

Study Question #1

Where is there dry weather flow?

All sites had measurable dry weather flow each week they were monitored.

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Key Findings

Study Question #2

Where are the greatest concentrations of E. coli and copies of the human DNA marker HF183?

Site	Average Flow (cfs)	*E. coli* Geometric mean *(MPN/100 mL)*
364A	1.052	2,269
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1- flowrates revised; 2- RL used for ND

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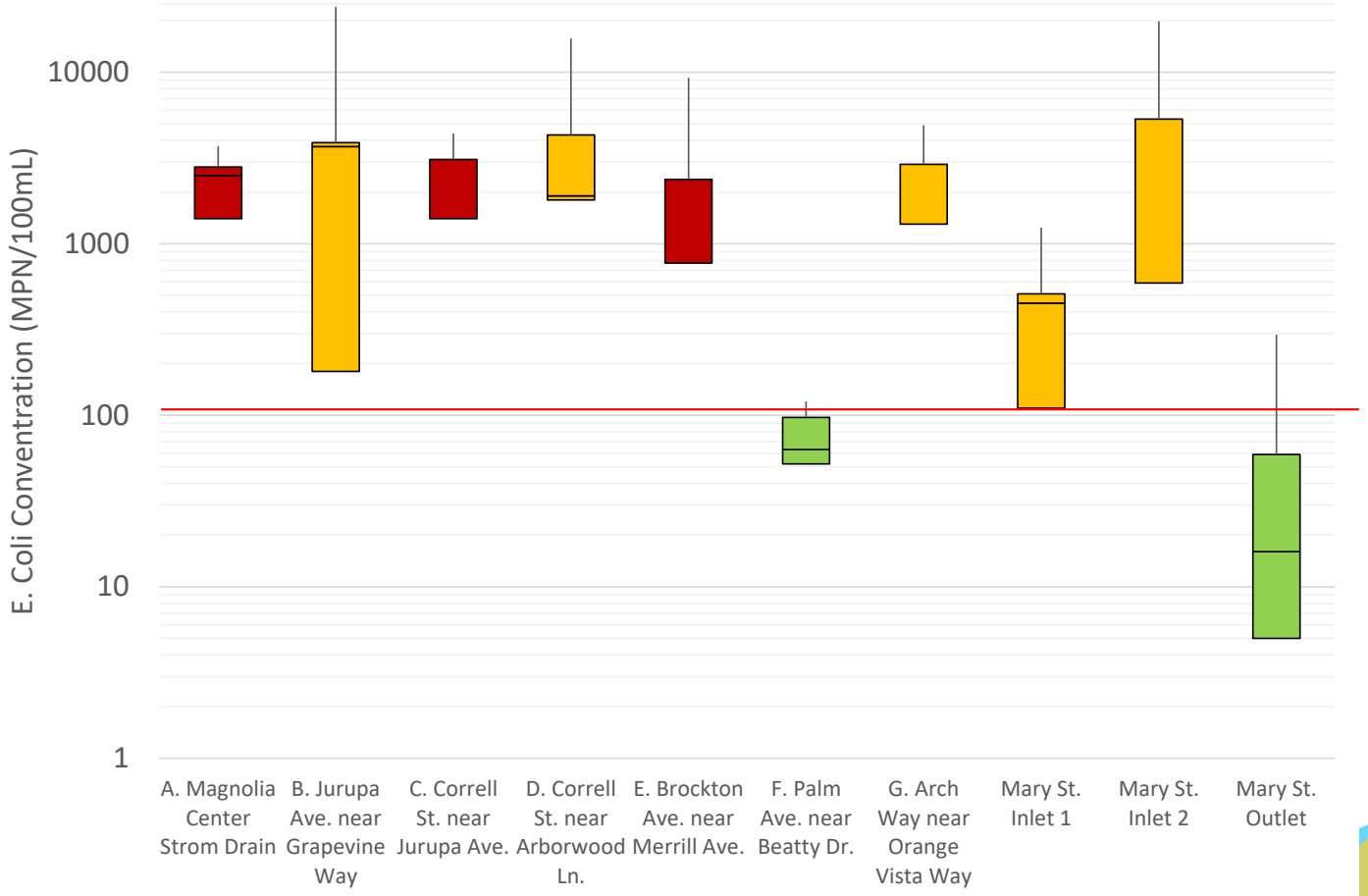
Key Findings

E. coli Concentrations



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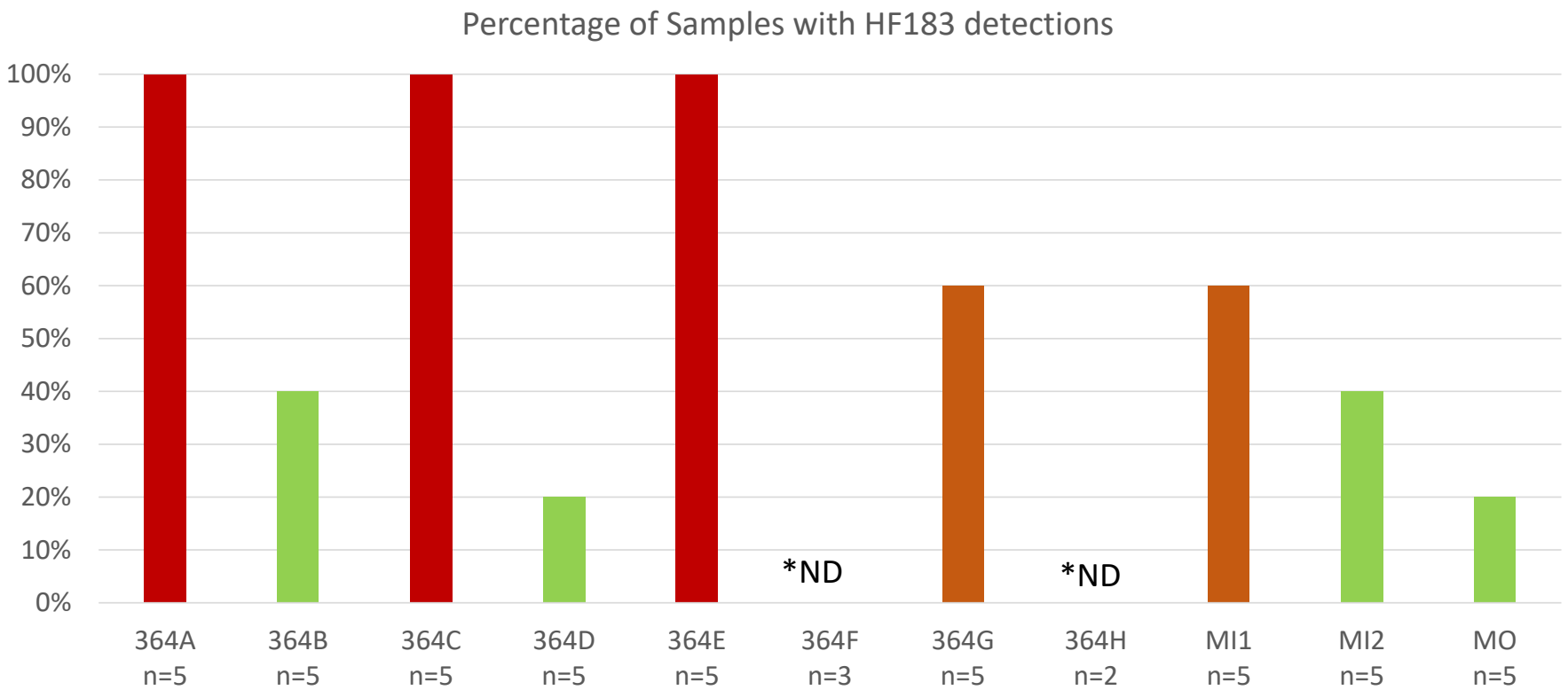

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Key Findings

Study Question #3

Can we decrease the investigation area to focus on controllable human sources of FIB?

- **Confirmed no surface water connectivity in dry weather between upper drainage area and Magnolia Center Strom Drain, eliminating ~50% of the area.**

- **Sub-drainage of Site 364E – Brockton Avenue near Merrill Avenue and its upstream connections will be further investigated to narrow down potential causes of bacterial indicators and controllable anthropogenic sources.**

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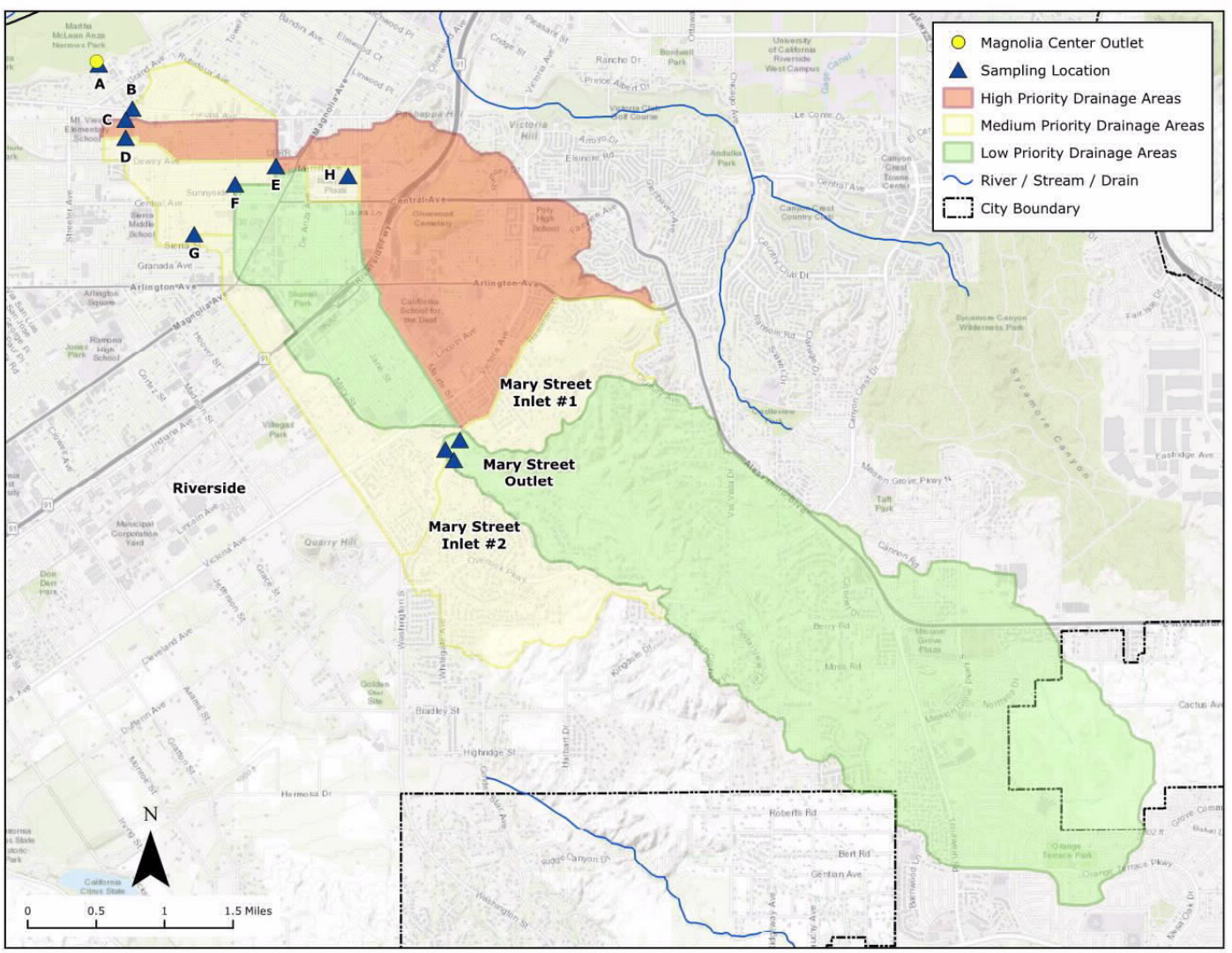
Key Findings



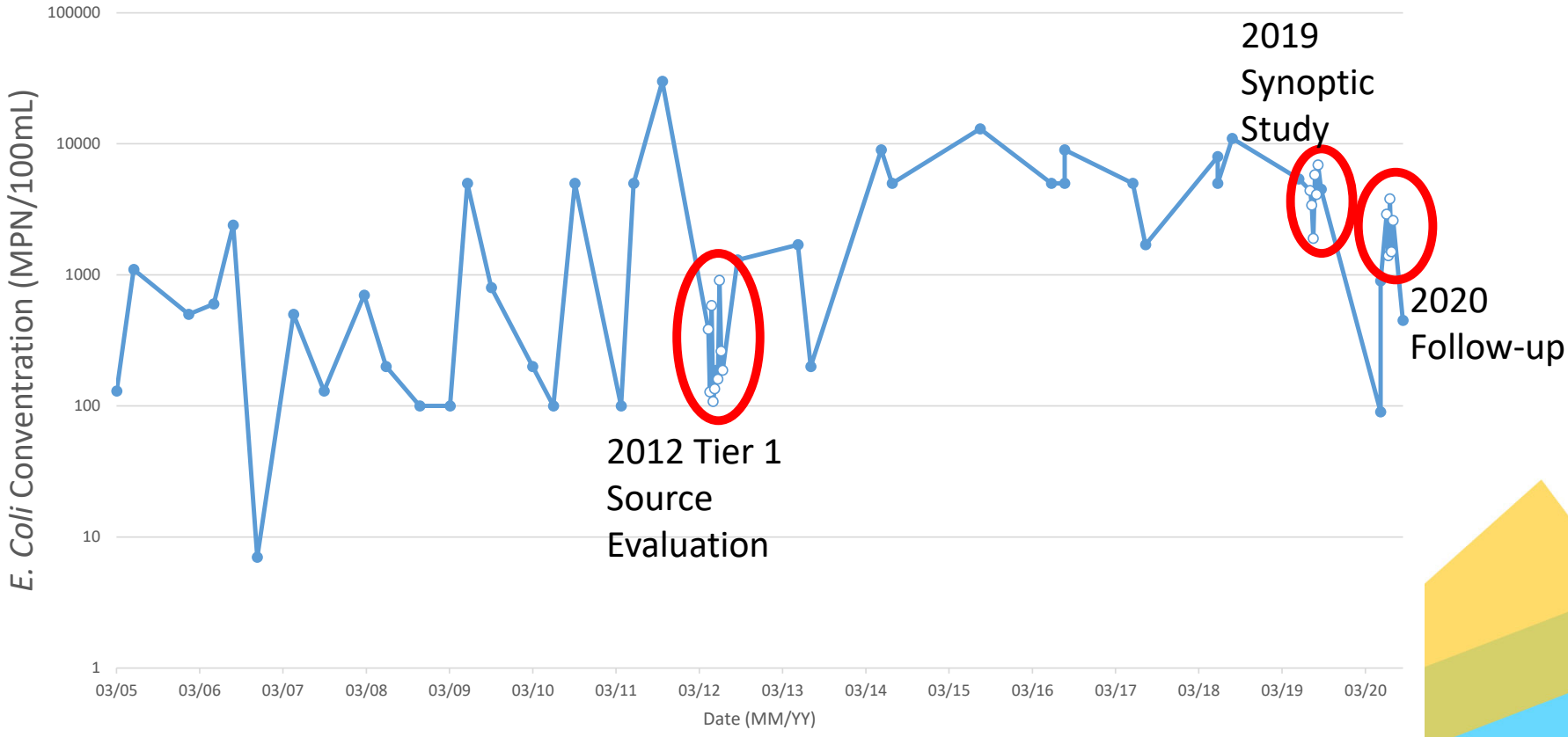
Key Findings

Site	MBAS detected above MRL	Above *E. coli* Geometric Mean Numeric Targets[1]	HF183 above 4,100 copies/100 mL
364A	Yes- 1 sample	Yes	Yes- 3 of 5 samples
364B	Yes- 4 samples	Yes	Yes- 1 of 5 samples
364C	No	Yes	Yes- 3 of 5 samples
364D	No	Yes	No
364E	No	Yes	Yes- 3 of 5 samples
364F	Yes-1 sample	No	No
364G	No	Yes	No
364H	Yes- 2 samples	Yes	No
MI1	Yes- 2 samples	Yes	No
MI2	No	Yes	No
MO	Yes- 1 sample	Yes	No

[1]*E. coli* 30-day geometric mean and six-week geometric mean are the same. Comparisons were made to both 113 organisms per 100 mL for MSAR TMDL and 100 CFU/100 mL for Bacteria Provisions WQO. There were no differences in results.

Key Findings

Historical *E. coli* Concentration



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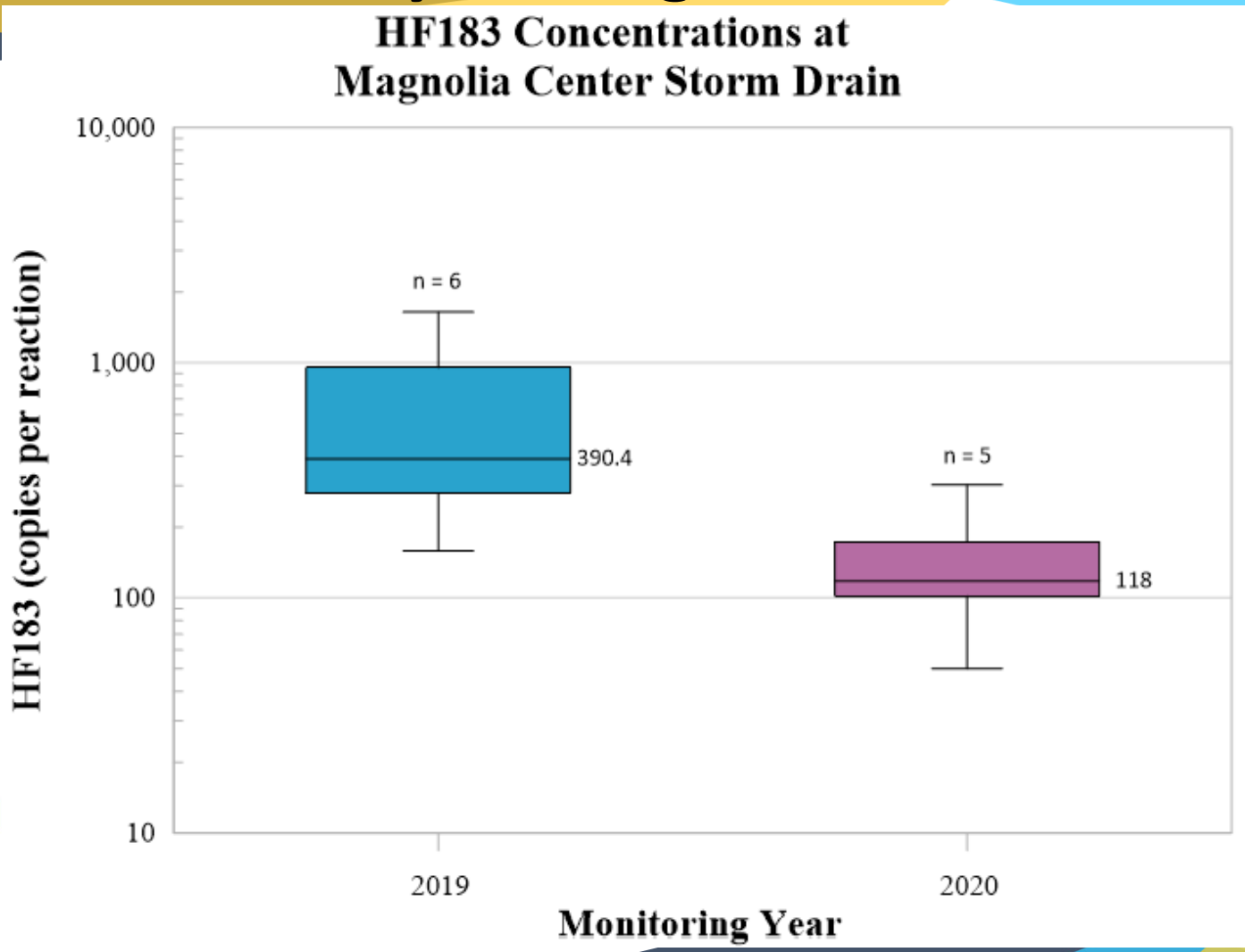

Conclusions & Next Steps

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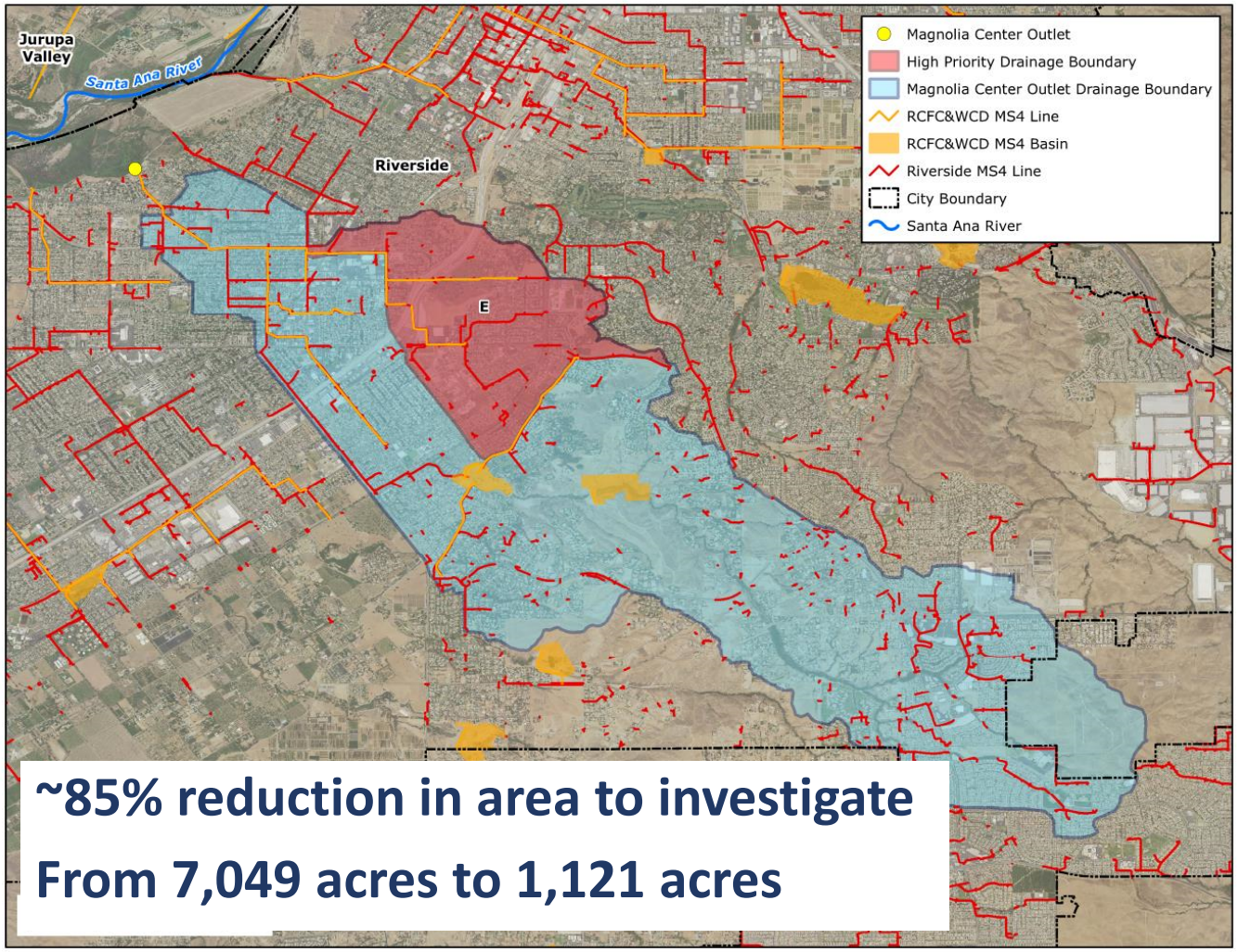
Conclusion



~85% reduction in area to investigate

From 7,049 acres to 1,121 acres

Next Steps

- The City of Riverside will focus investigation efforts on the 1,121-acre drainage area of Site 364E.

- The District will continue to monitor Magnolia Storm Drain Outfall as part of routine compliance.
  - Relevant data will be provided to the City for reference.

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Acknowledgements

Thanks to the teams that supported this study.

City of Riverside: Nicole Jimenez, Cindy Snavely-Peck, Alfredo Vasquez, Timothy Ridley, and Stormy Osifeso.

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E.S. Babcock Lab: Angela Brown

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Questions

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Extra slides if applicable for questions

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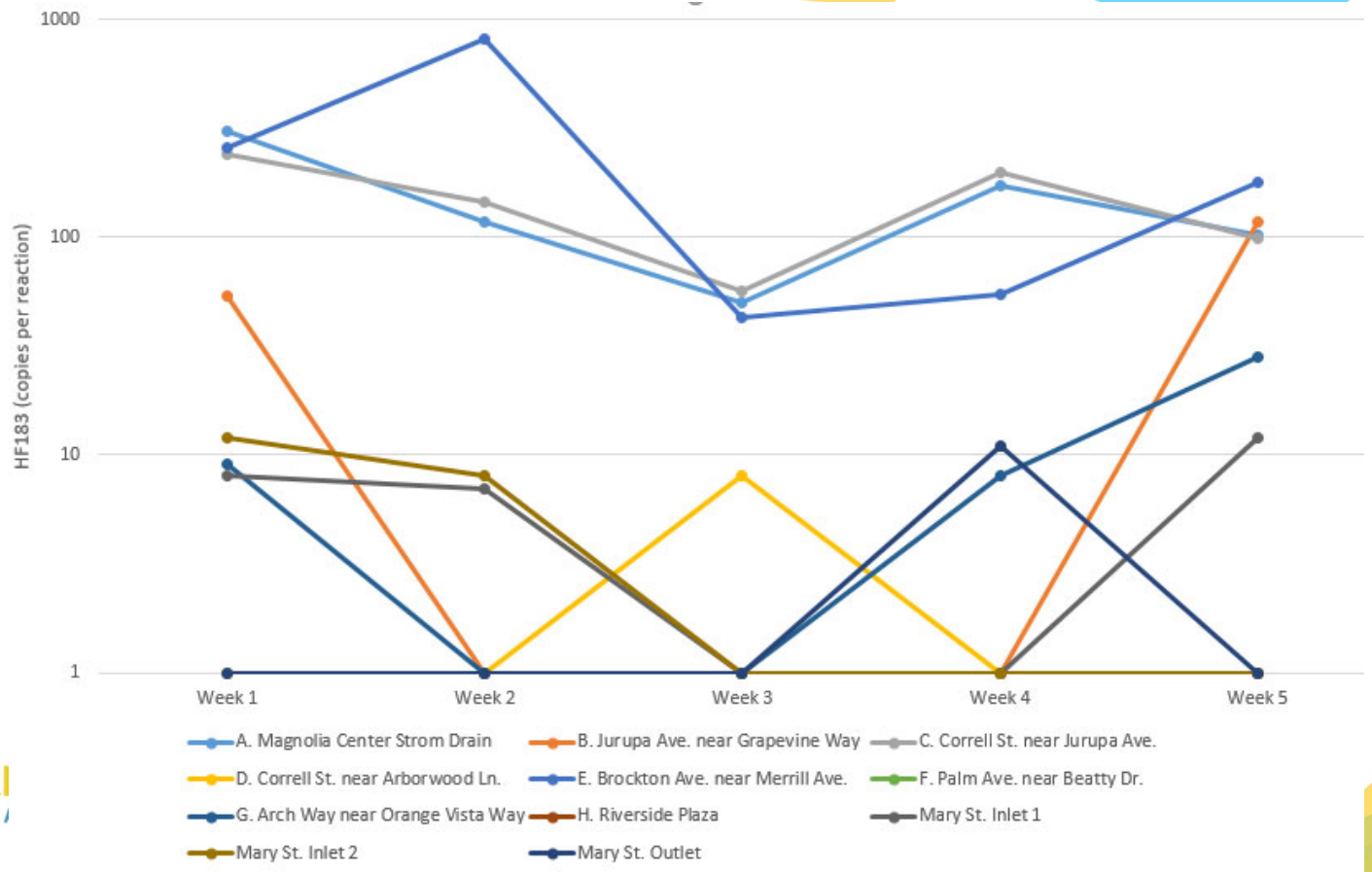
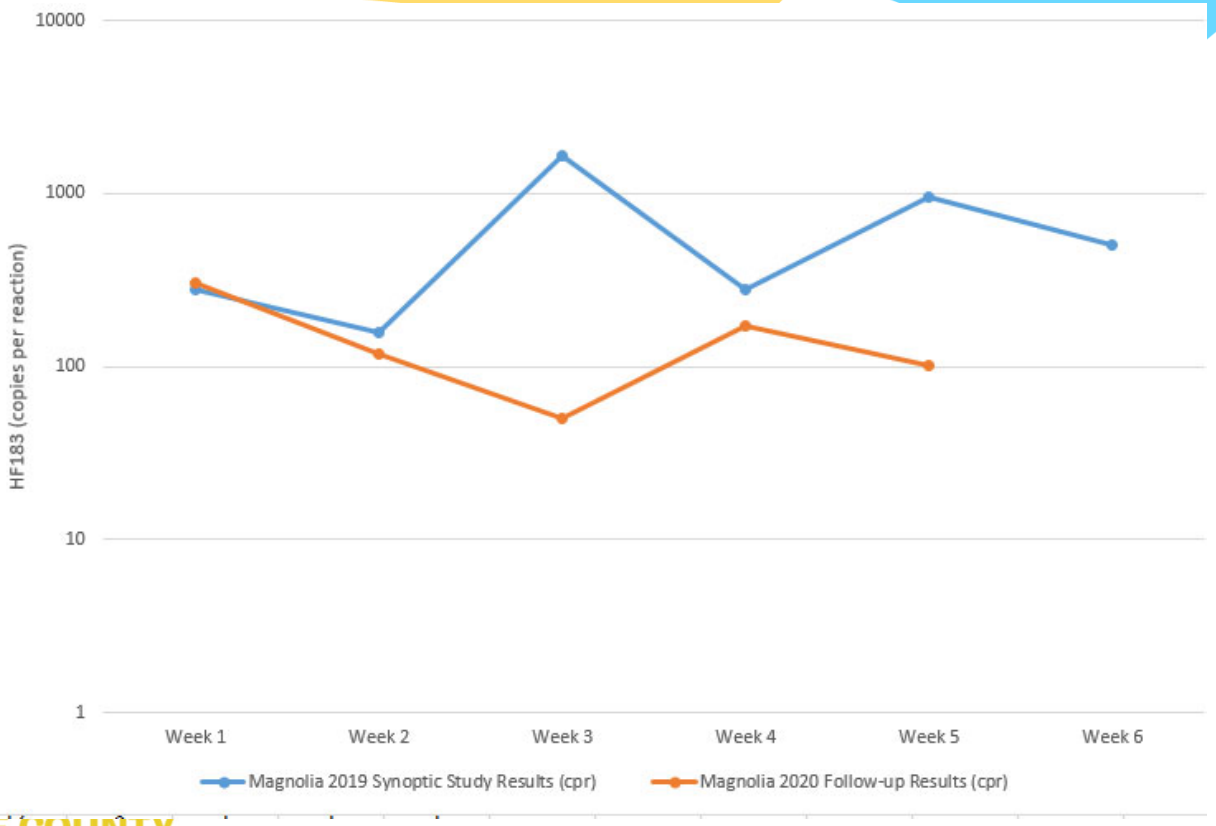
HF183 Concentrations



2019 Synoptic Study compared to 2020 Follow-up Investigation



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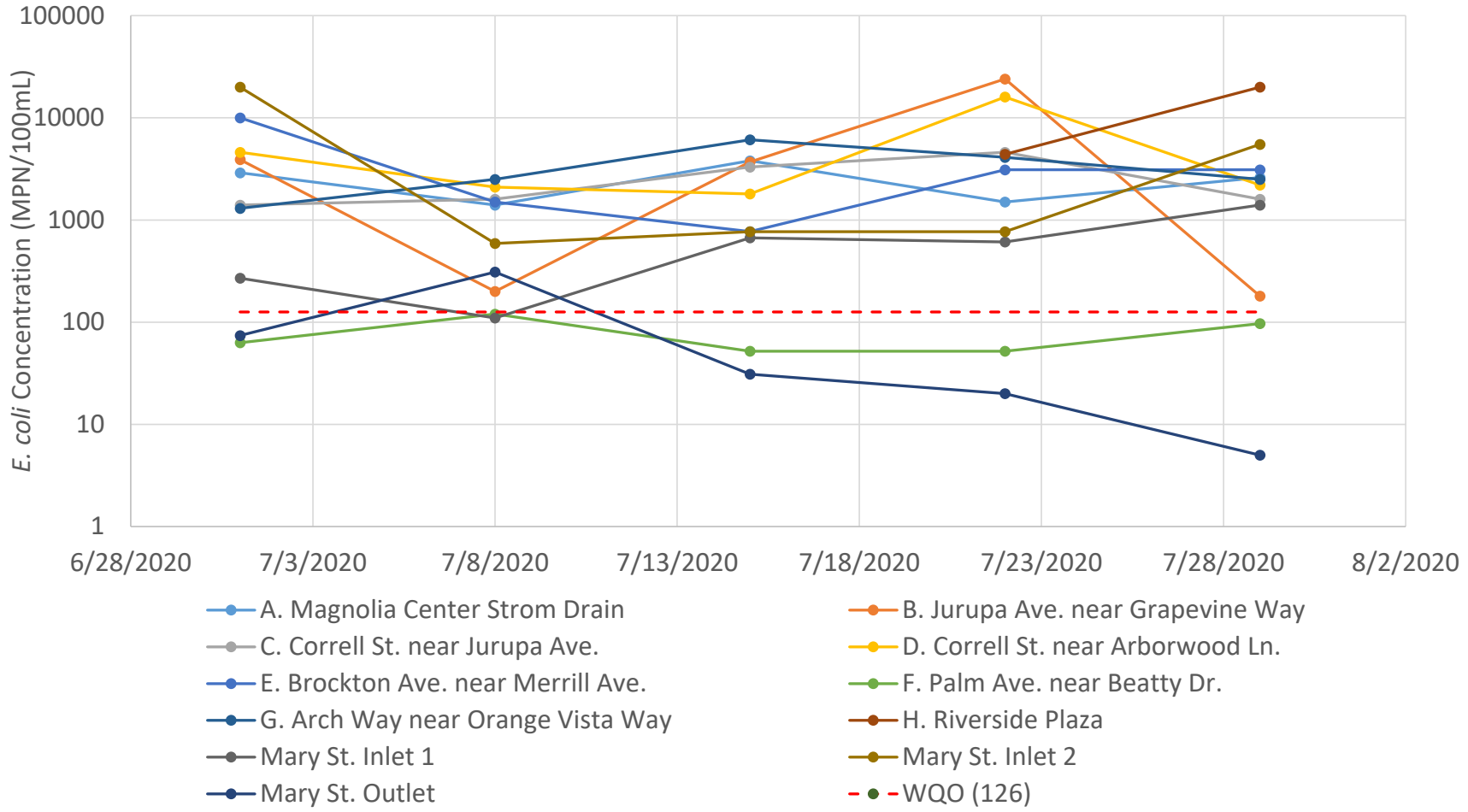
Monitoring Results
E. coli Concentrations