CITY OF WASHINGTON, ILLINOIS
Public Works Committee Agenda Communication

Meeting Date: March 7, 2022

Prepared By: Dennis Carr – City Engineer

Agenda Item: Smoke Testing Costs and I/I Discussion

Background: During the draft report presentation from Hamilton Consulting Engineers, two alternatives in particular were discussed amongst council as potential solutions for the Trunkline Project. For the alternative involving the reduction in I/I, smoke testing would need to be performed, as part of a Sanitary Sewer Evaluation Study (SSES), to identify illegal connections among other things. There were some differences in opinions at the council level, however, staff reached out to Robinson Engineering to acquire estimates and proposals to perform the smoke testing in Sanitary Basins 7&9 as well as with everything east of Wilmor..

Further Review: During review of Strand's flow metering, Hamilton's Draft Report, and Strands 2017 presentation to council regarding Sanitary Sewer Maintenance and Rehab, it was found that removal of I/I from basins 7&9 would not amount to enough flow removal and a price was also requested to smoke test everything East of Wilmor.

The flows discussed in Strand's Report on August 30th were from a 2.6-year storm intensity. Meter 6 measured the volume coming into STP1 at 11,671 gpm. This flow is a smaller flow than the combination of 7,8, and 9. Flow meter 7,8, and 9 combined for 16,117 gpm. The Strand report indicated that the difference in the flows between meter 6 and the combination of 7,8, and 9 could have been influenced by Control Chamber 1. This would likely mean that the Control Chamber is backing sewer up that exceeds 11,671 gpm, which would need to be removed as well. Hamilton's Relief Sewer alternative would bypass Control Chamber 1.

In looking at the combination of 7,8, and 9 (16,117 gpm) as the worst case, **We would need to reduce the peak flows by 8,291 gpm to get to the 7,826 gpm that the relief sewers could handle**. This would not include any additional I/I from basin 6, but considering the age of homes there, this will likely be another area to target in future.

Basin	Average Flow (gpm)	Aug 30 Flow (2.6 Year Storm) (gpm)	Peaking Factor		With 40% reduction in I/I (Per Strands 2017 Presentation) (gpm)
7	**56**	**3142**	**56.1**		1885.2
8	**636**	**9584**	**15.1**		5750.4
9	**78**	**3391**	**43.5**		2034.6
7+8+9	**770**	**16117**			**9670.2**

In Strand's 2017 presentation to council regarding the flow metering and I/I issues around the City, they noted on slide 33, that the reduction in I/I from the private side can reduce flows by 40%. A 40% reduction in I/I in basins 7,8, and 9 would only decrease flows to 9,670 gpm which exceeds the volume of the relief sewers included in Alternative E. This does not include the sewers in Basin 6 which would also add to the Trunkline flows.

Staff has been televising and lining sanitary sewers to address I/I on the public side for several years, but smoke testing could also potentially identify areas that we could address along our sanitary sewer or manhole structures.

Smoke Testing

A request was made to Robinson Engineering to provide the City with estimates for the smoke testing of basins 7 and 9 as well as everything East of Wilmor. Their smoke testing also includes additional analysis on the total amount of flow entering at each issue. Robinson provided staff a conservative estimate (formal proposal to follow) for these two options based on our GIS information as follows:

Basins 7&9 - 187 manholes- $56,000

Diameter	Sum of Shape_Length
4	105
6	4,631
8	21,080
10	2,270
12	8,406
15	5,013
18	3,068
<Null>	80
12in	205
Grand Total	**44,858**

Basins 7,8,9 (East of Wilmor) - 693 manholes- $152,000

Diameter	Sum of Shape_Length
0	311
4	272
6	12,023
8	90,092
10	8,703
12	16,564
15	7,393
16	975
18	6,147
21	877
24	1,710
36	2,128
42	1,432
<Null>	3,462
12in	205
8in	16
Grand Total	**152,312**

The smoke testing itself is not a huge issue for residents to accommodate. Smoke testing is done in communities across the nation. Disconnection of down spouts and sump pumps are easy fixes that would absolutely reduce our I/I issues and should be fixed. Whether or not these fixes alone will solve the I/I issues is only speculative, but to remove more I/I (footing tile and floor drain connection) would consider more intrusive and expensive solutions inside the private homes of residents. Our ordinance was amended in 2021 to take a softer approach with these connections, but unless adjusted, our ordinance would require the disconnection of footing tiles and floor drains with 6 months of a connection being identified.

Action Requested: Staff is looking for discussion on the direction forward regarding the smoke testing proposals.

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Capital Improvement Planning for Sanitary Sewer Maintenance and Rehabilitation

City of Washington, IL

City of Washington Est. 1825

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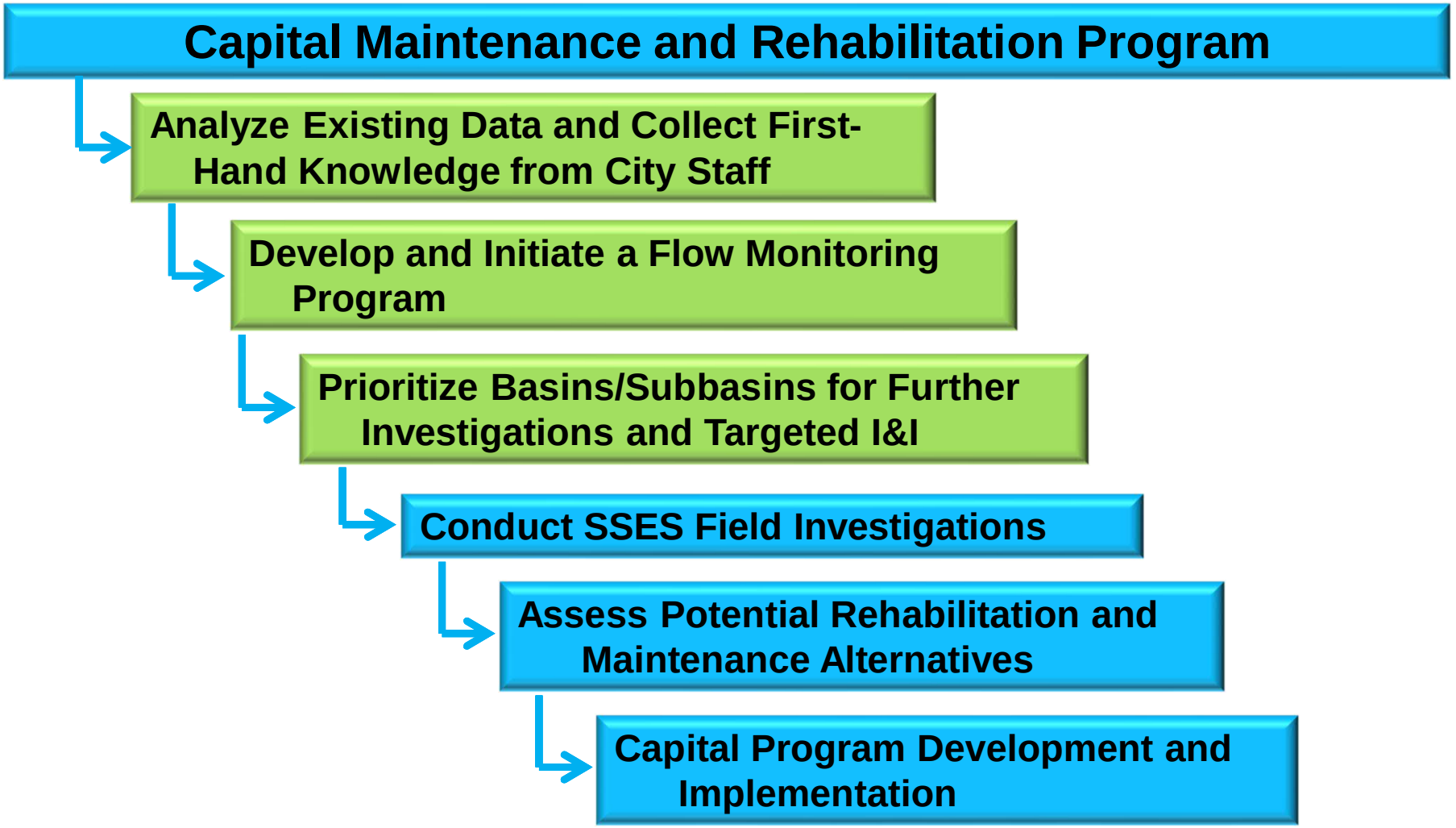
Planning for Sanitary Sewer System Maintenance and Rehabilitation



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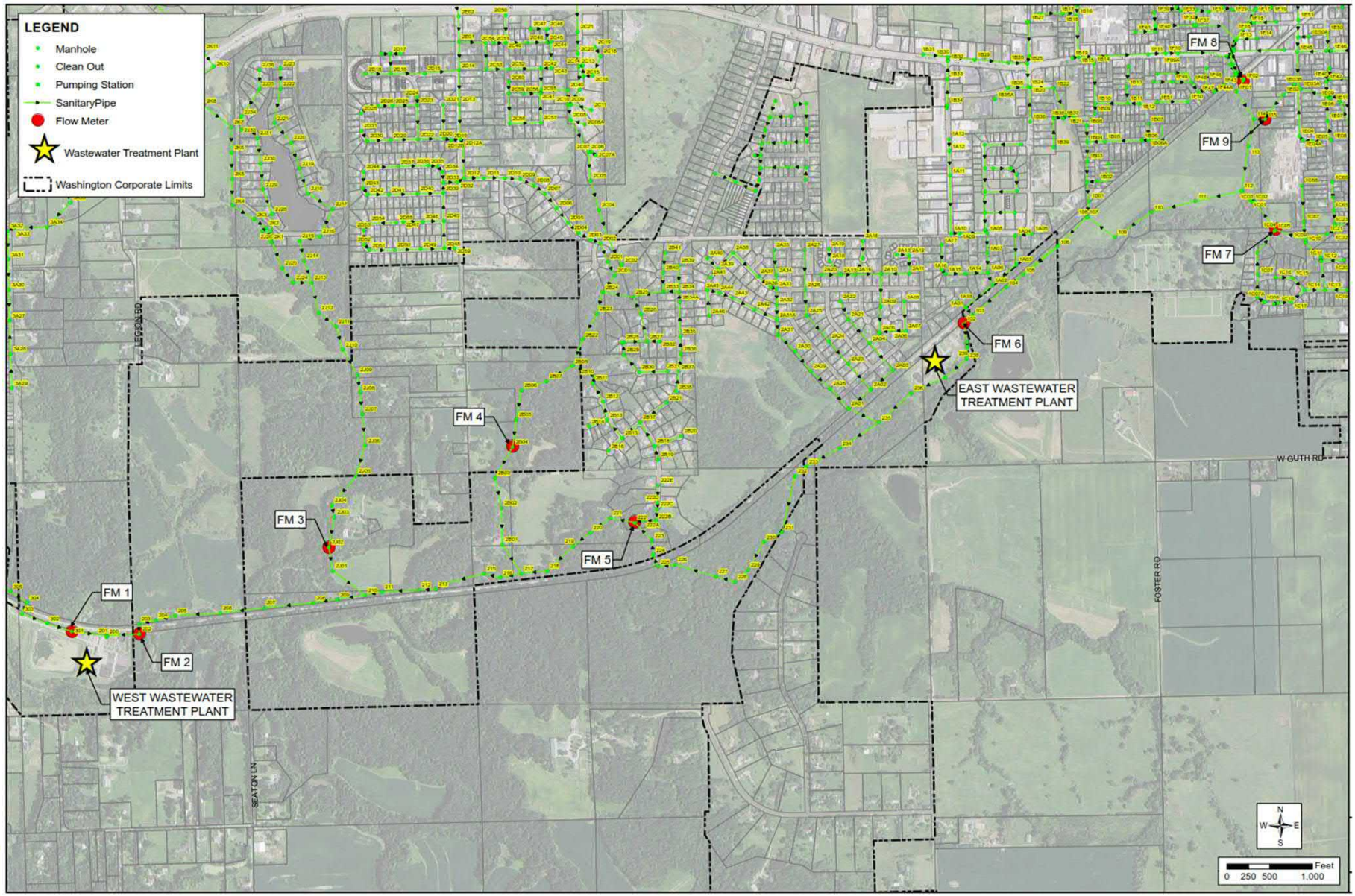
Farm Creek Trunk Sewer Flow Monitoring for Preliminary Engineering



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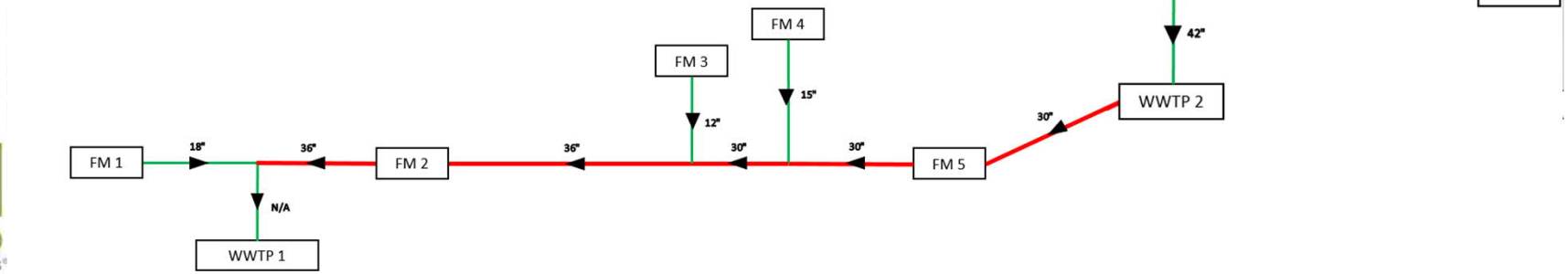

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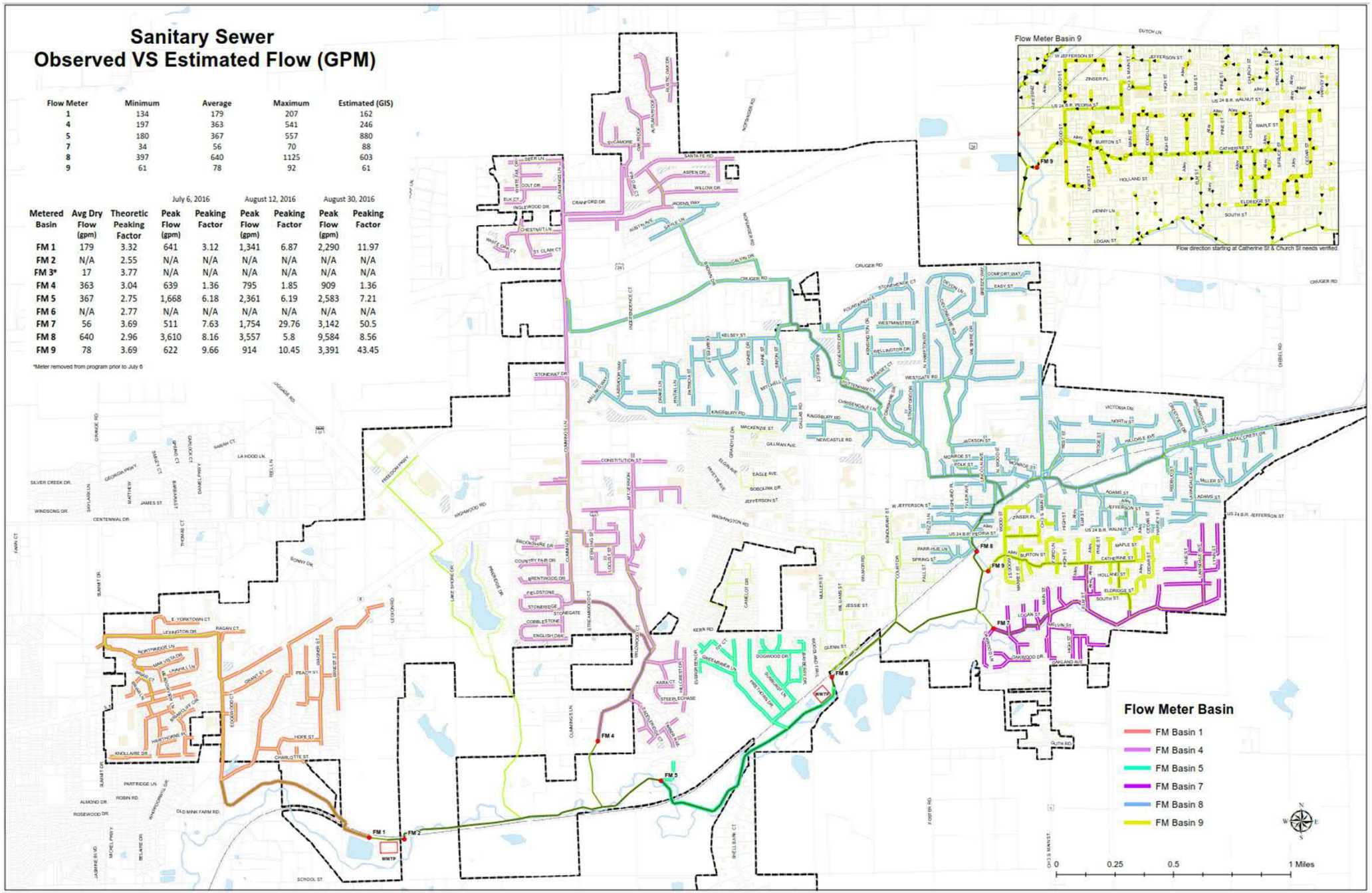
Conveyance System Sewer-shed Basins



Average Dry Weather Flow Assessment

- A four month flow monitoring program
- Dry weather flow analysis was performed to determine the average flow in the system at each flow meter

Flow Meter	Dry Weather Flow (gpm)		
	Minimum	Average	Maximum
FM 1	134	179	207
FM 3	11	17	24
FM 4	197	363	541
FM 5	180	367	557
FM 7	34	56	70
FM 8	397	640	1,125
FM 9	61	78	92

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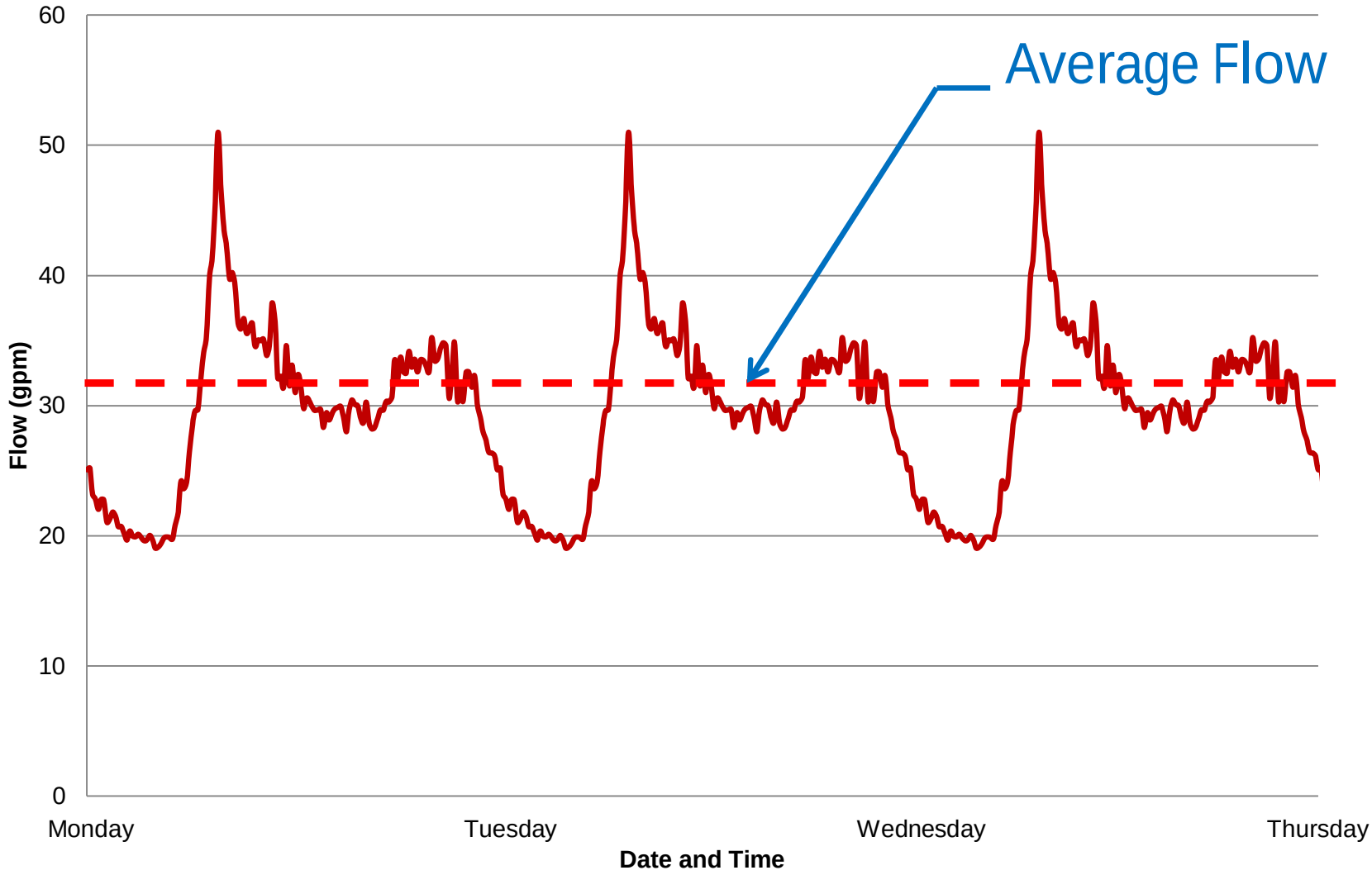
Excess Flow Evaluation – Dry Weather



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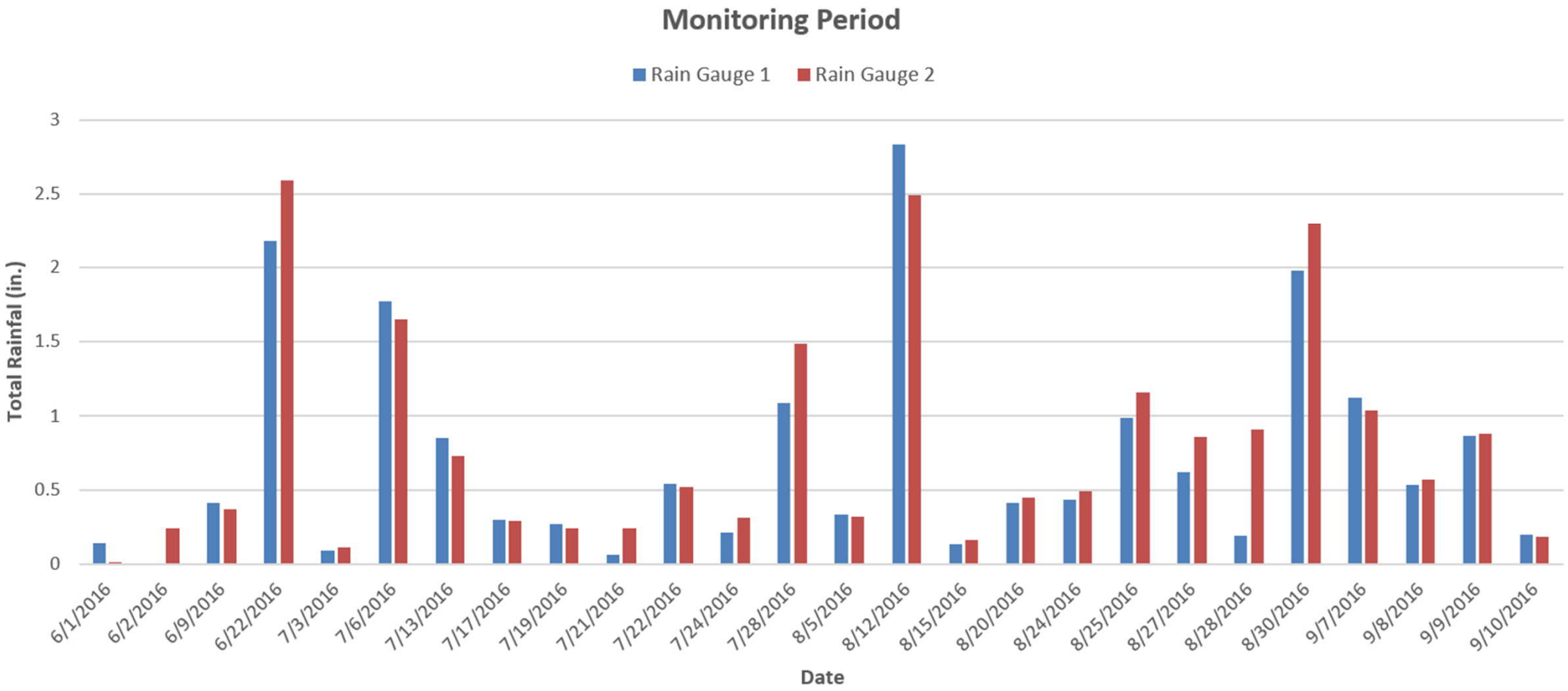
Excess Flow Evaluation – Rainfall Analysis

- **Sewer flow and rainfall data collected over a four month period**

Rain Gauge 1 - West WWTP **Rain Gauge 2 - East WWTP**



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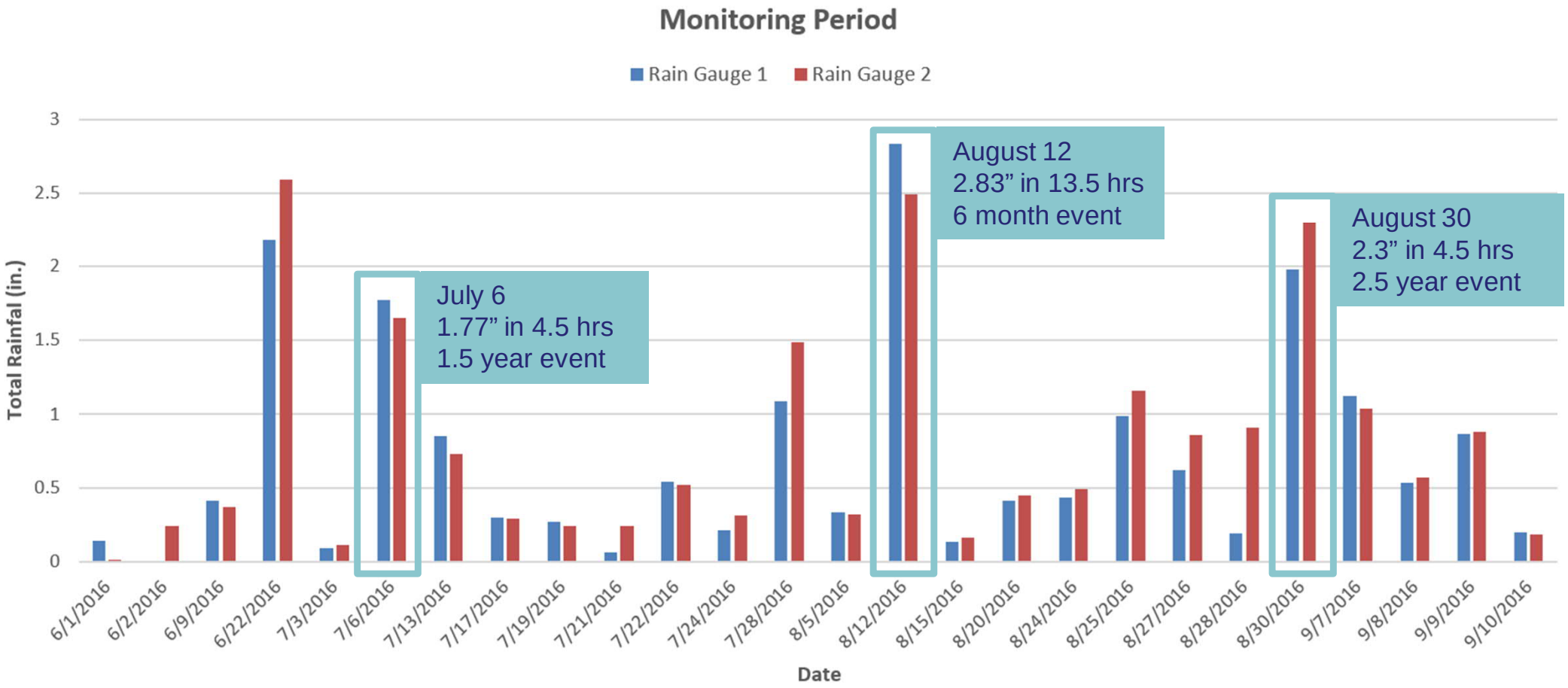
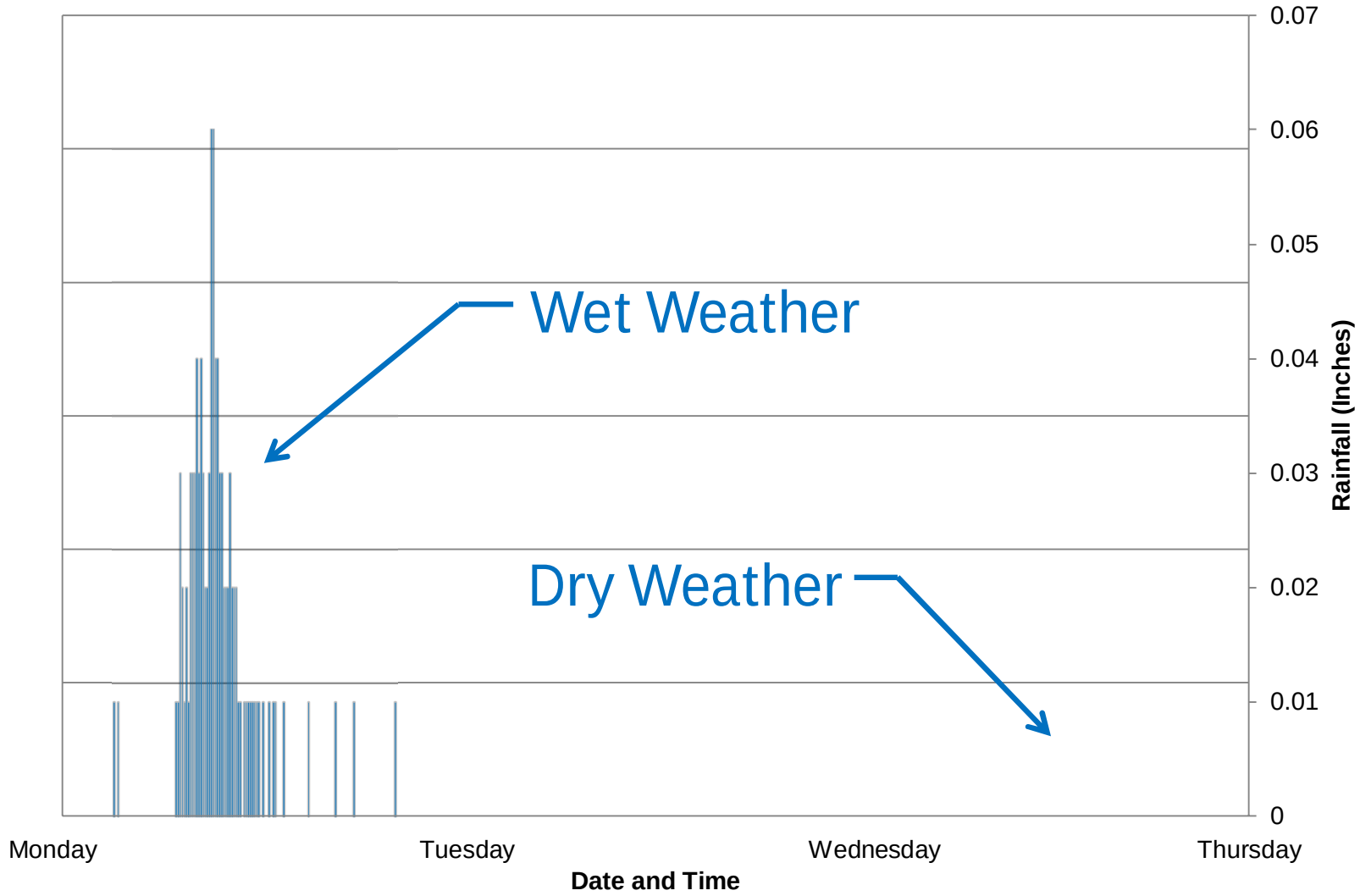


Excess Flow Evaluation – Rainfall Analysis



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Excess Flow Evaluation – Wet Weather Analysis

- Evaluation of wet weather flow for the three study rainfall events
- Evaluation #1 – Peak Flow

Metered Basin	Average Dry Weather Flow (gpm)	Theoretic Peaking Factor	July 6, 2016		August 12, 2016		August 30, 2016	
			Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor
FM 1	179	3.32	641	3.12	1,341	6.87	2,290	11.97
FM 3*	17	3.77	N/A	N/A	N/A	N/A	N/A	N/A
FM 4	363	3.04	639	1.36	795	1.85	909	1.36
FM 5	367	2.75	1,668	6.18	2,361	6.19	2,583	7.21
FM 7	56	3.69	511	7.63	1,754	29.76	3,142	50.50
FM 8	640	2.96	3,610	8.16	3,557	5.80	9,584	8.56
FM 9	78	3.69	622	9.66	914	10.45	3,391	43.45

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Excess Flow Evaluation – Wet Weather Analysis

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Metered Basin	Average Dry Weather Flow (gpm)	Theoretic Peaking Factor	July 6, 2016		August 12, 2016		August 30, 2016	
			Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor
FM 1	179	3.32	641	3.12	1,341	6.87	2,290	11.97
FM 3*	17	3.77	N/A	N/A	N/A	N/A	N/A	N/A
FM 4	363	3.04	639	1.36	795	1.85	909	1.36
FM 5	367	2.75	1,668	6.18	2,361	6.19	2,583	7.21
FM 7	56	3.69	511	7.63	1,754	29.76	3,142	50.50
FM 8	640	2.96	3,610	8.16	3,557	5.80	9,584	8.56
FM 9	78	3.69	622	9.66	914	10.45	3,391	43.45

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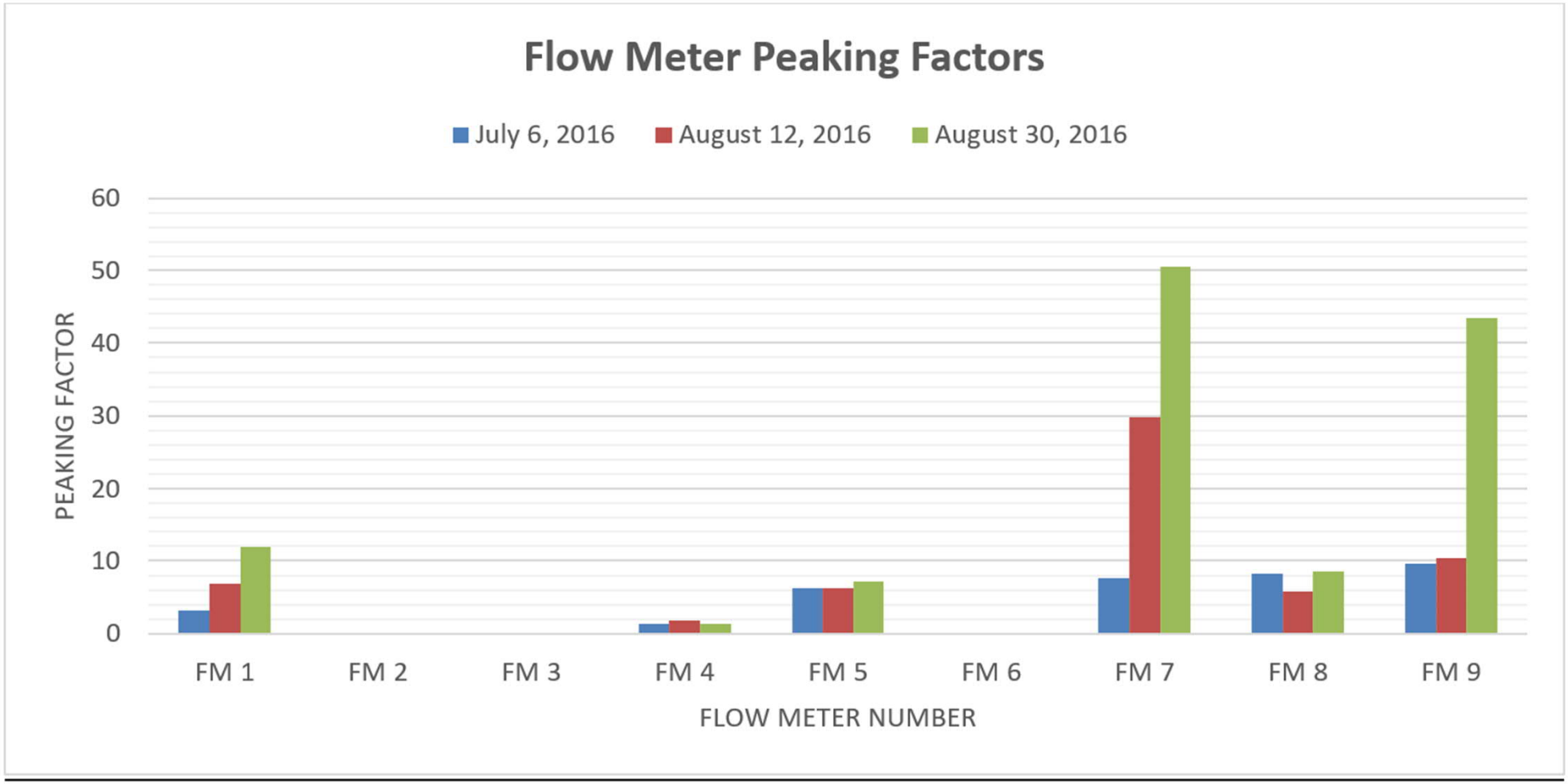
Excess Flow Evaluation – Wet Weather Analysis

- **Evaluation #1 – Peak Flow**



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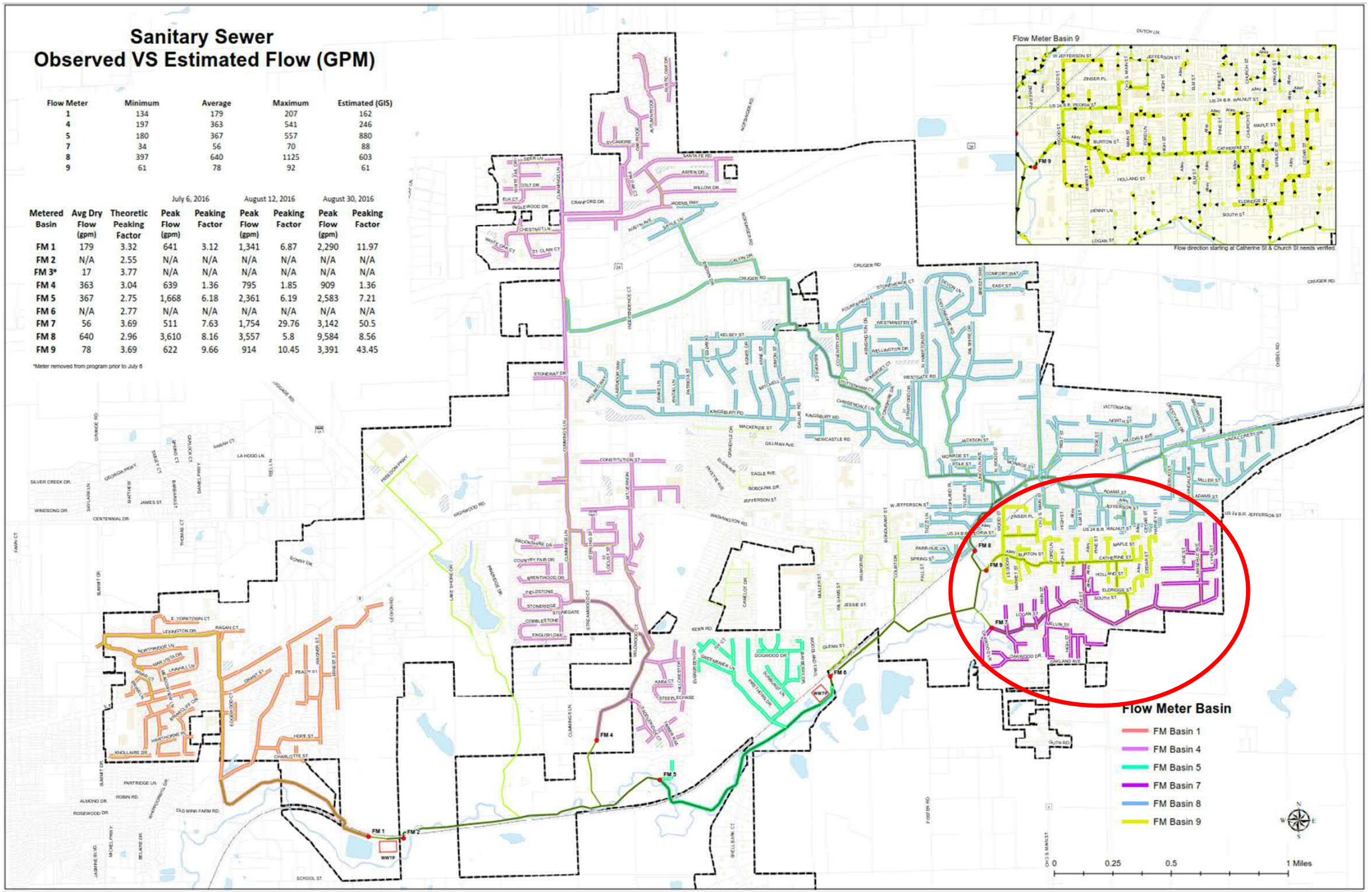
Excess Flow Evaluation – Wet Weather Analysis

Sanitary Sewer
Observed VS Estimated Flow (GPM)

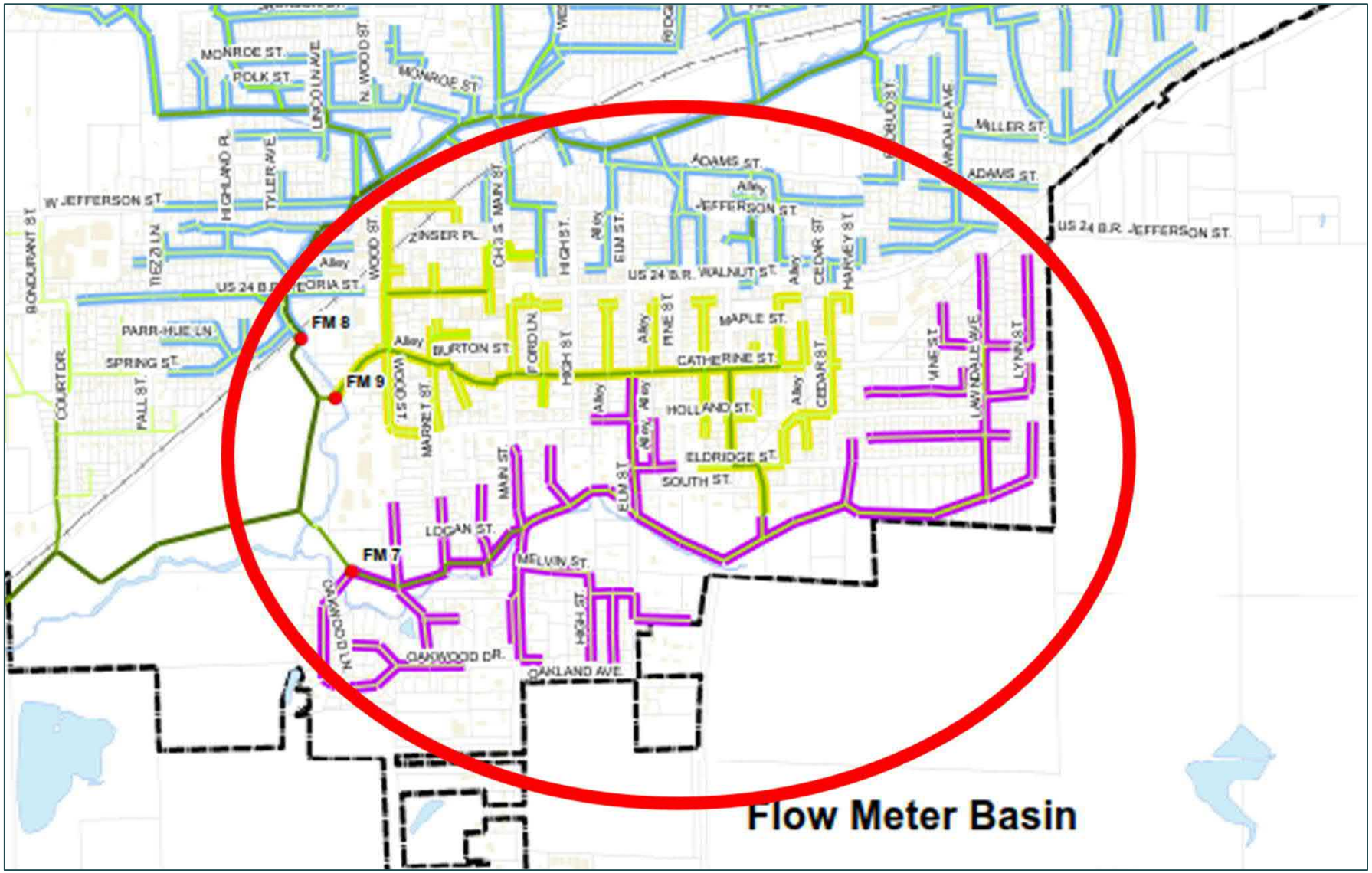
Flow Meter	Minimum	Average	Maximum	Estimated (GIS)
1	134	179	207	162
4	197	363	541	246
5	180	367	557	880
7	34	56	70	88
8	397	640	1125	603
9	61	78	92	61

			July 6, 2016		August 12, 2016		August 30, 2016	
Metered Basin	Avg Dry Flow (gpm)	Theoretic Peaking Factor	Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor
FM 1	179	3.32	641	3.12	1,341	6.87	2,290	11.97
FM 2	N/A	2.55	N/A	N/A	N/A	N/A	N/A	N/A
FM 3*	17	3.77	N/A	N/A	N/A	N/A	N/A	N/A
FM 4	363	3.04	639	1.36	795	1.85	909	1.36
FM 5	367	2.75	1,668	6.18	2,361	6.19	2,583	7.21
FM 6	N/A	2.77	N/A	N/A	N/A	N/A	N/A	N/A
FM 7	56	3.69	511	7.63	1,754	29.76	3,142	50.5
FM 8	640	2.96	3,610	8.16	3,557	5.8	9,584	8.56
FM 9	78	3.69	622	9.66	914	10.45	3,391	43.45

*Meter removed from program prior to July 6



Excess Flow Evaluation – Wet Weather Analysis



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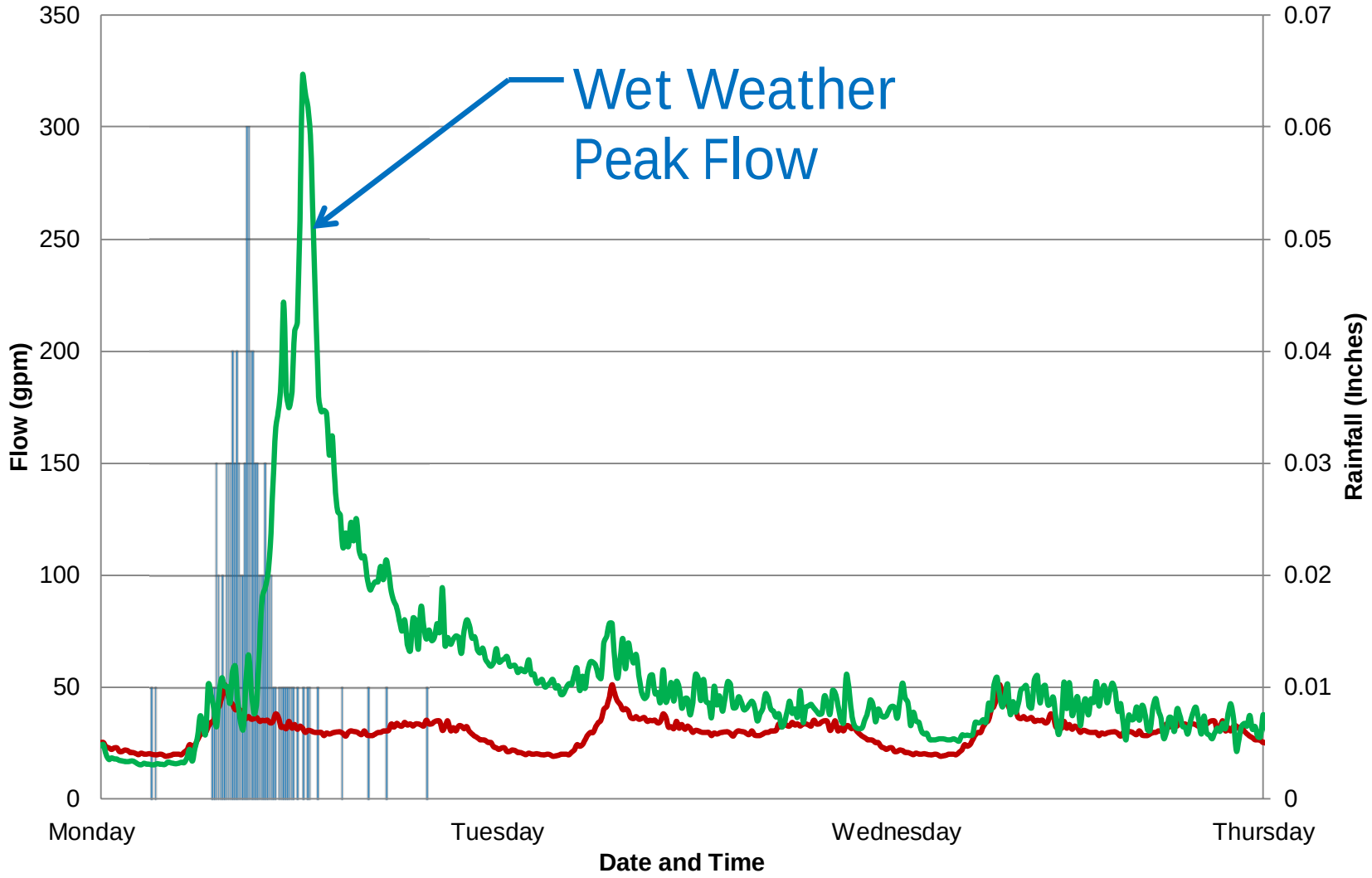

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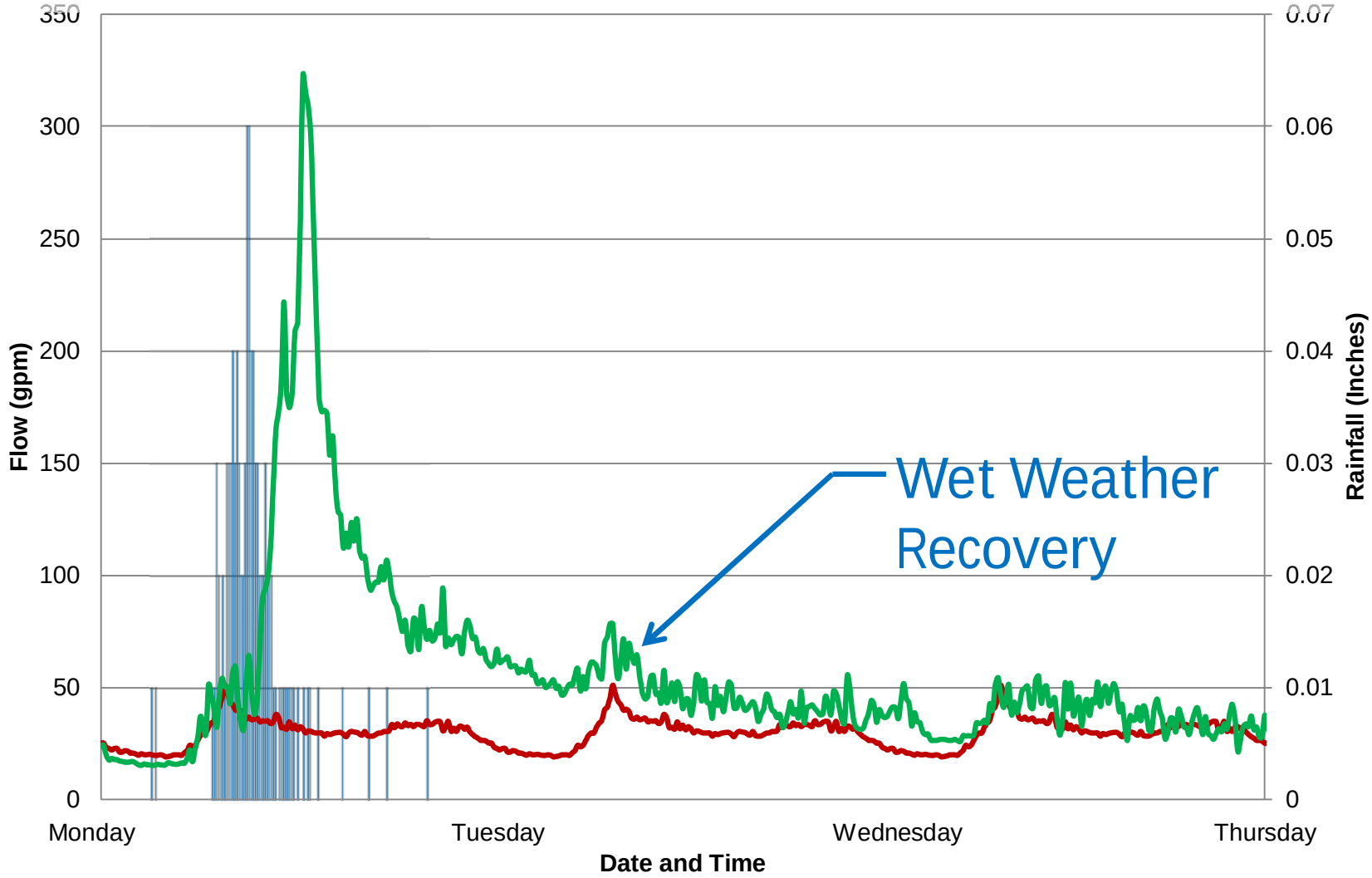
Excess Flow Evaluation – Wet Weather Analysis

- **Evaluation #2 – Excess Volume**



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Excess Flow Evaluation – Wet Weather Analysis

- **Evaluation #2 – Excess Volume**

Metered Basin	July 6	August 12	August 30
	I/I Volume	I/I Volume	I/I Volume
	1,000 gallons	1,000 gallons	1,000 gallons
FM 1	1,131.67	5,028.56	7,819.43
FM 4	1,470.23	667.45	247.66
FM 5	2,392.74	2,380.64	10,807.90
FM 7	709.05	1,164.33	8,365.95
FM 8	3,983.77	500.27	13,241.92
FM 9	591.58	546.48	30,308.90

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Excess Flow Evaluation – Wet Weather Analysis

- **Evaluation #2 – Excess Volume**

Metered Basin	July 6	August 12	August 30
	I/I Volume	I/I Volume	I/I Volume
	1,000 gallons	1,000 gallons	1,000 gallons
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FM 4	1,470.23	667.45	247.66
FM 5	2,392.74	2,380.64	10,807.90
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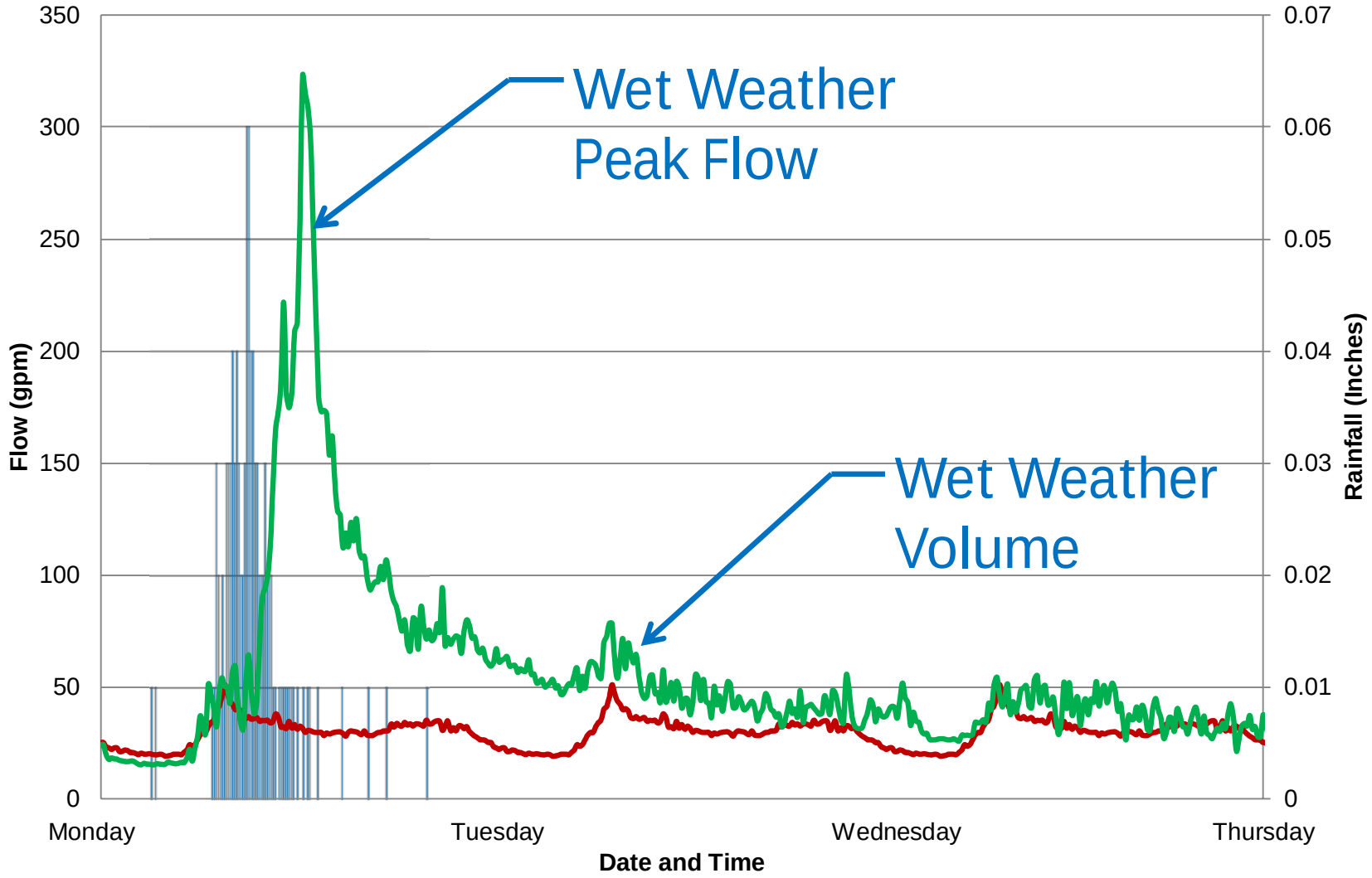
Excess Flow Evaluation – Wet Weather Analysis



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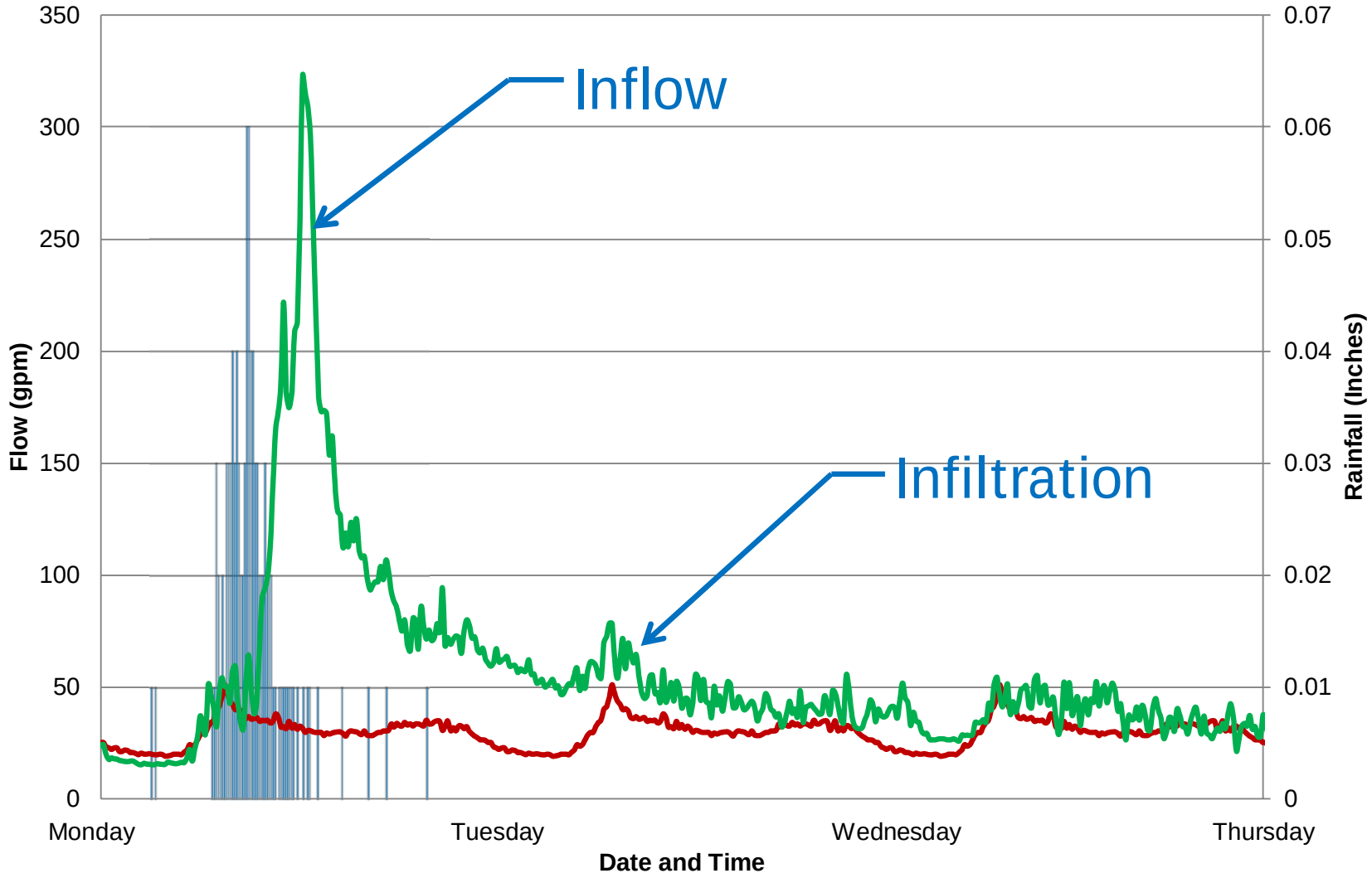
Excess Flow Evaluation – Wet Weather Analysis



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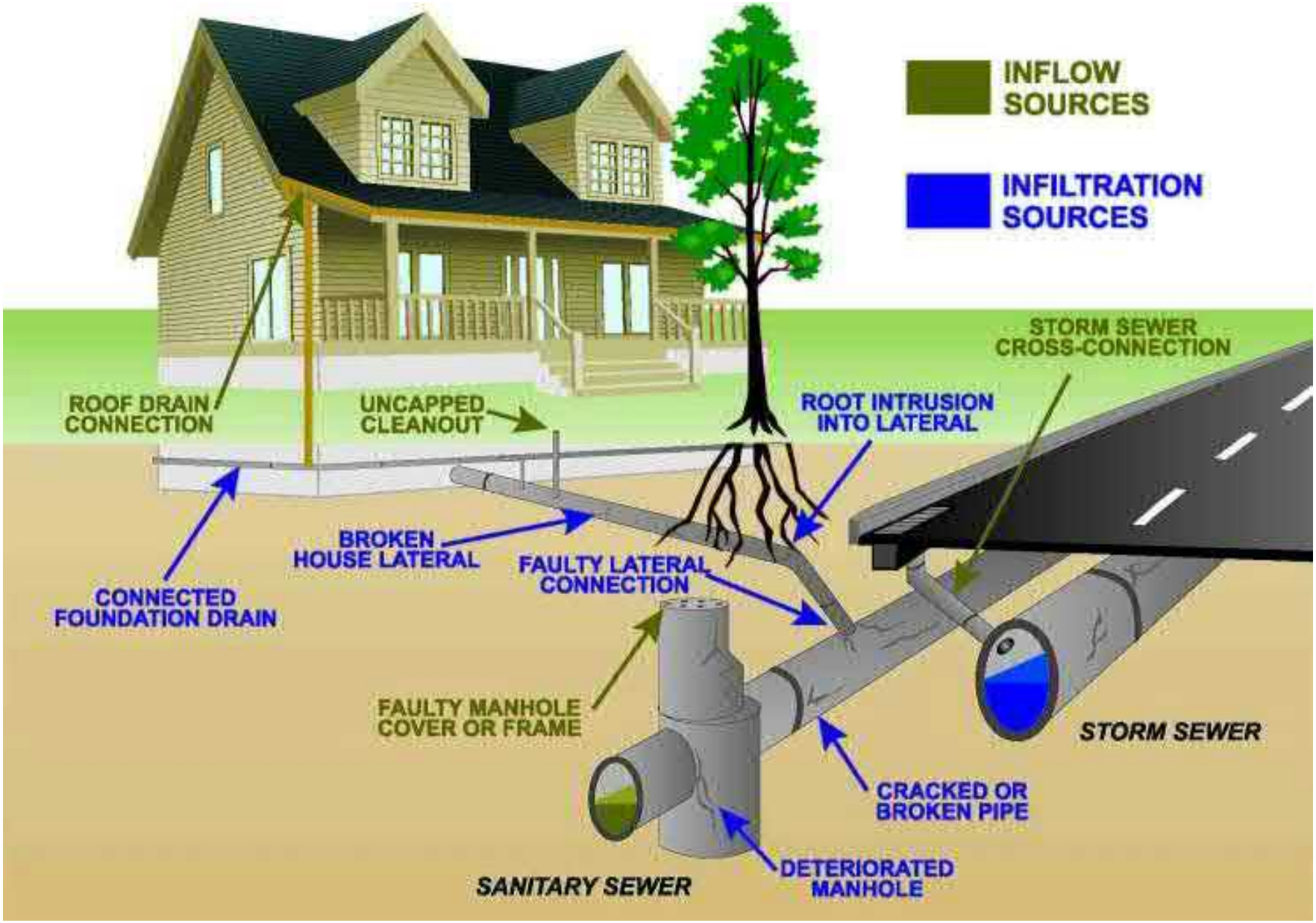
What is Inflow and Infiltration (I/I)



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Prioritization for I/I Investigations

Metered Basin	Average Dry Weather Flow (gpm)	Theoretic Peaking Factor	July 6, 2016		August 12, 2016		August 30, 2016	
			Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor
FM 1	179	3.32	641	3.12	1,341	6.87	2,290	11.97
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FM 9	78	3.69	622	9.66	914	10.45	3,391	43.45

Metered Basin	July 6 I/I Volume 1,000 gallons	August 12 I/I Volume 1,000 gallons	August 30 I/I Volume 1,000 gallons
FM 1	1,131.67	5,028.56	7,819.43
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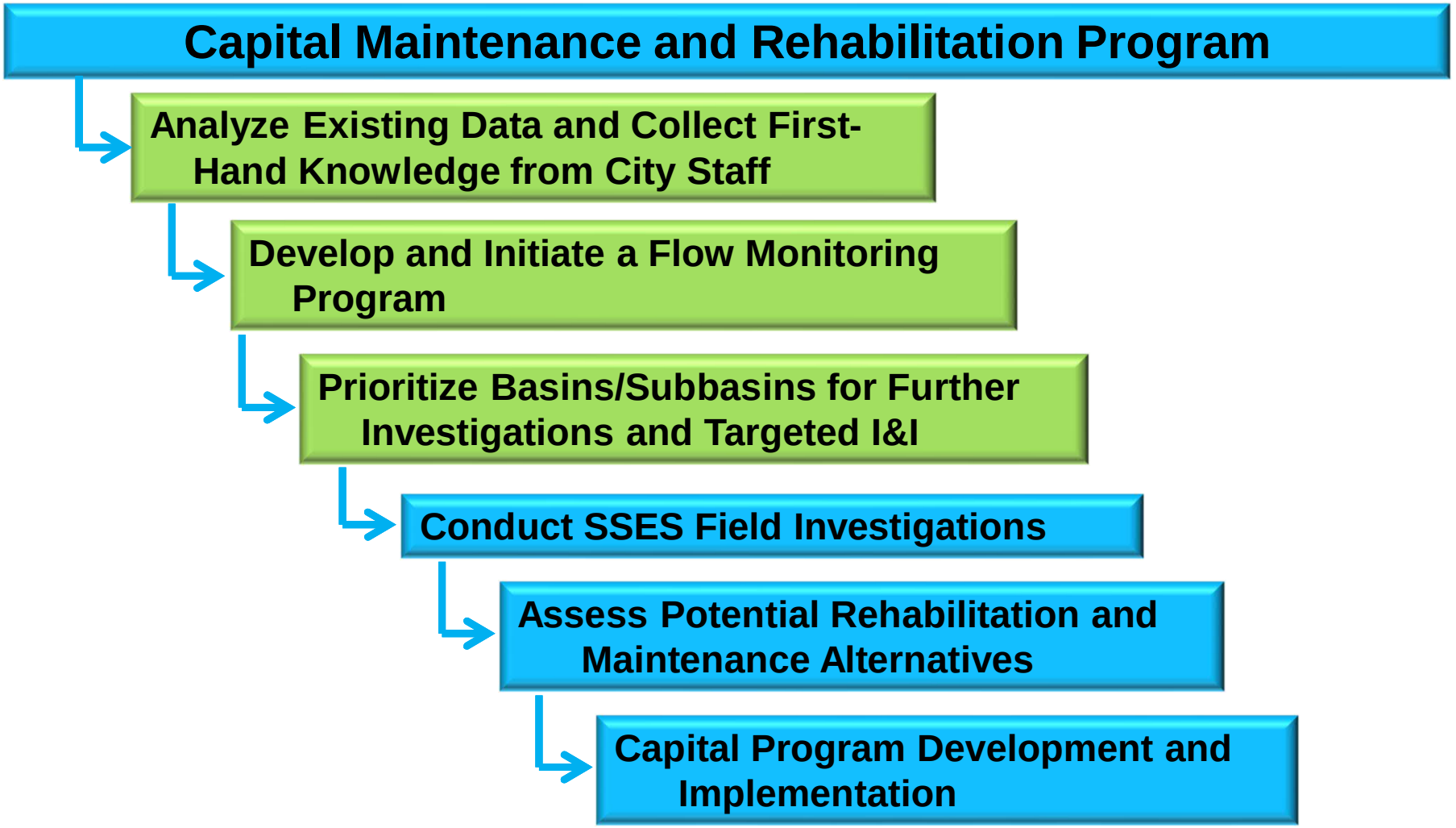
Planning for Sanitary Sewer System Maintenance and Rehabilitation



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An Effective Sanitary Sewer Maintenance and Rehabilitation Program Addresses Specific Goals

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Sanitary Sewer Evaluation Survey (SSES) Investigations Start with Manhole Inspections

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Potential Manhole Rehabilitation Methods are Determined by Trained Field Staff During Inspections

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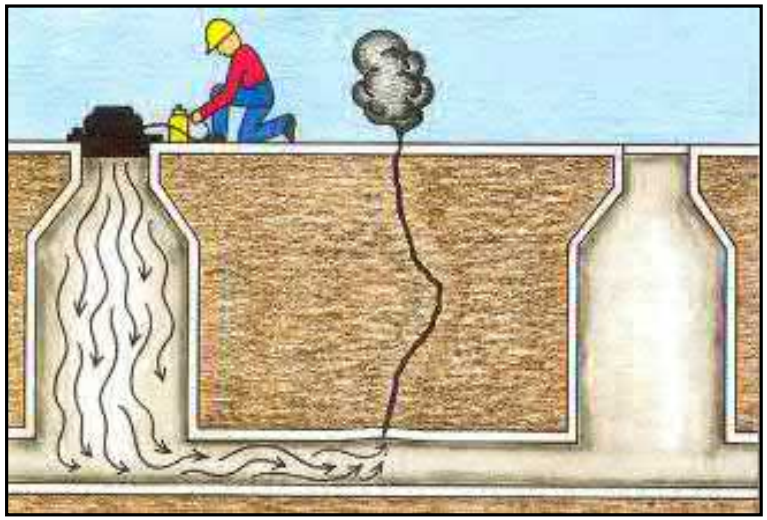
Smoke Testing Locates Sewer Deficiencies, Sources of Direct Inflow, and Cross Connections



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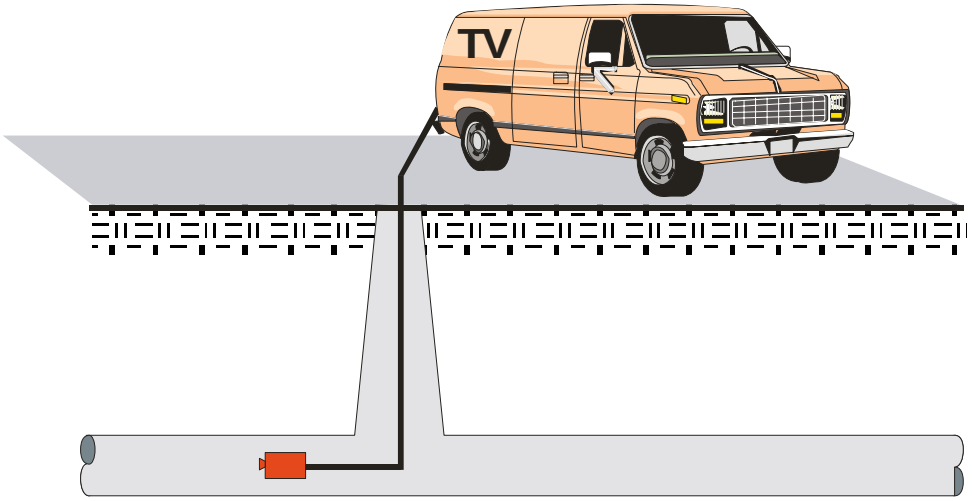
Field Investigations Focus Televising and Dye Testing for Significant Cost Savings

Goal: Televise Less – Reduce Cost



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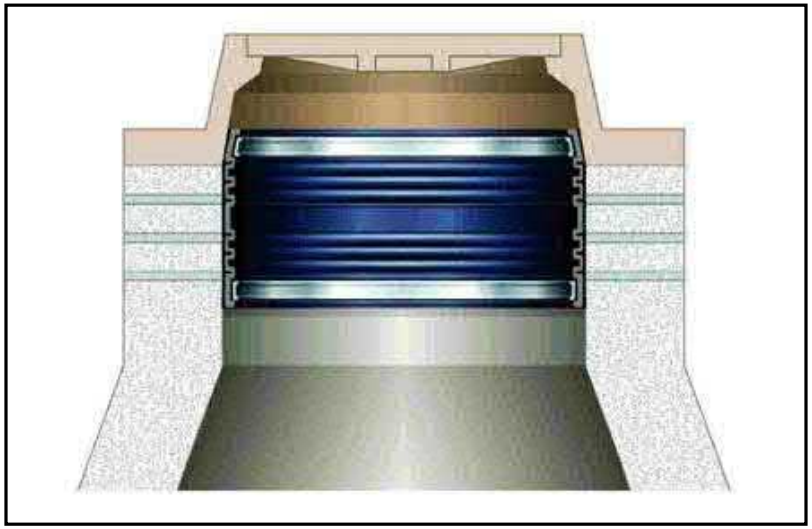
Initial Capital Program Depends on Understanding of Available and Appropriate Technologies



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Private Property Conveyance Has Significant Impact on Your Sanitary Sewer System

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Private Property Conveyance Has Significant Impact on Your Sanitary Sewer System

- Industry shifting to Private System Rehabilitation
- Public system rehabilitation success = 10% to 20% I/I reduction
- Private system rehabilitation success = 40% I/I reduction is highest reported
- Columbus, OH pilot study:
  - 75% of I/I from private sources
  - 30% I/I removal through private source program
- Miami-Dade study:
  - Lateral Repair Program cost 4x more per foot of pipe
  - 1/6 the cost in $/gallon removed
  - 1/8 the cost to pump, convey, and treat the excess flow
- MWRDGC requires all systems to develop a Private Sector Program (PSP)

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Private Property Illegal Connections and Sources of I/I

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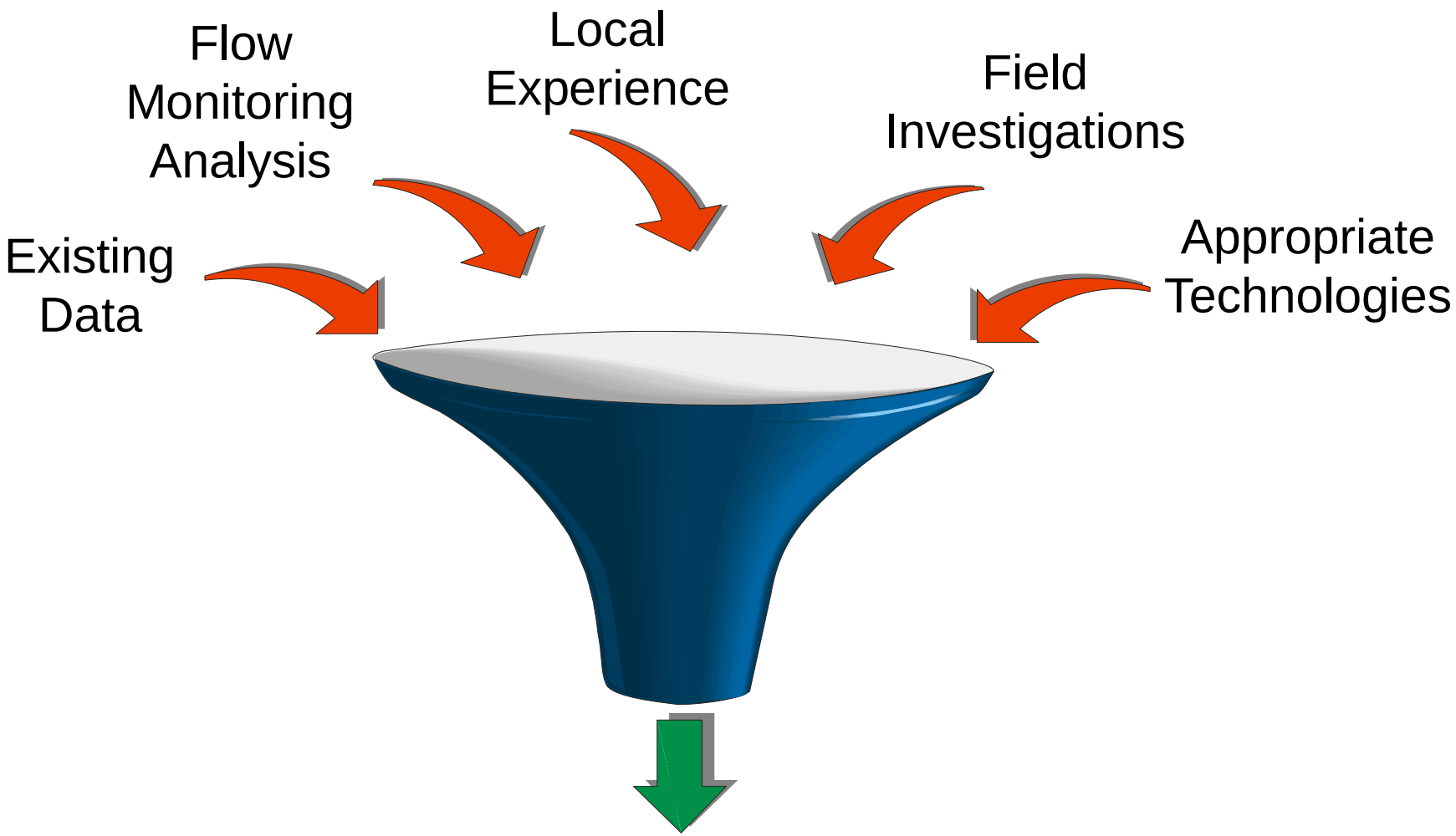
Results of These Efforts Leads to Positive Return on Investment



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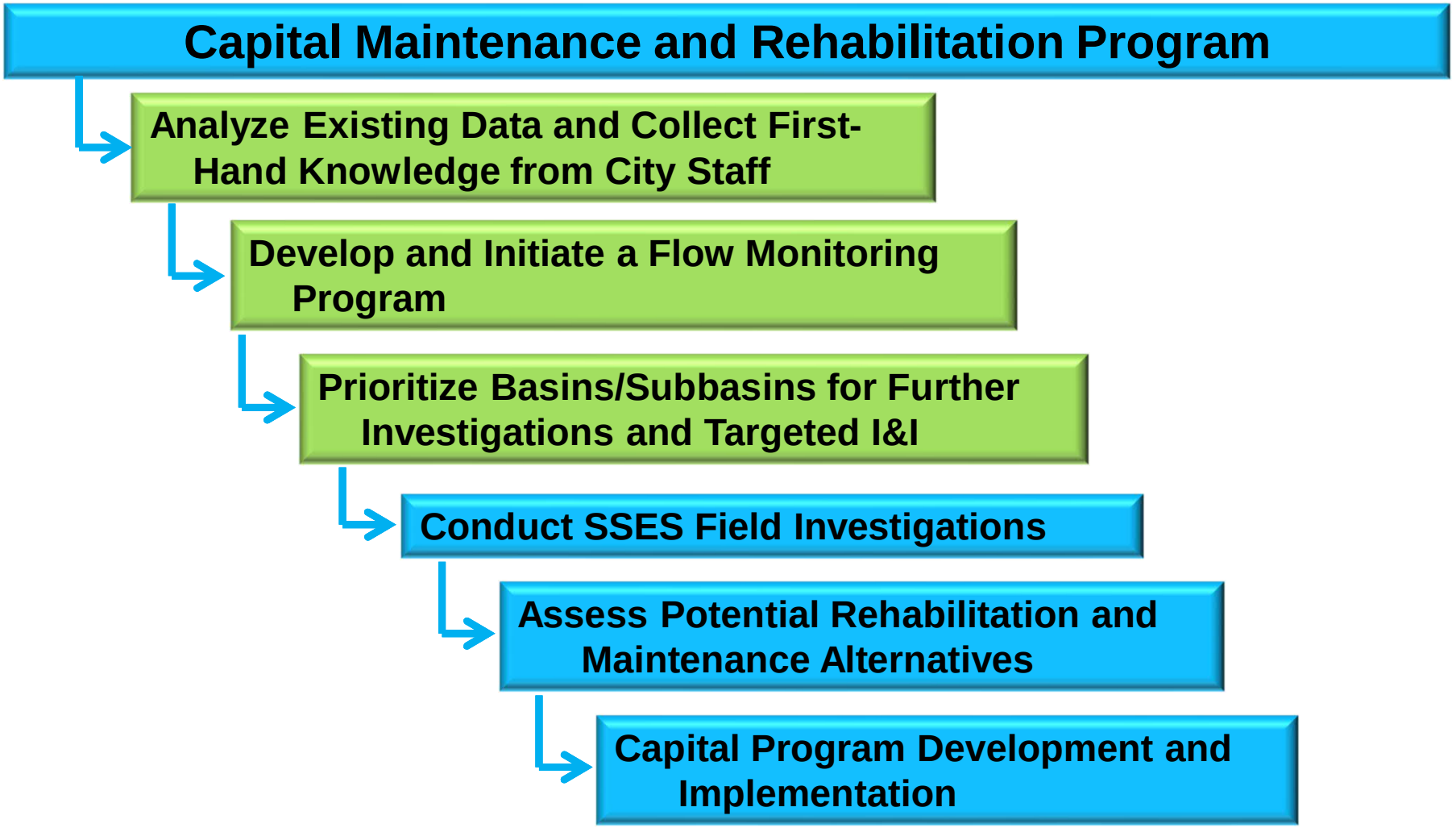
Planning for Sanitary Sewer System Maintenance and Rehabilitation



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Questions

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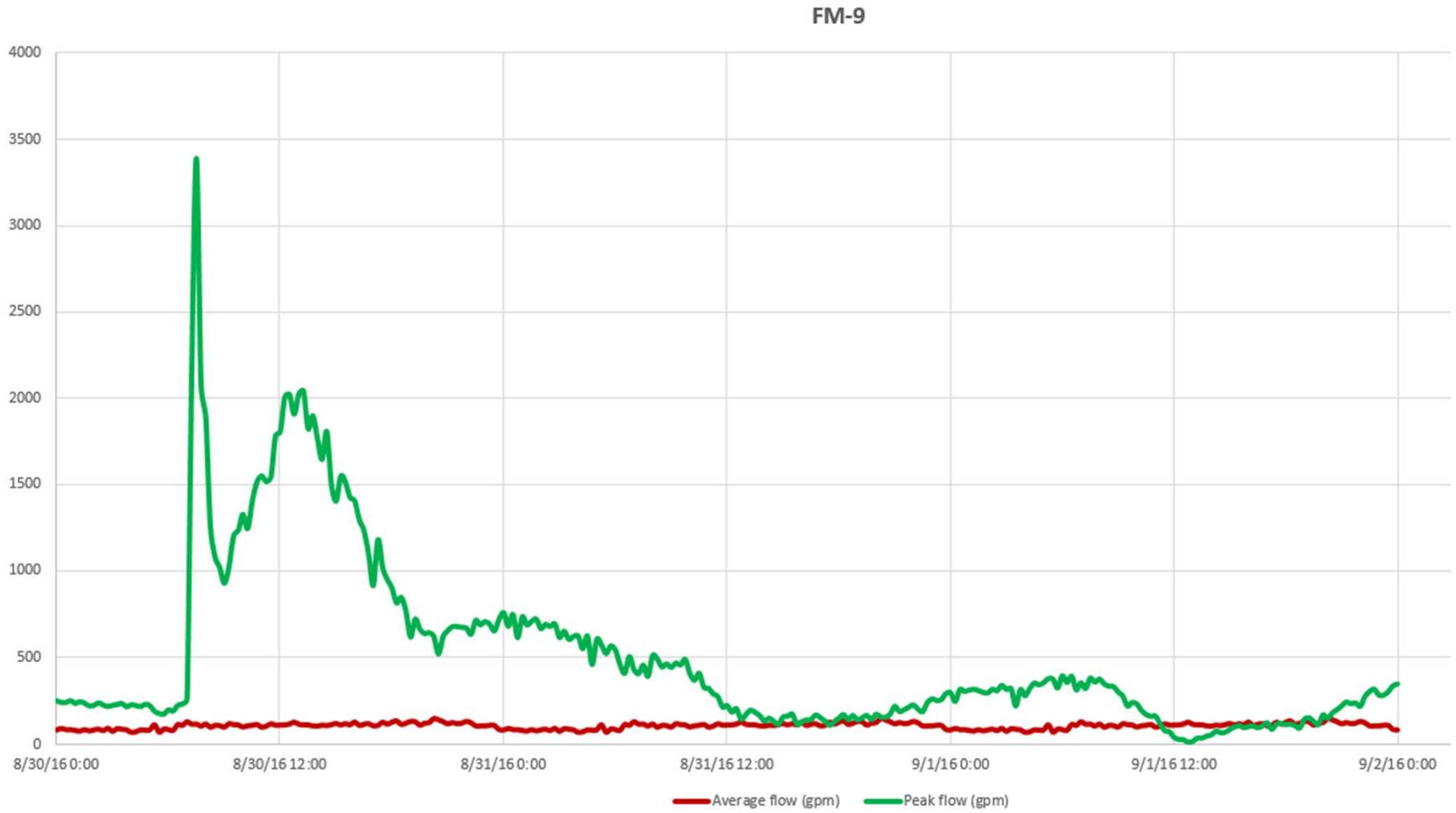
Excess Flow Evaluation – Wet Weather Analysis



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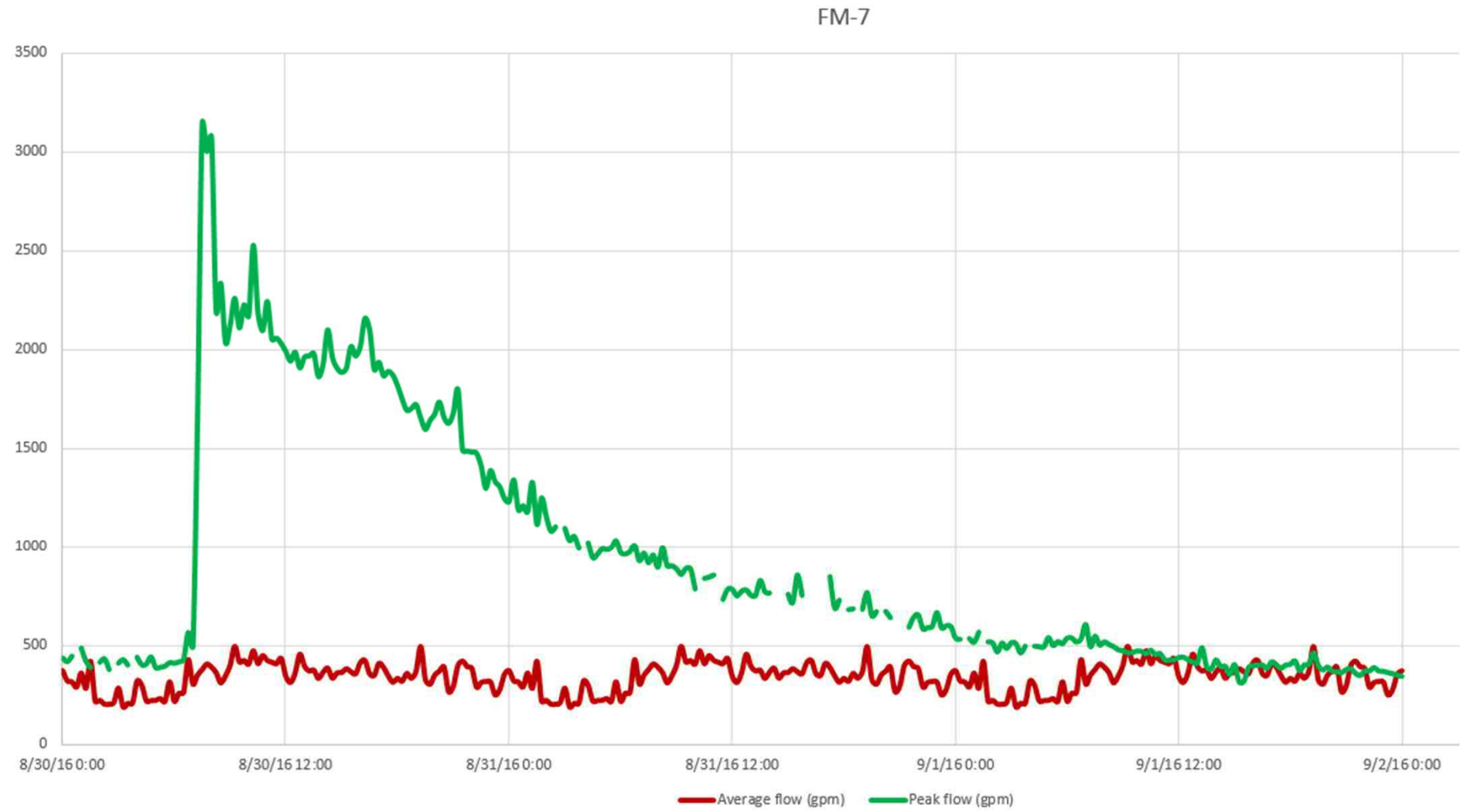

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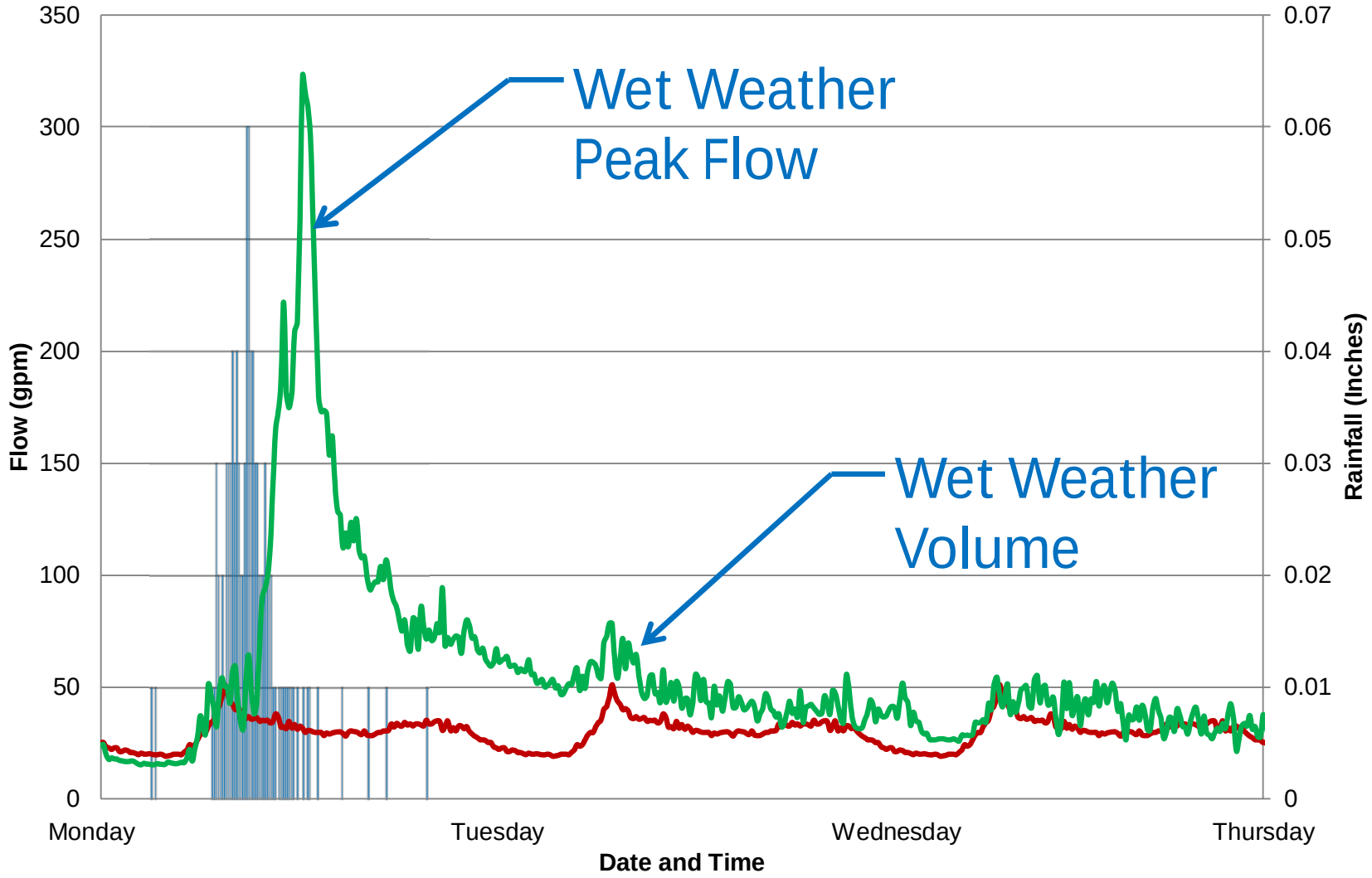

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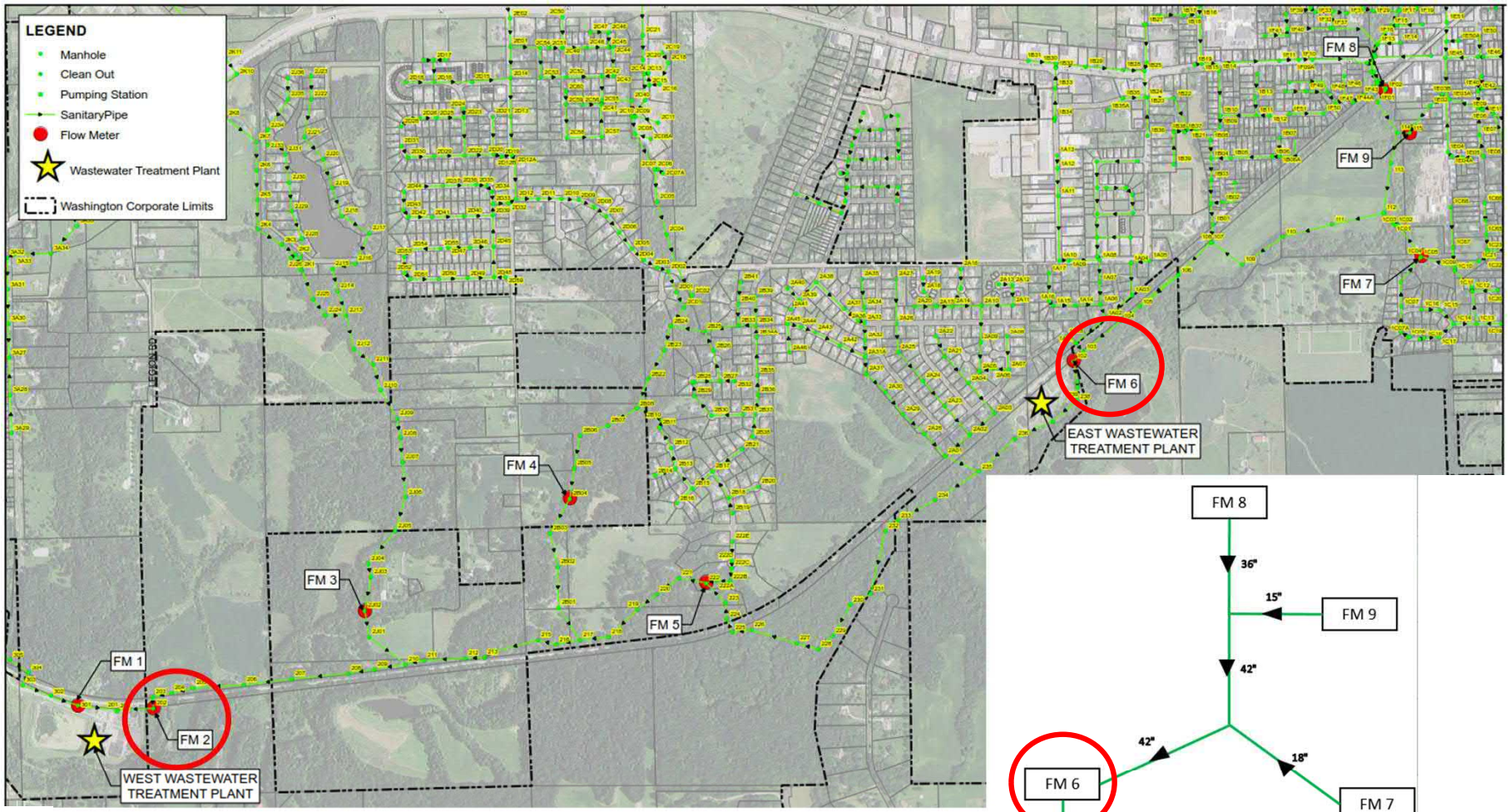
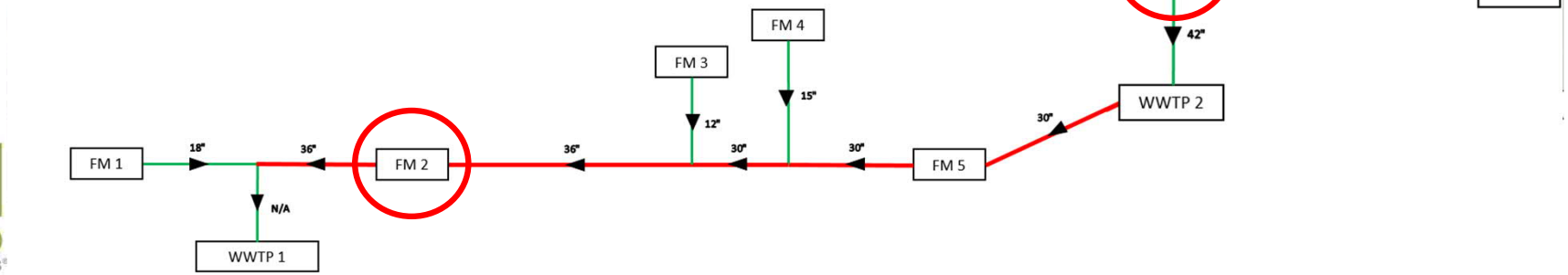
Farm Creek Trunk Sewer Flow Monitoring for Excess Flow Evaluation





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Farm Creek Trunk Sewer Flow Monitoring for Excess Flow Evaluation

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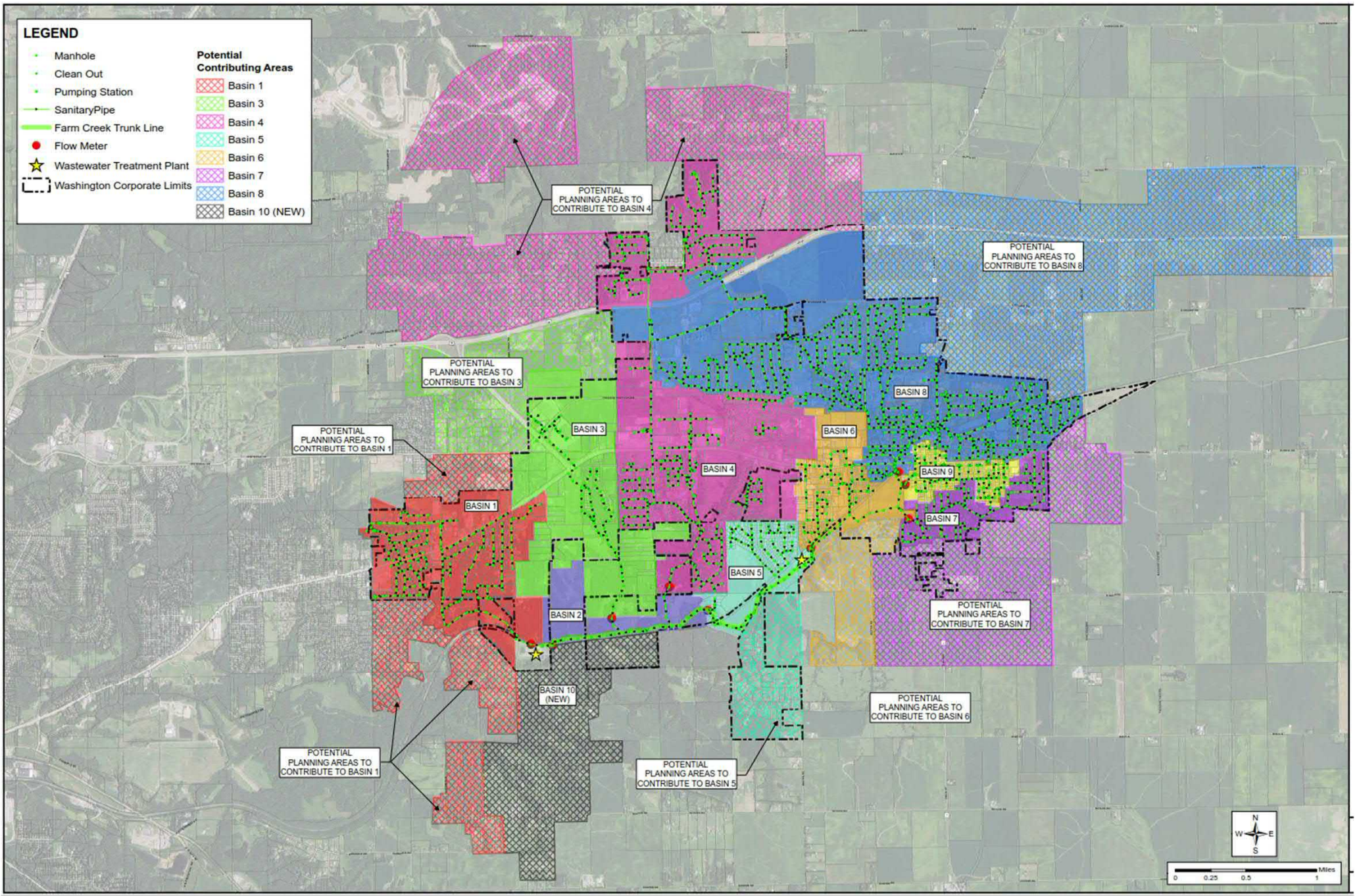
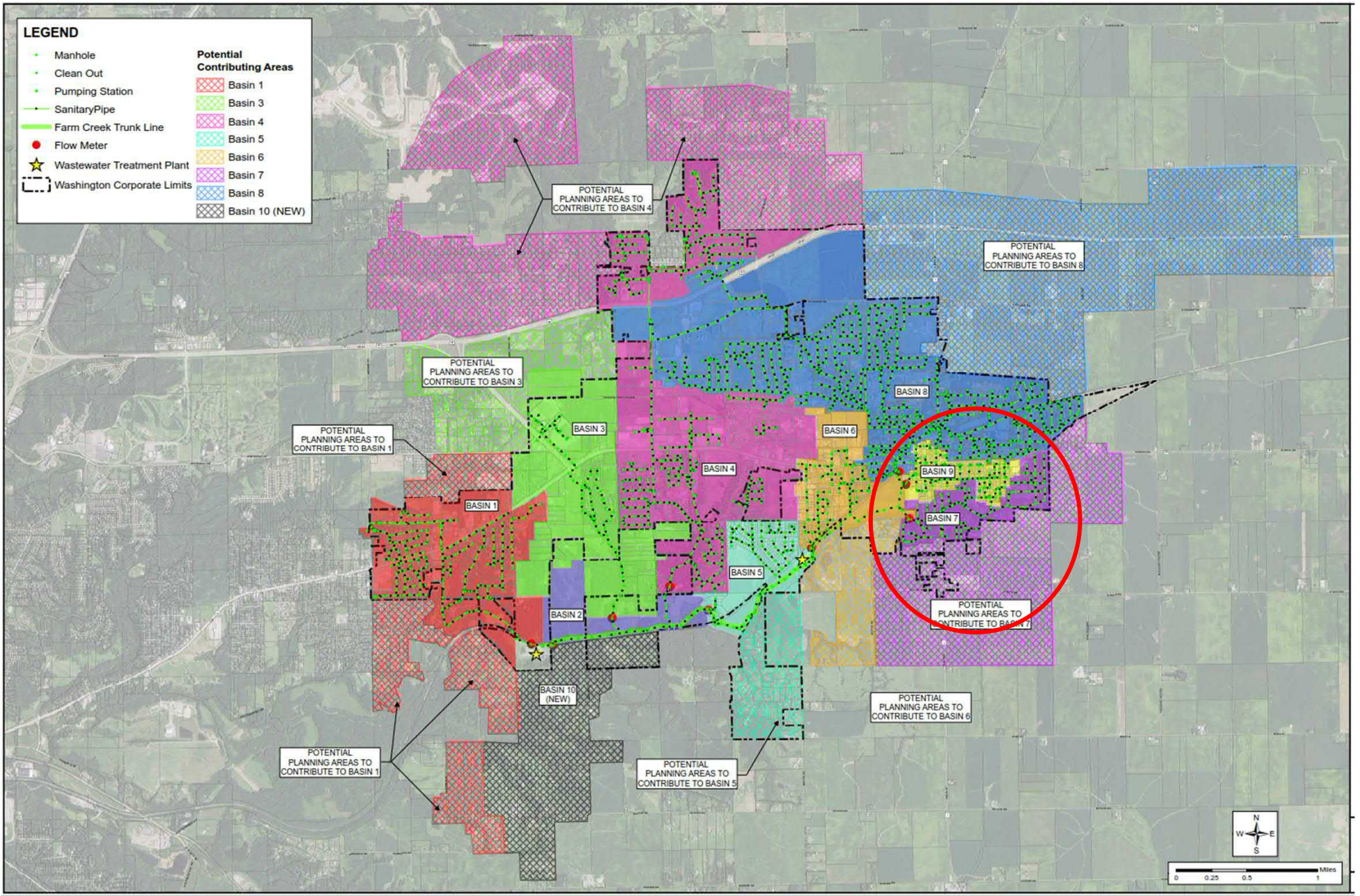
Conveyance System Sewer-shed Basins



Excess Flow Evaluation – Wet Weather Analysis



Excess Flow Evaluation – Rainfall Analysis

- **Sewer flow data and rainfall data was collected over a four month monitoring period at**

West WWTP (RG 1) **East WWTP (RG 2)**

- **Three rainfall events were selected for further study**

Date	RG 1				RG 2			
	Total Rainfall (in.)	Total Duration (hr.)	Maximum Rainfall Intensity	Maximum Rainfall Recurrence Interval	Total Rainfall (in.)	Total Duration (hr.)	Maximum Rainfall Intensity	Maximum Rainfall Recurrence Interval
7/6/2016	1.77	4.50	0.75 in. / 15 min.	1.5 years, 15 min.	1.65	4.25	0.52 in. / 15 min.	4.9 months, 15 min.
8/12/2016	2.83	13.50	0.52 in. / 15 min.	4.9 months, 15 min.	2.49	13.50	0.53 in./ 15 min.	5.1 months, 15 min.
8/30/2016	1.98	3.50	0.85 in. / 15 min.	2.6 years, 15 min.	2.3	4.50	0.72 in. / 15 min.	1.3 years, 15 min.

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Planning for Sanitary Sewer System Maintenance and Rehabilitation

- Update on recent sanitary sewer conveyance study
- Identification of priority areas
- Our Sustainable Watershed Evaluation Process supports all five of CMAP's Stormwater Advisor Tasks
- Our depth of relevant experience provides CMAP with confidence in solid planning and decision making

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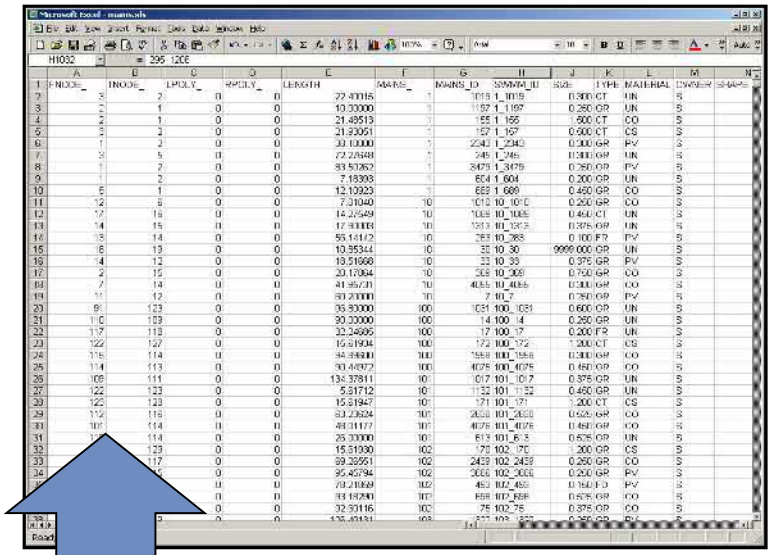
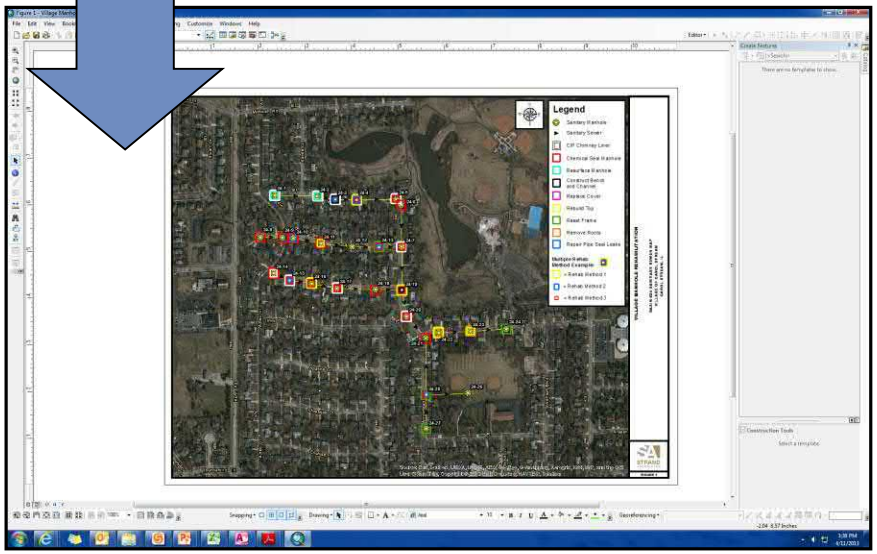
Use of PC Tablet Maximizes Efficiency During and After Field Investigations and to Update Village's GIS





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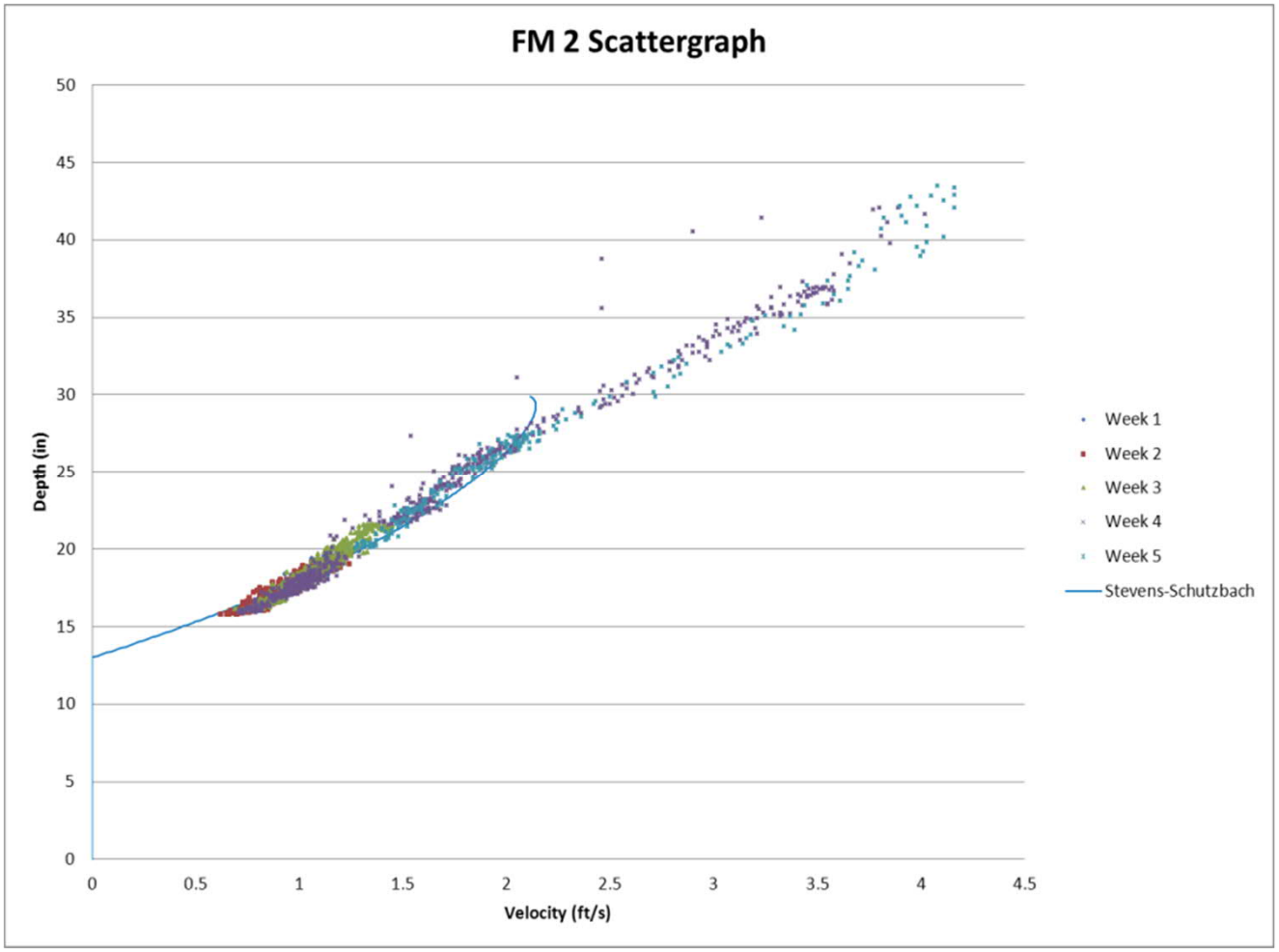
Data Quality Checks Confirm Flow Data is Accurate

- Rigorous Flow Metering Data Analysis
- Collection System-Wet Weather Performance



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Initial Capital Maintenance Program Depends on Understanding of Available and Appropriate Technologies

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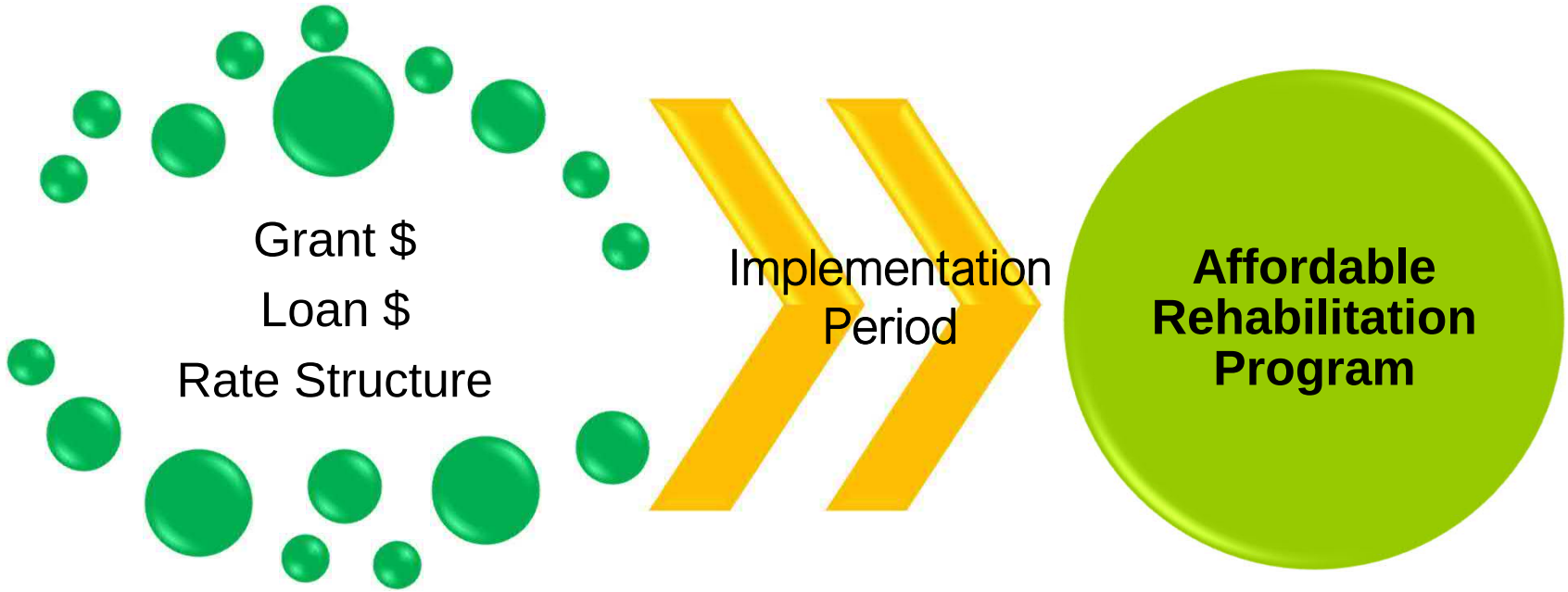
Project Timing and Funding Opportunities Play a Key Role in CIP Development



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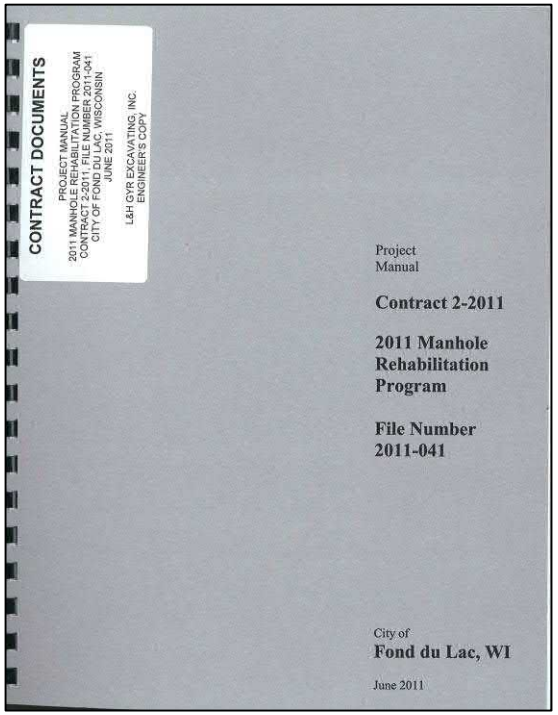
Contract Documents Yield Competitive Bids While Maintaining Construction Quality

More Bids

Competition

Lower Bids!



Maintain Quality

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