A Comprehensive Sanitary Sewer Study of the City of Warren

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Warren: Capital of the Western Reserve

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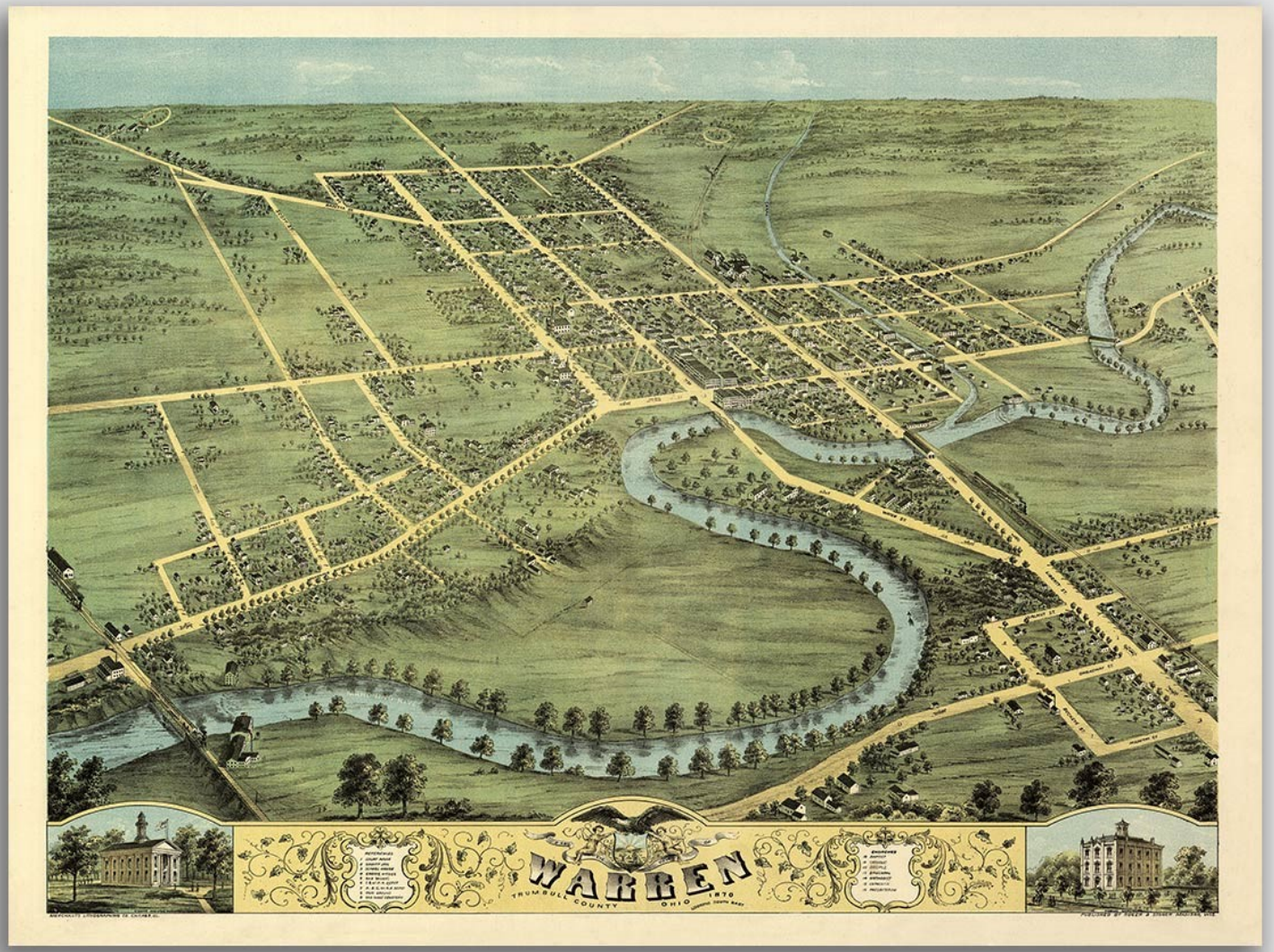
Warren: 1870



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Warren Sewer History

- 1st Sewers: Late 1800's

  Goal: Get it ALL to the River

- 1st WWTP 1962

  Goal: Get Most of it to the Plant

- Sewer Separation 1990's – 2006

  Closed all CSO's

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Catalyst Event

- Summer 2014: BIG Rain Event

  Many Warren Buildings: Basement Flooding
- EPA Permitted 1 SSO to be Reopened
- Hired AECOM: Downtown Sewer Study

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Downtown Study 2015

- Too many variables
- Inconclusive
- Expensive Solutions
- No Guarantees

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Comprehensive Sewer Study 2017-2018

- Eliminate the High Street SSO
- Alleviate Downtown Flooding
- Identify: System Bottlenecks
  Excessive I&I
- Create a Sewer System Model

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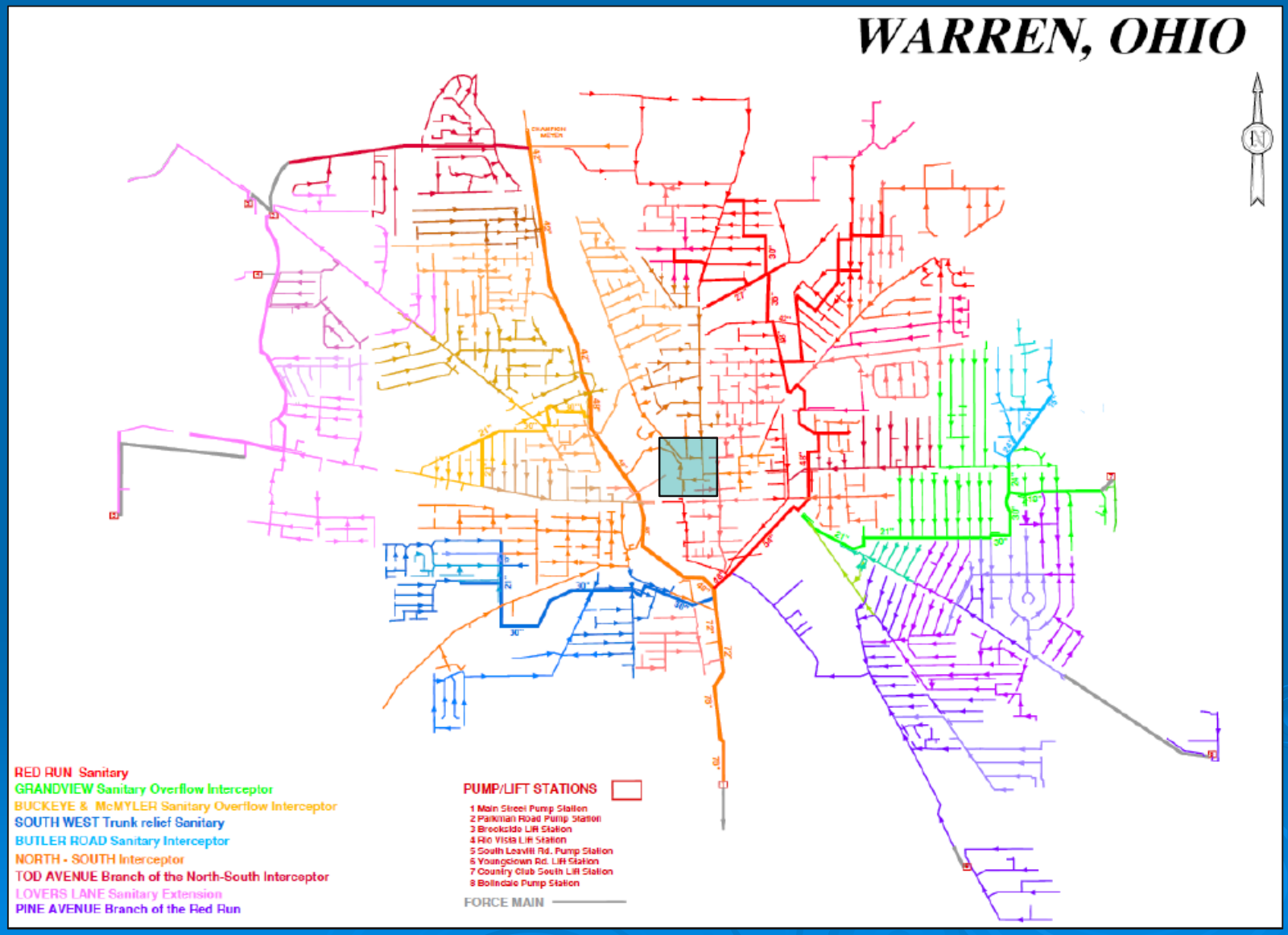
Sanitary Sewer System Map



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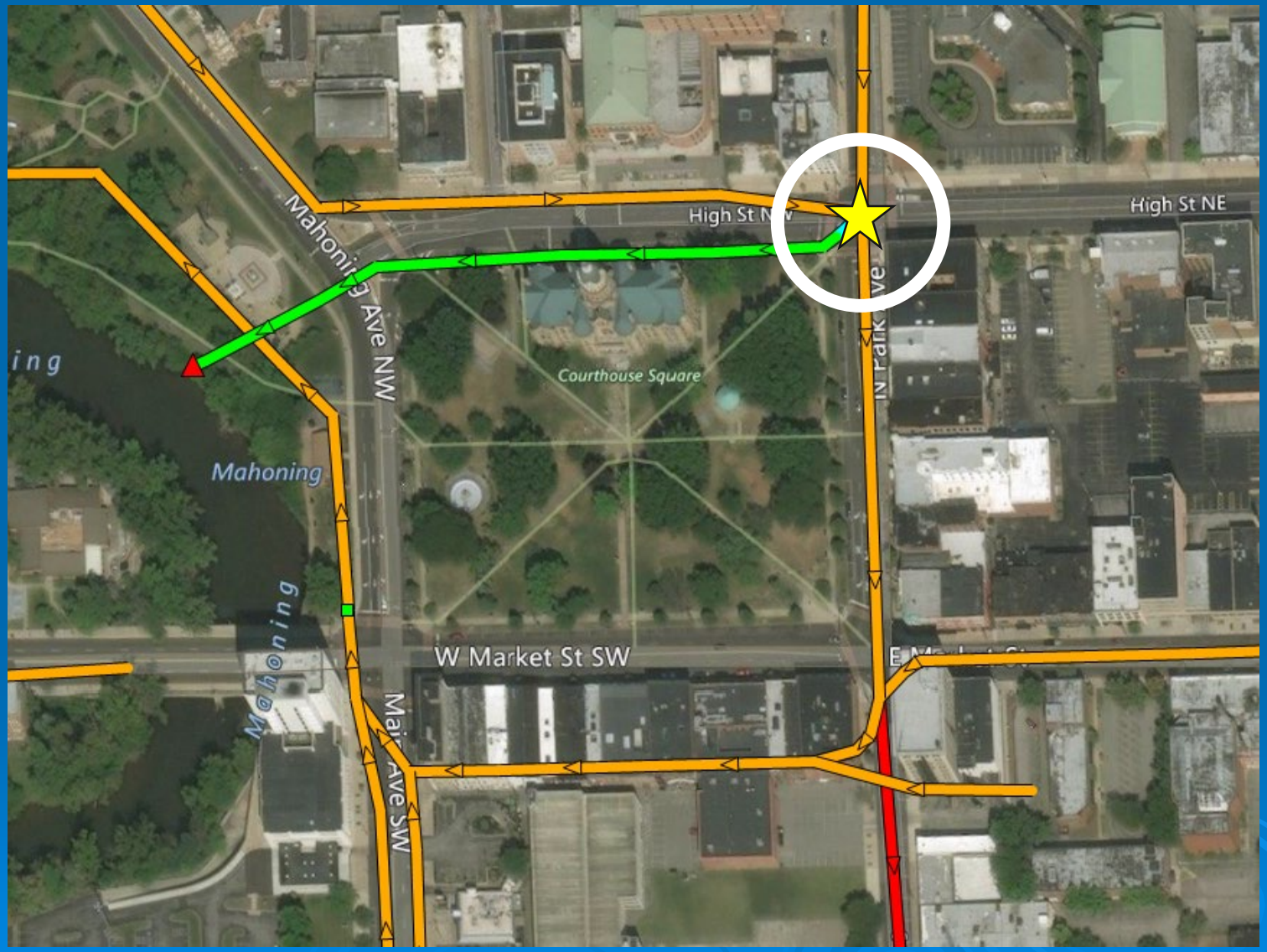
Downtown Warren SSO



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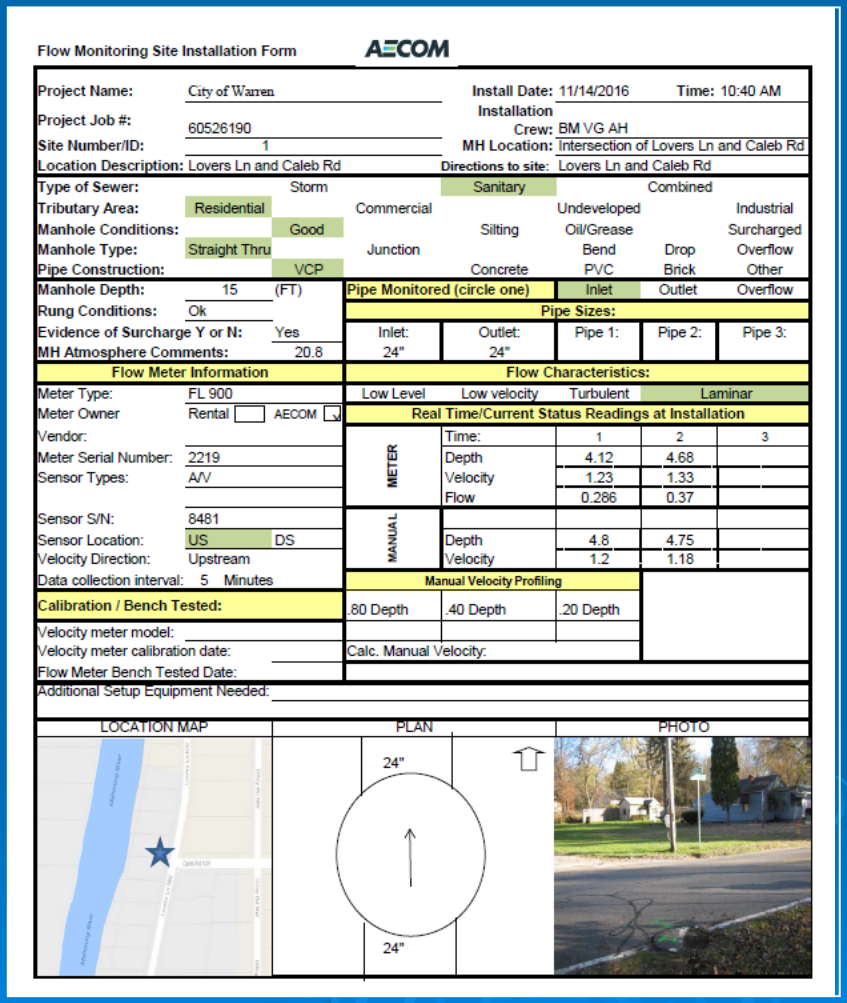
Task 1 Sewer System Characterization

- Flow monitoring and rain gauges installed in November 2016
- 36 flow monitors and 5 rain gauges
- Installed for approximately six months total (November 2016-June 2017)



Flow Monitoring Site Installation Form — AECOM

Project Name:	City of Warren		Install Date:	11/14/2016	Time:	10:40 AM
Project Job #:	60526190		Installation Crew:	BM VG AH		
Site Number/ID:	1		MH Location:	Intersection of Lovers Ln and Caleb Rd		
Location Description:	Lovers Ln and Caleb Rd		Directions to site:	Lovers Ln and Caleb Rd		
Type of Sewer:	Storm		Sanitary		Combined	
Tributary Area:	Residential	Commercial		Undeveloped		Industrial
Manhole Conditions:	Good		Silting	Oil/Grease		Surcharged
Manhole Type:	Straight Thru	Junction		Bend	Drop	Overflow
Pipe Construction:	VCP		Concrete	PVC	Brick	Other

Manhole Depth:	15 (FT)	Pipe Monitored (circle one)	Inlet	Outlet	Overflow
Rung Conditions:	Ok	Pipe Sizes:			
Evidence of Surcharge Y or N:	Yes	Inlet:	Outlet:	Pipe 1:	Pipe 2:	Pipe 3:
MH Atmosphere Comments:	20.8	24"	24"			

Flow Meter Information		Flow Characteristics:			
Meter Type:	FL 900	Low Level	Low velocity	Turbulent	Laminar
Meter Owner	Rental ☐ AECOM ☐	Real Time/Current Status Readings at Installation			
Vendor:			Time:	1	2	3
Meter Serial Number:	2219	METER	Depth	4.12	4.68	
Sensor Types:	A/V		Velocity	1.23	1.33	
			Flow	0.286	0.37	
Sensor S/N:	8481	MANUAL				
Sensor Location:	US DS		Depth	4.8	4.75	
Velocity Direction:	Upstream		Velocity	1.2	1.18	
Data collection interval:	5 Minutes	Manual Velocity Profiling			
Calibration / Bench Tested:		.80 Depth	.40 Depth	.20 Depth	
Velocity meter model:					
Velocity meter calibration date:		Calc. Manual Velocity:			
Flow Meter Bench Tested Date:					
Additional Setup Equipment Needed:					

LOCATION MAP | PLAN | PHOTO

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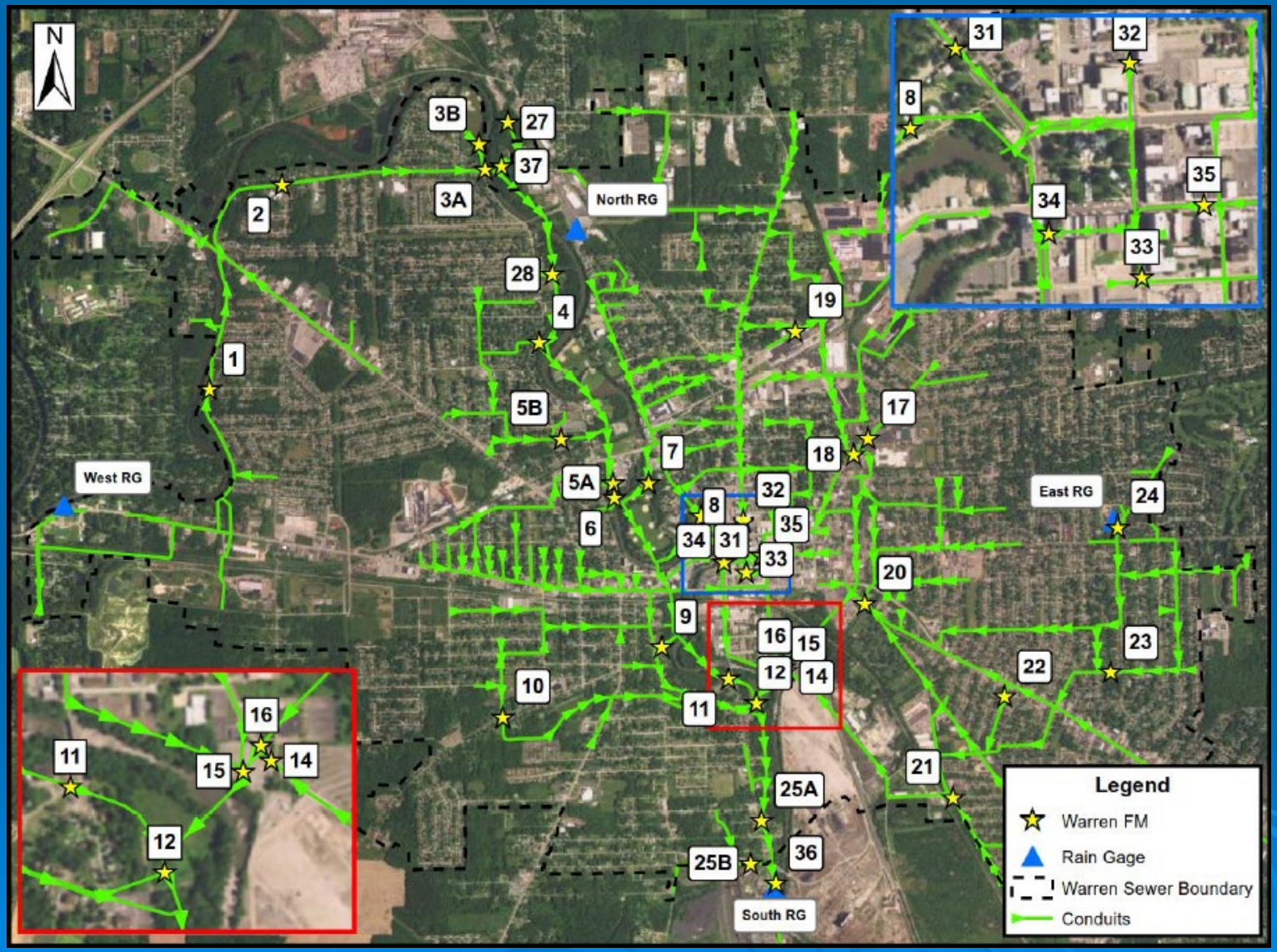
Flow Monitoring Locations



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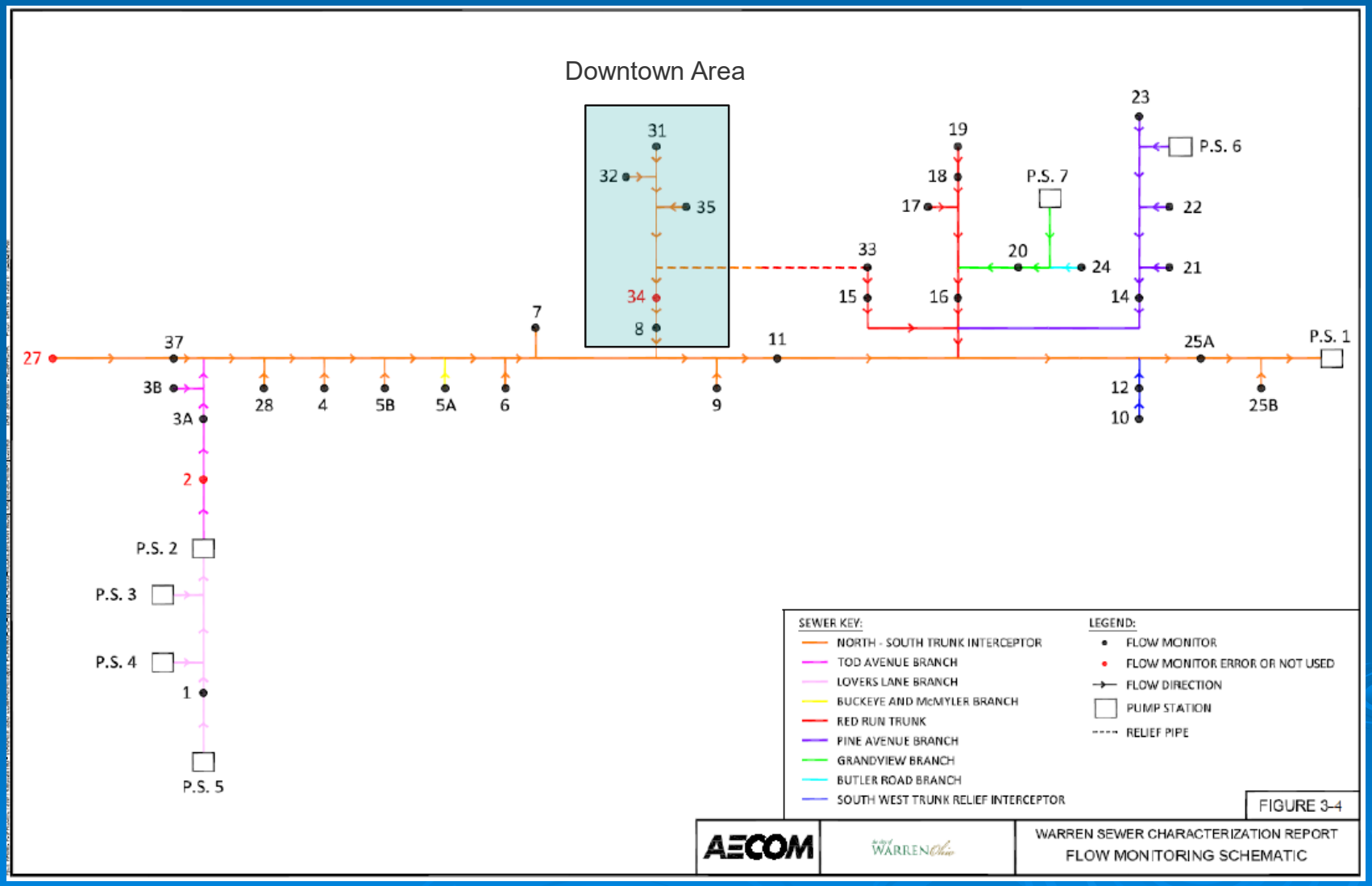
Flow Meter Schematic



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Task 1 – Flow Monitoring

System Characteristics Identified

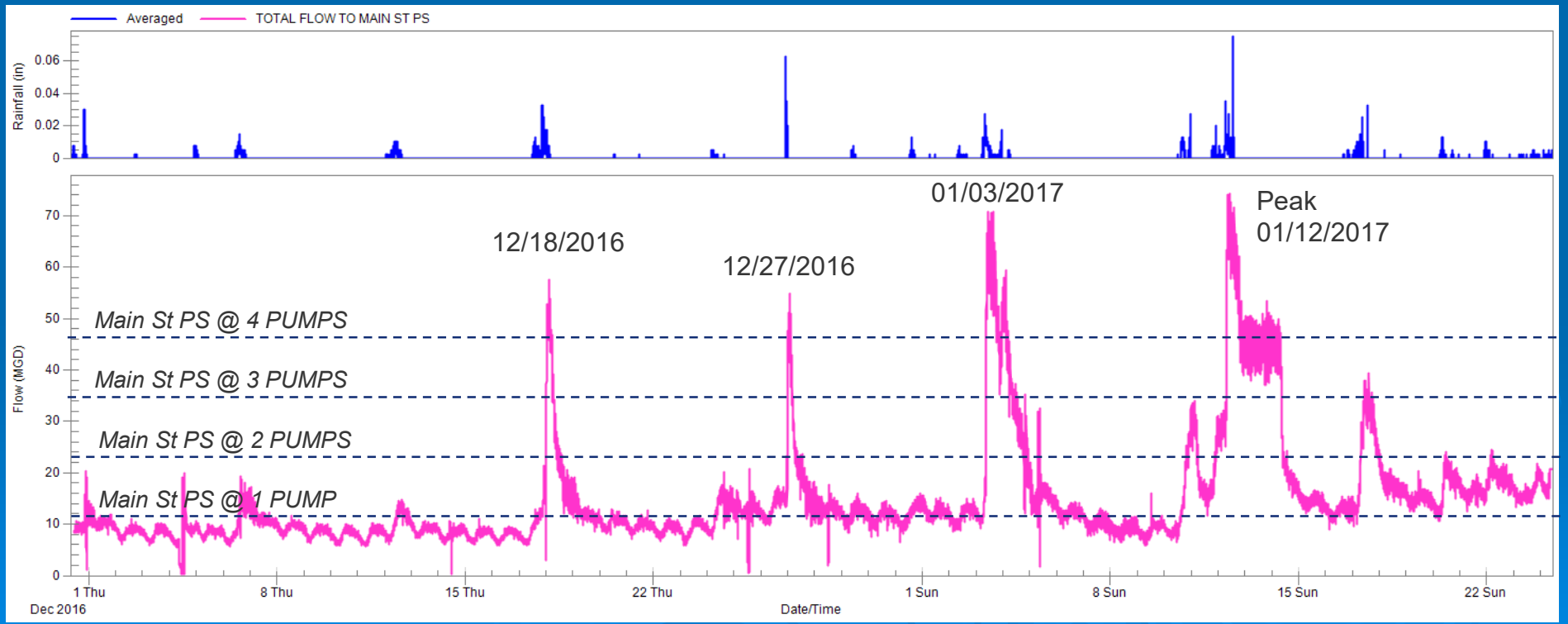
1. *Capacity issues*
2. *Identified tributary areas with large I/I contributions*
3. *High I/I percentage calculations*
4. *Inconsistent pump station operations*
5. *River inflow and infiltration*

Task 1 – Flow Monitoring

Total Flow at Main St PS = FM25A + FM25B

Comparison with Main St PS Capacity

- *Average Dry Weather Day: 8MGD*
- *Peak Flow recorded on Jan 12, 2017: 73MGD*



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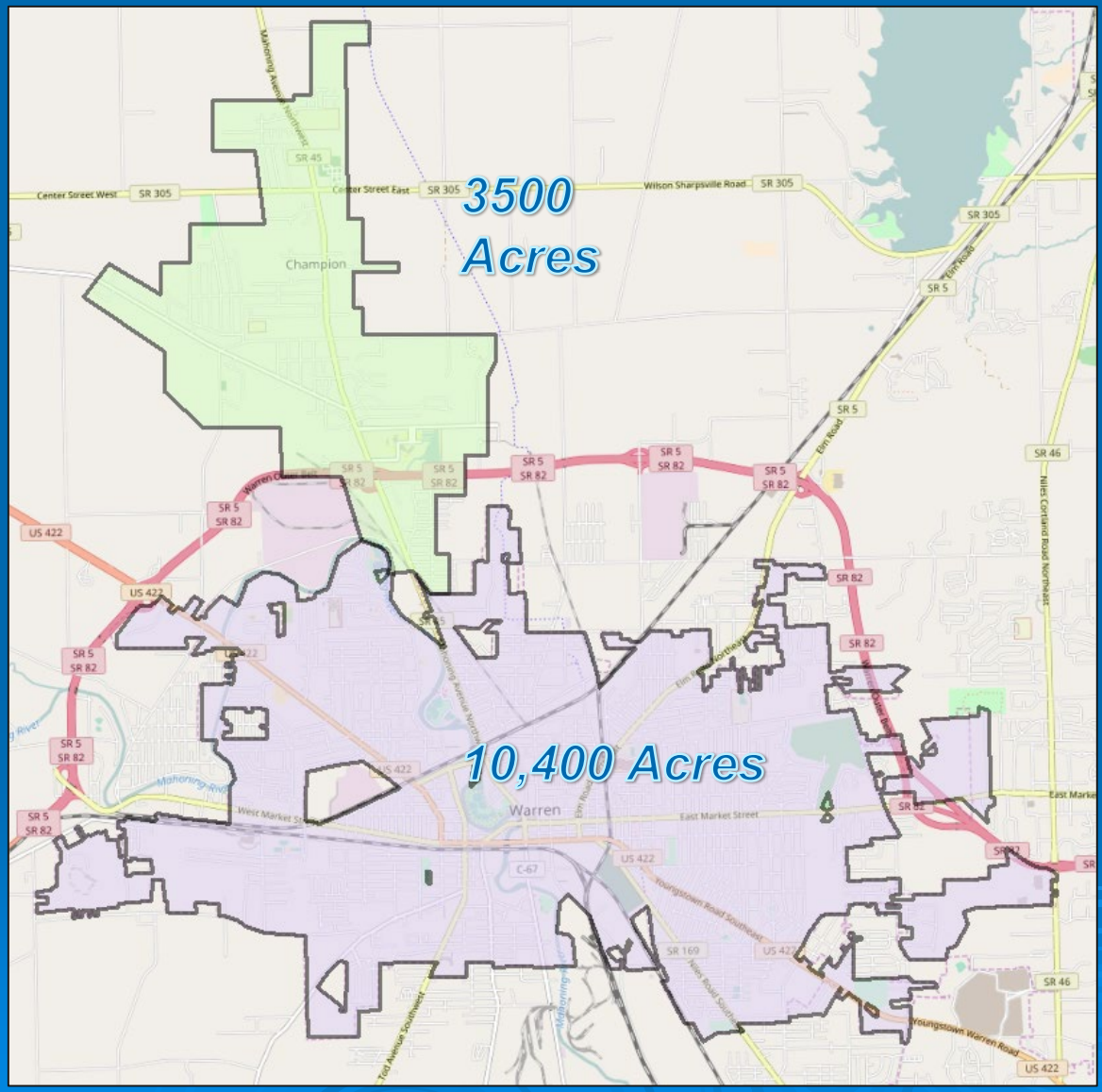
Champion vs. Warren



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Task 1 – Flow Monitoring

Flow from Champion

FM located upstream of permanent meter pit

Champion Meter Pit

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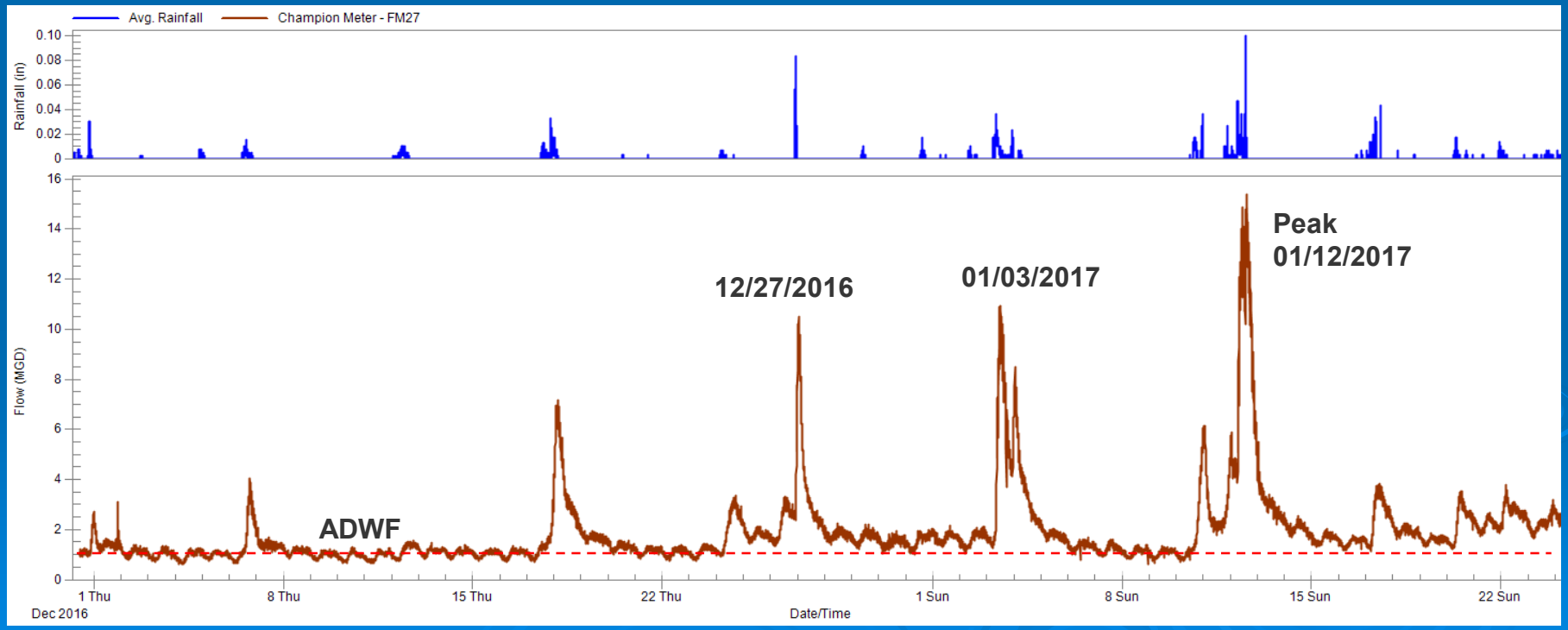
Task 1 – Flow Monitoring

Flow from Champion

- *Average Dry Weather Day ~ 1MGD 6% WPC Design Flow*
- *Peak Flow recorded on Jan 12, 2017 ~ 15MGD*
  37.5% WPC Peak Flow



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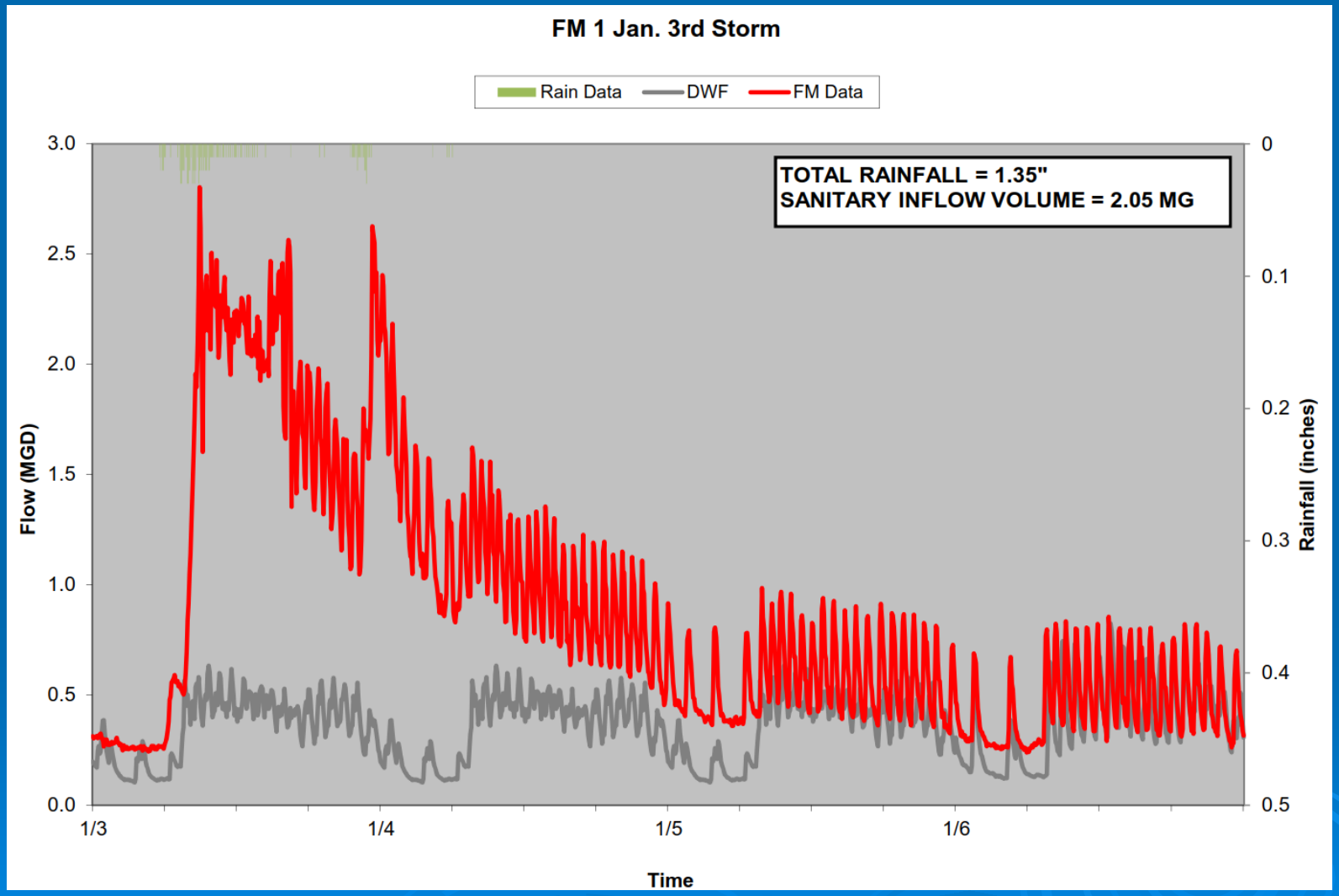
Task 1 – FM Report



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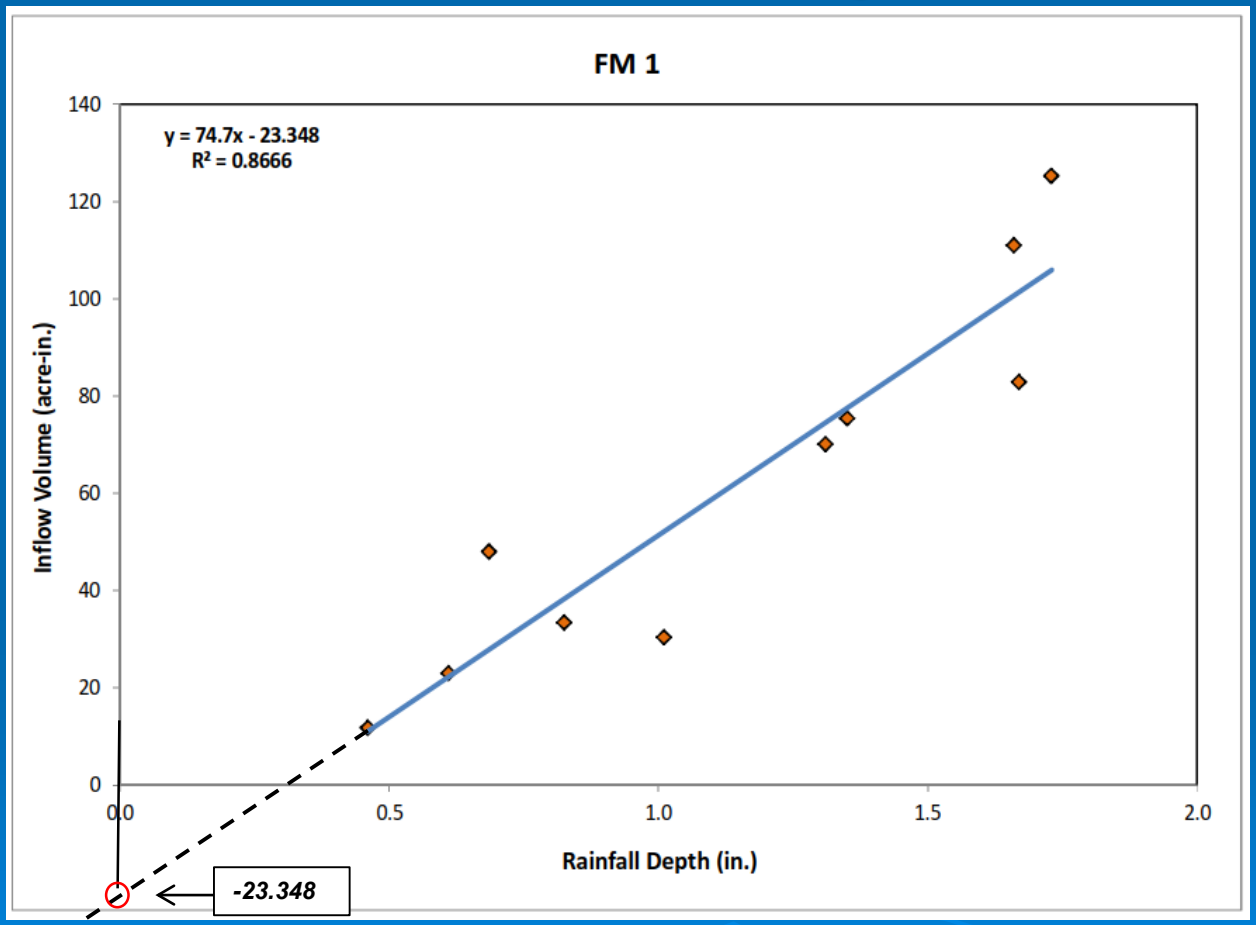
Task 1 – FM Report

Inflow Volume Linear Regression



- *Estimates depression storage*
- *Minimum rain that causes a response*
- *Predict Inflow*
- *Calculate Wet Weather I/I Ratio*

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Task 1 – FM Report

Wet Weather Flow

Flow Meter	Area (acres)	Adjusted Slope	Adjusted Y-Intercept	I/I Ratio (%)	Minimum Rainfall (in)
FM 6	60	36.742	2.8097	61.2	0.00
FM 25b	159	94.456	-11.791	59.4	0.12
FM 32	146	82.745	-14.35	56.7	0.17
FM 15	249	109.07	-13.386	43.7	0.12
FM 5b	236	96.491	-19.846	40.9	0.21
FM 17	320	127.82	10.372	39.9	0.00
FM 7	172	67.83	-11.938	39.4	0.18
FM 22	60	22.192	0.5388	37.0	0.00
FM 8+33	264	96.432	-21.782	36.6	0.23
FM 23	202	72.159	-1.9286	35.7	0.03
FM 4	168	57.032	-4.5161	34.0	0.08
FM 9	251	78.732	7.5387	31.4	0.00
FM 31	40	12.145	-2.1851	30.4	0.18
FM 19	141	42.069	-10.1	29.8	0.24
FM 24	158	37.673	-4.5887	23.8	0.12
FM 14+20	1864	438.79	-43.96	23.5	0.10
FM 21	241	43.422	-2.2933	18.0	0.05
FM 33	249	44.586	-5.9302	17.9	0.13
FM 10	208	36.546	-4.8173	17.6	0.13
FM 28	127	21.414	-2.6679	16.9	0.12
FM 12	549	89.44	43.084	16.3	0.00
FM 25a	12010	1925.4	-185.81	16.0	0.10
FM 14	1083	172.00	-0.5799	15.9	0.00
FM 16	3096	466.32	-63.142	15.1	0.14
FM 8	264	38.571	3.3436	14.6	0.00
FM 5a	325	46.165	-10.165	14.2	0.22
FM 3a	1578	187.6	-5.7801	11.9	0.03
FM 11	6827	767.39	-91.811	11.2	0.12
FM 1	669	74.7	-23.348	11.2	0.31
FM 18	1356	144.18	-48.662	10.6	0.34
FM 3b	64	2.3513	-0.6749	3.7	0.29
FM 37	3329	103.46	25.344	3.1	0.00

Dry Weather Flow

	Average Dry Weather Flow		Dry weather I/I		
FM	Weekday (MGD)	Weekend (MGD)	Weekday (MGD)	Weekend (MGD)	Average I/I (%)
25b	0.389	0.404	0.311	0.327	80.5
14	0.885	0.892	0.678	0.683	76.6
14+20	2.218	1.750	1.598	1.173	69.8
24	0.192	0.209	0.131	0.148	69.7
32	0.260	0.237	0.189	0.157	69.5
8	0.237	0.149	0.169	0.099	69.3
22	0.079	0.074	0.054	0.050	68.1
11	3.346	3.339	2.265	2.211	67.0
8+33	0.440	0.352	0.294	0.232	66.4
37	0.757	0.787	0.507	0.508	65.7
25a	5.948	6.832	3.767	4.494	64.6
20	1.333	0.858	0.919	0.491	64.4
15	0.324	-	0.207	-	63.8
33	0.203	0.203	0.125	0.133	63.5
31	0.039	0.039	0.027	0.022	62.8
18	0.595	0.508	0.371	0.309	61.7
21	0.116	0.117	0.072	0.067	59.9
7	0.160	0.182	0.108	0.096	59.6
28	0.058	0.053	0.030	0.035	59.1
16	2.443	2.276	1.494	1.270	58.6
23	0.346	0.380	0.174	0.246	57.9
19	0.040	0.048	0.021	0.030	57.7
17	0.203	0.208	0.118	0.116	57.0
5a	0.058	0.076	0.029	0.044	54.5
5b	0.147	0.183	0.076	0.101	53.6
10	0.137	0.135	0.082	0.061	52.6
4	0.066	0.098	0.032	0.050	50.5
3b	0.015	0.017	0.006	0.009	47.4
6	0.100	0.136	0.050	0.054	43.8
9	0.078	0.098	0.034	0.034	38.5
3a	0.345	0.799	0.125	0.307	37.8
12	0.157	0.150	0.054	0.047	32.8
1	0.357	0.378	0.091	0.107	26.9

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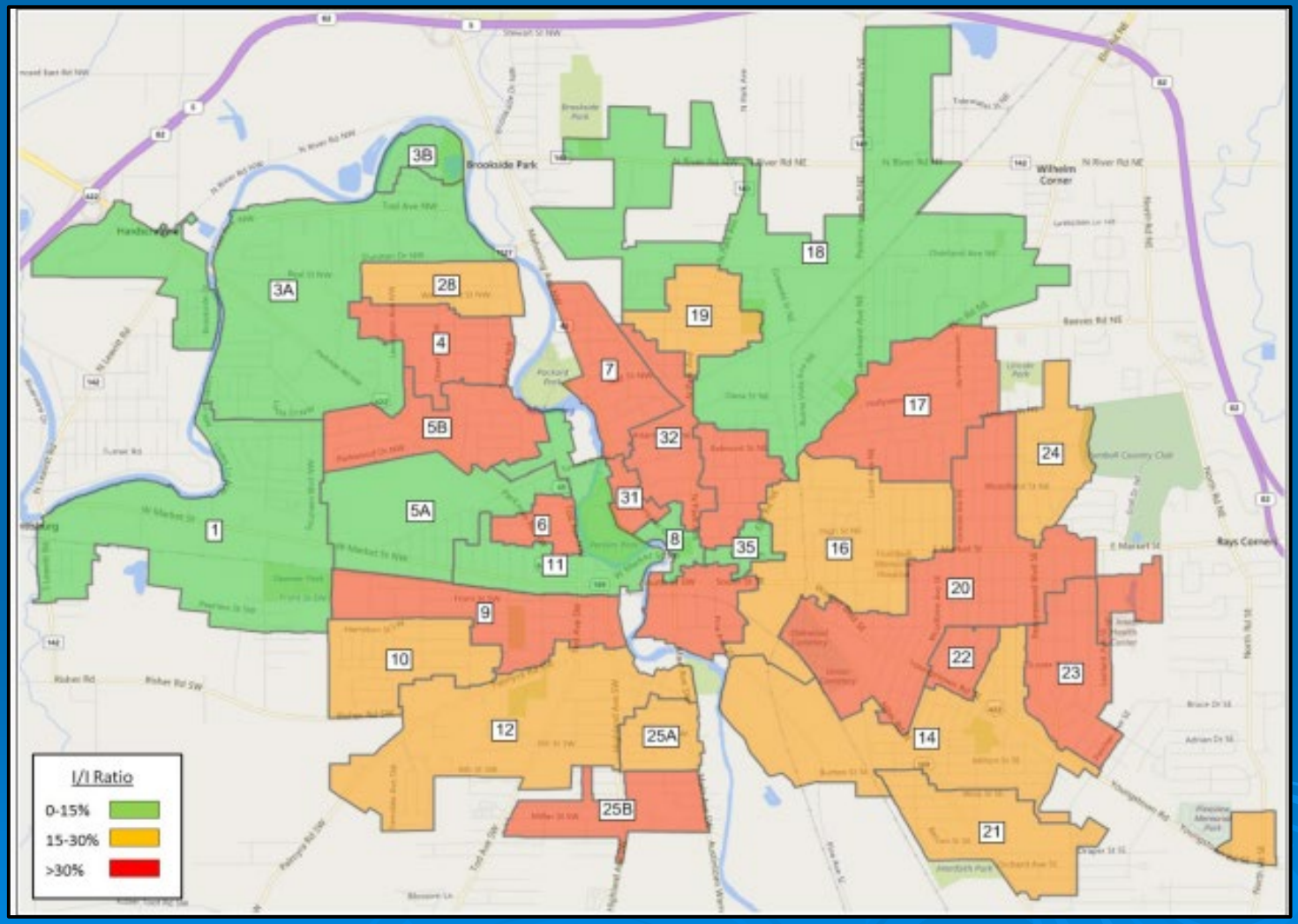
Task 1 – FM Report

Wet Weather Flow



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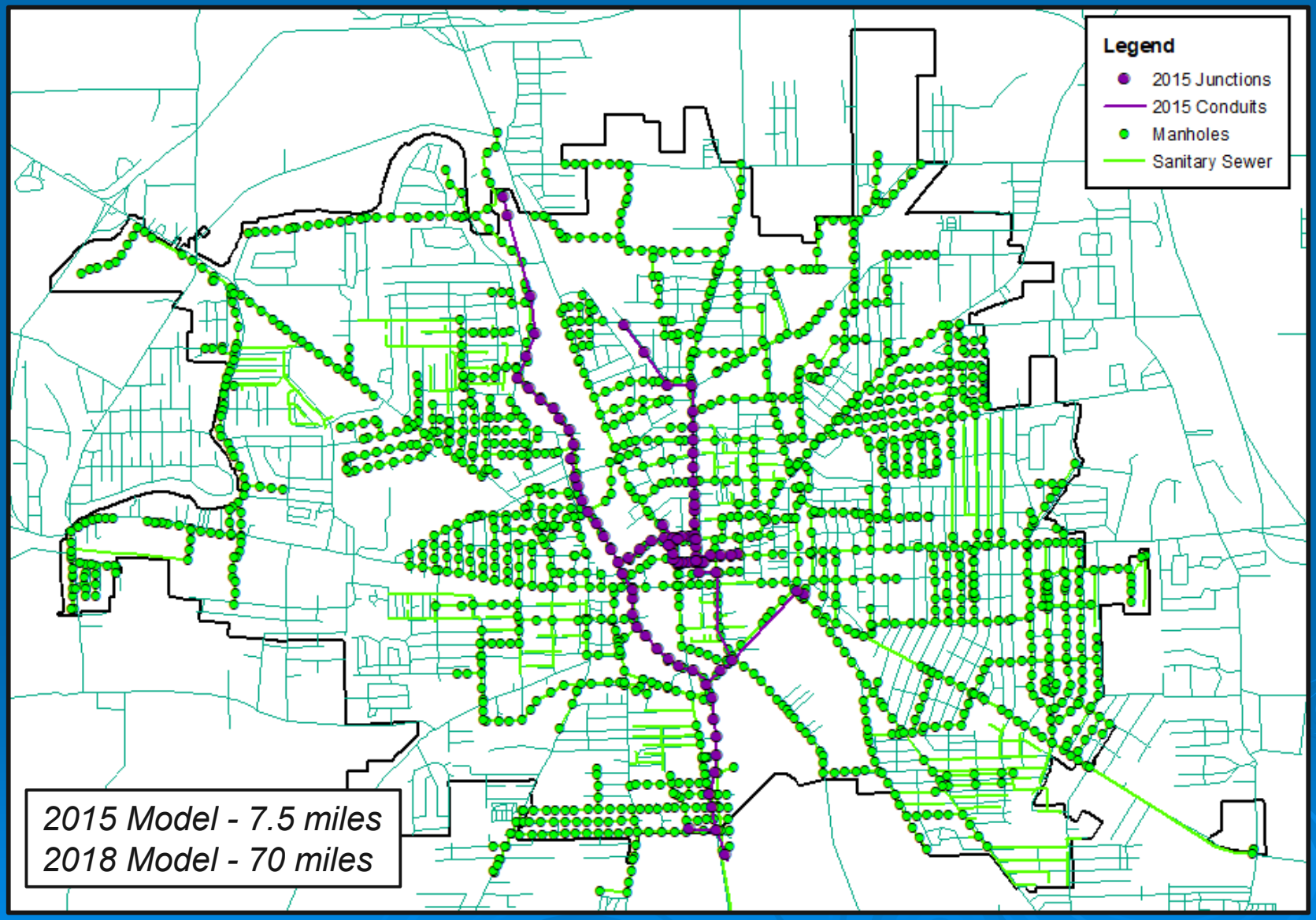
Task 2 - Hydraulic Modeling



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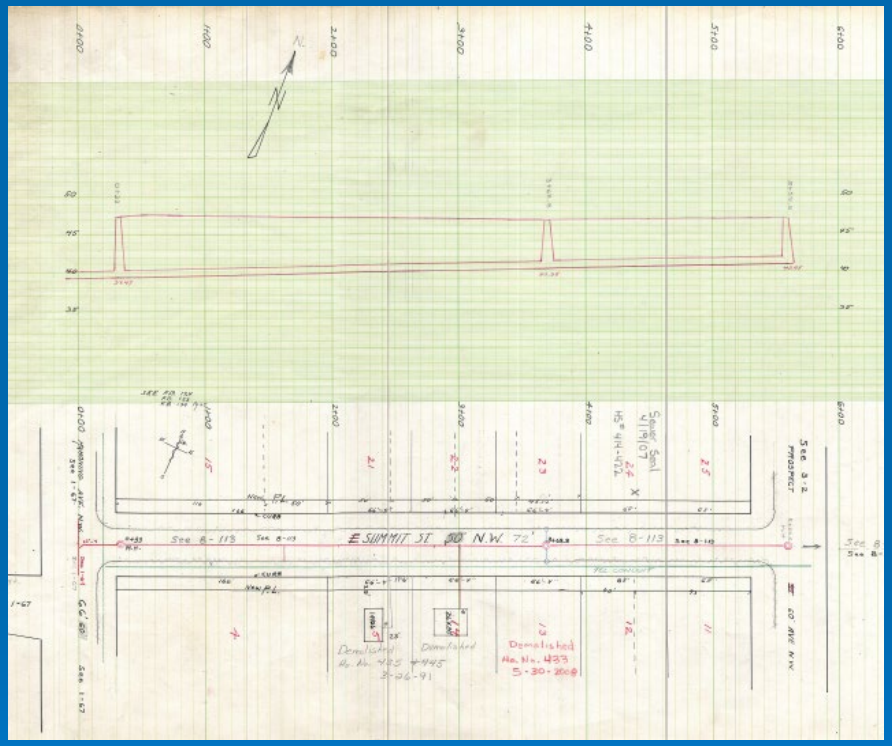
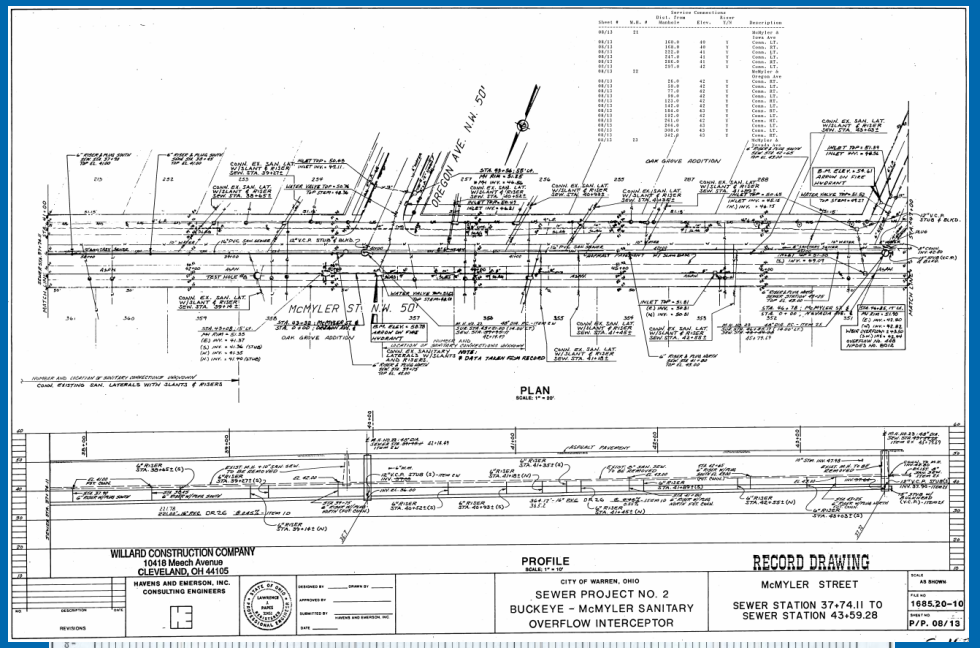
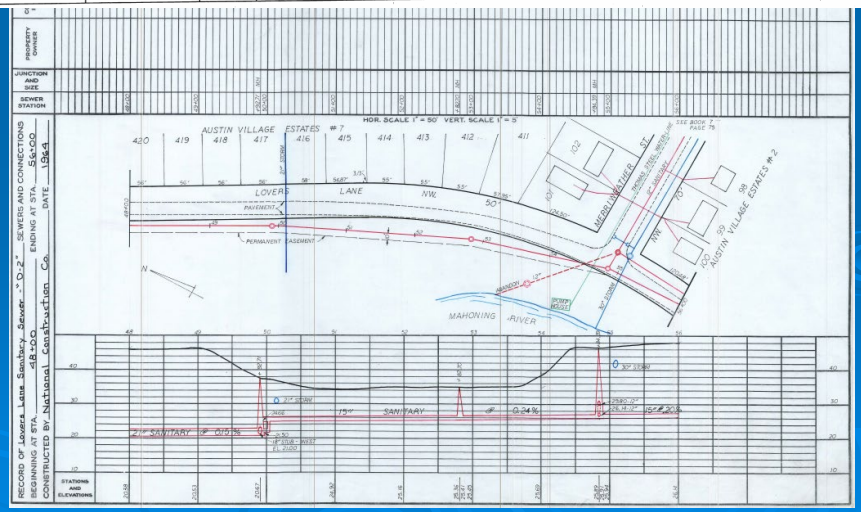
Task 2 - Hydraulic Modeling







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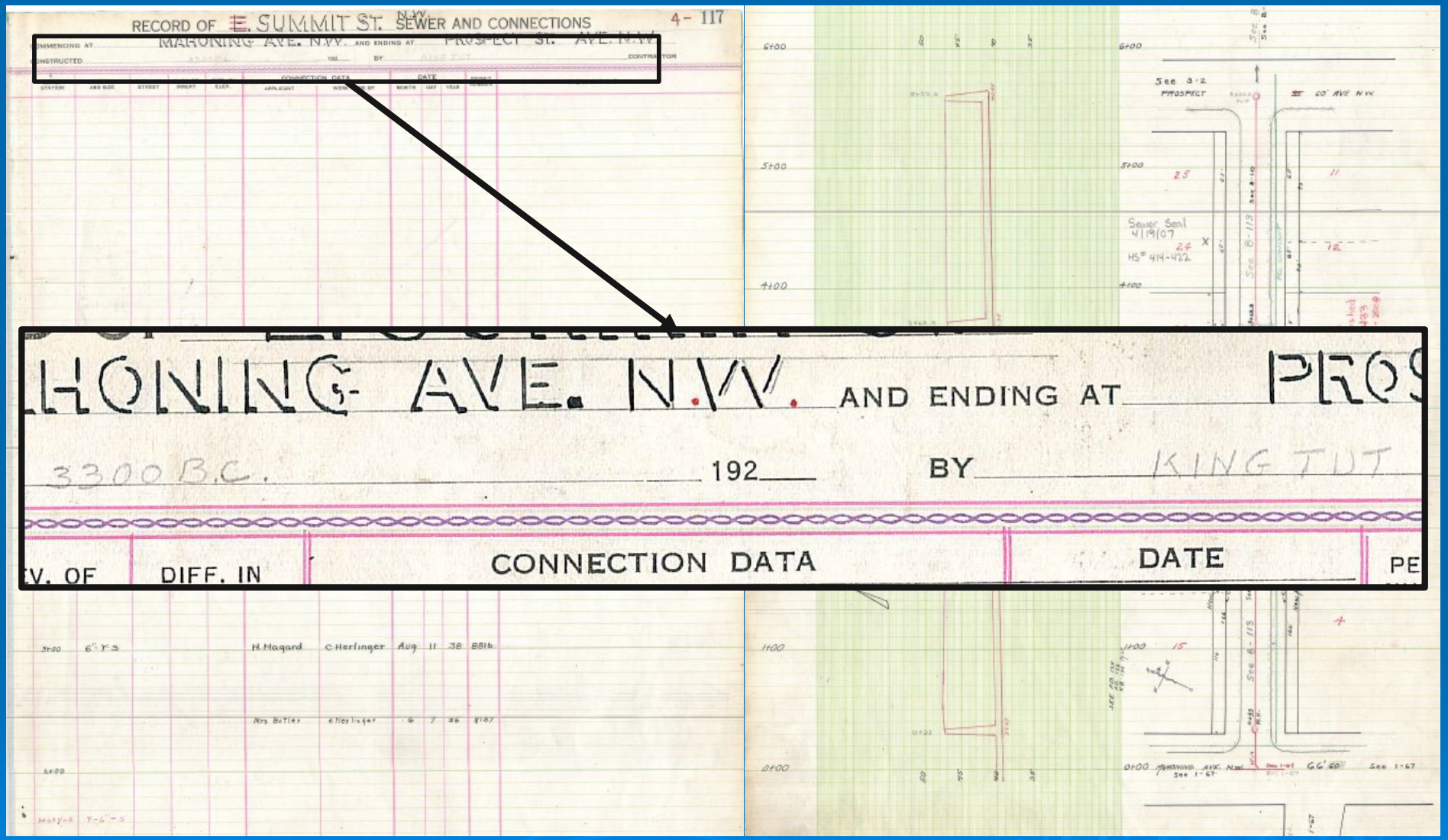
Task 2 - Hydraulic Modeling



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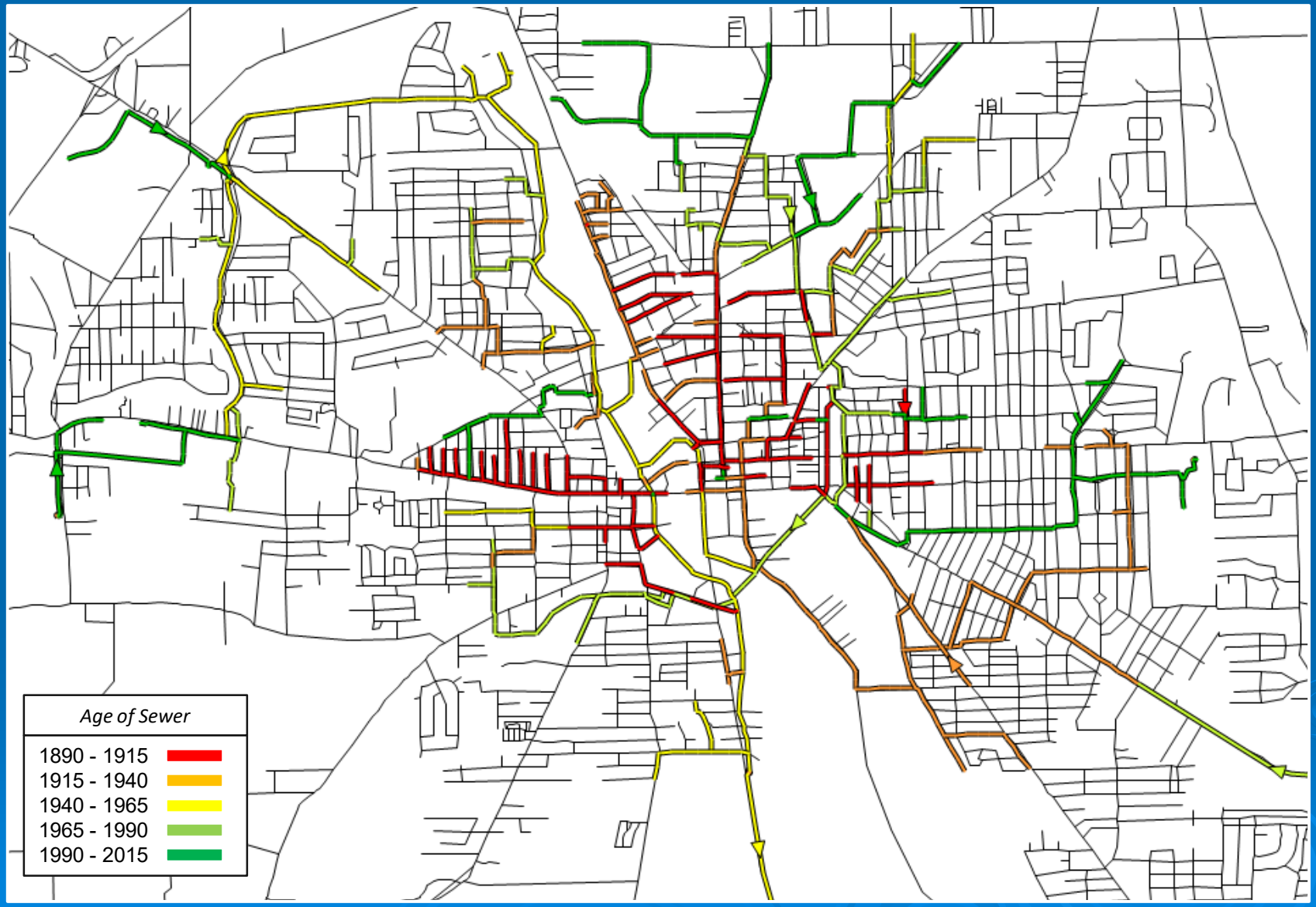
Task 2 - Hydraulic Modeling



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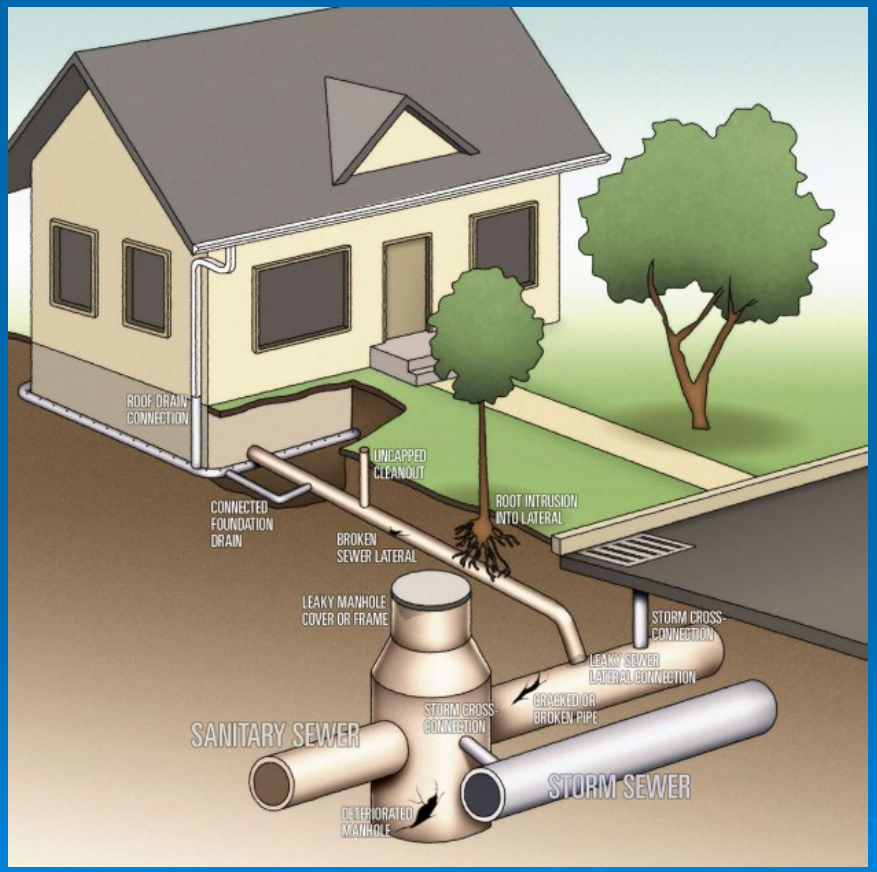
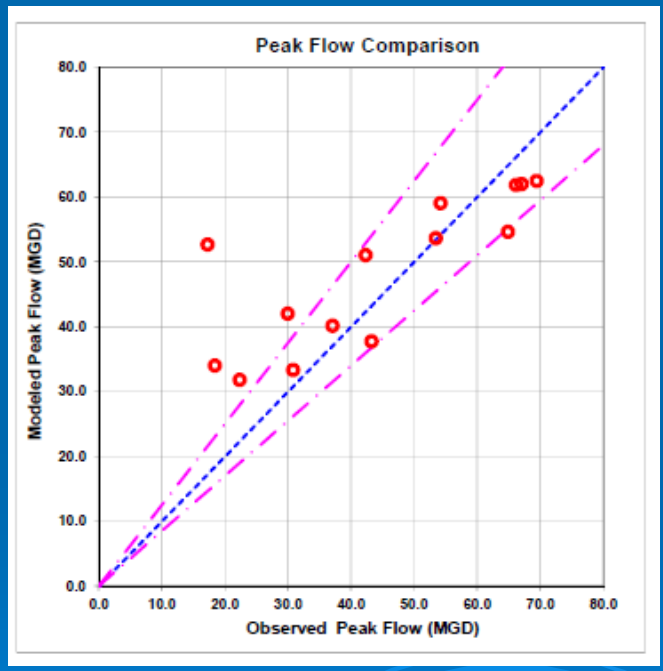
Task 2 - Hydraulic Modeling

Model Calibration

- *Utilized PCSWMM 6.1*



Utilized NEORSD Modeling Standards



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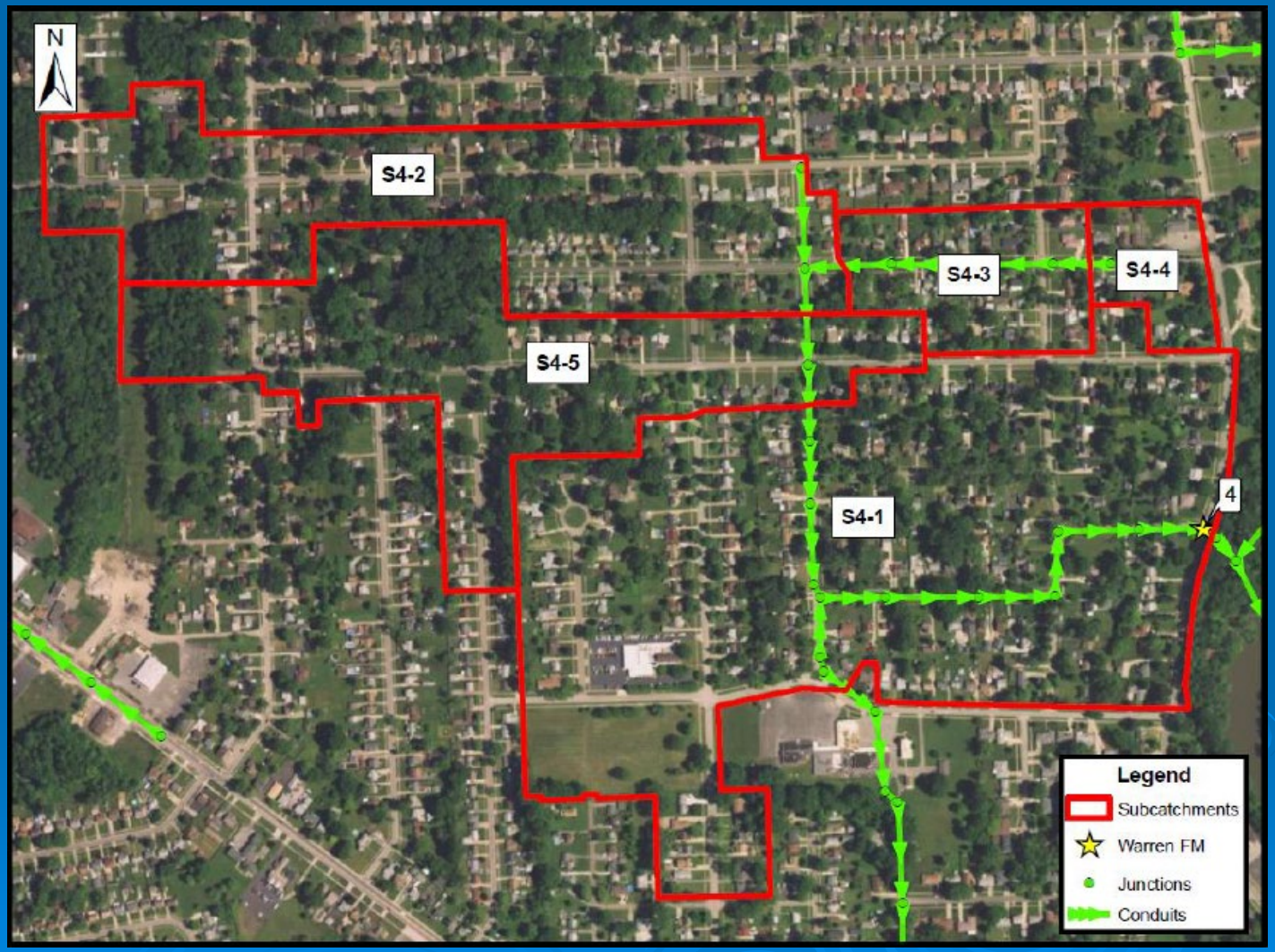
Task 2 - Hydraulic Modeling

Subcatchments

- *% impervious area*
- *flow length*
- *slope*
- *surface depression*
- *groundwater*



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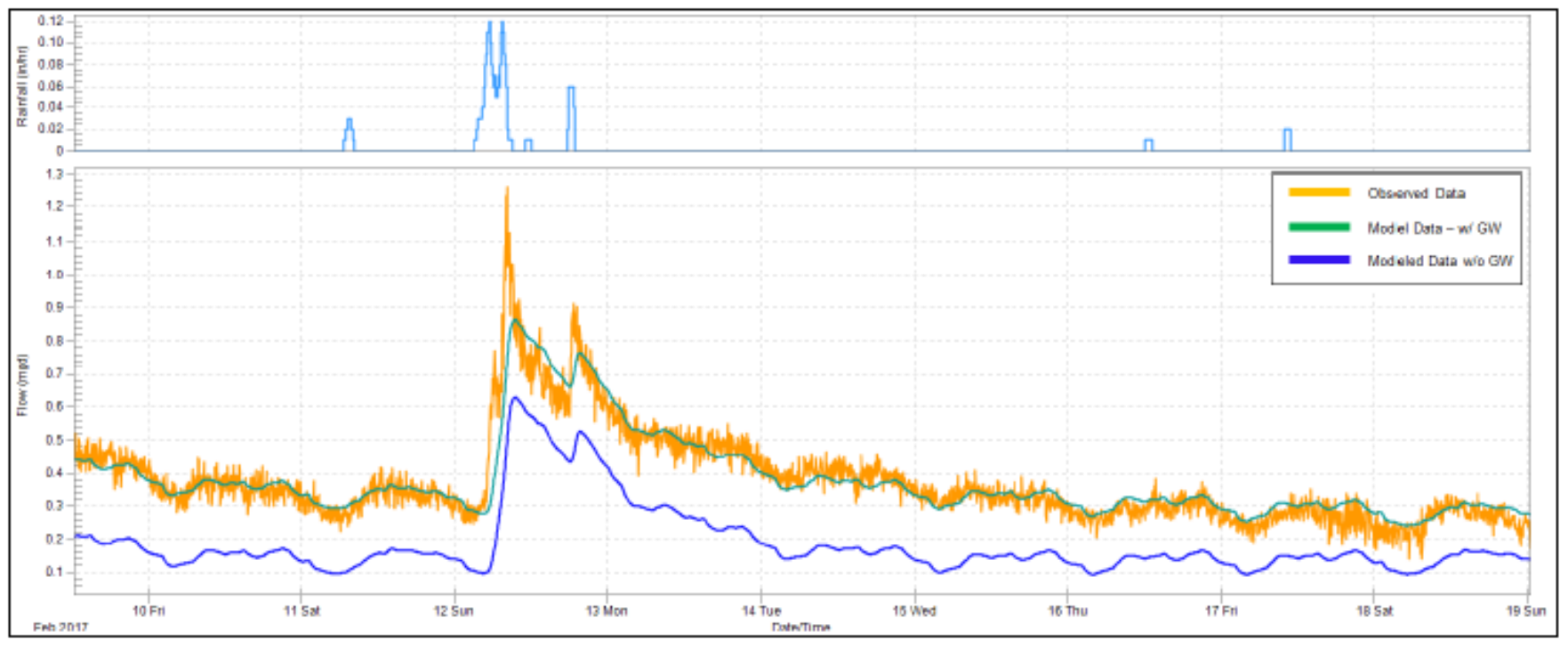
Task 2 - Hydraulic Modeling

Groundwater Effects



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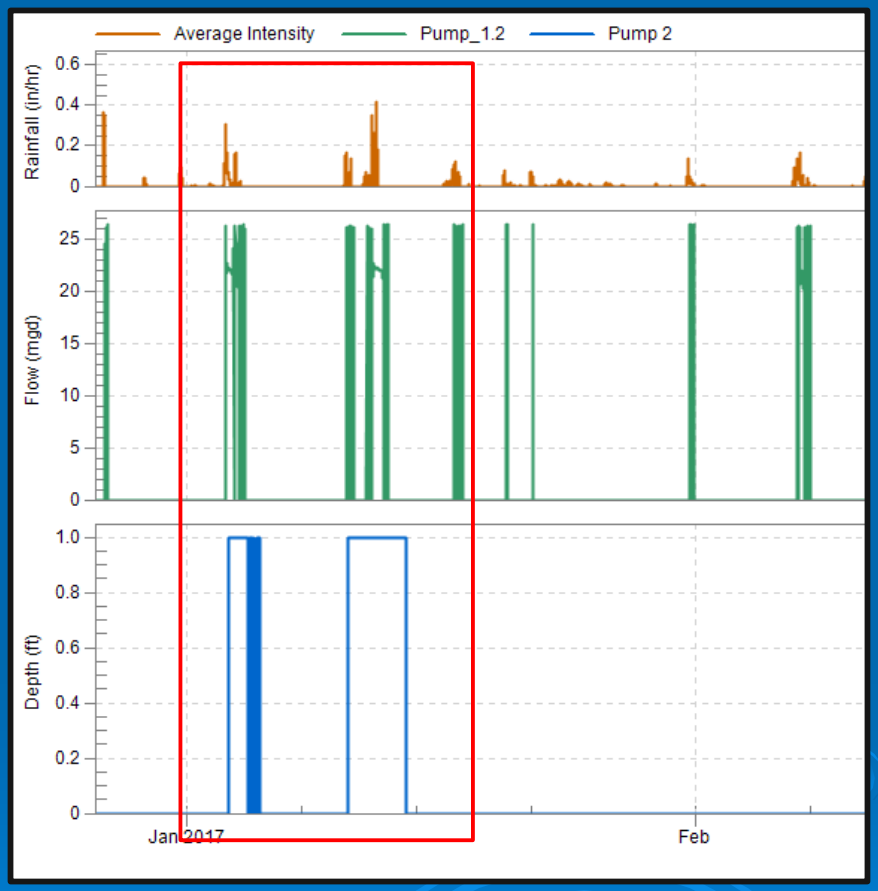
Task 2 - Hydraulic Modeling

Issue = Inconsistent pump station operations

Solution = Created a time series that alters the pump curve

- *Factor of 0 = off, Factor of 1 = on*



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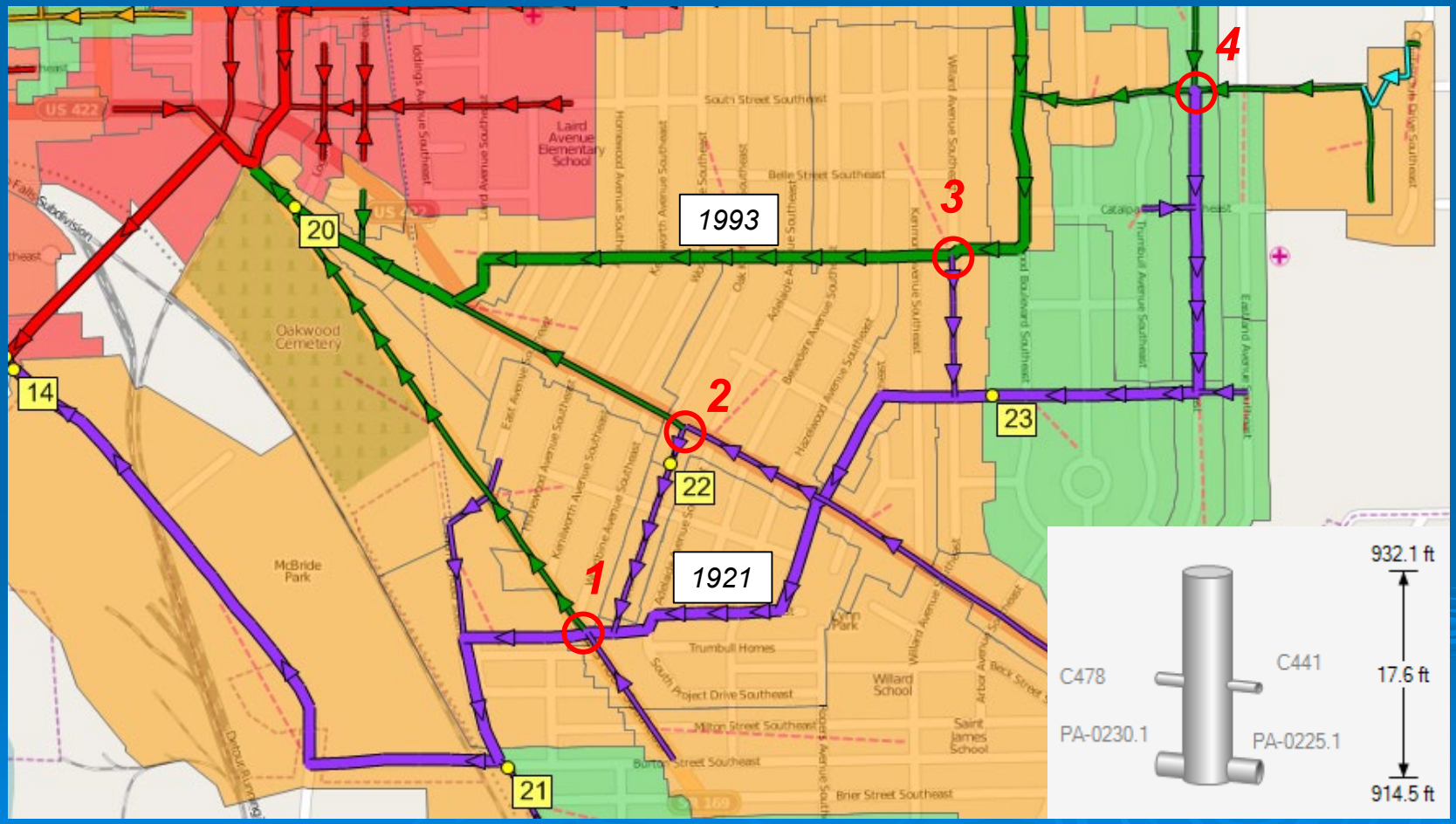
Task 2 – Other System Investigations

SE Sewer



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Task 2 - Hydraulic Modeling

Model Calibration Issues

1. *Main Pump Station*
2. *Unknown Interactions between Trunk Sewers*
3. *Mahoning River Influence*
4. *Un-modeled Pipes*
5. *Unknown Factors – flow restrictions, extra sources of I/I, inaccurate record drawings, covered or buried manholes*

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Task 2 – Baseline Model

Baseline Model serves as the platform for which sewer alternatives will be analyzed.

What will the baseline parameters include?

1. Infrastructure Upgrades Planned in the Immediate Future

- *Main PS Upgrade from 40 MGD to 55 MGD*

2. Elimination of High St. Overflow

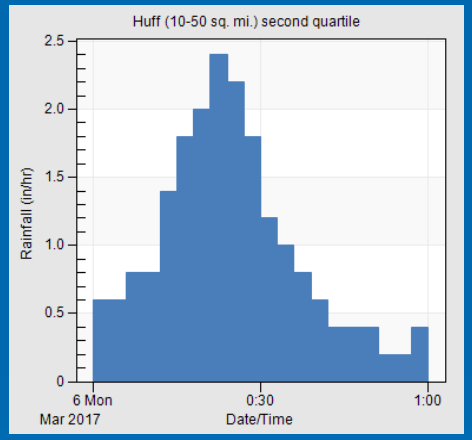
After baseline changes applied then alternative analysis can begin.

Alternatives Report

Level of Control

Based on results and various system attributes, three (3) different levels of control were selected for analysis.

- *1 year 6 hour storm event*
- *5 year 6 hour storm event*
- *10 year 6 hour storm event*



Implement alternatives and leave the monitored High Street SSO open until large rain events occur to demonstrate that flooding has been eliminated.

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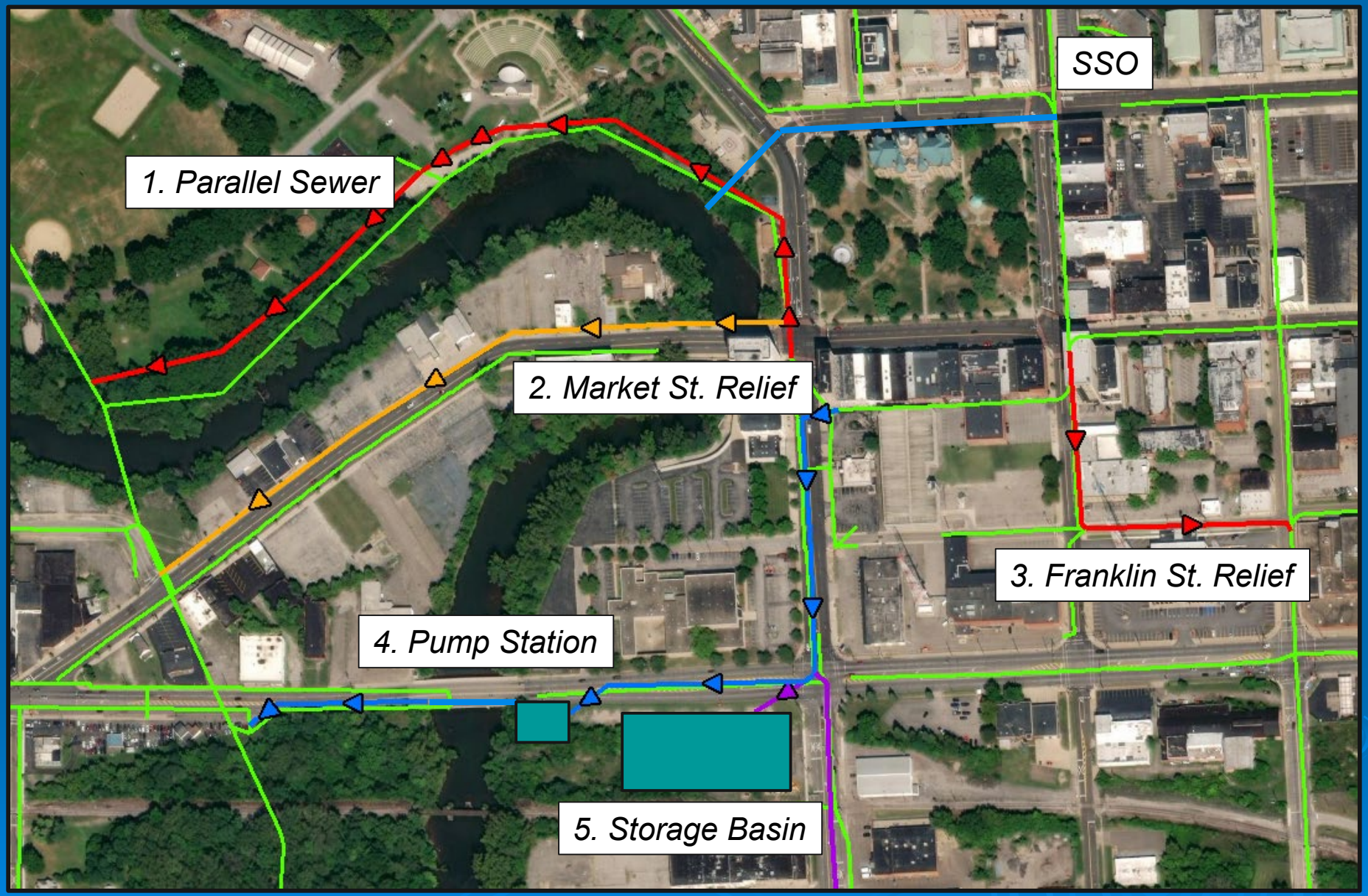

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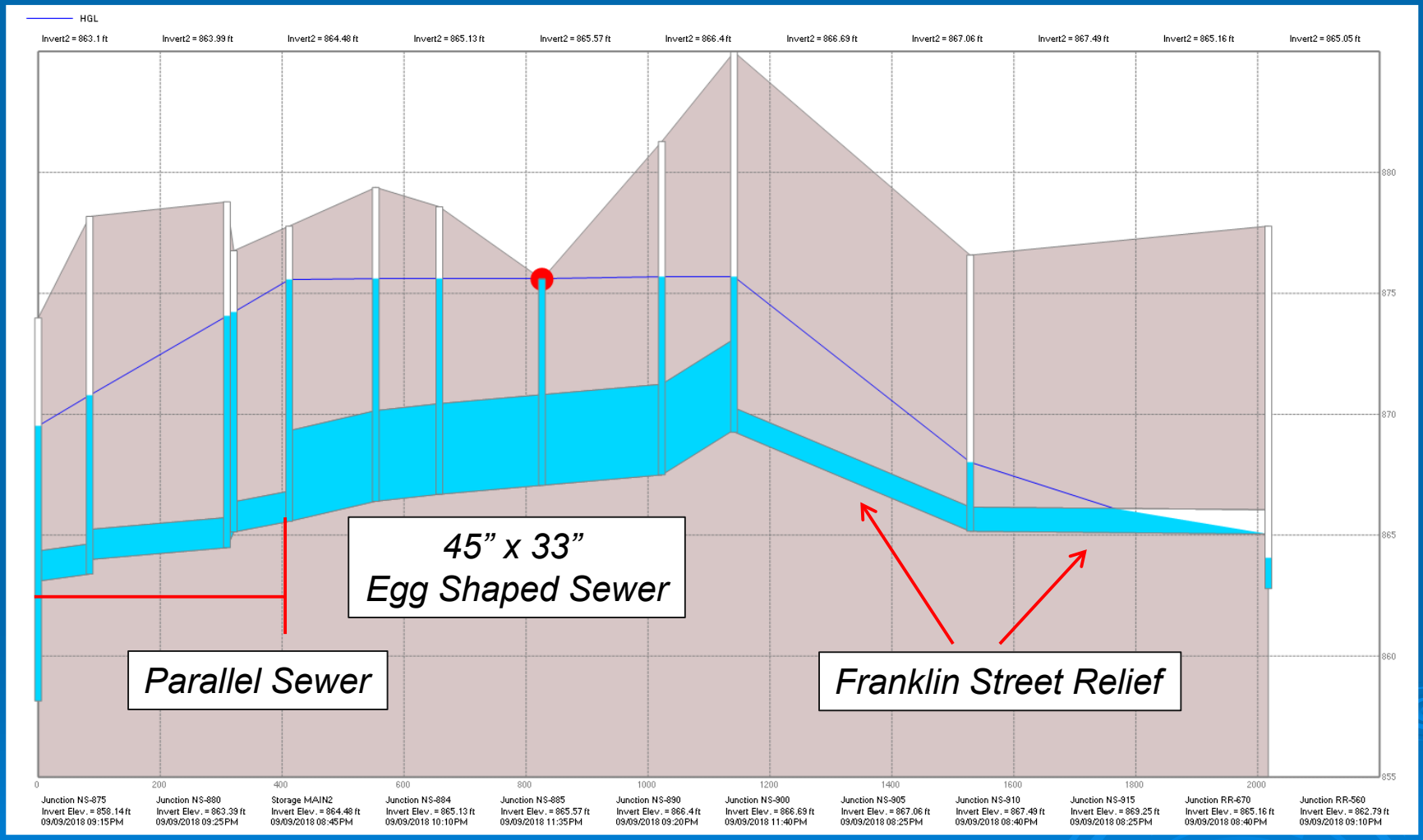

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Warren Current Sewer Project Schedule

EPA Requirements

- *David Grohl Alley Rehabilitation – January 1, 2020*
- *I/I Pilot Study – January 1, 2020*
- *Franklin Street Relief - December 1, 2020*
- *I/I Expanded Study - January 1, 2021*
- *Perkins Park Parallel Relief Sewer - June 1, 2021*

*The **Sewer System Model** allows Warren to make better decisions as we move through projects.*

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Questions?

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