FIVE MILE CREEK SEWER INTERCEPTOR REHABILITATION - DRAFT

DATE: SEPTEMBER 2026

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CHAPTER 1 – INTRODUCTION

BACKGROUND

The City of Sherwood has undertaken ongoing efforts to evaluate and improve the performance and reliability of its wastewater collection system, particularly within the Five Mile Creek Basin interceptor system. Previous studies identified sanitary sewer overflows (SSOs), wet weather capacity concerns, and the need for rehabilitation and improvements to portions of the existing interceptor system. A Preliminary Engineering Report (PER) prepared by Halff recommended rehabilitation of approximately 20,519 linear feet of interceptor sewer and identified the need for additional investigation to better evaluate system condition and hydraulic performance.

To advance the recommendations of the PER, the Sewer Committee, City of Sherwood retained Crist Engineers, Inc. under Task Order No. 06 executed December 16, 2025, attached to and made part of the Master Services Agreement to perform additional evaluation of the Five Mile Creek interceptor system. The scope of work included flow monitoring, condition assessment, surveying, and engineering analysis to further define existing conditions, identify hydraulic deficiencies, and support the development of future rehabilitation and improvement projects.

The need for additional evaluation was driven by recurring wet weather performance issues within the Five Mile Creek interceptor system, including known sanitary sewer overflows, surcharging conditions, and concerns regarding the ability of portions of the existing interceptor network to convey peak wet weather flows. While the PER identified rehabilitation needs within the system, additional field investigations were necessary to better understand the relationship between system condition, inflow and infiltration, and hydraulic capacity limitations affecting interceptor performance.

In December 2025, RJN Group, Inc. was retained by Crist Engineers, Inc. to perform a flow monitoring study and multi-sensor inspections (MSI) condition assessment of selected interceptor sewer facilities within the City of Sherwood collection system. The results of those investigations provide the basis for the hydraulic evaluation and recommendations presented in this report.

SUMMARY OF FINDINGS

Flow monitoring conducted within the Five Mile Creek interceptor system identified peak wet weather flows that exceeded the theoretical carrying capacity of portions of the existing interceptor. Peak wet-weather flows of approximately 5.63 MGD and 5.93 MGD were observed within Basins SW-06 and SW-02, respectively, while the theoretical capacity of the existing interceptor was estimated to be approximately 4.15 MGD based on available record information.

Subsequent field surveying performed as part of this study identified discrepancies between record drawings and actual field conditions. Hydraulic analysis of surveyed conditions indicated that approximately 70 percent of the surveyed interceptor pipe segments have a theoretical capacity below the peak wet-weather flows as measured during the monitoring period. Of that, approximately 10 percent of the surveyed interceptor length exhibits a reverse grade condition and approximately 28 percent of the surveyed interceptor length was found to be installed at slopes below current Ten State Standards guidance.

The Chesterfield Manhole was identified as a critical hydraulic control point within the study area. Survey data indicate that adequate upstream conveyance capacity exists; however, downstream adverse-grade conditions create a hydraulic restriction that contributes to surcharging and overflow conditions during elevated flow events.

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Multi-sensor inspection identified 127 defects associated with infiltration and an estimated 42,048 gallons per day of potential infiltration sources. While rehabilitation of these defects would reduce infiltration, the estimated hydraulic deficiencies within the interceptor indicate that rehabilitation alone is not expected to eliminate wet-weather surcharge conditions.

Hydraulic modeling demonstrated that targeted parallel interceptor improvements would reduce overflow duration at the Chesterfield Manhole, while a full parallel interceptor system improves conveyance capacity throughout the study corridor. Based on the results of the hydraulic analysis and modeling, phased construction of a parallel interceptor system was developed as a conceptual improvement strategy for future implementation.

STUDY AREA

The study area consists of a portion of the City of Sherwood's Satellite Sewer System located within the Five Mile Creek Basin. The Satellite Sewer System serves approximately 2,100 customers and conveys wastewater to the Five Mile Creek Wastewater Treatment Plant, which is owned and operated by North Little Rock Wastewater. The interceptor evaluated as part of this study consists primarily of 24-inch diameter gravity sewer and functions as a major conveyance facility within the basin. Figure 1-1 shows the study area, city limits, and color-coded drainage basins, which are labeled SW-01 through SW-07.

The study area generally extends along the Five Mile Creek interceptor corridor from the vicinity of flow monitoring location SW-07 upstream of the Chesterfield Manhole area, through flow monitoring basins SW-06 and SW-02 and includes the downstream interceptor facilities identified through previous studies as experiencing wet weather capacity concerns. The interceptor serves as a regional collection facility that receives flow from multiple upstream basins before conveying wastewater toward the Five Mile Creek Wastewater Treatment Plant.

Previous investigations identified this portion of the collection system as a critical area due to recurring sanitary sewer overflows, wet weather surcharging, and concerns regarding the ability of the existing interceptor to convey peak wet weather flows. As a result, the interceptor corridor was selected for additional flow monitoring, condition assessment, field surveying, and hydraulic evaluation to better define existing conditions and identify improvements necessary to support long-term system reliability and regulatory compliance.

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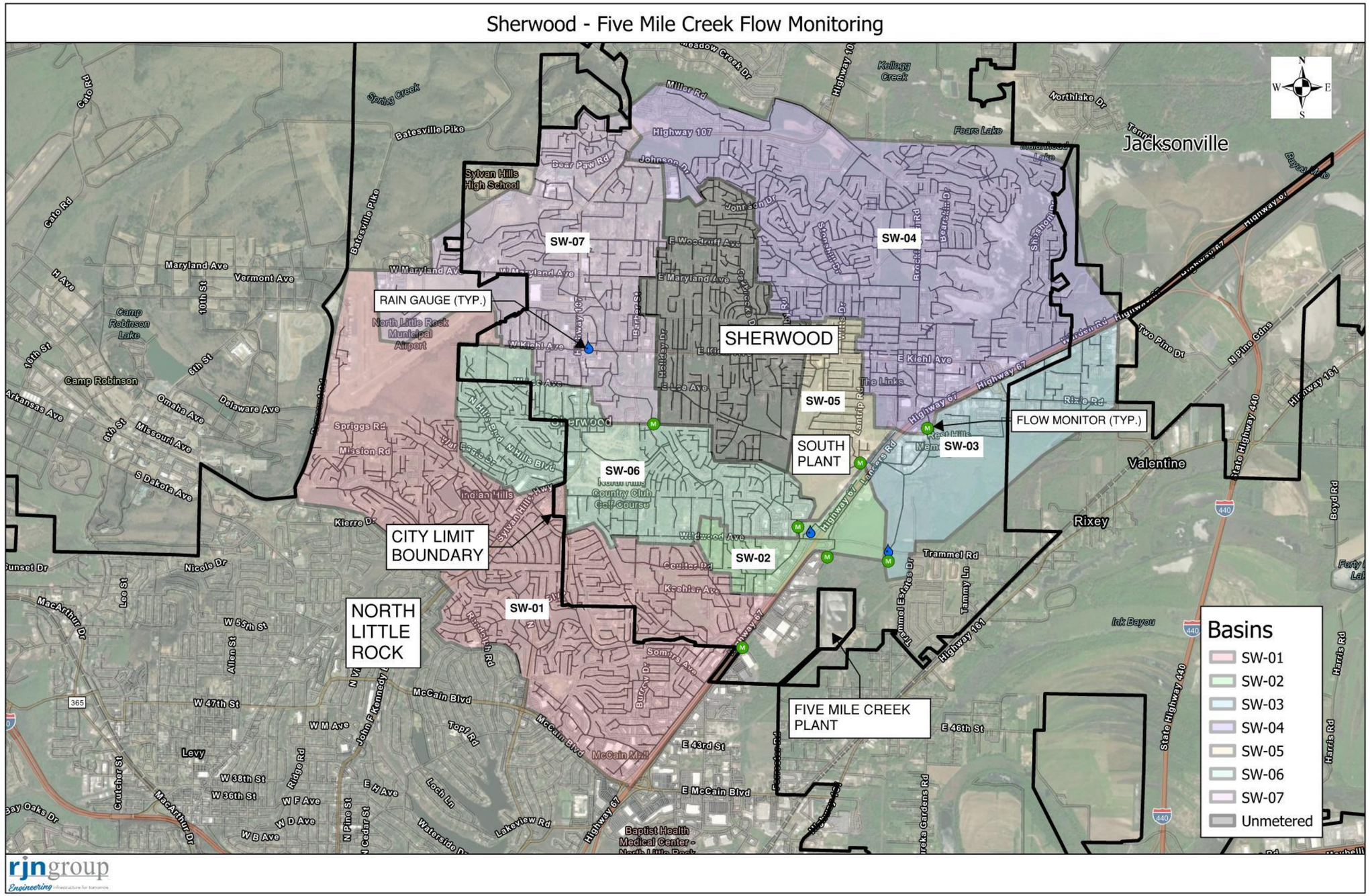


Figure 1-1: Five Mile Creek Basin Study Area

CHAPTER 2 – FLOW MONITORING AND DATA PROCESSING

As part of the overall evaluation of the Five Mile Creek interceptor system, RJN Group, Inc. conducted a flow monitoring program to evaluate sanitary sewer system performance under both dry weather and wet weather conditions. The flow monitors measured sewer flow for 74 days. During the monitoring period, eleven rain events with an average total of 18.25 inches were recorded. The collected data were used to characterize flow conditions throughout the study area, evaluate system response to rainfall events, and identify locations potentially affected by wet weather carrying capacity.

The seven (7) flow monitors and three (3) rain gauges were installed at select sites to capture performance of the sanitary sewer system. The locations of the flow monitors and rain gauges within the sewer system are shown in Figure 1-1 on page 3, and the corresponding flow network is illustrated in Figure 2-1.

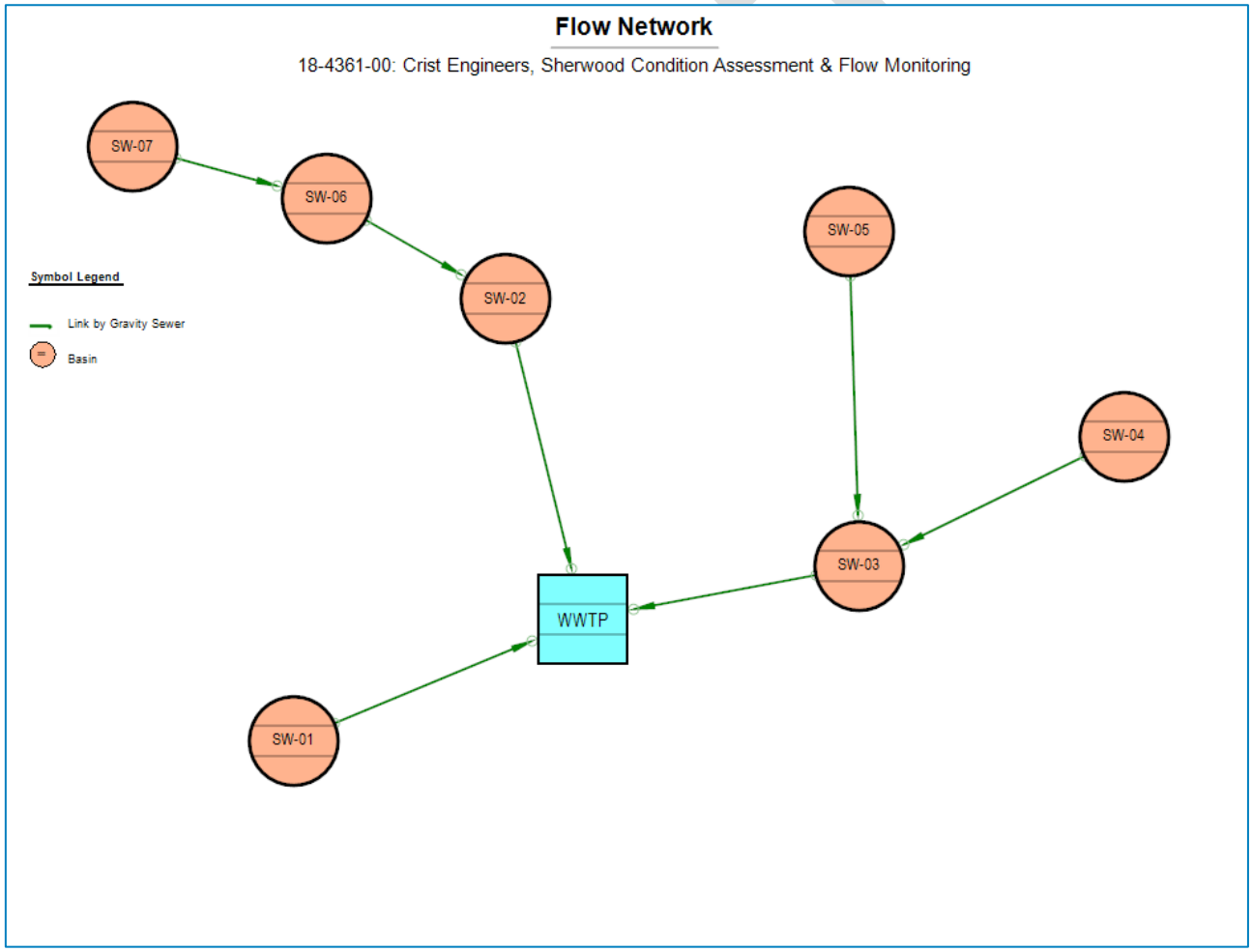


Figure 2-1: Flow Monitoring Network

FLOW MONITORING METHODOLOGY

The seven flow monitors and three rain gauges were active from March 18, 2026, to May 29, 2026, for a total of 74 days. Table 2-1 lists the meter locations by manhole ID and pipe dimensions. The height/width of opening, as indicated on the table, is the measured pipe dimension and does not reflect the nominal pipe size. Variations in the diameter can be caused due to deflections that occur at the mouth of a pipe during manhole installation. The measured pipe diameters/heights ranged from approximately 18-inches to 30-inches.

Flow meters were used to record depth and velocity of flow at five-minute intervals. Engineering review and input of additional calibration data was used to finalize the metered data. Manual depth and velocity readings (velocity profiles) were taken bi-weekly to verify the metered data. Average flow rates for 5-minute intervals were determined for each monitoring location. The average hourly flow rates were used to determine daily dry-weather and wet-weather flow rates. Flow data collected during rainfall events was evaluated to determine peak instantaneous inflow rates.

Table 2-1

Meter Locations

Site Name	Manhole ID	Site Address	Pipe Dimensions	
			Pipe Height (in)	Pipe Width (in)
SW-01	200325	5470 Landers Rd	30.06	29.82
SW-02	200138	6200 Landers Rd	24.86	24.12
SW-03	200121	6408 Waterleaf Ct	30.20	30.58
SW-04	200067	7724 Landers Rd	28.88	29.24
SW-05	200079	7351 Warden Rd	24.18	23.30
SW-06	200148	2404 Wildwood Ave	24.18	23.94
SW-07	200176	2 Greenview Cir	17.50	17.06

Alongside the flow monitoring study, a condition assessment of the large-diameter sewer interceptors within the Sherwood sewer shed was conducted using multi-sensor inspection (MSI). Building on previous inspections completed by the City, RJN performed MSI on the remaining uninspected mainlines. The deployment integrated closed-circuit television (CCTV) for visual defect identification, sonar for submerged debris and pipe geometry profiling below the flow line, and laser profiling and LiDAR to evaluate pipe wall conditions and deformation above the water surface.

RAINFALL RESULTS

Of the eleven recorded rainfall events, six rainfall events exceeded 1-inch of total rainfall within a 24-hour period, with a system-wide average of 18.25 inches of rain across the monitoring period. The most significant event occurred on May 28, 2026. Note that rain gauge SWRG-03 was out of service during this final event and was not calculated to the system average. Individual rain gauge totals and intensities are summarized in Table 2-2. The 5 minute electronic Excel data is provided with this report.

Table 2-2
Rainfall Summary

Date	SWRG-01		SWRG-02		SWRG-03	
	24-hr Precipitation Event	Peak 60-Minute Rainfall Intensity	Total Daily Rainfall	Peak 60-Minute Rainfall Intensity	Total Daily Rainfall	Peak 60-Minute Rainfall Intensity
	(in)	(in/hr)	(in)	(in/hr)	(in)	(in/hr)
4/4/2026	1.86	0.9	1.72	0.72	1.39	0.71
4/24/2026	3.1	0.76	2.05	0.48	1.73	0.29
4/26/2026	0.39	0.3	0.33	0.18	0.38	0.19
4/28/2026	0.9	0.45	0.95	0.95	0.86	0.43
5/6/2026	2.3	1.06	2.4	0.79	1.88	0.57
5/10/2026	0.63	0.39	1.3	0.48	0.89	0.26
5/22/2026	0.71	0.18	0.54	0.28	0.44	0.11
5/26/2026	0.56	0.54	0.2	0.2	0.34	0.09
5/27/2026	0.15	0.12	3.34	1.11	0.17	0.03
5/28/2026	7.2	2.07	5.31	2.62	-	0.02
5/29/2026	0.28	0.11	0.28	0.10	0.22	0.10
Total	**18.08**	**0.63 (Average)**	**18.42**	**0.72 (Average)**	**8.38**	**0.25 (Average)**

FLOW BALANCING QAQC

Flow balancing consisted of verifying downstream meters recording more flow than downstream meters throughout the metered system as a quality control check. Gross flows include contributions from upstream tributary meter locations, while discrete flows exclude upstream tributary meter locations. This flow-balance verification was conducted for all monitoring locations with multiple tributary basins. Figure 2-2 provides a graphical mass-balance comparison between downstream site SW-03 and its upstream contributors, SW-05 and SW-04. Detailed flow balance datasets are provided in Appendix A.

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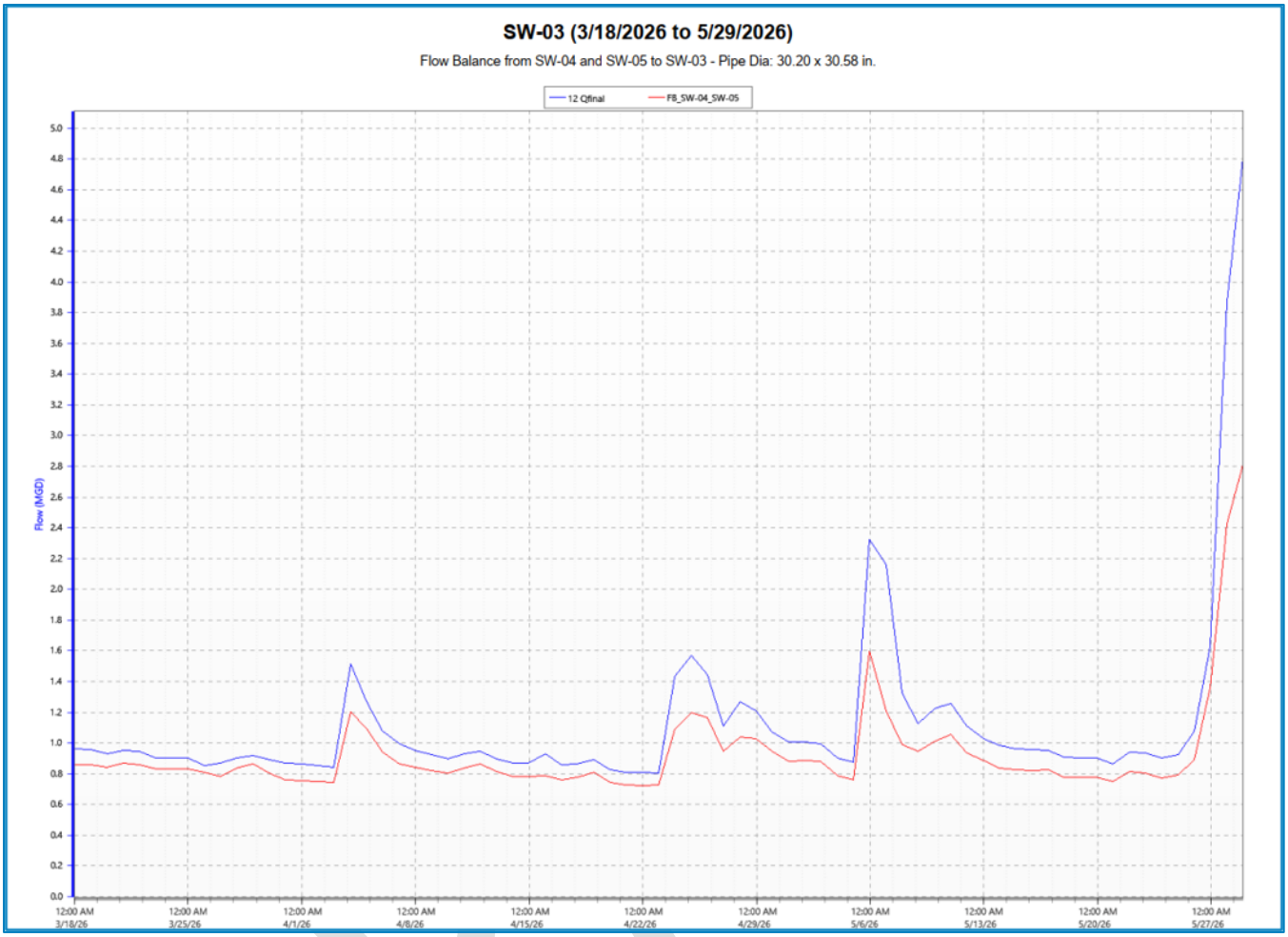


Figure 2-2

FLOW MONITORING ANALYSIS

Average Daily Dry-Weather Flow

Flow data collected during dry-weather/low-groundwater periods was analyzed to determine the average daily dry-weather flow for each meter location. The dry-weather period for this analysis was from March 18, 2026, through April 3, 2026, for all sites. These two weeks were selected due to little to no rainfall recorded during this period.

Wastewater flow during dry-weather periods will vary during the day in response to water consumption. By examining the diurnal curves for each meter, a peaking factor was determined. The peaking factor is the ratio of the peak hourly flow rate and the average daily flow. Typical dry weather peaking factors are between 1.5 and 2.5. The study area dry-weather peaking factors varied from 1.20 to 1.44 and are within the operating bounds. These values are detailed by basin in Table 2-3.

Table 2-3			
DRY-WEATHER PEAKING FACTOR			
Site	**Cumulative ADWF (MGD)**	**Cumulative Peak Hourly Flow Rate (MGD)**	**Dry-Weather Peaking Factor**
SW-01	1.76	2.46	1.40
SW-02	1.79	2.40	1.34
SW-03	0.91	1.26	1.38
SW-04	0.65	0.94	1.44
SW-05	0.17	0.23	1.32
SW-06	1.66	2.31	1.39
SW-07	1.10	1.31	1.20

Wet-weather Peaking Factor

Hydrographs with the average hourly flow rates were prepared to show the response that was present in each meter as a result of Inflow and Infiltration in the area. Figure 2-3 is an example of the hourly flow versus the rain fall in Site SW-01. Wet-weather flow hydrographs are provided in Appendix B along with the daily average, minimum and maximum flow rates.

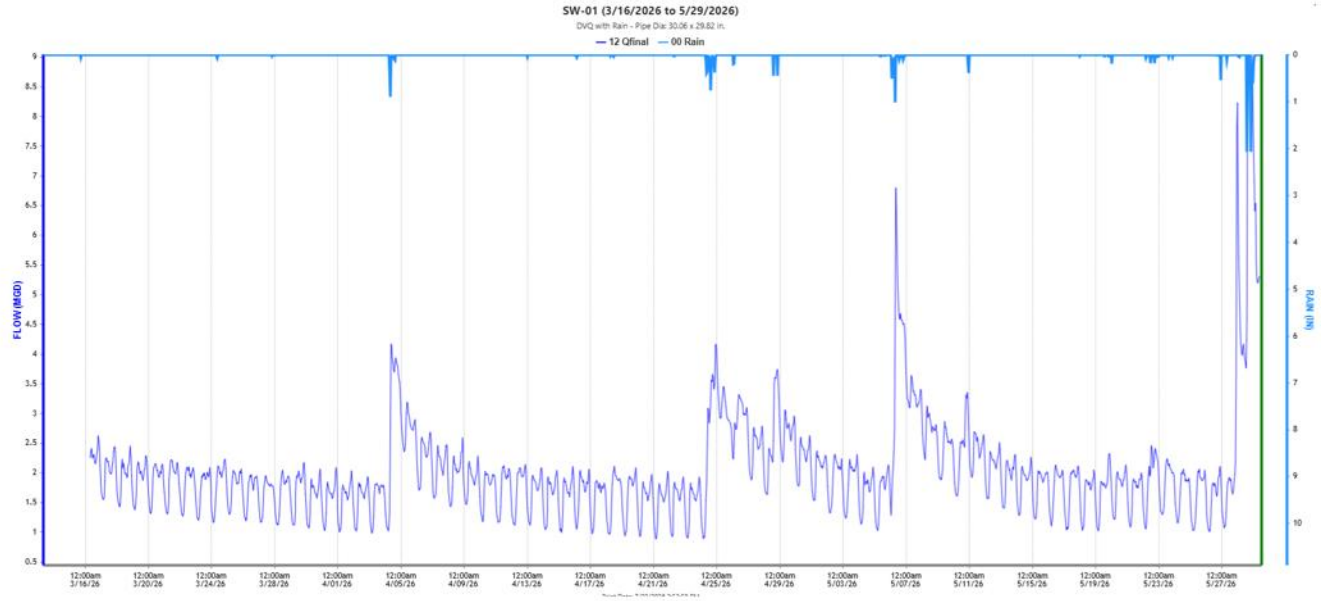


Figure 2-3

The wet-weather peaking factor is a ratio between the peak hourly flow during a rain event compared to the average daily flow during a dry-weather period. A wet-weather peaking factor under 4.00 is typically considered acceptable. The wet-weather peaking factors were calculated based on the total flow rate observed during the

May 6, 2026, storm. While a 50-year storm event was recorded, its extreme intensity makes it unsuitable for evaluating standard system response. Sites SW-03 was the only monitored location that exhibited a wet-weather peaking factor above 4.00. Table 2-4 shows the wet-weather peaking factors for all monitored locations. Figure 2-4 displays the dry weather period leading up to and including the May 6th rain event.

Table 2-4

WET-WEATHER PEAKING FACTOR

Site	Cumulative ADWF (MGD)	Cumulative Peak Hourly Flow Rate (MGD)	Wet-Weather Peaking Factor
SW-01	1.76	6.97	3.97
SW-02	1.79	5.93	3.32
SW-03	0.91	4.03	4.42
SW-04	0.65	2.48	3.80
SW-05	0.17	0.41	2.39
SW-06	1.66	5.63	3.39
SW-07	1.10	3.52	3.21

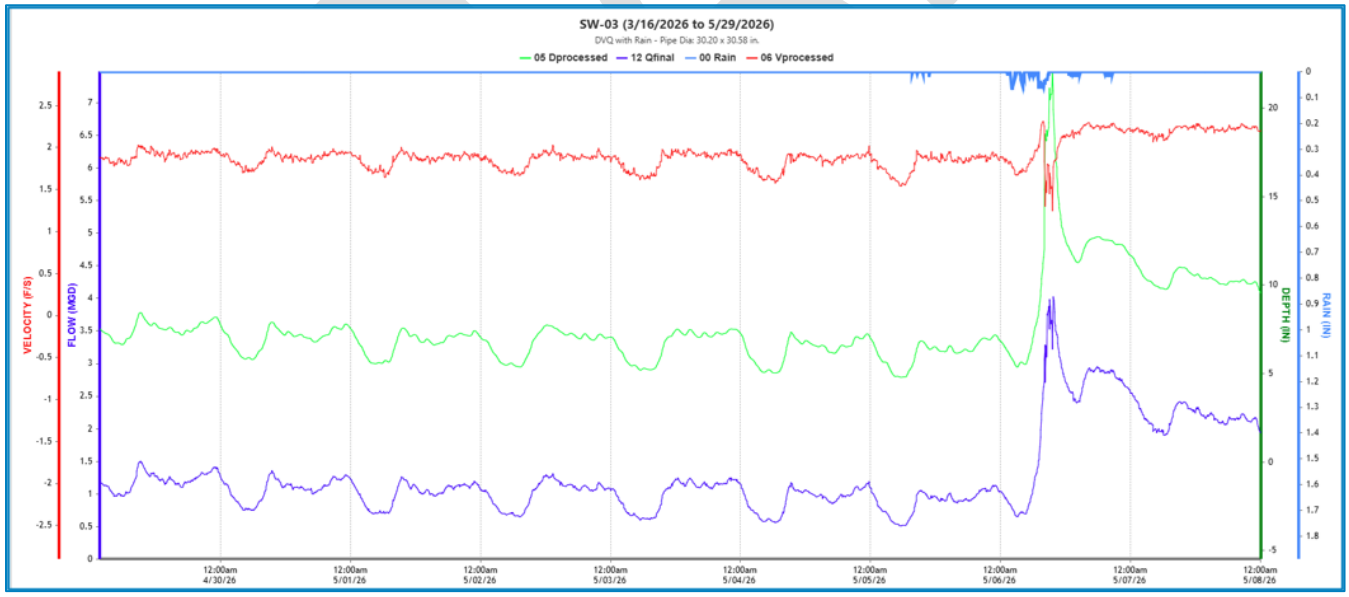


FIGURE 2-4

CHAPTER 3 – HYDRAULIC ANALYSIS

The flow monitoring program identified locations within the Five Mile Creek interceptor system where observed wet weather flows approached or exceeded the estimated carrying capacity of the existing gravity sewer system. To evaluate the significance of these observed flows, an initial hydraulic assessment was performed using available record drawings, GIS information, and theoretical gravity sewer capacities.

Theoretical capacity represents the maximum flow that can be conveyed through a gravity sewer under full-flow conditions and is commonly estimated using Manning's Equation. Manning's Equation relates the flow capacity of a gravity sewer to multiple hydraulic characteristics, including pipe diameter, slope, and pipe roughness. For gravity sewer systems, pipe diameter and slope are generally the primary variables governing hydraulic capacity.

The calculated theoretical capacities were compared to observed dry weather and wet weather flows recorded during the monitoring period to determine the degree of interceptor utilization and identify potential hydraulic restrictions within the system.

INITIAL HYDRAULIC CAPACITY ASSESSMENT

Desktop hydraulic calculations were performed using as-built records and GIS data for the pipe segments stretching from manhole 200176 to 200148. While the sewer main immediately leaving SW-07 has a gravity capacity of 9.13 MGD, a bottleneck exists further downstream, where structural slope and diameter changes restrict the theoretical gravity capacity to just 4.2 MGD.

To evaluate these hydraulic constraints, the measured flow data was compared against the Manning's capacity of the sewer to determine what percent of pipe capacity is used during dry-weather and wet-weather events. This analysis was completed utilizing the provided GIS, the nominal pipe diameters and assuming a Mannings "n" factor of 0.013. The results of the analysis are provided in Table 3-1 below

Table 3-1

Theoretical Capacity Utilization

Site	Nominal Pipe Size (in)	Theoretical Capacity (MGD)	Cumulative ADWF (MGD)	Dry Weather Utilization	Cumulative Peak Hourly Flow Rate (MGD)	Peak Wet Weather Utilization
SW-01	30	18.79	1.76	9%	6.97	37%
SW-02	24	4.15	1.79	43%	5.93	143%
SW-03	30	5.94	0.91	15%	4.03	68%
SW-04	30	14.55	0.65	4%	2.48	17%
SW-05	24	3.88	0.17	4%	0.41	11%
SW-06	24	4.15	1.66	40%	5.63	136%
SW-07	18	4.12	1.1	30%	3.52	94%

Under average dry-weather flow, all sites operate within their theoretical capacity. However, during peak wet-weather events, pipe utilization for sites SW-02 and SW-06 exceeds theoretical capacity, while SW-07 approaches capacity. The results of the initial hydraulic assessment indicated that portions of the interceptor system may be

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hydraulically deficient during wet weather conditions. Because the calculated capacities were based on record information and GIS data, additional field investigation was performed to verify interceptor geometry and develop a more representative assessment of system capacity based on surveyed field conditions.

UPDATED HYDRAULIC ANALYSIS FROM SURVEY FINDINGS

While peak wet weather flows were established through its flow monitoring program, the evaluation of system capacity was refined using field survey information collection throughout the study corridor.

For the interceptor evaluated in this study, pipe diameter and pipe slope are the primary variables influencing theoretical capacity. Larger diameter pipes provide greater cross-sectional flow area, while steeper slopes increase flow velocity and overall conveyance capacity. Conversely, flatter slopes reduce hydraulic capacity, even when pipe diameters remain unchanged.

A review of available record information indicated that much of the interceptor consisted of 24-inch gravity sewer installed at or near minimum allowable design slope. However, field survey data collected as part of this study identified discrepancies between record information and actual field conditions. Survey results indicated that some pipe segments have slopes greater than the assumed minimum slope, some have slopes less than the assumed minimum slope, and multiple segments exhibit negative slope conditions. In addition, minor discrepancies in recorded pipe diameters were identified in certain locations.

Because pipe slope has an influence on hydraulic capacity, the surveyed invert elevations were utilized to calculate actual pipe slopes between manholes. Manning's Equation was then applied using the field-verified pipe sizes and slopes to develop updated theoretical capacities for each interceptor segment. The resulting capacities provide a more representative assessment of existing system performance than capacities developed solely from record information and indicate that multiple segments have less available capacity than previously estimated due to adverse grades and negative slope conditions.

Figure 3-1 shows the surveyed field area between SW-06 and SW-02 where the identified deficiencies occur. Each pipe segment shown on the site plan has a calculated theoretical capacity below the peak wet-weather flow rate identified for its respective site. Approximately 70% of the surveyed gravity sewer interceptor is below the required capacity, of that, nearly 10% of the surveyed area has an inverse slope in opposition to the direction of flow, and 28% of the surveyed area was installed at slopes less than the minimum recommended by Ten State Standards (TSS) guidance.

From Figure 3-1, the green-shaded entries denote pipe segments located within Basin SW-06 that are under capacity, while the blue-shaded entries denote downstream pipe segments located within Basin SW-02 that are under capacity.

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ITEM	PIPE DESIGNATION	SITE	DIAMETER (IN)	SLOPE	CAPACITY (MGD)
1	200167-200164	SW-06			7.95
2	200164-200163	SW-06	24	0.59%	11.28
3	**200163-2000162**	**SW-06**	**24**	**0.08%**	**4.26**
4	200162-200161	SW-06	24	0.97%	14.47
5	**200161-200160**	**SW-06**	**24**	**0.11%**	**4.82**
6	**200159-200158**	**SW-06**	**24**	**0.09%**	**4.30**
7	**200158-200157**	**SW-06**	**24**	**0.08%**	**4.21**
8	200157-204498	SW-06	24	1.27%	16.52
9	204497-200156	SW-06	24	1.20%	16.06
10	**200156-200155**	**SW-06**	**24**	**-0.13%**	**ADV. SLOPE**
11	200155-200154	SW-06	24	0.17%	6.12
12	200154-200153	SW-06	24	0.19%	6.33
13	**200153-200152**	**SW-06**	**24**	**0.05%**	**3.27**
14	**200152-200151**	**SW-06**	**24**	**0.08%**	**4.08**
15	**200151-200150**	**SW-06**	**24**	**0.04%**	**2.97**
16	**200150-205134**	**SW-06**	**24**	**0.07%**	**3.98**
17	**200437-200438**	**SW-02**	**24**	**0.08%**	**4.26**
18	**200438-200439**	**SW-02**	**24**	**0.05%**	**3.29**
19	**200439-200149**	**SW-02**	**24**	**0.02%**	**2.03**
20	**200149-200148**	**SW-02**	**24**	**0.07%**	**3.96**
21	200148-205264	SW-02	20	0.45%	6.07
22	205264-200147	SW-02	20	1.84%	12.22
23	**200147-205265**	**SW-02**	**24**	**-0.05%**	**ADV. SLOPE**
24	**205265-200146**	**SW-02**	**24**	**-0.03%**	**ADV. SLOPE**
25	**200146-200145**	**SW-02**	**24**	**-0.06%**	**ADV. SLOPE**
26	**200145-200144**	**SW-02**	**24**	**0.09%**	**4.44**
27	**200144-200143**	**SW-02**	**24**	**0.15%**	**5.66**
28	**200143-200142**	**SW-02**	**24**	**-0.04%**	**ADV. SLOPE**
29	**200142-200141**	**SW-02**	**24**	**0.11%**	**4.81**
30	**200141-200140**	**SW-02**	**24**	**0.03%**	**2.70**
31	**200140-200139**	**SW-02**	**24**	**0.07%**	**4.00**
32	**200139-200138**	**SW-02**	**24**	**0.13%**	**5.33**
33	**200138-200137**	**SW-02**	**24**	**0.05%**	**3.21**
34	**200137-200136**	**SW-02**	**24**	**0.09%**	**4.31**



MANHOLES				
ITEM	MH. DESIGNATION	RIM ELEV.	INV. IN.	INV. OUT.
A	22800	268.63	256.58	255.42
B	22790	265.59	253.48	253.17
C	22480	266.96	252.84	252.79
D	22470	267.13	251.88	251.79
E	22460	265.02	251.52	251.48
F	22440	280.03	250.98	250.91
G	22430	263.49	250.58	250.56
H	22000	254.00	246.31	246.31
I	21990	251.57	245.54	243.97
J	21980	252.48	244.17	244.16
K	21970	255.76	243.38	243.55
L	21940	254.86	243.48	243.59
M	21930	256.17	243.41	243.2
N	21910	257.54	242.82	242.66
O	21900	255.13	242.63	242.59
P	21890	256.21	242.29	242.3
Q	21880	253.57	241.99	241.95
R	21871	253.59	241.81	241.66
S	21871A	255.46	241.62	241.71
T	21870	252.04	241.52	241.44
U	21861	250.50	239.55	239.72
V	21860	250.31	239.46	239.28
W	21240	250.24	239.34	239.21
X	21230	251.77	239.29	238.94
Y	21230A	251.73	239.01	238.98
Z	21230B	253.35	238.77	238.73
AA	21220	252.35	238.58	238.65
BB	162215A	248.80	238.72	238.65
CC	16215	248.63	238.42	238.37
DD	16220	246.75	238.26	238.23
EE	16230	248.90	238.1	238.11
FF	16250	250.02	237.76	237.7
GG	16240	247.51	237.53	237.42
HH	200136	250.67	237.08	236.85

CRIST ENGINEERS, INC.
CONSULTING ENGINEERS LITTLE ROCK, ARKANSAS
SHERWOOD, ARKANSAS
SHERWOOD REHAB

OVERALL SITE PLAN

DESIGNED:	JPS	JOB NO.	25044	DATE	NOV 2021	ADD. NO.	
DRAFTED:	SBM	SCALE:				SHEET NO.	----
CHECKED:	CAJ						

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P:\2025 Projects\25044 - City of Sherwood - 24-in Rehabilitation\06 - CAD\D01 - Civil\25044 - Overall Site Plan.dwg 9/25/2026 9:04 AM

Figure 3-1: Surveyed Interceptor with Identified Hydraulic Capacity Deficiencies

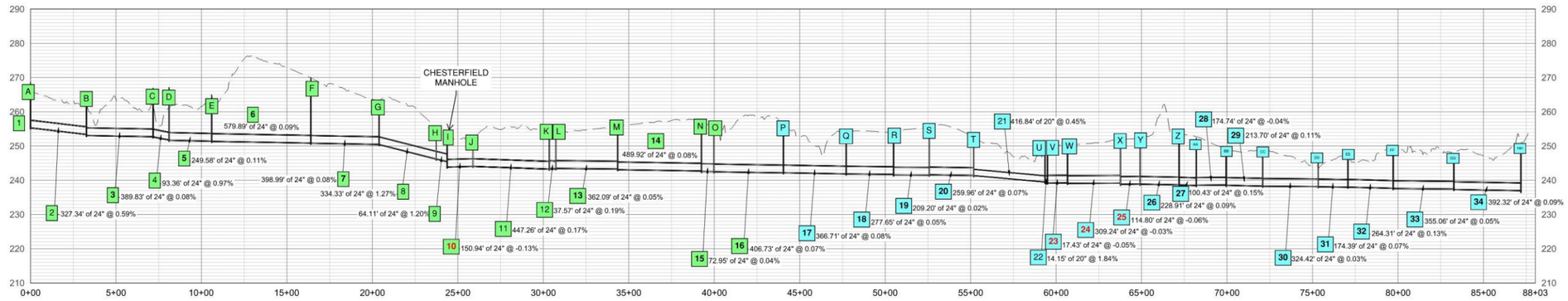
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GRAVITY SEWER PIPES					
ITEM	PIPE DESIGNATION	DIAMETER (IN)	LENGTH (FT)	SLOPE	CAPACITY (MGD)
1	200167-200164	24			7.95
2	200164-200163	24	327.34	0.59%	11.28
3	200163-2000162	24	389.83	0.08%	4.26
4	200162-200161	24	93.36	0.97%	14.47
5	200161-200160	24	249.58	0.11%	4.82
6	200159-200158	24	579.89	0.09%	4.30
7	200158-200157	24	398.99	0.08%	4.21
8	200157-204498	24	334.33	1.27%	16.52
9	204497-200156	24	64.11	1.20%	16.06
10	200156-200155	24	150.94	-0.13%	5.28
11	200155-200154	24	447.23	0.17%	6.12
12	200154-200153	24	37.57	0.19%	6.33
13	200153-200152	24	362.09	0.05%	3.27
14	200152-200151	24	489.92	0.08%	4.08
15	200151-200150	24	72.95	0.04%	2.97
16	200150-205134	24	406.73	0.07%	3.98

GRAVITY SEWER PIPES					
ITEM	PIPE DESIGNATION	DIAMETER (IN)	LENGTH (FT)	SLOPE	CAPACITY (MGD)
17	200437-200438	24	366.71	0.08%	4.26
18	200438-200439	24	277.64	0.05%	3.29
19	200439-200149	24	209.2	0.02%	2.03
20	200149-200148	24	259.96	0.07%	3.96
21	200148-205264	20	416.84	0.45%	6.07
22	205264-200147	20	14.15	1.84%	12.22
23	200147-205265	24	117.43	-0.05%	3.28
24	205265-200146	24	309.24	-0.03%	2.54
25	200146-200145	24	114.8	-0.06%	3.59
26	200145-200144	24	228.91	0.09%	4.44
27	200144-200143	24	100.43	0.15%	5.66
28	200143-200142	24	174.74	-0.04%	2.93
29	200142-200141	24	213.7	0.11%	4.81
30	200141-200140	24	324.42	0.03%	2.70
31	200140-200139	24	174.39	0.07%	4.00
32	200139-200138	24	264.31	0.13%	5.33
33	200138-200137	24	355.06	0.05%	3.21
34	200137-200136	24	392.32	0.09%	4.31

MANHOLES				
ITEM	MH. DESIGNATION	RIM ELEV.	INV. IN.	INV. OUT.
A	22800	268.63	256.58	255.42
B	22790	265.59	253.48	253.17
C	22480	266.96	252.84	252.79
D	22470	267.13	251.88	251.79
E	22460	265.02	251.52	251.48
F	22440	280.03	250.98	250.91
G	22430	263.49	250.58	250.56
H	22000	254.00	246.31	246.31
I	21990	251.57	245.54	243.97
J	21980	252.48	244.17	244.16
K	21970	255.76	243.38	243.55
L	21940	254.86	243.48	243.59
M	21930	256.17	243.41	243.2
N	21910	257.54	242.82	242.66
O	21900	255.13	242.63	242.59

MANHOLES				
ITEM	MH. DESIGNATION	RIM ELEV.	INV. IN.	INV. OUT.
P	21890	256.21	242.29	242.3
Q	21880	253.57	241.99	241.95
R	21871	253.59	241.81	241.66
S	21871A	255.46	241.62	241.71
T	21870	252.04	241.52	241.44
U	21861	250.50	239.55	239.72
V	21860	250.31	239.46	239.28
W	21240	250.24	239.34	239.21
X	21230	251.77	239.29	238.94
Y	21230A	251.73	239.01	238.98
Z	21230B	253.35	238.77	238.73
AA	21220	252.35	238.58	238.65
BB	162215A	248.80	238.72	238.65
CC	16215	248.63	238.42	238.37
DD	16220	246.75	238.26	238.23
EE	16230	248.90	238.1	238.11
FF	16250	250.02	237.76	237.7
GG	16240	247.51	237.53	237.42
HH	200136	250.67	237.08	236.85



EXISTING GRAVITY SEWER PROFILE

0 300'

1" = 300'

CRIST ENGINEERS, INC.
CONSULTING ENGINEERS LITTLE ROCK, ARKANSAS

SHERWOOD, ARKANSAS

SHERWOOD REHAB

OVERALL EXISTING GRAVTY SEWER PROFILE

DESIGNED:	JOB NO.	DATE	ADD. NO.
JPS	25044	NOV 2021	
DRAFTED: SBM	SCALE:		SHEET NO. ----
CHECKED: CAJ			

P:\2025 Projects\25044 - City of Sherwood - 24-in Rehabilitation\06 - CADD\01 - Civil\25044 - Overall Site Plan.dwg 9/25/2026 9:04 AM

Figure 3-2: Surveyed Interceptor Profile

Figure 3-2 presents the longitudinal profile of the surveyed interceptor. The Chesterfield Manhole (MH 21980), identified as Point "I" on Figures 3-1 and 3-2, has been identified as a location that experiences recurring sanitary sewer overflows during wet weather events. Review of the profile indicates that the upstream 24-inch interceptor enters the manhole at a slope greater than the minimum recommended design slope, providing adequate conveyance capacity to the structure. However, the downstream interceptor segment exhibits an adverse (negative) slope condition, creating a hydraulic restriction immediately downstream of the manhole.

As a result, flow conveyed to the manhole exceeds the capacity of the downstream interceptor during elevated flow conditions, causing surcharging within the manhole and contributing to overflow events. The hydraulic restriction is further compounded by the relatively low ground elevation at the manhole location, which limits the available surcharge storage volume. While increasing manhole depth or height could provide additional temporary storage, such an approach would not address the underlying conveyance deficiency and would only relocate surcharge conditions elsewhere within the interceptor system.

The interceptor profile also illustrates the generally flat grades present throughout much of the study corridor. These minimal slopes, combined with multiple adverse-grade segments, support the theoretical capacity analysis and indicate that available hydraulic capacity is constrained by existing interceptor geometry rather than pipe diameter alone.

Table 3-2 summarizes the surveyed pipe characteristics, calculated slopes, and resulting theoretical capacities, converted to million gallons per day, for each interceptor segment. The bolded entries identify gravity sewer segments with calculated theoretical capacities that are less than the observed peak wet weather flows and are therefore considered capacity deficient. The red bolded entries identify segments exhibiting adverse (negative) slopes, where the downstream invert elevation exceeds the upstream invert elevation. These conditions impede gravity flow and reduce the available hydraulic capacity of the interceptor.

Based on the surveyed slopes and pipe diameters, multiple interceptor segments were found to have theoretical capacities below the observed peak wet weather flows identified by RJN. The lowest calculated capacity among positively sloped segments was approximately 2.03 MGD for Pipe Segment 200439-200149. In addition, multiple interceptor segments were identified with adverse slopes, indicating locations where the downstream invert elevation is higher than the upstream invert elevation. These segments are not favorable to normal gravity flow and are expected to create localized surcharge conditions during elevated flow events.

As a result, the interceptor contains multiple hydraulic restrictions that limit its ability to convey the observed peak wet weather flows of 5.63 MGD within Basin SW-06 and 5.93 MGD within Basin SW-02. The presence of multiple adverse-grade segments further suggests that the effective hydraulic capacity of the interceptor is less than would be predicted by Manning's Equation alone. Therefore, the interceptor is considered hydraulically deficient under peak wet weather conditions and requires capacity improvements to provide reliable conveyance during wet weather events.

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Table 3-2

Calculated Theoretical Capacity from Surveyed Data

ITEM	PIPE DESIGNATION	SITE	DIAMETER (IN)	SLOPE	CAPACITY (MGD)
1	200167-200164	SW-06			7.95
2	200164-200163	SW-06	24	0.59%	11.28
3	200163-2000162	SW-06	24	0.08%	4.26
4	200162-200161	SW-06	24	0.97%	14.47
5	200161-200160	SW-06	24	0.11%	4.82
6	200159-200158	SW-06	24	0.09%	4.30
7	200158-200157	SW-06	24	0.08%	4.21
8	200157-204498	SW-06	24	1.27%	16.52
9	204497-200156	SW-06	24	1.20%	16.06
10	200156-200155	SW-06	24	-0.13%	INV. SLOPE
11	200155-200154	SW-06	24	0.17%	6.12
12	200154-200153	SW-06	24	0.19%	6.33
13	200153-200152	SW-06	24	0.05%	3.27
14	200152-200151	SW-06	24	0.08%	4.08
15	200151-200150	SW-06	24	0.04%	2.97
16	200150-205134	SW-06	24	0.07%	3.98
17	200437-200438	SW-02	24	0.08%	4.26
18	200438-200439	SW-02	24	0.05%	3.29
19	200439-200149	SW-02	24	0.02%	2.03
20	200149-200148	SW-02	24	0.07%	3.96
21	200148-205264	SW-02	20	0.45%	6.07
22	205264-200147	SW-02	20	1.84%	12.22
23	200147-205265	SW-02	24	-0.05%	INV. SLOPE
24	205265-200146	SW-02	24	-0.03%	INV. SLOPE
25	200146-200145	SW-02	24	-0.06%	INV. SLOPE
26	200145-200144	SW-02	24	0.09%	4.44
27	200144-200143	SW-02	24	0.15%	5.66
28	200143-200142	SW-02	24	-0.04%	INV. SLOPE
29	200142-200141	SW-02	24	0.11%	4.81
30	200141-200140	SW-02	24	0.03%	2.70
31	200140-200139	SW-02	24	0.07%	4.00
32	200139-200138	SW-02	24	0.13%	5.33
33	200138-200137	SW-02	24	0.05%	3.21
34	200137-200136	SW-02	24	0.09%	4.31

HYDRAULIC MODELING

A hydraulic model of the surveyed interceptor system was developed using Autodesk Civil 3D Storm and Sanitary Analysis (SSA). The gravity sewer network was constructed using the surveyed manhole rim elevations, invert elevations, pipe diameters, and pipe lengths obtained during the field investigation. SSA is a dynamic hydraulic modeling program used to simulate flow conditions within stormwater and sanitary sewer collection systems. The

software computes hydraulic grade lines (HGLs), flow depths, velocities, and surcharge conditions throughout a pipe network based on user-defined pipe characteristics, boundary conditions, and flow inputs.

A baseline sanitary flow was applied to the upstream manhole to establish initial system conditions. To evaluate wet weather performance, a two-hour flow event was simulated using the peak wet weather flows identified through the flow monitoring program. For Basin SW-06, a total flow of 5.63 MGD was applied at the upstream end of the interceptor. At the location where flows from Basin SW-02 enter the interceptor system, additional flow was introduced to increase the total downstream flow to 5.93 MGD, consistent with the peak wet weather flow observed within that basin.

The downstream end of the model was represented using a free-discharge boundary condition at the last surveyed manhole. This boundary condition does not replicate actual downstream system operation, as the interceptor continues beyond the limits of the surveyed study area and may be influenced by downstream surcharge conditions. Consequently, the model results should be considered a planning-level representation of interceptor performance within the study limits and not a complete representation of system-wide hydraulic behavior.

The hydraulic model was developed to evaluate relative system performance under existing and proposed conditions and to provide a graphical representation of flow behavior within the interceptor. Three modeling scenarios were analyzed:

- Scenario 1: Existing interceptor system with no improvements.
- Scenario 2: Existing interceptor system with a parallel gravity sewer section and associated manholes constructed within the vicinity of the Chesterfield Manhole.
- Scenario 3: Existing interceptor system with a parallel gravity sewer constructed along the full length of the studied interceptor corridor.

Additional information regarding the proposed parallel sewer improvements is provided in Chapter 6.

Figure 3-3 presents the hydraulic profiles for Scenarios 1 and 2. The blue-shaded area represents the baseline flow depth within the interceptor, while the red line represents the calculated hydraulic grade line during the simulated wet weather event. Under both scenarios, the first modeled overflow condition occurs at the Chesterfield Manhole. In Scenario 1, the modeled overflow condition occurs for approximately one hour during the two-hour flow event. In Scenario 2, the modeled overflow duration is reduced to approximately five minutes during the same event.

Figure 3-4 presents the hydraulic profile for Scenario 3. As in Figure 3-3, the blue-shaded area represents baseline flow conditions, and the red line represents the hydraulic grade line during the simulated wet weather event. Under the assumptions of the model, no overflow conditions were identified within the study area during the simulated two-hour flow event for Scenario 3.

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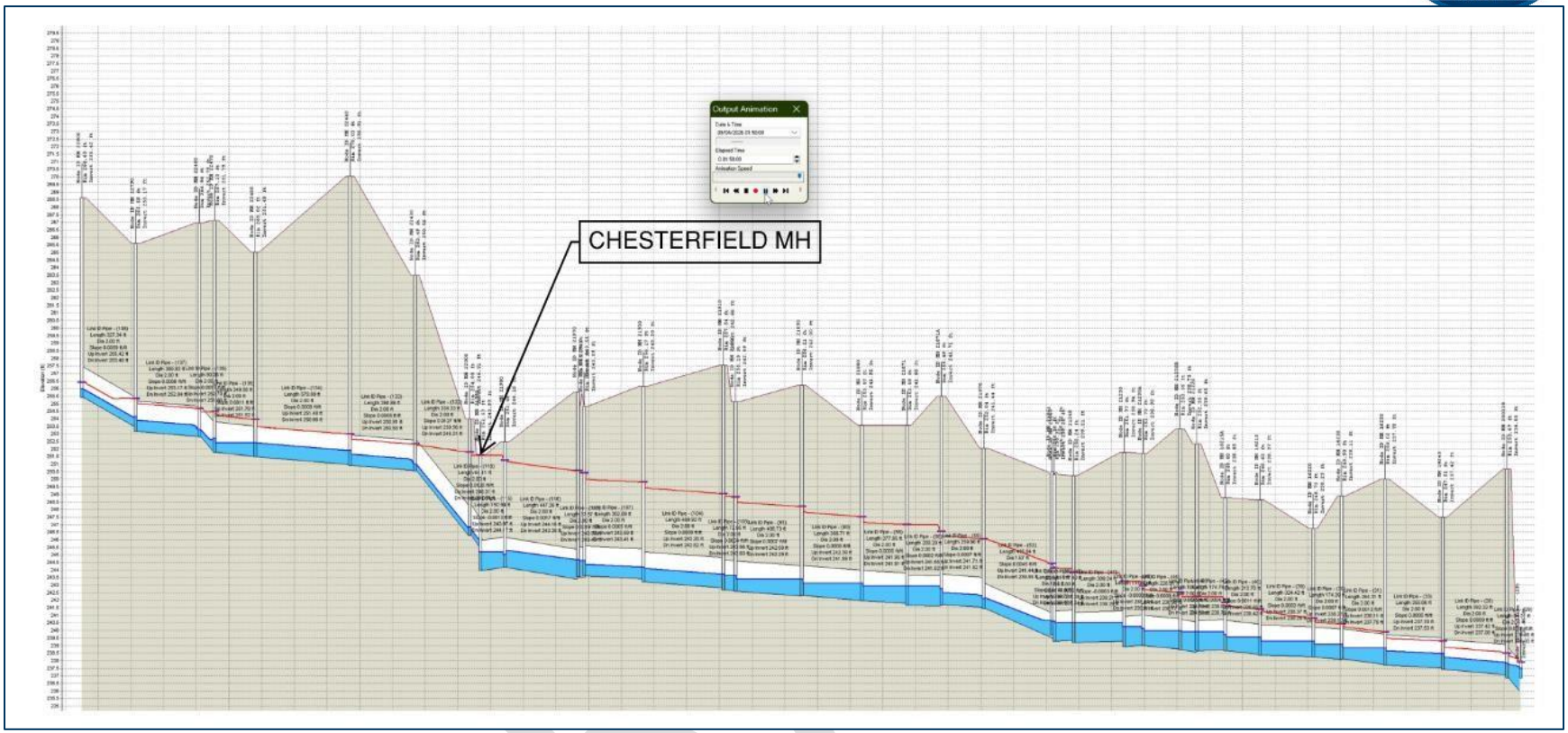


Figure 3-3: SSA Hydraulic Model Profile – Existing Conditions and Phase 1 Improvements

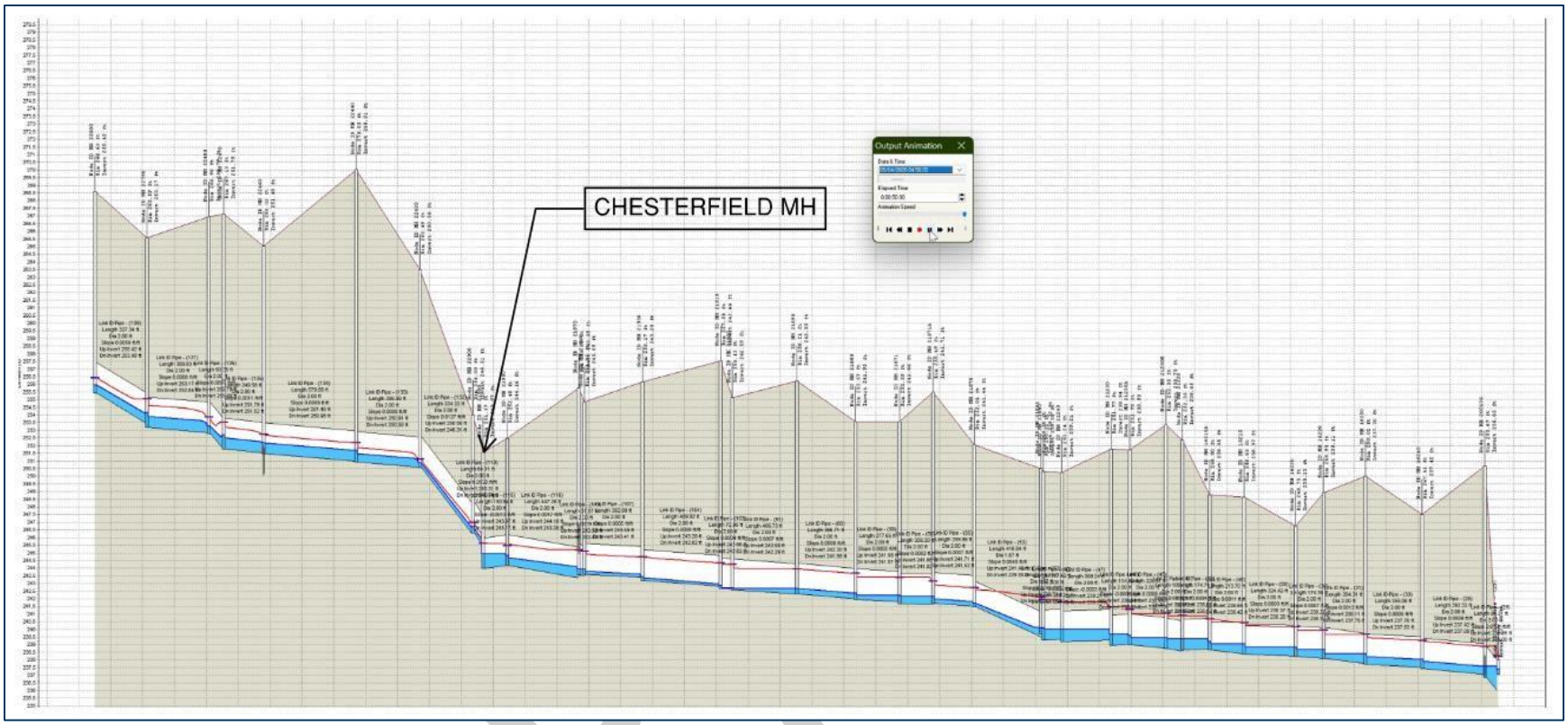


Figure 3-4: SSA Hydraulic Model – Full Parallel 24-Inch Gravity Sewer

CHAPTER 4 – CONDITION ASSESSMENT

MULTI SENSOR INSPECTION (MSI)

A total of 18,236 linear feet of sewer pipe was reviewed by RJN via CCTV. Of these, 2,659 linear feet represent lines previously inspected by ACE. Both newly collected CCTV findings and historical inspection records were evaluated to complete the assessment. CCTV analysis revealed 165 total defects, with 127 defects directly associated with infiltration. Additionally, the inspection identified 22 surface damage defects, 8 instances of defective sealing material, and 8 instances of obstacles in the pipe. While these do not directly contribute to system infiltration, they do affect the useful asset life of the pipe.

DETERMINATION OF INFILTRATION

Infiltration in a sanitary sewer system is defined as extraneous flow that enters the system through pipe joints and sewer line defects (including main sewer lines and building sewer lines). Two types of infiltration can be determined during a study: permanent infiltration and peak infiltration. Permanent infiltration is defined as extraneous flow that enters the system through the ground during periods of dry weather and low groundwater. Peak infiltration is defined as the maximum extraneous flow that enters the sewer system during high groundwater conditions due to a rain event.

INFILTRATION SOURCE QUANTIFICATION

Each of the infiltration sources identified during CCTV were evaluated and quantified in reference to the corresponding line segment. The sum of the observed infiltration sources is referred to as total identified infiltration. Where active infiltration was observed the estimated infiltration rate was estimated visually. For other defects a standard infiltration estimate was applied based on defect type. Total identified infiltration was estimated to be 42,048 gpd and is summarized by source type in Table 4-1.

Table 4-1

Distribution of Identified Infiltration Sources

Source	Quantity	Estimated Infiltration Rate (gpd)	Percent of Total Infiltration
Breaks	2	1,938	4.61%
Cracks/Fractures	24	7,858	18.69%
Holes	1	1,184	2.82%
Infiltration	85	32,124	76.40%
Roots	15	883	2.10%
Total	**127**	**42,048**	**100%**

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SEWER REPLACEMENT/REHABILITATION

Television inspection data was evaluated for repair of specific I/I and maintenance defects. This typically involves broken, fractured, or cracked pipes. The targeted I/I removal for these defects is 42,048 gpd. Maintenance defects include sections of pipe with sags, root intrusion, or other defects. Maintenance defects justify repair or replacement based upon their potential to cause future maintenance problems in the sewer system. These defects may not be large sources of I/I and would not be recommended for repair based on I/I removal alone but are recommended for repair to improve system reliability.

Sewer segments were recommended for either complete rehabilitation or point repair(s). Generally, point repair(s) are recommended if it will affect 10 percent or less of the total pipe; if it exceeds this amount, a complete rehabilitation of the pipe is also considered. Other considerations included are known problem areas, diameter of the pipe, and recommendation of adjacent segments.

Point repairs are recommended for one pipe, accounting for approximately 285 linear feet, and complete rehabilitation/replacement is recommended for 23 pipes (6,432 linear feet).

It should be emphasized that the rehabilitation of the line segments will improve collection system performance and system reliability, in addition to the assistance of reducing overflows by reducing I/I. Table 4-2 summarizes the preliminary line recommended remedial measures with Figure 4-1 illustrates their locations. It should also be noted that CIPP may not be ideal for segments experiencing hydraulic capacity issues, as the reduction in inner pipe diameter could further restrict flow capacity.

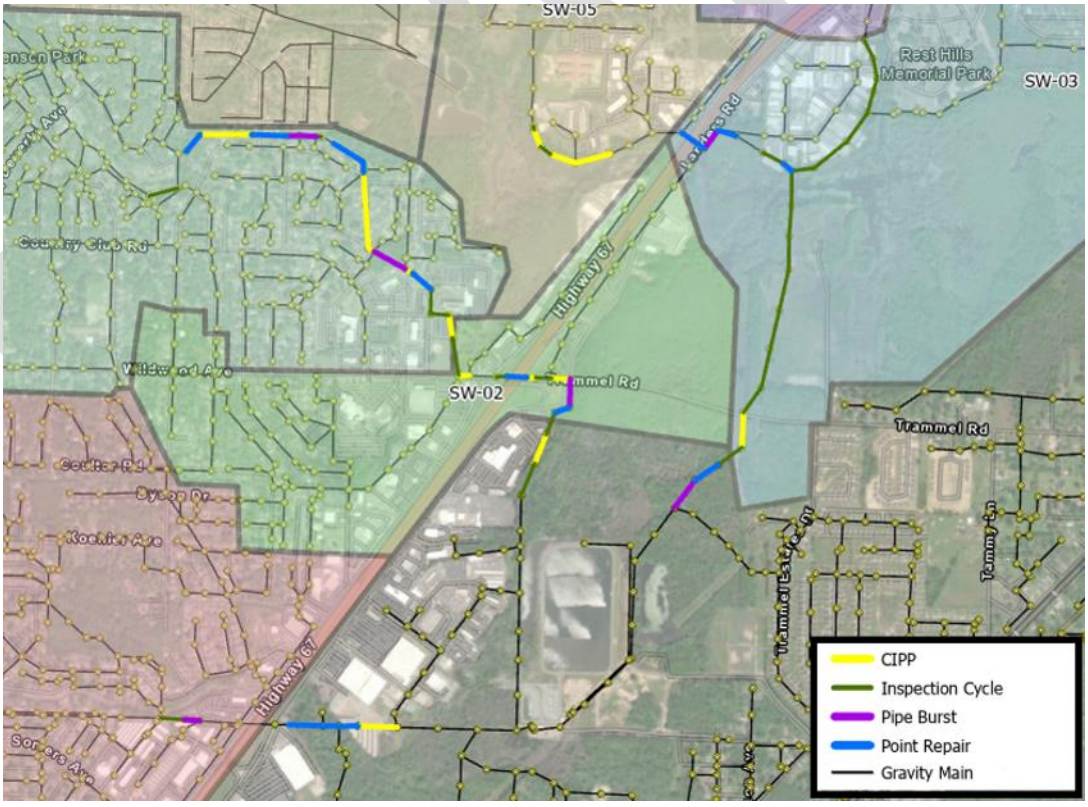


FIGURE 4-1

Table 4-2
Summary of Lines Recommended for Rehabilitation

	CIPP		Pipe Bursting		Point Repair		Estimated Construction Cost	Estimated Capital Cost
	Number of Lines	*Length (lf)*	*Number of Lines*	*Length (lf)*	*Number of Lines*	*Length (lf)*		
Total	17	4,569	6	1,863	16	285	$722,498	$939,247

Based on our evaluation of the CCTV inspections, the estimated cost per volume of I/I removed yields an effectiveness ratio of $22.36 per gpd of infiltration removed, assuming one hundred percet reduction. While repair recommendations and cost estimates have been compiled, these structural line repairs are not recommended as high-priority projects. Furthermore, structural rehabilitation should be deferred for any line segments identified for future upsizing to prevent redundant capital expenditures.

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CHAPTER 5 – INTERCEPTOR IMPROVEMENTS

Preliminary improvement alternatives were identified to address the hydraulic deficiencies within the interceptor system. As discussed in Chapter 3, hydraulic modeling was completed using several configurations of parallel interceptor improvements to evaluate their effect on system performance. The modeled improvements included a localized parallel interceptor in the vicinity of the Chesterfield Manhole and a parallel interceptor extending along the full length of the study corridor.

The modeling scenarios were developed to evaluate system performance under incremental levels of improvement; however, the modeled configurations should not be viewed as independent alternatives. Rather, they represent successive phases of a comprehensive interceptor improvement program. The hydraulic evaluation indicates that long-term improvement of interceptor performance and reliability requires construction of a parallel interceptor extending throughout the study corridor. Accordingly, the proposed improvements have been organized into multiple phases to support future implementation.

Phase 1 consists of construction of a parallel gravity sewer and associated manholes in the vicinity of the Chesterfield Manhole. This phase targets the area most directly associated with recurring surcharge and overflow conditions. Under the modeled peak wet weather event, implementation of this phase reduced the modeled overflow duration at the Chesterfield Manhole from approximately one hour to approximately five minutes during a two-hour peak flow event.

The remaining interceptor improvements identified in the full parallel interceptor model have been divided into additional implementation phases. Multiple preliminary alignments were evaluated to provide flexibility for future design, permitting, easement acquisition, and construction considerations. These subsequent phases collectively establish the full parallel interceptor system evaluated in the hydraulic model.

Figure 5-1 illustrates the proposed phased improvements and identifies the preliminary alignments associated with each phase and alternate route.

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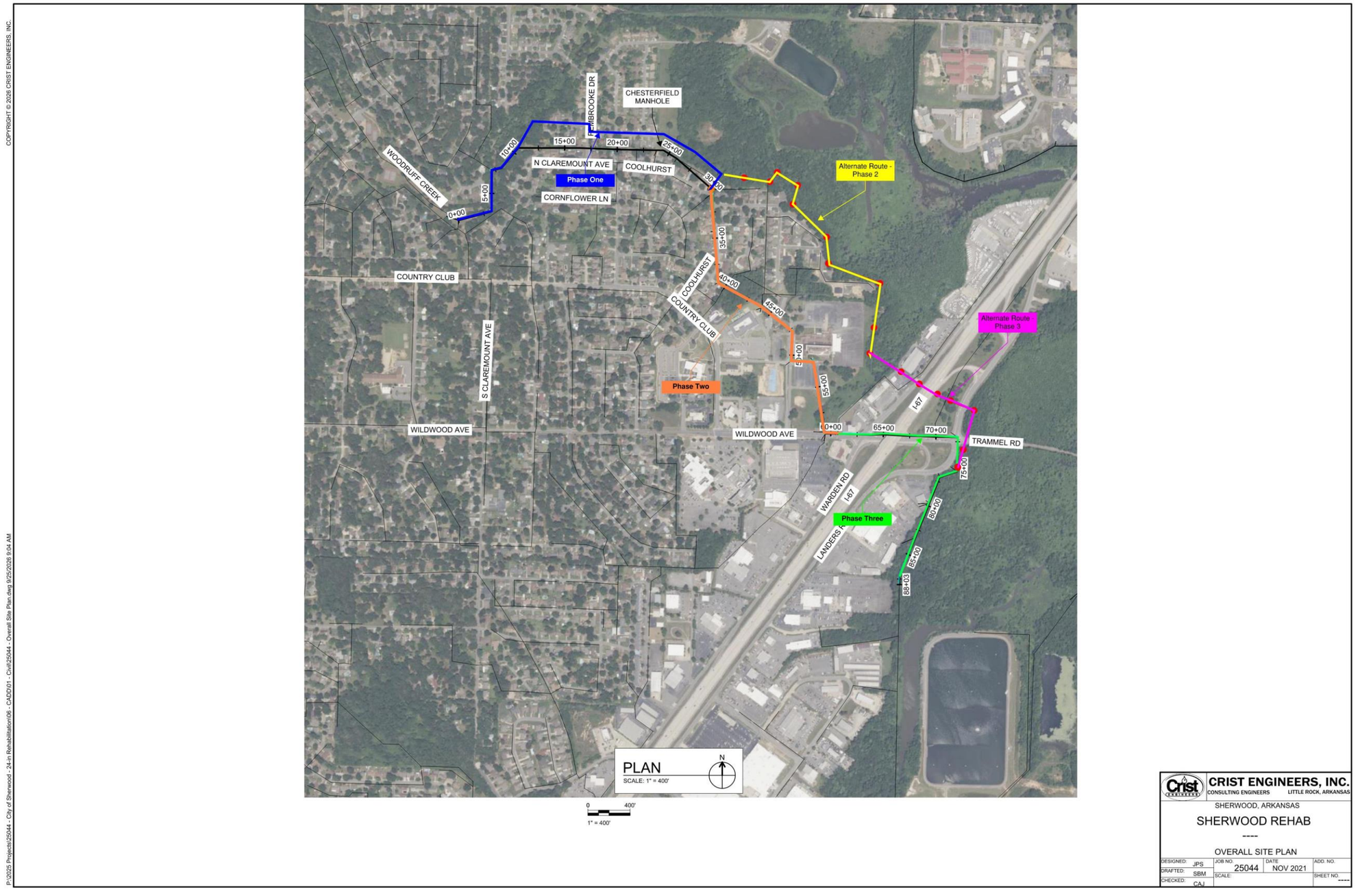


Figure 5-1: Preliminary Interceptor Improvements Phasing Plan

COST ESTIMATES

This section presents planning-level cost estimates for each proposed phase of interceptor improvements. The estimates were developed to evaluate the relative cost of the proposed improvements and provide the City with an order-of-magnitude opinion of probable construction cost for future budgeting and capital improvement planning purposes.

Cost estimates were developed on a manhole-to-manhole basis using the proposed pipe alignments, preliminary pipe sizing, anticipated construction methods, and site-specific conditions observed during field investigations. Individual cost estimates were prepared for each interceptor segment and subsequently combined to develop total project costs for each implementation phase.

The estimates include construction of gravity sewer pipe, manholes, and associated appurtenances, as well as ancillary improvements required to complete the work. Depending on site conditions, individual segments may include clearing and grubbing, trench excavation, trench safety systems, traffic control, pavement restoration, erosion and sediment control measures, utility crossings, bore and casing installations, acceptance testing, and reconnection of existing interceptor facilities. Quantities and construction requirements vary between segments and were developed based on available field information and preliminary engineering judgment.

In addition to direct construction costs, the estimates include contractor mobilization and demobilization, bonds and insurance, contingency, applicable taxes, contractor overhead and profit, and professional services. Because the improvements are currently at the conceptual planning level, a contingency of 25 percent was included to account for uncertainties associated with final design, subsurface conditions, utility conflicts, permitting requirements, easement acquisition, and future market conditions.

The resulting estimates are intended for planning and comparison purposes only and should not be considered detailed engineer's estimates or construction bid amounts. Costs will require refinement as project development progresses through final design.

DISCLAIMER AND BASIS OF ESTIMATE

Planning-level cost estimates are presented based on AACE Class 4 and Class 5 “Order-of-Magnitude” estimates, as defined by the Association for the Advancement of Cost Engineering (AACE). These estimates are prepared without detailed engineering data and rely on historical data, estimating guides, and cost curves. The intended use is for planning purposes and comparing alternatives. Actual costs at the time of project implementation will depend on project complexity, labor and material costs, market conditions, and final scope of work. Further refinement of cost analyses should occur during detailed design.

Capital project estimates include:

- 25% contingency on capital costs
- 16% for professional services, inclusive of contingencies

Costs are presented in current (2026) dollars and are based on the most recent ENR Construction Cost Index (CCI) value of 14,506.85 (September 2026) with an annual inflation rate of +4.2%.

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Table 5-1						
AACE Cost Estimate Classification Table						
Class	ANSI Classification	Typical Use	Project Definition	Expected Range of Accuracy (Low)	Expected Range of Accuracy (High)	Other Terms
Class 5	Order-of-Magnitude	Strategic Planning; Concept Screening	0%–2%	-50% to -20%	+30% to +100%	ROM; Ballpark; Blue Sky; Ratio
Class 4		Feasibility Study	1%–15%	-30% to -15%	+20% to +50%	Feasibility; Top-down; Screening; Pre-design
Class 3	Budgetary	Budgeting	10%–40%	-20% to -10%	+10% to +30%	Budget; Basic Engineering; Semi-detailed
Class 2	Definitive	Bidding; Project Controls; Change Management	30%–75%	-15% to -5%	+5% to +20%	Engineering; Bid; Detailed; Control
Class 1		Bidding; Project Controls; Change Management	65%–100%	-10% to -3%	+3% to +15%	Detailed; Forced Detail

PHASING AND ROUTE OPTION COST ESTIMATES

Manhole-to-manhole cost estimates were developed for each proposed phase and associated route option. For Phases 2 and 3, two preliminary alignments were evaluated. Route Option 1 generally follows a more direct parallel alignment adjacent to the existing interceptor corridor. Figure 5-1 illustrates this alignment, with the Phase 2 route shown in orange and the Phase 3 route shown in green.

The nomenclature used throughout the cost estimate tables corresponds to the existing interceptor segments being paralleled. Segment designations consisting only of lettered identifiers (e.g., A-B) represent proposed

improvements that directly parallel the existing interceptor between the corresponding manholes. Segment designations containing both letters and numbers (e.g., L1-M1) represent proposed interceptor segments that deviate from the existing alignment and follow an alternate route between connection points. This naming convention is intended to distinguish direct parallel improvements from segments where an alternative alignment is proposed.

Table 5-2 summarizes the estimated costs for each manhole-to-manhole segment included within the proposed phasing plan. Cost estimates were developed using the methodology and assumptions described previously and include all applicable construction items, restoration requirements, contingencies, contractor costs, and professional services necessary to complete the improvements. The individual segment costs were then combined to develop total estimated costs for each phase of construction.

Table 5-2

Option 1

Phase 1		**Phase 2**		**Phase 3**	
Parallel Segment	Segment Cost	Parallel Segment	Segment Cost	Parallel Segment	Segment Cost
A-B	$460,000	L1-M1	$341,000	X-Y	$967,000
B-C	$604,000	M1-N	$199,000	Y-Z	$232,000
C-D	$229,000	N-O	$628,000	Z-AA	$1,484,000
D-E1	$433,000	O-P	$749,000	AA-BB	$241,000
E1-F1	$441,000	P-Q	$186,000	BB-CC	$318,000
F1-G1	$784,000	Q-R	$640,000	CC-DD	$1,672,000
G1-H1	$197,000	R-S	$621,000	DD-EE	$539,000
H1-I1	$733,000	S-T	$504,000	EE-FF	$299,000
I1-J1	$729,000	T-U	$422,000	FF-GG	$498,000
J1-K1	$636,000	U-V	$477,000	GG-HH	$575,000
K1-L1	$674,000	V-W	$368,000	HH-II	$695,000
		W-X	$290,000		
Phase 1 Total	**$5,920,000**	**Phase 2 Total**	**$5,425,000**	**Phase 3 Total**	**$7,520,000**
				Easements	**$220,000**
				Total Option 1	**$19,085,000**

Table 5-3 summarizes the estimated costs for each manhole-to-manhole segment included within the proposed phasing plan for Route Option 2. Cost estimates were developed using the same methodology, assumptions, and planning-level considerations described previously. The alignment associated with Route Option 2 is illustrated in Figure 5-1, with the proposed Phase 2 improvements shown in yellow and the proposed Phase 3 improvements shown in pink. As with Route Option 1, individual segment costs were developed on a manhole-to-manhole basis and subsequently combined to establish the total estimated cost for each phase of implementation.

Table 5-3					
Option 2					
Phase 1		**Phase 2**		**Phase 3**	
Parallel Segment	Segment Cost	Parallel Segment	Segment Cost	Parallel Segment	Segment Cost
A-B	$460,000	L1-M2	$382,000	V1-W1	$669,000
B-C	$604,000	M2-N1	$453,000	W1-X1	$480,000
C-D	$229,000	N1-O1	$393,000	X1-Y1	$1,779,000
D-E1	$433,000	O1-P1	$717,000	Y1-Z1	$365,000
E1-F1	$441,000	P1-Q1	$521,000	Z1-AA1	$1,542,000
F1-G1	$784,000	Q1-R1	$810,000	AA1-BB1	$759,000
G1-H1	$197,000	R1-S1	$615,000	BB1- EE	$370,000
H1-I1	$733,000	S1-T1	$784,000		
I1-J1	$729,000	T1-U1	$645,000		
J1-K1	$636,000	U1-V1	$652,000		
K1-L1	$674,000				
Phase 1 Total	**$5,920,000**	**Phase 2 Total**	**$5,972,000**	**Phase 3 Total**	**$5,964,000**
				Easements	**$180,000**
				Total Option 2	**$18,036,000**

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CHAPTER 6 – CONCLUSIONS & RECOMMENDATIONS

SUMMARY OF RECOMMENDATIONS

Based on the results of flow monitoring, condition assessment, field surveying, hydraulic evaluation, and planning-level hydraulic modeling, the following recommendations are provided for the Five Mile Creek interceptor system.

1. System-Wide Hydraulic Modeling

   The planning-level hydraulic evaluation completed as part of this study identified capacity deficiencies within the Five Mile Creek interceptor system and demonstrated the importance of downstream hydraulic controls on system performance. While the flow monitoring program, field survey, and SSA modeling provided valuable insight into existing conditions, a comprehensive dynamic hydraulic model should be developed to evaluate the response of the entire Sherwood Sewer System under varying flow conditions.

   The flow monitoring data collected during this study provides a suitable basis for model calibration and verification. Development of a dynamic hydraulic model will allow the City to better evaluate wet-weather system performance, quantify surcharge conditions, assess the interaction between upstream and downstream facilities, and refine long-term capital improvement planning.

   The hydraulic model should be used to evaluate the phased interceptor improvements identified in this report and determine whether modifications to pipe sizing, alignment, project limits, or implementation priorities would improve overall system performance. (Estimated Cost: $180,000)

2. Phase 1 Capacity Improvements

   Based on the hydraulic evaluation, field survey data, and planning-level modeling completed as part of this study, the Phase 1 improvements identified in the vicinity of the Chesterfield Manhole represent the most effective initial interceptor capacity project.

   The proposed parallel interceptor in this area directly addresses the hydraulic restriction associated with the recurring surcharge and overflow conditions identified during the study. The planning-level hydraulic model demonstrated a reduction in overflow duration during simulated peak wet-weather events following implementation of the Phase 1 improvements.

   Following completion of the system-wide hydraulic model, the Phase 1 improvements should be further evaluated and advanced into preliminary and final design using the additional information provided by the calibrated model.

3. Rehabilitation and I/I Reduction

   The interceptor rehabilitation recommendations identified through the multi-sensor inspection (MSI) program should continue to be implemented as funding and project schedules allow. Rehabilitation measures, including but not limited to manhole rehabilitation, cured-in-place pipe (CIPP) lining, and pipe

DRAFT

bursting, are expected to improve system reliability and reduce known sources of infiltration and inflow (I/I). Additional sanitary sewer evaluation efforts, including CCTV inspections, smoke testing, and supplemental MSI assessments, should be performed to further identify and quantify I/I sources.

4. Capital Improvement Planning

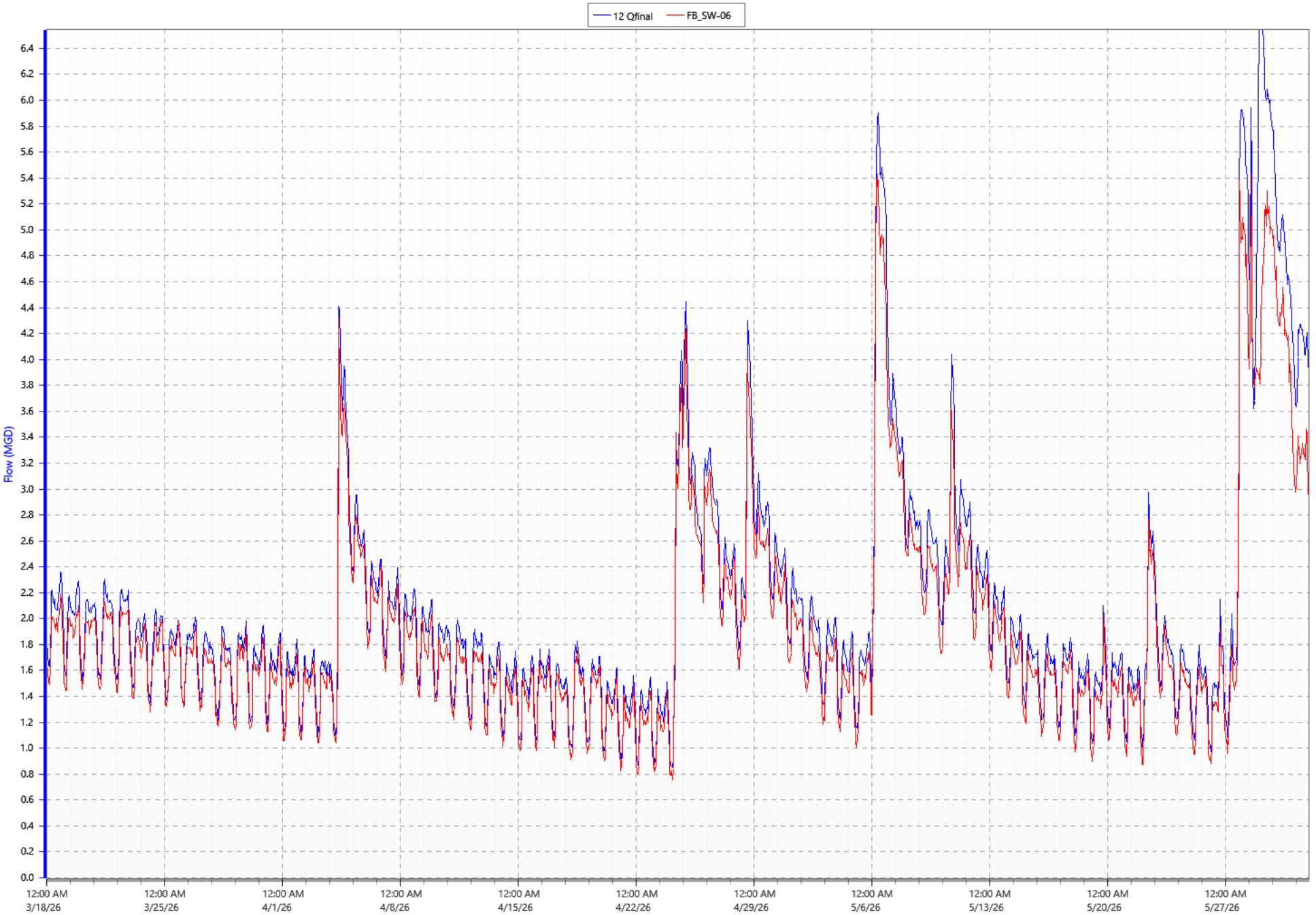
The phased interceptor improvements presented in this report should be incorporated into the City's capital improvement planning process. Cost estimates presented herein are intended for planning purposes and provide a framework for budgeting, funding applications, and future project development. Final project limits and design criteria should be refined through subsequent hydraulic modeling and engineering design efforts

DRAFT

APPENDIX A – F**LOW** BALANCING

SW-02 (3/18/2026 to 6/1/2026)

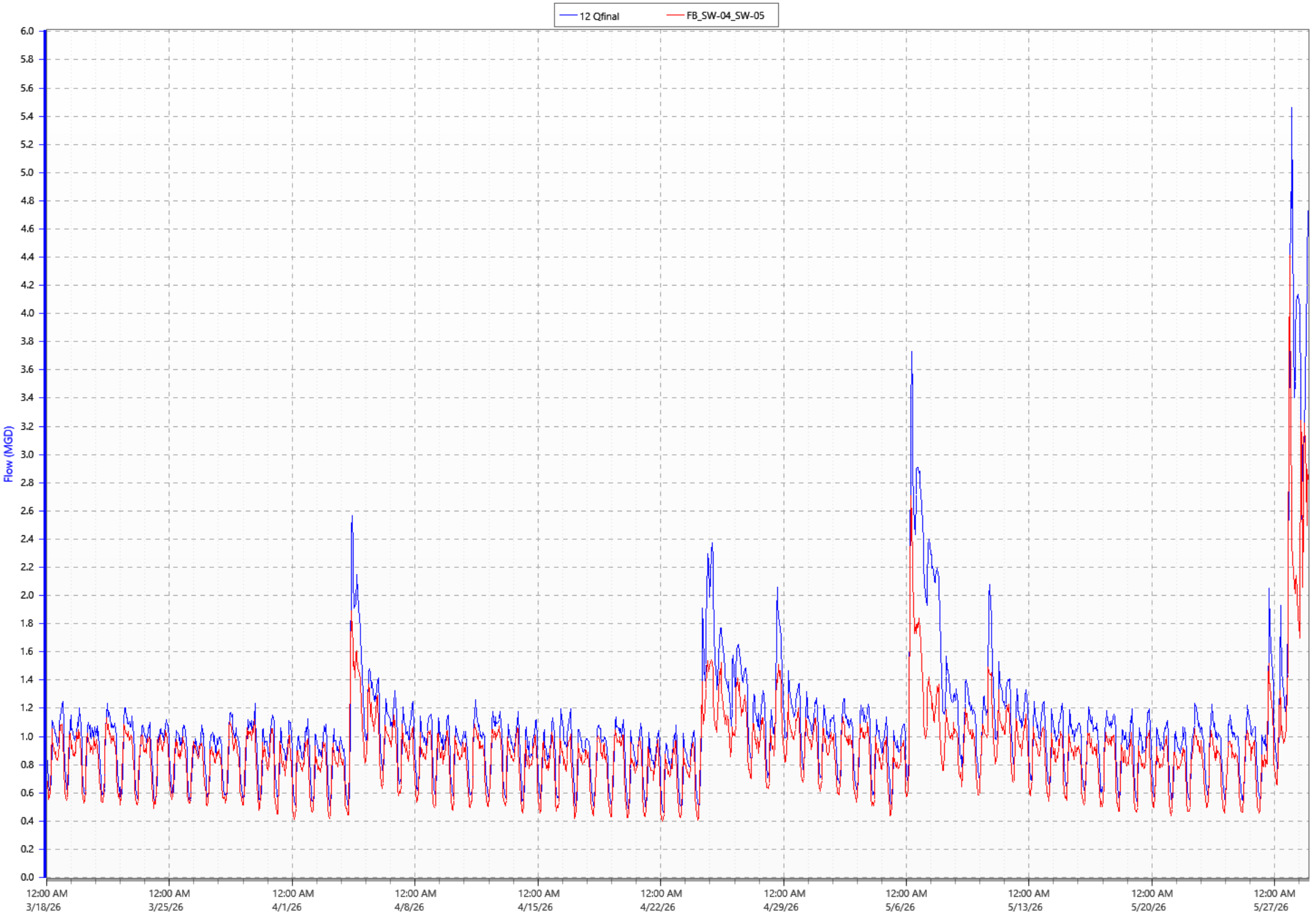
Flow Balance from SW-06 to SW-02 - Pipe Dia: 24.86 x 24.12 in.



Print Date: 7/6/2026 5:09:50 PM

SW-03 (3/18/2026 to 5/29/2026)

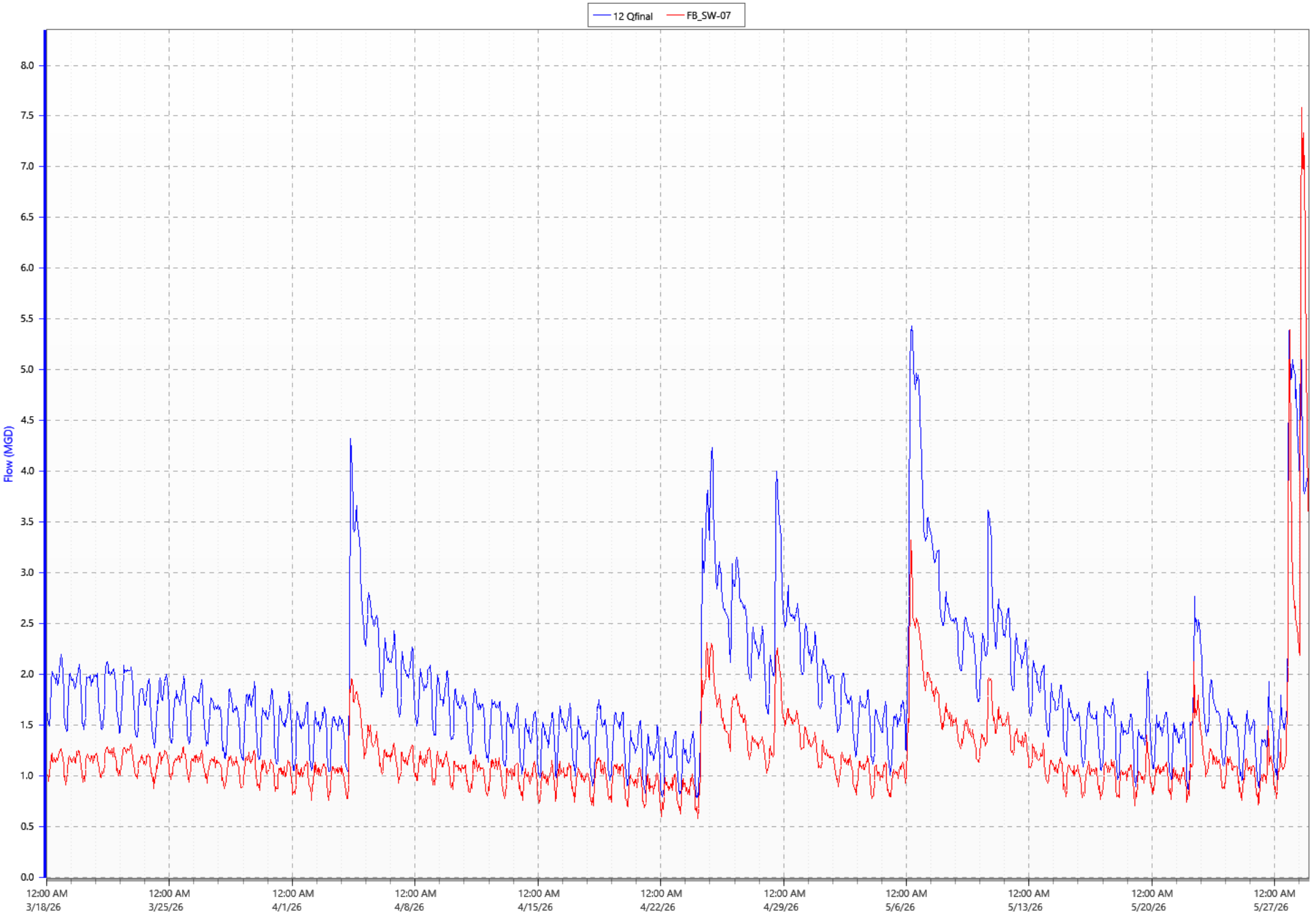
Flow Balance from SW-04 and SW-05 to SW-03 - Pipe Dia: 30.20 x 30.58 in.



Print Date: 7/6/2026 5:11:18 PM

SW-06 (3/18/2026 to 5/29/2026)

Flow Balance from SW-07 to SW-06 - Pipe Dia: 24.18 x 23.94 in.

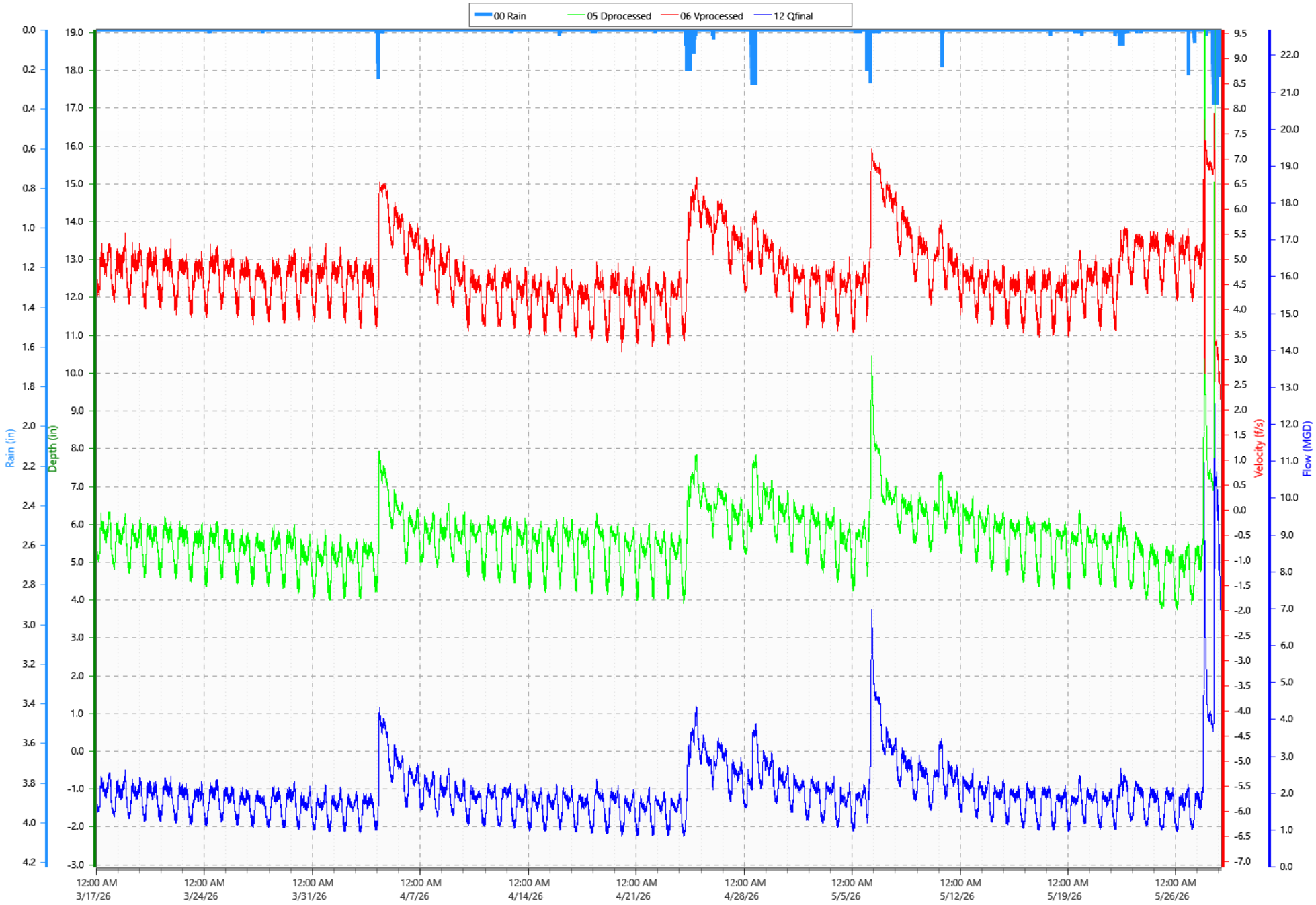


Print Date: 7/6/2026 5:11:36 PM

APPENDIX B – HYDROGRAPHS

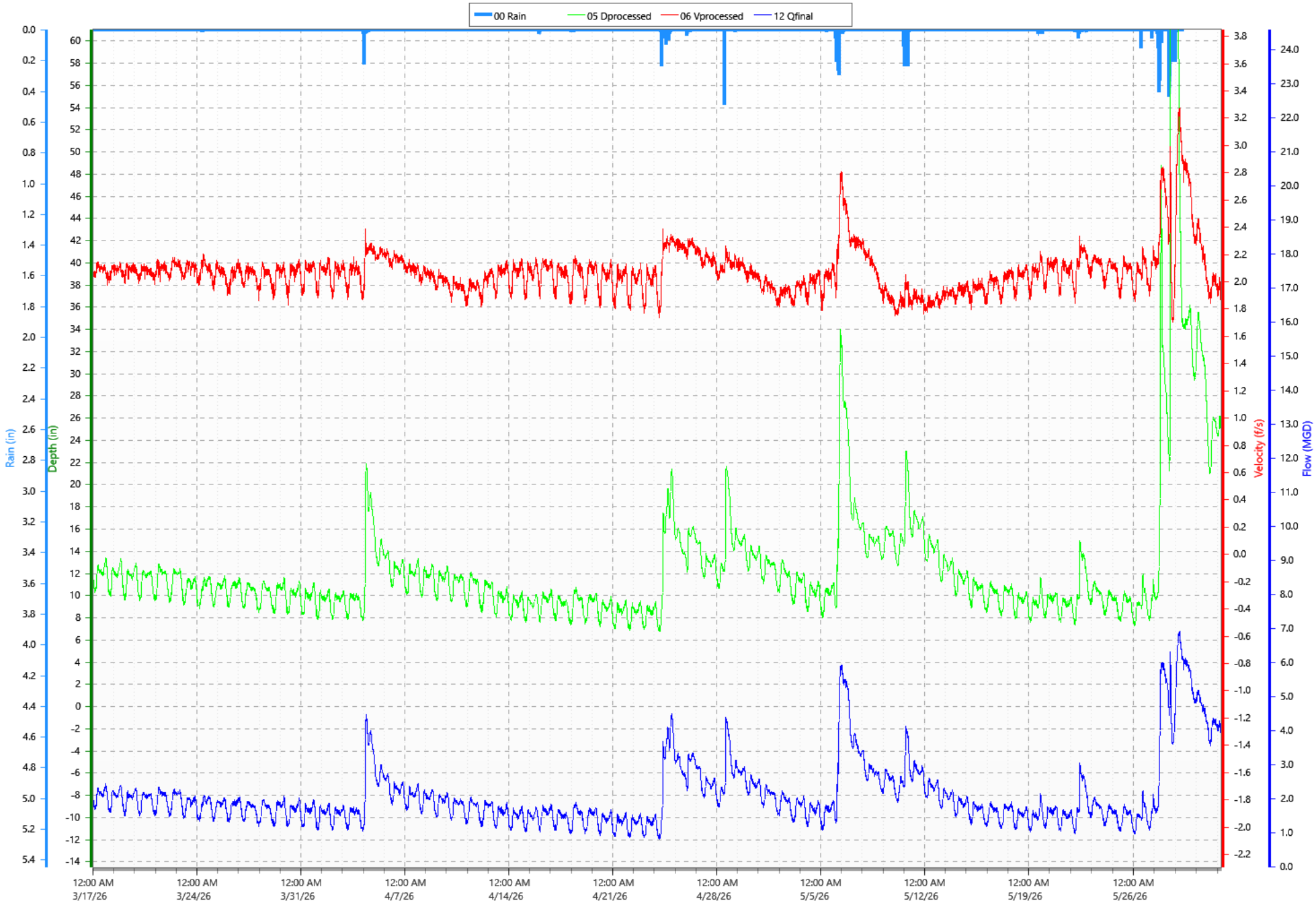
SW-01 (3/17/2026 to 5/29/2026)

DVQ with Rain - Pipe Dia: 30.06 x 29.82 in.



SW-02 (3/17/2026 to 6/1/2026)

DVQ with Rain - Pipe Dia: 24.86 x 24.12 in.



SW-03 (3/16/2026 to 5/29/2026)

DVQ with Rain - Pipe Dia: 30.20 x 30.58 in.



SW-04 (3/17/2026 to 5/29/2026)

DVQ with Rain - Pipe Dia: 28.88 x 29.24 in.



SW-05 (3/18/2026 to 5/29/2026)

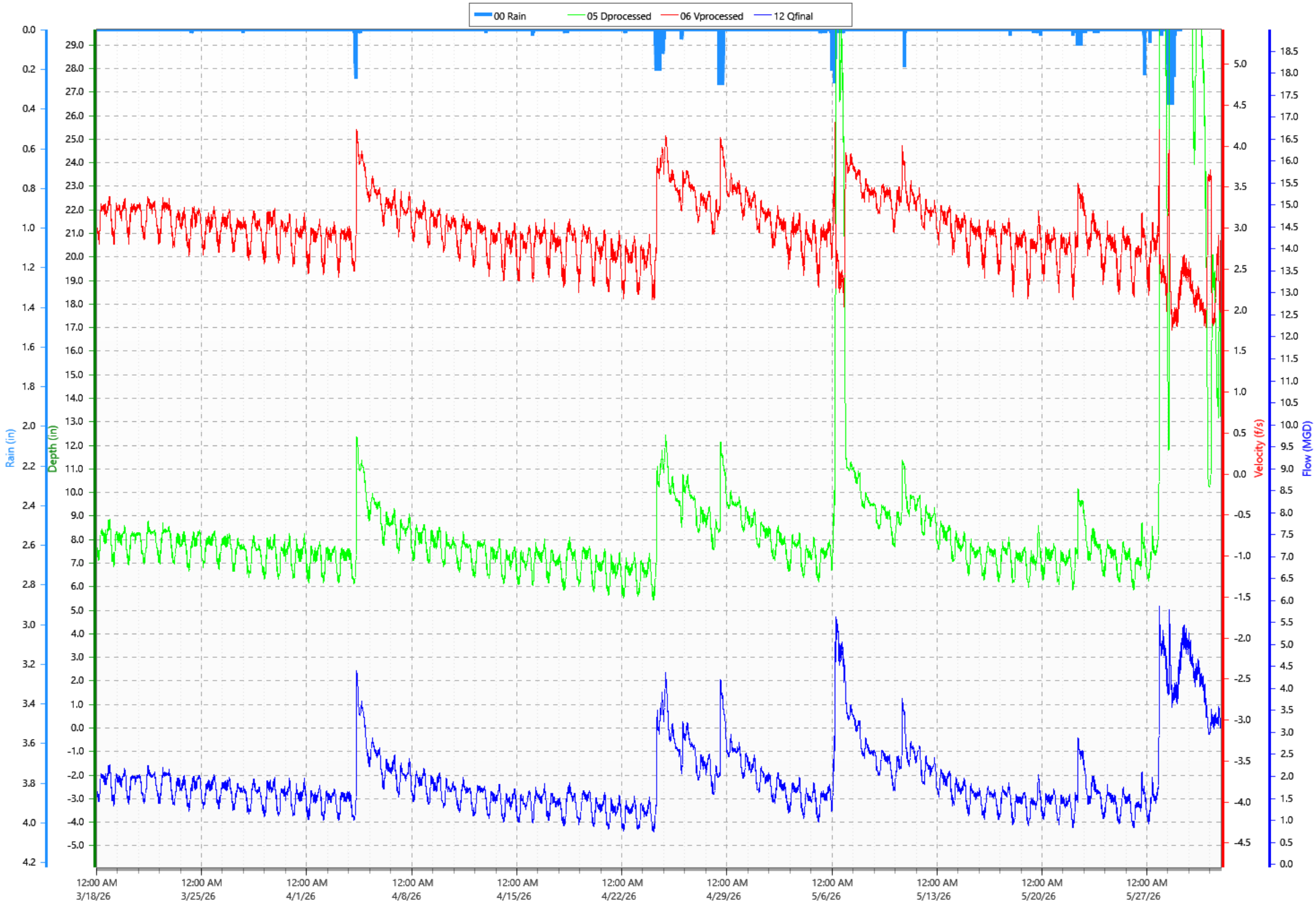
DVQ with Rain - Pipe Dia: 24.18 x 23.30 in.



Print Date: 7/7/2026 10:00:54 AM

SW-06 (3/18/2026 to 6/1/2026)

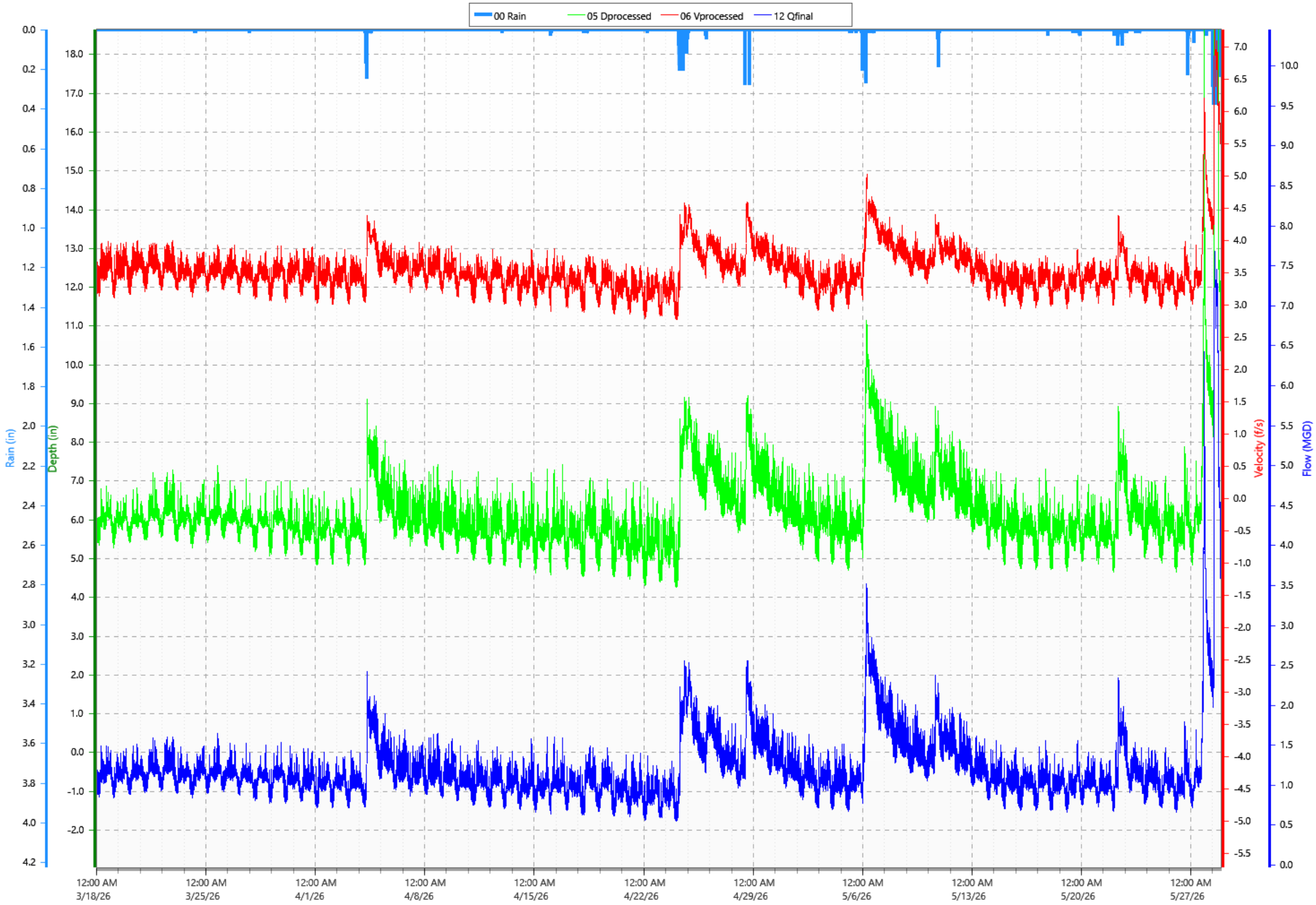
DVQ with Rain - Pipe Dia: 24.18 x 23.94 in.



Print Date: 7/6/2026 5:17:58 PM

SW-07 (3/18/2026 to 5/29/2026)

DVQ with Rain - Pipe Dia: 17.50 x 17.06 in.



Print Date: 7/6/2026 5:18:04 PM

APPENDIX C – MONITOR INSTALLATION SITE SHEETS

rjn group	**Crist Engineers** Sherwood Condition Assessment & Flow Monitoring	**Site Name** SW-01

Inspected By	kbelk	**Project No.**	**Site Code**
Inspected Date/Time	2/25/2026 3:39 PM	18-4361-00	T

System Information

Target Pipe Dia. (in)	30.0
Municipality	Sherwood
District	Sherwood
Assigned Rain Gauge	SWRG-01
Client Manhole #	200325
U/S Connecting MH I.D	200324
System Characteristics:	
Residential - ☑ Commercial - ☑ Industrial - ☐	
P/S Influence	No
WWTP Influence	

Location Information

Site Address	5470 Landers Rd
Site Access	Off-Road
Longitude	-92.21160000
Latitude	34.80370000
MH Type	Poured Concrete
Manhole Depth (ft)	11.17
Manhole Width (ft)	5.0
Elevated MH	Yes
Height Elevated (ft)	0.3
Structural Integrity	Safe

Site Information

Pipe Height (in)	30.06
Pipe Width (in)	29.82
Pipe Type	Polyvinyl Chloride
Pipe Shape	Elliptical
O2	**LEL %**
H2S	**CO**

Hydraulic Information

Flow Depth (in)	6.00
Instant Velocity (fps)	4.00
Surcharge Evidence (ft)	
Silt Type	None
Silt Depth (in)	0.00
Needs Cleaning	No
Backwater	No
Flow Path	Slight Bend
Drop Inlet	No
Hydraulic Rating	Fair

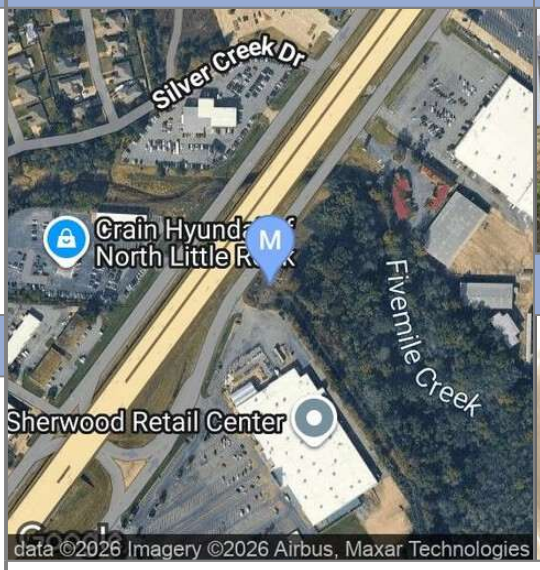
Installation Notes

Location in Pipe (ft)	1.5
Location from Manhole	Upstream
Sensors	Pressure, Velocity, and Ultra
Antenna Surface	[Default] Code: Structure Cover
Signal Strength	75

Post Installation Notes

Meter Type	ADS
Telemetry Type	ADS
Installation Date	3/16/2026

Area Location Map



Area View Picture



Top View Picture



Access Notes Tractor Suppli parking lot next to billboard

Investigation Photo



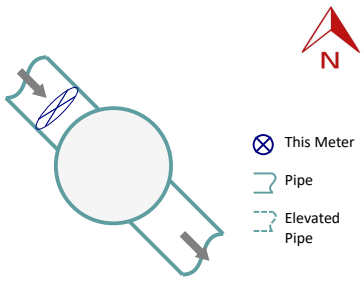
Hydraulic Characteristics

Installation Photo

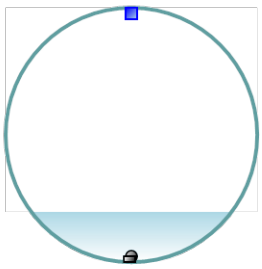


Installation Notes

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Approvals

Recommended by FSP	**Client Approval**

rjn group	**Crist Engineers** Sherwood Condition Assessment & Flow Monitoring	**Site Name** SW-02

Inspected By	kbelk	**Project No.**	**Site Code**
Inspected Date/Time	2/25/2026 3:57 PM	18-4361-00	T

System Information

Target Pipe Dia. (in)	24.0
Municipality	Sherwood
District	Sherwood
Assigned Rain Gauge	SWRG-01
Client Manhole #	200138
U/S Connecting MH I.D	200139
System Characteristics:	
Residential - ☑ Commercial - ☑ Industrial - ☐	
P/S Influence	No
WWTP Influence	

Location Information

Site Address	6200 Landers Rd
Site Access	Roadway, Low Traffic
Longitude	-92.20170000
Latitude	34.81260000
MH Type	Lined
Manhole Depth (ft)	12.30
Manhole Width (ft)	5.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Site Information

Pipe Height (in)	24.86
Pipe Width (in)	24.12
Pipe Type	Concrete
Pipe Shape	Elliptical
O2	**LEL %**
H2S	**CO**

Hydraulic Information

Flow Depth (in)	10.00
Instant Velocity (fps)	2.00
Surcharge Evidence (ft)	9.00
Silt Type	None
Silt Depth (in)	0.00
Needs Cleaning	No
Backwater	Yes
Flow Path	Straight
Drop Inlet	No
Hydraulic Rating	Good

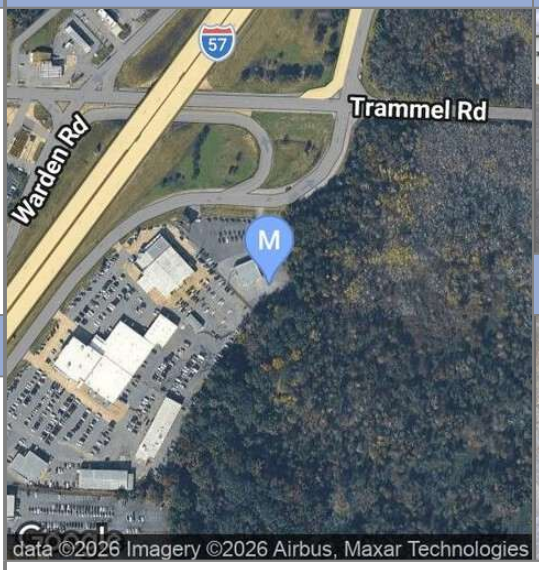
Installation Notes

Location in Pipe (ft)	2.0
Location from Manhole	Upstream
Sensors	Pressure, Velocity, and Ultra
Antenna Surface	Paved Surface
Signal Strength	75

Post Installation Notes

Meter Type	ADS
Telemetry Type	ADS
Installation Date	3/16/2026

Area Location Map



Area View Picture



Top View Picture



Access Notes Behind landers preowned

Investigation Photo



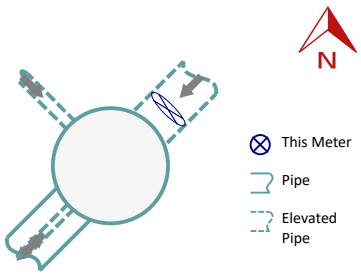
Installation Photo



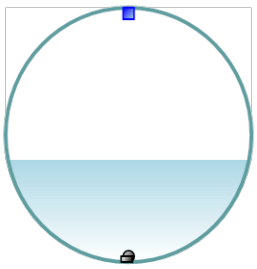
Hydraulic Characteristics GS013926.360

Installation Notes

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Approvals

Recommended by FSP	Client Approval

rjn group	**Crist Engineers** Sherwood Condition Assessment & Flow Monitoring	**Site Name** SW-03

Inspected By	kbelk	**Project No.**	**Site Code**
Inspected Date/Time	2/25/2026 4:26 PM	18-4361-00	D-1

System Information

Target Pipe Dia. (in)	30.0
Municipality	Sherwood
District	Sherwood
Assigned Rain Gauge	SWRG-03
Client Manhole #	200121
U/S Connecting MH I.D	200122
System Characteristics:	
Residential - ☑ Commercial - ☑ Industrial - ☑	
P/S Influence	No
WWTP Influence	

Location Information

Site Address	6408 Waterleaf Ct
Site Access	Off-Road
Longitude	-92.19440000
Latitude	34.81210000
MH Type	Poured Concrete
Manhole Depth (ft)	12.56
Manhole Width (ft)	5.0
Elevated MH	Yes
Height Elevated (ft)	2.0
Structural Integrity	Safe

Site Information

Pipe Height (in)	30.20
Pipe Width (in)	30.58
Pipe Type	Concrete
Pipe Shape	Elliptical
O2	**LEL %**
H2S	**CO**

Hydraulic Information

Flow Depth (in)	6.00
Instant Velocity (fps)	1.00
Surcharge Evidence (ft)	
Silt Type	None
Silt Depth (in)	0.00
Needs Cleaning	No
Backwater	No
Flow Path	Slight Bend
Drop Inlet	No
Hydraulic Rating	Fair

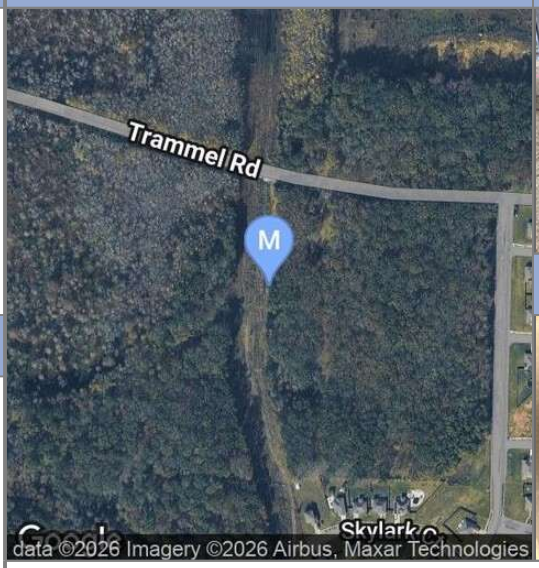
Installation Notes

Location in Pipe (ft)	3.0
Location from Manhole	Upstream
Sensors	Pressure, Velocity, and Ultra
Antenna Surface	[Default] Code: Structure Cover
Signal Strength	75

Post Installation Notes

Meter Type	ADS
Telemetry Type	ADS
Installation Date	3/16/2026

Area Location Map



Area View Picture



Top View Picture



Access Notes Power line trail off of trammel rd before the neighborhood

Investigation Photo



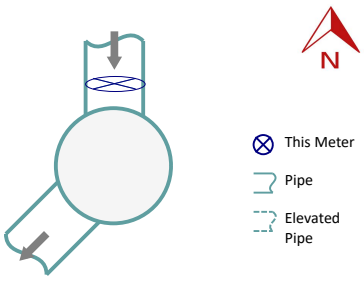
Installation Photo



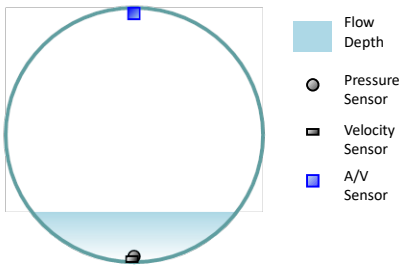
Hydraulic Characteristics GS013928.360

Installation Notes

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Approvals

Recommended by FSP	Client Approval

rjn group	**Crist Engineers** Sherwood Condition Assessment & Flow Monitoring	**Site Name** SW-04

Inspected By	kbelk	**Project No.**	**Site Code**
Inspected Date/Time	2/25/2026 4:39 PM	18-4361-00	T

System Information

Target Pipe Dia. (in)	30.0
Municipality	Sherwood
District	Sherwood
Assigned Rain Gauge	SWRG-03
Client Manhole #	200067
U/S Connecting MH I.D	200066
System Characteristics:	
Residential - ☑ Commercial - ☑ Industrial - ☐	
P/S Influence	No
WWTP Influence	

Location Information

Site Address	7724 Landers Rd
Site Access	Off-Road
Longitude	-92.18960000
Latitude	34.82540000
MH Type	Poured Concrete
Manhole Depth (ft)	10.11
Manhole Width (ft)	5.0
Elevated MH	Yes
Height Elevated (ft)	0.5
Structural Integrity	Safe

Site Information

Pipe Height (in)	28.88
Pipe Width (in)	29.24
Pipe Type	Lined
Pipe Shape	Elliptical
O2	**LEL %**
H2S	**CO**

Hydraulic Information

Flow Depth (in)	5.00
Instant Velocity (fps)	1.00
Surcharge Evidence (ft)	10.11
Silt Type	None
Silt Depth (in)	0.00
Needs Cleaning	No
Backwater	Yes
Flow Path	Straight
Drop Inlet	No
Hydraulic Rating	Fair

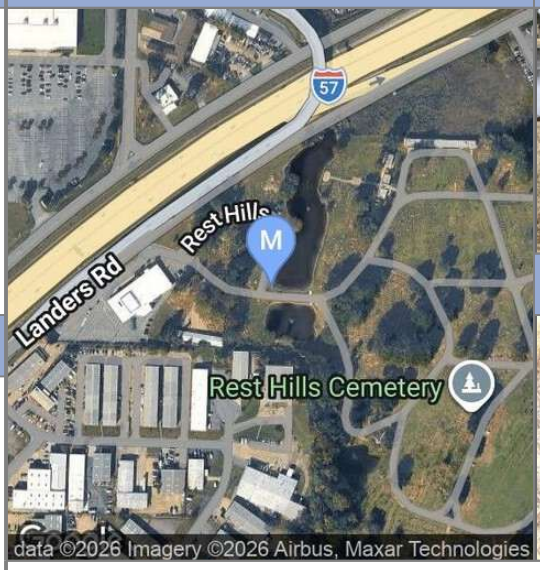
Installation Notes

Location in Pipe (ft)	2.0
Location from Manhole	Upstream
Sensors	Pressure, Velocity, and Ultra
Antenna Surface	Non-Paved Surface
Signal Strength	75

Post Installation Notes

Meter Type	ADS
Telemetry Type	ADS
Installation Date	3/16/2026

Area Location Map



Area View Picture



Top View Picture



Access Notes In cemetery by the 2 ponds

Investigation Photo



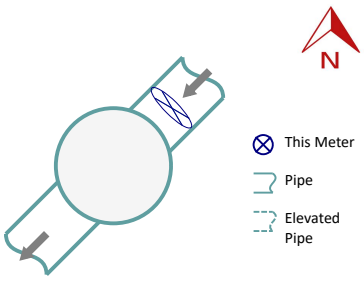
Installation Photo



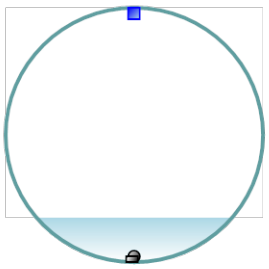
Hydraulic Characteristics GS013932.360

Installation Notes

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Approvals

Recommended by FSP	Client Approval

rjn group	**Crist Engineers** Sherwood Condition Assessment & Flow Monitoring	**Site Name** SW-05

Inspected By	kbelk	**Project No.**	**Site Code**
Inspected Date/Time	2/25/2026 6:54 PM	18-4361-00	D-5

System Information

Target Pipe Dia. (in)	24.0
Municipality	Sherwood
District	Sherwood
Assigned Rain Gauge	SWRG-01
Client Manhole #	200079
U/S Connecting MH I.D	200080
System Characteristics:	
Residential - ☑ Commercial - ☑ Industrial - ☐	
P/S Influence	No
WWTP Influence	

Location Information

Site Address	7351 Warden Rd
Site Access	Off-Road
Longitude	-92.19670000
Latitude	34.82200000
MH Type	Poured Concrete
Manhole Depth (ft)	11.75
Manhole Width (ft)	4.0
Elevated MH	Yes
Height Elevated (ft)	0.2
Structural Integrity	Safe

Site Information

Pipe Height (in)	24.18
Pipe Width (in)	23.30
Pipe Type	Concrete
Pipe Shape	Elliptical
O2	**LEL %**
H2S	**CO**

Hydraulic Information

Flow Depth (in)	4.00
Instant Velocity (fps)	0.50
Surcharge Evidence (ft)	
Silt Type	Medium
Silt Depth (in)	2.00
Needs Cleaning	No
Backwater	No
Flow Path	Slight Bend
Drop Inlet	No
Hydraulic Rating	Fair

Installation Notes

Location in Pipe (ft)	2.0
Location from Manhole	Upstream
Sensors	Pressure, Velocity, and Ultra
Antenna Surface	[Default] Code: Structure Cover
Signal Strength	75

Post Installation Notes

Meter Type	ADS
Telemetry Type	ADS
Installation Date	3/17/2026

Area Location Map



Area View Picture



Top View Picture



Access Notes In ravine by telephone pole.

Investigation Photo



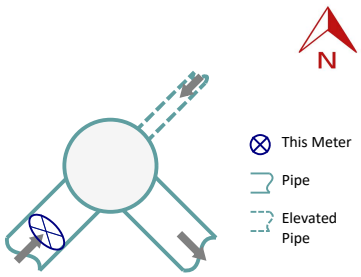
Hydraulic Characteristics Silt also in channel, slow flow. Site would to be rotated to 7-8 clock and have a CS8

Installation Photo

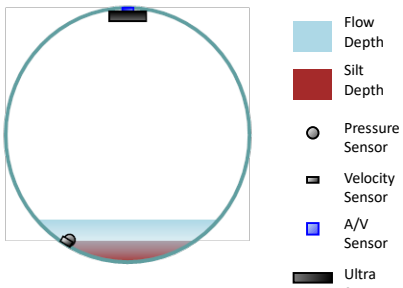


Installation Notes

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 7:00

Velocity Clock Position: 7:00

Approvals

Recommended by FSP **Client Approval**

	Crist Engineers	Site Name
rjn group	Sherwood Condition Assessment & Flow Monitoring	SW-06

Inspected By	kbelk	Project No.	Site Code
Inspected Date/Time	2/25/2026 6:06 PM	18-4361-00	T

System Information

Target Pipe Dia. (in)	24.0
Municipality	Sherwood
District	Sherwood
Assigned Rain Gauge	SWRG-01
Client Manhole #	200148
U/S Connecting MH I.D	200149
System Characteristics:	
Residential - ☑ Commercial - ☑ Industrial - ☐	
P/S Influence	No
WWTP Influence	

Location Information

Site Address	2404 Wildwood Ave
Site Access	Roadway, Low Traffic
Longitude	-92.20520000
Latitude	34.81550000
MH Type	Poured Concrete
Manhole Depth (ft)	10.57
Manhole Width (ft)	4.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Site Information

Pipe Height (in)	24.18
Pipe Width (in)	23.94
Pipe Type	Concrete
Pipe Shape	Elliptical
O2	LEL %
H2S	CO

Hydraulic Information

Flow Depth (in)	4.00
Instant Velocity (fps)	1.50
Surcharge Evidence (ft)	8.00
Silt Type	None
Silt Depth (in)	0.00
Needs Cleaning	No
Backwater	Yes
Flow Path	Slight Bend
Drop Inlet	No
Hydraulic Rating	Fair

Installation Notes

Location in Pipe (ft)	2.0
Location from Manhole	Upstream
Sensors	Pressure, Velocity, and Ultra
Antenna Surface	Paved Surface
Signal Strength	75

Post Installation Notes

Meter Type	ADS
Telemetry Type	ADS
Installation Date	3/17/2026

Area Location Map



Area View Picture



Top View Picture



Access Notes In parking lot

Investigation Photo



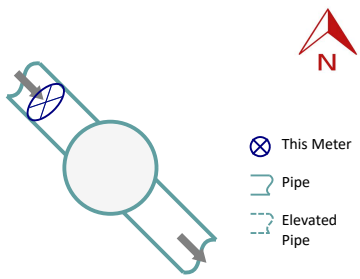
Installation Photo



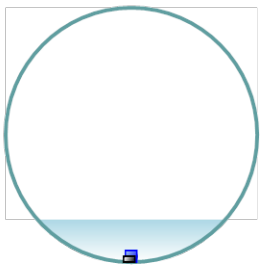
Hydraulic Characteristics GS013934.360

Installation Notes

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Approvals

Recommended by FSP	Client Approval

rjn group	**Crist Engineers** Sherwood Condition Assessment & Flow Monitoring	**Site Name** SW-07

Inspected By	cpruett	**Project No.**	**Site Code**
Inspected Date/Time	3/17/2026 12:51 PM	18-4361-00	T

System Information

Target Pipe Dia. (in)	18.0
Municipality	Sherwood
District	
Assigned Rain Gauge	SWRG-02
Client Manhole #	200176
U/S Connecting MH I.D	200177
System Characteristics:	
Residential - ☑ Commercial - ☑ Industrial - ☐	
P/S Influence	No
WWTP Influence	

Location Information

Site Address	2 Greenview Cir
Site Access	Off-Road
Longitude	-92.22260000
Latitude	34.82570000
MH Type	Poured Concrete
Manhole Depth (ft)	14.22
Manhole Width (ft)	4.0
Elevated MH	No
Height Elevated (ft)	
Structural Integrity	Safe

Site Information

Pipe Height (in)	17.50		
Pipe Width (in)	17.06		
Pipe Type	Lined		
Pipe Shape	Elliptical		
O2	20.9	**LEL %**	0.0
H2S	0.0	**CO**	0.0

Hydraulic Information

Flow Depth (in)	5.36
Instant Velocity (fps)	3.41
Surcharge Evidence (ft)	
Silt Type	None
Silt Depth (in)	0.00
Needs Cleaning	No
Backwater	No
Flow Path	Slight Bend
Drop Inlet	No
Hydraulic Rating	Good

Installation Notes

Location in Pipe (ft)	2.0
Location from Manhole	Upstream
Sensors	Pressure, Velocity, and Ultra
Antenna Surface	Paved Surface
Signal Strength	75

Post Installation Notes

Meter Type	ADS
Telemetry Type	ADS
Installation Date	3/17/2026

Area Location Map



Area View Picture



Top View Picture



Access Notes I'm sidewalk next to storm ditch

Investigation Photo



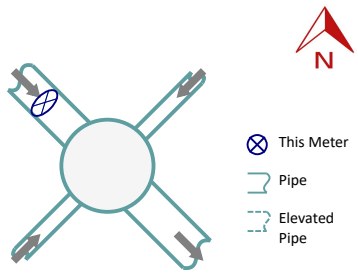
Hydraulic Characteristics SCAN: GS014395.360 GH014394.MP4

Installation Photo

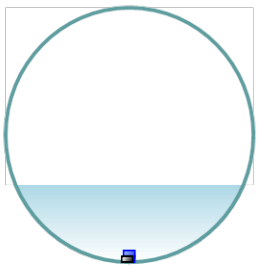


Installation Notes

Install Plan Sketch



Install Cross-Section Sketch



Pressure Clock Position: 6:00

Velocity Clock Position: 6:00

Approvals

Recommended by FSP	Client Approval

APPENDIX D – RAIN GAUGE INSTALLATION **SITE SHEETS**

rjn group	Crist Engineers Sherwood Condition Assessment & Flow Monitoring	RG Site Name SWRG-01

Project	Project No.	Inspection Date/Time	Facility Name
Sherwood Condition Assessment & Flow Monitoring	*18-4361-00*	*3/13/2026 2:27 PM*	*Waffle House*
		Inspected By	**Access Instructions**
		kbelk	*On freezer on back of building*
Site Address:	*6501 Warden Rd*		
Latitude / Longitude	34.81510000	-92.20370000	

Contact Info

Name	*Doug*
Title	*Store Manager*
Phone #	*5018330036*

Tipping Bucket Serial #

63651-215

Logger Serial #

5120016604

Rain Gauge Manufacturer

Texas Electronics

Recommended for Installation	☑

Location Diagram of Rain Gauge



Installation Instructions

Freezer back of building

Area Location Map



Building Photo



Installation Photo



Ladder Location Photo

rjn group	Crist Engineers Sherwood Condition Assessment & Flow Monitoring	RG Site Name SWRG-02

Project	Project No.	Inspection Date/Time	Facility Name
Sherwood Condition Assessment & Flow Monitoring	*18-4361-00*	*3/13/2026 3:26 PM*	*CVS Pharmacy*
		Inspected By	**Access Instructions**
		kbelk	*Back right corner of dumpster wall*
Site Address:	*203 E Kiehl Ave*		
Latitude / Longitude	34.83330000	-92.23050000	

Contact Info

Name	*Mary Beth*
Title	*Store Manager*
Phone #	*5018341090*

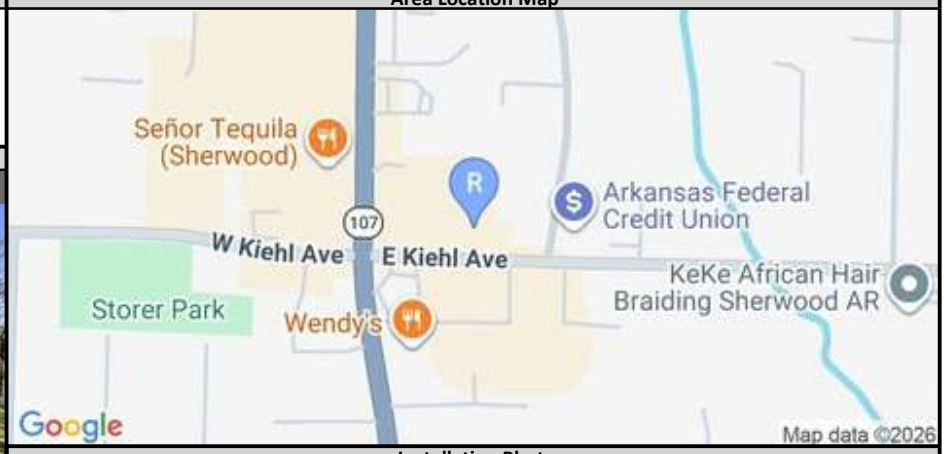
Tipping Bucket Serial #	*16644-296*
Logger Serial #	*120016668*
Rain Gauge Manufacturer	*Texas Electronics*
Recommended for Installation	☑

Location Diagram of Rain Gauge



Installation Instructions

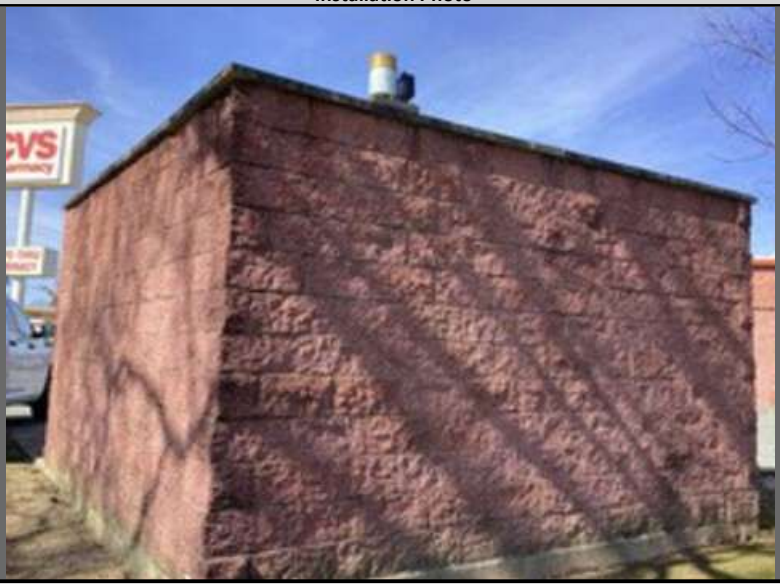
Area Location Map



Building Photo



Installation Photo



Ladder Location Photo

rjn group	Crist Engineers Sherwood Condition Assessment & Flow Monitoring	RG Site Name SWRG-03

Project	Project No.	Inspection Date/Time	Facility Name
Sherwood Condition Assessment & Flow Monitoring	*18-4361-00*	*3/13/2026 4:25 PM*	*Sherwood Manhole*
		Inspected By	**Access Instructions**
		kbelk	*Park in driveway across from the manhole, walk across road*
Site Address:	*6301 Trammel Rd*		
Latitude / Longitude	34.81330000	-92.19430000	

Contact Info

Name	*City Contact*
Title	*City*
Phone #	*000*

Tipping Bucket Serial #	*16958-396*
Logger Serial #	*0221016736*
Rain Gauge Manufacturer	*Texas Electronics*
Recommended for Installation	☑

Location Diagram of Rain Gauge



Installation Instructions

Area Location Map



Building Photo



Installation Photo



Ladder Location Photo