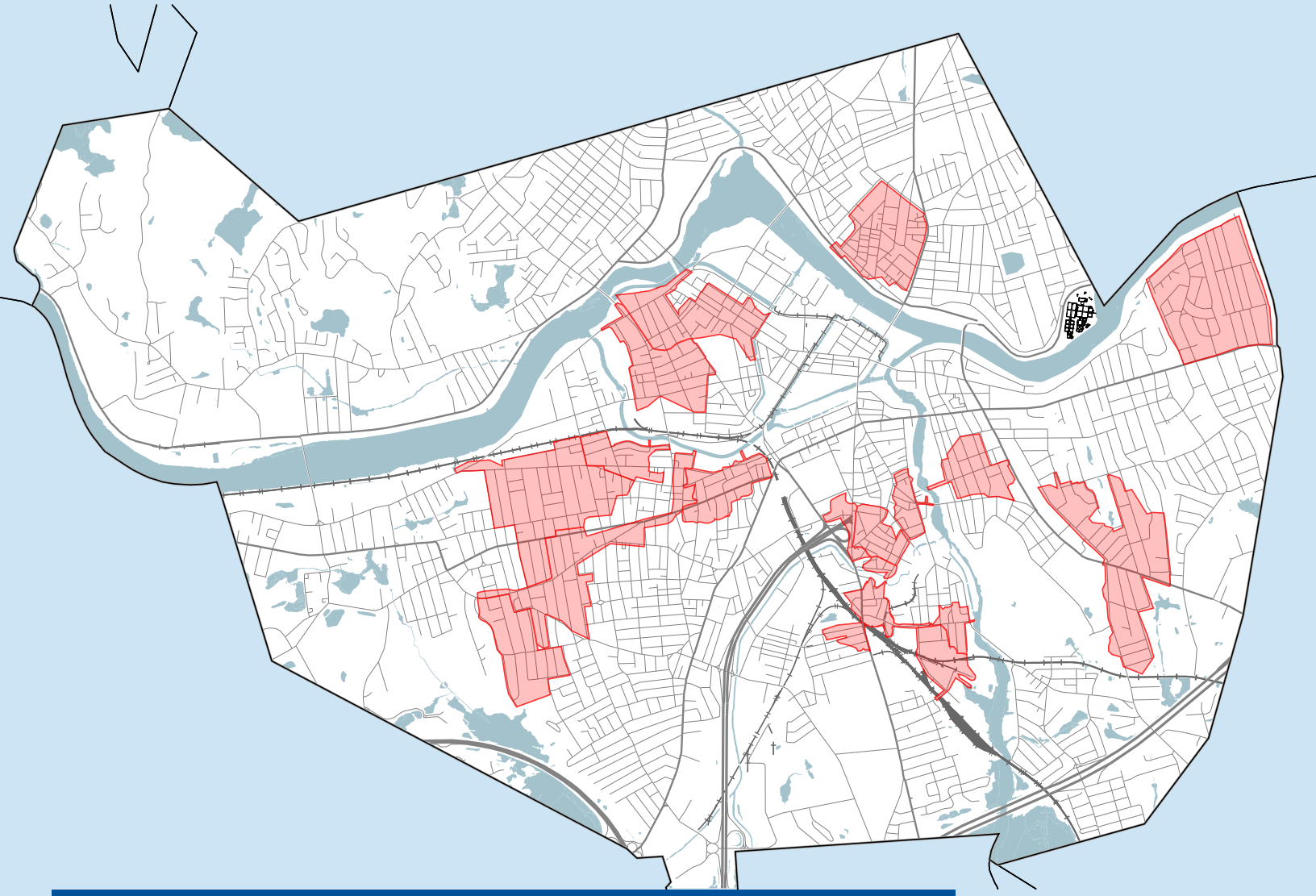


FINAL REPORT

DECEMBER 2024

Phase 3 Candidate Area Sewer Separation Preliminary Design Report

Volume 2 of 2 (Appendices)

Lowell Regional Wastewater Utility

DUCK ISLAND

LOWELL REGIONAL WASTEWATER UTILITY

CDM Smith

Appendices

Appendix A	Memorandum Proposed Phase 3 Sewer Separation Program (presenting Phase 3 Candidate Areas) (CDM Smith, January 24, 2023)
Appendix B	CSO Discharge Station Schematics
Appendix C	Lowell Sewer and Street Flooding Issues Survey
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Appendix A Memorandum Proposed Phase 3 Sewer Separation Program (presenting Phase 3 Candidate Areas) (CDM Smith, January 24, 2023)

Memorandum

To: *Evan Walsh, LRWWU*
Aaron Fox, LRWWU

From: *James Drake*

Date: *January 24, 2023*

Subject: *Proposed Phase 3 Sewer Separation Program Discussion*

As part of CDM Smith's response to the recent Request for Proposals for Engineering Services Associated with Sewer Separation Program and Consent Decree Compliance (RFP 23-27), we completed a review of the proposed future areas of combined sewer separation. Based upon that review, we provide the following observations and suggestions.

It is our understanding that the City reviewed the past 2004 Warren Area Preliminary Design Report (PDR) and identified the next highest priorities for separation based on the 2004 Prioritization Matrix. Priorities established in 2004, more than 18 years ago, have likely changed based on past sewer separation projects, more recent flooding issues, community development since that time, constructability issues learned from the past separation programs, and discharge opportunities and challenges.

Warren Basin Priorities

Without an update of the PDR, CDM Smith used Table 5-1 (attached) from the original report to consider the potential candidate separation areas a bit further. Table 5-1 modified to show the ranking by the priority scores in 2004 and the following observations were made:

- All projects in red text were the original report priorities for separation. Not all the projects were completed, and Lowell originally proposed in the Consent Decree negotiations to finish these highest 2004 priorities.
- Projects that have been essentially completed are crossed out. It is interesting to note that many projects that were not part of the original priorities were completed by the City upon further assessment and design. Projects like Lincoln East, Industrial Avenue East, and Plan Street were added to other adjacent sewer separation construction projects based on construction challenges, adaptive approaches, and cost-effectiveness.
- Projects in purple show the next highest priorities with a total score of 24 or higher– many of these have already been completed.

- CDM Smith then identified in green additional project areas in the Warren Basin that could also be considered candidates. These include the Grand Avenue and Pevey Street combined sewer areas that contribute to the sewer surcharge and SSOs along the Middlesex Interceptor and at the Boys and Girls Club.

It is important to note that, given the passage of time, it is technically warranted and necessary to update the Warren PDR to identify the highest ranked combined sewer areas remaining in the basin versus being required to rely on the 2004 information. The high priority areas described above were selected based on our engineering judgement and experience with separation projects in other areas of the City.

Figure 1, attached, provides an overview of these potential candidate areas. The figure shows the Grand and Pevey areas in purple as the next candidate separation areas to consider **if** the Warren PDR is not updated.

Other City Priorities Noted in Consent Decree (CD) Negotiations

Figure 1 also shows (in red) the City's other priorities discussed in the CD (outside of the Warren Basin), including Tilden Street and the Humphrey's Brook combined sewer basins. The Humphrey's Brook Basin is reportedly one of the highest priorities for the City based on:

- recent street flooding reported in the low lying areas of the basin (Coburn Street, etc.), and
- significant baseflow reductions that might be achieved by redirecting Humphrey's Brook stormwater flow (500 acres of Dracut flow) directly to the Merrimack River (if cost-effective).

The Humphreys' Brook PDR was completed in 2000. Many existing conditions have changed and there are still many challenges left in preliminary and final design that must be addressed to determine the best and most cost-effective pipe routes and discharge options for this area. Based on discussions with the City, it was determined that proceeding with a preliminary and final design of this area is the best approach for the City and should be included in CD negotiations.

Other Candidate Separation Areas That May Be Cost-Effective

The attached figure also shows areas in brown that should also be considered for potential separation including Wentworth-Douglas Road, Burnham, and Tilden 2. These areas have been considered over the years as part of separate conceptual sewer separation plans and/or as part of past Long-Term Control Plan development. Sewer separation plans have been conceptually developed for these areas as they were either adjacent to existing sewer separation projects (Tilden 2), had readily available discharge locations (Burnham), or corrected past surface flooding issues (Wentworth-Douglas Road).

Appropriate Separation Approach

An appropriate (and cost effective) separation approach for the City is one that integrates existing knowledge of the system, public input, CSO benefits, baseflow benefits, discharge option familiarity, and constructability assessments. The City has engaged CDM Smith to develop the appropriate plan to identify and prioritize candidate areas for the Phase 3 Separation Program. To do that, we need the flexibility to make the most informed decisions for the separation program. As identified in the 2014 LTCP, the City had made significant and cost-effective progress in CSO mitigation, which included sewer separation in the Warren Basin along with separation of key areas in the City. Time should be taken to reassess these past priorities and identify these problem areas again with significant public input. Selecting a list of combined sewer areas to separate based on outdated system information and public input is not appropriate in our experience.

For information only, we have included a table that presents updated conceptual separation costs for the areas shown in the attached figure. We have updated these costs based solely on the ENR. The cost estimates do not reflect the current economic climate, which is significantly impacted by material shortages and contractor availability and staffing. These costs also do not reflect any current project challenges that have arisen since the original reports and/or conceptual plans were developed (for example, these costs do not include any Humphrey's Brook Area outfall discharge issues). However, the updated costs provide an indication of the likely minimum costs of separation projects that include the original areas within the Warren Basin, Humphreys' Brook Basin, and the Tilden Basin, along with other areas that may be cost-effective to separate as part of an overall program for CSO control.

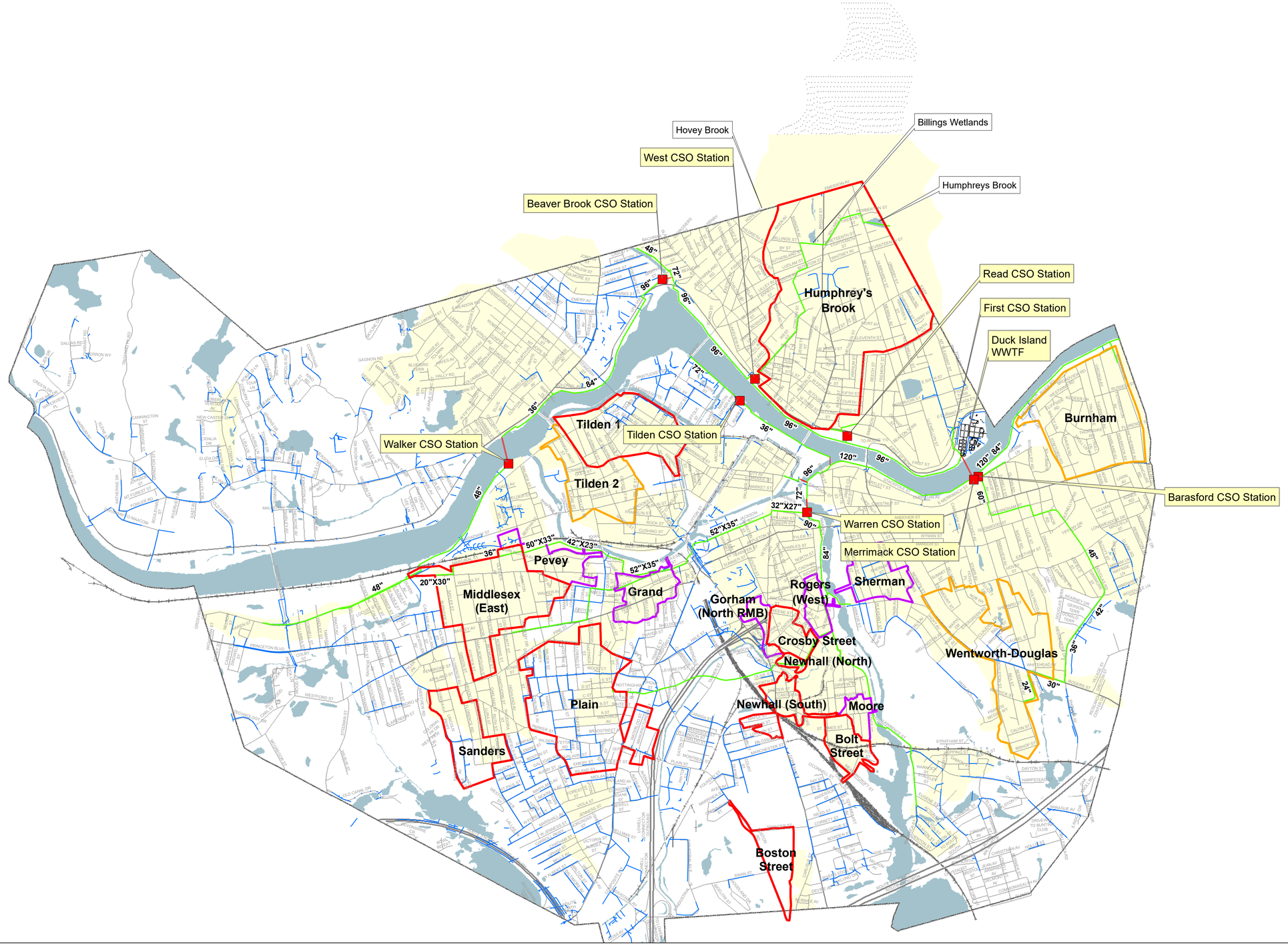
Based on discussions with the City, it would be technically best to allow the City to proceed with Preliminary and Final Design of the Humphrey's Brook Basin to address some of the highest priorities in the City with respect to extraneous flow reduction. This project also requires the longest time to allow for proper engineering and public outreach, and to coordinate with other governmental agencies to address the outfall challenges.

A Preliminary Design Report should be completed to update the remaining combined sewer areas in the Warren Basin and to incorporate the other candidate areas included in the attached figure. From this PDR, the City can develop a program for prioritized sewer separation that addresses public input regarding current system problems, clearly identifies the outfall locations that are constructable, incorporates updated SWMM simulations of the combined sewer system to evaluate CSO control effectiveness, and updates cost estimates and construction challenges to develop and address all City priorities for separation.

Outfall Name	Size	Surface Water	Primary Tributary Sewer Area	Outfall Tributary Acreage	Relative Impacts/Issues Rating										Total Score
					Cost Ratio	Questionnaire Results	Infiltration Reduction	CSO Reduction	Stream Impacts	City's Repetitive Problems	Infrastructure Improvements	Construct-ablilty	Property/ Traffic Impacts	Potential Road Projects	
~~Industrial Avenue/Wellman (west)~~	~~72"~~	~~River Meadow Brook~~	~~26~~	~~128~~	~~2~~	~~5~~	~~5~~	~~5~~	~~3~~	~~10~~	~~2~~	~~1~~	~~1~~	~~5~~	~~39~~
~~Weed Street~~	~~60" (48" Jacking Alt.)~~	~~Concord River~~	~~16B~~	~~56~~	~~0~~	~~4~~	~~3~~	~~5~~	~~5~~	~~4~~	~~2~~	~~3~~	~~2~~	~~3~~	~~31~~
~~**Plain Street**~~	~~**72"**~~	~~River Meadow Brook~~	~~**18**~~	~~**192**~~	~~**0**~~	~~**5**~~	~~**5**~~	~~**5**~~	~~**3**~~	~~**6**~~	~~**1**~~	~~**1**~~	~~**1**~~	~~**3**~~	~~**30**~~
Newhall Street (South)	42"	River Meadow Brook	10	31	0	1	5	5	3	10	0	3	1	1	29
~~Lincoln Street (West)~~	~~36"~~	~~River Meadow Brook~~	~~18~~	~~76~~	~~0~~	~~4~~	~~5~~	~~5~~	~~3~~	~~6~~	~~2~~	~~2~~	~~1~~	~~0~~	~~28~~
Middlesex (East)	**6'x5' Concrete Culvert**	Black Brook	**32A**	**140**	**4**	**5**	**1**	**5**	**0**	**6**	**1**	**1**	**1**	**4**	**28**
Bolt Street	**60"**	Concord River	**10**	**30**	**4**	**0**	**5**	**5**	**5**	**0**	**1**	**3**	**3**	**2**	**28**
Newhall Street (North)	**18"**	River Meadow Brook	**10**	**4**	**4**	**1**	**5**	**5**	**3**	**2**	**0**	**4**	**2**	**1**	**27**
~~Gorham Street (South RMB)~~	~~30"~~	~~River Meadow Brook~~	~~10~~	~~13~~	~~4~~	~~1~~	~~5~~	~~5~~	~~3~~	~~2~~	~~3~~	~~3~~	~~2~~	~~0~~	~~27~~
Sanders Avenue	**30"**	Black Brook	**25**	**66**	**4**	**4**	**2**	**2**	**0**	**2**	**2**	**4**	**3**	**4**	**27**
Crosby Street	**42"**	River Meadow Brook	**10**	**26**	**1**	**3**	**5**	**5**	**3**	**2**	**3**	**3**	**2**	**0**	**27**
Boston Road	**30"**	Wetlands	**16A**	**34**	**5**	**0**	**5**	**5**	**1**	**0**	**0**	**4**	**4**	**3**	**27**
Sherman Street	**42"**	Concord River	**8**	**41**	**4**	**2**	**3**	**5**	**5**	**0**	**3**	**2**	**1**	**0**	**25**
Gorham Street (North RMB)	**30"**	River Meadow Brook	**10**	**13**	**2**	**0**	**5**	**5**	**3**	**0**	**1**	**4**	**2**	**4**	**25**
Rogers Street (West)	**36"**	Concord River	**10**	**18**	**0**	**1**	**5**	**5**	**5**	**2**	**2**	**3**	**2**	**1**	**25**
~~Industrial Ave (east)~~	~~42"~~	~~River Meadow Brook~~	~~16A~~	~~13~~	~~0~~	~~0~~	~~5~~	~~5~~	~~3~~	~~0~~	~~1~~	4	4	~~3~~	~~25~~
~~Lincoln Street (East)~~	~~7'x4' Box Culvert~~	~~River Meadow Brook~~	~~16A~~	~~144~~	~~4~~	~~0~~	~~3~~	~~5~~	~~3~~	~~2~~	~~0~~	~~1~~	~~3~~	~~3~~	~~24~~
Seneca Street	**42"**	**Concord River**	**15**	**49**	**3**	**1**	**0**	**2**	**5**	**2**	**1**	**4**	**4**	**2**	**24**
~~West Albert Street~~	~~18"~~	~~Black Brook~~	~~25~~	~~5~~	~~3~~	~~0~~	~~2~~	~~3~~	~~0~~	~~0~~	~~2~~	~~5~~	4	~~5~~	~~24~~
Moore Street	**36"**	Concord River	**14**	**14**	**2**	**0**	**5**	**2**	**5**	**0**	**1**	**2**	**3**	**4**	**24**
~~Upham Street~~	~~15"~~	~~Black Brook~~	~~25~~	~~5~~	~~4~~	~~0~~	~~2~~	~~2~~	~~0~~	~~0~~	4	~~5~~	~~4~~	~~3~~	~~24~~
~~Chatham Street~~	~~18"~~	~~Black Brook~~	~~25~~	~~7~~	~~3~~	~~0~~	~~2~~	~~2~~	~~0~~	~~0~~	4	~~5~~	~~4~~	~~3~~	~~23~~
Walker Street	18"	Pawtucket Canal	32A	8	5	1	0	4	4	0	0	5	4	0	23
Chelmsford Street	18"	Black Brook	24	14	5	0	5	3	0	2	0	3	2	3	23
Rogers Street (East)	48"	Concord River	8	75	4	1	3	5	5	0	1	2	2	0	23
Saunders Street	60"	Pawtucket Canal	23	98	1	5	0	4	4	2	1	2	1	3	22
Carroll Parkway	15"	Black Brook	25	6	4	1	2	2	0	0	1	5	4	3	22
Church Street	48"	Concord River	19	26	2	0	5	2	5	2	1	2	2	1	22
Grand Avenue	**48"**	**Pawtucket Canal**	**23**	**38**	**3**	**1**	**0**	**4**	**4**	**2**	**1**	**2**	**2**	**3**	**22**
Lawrence Street (North)	36"	Concord River	10	21	0	1	5	5	5	0	2	2	2	0	22
Westchester Street	30"	Black Brook	25	22	3	1	2	2	0	2	2	4	3	3	22
Commonwealth Avenue	24"	Concord River	11	11	4	0	0	1	5	0	0	5	4	2	21
Pevey Street	**48"**	**Pawtucket Canal**	**23**	**37.0**	**4**	**0**	**0**	**4**	**4**	**0**	**0**	**3**	**2**	**4**	**21**
Belle Avenue	15"	Black Brook	25	5	3	0	2	2	0	0	4	5	4	0	20
Whipple Street	30"	River Meadow Brook	10	10	0	0	5	5	3	0	2	3	2	0	20
Lawrence Street (South)	48'	River Meadow Brook	14	27	0	1	5	2	3	2	1	2	1	3	19
West Jenness Street	15"	Black Brook	25	8	4	1	2	2	0	0	1	5	3	1	19
Misc 13	15"	Marginal Brook	13	13	0	3	0	2	0	2	2	5	3	2	19
Marshall Avenue	36"	Black Brook	25	24	2	1	2	2	0	0	2	4	3	2	18
Edwards Street	36"	Merrimack River	28	26	4	0	0	0	5	0	0	2	2	5	18
Middlesex (West)	30"	Merrimack River	30	7	0	1	0	0	5	4	1	2	2	3	18
Gorham Street (North PC)	60"	Pawtucket Canal	19	84	0	1	5	2	4	2	1	1	1	1	18
Caleb Street	15"	Black Brook	30	8	5	0	0	0	0	0	0	5	4	3	17
Joffre Street	15"	Black Brook	30	3	4	1	0	0	0	0	0	5	4	3	17
Westford Street	36"	Black Brook	29	30	5	1	0	0	0	2	0	3	3	2	16
Shawmut Ave	42"	Black Brook	30	54	5	2	0	0	0	2	0	3	2	2	15
Baldwin Street	30"	Black Brook	30	29	5	1	0	0	0	2	0	3	3	0	14
Princeton Street	42"	Black Brook	28	23	5	0	0	0	0	2	0	3	2	2	14
Andover Street	36"	Concord River	6	31	0	1	0	0	5	0	0	3	2	2	12
Wood Street	6'x4' Concrete Culvert	Black Brook	28	37	1	0	0	0	0	0	0	2	3	0	6
TOTAL				1880											

NOTE: See text of report for determination of rating critieria.

Table 5-2
Matrix of Project Prioritization Points



Legend

- Diversion Station and CSO Outfall
- Interceptor/Trunk Sewer
- Storm Drain
- LRWWU Identified Target Area in RFQ
- Other Top Ranking Areas from Warren PDR 2004
- Additional Areas for Consideration from 2014 LTCP
- Combine Sewer Area

0 1,000 2,000 Feet

Lowell, Massachusetts

Figure 1
Target Separation Areas

Lowell, Massachusetts

Updated Costs of Potential Candidate Separation Area without Doing an Updated PDR

Outfall Name	Outfall Diameter	Total Drain Length	Outfall Tributary Acreage	Cost Escalated to Nov 2022
Humphrey's Brook Area	5'x6' Box	47200	435	$52,200,000
Warren - LRWU Identified Target Area				
Bolt Street	60"	2,261	30	$4,500,000
Boston Road	30"	3,869	34	$3,500,000
Crosby Street	42"	3,545	26	$5,600,000
Middlesex (East)	6'x5' Box	14,975	140	$21,700,000
Newhall Street (North)	18"	606	4	$500,000
Newhall Street (South)	42"	5,648	31	$8,900,000
Plain Street	72"	*already partially separated*		
Sanders Avenue	30"	8,821	66	$10,500,000
Warren - Other Top Ranking from 2004 PDR				
Gorham Street (North RMB)	30"	1,795	13	$2,300,000
Grand Avenue	48"	5,243	38	$7,400,000
Moore Street	36"	2,443	14	$3,800,000
Pevey Street	48"	3,940	37.0	$6,200,000
Rogers Street (West)	36"	3,224	18	$4,900,000
Sherman Street	42"	4,587	41	$7,500,000
2014 LTCP - Additional Areas for Consideration				
Tilden LRWU Target Area	-	-	100	$16,200,000
Tilden Additional Area	66"	11,400	70	$11,300,000
Wentworth/Douglas Area	60"	16,000	154	$23,900,000
Burnham Street Area	72"	21,300	155	$38,100,000
			Total	**$229,000,000**

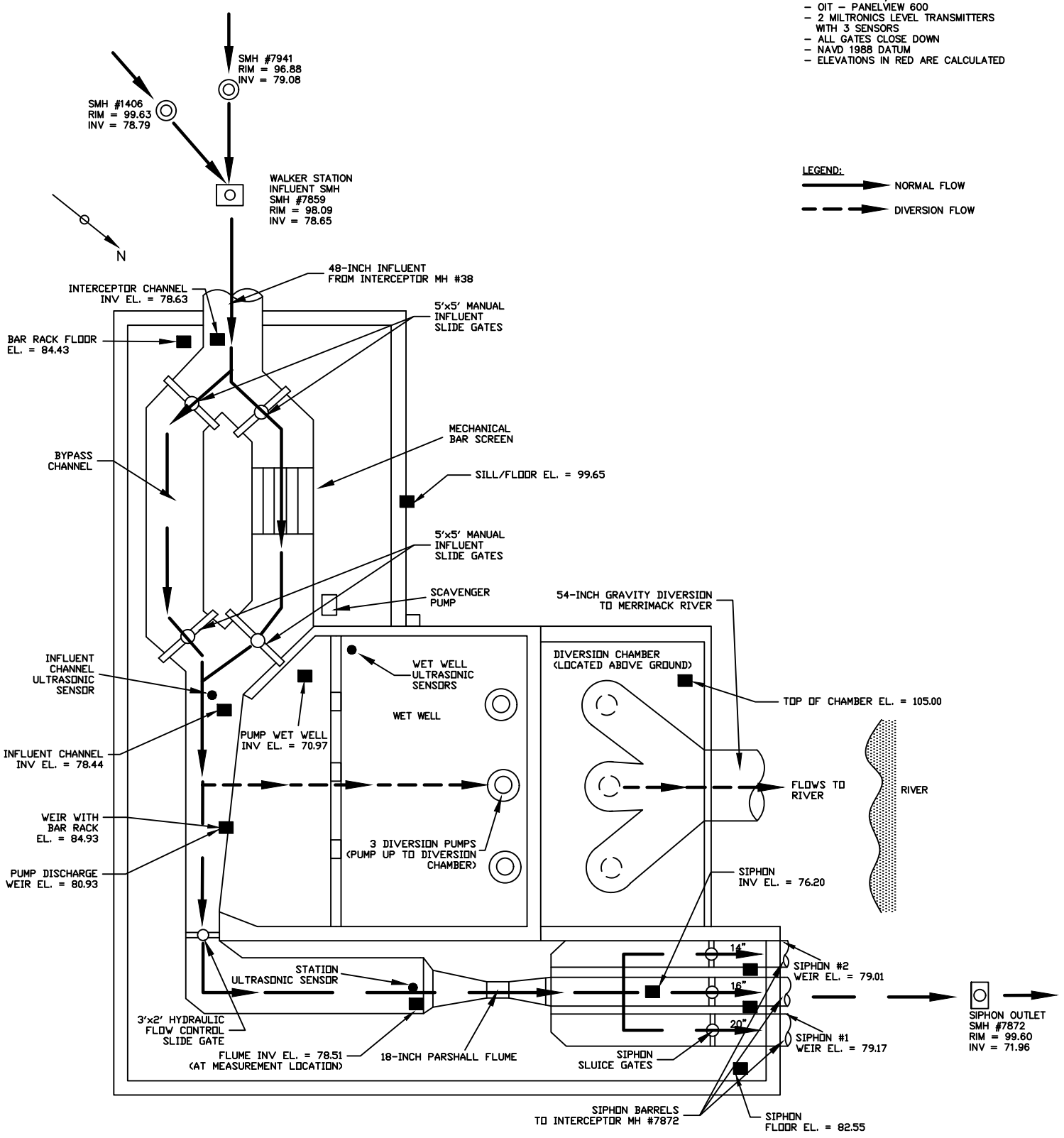
NOTE:

The Estimed Costs for Separation included in this table area based on prior reports and updated per ENR.

These costs do not reflect the current economic climate or challenges associated with recent material shortages or Contractor Availability. These also do not reflect any updates to address constructability challenges that should be addressed via a preliminary design phase of engineering.

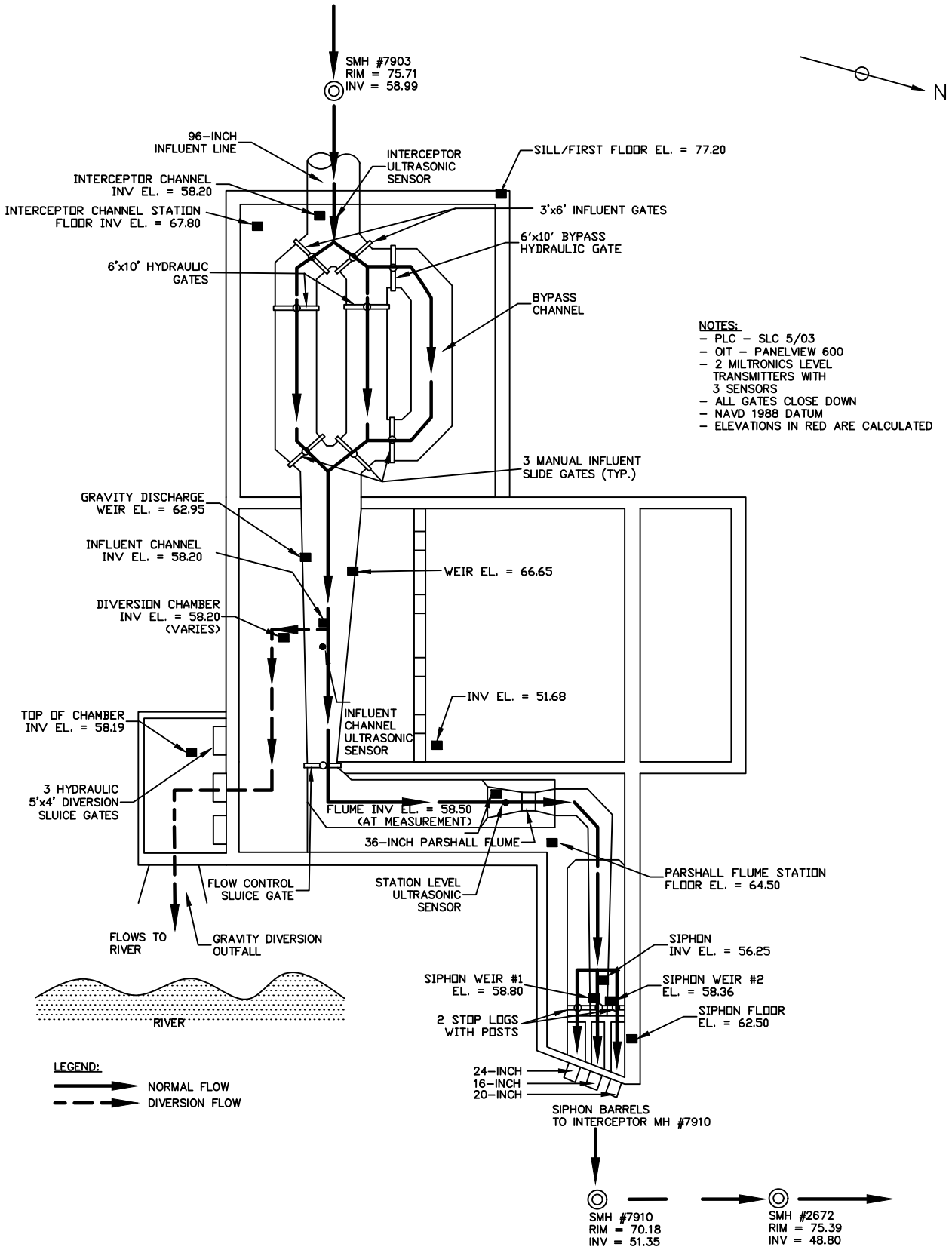
Appendix B CSO Discharge Station Schematics

NOTES:
- PLC – SLC 5/03
- OIT – PANELVIEW 600
- 2 MILTRONICS LEVEL TRANSMITTERS WITH 3 SENSORS
- ALL GATES CLOSE DOWN
- NAVD 1988 DATUM
- ELEVATIONS IN RED ARE CALCULATED



LOWELL REGIONAL WASTEWATER UTILITY	REV	DESCRIPTION	DATE	**WALKER STREET DIVERSION STATION**
	REV-2	UPDATED FOR HFMP	APR 25, 2023	
	REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009	
	DESIGNED BY: AF, CH	APPROVED BY:		
	DRAWN BY: DP	REVIEWED BY: EW		

JOB NO.:
DATE: 4/25/2023
SCALE: NOT TO SCALE
SHEET: 1 of 1



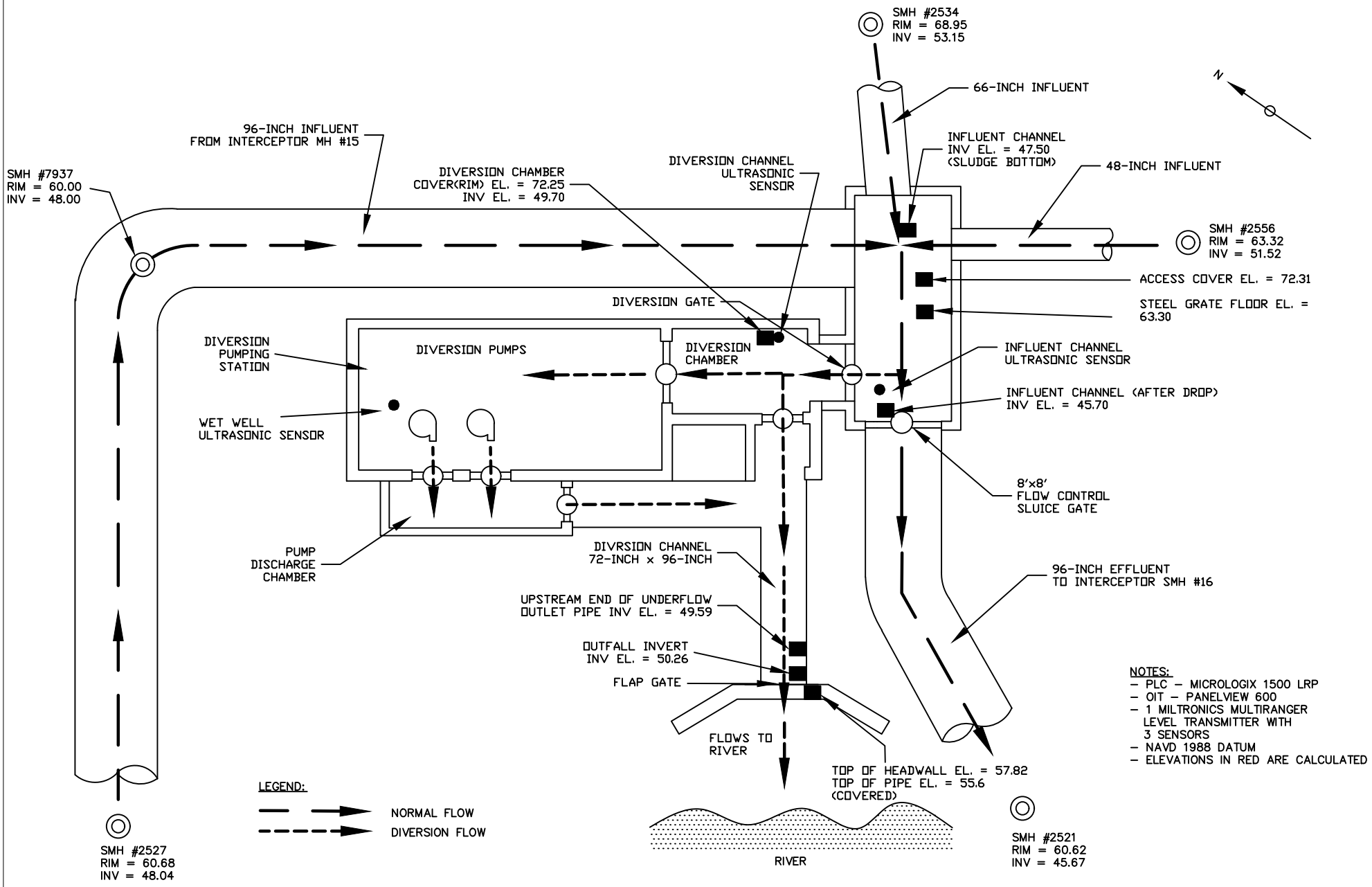
LOWELL REGIONAL WASTEWATER UTILITY

REV	DESCRIPTION	DATE
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REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009

DESIGNED BY: AF, CH	APPROVED BY:
DRAWN BY: DP	REVIEWED BY:

BEAVER BROOK DIVERSION STATION

JOB NO.:	
DATE: 4/25/2023	
SCALE: NOT TO SCALE	
SHEET: 1 of 1	



LOWELL REGIONAL WASTEWATER UTILITY

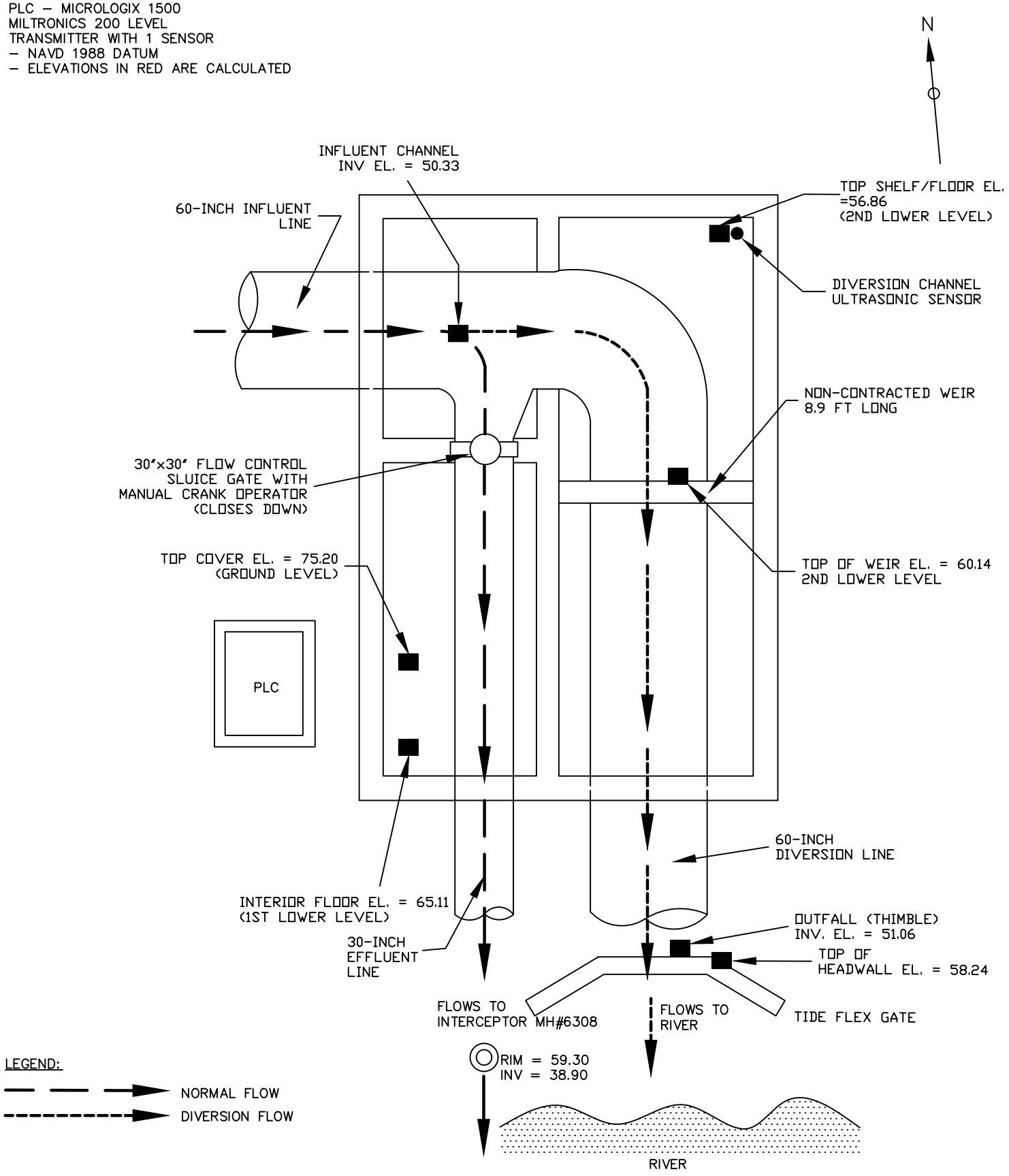
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REV-2	UPDATED FOR HFMP	APR 25, 2023
REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009

DESIGNED BY: AF, CH	APPROVED BY:
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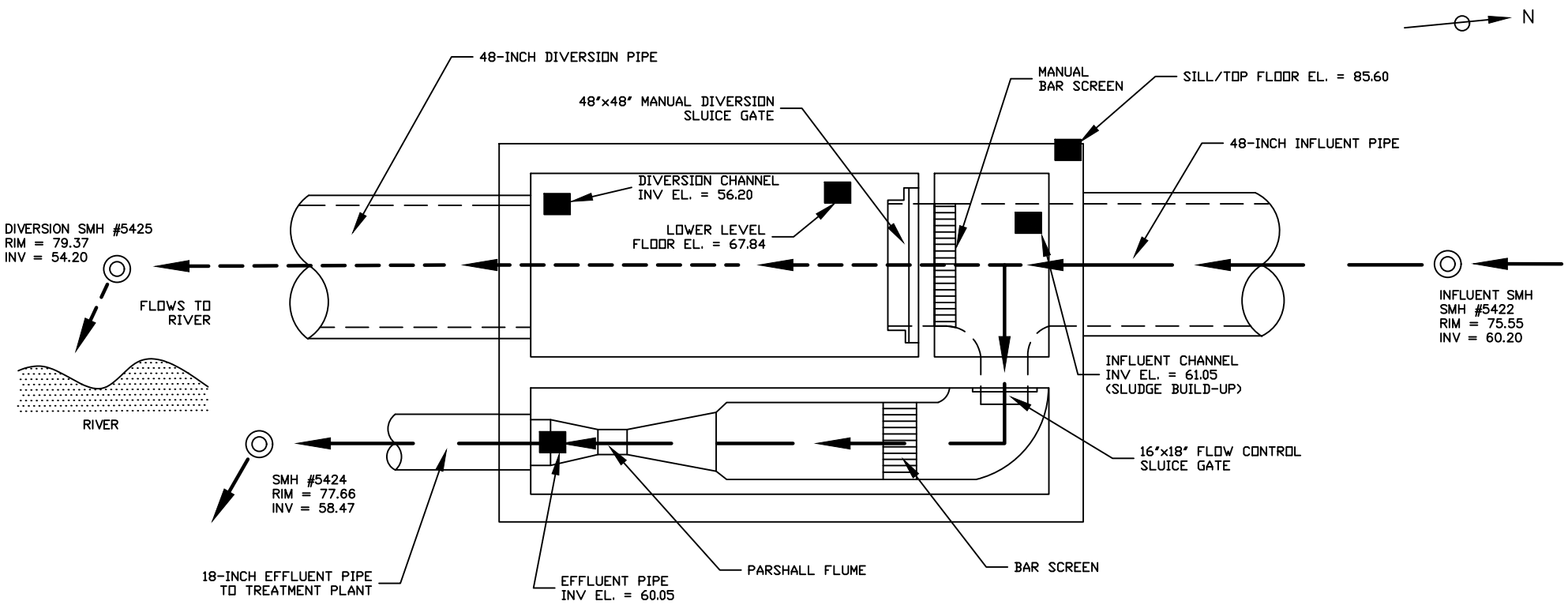
WEST STREET DIVERSION STATION

JOB NO.:
DATE: 4/25/2023
SCALE: NOT TO SCALE
SHEET: 1 of 1

NOTES:
PLC LOCATED ABOVE GROUND
PLC – MICROLOGIX 1500
MILTRONICS 200 LEVEL
TRANSMITTER WITH 1 SENSOR
– NAVD 1988 DATUM
– ELEVATIONS IN RED ARE CALCULATED



LOWELL REGIONAL WASTEWATER UTILITY	REV	DESCRIPTION	DATE	**READ STREET DIVERSION STATION**	JOB NO.:
	REV-2	UPDATED FOR HFMP	APR 25, 2023		DATE: 4/25/2023
	REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009		SCALE: NOT TO SCALE
	DESIGNED BY: AF, CH	APPROVED BY:			SHEET: 1 of 1
	DRAWN BY: DP	REVIEWED BY: EW			



NOTES:
- FISHER PORTER FLOW CHART
- LEVEL SENSOR
- NO PLC
- ALL GATES CLOSE DOWN
- NAVD 1988 DATUM
- ELEVATIONS IN RED ARE CALCULATED

LEGEND:

NORMAL FLOW

DIVERSION FLOW

LOWELL REGIONAL WASTEWATER UTILITY

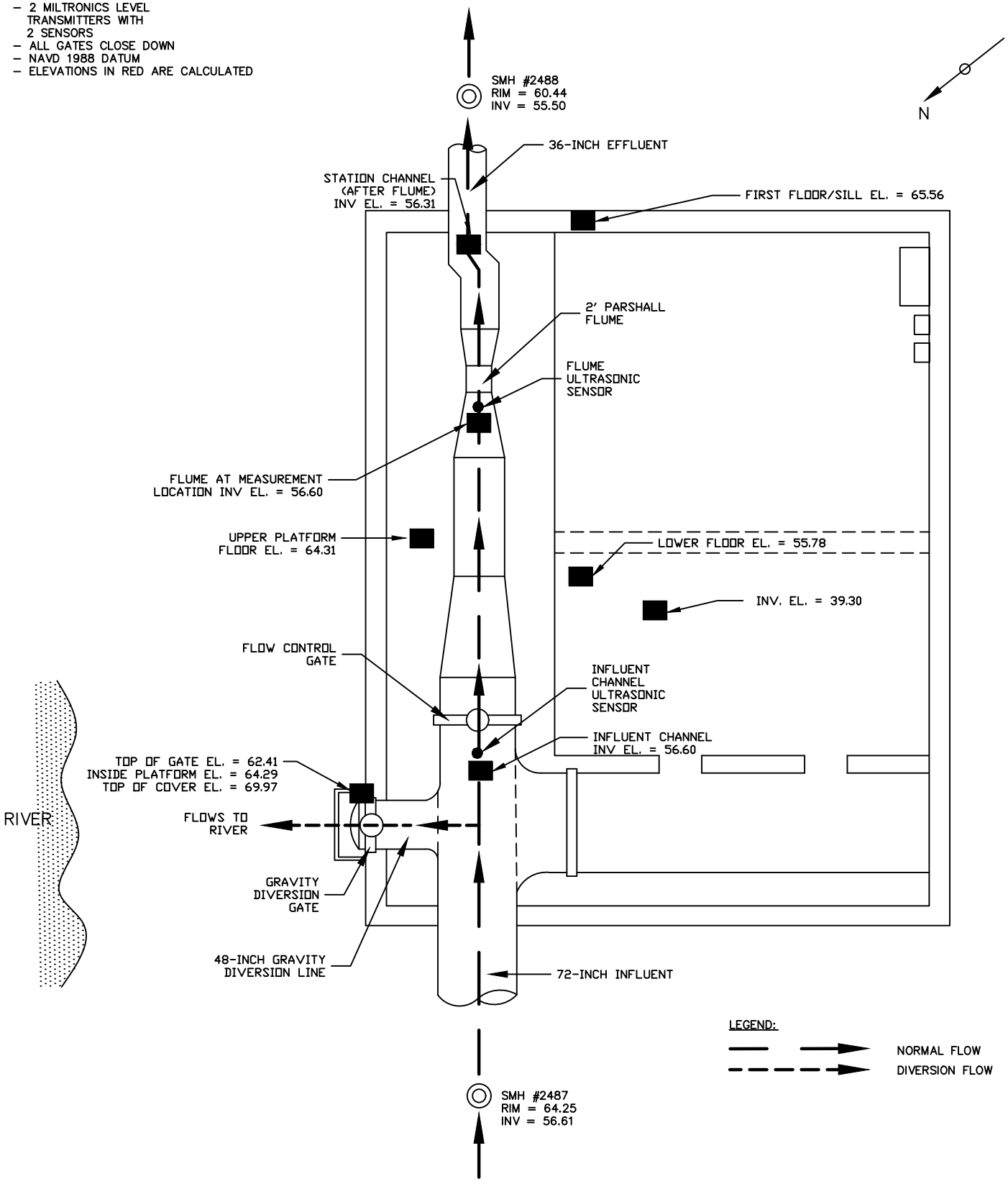
REV	DESCRIPTION	DATE
REV-2	UPDATED FOR HFMP	APR 25, 2023
REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009

DESIGNED BY: AF, CH	APPROVED BY:
DRAWN BY: DP	REVIEWED BY: EW

FIRST STREET DIVERSION STATION

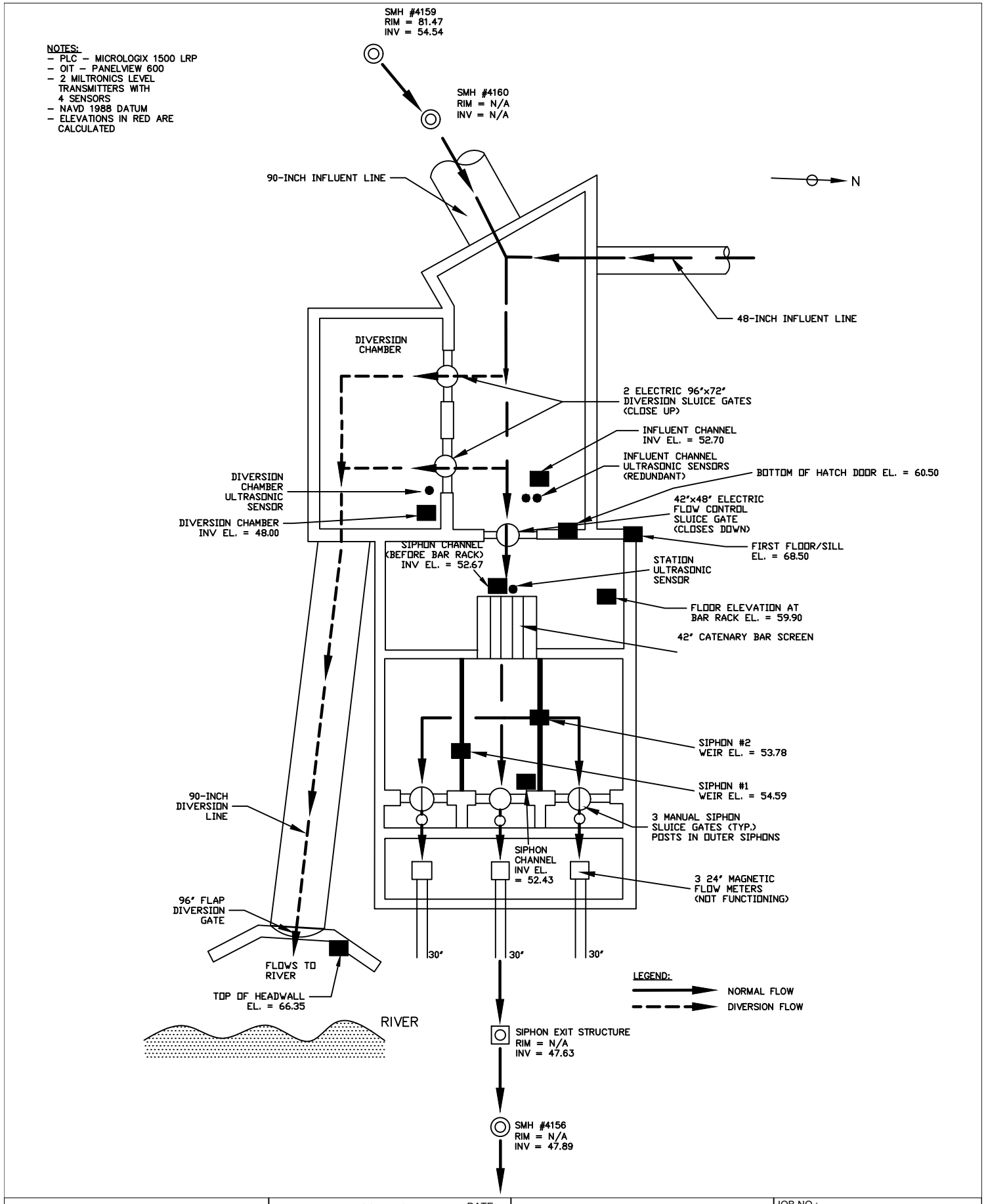
JOB NO.:
DATE: 4/25/2023
SCALE: NOT TO SCALE
SHEET: 1 of 1

NOTES:
- PLC – SLC 5/03
- OIT – PANELVIEW 600
- 2 MILTRONICS LEVEL TRANSMITTERS WITH 2 SENSORS
- ALL GATES CLOSE DOWN
- NAVD 1988 DATUM
- ELEVATIONS IN RED ARE CALCULATED



LOWELL REGIONAL WASTEWATER UTILITY	REV	DESCRIPTION	DATE	**TILDEN STREET DIVERSION STATION**
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	REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009	
	DESIGNED BY: AF, CH	APPROVED BY:		
	DRAWN BY: DP	REVIEWED BY: EW		

JOB NO.:
DATE: 4/25/2023
SCALE: NOT TO SCALE
SHEET: 1 of 1



LOWELL REGIONAL WASTEWATER UTILITY

REV	DESCRIPTION	DATE
REV-2	UPDATED FOR HFMP	APR 25, 2023
REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009

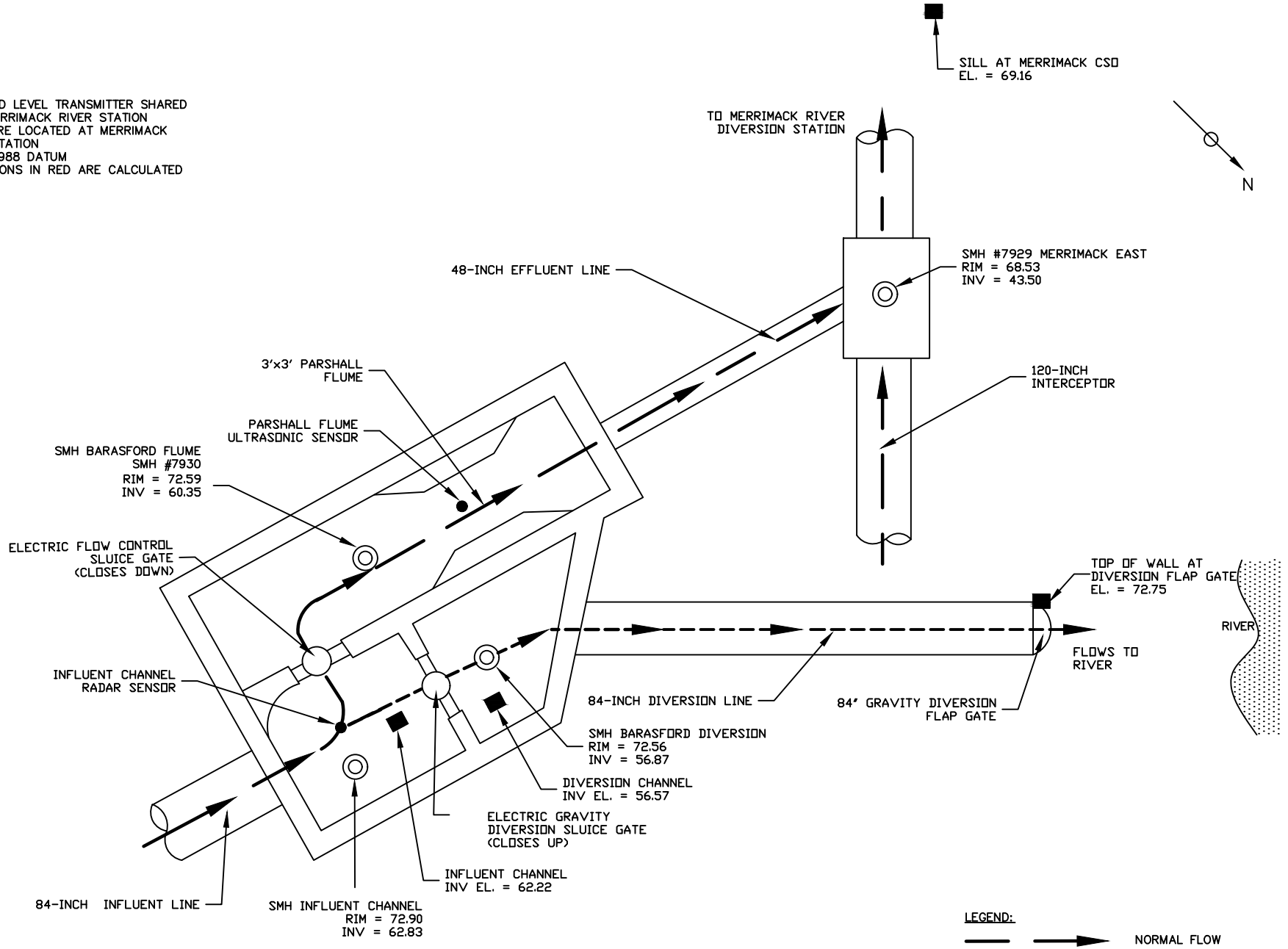
DESIGNED BY: AF, CH	APPROVED BY:
DRAWN BY: DP	REVIEWED BY: EW

WARREN STREET DIVERSION STATION

JOB NO.:	
DATE: 4/25/2023	
SCALE: NOT TO SCALE	
SHEET: 1 of 1	

NOTES:

- PLC AND LEVEL TRANSMITTER SHARED WITH MERRIMACK RIVER STATION BOTH ARE LOCATED AT MERRIMACK RIVER STATION
- NAVD 1988 DATUM
- ELEVATIONS IN RED ARE CALCULATED



LOWELL REGIONAL WASTEWATER UTILITY

REV	DESCRIPTION	DATE
REV-2	UPDATED FOR HFMP	APR 25, 2023
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DESIGNED BY: AF, CH	APPROVED BY:
DRAWN BY: DP	REVIEWED BY: EW

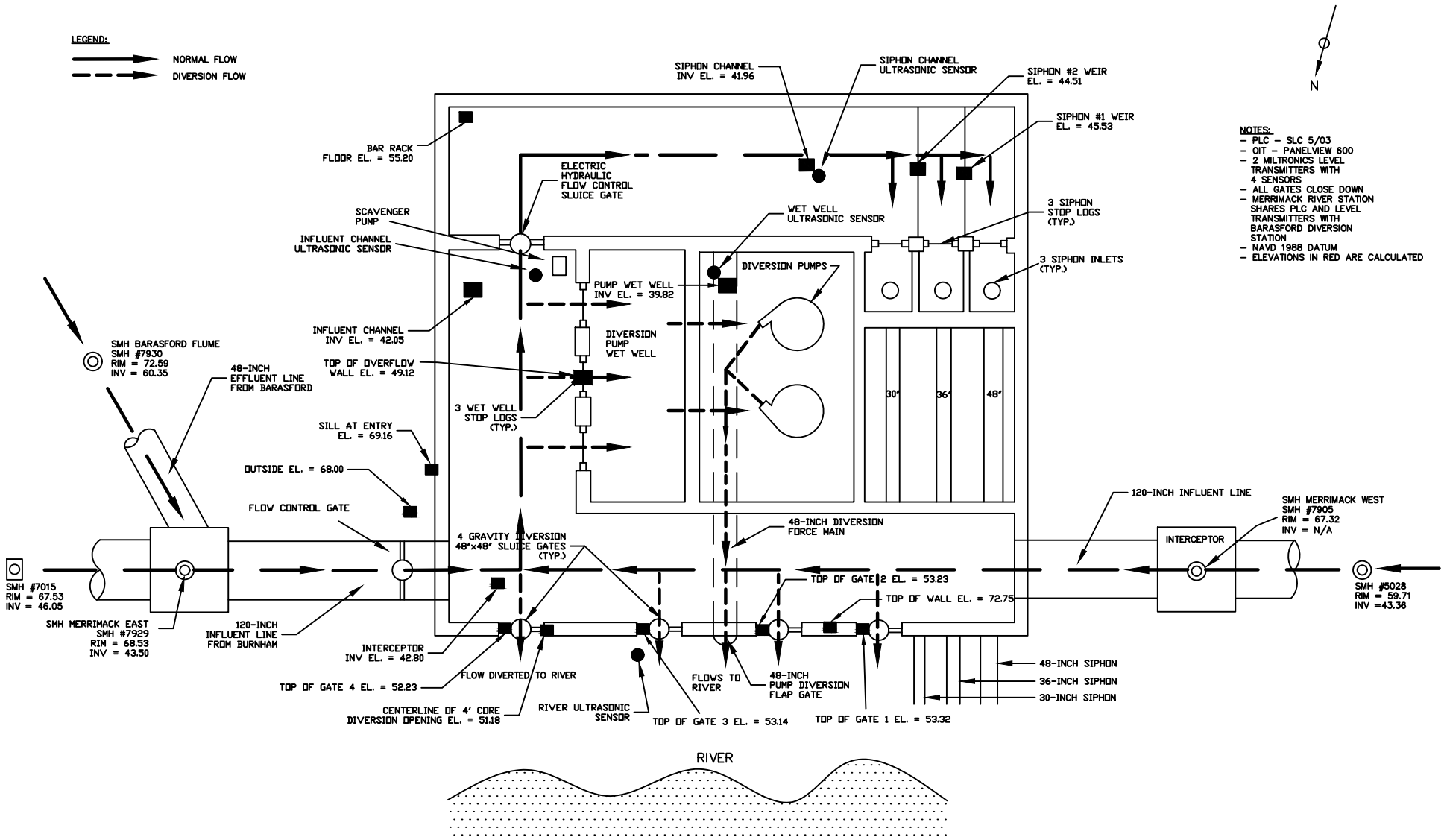
BARASFORD AVENUE DIVERSION STATION

JOB NO.:

DATE: 4/25/2023

SCALE: NOT TO SCALE

SHEET: 1 of 1



LOWELL REGIONAL WASTEWATER UTILITY

REV	DESCRIPTION	DATE
REV-2	UPDATED FOR HFMP	APR 25, 2023
REV-1	SUBMITTED FOR REVIEW	SEPT 9, 2009

DESIGNED BY: AF, CH	APPROVED BY:
DRAWN BY: DP	REVIEWED BY: EW

MERRIMACK RIVER DIVERSION STATION

JOB NO.:

DATE: 4/25/2023

SCALE: NOT TO SCALE

Appendix C Lowell Sewer and Street Flooding Issues Survey

Lowell Sewer and Street Flooding Issues Survey

Project Overview | Take the Survey! | Explore the Survey Results on a Map

Dear Resident,
The Lowell Regional Wastewater Utility (LRWWU) is developing a comprehensive Capital Improvements Program (CIP) to update the City's aging sewer and drainage piping systems to comply with Federal and State regulatory requirements.

The Utility, with assistance from our engineering consultant CDM Smith, is asking for input from Lowell residents and visitors, via this online survey, to identify first-hand problems and experiences with the sewer and drainage systems.

This survey has questions regarding sewer system backups into property basements and local street flooding during storm events. This information will be critical in the development of the CIP to establish the City's priorities to address regulatory requirements.

We appreciate your prompt cooperation and time in filling out this survey. Each verifiable response will be entered into a future raffle. LRWWU will select two winners for a $50.00 Market Basket Gift Card. We will arrange with you via email or phone number to get the gift card to the winners.

If you have any questions or would like to take this survey via phone, please contact our consultant: CDM Smith, Jefferson Mill, 670 N. Commercial Street, Suite 208, Manchester, NH 03101 Attn: Zach Robarts @ 603-222-8310

Name:*

Email Address:*

Telephone Number:

Other Contact Number:

Is there a sump pump in your basement?



*

- Yes
- No

What issues are you reporting?*

- Sewer/basement backup or street flooding at a particular property
- Other general location of street flooding in Lowell
- I have no sewer or flooding issues

How many times have you previously reported basement backups or flooding problems to the City of Lowell?*

The City of Lowell would like to hear more about any related sewer and/or flooding problems. Please include how often it has occurred, how long an event occurs, and any other important information. Any additional information will help the City to identify solutions.

Comments:

1000

After you have completed the questionnaire, please press the submit button on the bottom of the screen. Your response is greatly appreciated.

Submit

Appendix D Lowell Collection System Model Calibration and Validation Documentation (CDM Smith, 12/19/2024)

Memorandum

To: *Evan Walsh, Engineering Manager, Lowell Regional Wastewater Utility*

From: *Lauren Dwyre, Project Engineer*
Tatyana Dudiac, PE, Project Engineer
Mitch Heineman, PE, BC.WRE, BCEE, Senior Engineer

Date: *December 19, 2024*

Subject: *Lowell Collection System Model Calibration, Validation, and Representative Period Selection*

1.0 Introduction

This memorandum details the update, expansion, and calibration of the Lowell SWMM Collection System Model as part of the Phase 3 Candidate Area Sewer Separation Preliminary Design Report (Phase 3 PDR). As part of the I/I analysis, the Lowell Regional Wastewater Utility (LRWWU or Utility) conducted a metering program in spring 2023. This program was beneficial for updating the model to support planning efforts and the Phase 3 PDR. Key model updates included recalibration of hydrology and hydraulic components of the model to reflect existing conditions. The model was based on the previous model used for the 2019 Integrated LTCP (Hazen and Sawyer). Calibration was based on flow metering conducted between March and June 2023 and the Utility's system-wide supervisory control and data acquisition (SCADA) system for all of 2023. Improvements were made to the model's sanitary flow rates, diurnal patterns, and control rules at CSO stations in support of model accuracy and calibration. The model was expanded to include additional areas and the model inputs were updated based on various sources, such as Geographic Information System (GIS), SCADA, and closed-circuit television (CCTV) inspections. This updated model was used to support analyses for the Phase 3 PDR.

2.0 Previous Work

The current model builds upon previous model updates by CDM Smith in 2014 and the 2019 Integrated Capital Plan Report completed by Hazen. The 2014 work involved recalibrating sanitary flows, hydrology, and hydraulic components to existing conditions at 24 temporary flow meters, updating control rules at the diversion stations, and adding the Merrimack River and other waterways to the model. Updates for the 2019 Integrated Capital Plan included recalibrating the model to 26 temporary flow meters from April 2018 to August 2018 and adding of the North Bank Control Station to the model after its construction in 2018. For this project, CDM Smith further revised diversion station control rules to match current operating protocols.

3.0 Data Sources

3.1 Introduction

For the Phase 3 PDR, the collection system model was updated with the best available information on the existing collection system. The key data sources used in updating, expanding, calibrating, and validating the model include:

- Spring 2023 flow metering data collected by ADS Environmental Services under contract to Kleinfelder in support of the Utility's infiltration/inflow identification and removal program
- Precipitation data: National Oceanographic and Atmospheric Administration (NOAA) quantitative precipitation estimates (QPE) (i.e., radar-derived gridded rainfall), the Utility, Lowell Regional Water Utility, National Weather Service (NWS), and ADS gages
- The Utility's comprehensive SCADA from January 1 to December 31, 2023, which includes water depth sensors, overflow data, and gate positions data at each CSO Station .
- Sewer depth-only meters managed by ADS
- The Utility's record drawings
- Field and CCTV inspection data. Inspections were conducted primarily to verify observations from the flow metering data and to clarify hydraulic connections, including flow splits.
- Utility GIS data

Each of the data sources was integrated and cross-referenced to update the model to represent the conditions of the Utility's collection system as of 2023.

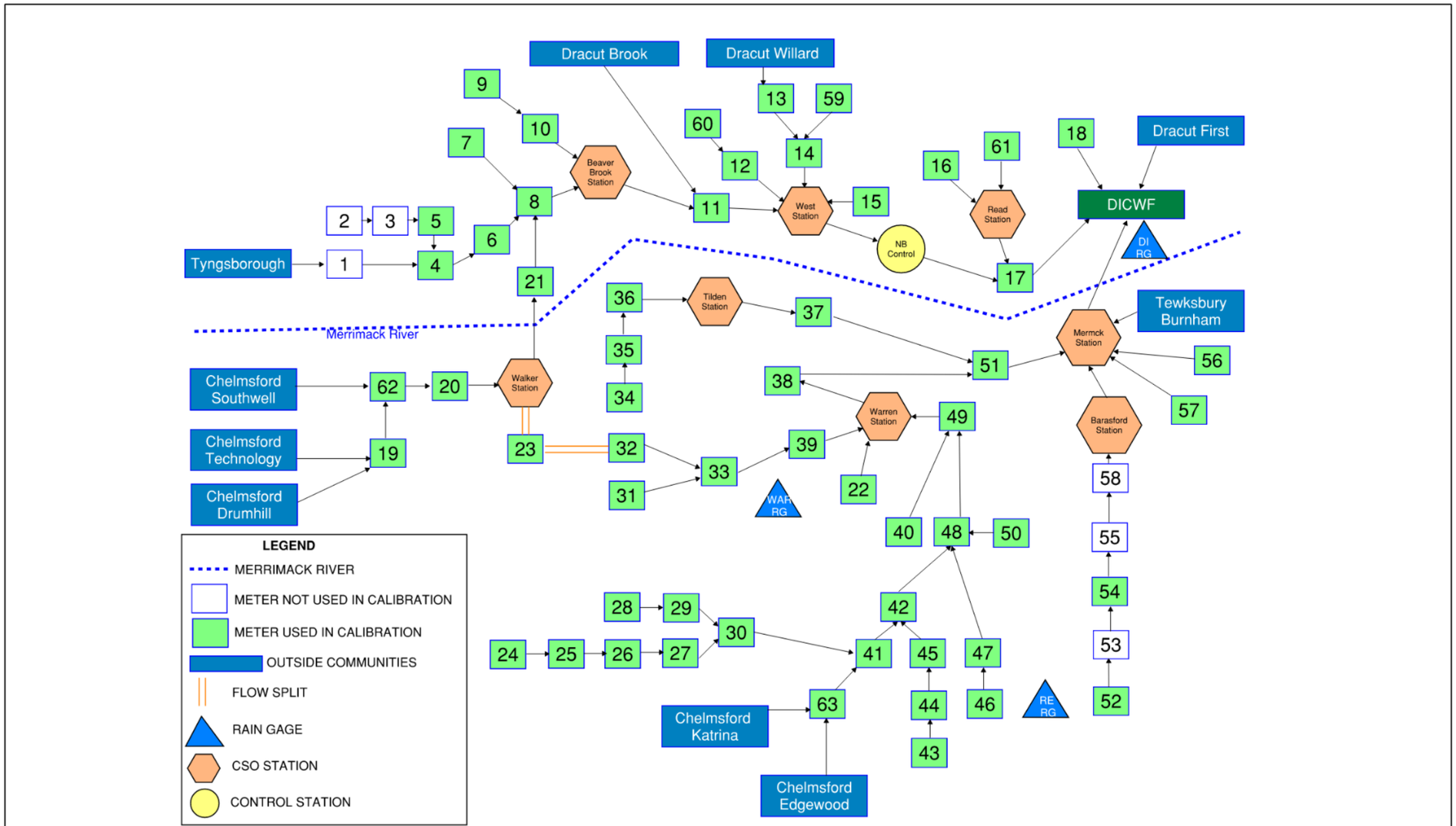
3.2 Flow Metering Program

As part of the Utility's Infiltration/Inflow (I/I) Abatement Plan (Kleinfelder, 2022), a comprehensive city-wide flow metering program was implemented in the spring of 2023, conducted by ADS. The metering program included deployment of temporary meters at 63 sites from March through June 2023. **Figure 1** and **Figure 2** show a schematic and a map of the metering sites.

Upon review of the final metering data for all sites, certain meters were excluded from Kleinfelder's I/I analysis due to poor data quality and flow balance issues. These meters, which accounted for 17% of the total system metered, were located upstream of the Utility's Barasford and Warren CSO Diversion Stations. Ten gaging sites (27, 29, 30, 41, 51, 52, 53, 54, 55, and 58) were re-metered by ADS in Spring 2024 to better resolve infiltration and inflow volumes. The 2024 data were not yet finalized when model calibration was completed.

Most of the data that Kleinfelder excluded from the I/I analysis was used judiciously for model calibration. Although the dry weather flow measurements were not considered reliable, level measurements were considered valid, and wet weather data were reasonably consistent with regard to flow balance among sites. The principal issue with the data was that at numerous sites velocity data could not be sensibly reconciled with observed depths. Meters 1, 2, and 3 had good quality data but were not used as they lay near the western boundary of the City in fully separated areas beyond the limits of the pipes represented in the hydraulic model.

The flow metering data collected during the program is summarized in **Table 1** and includes information on the average, minimum, and maximum flows at each metering location grouped by CSO Diversion Stations. The table also identifies meters that encountered data quality and flow balance issues and were either excluded from the model calibration process or used for calibration with limitations.



CDM Smith

Lowell, Massachusetts
Lowell Collection System Model
Calibration and Validation
Figure 1
Meter Location Schematic

DRACUT

TYNGSBOROUGH

ANDOVER

TEWKSBURY

CHELMSFORD

DRACUT - WILLARD

DRACUT - BOOK

TYNSBOROUGH - TYNGSBORO

CHELMSFORD - SOUTHWELL

CHELMSFORD - TECHNOLOGY

CHELMSFORD - DRUMHILL

TEWKSBURY - BURNHAM

DUCK ISLAND WWTF

DRACUT - FIRST ST

CHELMSFORD - KATRINA

CHELMSFORD - EDGEWOOD

EDGEWOOD

PAWTUCKET

PRINCETON

KATRINA

Merrimack River

Pawtucket Canal

Concord River

River Meadow Brook

Beaver

Tilden 1

Tilden

West

West/Coburn/Jewett

Read

North Bank Flow Control Station

First

Barasford

Merrimack

Warren

Walker

Tilden 2

Pevey

Grand

Sherman

Wentworth -Douglas

Burnham

Gorham (North RMB)

Newhall (North)

Newhall (South)

Middlesex (East)

Saunders

Sanders

Rogers (West)

Crosby Street

Moore

Bolt Street

Meter Basin							
4	16	29	45	58			
5	17	30	46	59			
6	18	31	47	60			
7	19	32	48	61			
8	20	33	49	62			
9	21	37	50	63			
10	22	38	51	Duck Island			
11	23	39	52	Merrimack Control Station			
12	24	40	53				
13	25	41	54				
14	26	42	55				
15	27	43	56				
	28	44	57				

Legend

- 1 Flow Meter Location
- Community Revenue Meter
- Pump Station in Hydraulic Model
- Diversion Station and CSO Outfall
- North Bank Flow Control Station
- Hydraulic Model Conduit
- Phase 3 Candidate Areas

0 1,000 2,000 4,000 Feet

N W E S

CDM Smith

DUCK ISLAND LOWELL REGIONAL WASTEWATER UTILITY

Lowell, Massachusetts
Phase 3 Candidate Area
Sewer Separation PDR
Figure 2
Flow Meter Location Map

Table 1 2023 Temporary Metering Locations and Flow Data Statistics

ID	Meter Location	Minimum Flow (mgd)	Average Flow (mgd)	Maximum Flow (mgd)	Calibration Status
Beaver Brook CSO Diversion Station					
1	1001 Pawtucket Boulevard				Beyond hydraulic model limits
2	821 Varnum Avenue				Beyond hydraulic model limits
3	Varnum Ave. at Laurie Ln.				Beyond hydraulic model limits
4	360 Varnum Avenue	0.01	1.18	4.37	✓
5	391 Varnum Avenue	0.10	0.54	3.60	✓
6	15 Woodward Avenue	1.79	2.82	22.06	✓
7	Mt Grove Street and 4th Ave.	0.14	0.34	39.21	✓
8	Off VFW Highway	3.14	6.19	72.56	Wet weather flow questionable
9	Riverside St. at Sparks St.	0.07	0.28	9.09	✓
10	911 Martin Street	2.77	6.52	54.05	Wet weather flow questionable
21	Varnum Ave. SW of Mammoth Road	0.94	2.45	20.33	✓
West CSO Diversion Station					
11	Merrimack Walking Path	3.02	7.11	48.72	✓
12	427 Lakeview Avenue	0.12	0.76	58.39	✓
13	Barker Ave, at Sutherland St.	0.29	1.29	31.67	✓
14	54 West Street	0.56	1.99	39.96	✓
15	Coburn St. and Lakeview Ave.	0.11	0.39	23.74	✓
59	85 Hildreth Street	0.05	0.16	11.55	✓
60	George Ave	0.00	0.18	6.321	✓
Read CSO Diversion Station					
16	Bridge Street at West 5th St	0.00	0.10	7.757	✓
61	38 Myrtle Street	0.03	0.30	1.901	✓
Duck Island					
17	Merrimack Walking Path (333 First Street Blvd.)	4.13	11.31	60.82	✓
18	Duck Island	0.04	0.23	3.779	Wet weather flow questionable
Walker CSO Diversion Station					
19	115 Hadley Street	0.23	0.50	2.281	Wet weather flow questionable
20	915 Pawtucket Street	0.60	2.09	24.79	✓
62	Middlesex St at Baldwin St	0.05	0.83	14.48	✓
23	42 Foster Street	0.08	0.22	10.11	✓
Warren CSO Diversion Station					
22	Williams Street	0.00	0.03	13.11	✓
24	W Albert St and Baltimore Ave	0.05	0.16	0.875	✓
25	Chelmsford St at Jenness St	0.11	0.28	5.14	✓
26	63 Chelmsford Street	0.17	0.52	17.25	✓

ID	Meter Location	Minimum Flow (mgd)	Average Flow (mgd)	Maximum Flow (mgd)	Calibration Status
27	480 Chelmsford Street	0.08	0.37	19.83	✓
28	144 Shaw Street	0.19	0.49	20.77	✓
29	38 Nottingham Street	0.56	1.53	68.97	✓
30	Lowell Connector near Leverett St.	1.23	2.51	75.8	✓
31	Branch Street and Queen St.	0.00	0.06	14.75	✓
32	101 Pevey Street	0.08	0.25	14.95	✓
33	355 Jackson Street	0.07	0.48	38.79	✓
39	34 Hurd Street	0.18	0.75	45.65	✓
40	219 Church Street	0.02	0.23	29.73	✓
41	Olive Street	2.08	5.40	114.2	✓
42	549 Lawrence Street	2.82	7.79	120.1	✓
43	76 Maple Steet	0.05	0.12	0.316	✓
44	978 Gorham Street	0.11	0.38	8.226	✓
45	Gorham & Olive Street	0.31	0.90	29.2	✓
46	Woburn Street at Carmine St	0.08	0.21	2.223	✓
47	Concord Riverbank Park	0.02	0.28	2.843	✓
48	174 Warren Court	3.98	9.66	202.4	✓
49	132 Warren Street	4.14	10.64	241.7	✓
50	68 Rogers Street	0.05	0.32	16.1	✓
63	Canada Street and Tanner St.	0.16	2.18	5.779	✓
Tilden CSO Diversion Station					
34	116 Suffolk Street	0.04	0.23	14.91	✓
35	432 Suffolk Street	0.32	0.93	22.06	✓
36	Cabot St in grass	0.55	1.49	43.71	Wet weather flow questionable
Merrimack CSO Diversion Station					
37	1 River Place Building C	0.68	2.12	17.35	✓
38	50 Stackpole Street	3.74	9.72	113.2	✓
51	Stackpole St at Corrigan Ave	7.15	14.57	159.7	✓
56	188 River Road	0.09	0.29	23.87	✓
57	230 Burnham Road	0.00	0.13	31.37	✓
Barasford CSO Diversion Station					
52	651 Rogers Street	0.23	0.52	15.81	✓
53	306 Douglas Road	0.19	0.63	25.85	Flow questionable
54	Andover St at Guild Street	0.61	1.46	59.55	✓
55	20 Barasford Avenue	0.08	1.42	62.47	Flow questionable
58	678 East Merrimack Street	0.88	2.34	148.2	Flow questionable

SCADA data collected by the Utility also helped inform model calibration. These include measurements of levels, flowrates, and gate positions at the CSO Diversion Stations, the North Bank Control Station, and Duck Island, as listed in Table 2. Timeseries for 26 of these data streams are included with the dry wet weather plots for spring 2023 in **Attachment 1** and wet weather plots for spring 2023 meters in **Attachment 2**.

Table 2 SCADA Metering Used in Calibration

Location	Depth (ft)	Outflow (mgd)	CSO (mgd)	Gate Position (fraction open)
Walker		✓	✓	
Beaver		✓		
West	✓			✓
North Bank	✓			
Read	✓		✓	
Tilden	✓✓	✓	✓	✓✓
Warren	✓✓		✓	✓
Barasford	✓	✓	✓	✓✓
Merrimack	✓		✓	
Duck Island		✓		

While ADS deployed a temporary rain gage at Sheehy Park in spring 2023 to accompany the flow metering program, CDM Smith elected to use NOAA's QPE data for model calibration. The QPE data provided a more comprehensive view of rainfall distribution across Lowell, as discussed in the next section.

3.4 Precipitation Data

The Warren gage was selected to characterize 2023 storms discussed in the Rainfall Analysis section of this memo. The Warren gage is one of the three rain gages maintained by the Utility. It records rainfall data at 5-minute intervals and is located 0.4 miles southeast of Lowell City Hall. The rain gage provided local data on rainfall intensity and duration, which helped to characterize storms and assess storm impacts on the collection system during the ADS metering period and during summer 2023 when several sanitary sewer overflows (SSO) occurred.

NOAA's hourly Multi-Radar Multi-Sensor Quantitative Precipitation Estimation (QPE) data was used for model calibration and to validate the model against available level and CSO data from the Utility. The QPE data was intersected with the subcatchments, allowing each one to have its own rainfall timeseries. The hourly timeseries were then synthetically disaggregated to 15-minute intervals. The QPE data provided representative rainfall across the city, especially during summer storms with high spatial and temporal variability.

Data from the Warren gage and the QPE were compared with data from the Lowell National Weather Service (NWS) Cooperative Observer Program (COOP) gage, three gages maintained by the Utility, and a gage operated by ADS. Stations were selected for analysis based on proximity to Lowell and historical data quality. **Table 3** lists the gages discussed in this section.

Table 3 Rain Gages Analyzed

Gage Name	Data Maintainer	Operator	Recording Frequency	Distance from Lowell City Hall (mi)	Period of Record
Lowell COOP	NWS	Lowell Regional Water Utility	Daily	3 WSW	1892-1970, 1978-present
Warren	LRWWU	LRWWU	5-minute	0.4 SE	1/1-12/31/2023
Duck Island	LRWWU	LRWWU	5-minute	1.2 E	1/1-12/31/2023
Rivers Edge	LRWWU	LRWWU	5-minute	2 SSE	1/1-12/31/2023
Sheehy Park	ADS	ADS	5-minute	1 W	3/30-6/16/2023
QPE	NOAA	NOAA	Hourly, synthetically disaggregated to 15-minute intervals	One gage per subcatchment	1/1-12/31/2023

The Lowell COOP gage is maintained by the Lowell Regional Water Utility (815 Pawtucket Boulevard). Daily precipitation has been measured at this site since the 1980s. In combination with earlier locations downtown, this gage offers a record of daily precipitation in Lowell since the 1890s. Rainfall in summer 2023, for June through August, totaled 24.3 inches, the greatest total in the record, exceeding the 12.2 inches average for 1991-2020, and 23.4 inches recorded in 1938.

The rainfall totals tell only part of the story. While no storm exceeded 3 inches of rain in 24 hours (about a 2-year event), six 2-year 1-hour depths were recorded at the Utility's Rivers Edge precipitation gage, and from four to seven 1-year depths at durations from 15-minutes to 2 hours were recorded at the Utility's Duck Island Wastewater Treatment Plant (Duck Island), Rivers Edge Road, and Warren precipitation gages. For this reason, it is important to compare the Utility and NWS measurements to assess the validity of the Utility's data.

Table 4 shows that precipitation was close to average through May at the Lowell COOP and Utility gages, with 17.0 inches recorded at the Lowell COOP site, slightly lower than the site's 19.0-inch average for 1991-2020 (i.e., the 30-year climate "normal" compiled by NWS). The QPE also recorded above-average rainfall from January through May and slightly exceeded all Utility gages.

June, July, and August were all much wetter than average. June and August rainfall totals fell within the 90th percentile in comparison with the 130-year historical record, and July was the third wettest July on record, behind 1938 (12.8 inches) and 1915 (11.7 inches). Utility rain gages recorded higher totals than the Lowell COOP gage in most gage-months from March through August, except for Rivers Edge in March (4.6 vs. 4.7 inches) and Duck Island in July (9.8 vs. 10.7 inches). The QPE also recoded higher than average totals, except in April (3.9 vs. 4.1 inches) and May (2.7 vs. 3.8 inches). While it is plausible that the Utility sites were all generally wetter than the COOP site, it is also possible that one or more of the Utility sites over-reported rainfall (or that the COOP site is drier).

For the year, rainfall totals at both the Utility gages and QPE were above average and closely aligned, with the totals close to each other. The total at the Warren gage was slightly higher than the QPE, with less than 2% difference. During the summer months, totals across all Utility gages and QPE were also similar. The Warren gage and QPE, used for rainfall characterization and calibration respectively, confirm the good quality of the data.

Table 4 2023 Monthly Precipitation

Period	Lowell NWS COOP 1991-2020	Lowell NWS COOP 2023	LRWWU Duck Island 2023	LRWWU Rivers Edge 2023	LRWWU Warren 2023	QPE 2023	ADS Sheehy Park2023[1]
Jan	3.6	5.6	5.3	5.6	5.8	6.4	
Feb	3.2	1.5	0.8	1.2	0.8	2.1	
Mar	4.3	4.7	4.7	4.6	5.8	6.3	0.3
Apr	4.1	3.4	4.5	4.1	4.5	3.9	4.5
May	3.8	1.8	2.6	2.7	2.8	2.7	2.8
Jun	4.4	6.8	7.7	7.1	7.0	6.6	2.4
Jul	3.9	10.7	9.8	11.9	11.3	11.0	
Aug	4.0	6.8	8.9	9.4	8.9	7.6	
Sep	3.9	6.9	5.9	7.0	6.8	7.2	
Oct	5.0	3.0	2.2	2.2	2.4	2.3	
Nov	3.9	2.2	2.2	2.0	2.4	2.2	
Dec	4.5	8.2	7.5	8.0	8.4	7.2	
Total	***48.5***	***61.7***	***62.1***	***65.9***	***66.9***	***65.7***	***7.3***
Jan-May	19.0	17.0	17.9	18.2	19.8	21.5	
Jun-Aug	12.2	24.3	26.5	28.4	27.1	25.3	

[1] ADS gage active from March 30 until June 15

3.5 LRWWU SCADA

The LRWWU SCADA system collects 15-minute interval data on depth, flow, and gate position at all CSO diversion stations, as well as at Duck Island. The level depth data at the CSO diversion station influent channel, gravity flow, and gate position were used to validate the model. This data helped to balance the flow at both the South and North Bank interceptors, and at Duck Island.

The overall model was validated using a full year of SCADA, including the spring period when a temporary flow meter program was deployed. This data allowed for validation of calibration at meters contributing to each CSO station.

The North Bank Interceptor includes the following stations: Walker, Beaver, West, Read, and the North Bank Flow Control Station. The South Bank Interceptor stations include Tilden, Warren, Barasford, and Merrimack. All stations, except for Read, are direct interceptor control stations. The CSO diversion stations are designed to discharge flow either by gravity or pumping to relieve surcharge. Barasford, Beaver, Merrimack, Tilden, Walker, and West stations are equipped with flow control gates to regulate flow and maximize interceptor storage. Levels in the influent channels and interceptors are monitored for control. Flow control and gravity diversion gates are programmed to open and close when certain levels are reached, optimizing storage while protecting upstream areas. Each station calculates diverted flow using one or more methods, depending on the gate style, structure configuration, and dimensions, as outlined in the Utility's High Flow Management Plan (Wright-Pierce, 2023).

3.6 Depth-only Meters

Lowell has depth-only sensors installed throughout the system to monitor sewer system levels and street flooding. Five sensors installed in low-lying areas were considered for calibration to 2023 conditions. These meters were located at 67 Payne Street, Eagle Court, 35 Windward Road, 34 Coburn Street, and at the intersection of Gorham Street and Moore Street. The 34 Coburn Street sensor recorded no overflows in 2023. The Gorham/Moore sensor, installed in December 2023, was excluded from the calibration due to its late installation.

Figure 3 illustrates the location of the five depth-only meters, each marked by a green circle. Each sensor records continuous 5-minute depth data. SSO occurs when the liquid depth reaches the top of the manhole where the meter is located. For example, the top-of-cover elevation is 9.6 feet at 67 Payne Street, 8.45 feet at Windward Road, and 5.25 feet at Eagle Court. These depth data were used to validate the model using SSO records published in the Utility's Annual Sewage Notification Report.

Although the validation period spanned the entire year of 2023, the first overflow event across all meters was not observed until June 26, 2023. As no SSO was reported prior to this date, validation for these meters focused on summer storms.



Figure 3 Level Sensor Locations

4.0 Rainfall Data Analysis

As discussed in **Section 3.4**, Lowell experienced notably higher-than-average rainfall in 2023 compared to historical data. The Warren gage was chosen to characterize 2023 storms in Lowell. **Table 5** shows that spring storms were generally small, with the largest one having a 6-month annual recurrence interval (ARI) on a 24-hour duration. However, several summer 2023 storms exceeded typical intensity and frequency patterns. Lowell recorded approximately 25 inches of rain between June and August 2023, the highest in the historical record, surpassing the previous record of 23.4 inches in 1938.

At the Warren rain gage, no single storm exceeded 3 inches of rain in 24 hours, but several storms recorded significant rainfall depths over shorter durations. For example, July 21 had a 20-year, 1-hour ARI with a total depth of 2.35 inches. The June 26 storm had a 5-year, 1-hour, and 3-year, 30-minute ARI, with 2.57 inches total rainfall. The remaining storms had maximum ARIs ranging from three years to less than one month. **Table 6** summarizes summer 2023 storm statistics.

Table 5 Spring 2023 Wet Weather Events at Warren Rain Gage

Date	Rainfall (inches)			ARI		
	1-hour	6-hour	24-hour	1-hour	6-hour	24-hour
April 23	0.34	1.11	2.07	1-month	3-month	6-month
April 29	0.29	0.70	1.94	<1-month	1-month	5-month
April 30	0.42	1.17	1.94	2-month	3-month	5-month
May 2	0.23	0.37	0.44	<1-month	<1-month	<1-month
May 20	0.35	0.98	1.52	1-month	2-month	2-month

Table 6 Summer 2023 Wet Weather Events at Warren Rain Gage

Date	Rainfall (inches)			ARI		
	1-hour	6-hour	24-hour	1-hour	6-hour	24-hour
June 26	1.40	1.95	2.57	5-year	2-year	1-year
June 28	0.89	1.24	1.31	6-month	4-month	2-month
July 21	1.92	2.34	2.34	23-year	3-year	10-month
July 29	1.24	2.19	2.21	3-year	2-year	8-month
August 8	0.66	1.28	1.43	4-month	4-month	2-month
August 10	0.91	1.58	1.58	1-year	9-month	3-month
August 15	0.22	0.84	0.89	<1-month	2-month	<1-month
August 18	0.8	1.21	1.78	7-month	4-month	4-month
August 22	0.95	0.95	0.95	1-year	2-month	<1-month
August 24	0.43	0.83	1.47	2-month	2-month	2-month

5.0 Model Updates

The collection system model was updated and improved to develop baseline conditions for the existing system to support this project. The updated model incorporates revised hydraulics, hydrology, dry weather flow estimates, and wet weather response. The model was updated and run in PCSWMM, a

stormwater modeling software built on the US Environmental Protection Agency Stormwater Management Model (EPA SWMM) version 5 engine.

The most significant model updates are discussed below:

- Sanitary flow rates were updated system-wide based on 2020 Census population for distribution of flow by catchment. Previously, SWMM model relied on flow values estimated from dry weather flow metering. Using population data allows for a better estimation of sanitary flow for unmetered areas. The 2020 Census blocks for Lowell were overlayed using GIS with the model subcatchment areas and the population per subcatchment was added to the model. To determine the sanitary flow from each subcatchment, a gallon per capita-day (gpcd) of 56 was applied system-wide. This value was determined based on analysis of dry weather flows throughout 223. The per capita value is multiplied by each subcatchment's population to obtain the sanitary wastewater flow.
- An updated hourly diurnal pattern was created based on the typical pattern observed in 2023 metering data. This pattern was applied system-wide to the sanitary flow.
- The configuration of all control gates was updated to be more representative of observed operations. Rules at Barasford Diversion Station, Beaver Brook Diversion Station, Merrimack Diversion Station, North Bank Control Station, Walker Diversion Station, and West Street Diversion Station were updated to better match dry and wet weather operations as described in the 2023 High Flow Management Plan and recorded by the SCADA flow and depth meters. The overview of the existing system is presented in Section 2 of the report.
- The model was expanded and further delineated in multiple areas throughout Lowell:
  - Model updates and expansion in the Centralville neighborhood are summarized in Appendix D of the Centralville Sewer Separation Revised Preliminary Design Report (CDM Smith, July 2024).
  - In the Barasford CSO basin, the pipe network was extended to Windward Road and Andover Street. Additionally, several subcatchments east of Douglas Road and south of Rogers Street that drain to Trull Brook and wetlands near Phoenix Avenue wetland area were classified as not contributing to the combined sewer system.
  - Additional areas where the model was expanded include Lakeview Ave/Coburn St area (near Meter 15), Lakeview Avenue/Aiken Street area (upstream of Meter 12), and Chelmsford Street (upstream of Meter 25).
  - Three pump stations were incorporated into the model, two of which are located upstream of Meter 63 and one upstream of Meter 25, which was added as part of the Chelmsford Street hydraulic update. Junction and pipe information for all three pump stations were sourced from GIS. Flows from larger subcatchments were re-distributed into smaller subcatchments after splitting them.
- Improved the representation of the model hydrology tributary to each CSO and the interceptor system. Review of the Utility's GIS and record plans was performed to identify which areas were combined sewer areas, partially separated or fully separated areas. This classification was used to update the model subcatchment system type. Additionally, connectivity and boundaries of all

catchments were reviewed to confirm that model representation of the contributing area to the combined sewer was appropriate.

- Updated subcatchment imperviousness using available data from the MassGIS Imperviousness 2016 1-meter dataset.
- Subcatchment slopes were updated based on MassGIS lidar data.
- CDM Smith used NOAA's QPE data to calibrate the model for the 2023 metering period. The QPE offers a high quality, nationwide hourly dataset on a 1-km grid that can be readily applied anywhere in the US with modest effort, making it valuable for model calibration and hindcasting in municipal engineering studies. This dataset was synthetically disaggregated to 5-minute data using the stochastic method for synthetic disaggregation of hourly precipitation records.
- Groundwater. The model's groundwater calibration was updated based on SCADA at Duck Island and all CSO diversion stations.

6.0 Model Calibration and Validation

6.1 Introduction

The updated model was calibrated to dry weather and wet weather and validated to a continuous 12-month period using 2023 SCADA. The calibration process utilized observed data from three main sources – the ADS meters, the continuous 15-minute SCADA, and the 15-minute level data maintained by ADS. The SCADA output included time series of gate operations (percent open), channel and interceptor depths, and station flows. Control logic for the gates was later applied for design storm and long-term simulations to assess system performance under existing and alternative conditions. The control logic is based on the High Flow Management Plan and operation and maintenance manuals for the CSO stations.

The model accounts for various wet weather contributions to the system including drainage from combined areas; I/I from sewered areas in Chelmsford, Dracut, Tewksbury, and Tyngsborough; and drainage from Hovey Wetland, Billings Wetland, and Humphrey's Brook.

6.2 Dry Weather Flow

Dry weather calibration focuses on aligning simulated flows with observed meter data during a selected dry period for each meter location, while maintaining a flow balance at Duck Island. This includes both diurnally varying sanitary flows and groundwater infiltration. Updates to sanitary flow rates are covered in the Model Updates Section of this Appendix. Groundwater levels and pipe infiltration were directly modeled using SWMM's groundwater simulation component, which simulates water table levels within each subcatchment. In cases where simulated dry weather flows were significantly lower than observed data, adjustments were made to the baseflow by modifying inflow/infiltration (I/I) or upstream flows.

Prior to depth calibration, system GIS data of the system was reviewed to ensure the correct pipe invert elevations and slopes were used. Manning's coefficients for conduits were initially set to 0.013 but adjusted between 0.011 and 0.020 to improve calibration of both depth and velocity. Higher Manning's coefficients may reflect the influence of pipe age, obstructions, and sediment buildup. Sediment adjustments were applied to certain conduits to improve depth calibration, based on ADS meter install logs for meters 11, 38, 43, 44, and 51. Sediment levels were also assigned to several pipe segments based on imbalances between measured depth levels and velocity readings, specifically on Baltimore

Avenue and Chelmsford Street. These sections were later inspected to validate the model's findings. In both locations, CCTV inspection confirmed the presence of sediment deposits and obstructions. The average sediment level of 1.9 inches and 9.6 inches was assigned to several pipe stretches on Baltimore Avenue and Chelmsford Street, respectively.

Dry weather calibration ideally requires a period of at least a week with no precipitation. To capture accurate diurnal patterns, the period should encompass both weekdays and weekends. For all ADS meters in the system, the best dry weather calibration period was determined to be May 7 to May 18, 2023. Less than 0.1 inches of rain was measured at the LRWWU Warren rain gage between May 3 and May 19.

Dry weather flow from the outlying communities was calibrated to permanent flow metering data for three sites measuring 5-minute flowrates from Dracut and one from Tewksbury. One diurnal wastewater pattern was established for Lowell, and one for the outlying communities. While the model previously had 19 different patterns, this simpler representation was judged appropriate to characterize sanitary flow across the system, as evidenced in the dry weather calibration plots presented in **Attachment 1**. Figures in the attachment for the four community meters show average daily flows for September 2022 through September 2023, as well as hourly flows for all of September 2023.

Figure 4 and **Figure 5** show timeseries of simulated and observed flow at Meter 17 and Meter 51, respectively, during the spring dry weather period. Meter 17 was located on the 96-inch North Bank Interceptor downstream of the North Bank Control Station and Read CSO Diversion Station. Meter 51 was located on the 120-inch South Bank Interceptor downstream of the Warren CSO Diversion Station and Tilden CSO Diversion Station. The dry weather calibration plots for flow, velocity, and depth for all the temporary meters are presented in **Attachment 1**. At some locations, the model underestimated or overestimated depth and velocity. For example, the average modelled flow at meter 17 is 9% higher observed and the modelled flow is lower at meter 51 by 12%; both are within the acceptable range.

Calibration graphics in this report and its attachments present observed and simulated depths, velocities, and discharges. However, some of the velocity measurements presented are inconsistent with the reported discharges, i.e., the product of wetted pipe area (calculated from measured depth and pipe dimensions) and velocity does not equal reported discharge. This occurred because the metering vendor made numerous adjustments to reported flowrates to address flow balance discrepancies identified by Kleinfelder and CDM Smith, but did not adjust reported velocities accordingly. Thus, while all modeled timeseries conform with the continuity equation Q = VA, many of the observed timeseries do not. The reported velocities are presented without modification despite this inconsistency. CDM Smith chose to display observed velocity whether or not it conformed with the continuity equation. While the reported values may be erroneous, they can be expected to be within reasonable range of the true values, and their range likely is a reasonable indicator of actual variations over time.

At some sites, it was not possible to reconcile observed and simulated dry weather flows. Simulated flows are not well matched to observed flow at meters 18, 22, 52, 55, and 58. Meter 22 experienced multiple malfunctions, recording nearly zero flow during dry weather on several occasions. Data from Meter 18 appears erroneous, showing no wet weather response and a distinct diurnal pattern through early May, after which the pattern changes significantly, and the meter begins recording wet weather events through the end of metering program. The flow imbalance is also shown on the hydrograph for Duck Island, where simulated flow exceeds observed flow. During wet weather calibration however, a flow imbalance at most of these meters was not apparent.

The dry weather calibration achieved a flow balance with the simulated dry weather effluent at Duck Island closely matching the SCADA effluent data (**Figure 6**).

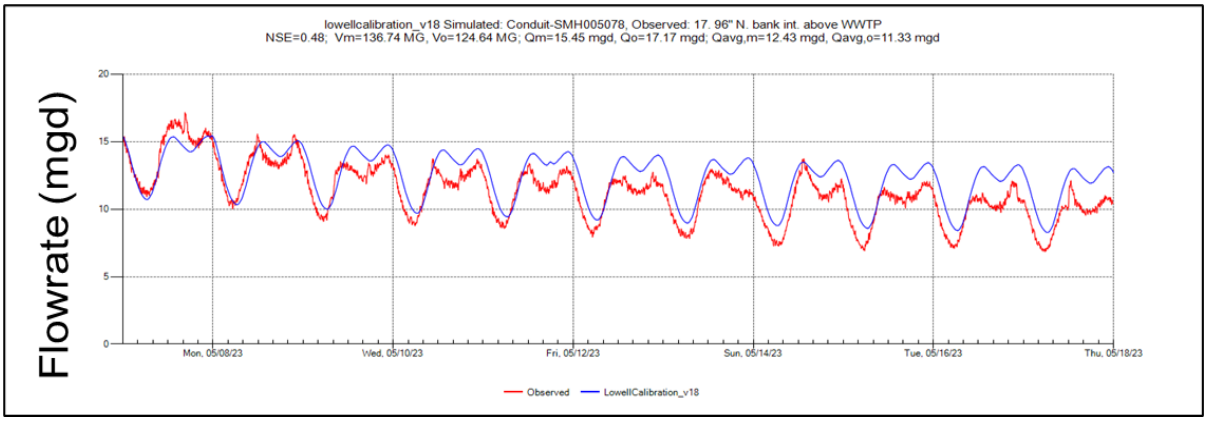


Figure 4 Simulated and Observed Flow at Meter 17 during Dry Weather Period

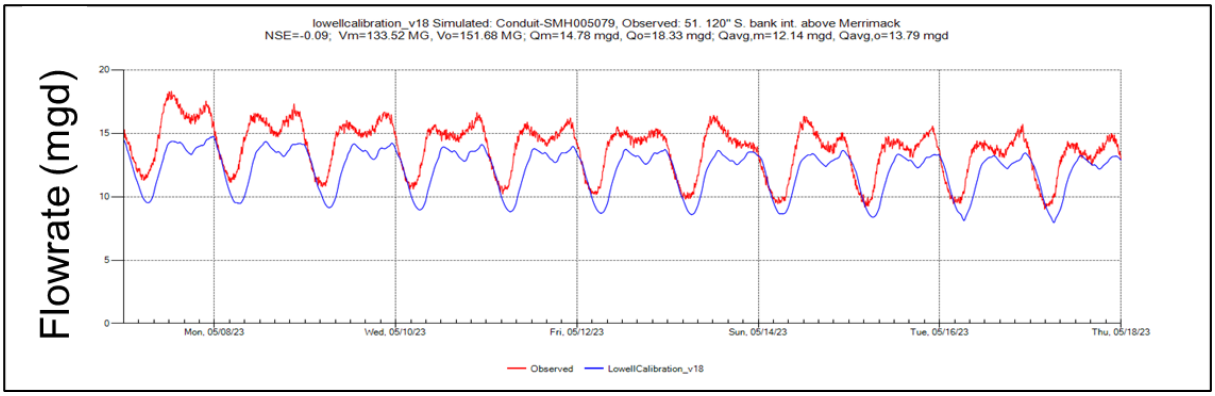


Figure 5 Simulated and Observed Flow at Meter 51 during Dry Weather Period

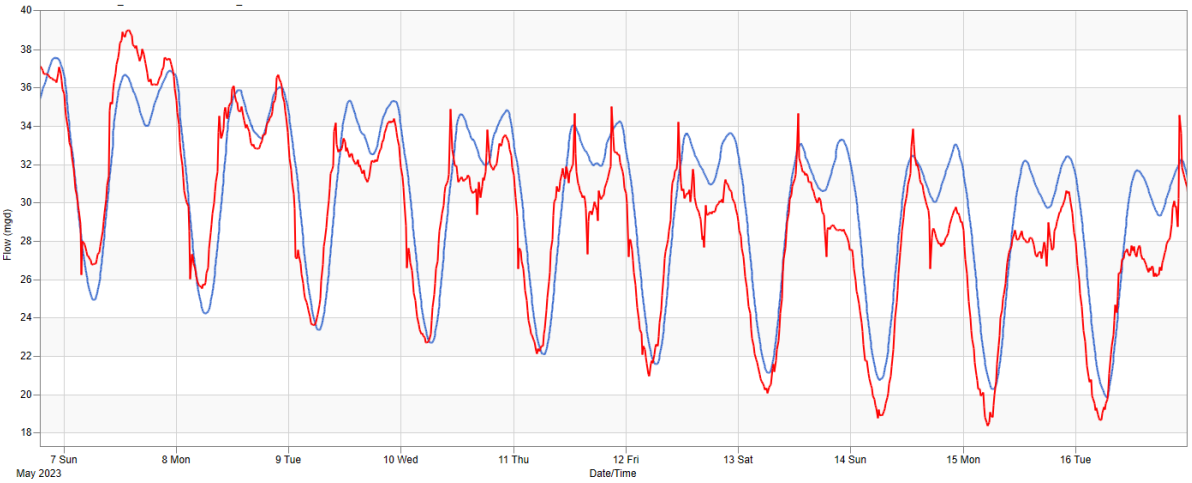


Figure 6 Simulated and Observed Flow at Duck Island during Dry Weather Period

6.3 Wet Weather Calibration

Wet weather calibration was performed to ensure robust representation of the system's response to rainfall, following guidelines adapted from those promulgated by the UK Chartered Institution of Water and Environmental Management (CIWEM), as summarized in **Table 7.** Whereas the CIWEM document recommends that the guidelines in Table 6 be used to judge three selected calibration storms, CDM Smith uses the guidelines for assessing performance throughout the calibration period. Additionally, while the guidelines do not identify velocity calibration criteria, the scatterplots discussed later in this document and included in its attachments present velocity data using the error tolerances specified for peak flows in the CIWEM guidelines. The "fit" criteria for depth, velocity, peak flow, and volume in Table 6 are plotted as red lines in the scatterplots. The model is considered well-calibrated when the majority of storm event statistics fall within the bounds of the two red lines shown in each scatterplot. Good calibration was attained at most metered locations, but not everywhere, both because the model is an imperfect representation of the collection system, and because metering data is inevitably flawed as well.

Wet weather calibration was supported using NetSTORM, a CDM Smith software program, for rainfall analysis and model output post-processing. This facilitated detailed assessment of rainfall events and their impact on the system. To achieve an accurate match between simulated and observed data, key hydrologic and hydraulic parameters were adjusted in the model. The primary adjustments included subcatchment width (hydrograph shape parameter) and percent routed (controlling effective imperviousness), which were critical in matching the shape and magnitude of runoff hydrographs. To achieve a closer match between simulated and observed depths, adjustments were made to the pipe Manning's N coefficient when necessary.

Table 7 Wet Weather Model Calibration Criteria

Parameter	Fit	Comments
Shape	Good match (Nash-Sutcliffe Efficiency Coefficient if used >0.5)	An evaluation technique may be used to compare the shape such as the Nash-Sutcliffe Efficiency Coefficient together with a visual check.
Time of peaks and troughs	±0.5 hour	Timing of peaks and troughs should be similar having regard to the duration of the event
Peak depth (unsurcharged)	Greater of ±0.3 ft or ±10%	
Peak depth (surcharged)	+1.5 to -0.3 ft	Relaxation may be appropriate in deep sewers
Peak velocity	+25% to -15%	Velocity not included in CIWEM guidelines
Peak flow	+25% to -15%	
Flow volume	+20% to -10%	Excluding poor / missing data

Four ADS meters close to Duck Island were initially given close consideration for wet weather calibration:

- Meter 17 downstream of the North Bank Control Station and Read Diversion Station
- Meter 18, serving the First Street catchment immediately north of Duck Island
- Meter 51 on the south bank immediately west and upstream of the Merrimack Diversion Station

- Meter 58 immediately upstream of the Barasford Diversion Station

However, Meter 18 had limited value for calibration due to metering issues during the late April and early May storms. Meter 58 was also problematic due to measurement issues. Final calibration prioritized Meters 17 and 51, SCADA measurements at Duck Island, and 2023 CSO and SSO statistics. Wet weather calibration plots for all meters are presented in **Attachment 2**. One set of plots shows observed and simulated conditions for the storms occurring between April 23 and May 2; the other plots show only the May 20 storm.

The following subsections detail the methodology, calibration results, validation process, and key findings from the wet weather calibration efforts.

6.3.1 Spring 2023

Five principal spring storms occurring on April 23, April 29, April 30, May 2, and May 20, 2023 were selected for primary wet weather calibration. Statistics for these events were provided in the Rainfall Data Analysis section of this document.

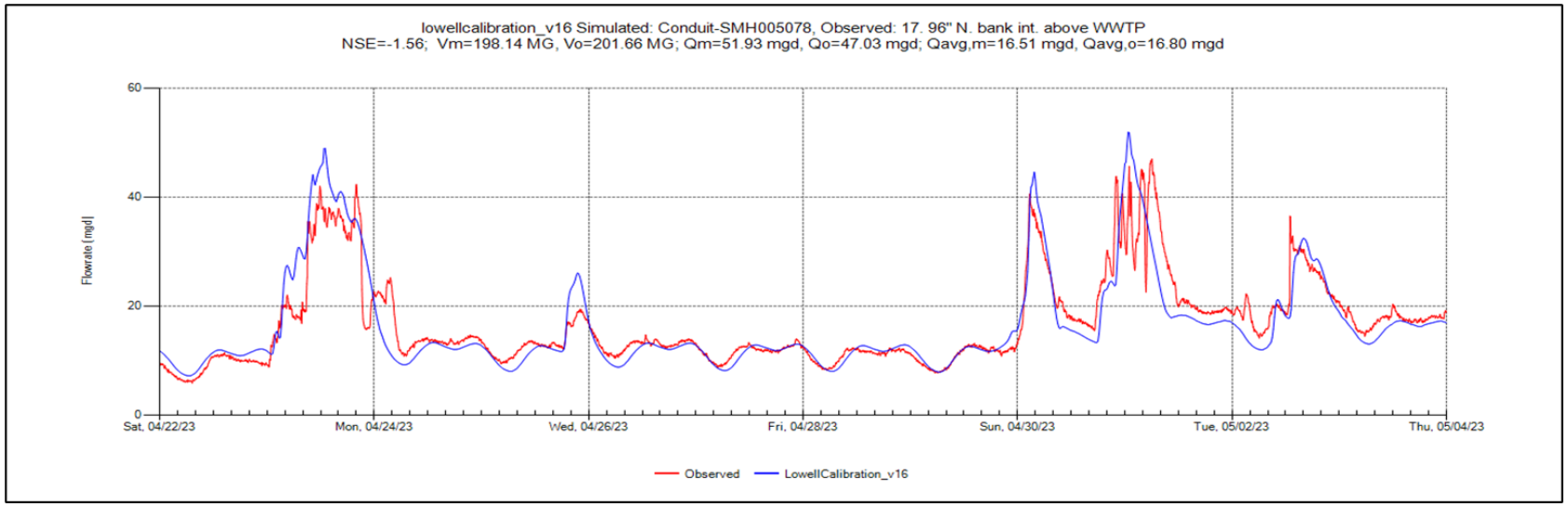
Scatterplots and hydrographs were generated to assess wet weather calibration for the metering period, using data from the spring metering program and the Utility's SCADA. **Figure 7** and **Figure 8** include scatterplots showing the relationship between simulated versus observed events for peak flow, depth, velocity, and total volume at Meters 17 and 51, as well as at Duck Island. The black line on the scatterplots indicates the one-to-one correspondence between simulated and observed events, with events overestimated by the model lying above the black line. The red lines indicate upper and lower boundaries for acceptable calibration accuracy, as adapted from the CIWEM guidelines. Overall, most data points fall within the red lines, representing acceptable calibration, with some minor exceptions.

At Meter 17, the velocity is slightly overestimated, while at Meter 51, it is underestimated. Velocity data was problematic at several metering locations as noted above. Where velocity results were not considered reliable, depth and flow were prioritized for calibration adjustments.

The hydrographs compare the model results (blue trace) with observed data (red). At both Meters 17 and 51, the model closely simulates and follows the observed data, particularly in terms of peak flow and dry weather flow between the storms, indicating good calibration.

Figure 9 shows scatterplots at Duck Island for peak discharge and volume. Most of the points lie within the red lines, confirming the overall flow balance at the treatment plant and validating good calibration to the spring events. This also helps verify calibration at the meters where data was not directly used for calibration, such as Meters 18 and 58.

Scatterplots for the spring 2023 meters are presented in **Attachment 3**.



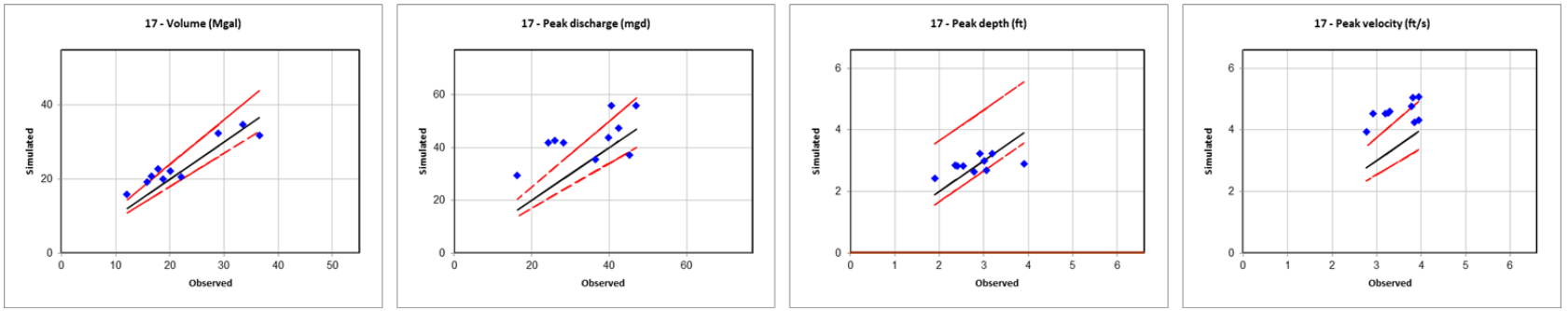


Figure 7 Wet Weather Flow Hydrographs and Scatterplots at Meter 17 during Spring Storms

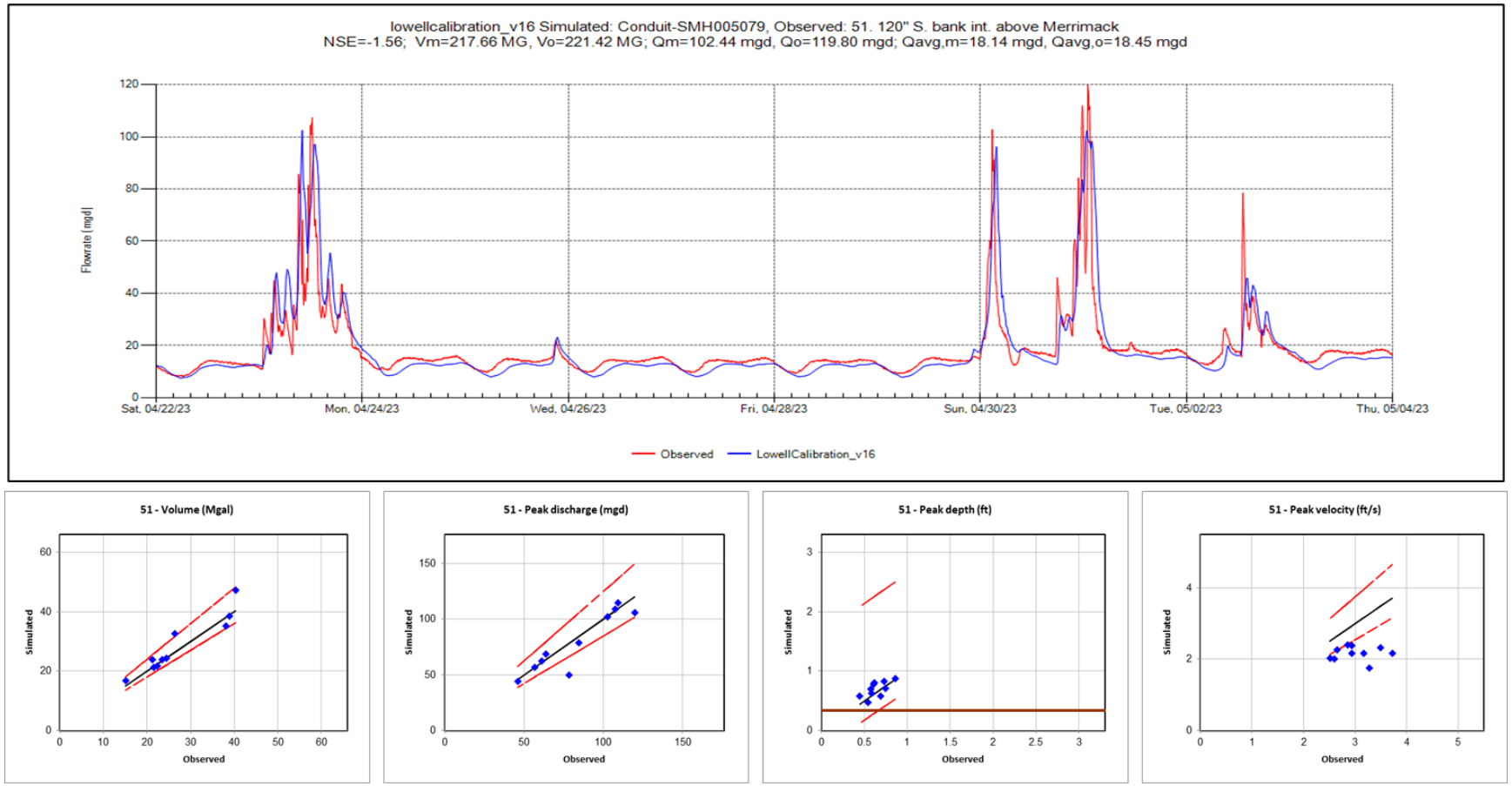


Figure 8 Wet Weather Flow Hydrographs and Scatterplots at Meter 51 during Spring Storms

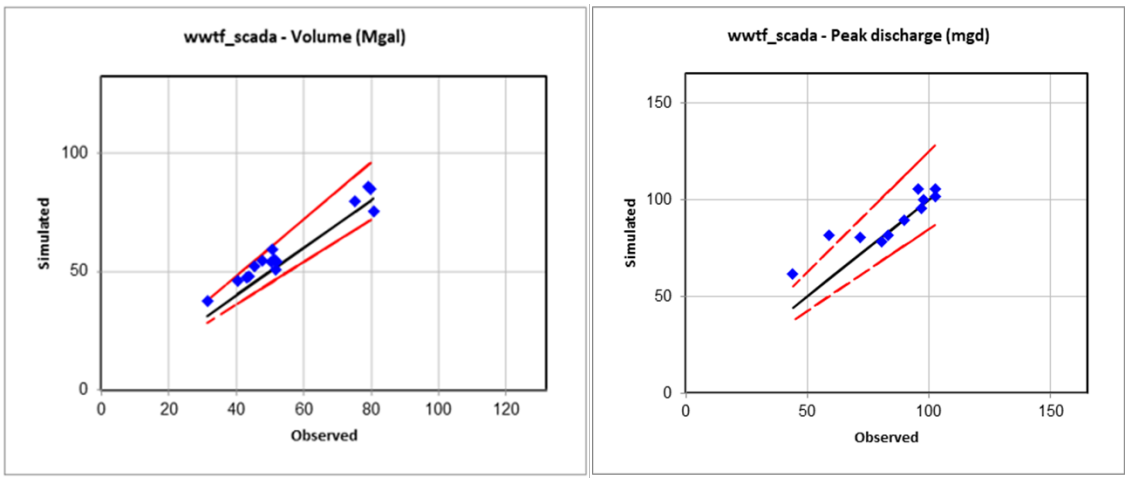


Figure 9 Wet Weather Calibration Scatterplots at Duck Island during Spring Storms

6.3.2 Summer 2023

The summer 2023 calibration included several spatially distributed and large storms, with the biggest one being the July 21 storm. This storm was classified as a 25-year storm based on a 1-hour duration and a 3-year storm based on a 6-hour duration. This storm caused significant flooding problems in some areas, but not others. Other major storms occurred on June 26 and July 29, classified as a 5-year and a 4-year storms at 1-hour duration, respectively. It was crucial to adjust model paraments to match these storms accordingly to ensure the model could perform well in smaller scale storms as well as the high intensity storms that occurred in the summer.

The model was calibrated to all CSO control stations and level meters. As mentioned previously, the calibration process used the 15-minute disaggregated QPE rainfall data. At the control stations, discharge coefficients of the gates were refined to improve the match between modeled and observed SCADA depth data at the structure influent channel. **Attachment 4** presents flows, levels, and gate settings at the Utility's SCADA sites for summer 2023, as well as level measurements at five manholes monitored by ADS.

The annual CSO statistics and specific changes to the control stations are covered in the Full-Year 2023 CSO Statistics sub-section of this Appendix.

Three level meters were used for model calibration in 2023: 67 Payne Street, Eagle Court, and Windward Road. The 34 Coburn Street meter was not used in calibration because no SSO was recorded at this meter; the depth in the manhole never reached the 9.5-foot threshold required to trigger SSO during high intensity storms. Similarly, the Moore Street meter was excluded, as its sensor was not installed until December 2023, after the summer storms.

Table 8 presents observed and modeled SSO statistics for the summer storms. The table indicates the liquid depth at which SSO is flagged: 9.6 feet at 67 Payne Street, 8.45 feet at Eagle Court, and 5.25 feet at Windward Road.

In some cases, observed SSO was minimal and lasted less than 15 minutes. In these instances, the model was unable to replicate observed SSO due to the disaggregation interval of the rainfall data. For example, on June 27, 20 gallons of SSO was reported at Eagle Court. The model did not simulate this brief event. A similar case occurred at Windward Road during another June 27 event and at 67 Payne Street at the July 21 event.

Overall, the number of observed and modeled SSO events is consistent, confirming the model as a reliable tool for further analysis. It effectively simulates both the timing and magnitude of SSO for most storms during the summer 2023 calibration period.

Table 8 2023 SSO

Event	Warren Rain Gage 1-hour ARI	67 Payne Street (9.6 ft)		Eagle Court (8.45 ft)		Windward Road (5.25 ft)	
		Observed	Modeled	Observed	Modeled	Observed	Modeled
June 27	5-year	✓	✓	✓	✓	✓	✓
June 28	11-month	✓	x	✓ 20 gal	x	✓	x[1]
July 3	3-month	x	x	x	x	✓	x[1]
July 14	11-month	✓	✓	✓	✓	x	x
July 16	2-month	✓[2]	x	x	x	x	x
July 21	23-year	✓	✓	✓	✓	✓	✓
July 29	3-year	✓	✓	✓	✓	✓	✓
August 8	4-month	✓	x	✓	x	✓	✓
August 10	1-year	✓	✓	✓	✓	✓	x [1]
August 18	7-month	✓	✓	✓	✓	✓	✓
September 11	5-month	✓	✓	✓	✓	x	x
Total		10	7	9	7	8	5

[1] QPE disaggregation resulted in less intense storm than observed

[2] 10 gal SSO reported although reported depth did not reach 9.6'

6.4 Level Meter Validation

In addition to the five level meters assessed for 2023 calibration, 11 other depth-only locations have been monitored across the system since 2020; **Table 9** lists all 16 locations. Nine locations were active as of October 2024. The 2020 through 2024 level data was used to validate model simulation of SSO and peak depths. The model was run from July 2020 to October 2024 using 15-minute rain data collected at the Warren CSO Station. The Warren gage was chosen for this validation because it has continuous data during the four-year period for the validation. Three sites were not identified as high priority locations by the Utility and were not used for model validation:

- The model was not extended to 74 West Meadow Road. This meter recorded no SSO throughout its deployment from October 2021 to April 2022.
- The model was not extended to 30 French Street or 21 Tyler Park. These meters had less than one month of data at the time of the analysis, and no large wet weather events occurred during that period.

Table 9 Manhole Level Metering 2020-2024

Name	Period Active	Manhole Depth (ft)	SSO?	Comments
35 Windward Road	7/31/20-present	5.25	Yes	Good validation
96 Marginal Street	8/4/20-10/7/21	16.6	Yes	Overall good validation; some metering issues
91 Pevey Street	8/12/20-3/31/21	15.0	No	Overall good validation; some metering issues
657 Middlesex Street	9/22/20-2/2/22	9	Yes	Good validation
67 Payne Street	9/7/21-present	9.5	Yes	Good validation
Eagle Court	3/20/22-present	8.6	Yes	Good validation
124 Raven Road	3/19/21-8/24/21	15.0	No	Assumed blockage during deployment
246 Raven Road	8/24/21-8/5/23	8.1	Yes	Assumed blockage at start of deployment; good validation for 2023 wet weather events
776 Lakeview Avenue	10/7/21-12/14/22	11.8	No	Levels highest in beginning of deployment period then significantly lower second half of record; needs more investigation
Lakeview Avenue-Ennell Street	9/16/24-present	12.8	No	Deployment too short; not validated
34 Coburn Street	1/1/22-present	9.3	No	Good validation
23 St James	4/29/24-present	9.4	No	Identified metering issues – used for SSO event validation but not peak depth validation
Gorham-Moore	12/14/23-present	18.7	No	Identified metering issues – not used for validation
74 West Meadow Road	10/7/21-4//22	11.4	No	Model not extended to this location – not used for validation
21 Tyler Park	9/16/24-present	11.2	No	Model not extended to this location – not used for validation
30 French Street	9/16/24-present	12.3	No	Model not extended to this location – not used for validation

Metering issues identified during validation of the Gorham/Moore site were confirmed by the Utility. This gage was used to validate that no SSO occurred at this location, but peak depths were not used. Additionally, there were a handful of locations where metered flow depth dropped significantly that the model did not reproduce, likely due to removal of blockages. The model was primarily used to simulate 2023 conditions; it was not configured to represent conditions prior to removal of blockages.

Nine level gages were validated and are shown in the “Comments” column in **Table 9**. The seven largest storms recorded at the Warren Street gage over the four-year period are listed in **Table 10**. **Figures 10** through **17** present selected results from these simulations. In some instances, the model replicates observed conditions well. In others, the model shows peak levels close to observations, but with differing hydrograph timing and/or shape. These differences may be due in part to differences between actual rainfall within a local catchment versus the Warren gage rainfall used in the simulation (it is for this reason that QPE data was used in the detailed 2023 calibration discussed earlier).

Table 10 Principal 2020-2024 Storms at Warren Rain Gage Used for SSO Validation

Date	Rainfall (in.)			ARI		
	1-hr	6-hr	24-hr	1-hr	6-hr	24-hr
9/10/2020	1.51	1.68	1.68	1-year	5-month	2-month
7/9/2021	0.80	2.32	2.32	4-month	11-month	5-month
7/12/2021	0.62	1.55	1.72	2-month	4-month	2-month
6/26/2023	1.40	1.95	2.57	5-year	2-year	1-year
6/28/2023	0.89	1.24	1.31	6-month	4-month	2-month
7/14/2023	0.90	0.96	0.96	4-month	1-month	<1-month
7/29/2024	2.00	2.00	2.00	5-year	9-month	3-month

- **Figures 10** and **11** show modeled and observed depth during a wet weather event on September 10, 2020 for 96 Marginal Street and 91 Pevey Street, respectively. Figure 10 suggests that there is a clock anomaly for the level meter data, given that the modeled level response to the same rainfall data in Figure 11 is synchronous with the elevated level measurements at that site.
- **Figure 12** shows a series of wet weather events from July 9-13, 2021 at 657 Middlesex Street.
- **Figures 13** through **16** show a series of wet weather events from June 26 – July 21, 2023 at 35 Windward Street, 67 Payne Street, Eagle Court, and 246 Raven Street, respectively.
- **Figure 17** shows that the model simulates SSO on July 29, 2024 at the St. James meter although no SSO was recorded. The level meter recorded no wet weather response, despite the Warren rain gage recording a 2-year, 1-hour rainfall. This is due to this storm being spatially variable and precipitation being less intense at St. James than at Warren CSO Station. The model only simulated this one SSO during the meter installation period.

Timeseries plots for representative periods from 2020 through 2024 at depth-only monitoring sites are presented in **Attachment 5.**

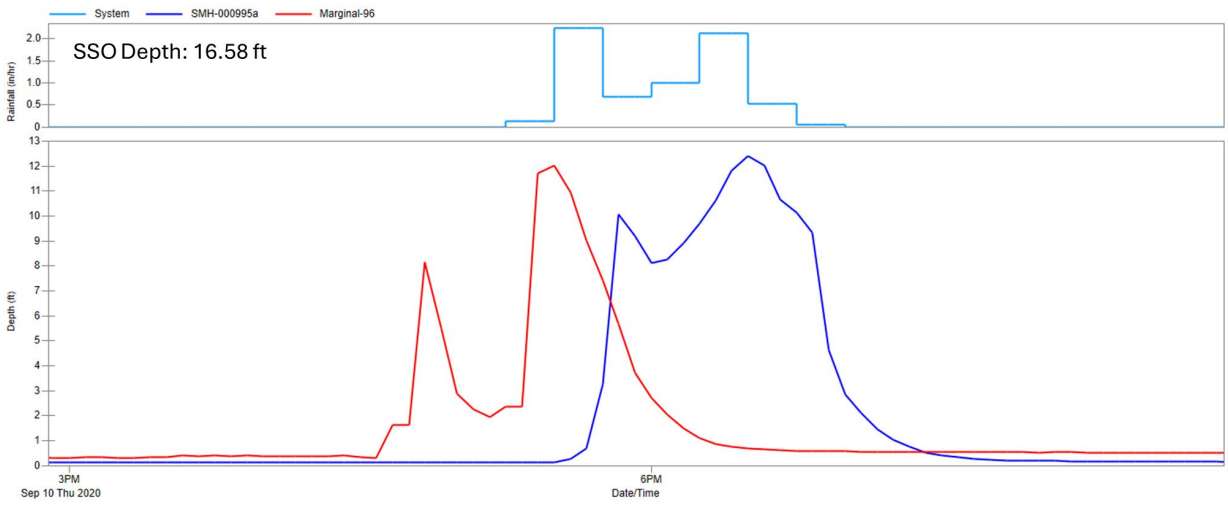


Figure 10 September 10, 2020 Model Verification of 96 Marginal Street Depth-only Meter

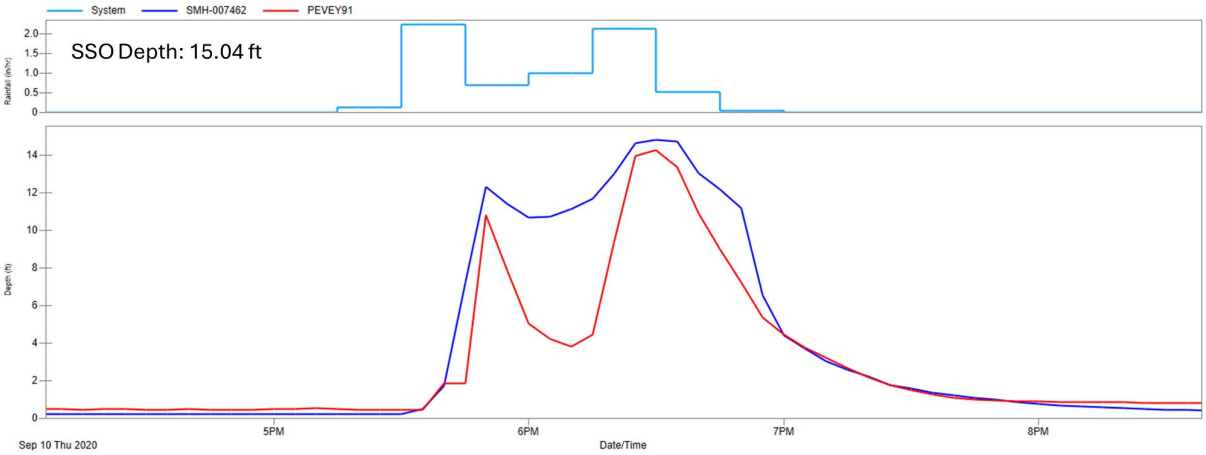


Figure 11 September 10, 2020 Model Verification of 91 Pevey Street Depth-only Meter

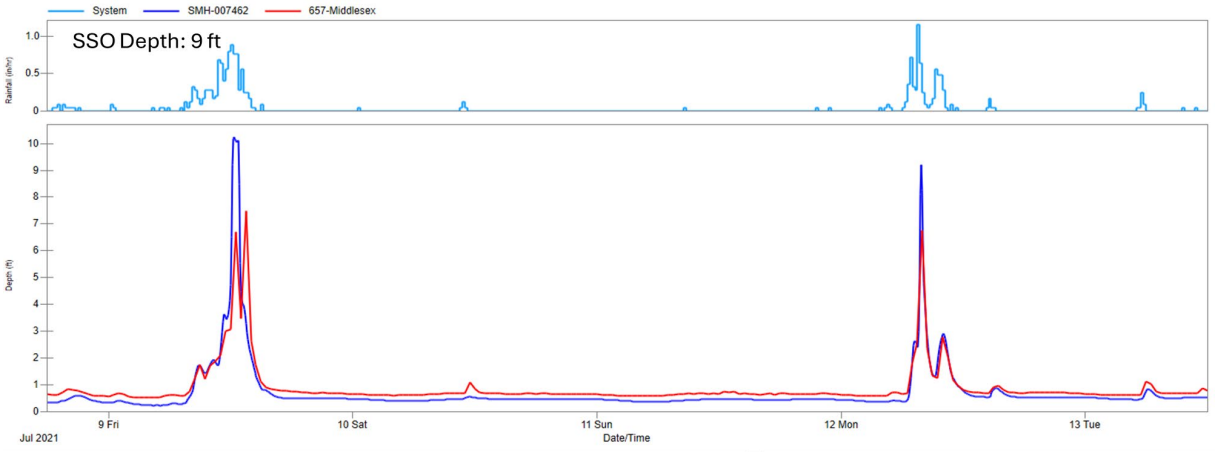


Figure 12 July 2021 Model Verification of 657 Middlesex Street Depth-only Meter

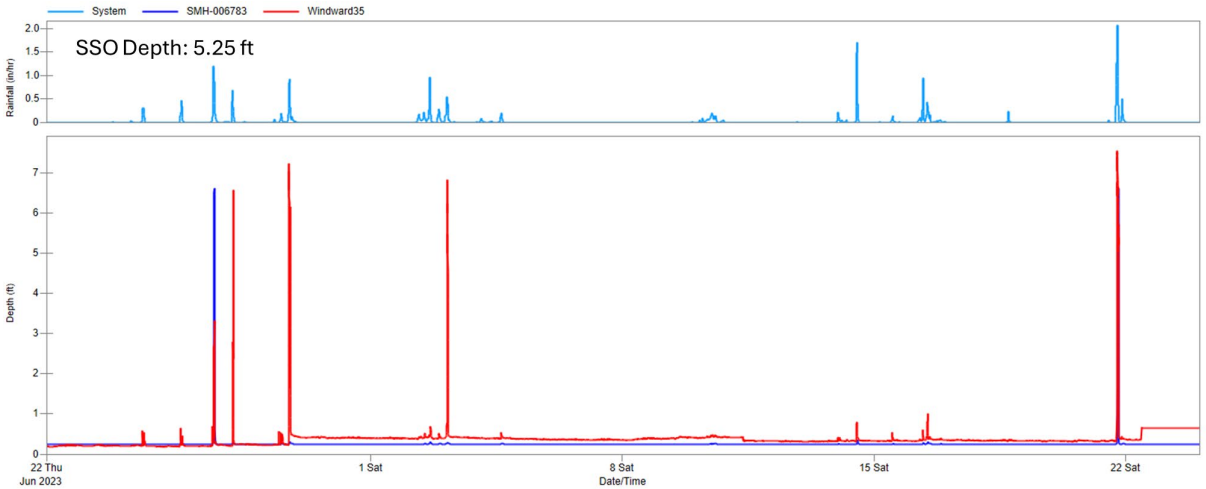


Figure 13 June 26-July 22, 2023 Model Verification of 35 Windward Street Depth-only Meter

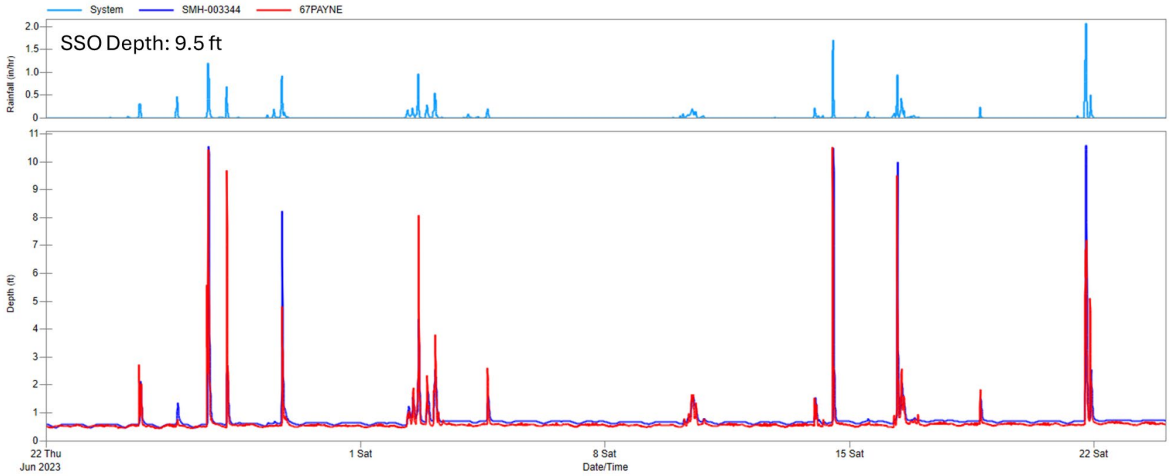


Figure 14 June 26-July 22, 2023 Model Verification of 67 Payne Street Depth-only Meter

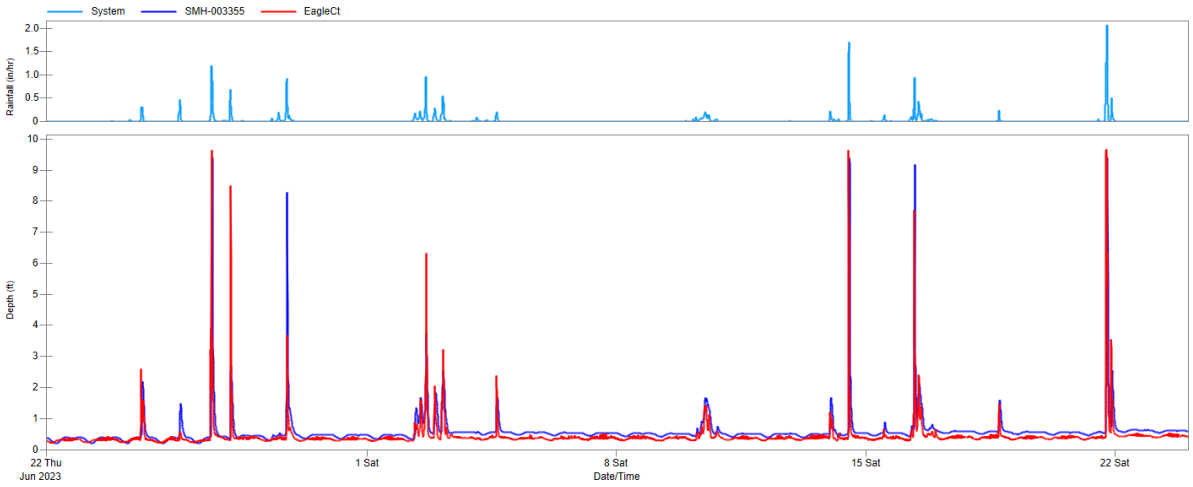


Figure 15 June 26-July 22, 2023 Model Verification of Eagle Court Depth-only Meter

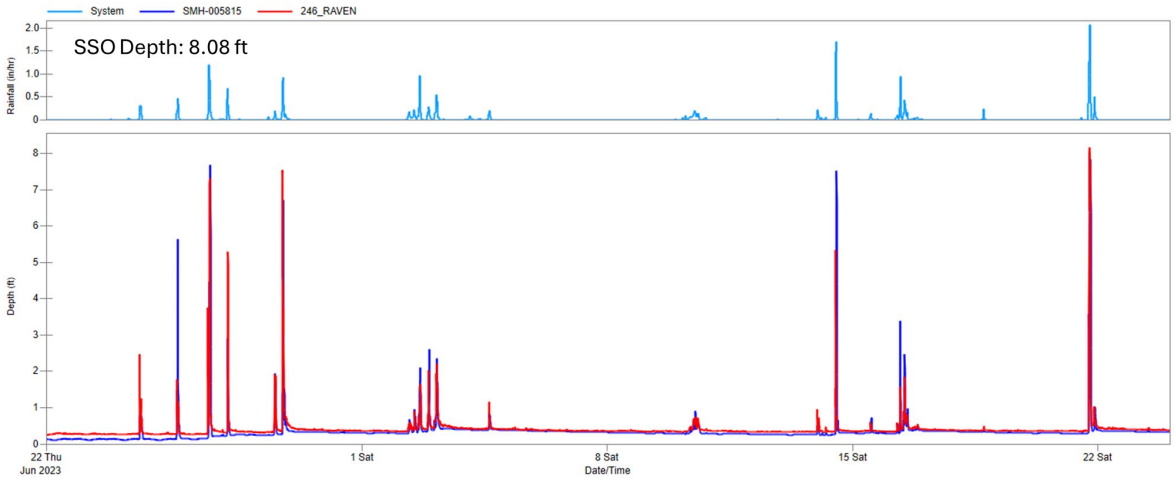


Figure 16 June 26-July 22, 2023 Model Verification of 246 Raven Street Depth-only Meter

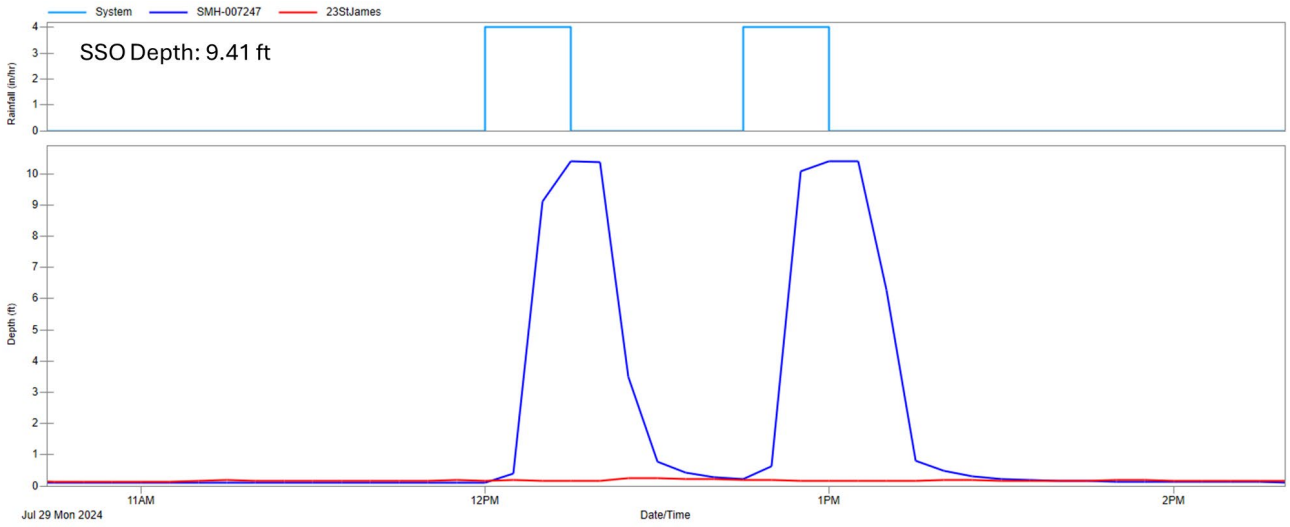


Figure 17 June 26-July 22, 2023 Model Verification of 23 St James Street Depth-only Meter

6.5 Full-Year 2023 CSO Statistics

The model was run from January 1 to December 31, 2023 using the QPE precipitation data to compare the annual CSO at all CSO stations in the model to the observed CSO from the SCADA. This simulation run was used to validate the model for CSO at all stations. The volume of CSO, number of events, and the duration of overflows were compared. The model simulated 174 CSO events for the year 2023, with a total volume of 817 MG. In comparison, SCADA reported 201 events, with a total volume of 789 million gallons. This results in a 16% lower count in the number of events and 4% higher calculation of total CSO volume by the model. The difference between the simulated and reported CSO number of events and volume was primarily due to the exclusion of the Walker and Beaver stations from the calculations. These stations were excluded because of issues with the SCADA weir flow calculations, which produced irregular data. The other differences between the SWMM model results and the measured CSO events is likely influenced by the metering issues at the CSO stations and the duration of reported events.

Table 11 below summarizes the 2023 CSO statistics, comparing modeled versus reported data. The duration of reported CSO events that lasted less than 15 minutes may not always be replicated by the model. The difference in the number of events may also be impacted by when the event is calculated to have started. This can affect the number of modeled CSO events compared to the reported ones, especially for short-duration events. Specific comments on the differences in overflow volumes for stations with a percent error greater than 15% are discussed below. These stations were analyzed to better understand potential causes for the variance.

- Walker CSO Diversion Station - issue with SCADA code that is used to calculate CSO volume using weir flow calculations; therefore, focused on calibrating the number and duration of CSO events.
- Beaver CSO Diversion Station – several spring events were deleted from the SCADA record because they may not had been real and were caused by the weir flow calculation error.

- Read Street CSO Diversion Station – the reported and modeled CSO volume were 0.6 and 0.7 MG, respectively. The calculated percent difference of 17% may be overestimated due to reported number rounding.
- Barasford CSO Diversion Station – the modeled number of CSO events resulted in a 17% lower volume than reported could be due to model calibration issues, simplified assumptions, and the CSO station complexity. The Barasford area had the most problematic meters; several sites were re-metered in the spring 2024.

Table 11 Annual 2023 CSO Statistics

CSO		Reported		Simulated		Error	
		Events	MG	Events	MG	Events	MG
North Bank	Walker	14	41[1]	11	11	-21%	--
	Beaver	27[2]	43[1,2]	16	12	--	--
	West	33	246	27	269	-18%	9%
	Read	8	0.6	3	0.7	-63%	17%
South Bank	Tilden	33	44	23	41	-30%	-6%
	Warren	27	159	27	164	0%	3%
	Barasford	27	124	34	103	26%	-17%
	Merrimack	32	216	33	217	3%	1%
Total		**201**	**789**	**174**	**817**	**-13%**	**4%**

[1] Issue with SCADA weir flow calculation - Walker and Beaver Brook CSO volume not included in percent error calculation
[2] SCADA measurement issue noted in spring 2023; data not considered reliable

7.0 Representative Period Selection

7.1 Overview

Previous CSO control plan modeling for Lowell was based on five-year rainfall-runoff simulations. Those analyses used Logan Airport hourly precipitation for 1969-1973. Those same periods were also used in studies for Haverhill and Lawrence. The selection of representative precipitation is re-examined here, considering the additional data that are available since that period was selected in the 1990s.

Daily precipitation records for Lowell have been maintained since 1855. Data for 1892 through the present, collected at the water treatment plant, are maintained by the National Centers for Environmental Information (NCEI) as COOP station 194313. Significant gaps and deficiencies exist in this dataset, however. Lawrence, 11 miles northeast of Lowell, has daily data beginning 1874, with a nearly continuous dataset beginning 1893. Data for two stations located in Lawrence are currently maintained at NCEI COOP station 194105 along the south bank of the Essex Dam, and Automated Surface Observation System (ASOS) station KLWM at Lawrence Municipal Airport. The COOP data receives additional quality control as part of the US Historical Climatology Network. The Lawrence ASOS station has hourly and daily datasets as well as data at one-minute intervals since 2005. The one-minute data are not quality-controlled; ASOS data generally require extensive checking and often have significant gaps.

Other datasets are available for the Lowell area. These include data collected by LRWWU at Duck Island, the Warren CSO Diversion station, and at a site on River's Edge Road, stations participating in the private Wunderground network (e.g. KMALOWEL100 at UMass Lowell), Citizens Weather Observer Program gage CW3660 on Van Greenby Road, CoCoRaHS daily precipitation station MA-MD-222 on Burnham Road, and COOP stations in Bedford MA (12 mi SE), Hudson (10 mi NW), and Nashua (9 mi NW).

These various sources of long-term daily and recent high-frequency precipitation data do not offer the long-term high-quality digital hourly precipitation data that is most useful for identifying historic simulation datasets. The nearest such dataset is for Boston's Logan Airport, 25 miles to the southeast. A long-term precipitation dataset for collection system simulation is thus most readily established using Boston data with consideration for climatic differences between Lowell and Boston.

7.2 Annual Precipitation Statistics

Annual "normal" precipitation for Lowell, as defined by the National Weather Service is 49 inches, based on the period 1991-2020. **Table 12** shows precipitation normals for Lowell and nearby cities.

Table 12 1991-2020 Lowell Area Precipitation Normals

ID	Location	Distance	Inches
194313	Lowell		49.0
194105	Lawrence	11 NE	49.3
193505	Haverhill	17 NE	49.6
190535	Bedford	12 SE	48.9
196783	Reading	15 SE	50.0
014739	Boston Logan	25 SE	43.6
275703	Nashua	9 NW	46.3
274234	Hudson	10 NW	46.1
275712	Nashua 2 NNW	11 NW	48.2

Source: National Weather Service

The table indicates that Lowell receives more average annual precipitation than Boston, slightly less than Lawrence and Haverhill to the northeast, and slightly more than nearby New Hampshire communities.

Figure 18 shows annual precipitation at Lowell, Lawrence, and Boston since 1920, along with a 10-year moving average for Boston. The data suggest that Lowell was markedly wetter than the other communities from 2008 through 2014. However, this appears to be flawed data rather than a shift in local weather. The shift corresponds with relocation of the rain gage within the water treatment plant in December 2007. The moving average line for Boston shows that its precipitation averaged 39 inches a year prior to 1950 but has averaged 43.0 inches since 1970.

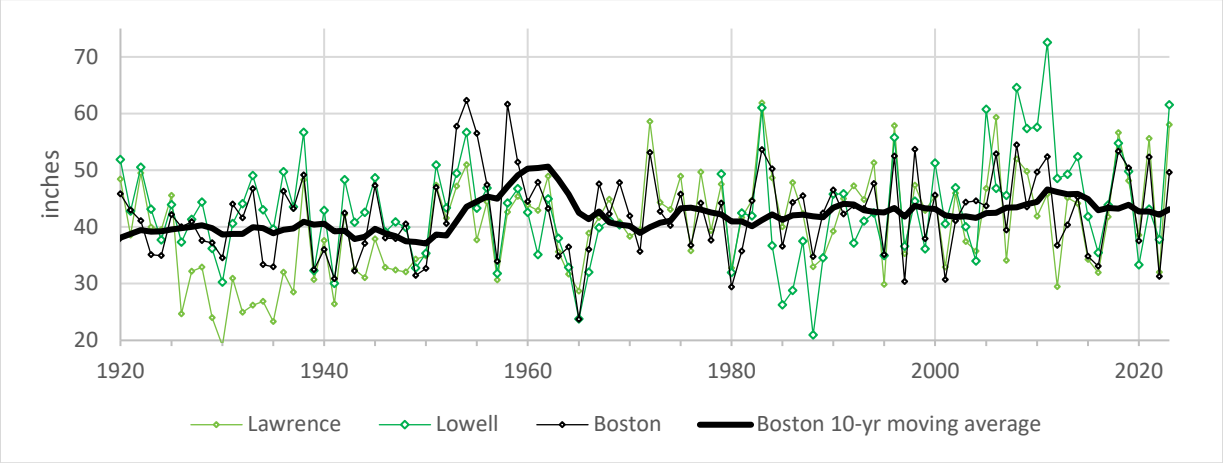


Figure 18 Annual Precipitation

As CSO is driven by large rain events, the incidence of days with precipitation exceeding one inch and two inches is presented in **Figure 19**. Only Boston data are presented, as it has the most reliable long-term record, and is reasonably representative of, although slightly drier than, Lowell. The figure shows that the number of days per year with at least one inch of precipitation has hovered near 10 over the year, while the number of days per year with at least two inches has averaged 1.7.

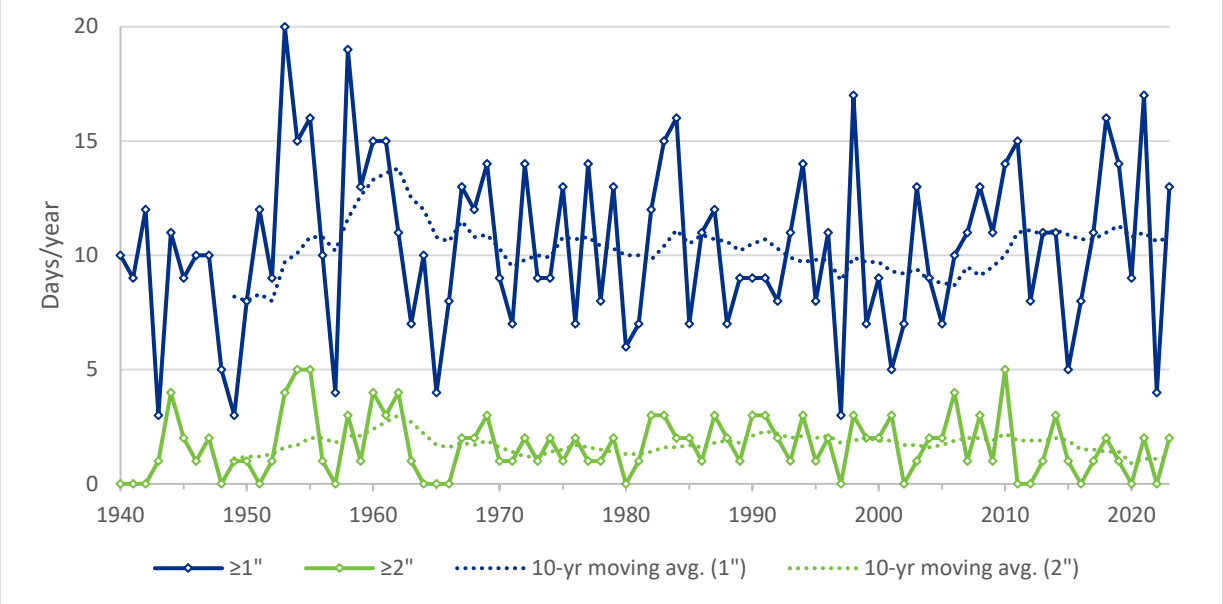


Figure 19 Logan Airport Days per Year with Precipitation above Thresholds

These data collectively indicate that modest long-term trends in annual precipitation in the region exist, but that the long-term record can be considered “stationary”, i.e. based on the same overall climate. This indicates the overall consistency of the historic dataset for use in selecting a period representing average conditions over recent decades; it does not preclude the presence of trends in recent data and is not a predictor of future climate.

7.3 Representative Period Selection

The 1969-1973 Boston hourly data used in prior Lowell CSO facilities planning averaged 44.3 inches of precipitation annually. Candidate representative periods for the updated analyses were screened according to the following criteria:

- a five-year period since 1970 with close to 49 inches average annual precipitation
- years with storms with ARIs exceeding 10 years are less preferable
- there should be close to five one-year and larger events at durations from 1 to 24 hours over the five years

Since 1970, Boston's average annual precipitation averaged 47 inches or more in the five-year periods for 2004-2008 through 2008-2012 as well as from 2017-2021.

Table 13 lists events in the Boston hourly record since 1970 where ARI exceeds 10 years at any duration from one to 24 hours based on Lowell Atlas 14 statistics.

Table 13 10-year Events in Boston Hourly Precipitation Record

Date	ARI (years) at duration (hours)					
	1	2	3	6	12	24
July 31, 1985	35	45	70	35	15	10
October 13, 1990				15		
November 22, 1992				10		
December 11, 1992						15
October 20, 1996					20	45
June 13, 1998			25	20	25	25
September 10, 1999		10	10	20	15	10
May 13, 2006						10
July 30, 2007	10					
July 10, 2010	10					
September 1, 2021				10	10	

Table 14 shows annual average precipitation for Boston over each candidate period along with the number of 1-year events in each candidate period for 1-hour through 24-hour durations based on Atlas 14; the ideal 5-year period would have five 1-year events at each duration.

Table 14 1-year Events during Candidate Periods

Start	End	Average annual precipitation (inches)	Number of events ≥1-yr ARI at duration					
			1-h	2-h	3-h	6-h	12-h	24-h
2004	2008	47.0	3	2	4	7	7	8
2005	2009	46.8	3	2	3	5	6	6
2006	2010	48.0	5	4	5	6	6	8
2007	2011	47.9	5	4	5	6	5	6
2008	2012	47.3	4	3	4	5	4	6
2017	2021	47.4	5	7	5	5	5	3

Each of the five-year periods listed in **Table 14** provides a sound basis for representative period simulation. As the period from 2005 through 2009 had been used in prior analyses performed by CDM Smith for the Utility, that period was selected for the present study. While 2005 through 2009 is chosen to be representative of long-term conditions in Lowell, it does not necessarily match actual weather there during that period. **Table 15** shows that annual precipitation among Boston, Lawrence, and Hudson (the Lowell COOP record is not shown due to data deficiencies over that period) is comparable among the three stations, although Boston generally lags the other locations. **Figure 20** shows monthly precipitation at these locations over the five years. Boston slightly trails Lawrence and Hudson much of the time, with a large gap in October 2005, when remnants of two tropical storms produced extreme rainfall across much of New England. However, its overall pattern of precipitation closely resembles that observed in the Lowell area.

Table 15 Annual Precipitation 2005-2009

Year	Boston	Lawrence	Hudson
2005	43.7	51.7	59.1
2006	52.9	59.0	56.0
2007	39.5	39.6	44.9
2008	54.5	54.1	62.5
2009	43.5	45.5	47.1
Average	46.8	50.0	53.9

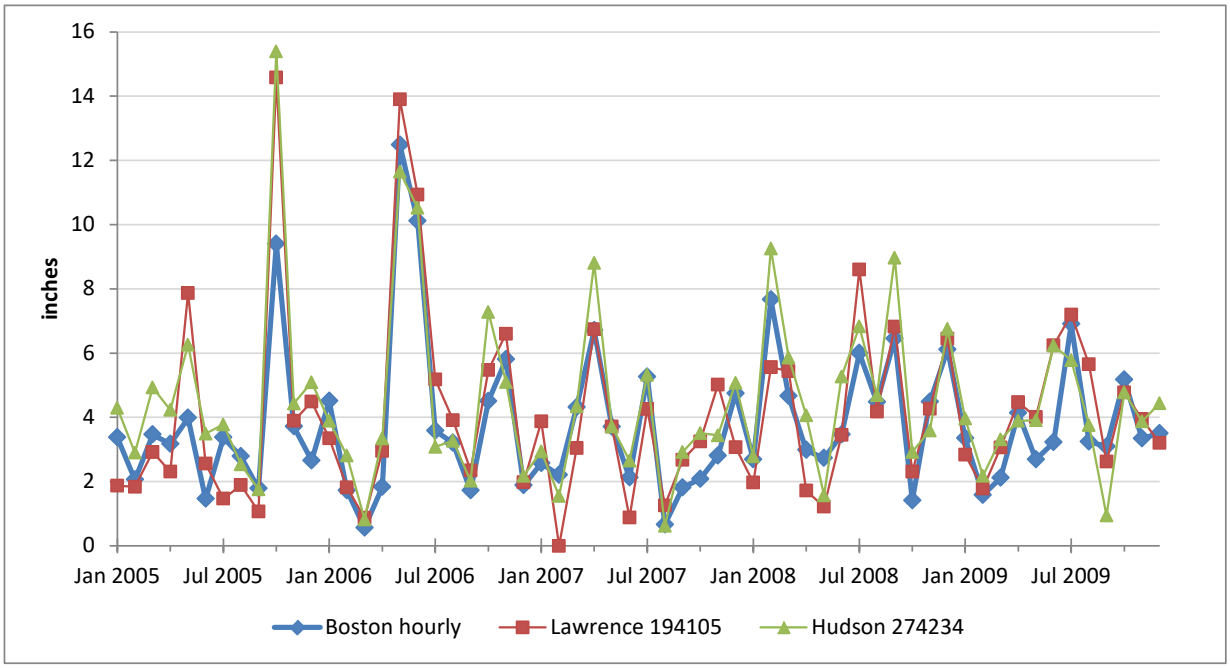


Figure 20 2005-2009 Monthly Precipitation

It is preferable to use data with the same time step for model calibration and system assessment simulations. As the model is calibrated to 15-minute data obtained during the 2023 flow monitoring program, the Boston hourly record was synthetically disaggregated to 15-minute intervals using CDM Smith's NetSTORM software.

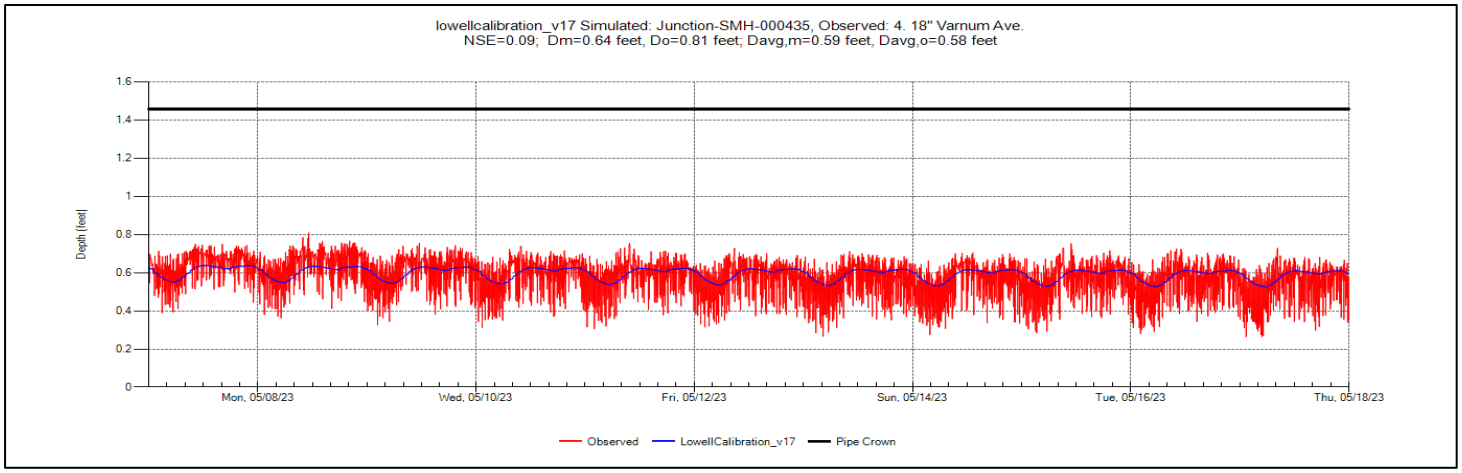
In summary, while Logan Airport precipitation is less than in the Lowell area, the overall pattern of storms in Boston is comparable with Lowell, and Logan has the most reliable long-term data in the region. A consecutive five-year period from 2005-2009 for Boston was used for Lowell long-term simulations. The selected period is wetter than average for Boston, but close to average conditions for Lowell.

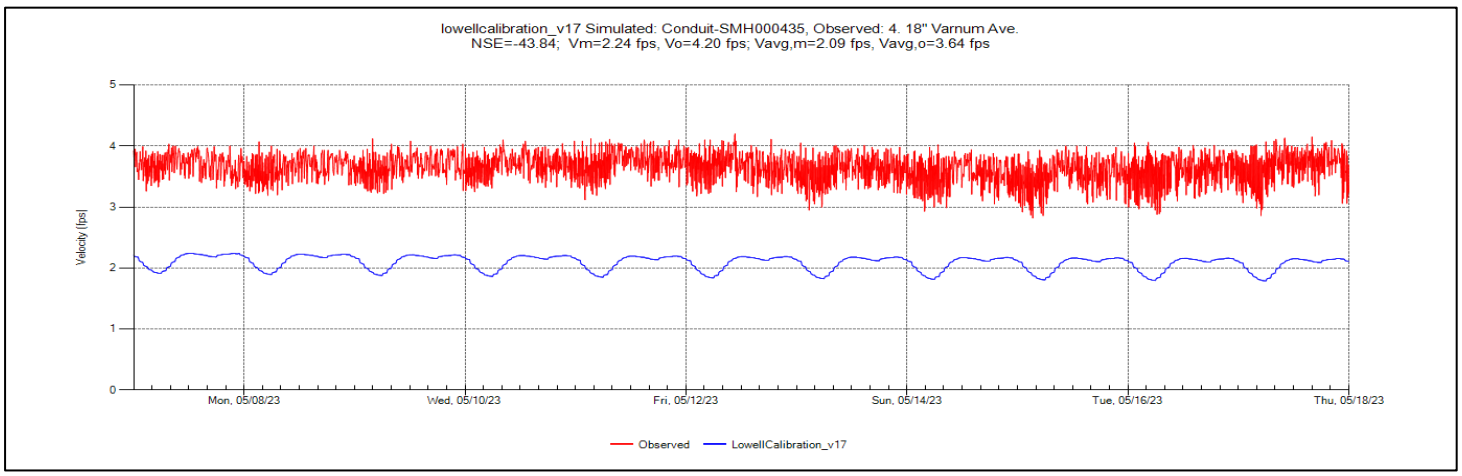
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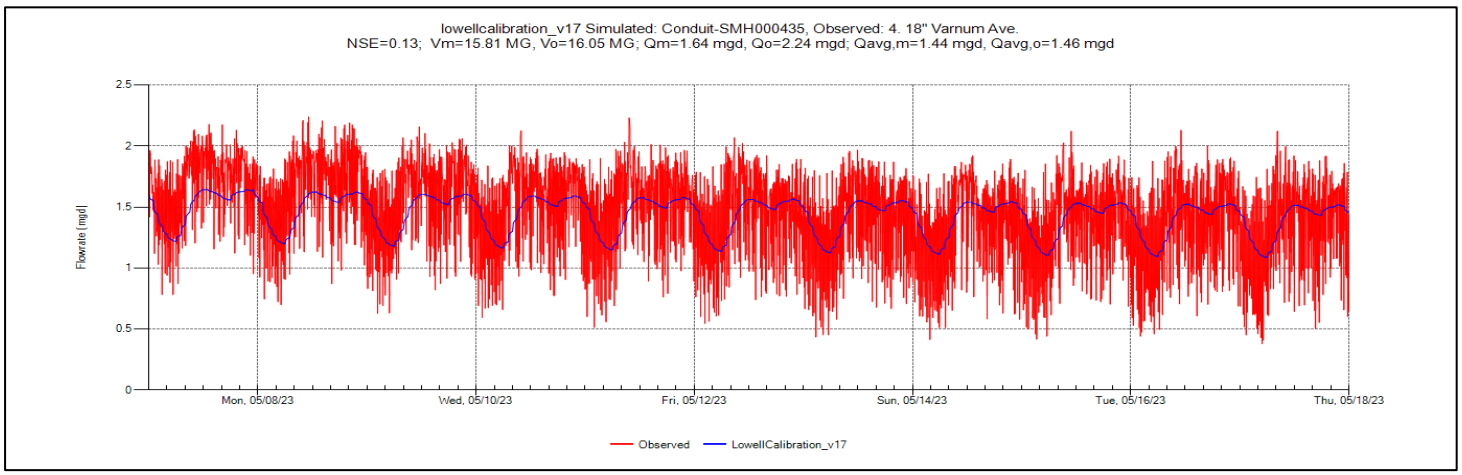
Dry Weather Timeseries Temporary Meters

Simulated Versus Observed Flow at Flow Meter Sites

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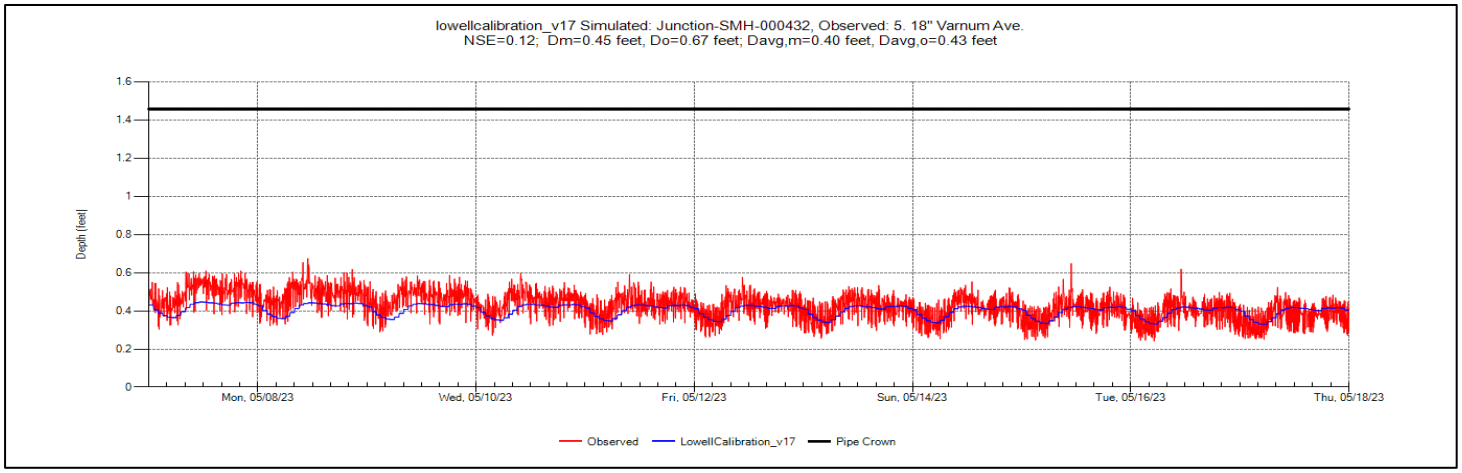


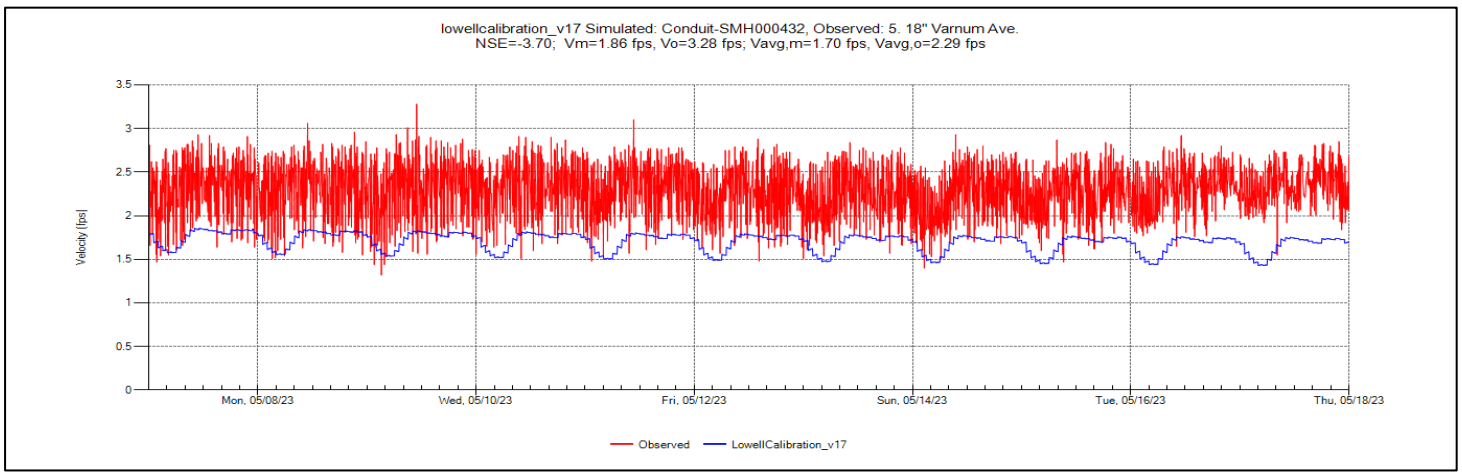


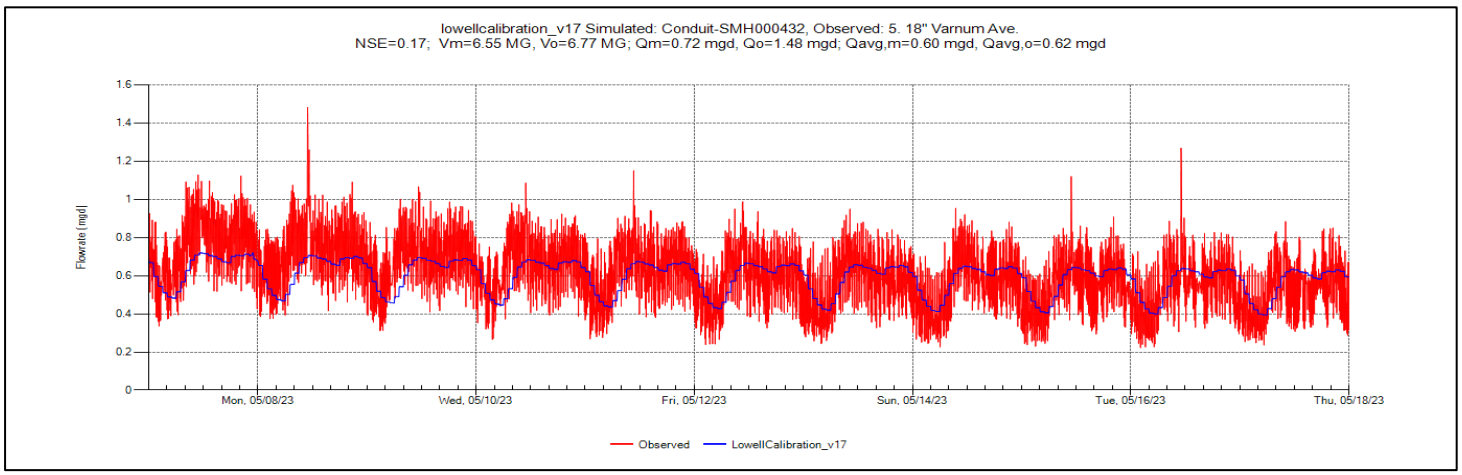


Simulated Versus Observed Flow at Flow Meter Sites

05-DryPeriod

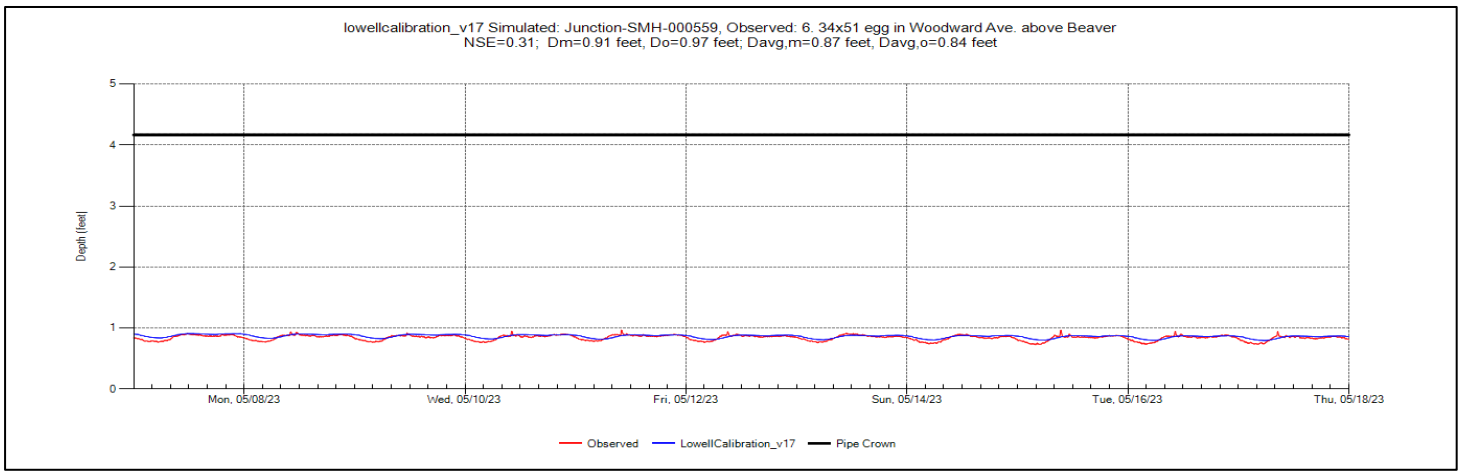


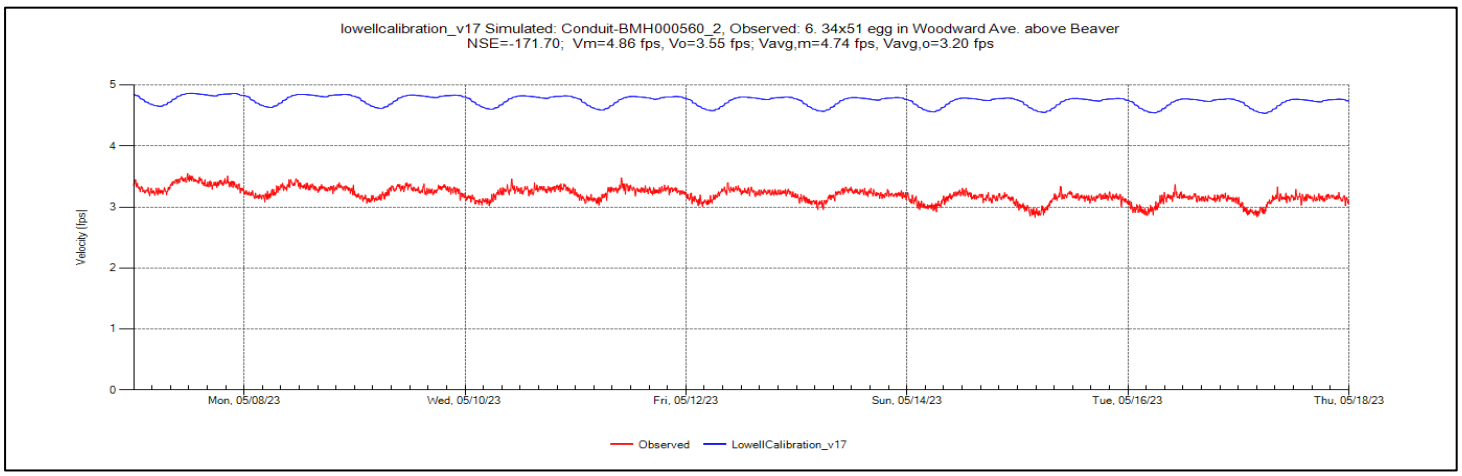


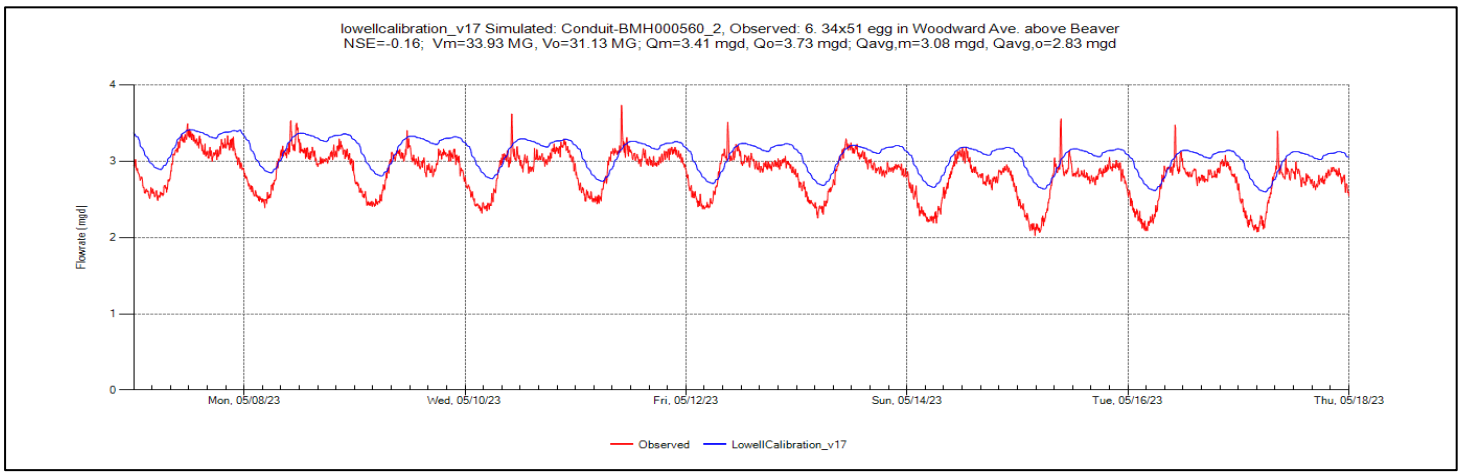


Simulated Versus Observed Flow at Flow Meter Sites

06-DryPeriod

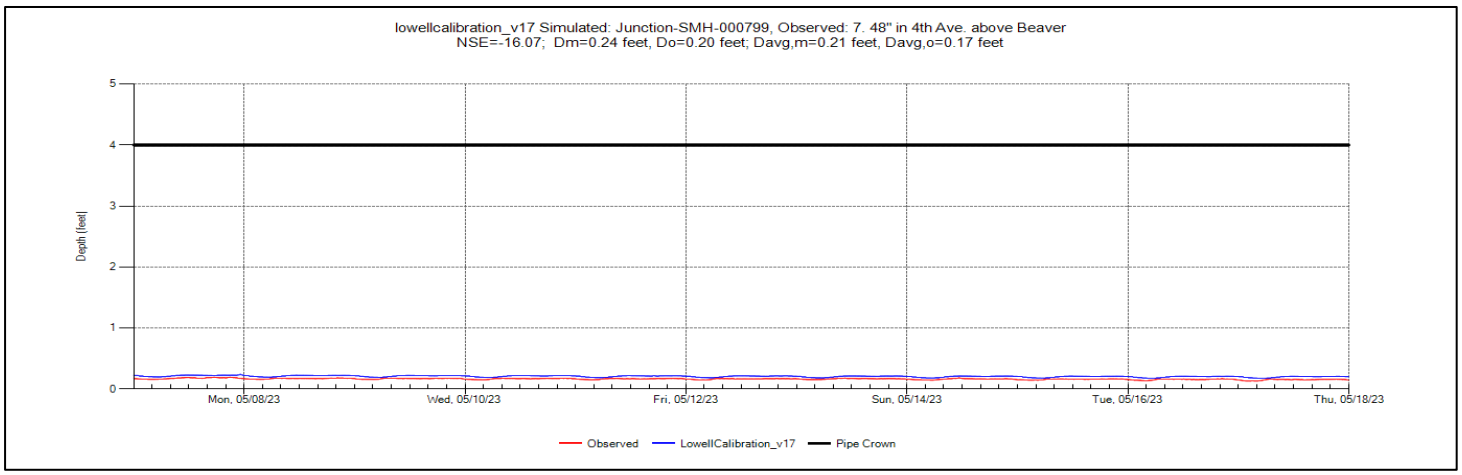


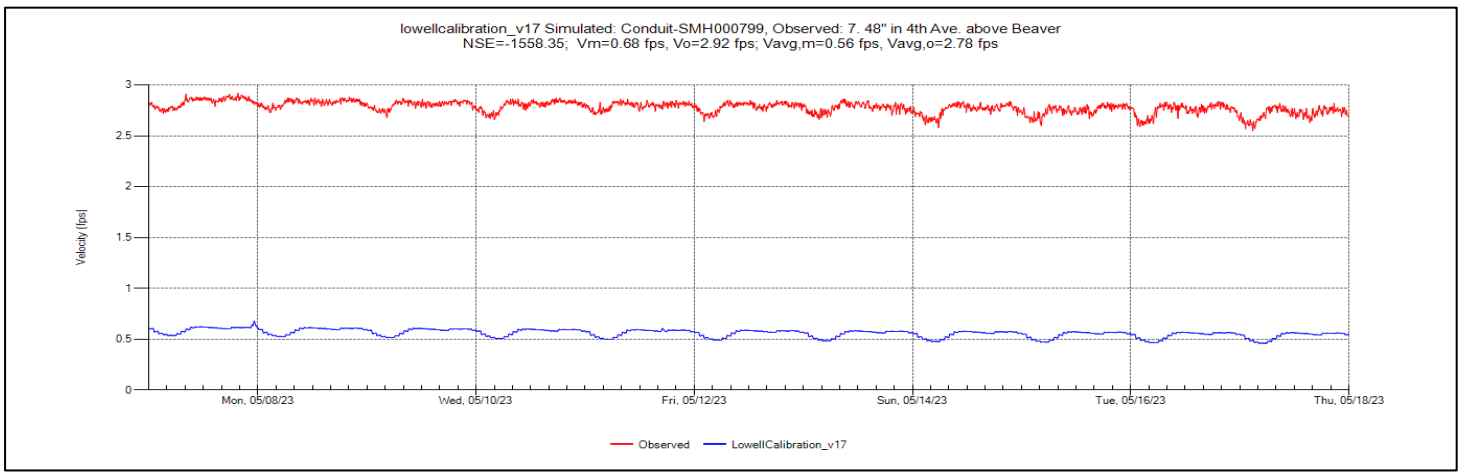


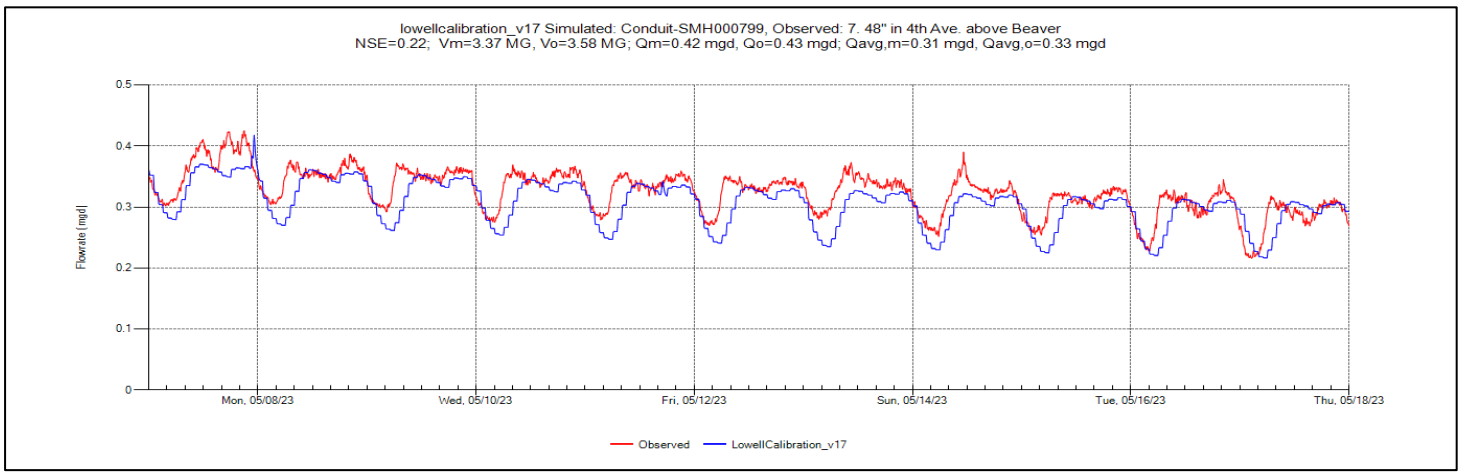


Simulated Versus Observed Flow at Flow Meter Sites

07-DryPeriod

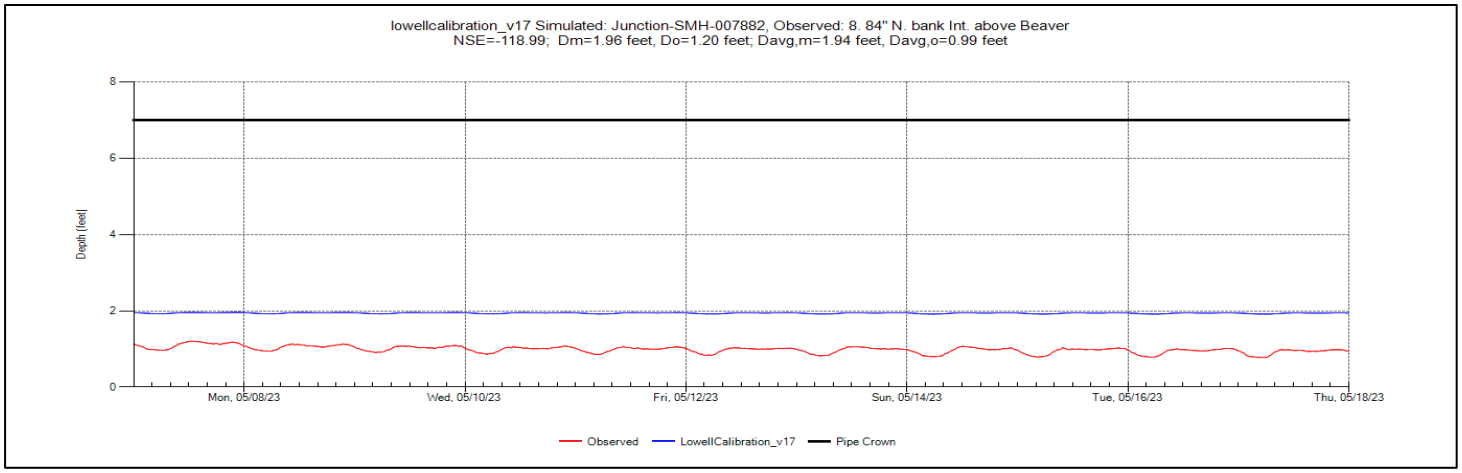


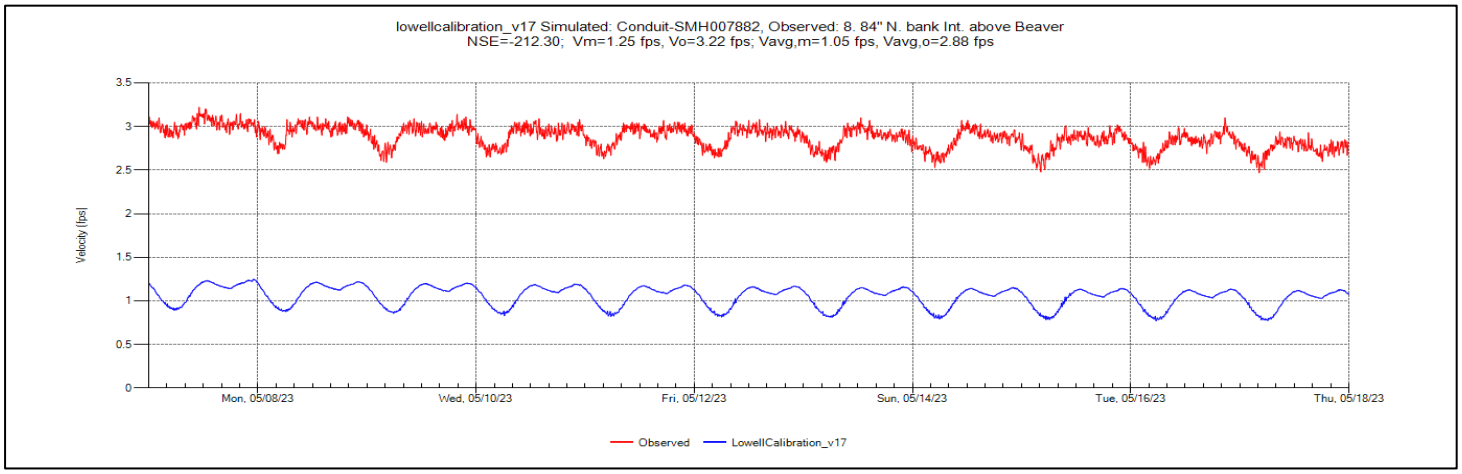


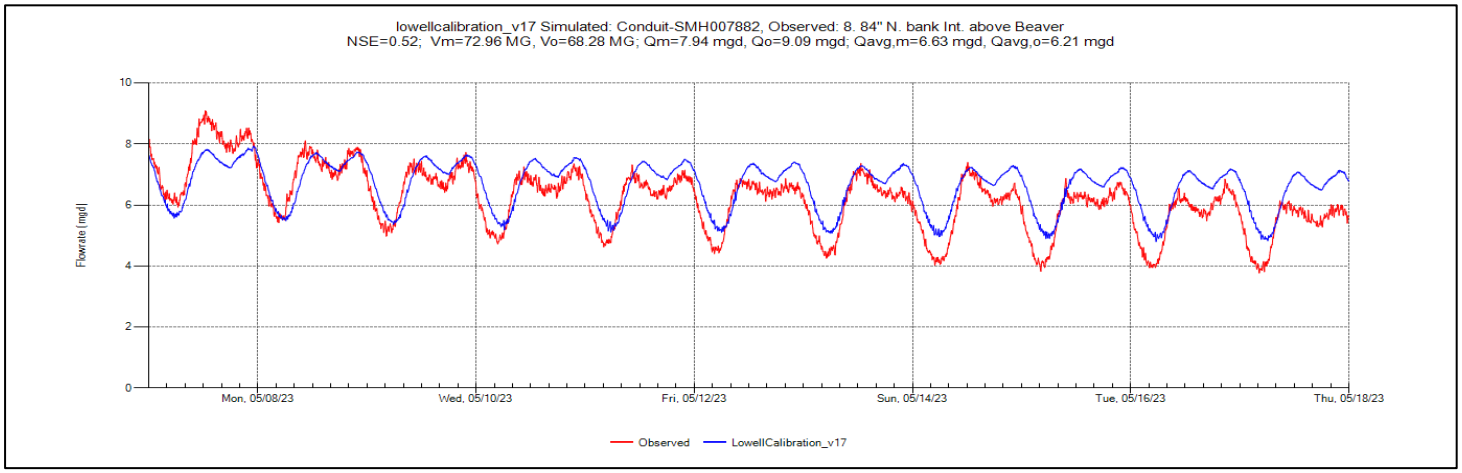


Simulated Versus Observed Flow at Flow Meter Sites

08-DryPeriod

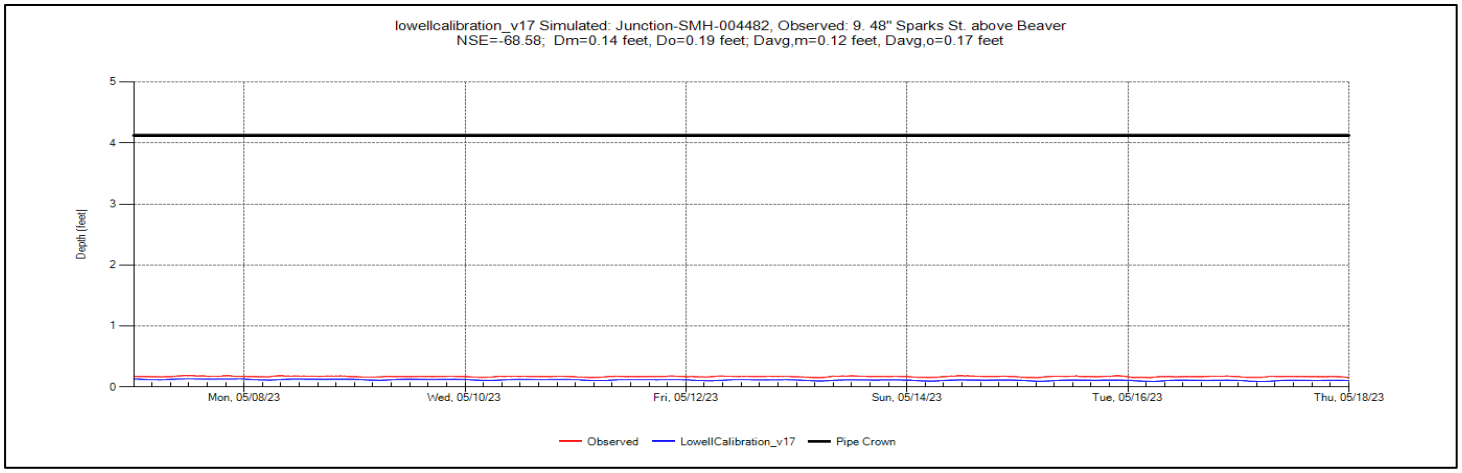


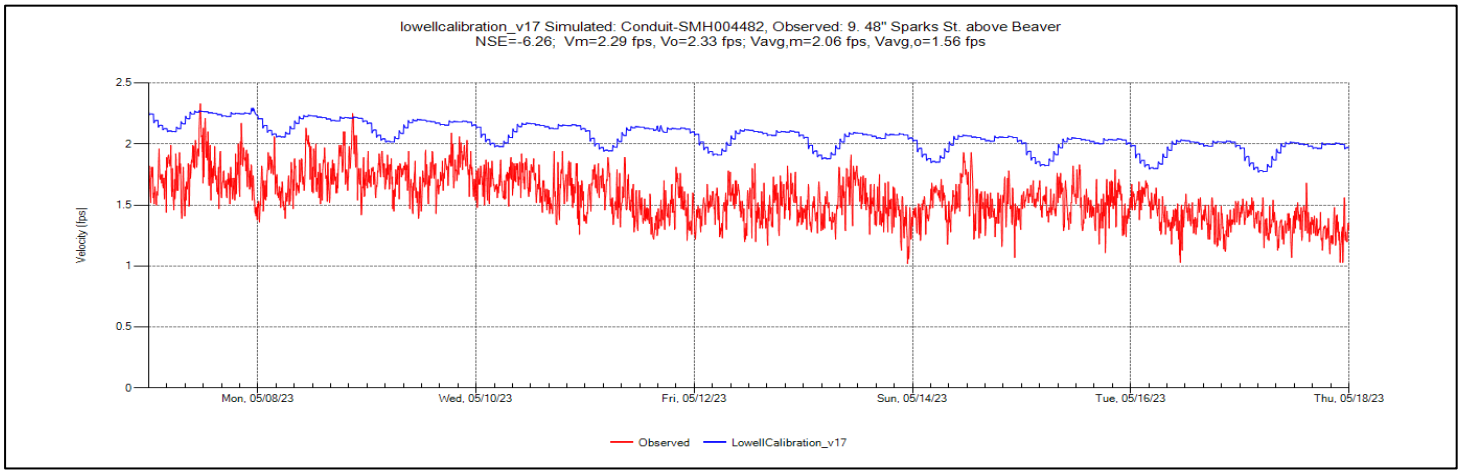


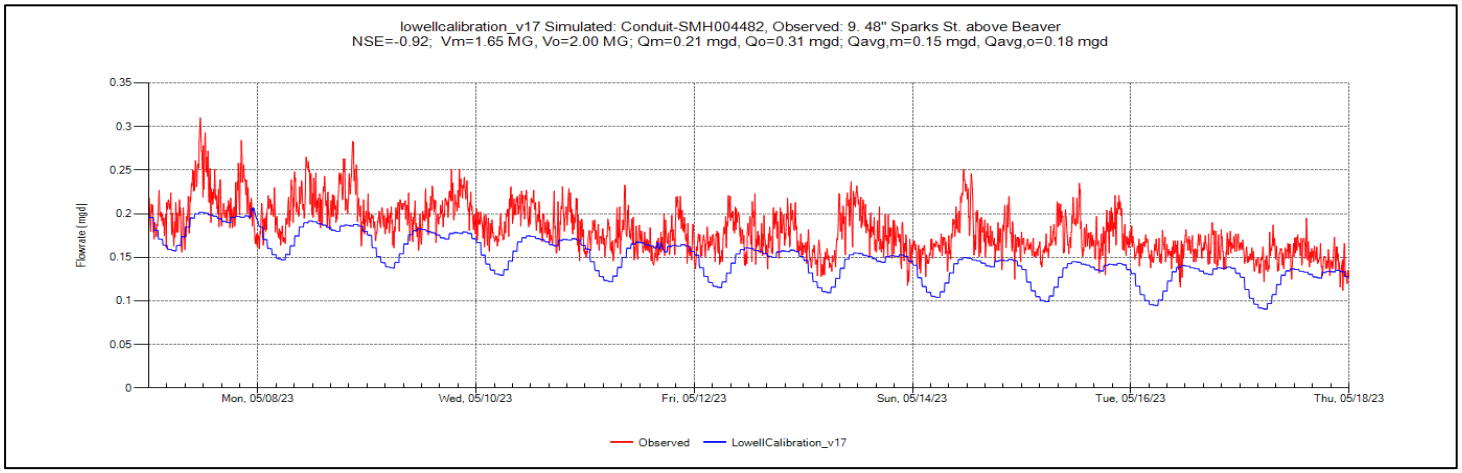


Simulated Versus Observed Flow at Flow Meter Sites

09-DryPeriod

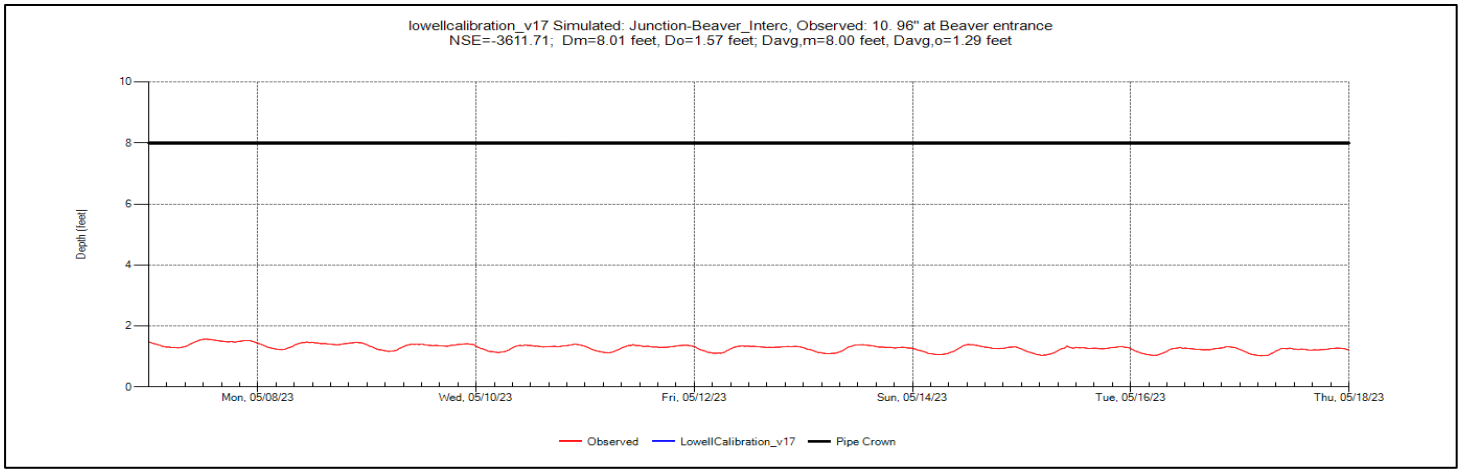


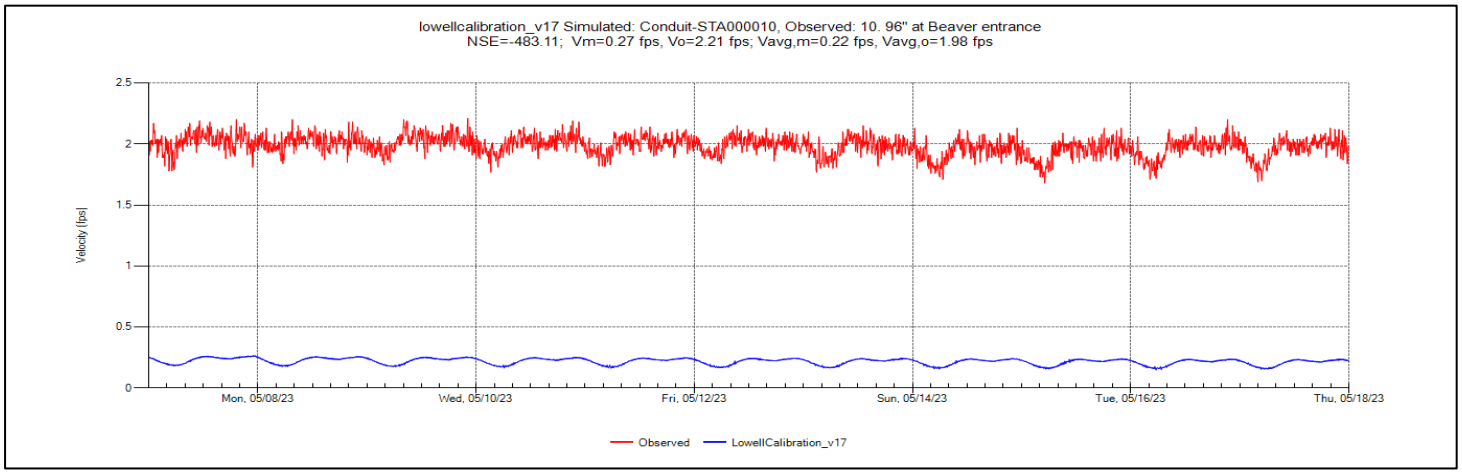


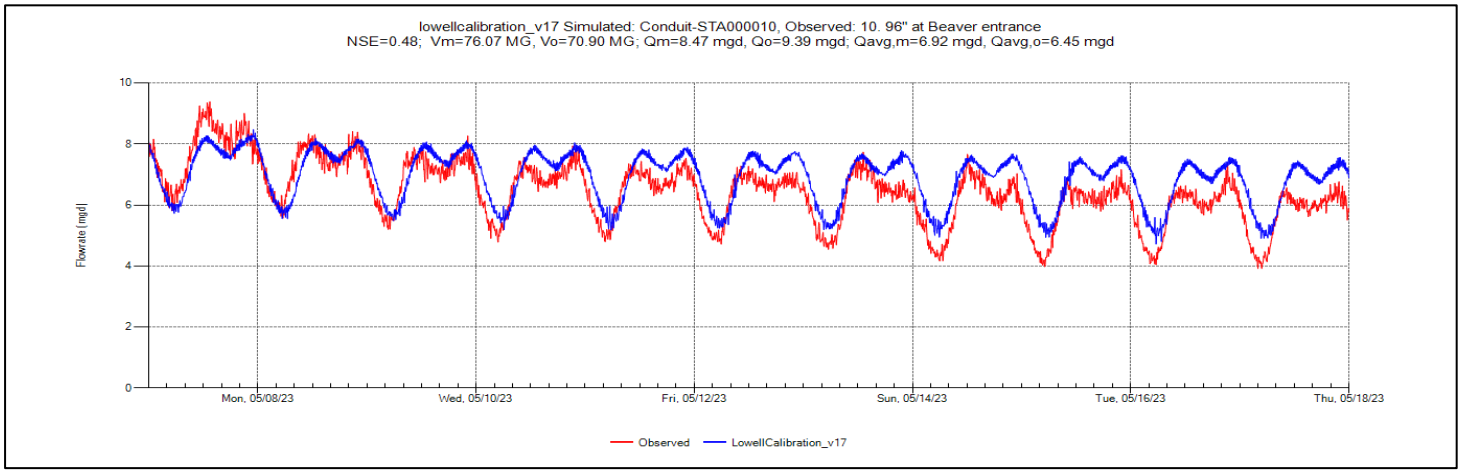


Simulated Versus Observed Flow at Flow Meter Sites

10-DryPeriod

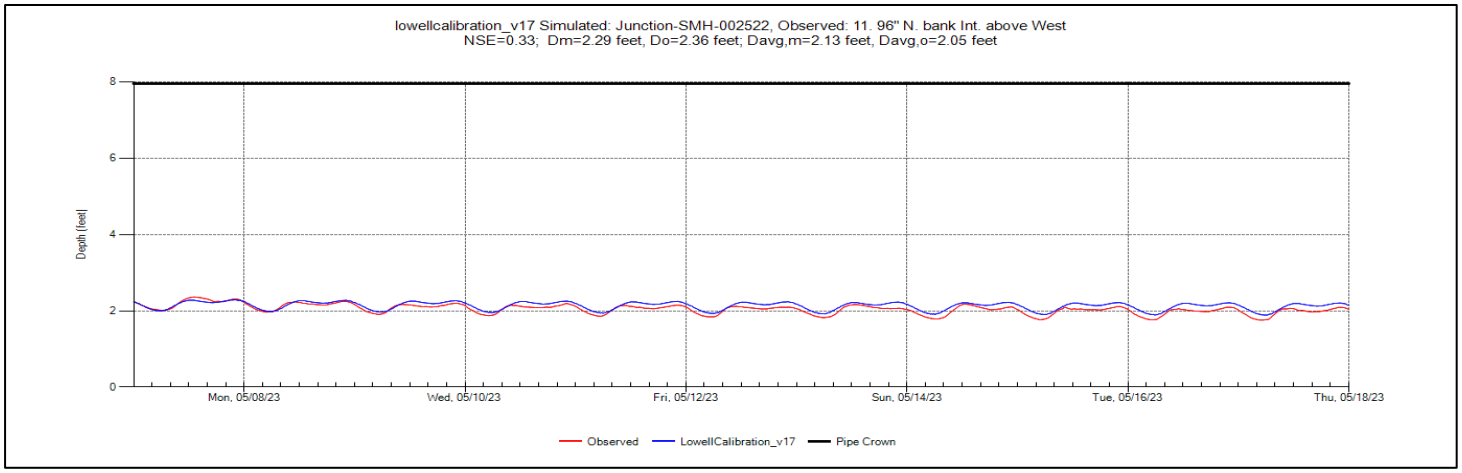


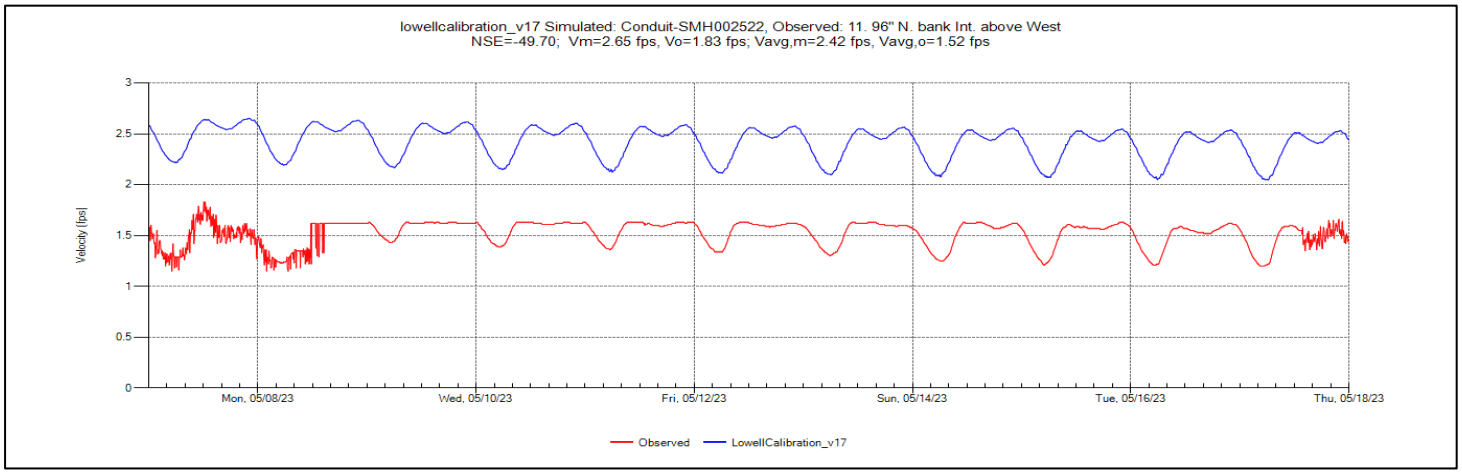


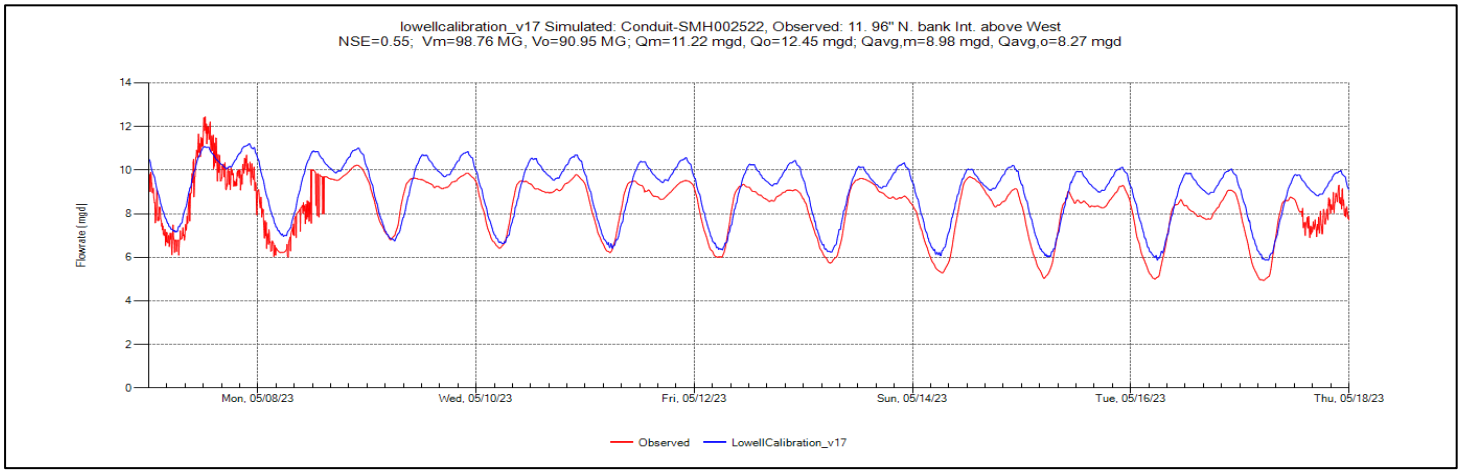


Simulated Versus Observed Flow at Flow Meter Sites

11-DryPeriod

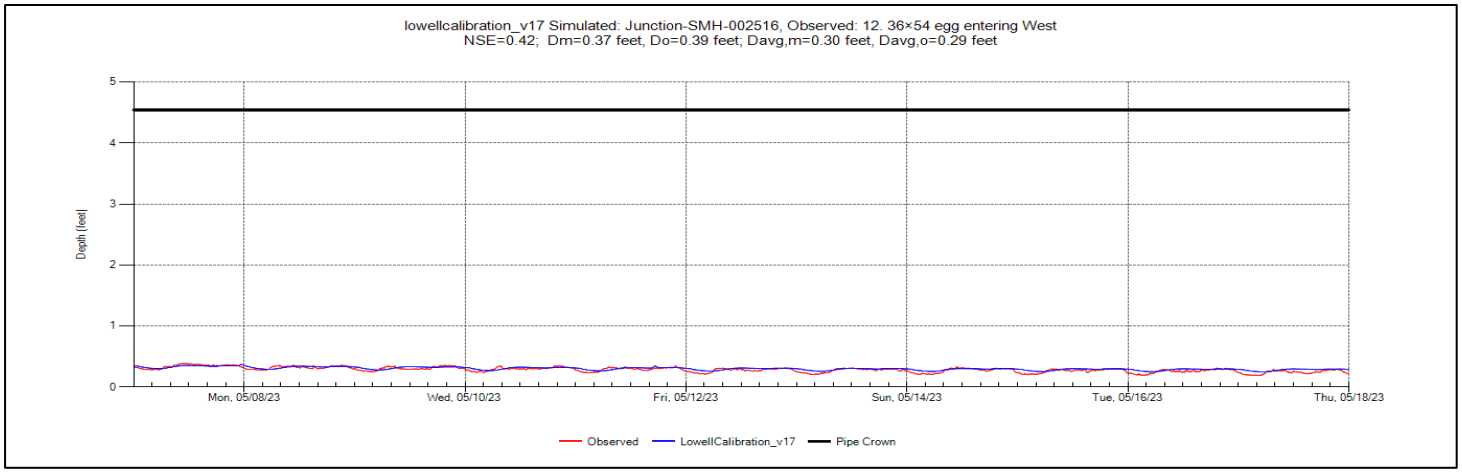


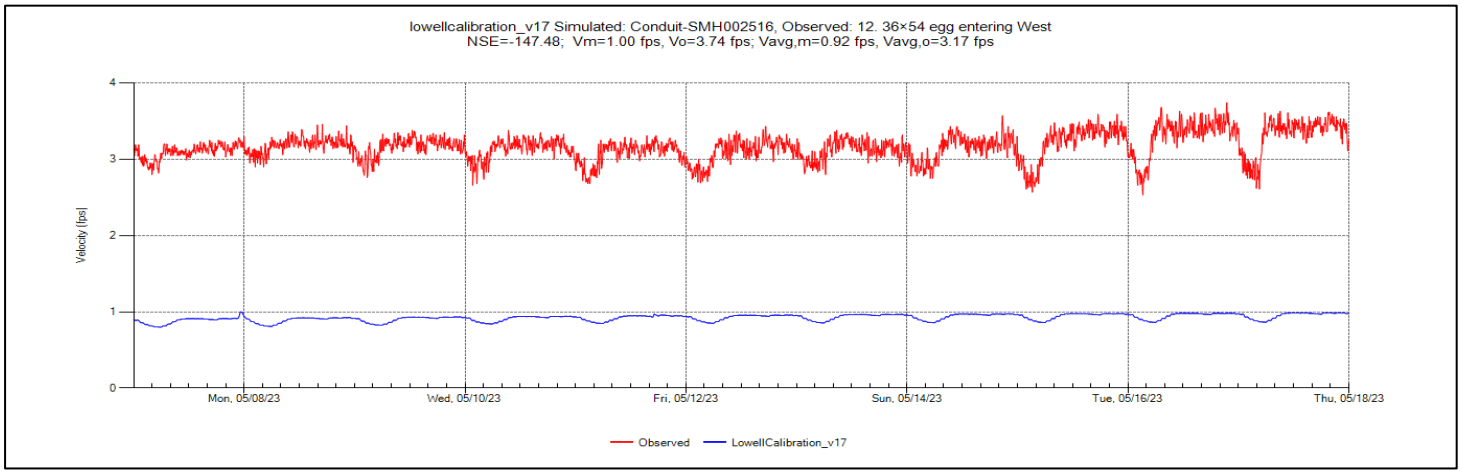


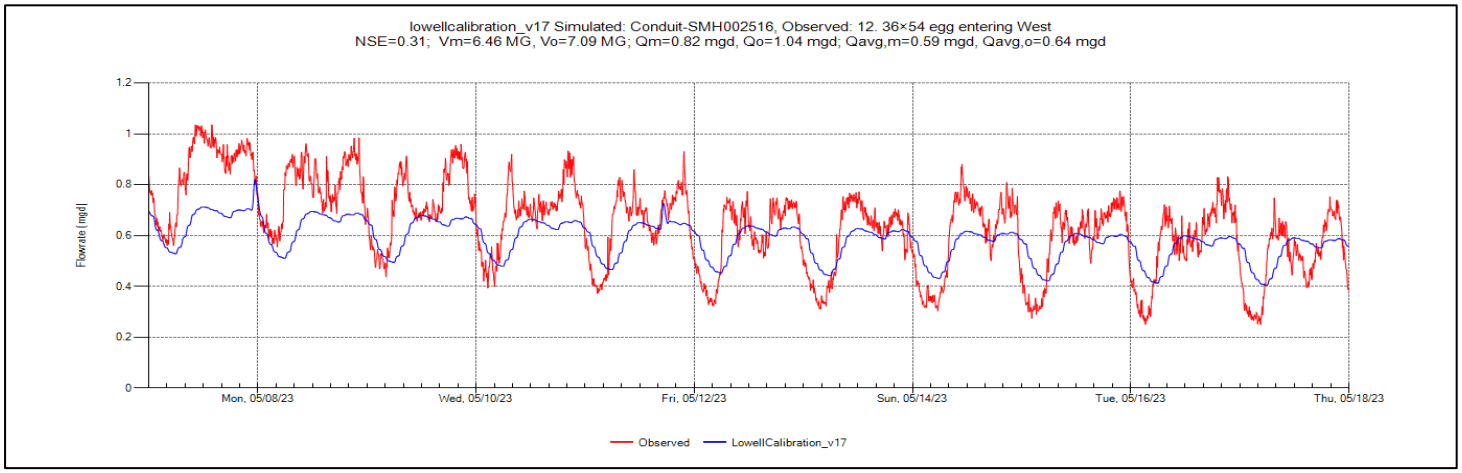


Simulated Versus Observed Flow at Flow Meter Sites

12-DryPeriod

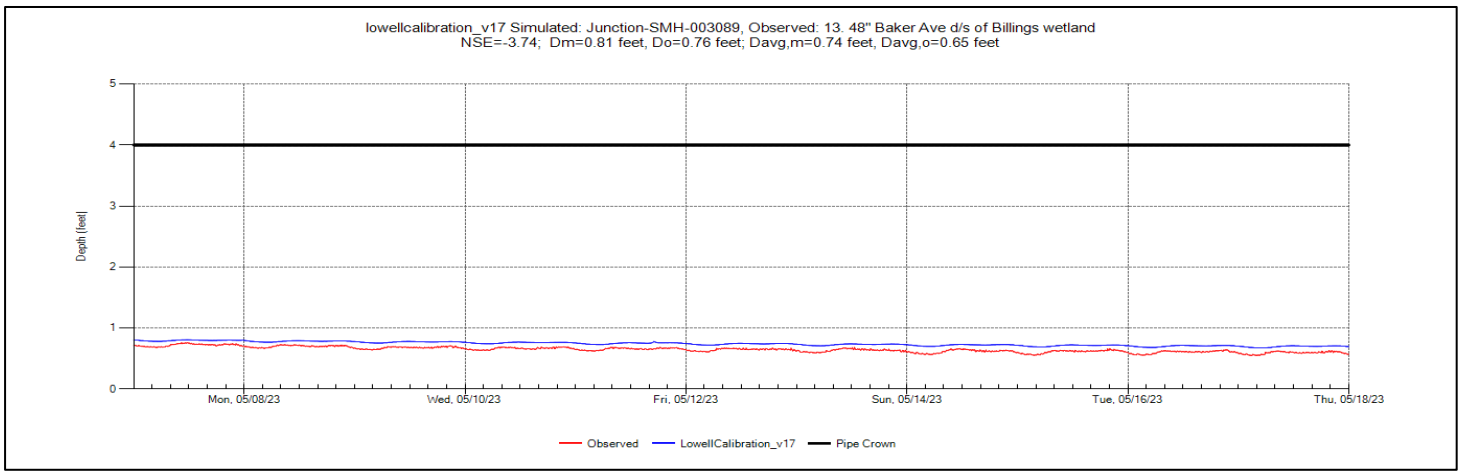


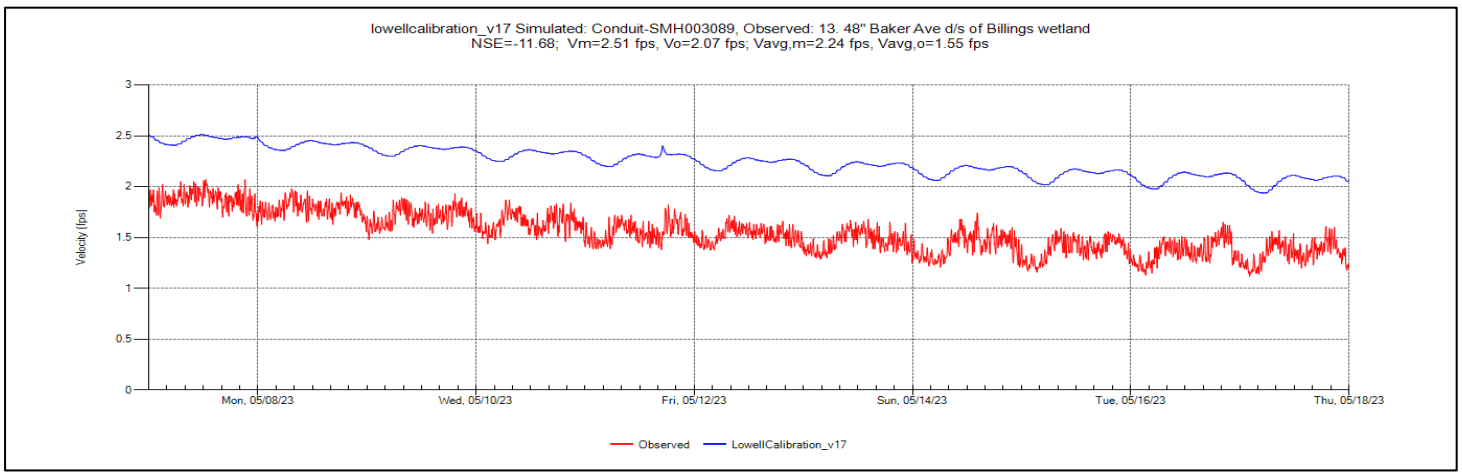


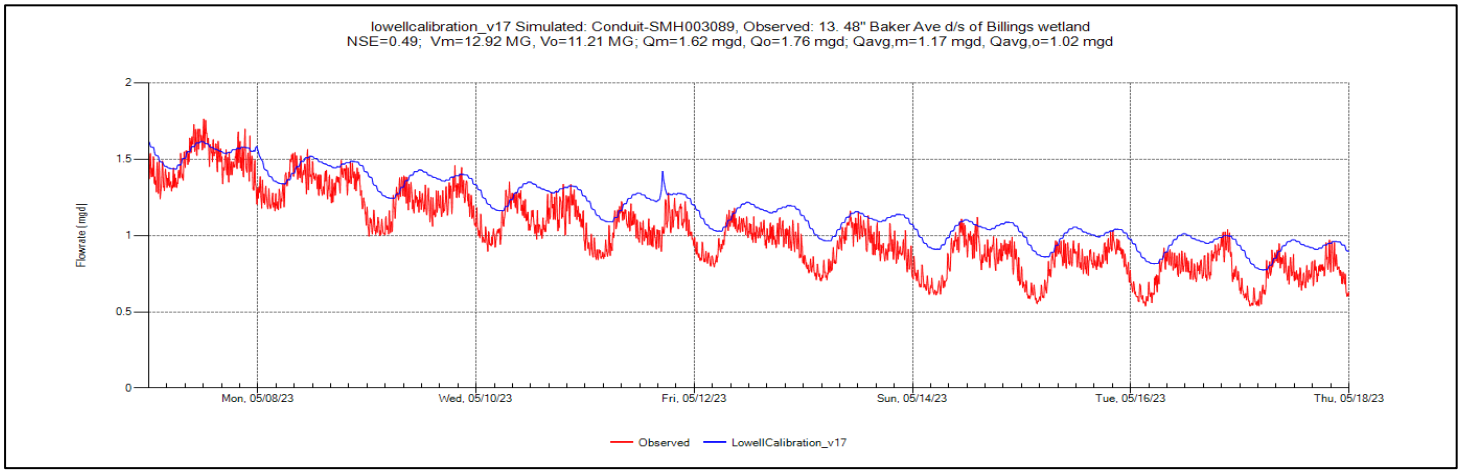


Simulated Versus Observed Flow at Flow Meter Sites

13-DryPeriod

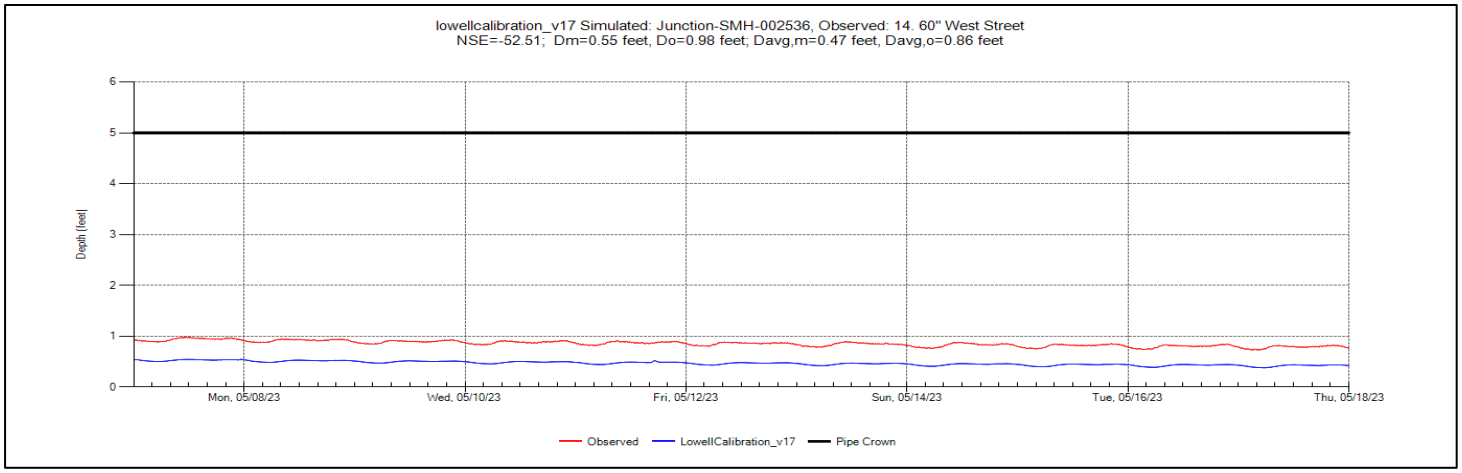


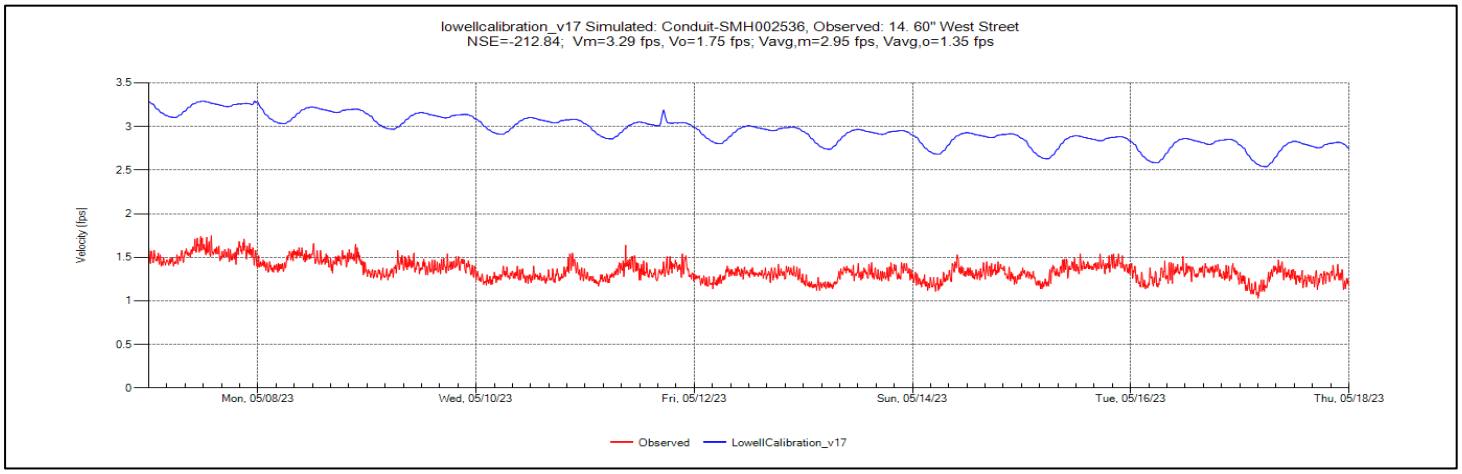


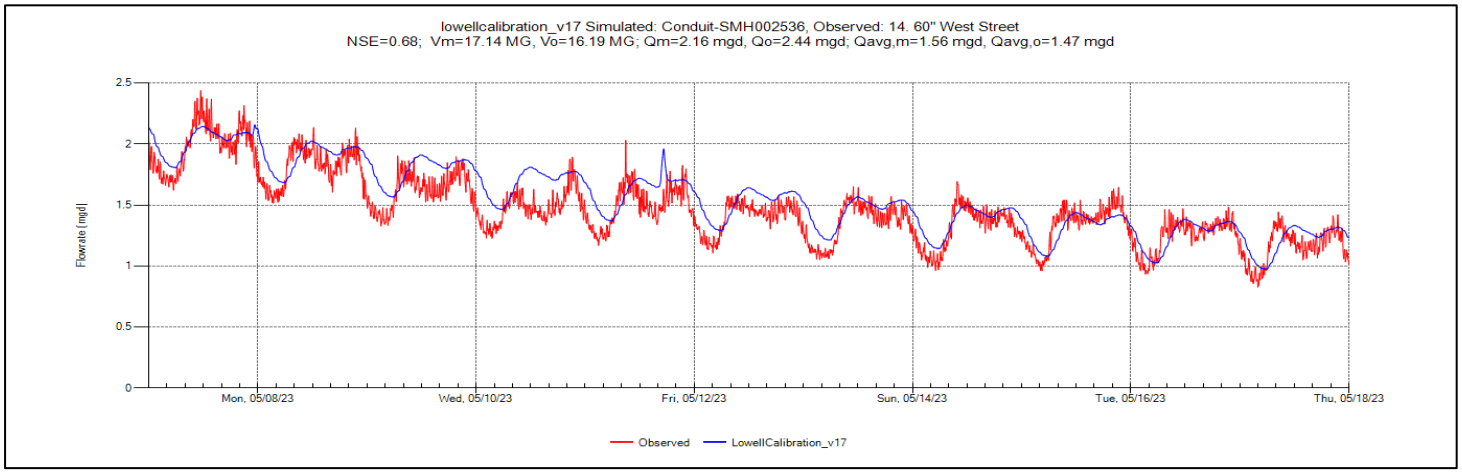


Simulated Versus Observed Flow at Flow Meter Sites

14-DryPeriod

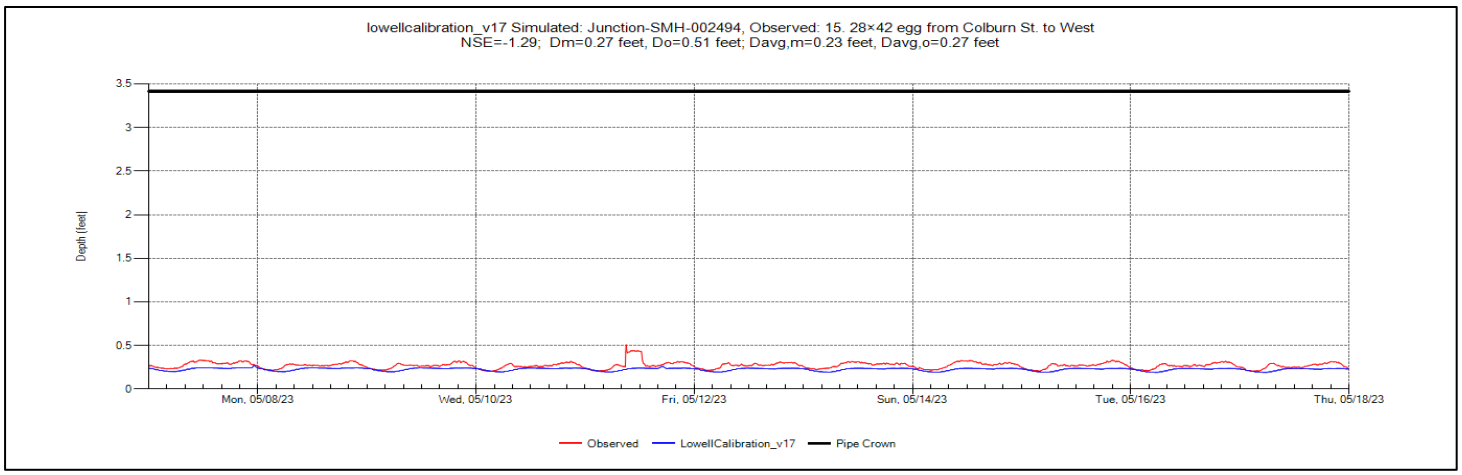


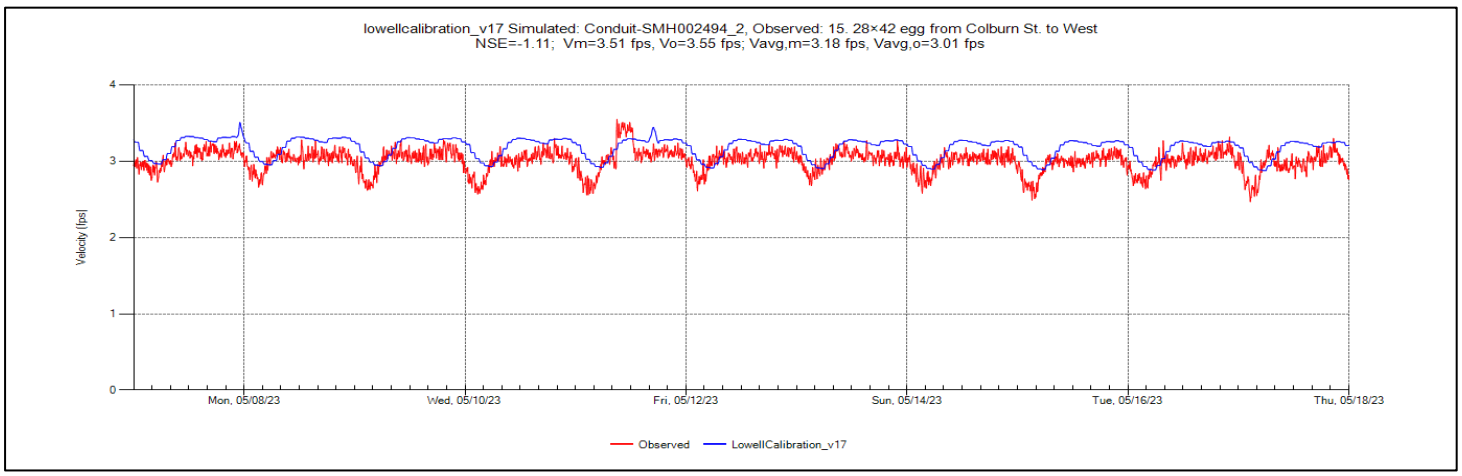


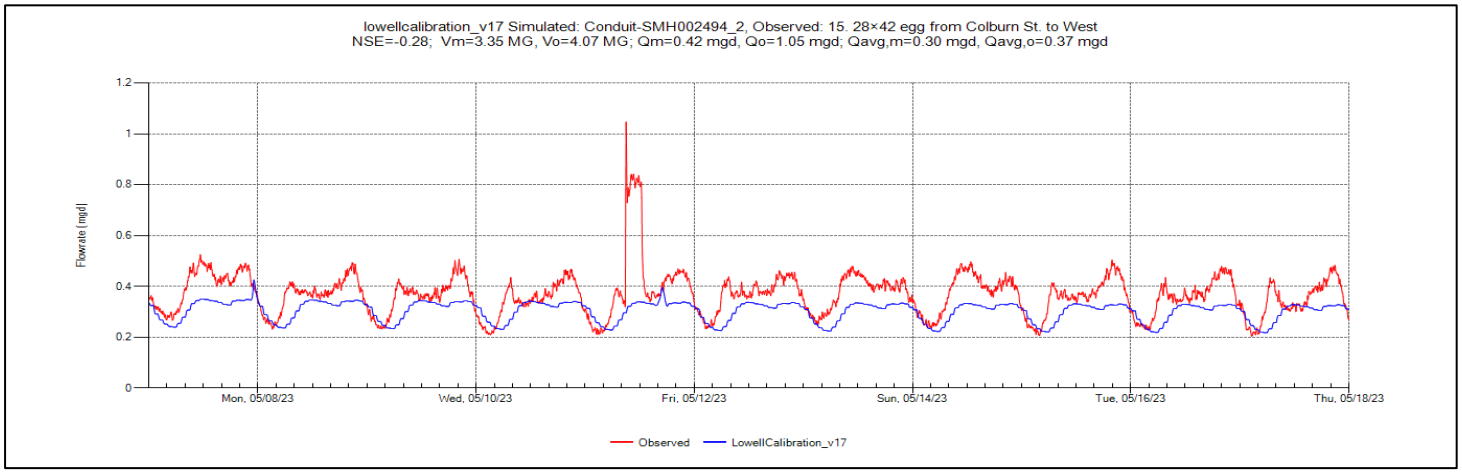


Simulated Versus Observed Flow at Flow Meter Sites

15-DryPeriod

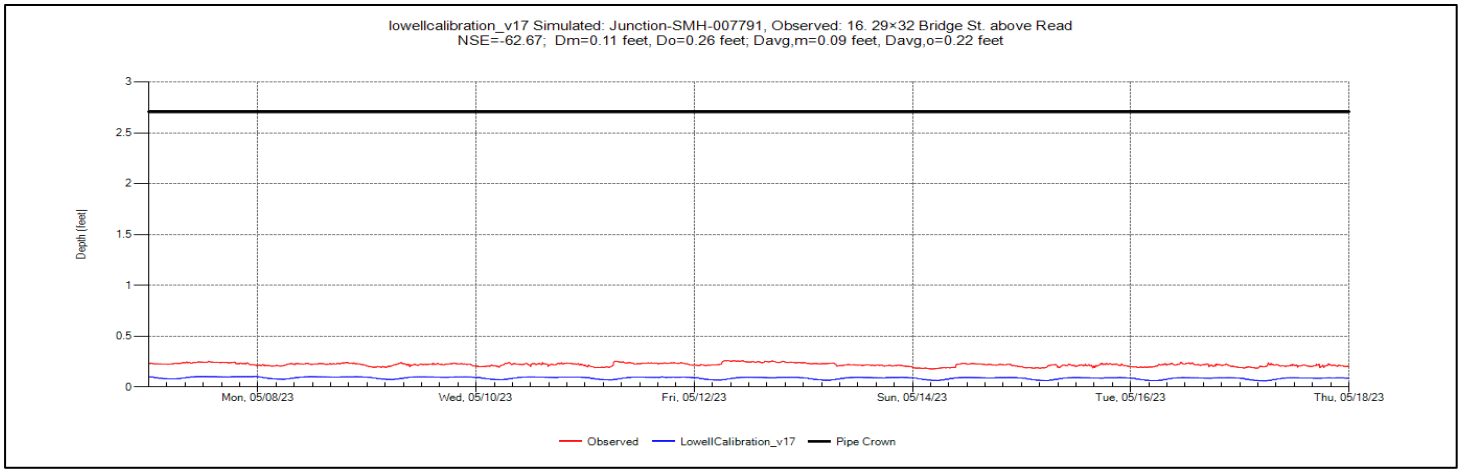


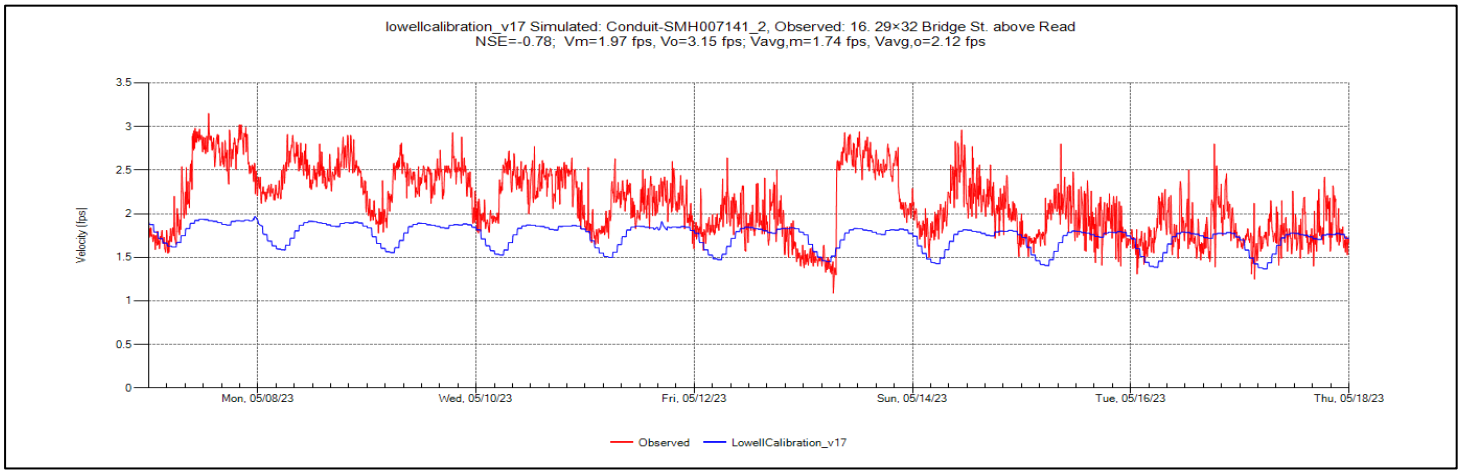


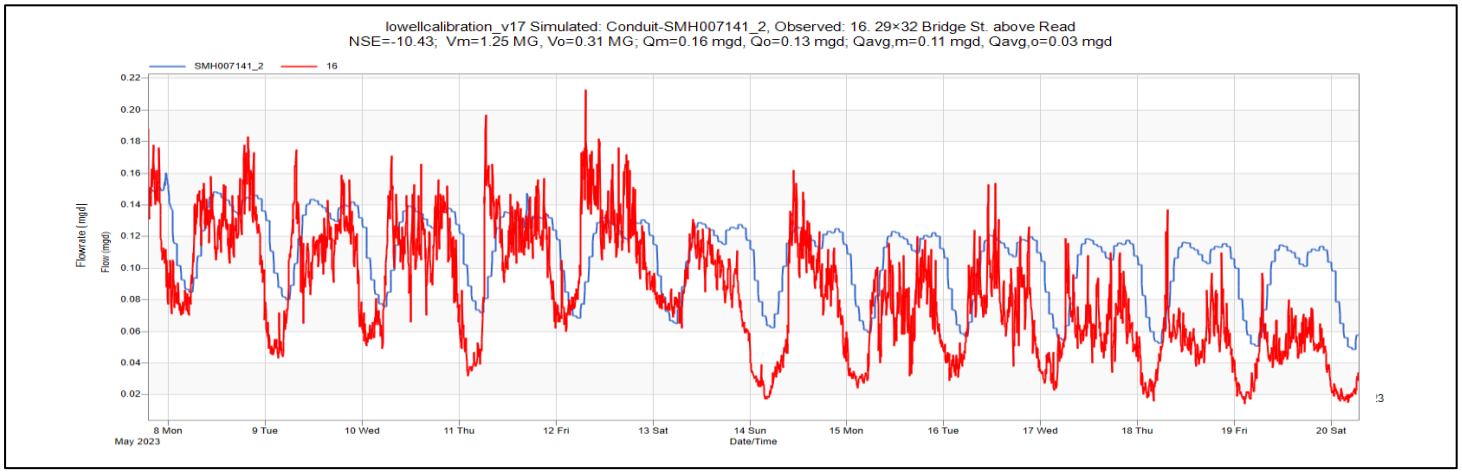


Simulated Versus Observed Flow at Flow Meter Sites

16-DryPeriod

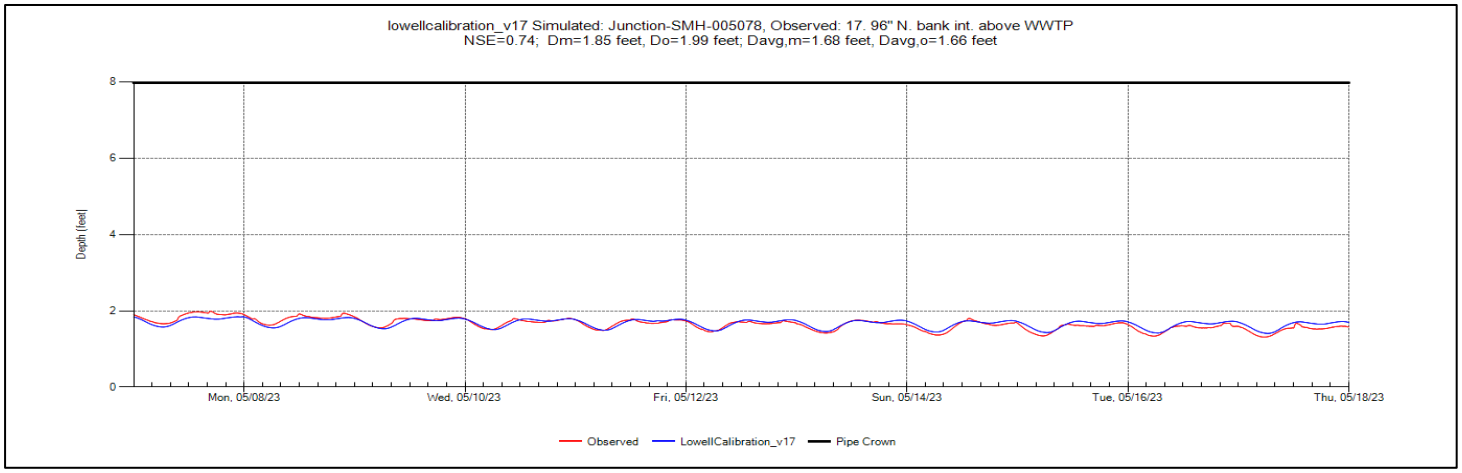


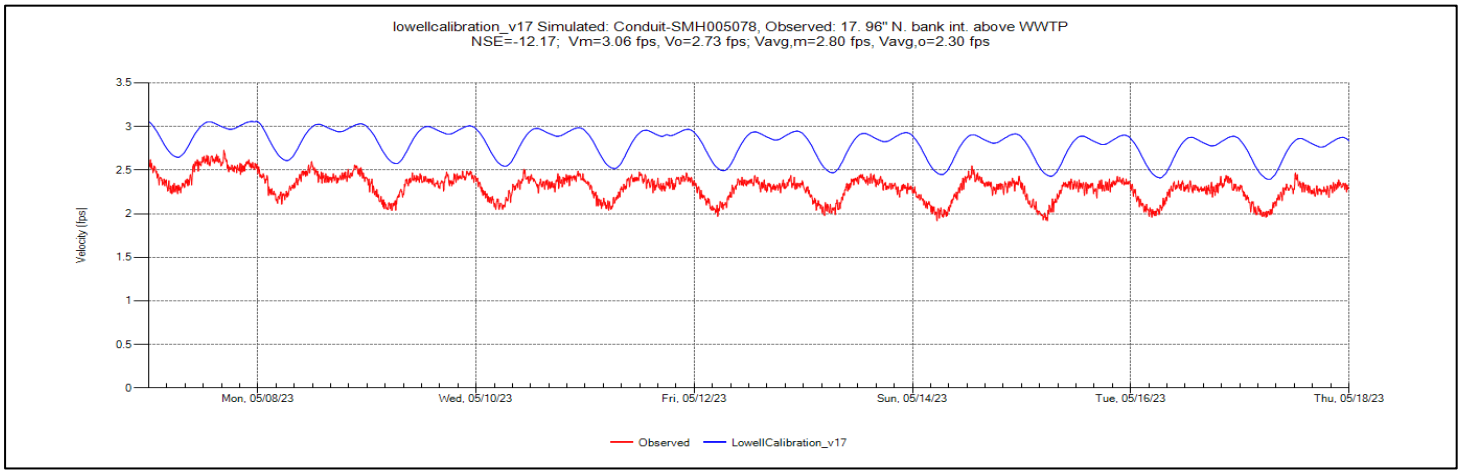


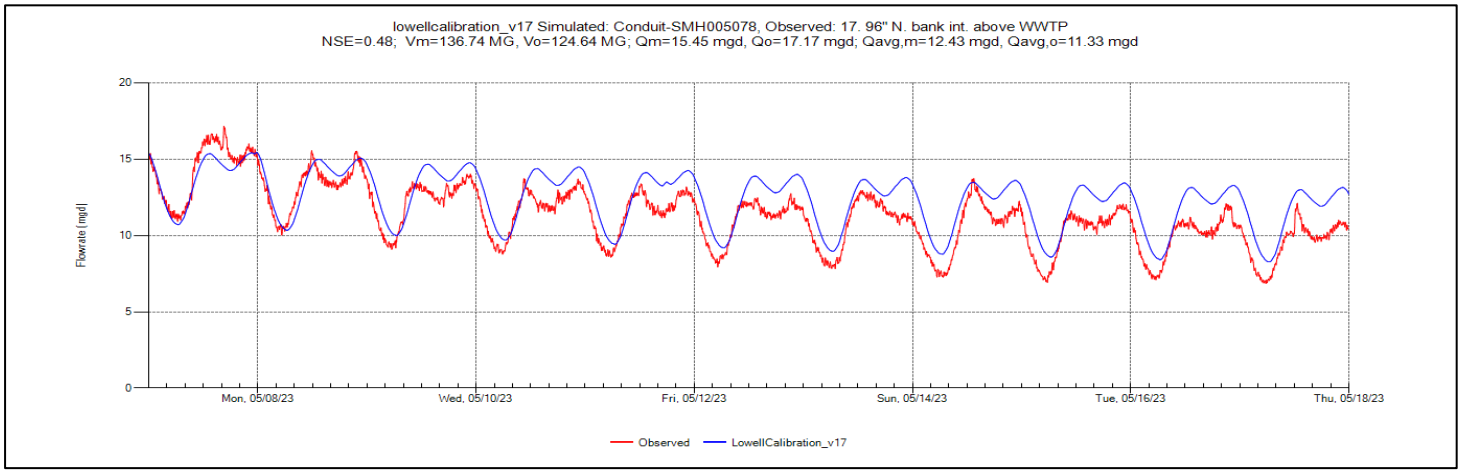


Simulated Versus Observed Flow at Flow Meter Sites

17-DryPeriod

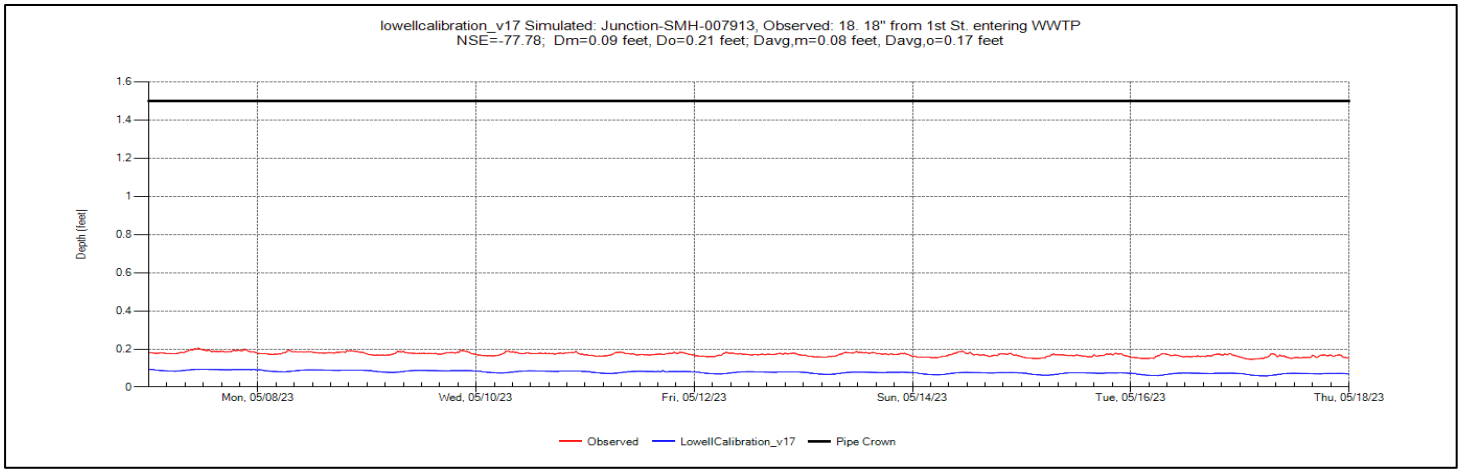


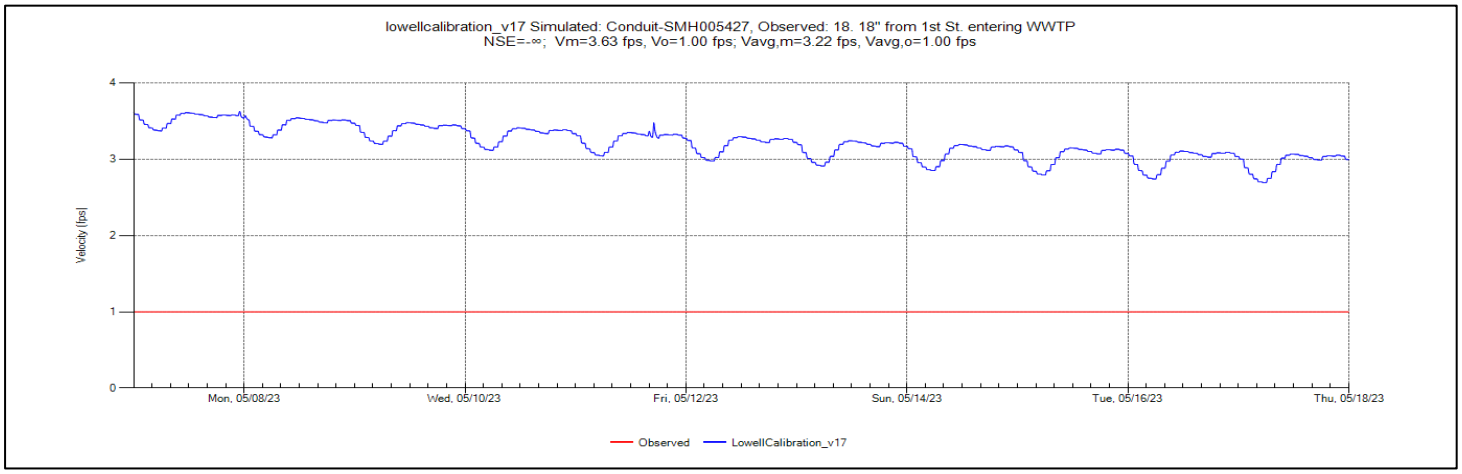


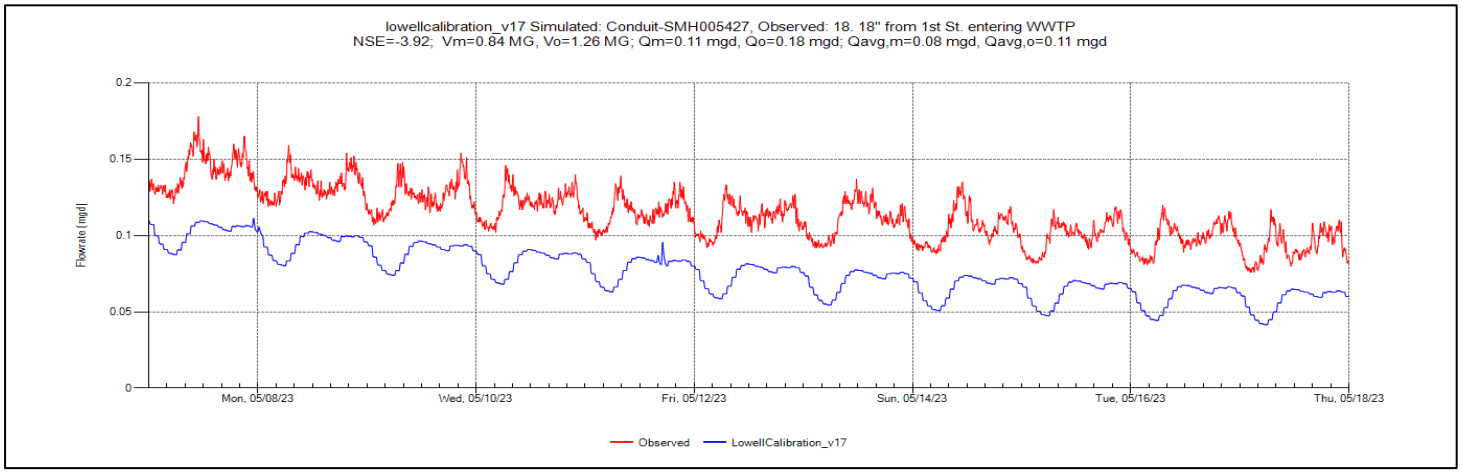


Simulated Versus Observed Flow at Flow Meter Sites

18-DryPeriod

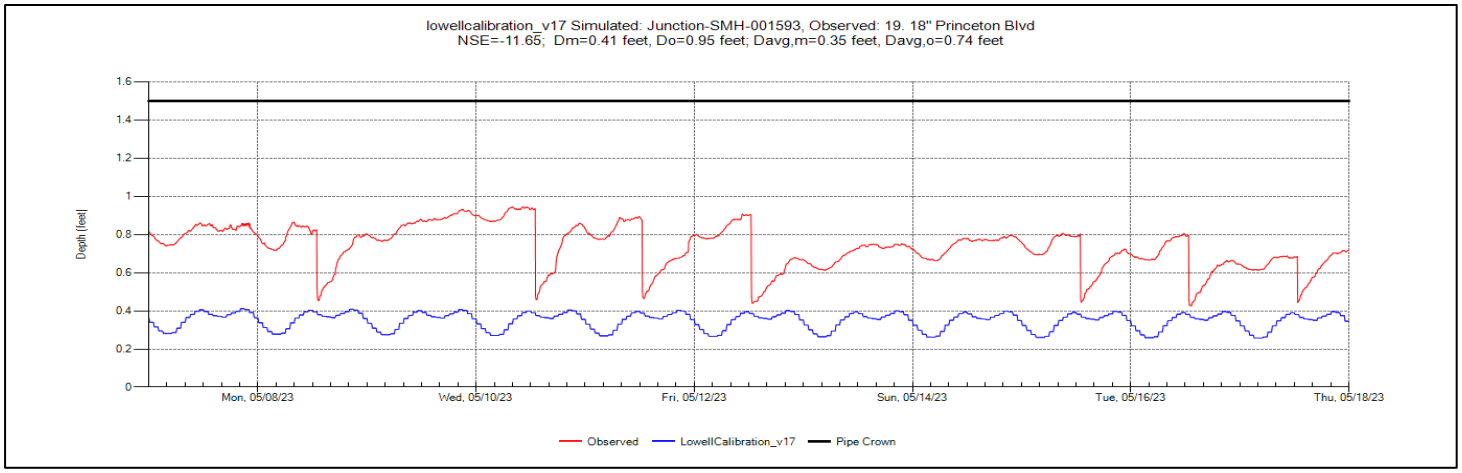


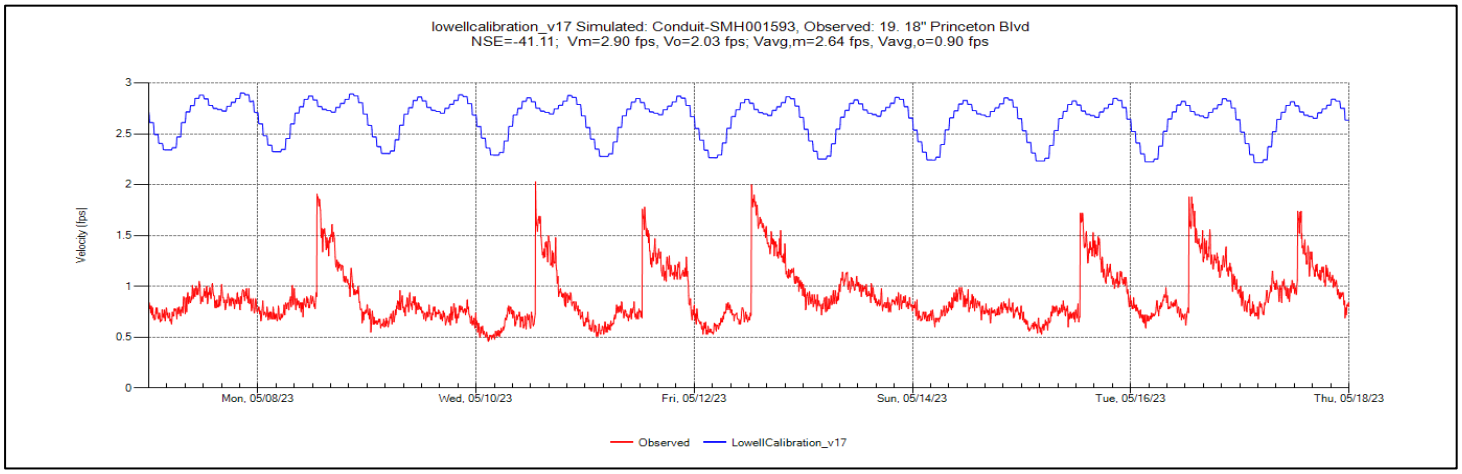


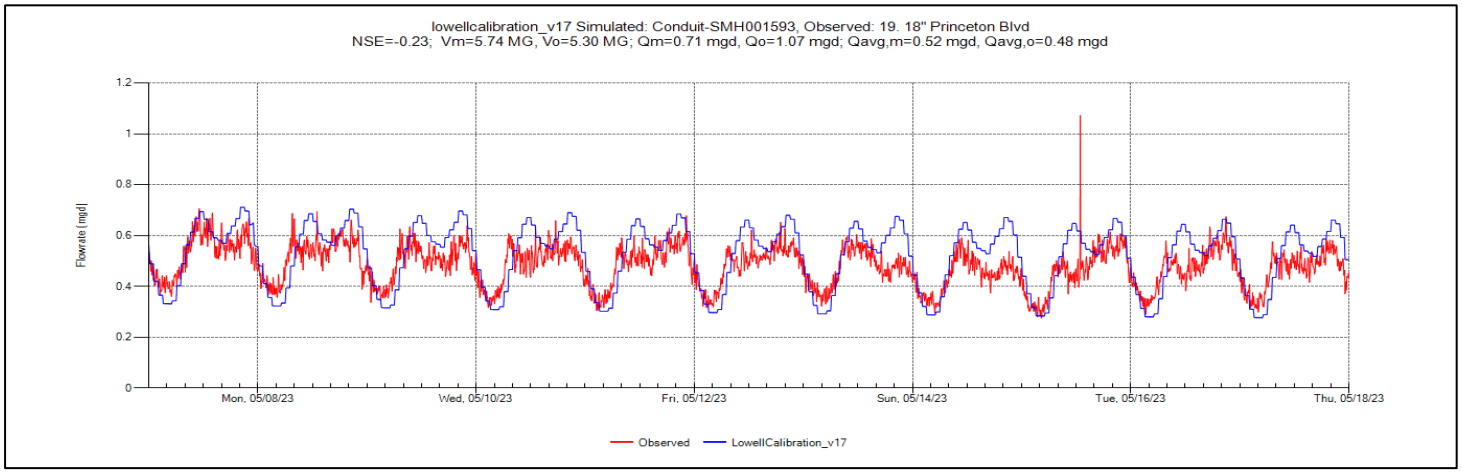


Simulated Versus Observed Flow at Flow Meter Sites

19-DryPeriod

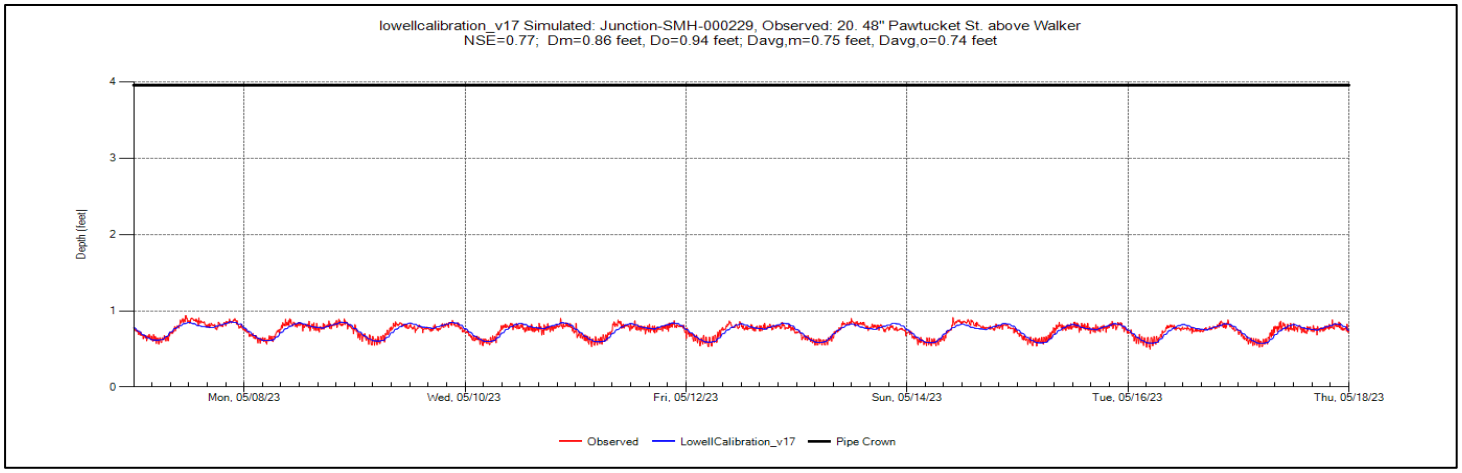


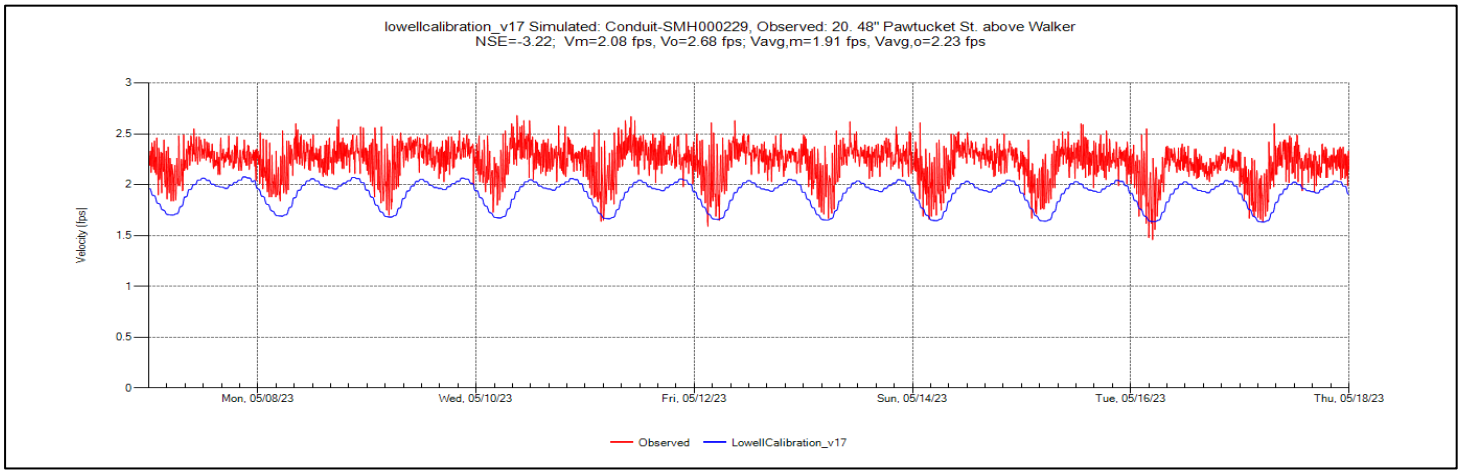


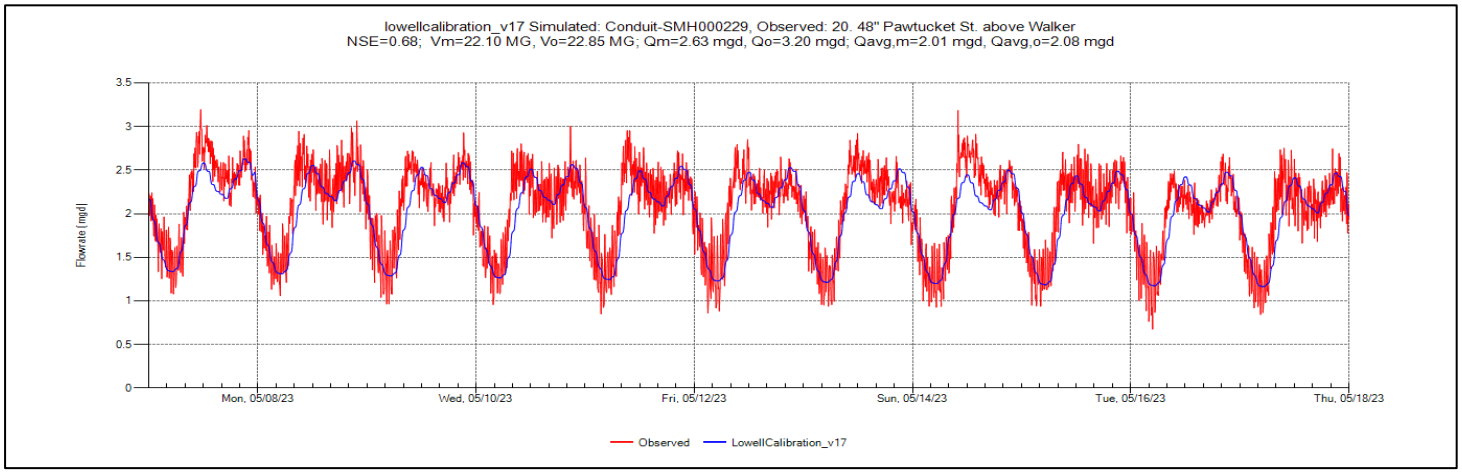


Simulated Versus Observed Flow at Flow Meter Sites

20-DryPeriod

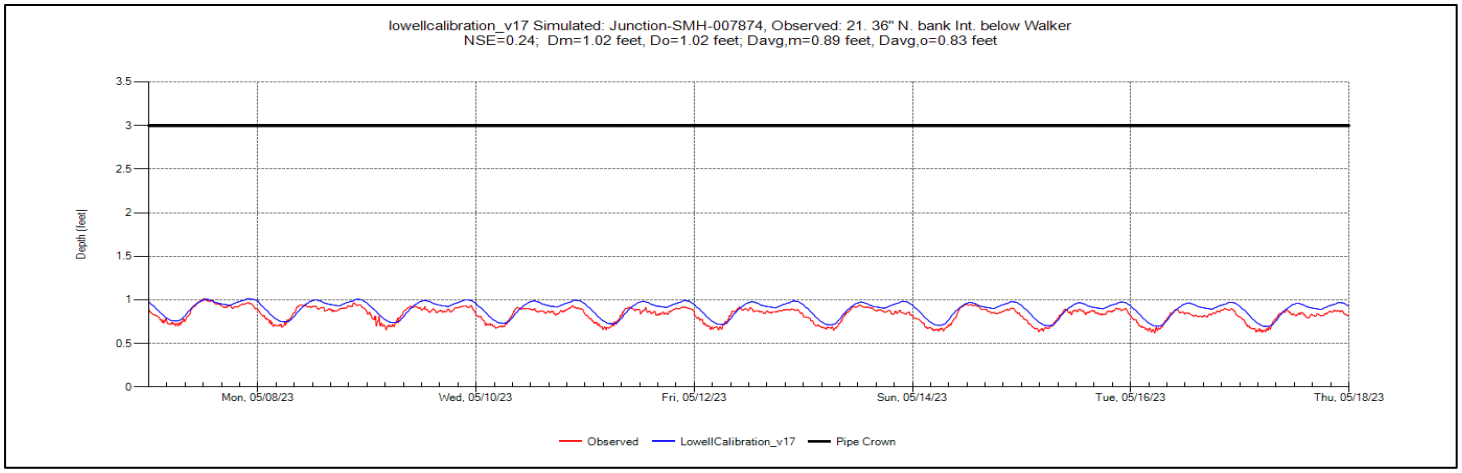


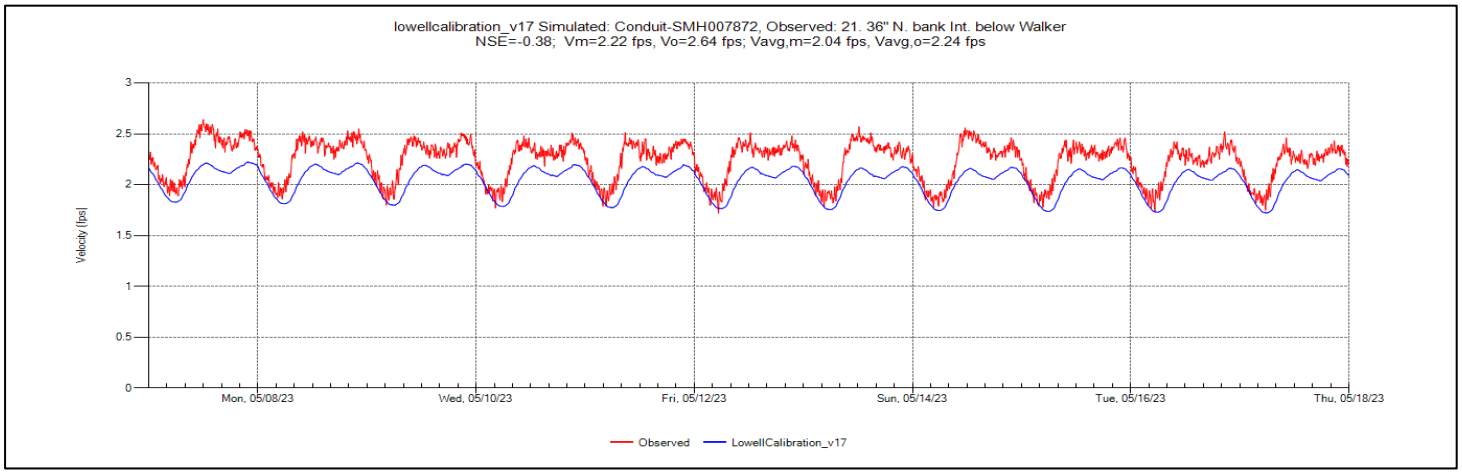


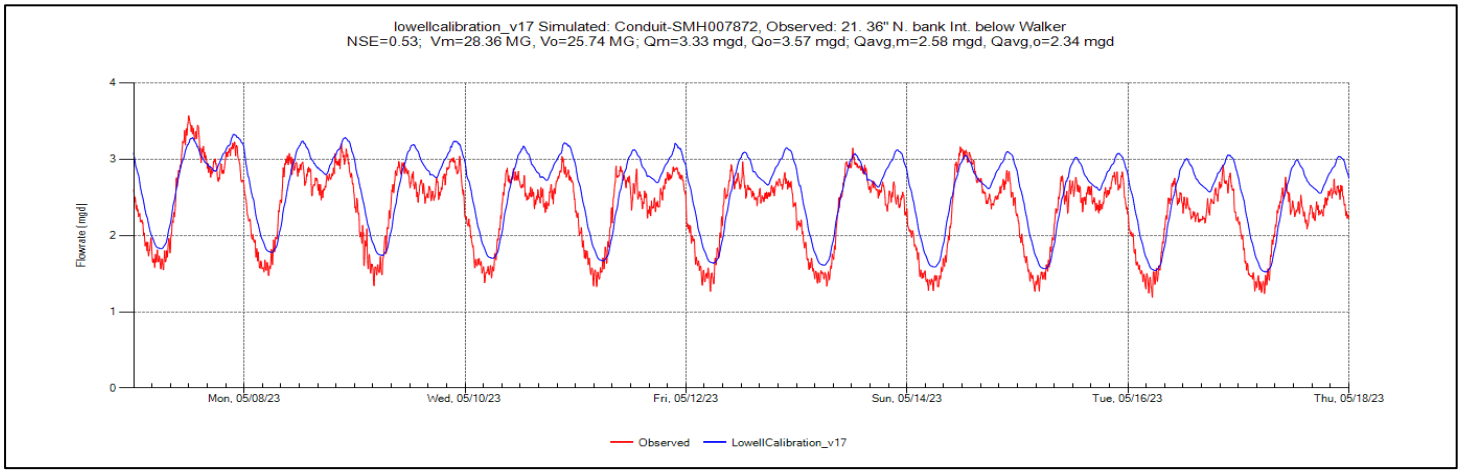


Simulated Versus Observed Flow at Flow Meter Sites

21-DryPeriod

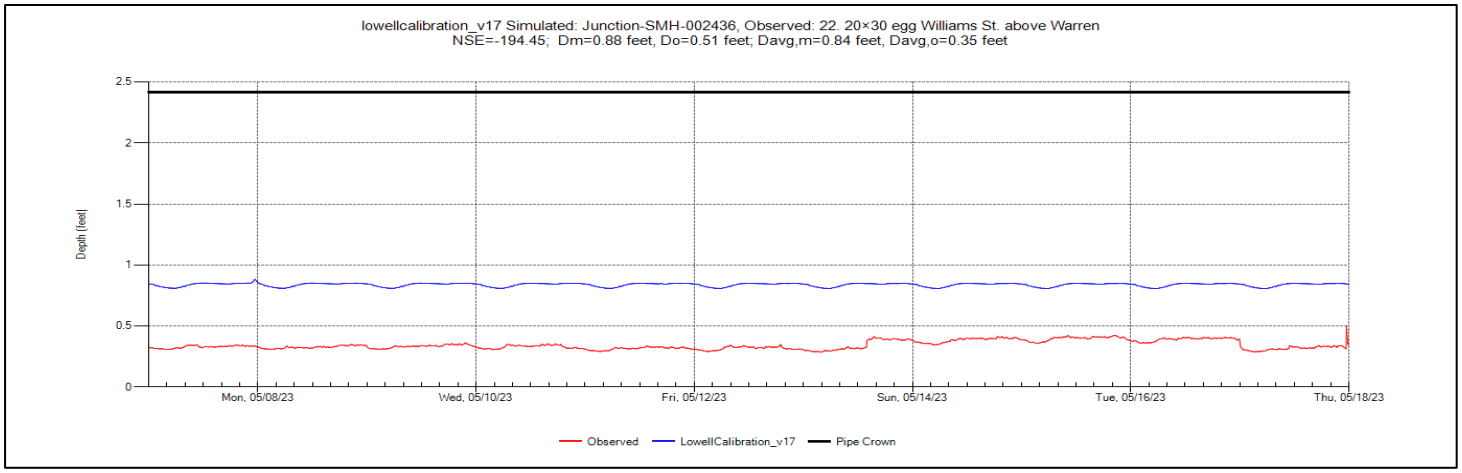


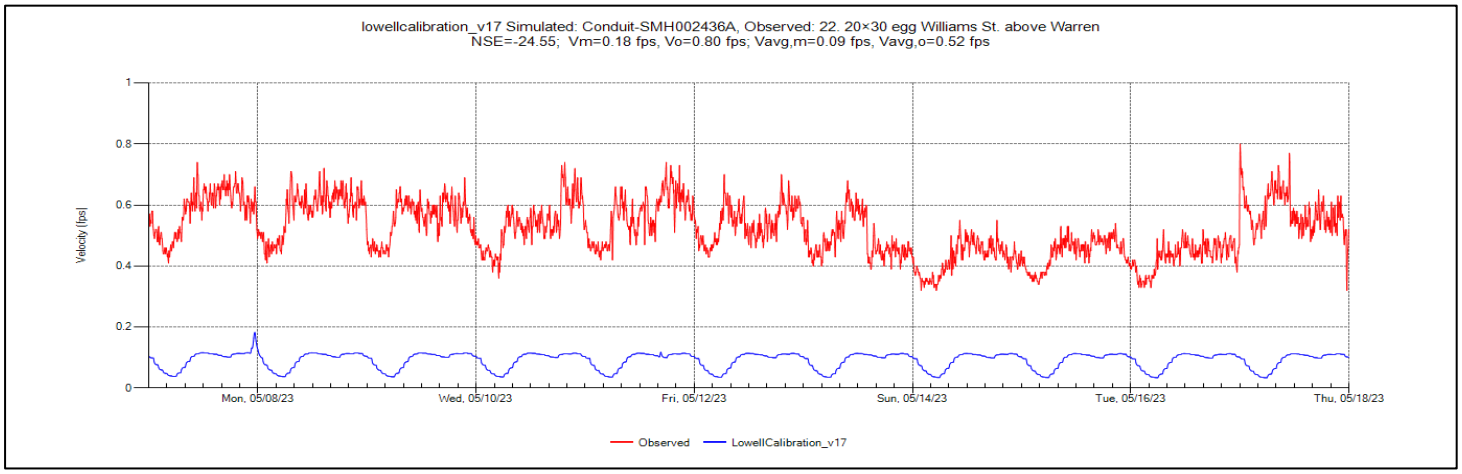


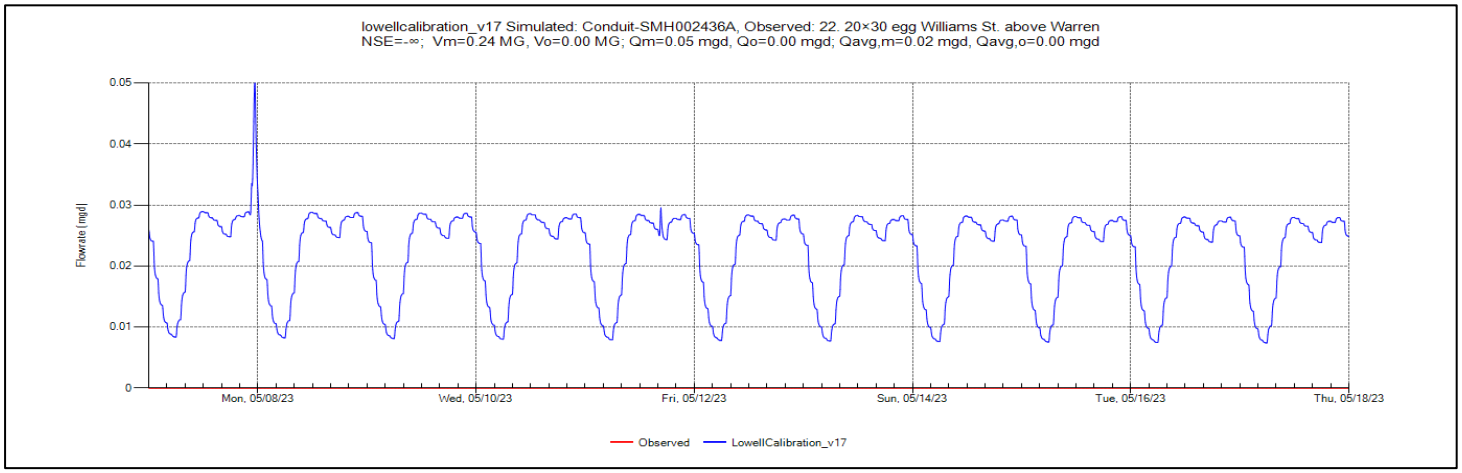


Simulated Versus Observed Flow at Flow Meter Sites

22-DryPeriod

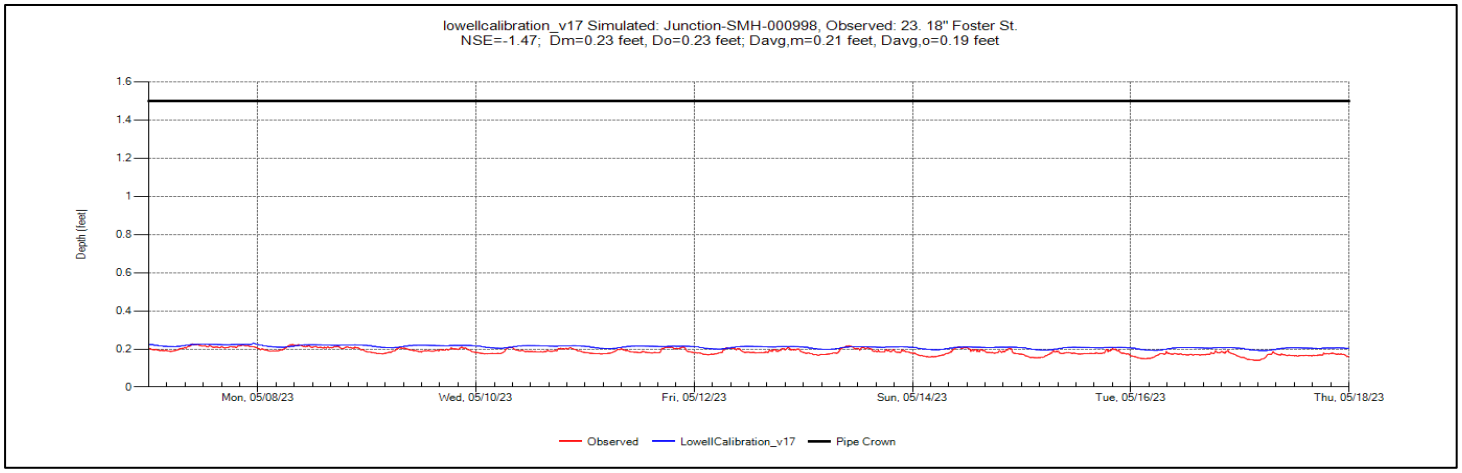


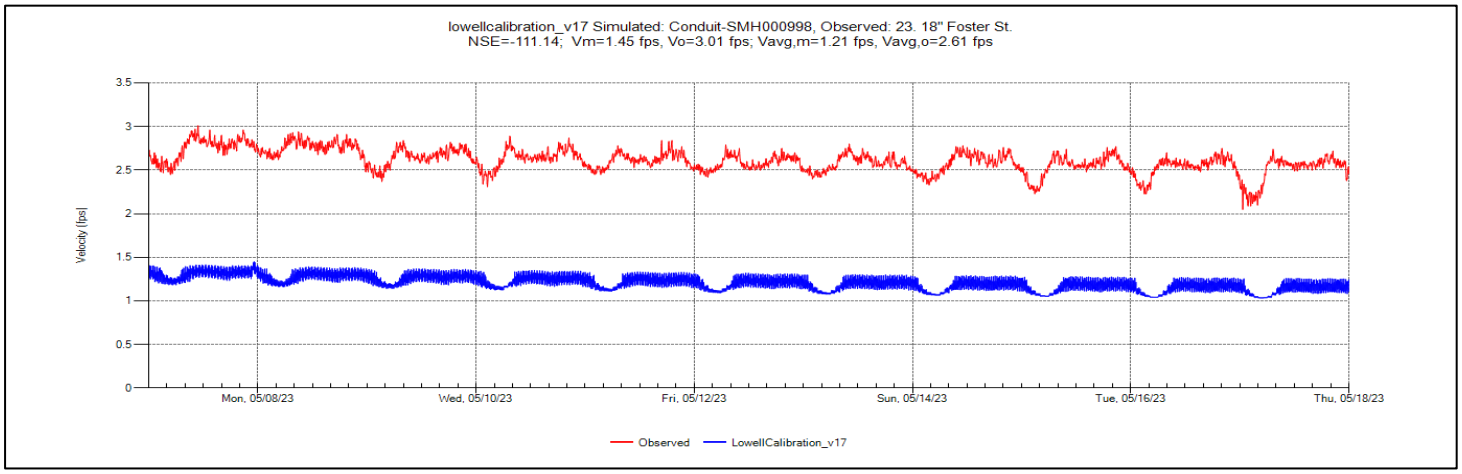


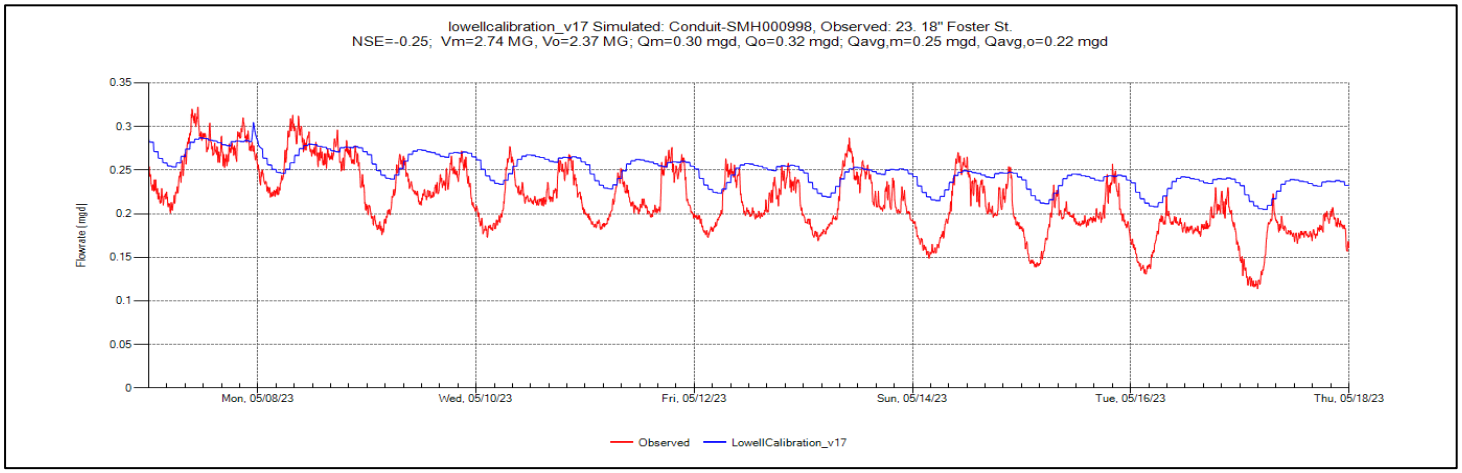


Simulated Versus Observed Flow at Flow Meter Sites

23-DryPeriod

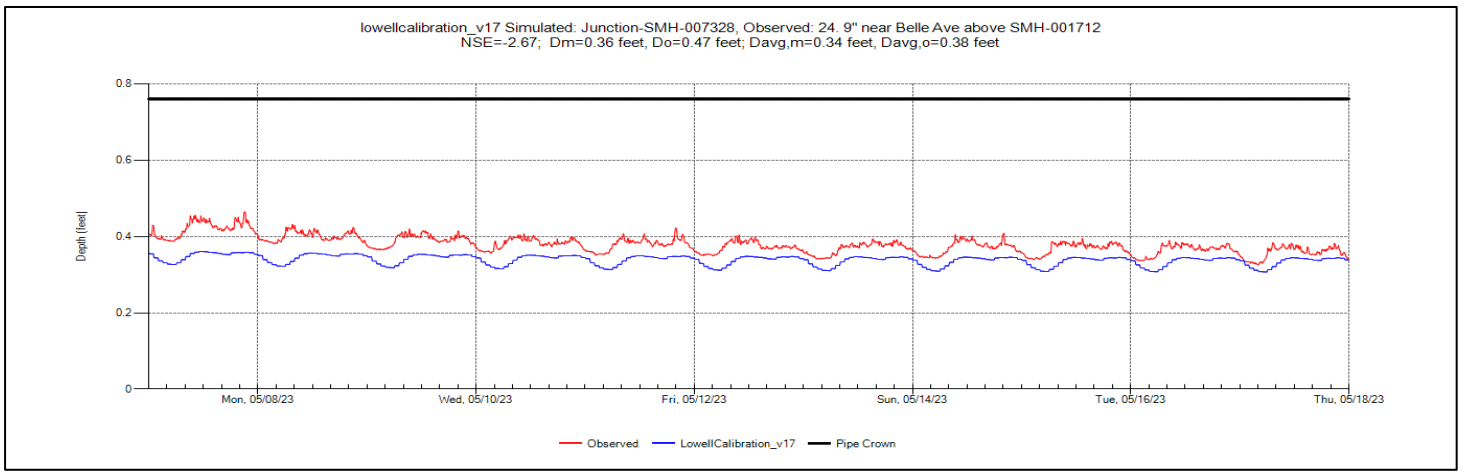


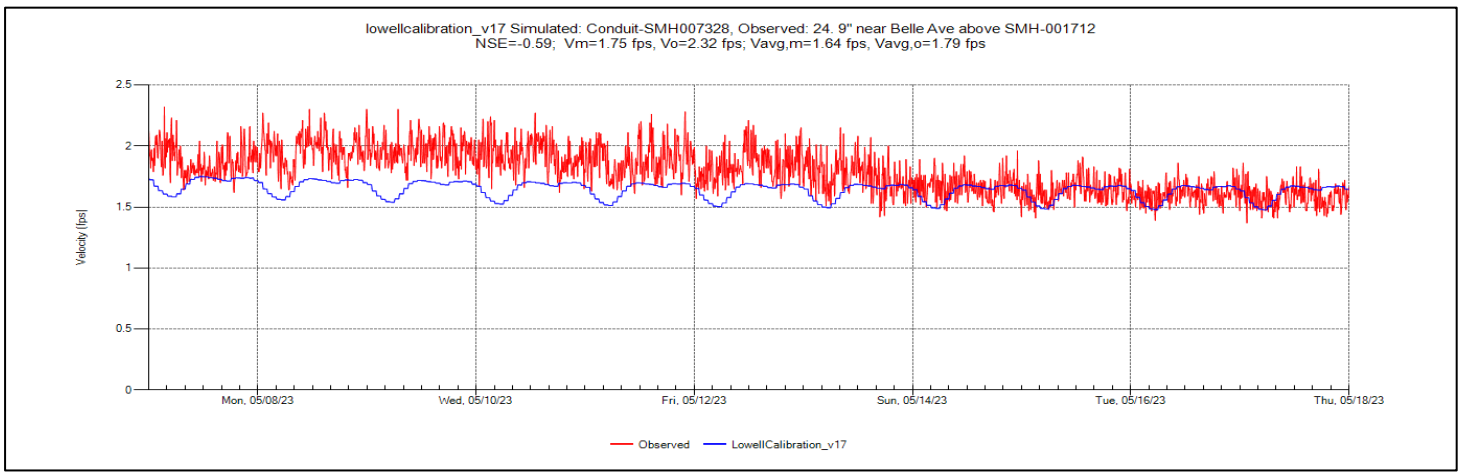


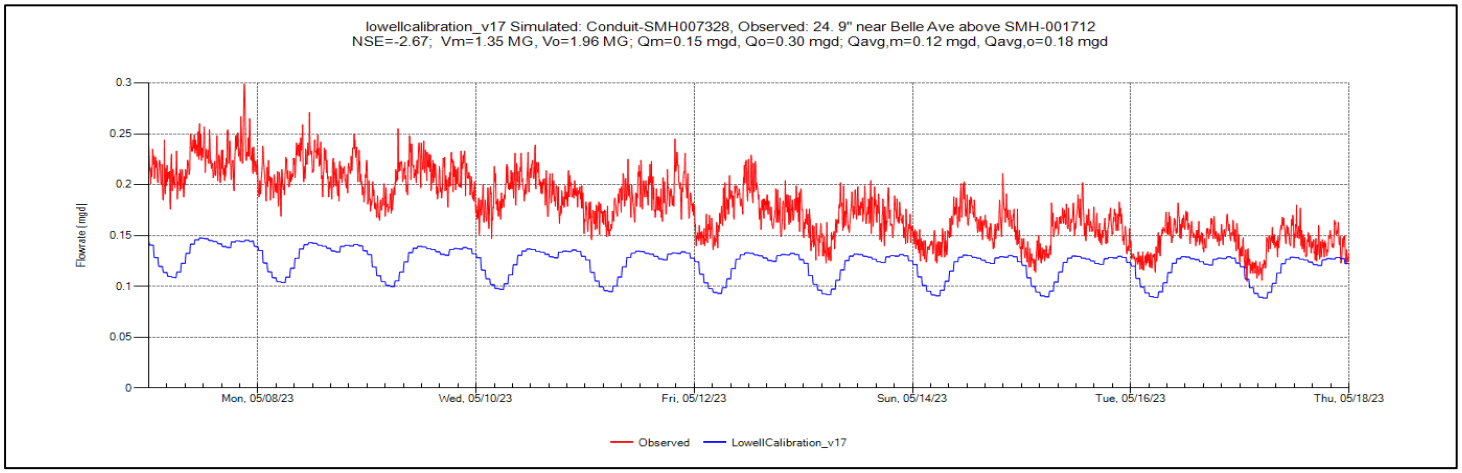


Simulated Versus Observed Flow at Flow Meter Sites

24-DryPeriod

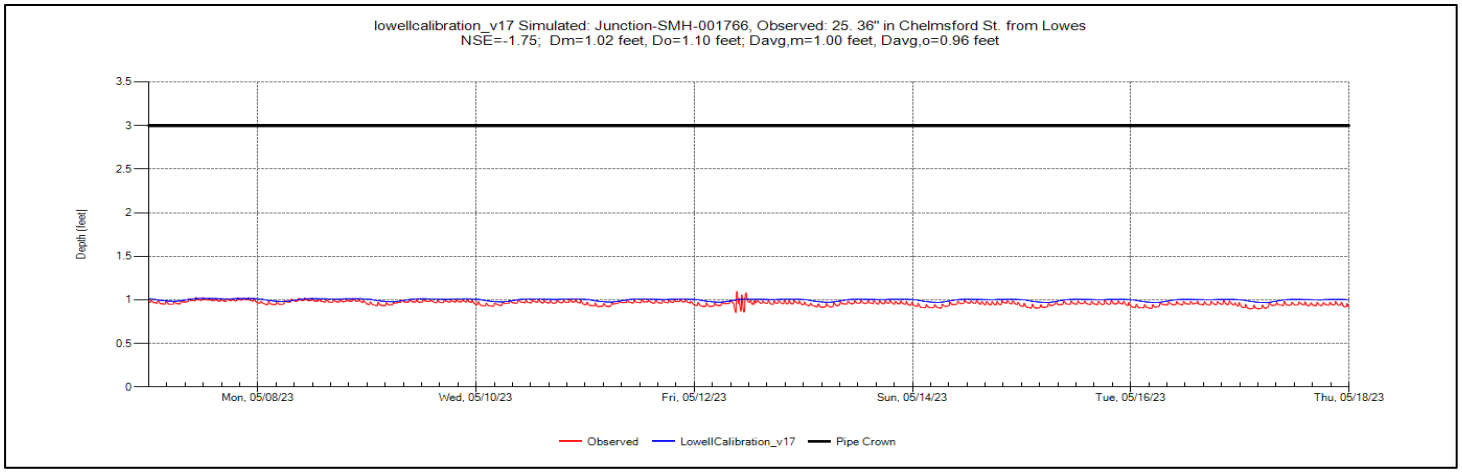


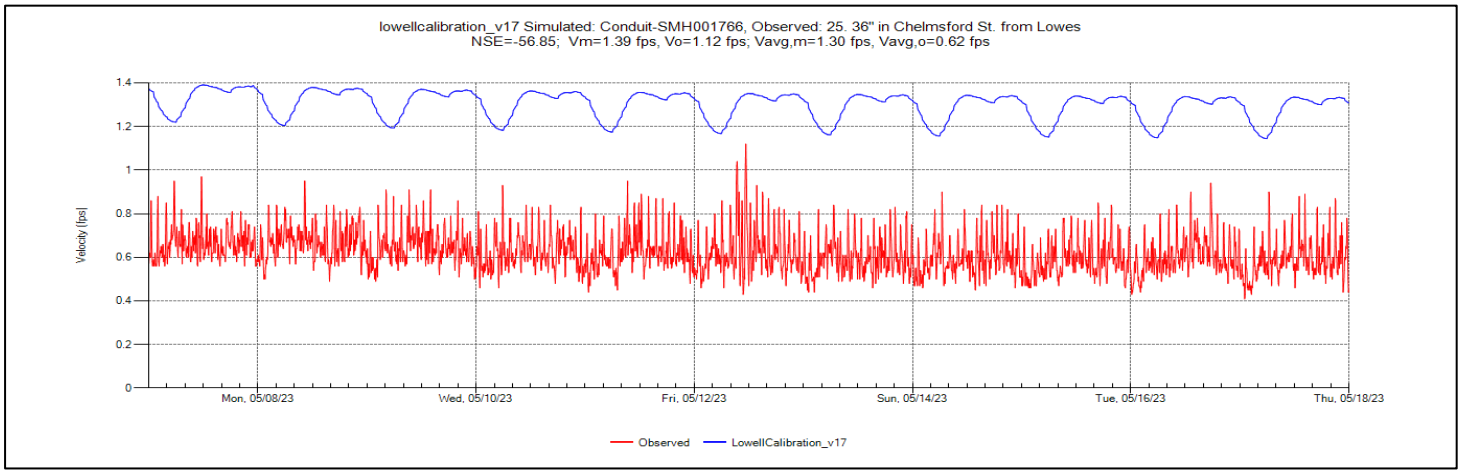


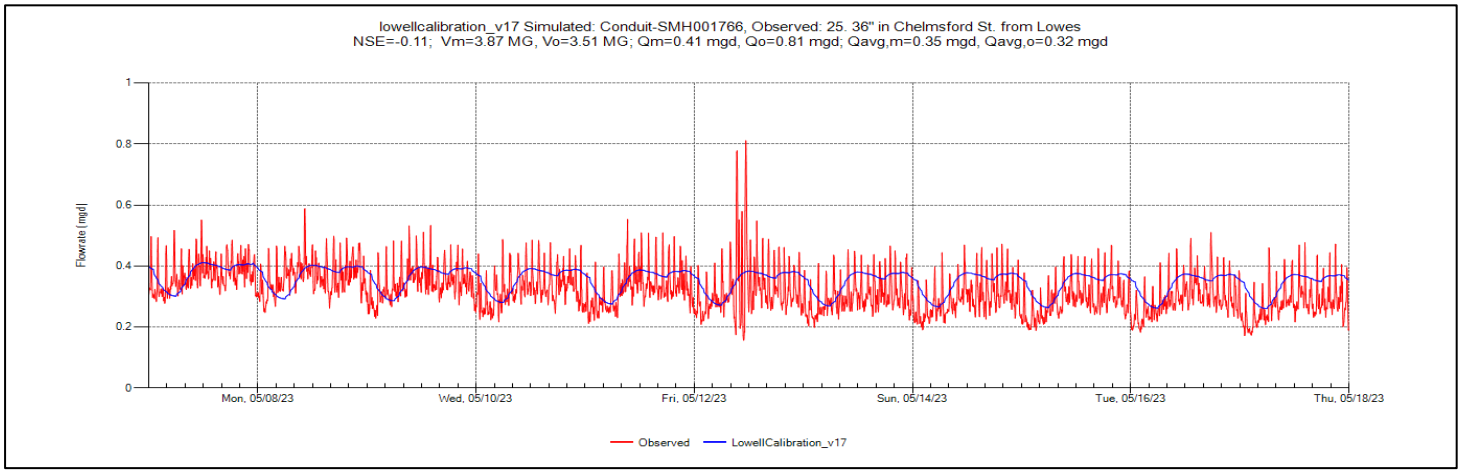


Simulated Versus Observed Flow at Flow Meter Sites

25-DryPeriod

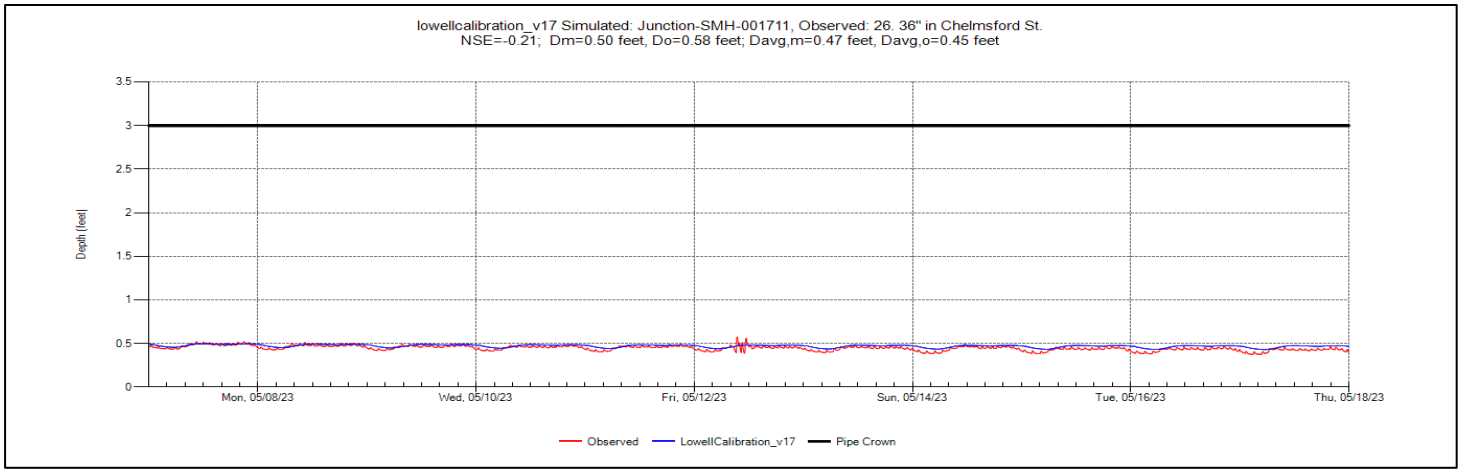


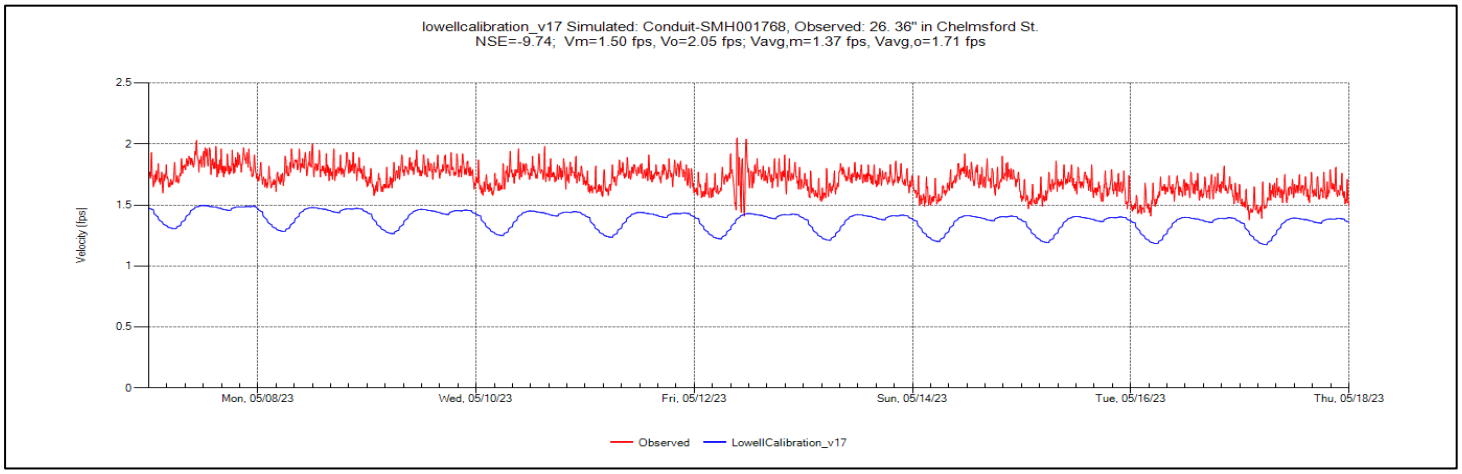


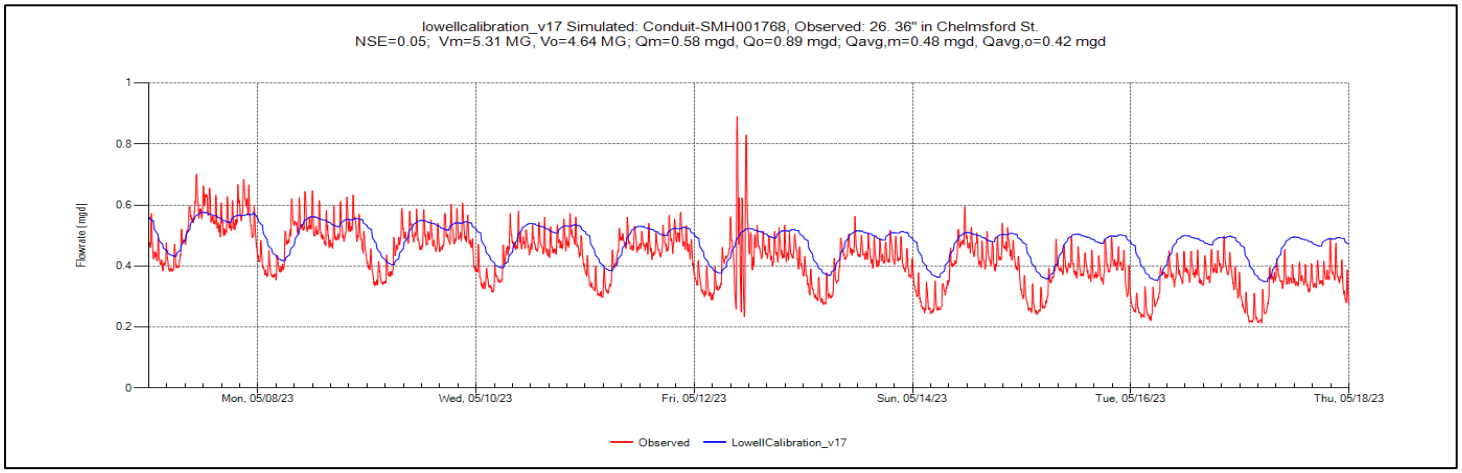


Simulated Versus Observed Flow at Flow Meter Sites

26-DryPeriod

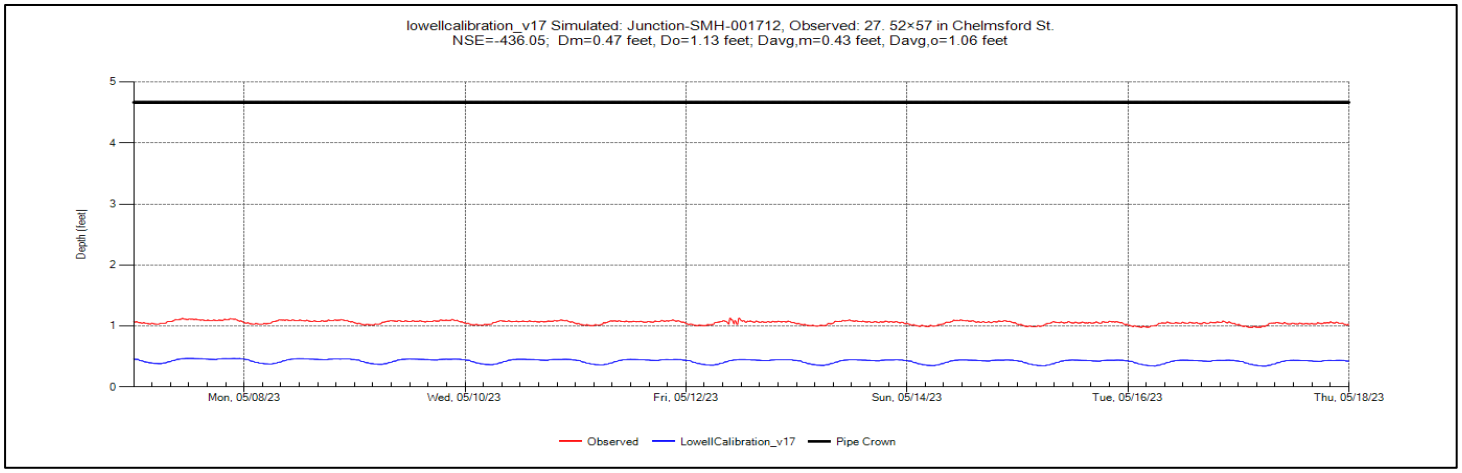


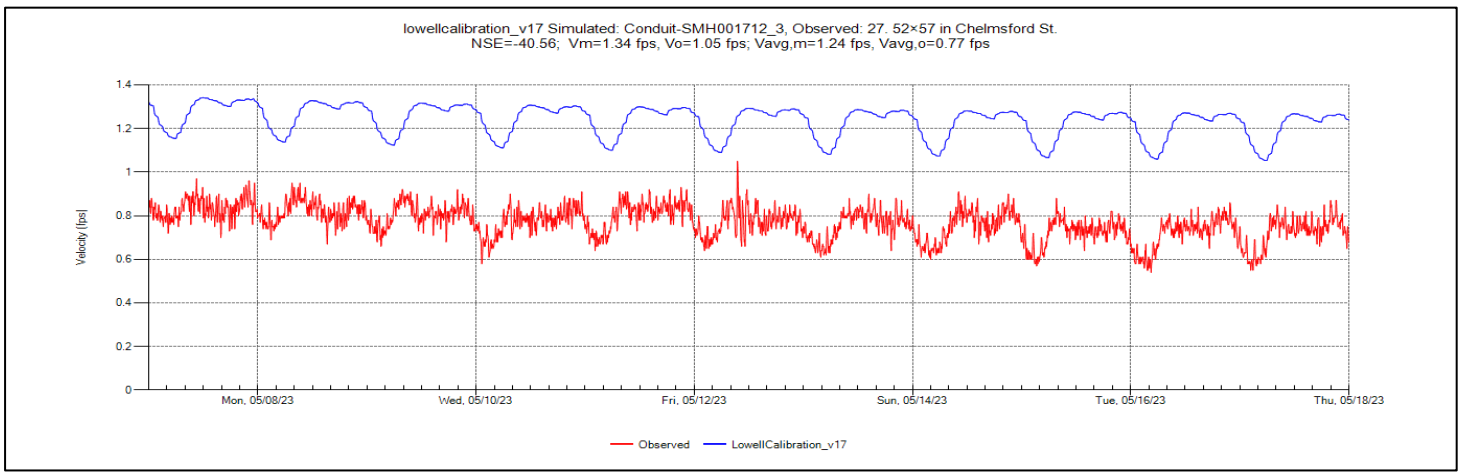


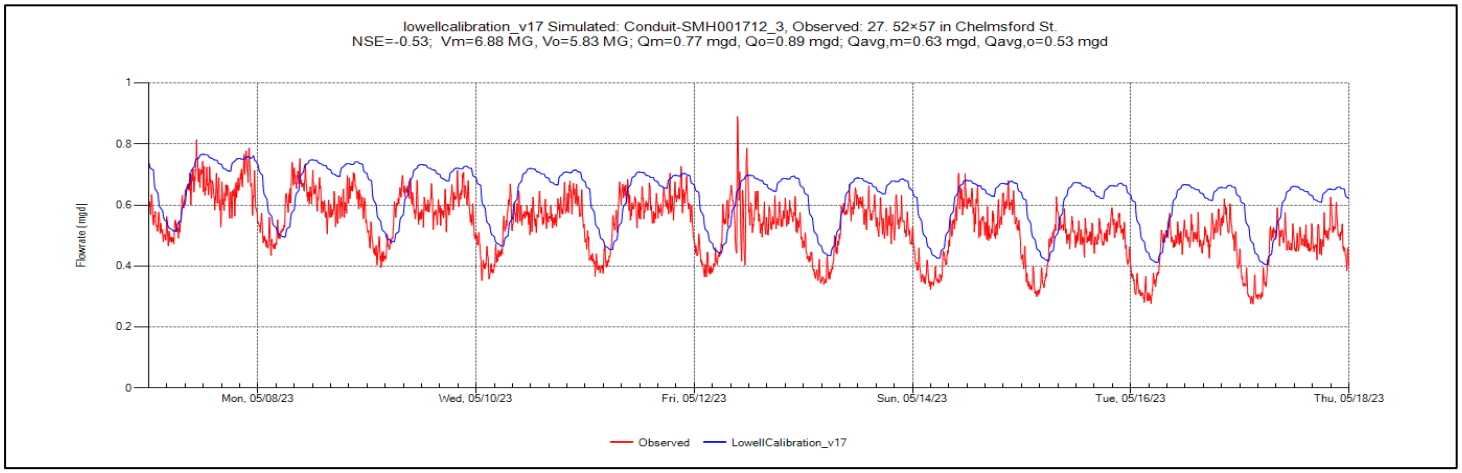


Simulated Versus Observed Flow at Flow Meter Sites

27-DryPeriod

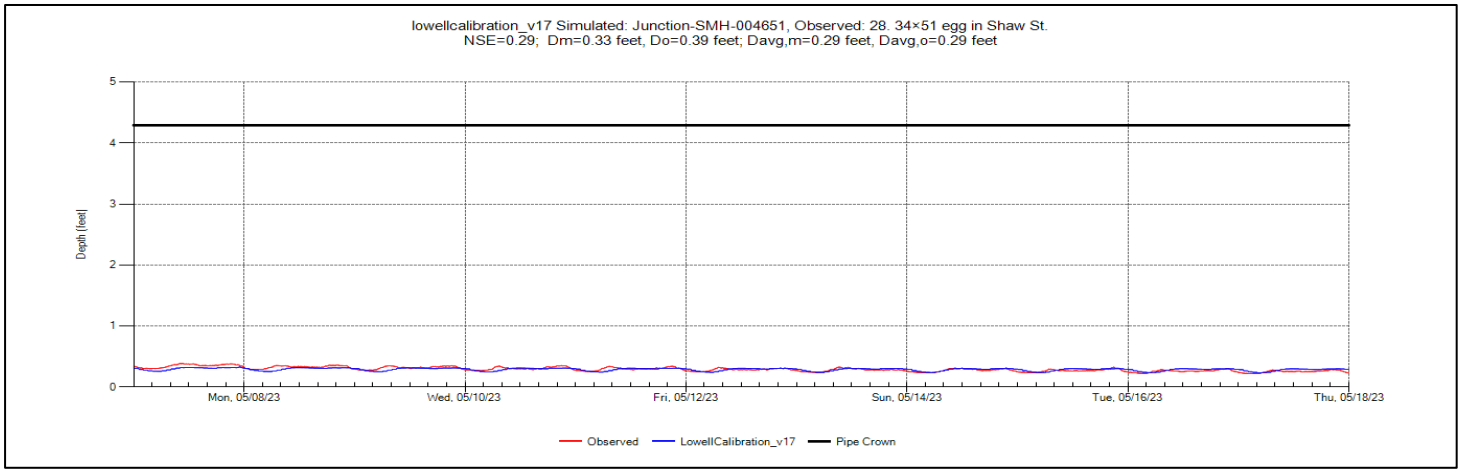


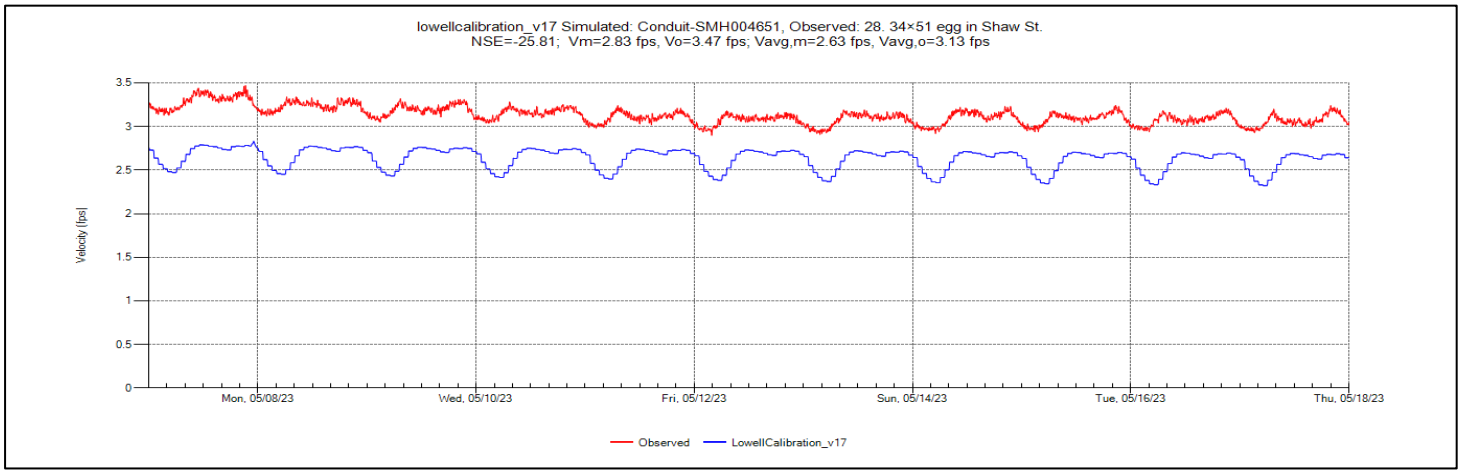


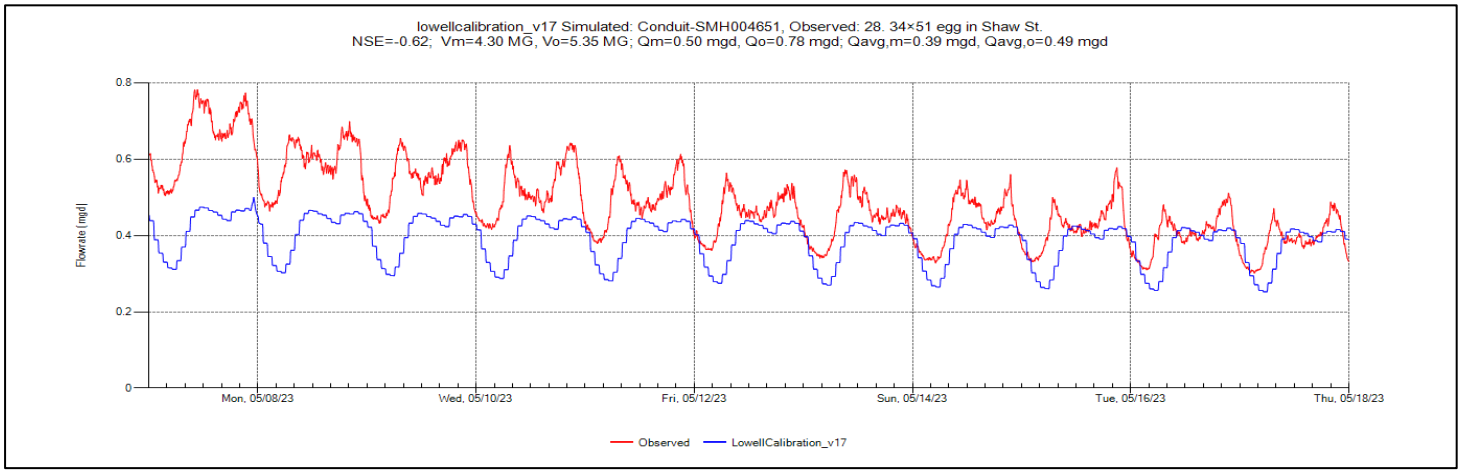


Simulated Versus Observed Flow at Flow Meter Sites

28-DryPeriod

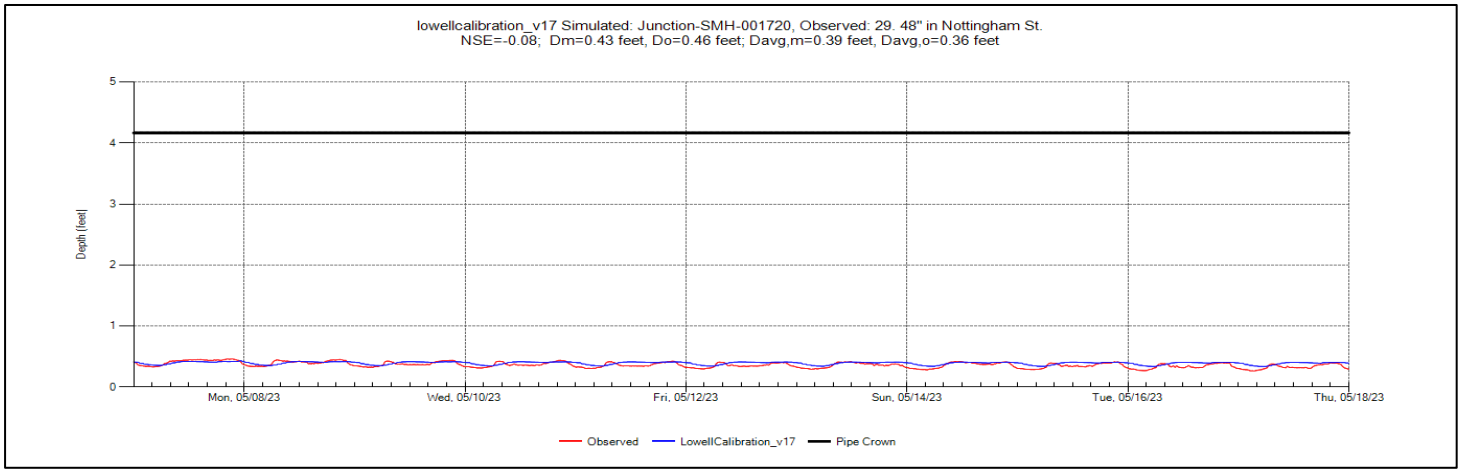


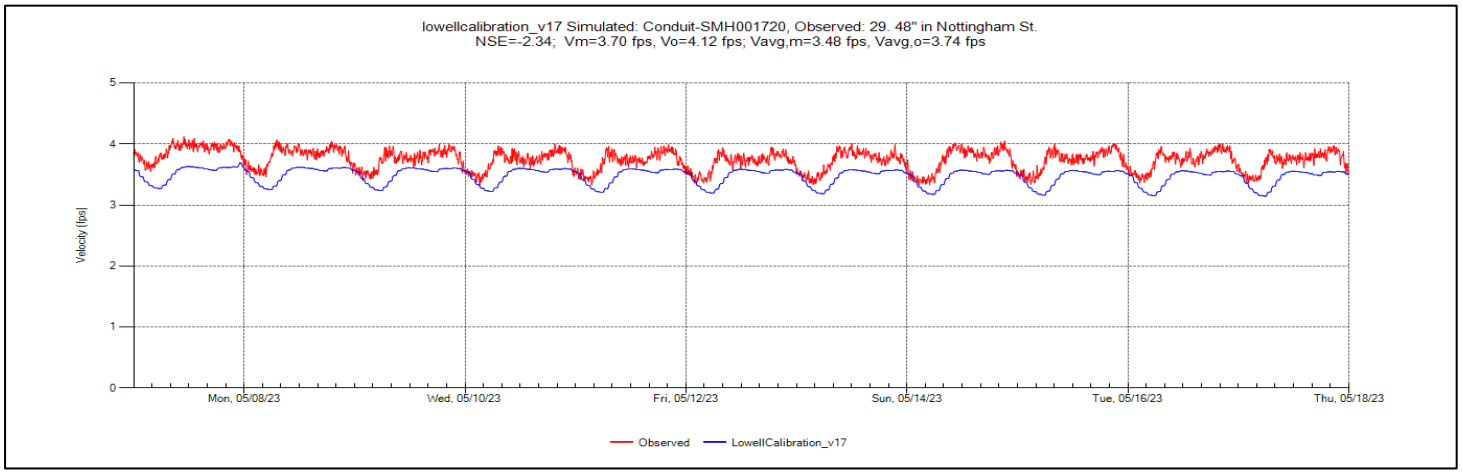


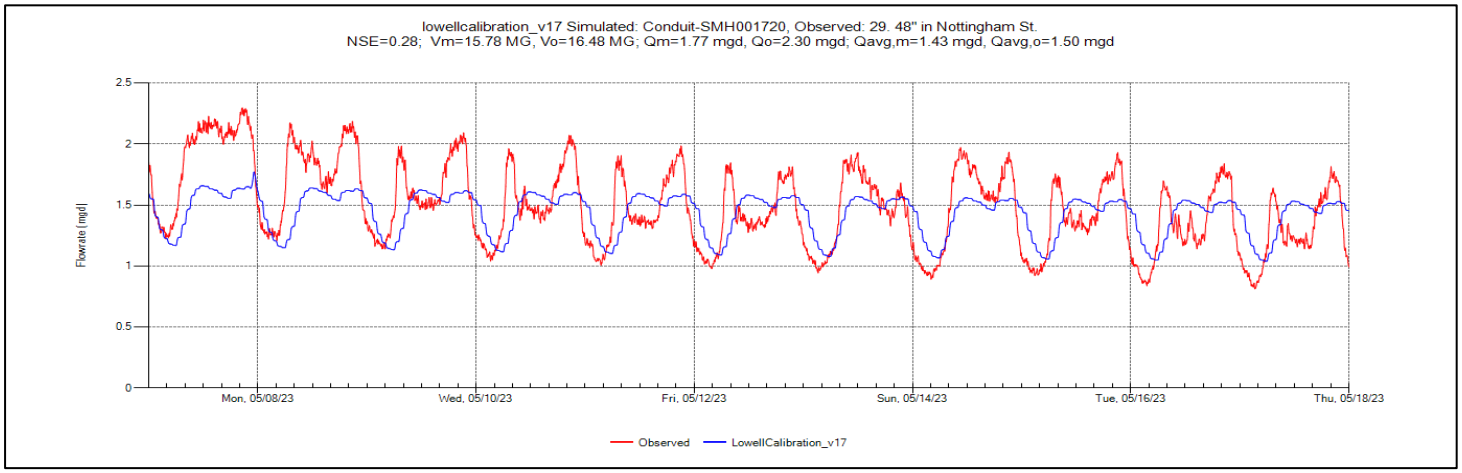


Simulated Versus Observed Flow at Flow Meter Sites

29-DryPeriod

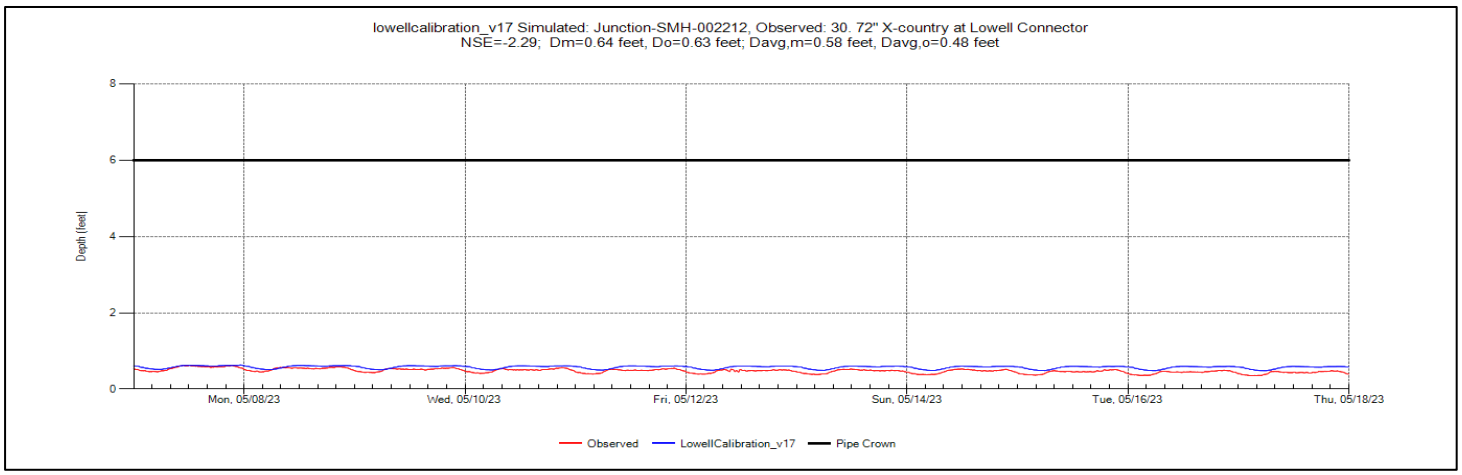


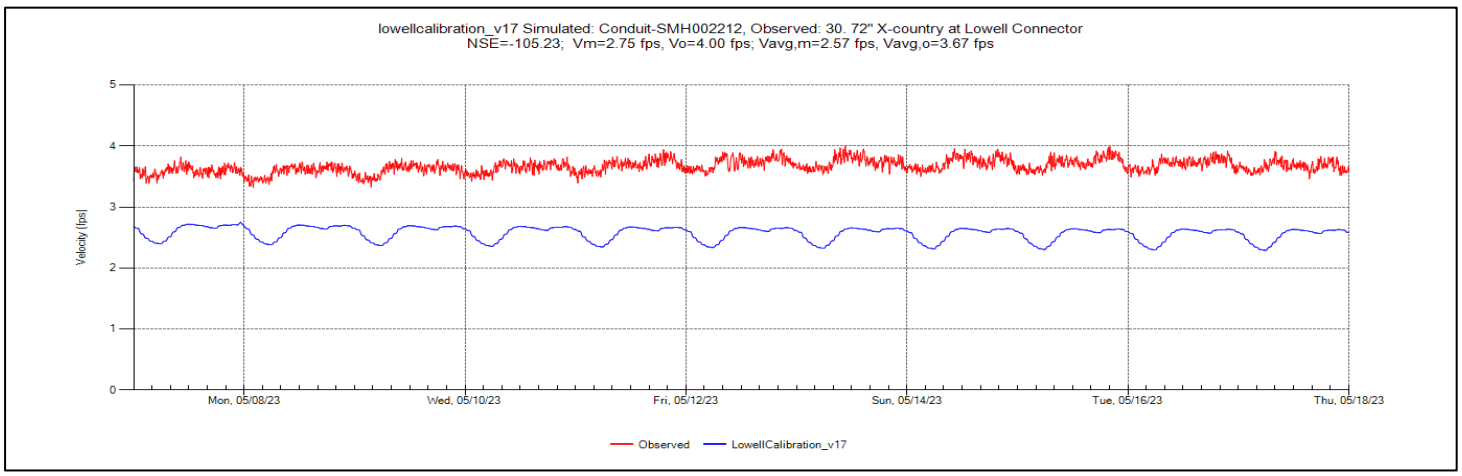


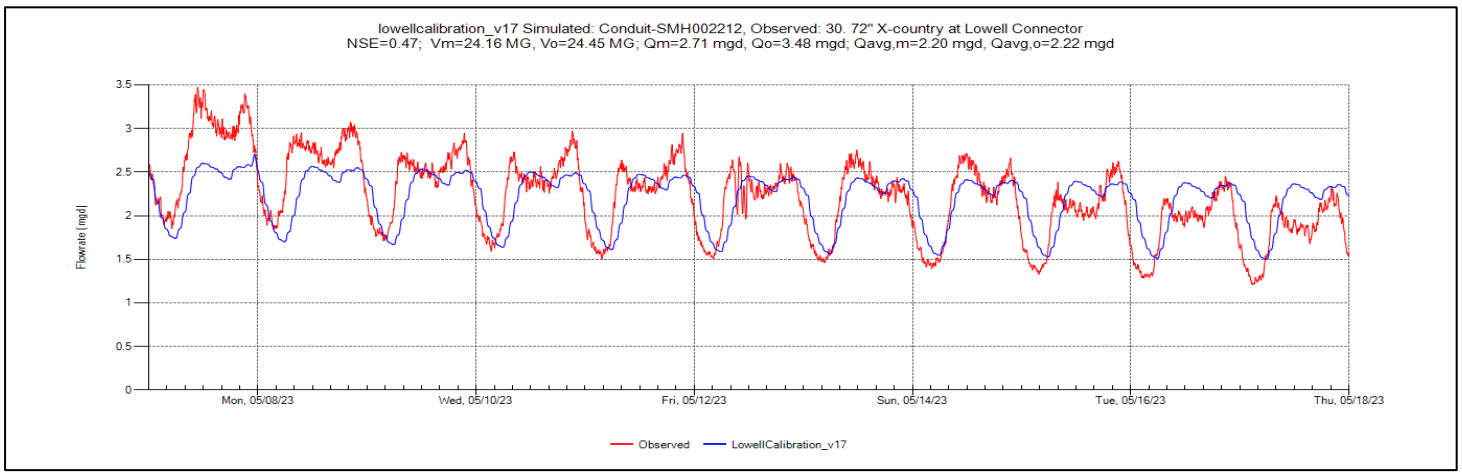


Simulated Versus Observed Flow at Flow Meter Sites

30-DryPeriod

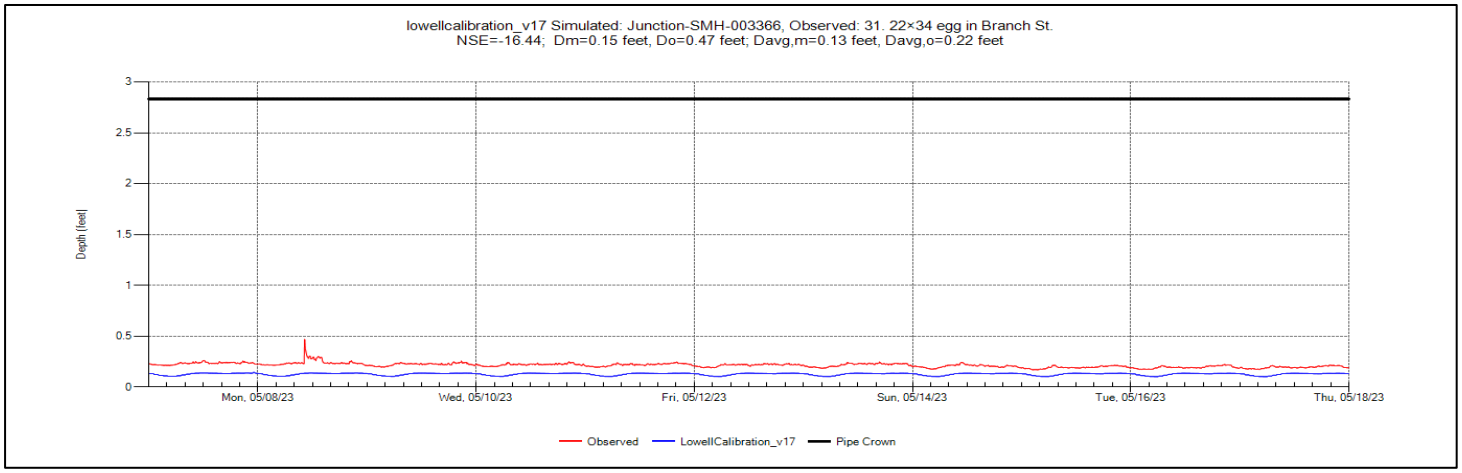


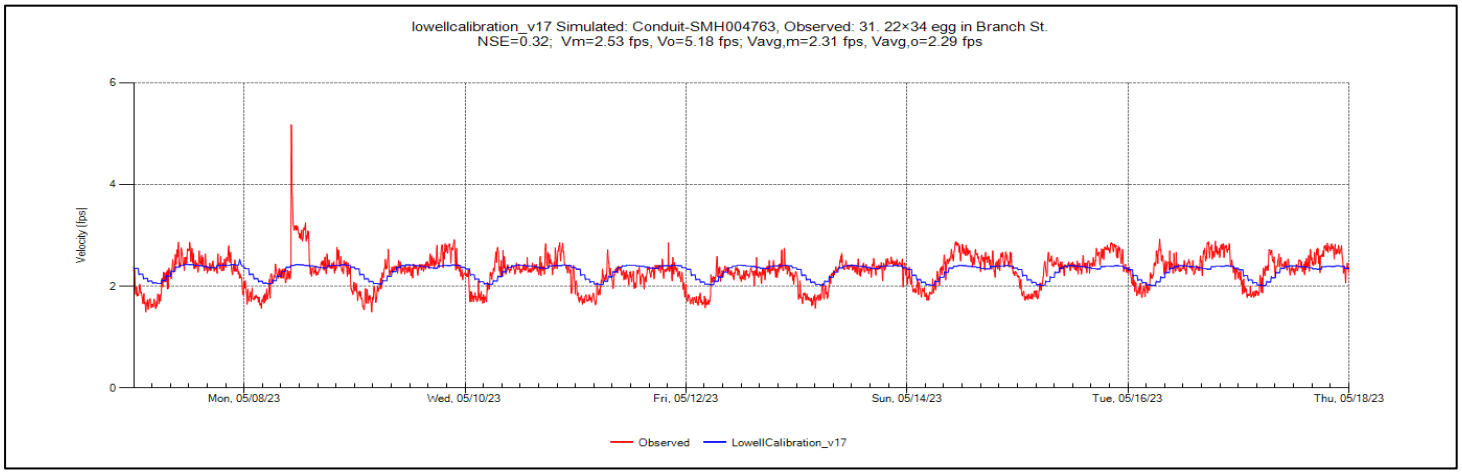


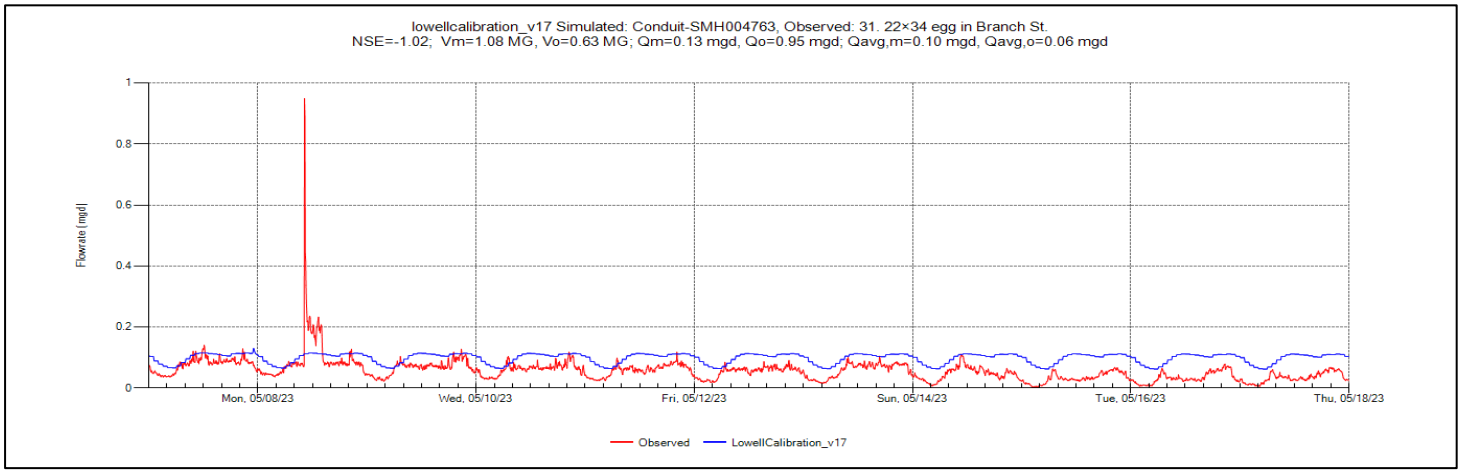


Simulated Versus Observed Flow at Flow Meter Sites

31-DryPeriod

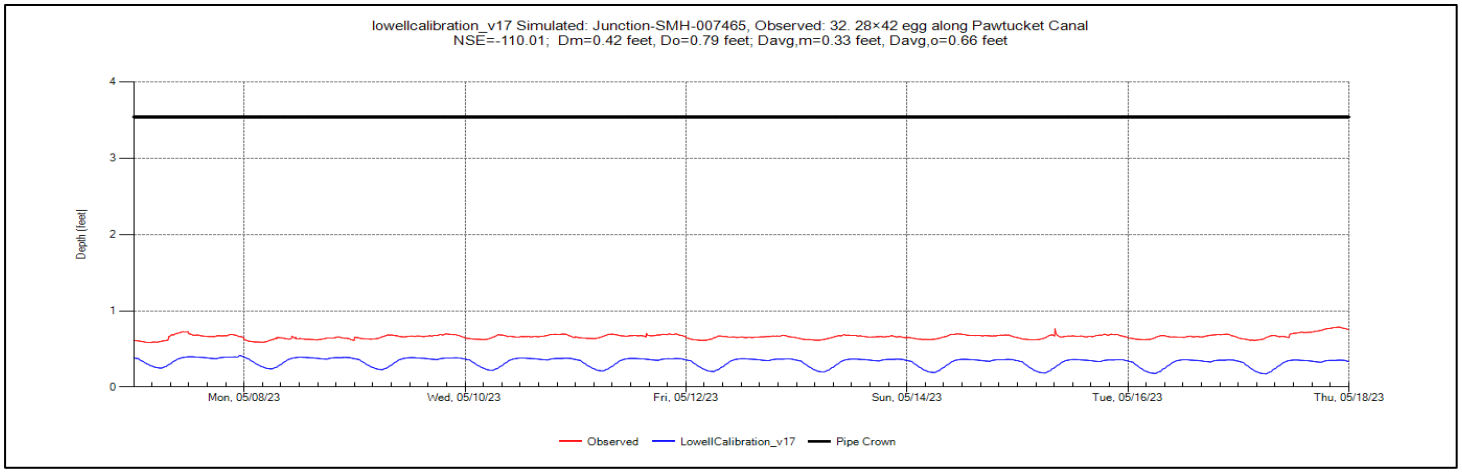


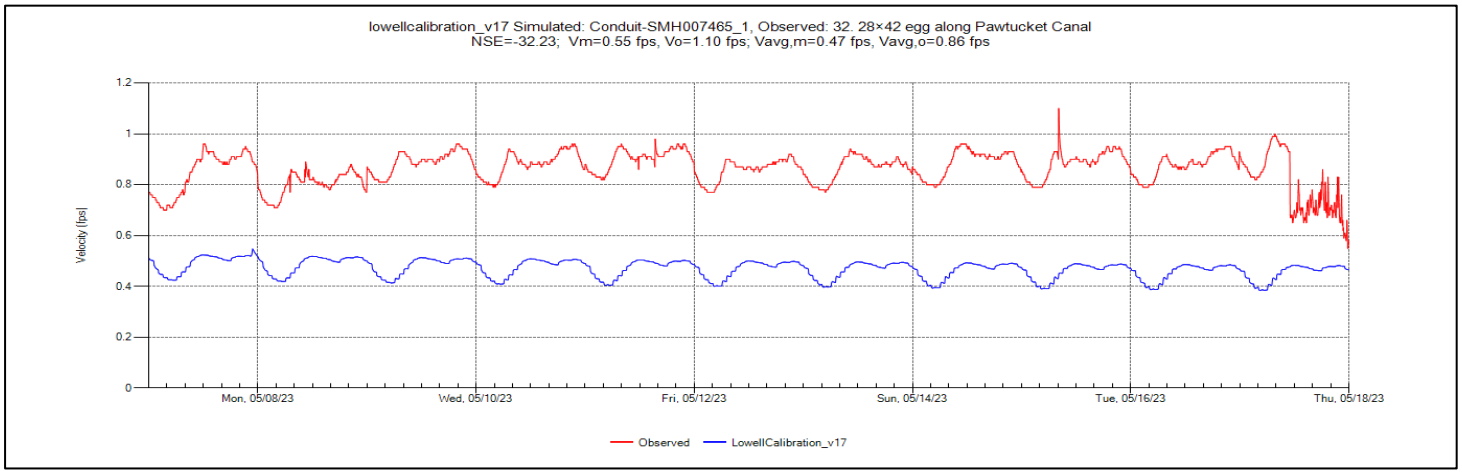


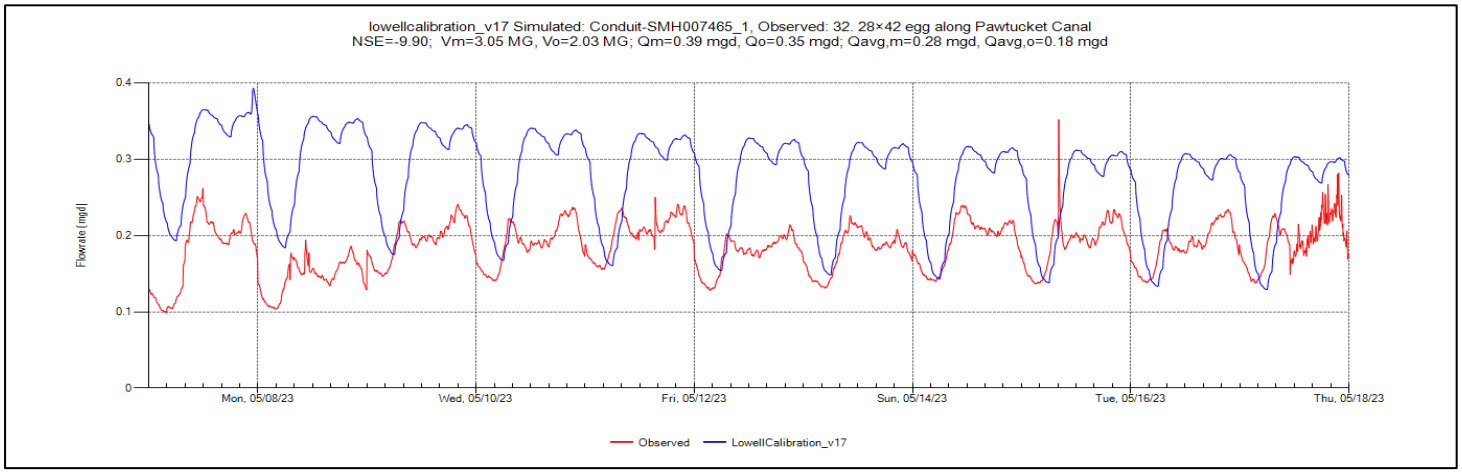


Simulated Versus Observed Flow at Flow Meter Sites

32-DryPeriod

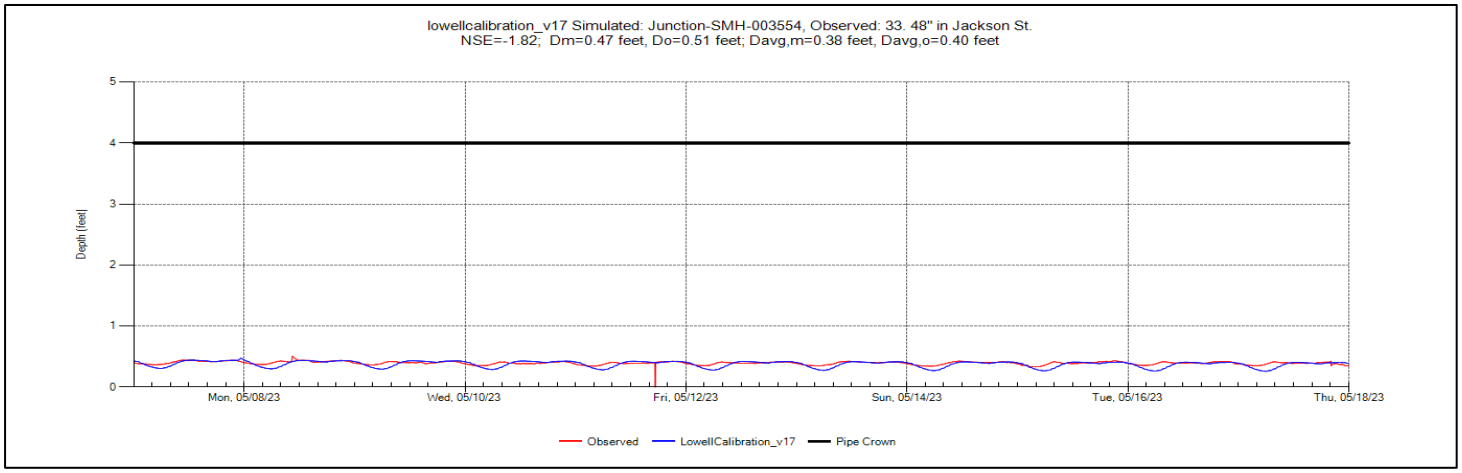


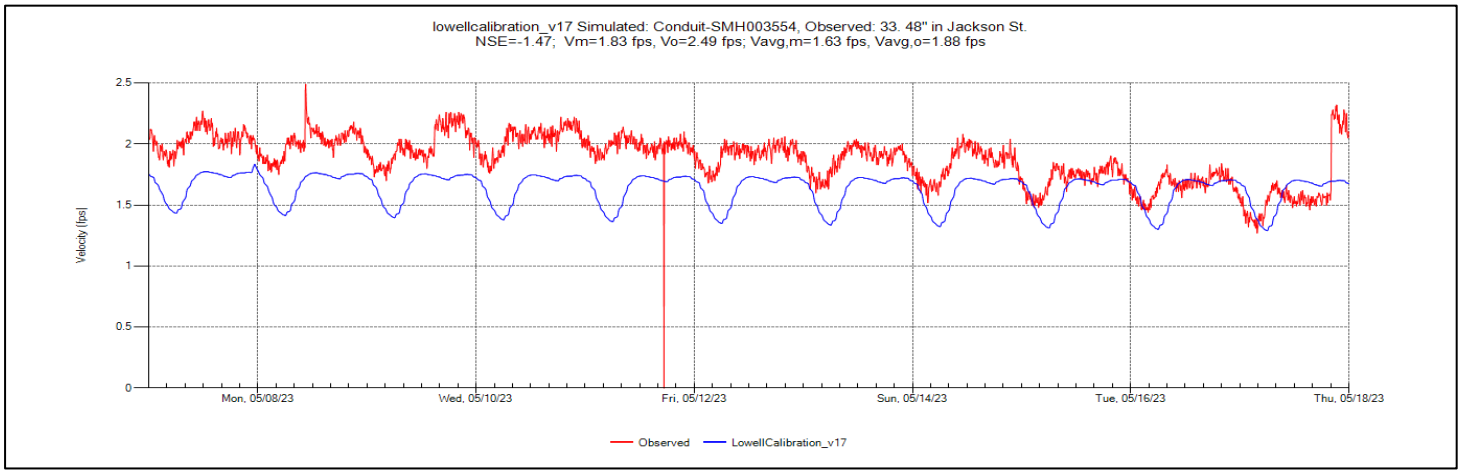


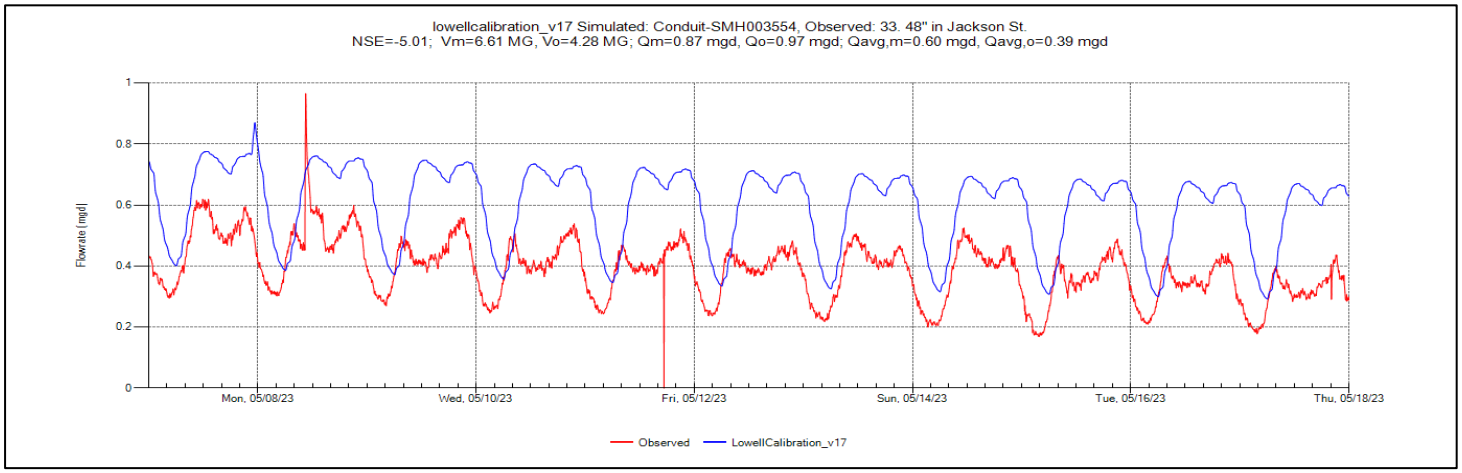


Simulated Versus Observed Flow at Flow Meter Sites

33-DryPeriod

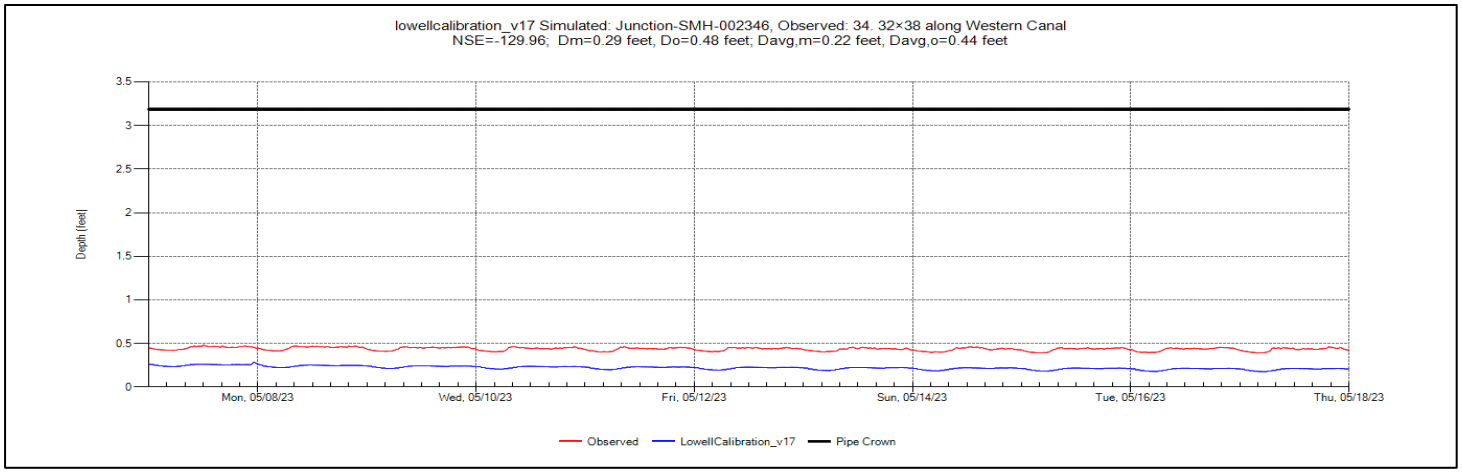


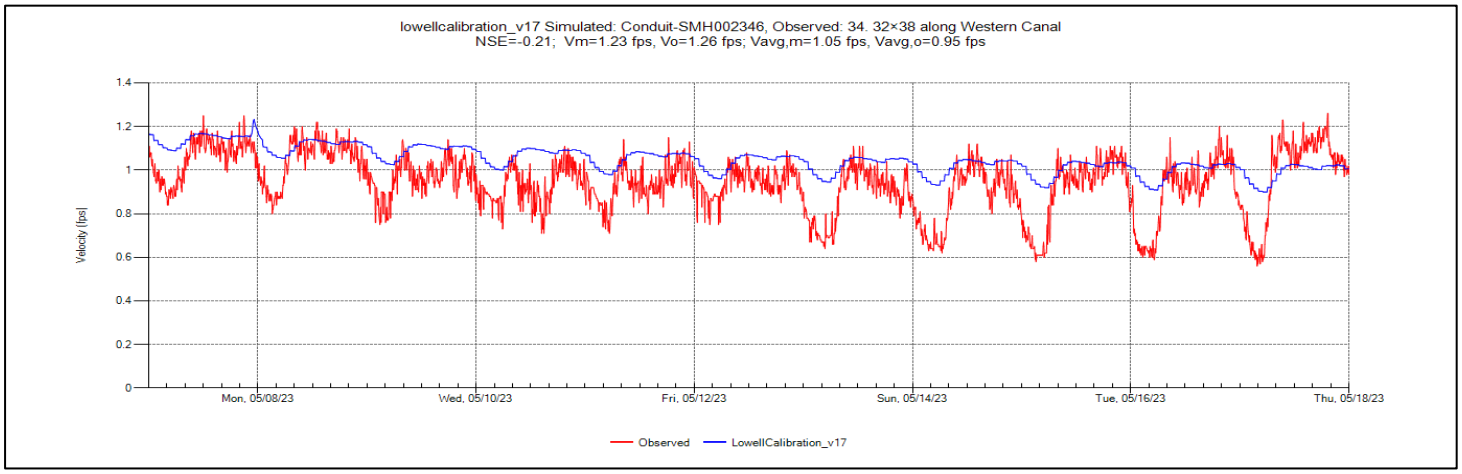


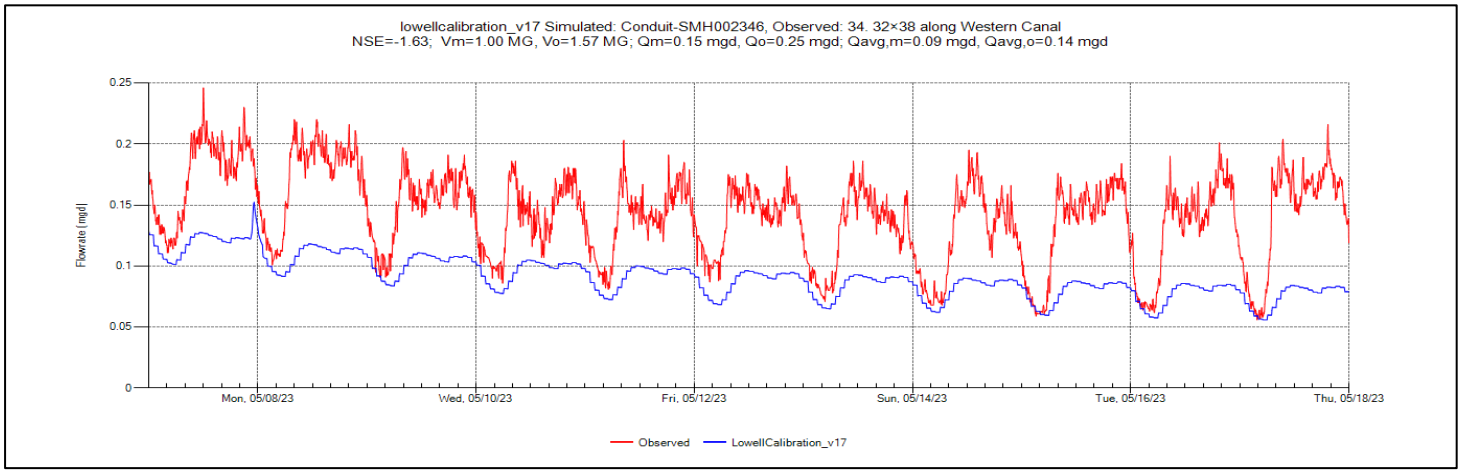


Simulated Versus Observed Flow at Flow Meter Sites

34-DryPeriod

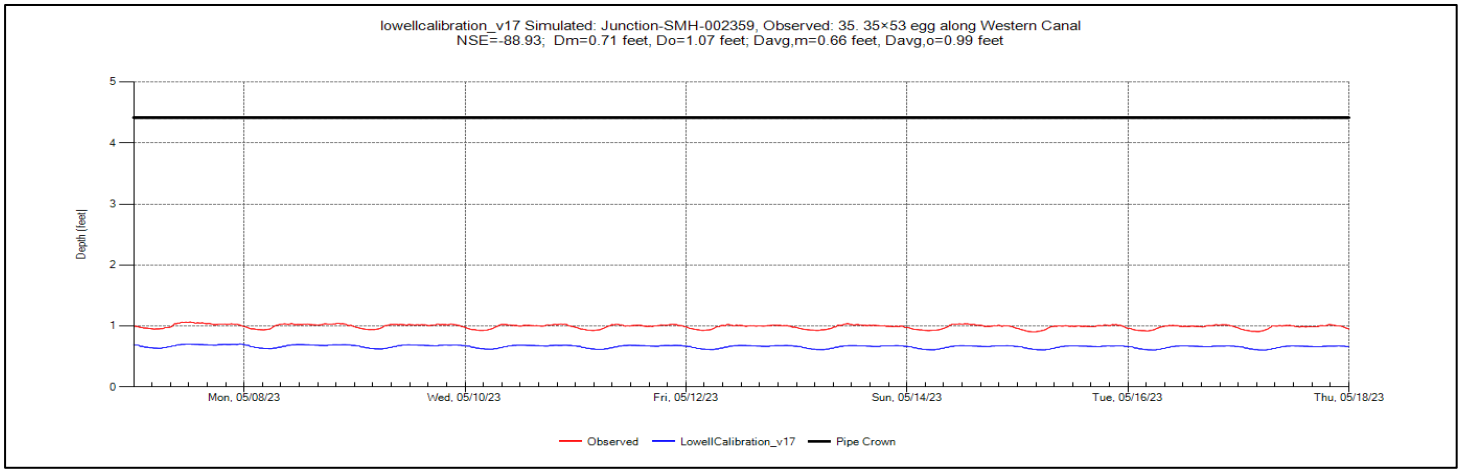


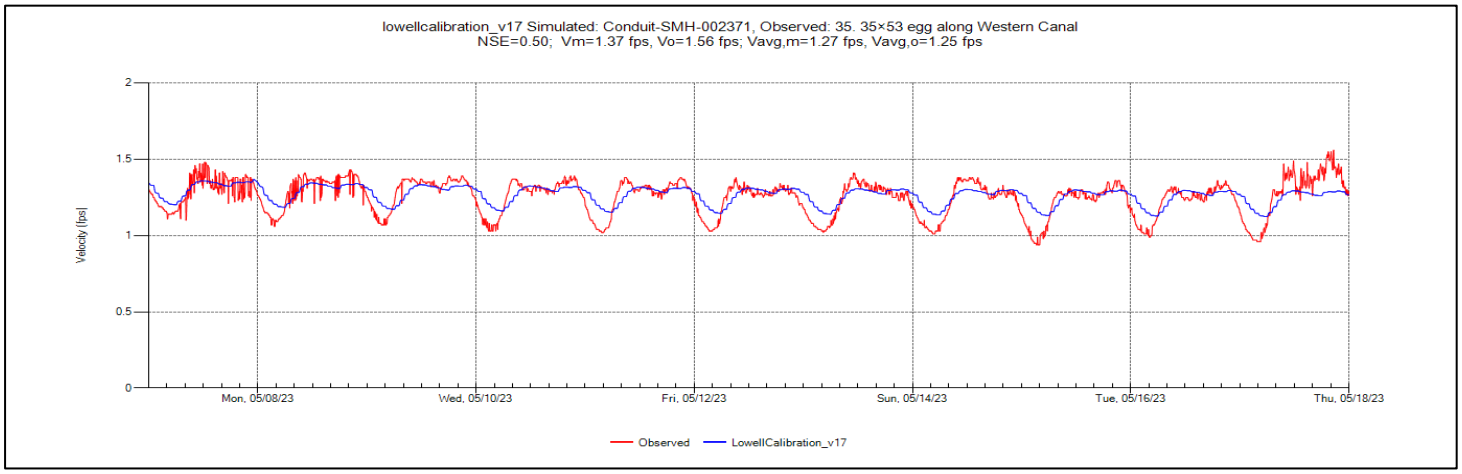


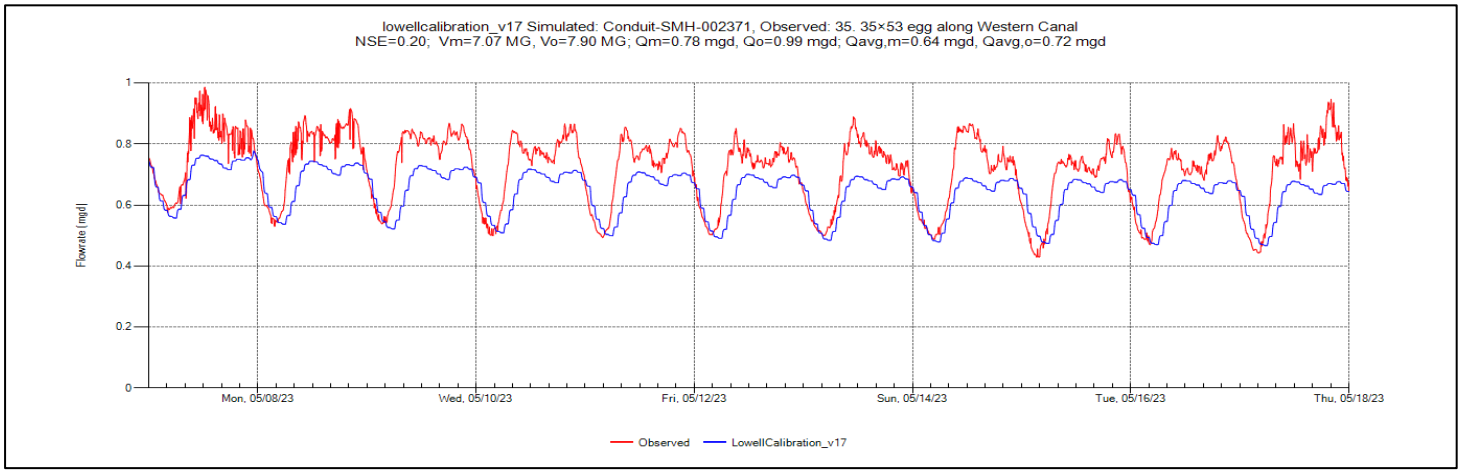


Simulated Versus Observed Flow at Flow Meter Sites

35-DryPeriod

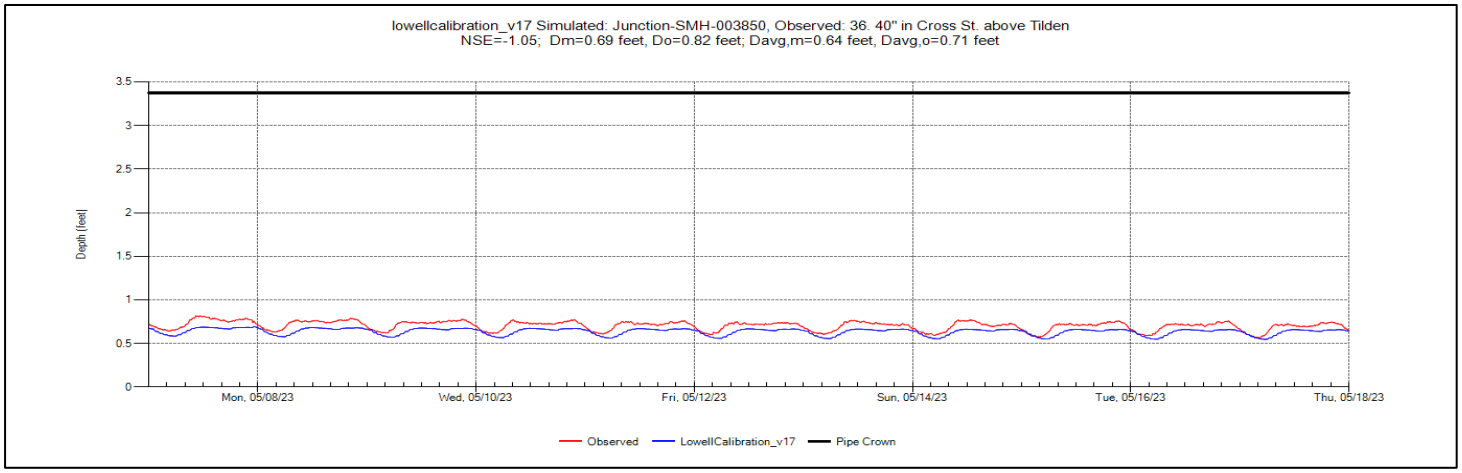


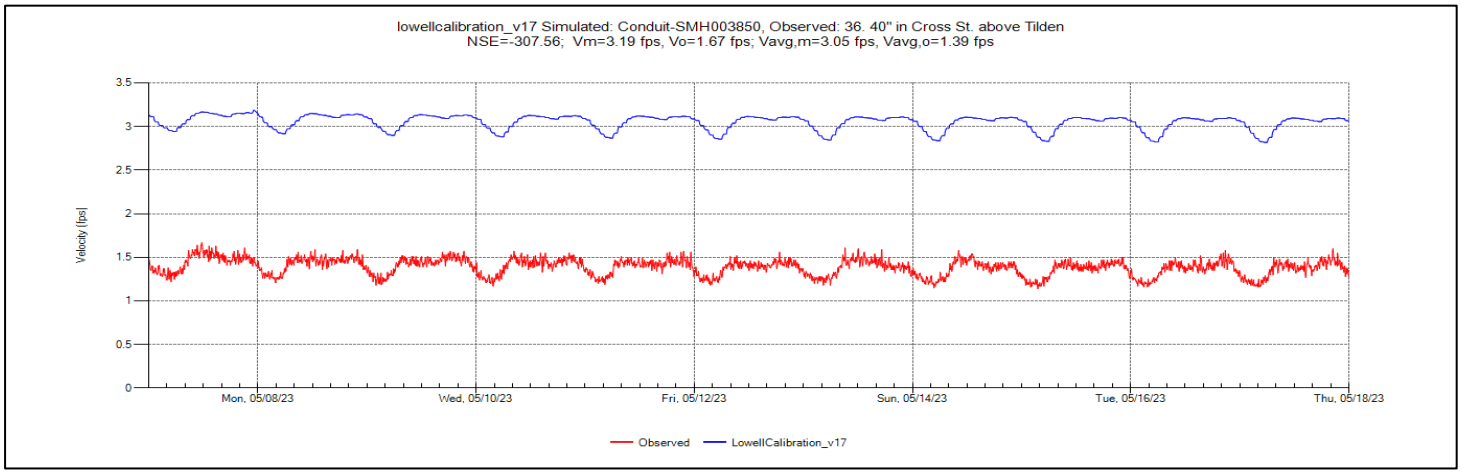


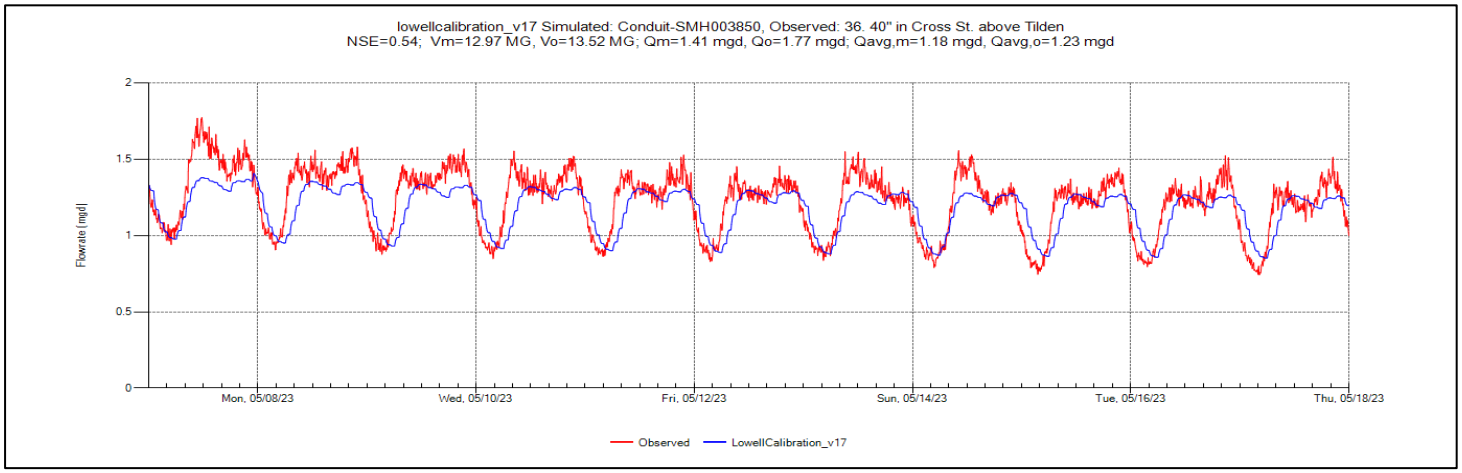


Simulated Versus Observed Flow at Flow Meter Sites

36-DryPeriod

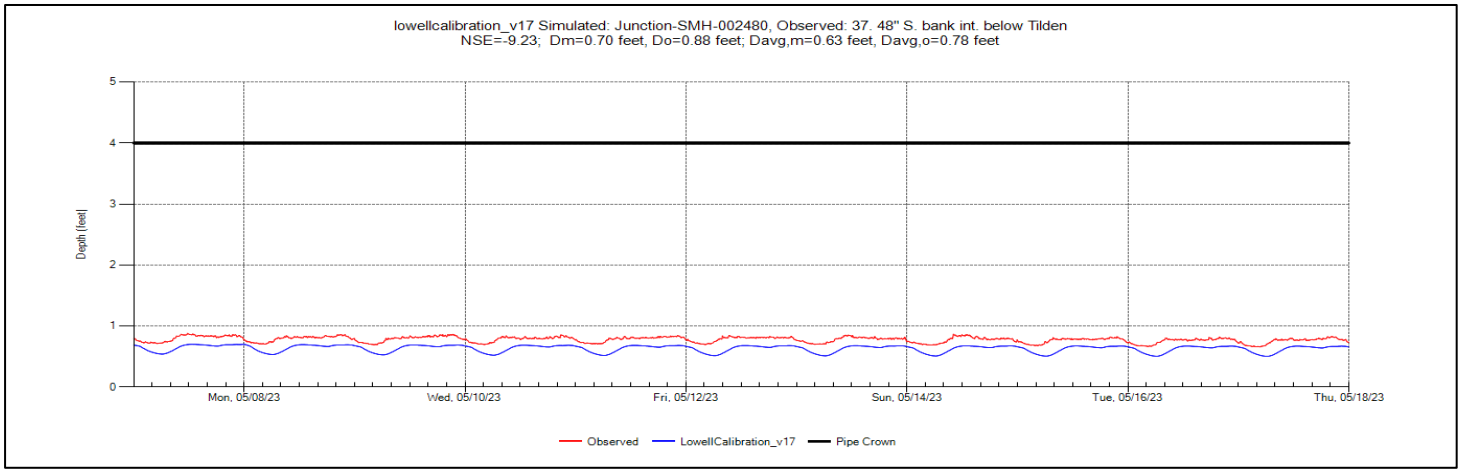


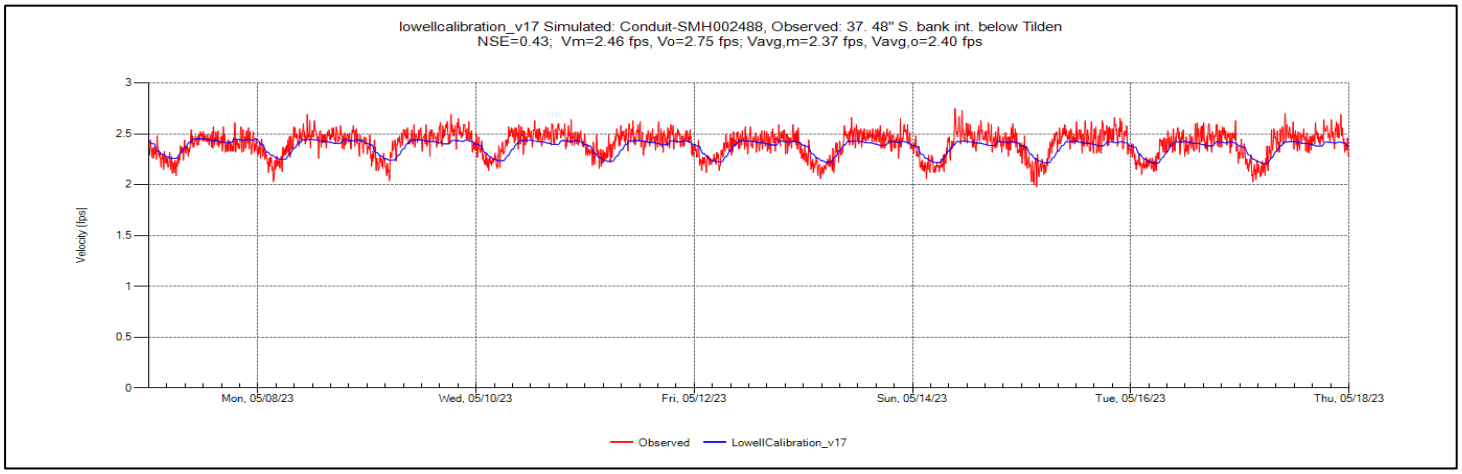


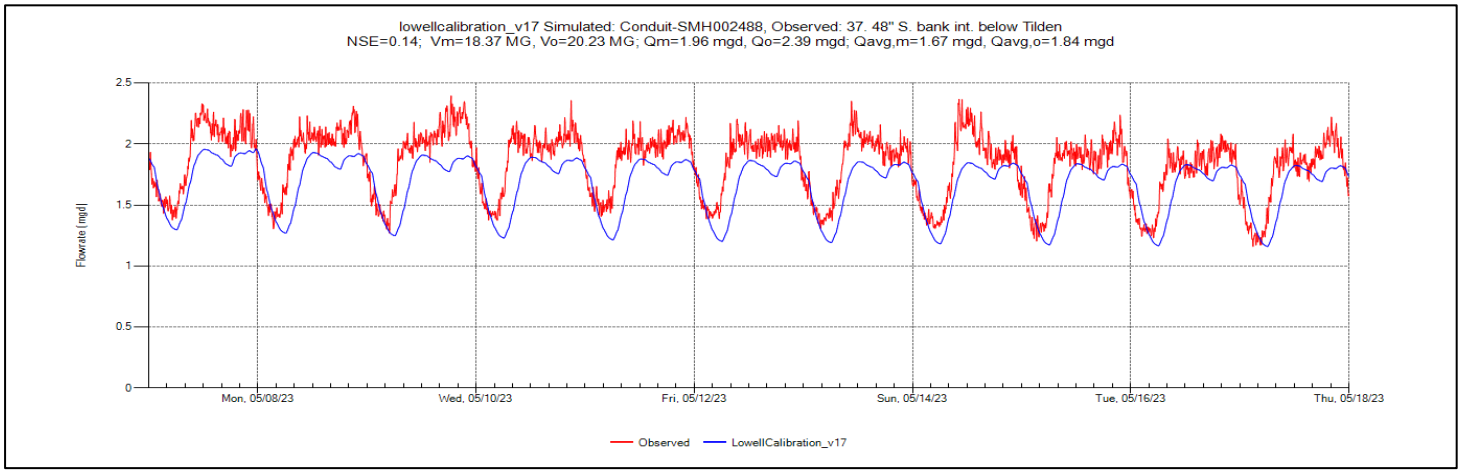


Simulated Versus Observed Flow at Flow Meter Sites

37-DryPeriod

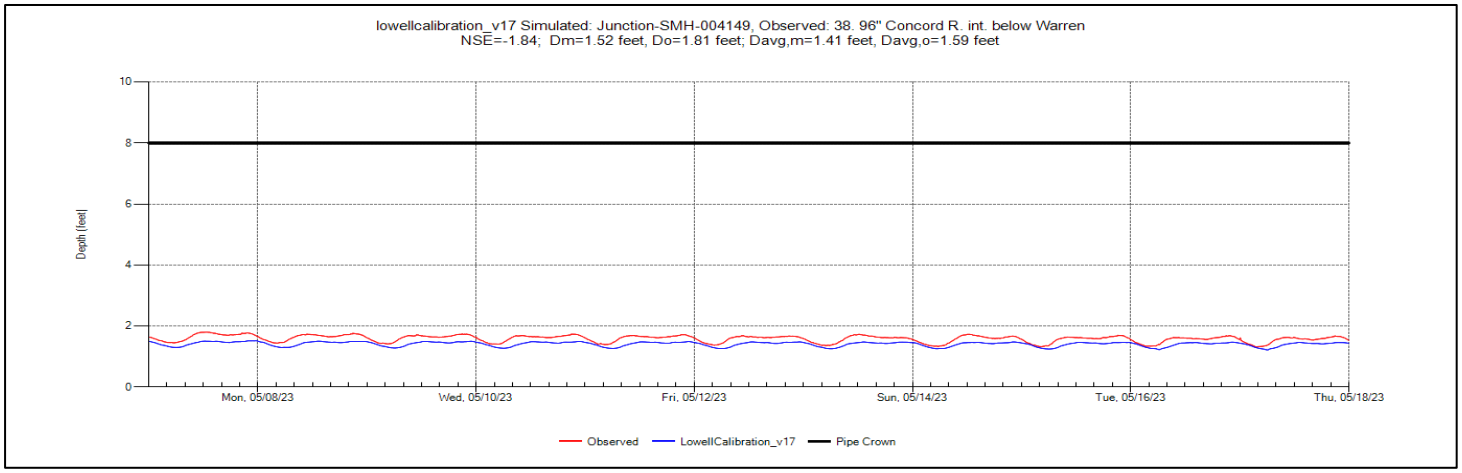


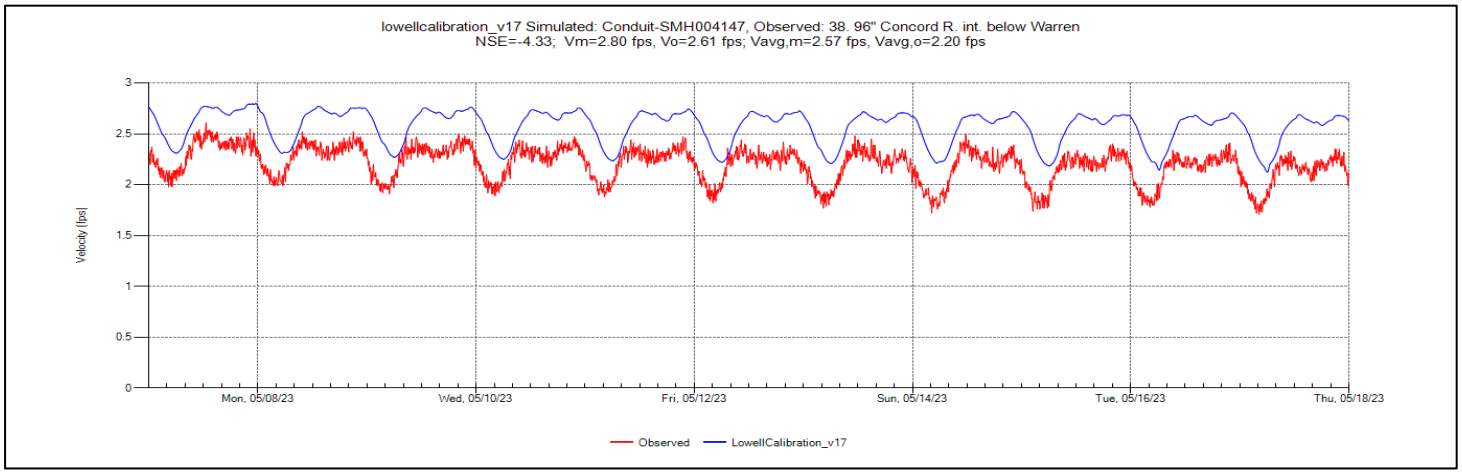


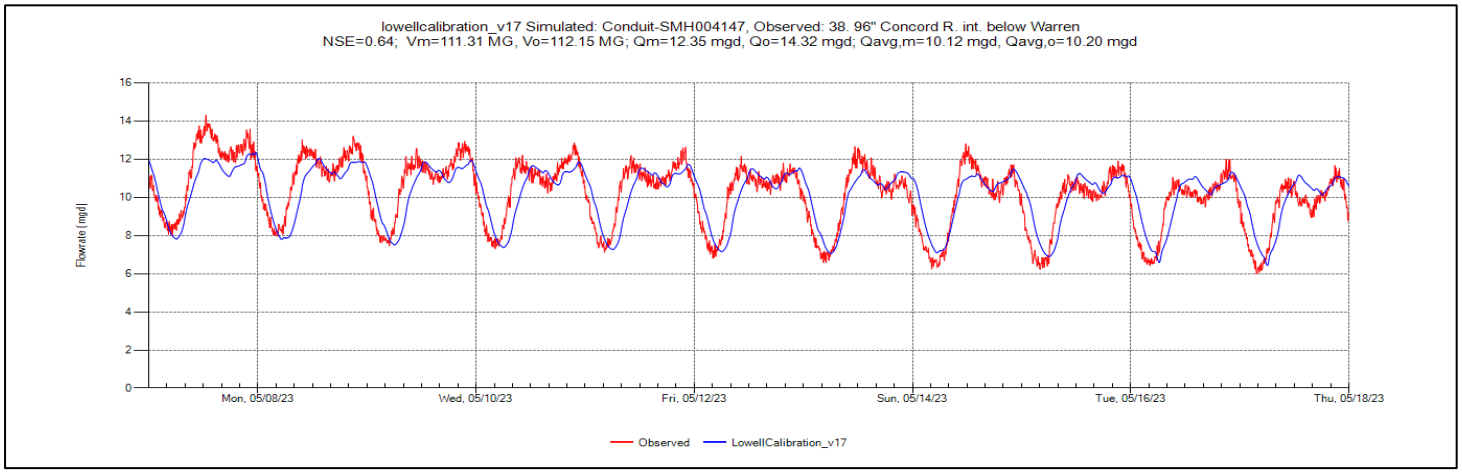


Simulated Versus Observed Flow at Flow Meter Sites

38-DryPeriod

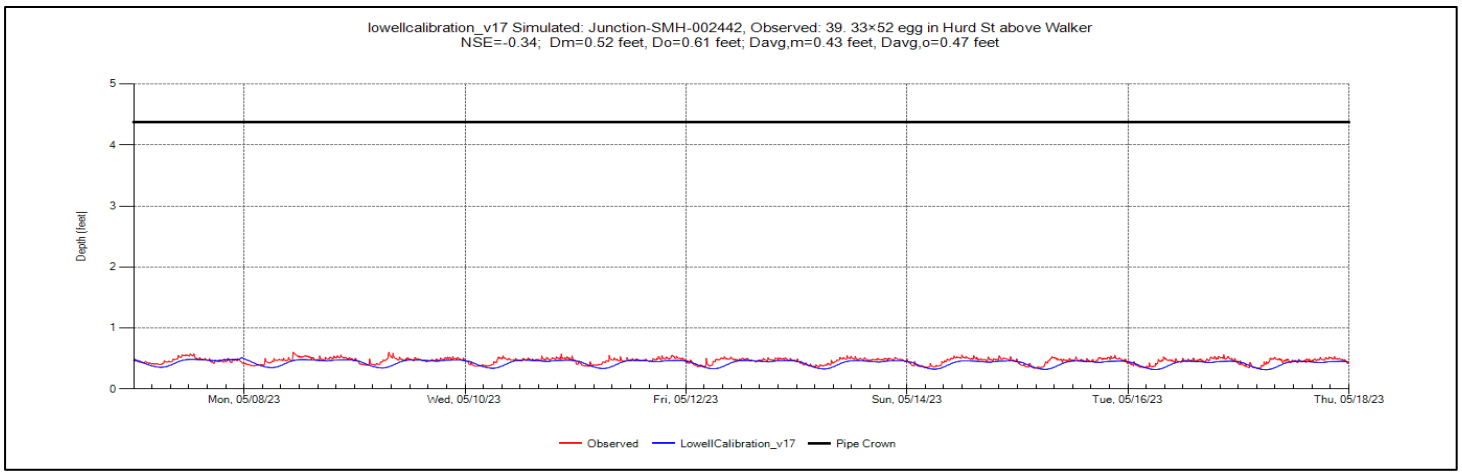


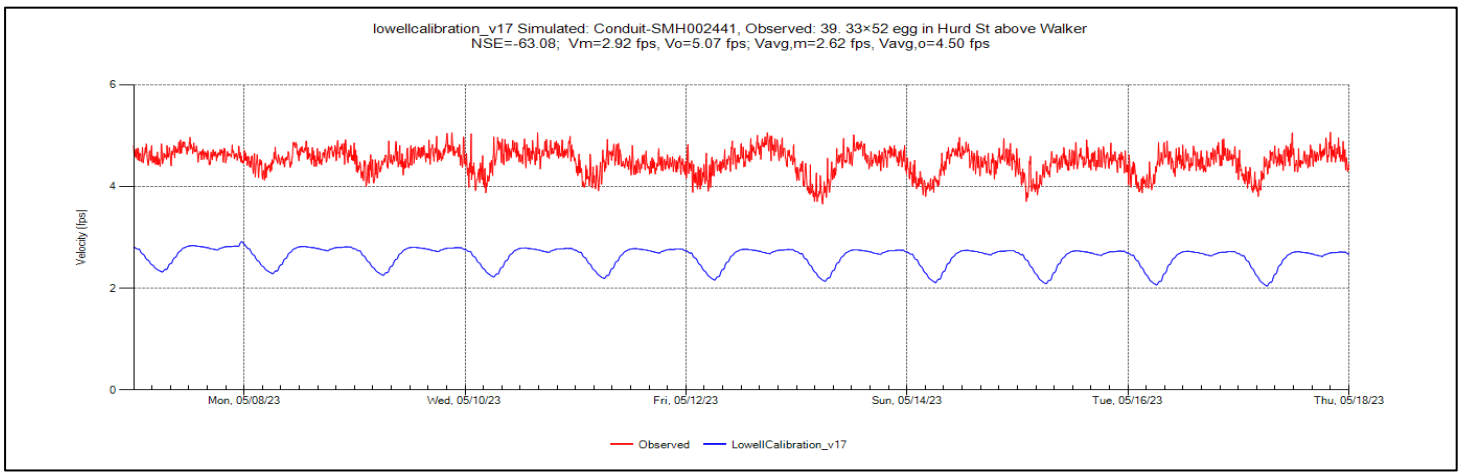


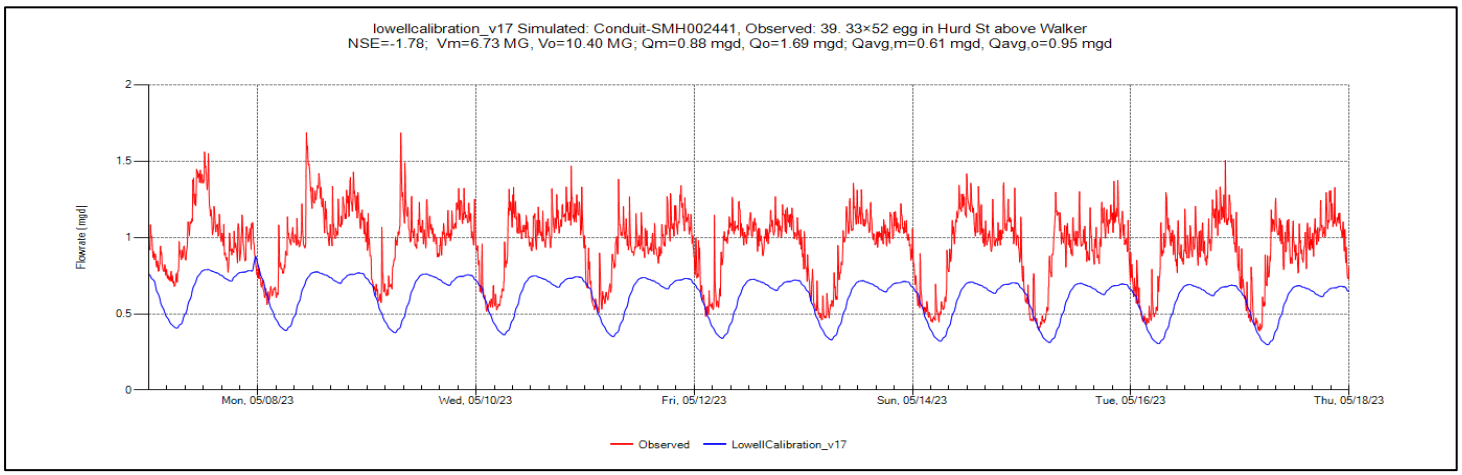


Simulated Versus Observed Flow at Flow Meter Sites

39-DryPeriod

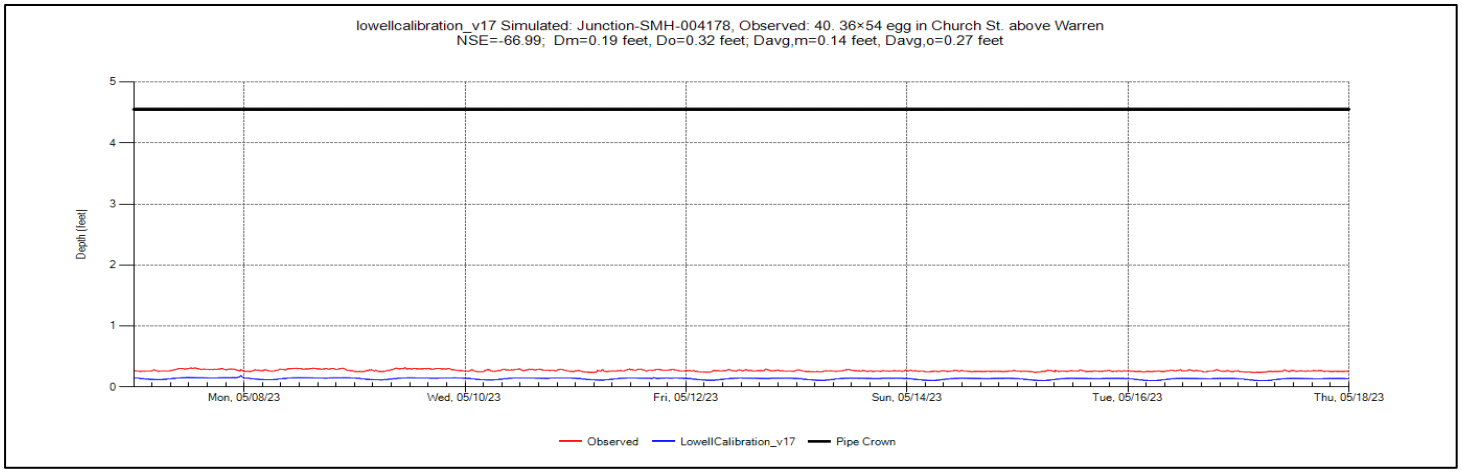


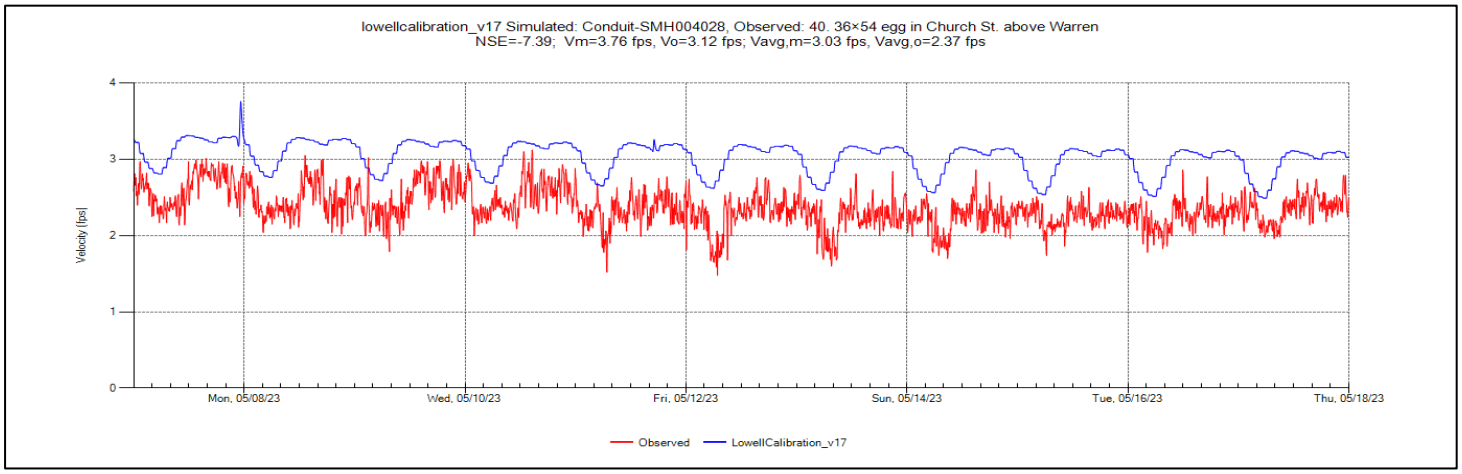


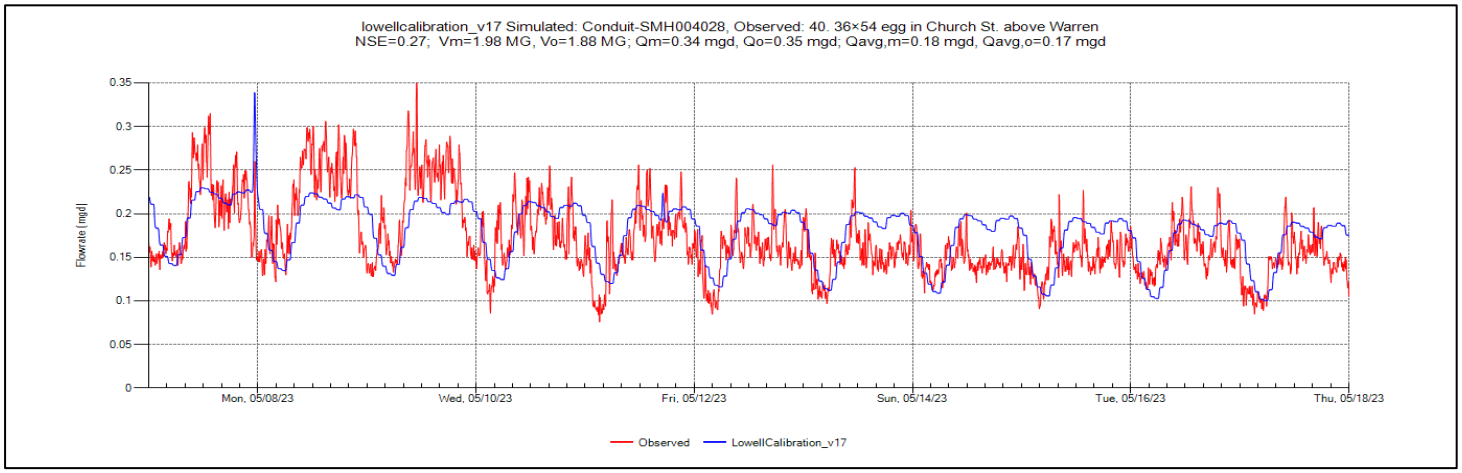


Simulated Versus Observed Flow at Flow Meter Sites

40-DryPeriod

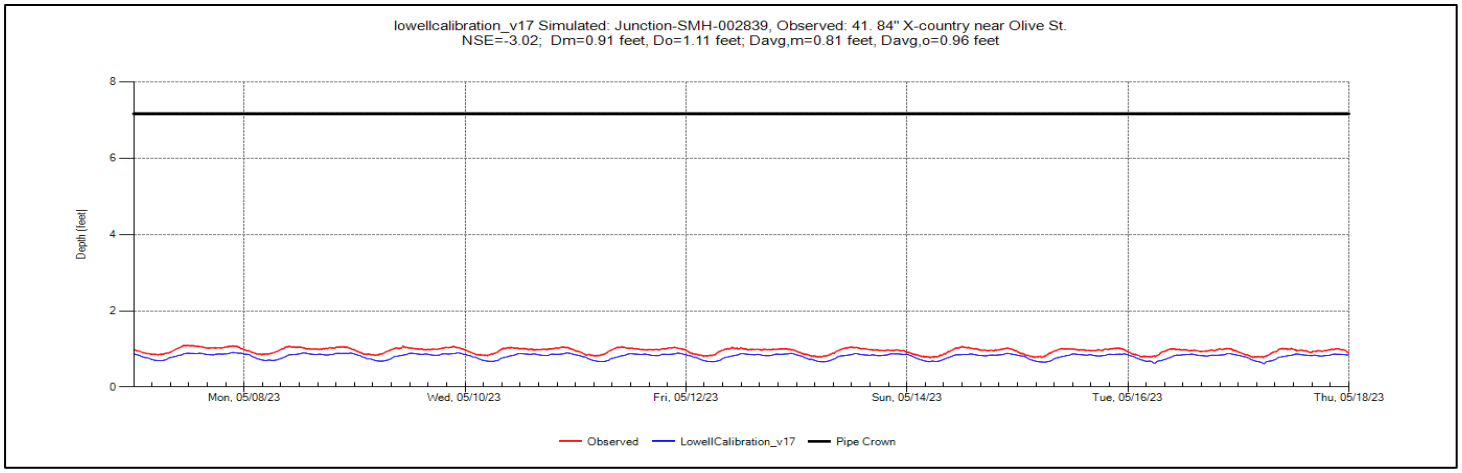


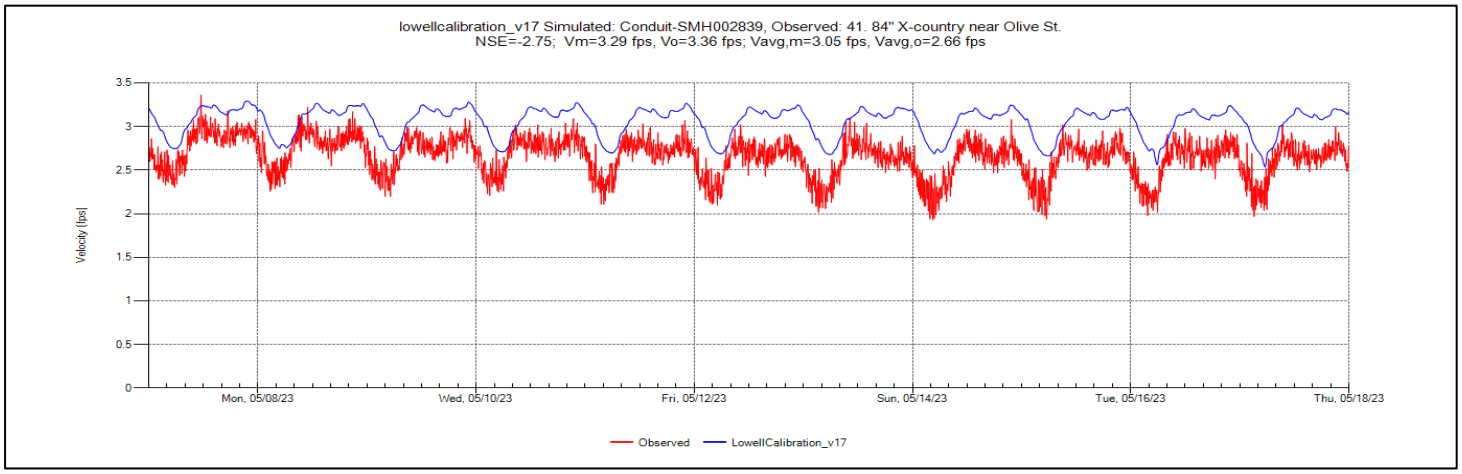


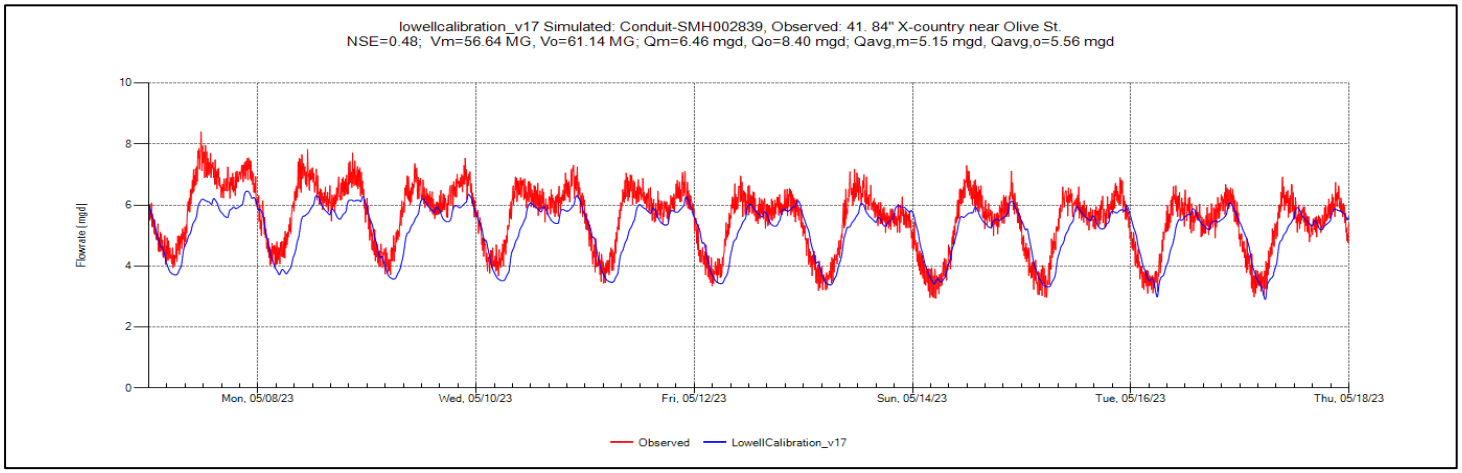


Simulated Versus Observed Flow at Flow Meter Sites

41-DryPeriod

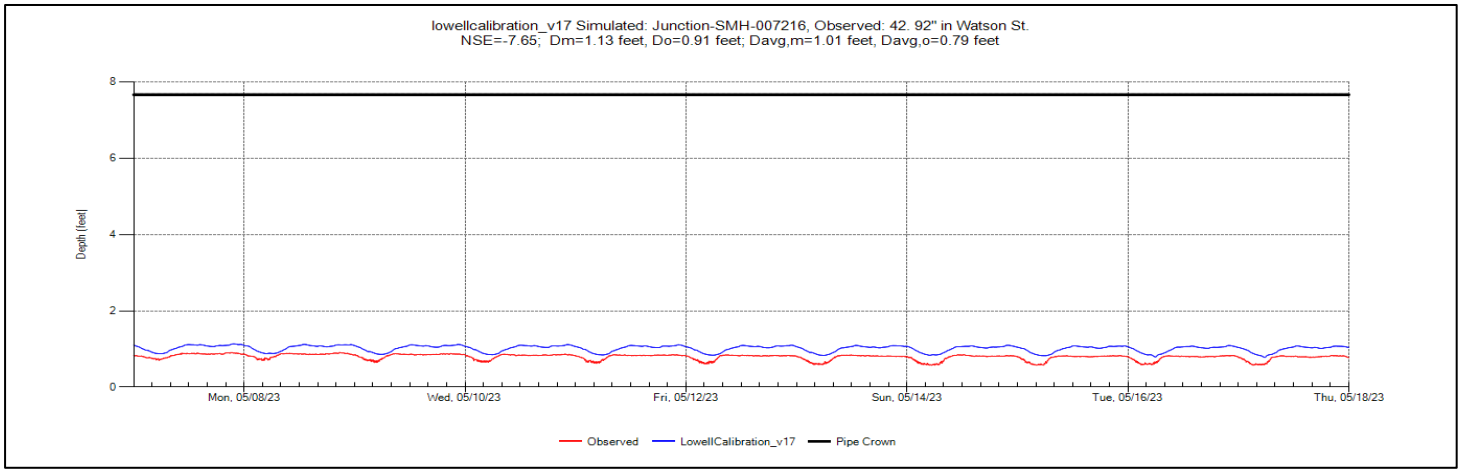


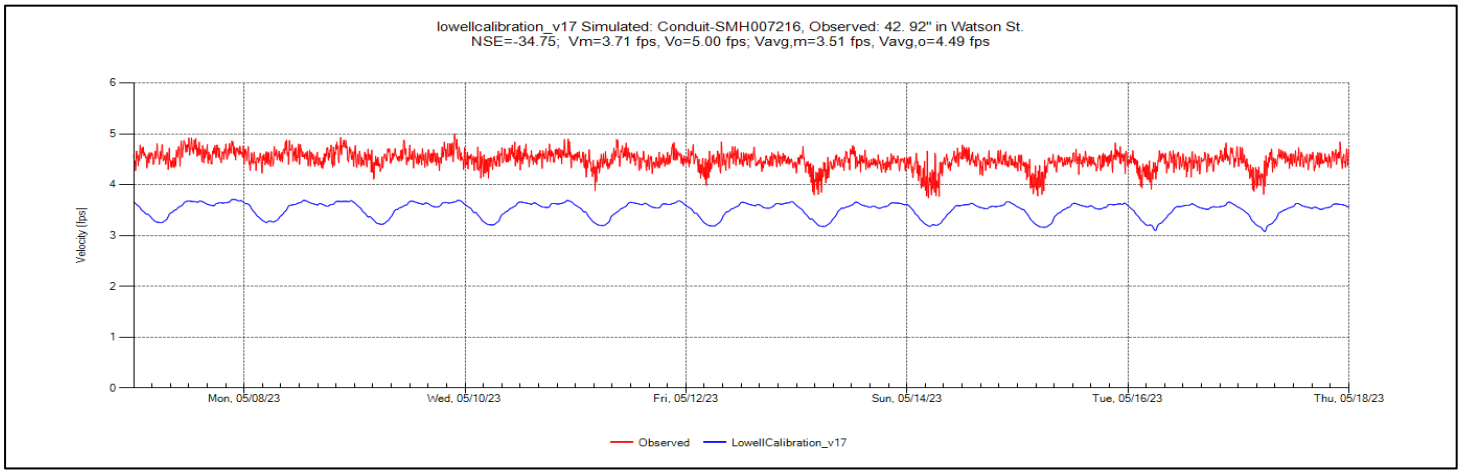


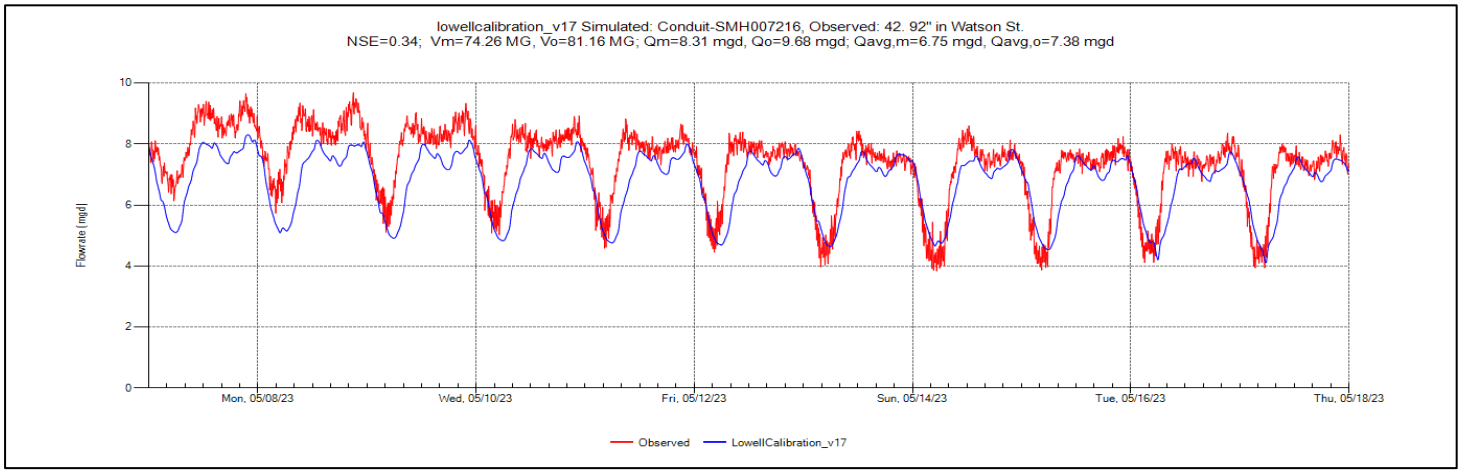


Simulated Versus Observed Flow at Flow Meter Sites

42-DryPeriod

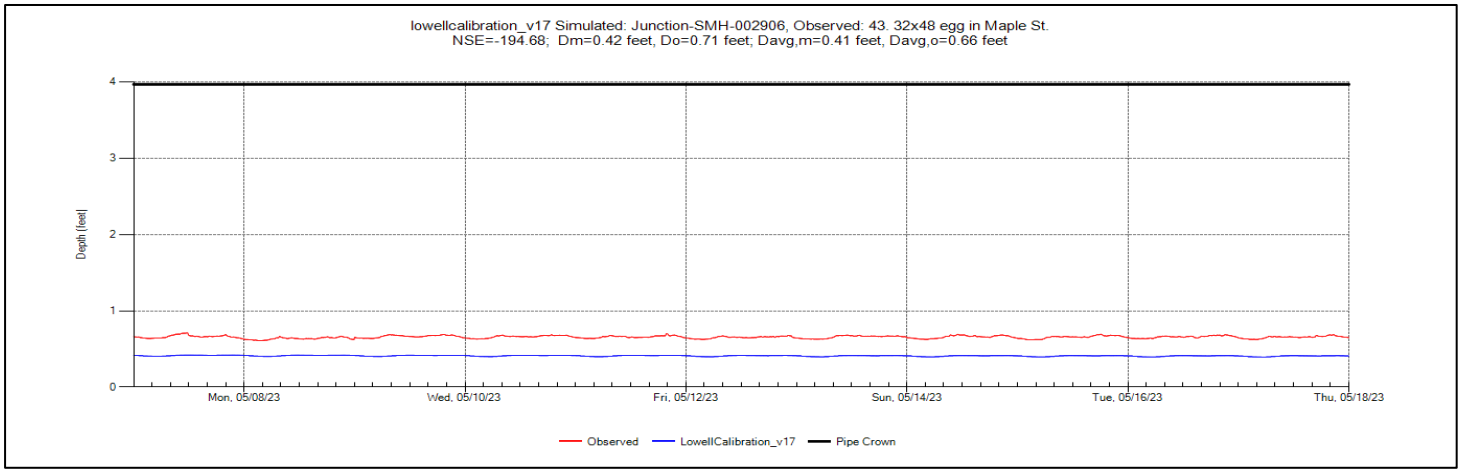


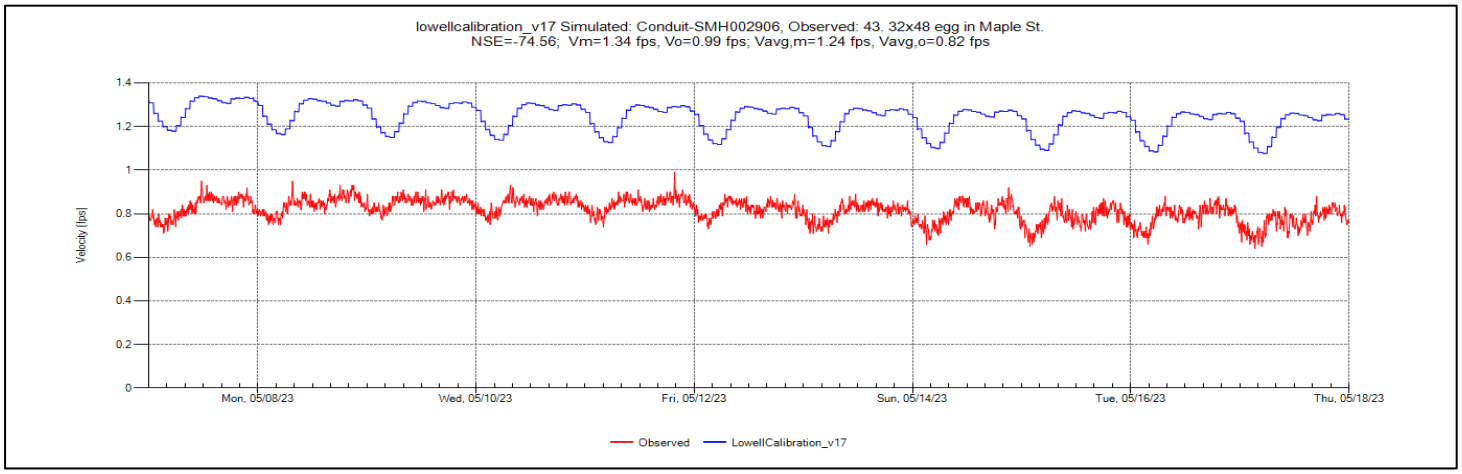


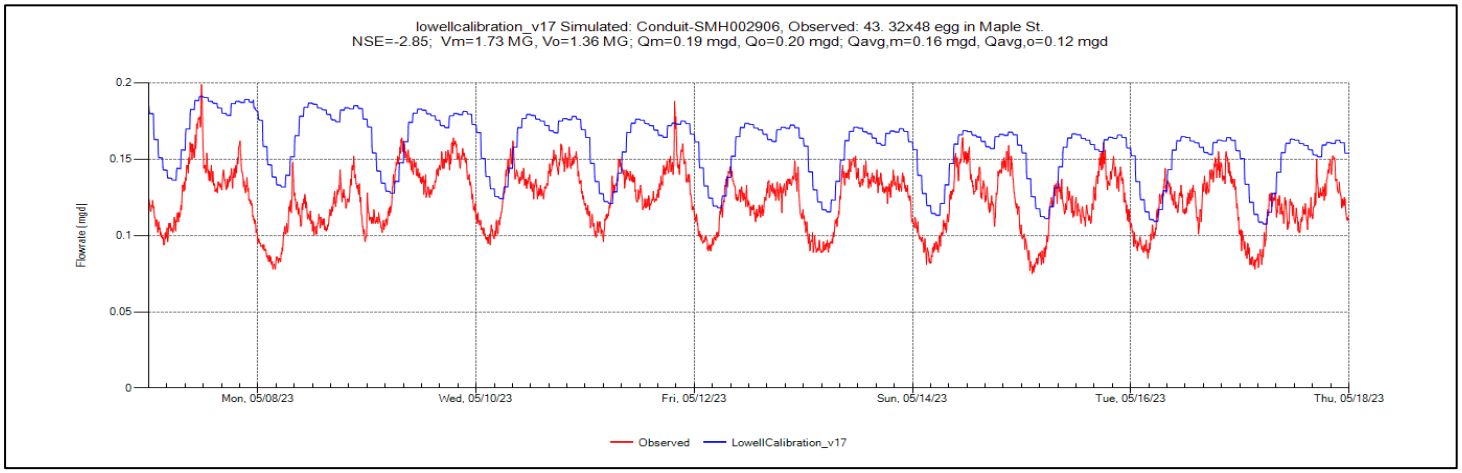


Simulated Versus Observed Flow at Flow Meter Sites

43-DryPeriod

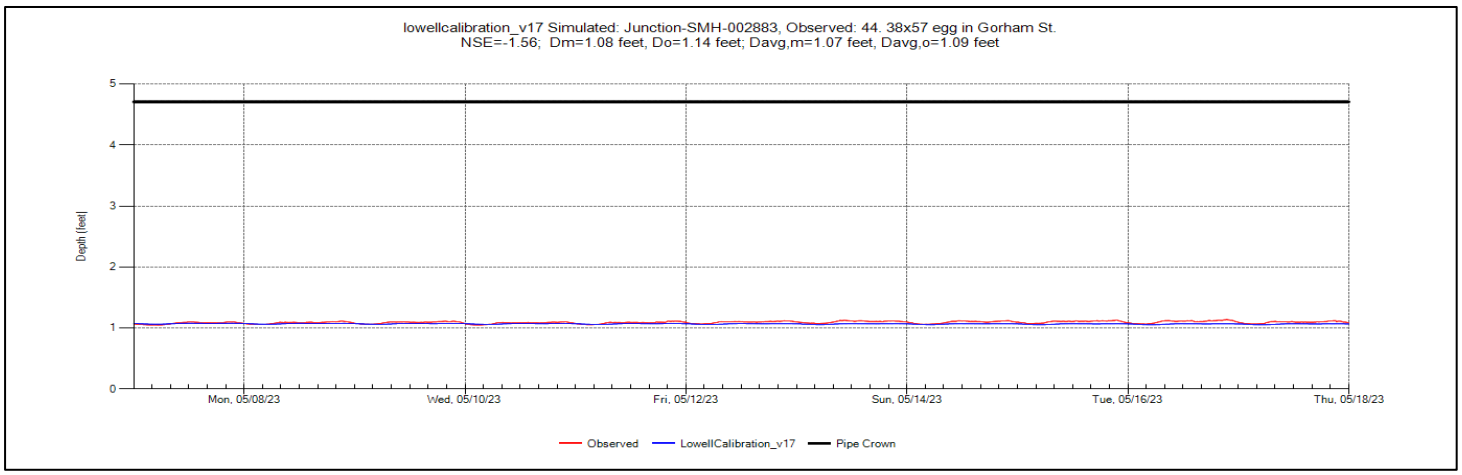


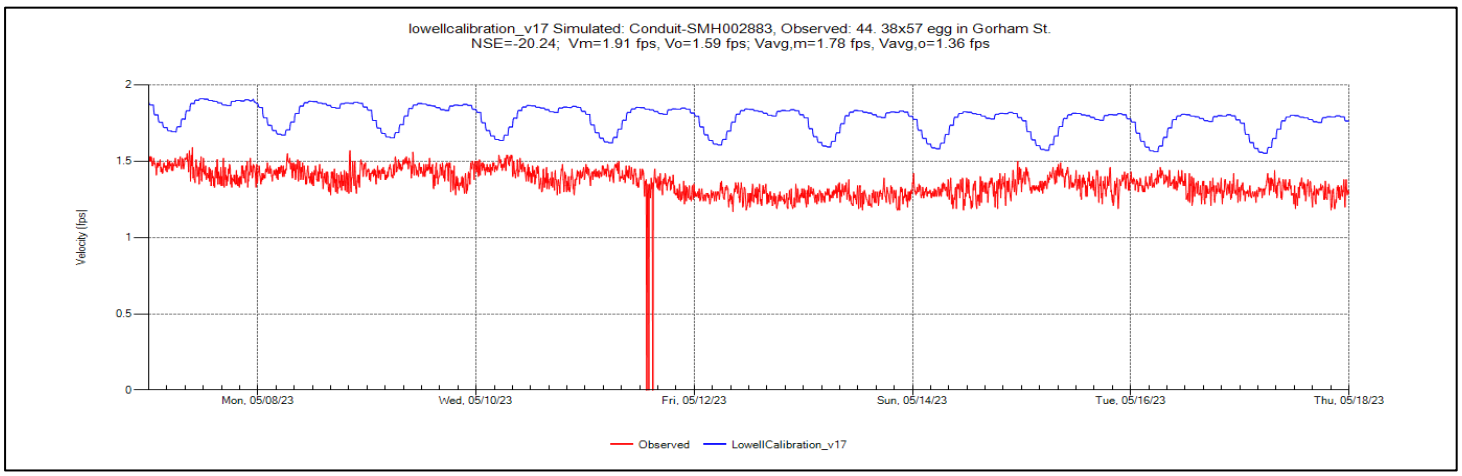


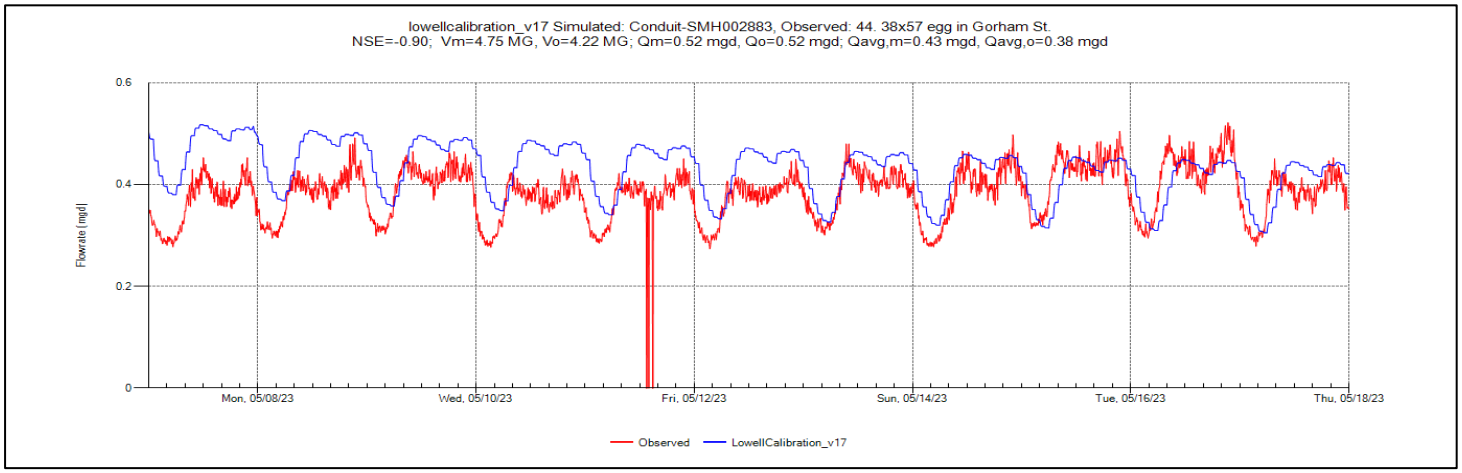


Simulated Versus Observed Flow at Flow Meter Sites

44-DryPeriod

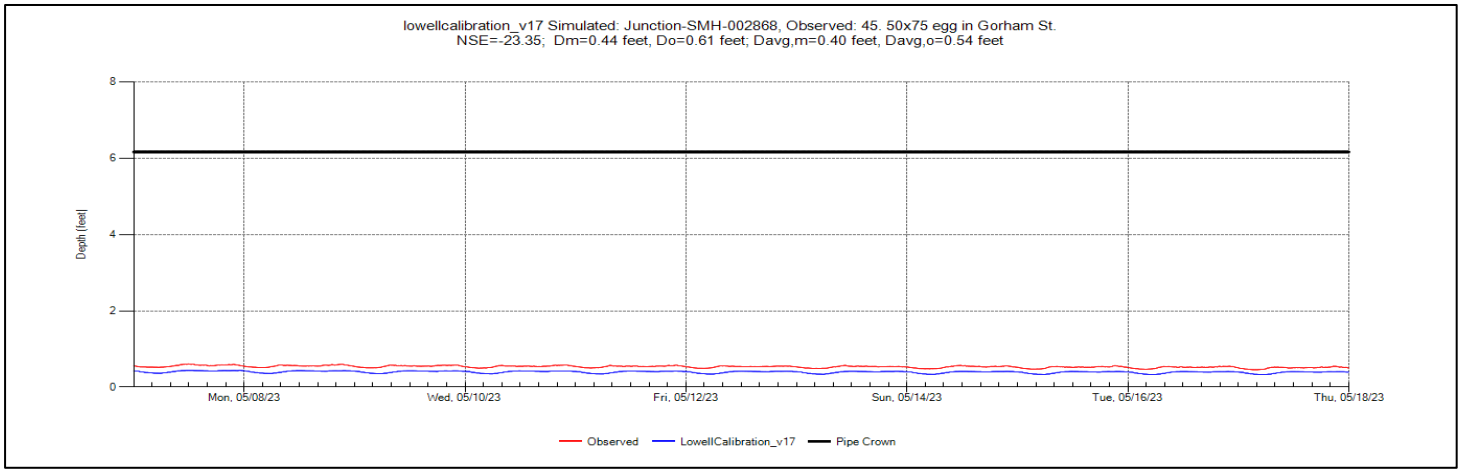


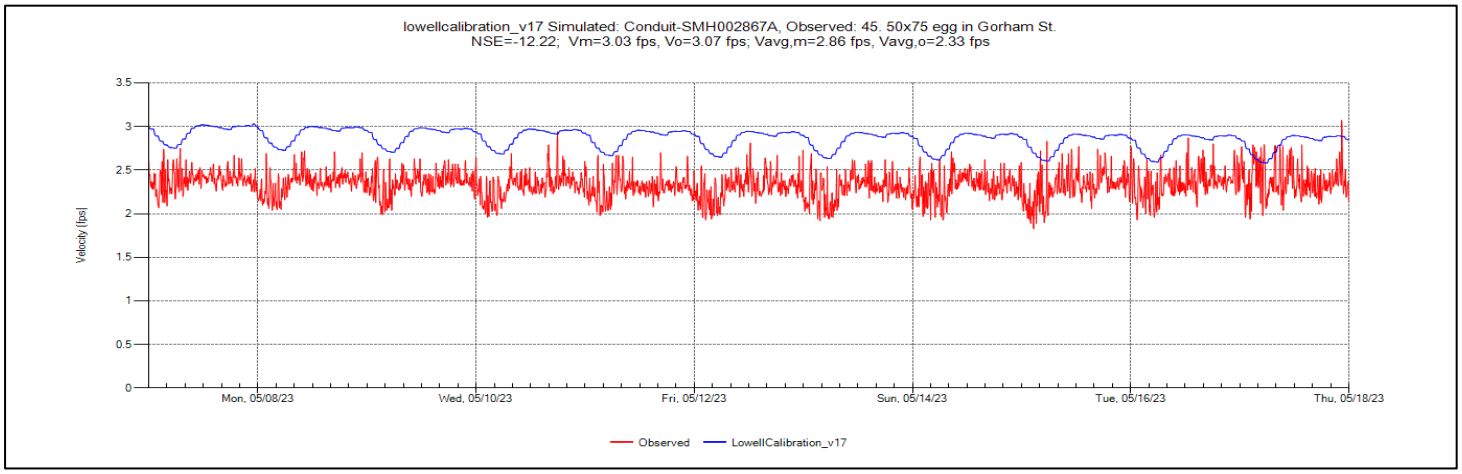


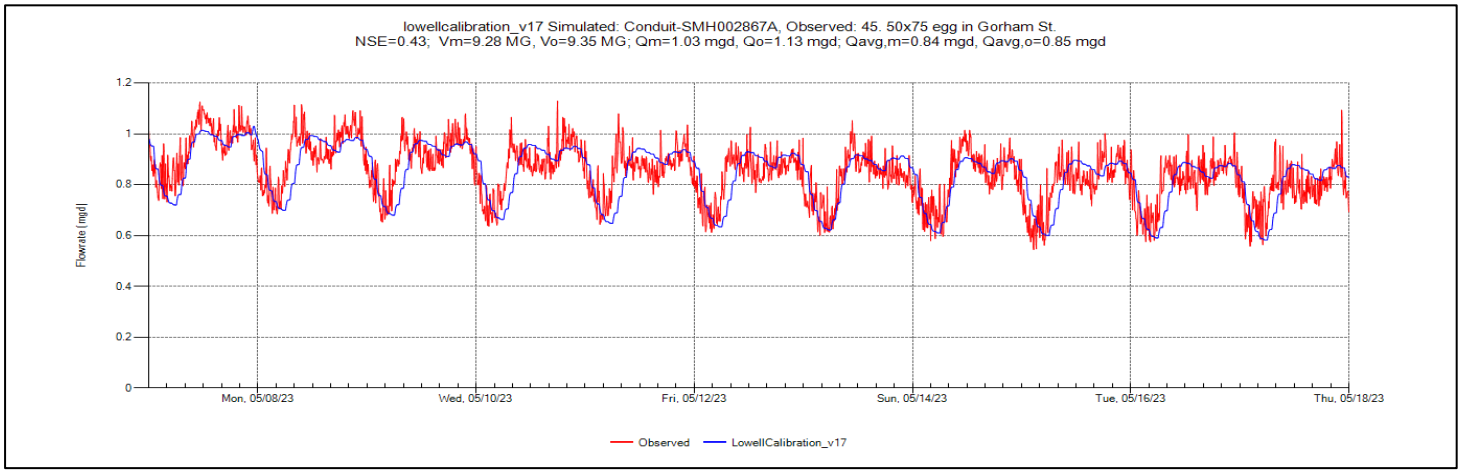


Simulated Versus Observed Flow at Flow Meter Sites

45-DryPeriod

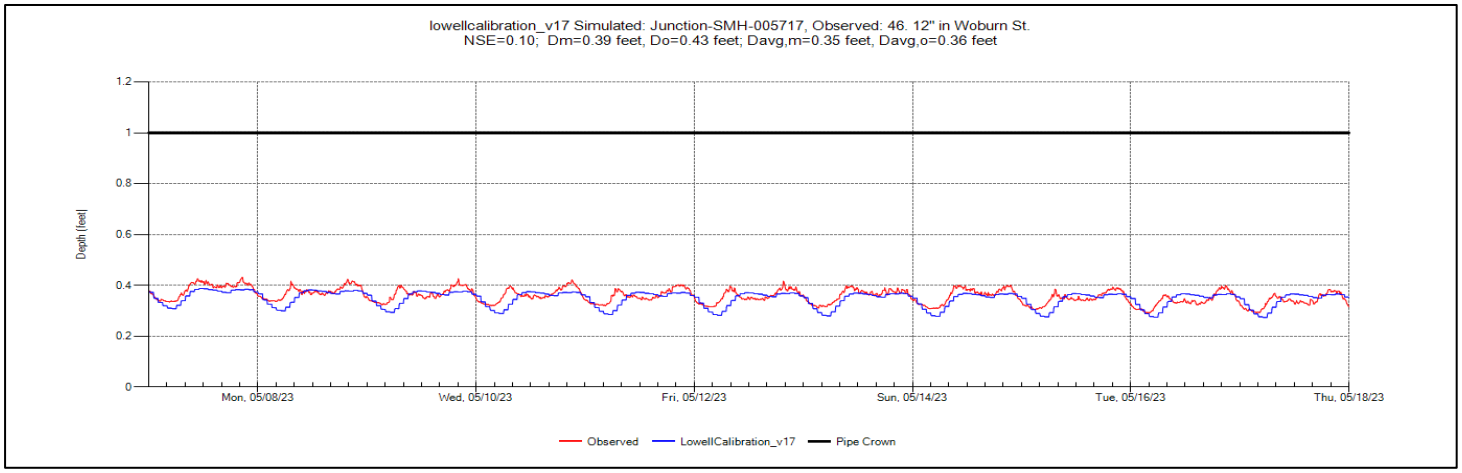


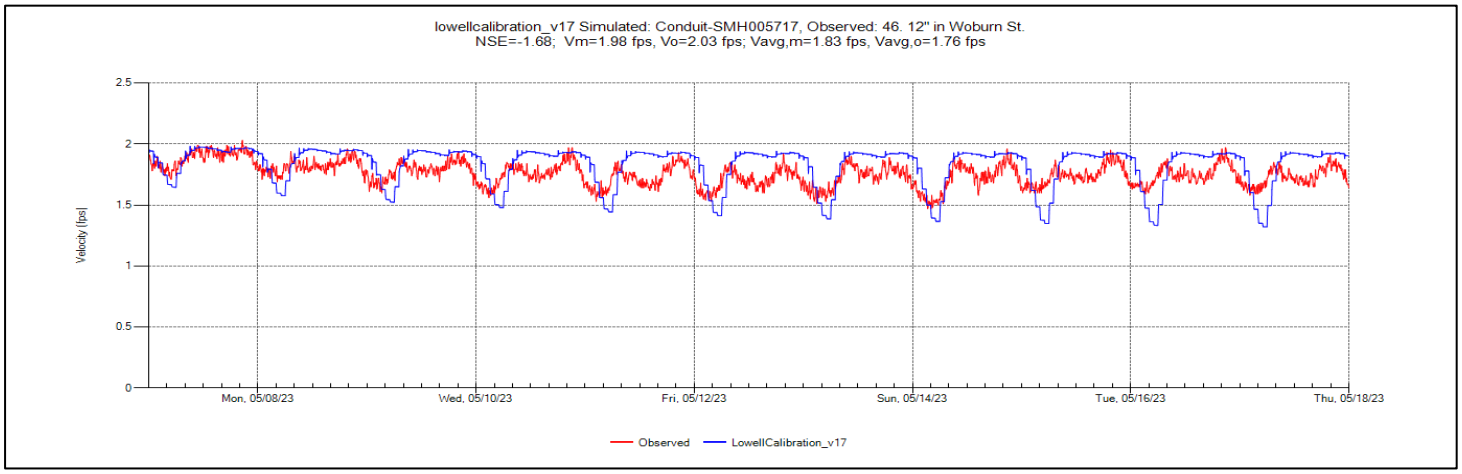


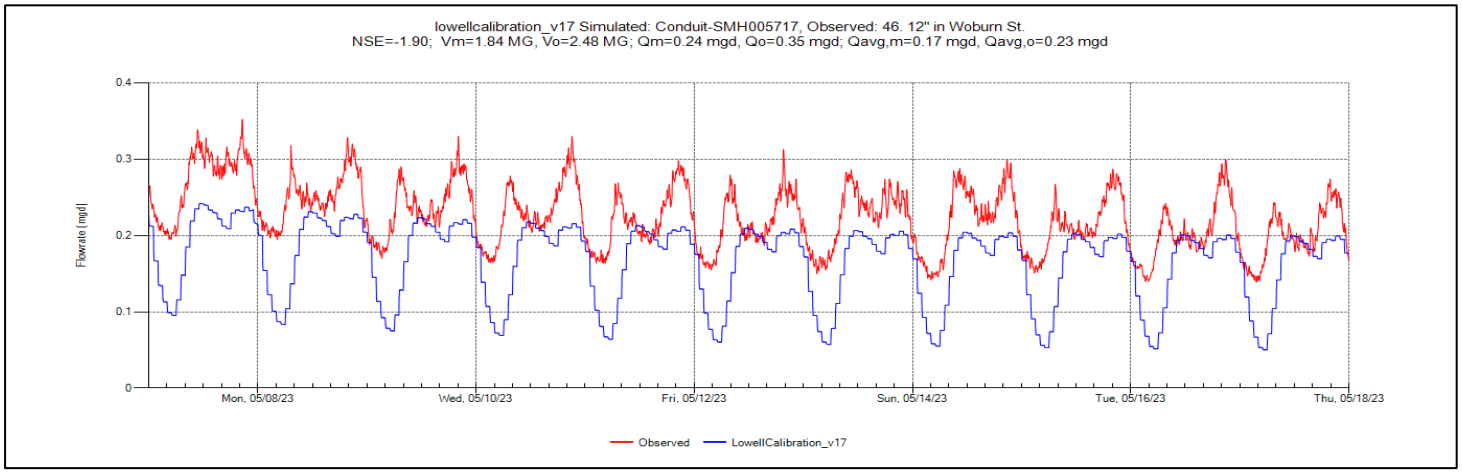


Simulated Versus Observed Flow at Flow Meter Sites

46-DryPeriod

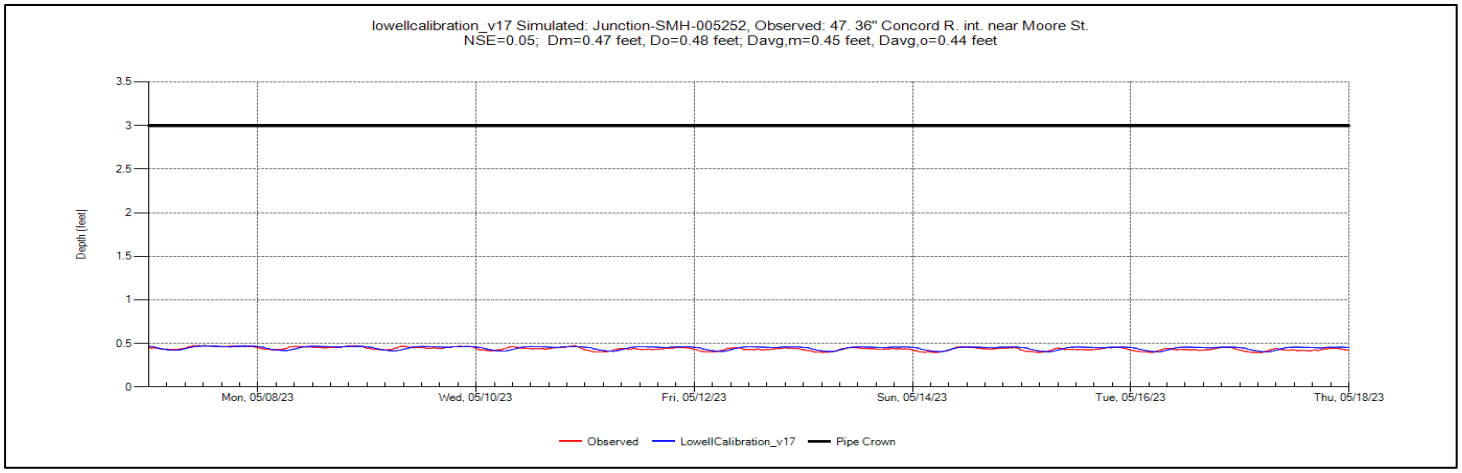


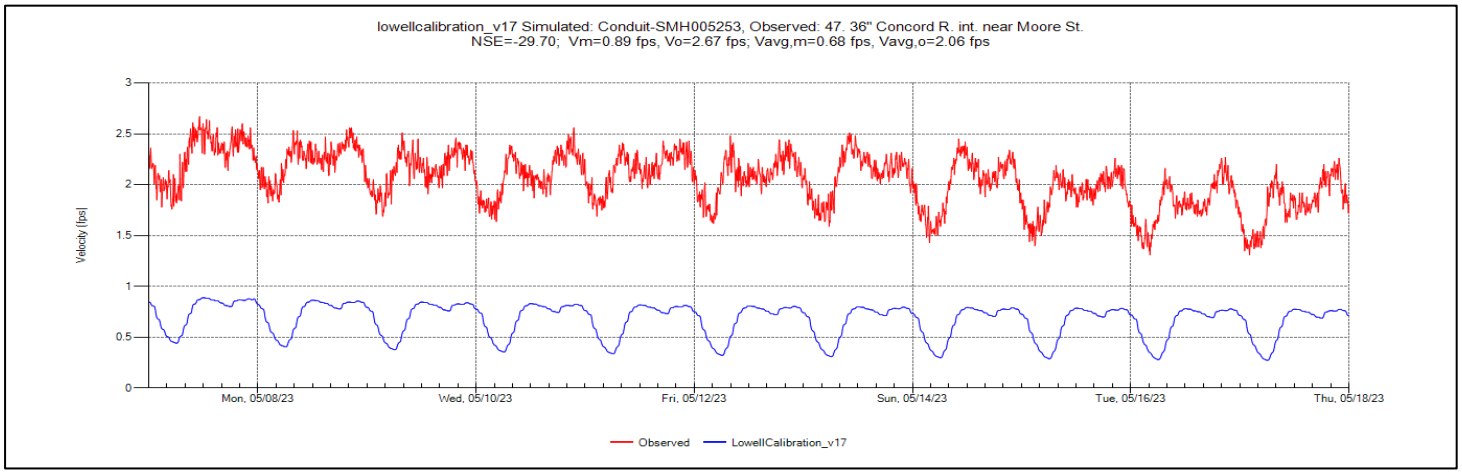


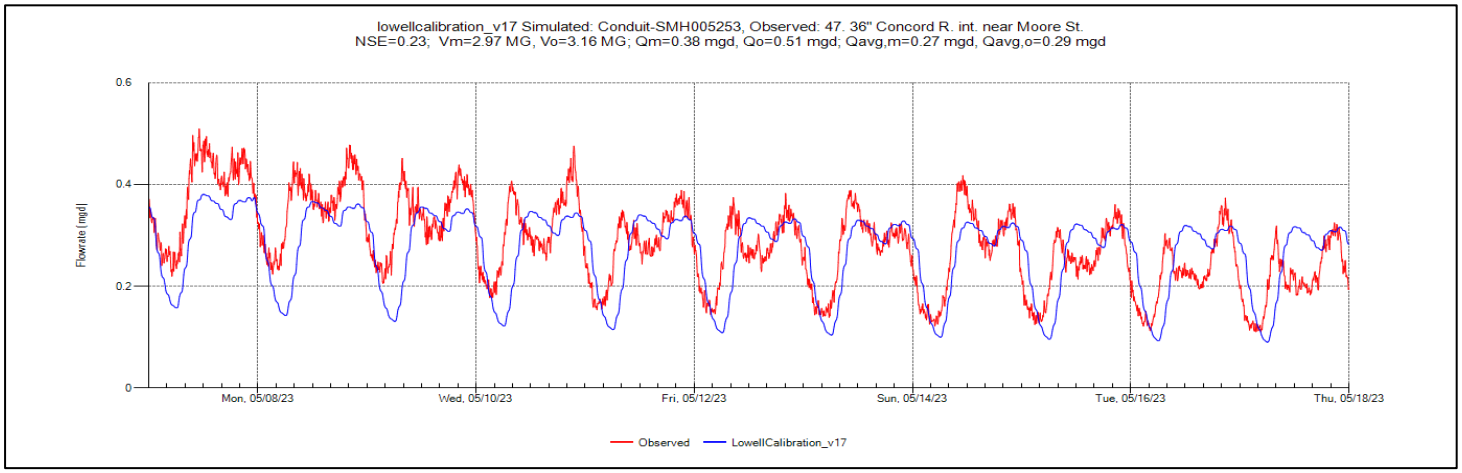


Simulated Versus Observed Flow at Flow Meter Sites

47-DryPeriod

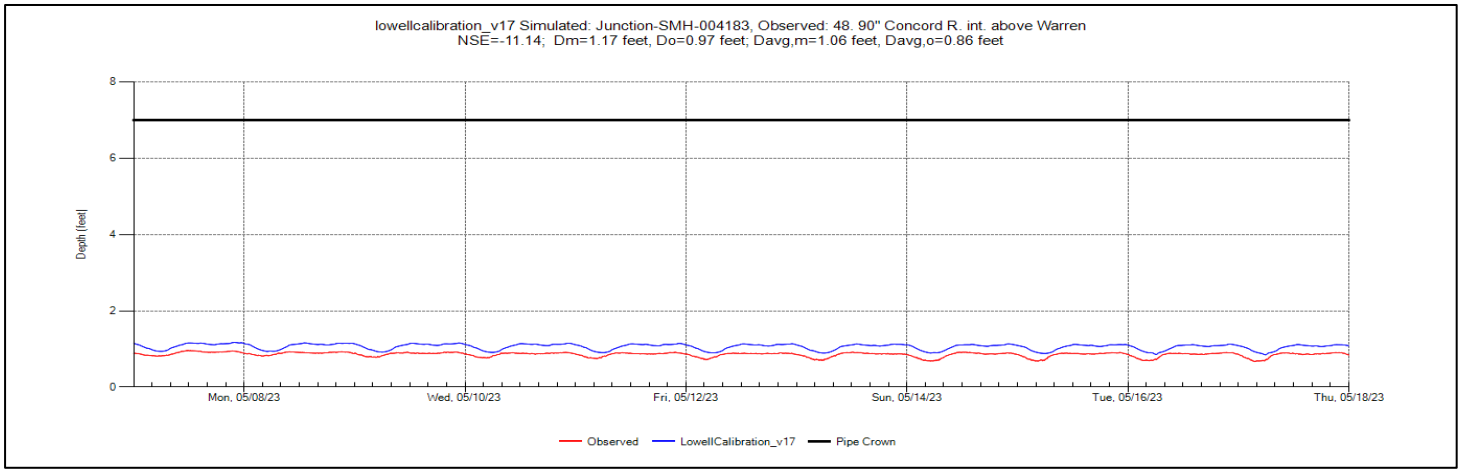


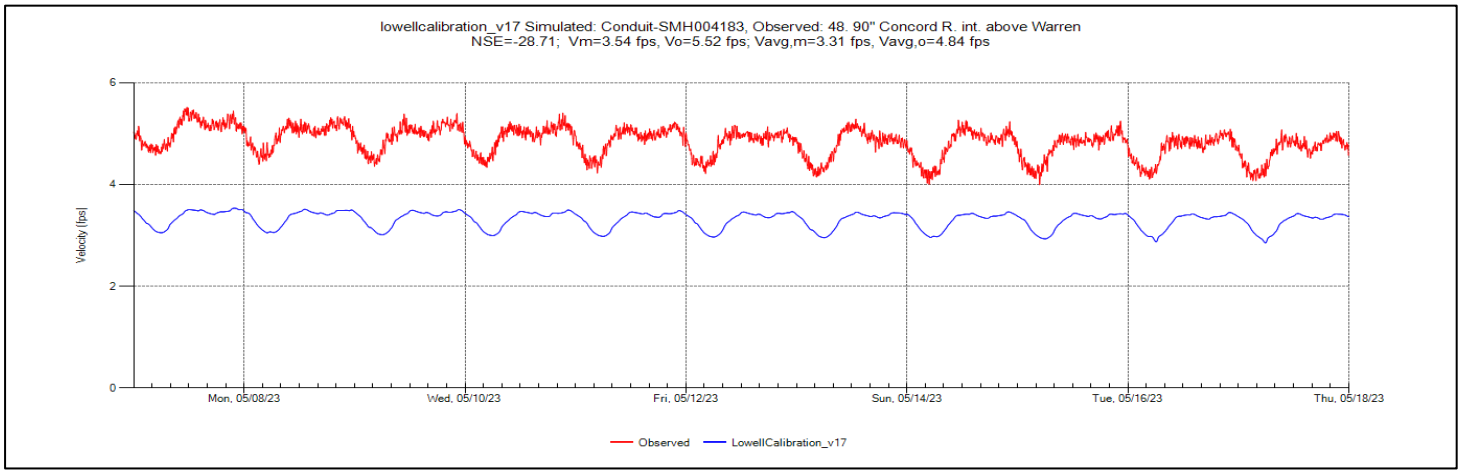


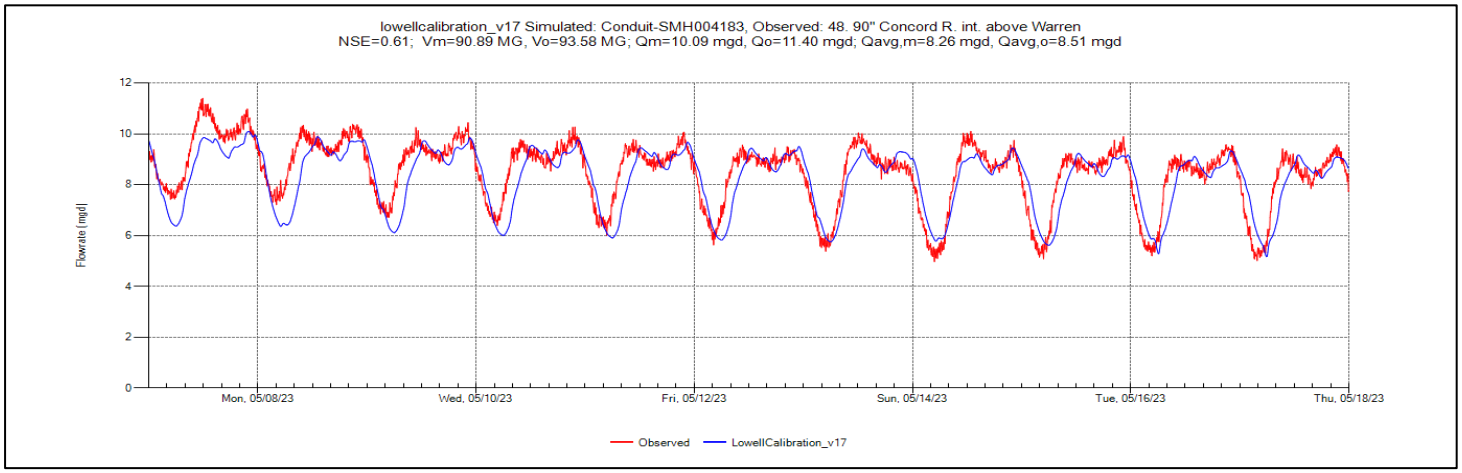


Simulated Versus Observed Flow at Flow Meter Sites

48-DryPeriod

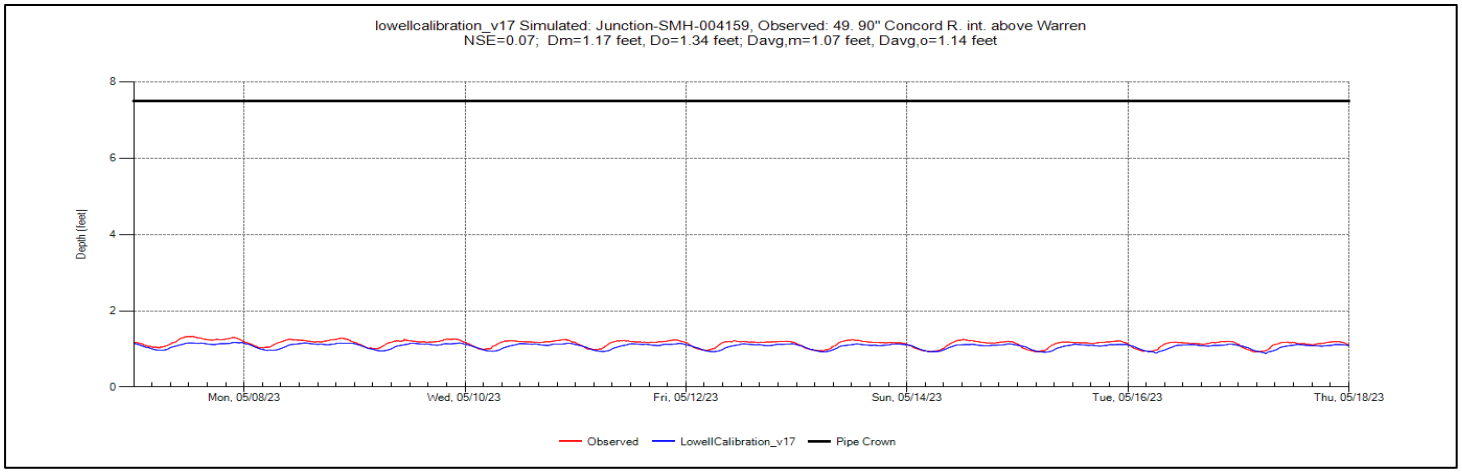


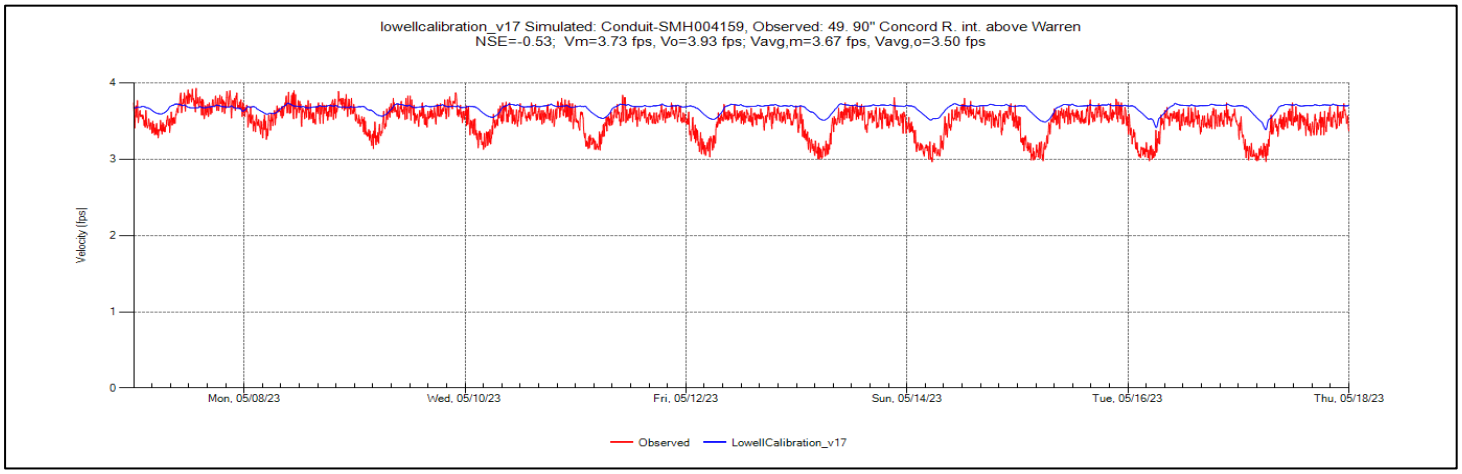


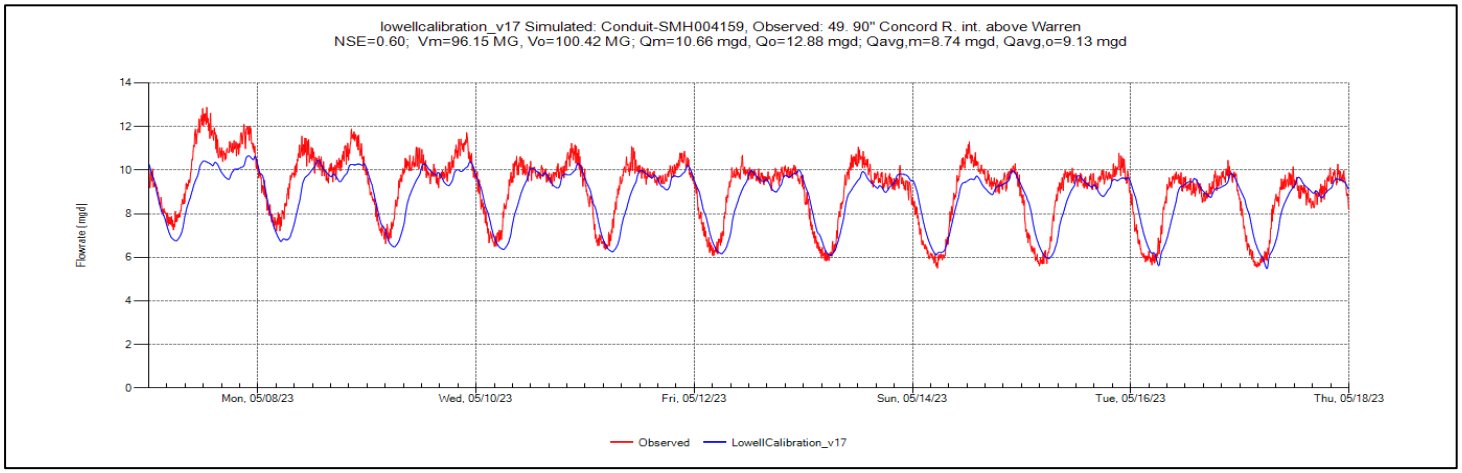


Simulated Versus Observed Flow at Flow Meter Sites

49-DryPeriod

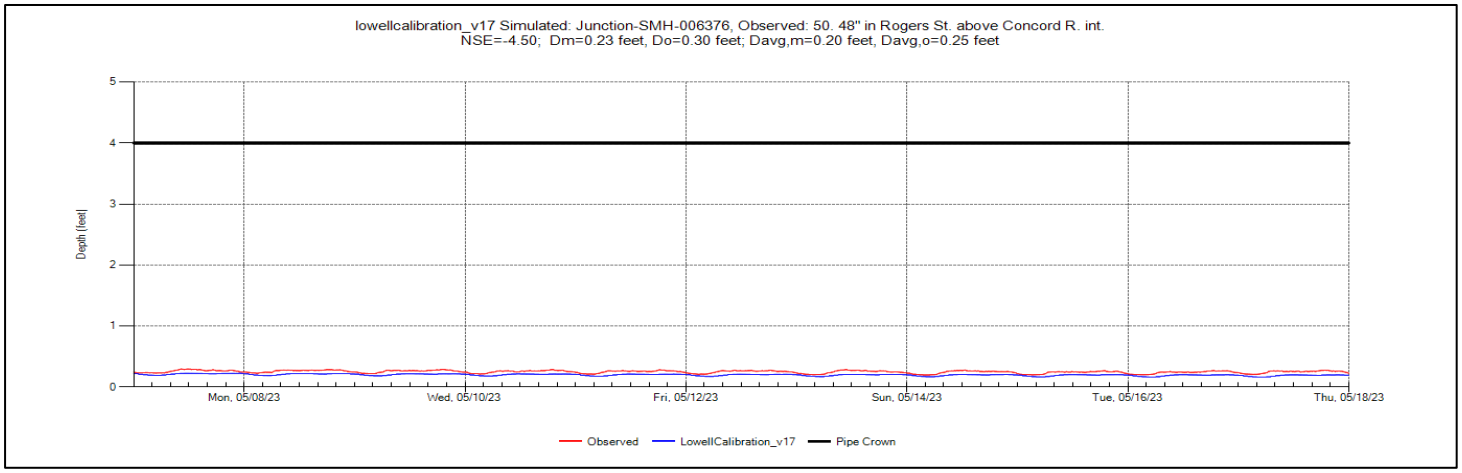


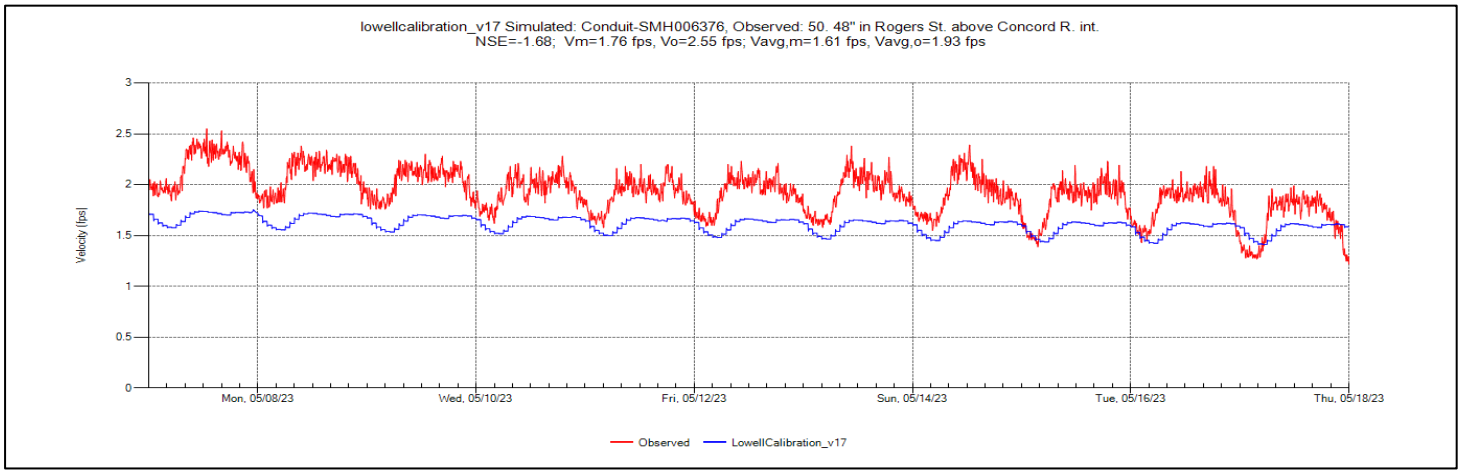


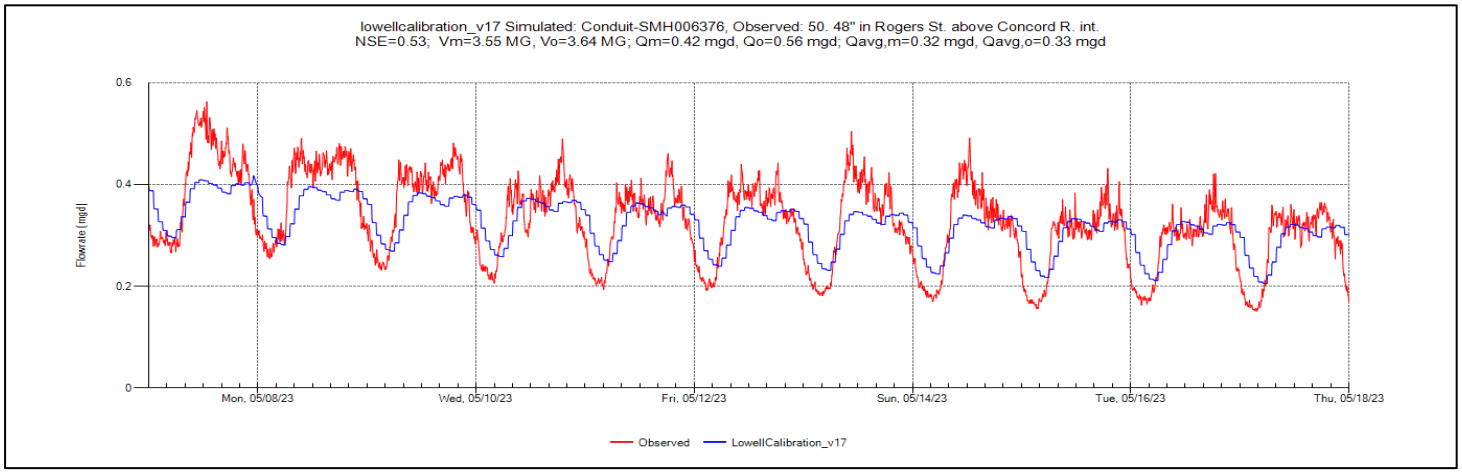


Simulated Versus Observed Flow at Flow Meter Sites

50-DryPeriod

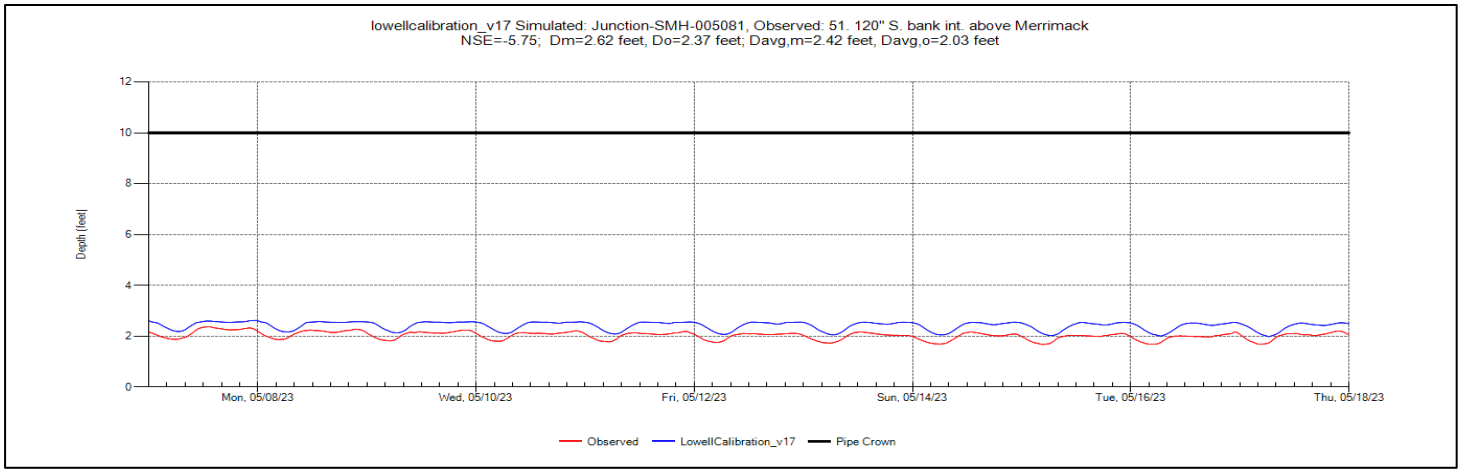


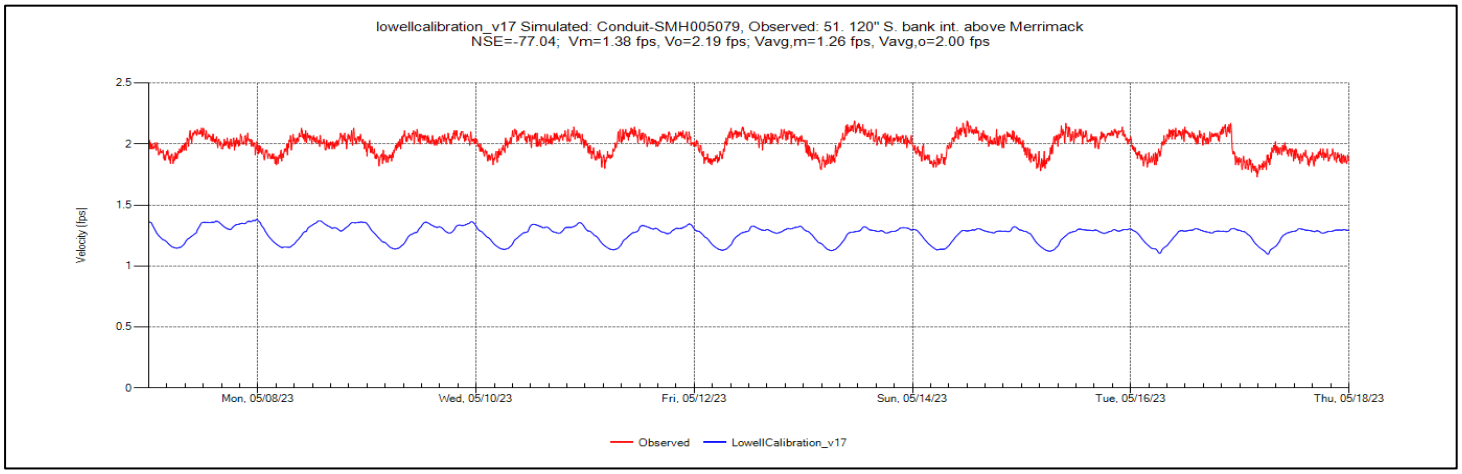


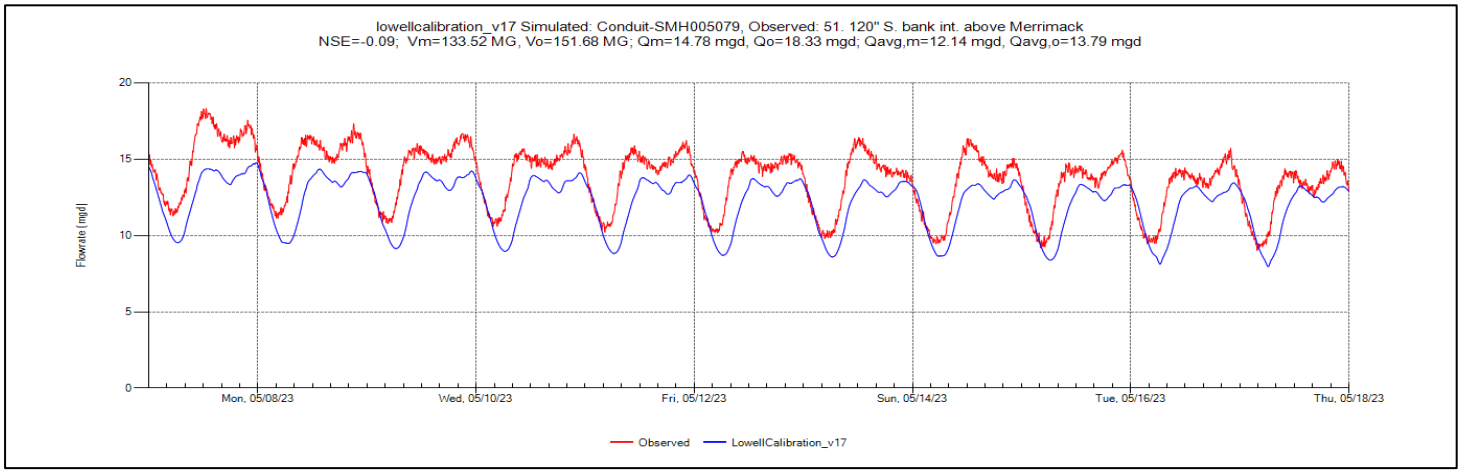


Simulated Versus Observed Flow at Flow Meter Sites

51-DryPeriod

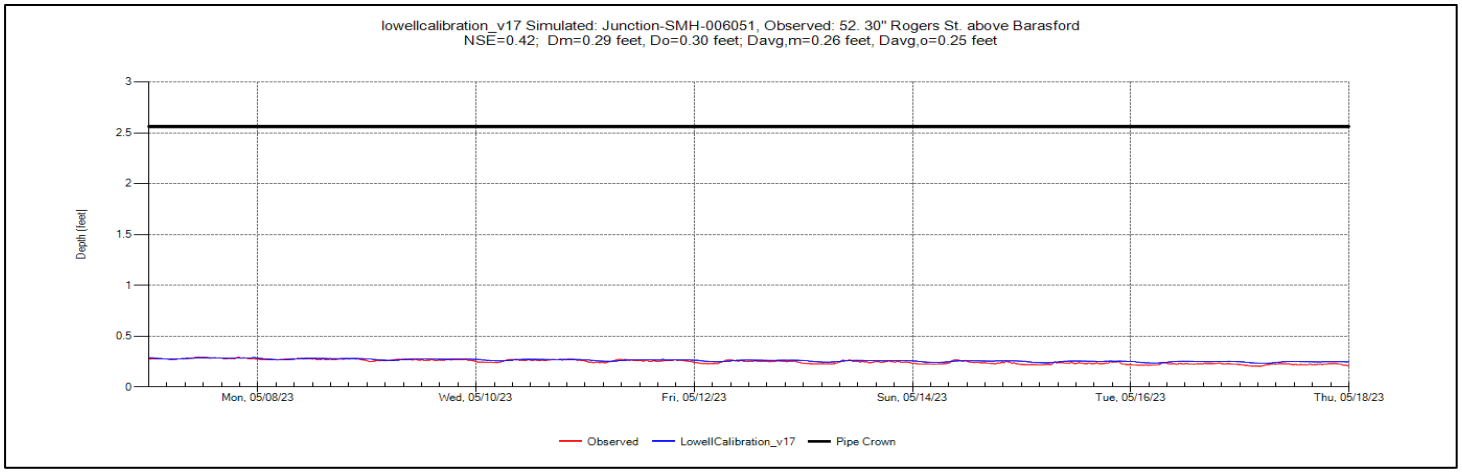


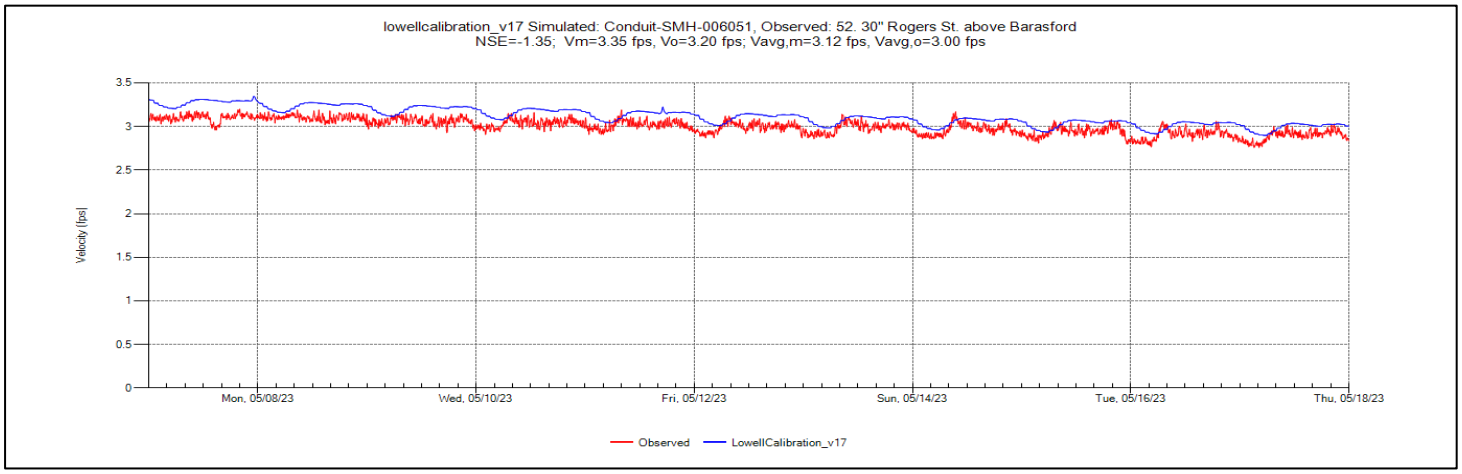


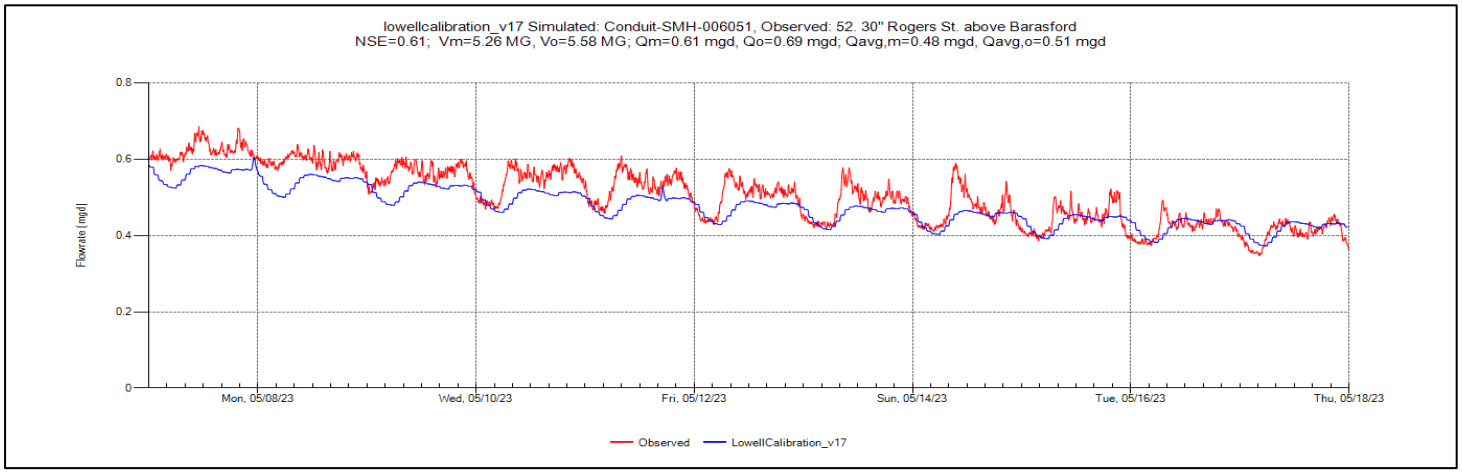


Simulated Versus Observed Flow at Flow Meter Sites

52-DryPeriod

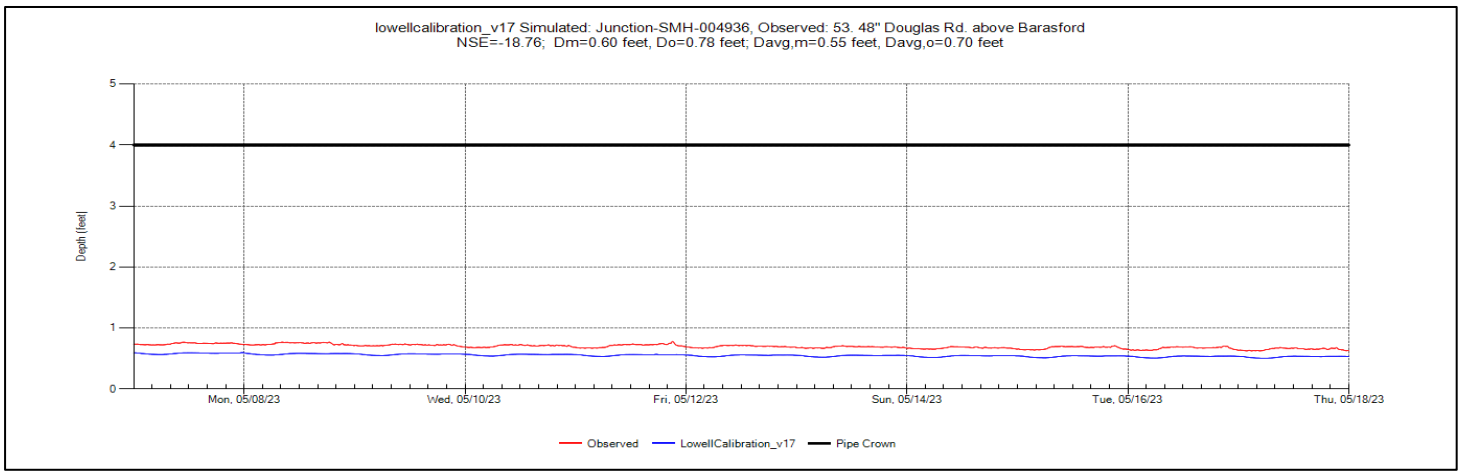


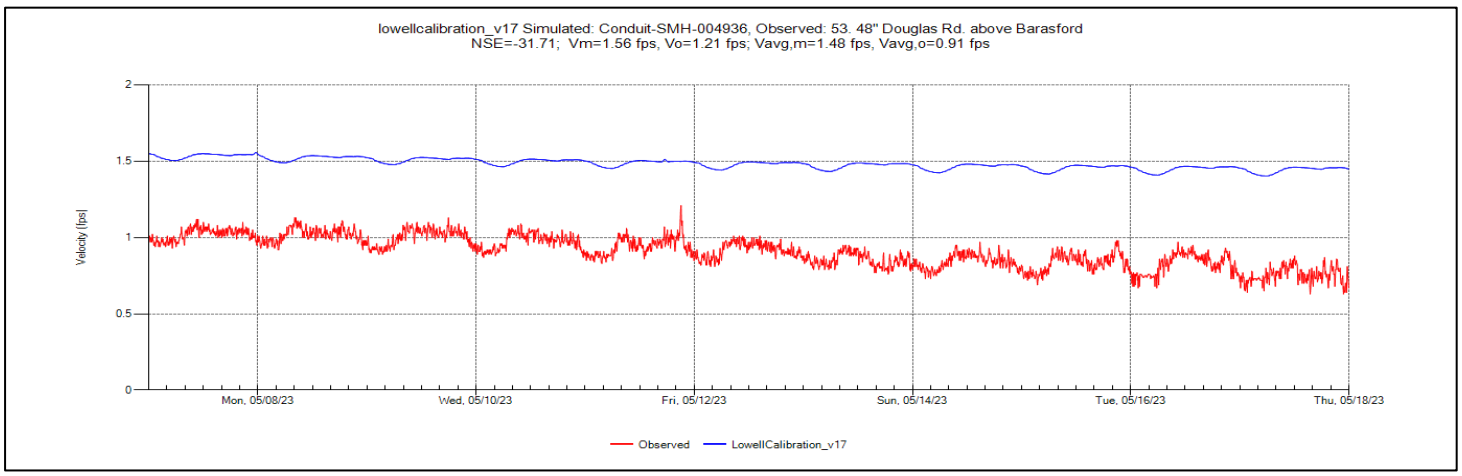


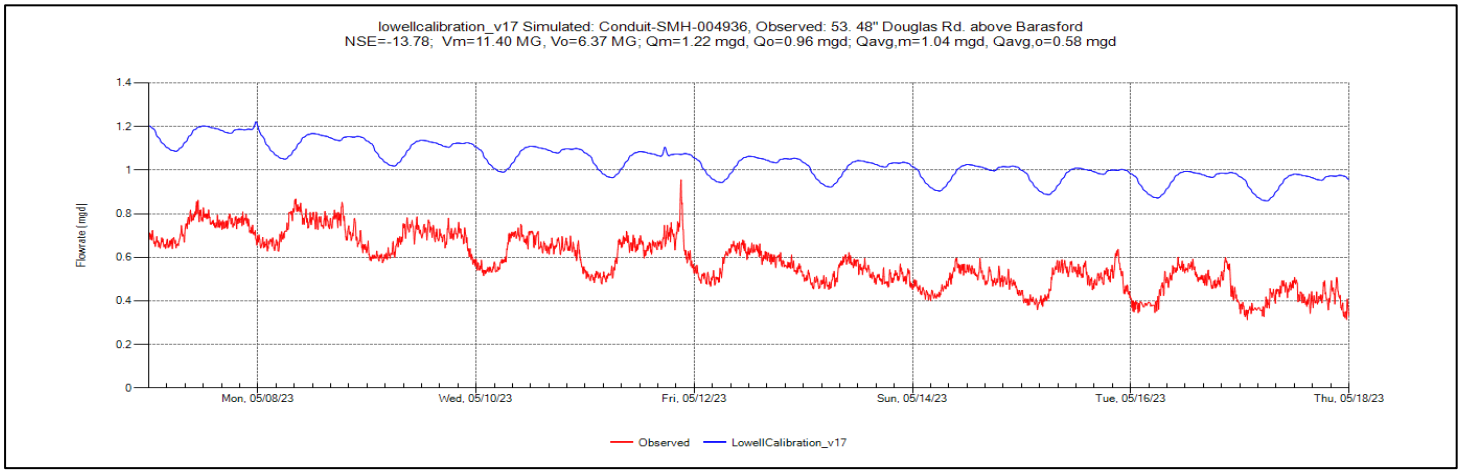


Simulated Versus Observed Flow at Flow Meter Sites

53-DryPeriod

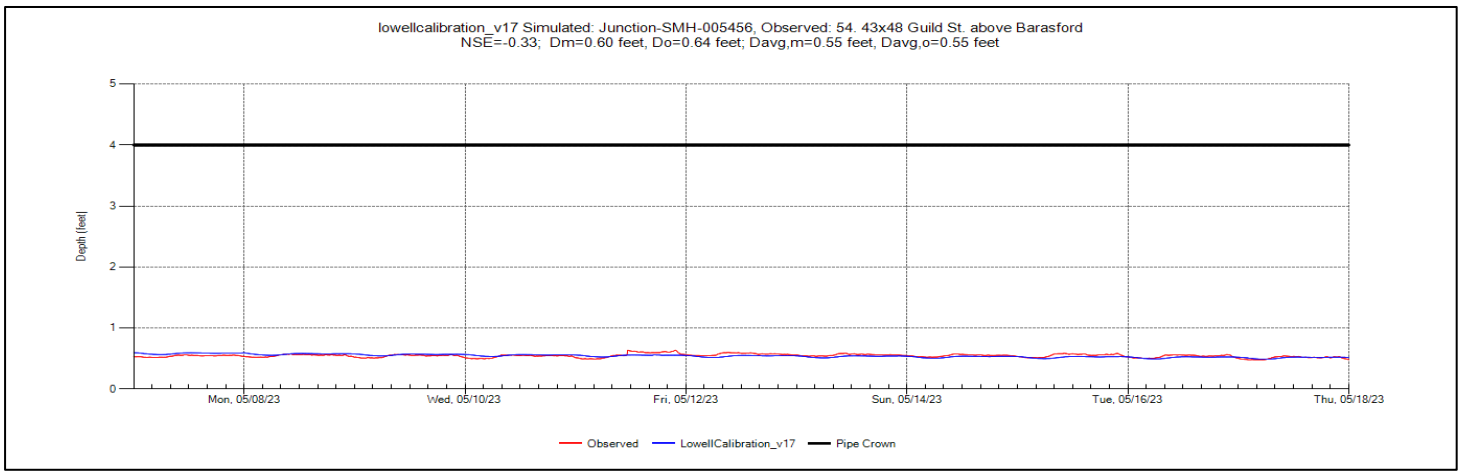


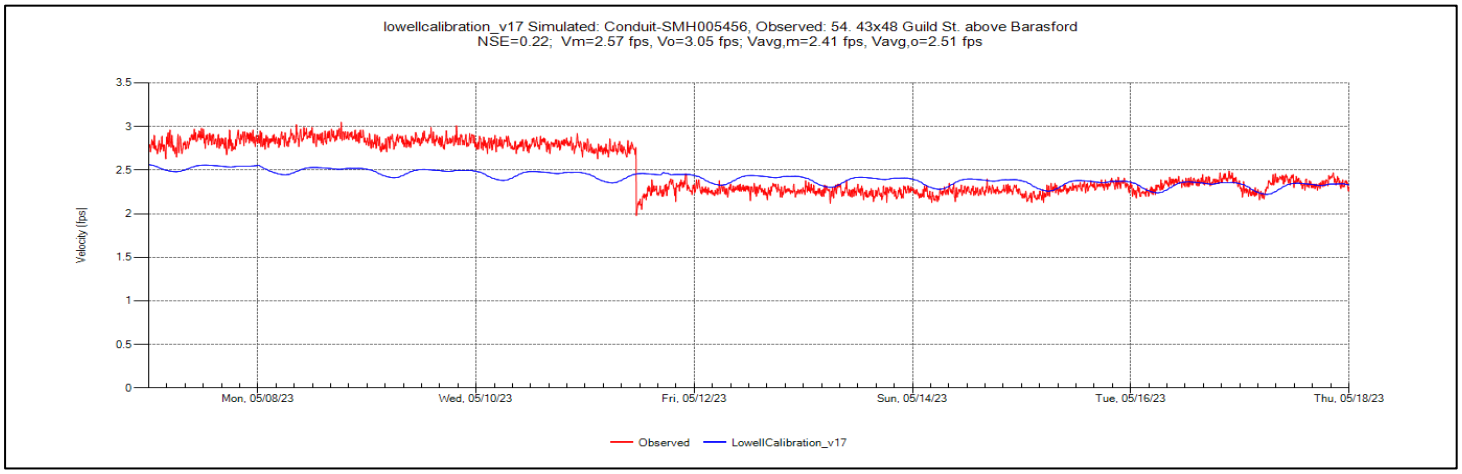


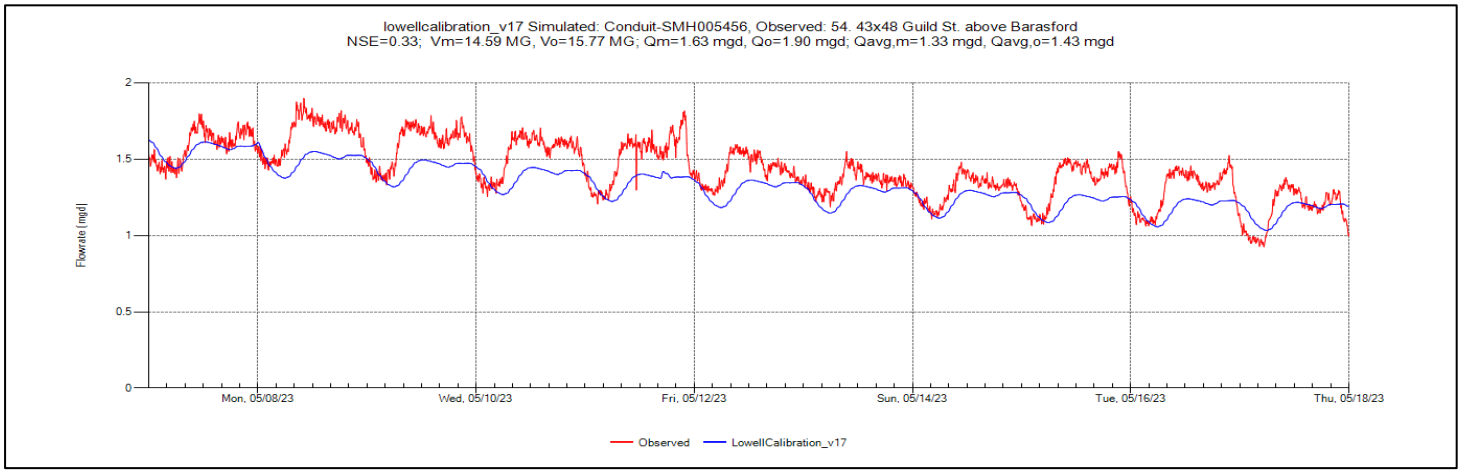


Simulated Versus Observed Flow at Flow Meter Sites

54-DryPeriod

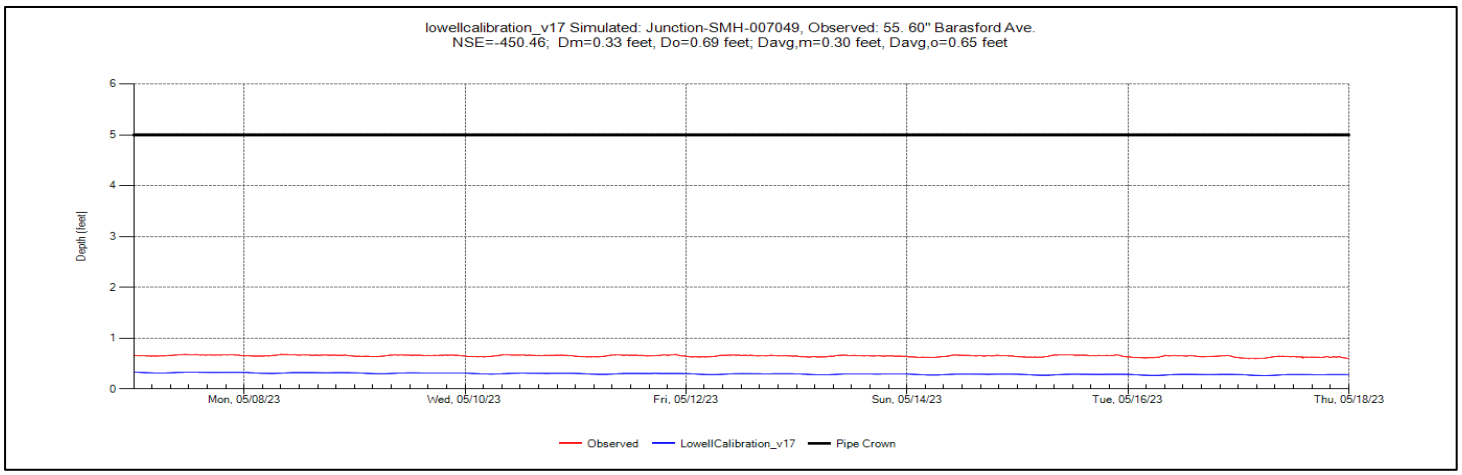


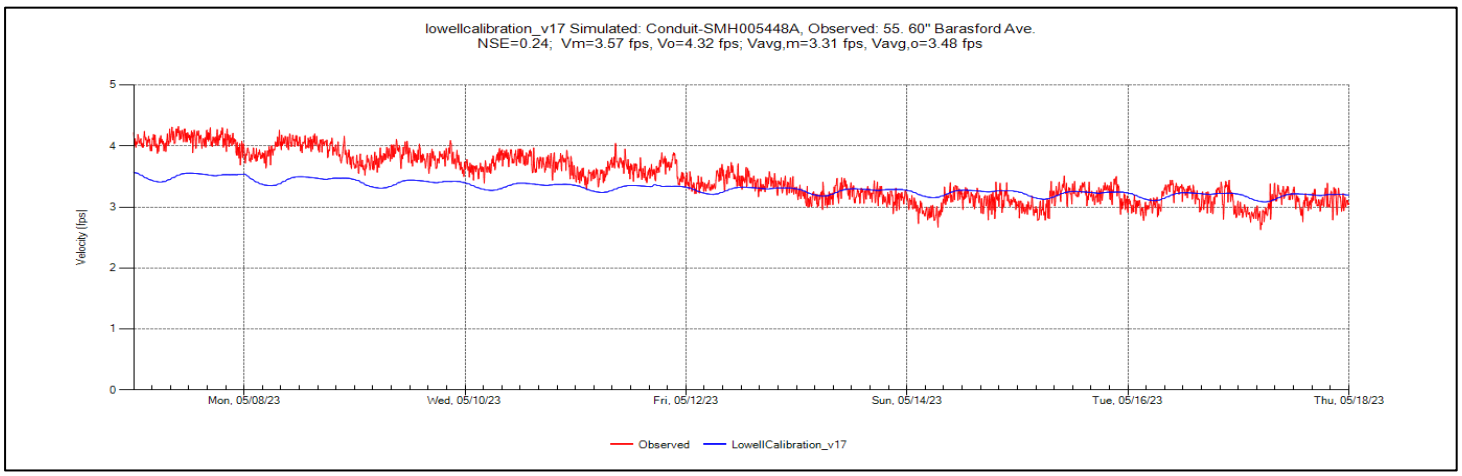


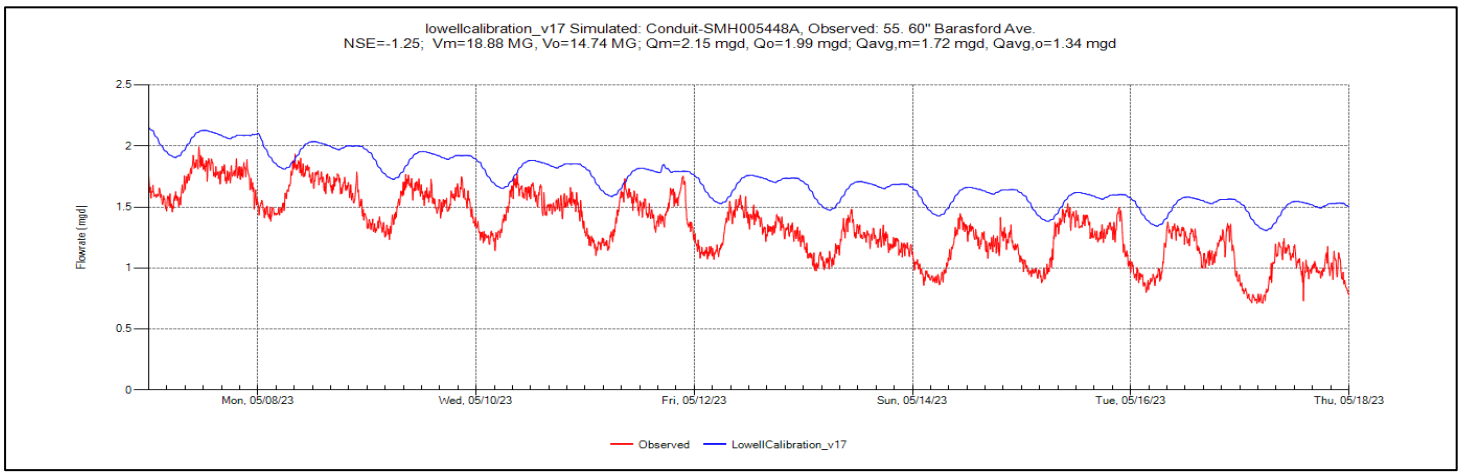


Simulated Versus Observed Flow at Flow Meter Sites

55-DryPeriod

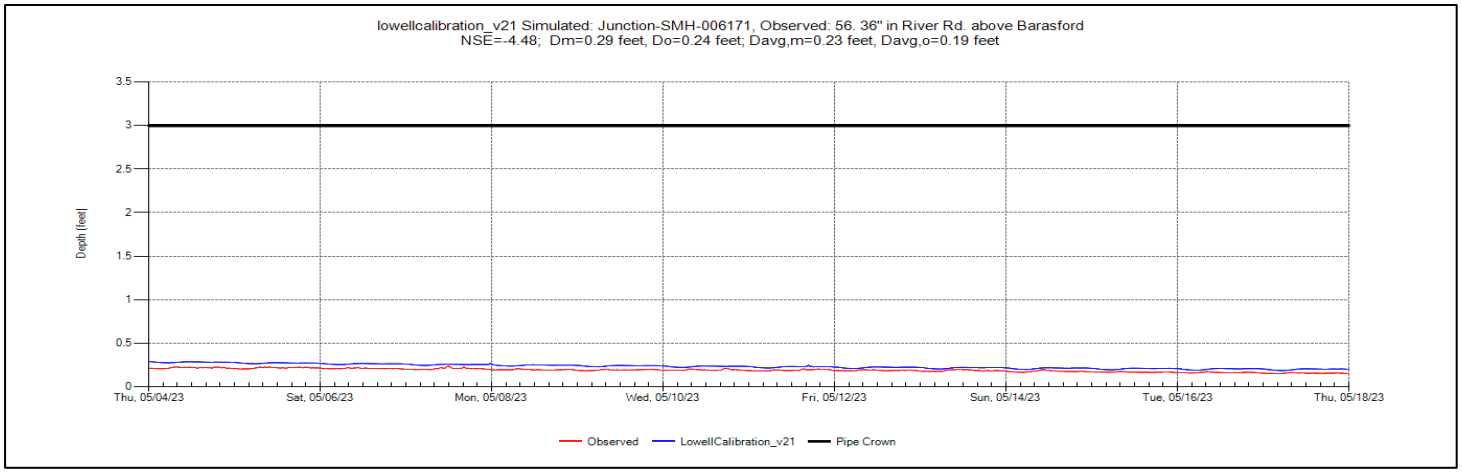


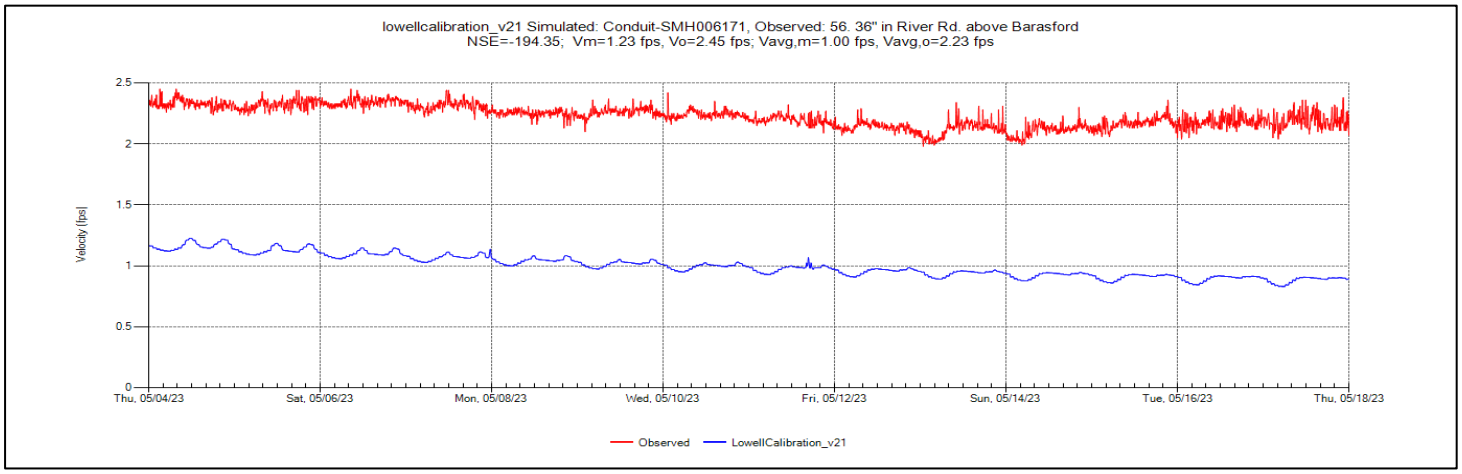


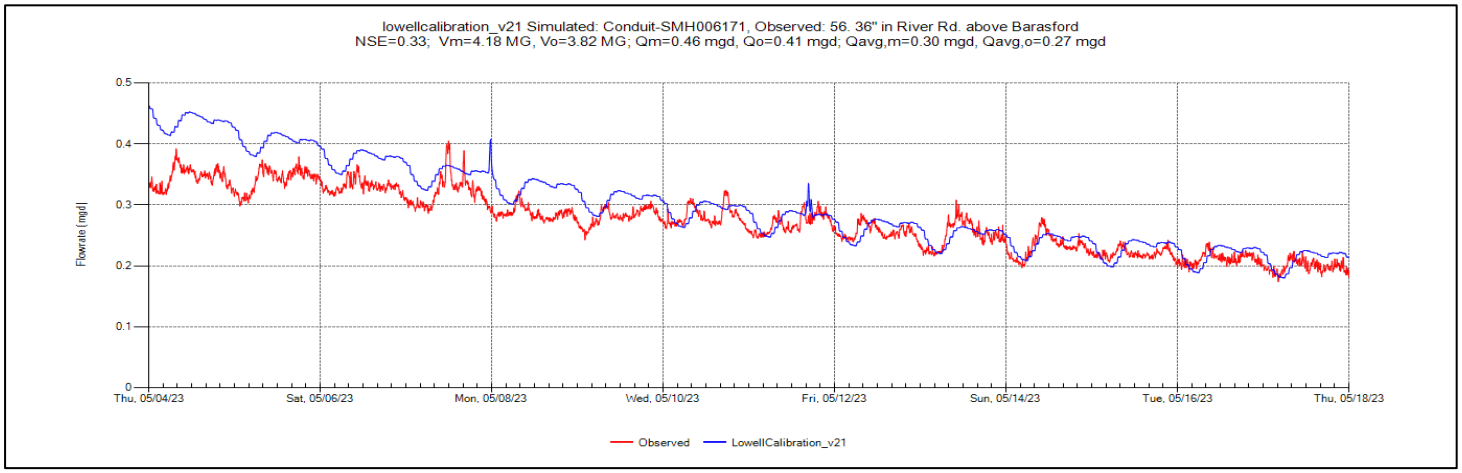


Simulated Versus Observed Flow at Flow Meter Sites

56-DryPeriod

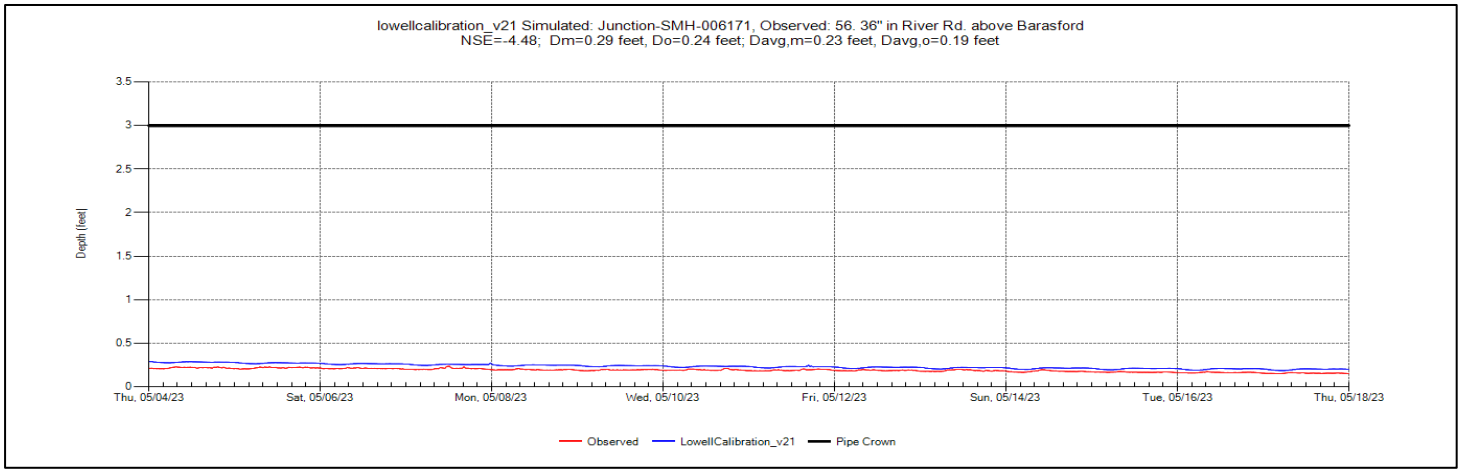


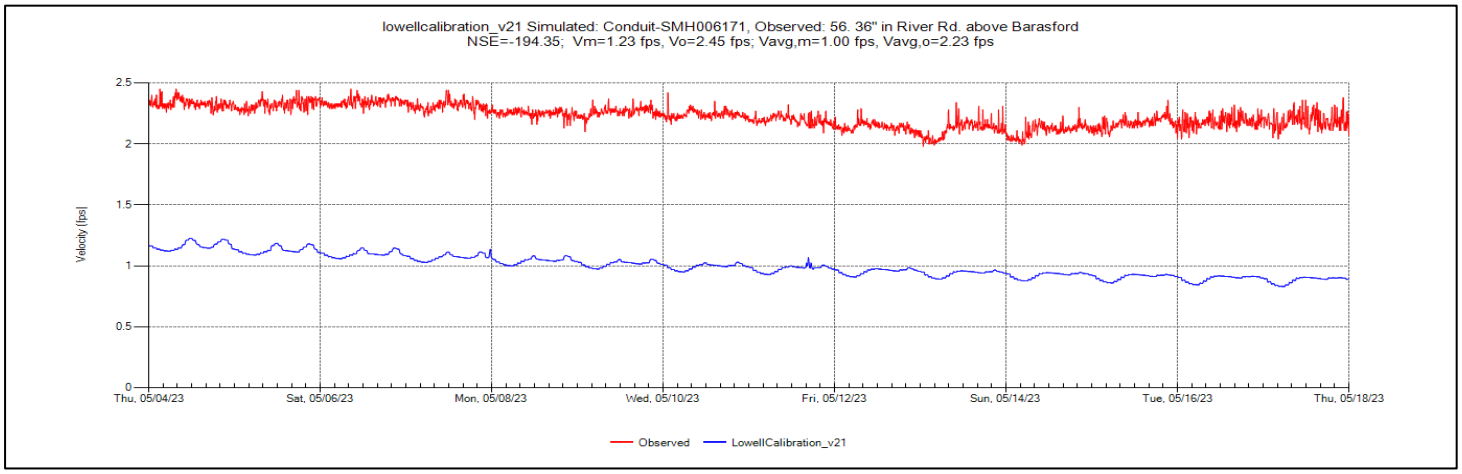


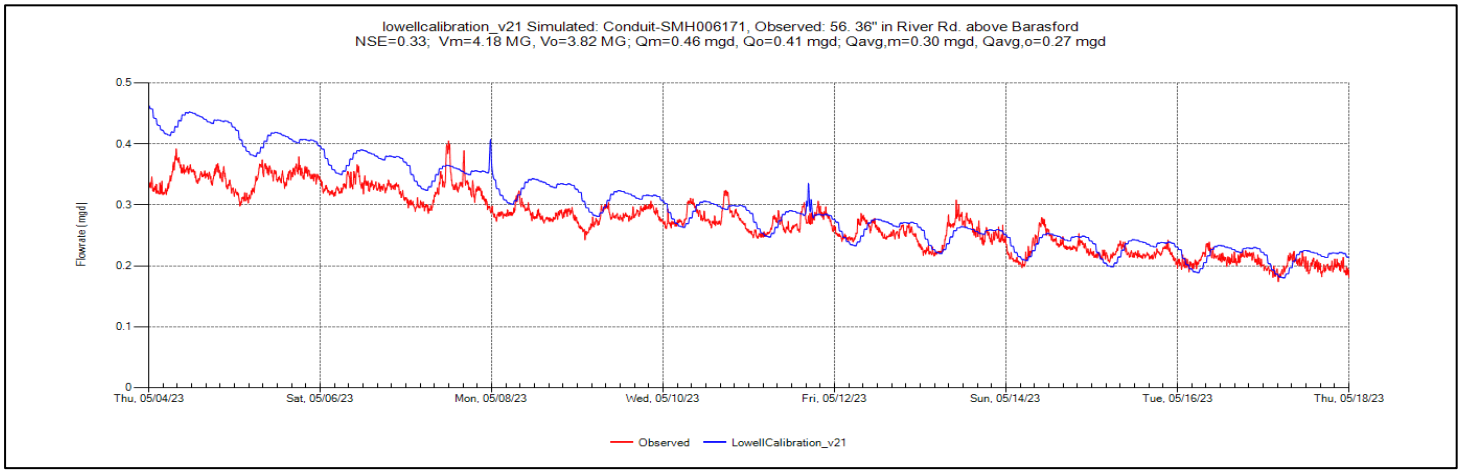


Simulated Versus Observed Flow at Flow Meter Sites

56-DryPeriod

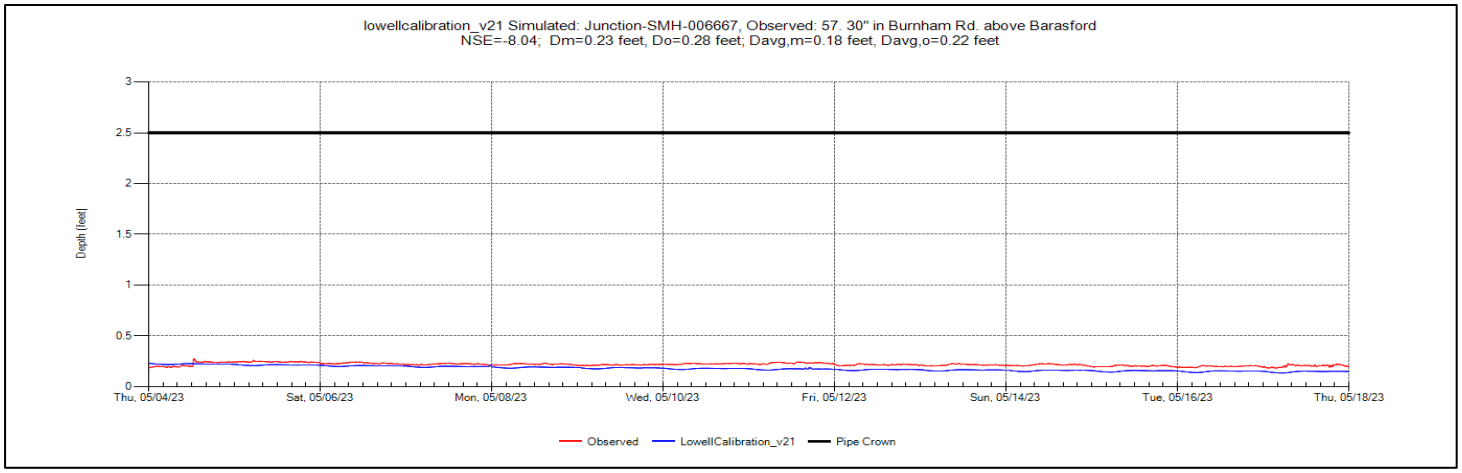


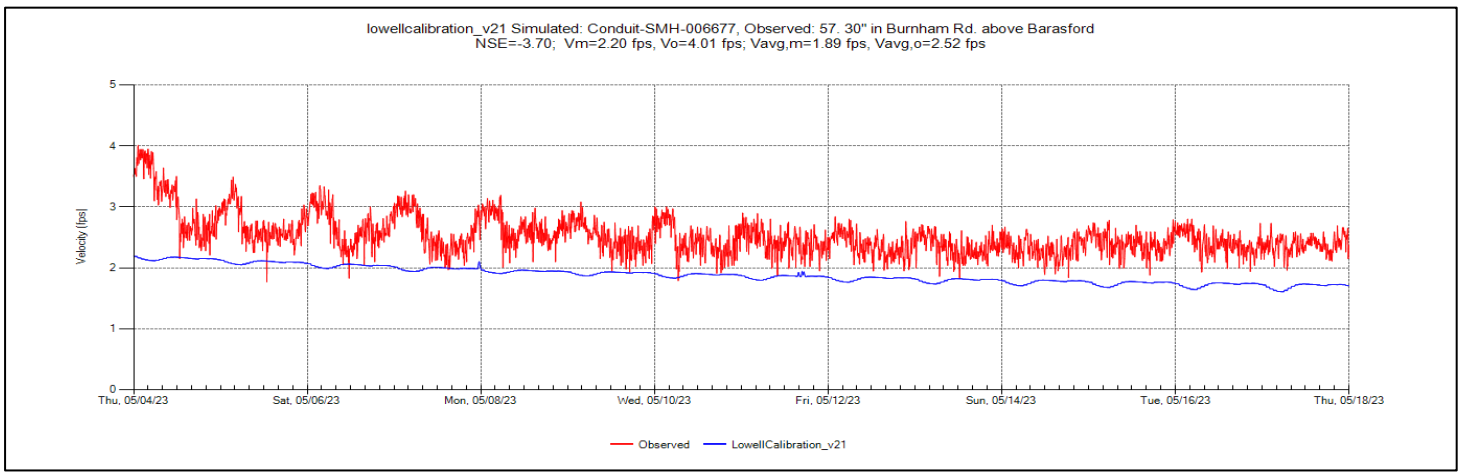


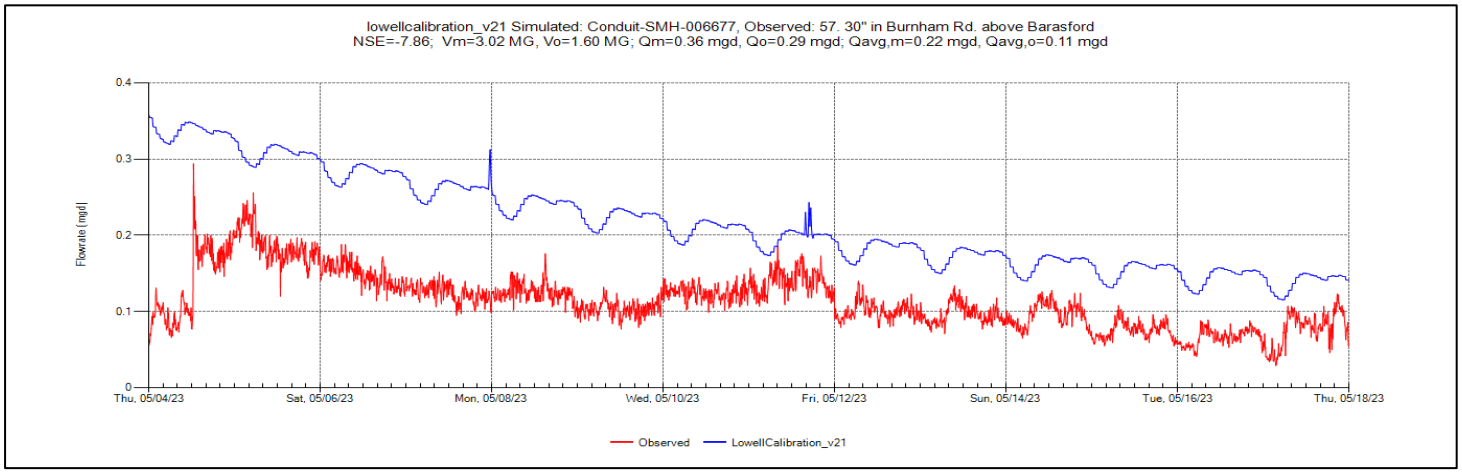


Simulated Versus Observed Flow at Flow Meter Sites

57-DryPeriod

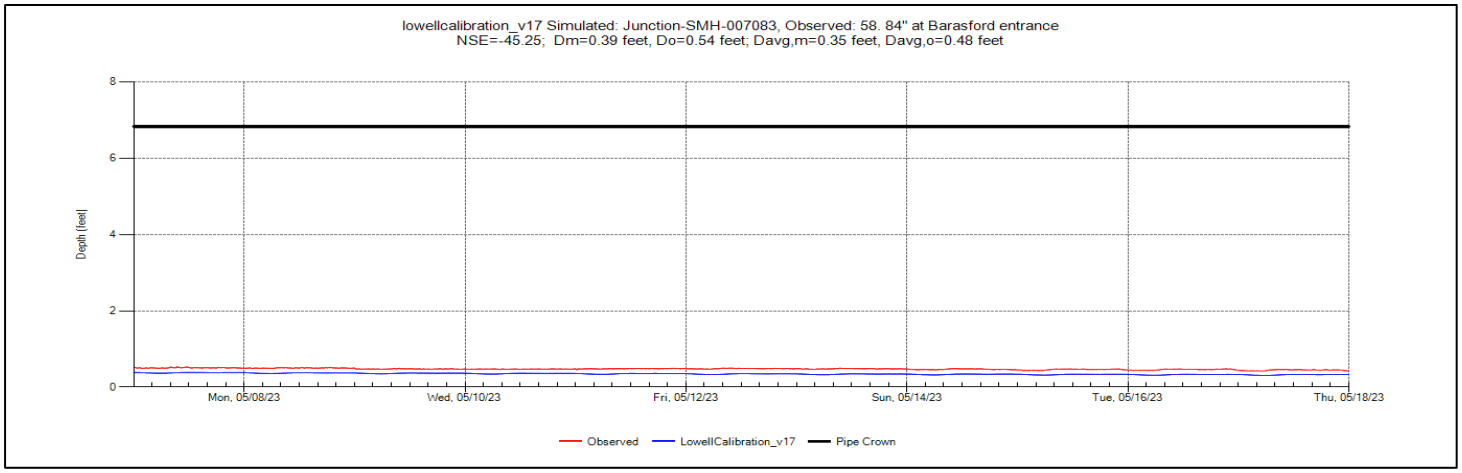


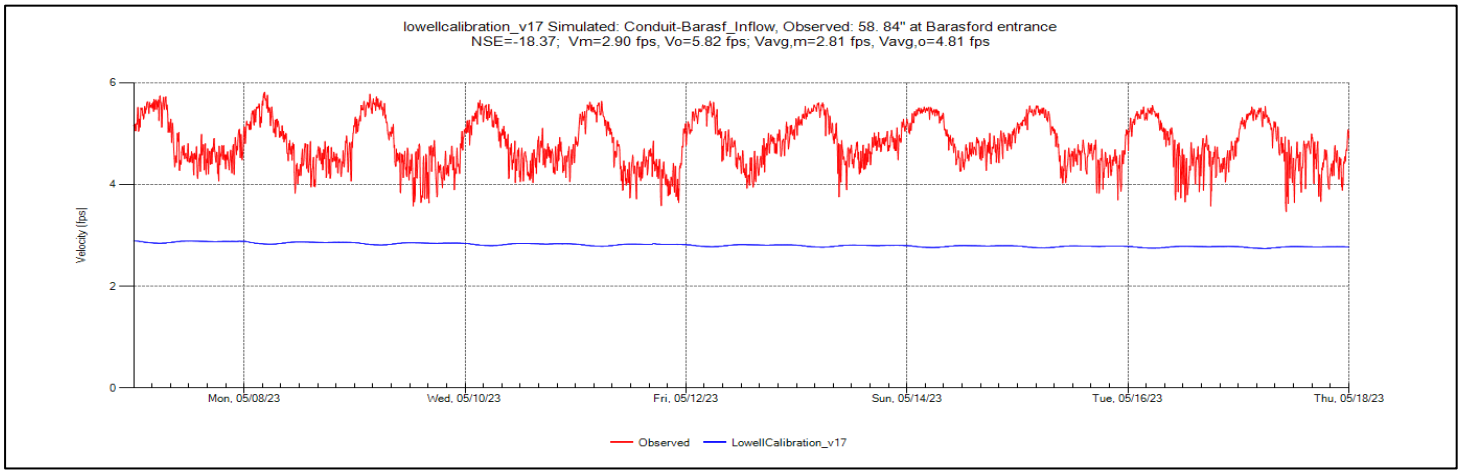


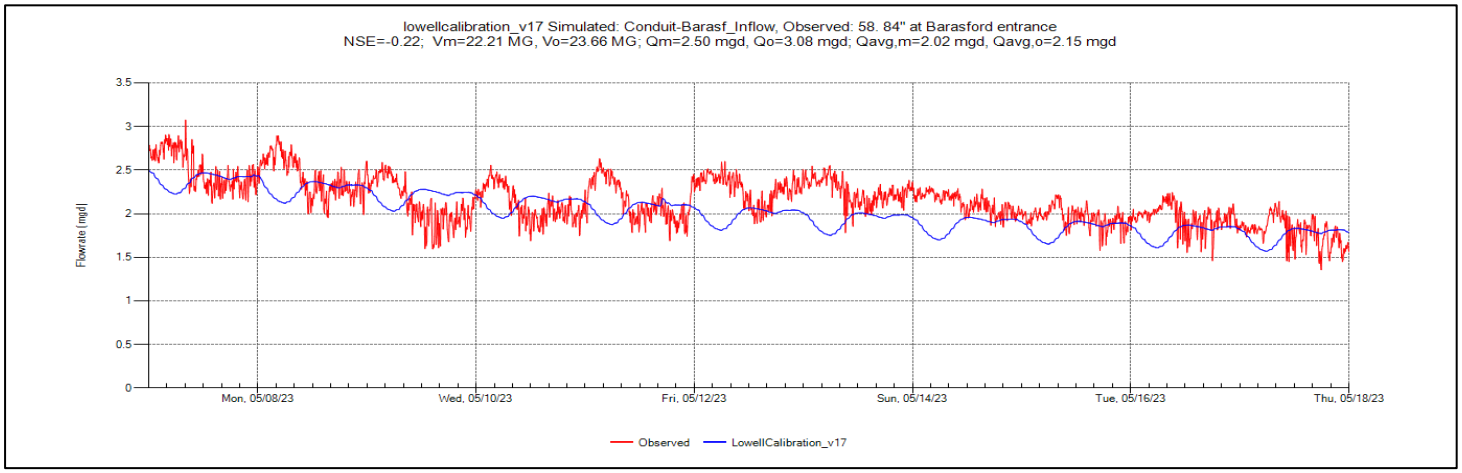


Simulated Versus Observed Flow at Flow Meter Sites

58-DryPeriod

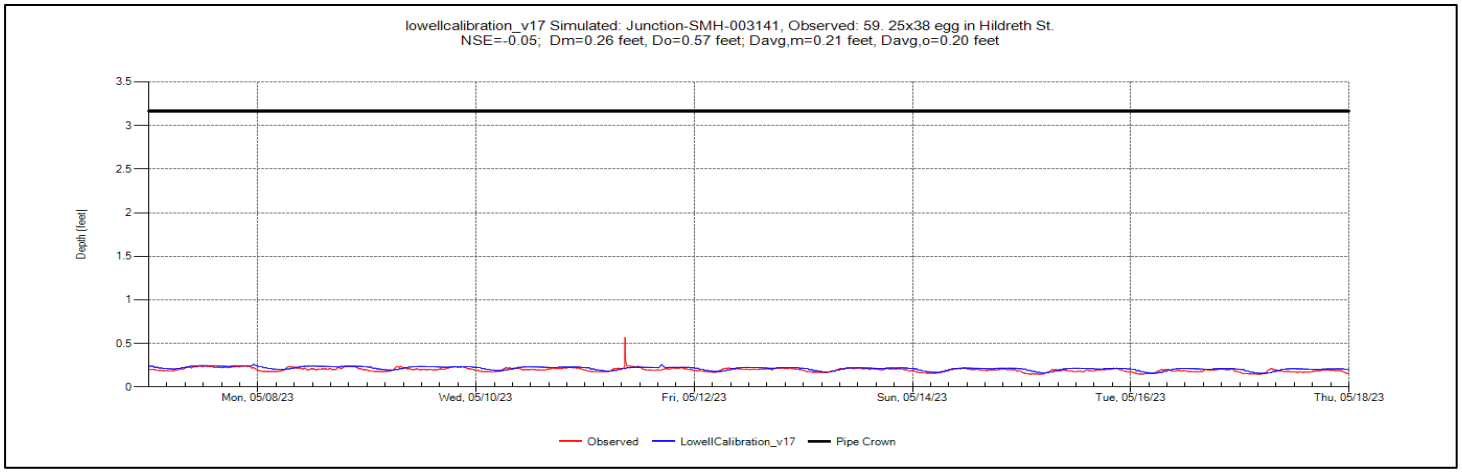


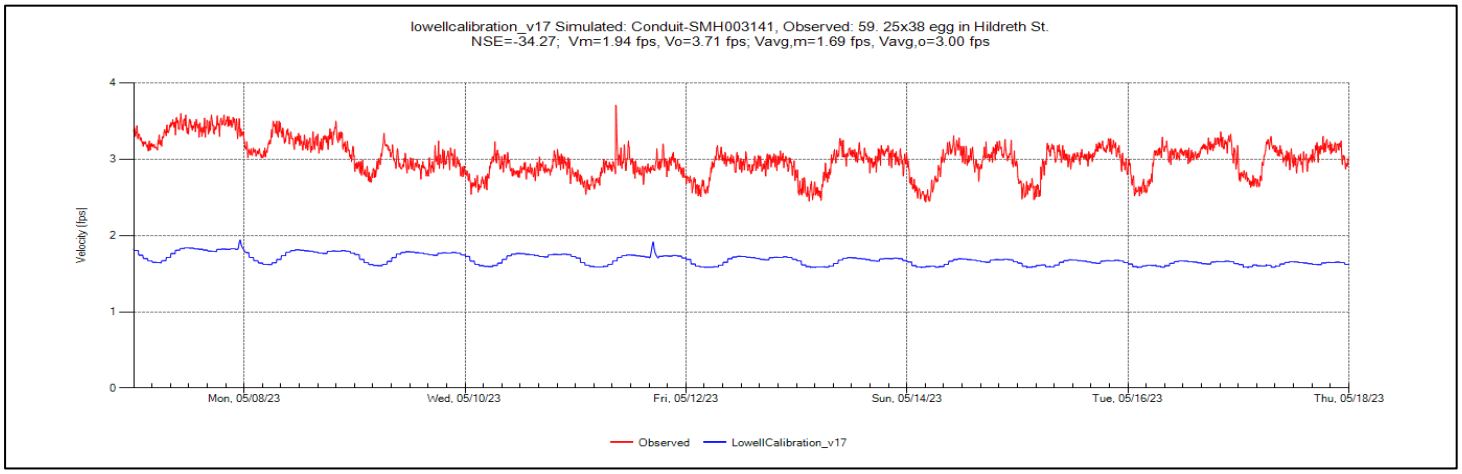


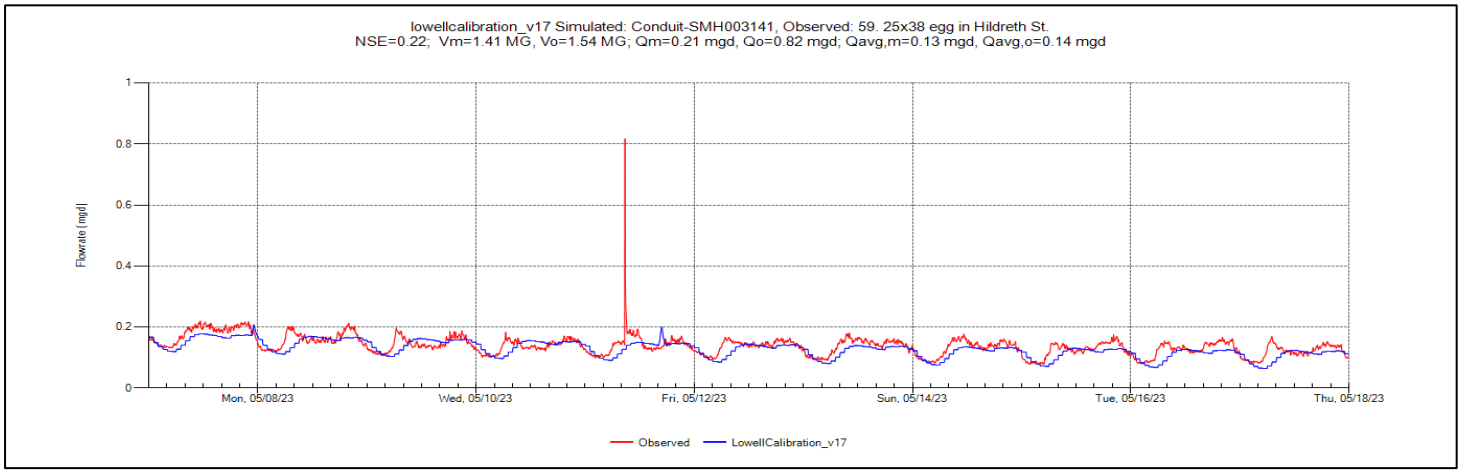


Simulated Versus Observed Flow at Flow Meter Sites

59-DryPeriod

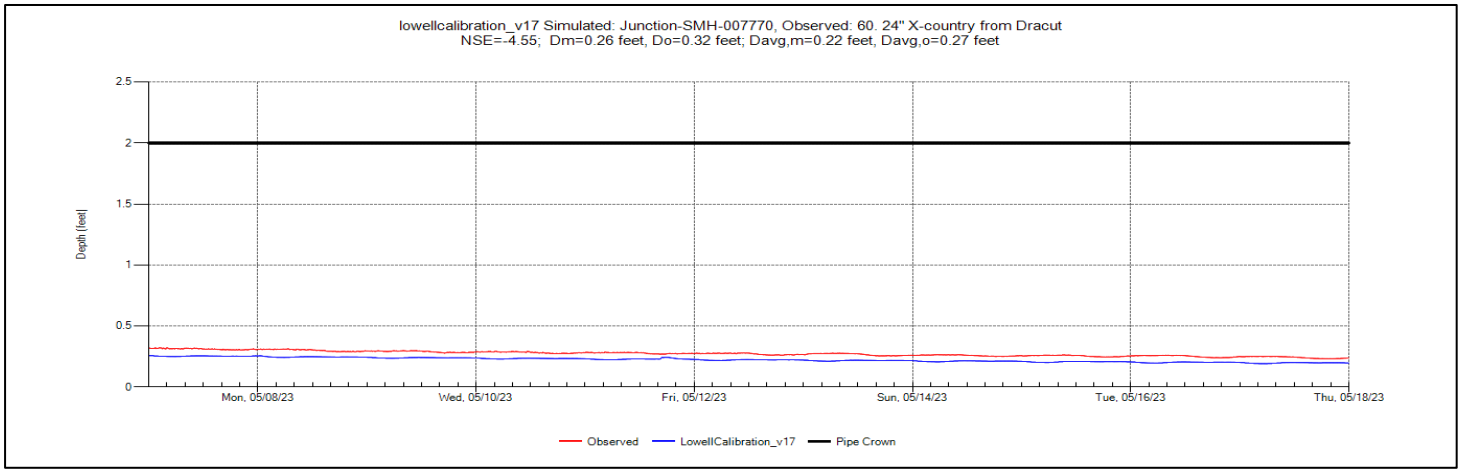


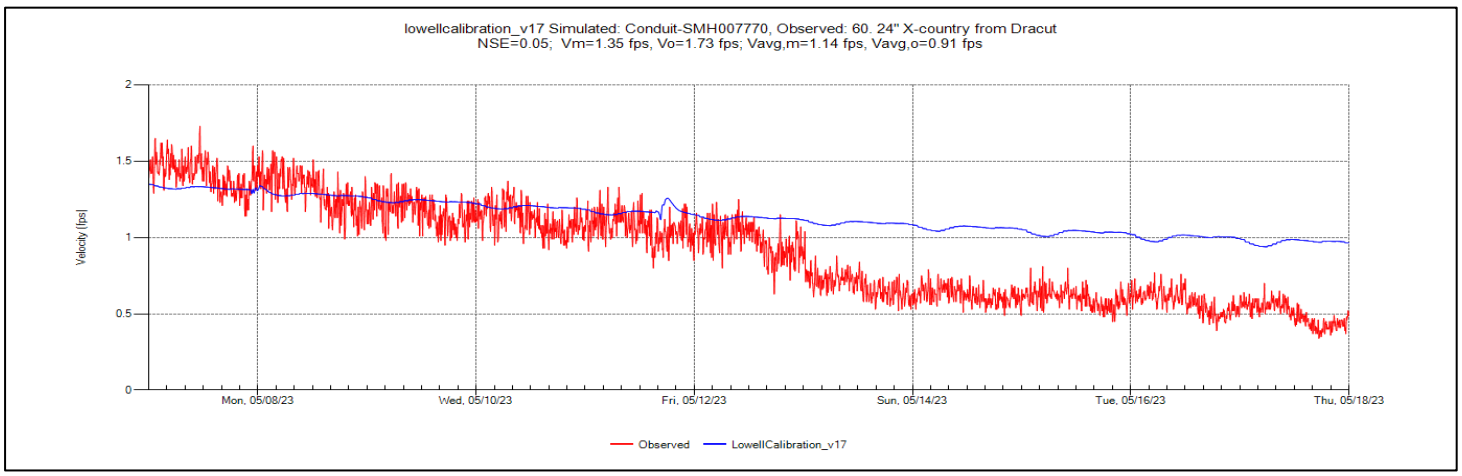


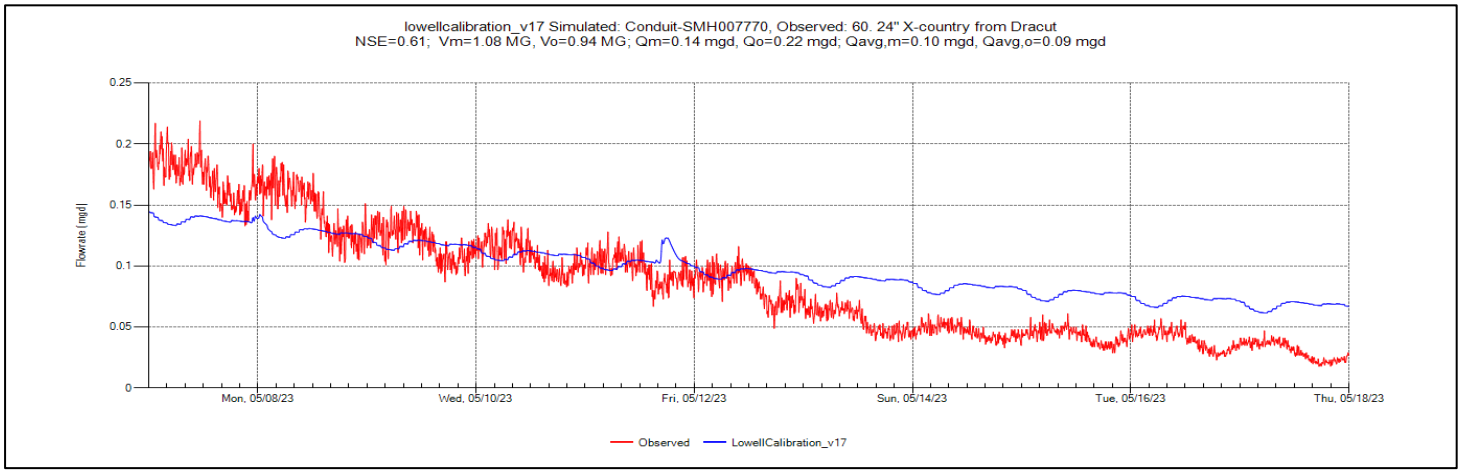


Simulated Versus Observed Flow at Flow Meter Sites

60-DryPeriod

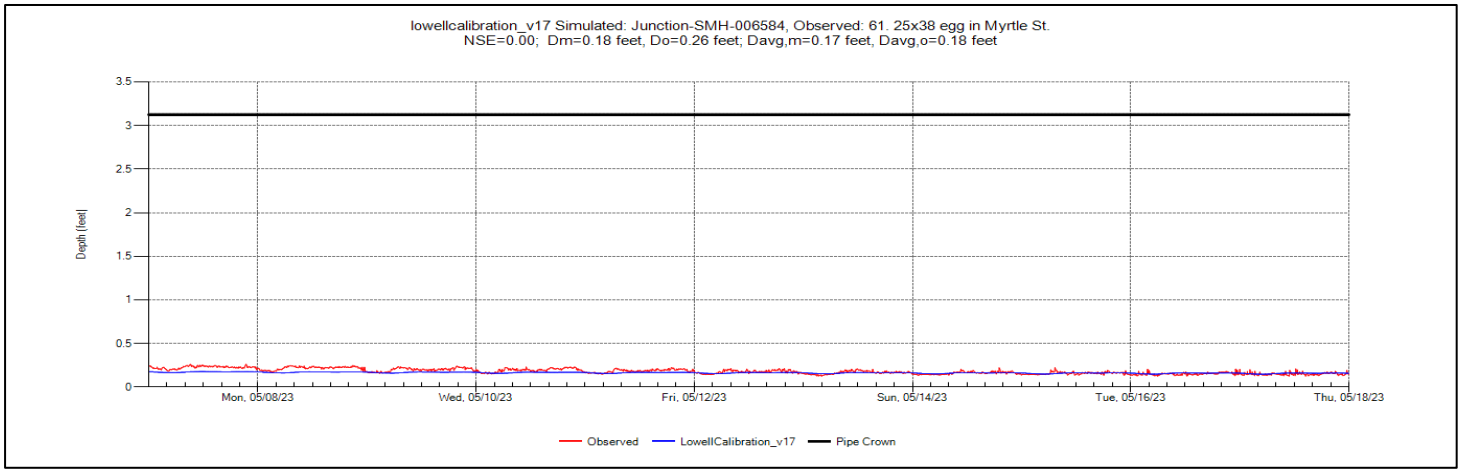


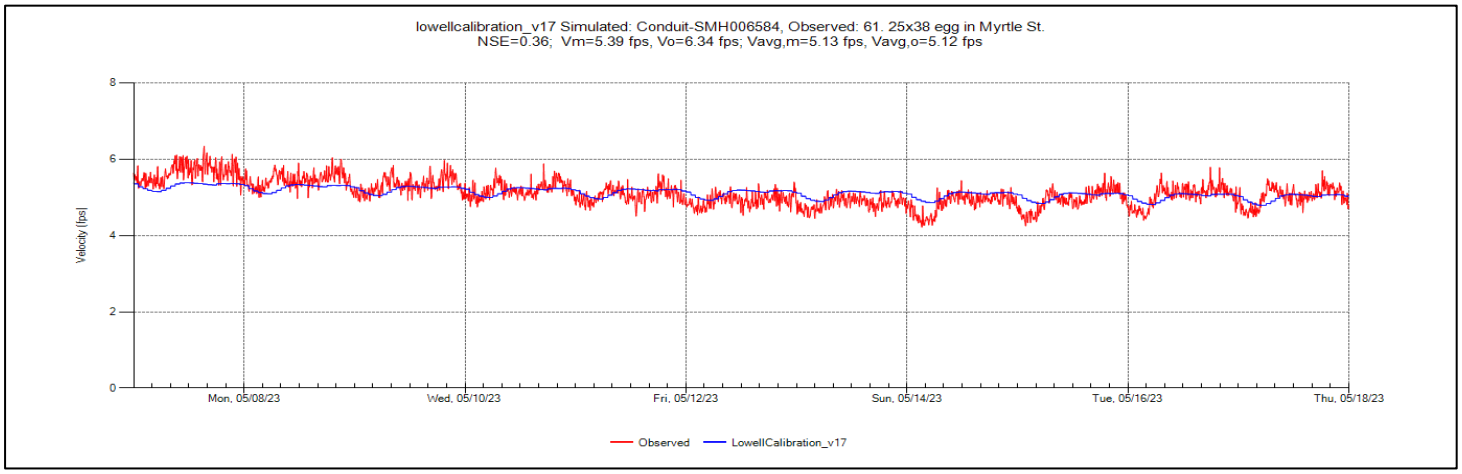


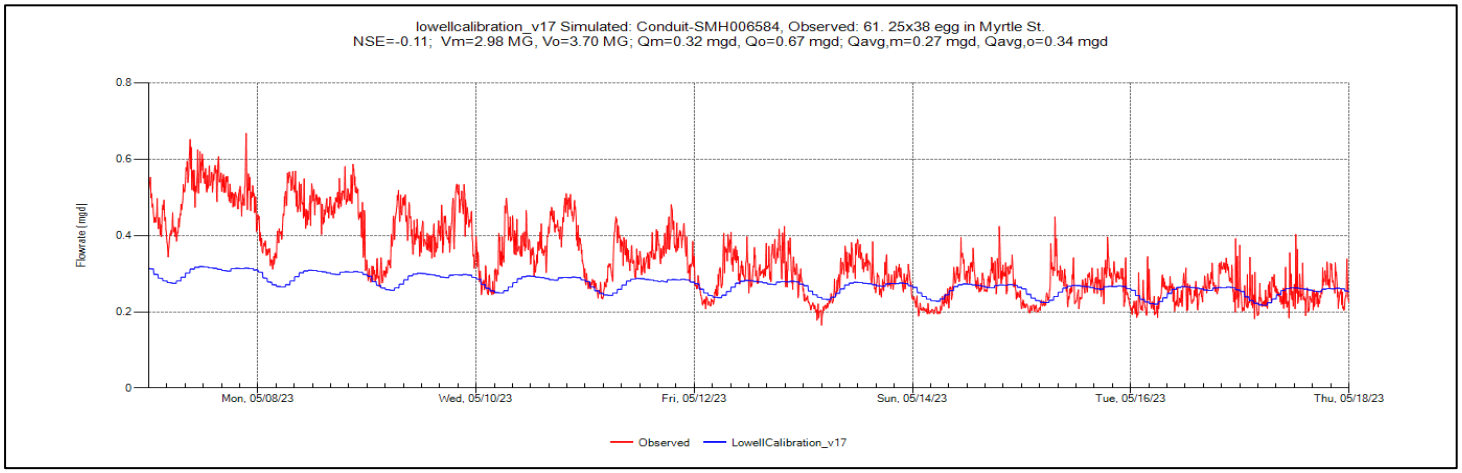


Simulated Versus Observed Flow at Flow Meter Sites

61-DryPeriod

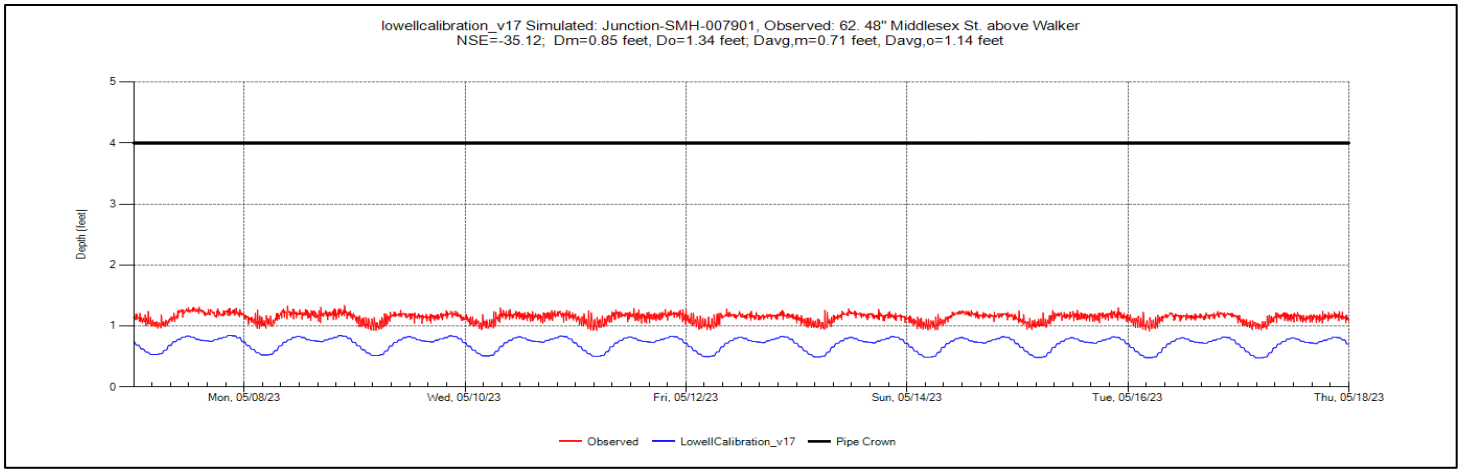


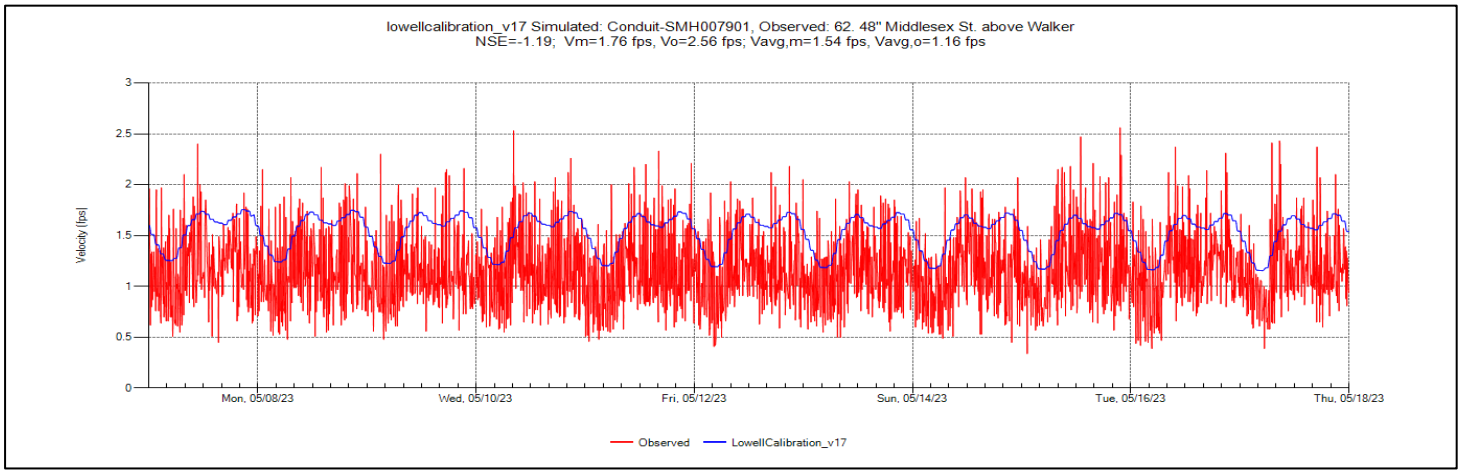


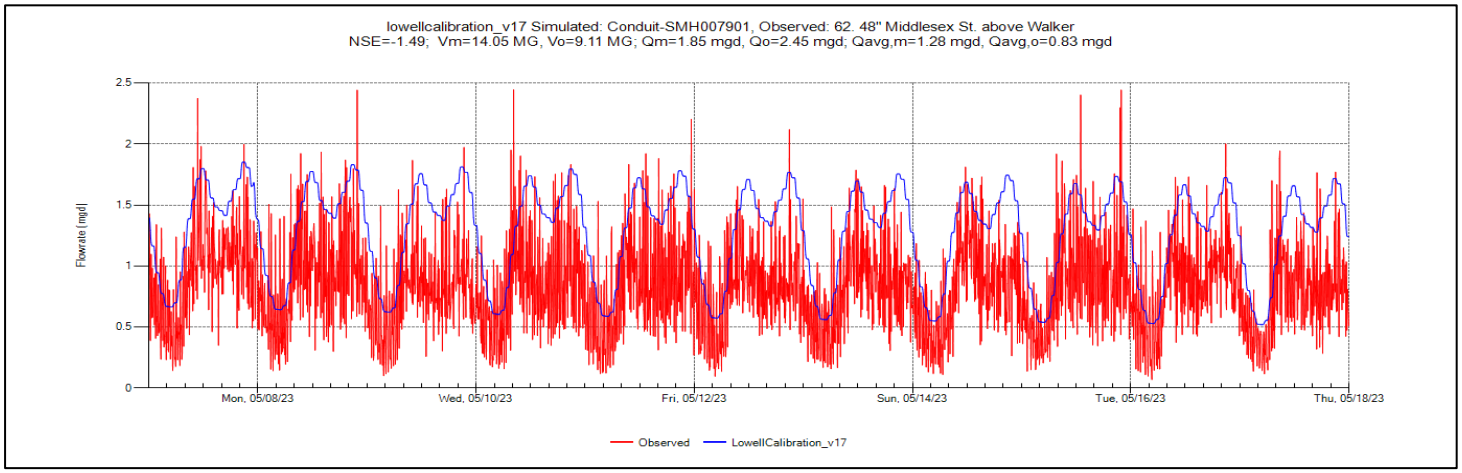


Simulated Versus Observed Flow at Flow Meter Sites

62-DryPeriod

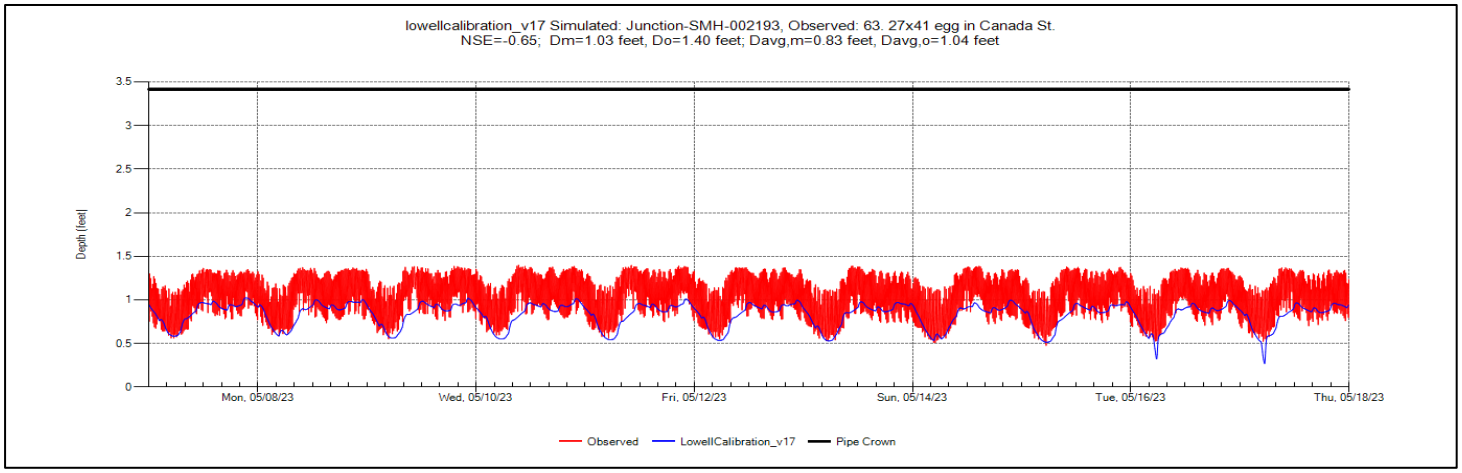


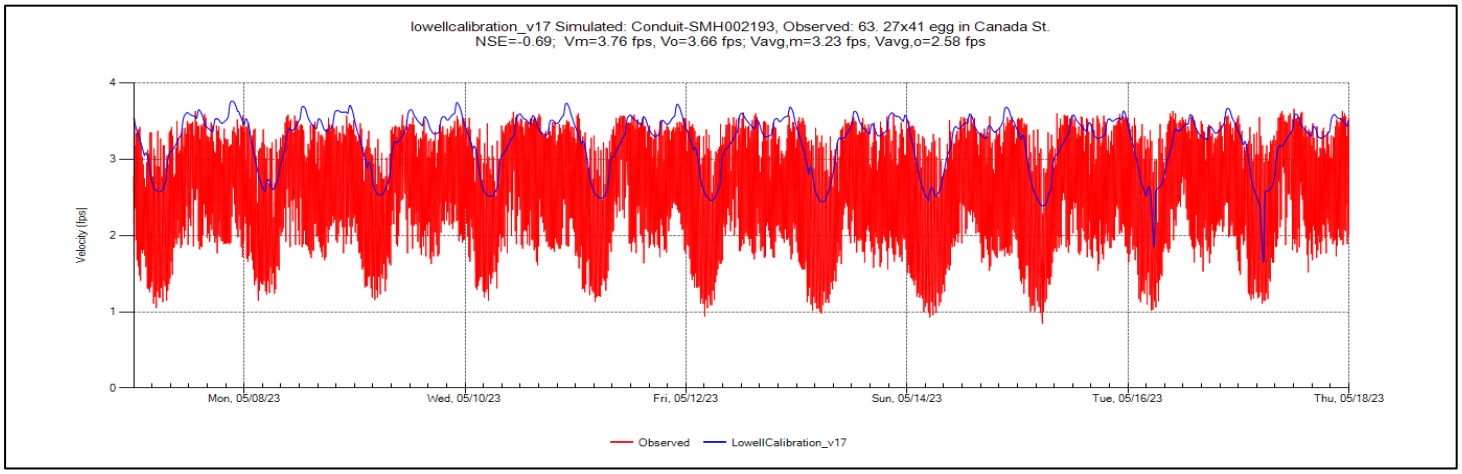


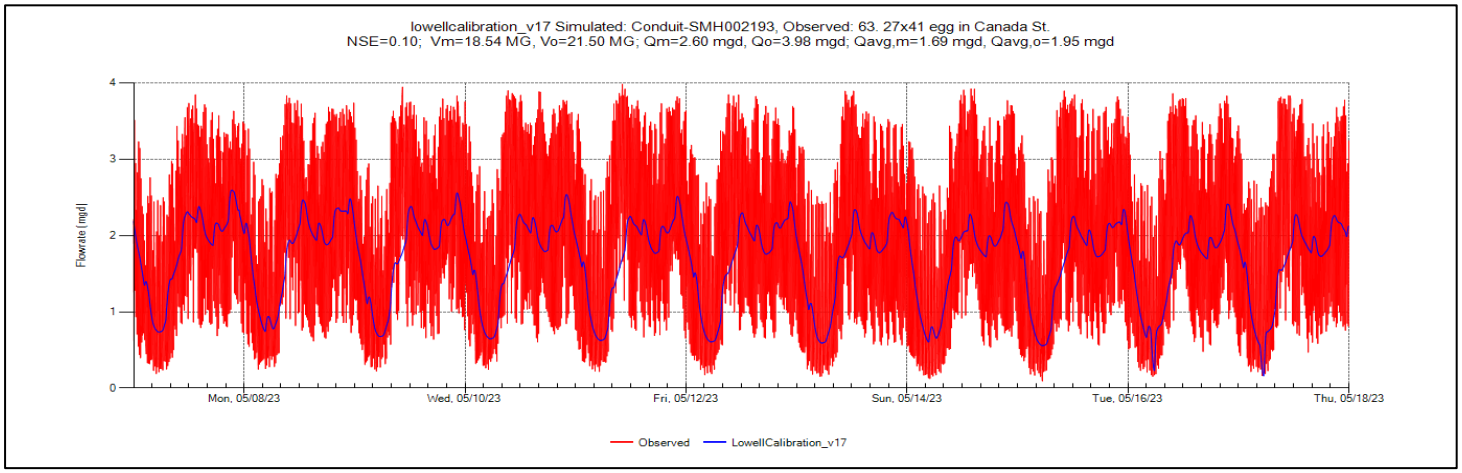


Simulated Versus Observed Flow at Flow Meter Sites

63-DryPeriod





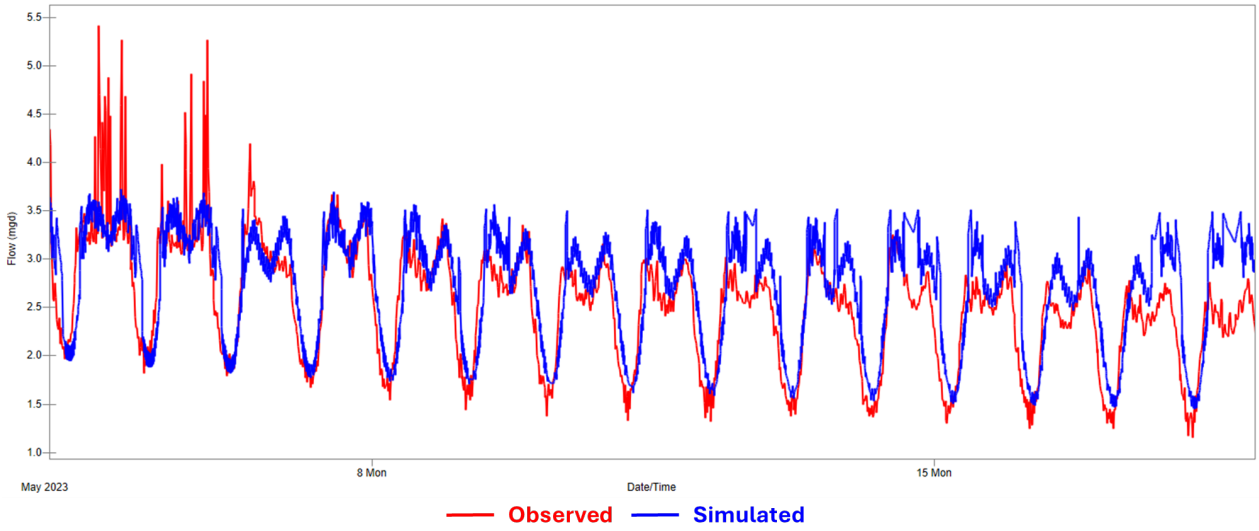


Dry Weather Timeseries CSO Diversion Structures

CSO Diversion Stations: Dry Weather Period

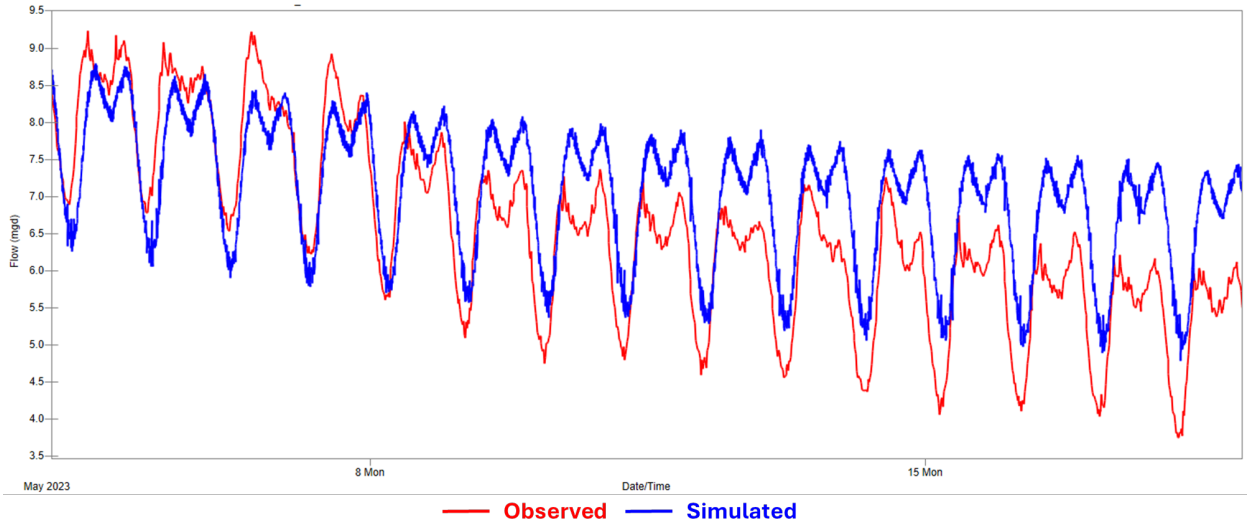
Walker

Station Flow (mgd)



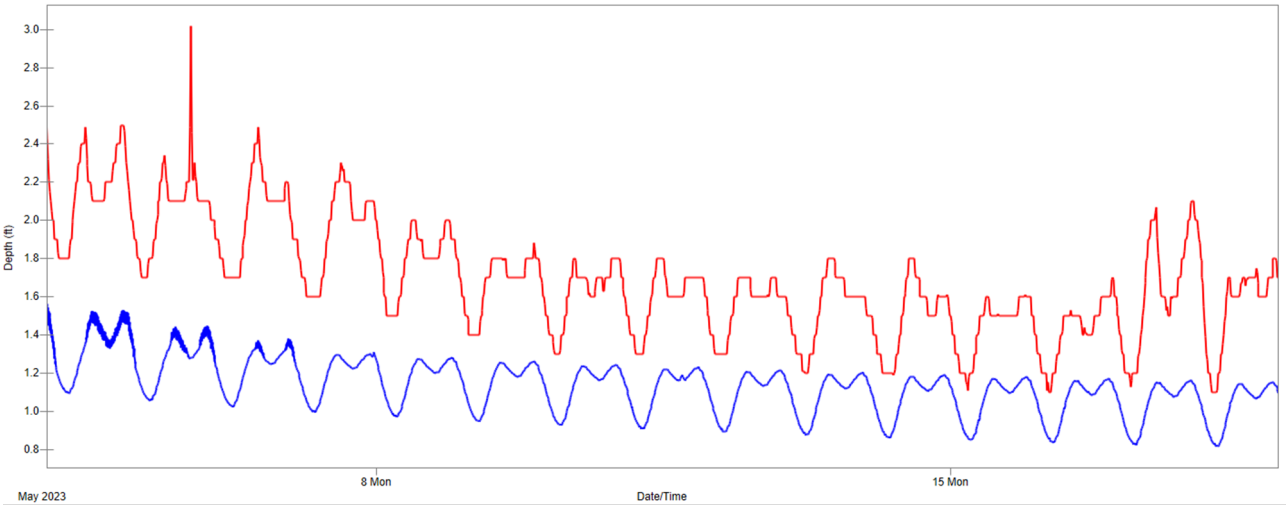
Beaver Brook

Station Flow (mgd)



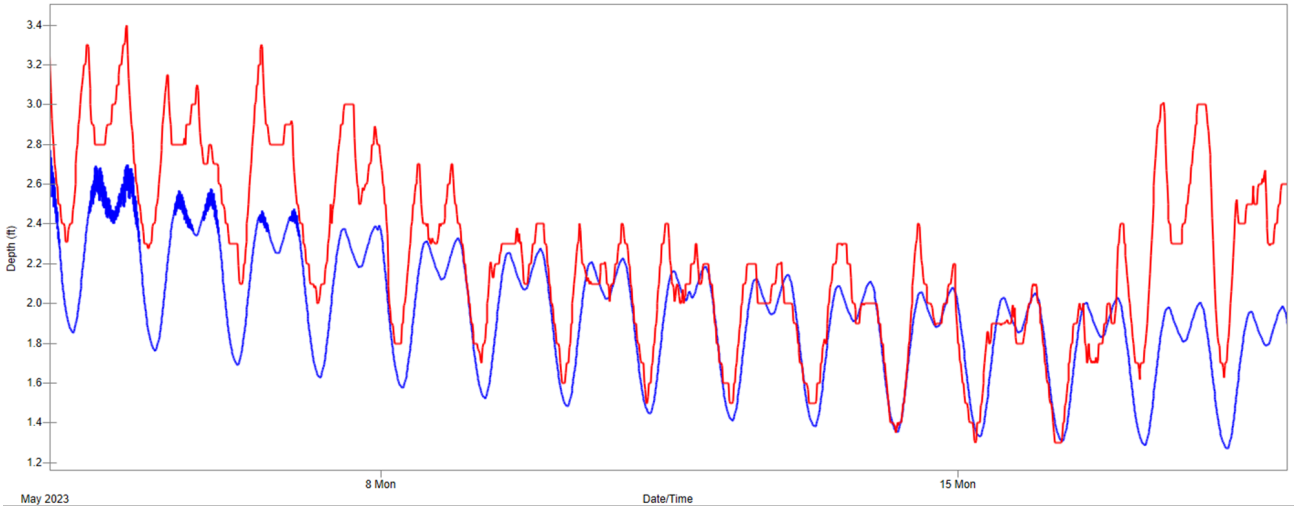
West Street

Interceptor Depth (ft)



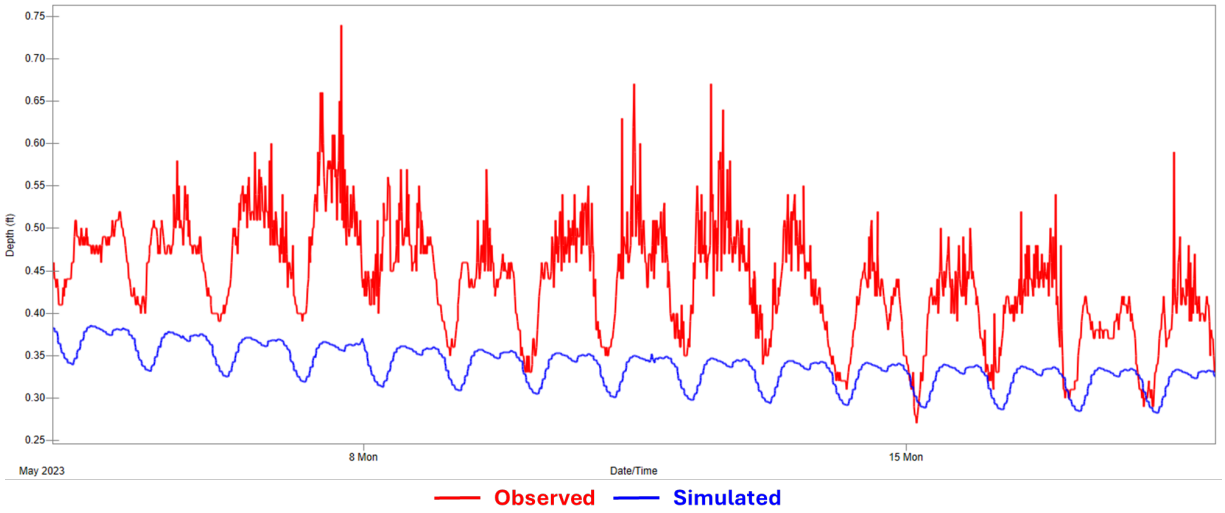
North Bank Control Station

Station Depth (ft)



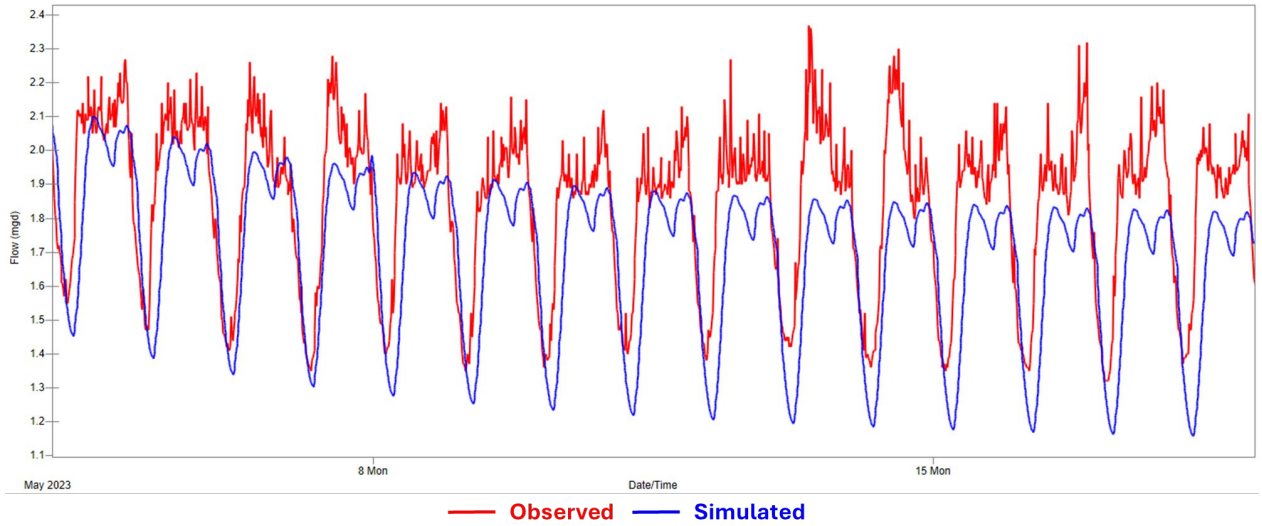
Read Street

Influent Channel Depth (ft)



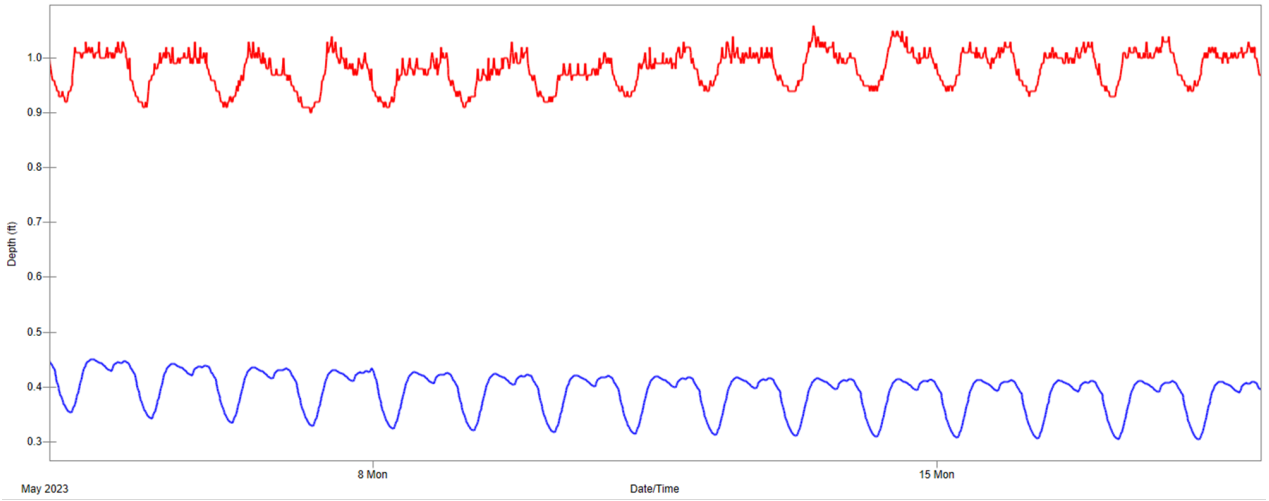
Tilden

Station Flow (mgd)



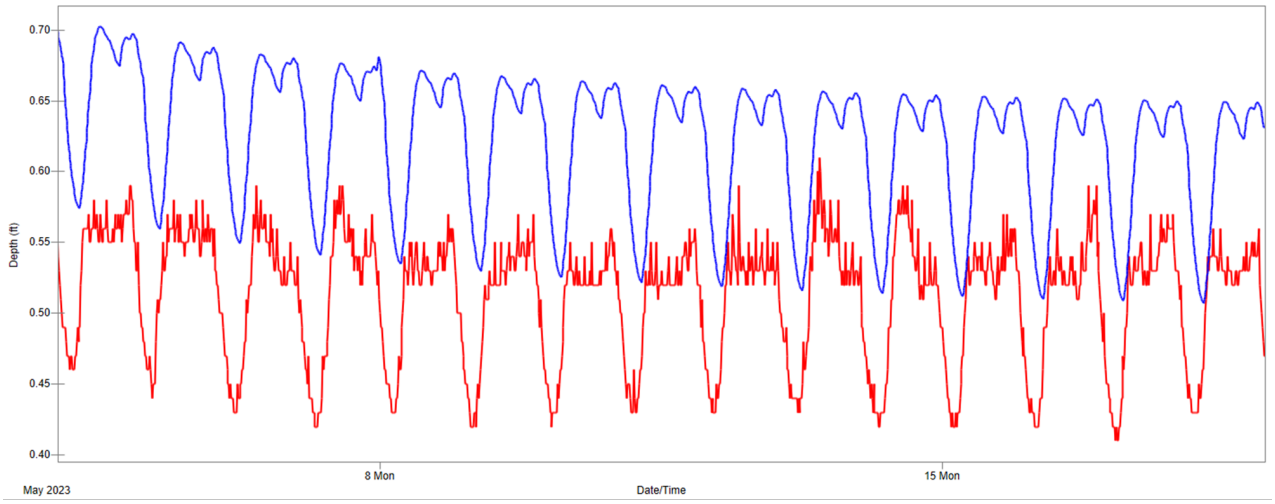
Tilden

Influent Channel Depth (ft)



Observed Simulated

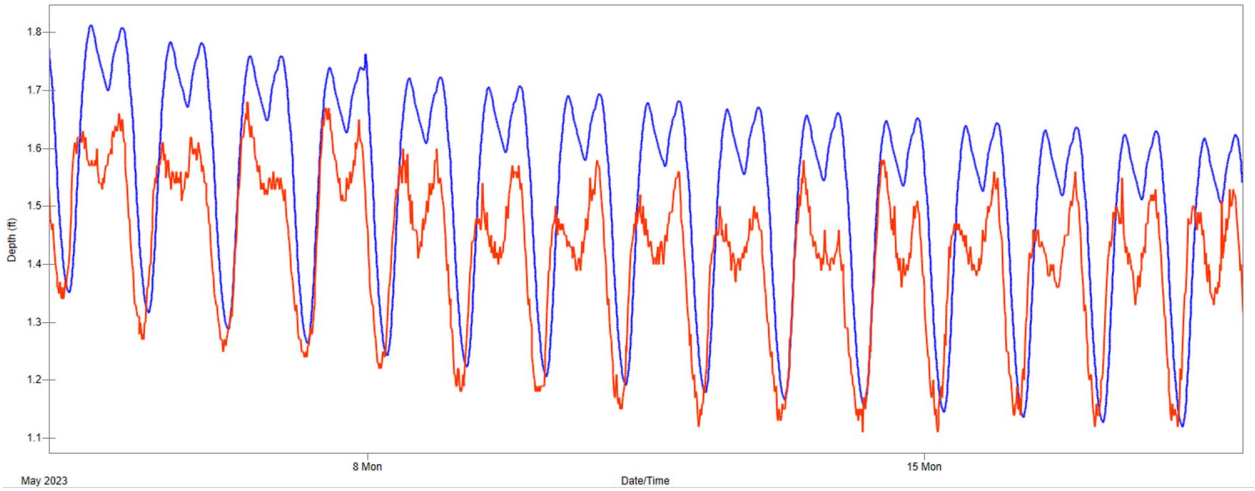
Tilden Flume Depth (ft)



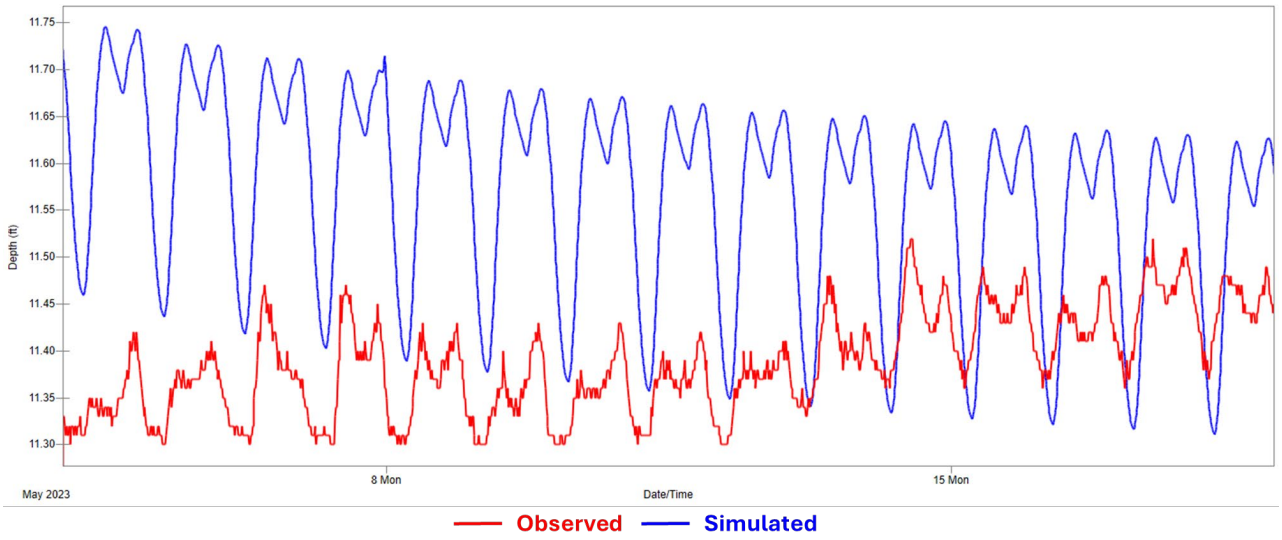
Observed Simulated

Warren

Influent Depth (ft)

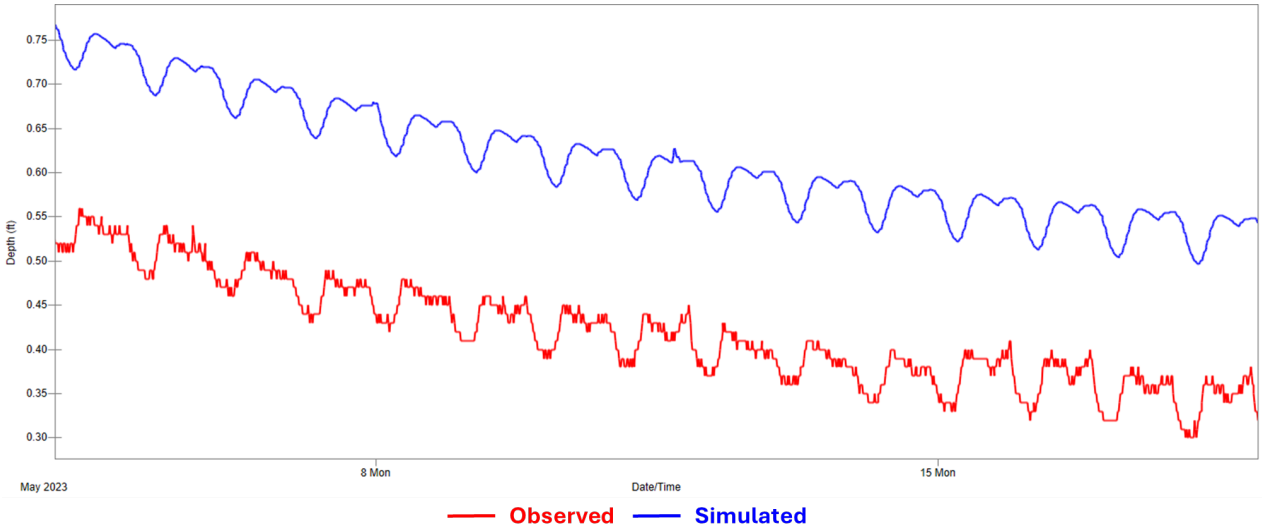


Siphon Depth (ft)

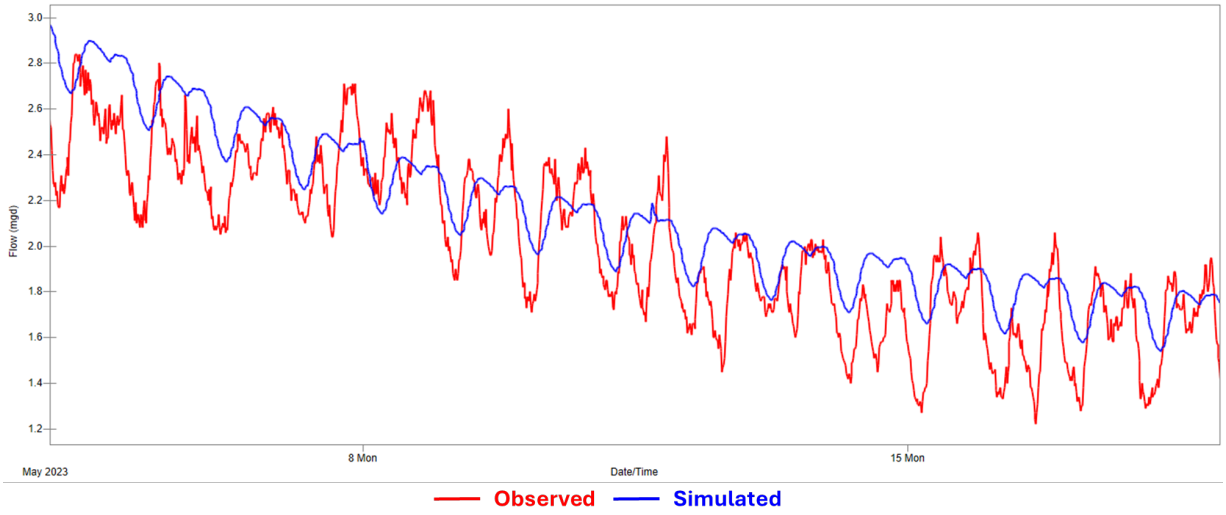


Barasford

Influent Depth (ft)

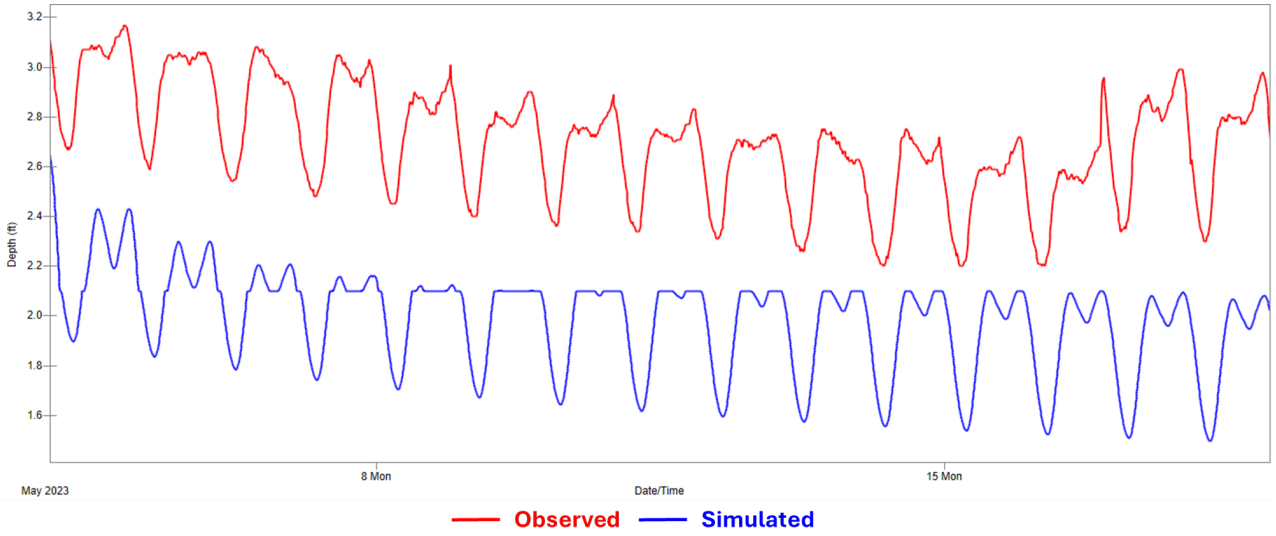


Station Flow (mgd)



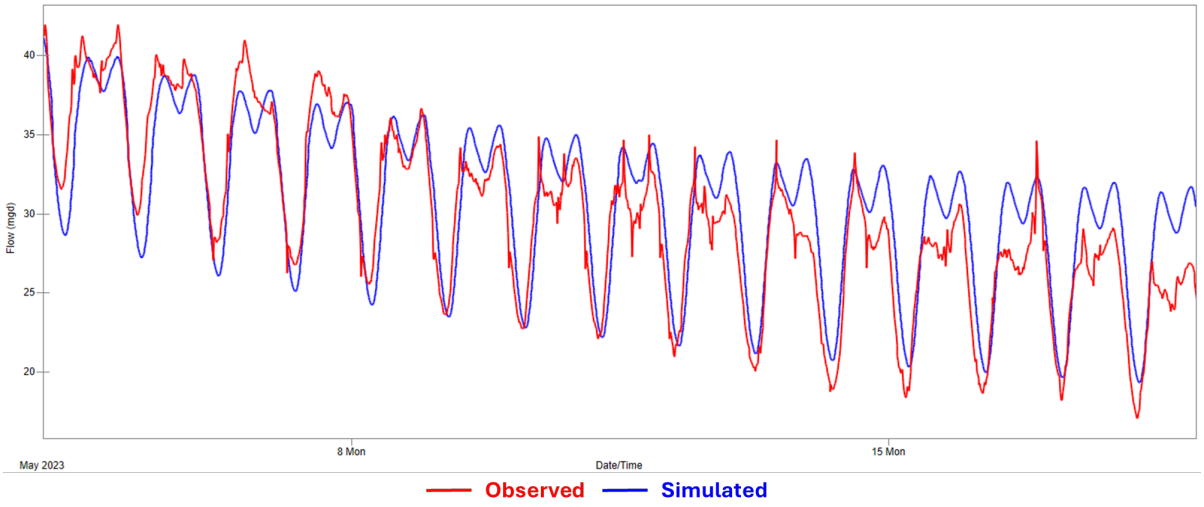
Merrimack

Station Depth (ft)



Duck Island

Effluent Flow (mgd)

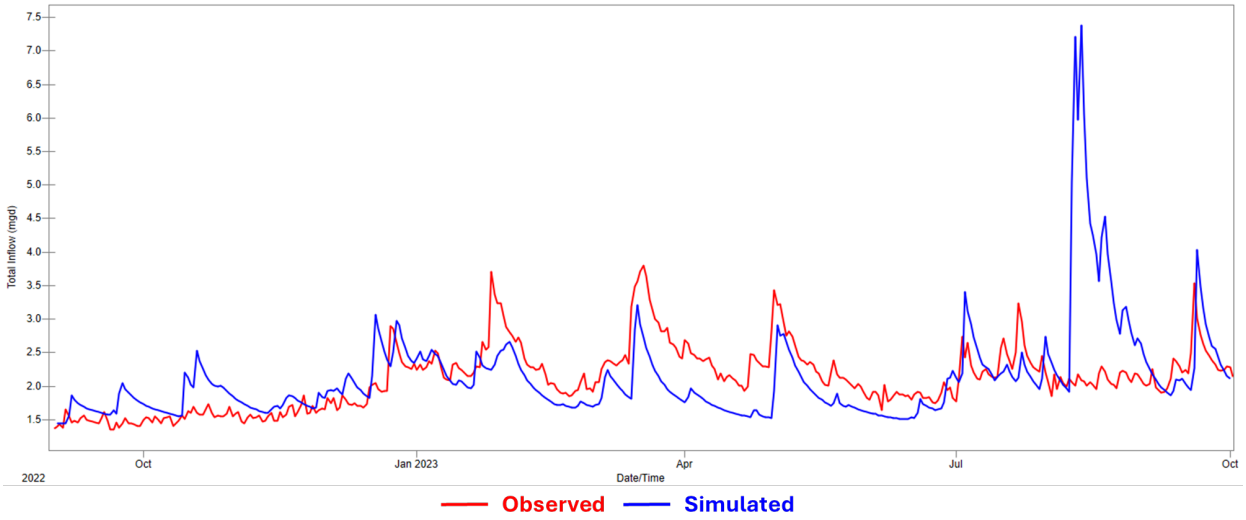


Community Meters 2022-2023

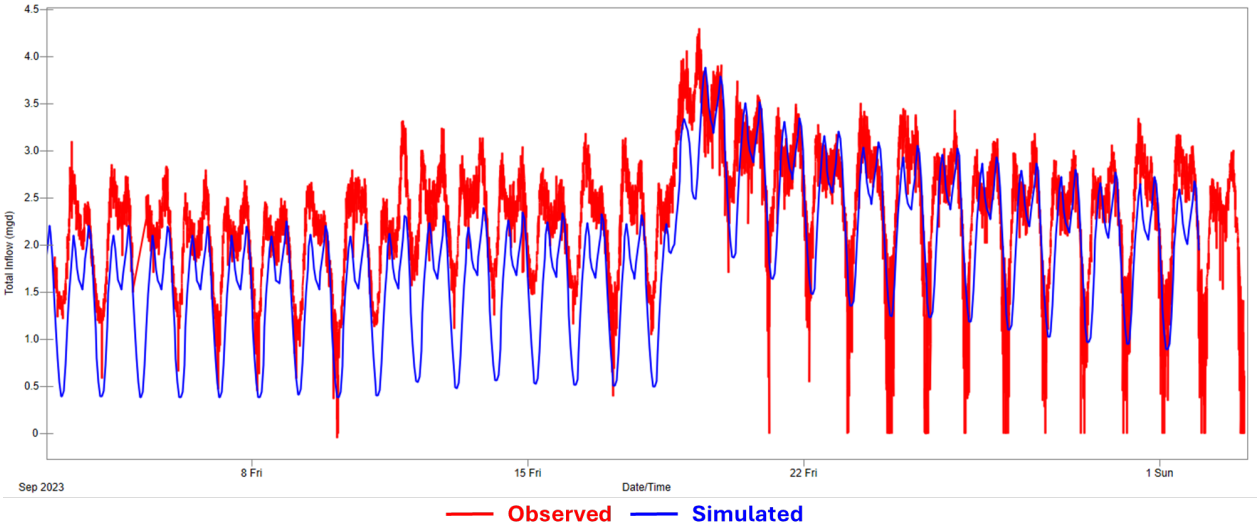
Community Meters

Dracut – Book

Daily Inflow (mgd): 9/22/2022-10/1/2023

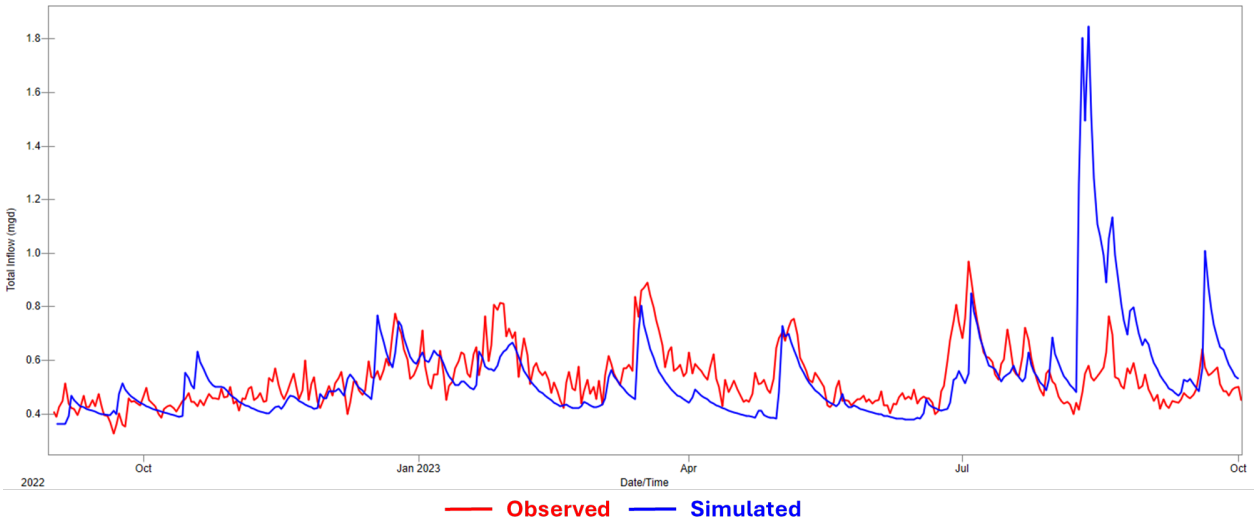


Hourly Inflow (mgd):

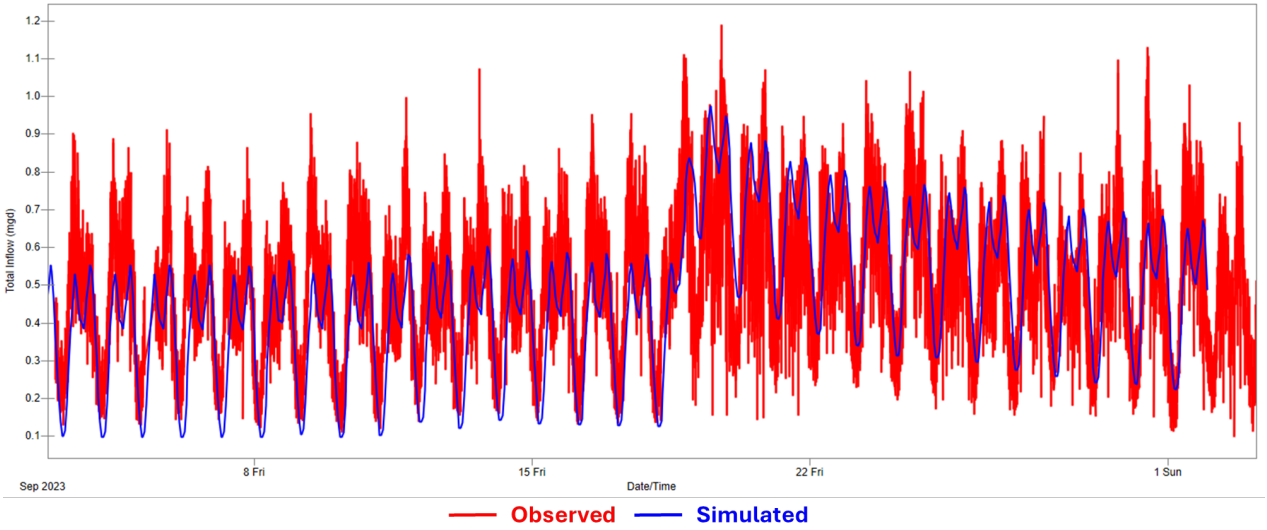


Dracut – First

Daily Inflow (mgd): 9/22/2022-10/1/2023

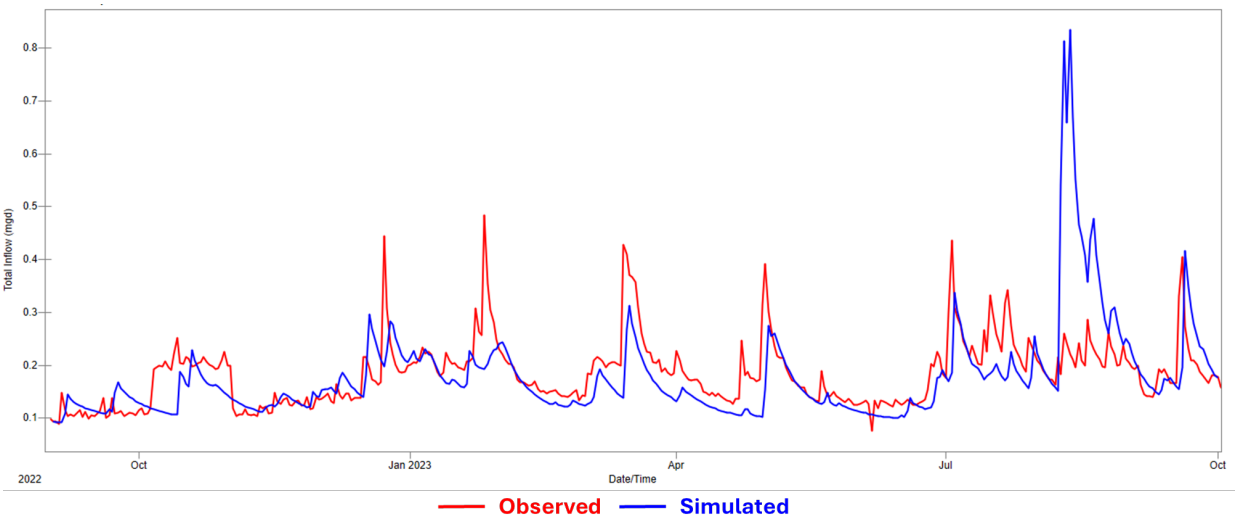


Hourly Inflow (mgd):

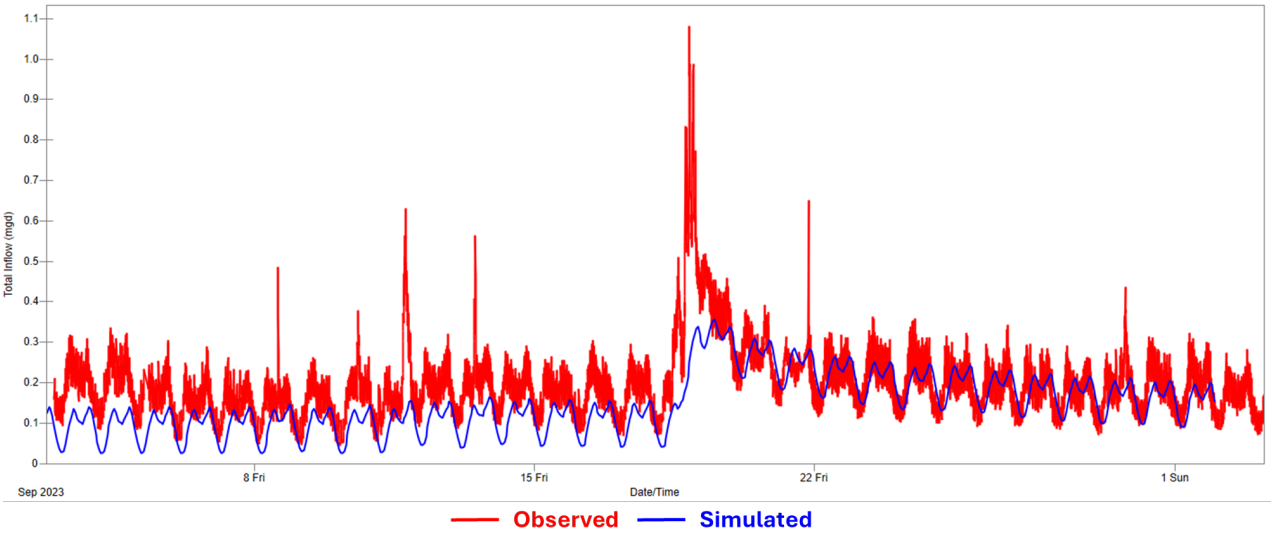


Dracut – Willard

Daily Inflow (mgd): 9/22/2022-10/1/2023

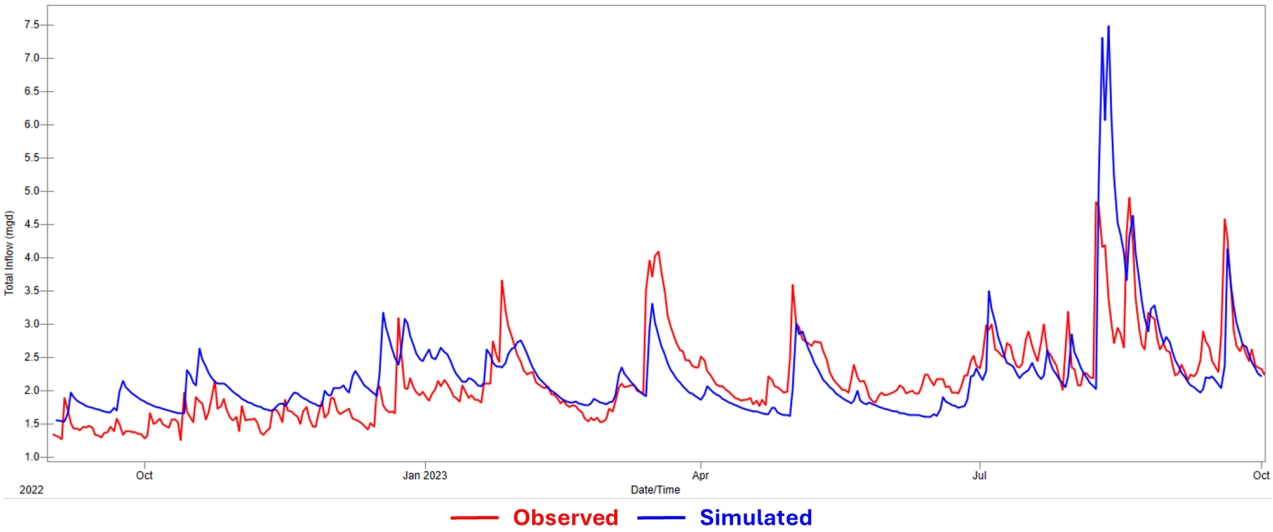


Hourly Inflow (mgd):

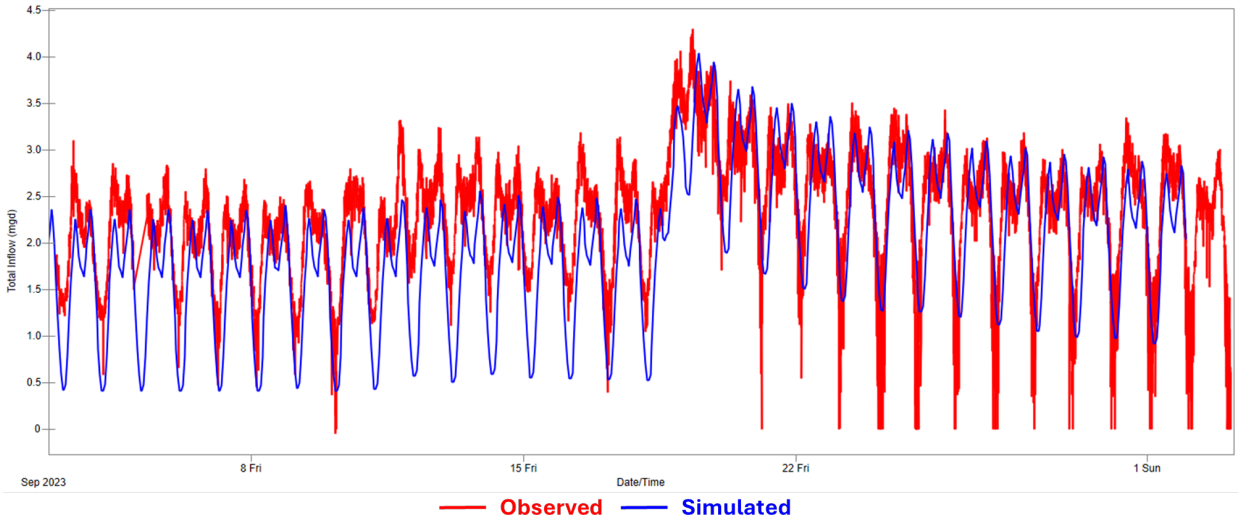


Tewksbury – Merrimack

Daily Inflow (mgd): 9/22/2022-10/1/2023



Hourly Inflow (mgd):

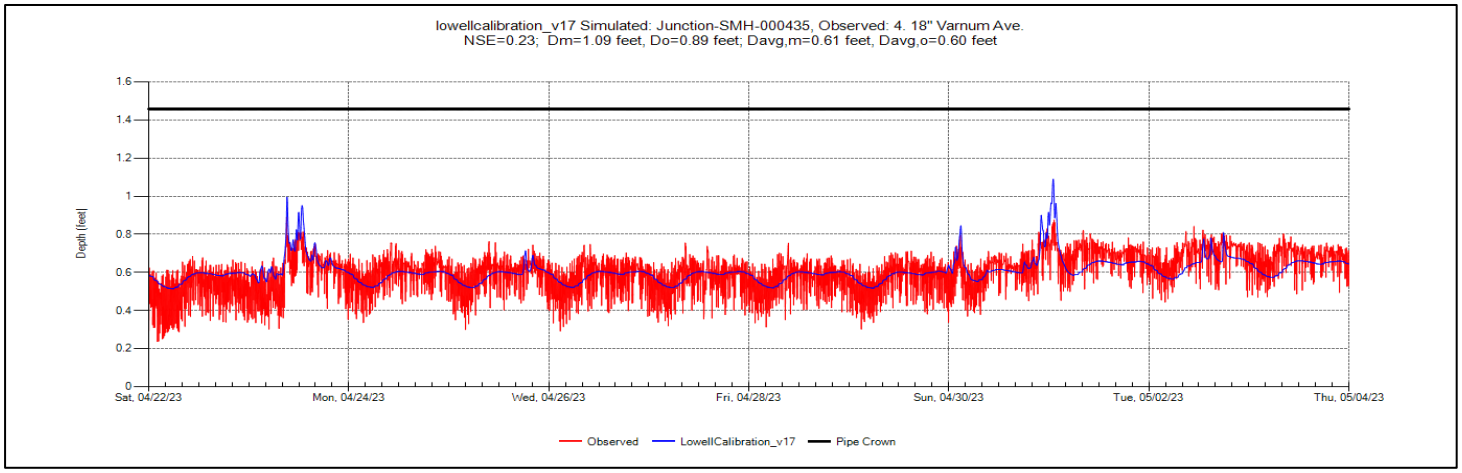


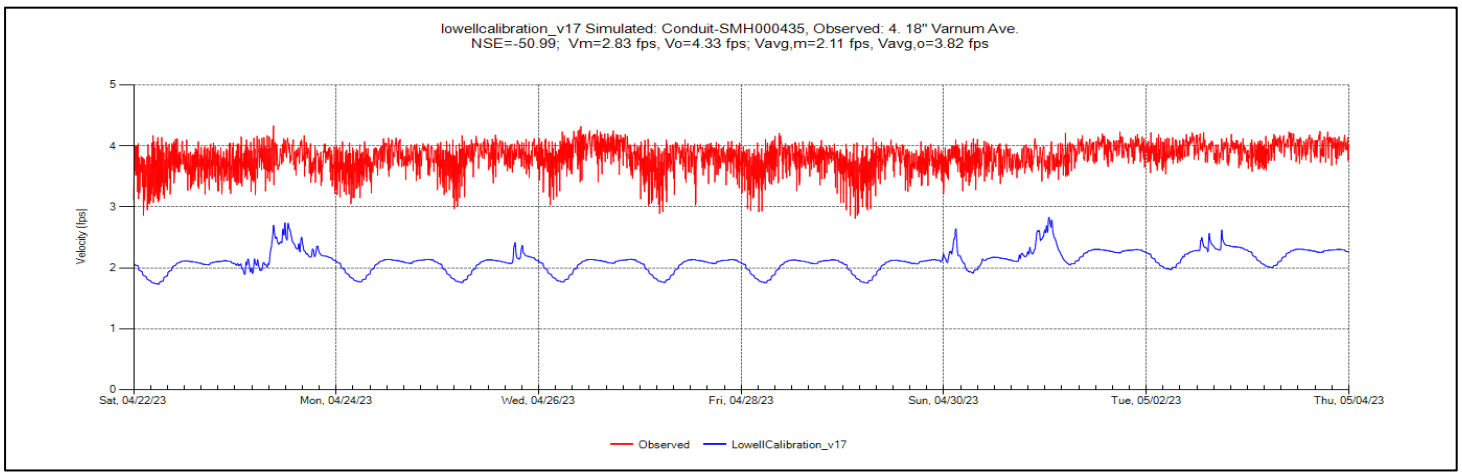
Attachment 2

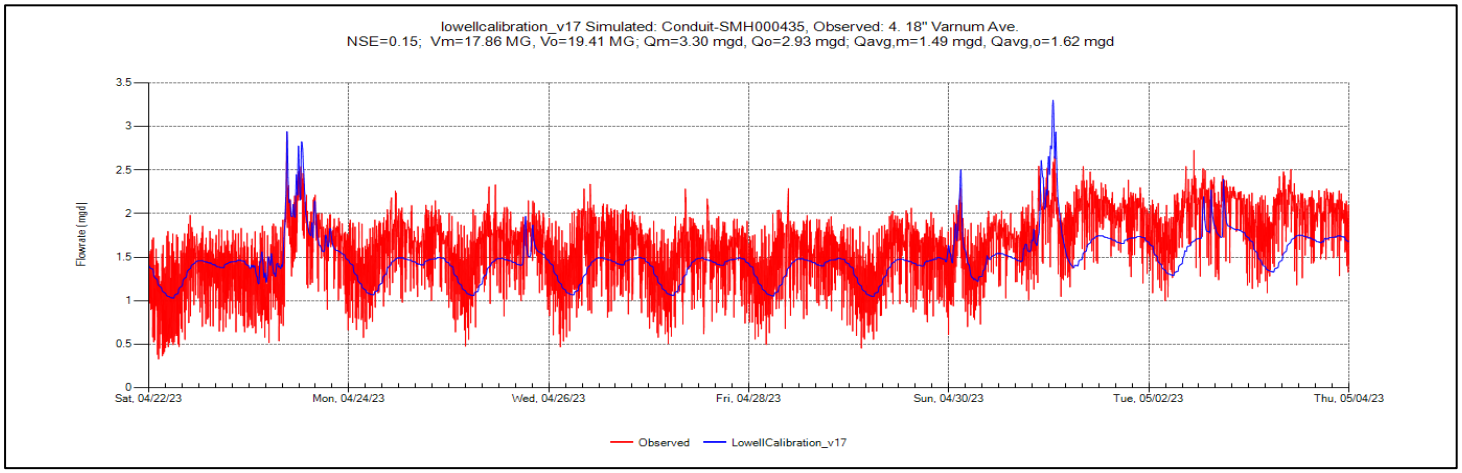
Wet Weather Timeseries Temporary Meters
April-May Storms

Simulated Versus Observed Flow at Flow Meter Sites

04-April-May Storms

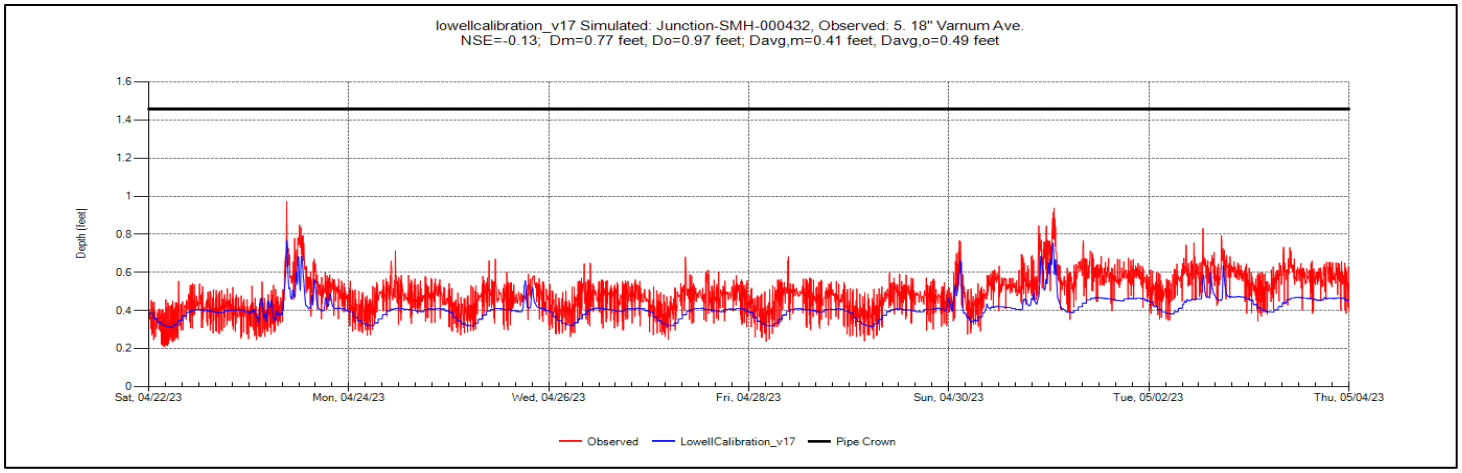


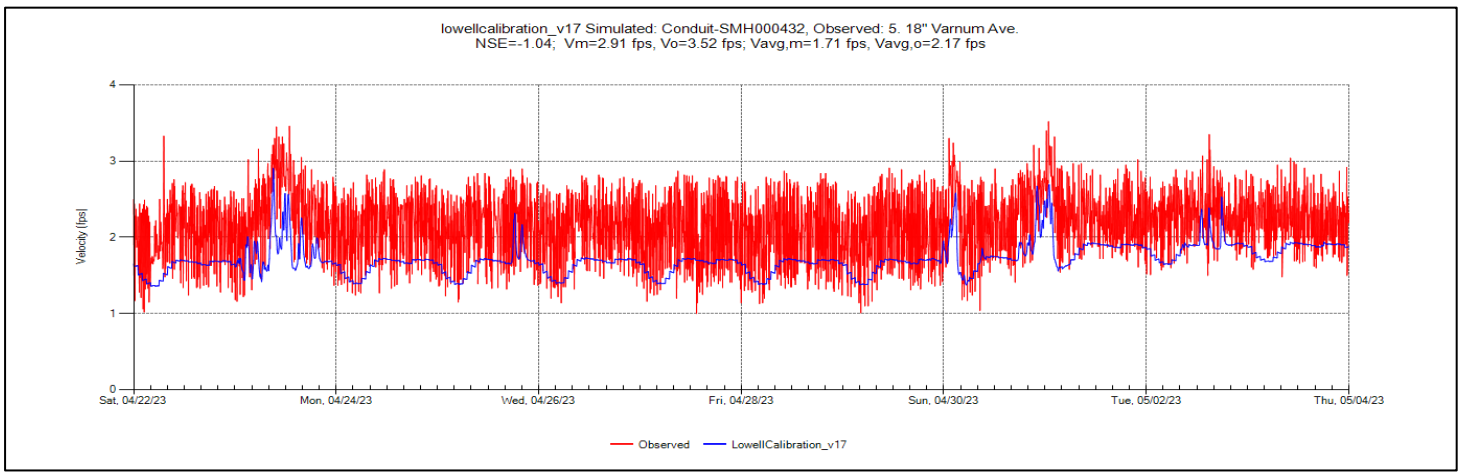


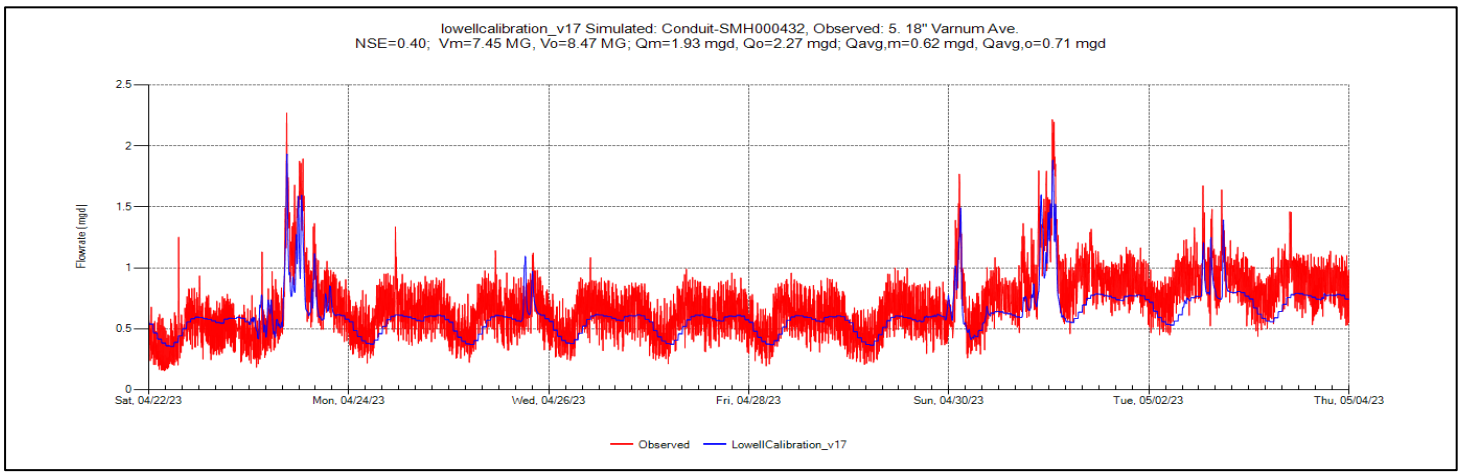


Simulated Versus Observed Flow at Flow Meter Sites

05-April-May Storms

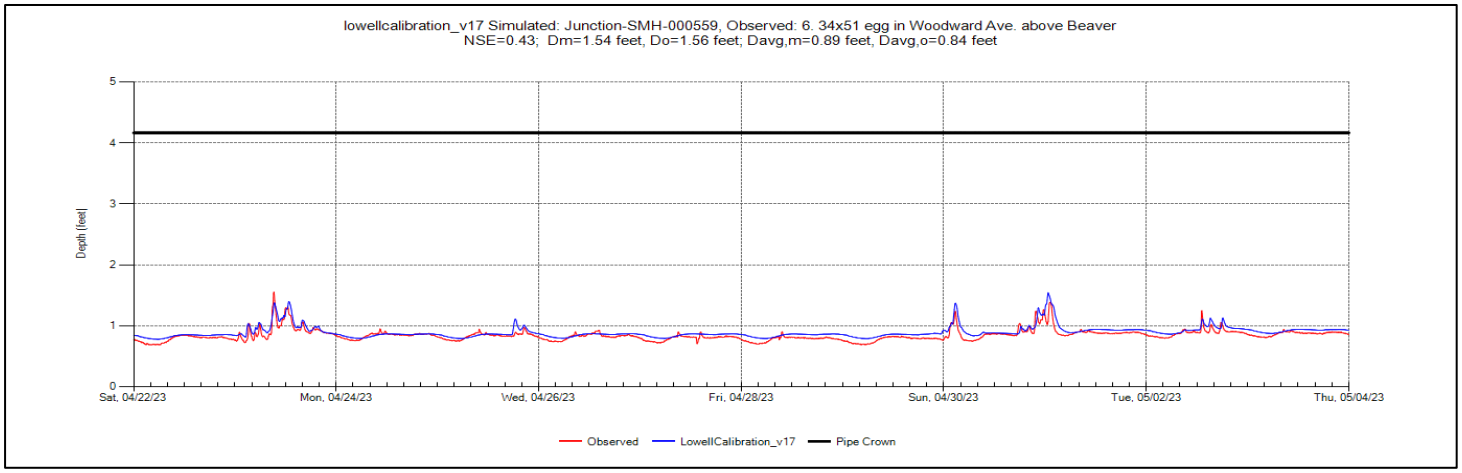


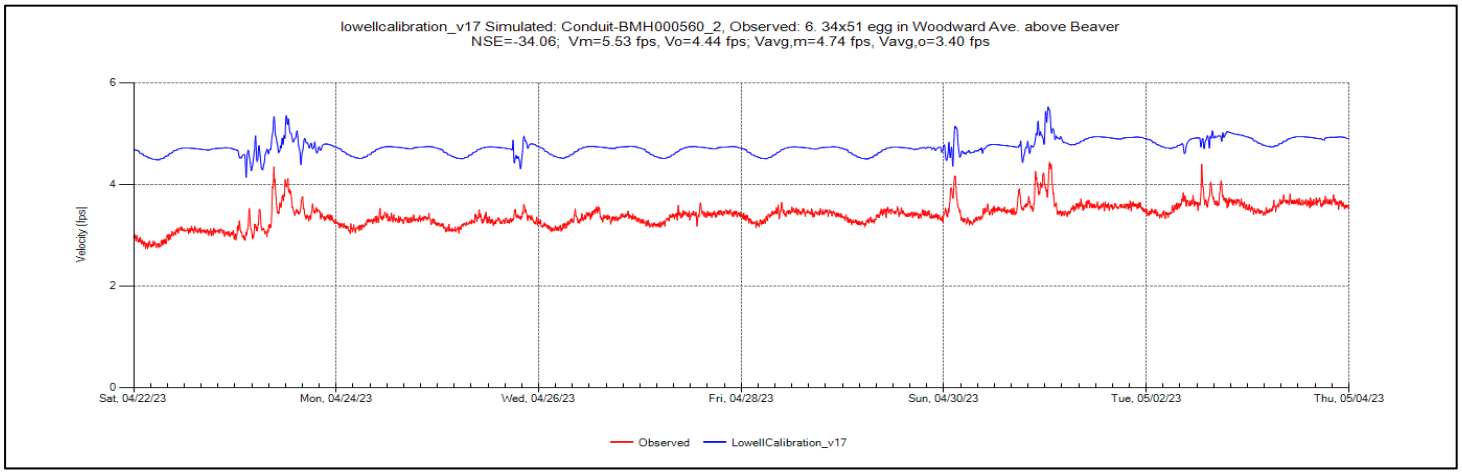


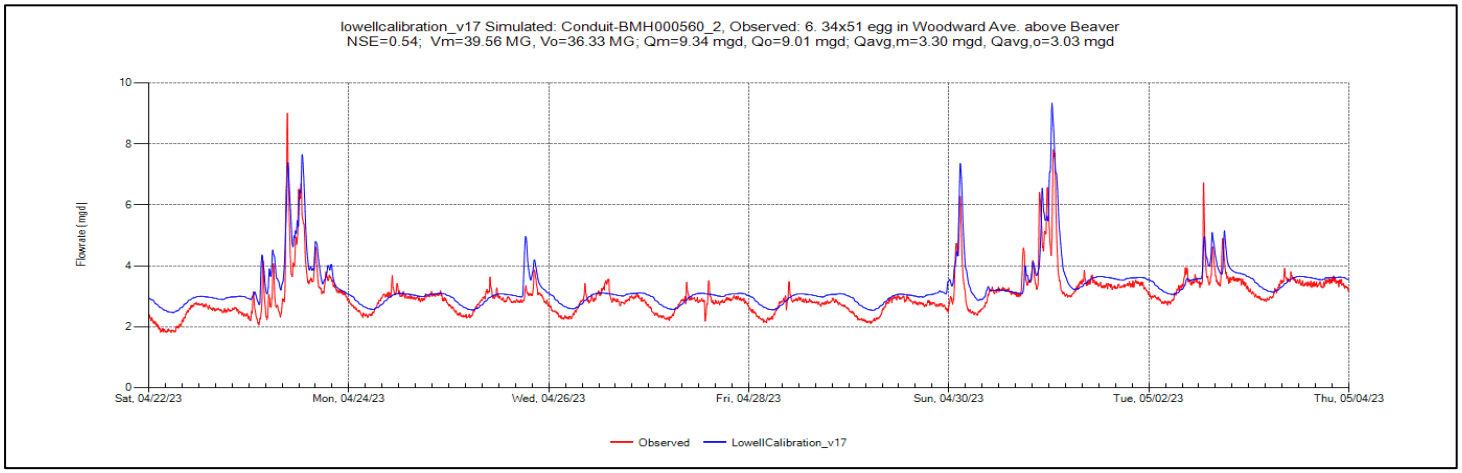


Simulated Versus Observed Flow at Flow Meter Sites

06-April-May Storms

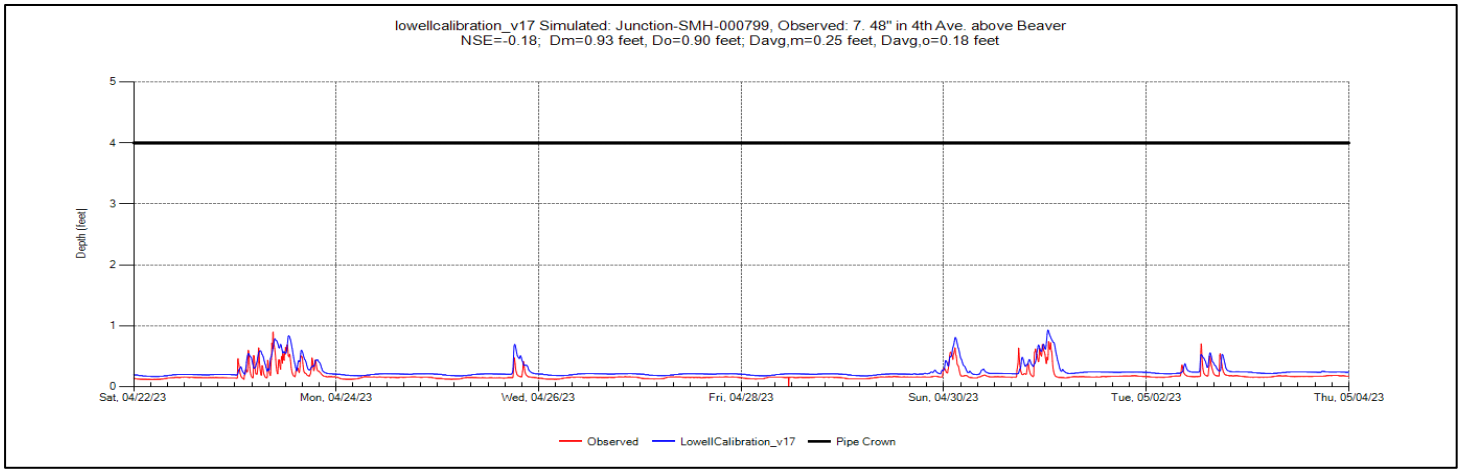


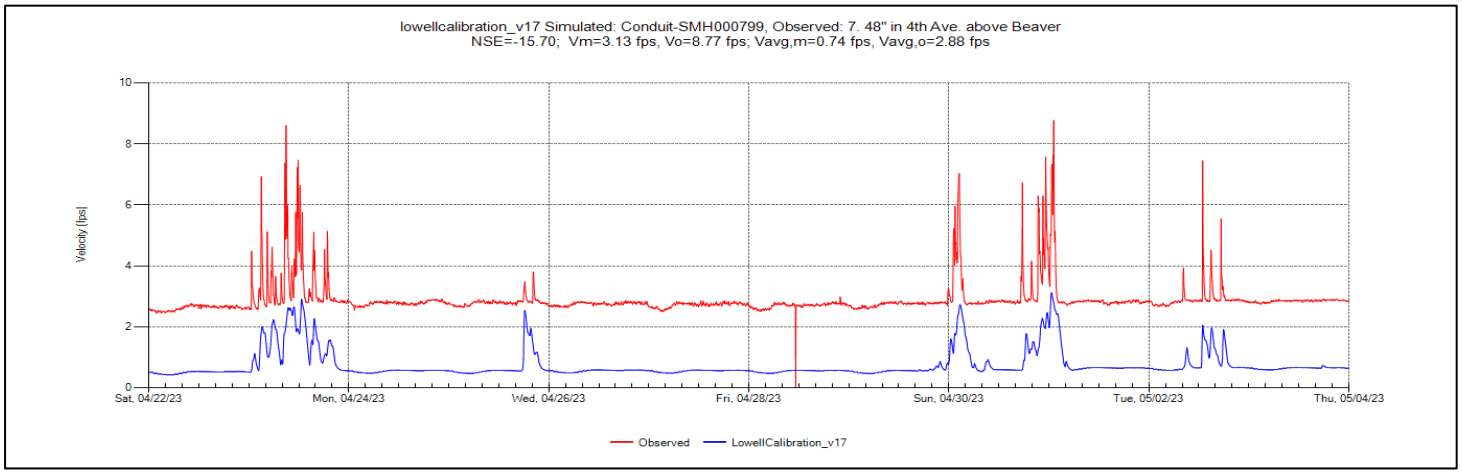


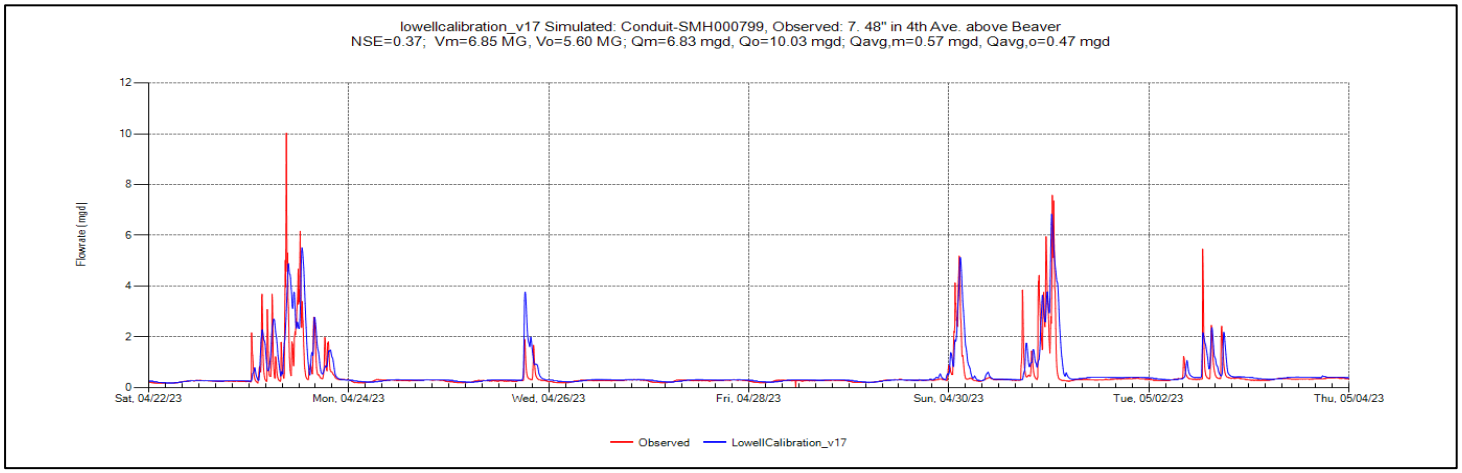


Simulated Versus Observed Flow at Flow Meter Sites

07-April-May Storms

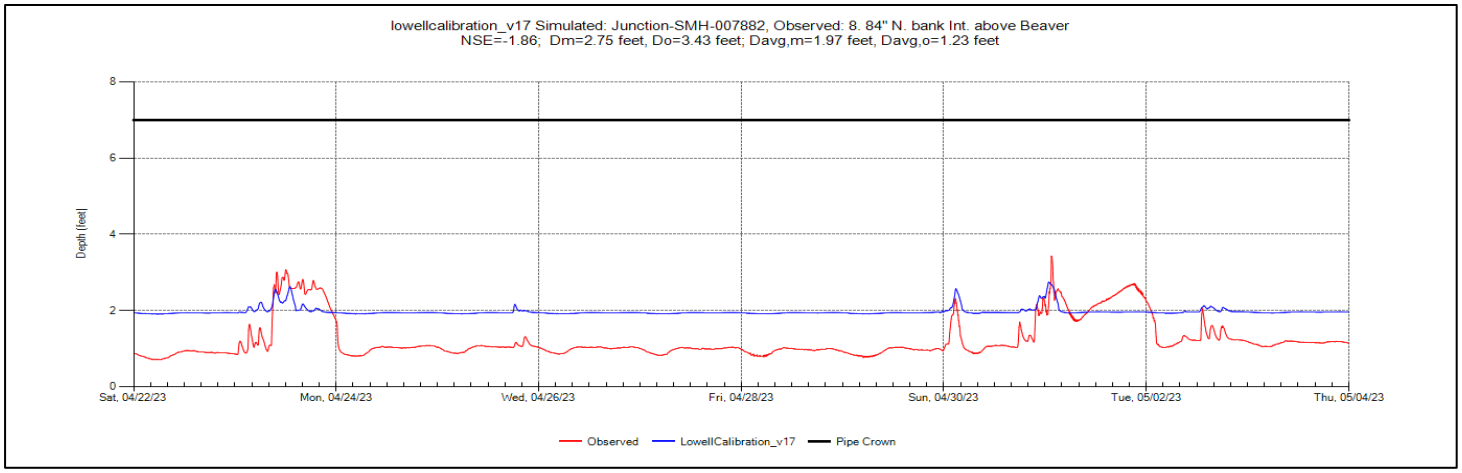


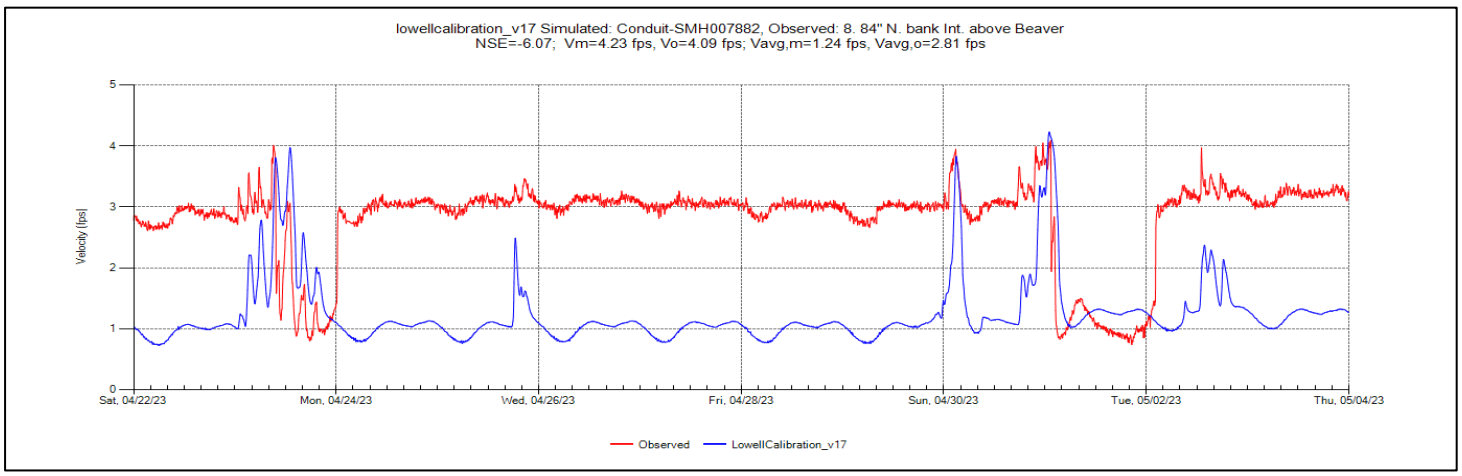


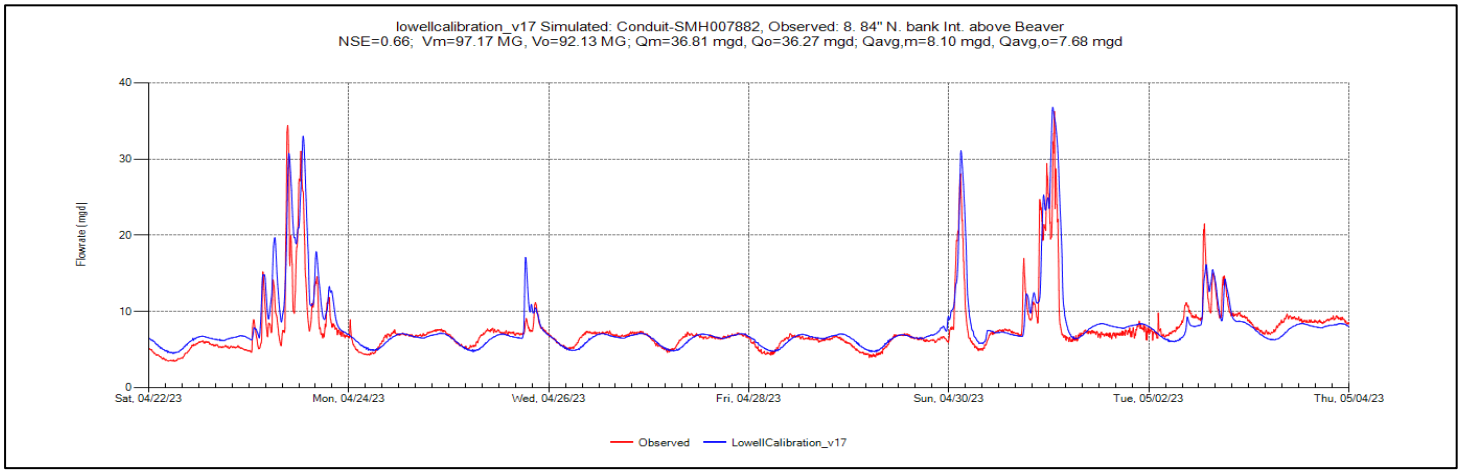


Simulated Versus Observed Flow at Flow Meter Sites

08-April-May Storms

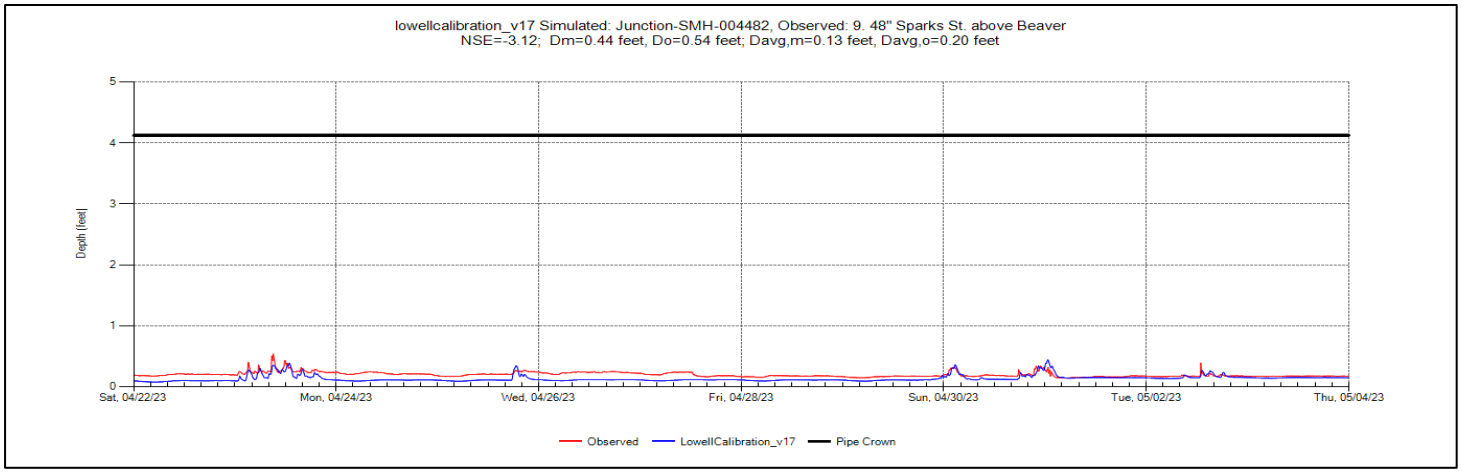


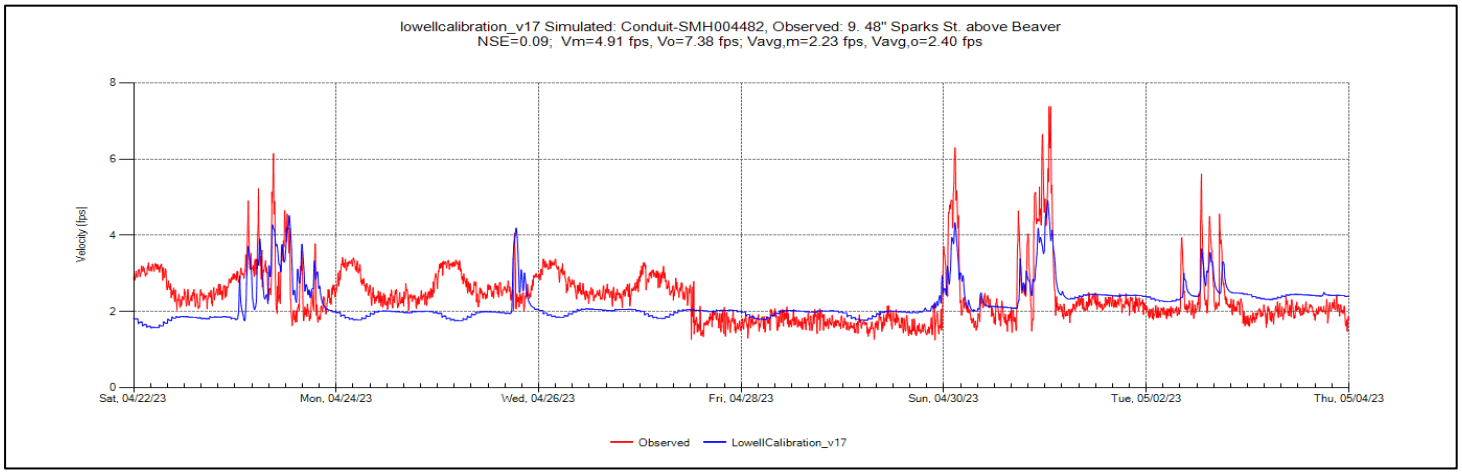


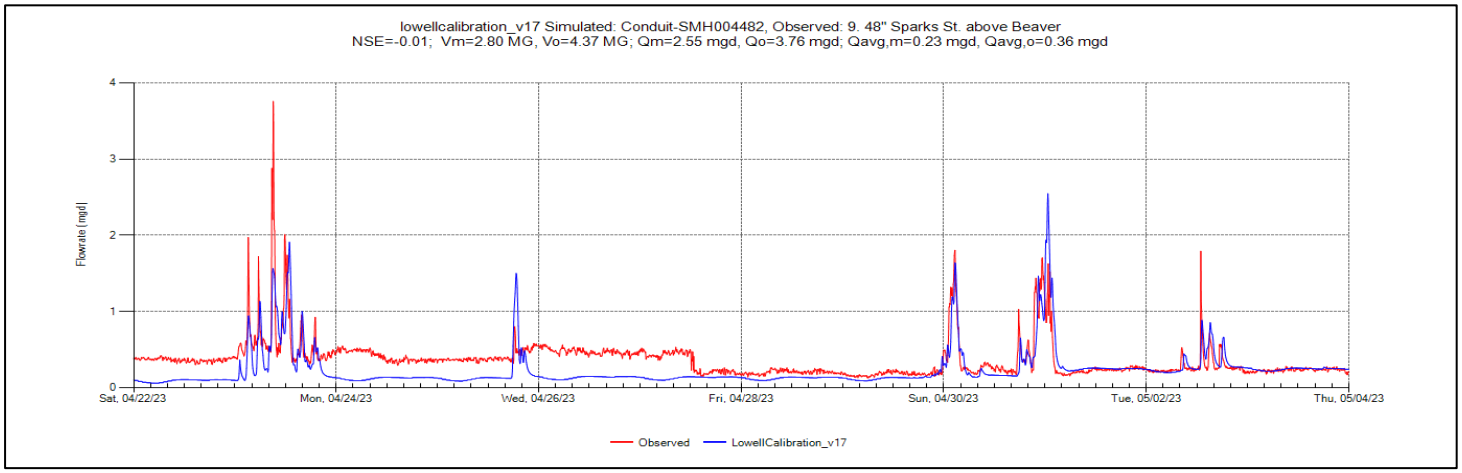


Simulated Versus Observed Flow at Flow Meter Sites

09-April-May Storms

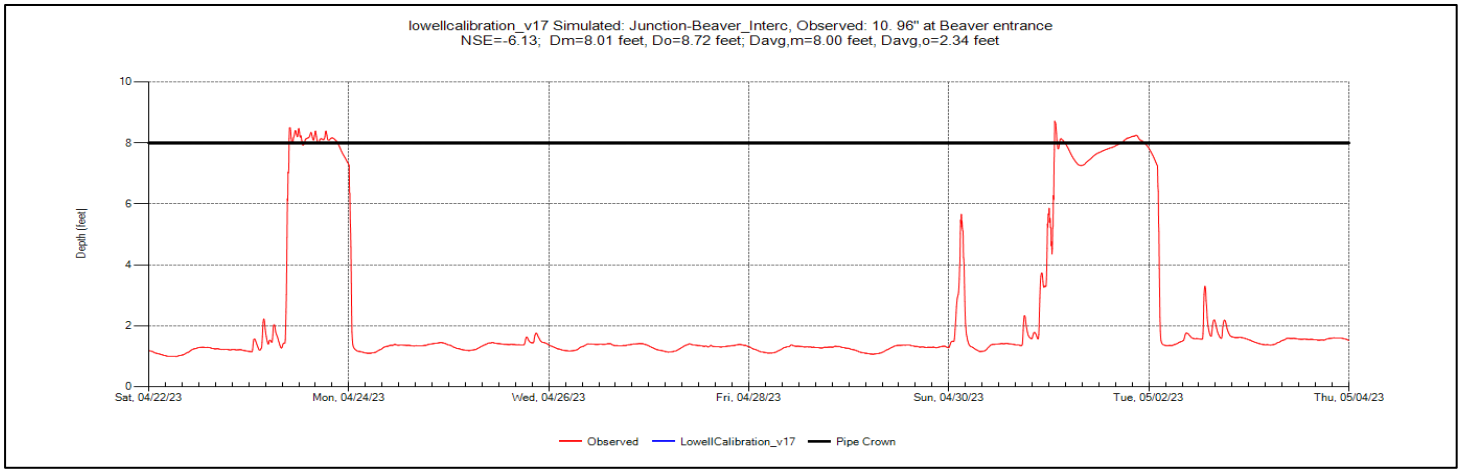


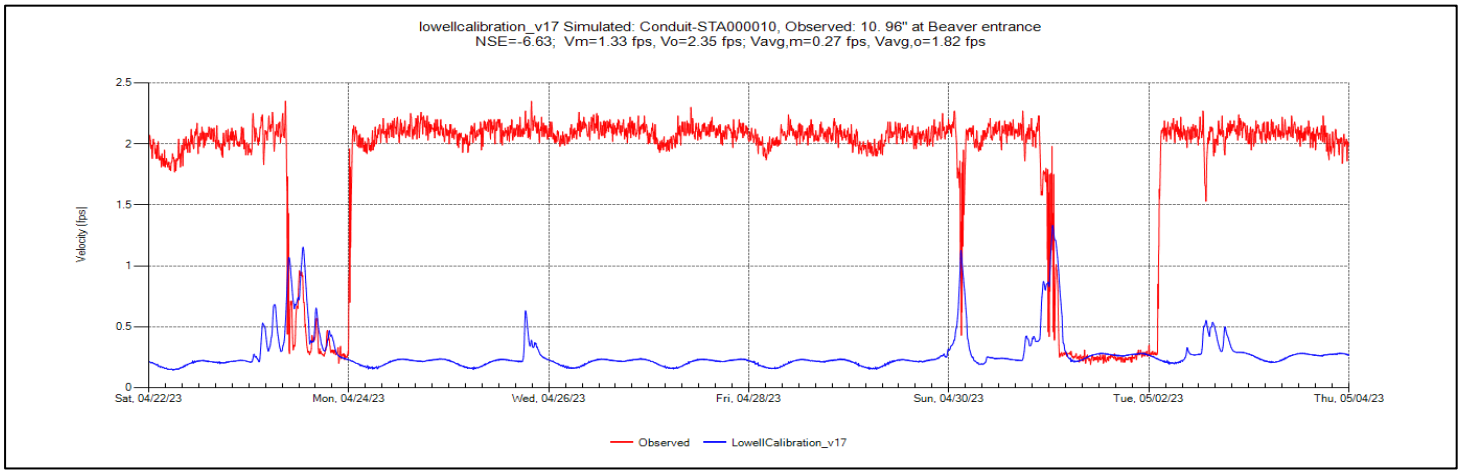


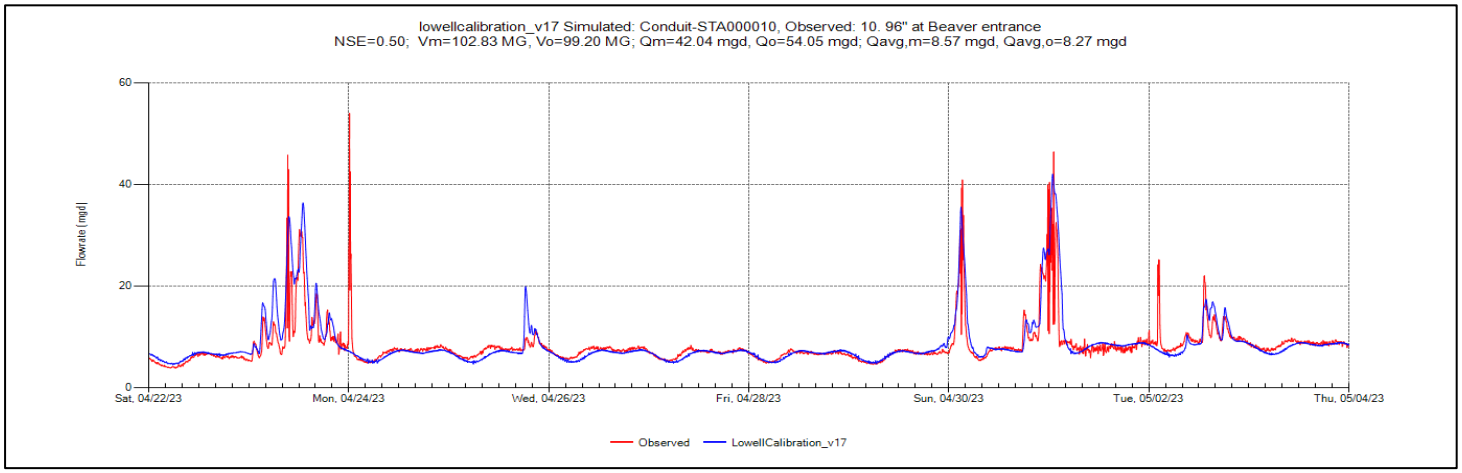


Simulated Versus Observed Flow at Flow Meter Sites

10-April-May Storms

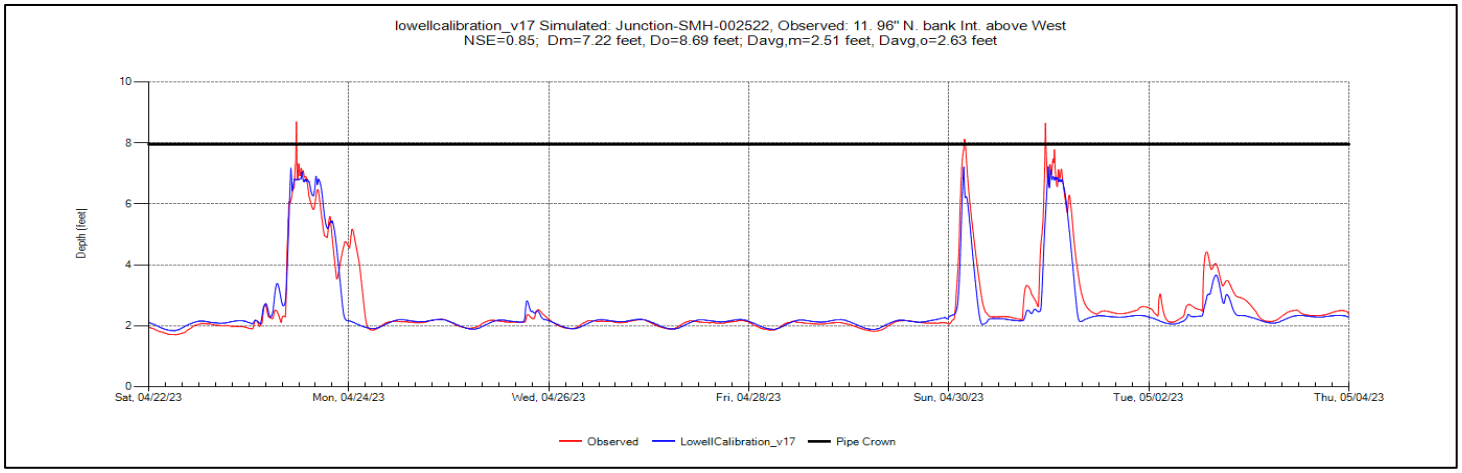


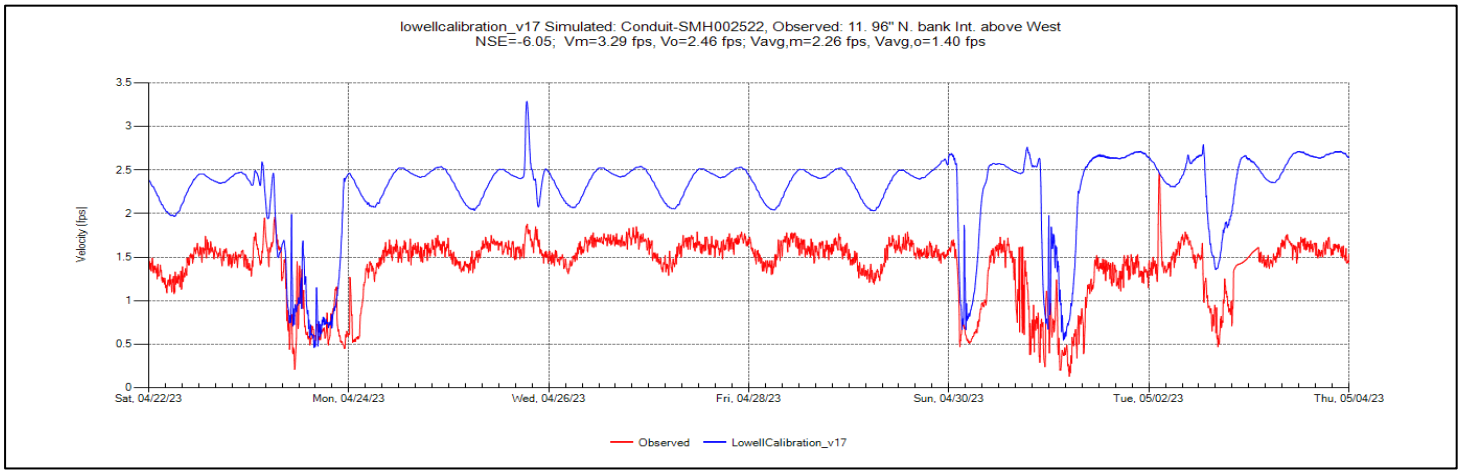


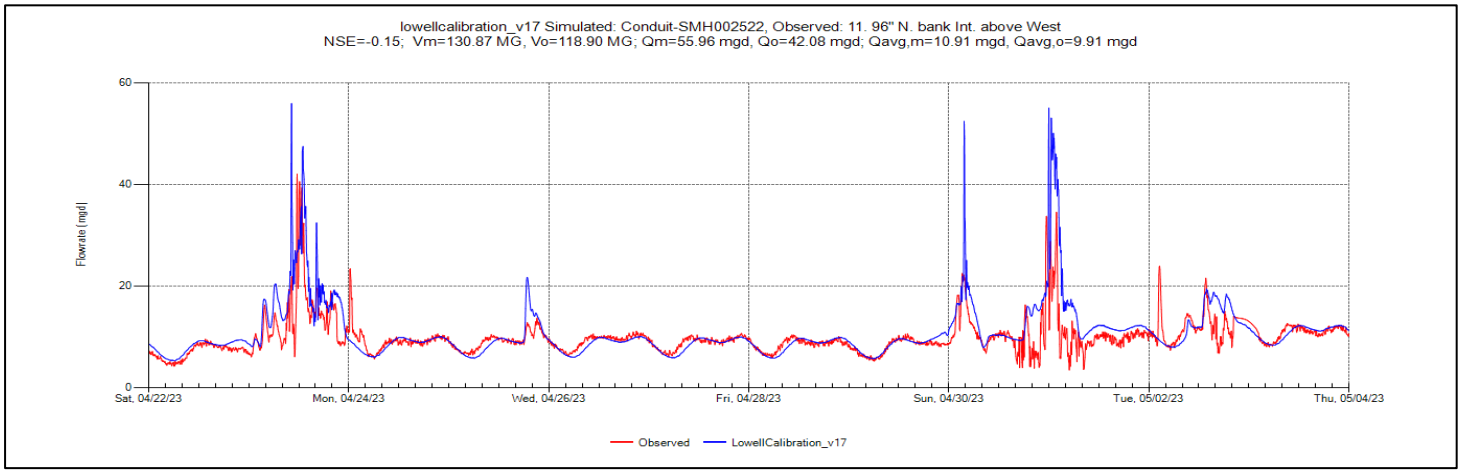


Simulated Versus Observed Flow at Flow Meter Sites

11-April-May Storms

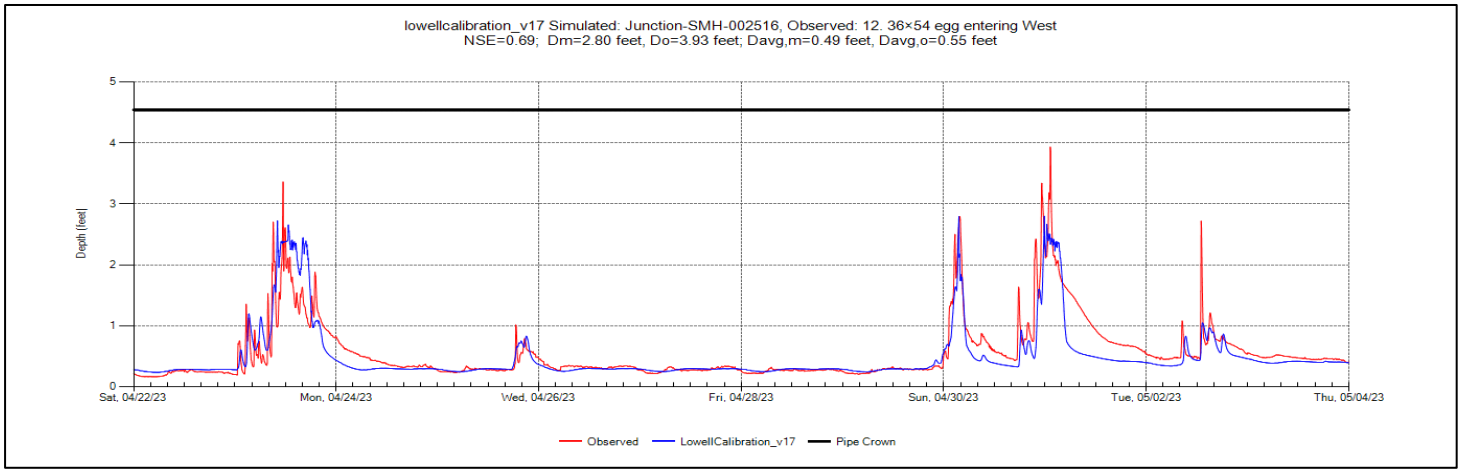


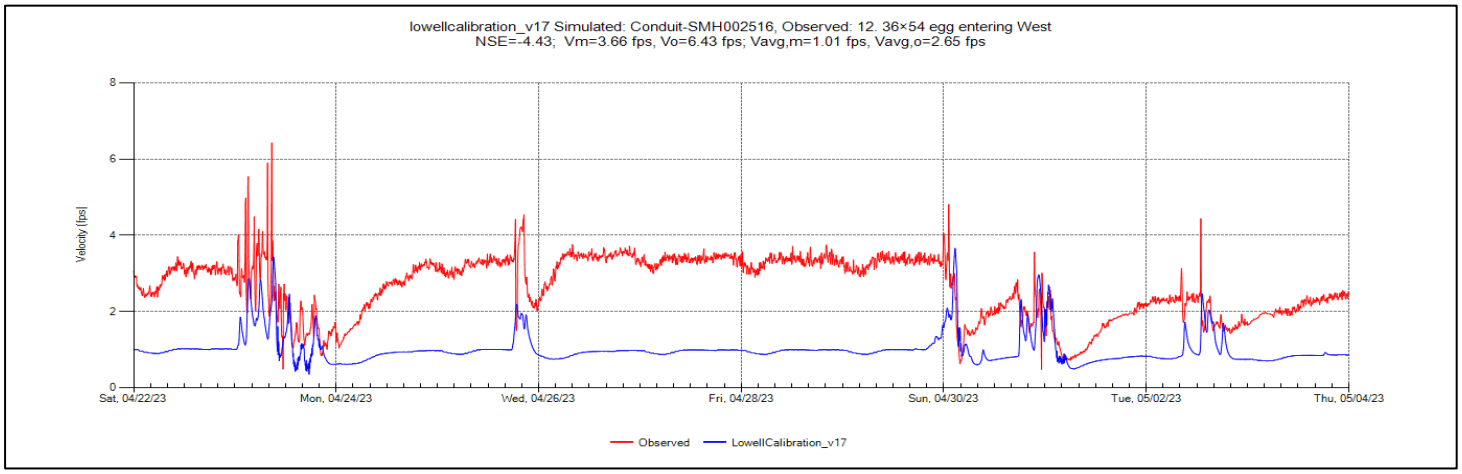


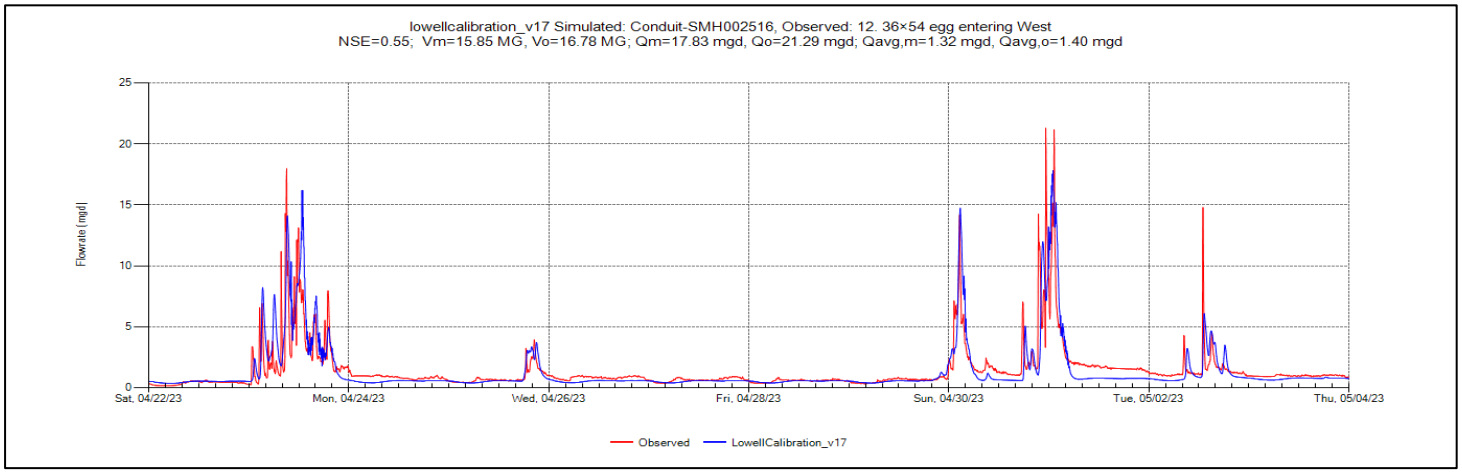


Simulated Versus Observed Flow at Flow Meter Sites

12-April-May Storms

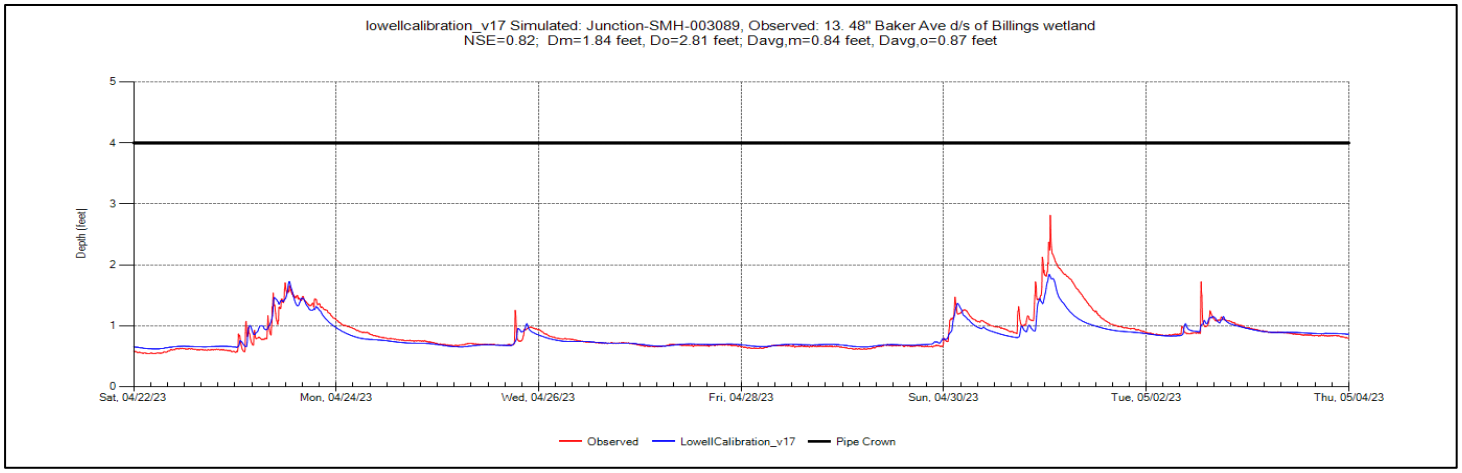


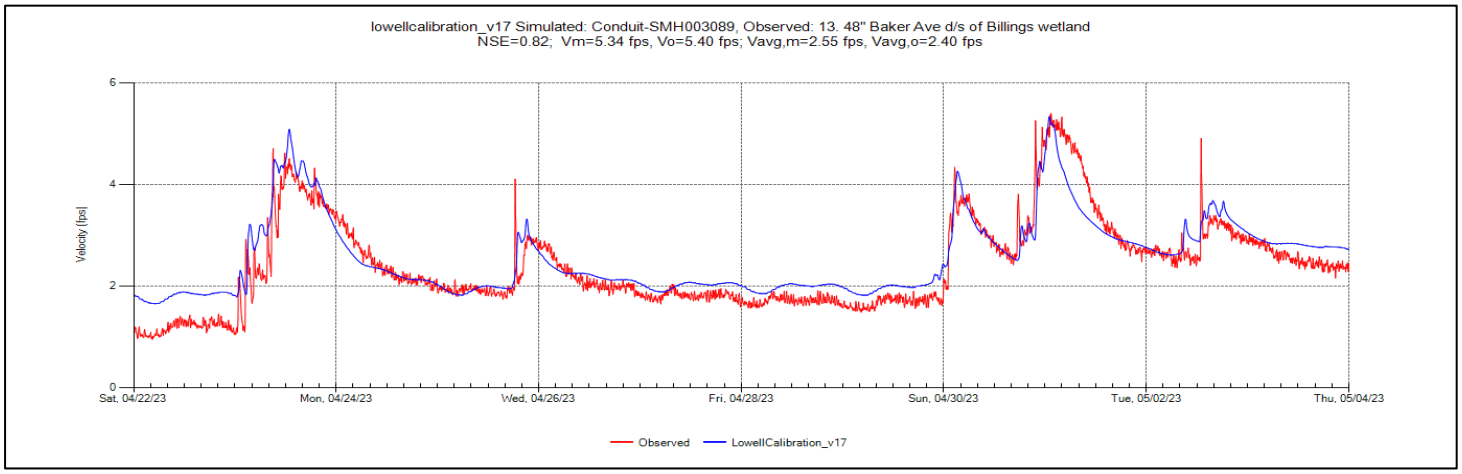


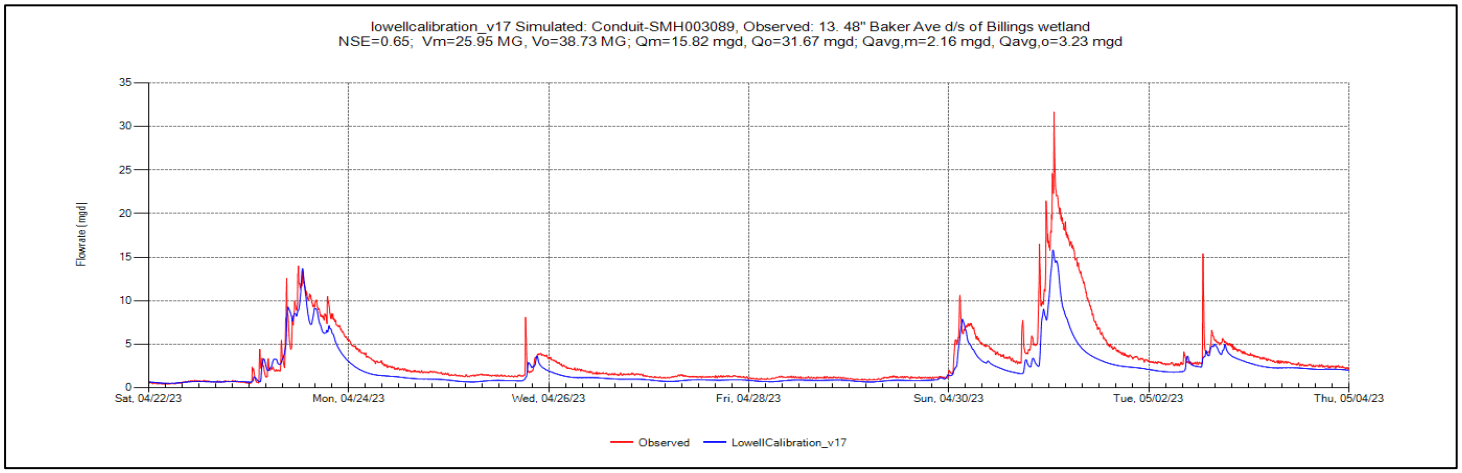


Simulated Versus Observed Flow at Flow Meter Sites

13-April-May Storms

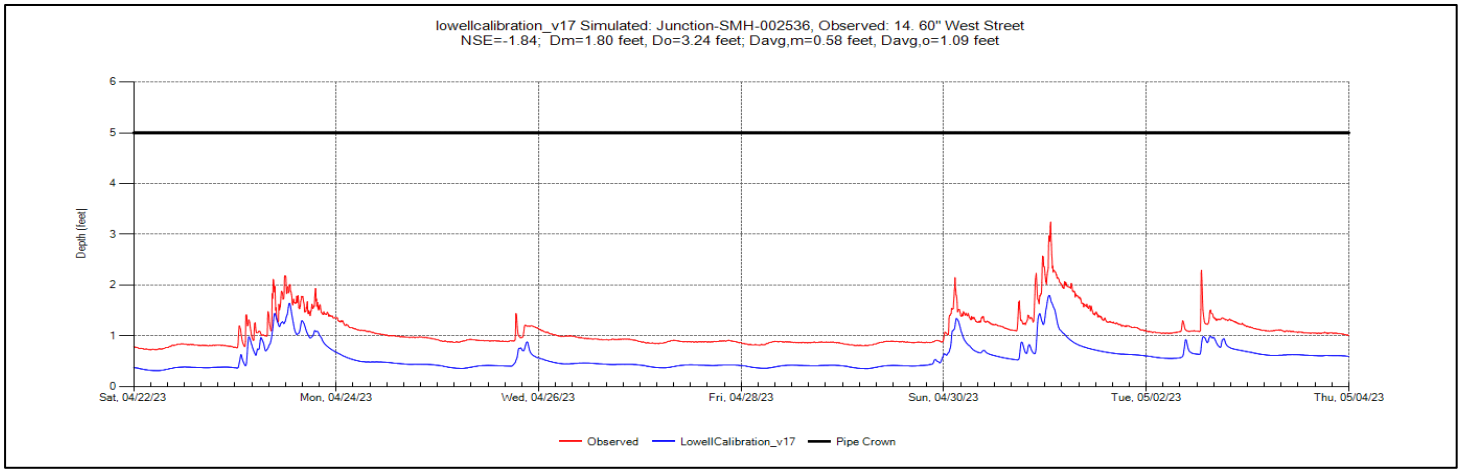


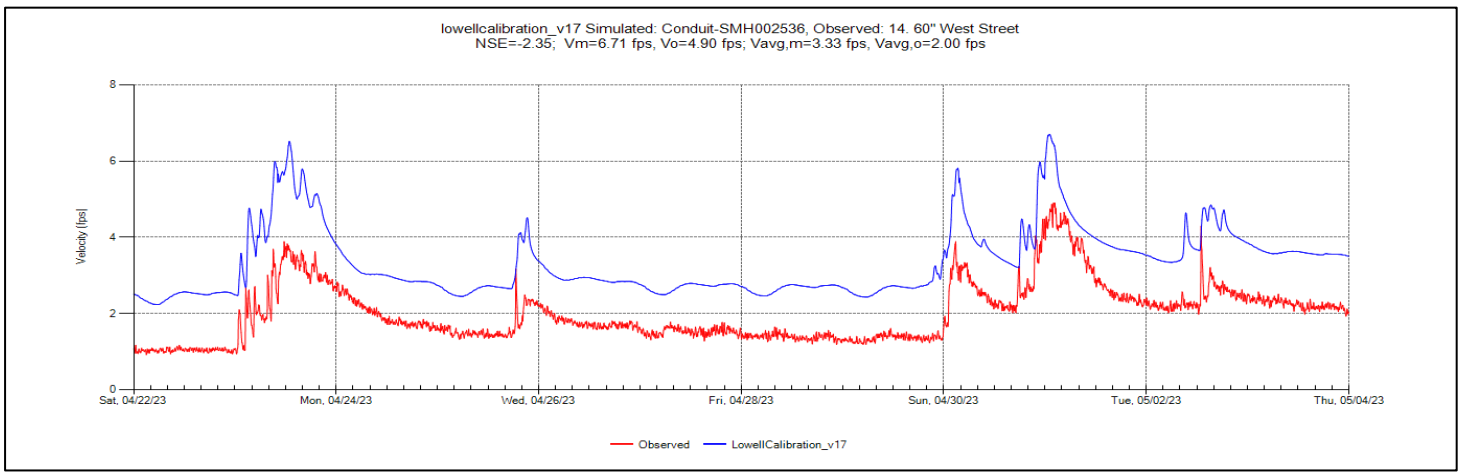


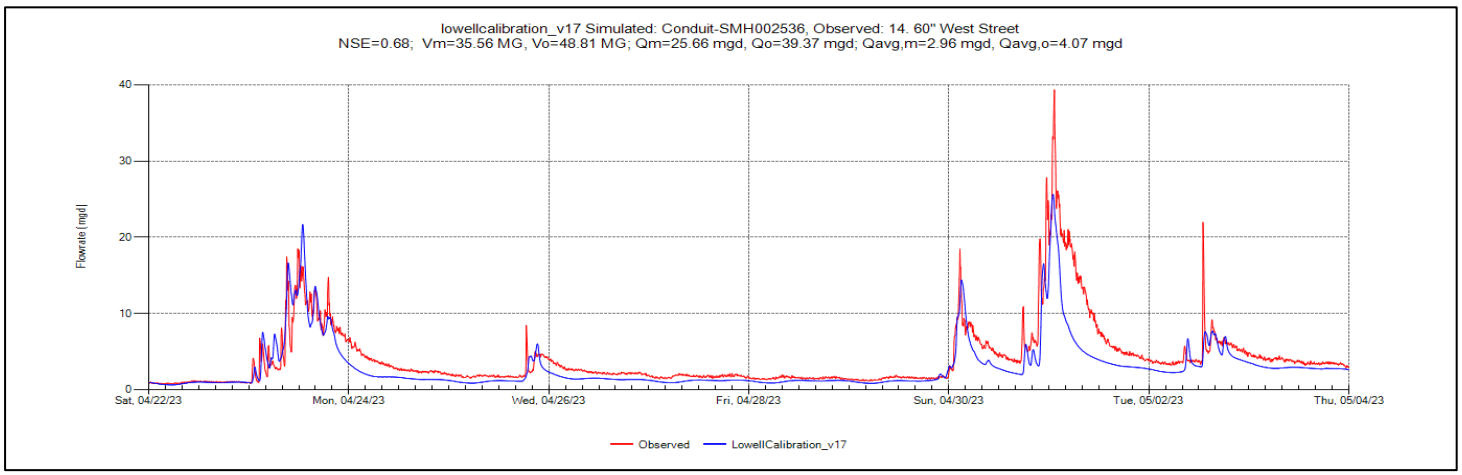


Simulated Versus Observed Flow at Flow Meter Sites

14-April-May Storms

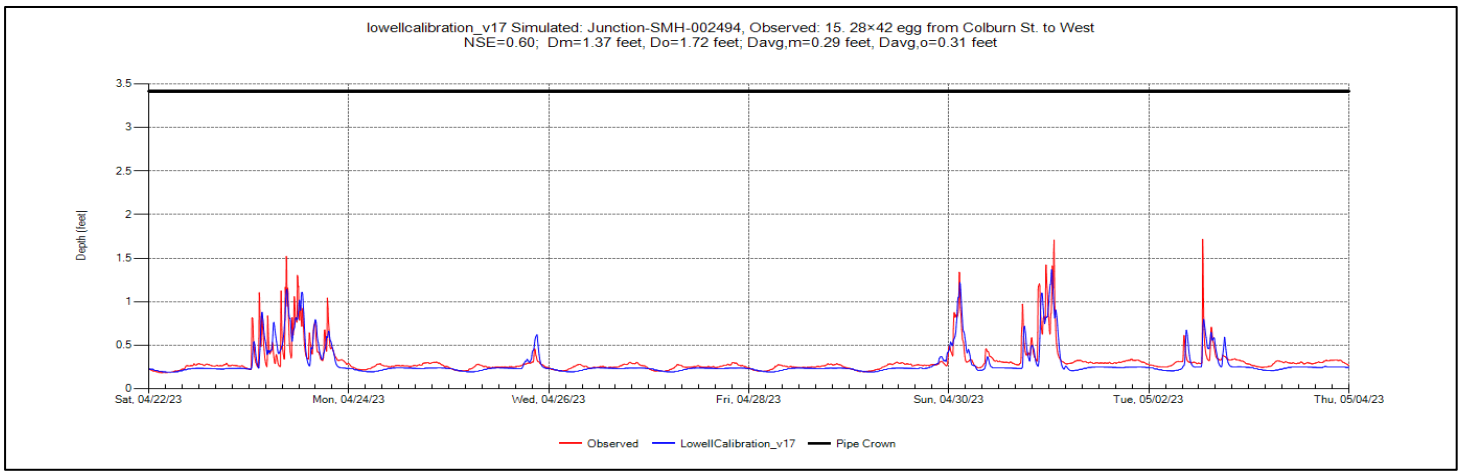


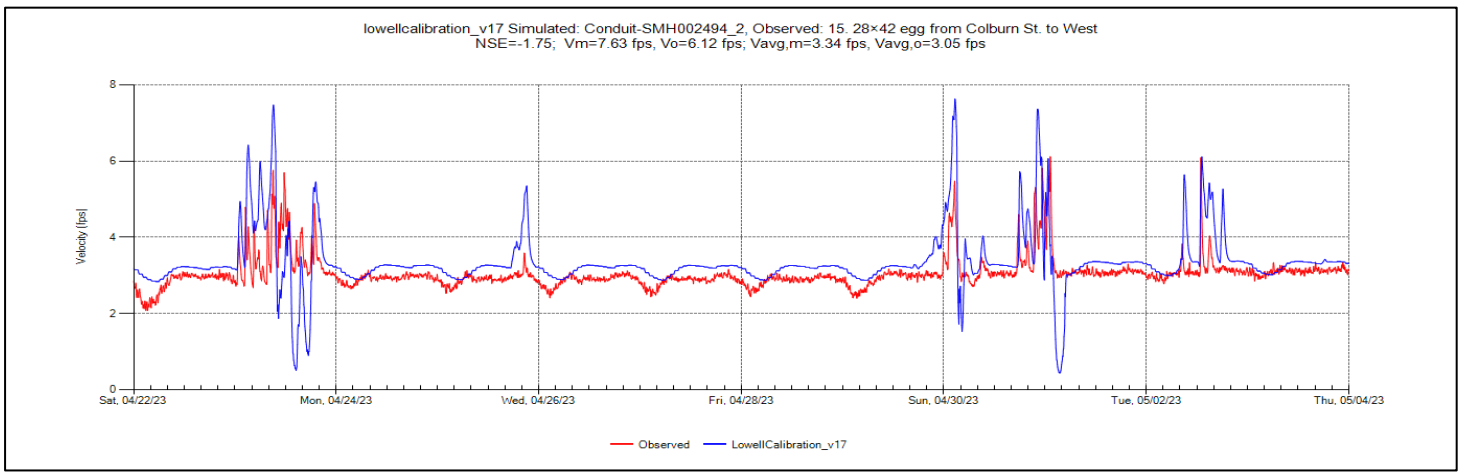


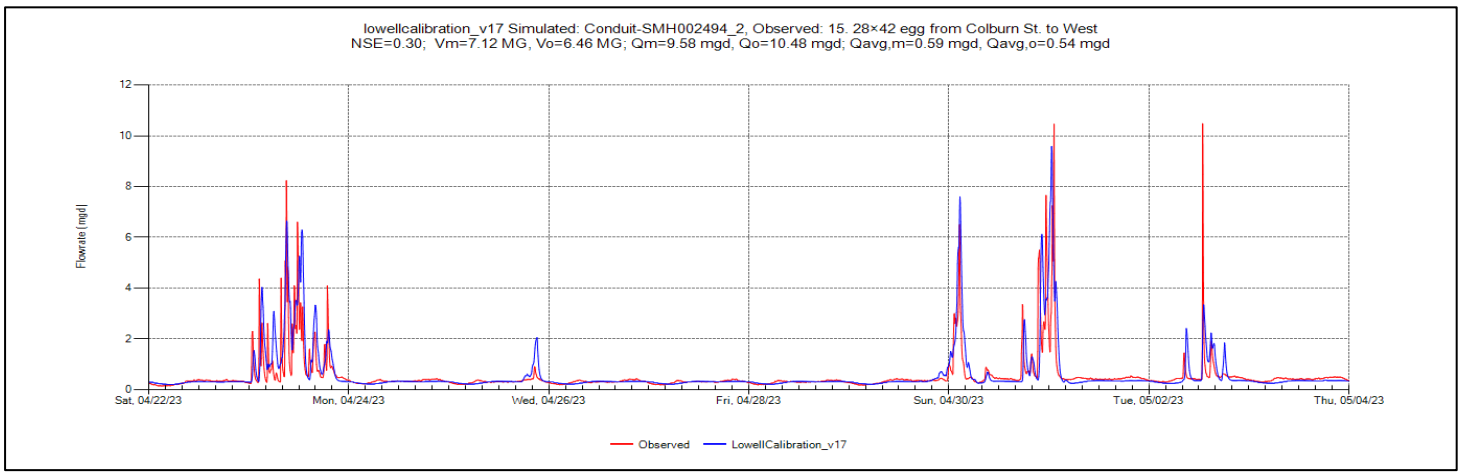


Simulated Versus Observed Flow at Flow Meter Sites

15-April-May Storms

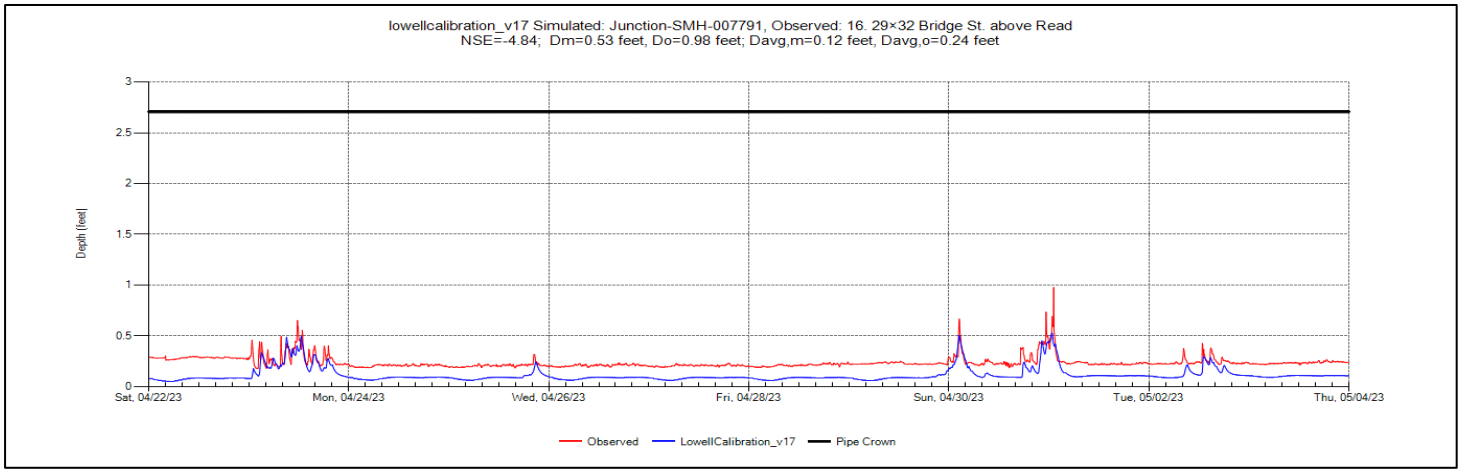


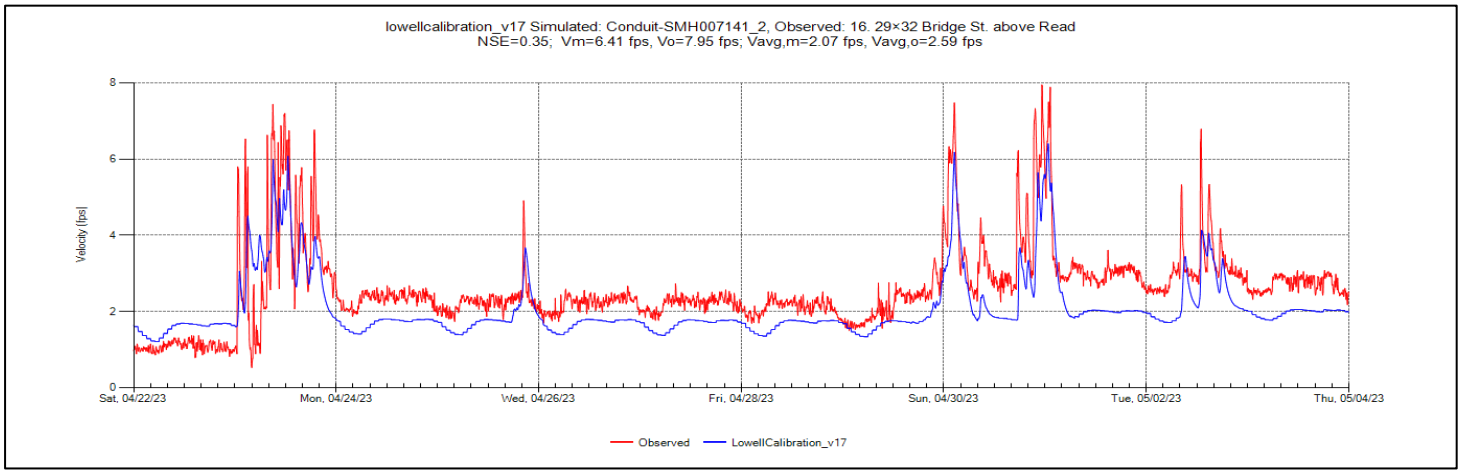


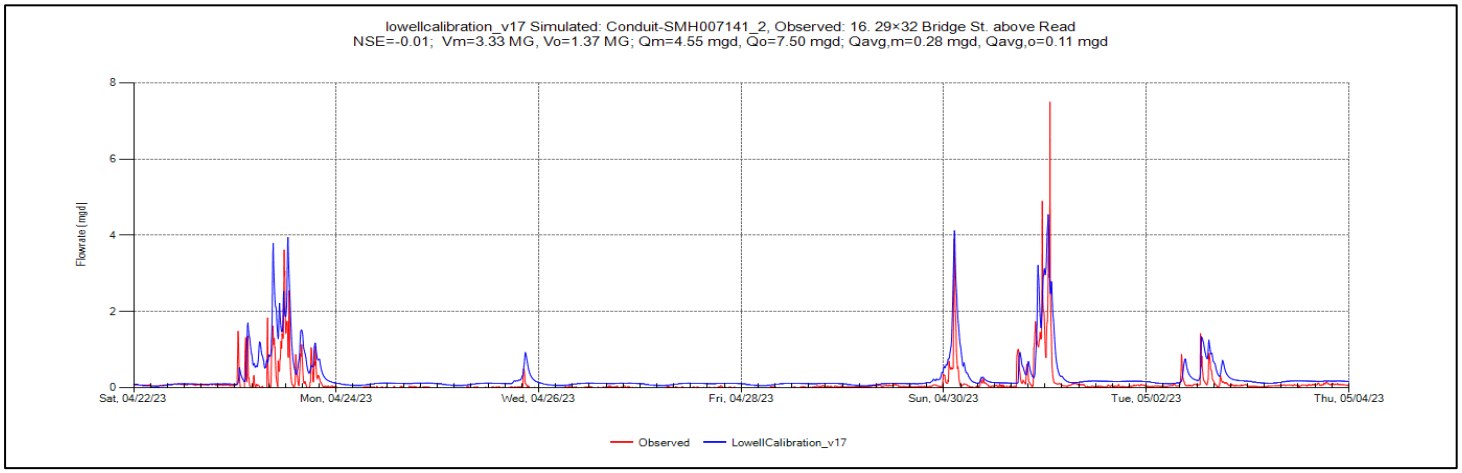


Simulated Versus Observed Flow at Flow Meter Sites

16-April-May Storms

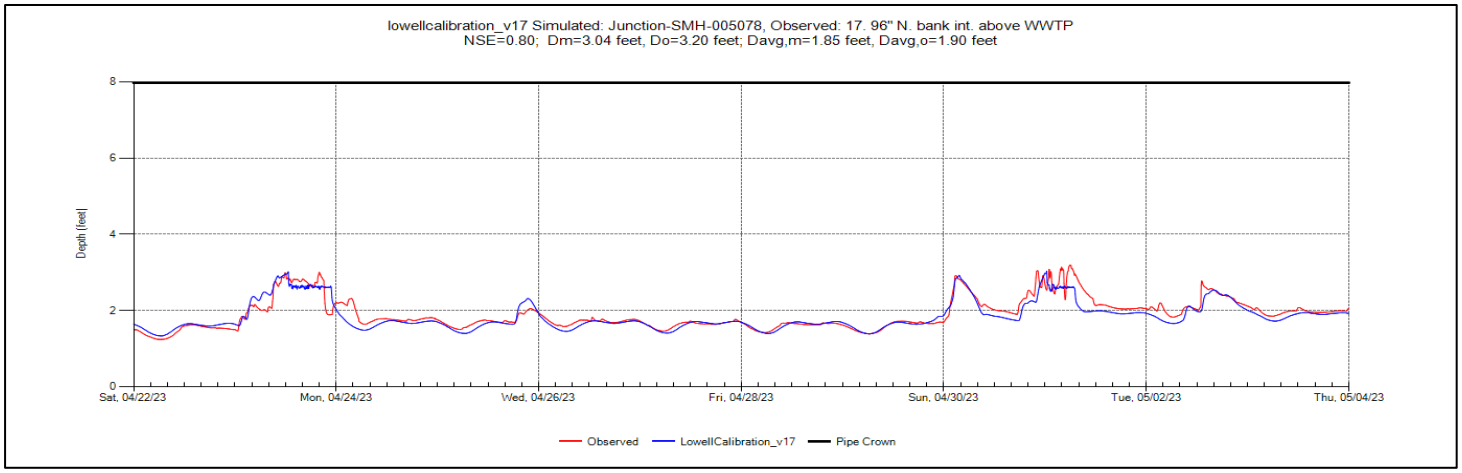


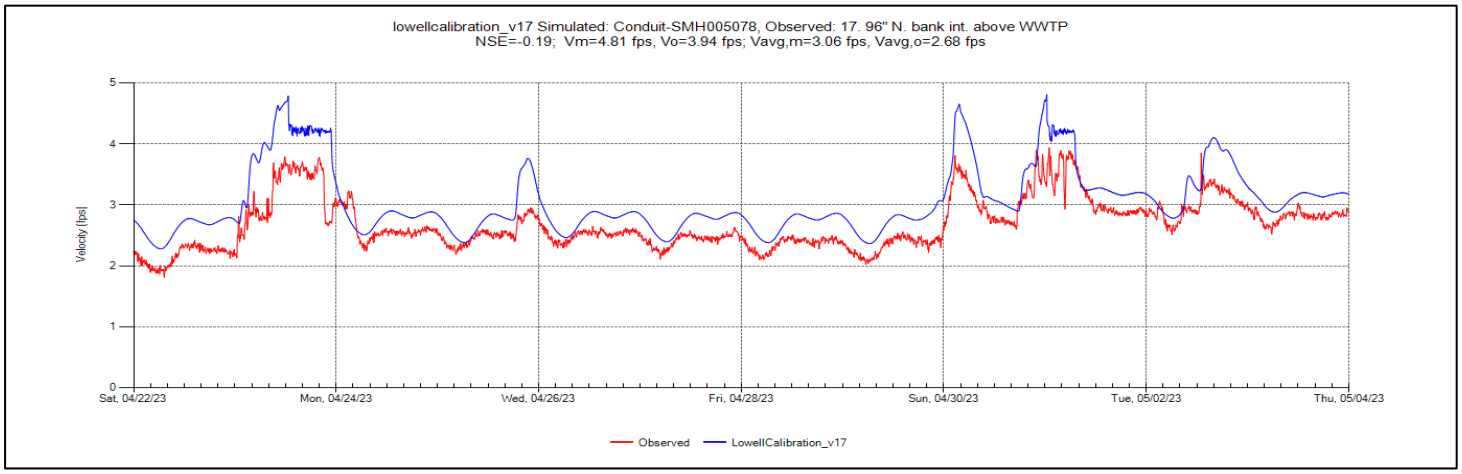


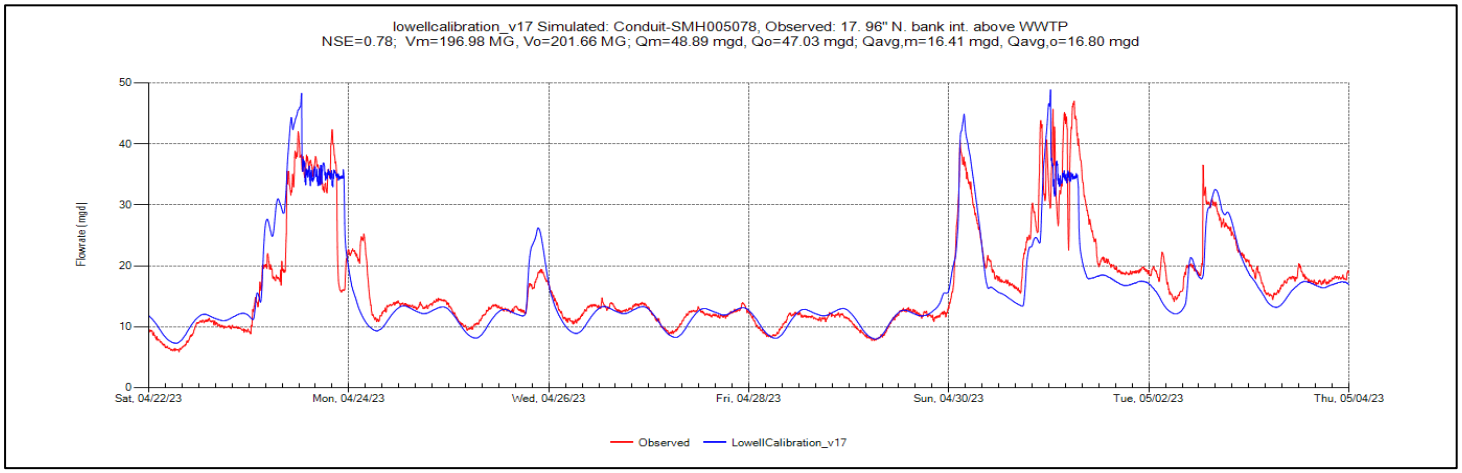


Simulated Versus Observed Flow at Flow Meter Sites

17-April-May Storms

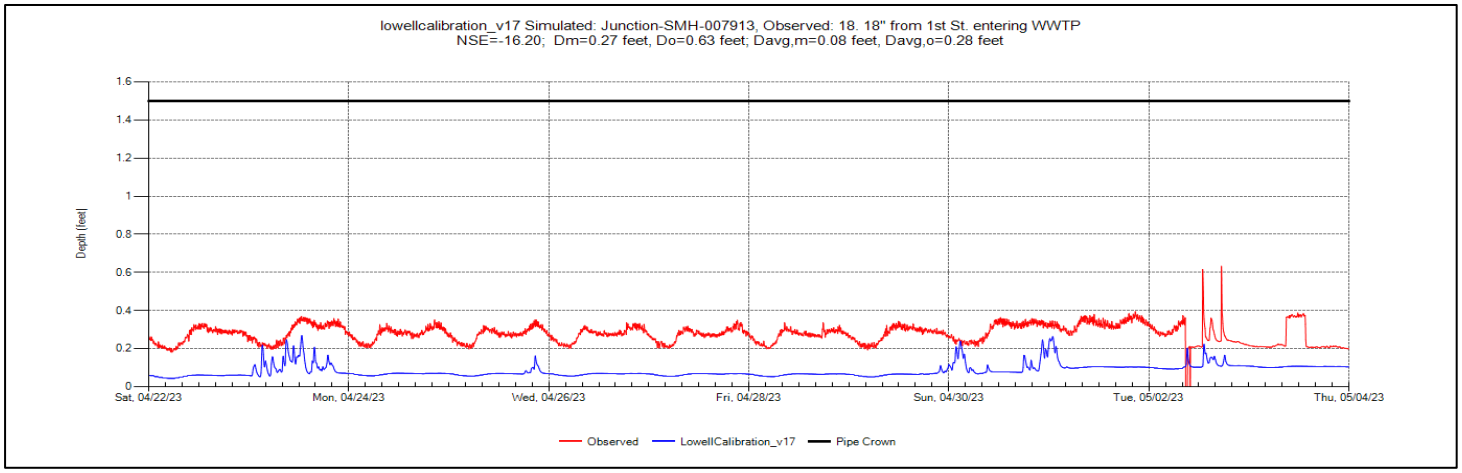


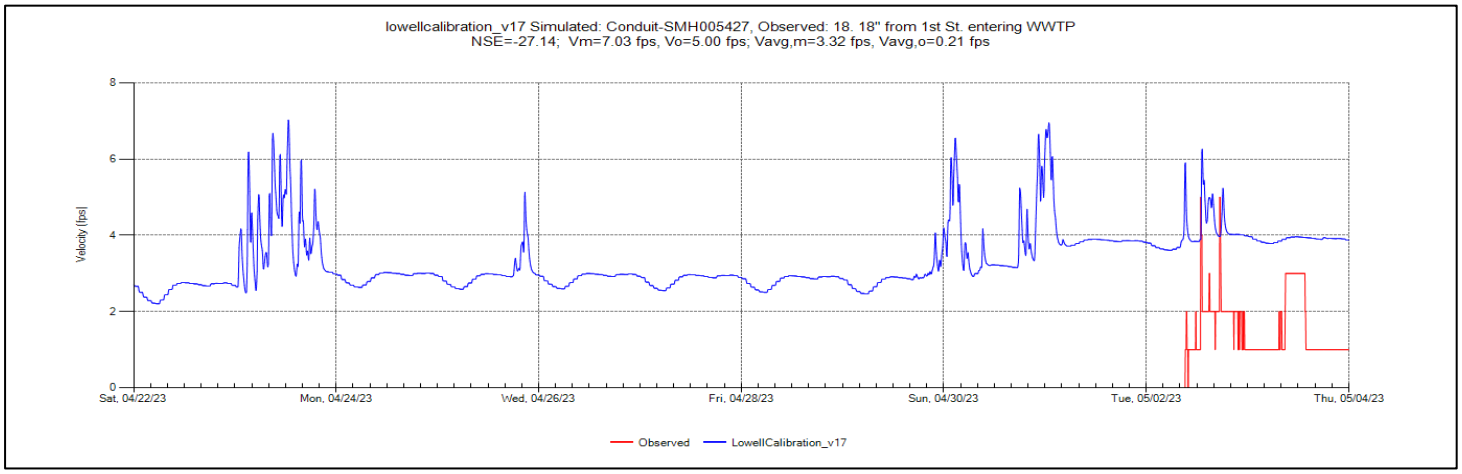


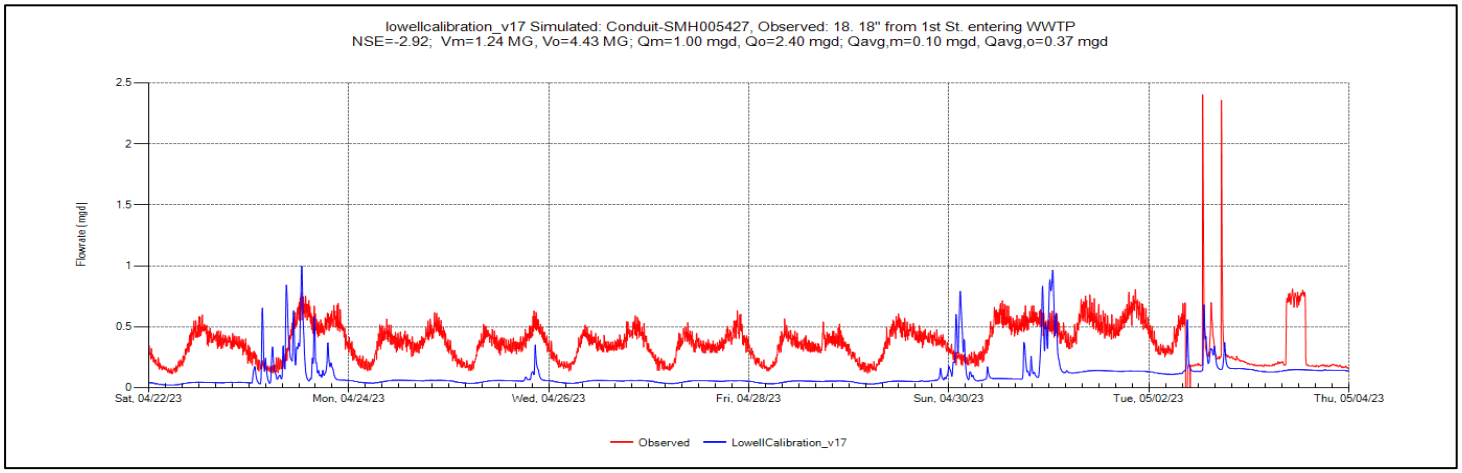


Simulated Versus Observed Flow at Flow Meter Sites

18-April-May Storms

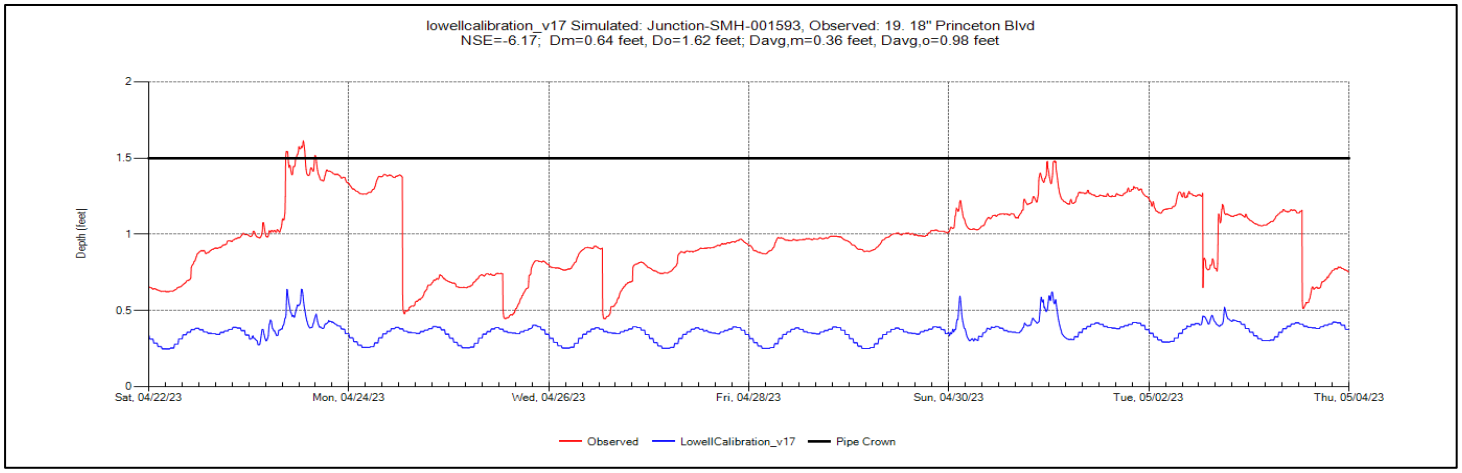


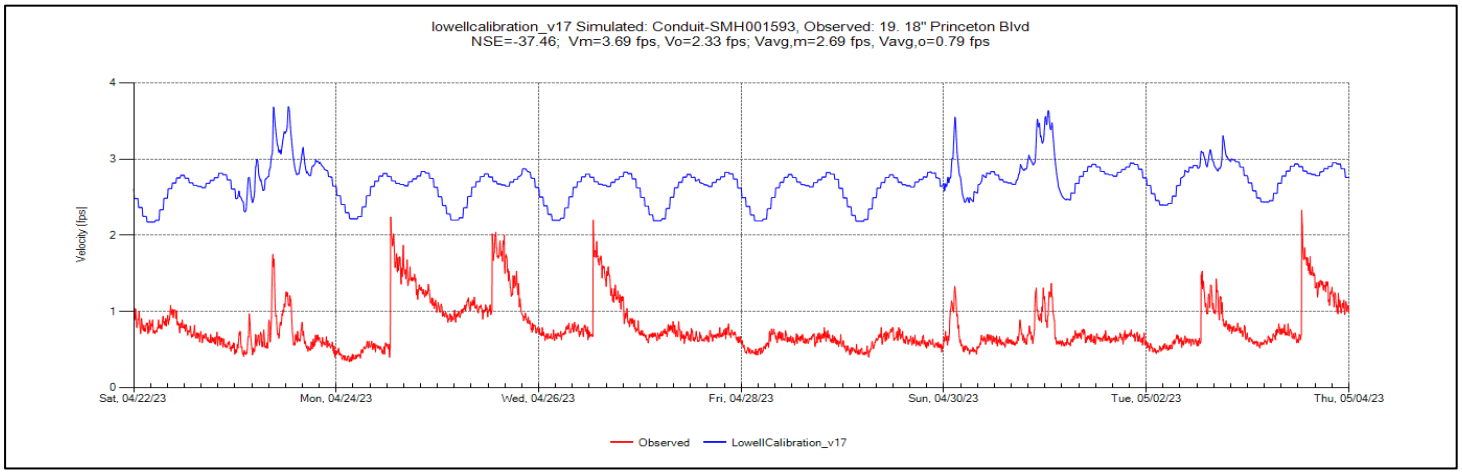


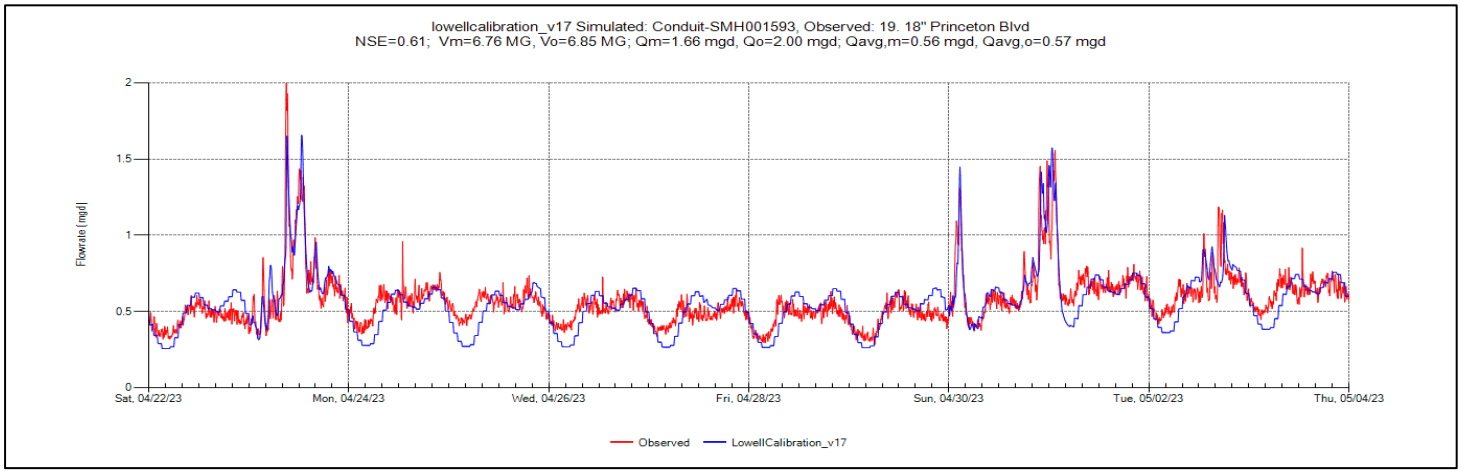


Simulated Versus Observed Flow at Flow Meter Sites

19-April-May Storms

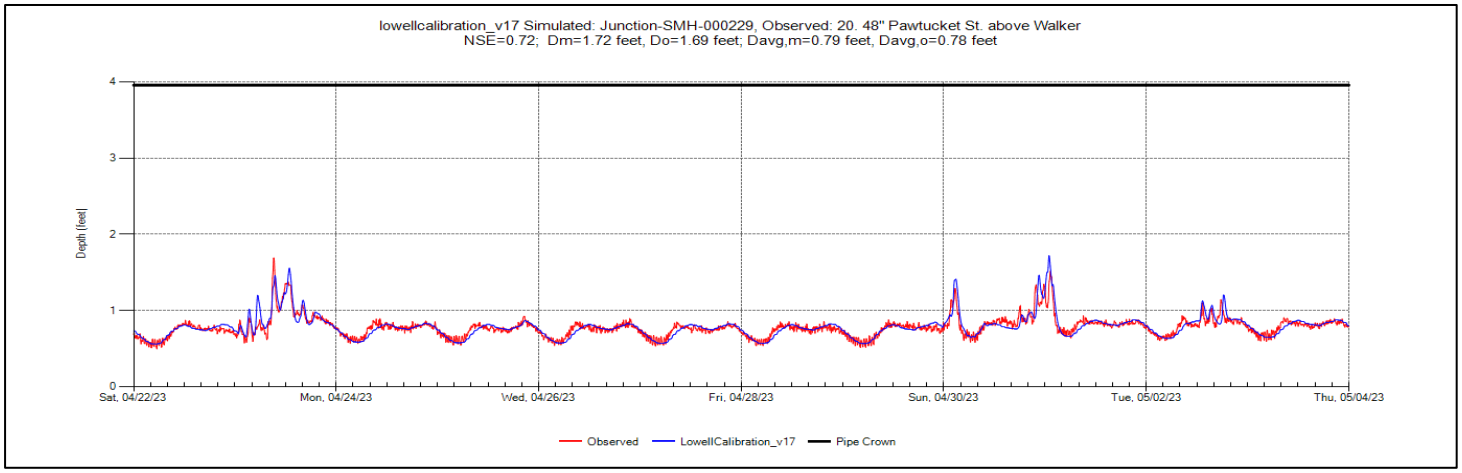


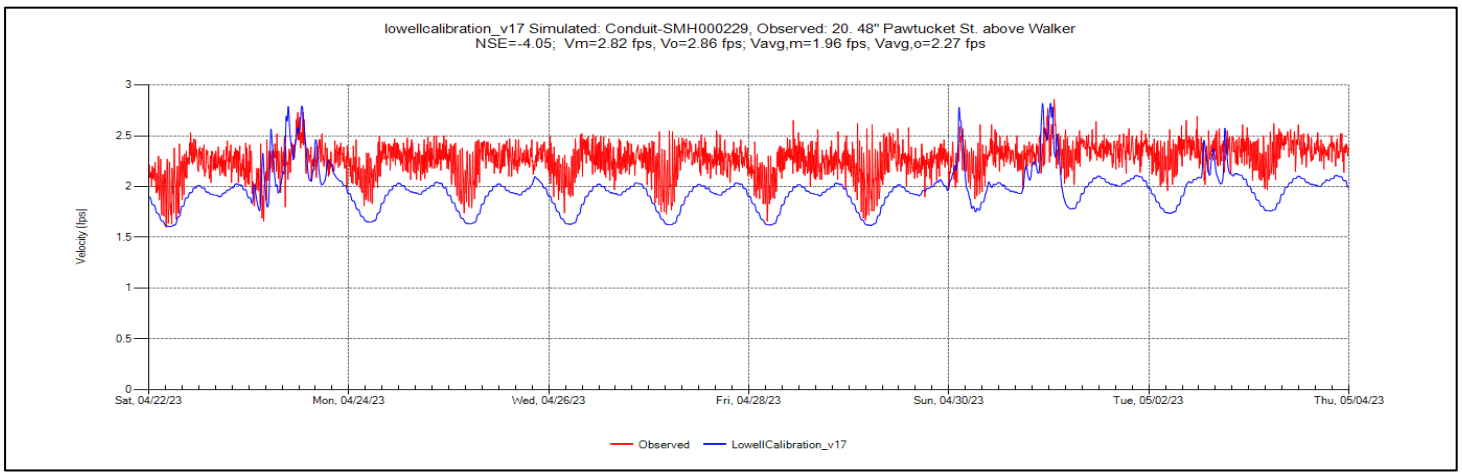


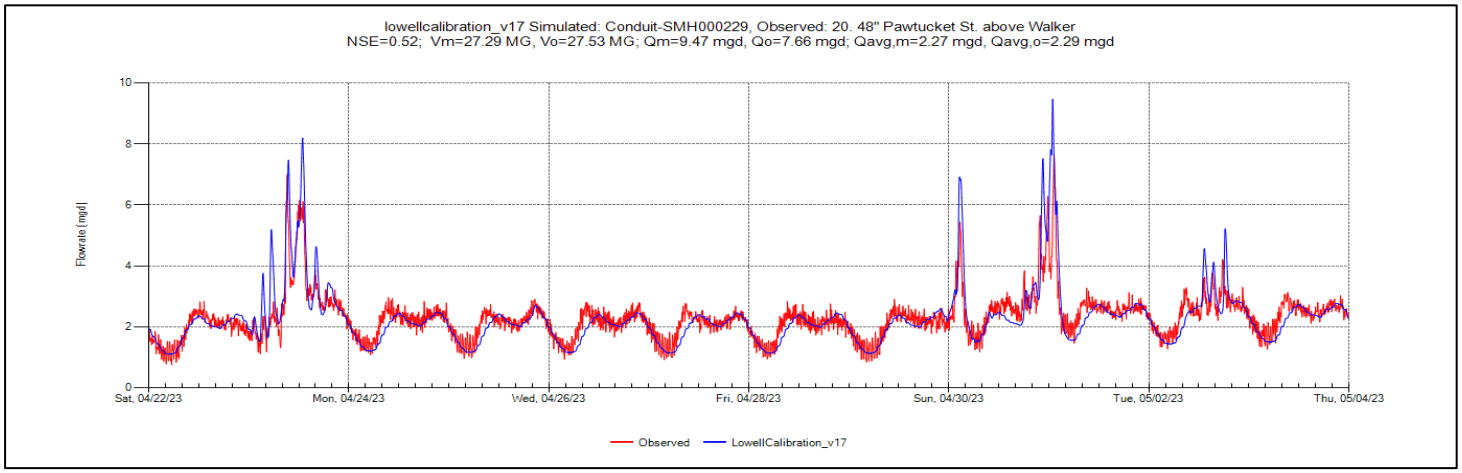


Simulated Versus Observed Flow at Flow Meter Sites

20-April-May Storms

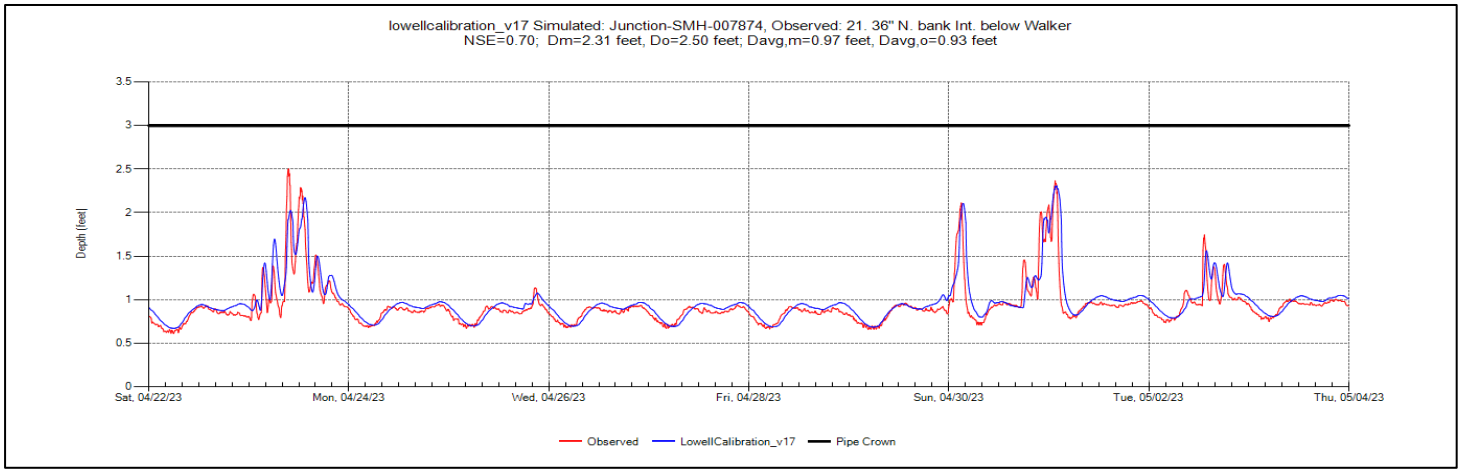


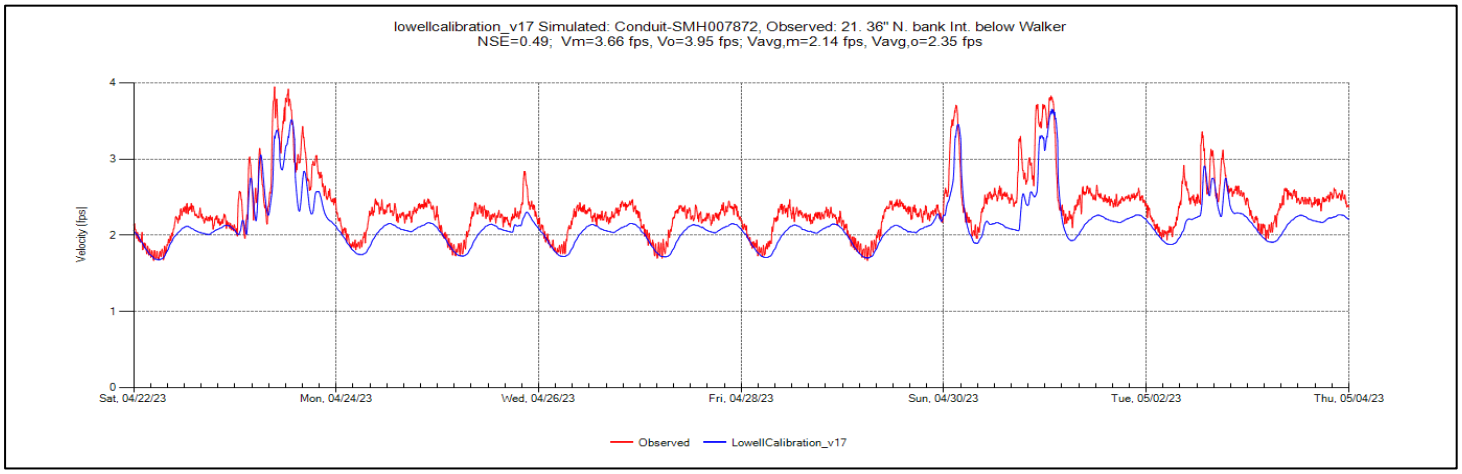


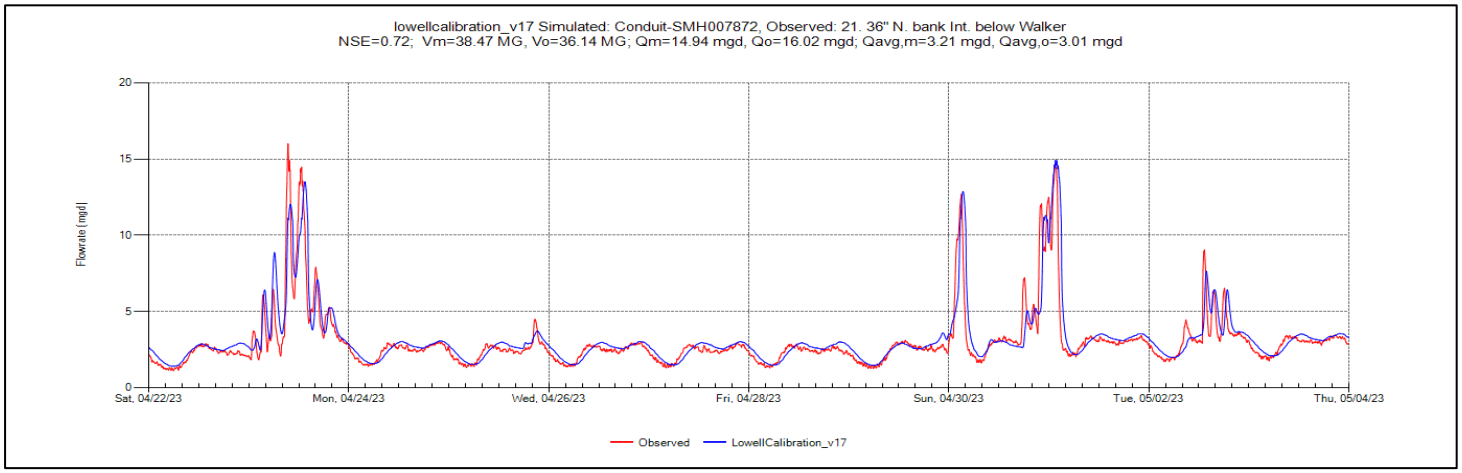


Simulated Versus Observed Flow at Flow Meter Sites

21-April-May Storms

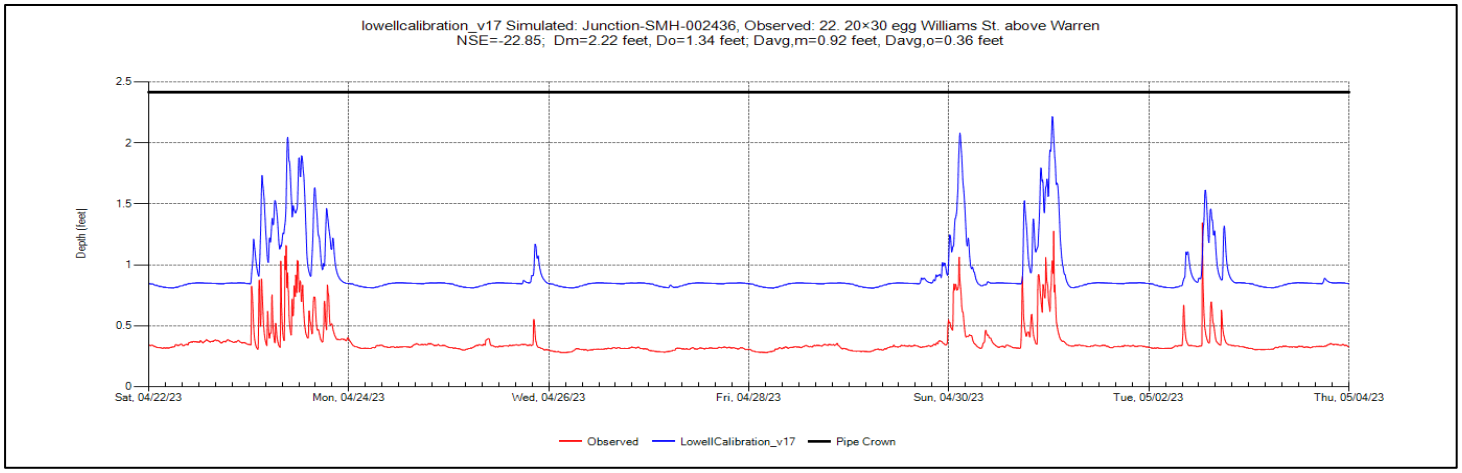


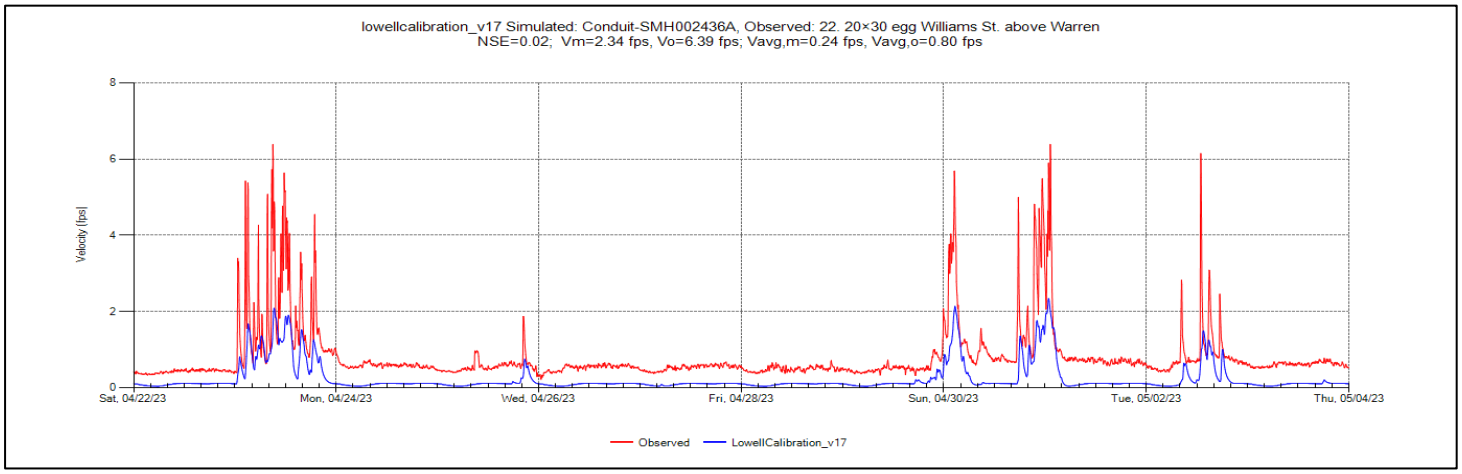


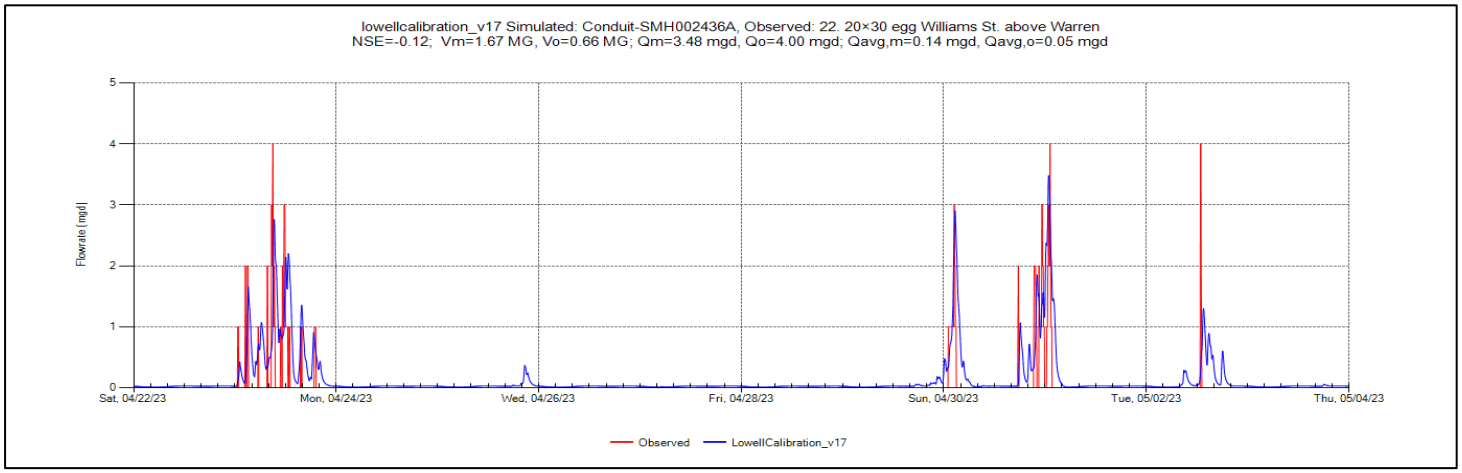


Simulated Versus Observed Flow at Flow Meter Sites

22-April-May Storms

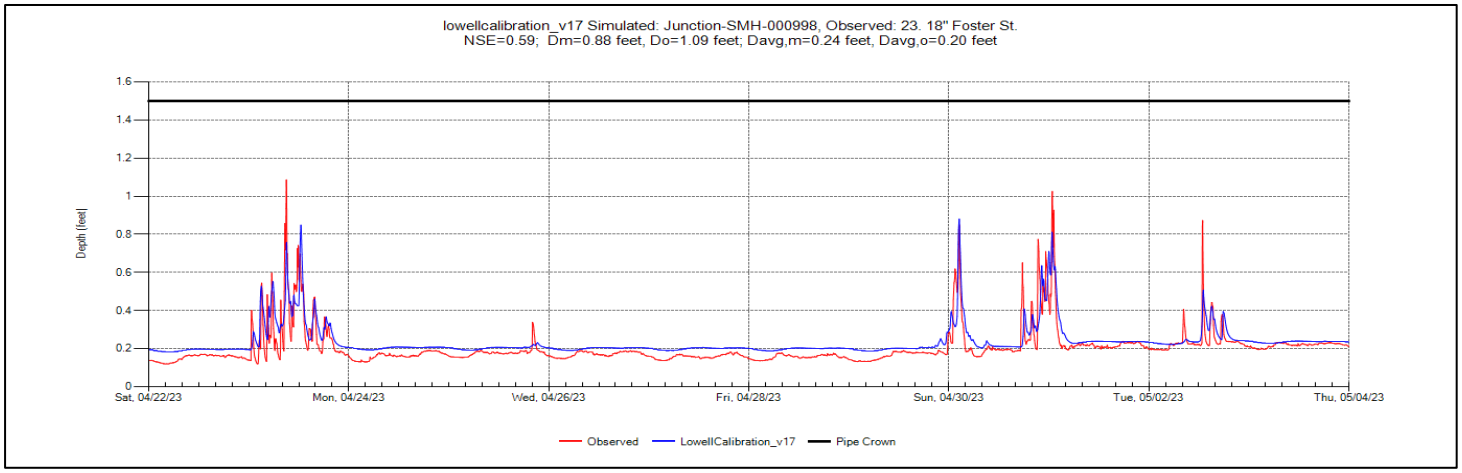


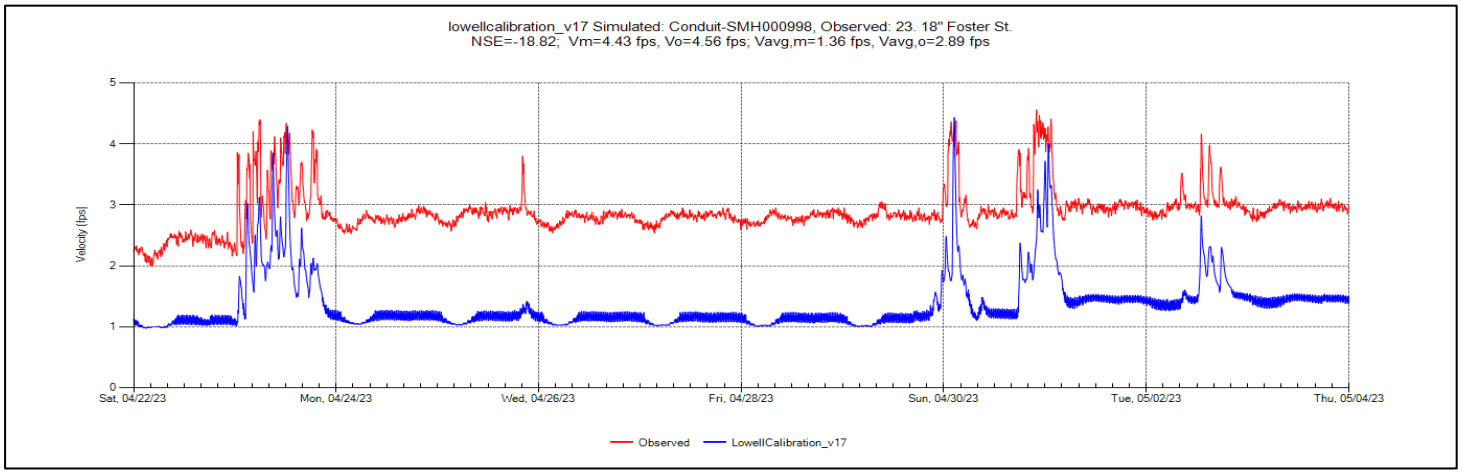


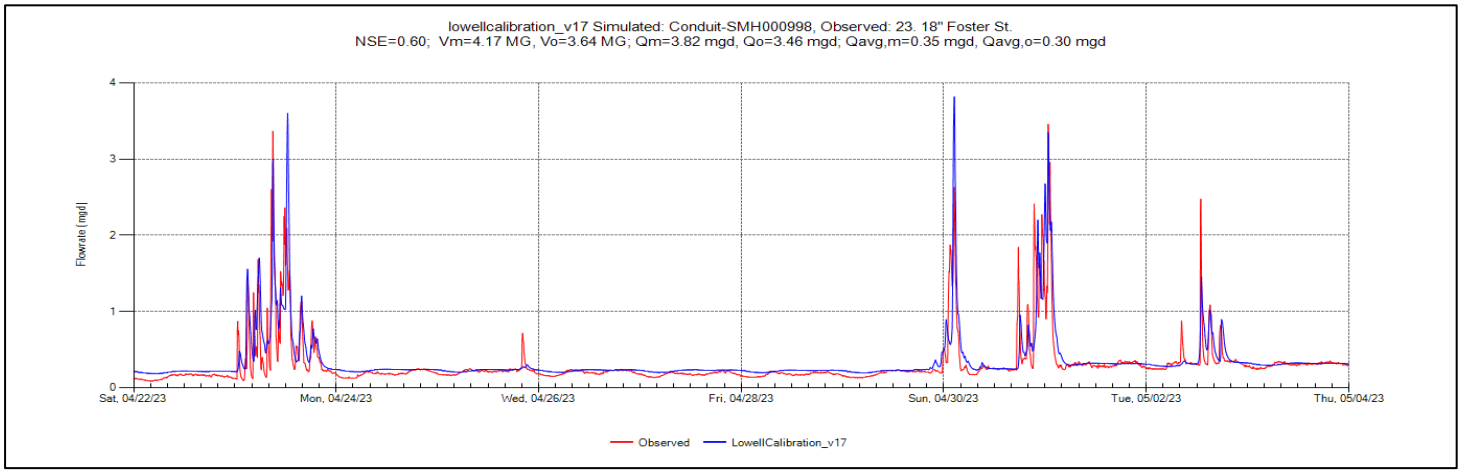


Simulated Versus Observed Flow at Flow Meter Sites

23-April-May Storms

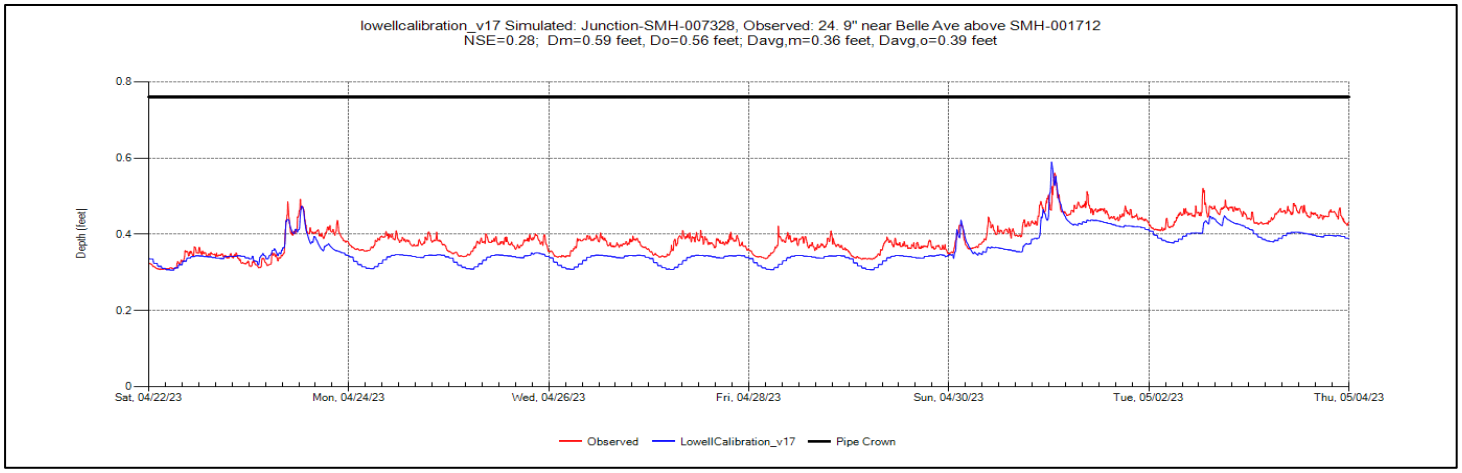


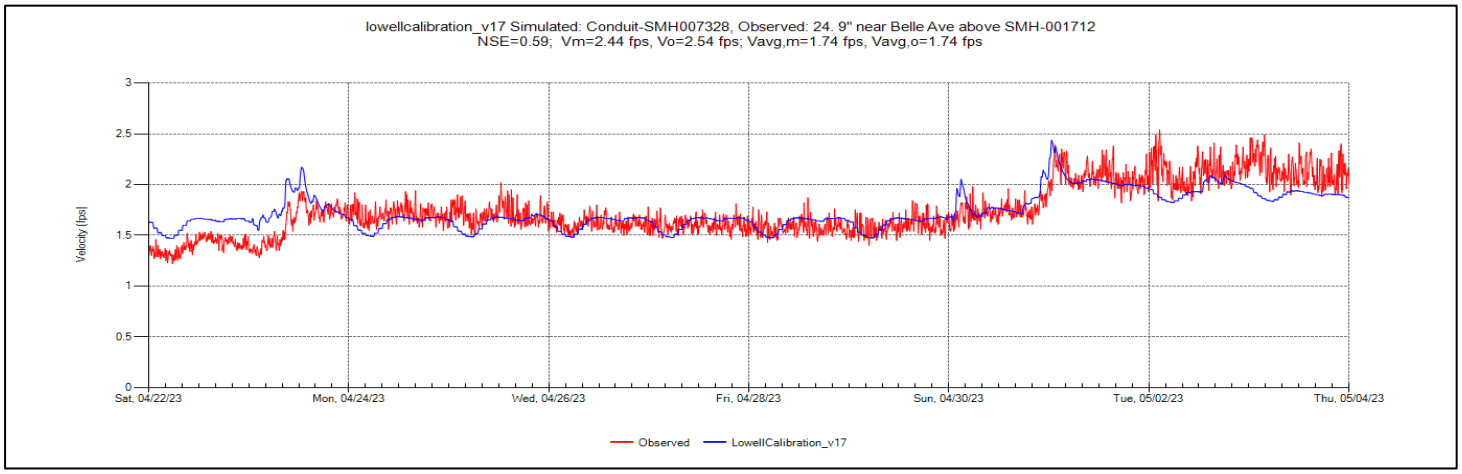


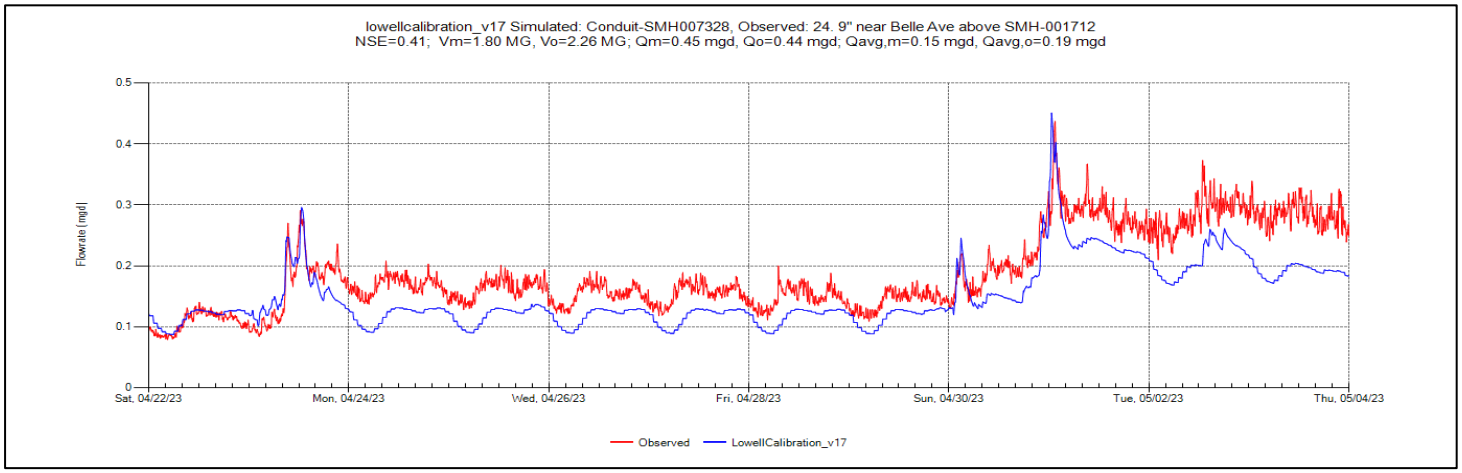


Simulated Versus Observed Flow at Flow Meter Sites

24-April-May Storms

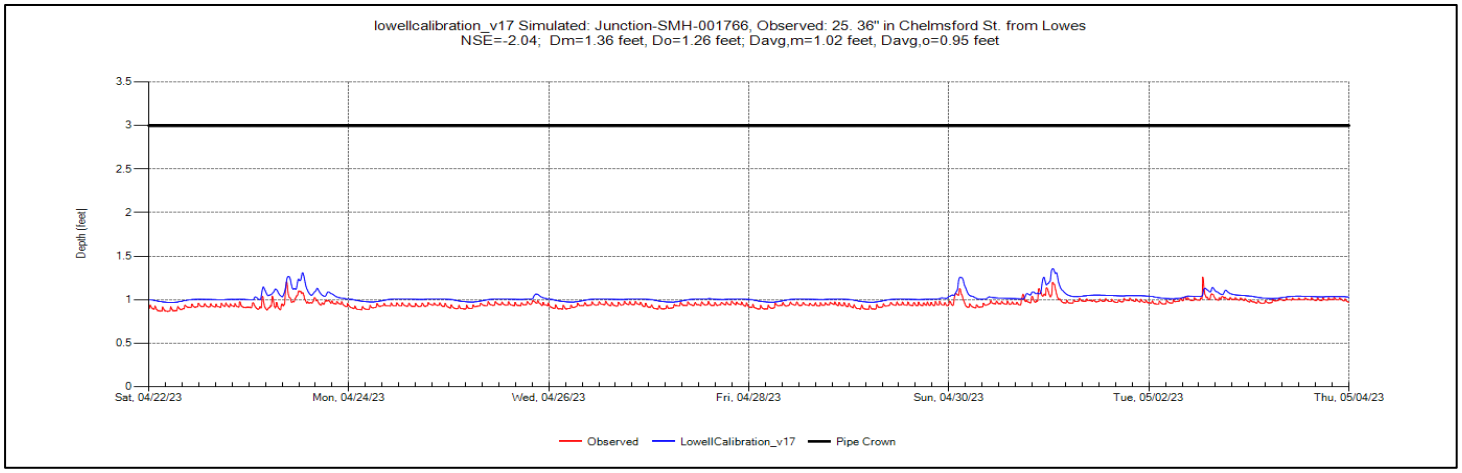


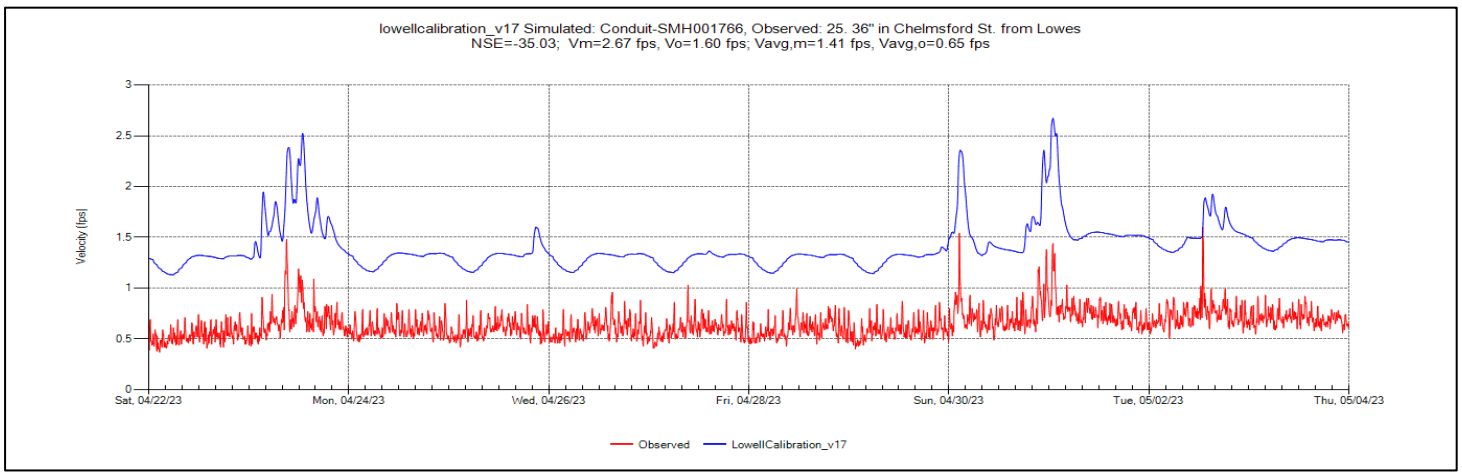


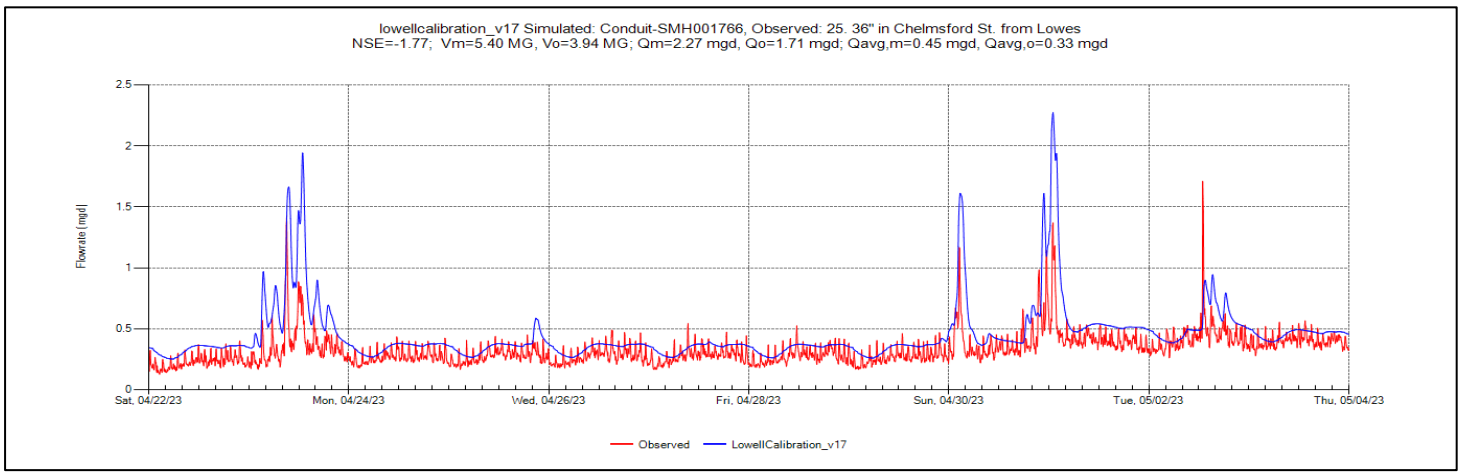


Simulated Versus Observed Flow at Flow Meter Sites

25-April-May Storms

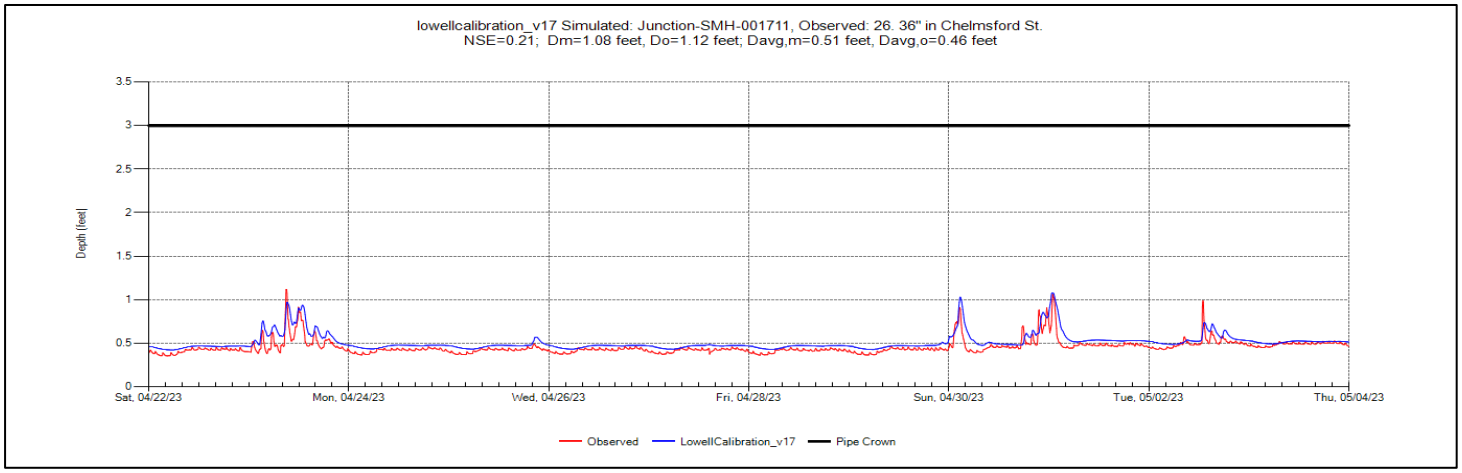


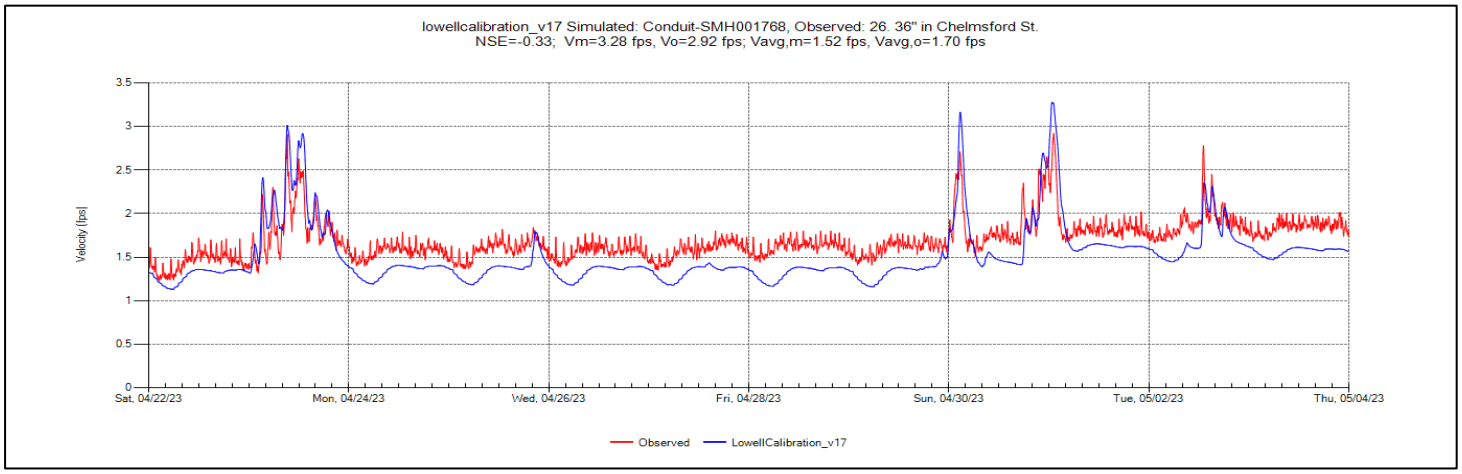


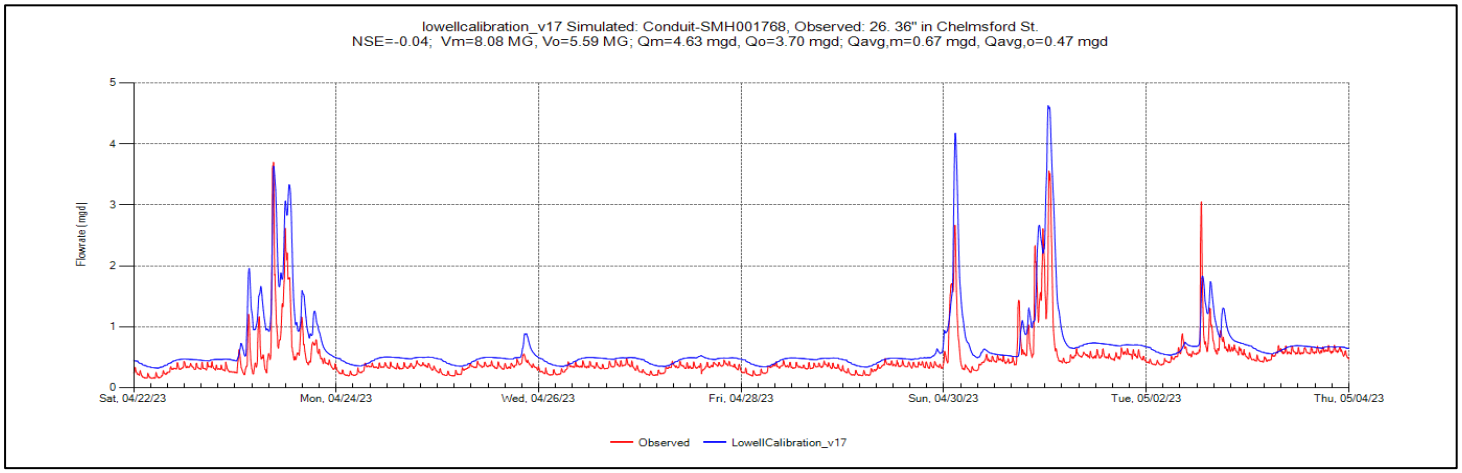


Simulated Versus Observed Flow at Flow Meter Sites

26-April-May Storms

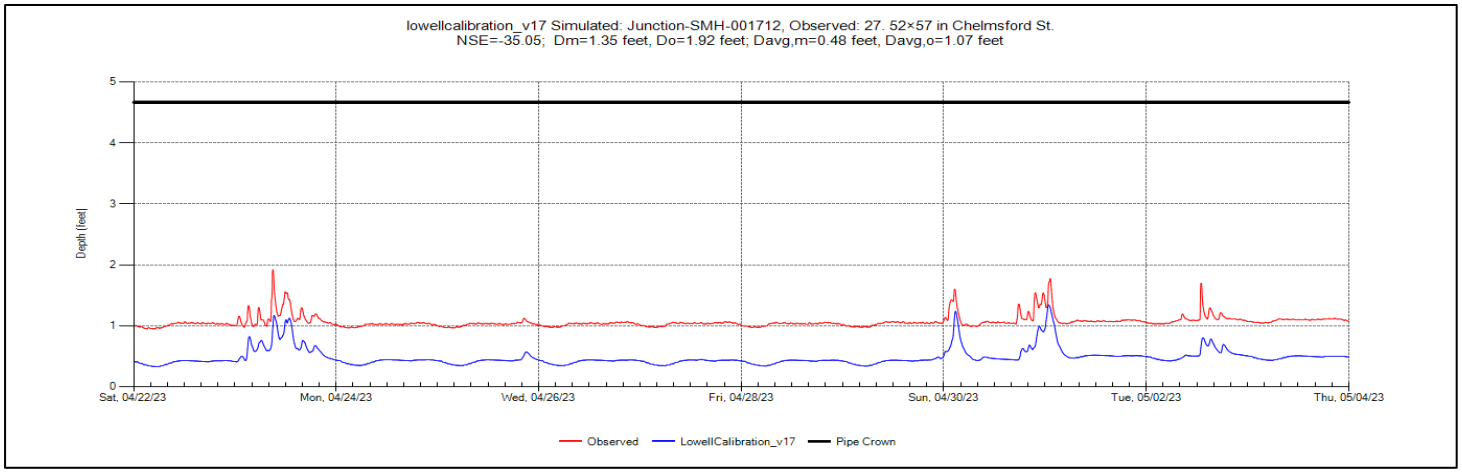


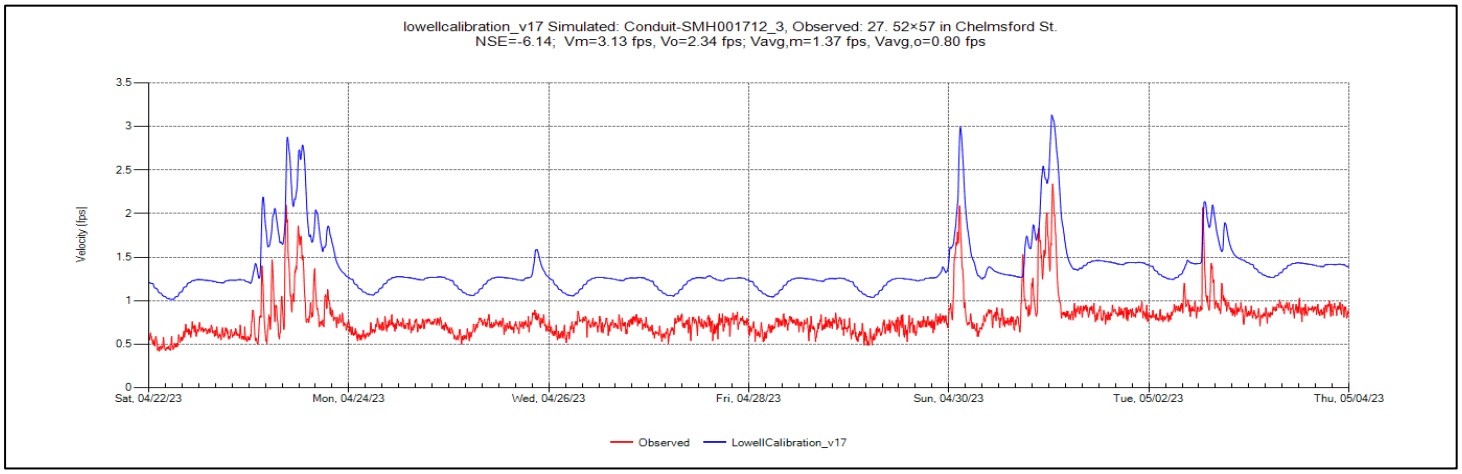


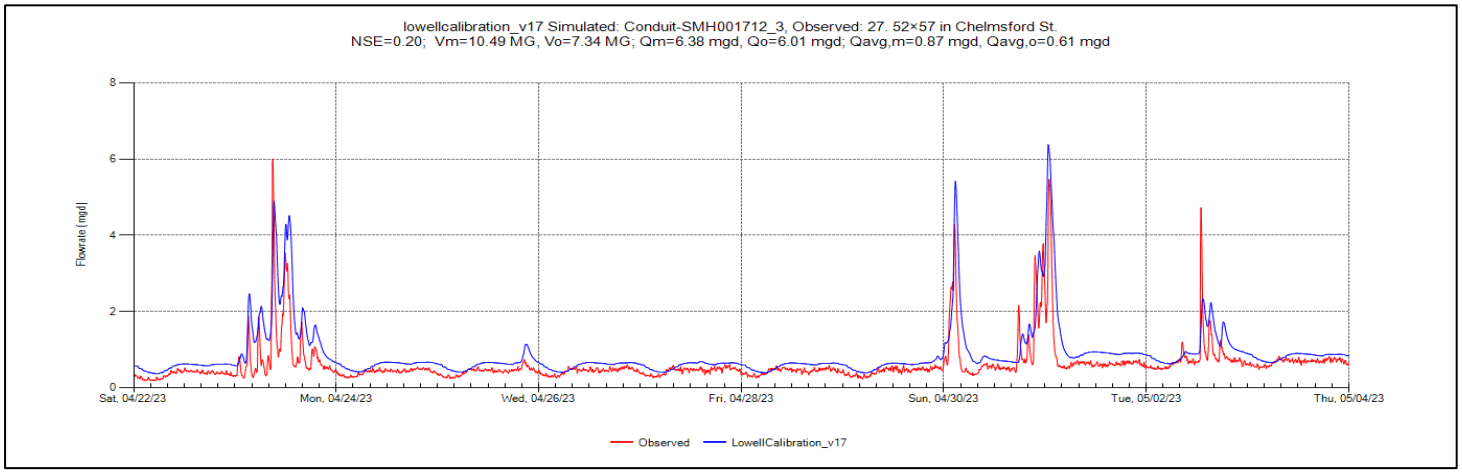


Simulated Versus Observed Flow at Flow Meter Sites

27-April-May Storms

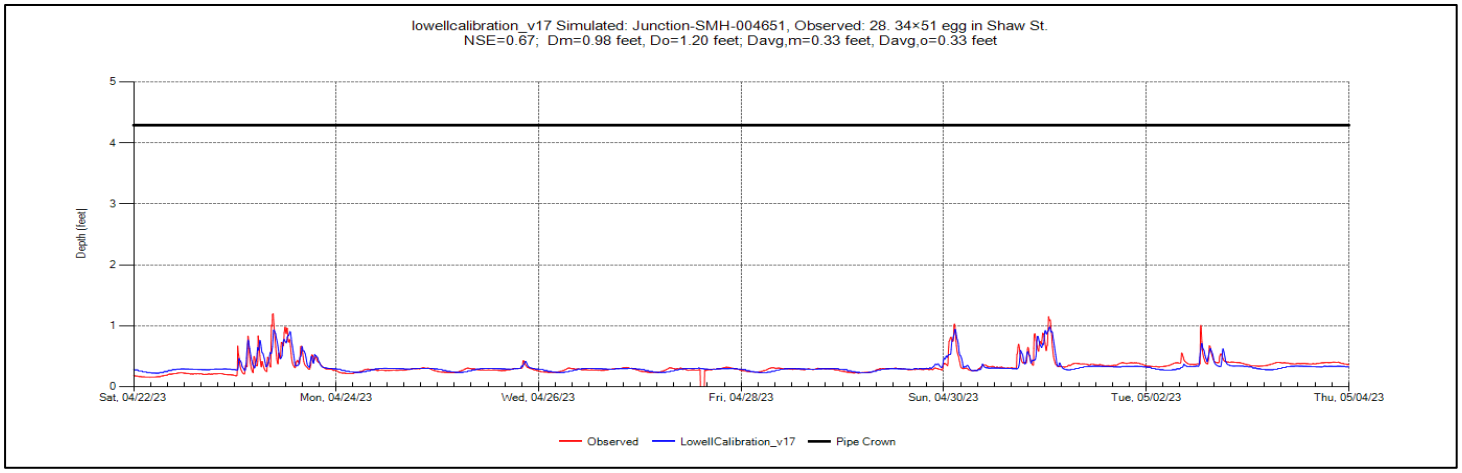


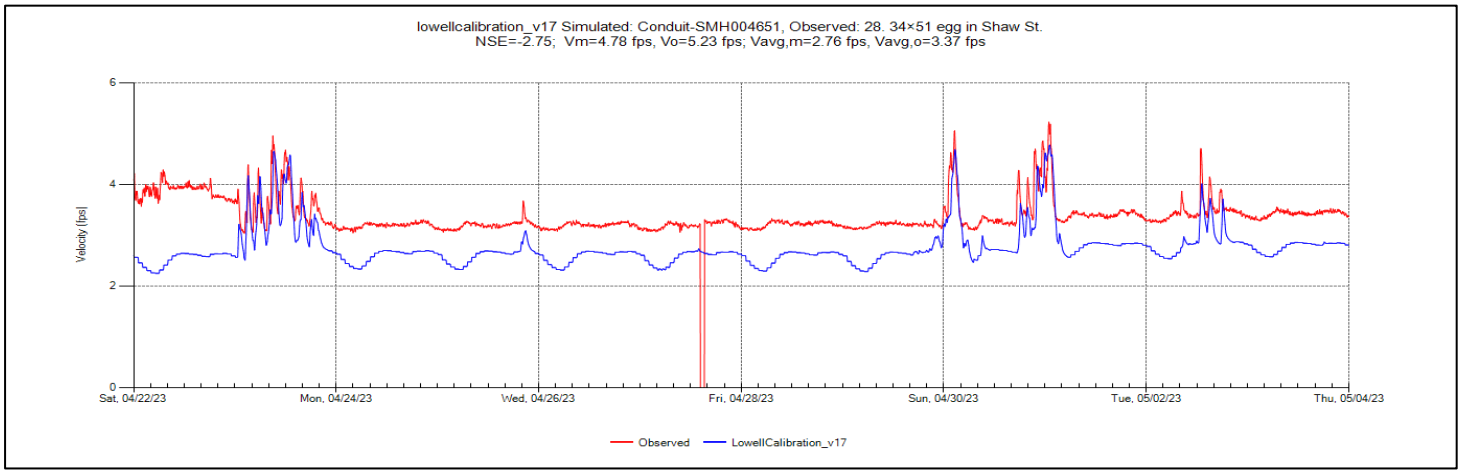


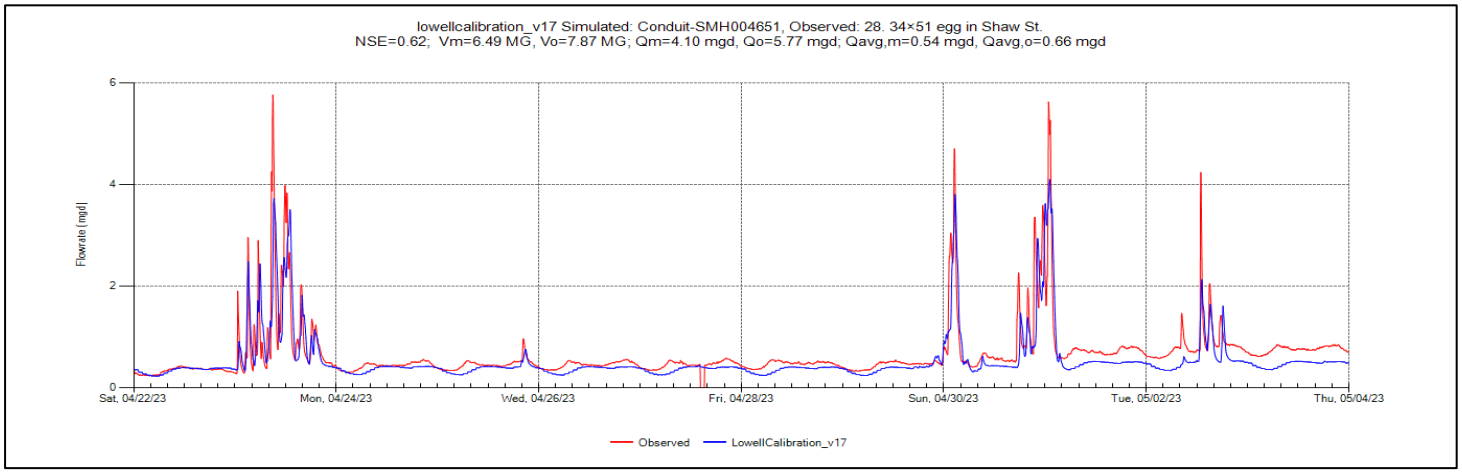


Simulated Versus Observed Flow at Flow Meter Sites

28-April-May Storms

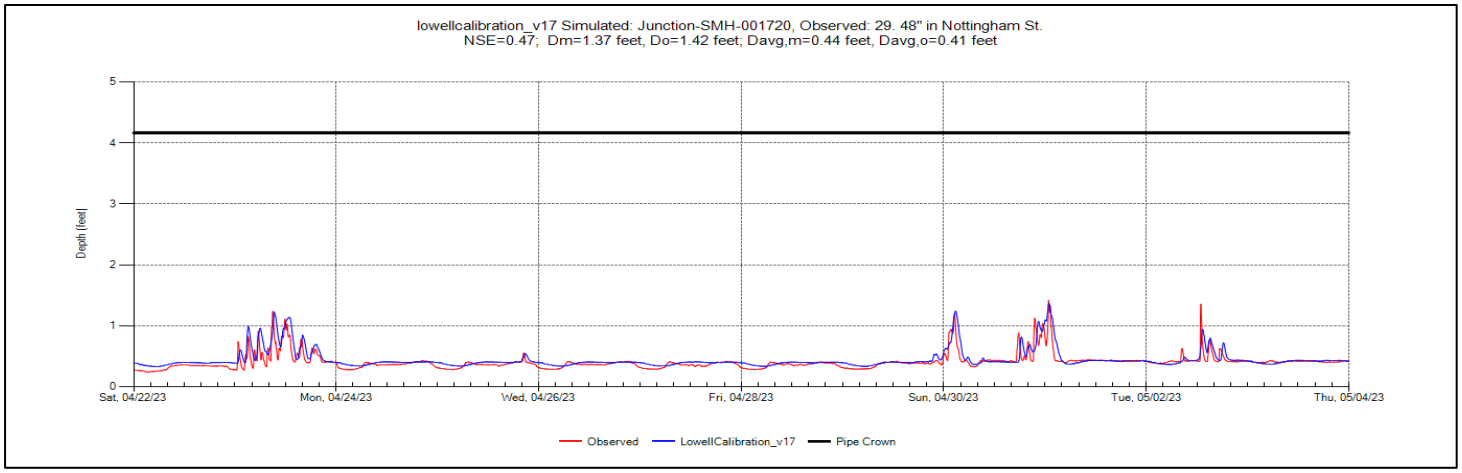


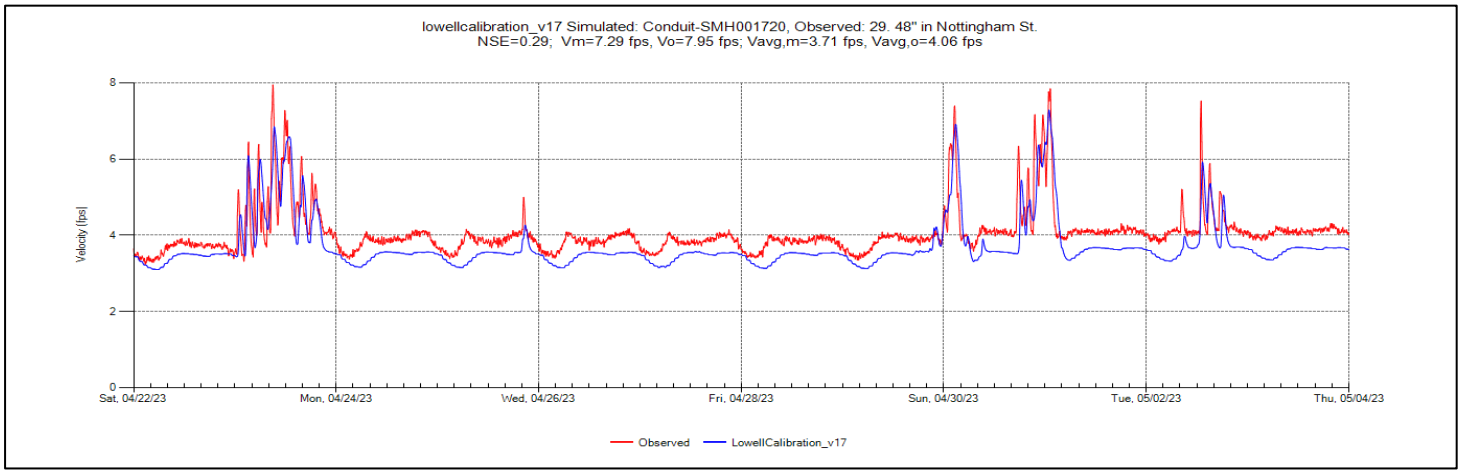


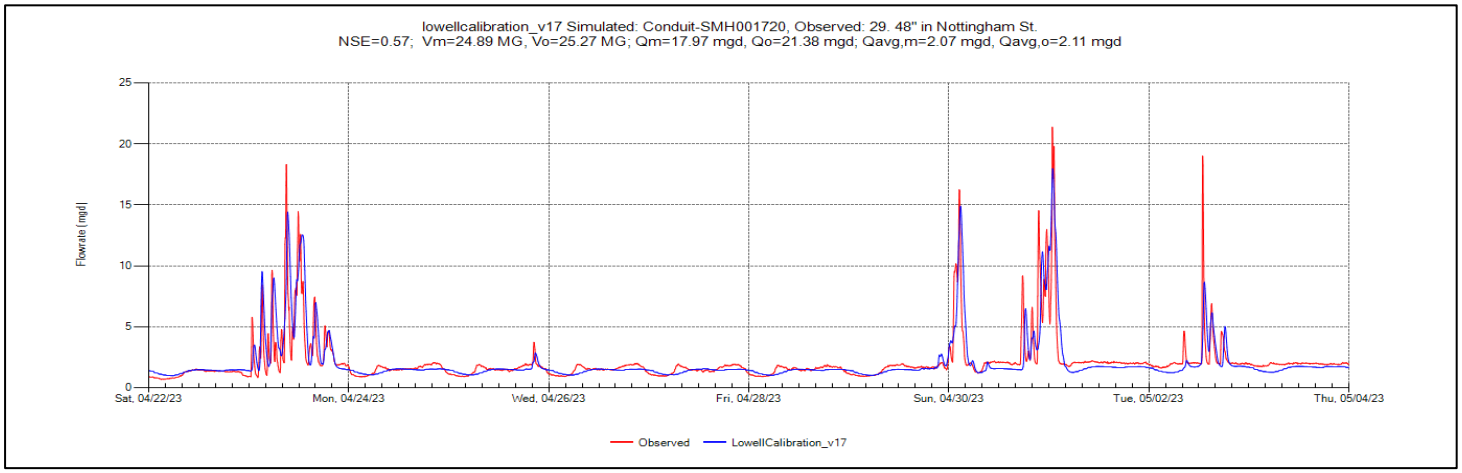


Simulated Versus Observed Flow at Flow Meter Sites

29-April-May Storms

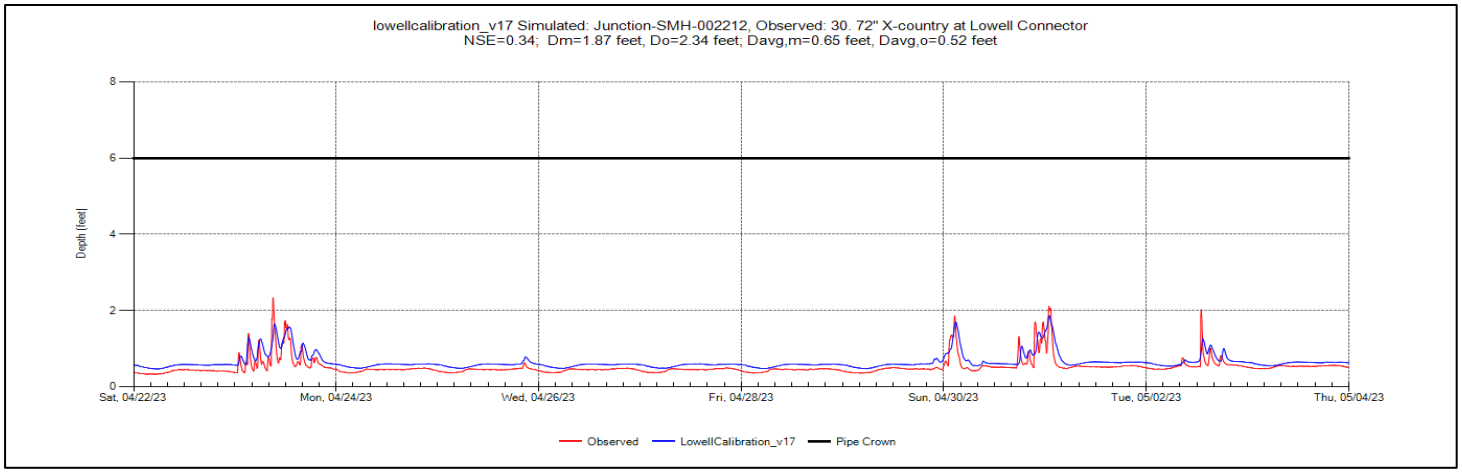


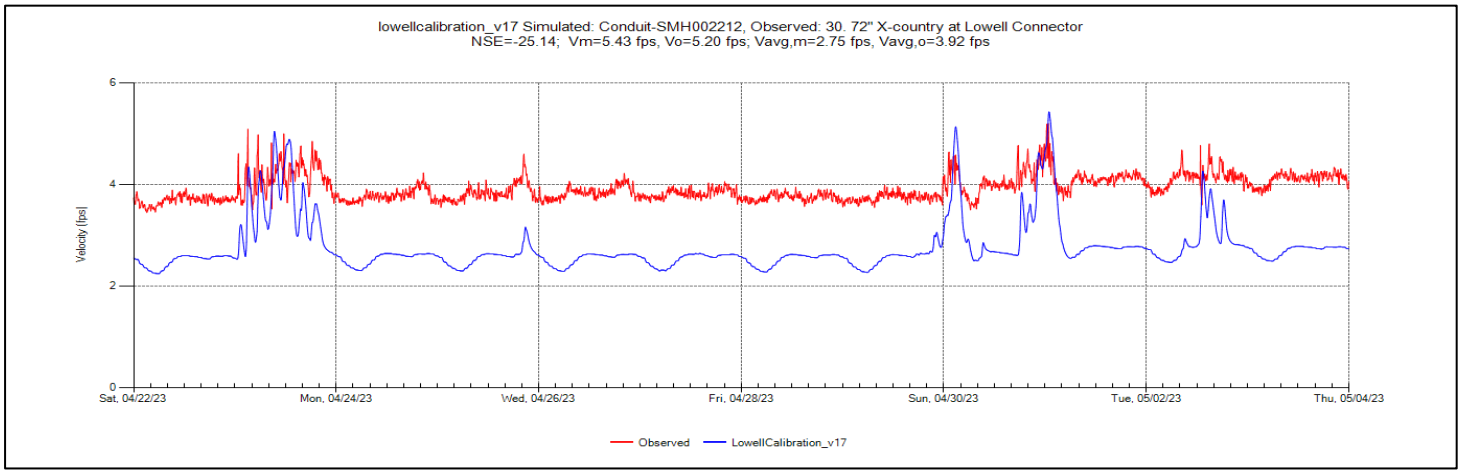


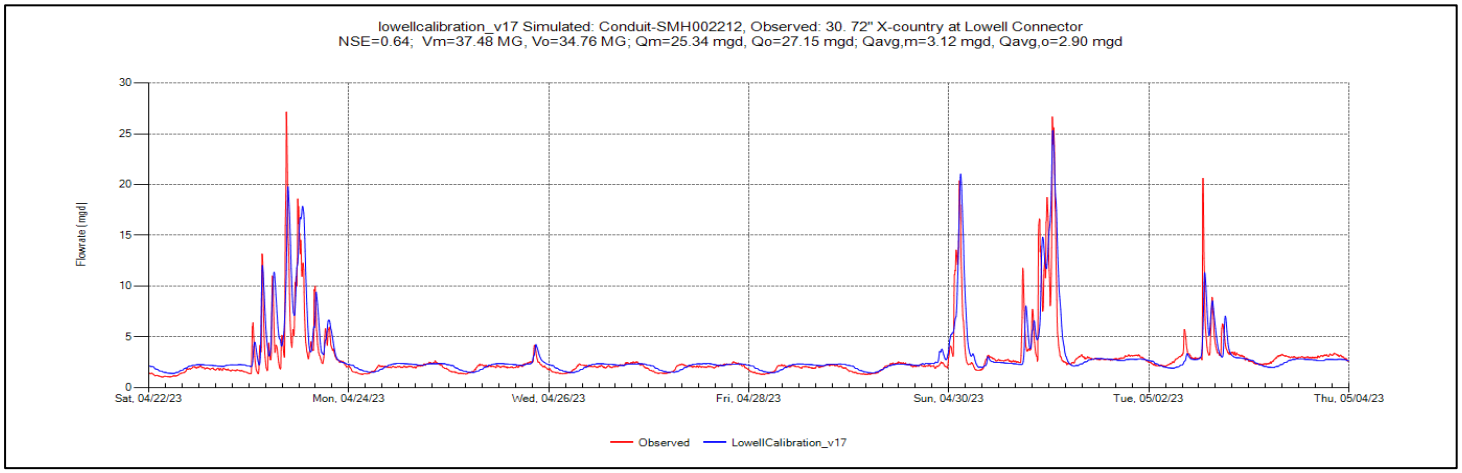


Simulated Versus Observed Flow at Flow Meter Sites

30-April-May Storms

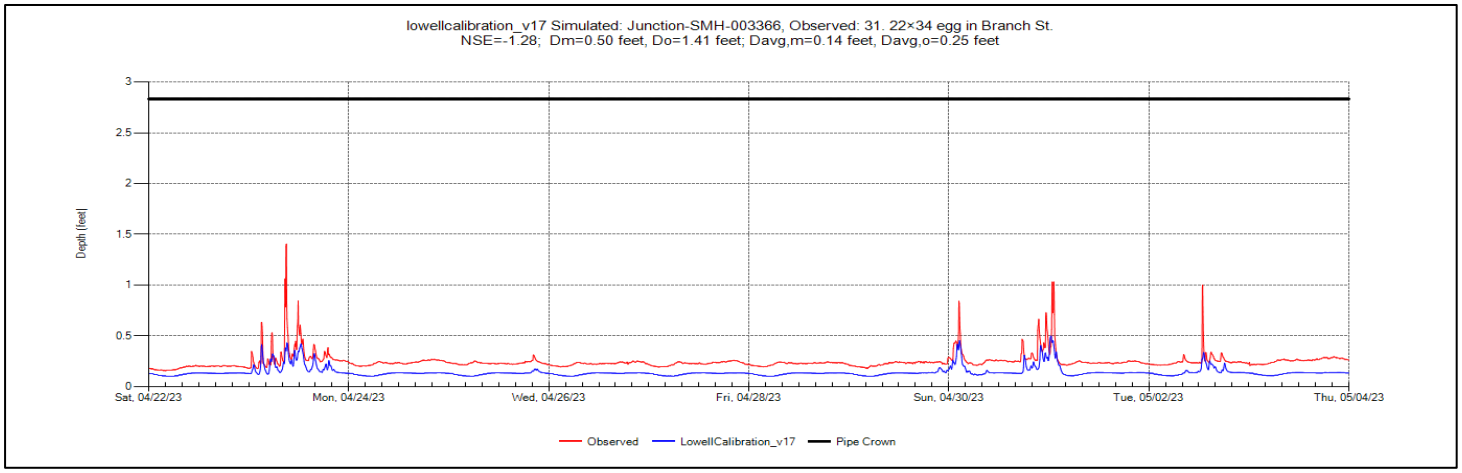


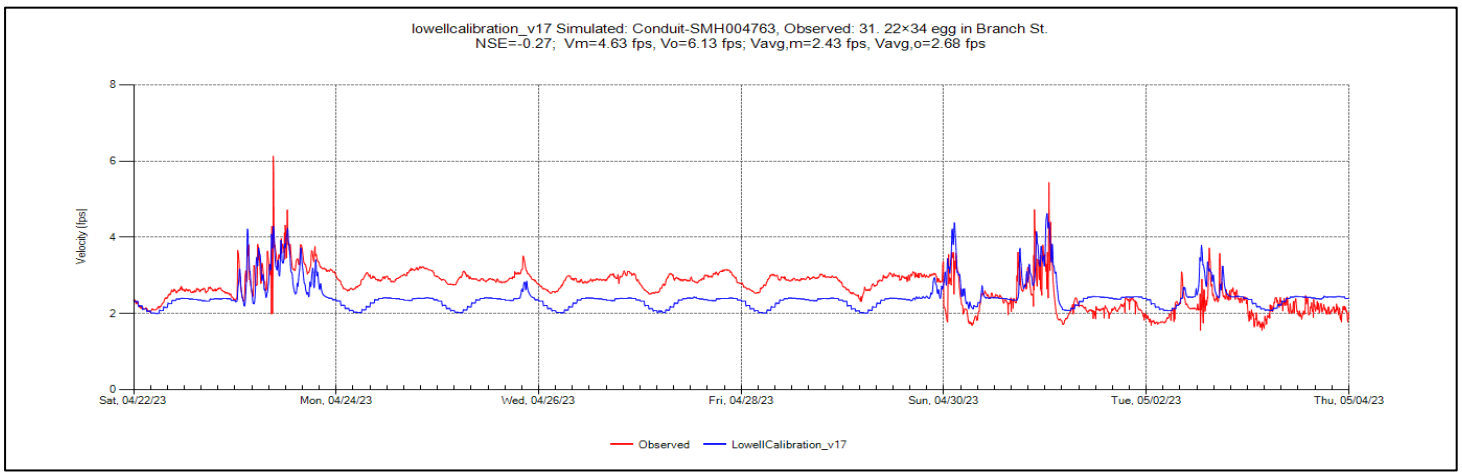


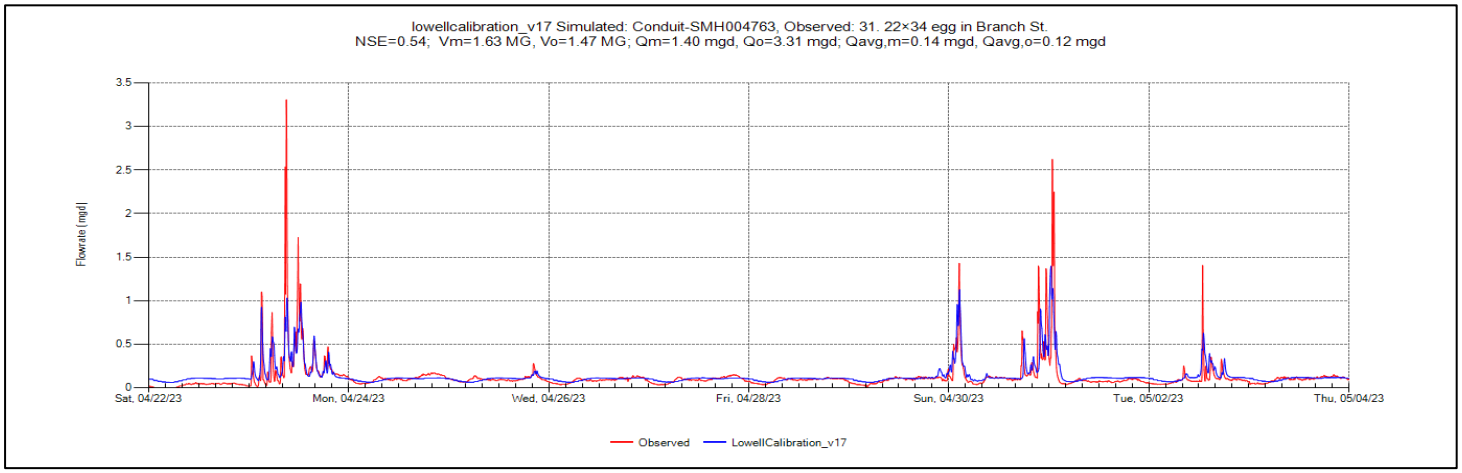


Simulated Versus Observed Flow at Flow Meter Sites

31-April-May Storms

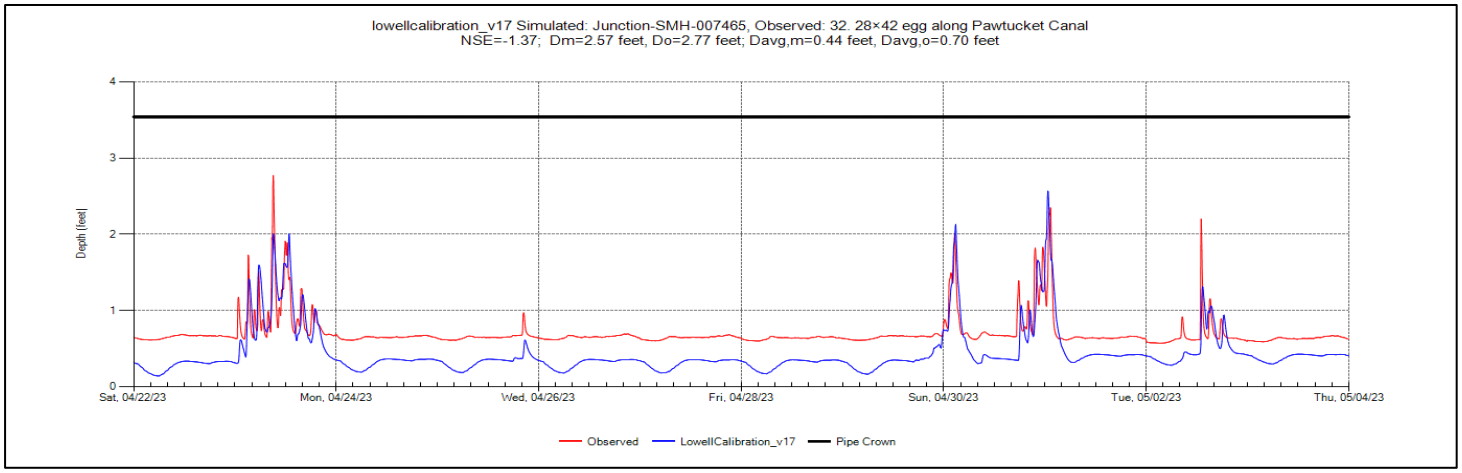


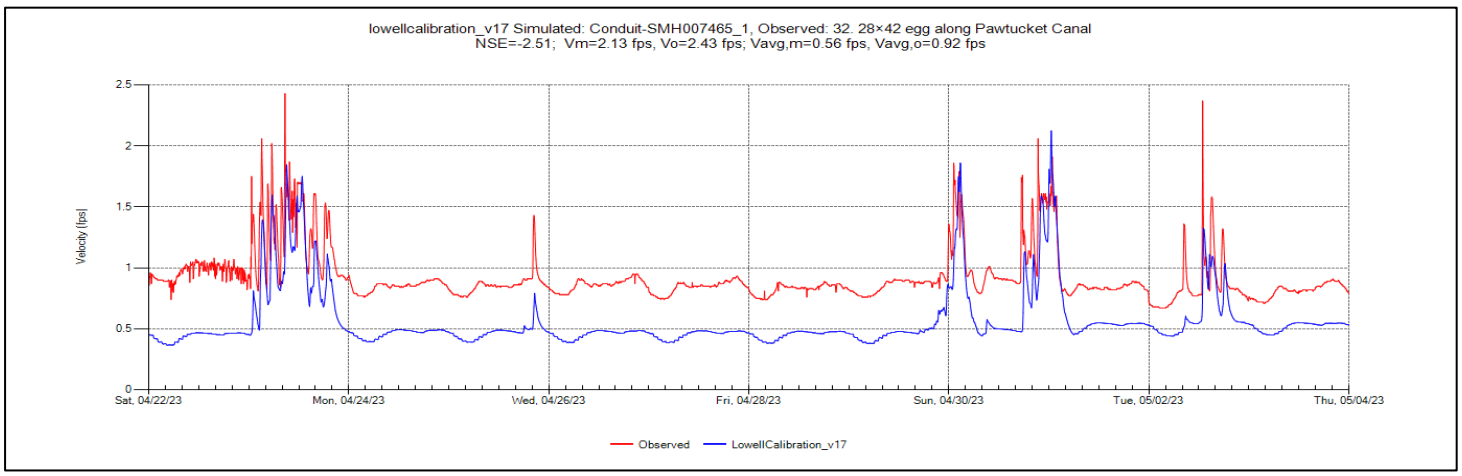


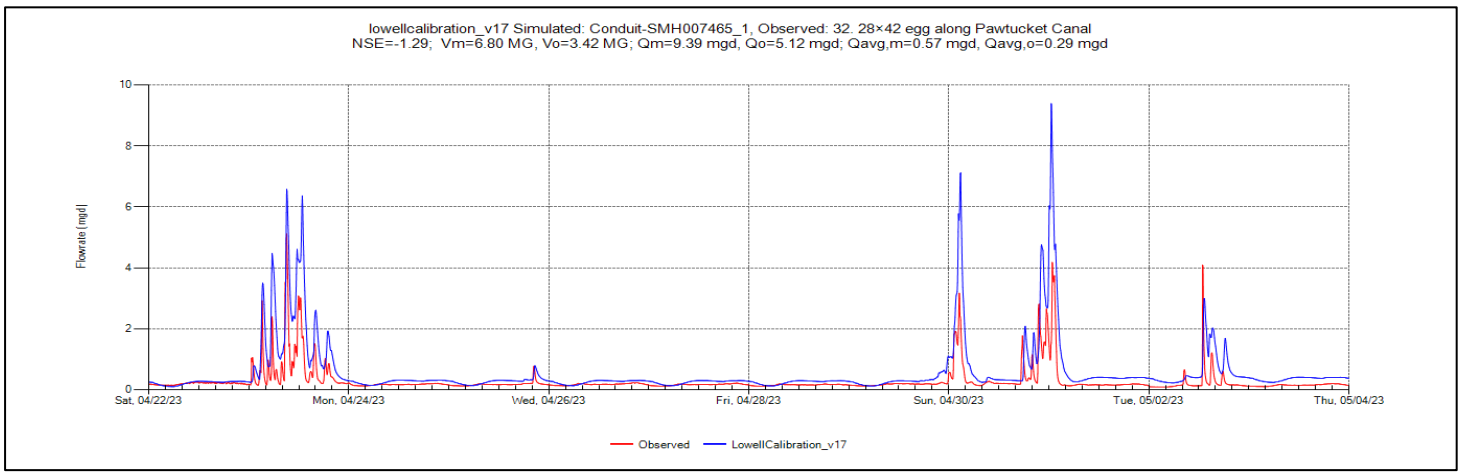


Simulated Versus Observed Flow at Flow Meter Sites

32-April-May Storms

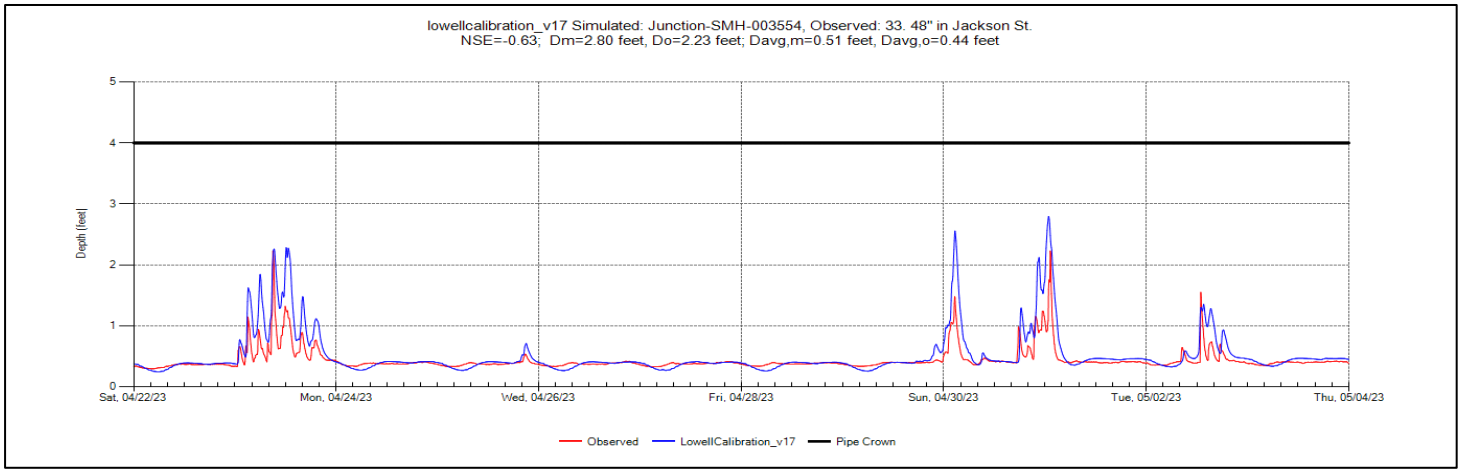


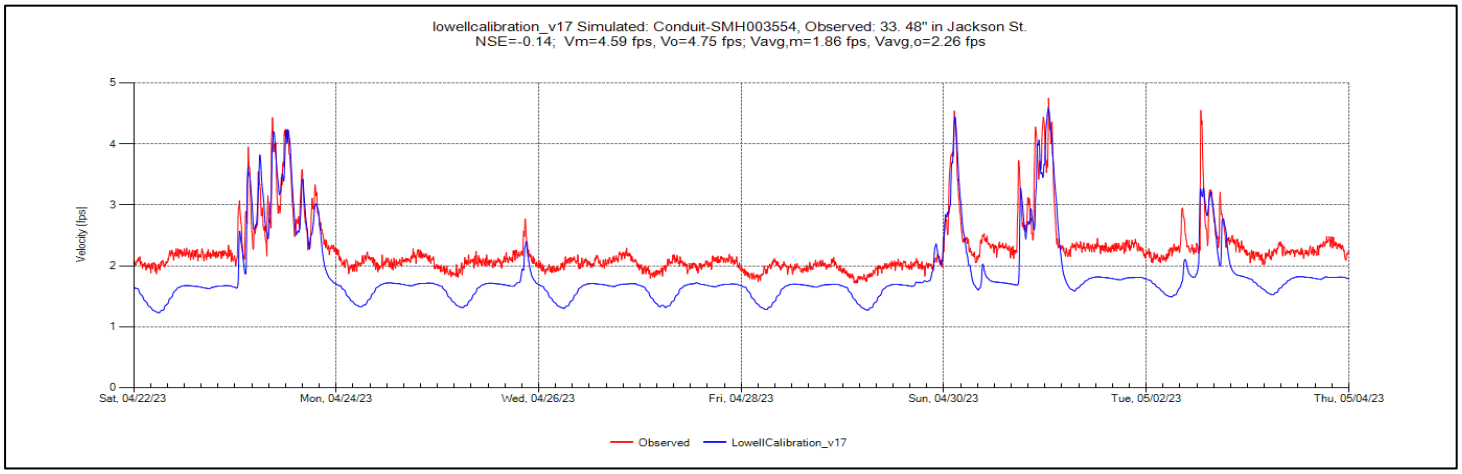


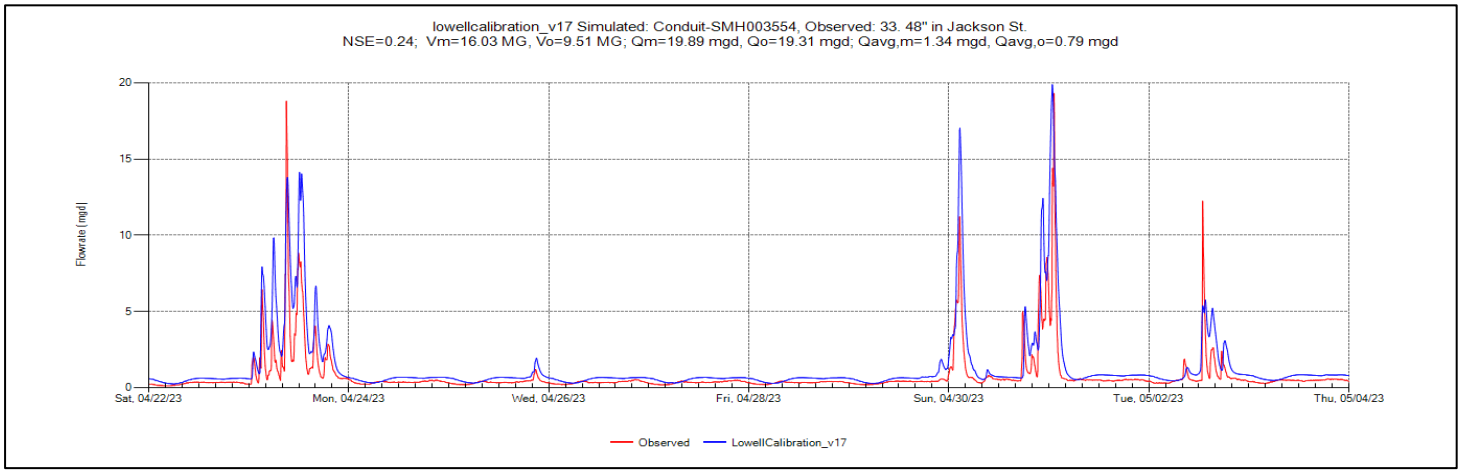


Simulated Versus Observed Flow at Flow Meter Sites

33-April-May Storms

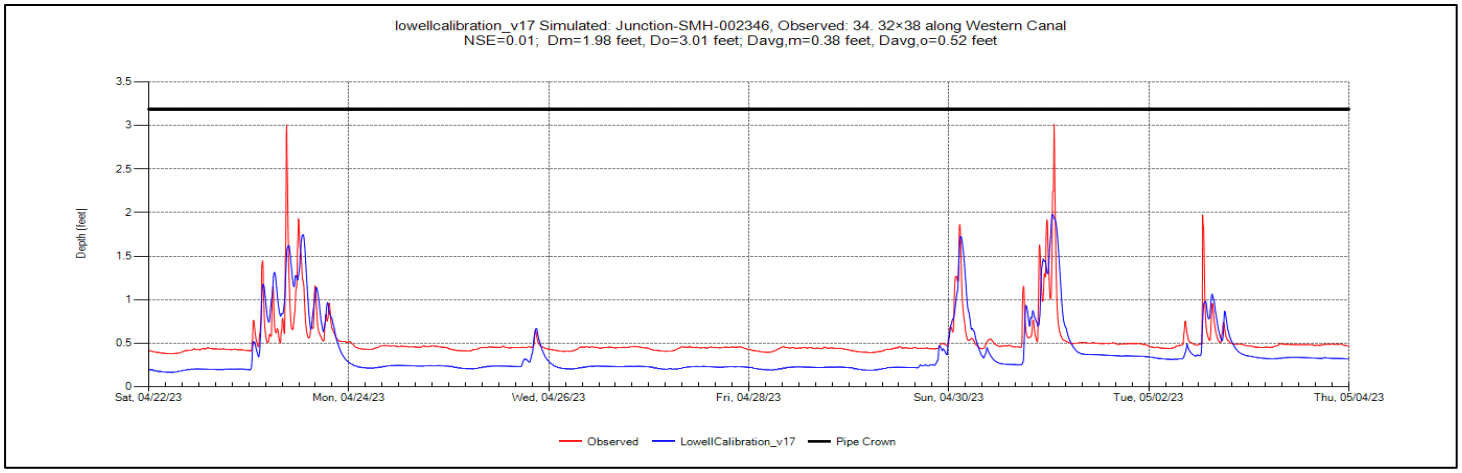


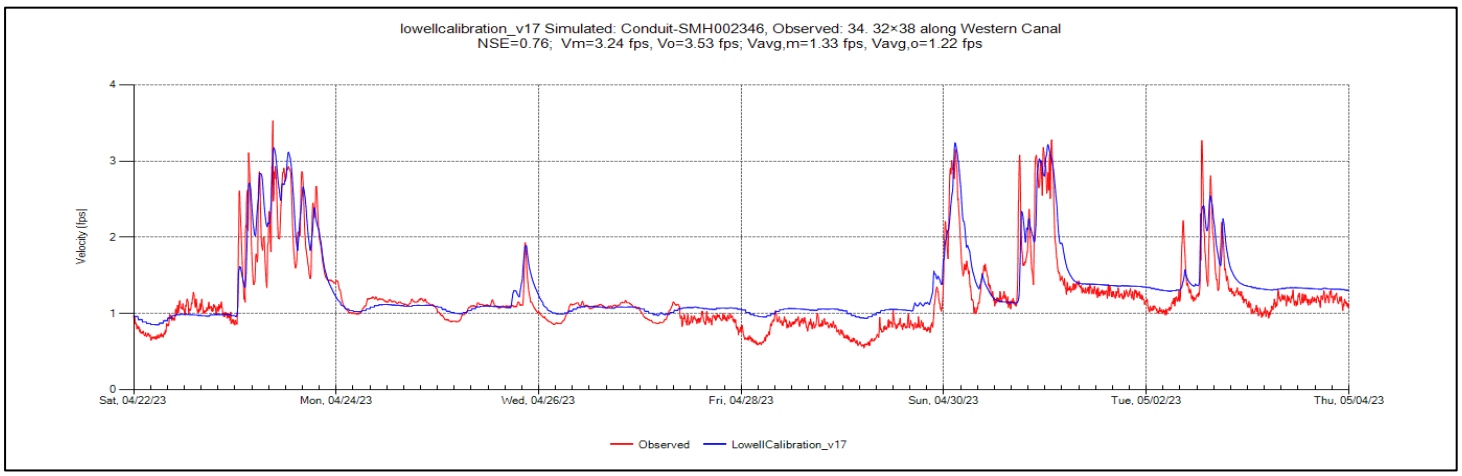


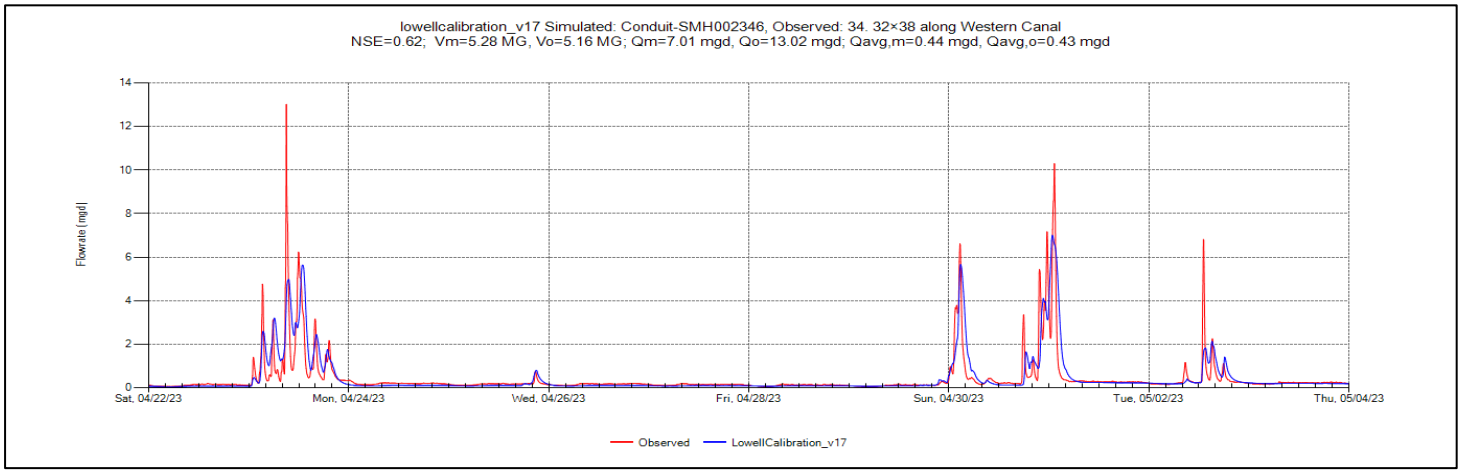


Simulated Versus Observed Flow at Flow Meter Sites

34-April-May Storms

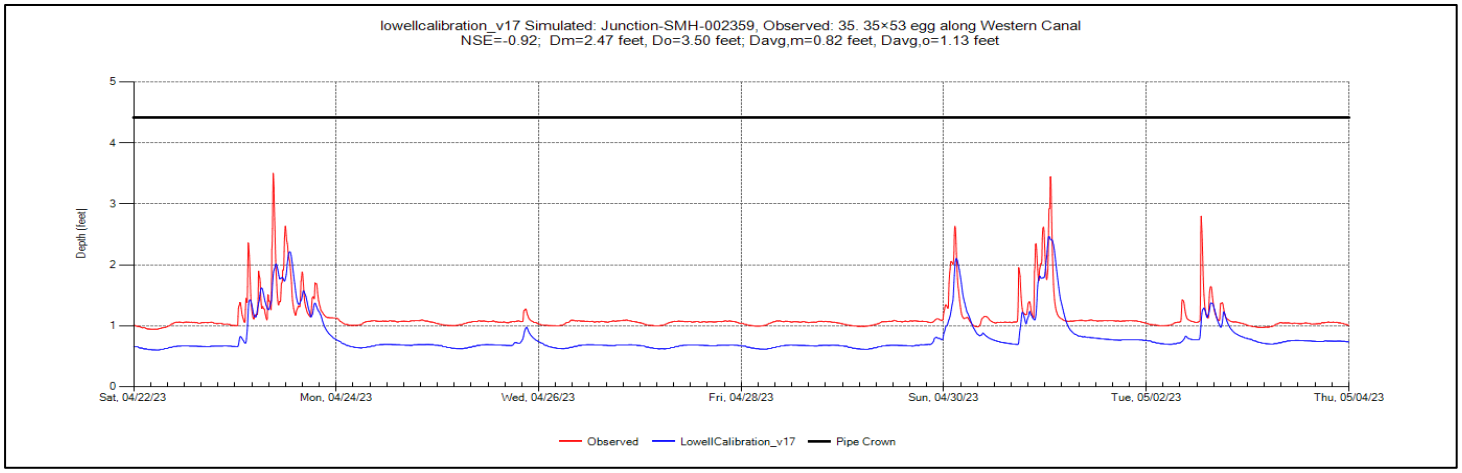


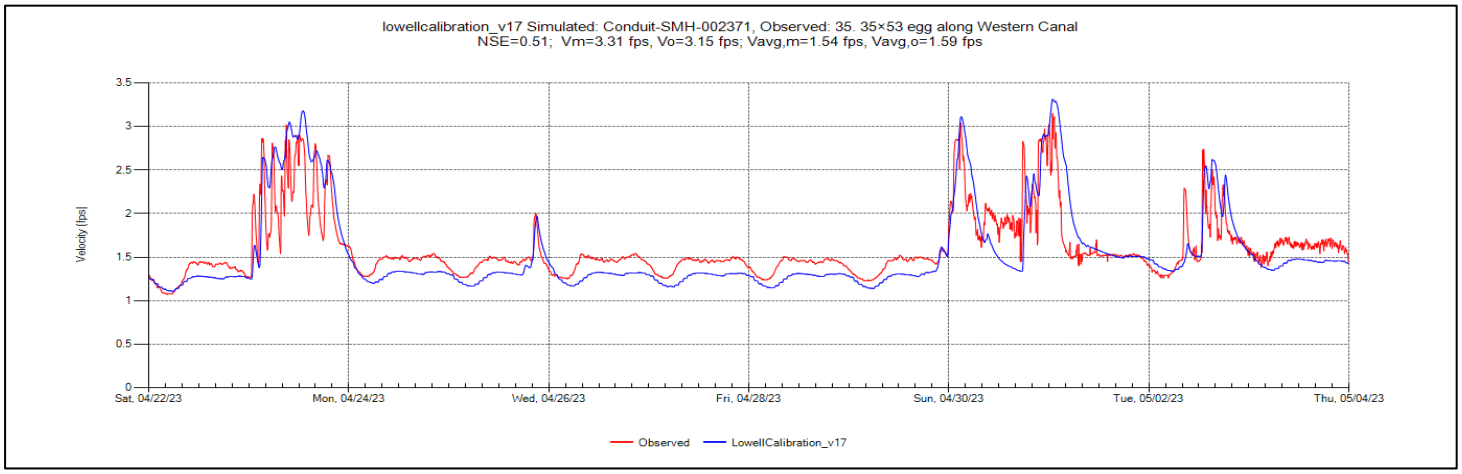


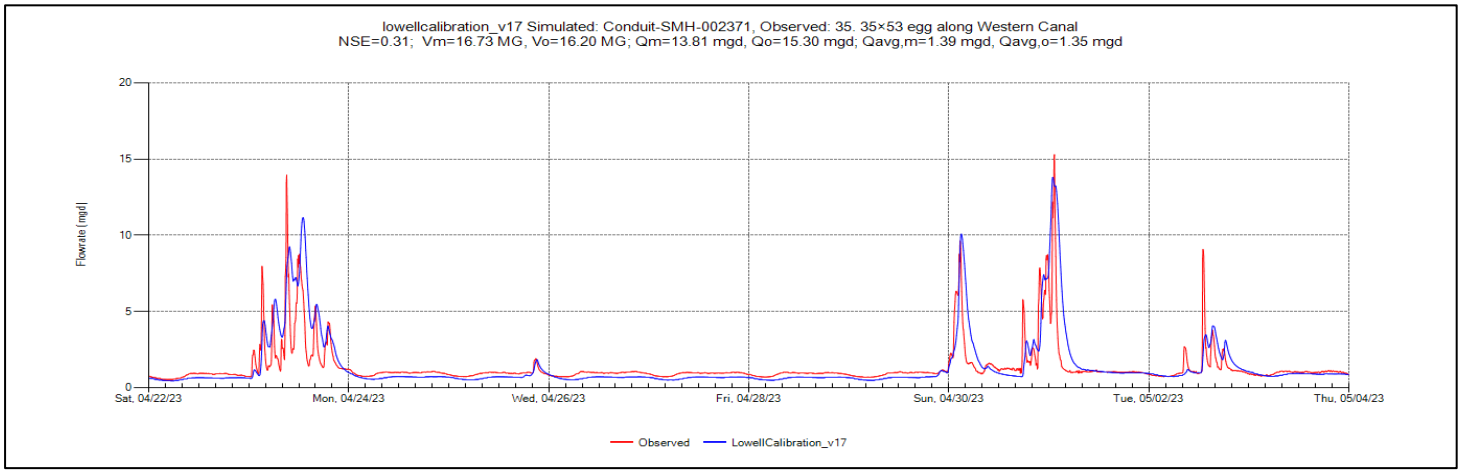


Simulated Versus Observed Flow at Flow Meter Sites

35-April-May Storms

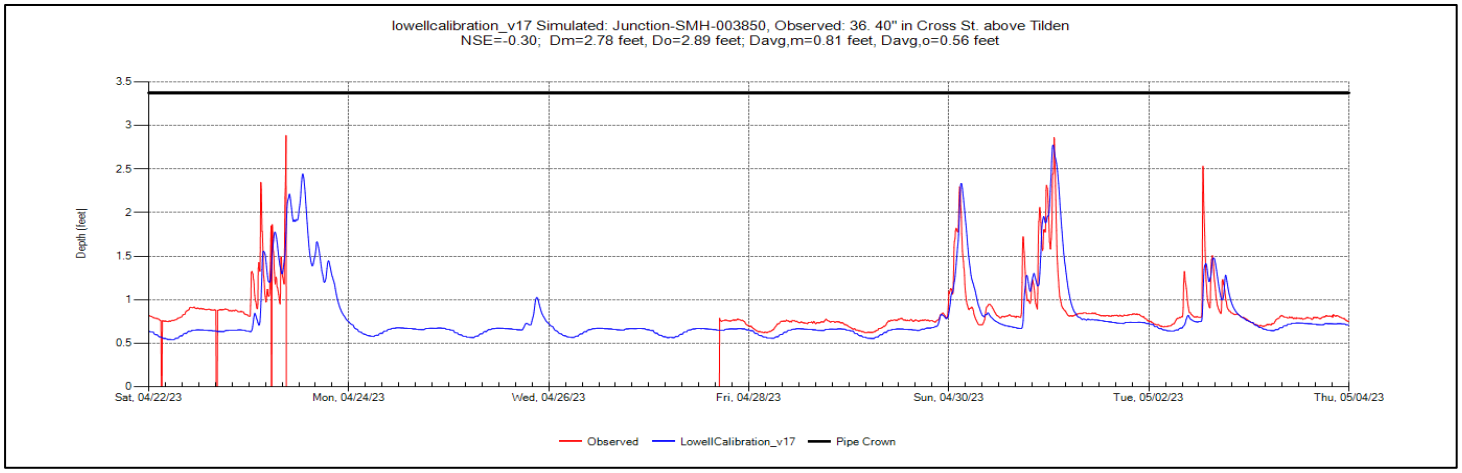


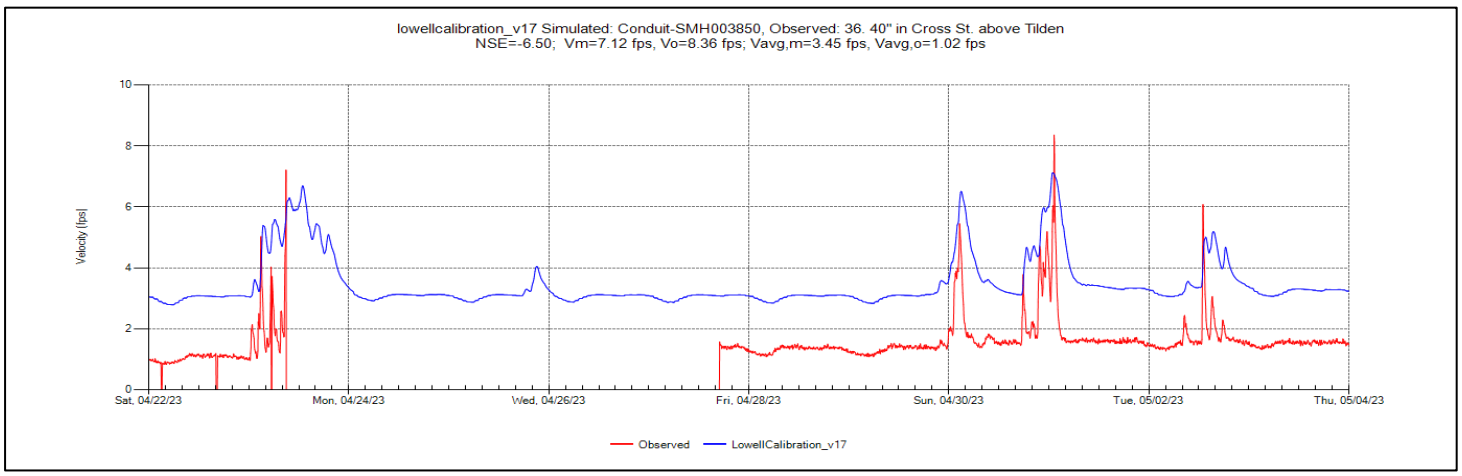


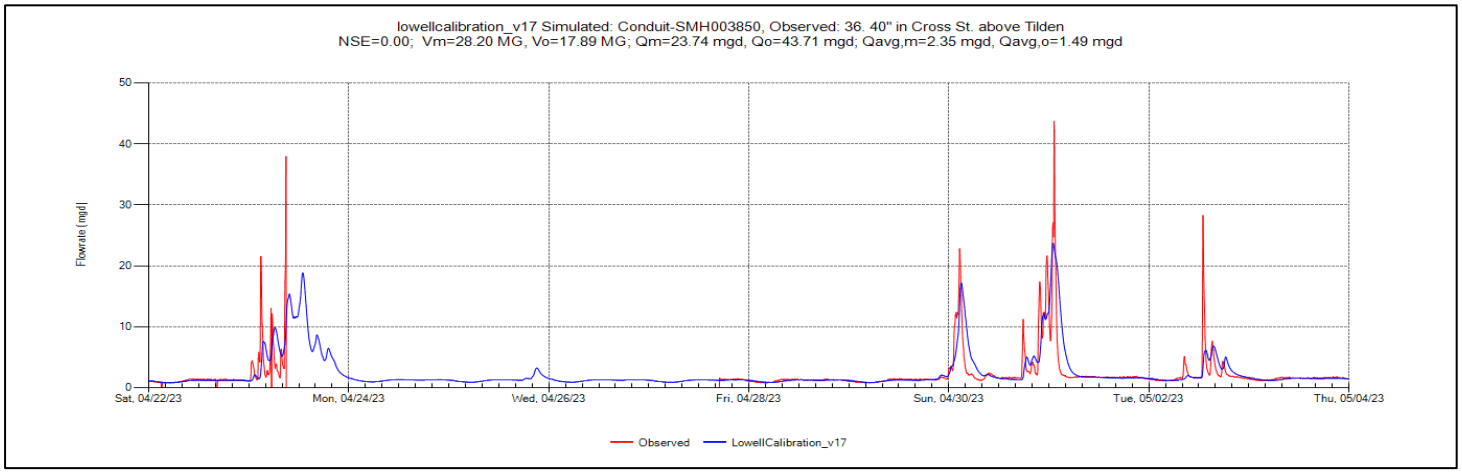


Simulated Versus Observed Flow at Flow Meter Sites

36-April-May Storms

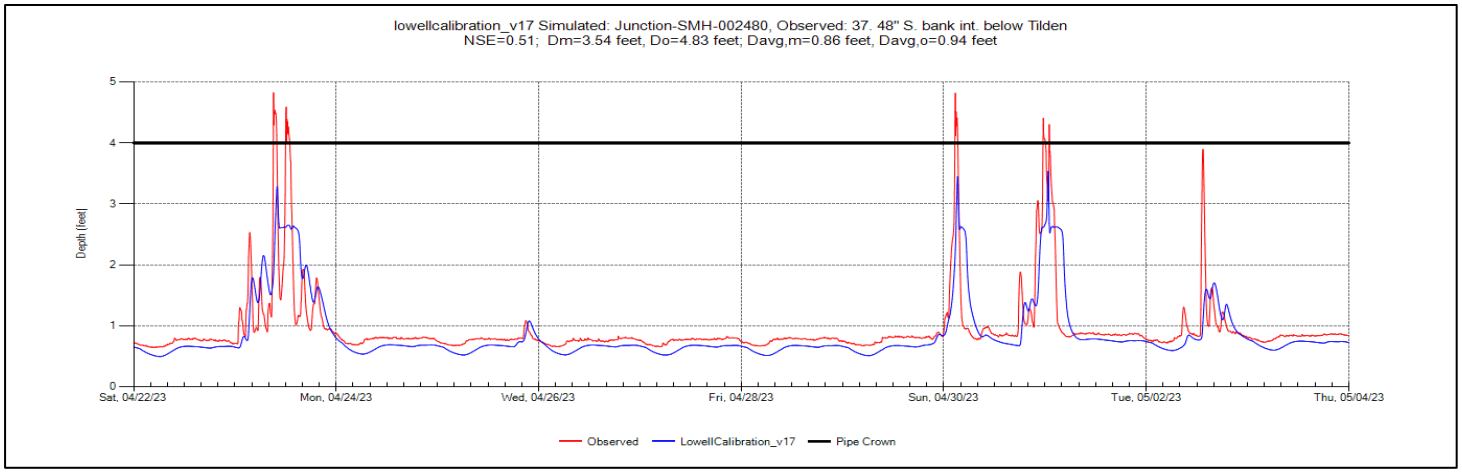


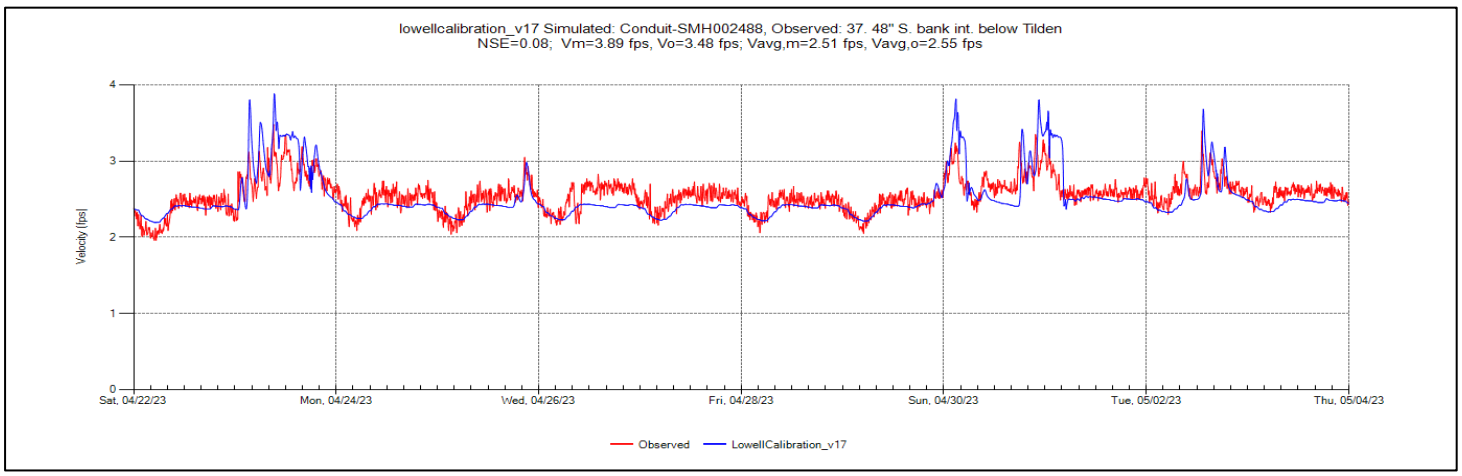


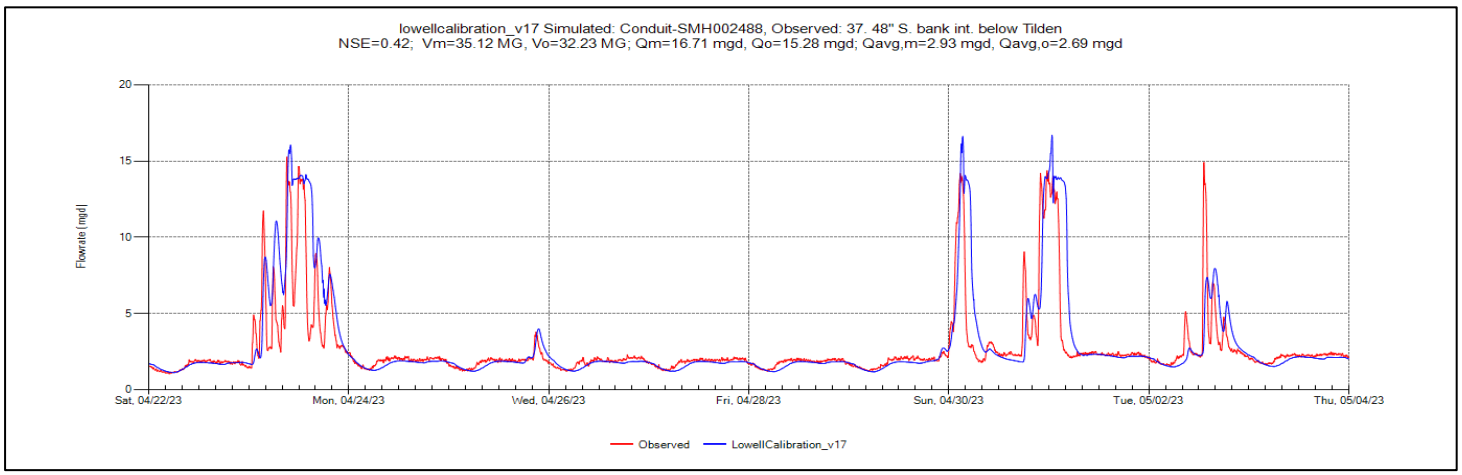


Simulated Versus Observed Flow at Flow Meter Sites

37-April-May Storms

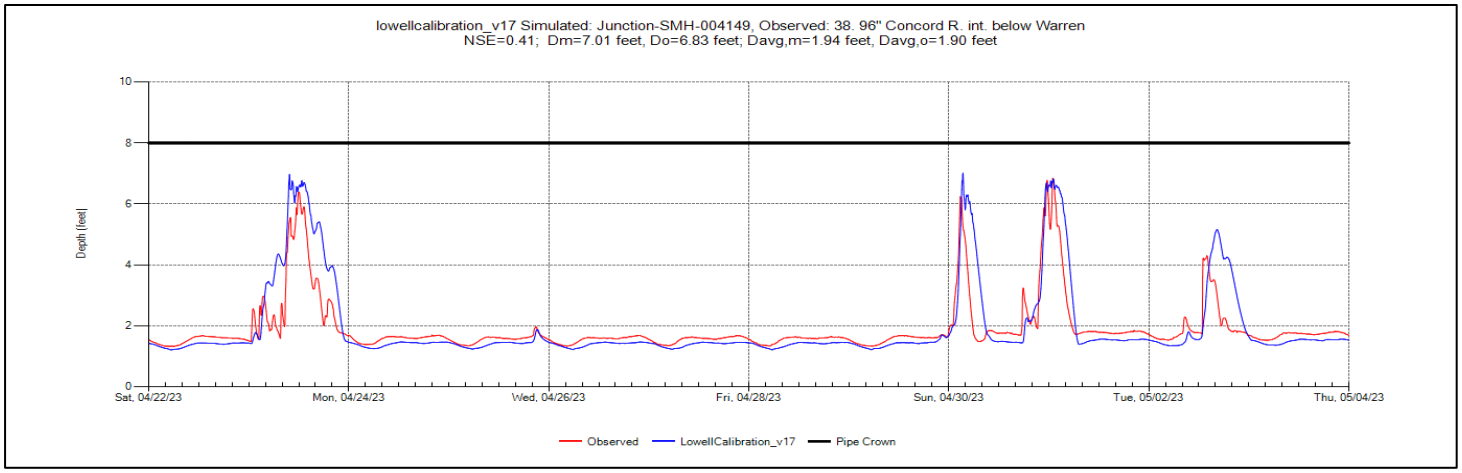


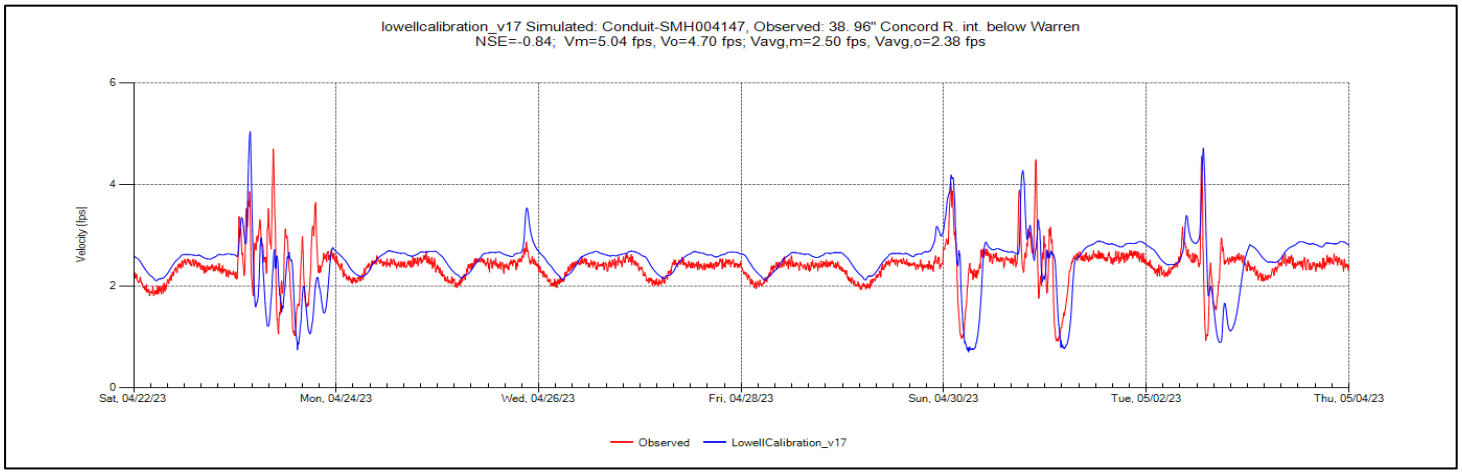


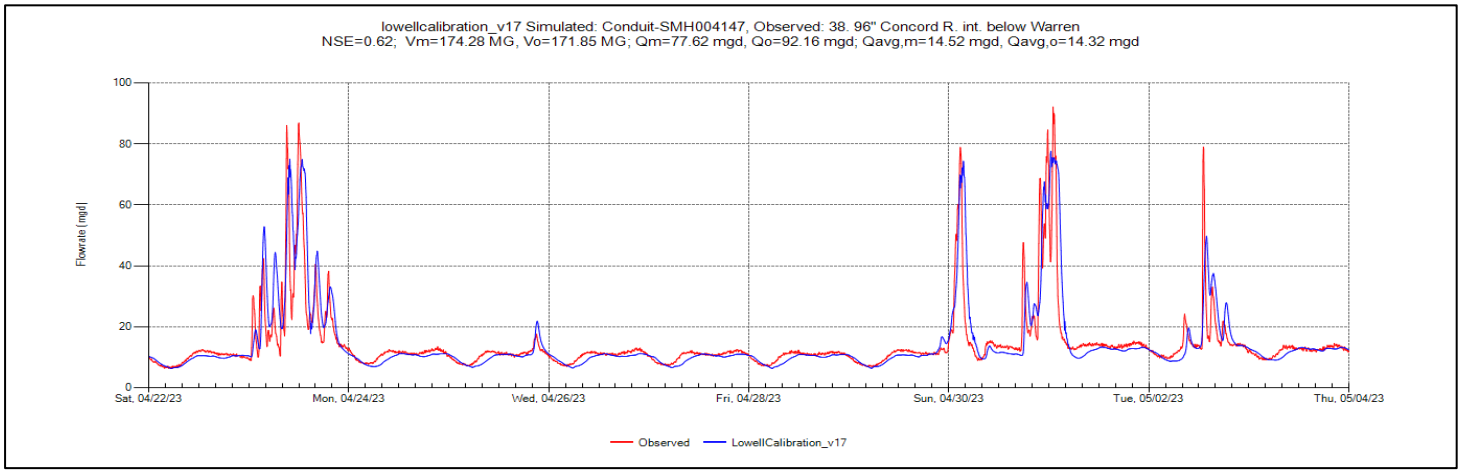


Simulated Versus Observed Flow at Flow Meter Sites

38-April-May Storms

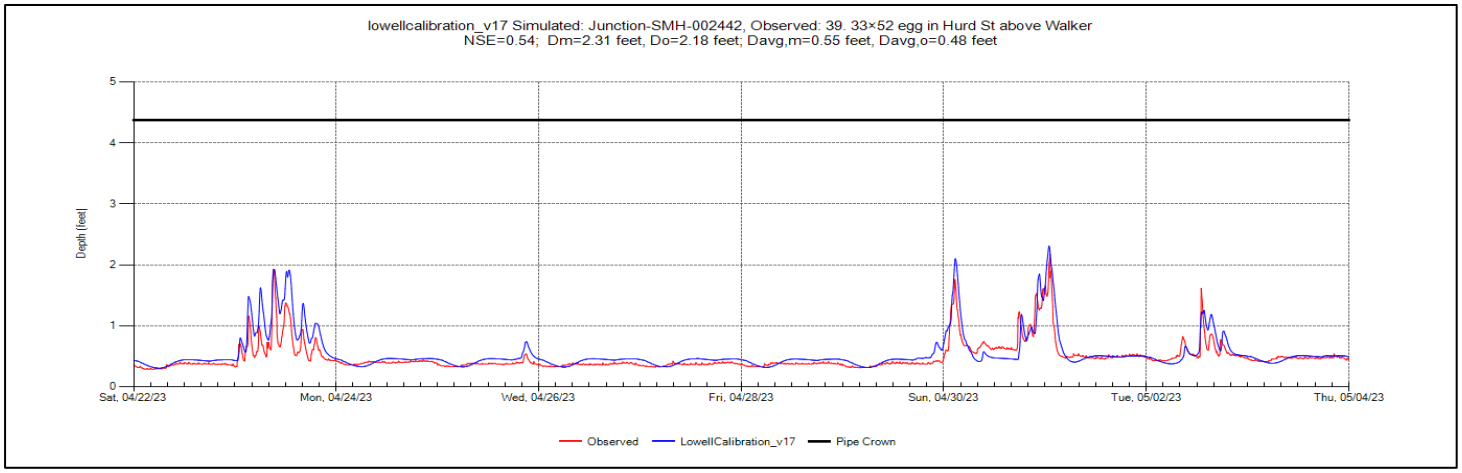


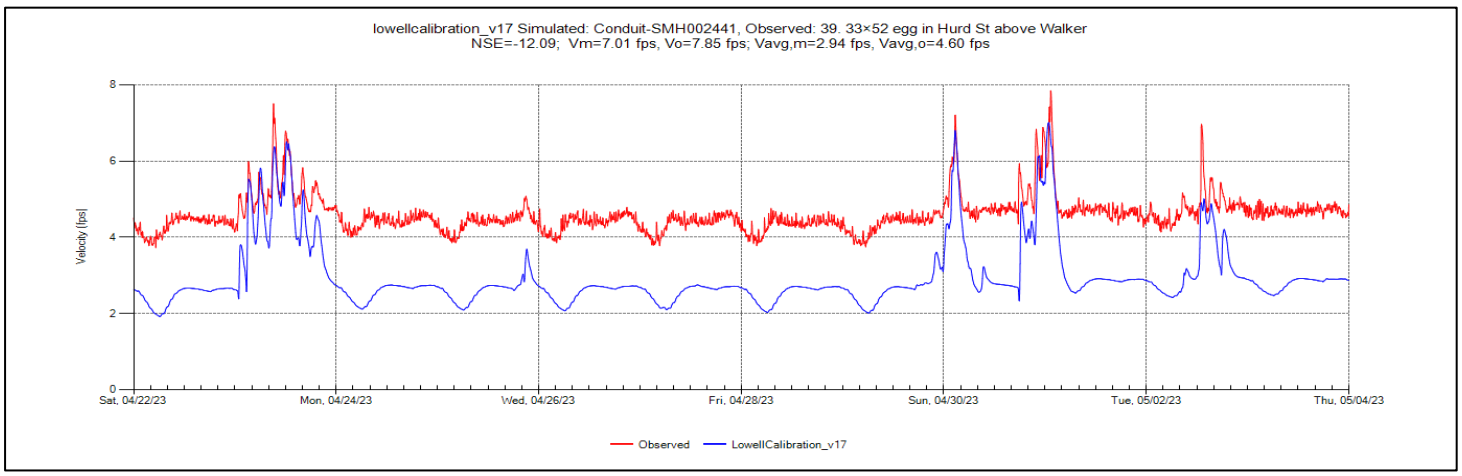


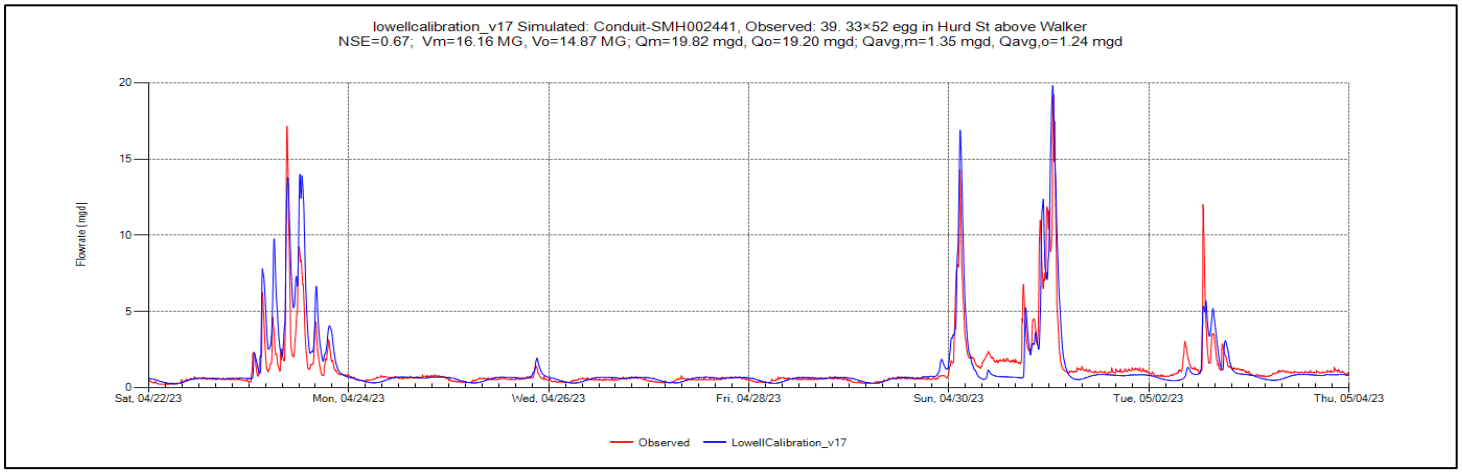


Simulated Versus Observed Flow at Flow Meter Sites

39-April-May Storms

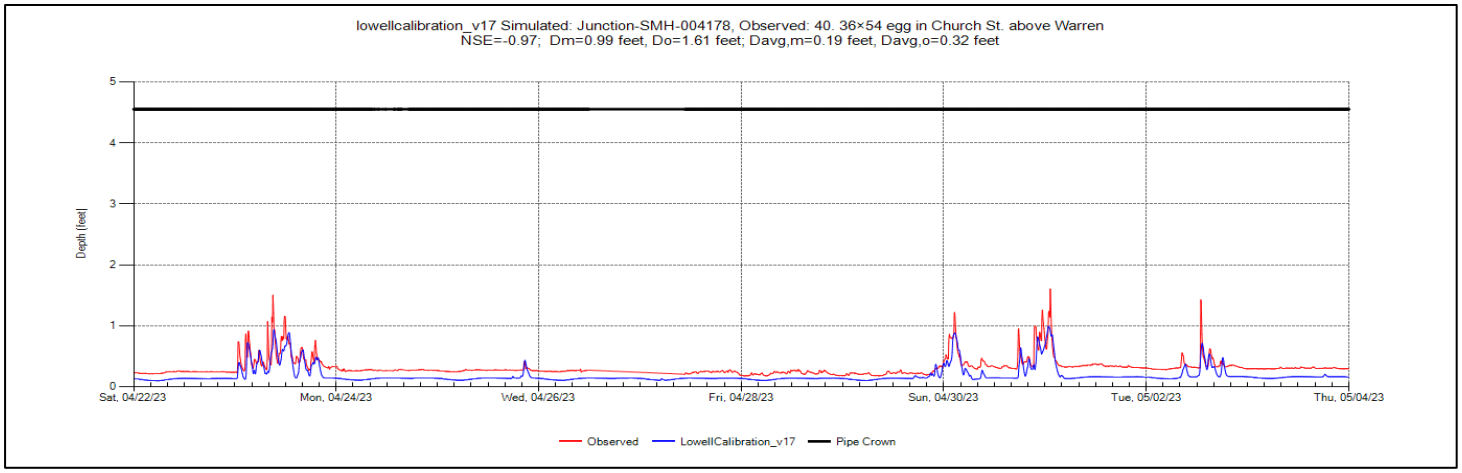


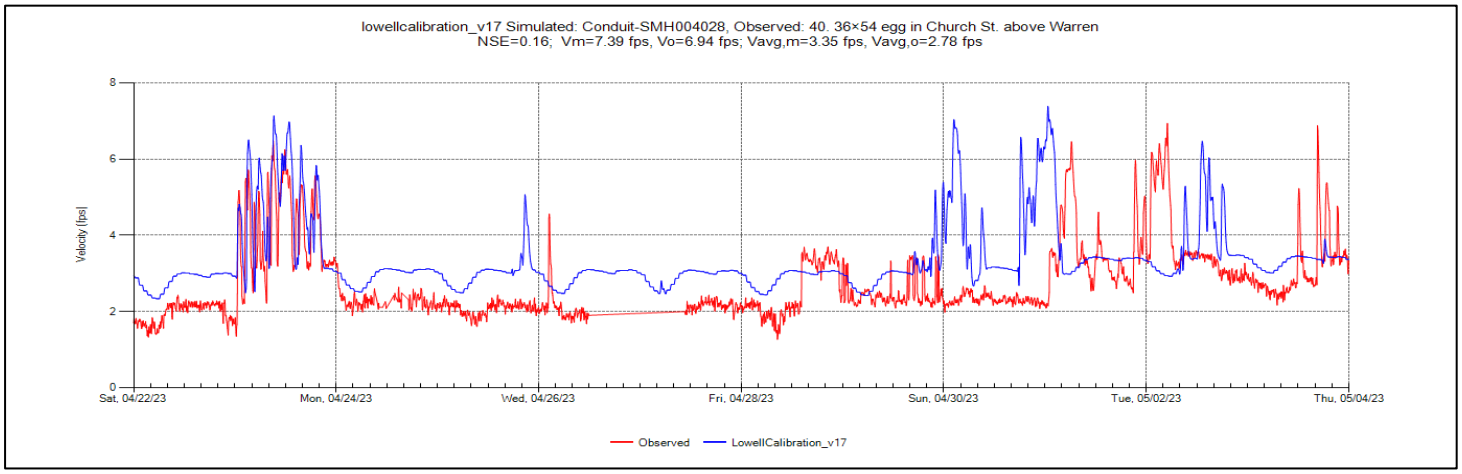


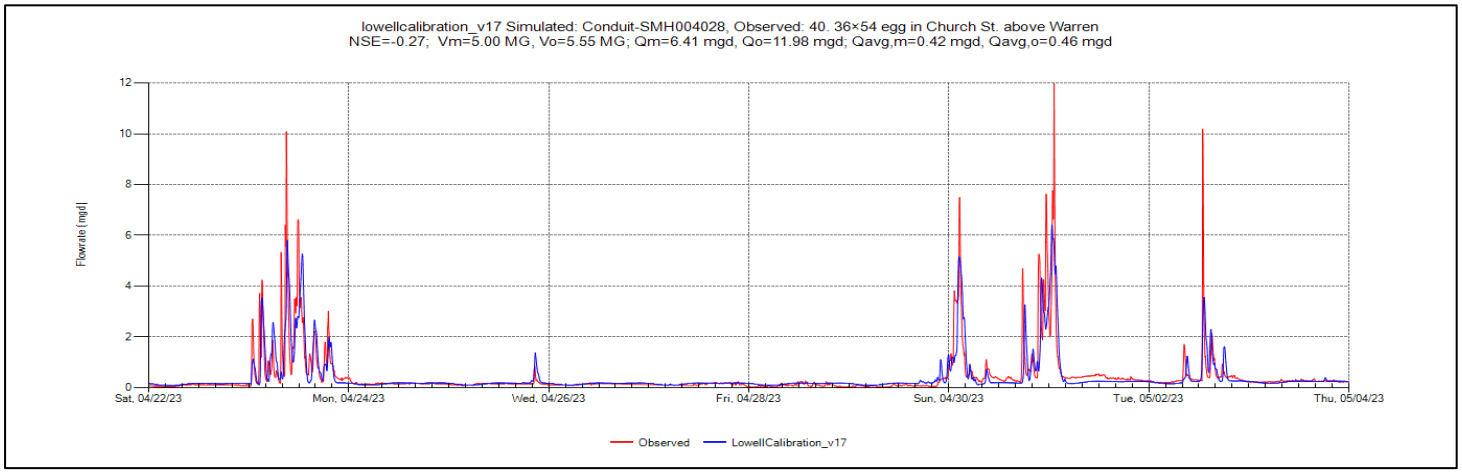


Simulated Versus Observed Flow at Flow Meter Sites

40-April-May Storms

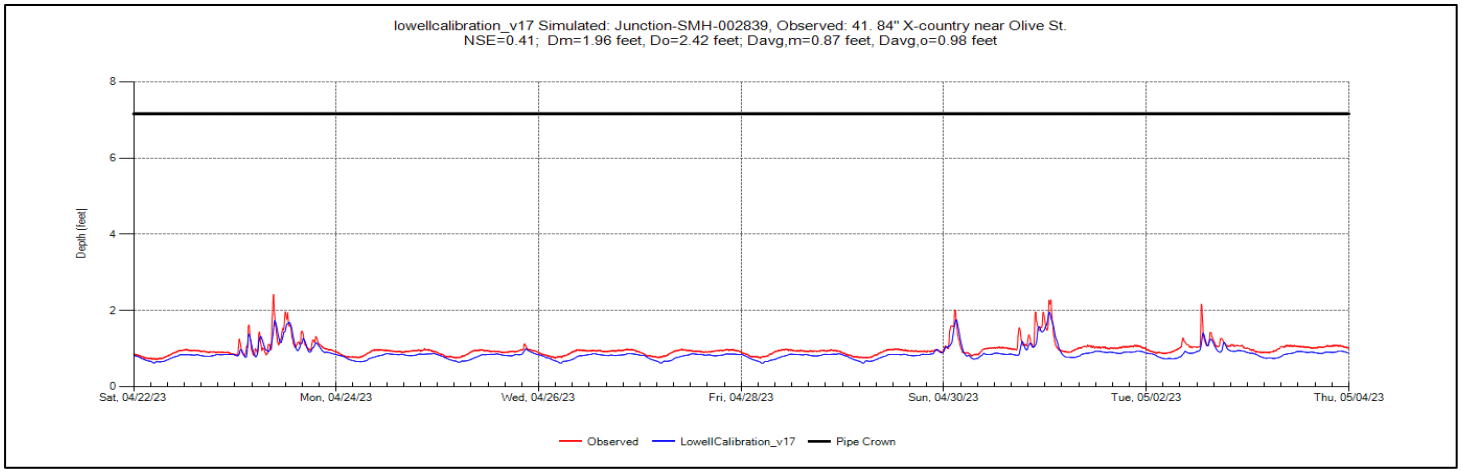


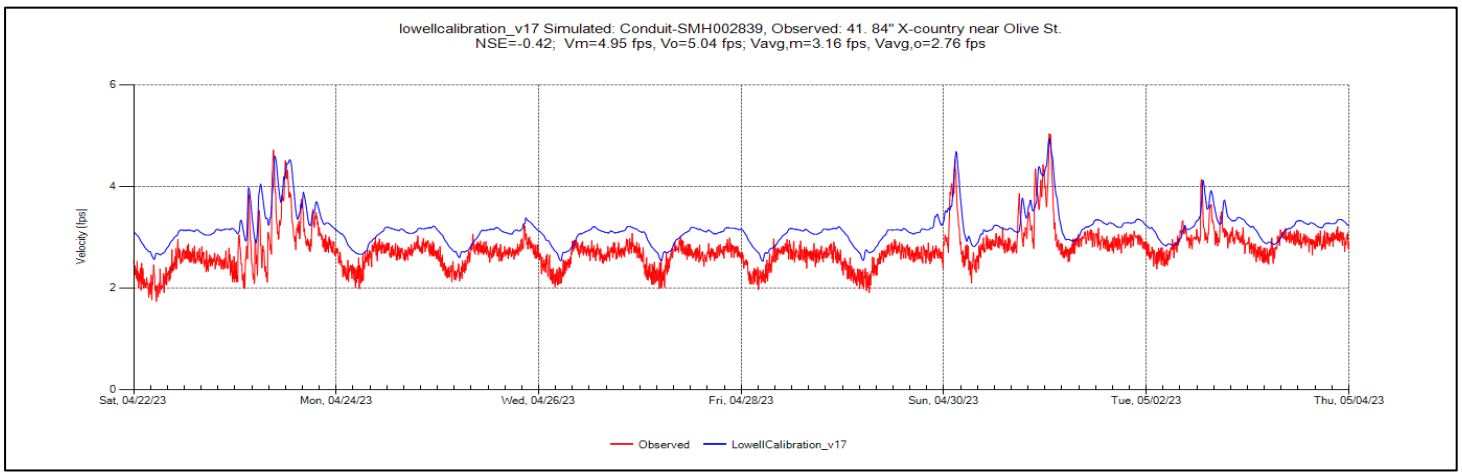


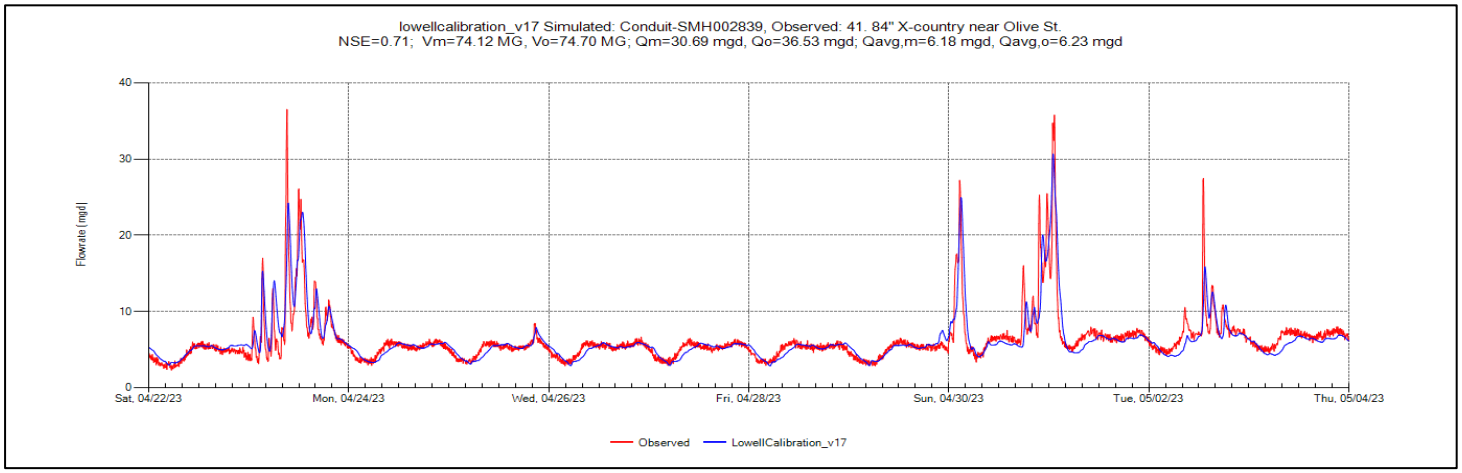


Simulated Versus Observed Flow at Flow Meter Sites

41-April-May Storms

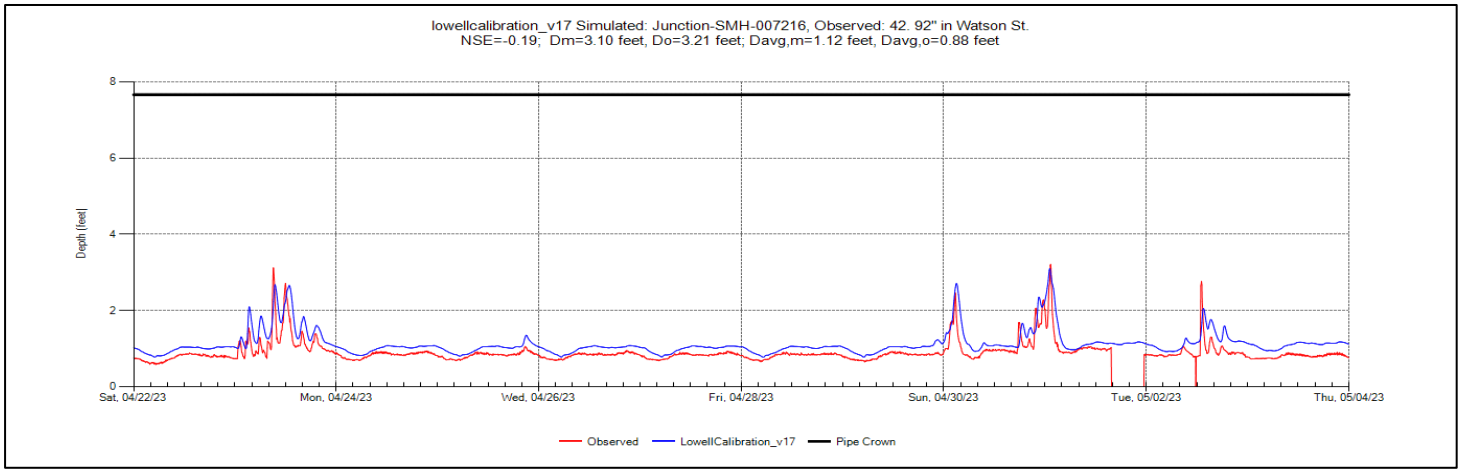


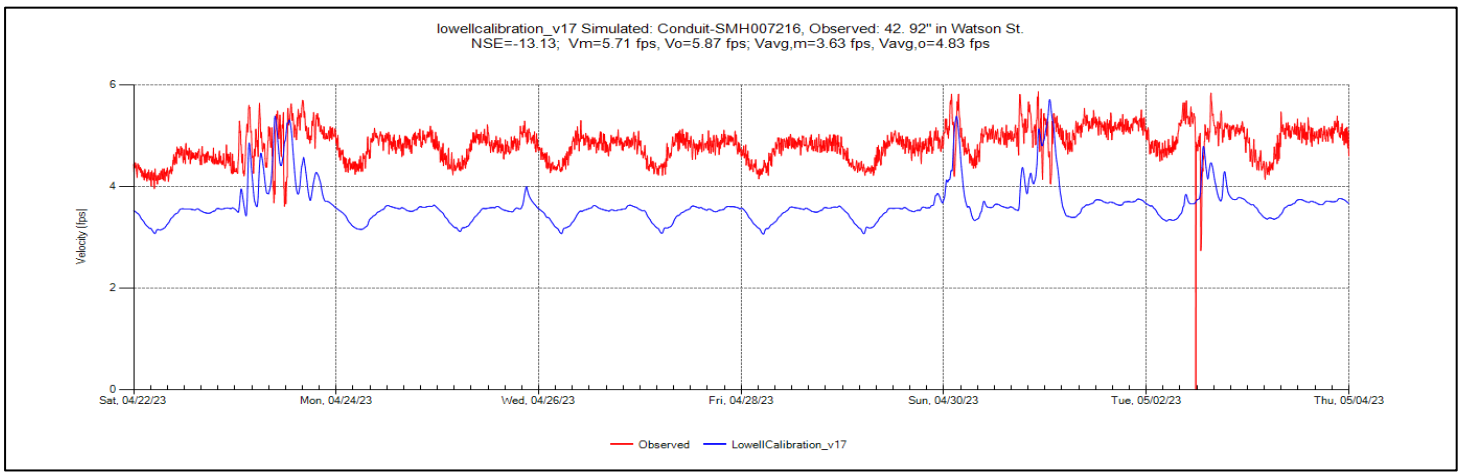


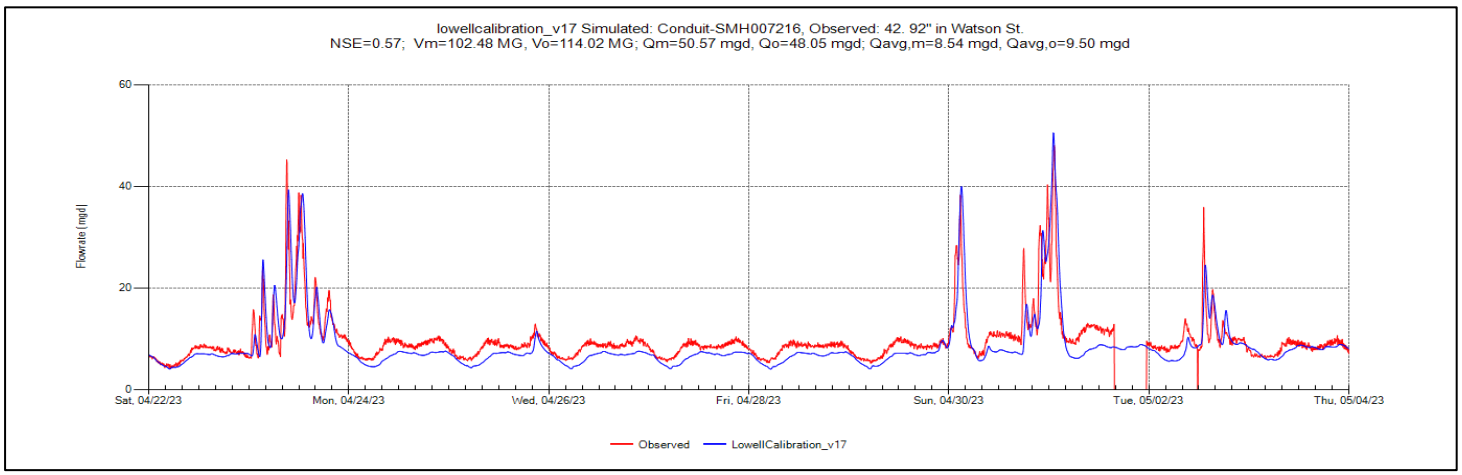


Simulated Versus Observed Flow at Flow Meter Sites

42-April-May Storms

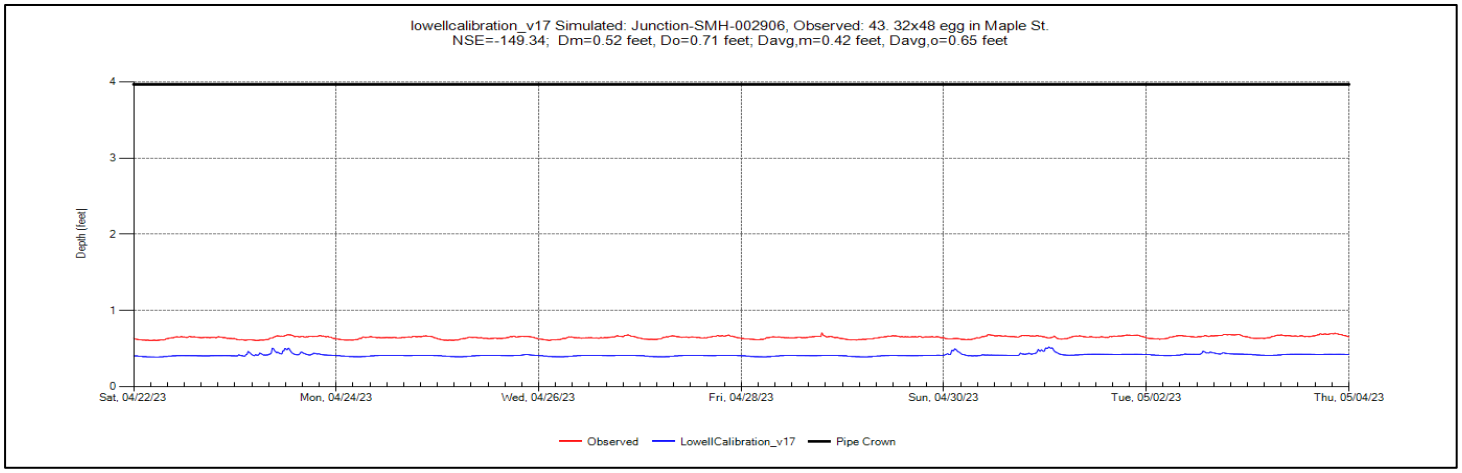


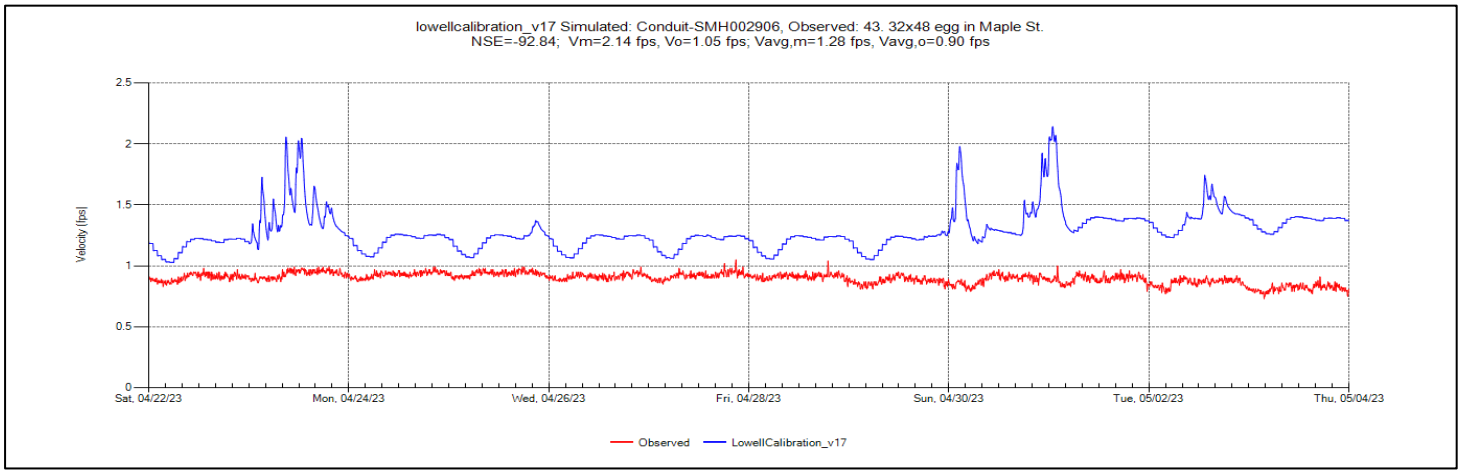


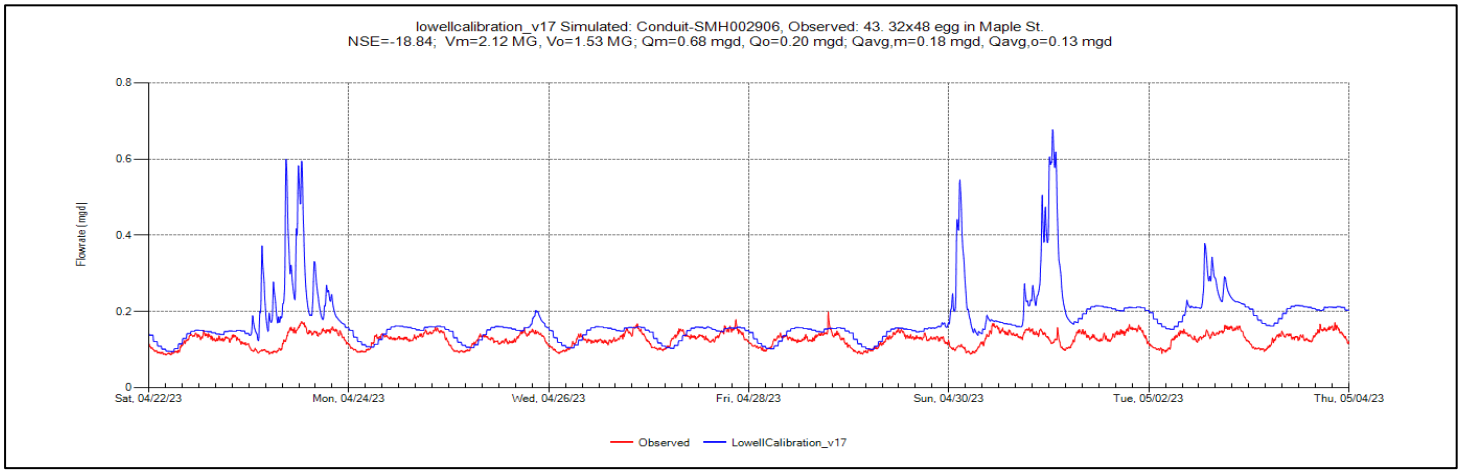


Simulated Versus Observed Flow at Flow Meter Sites

43-April-May Storms

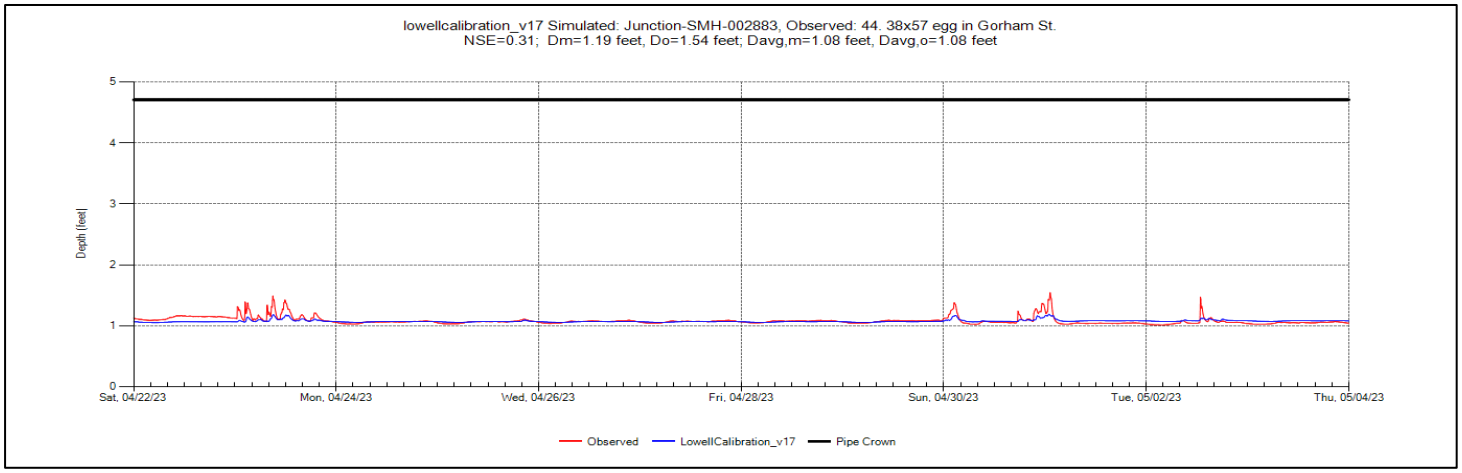


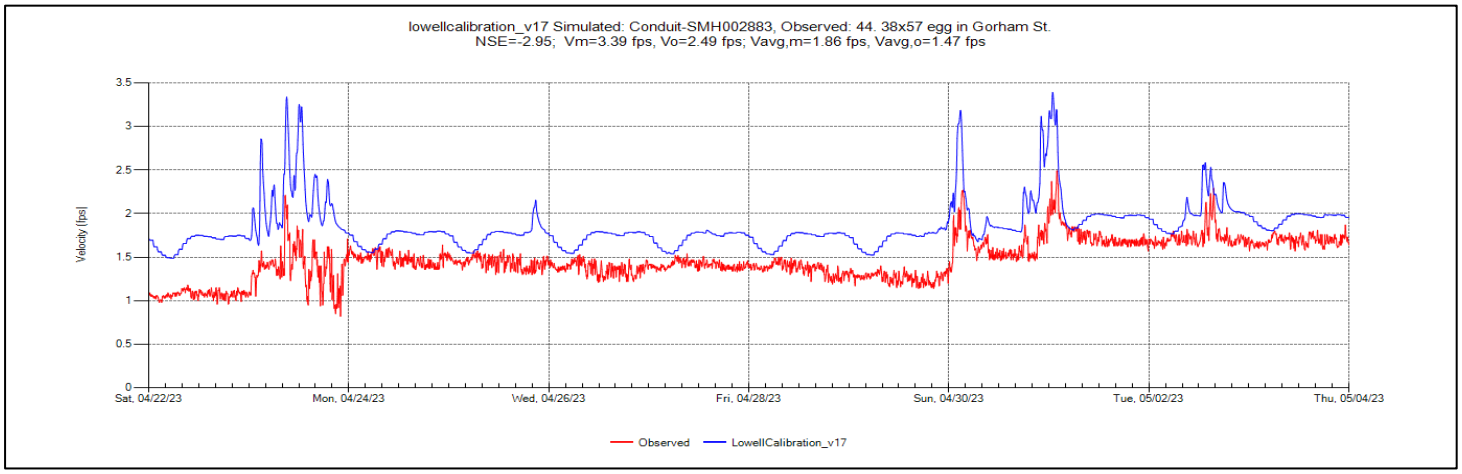


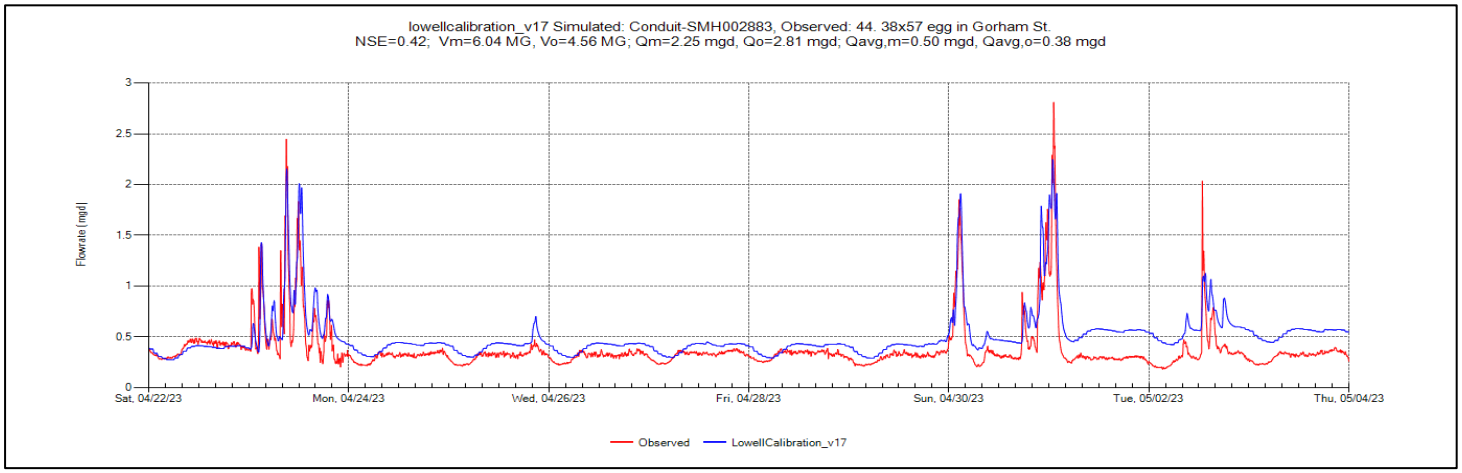


Simulated Versus Observed Flow at Flow Meter Sites

44-April-May Storms

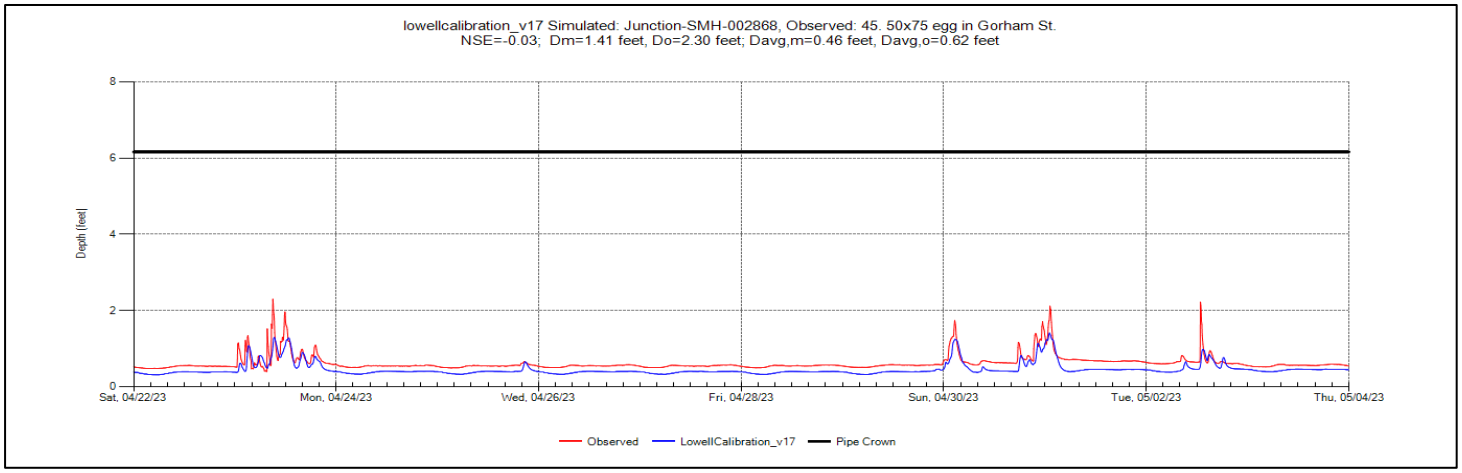


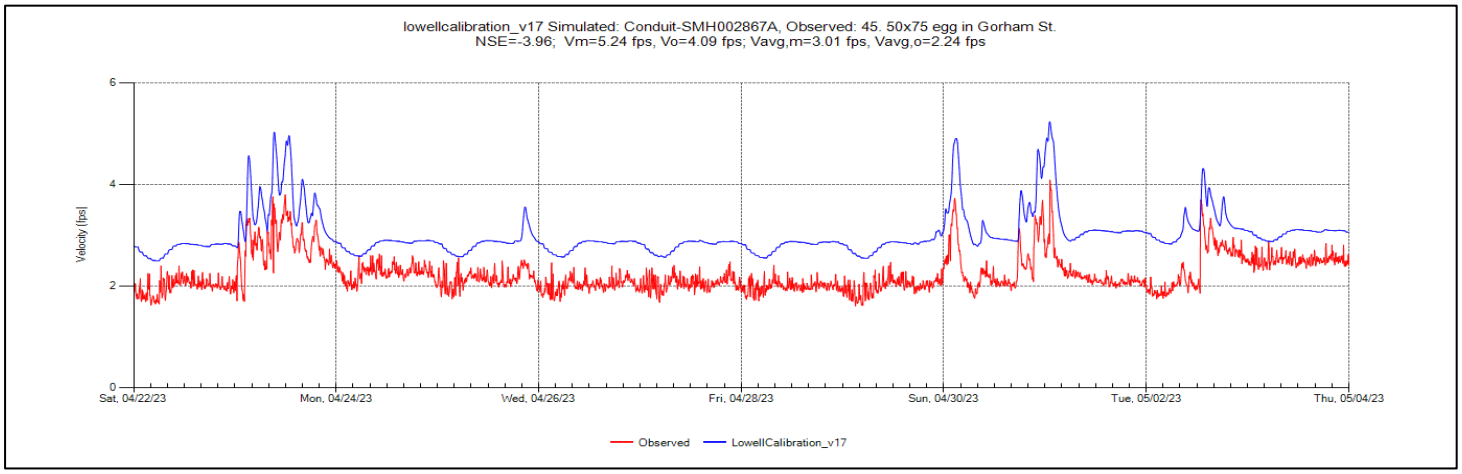


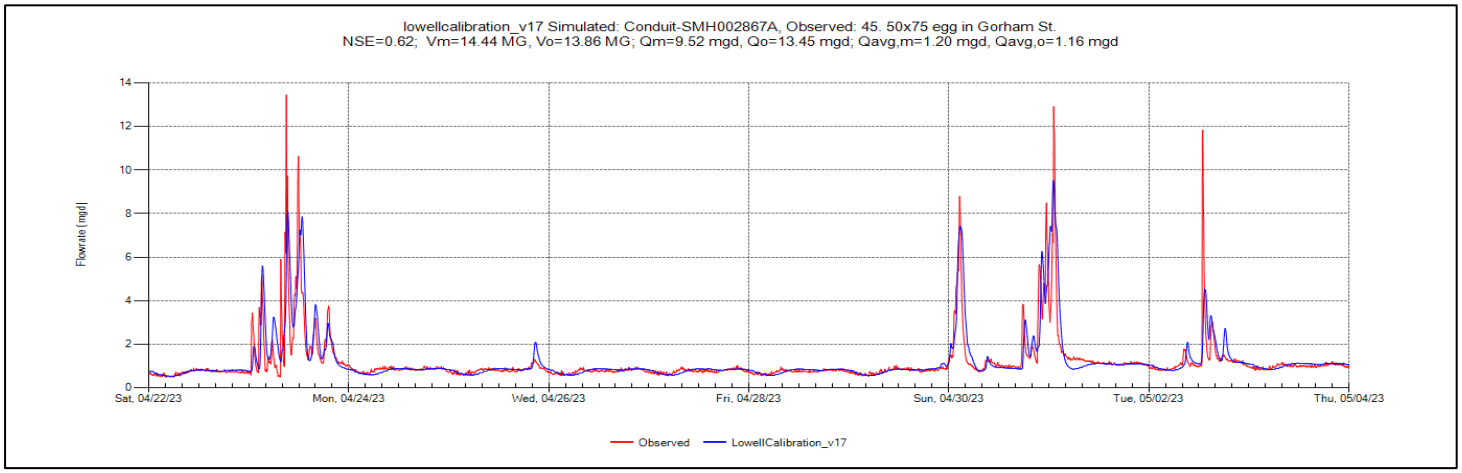


Simulated Versus Observed Flow at Flow Meter Sites

45-April-May Storms

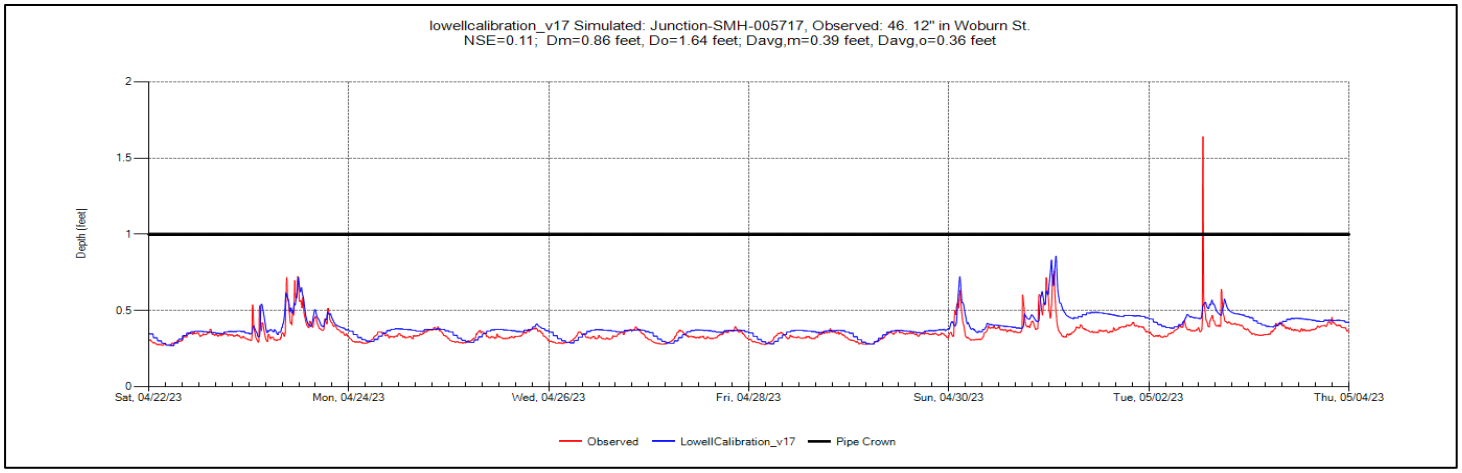


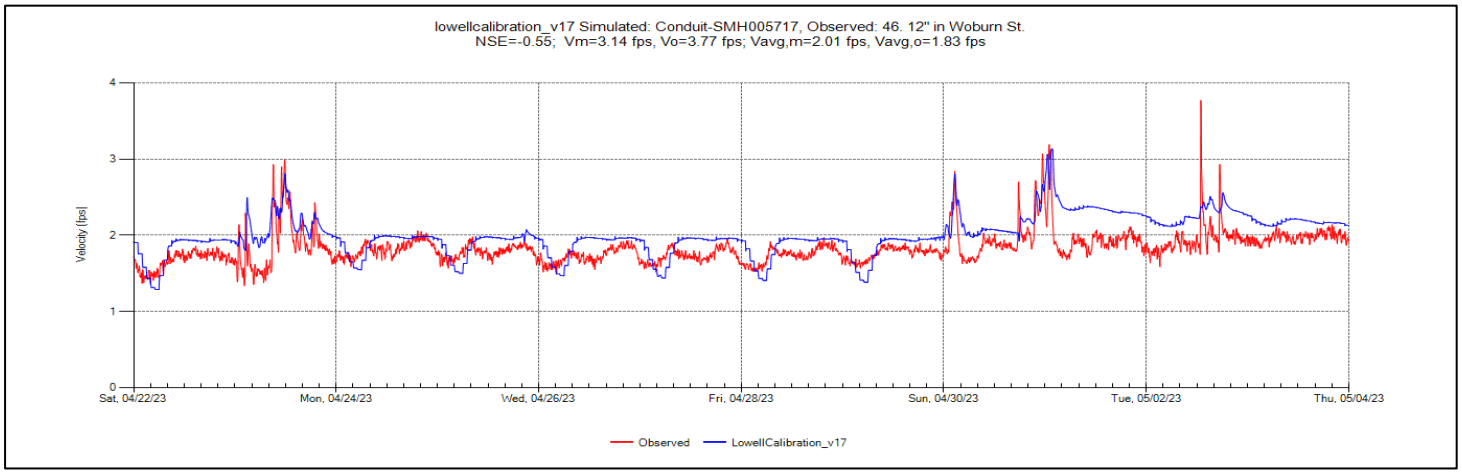


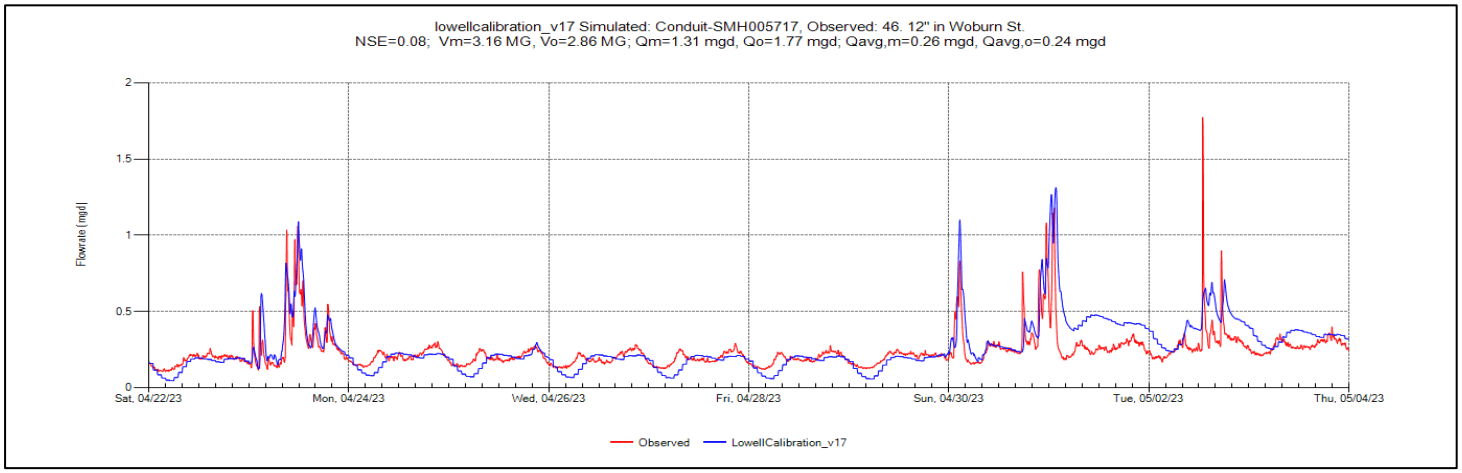


Simulated Versus Observed Flow at Flow Meter Sites

46-April-May Storms

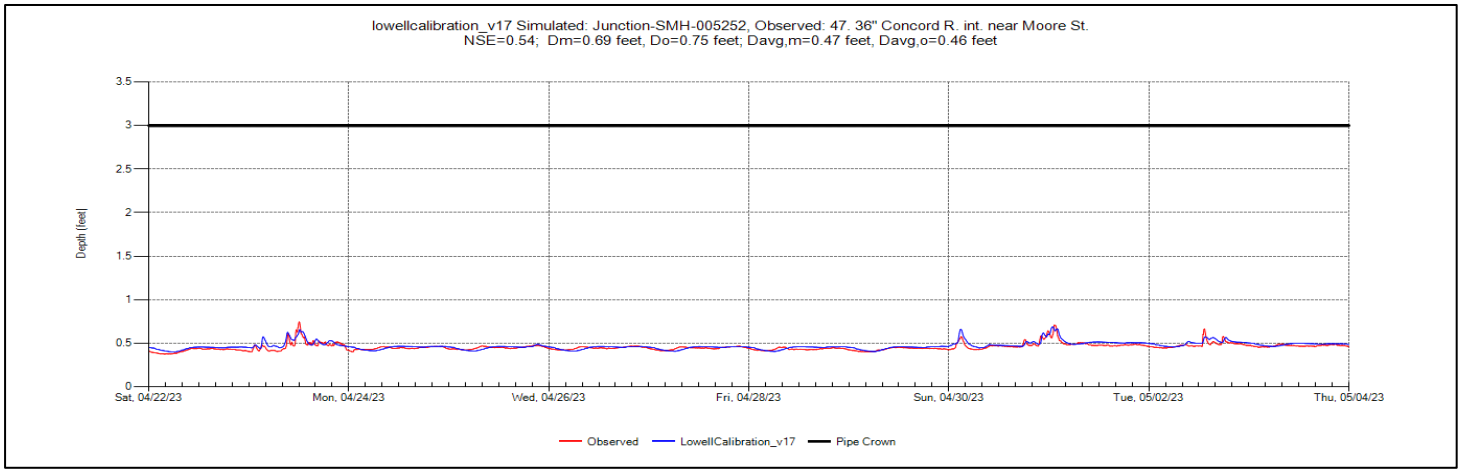


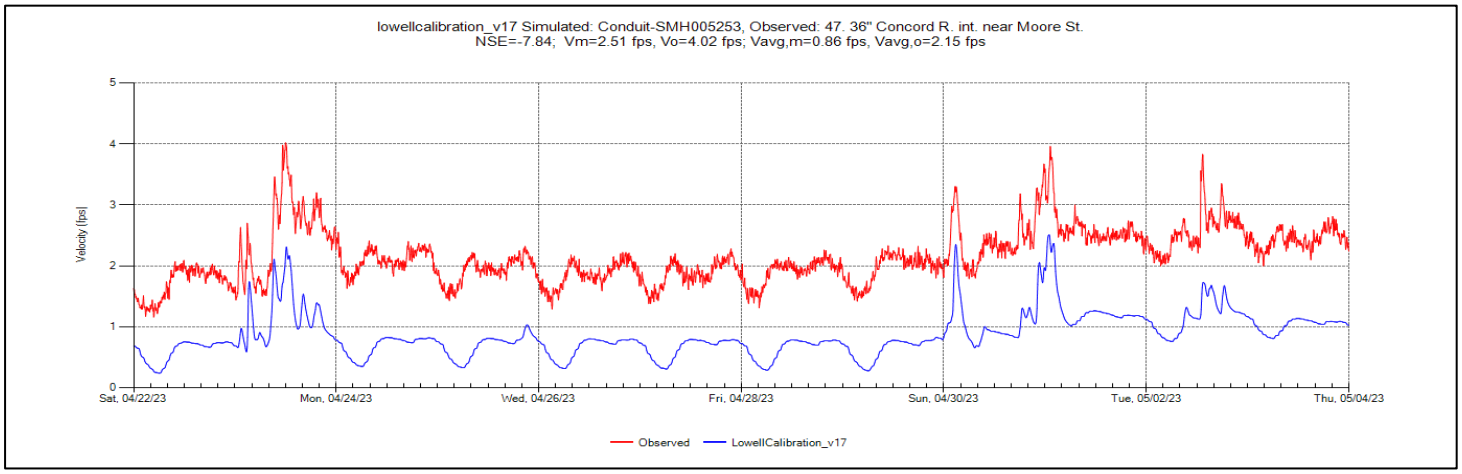


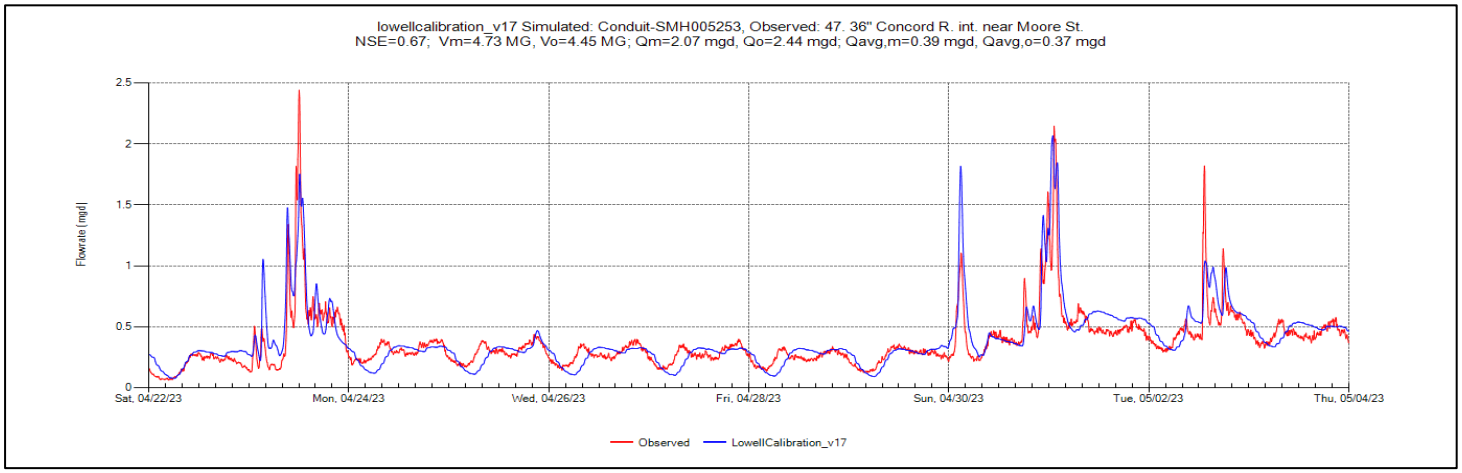


Simulated Versus Observed Flow at Flow Meter Sites

47-April-May Storms

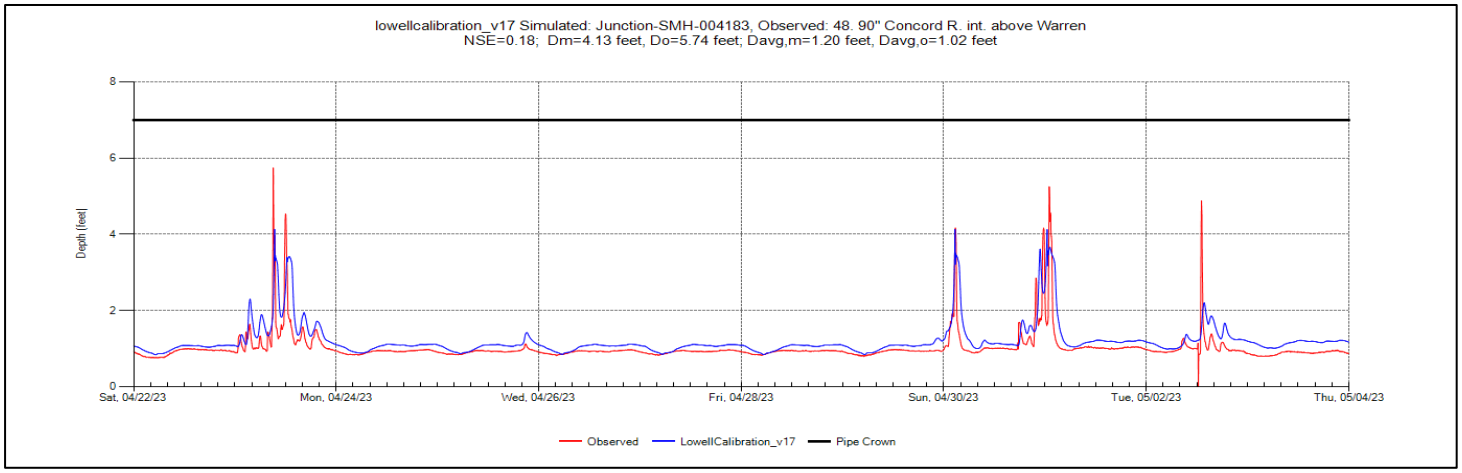


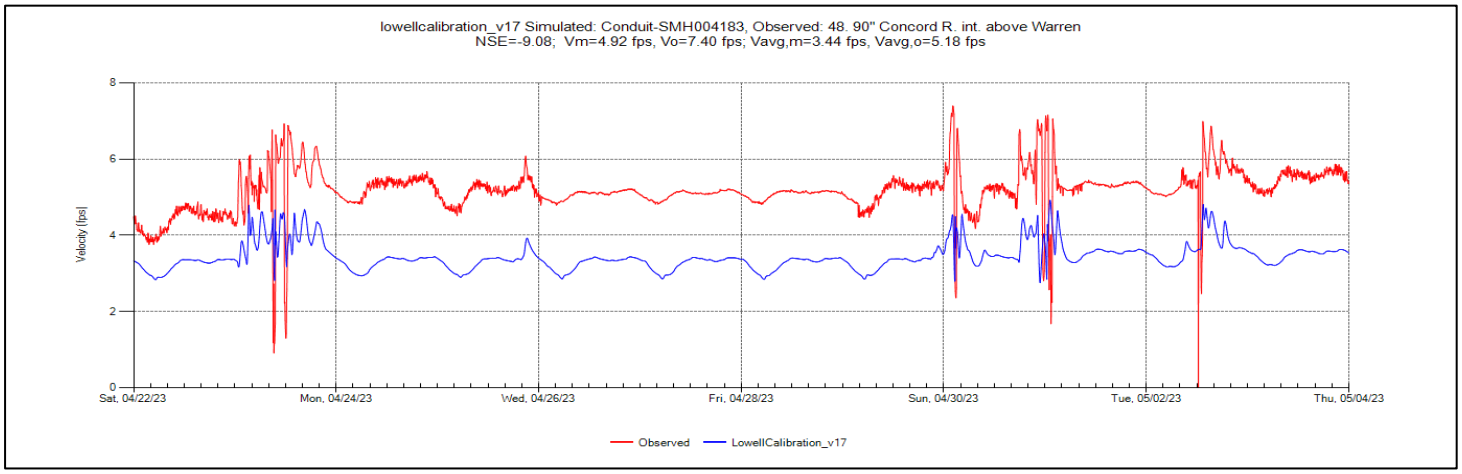


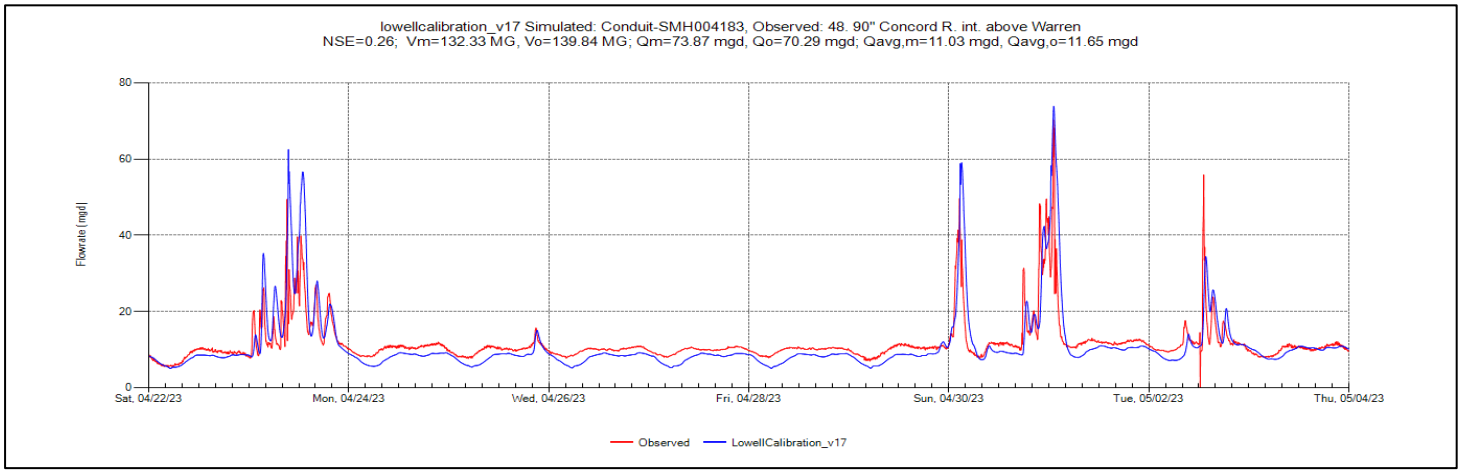


Simulated Versus Observed Flow at Flow Meter Sites

48-April-May Storms

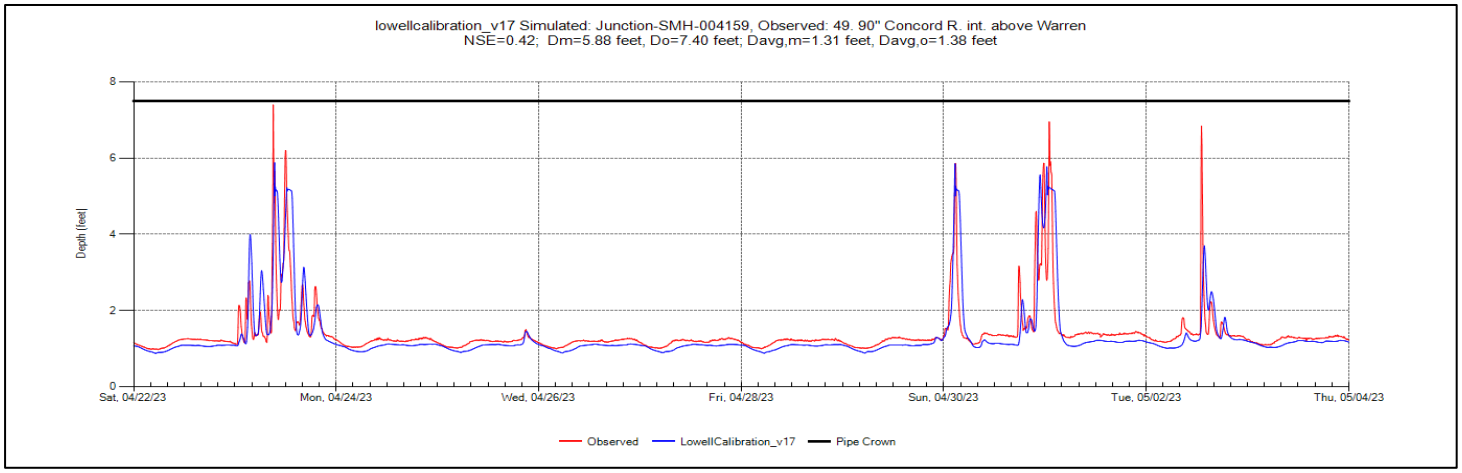


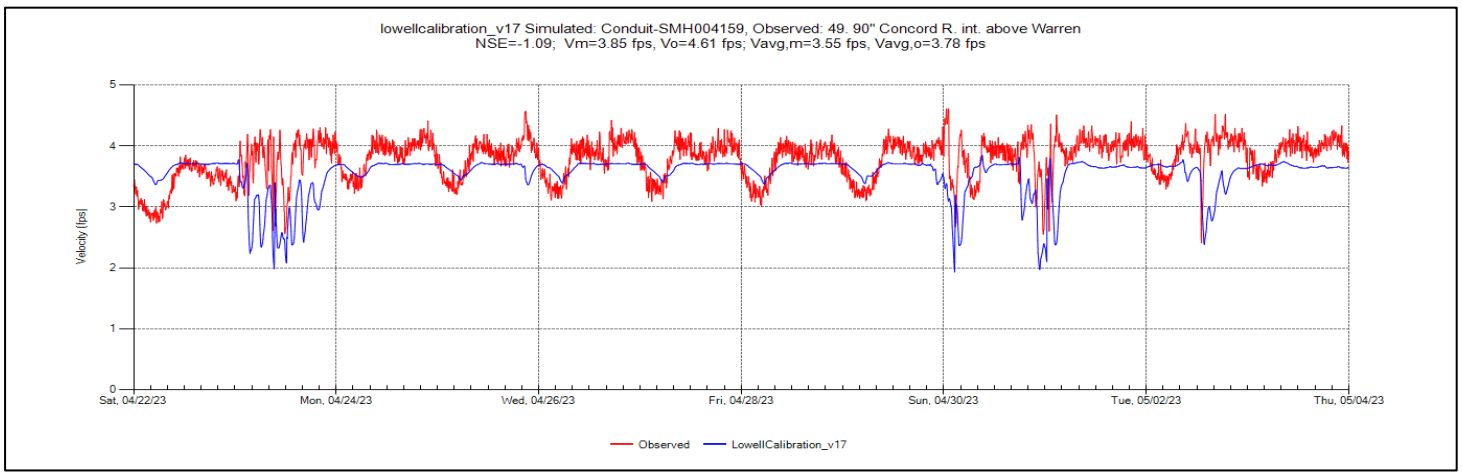


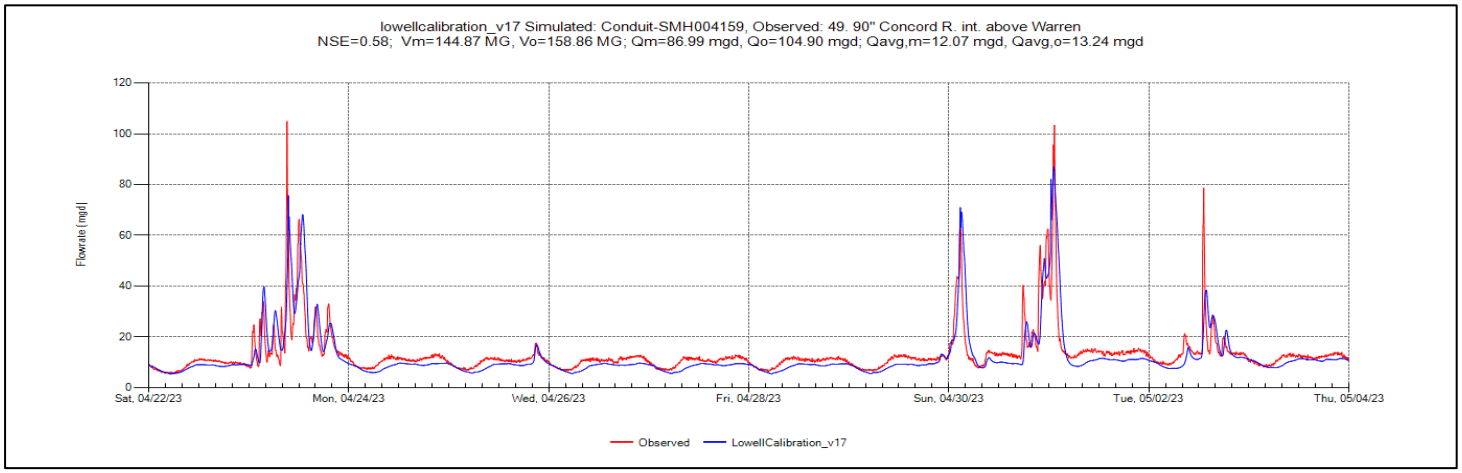


Simulated Versus Observed Flow at Flow Meter Sites

49-April-May Storms

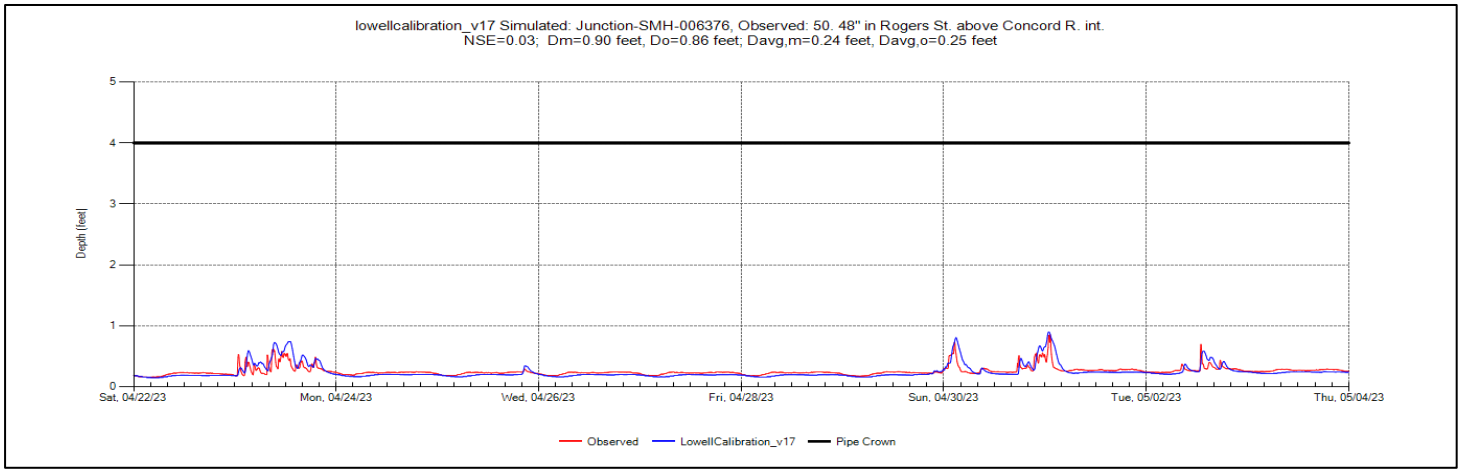


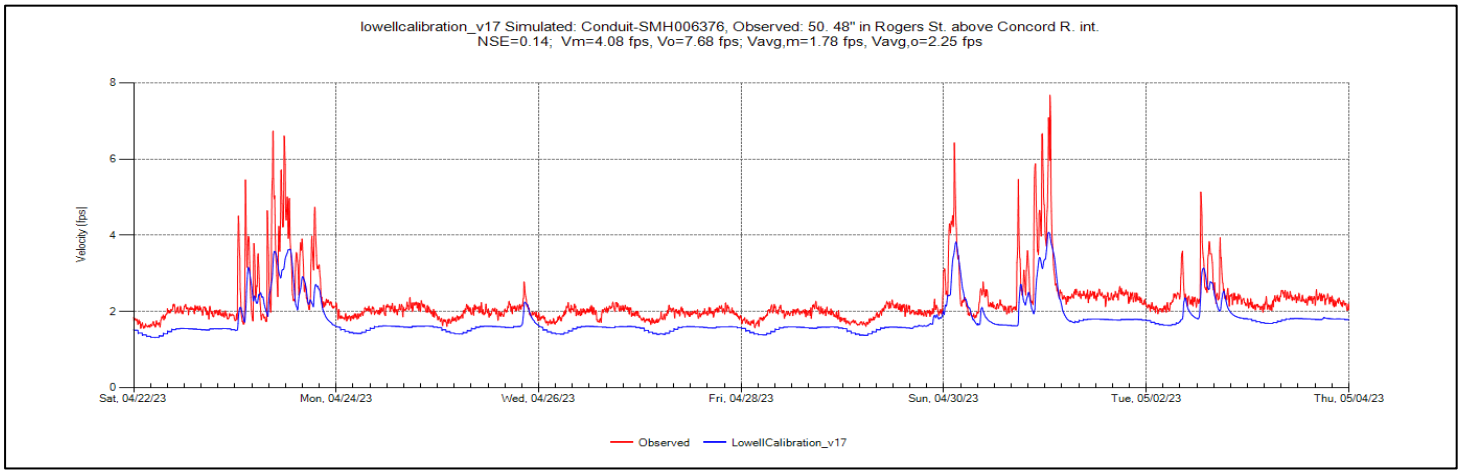


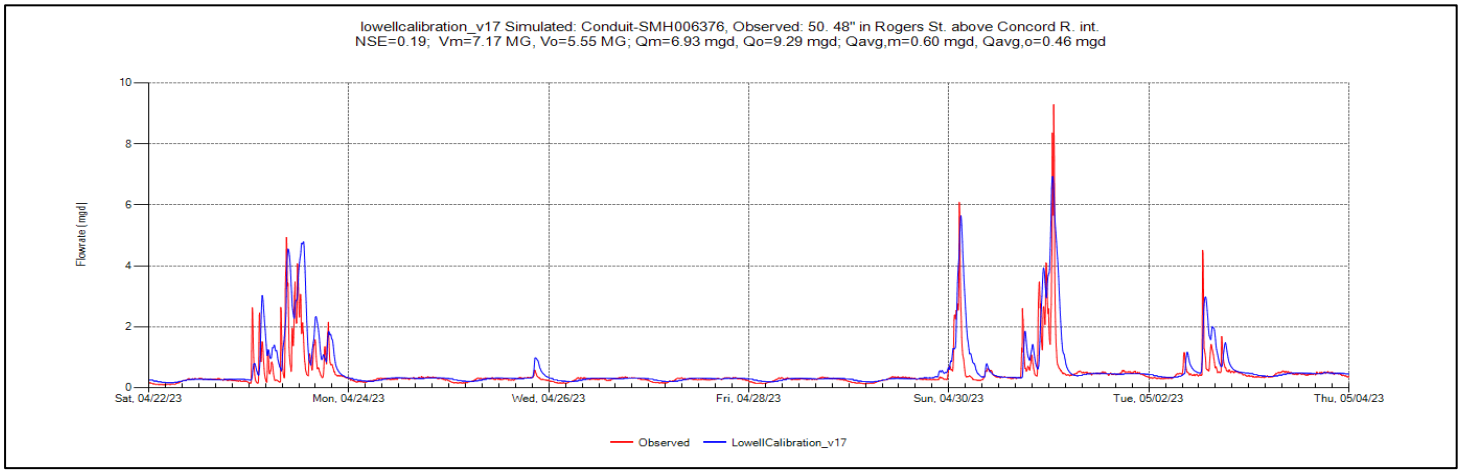


Simulated Versus Observed Flow at Flow Meter Sites

50-April-May Storms

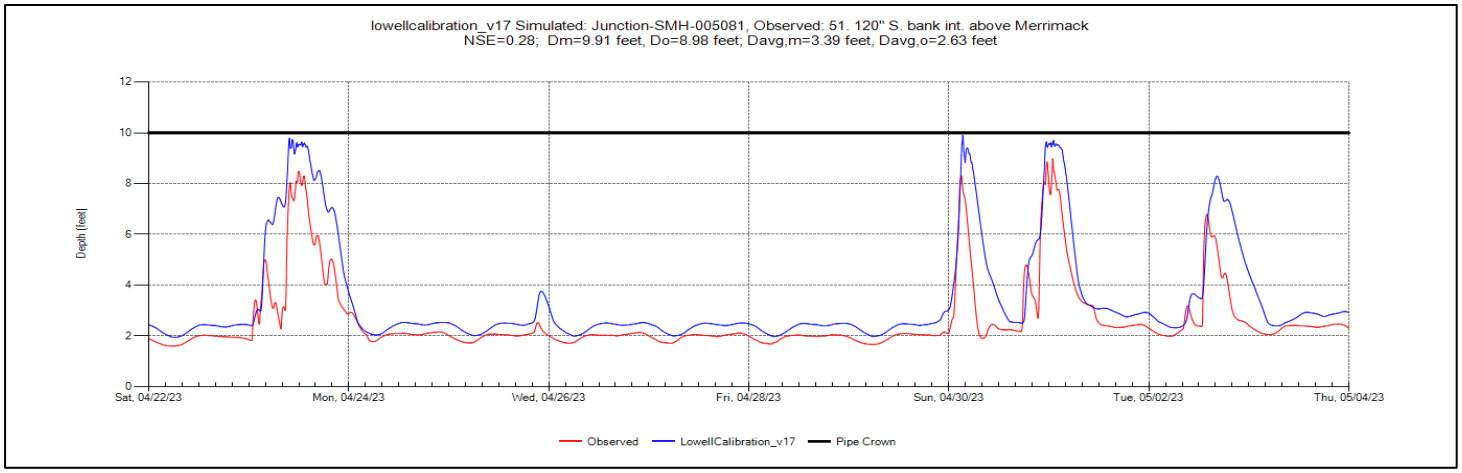


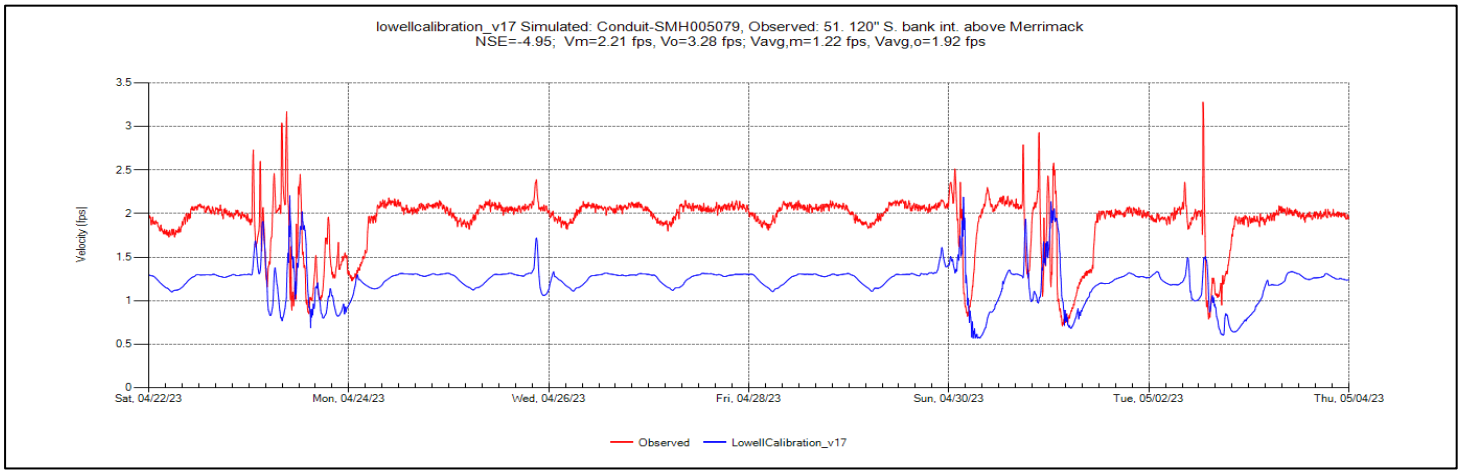


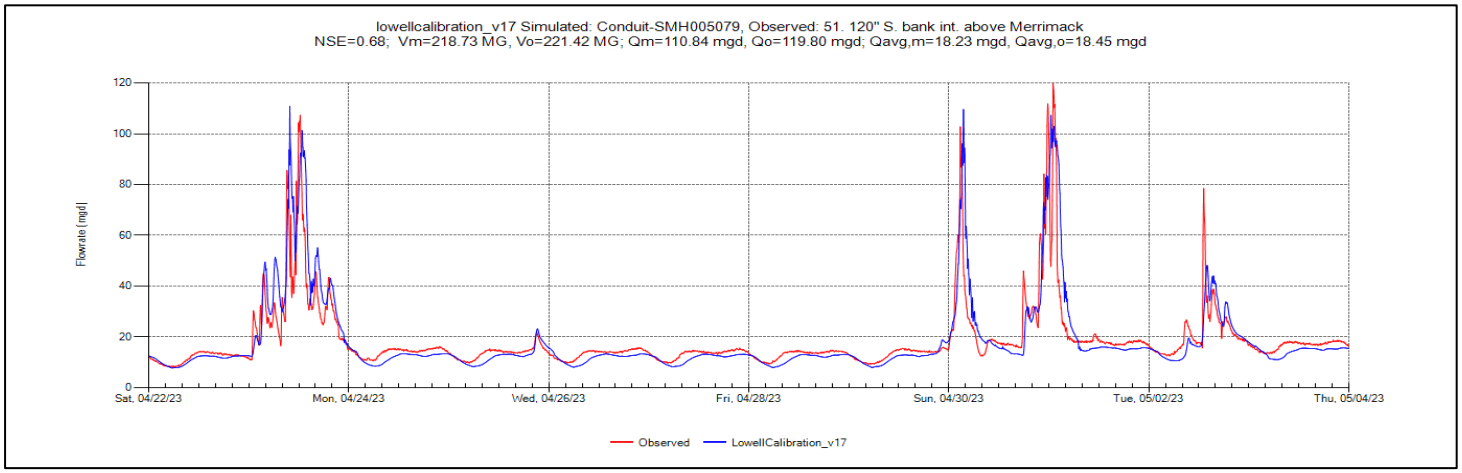


Simulated Versus Observed Flow at Flow Meter Sites

51-April-May Storms

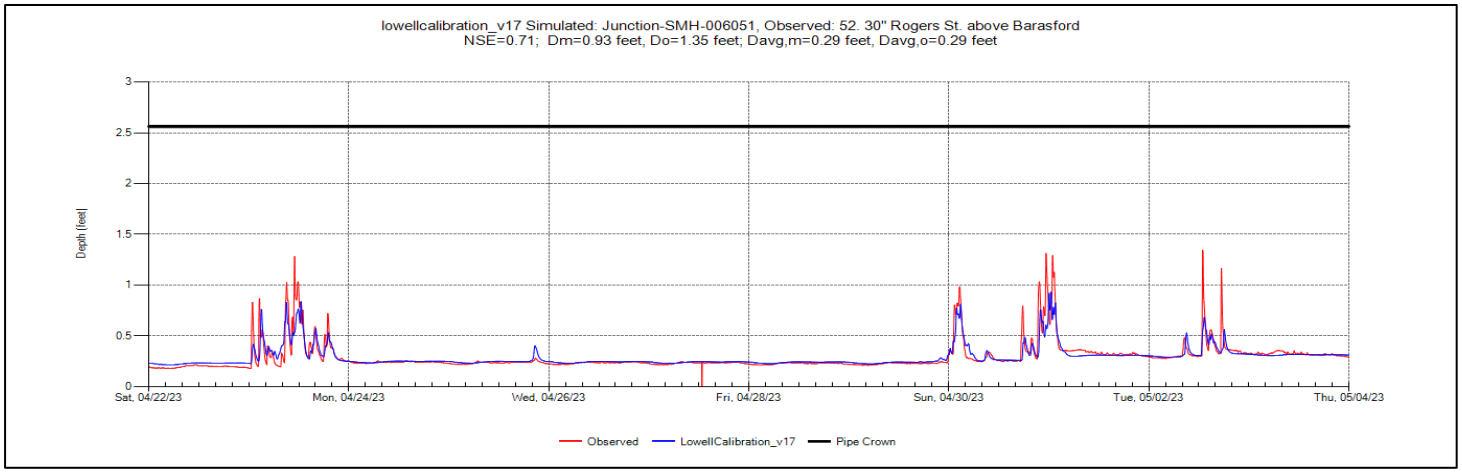


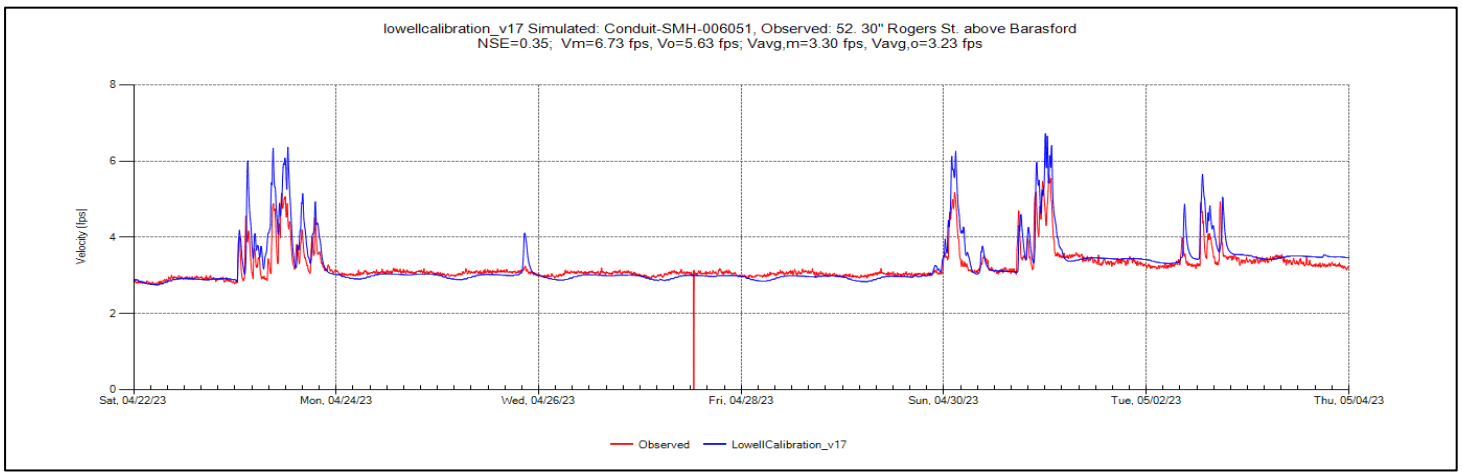


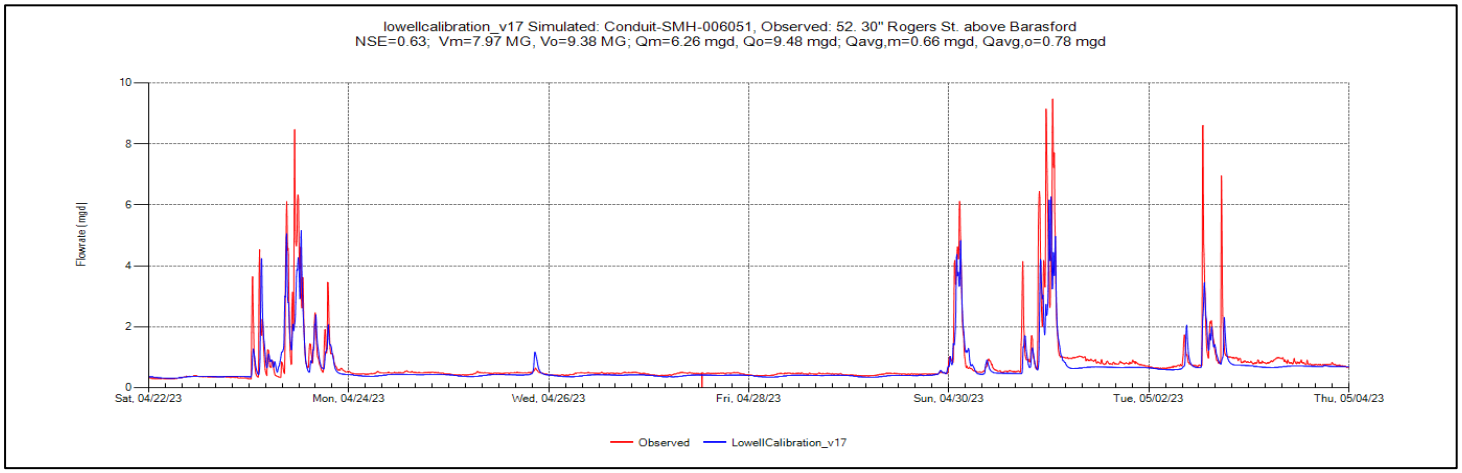


Simulated Versus Observed Flow at Flow Meter Sites

52-April-May Storms

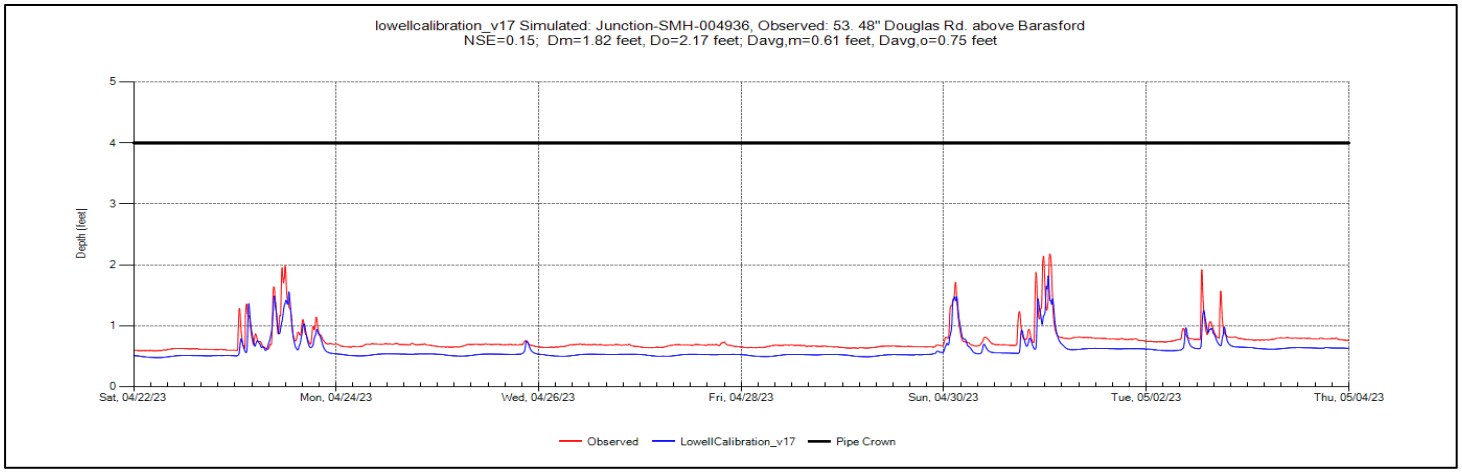


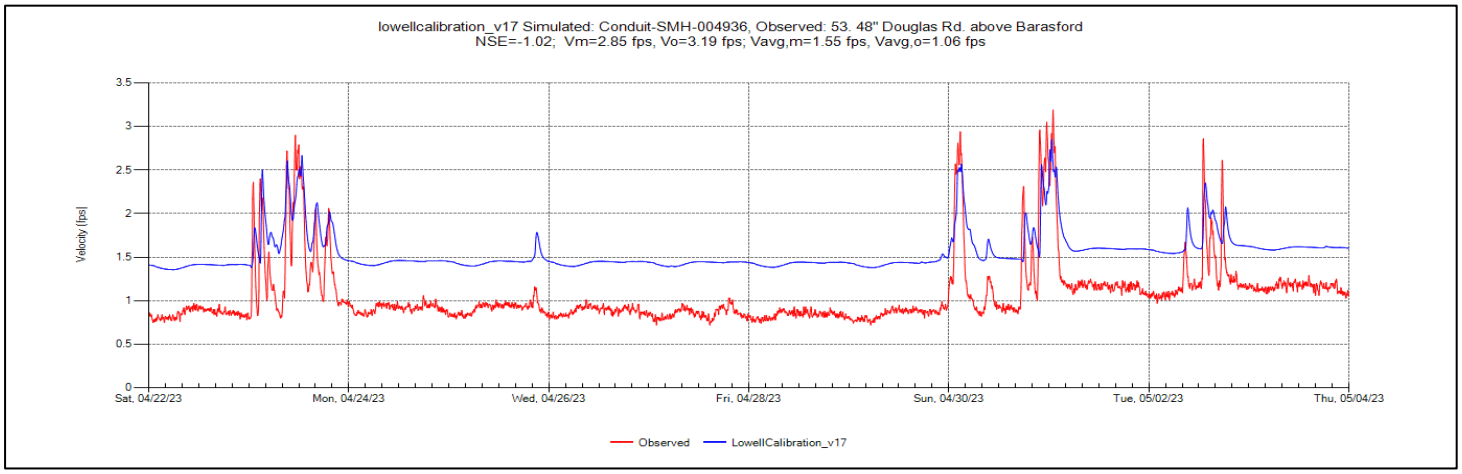


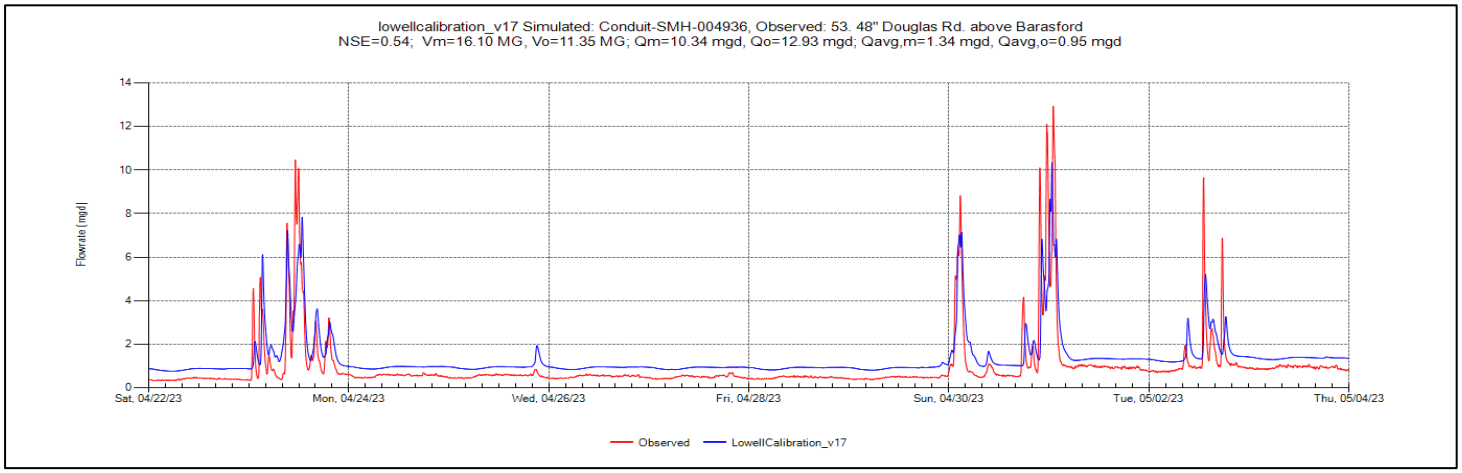


Simulated Versus Observed Flow at Flow Meter Sites

53-April-May Storms

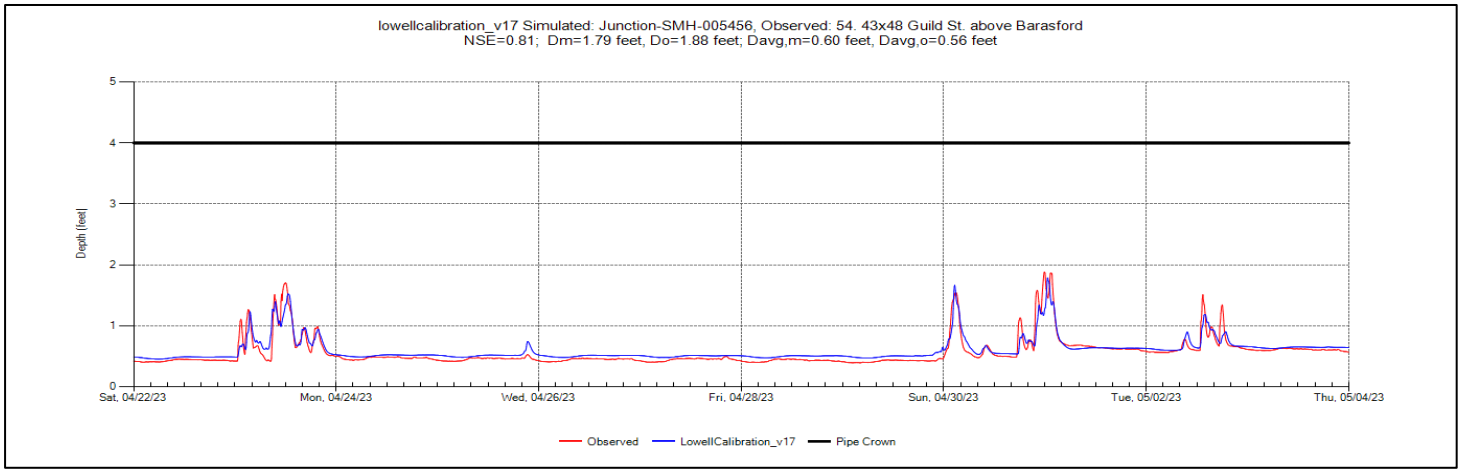


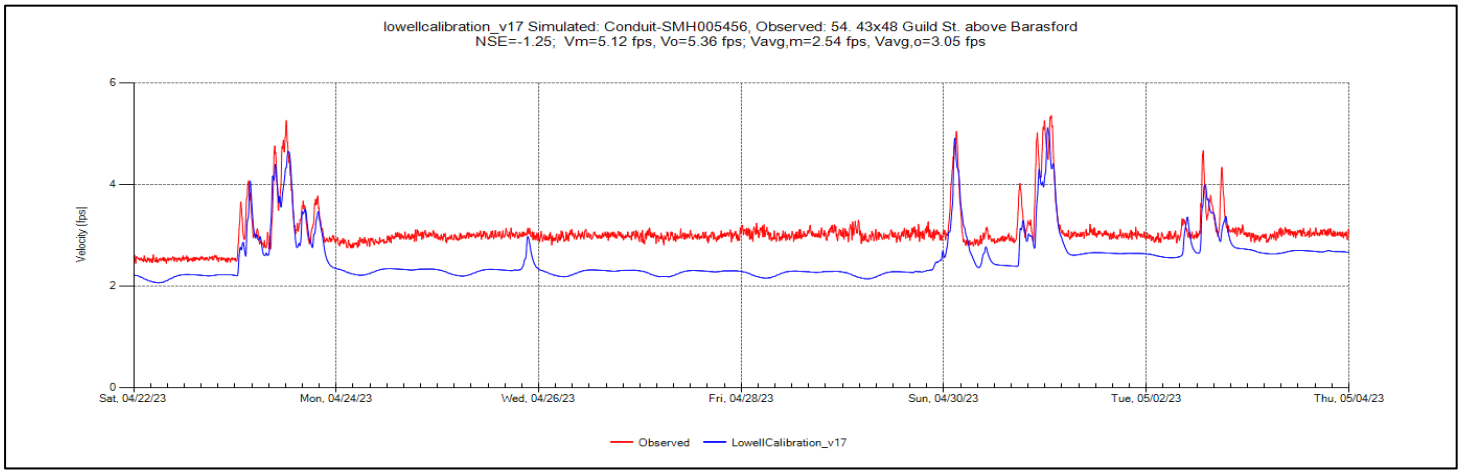


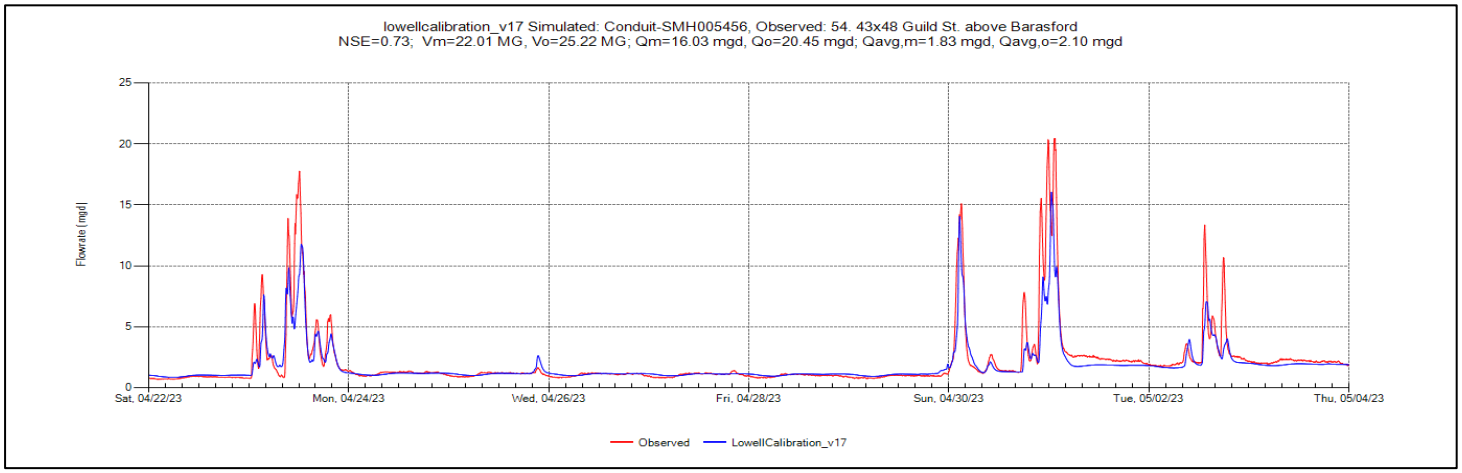


Simulated Versus Observed Flow at Flow Meter Sites

54-April-May Storms

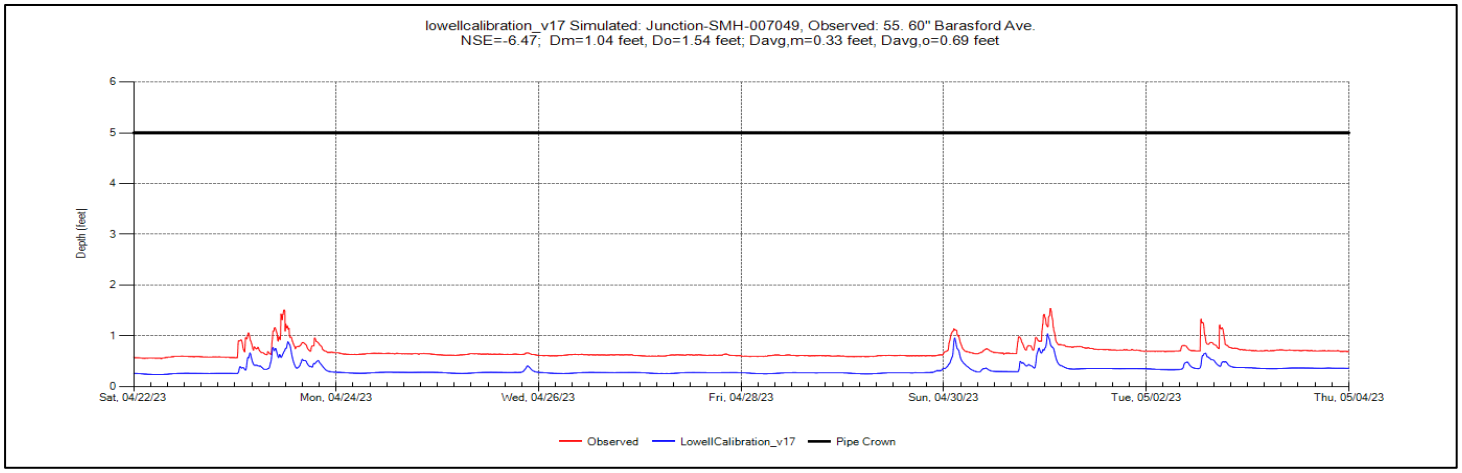


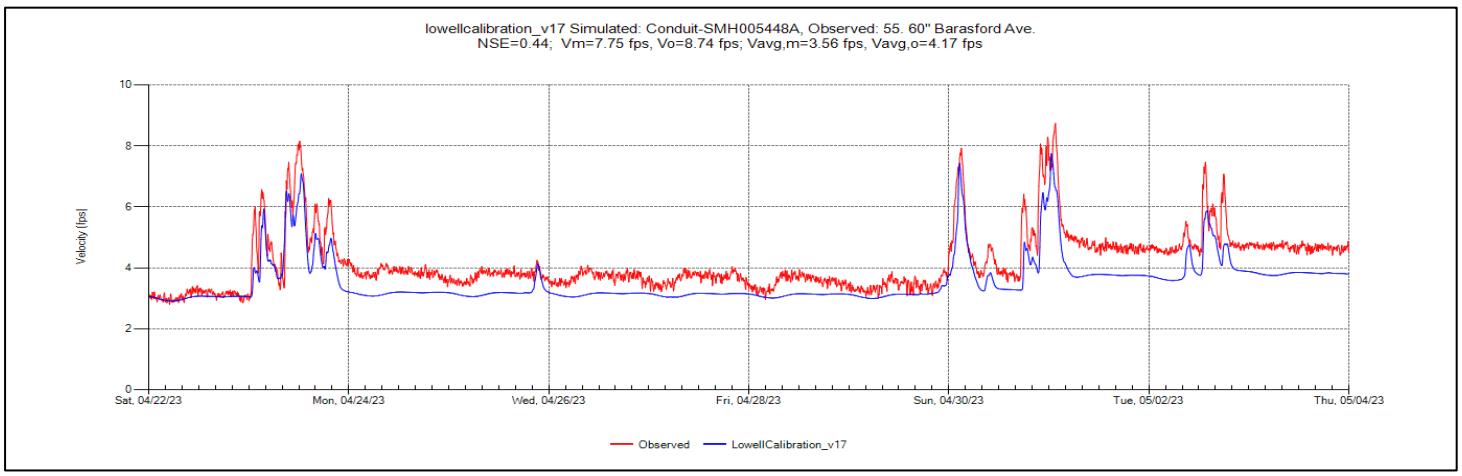


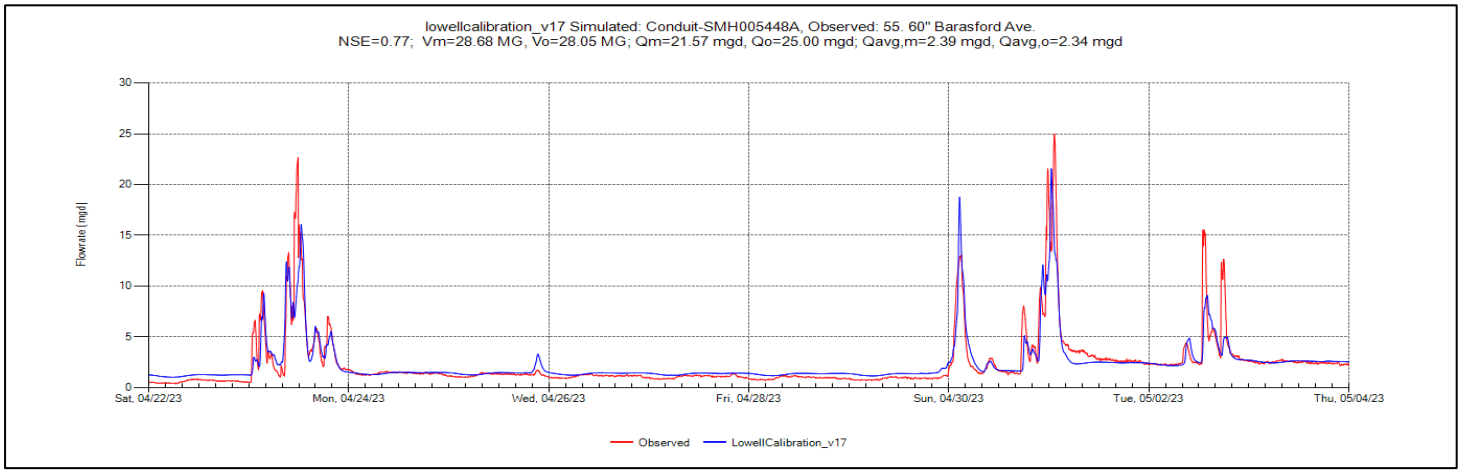


Simulated Versus Observed Flow at Flow Meter Sites

55-April-May Storms

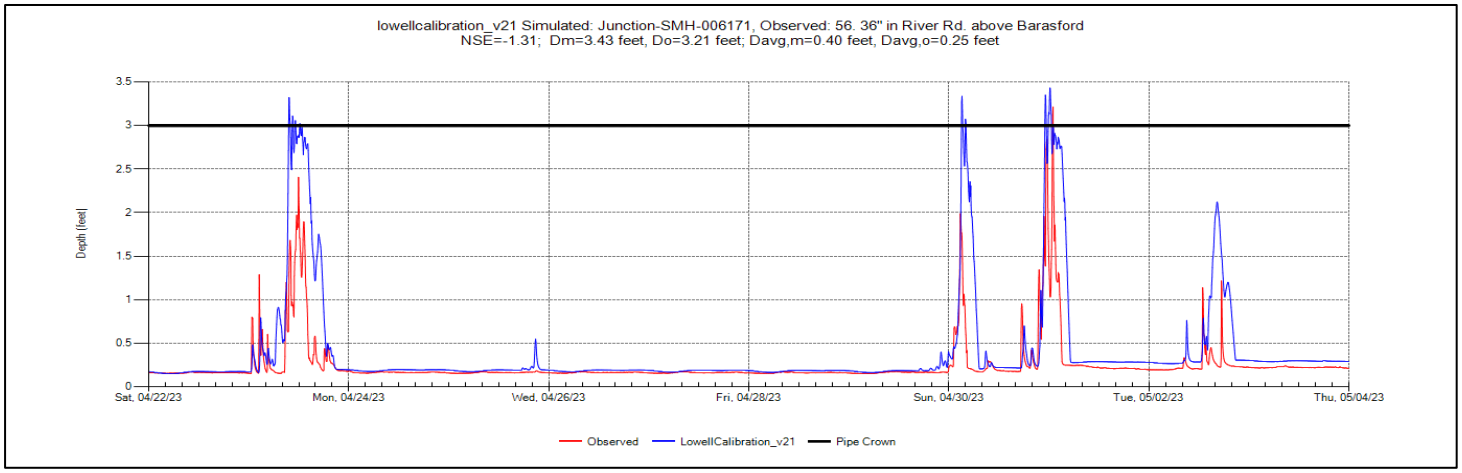


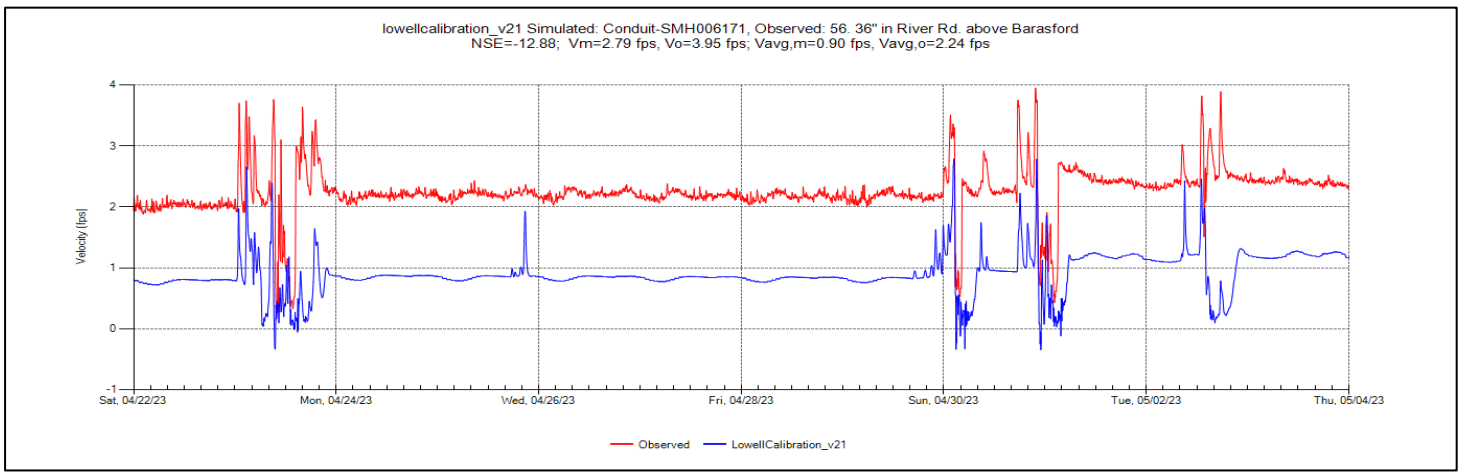


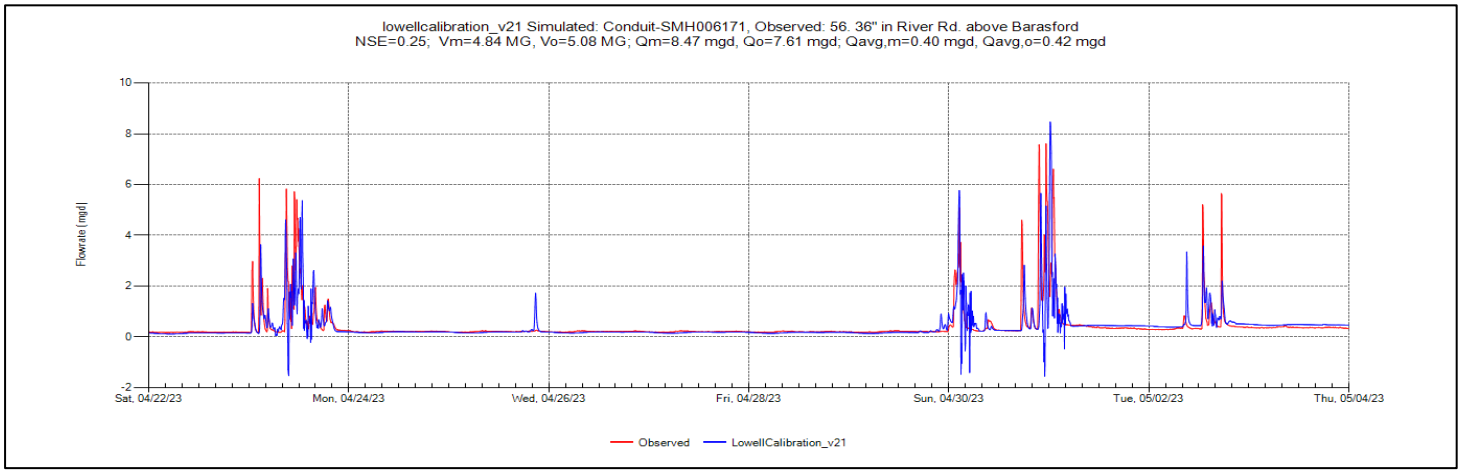


Simulated Versus Observed Flow at Flow Meter Sites

56-April-May Storms

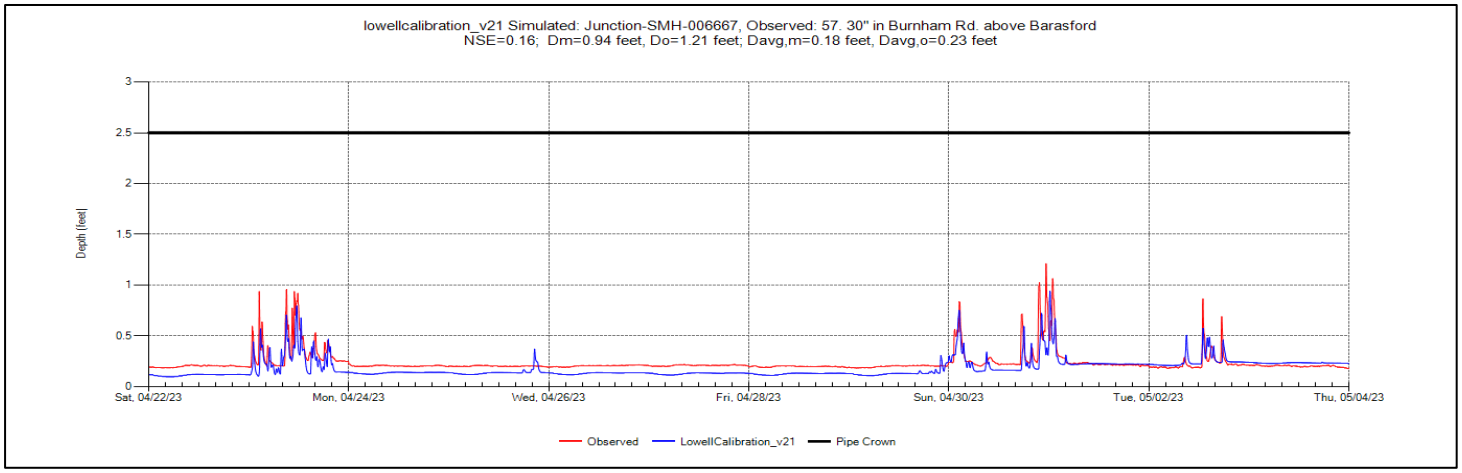


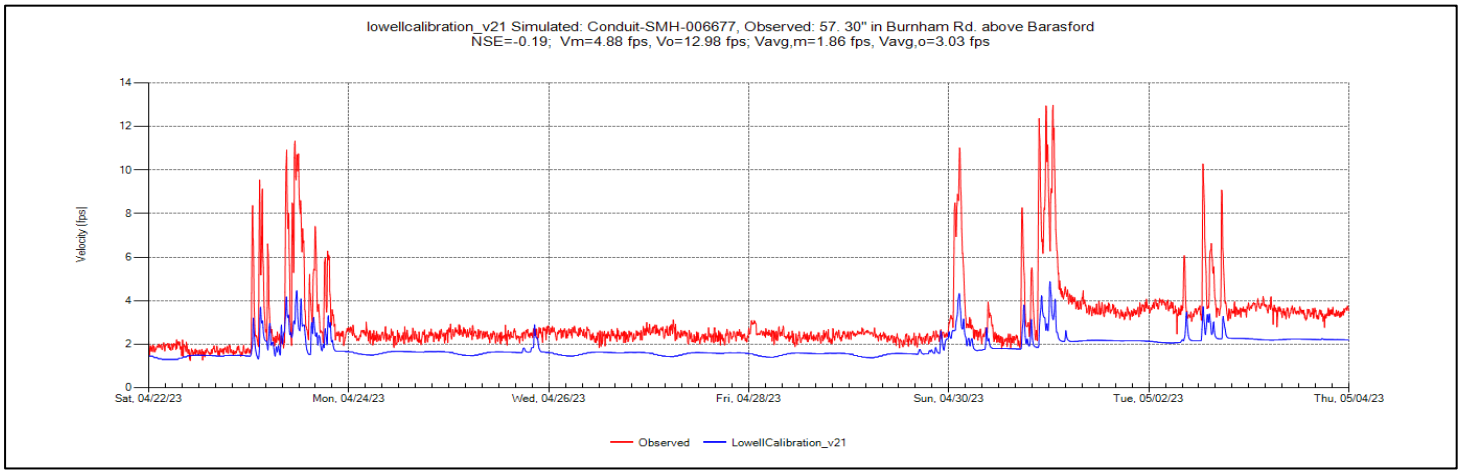


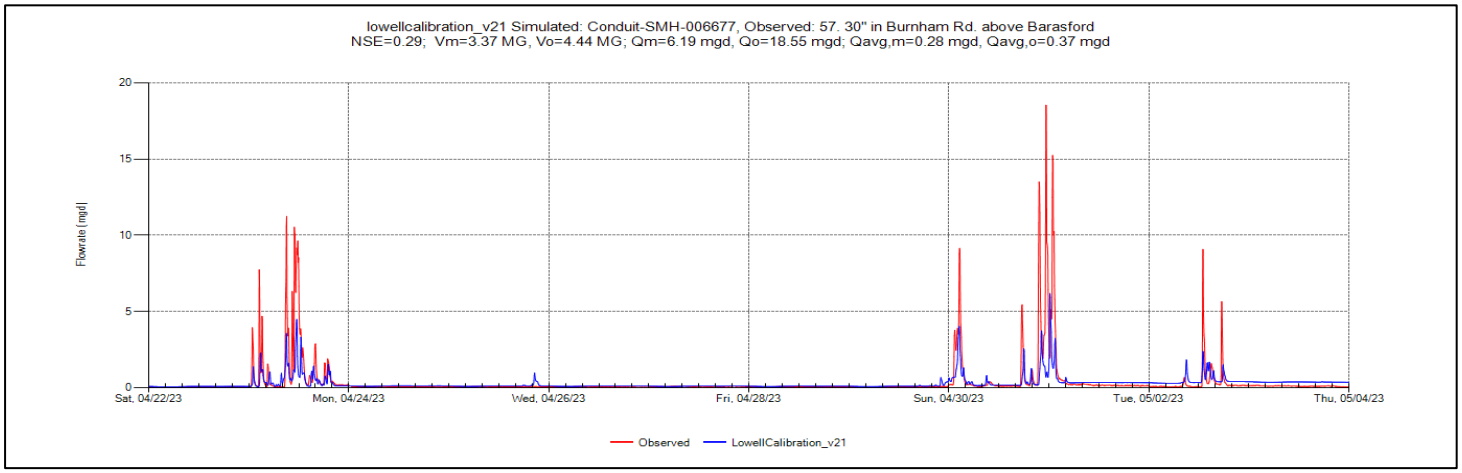


Simulated Versus Observed Flow at Flow Meter Sites

57-April-May Storms

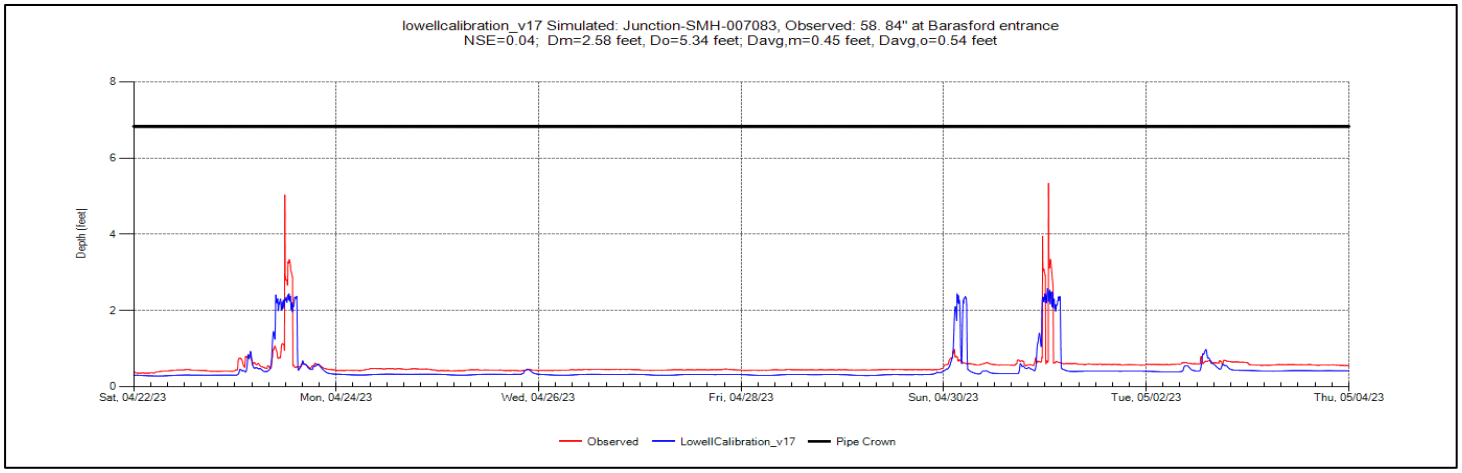


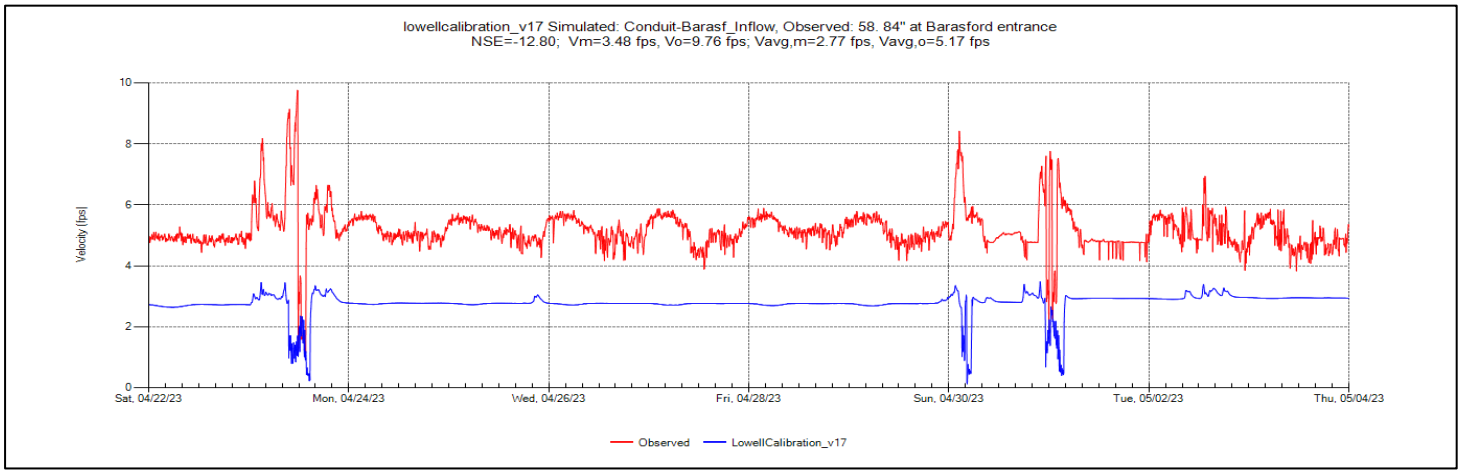


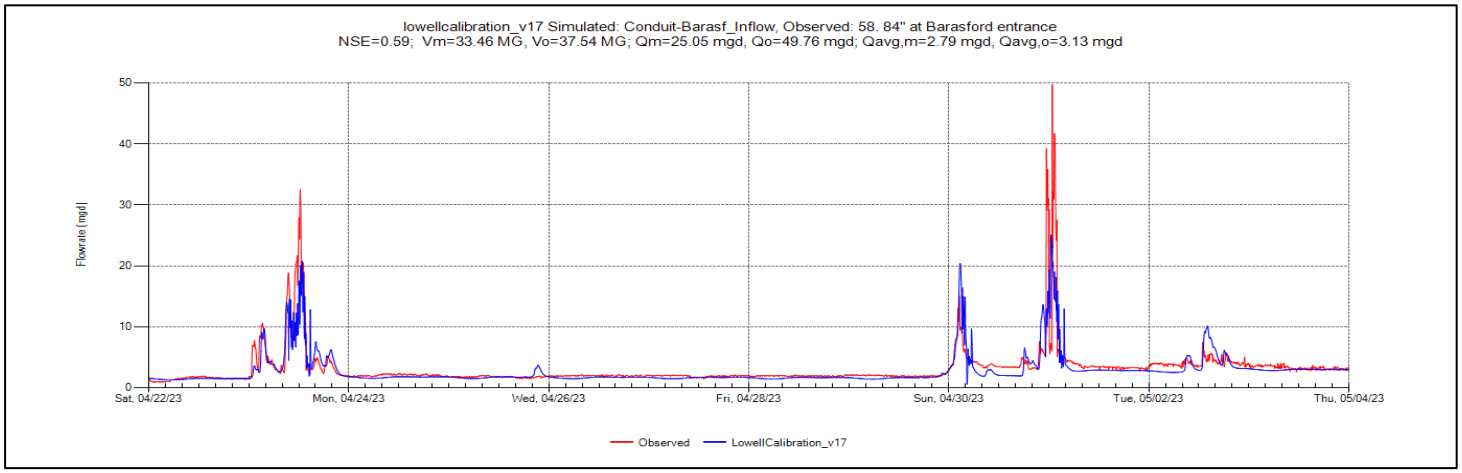


Simulated Versus Observed Flow at Flow Meter Sites

58-April-May Storms

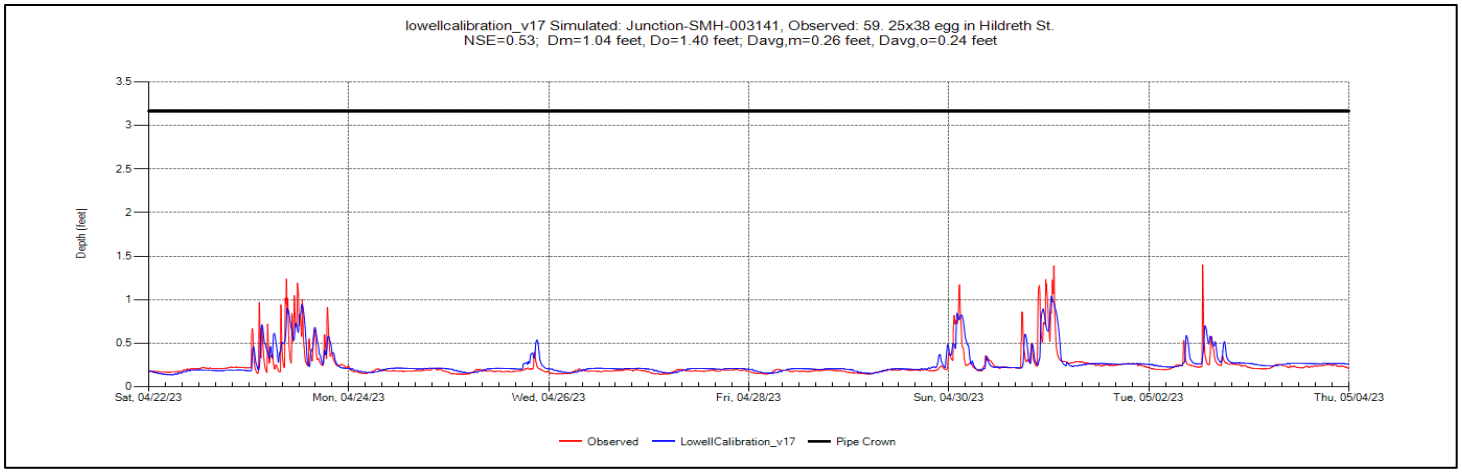


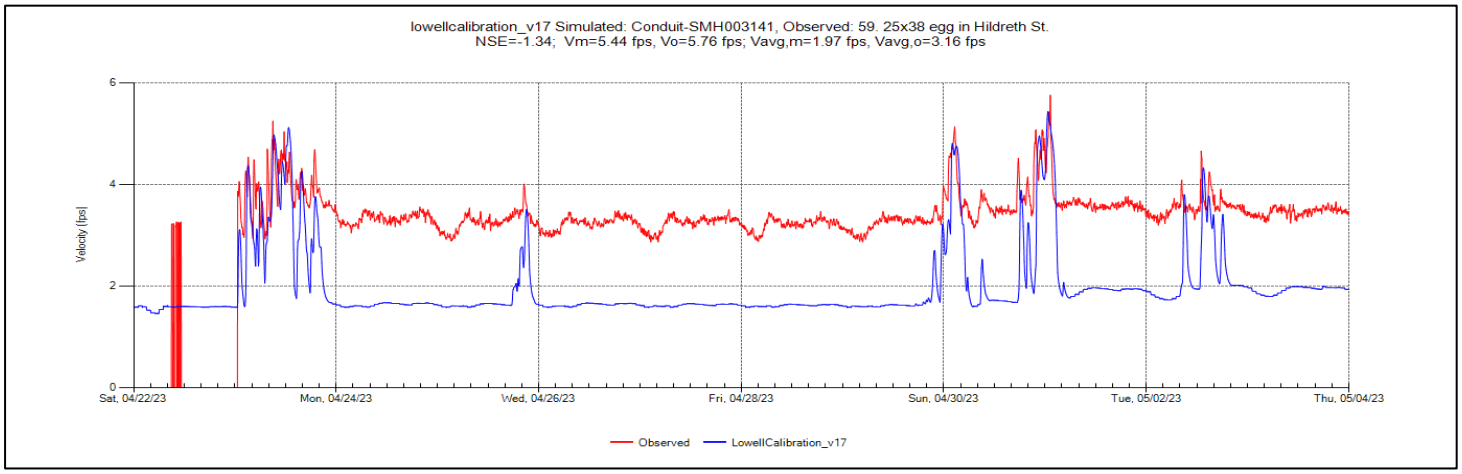


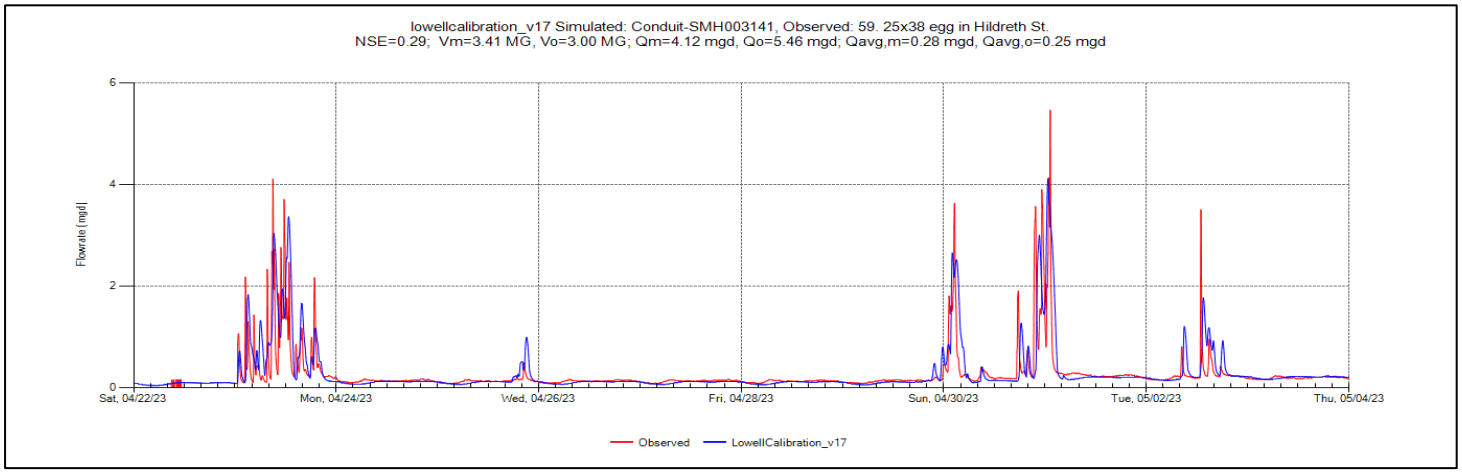


Simulated Versus Observed Flow at Flow Meter Sites

59-April-May Storms

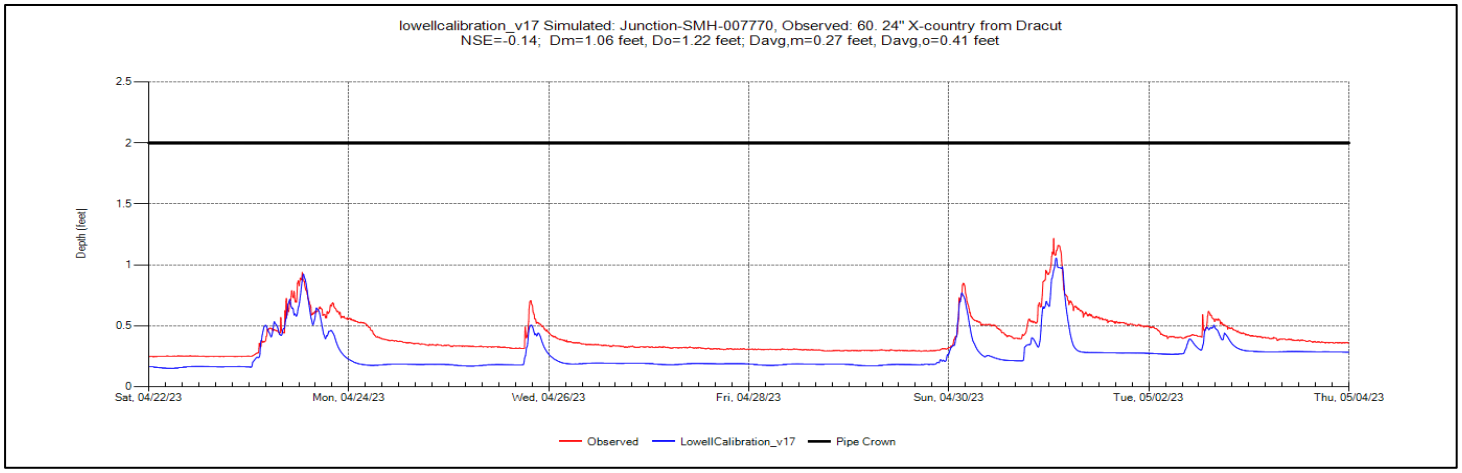


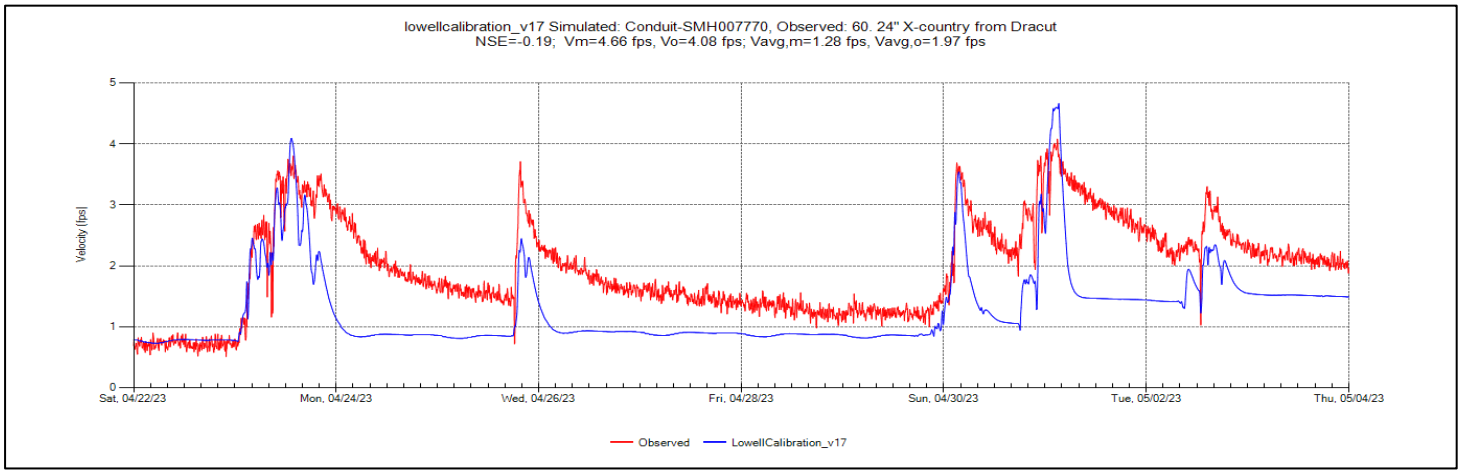


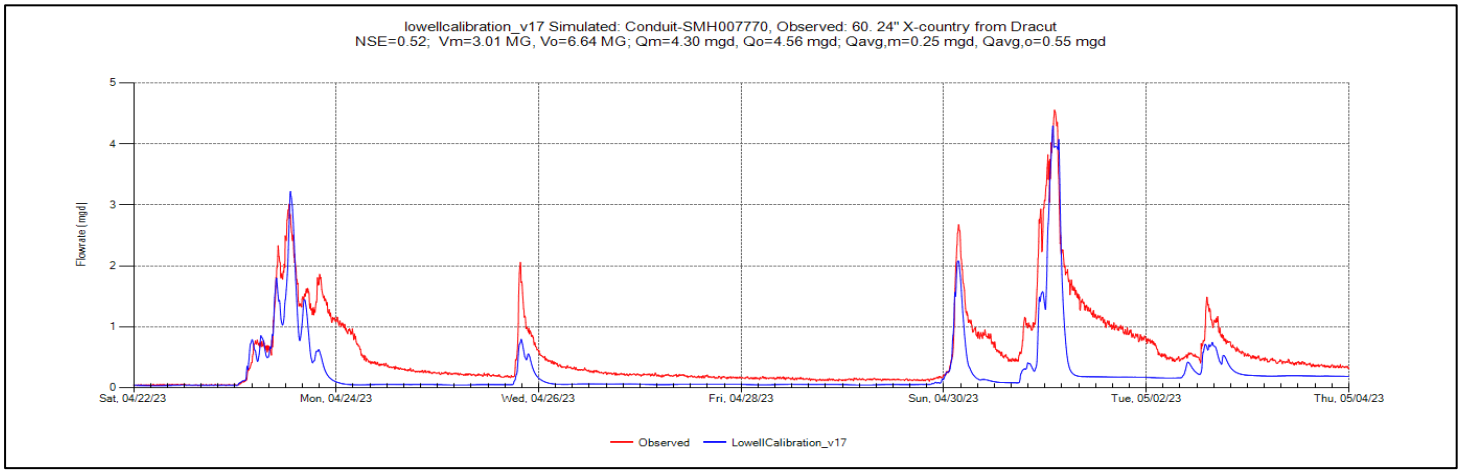


Simulated Versus Observed Flow at Flow Meter Sites

60-April-May Storms

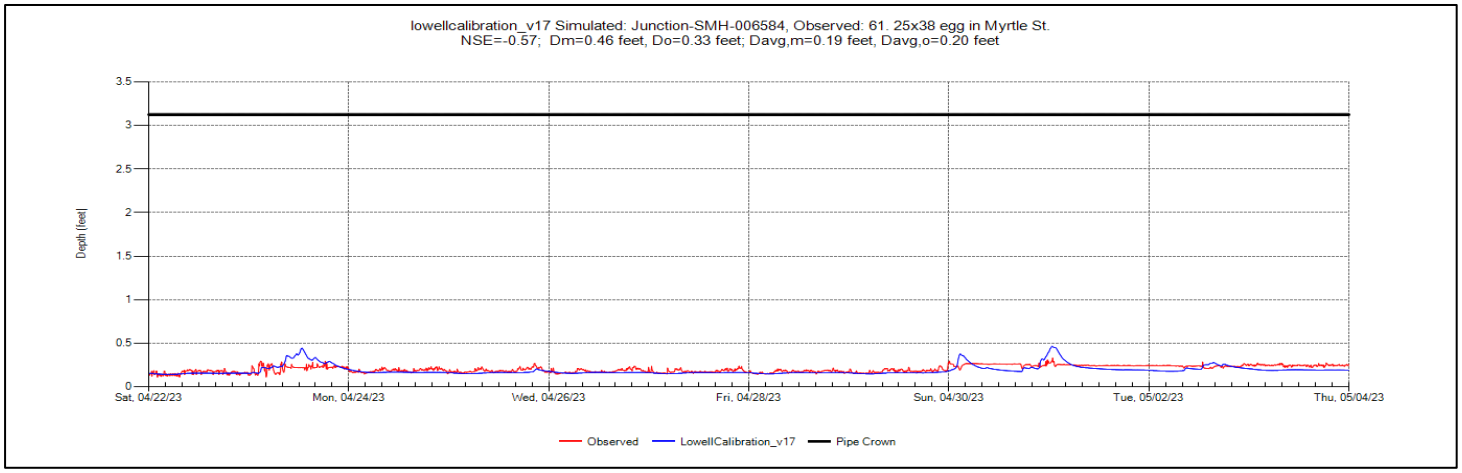


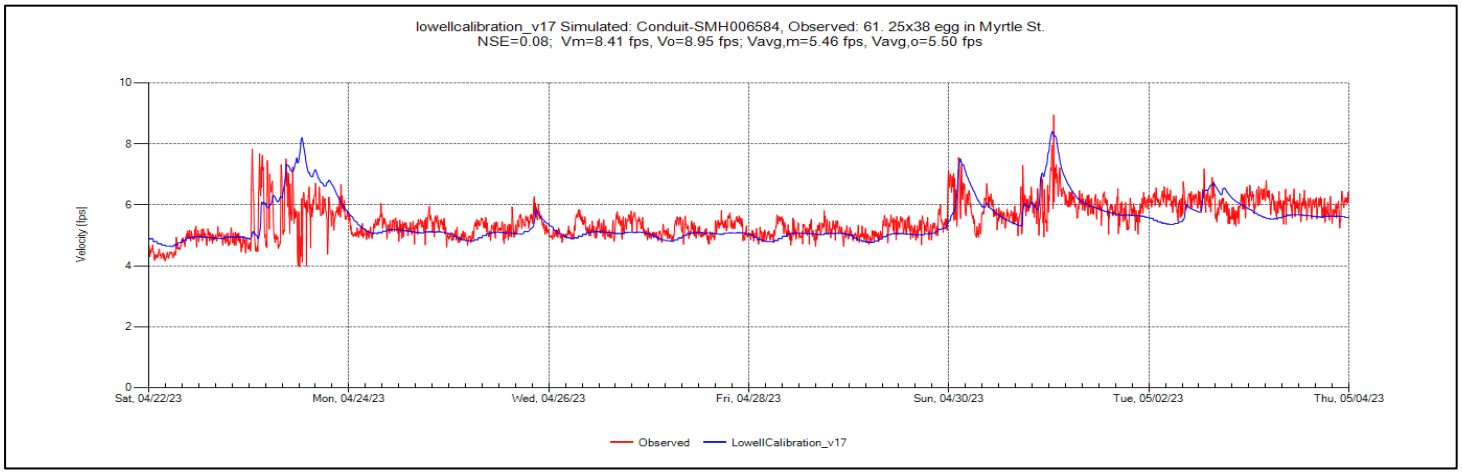


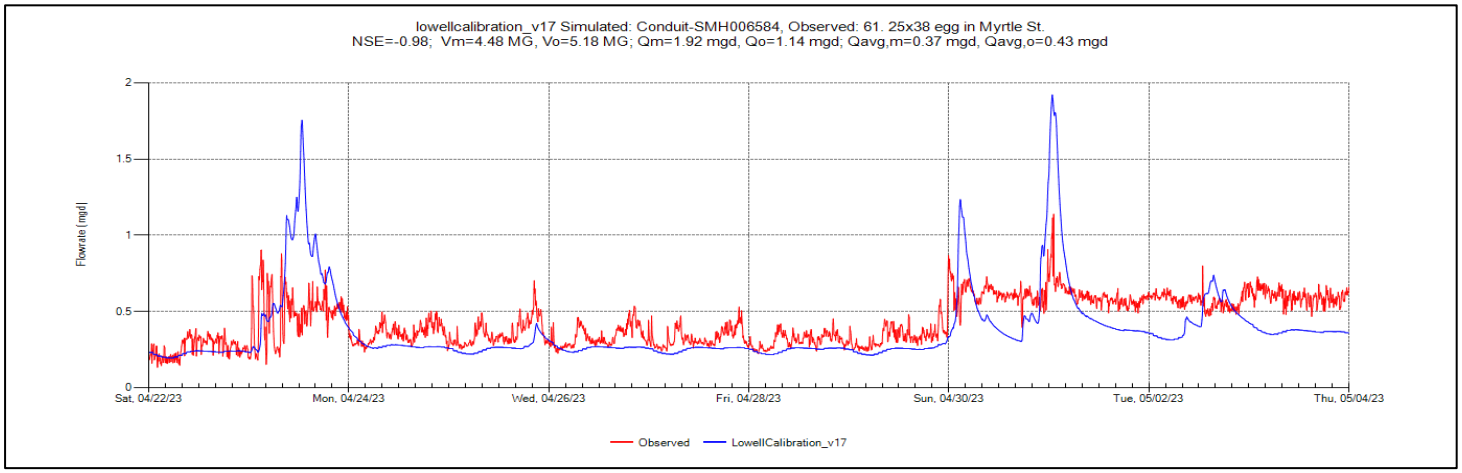


Simulated Versus Observed Flow at Flow Meter Sites

61-April-May Storms

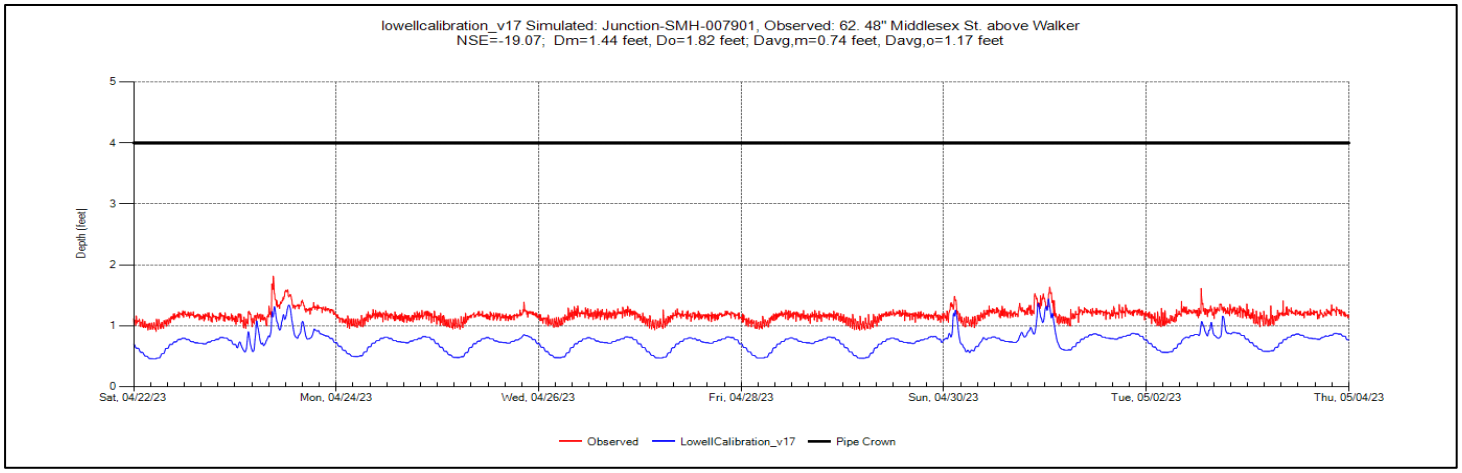


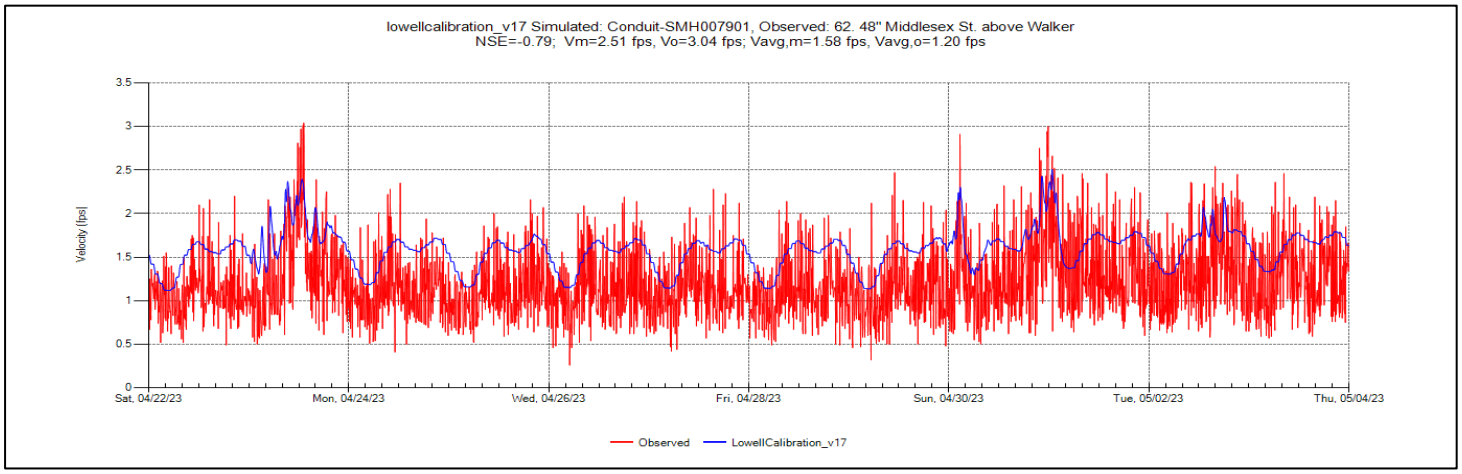


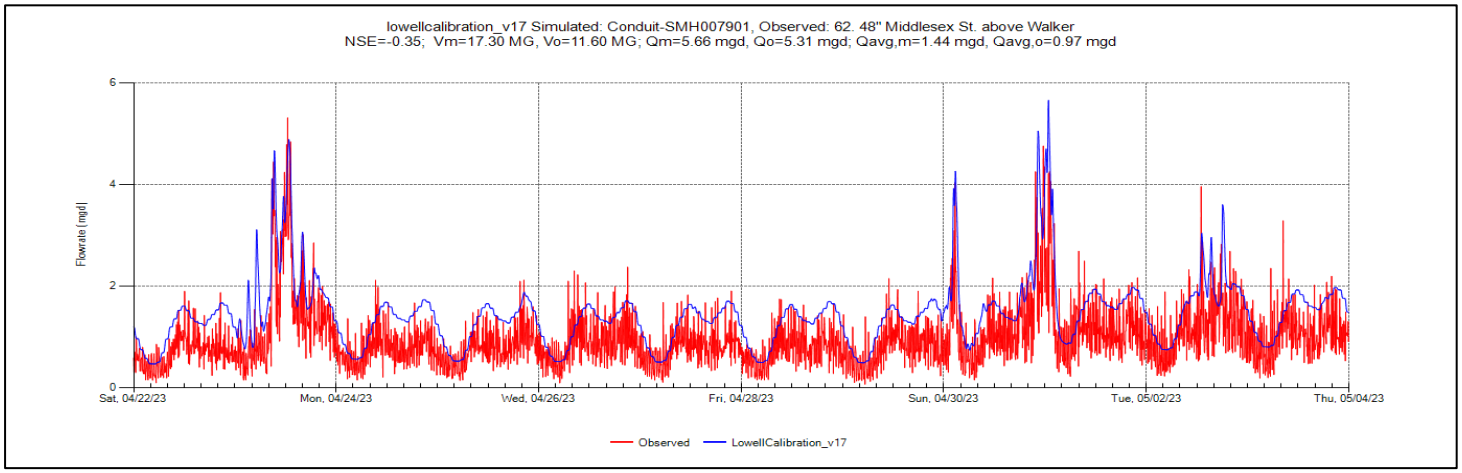


Simulated Versus Observed Flow at Flow Meter Sites

62-April-May Storms

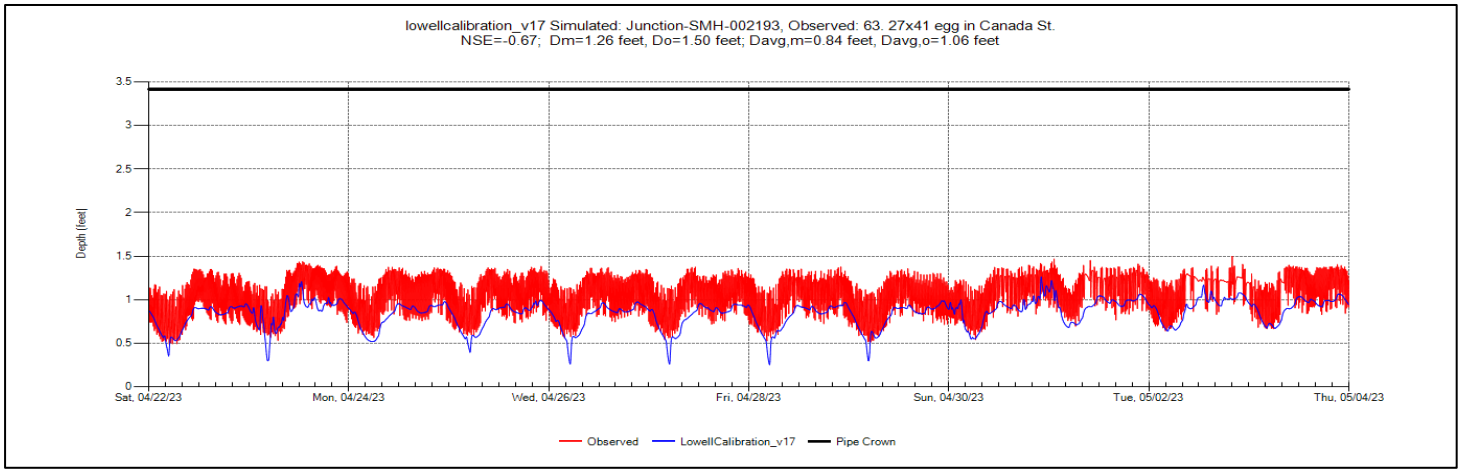


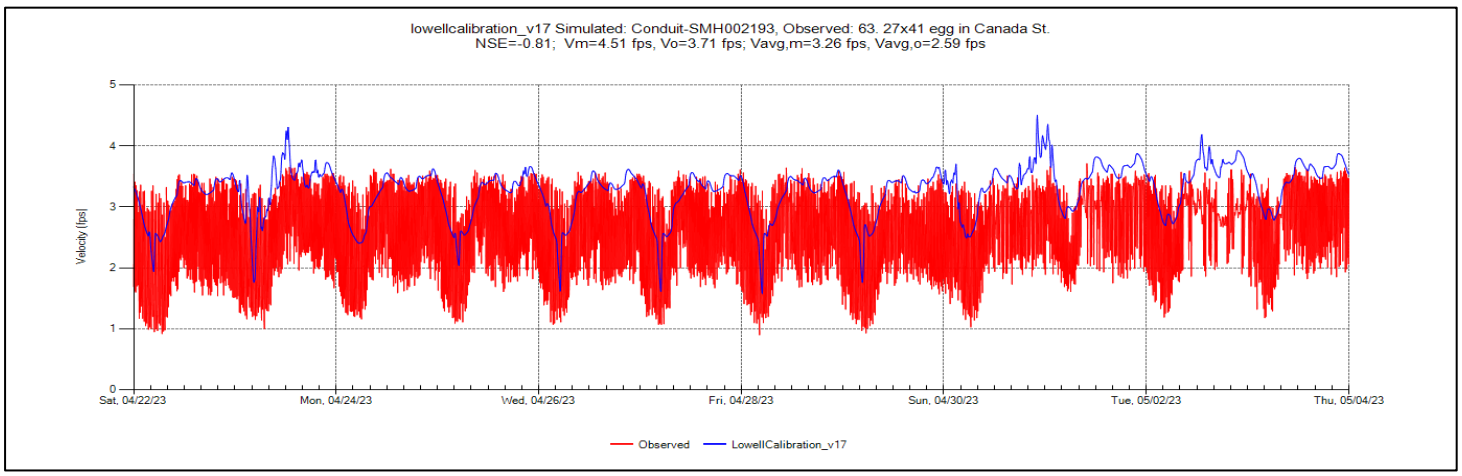


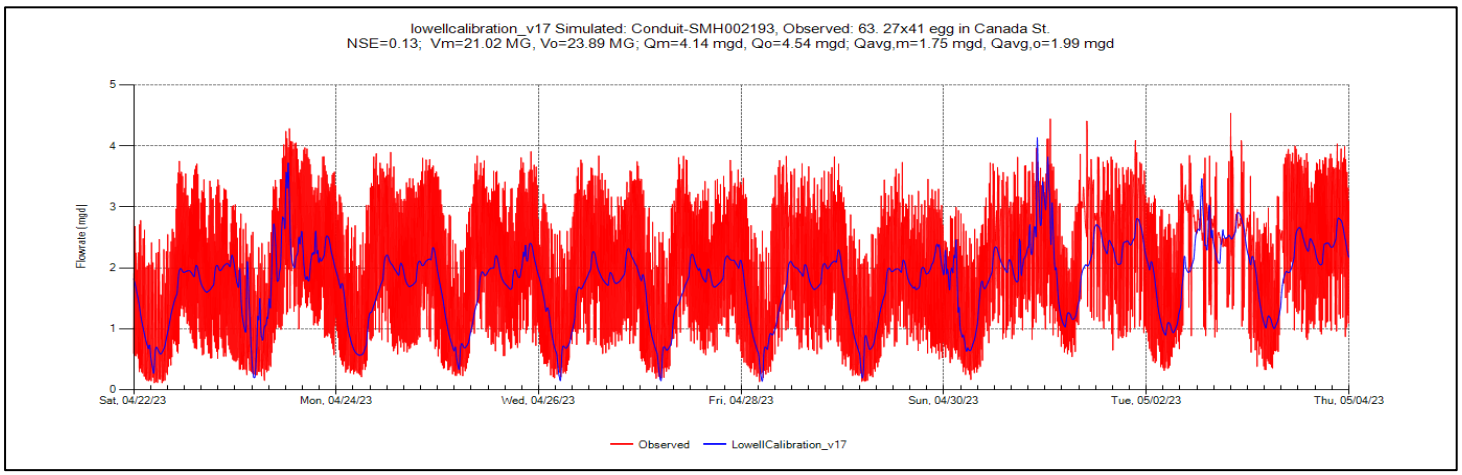


Simulated Versus Observed Flow at Flow Meter Sites

63-April-May Storms





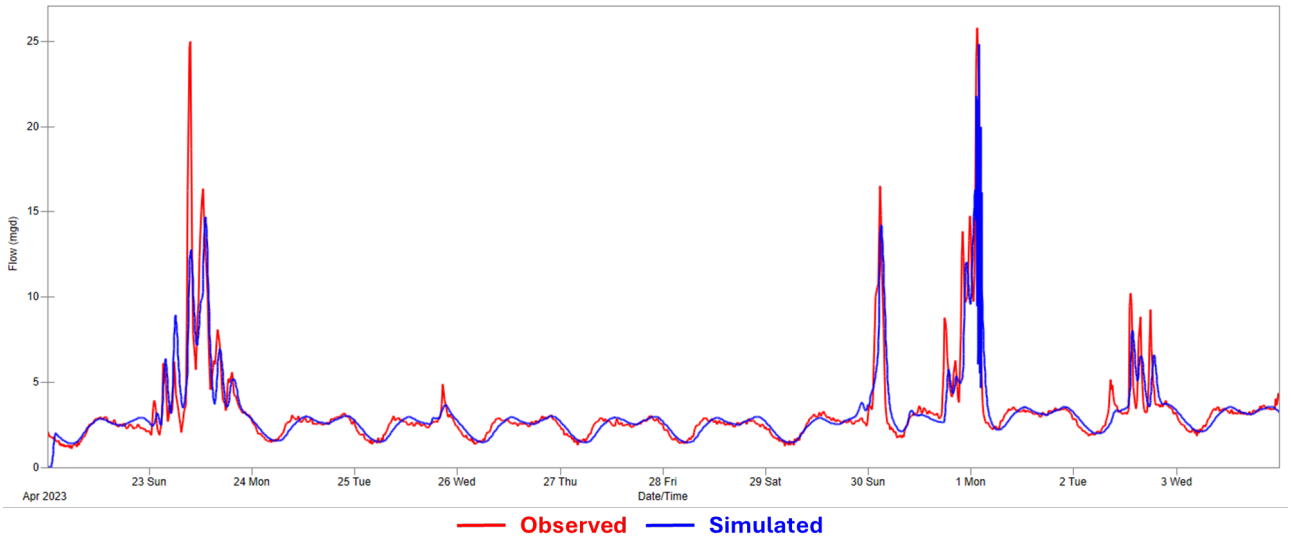


Wet Weather Timeseries CSO Diversion Structures April-May 2023

CSO Diversion Structures: April – May Storms

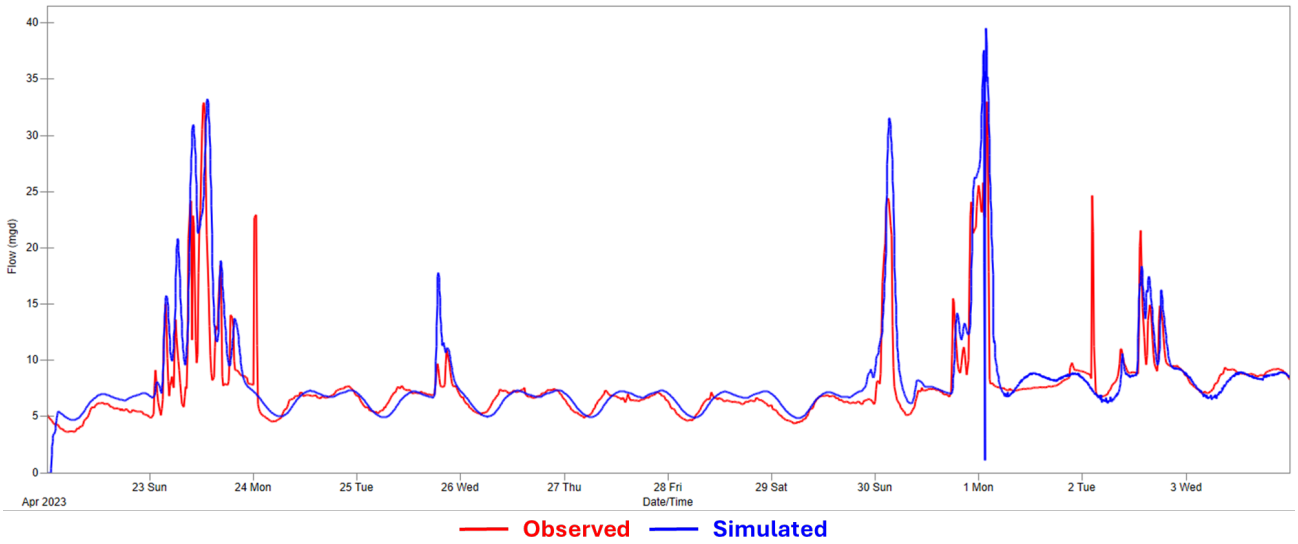
Walker

Station Flow (mgd)



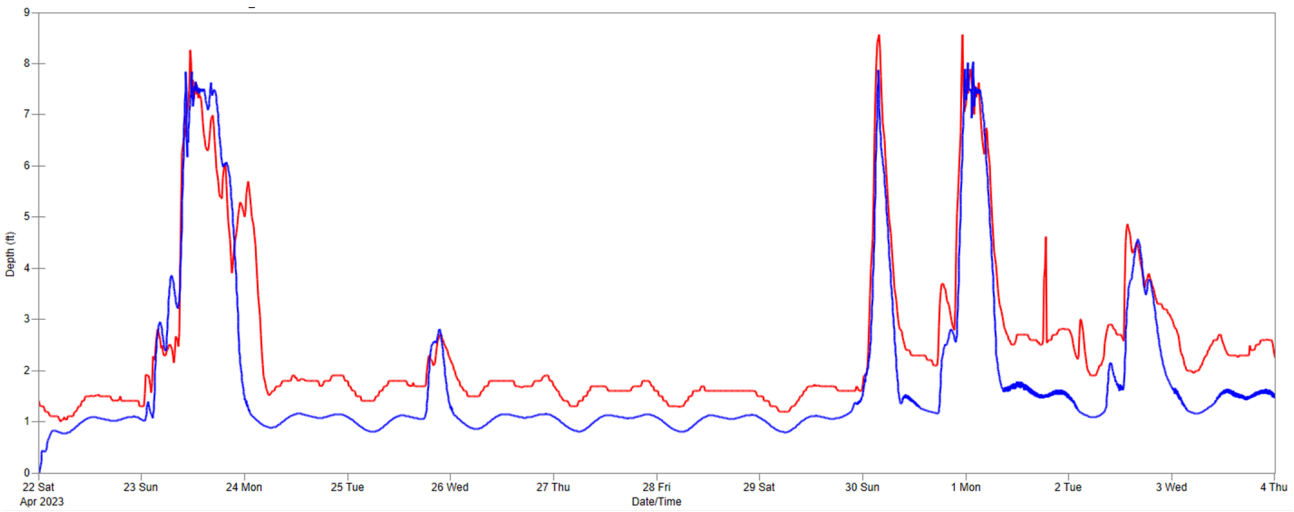
Beaver Brook

Station Flow (mgd)

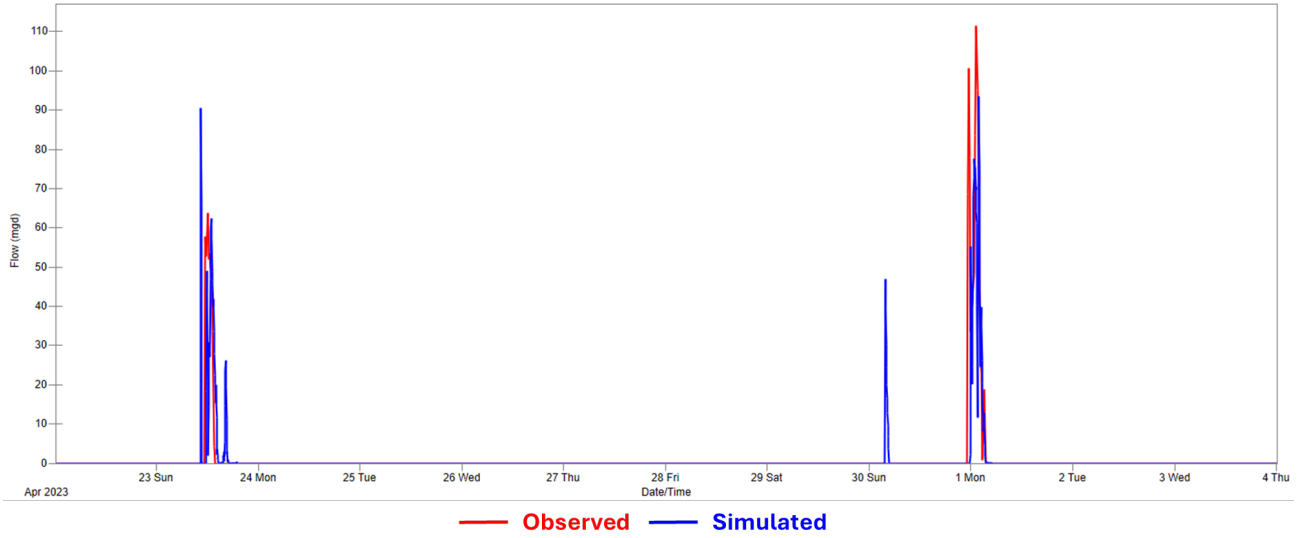


West Street

Interceptor Depth (ft)

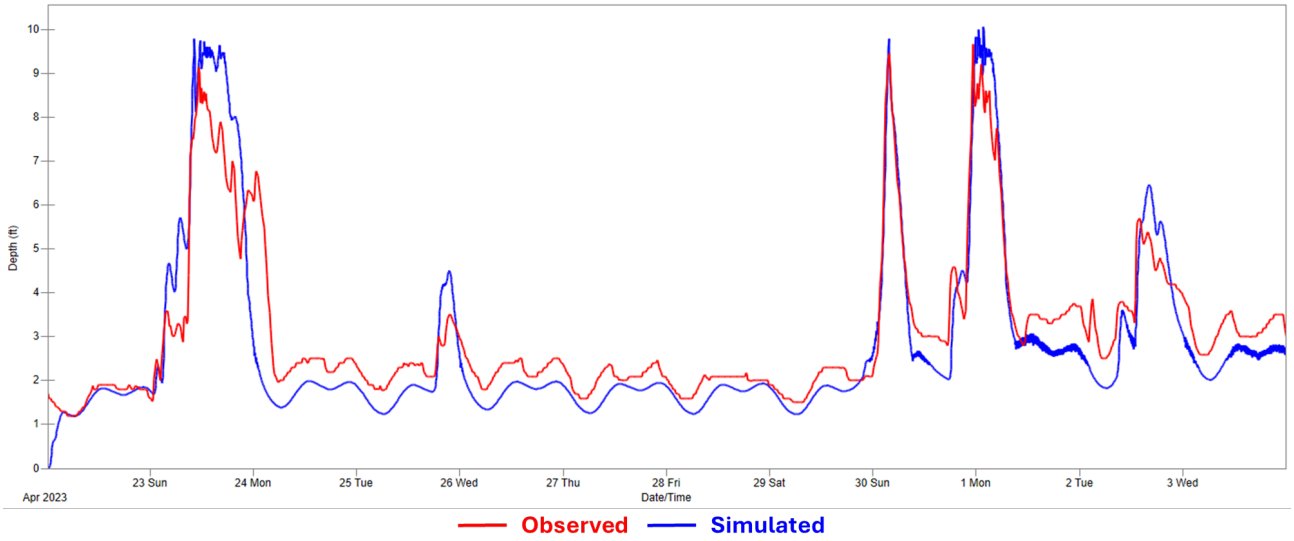


Gravity Diversion Flow (mgd)



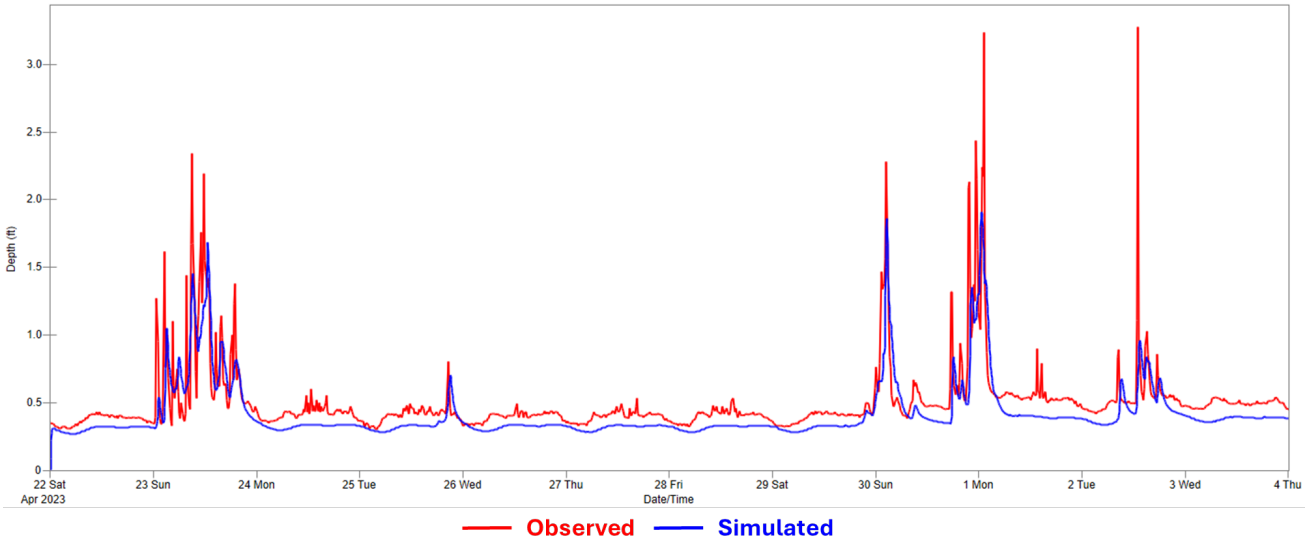
North Bank Control Station

Station Depth (ft)



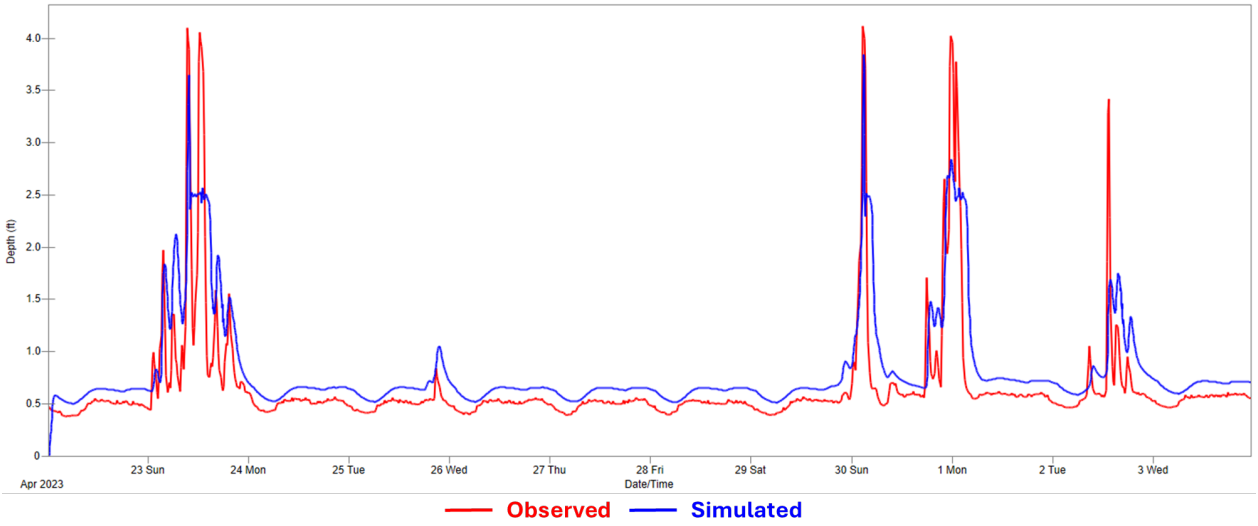
Read Street

Influent Channel Depth (ft)

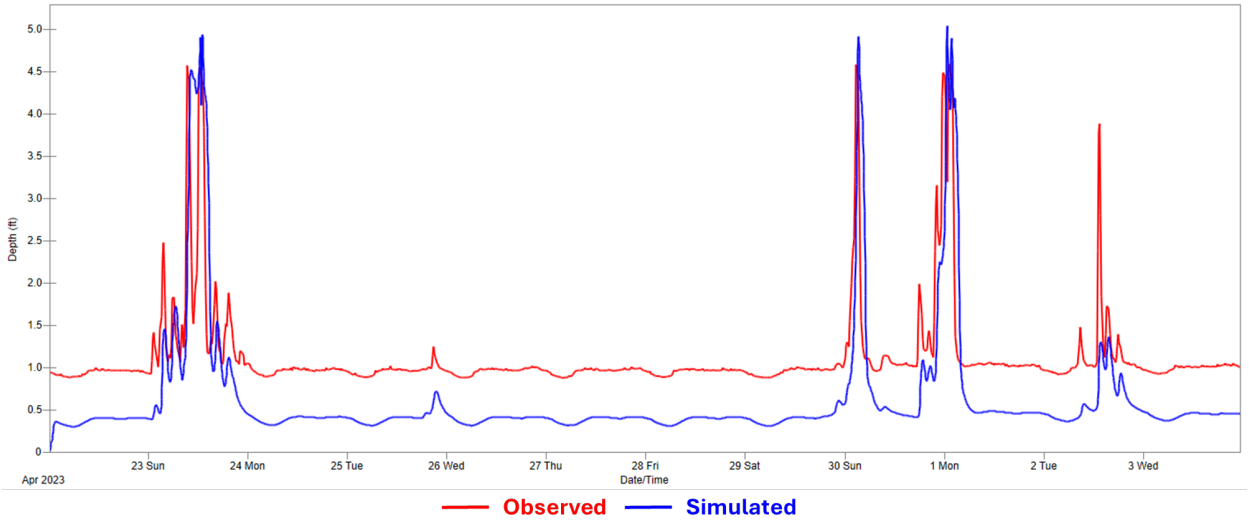


Tilden

Flume Depth (ft)

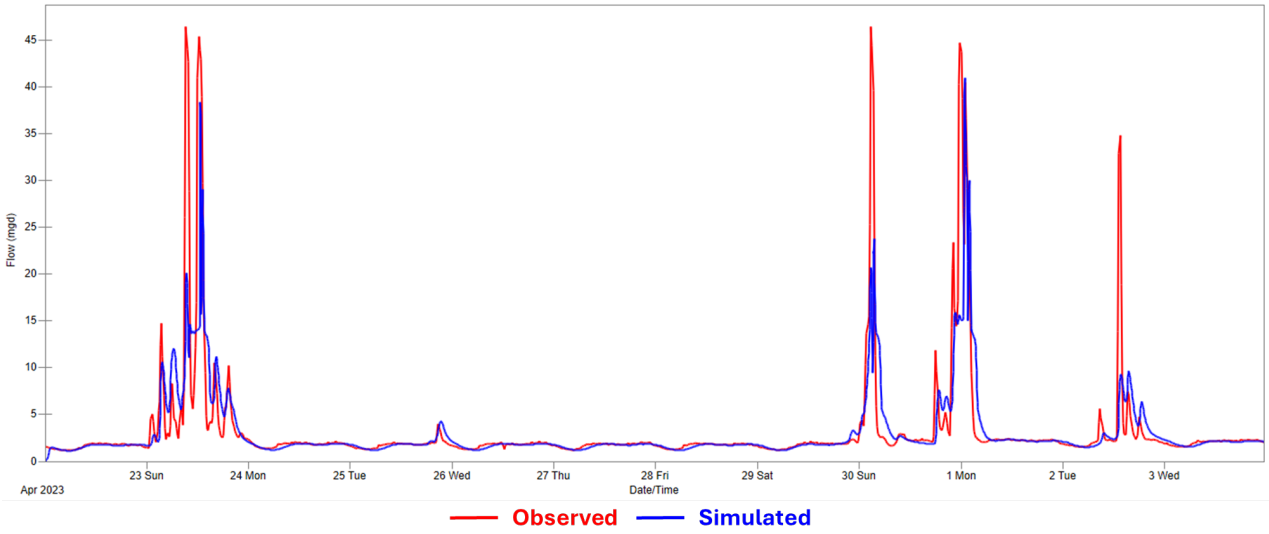


Influent Channel Depth (ft)

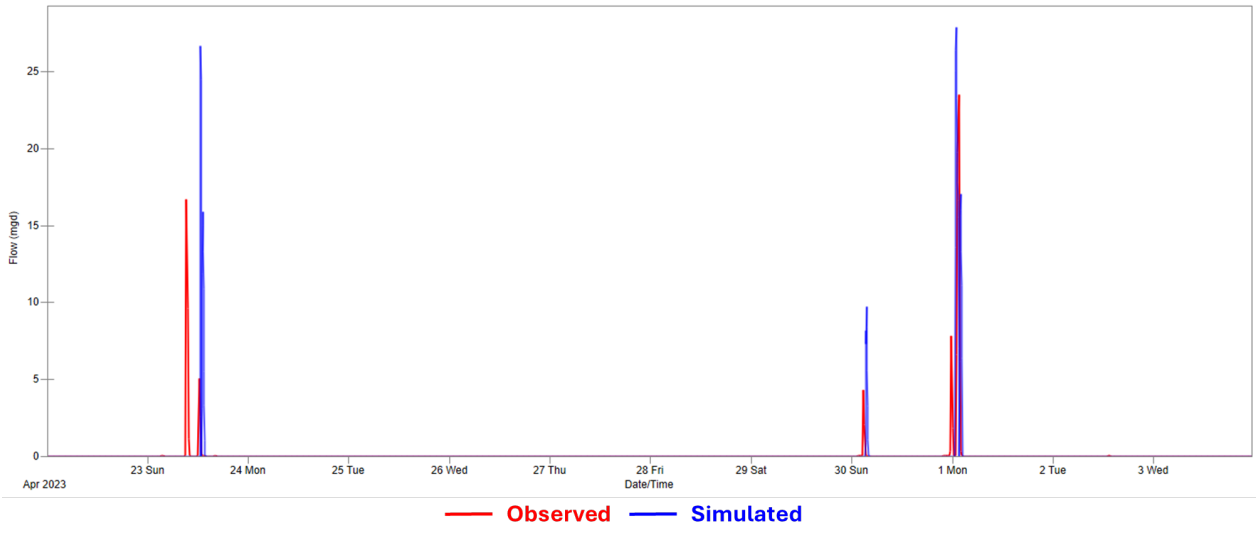


Tilden

Station Flow (mgd)

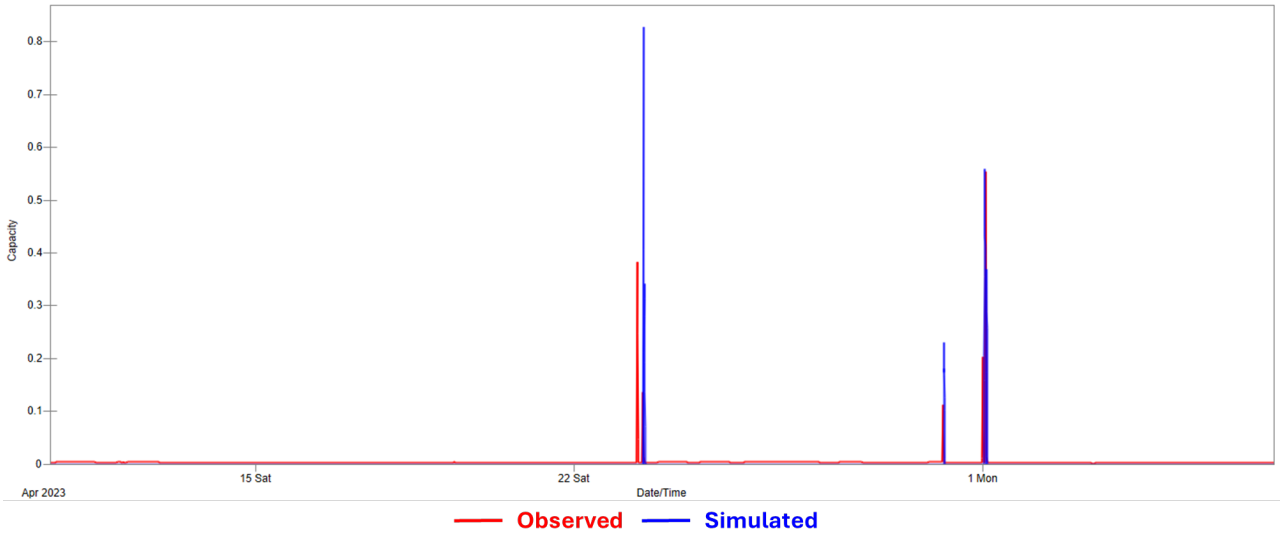


Gravity Diversion Flow (mgd)

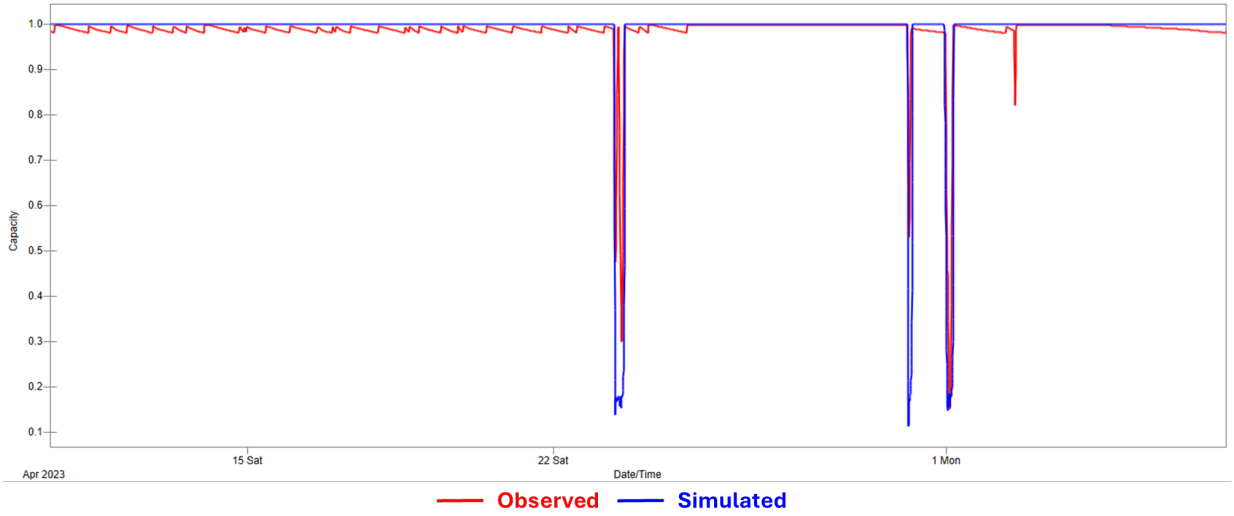


Tilden

Diversion Gate Position

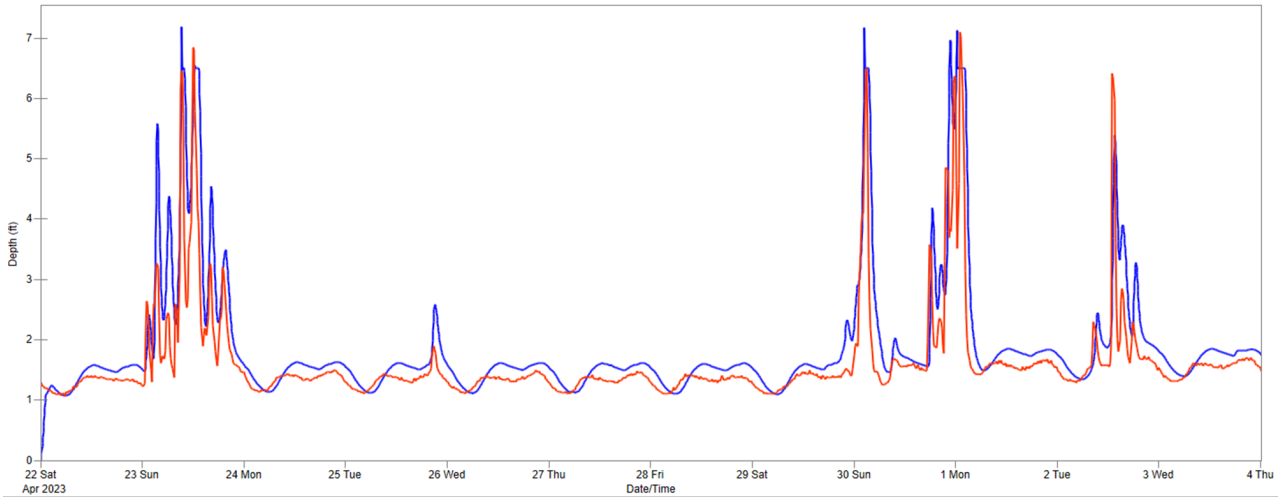


Control Gate Position

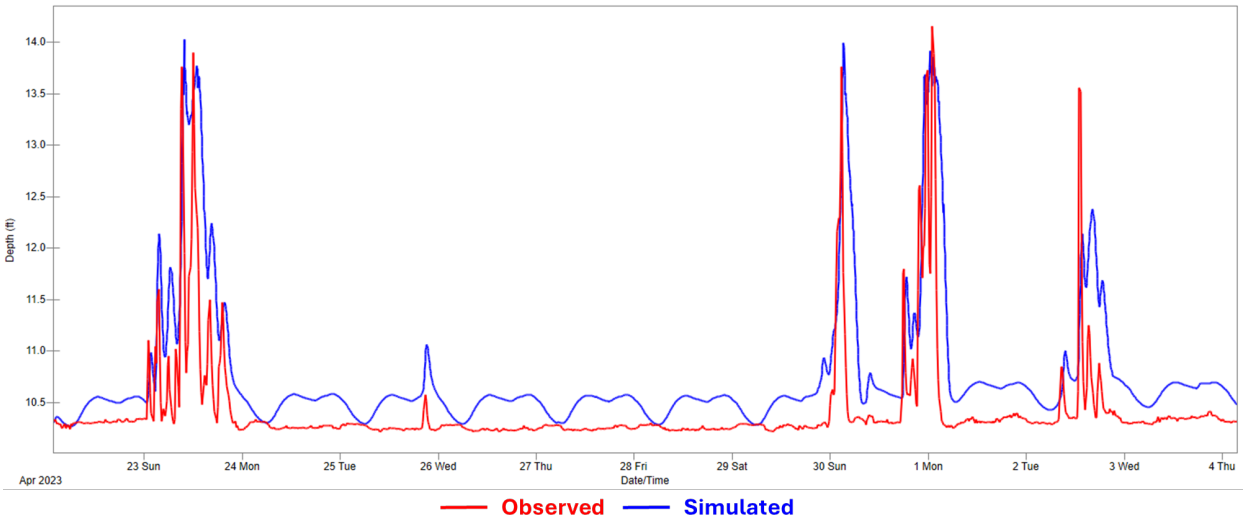


Warren

Influent Depth (ft)

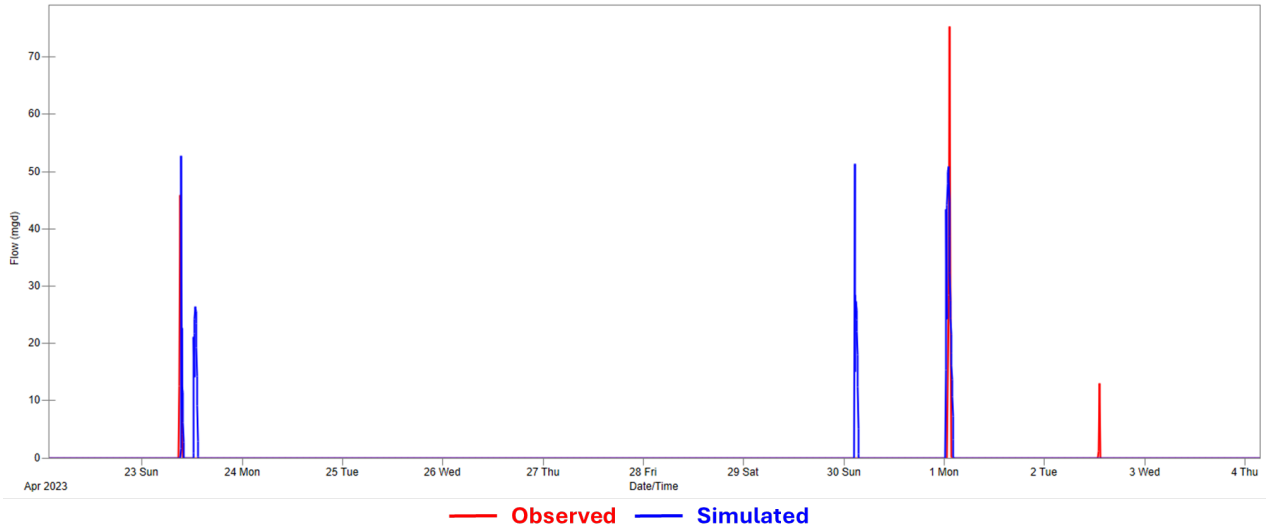


Siphon Depth (ft)

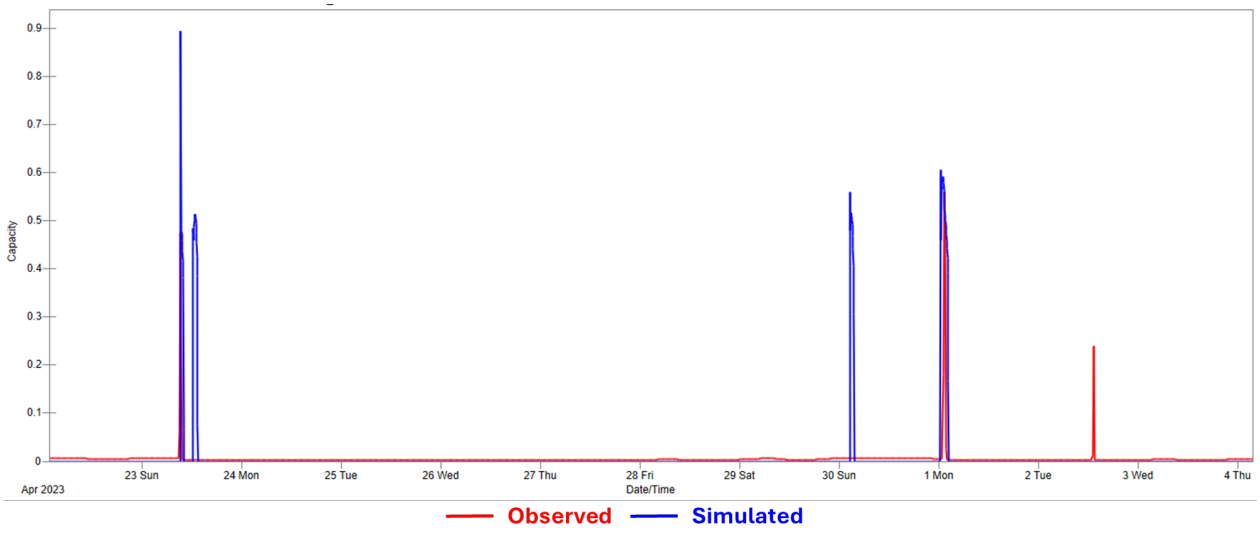


Warren

Gravity Diversion Flow (mgd)

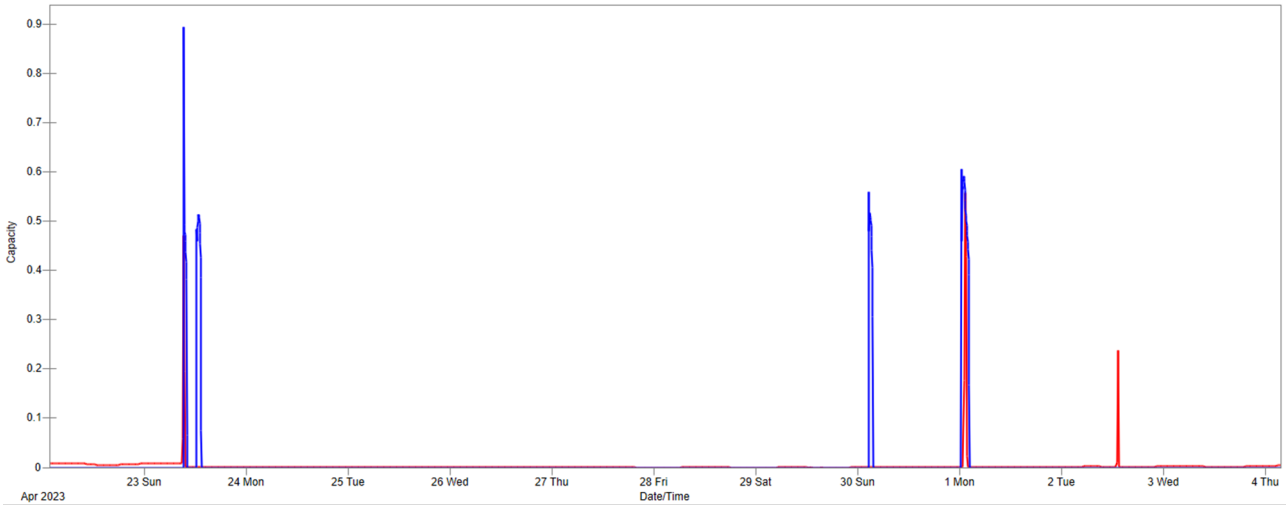


Gate No.1 Position



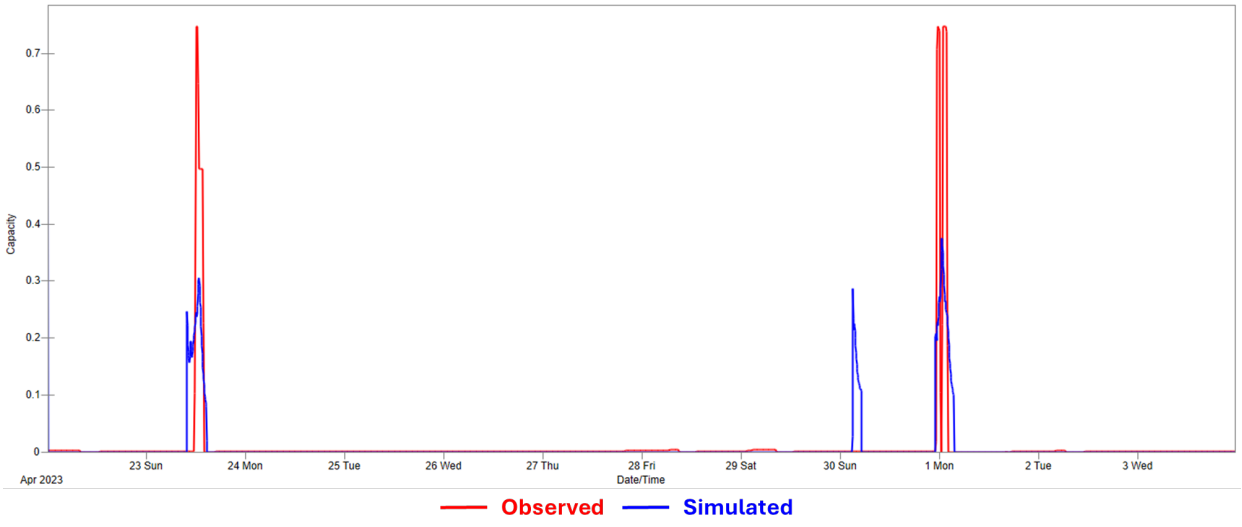
Warren

Gate No. 2 Position



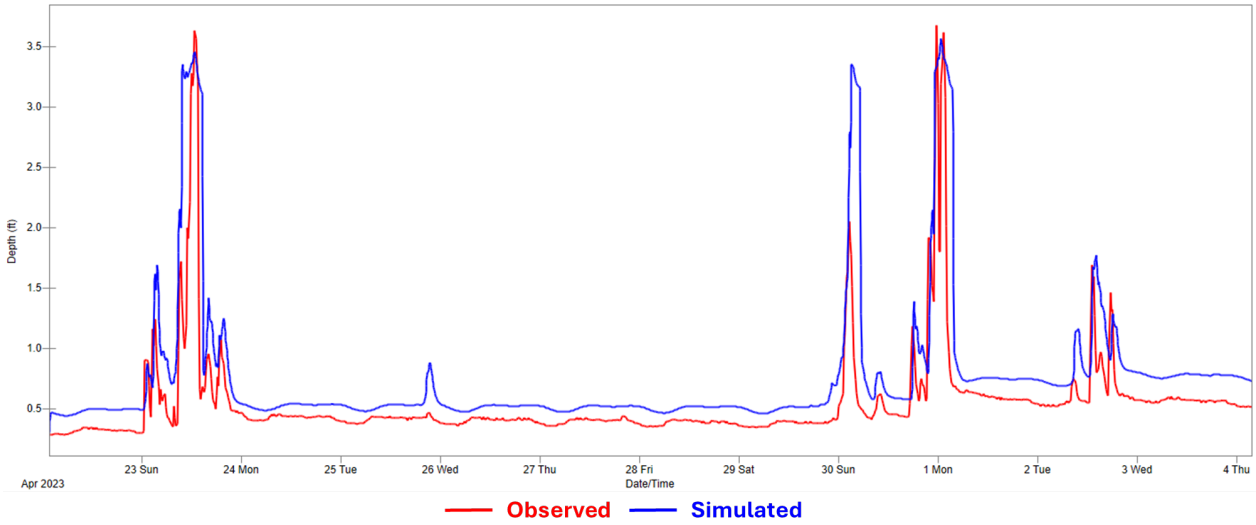
Barasford

Diversion Gate Position

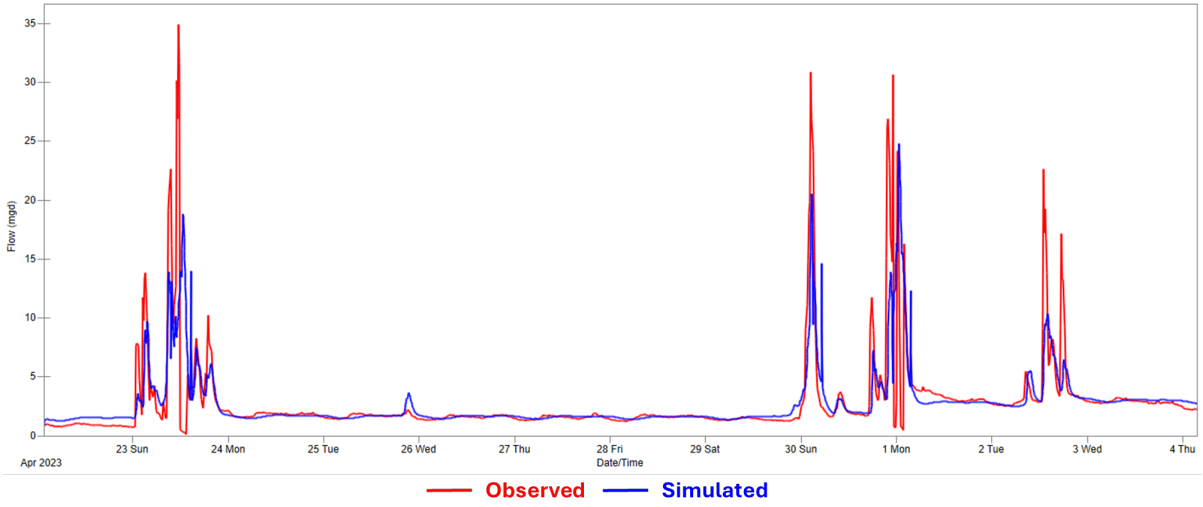


Barasford

Influent Depth (ft)

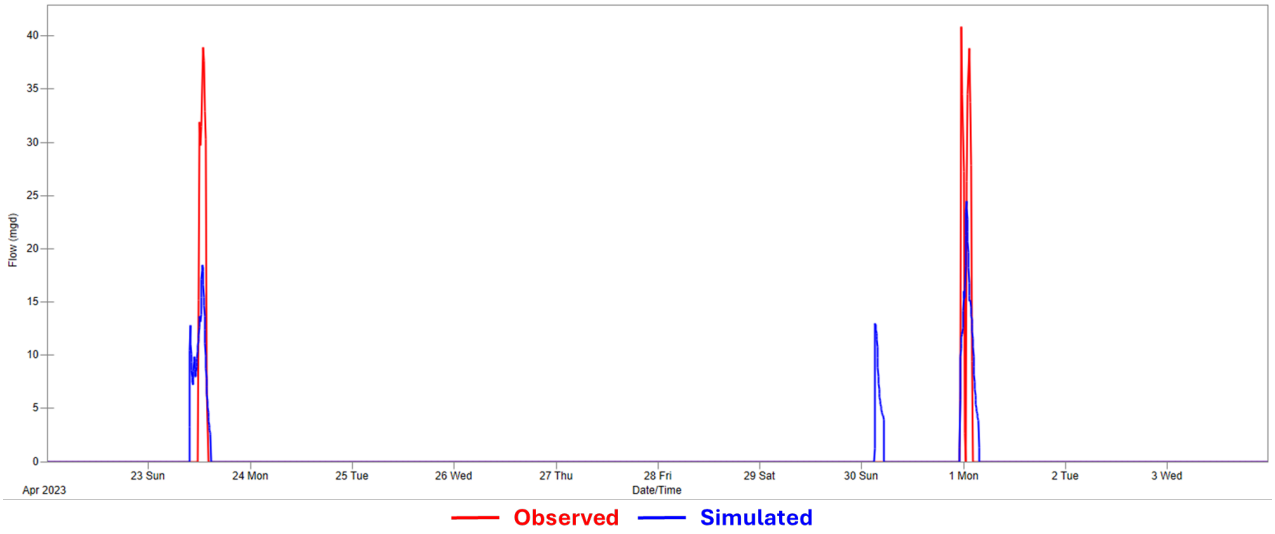


Station Flow (mgd)

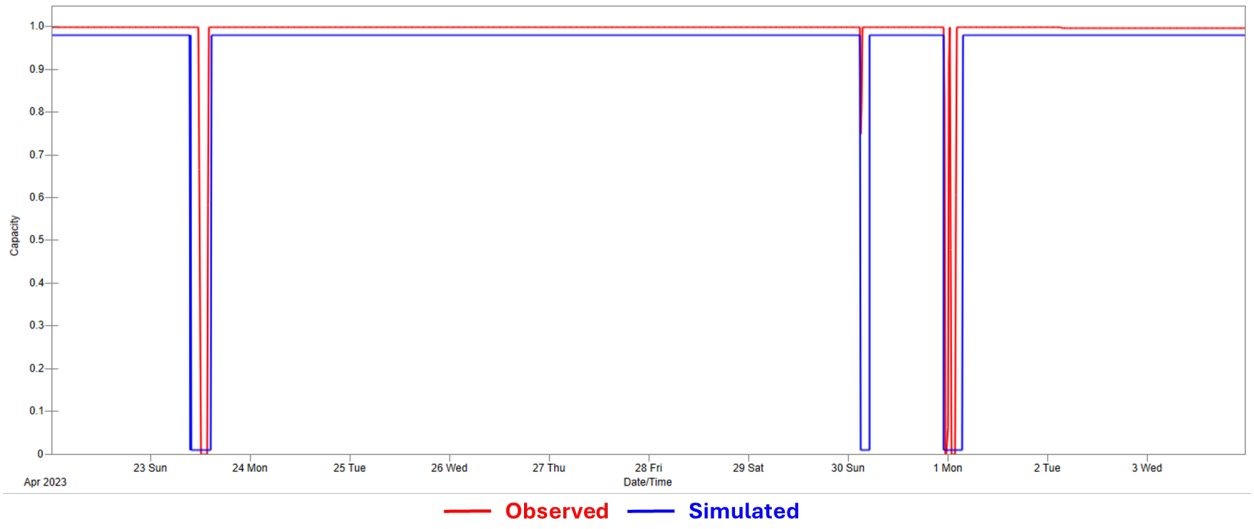


Barasford

Gravity Diversion Flow (mgd)

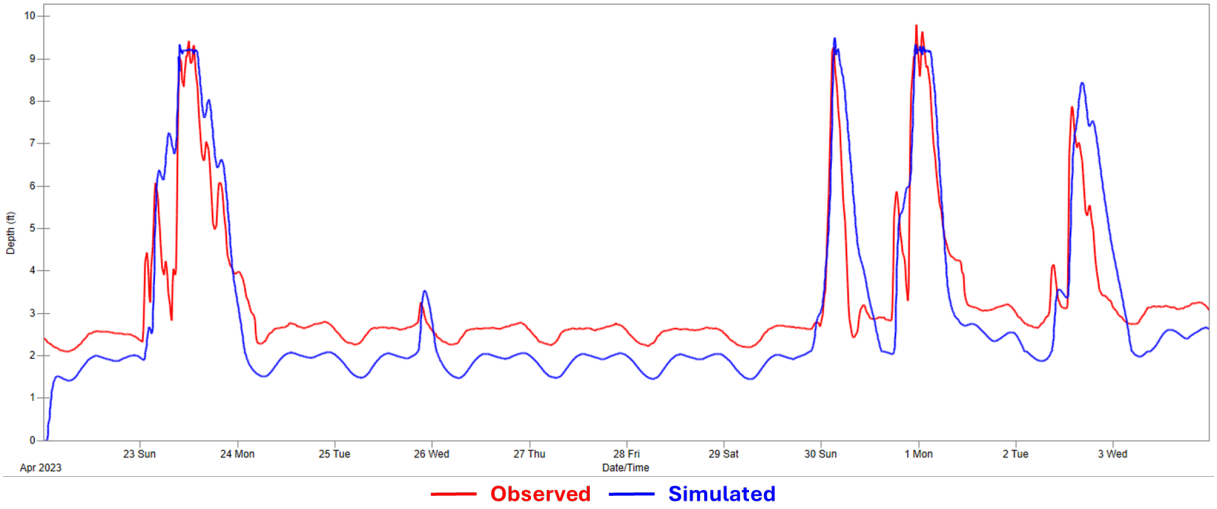


Control Gate Position

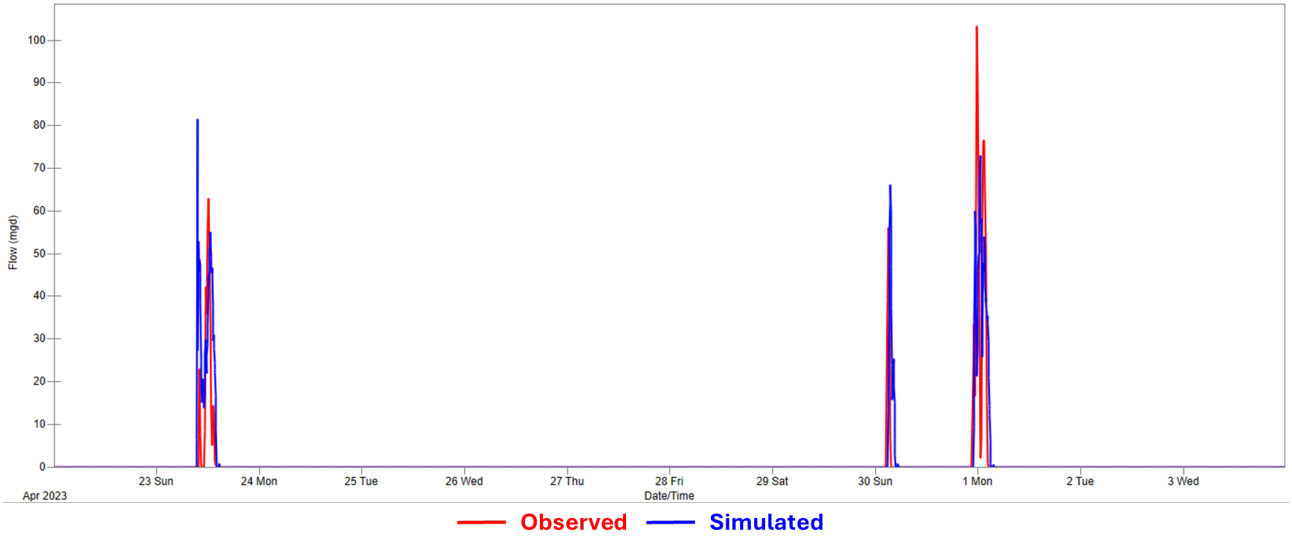


Merrimack

Interceptor Depth (ft)

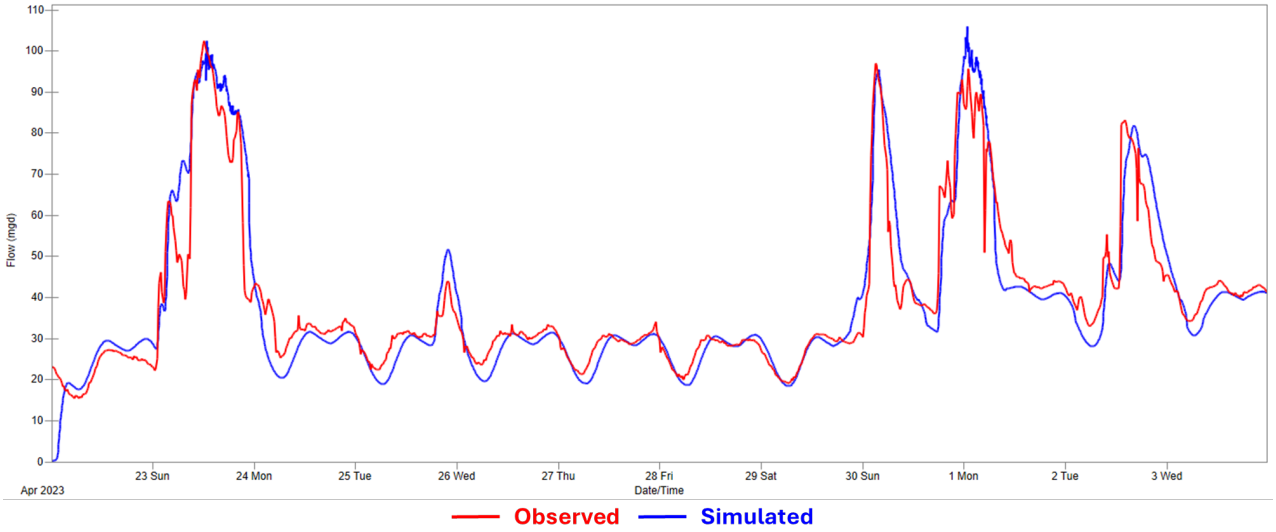


Gravity Diversion Flow (mgd)



Duck Island

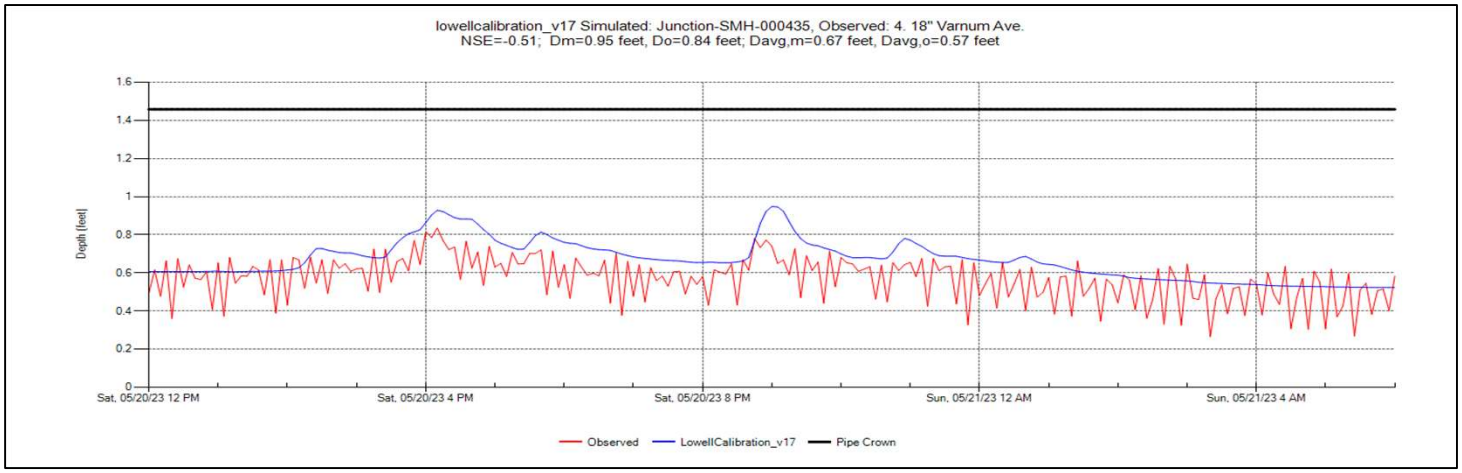
Effluent Flow (mgd)

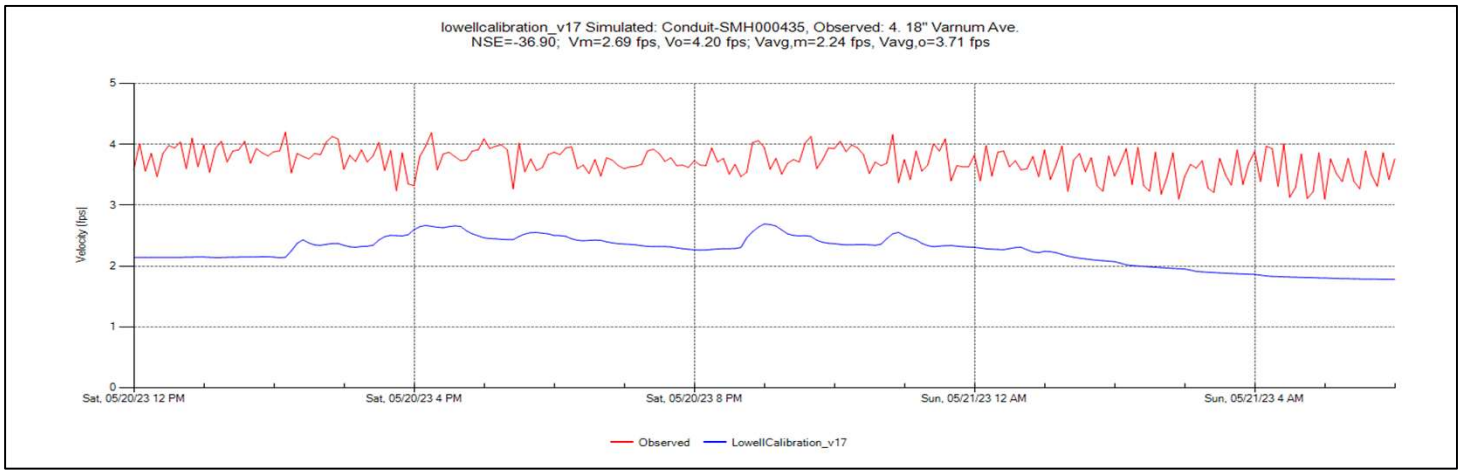


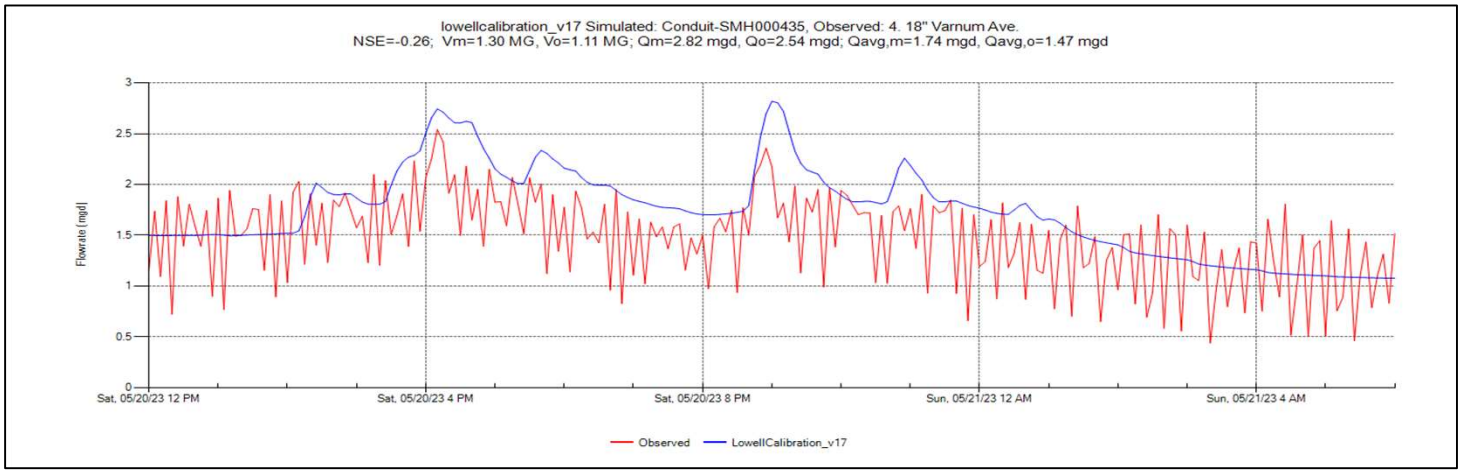
Wet Weather Timeseries Temporary Meters May 20, 2023

Simulated Versus Observed Flow at Flow Meter Sites

04-May 20

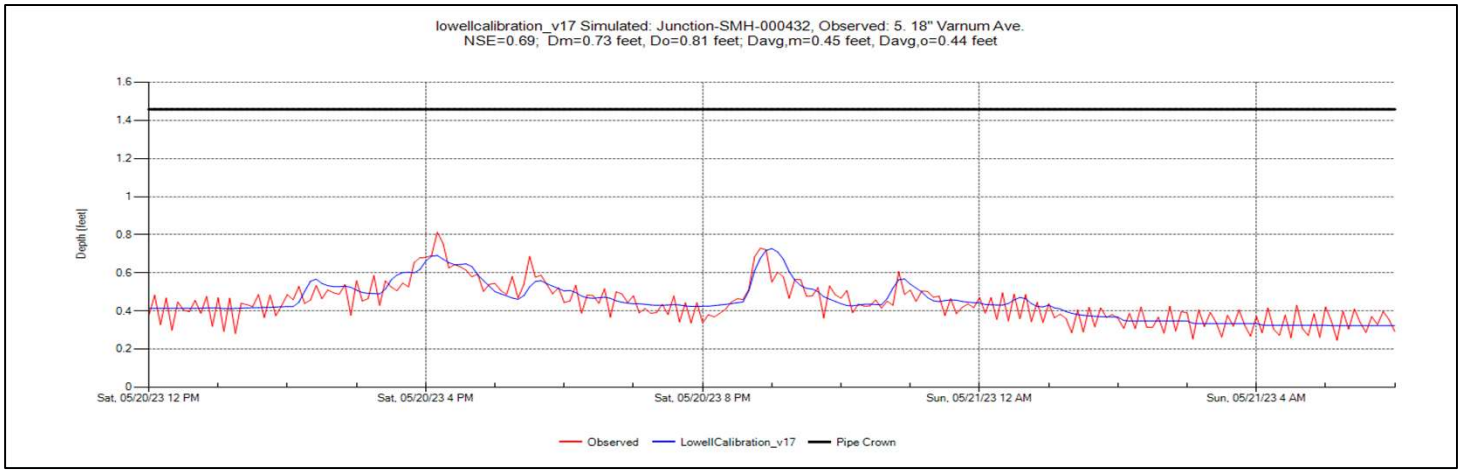


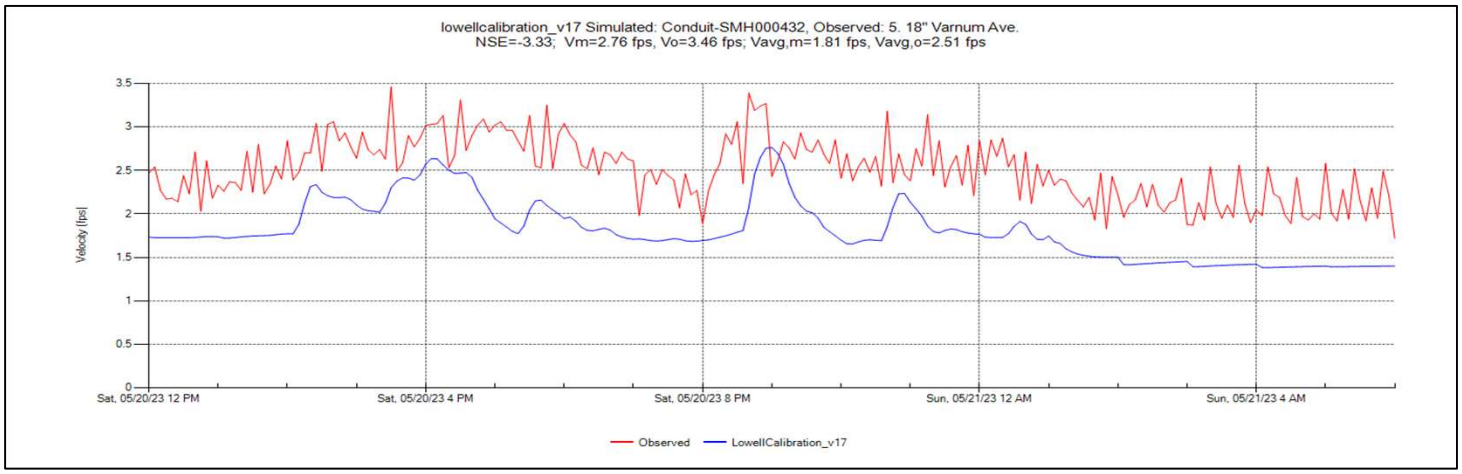


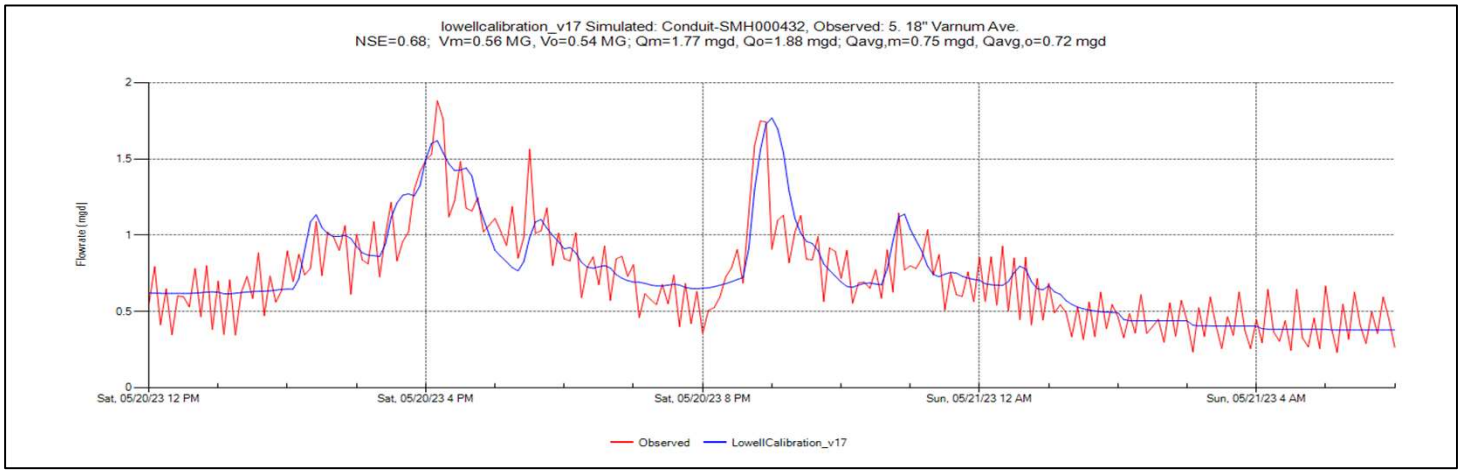


Simulated Versus Observed Flow at Flow Meter Sites

05-May 20

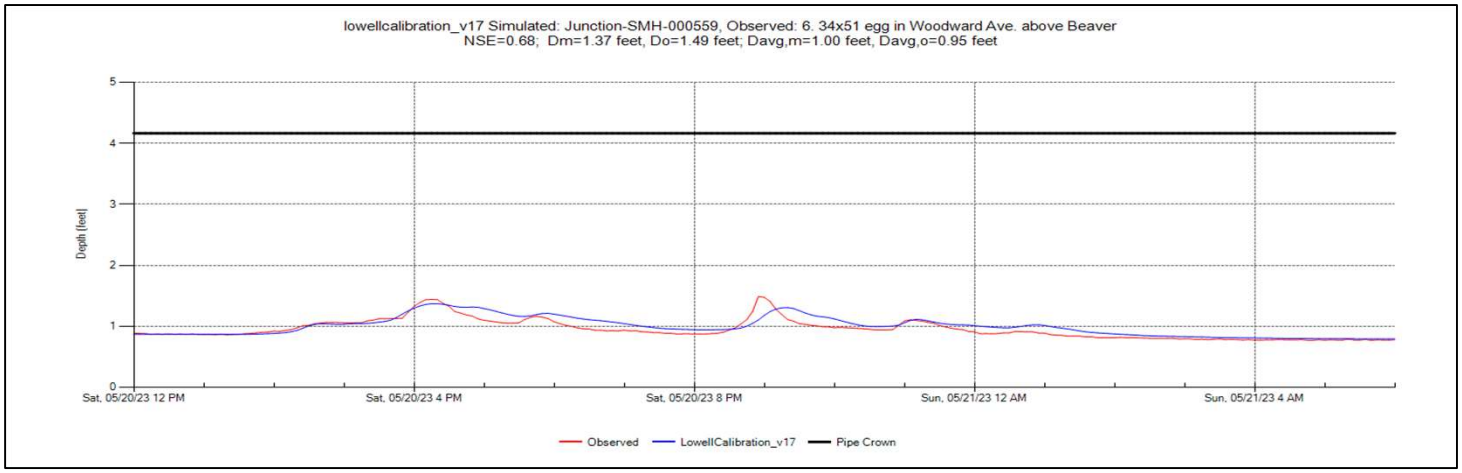


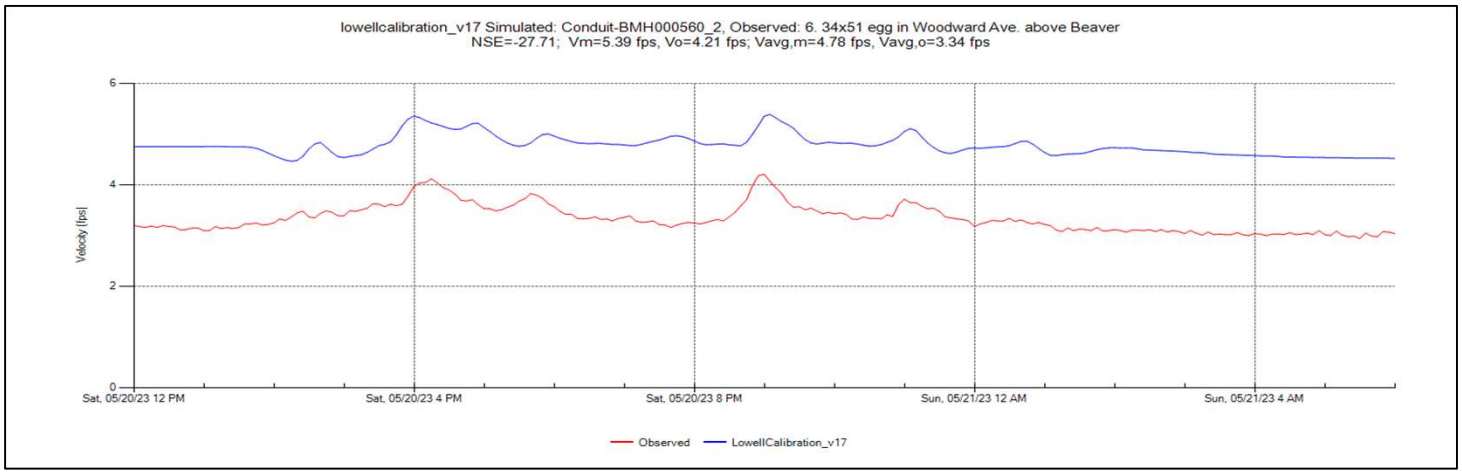


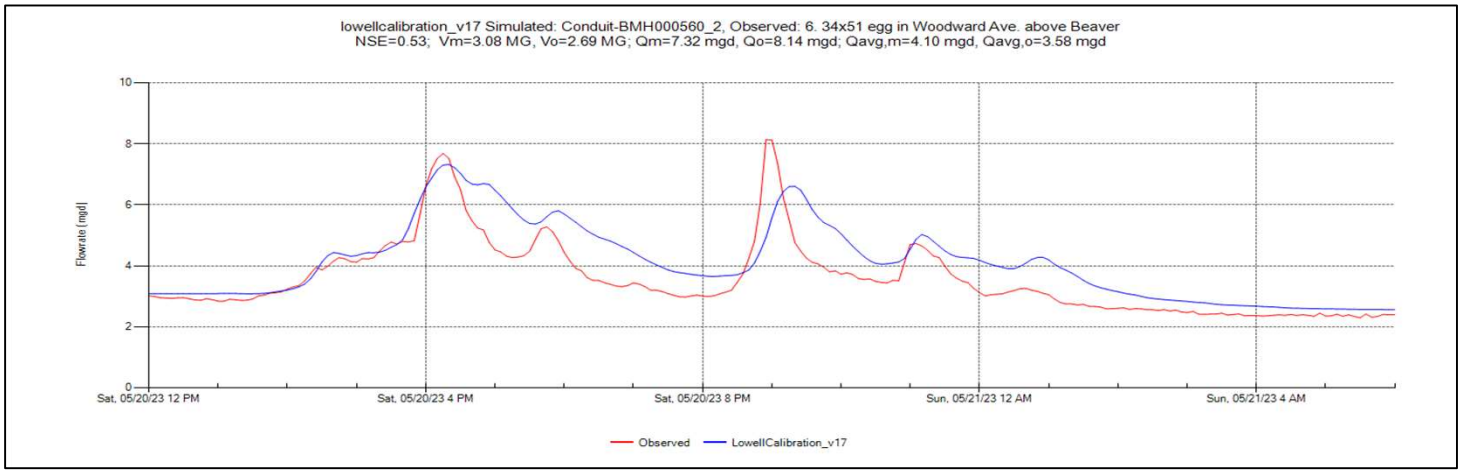


Simulated Versus Observed Flow at Flow Meter Sites

06-May 20

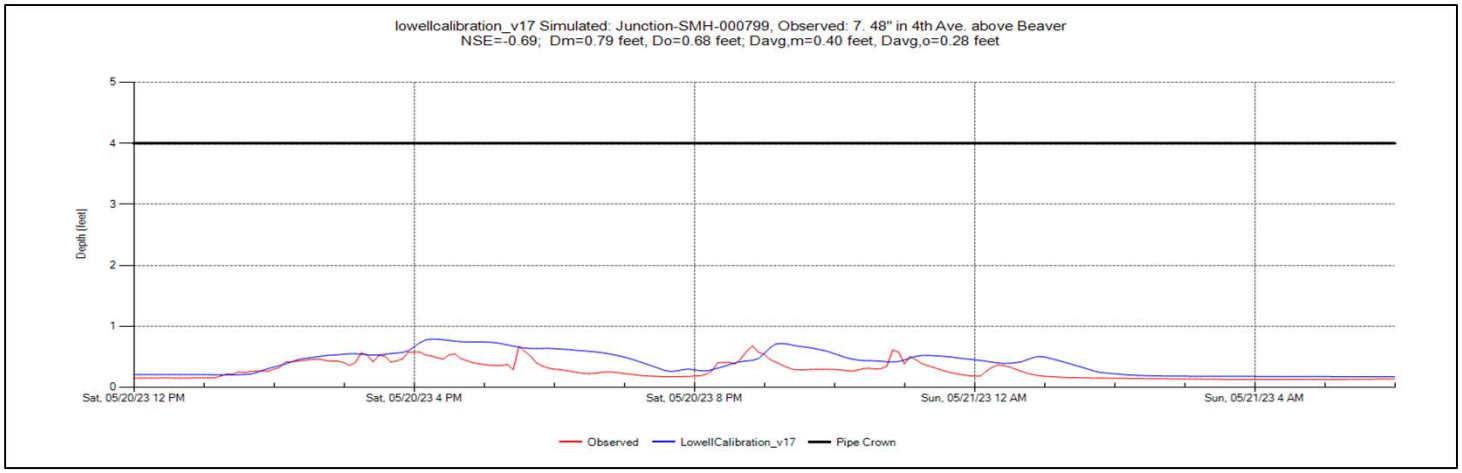


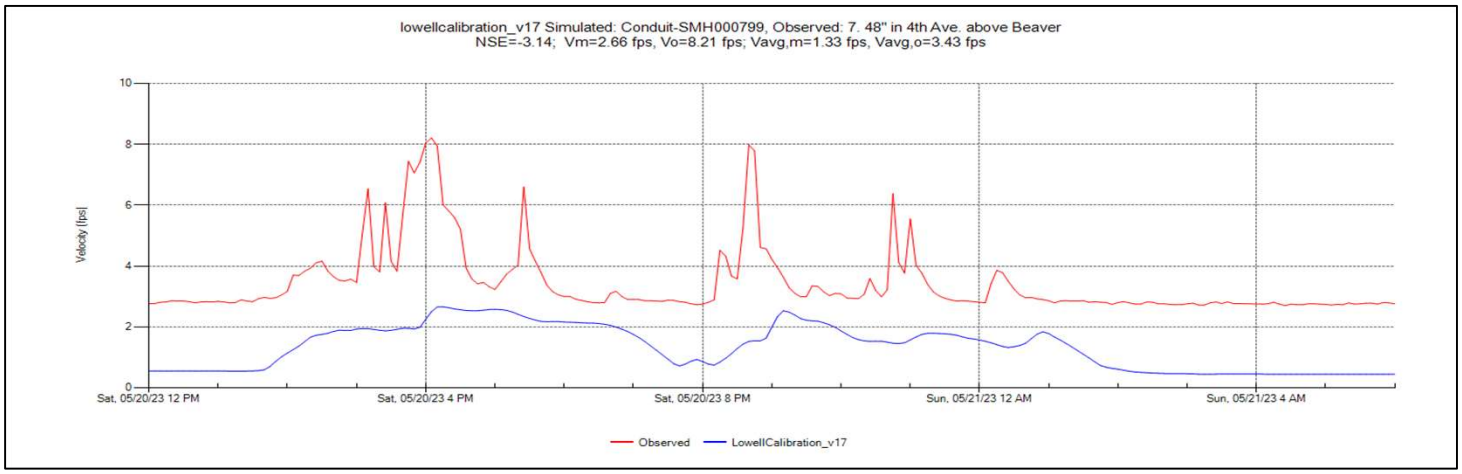


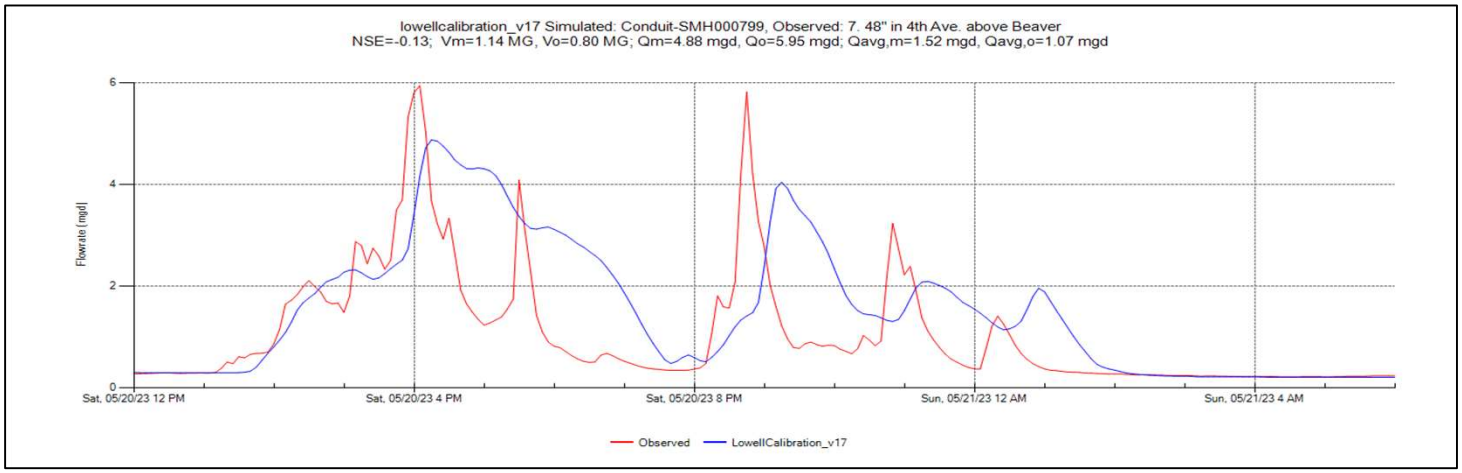


Simulated Versus Observed Flow at Flow Meter Sites

07-May 20

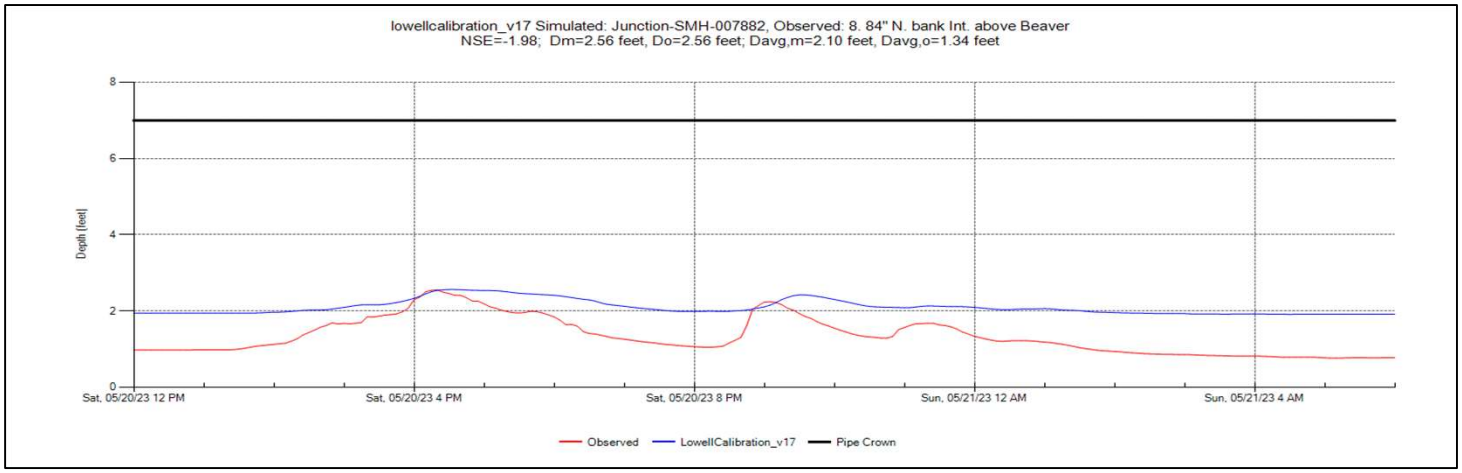


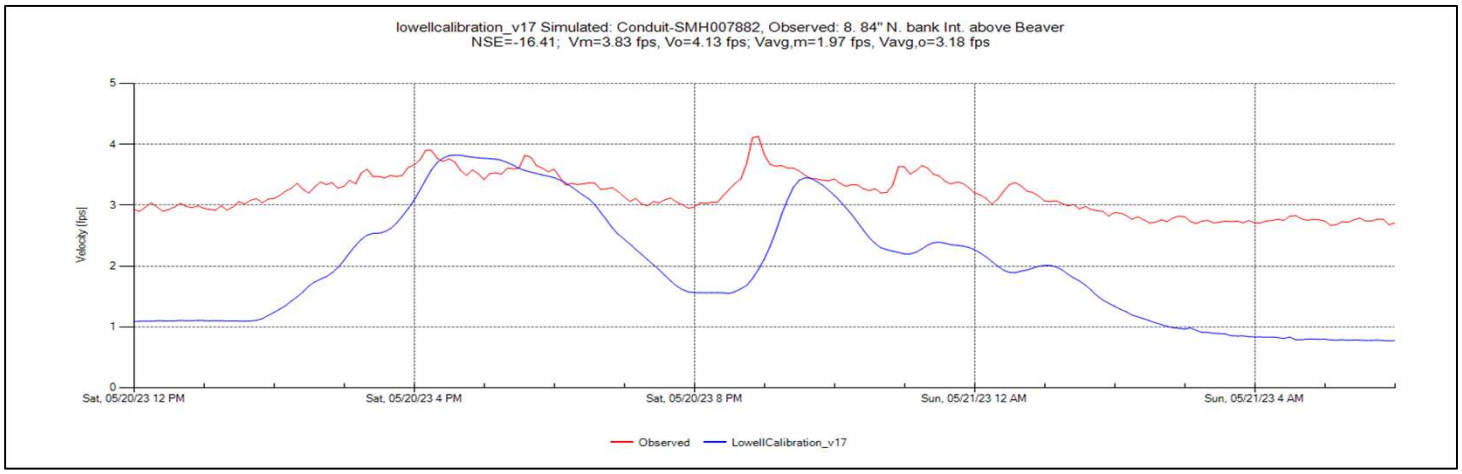


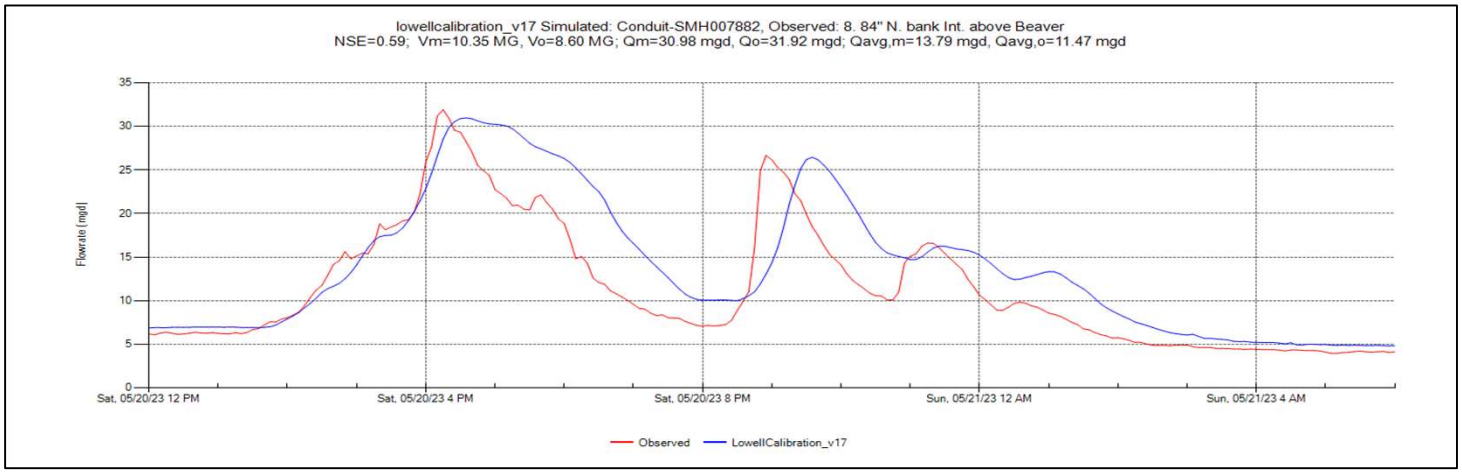


Simulated Versus Observed Flow at Flow Meter Sites

08-May 20

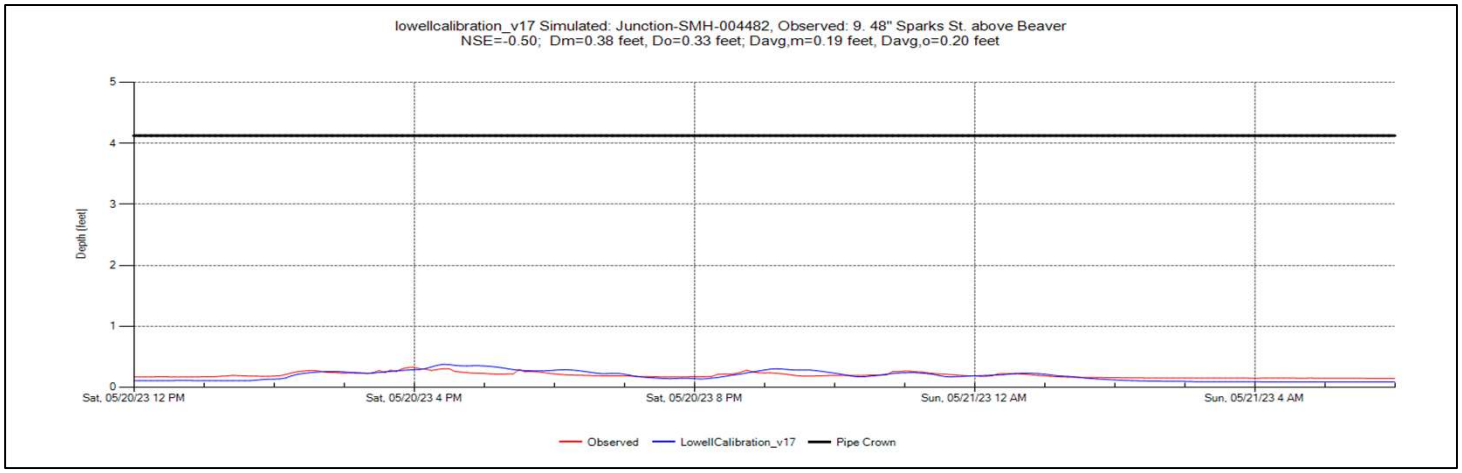


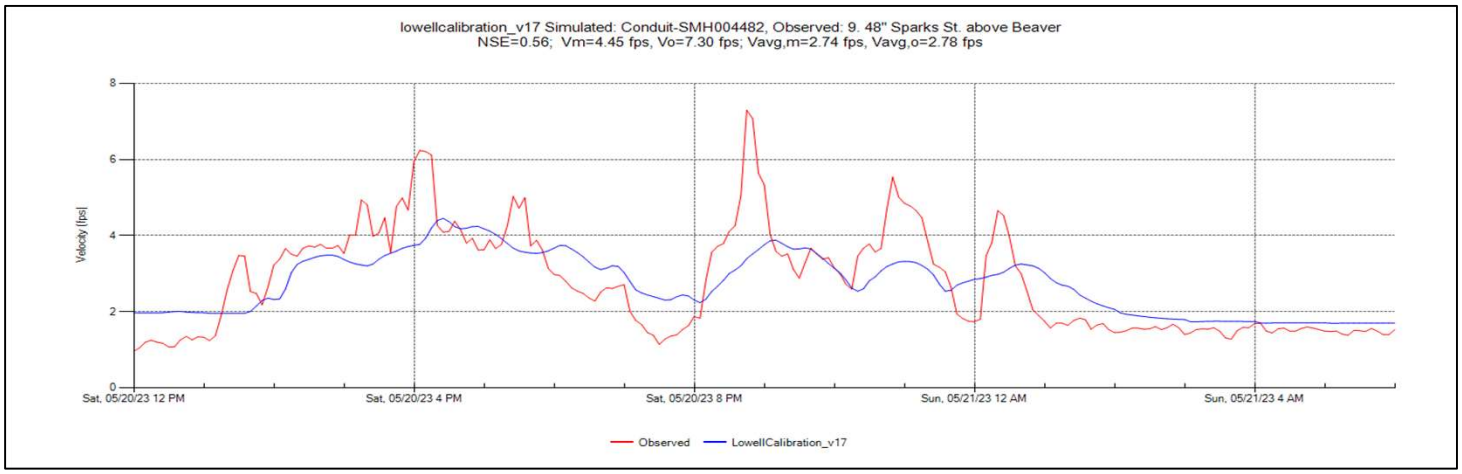


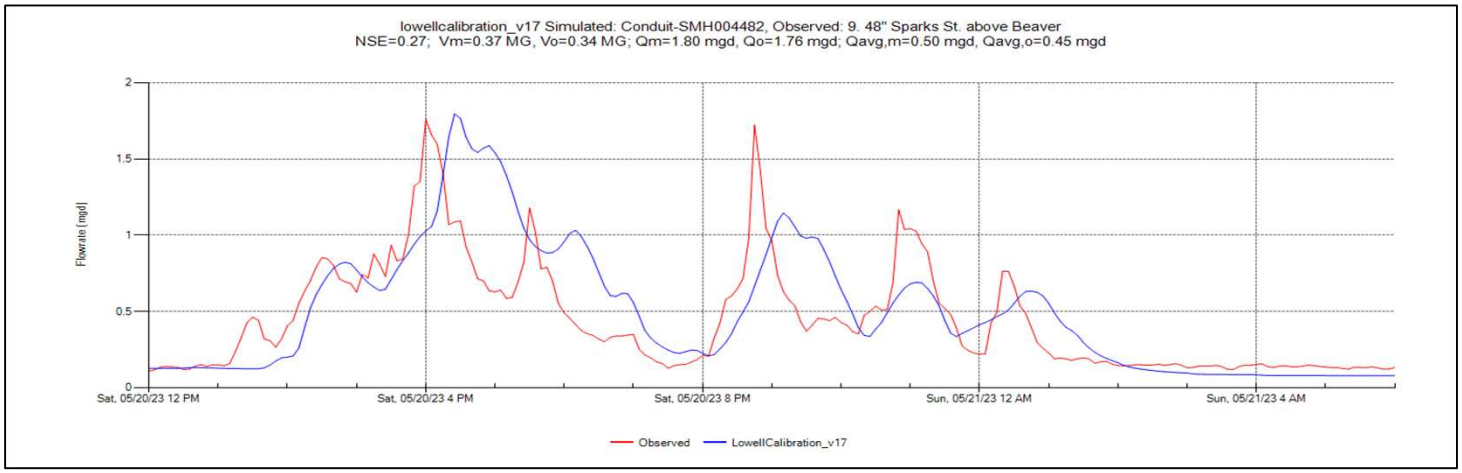


Simulated Versus Observed Flow at Flow Meter Sites

09-May 20

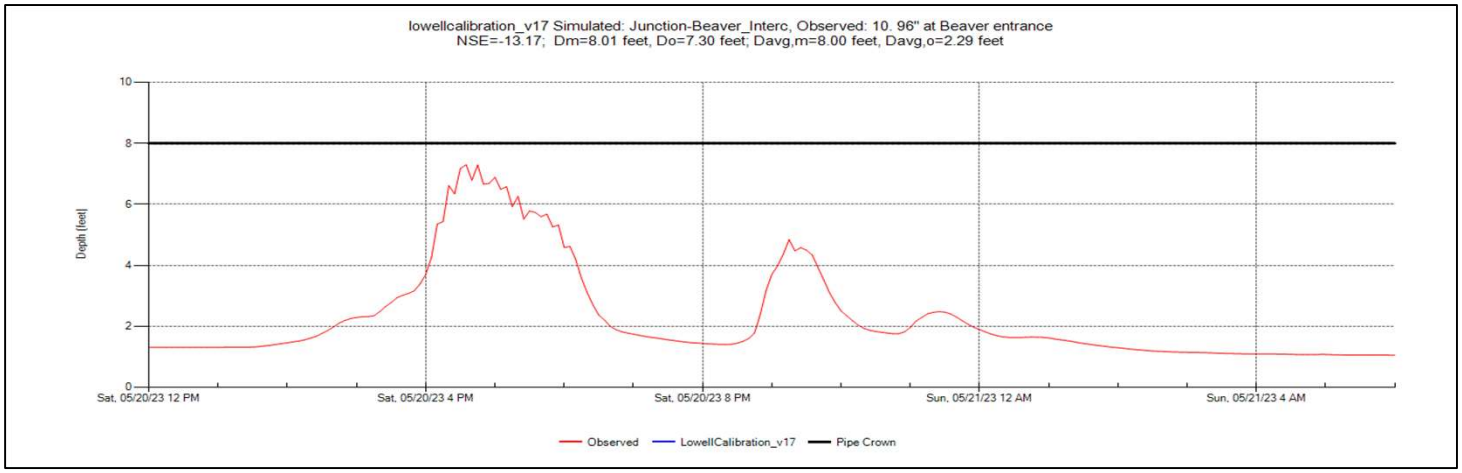


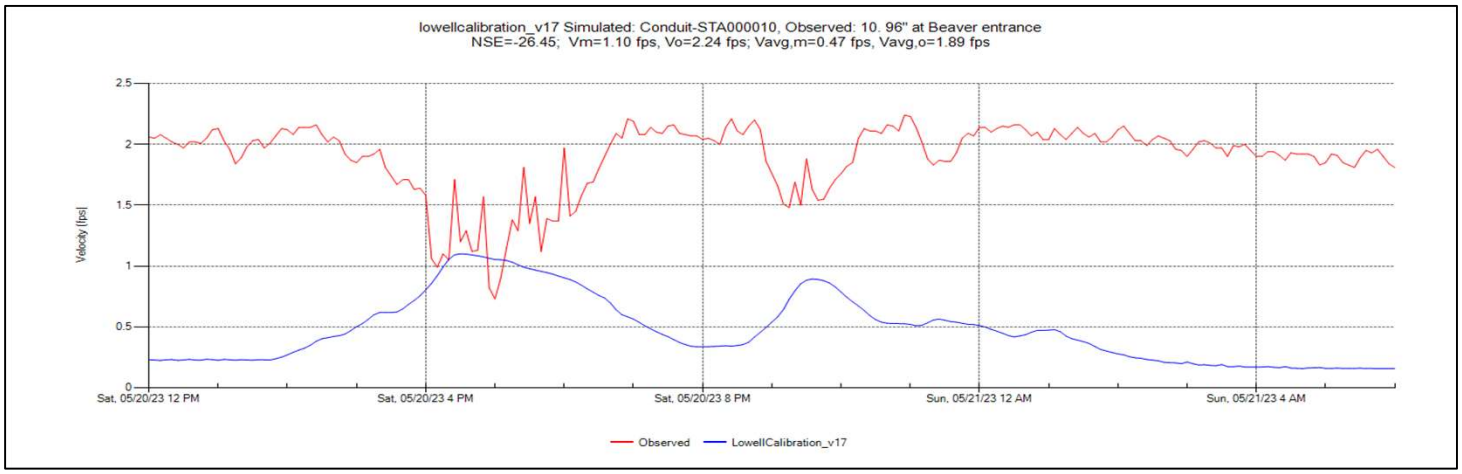


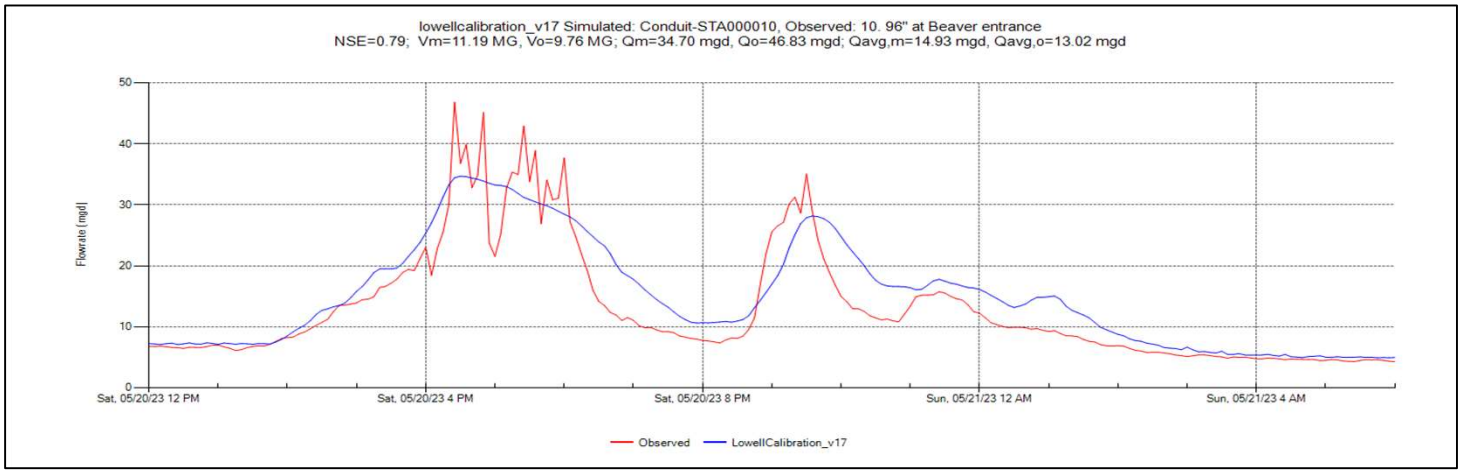


Simulated Versus Observed Flow at Flow Meter Sites

10-May 20

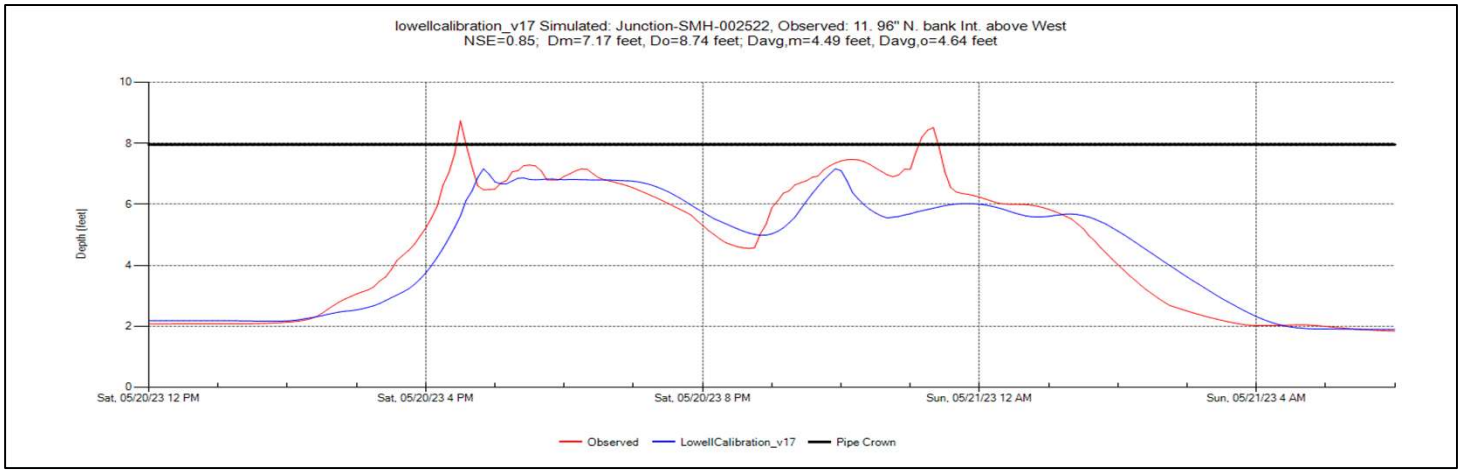


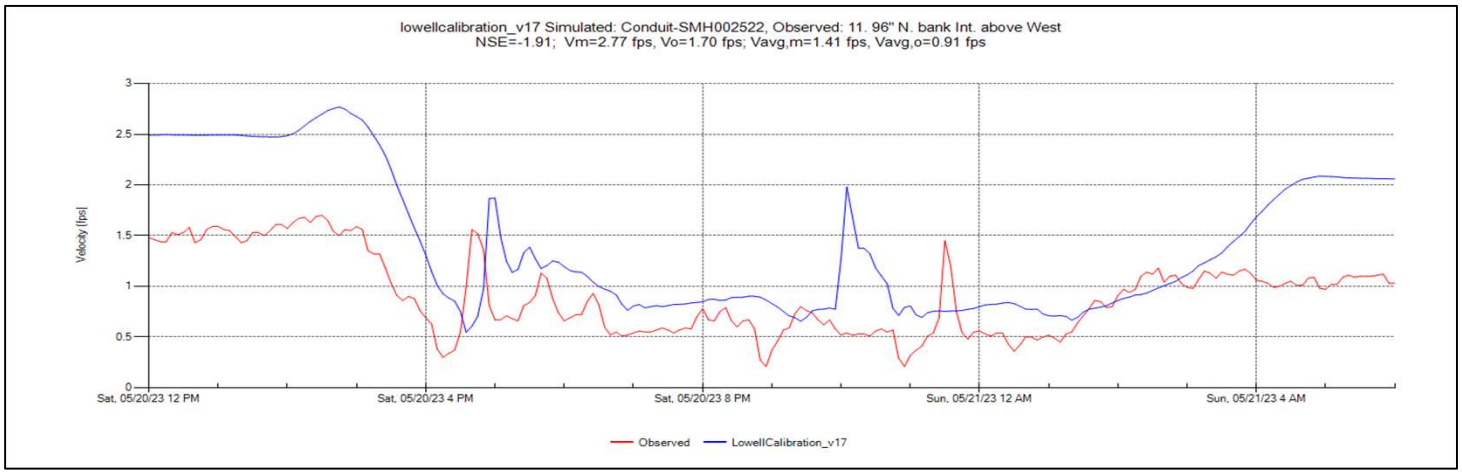


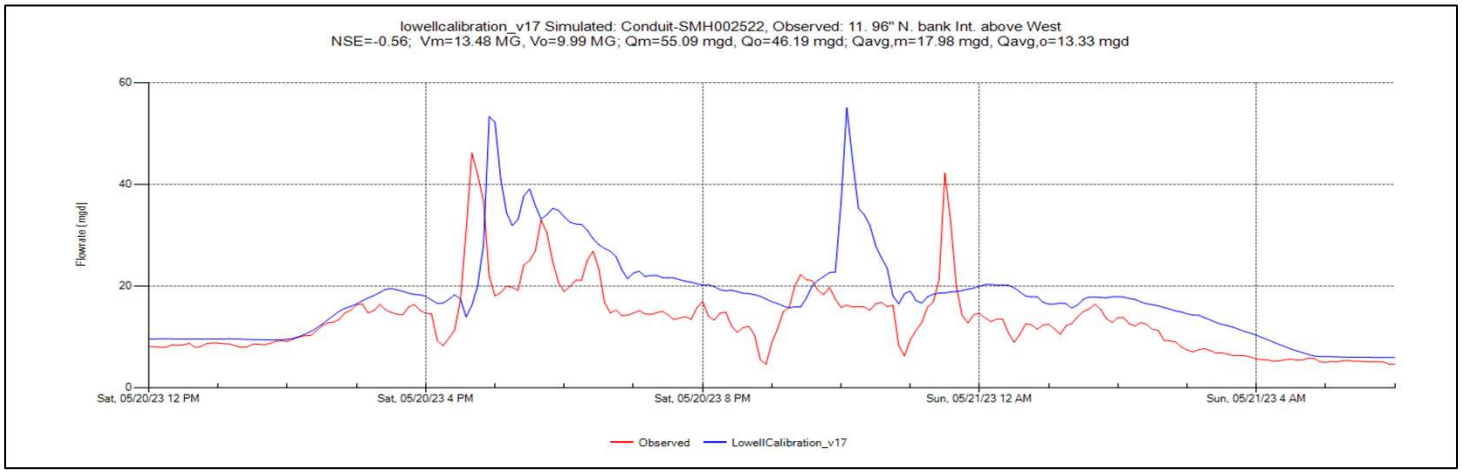


Simulated Versus Observed Flow at Flow Meter Sites

11-May 20

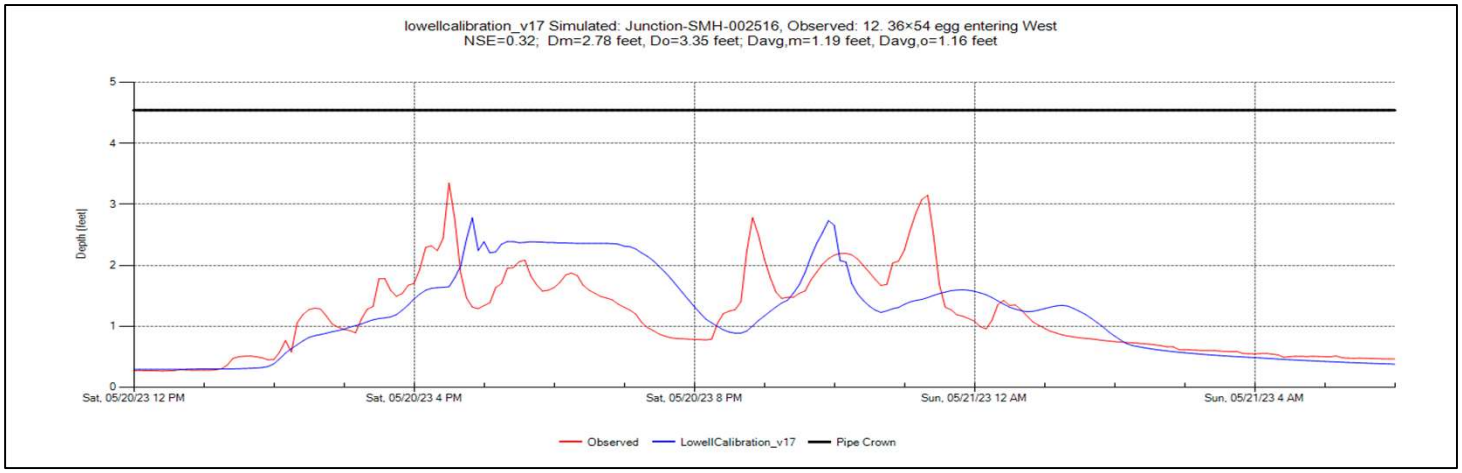


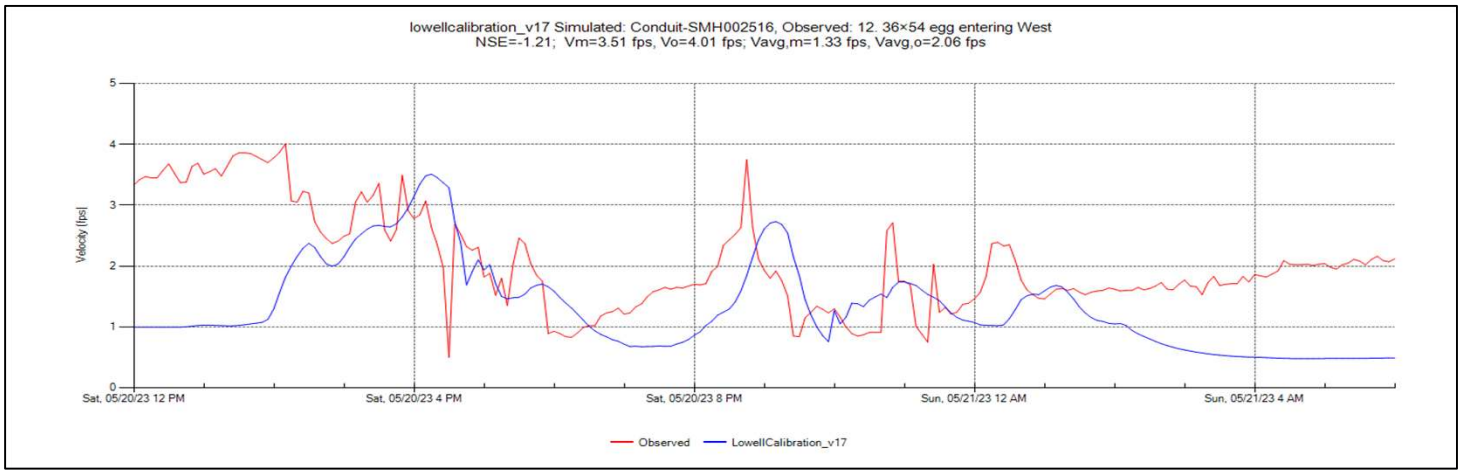


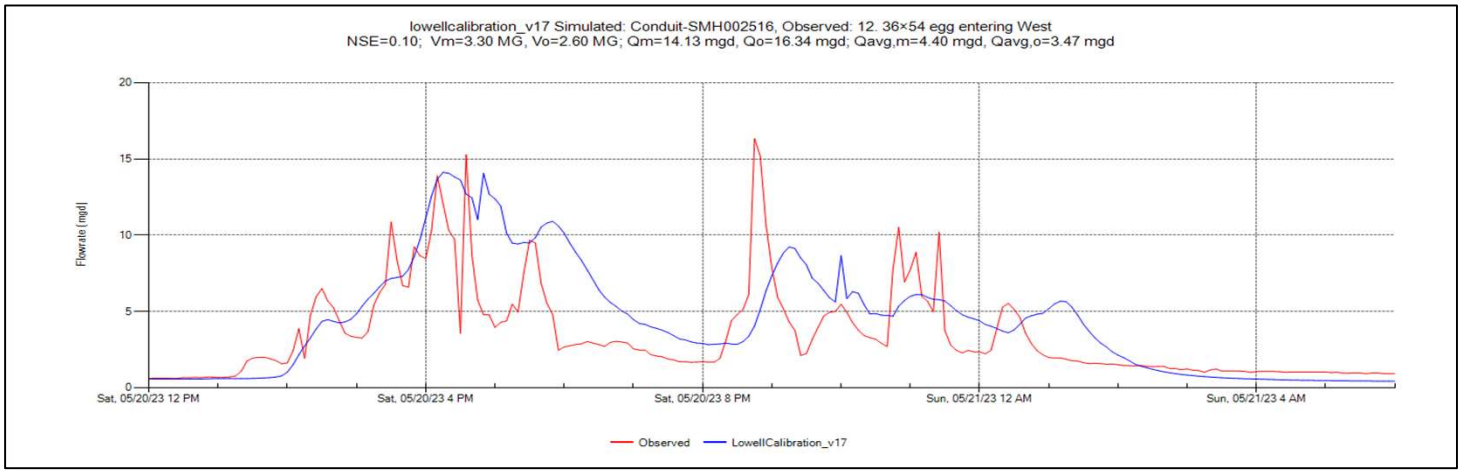


Simulated Versus Observed Flow at Flow Meter Sites

12-May 20

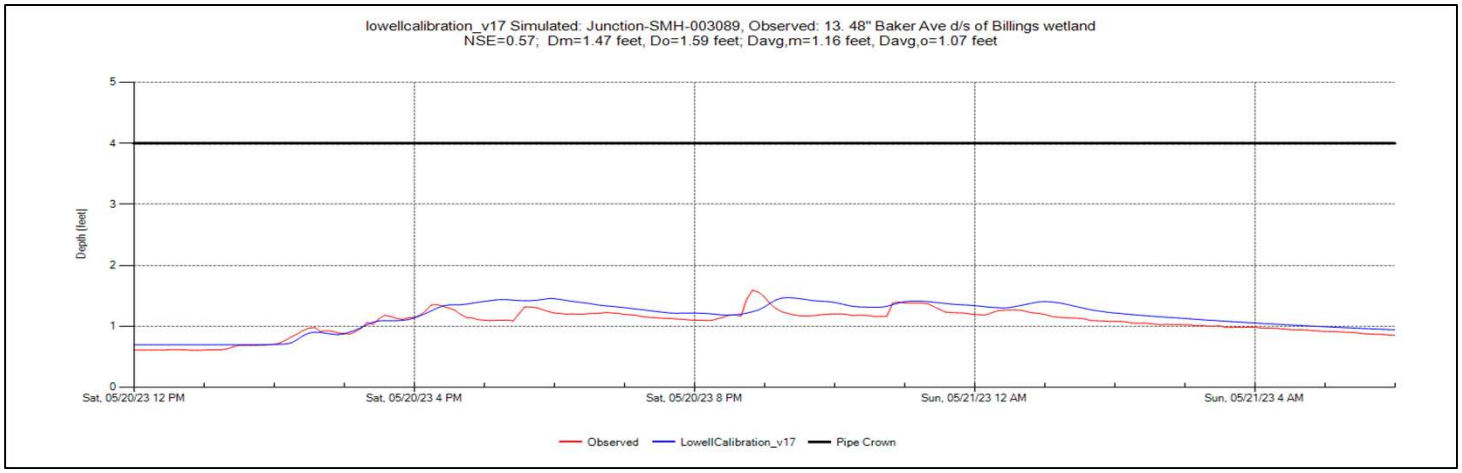


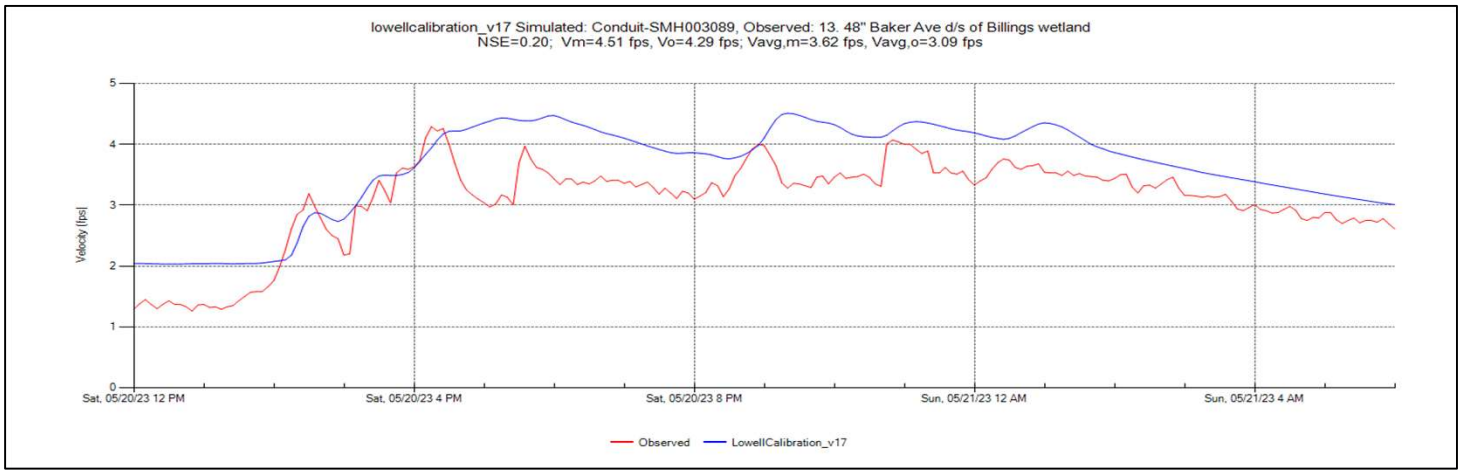


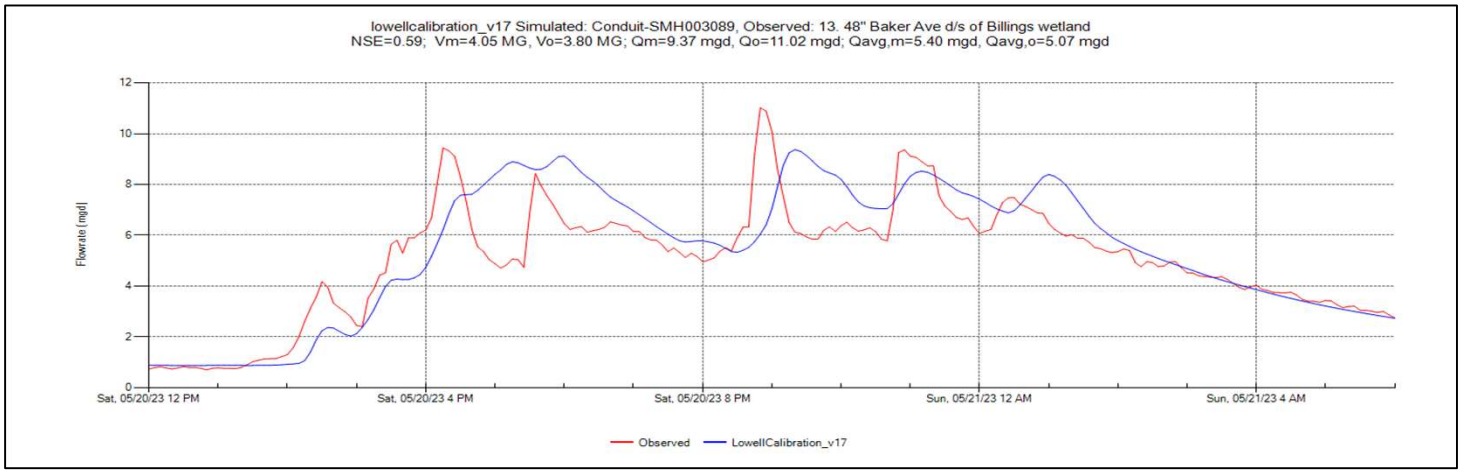


Simulated Versus Observed Flow at Flow Meter Sites

13-May 20

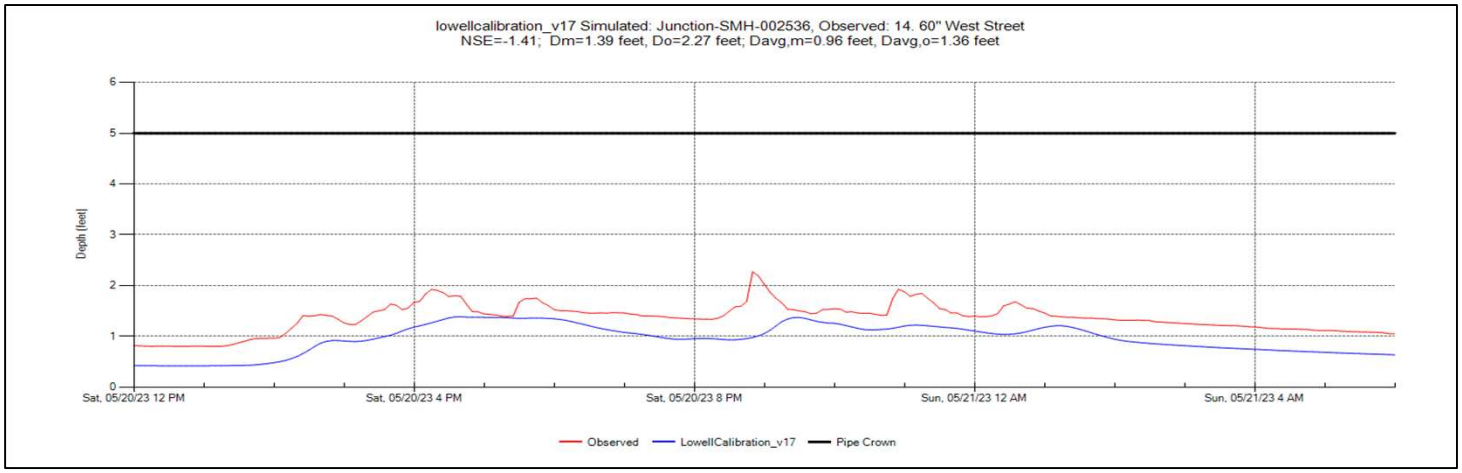


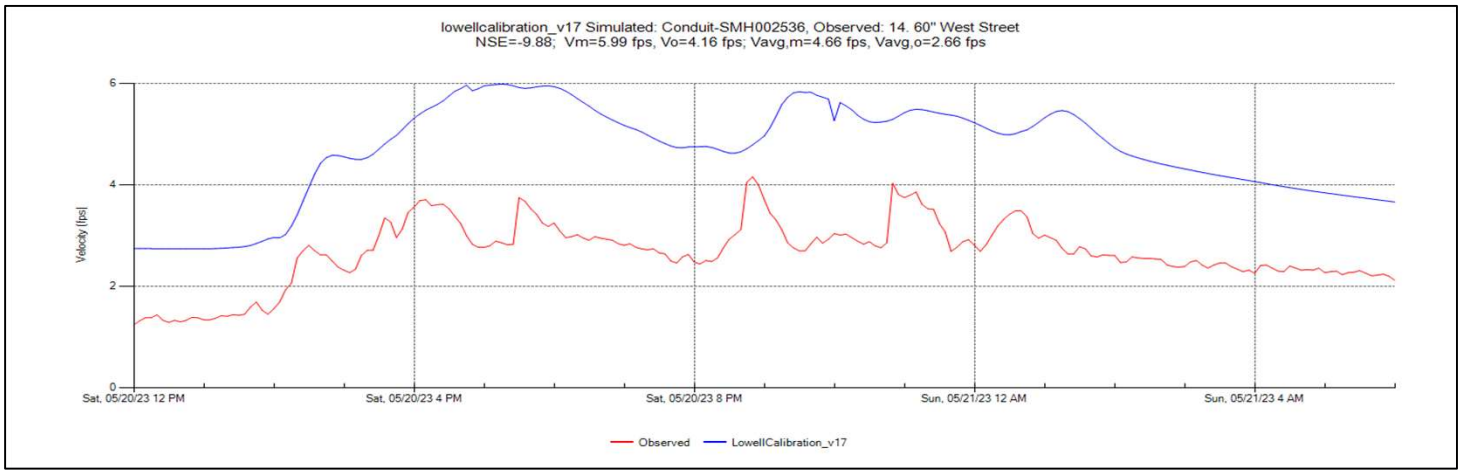


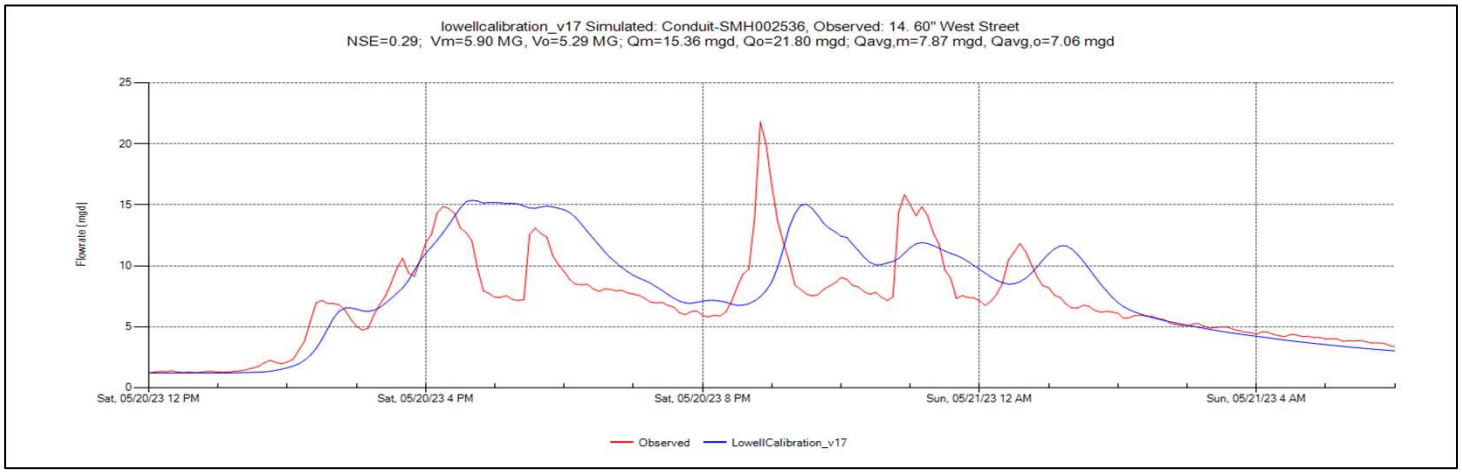


Simulated Versus Observed Flow at Flow Meter Sites

14-May 20

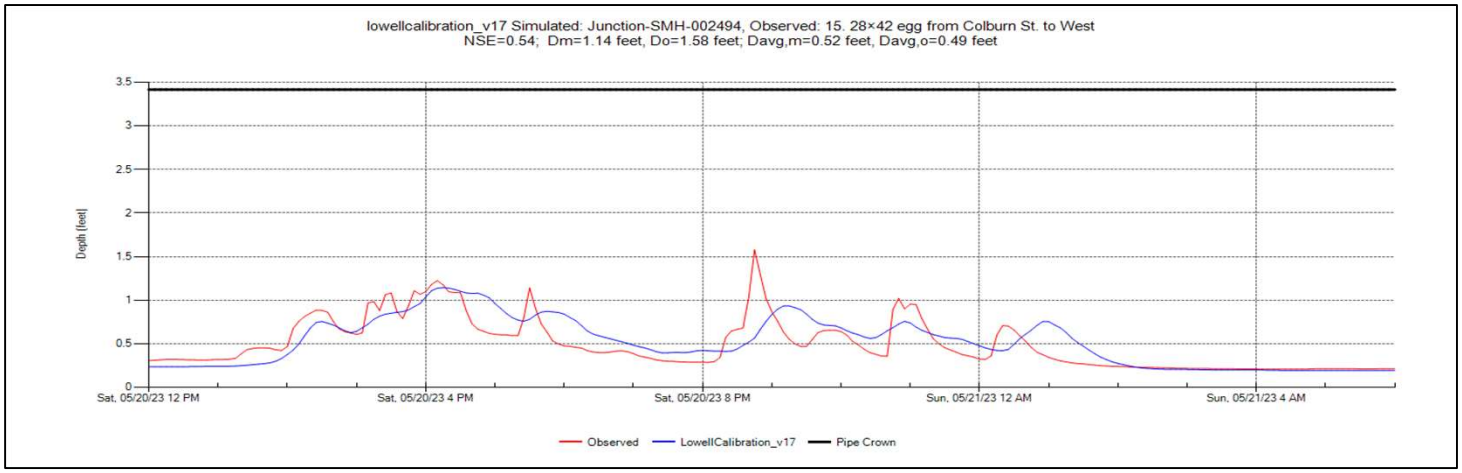


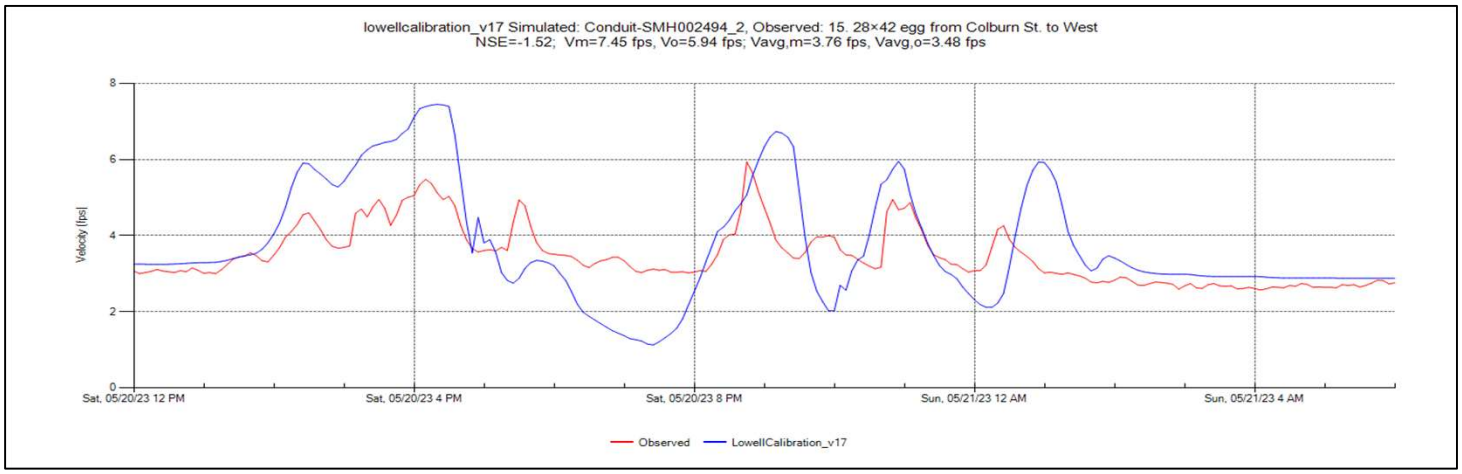


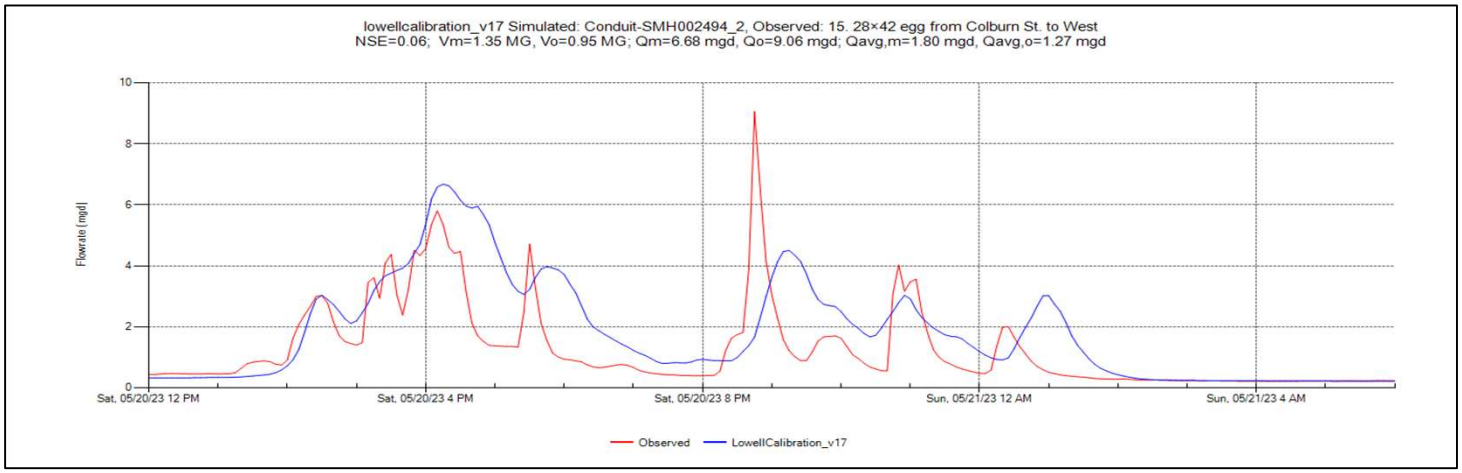


Simulated Versus Observed Flow at Flow Meter Sites

15-May 20

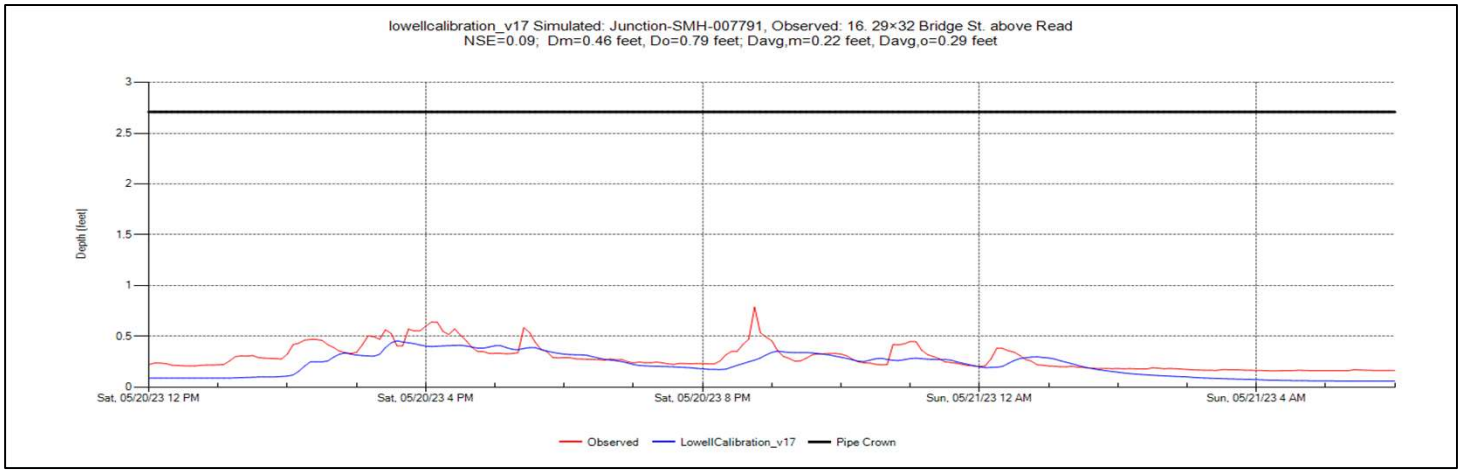


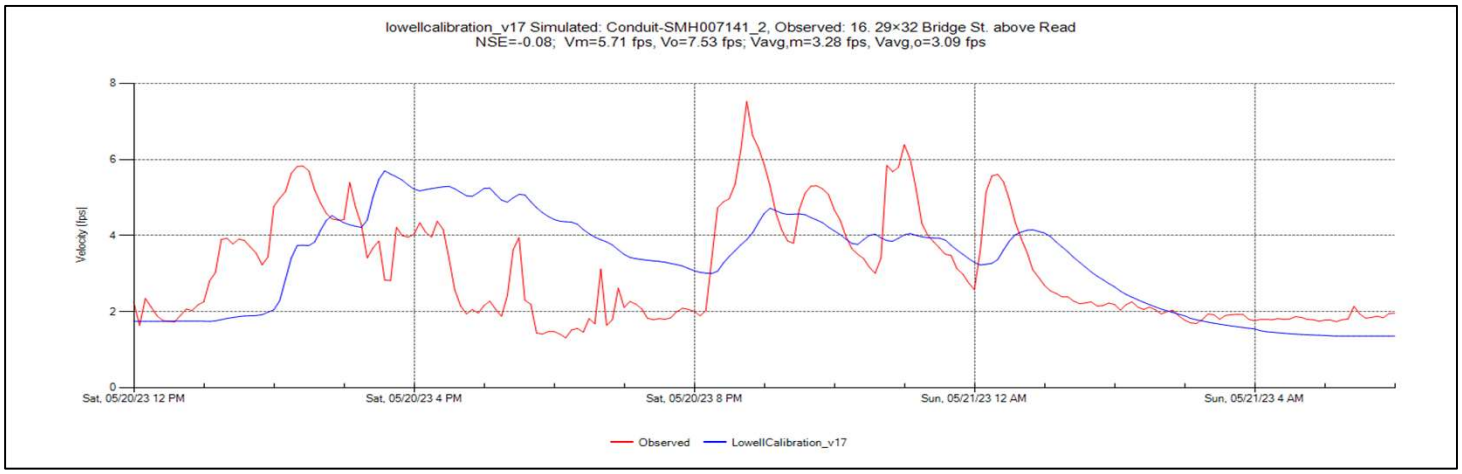


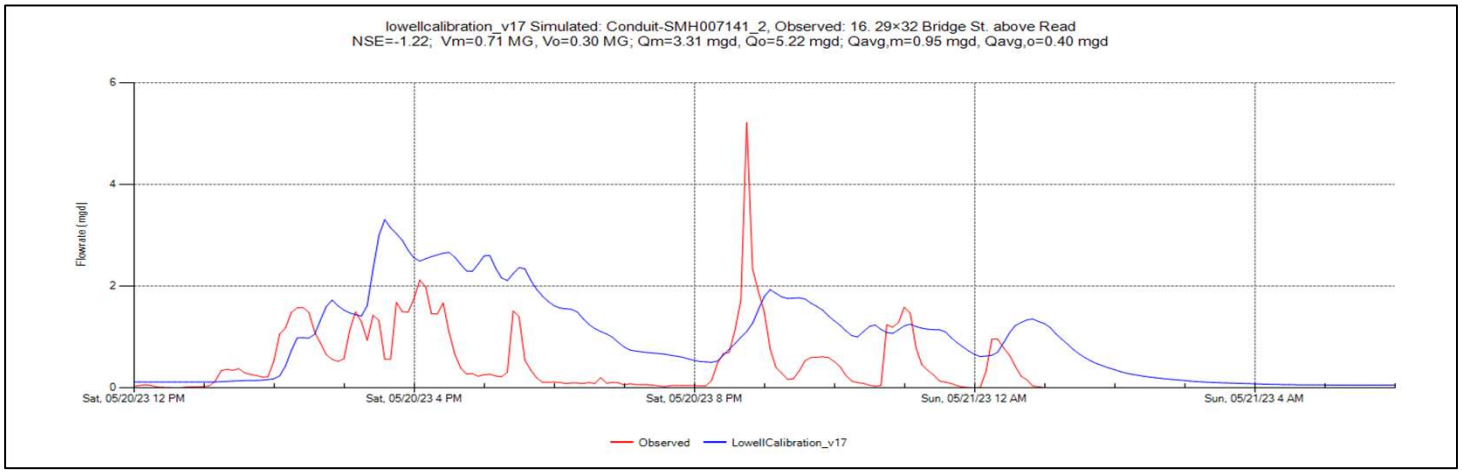


Simulated Versus Observed Flow at Flow Meter Sites

16-May 20

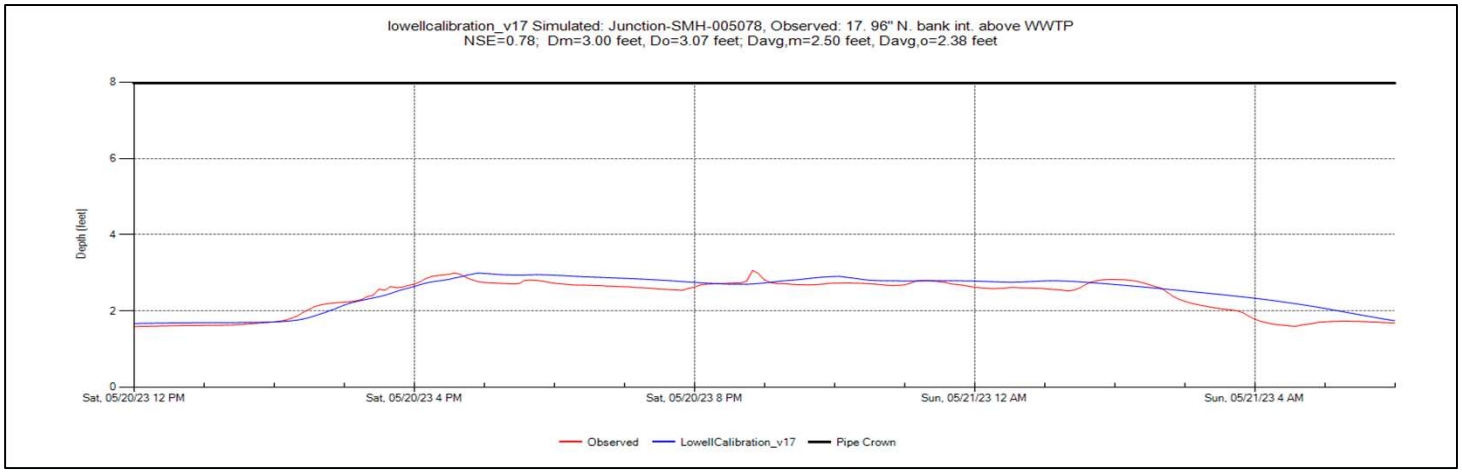


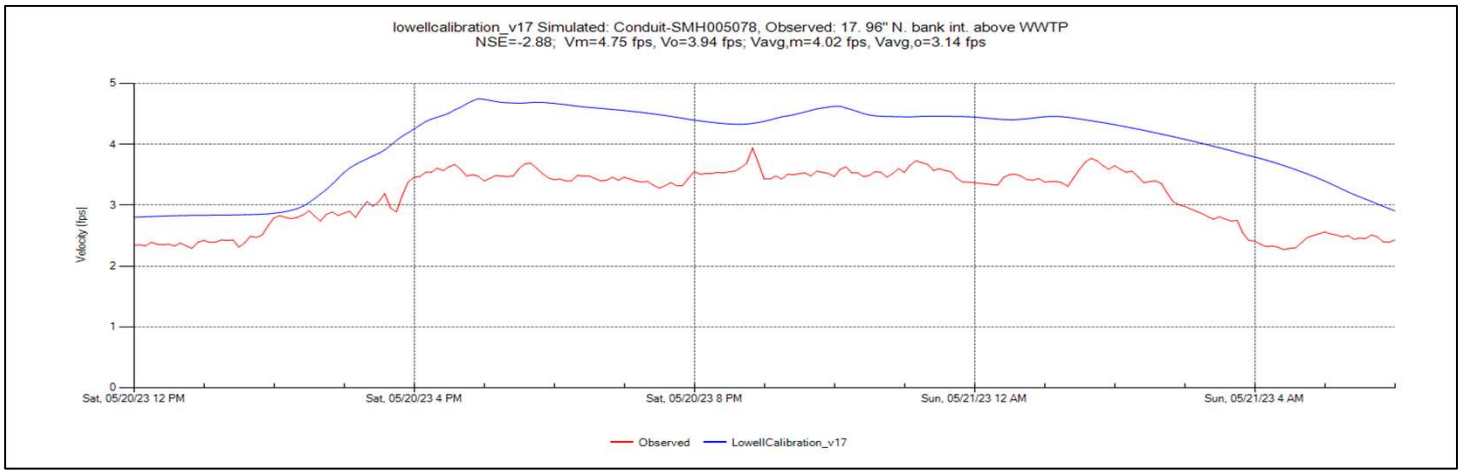


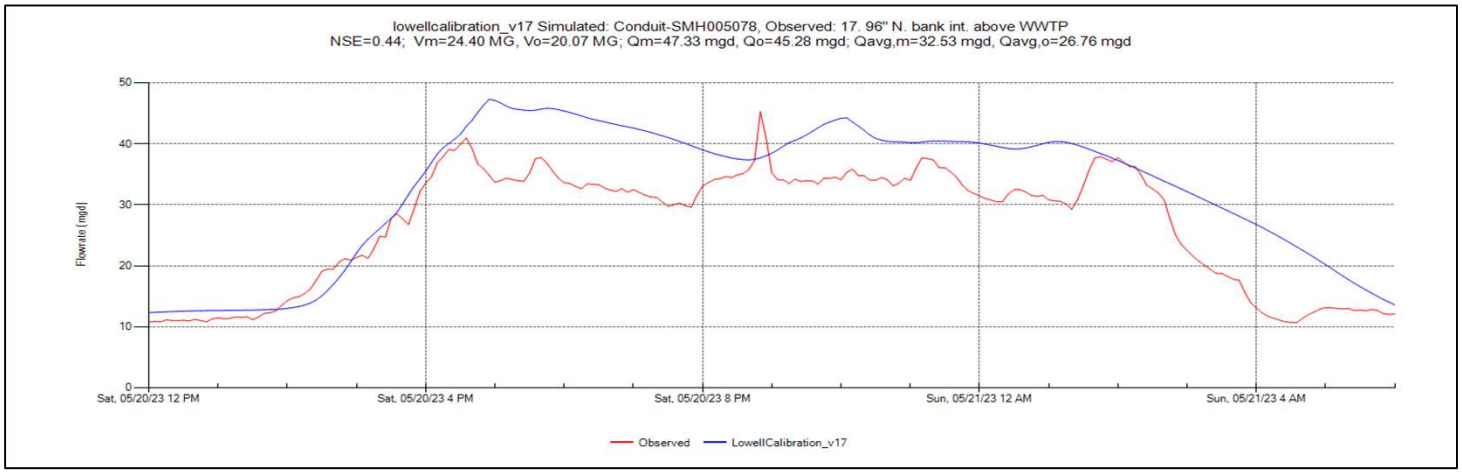


Simulated Versus Observed Flow at Flow Meter Sites

17-May 20

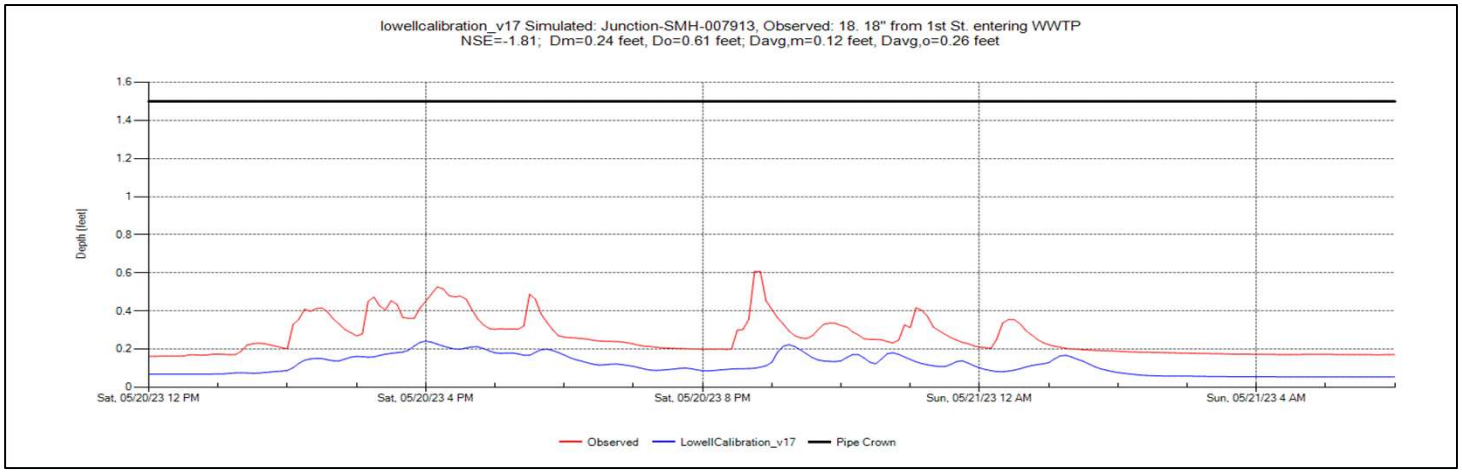


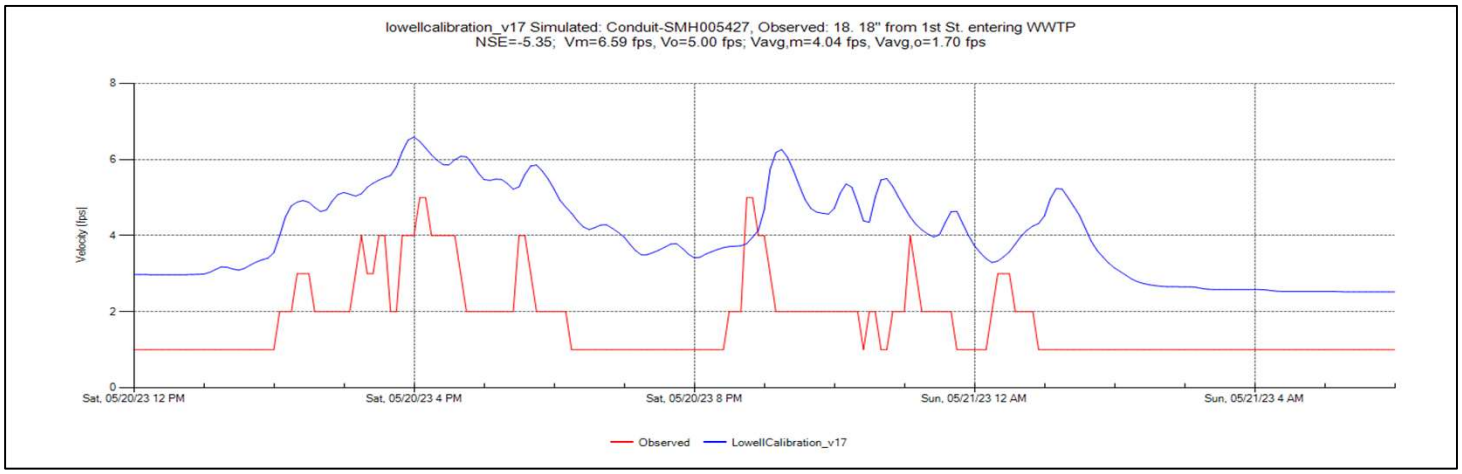


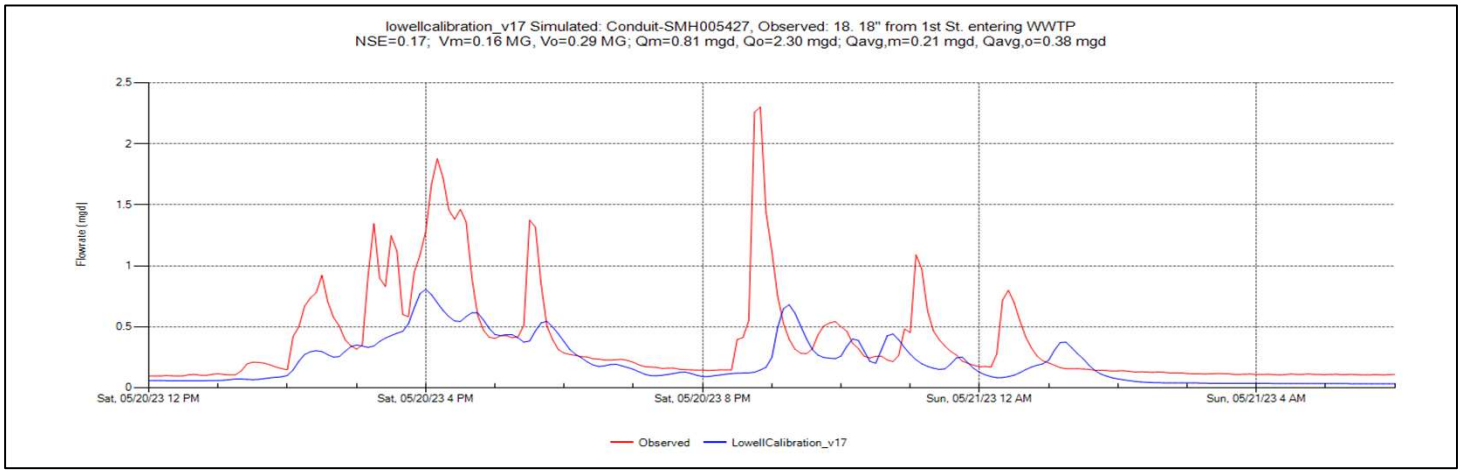


Simulated Versus Observed Flow at Flow Meter Sites

18-May 20

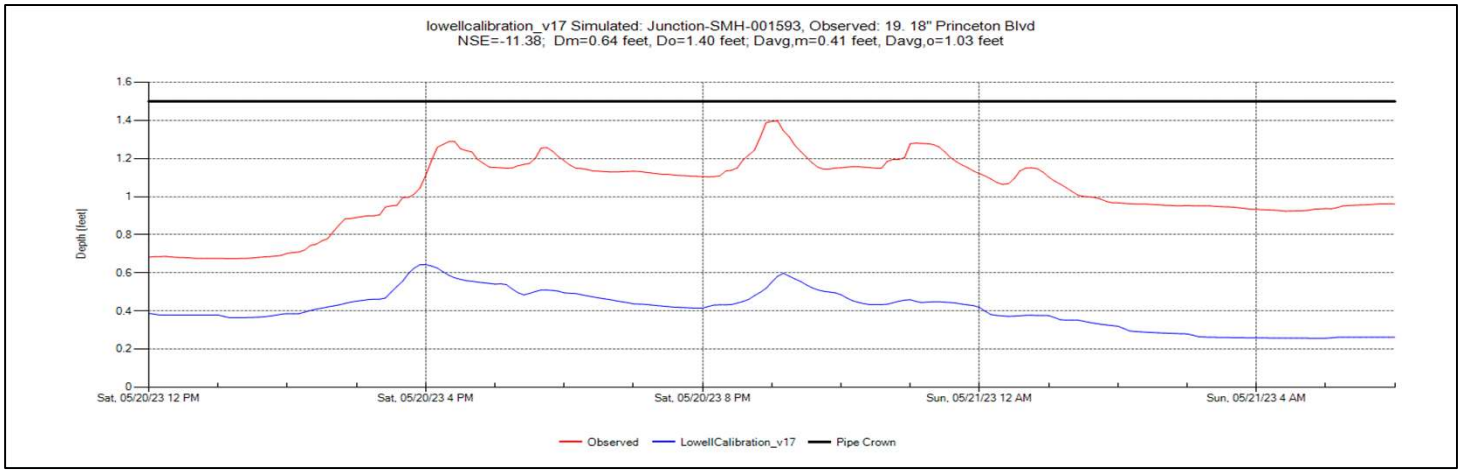


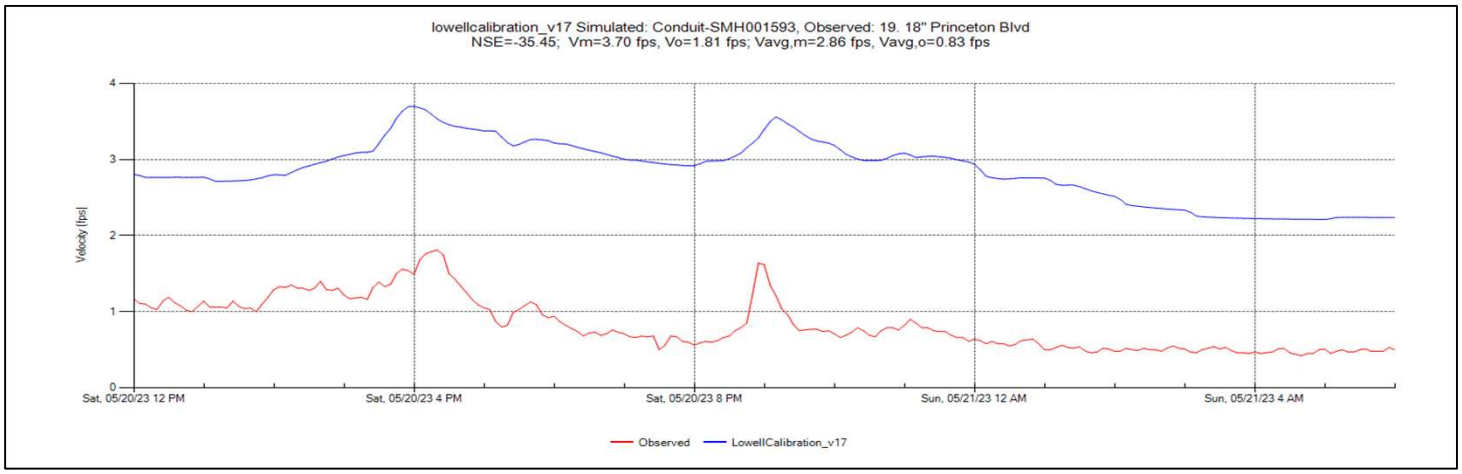


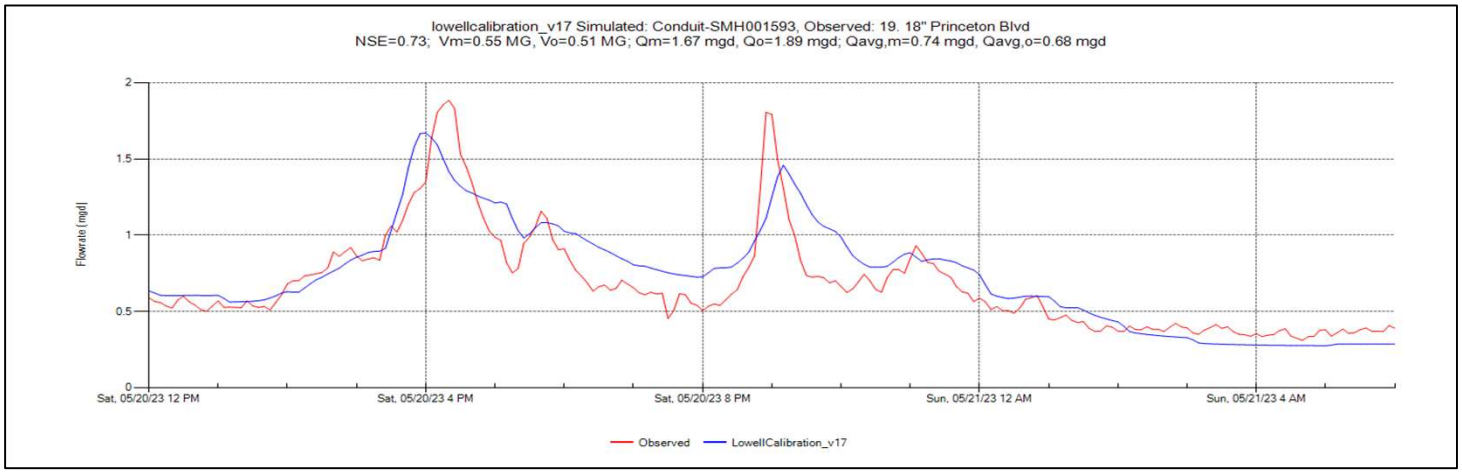


Simulated Versus Observed Flow at Flow Meter Sites

19-May 20

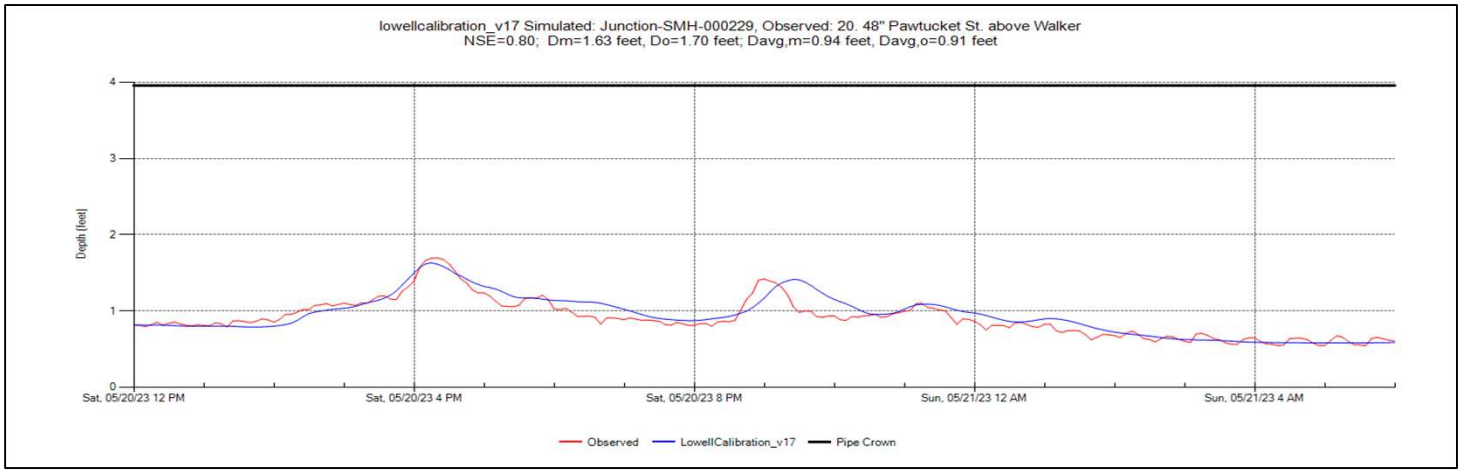


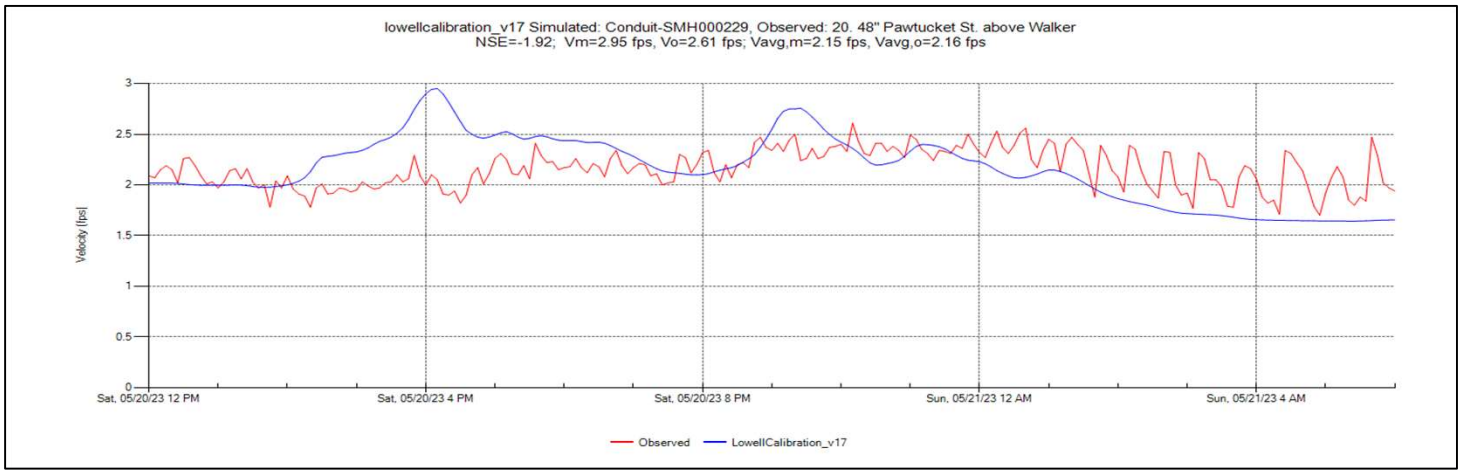


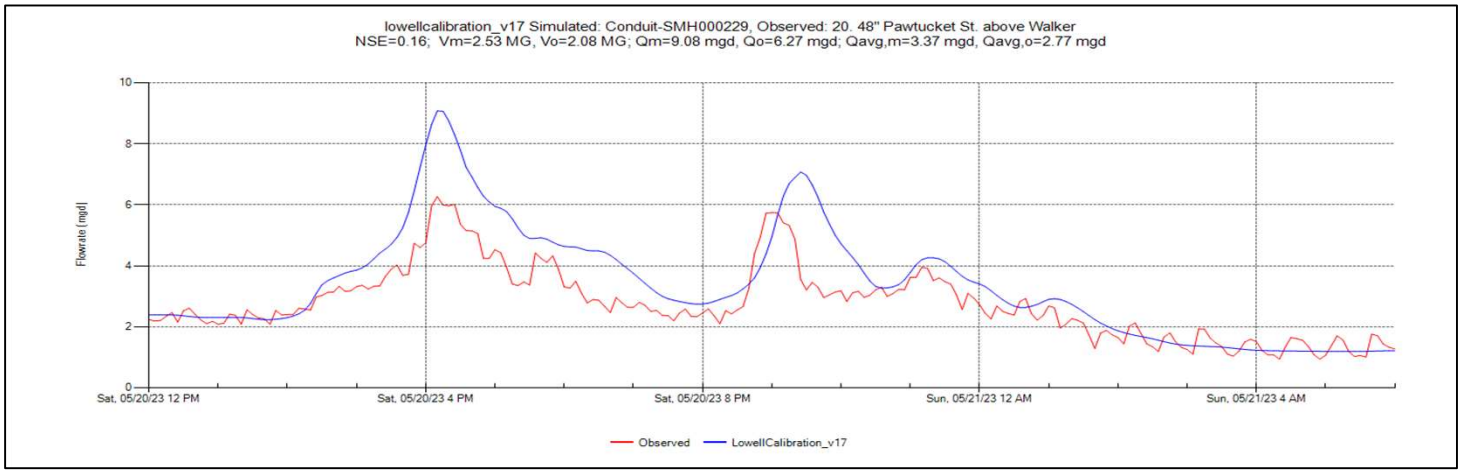


Simulated Versus Observed Flow at Flow Meter Sites

20-May 20

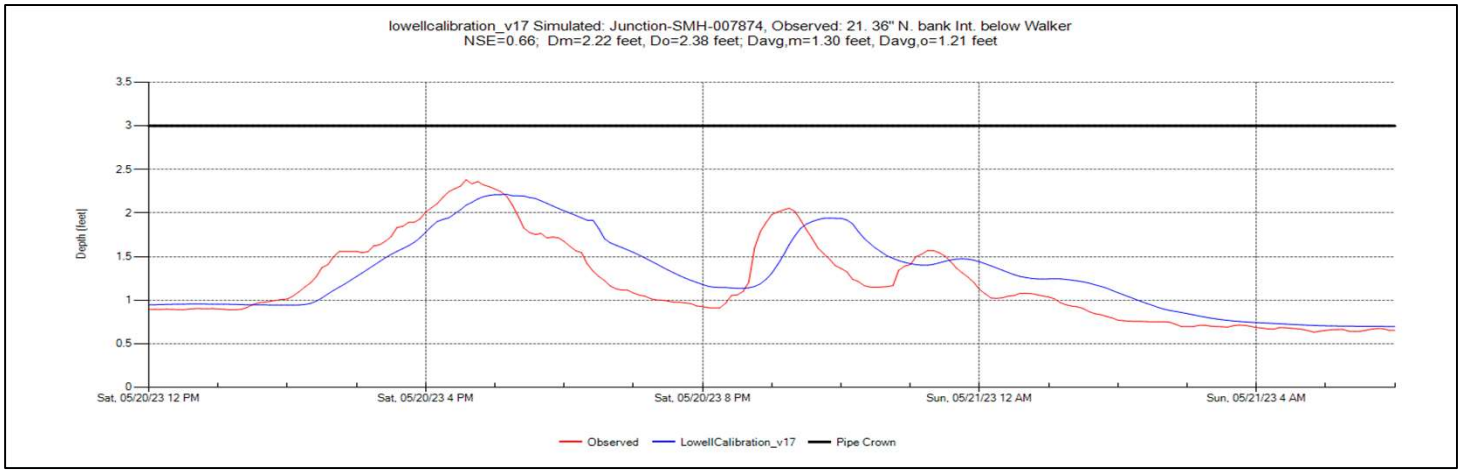


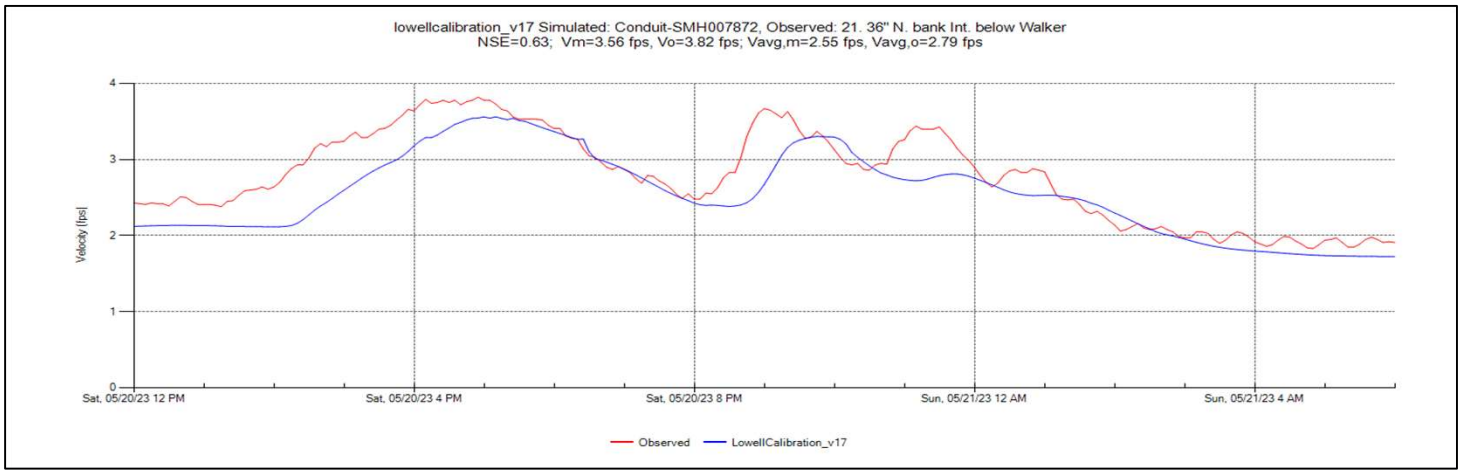


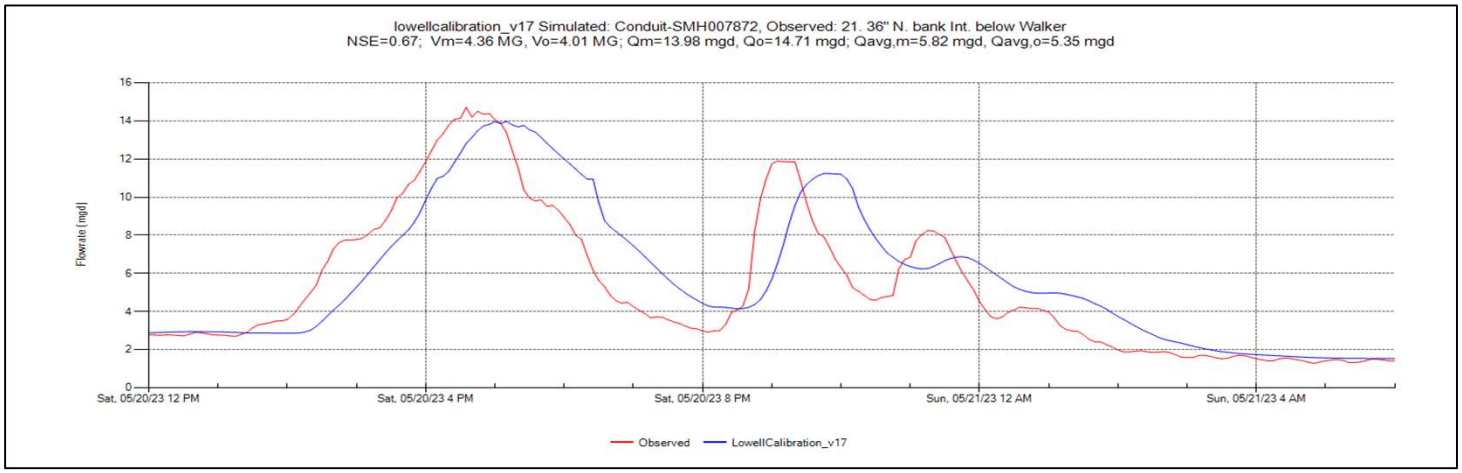


Simulated Versus Observed Flow at Flow Meter Sites

21-May 20

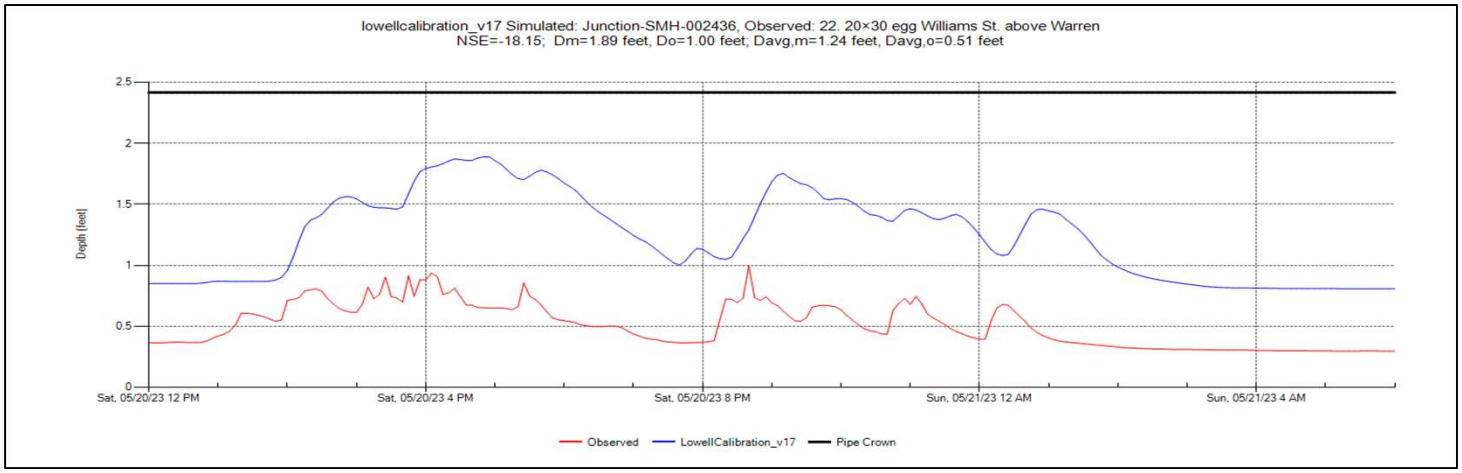


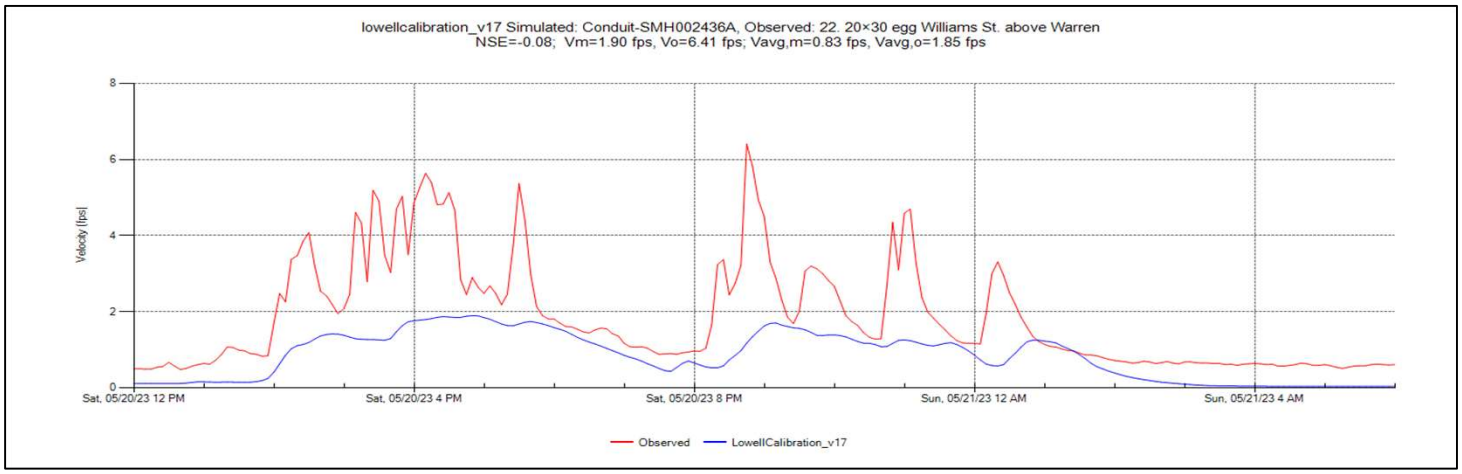


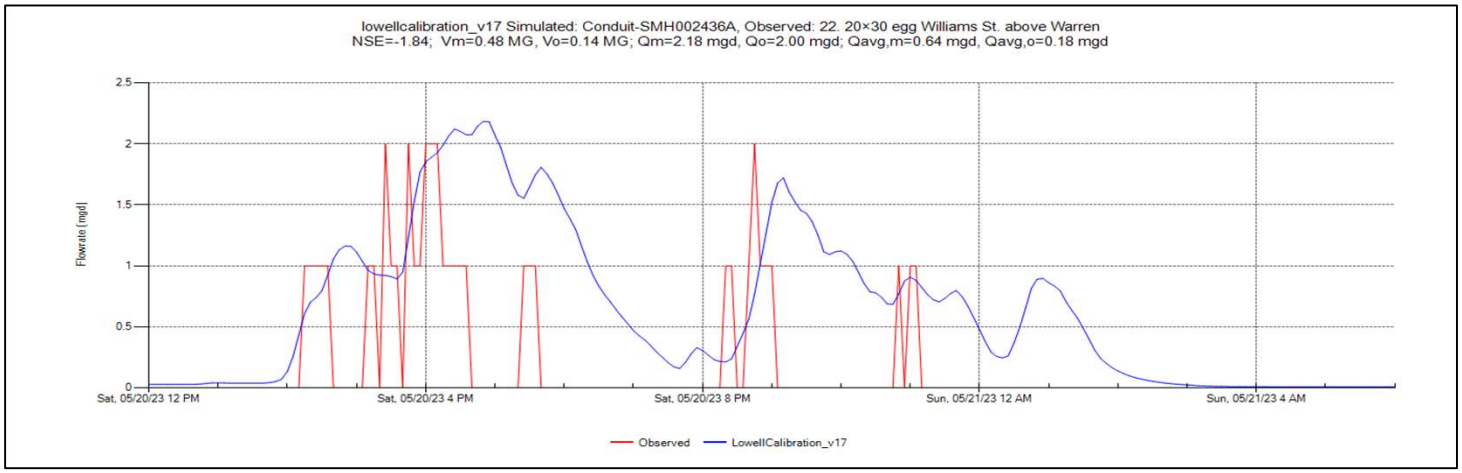


Simulated Versus Observed Flow at Flow Meter Sites

22-May 20

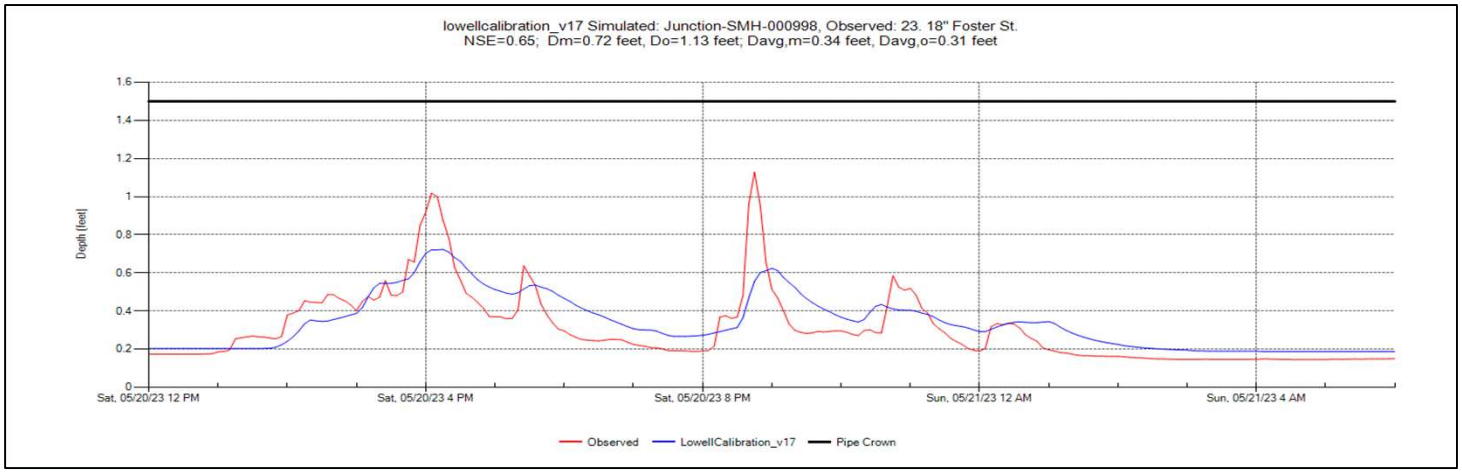


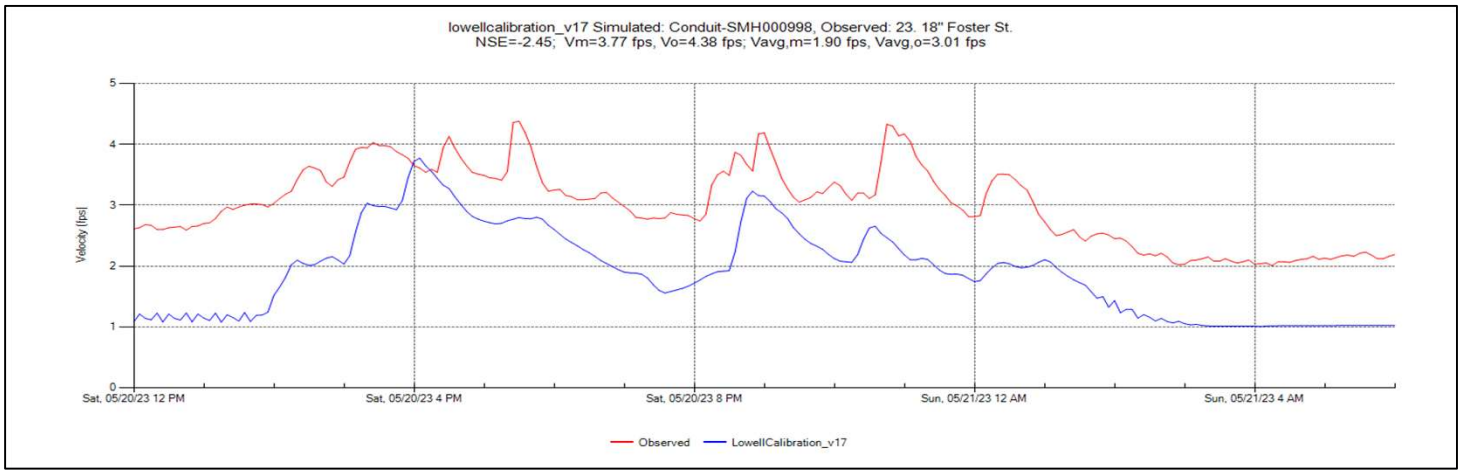


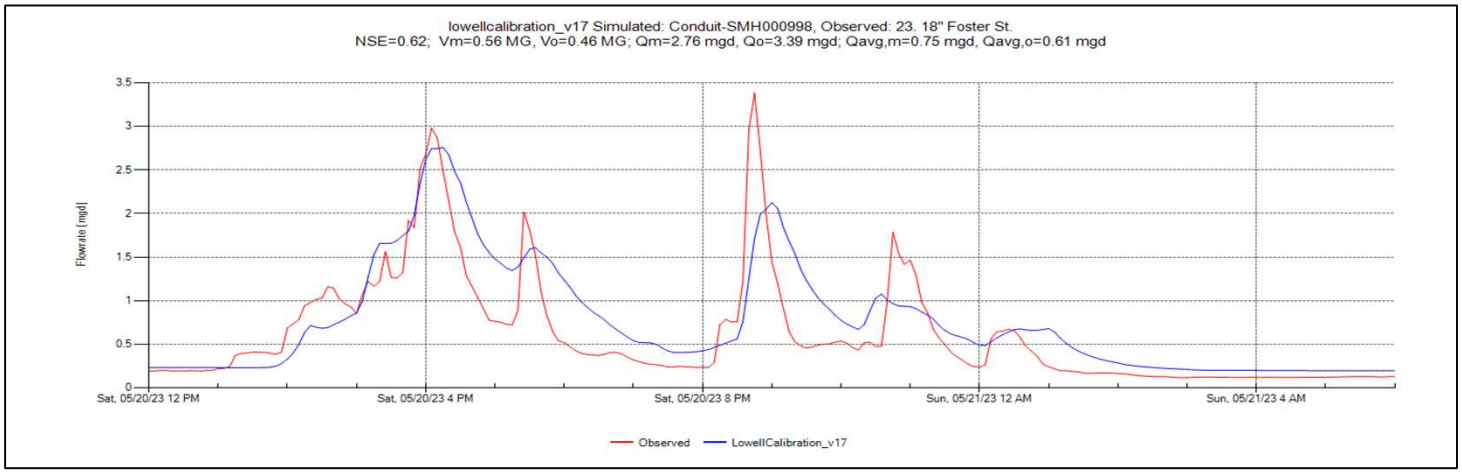


Simulated Versus Observed Flow at Flow Meter Sites

23-May 20

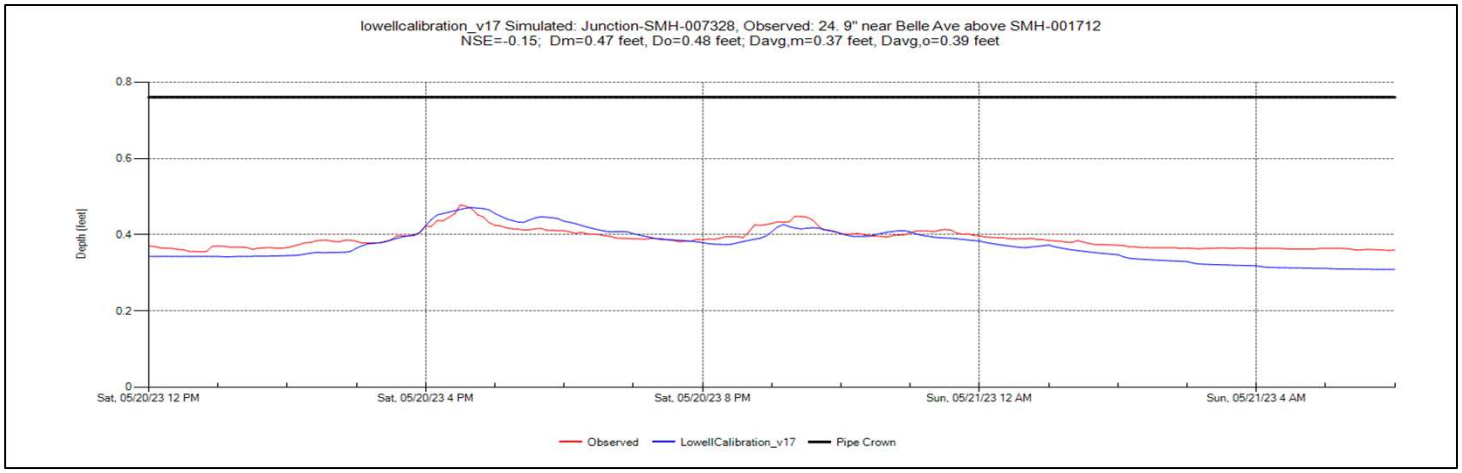


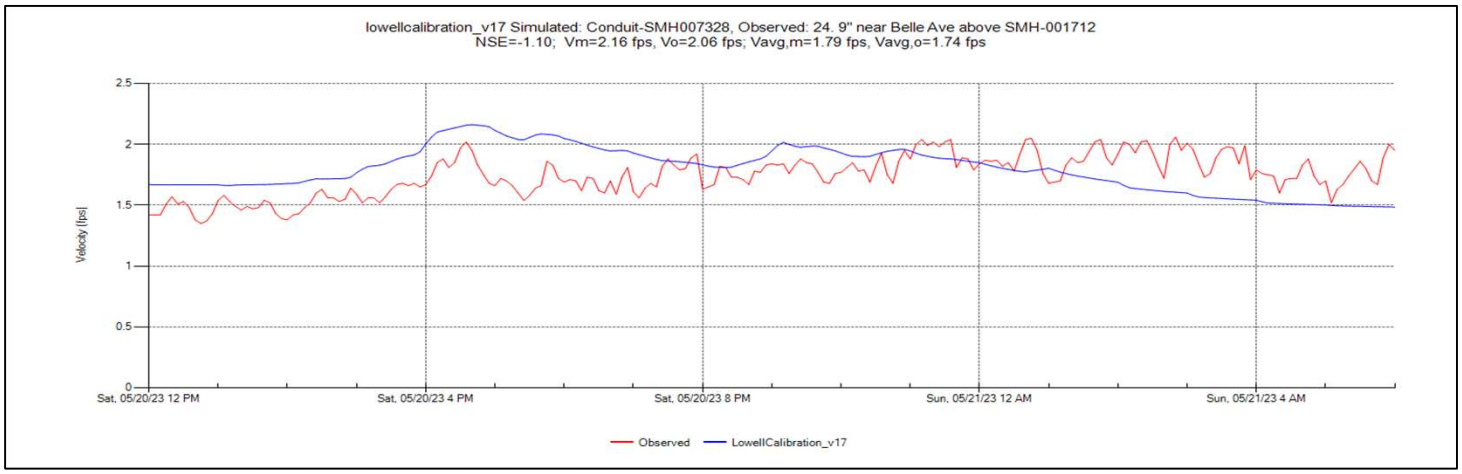


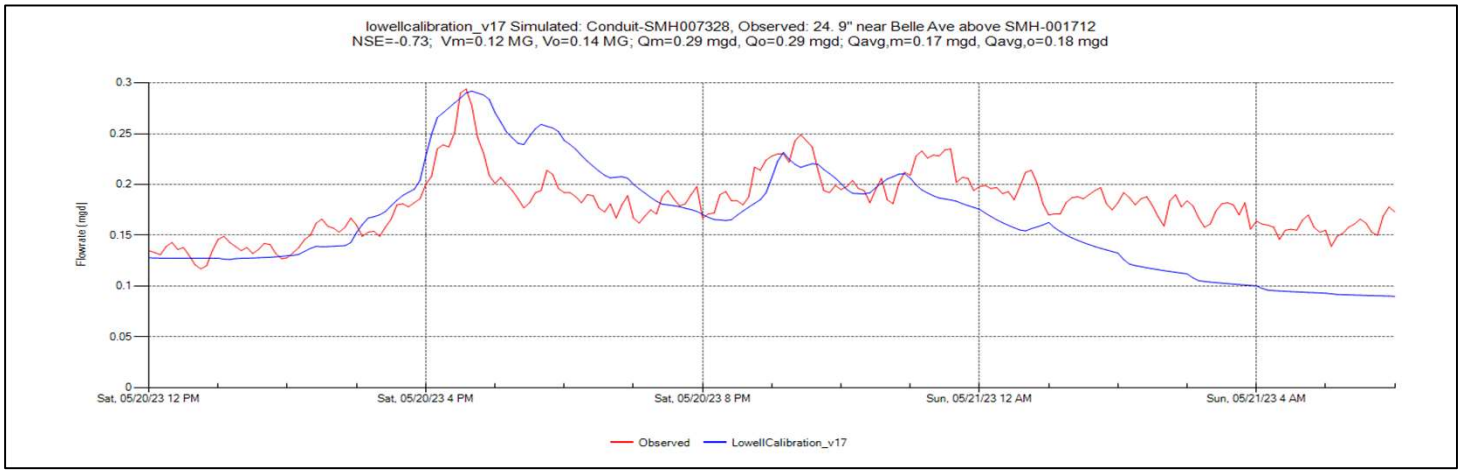


Simulated Versus Observed Flow at Flow Meter Sites

24-May 20

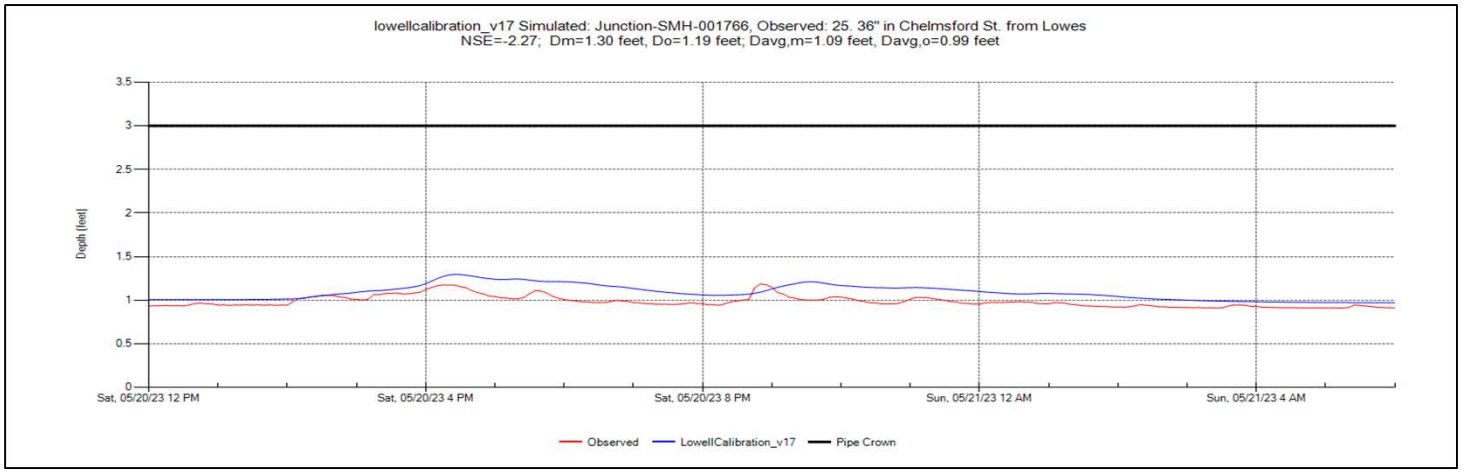


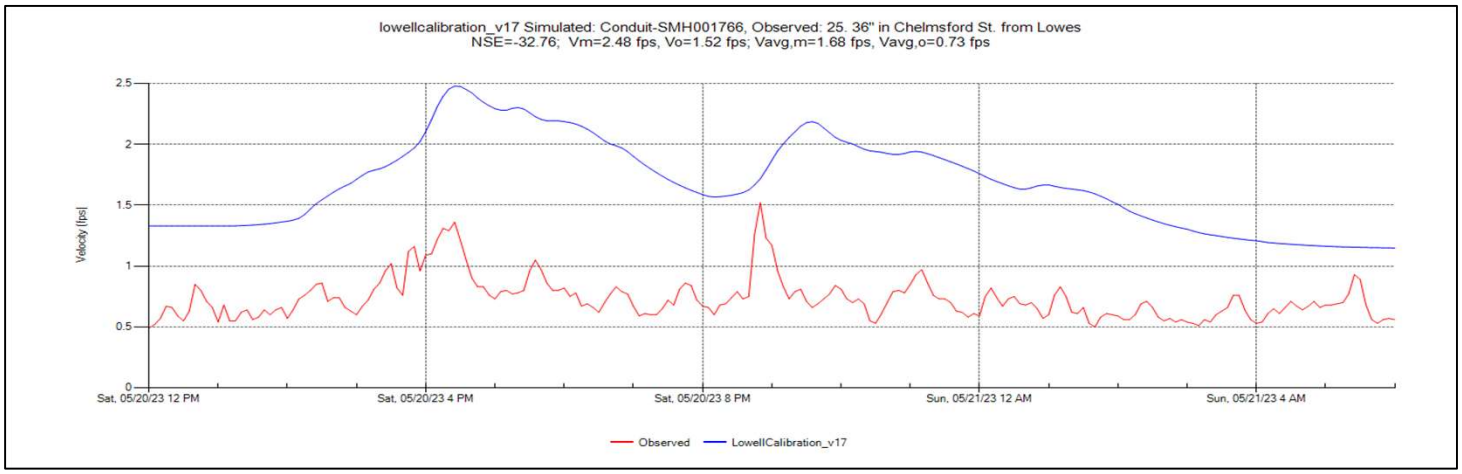


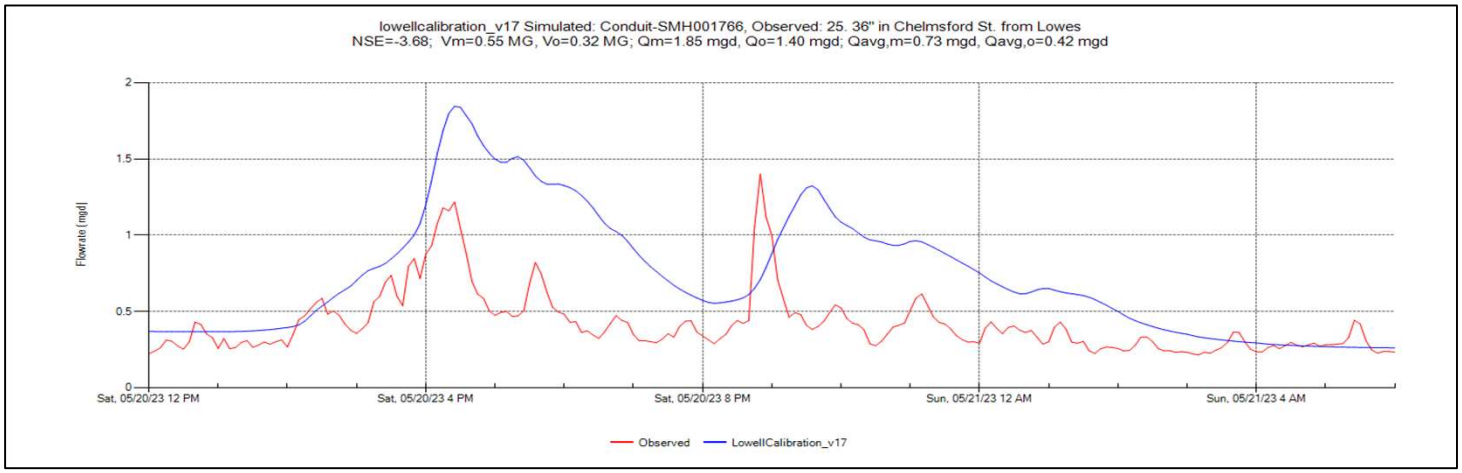


Simulated Versus Observed Flow at Flow Meter Sites

25-May 20

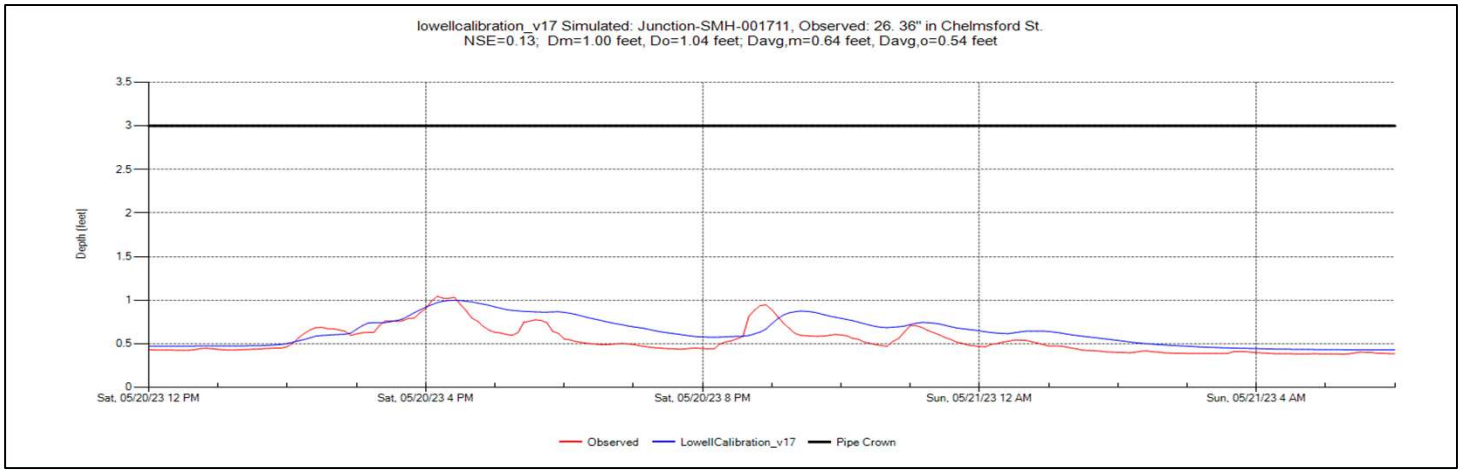


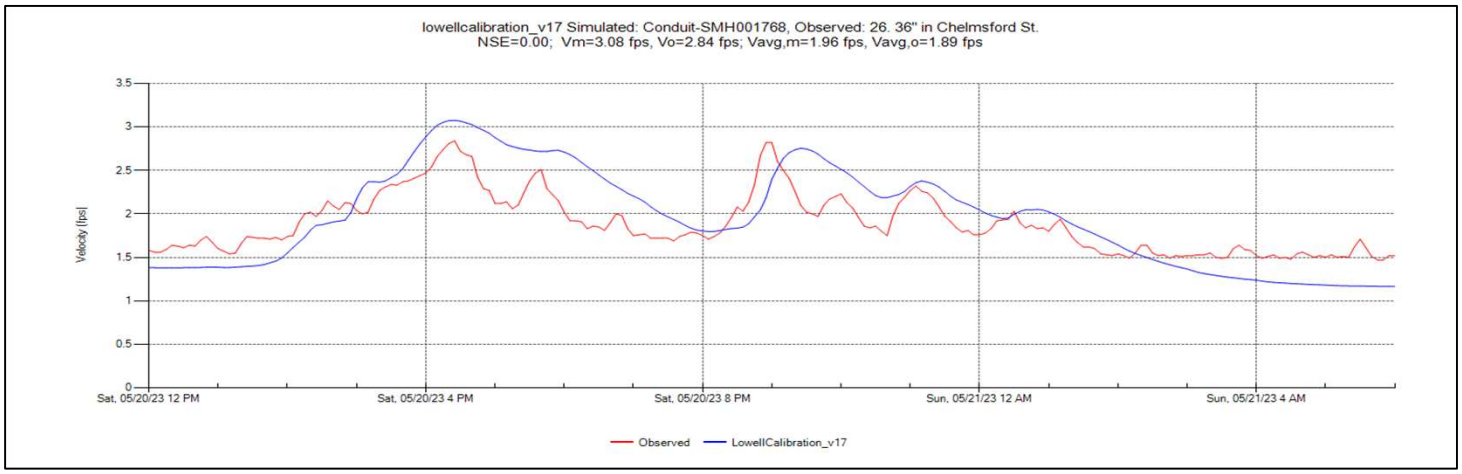


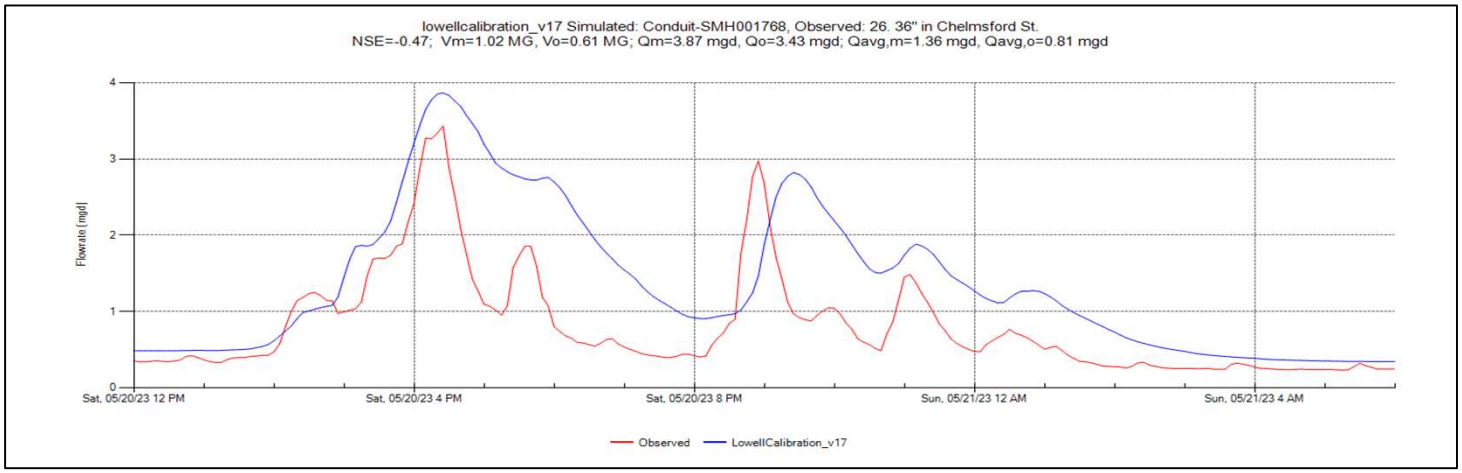


Simulated Versus Observed Flow at Flow Meter Sites

26-May 20

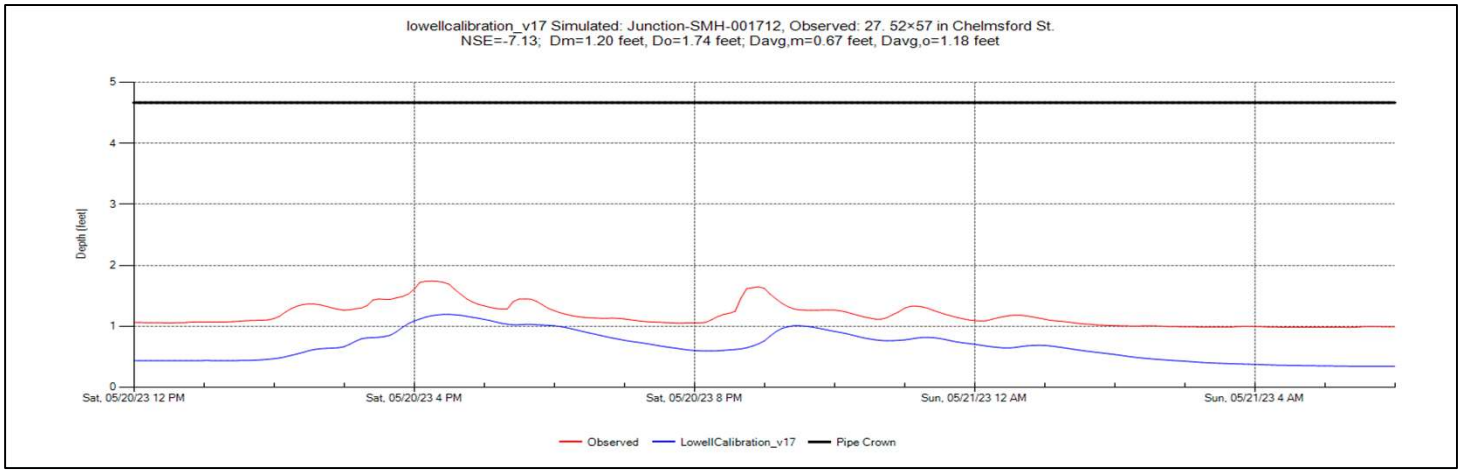


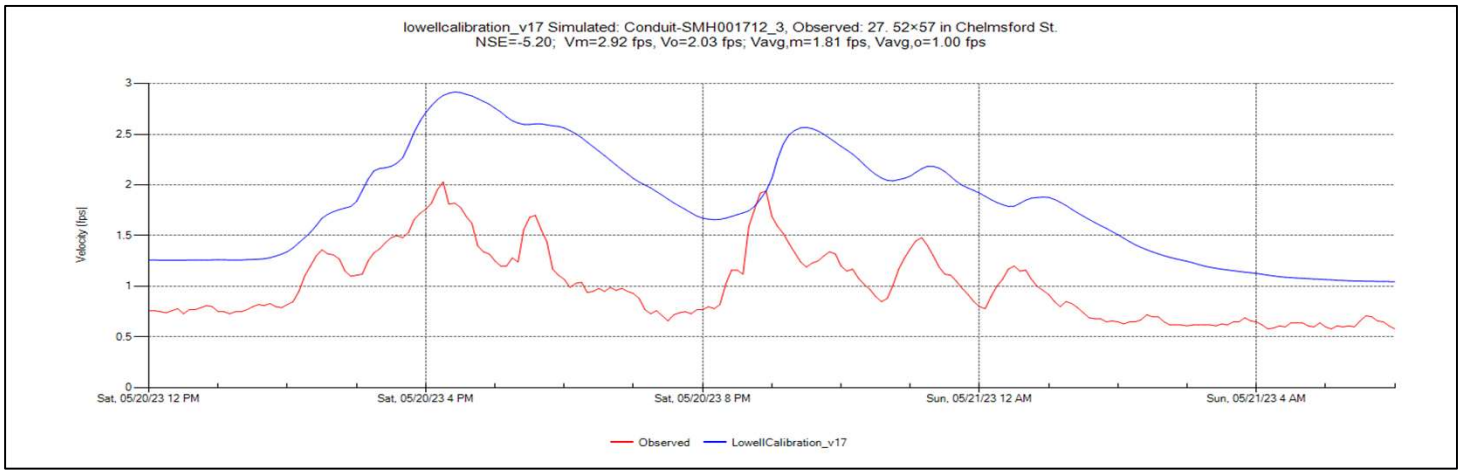


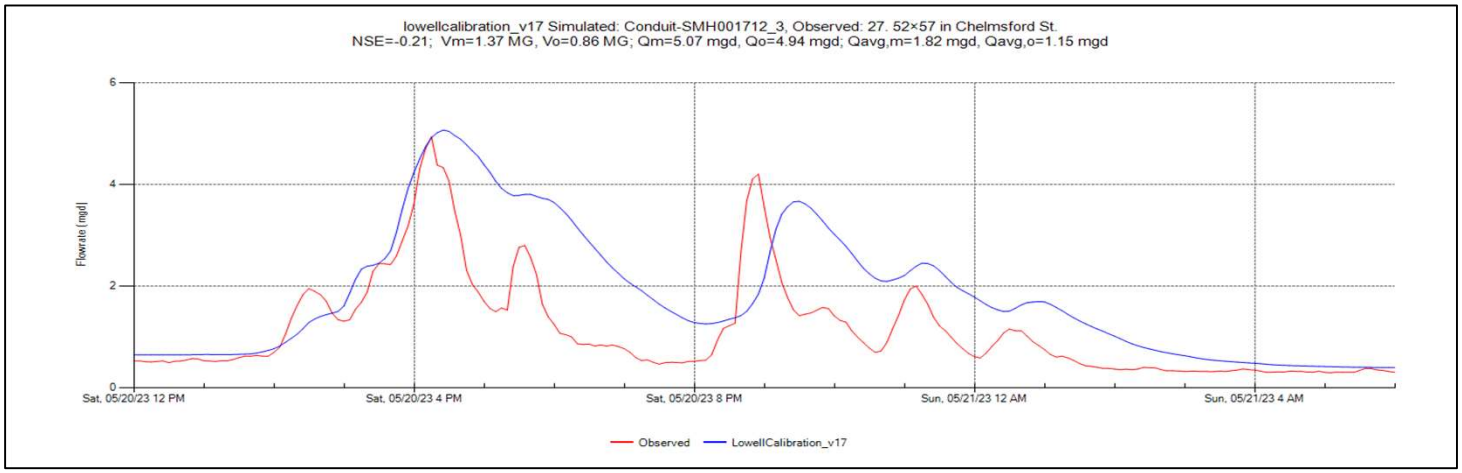


Simulated Versus Observed Flow at Flow Meter Sites

27-May 20

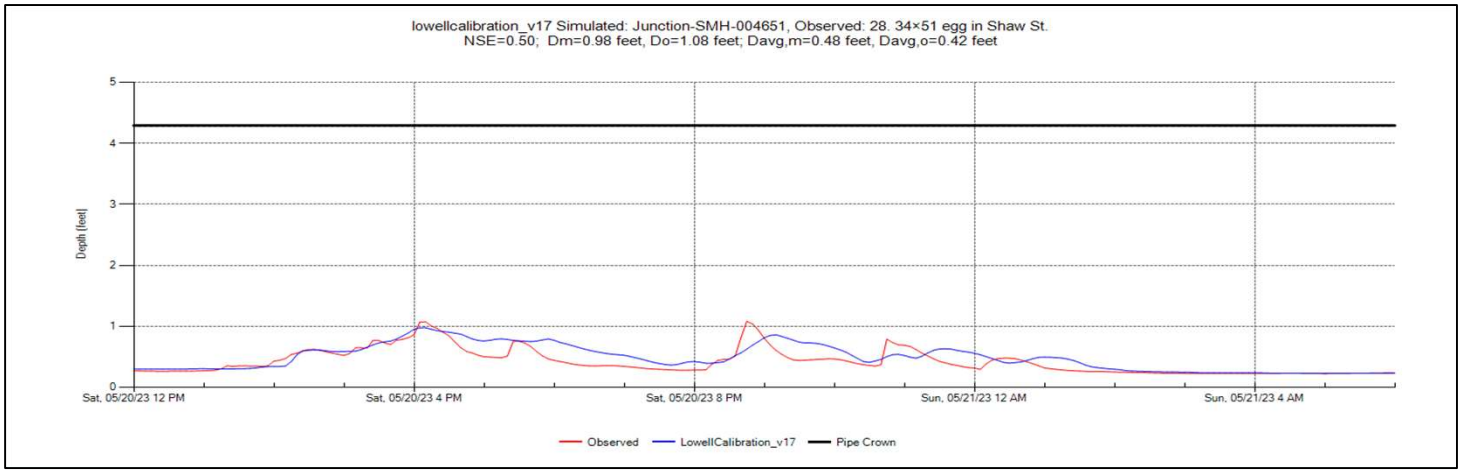


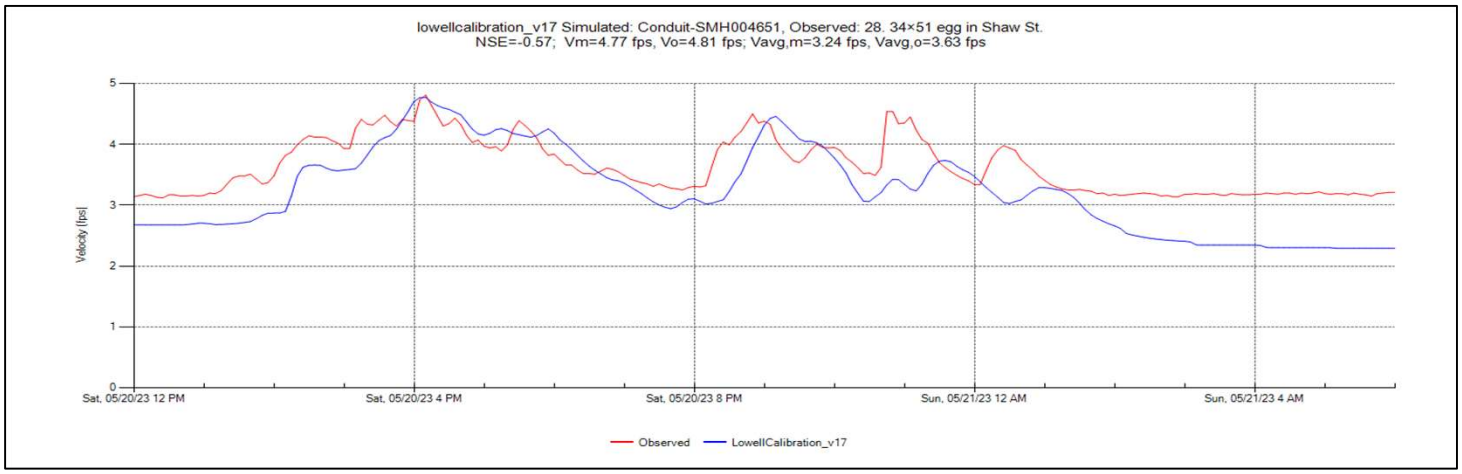


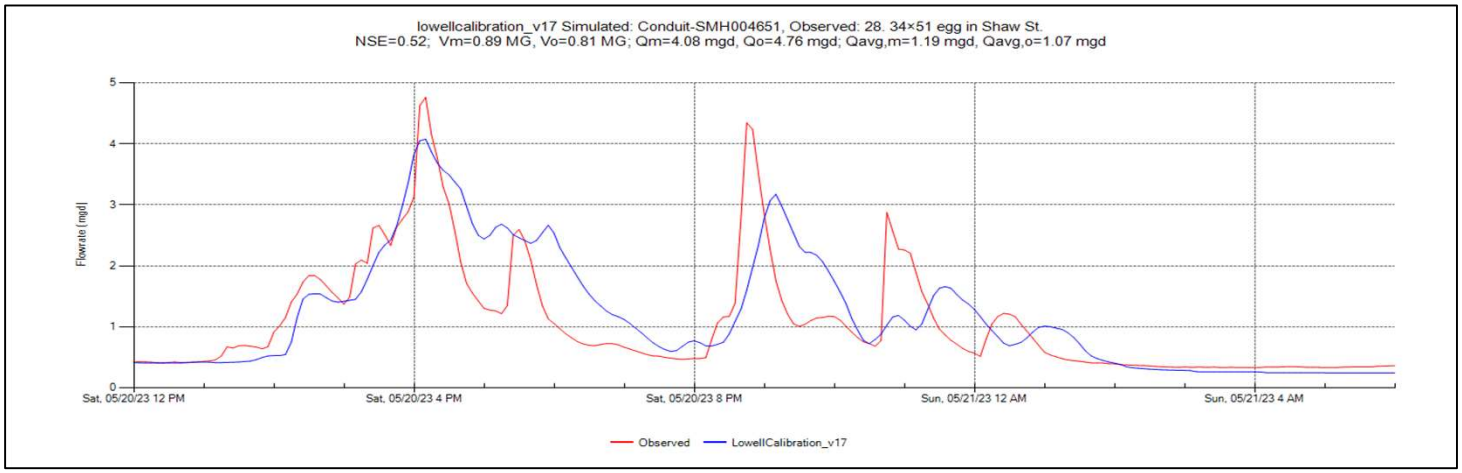


Simulated Versus Observed Flow at Flow Meter Sites

28-May 20

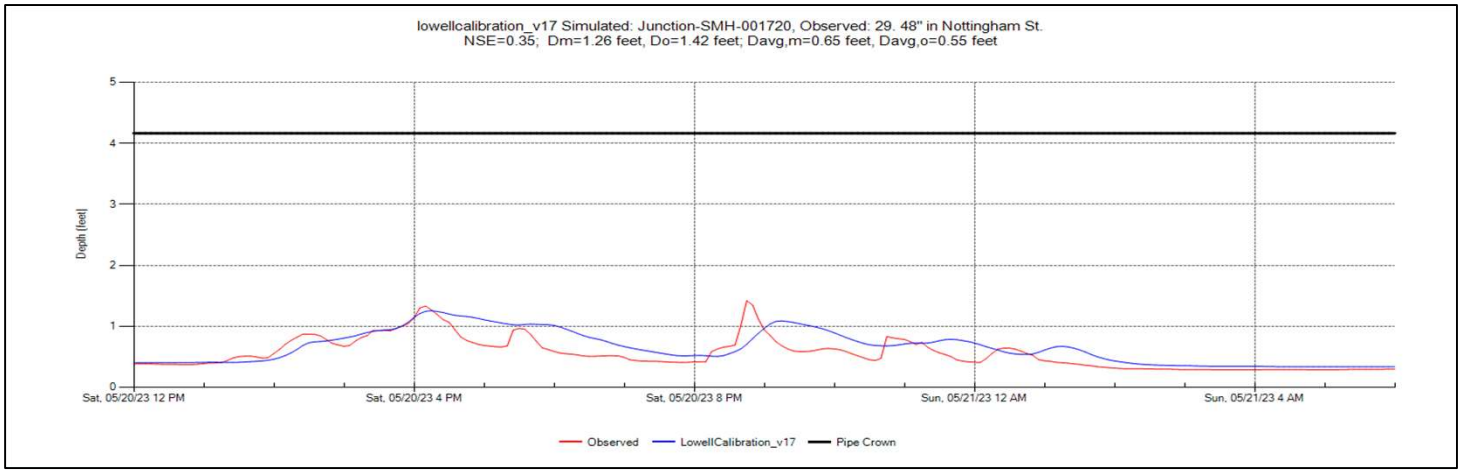


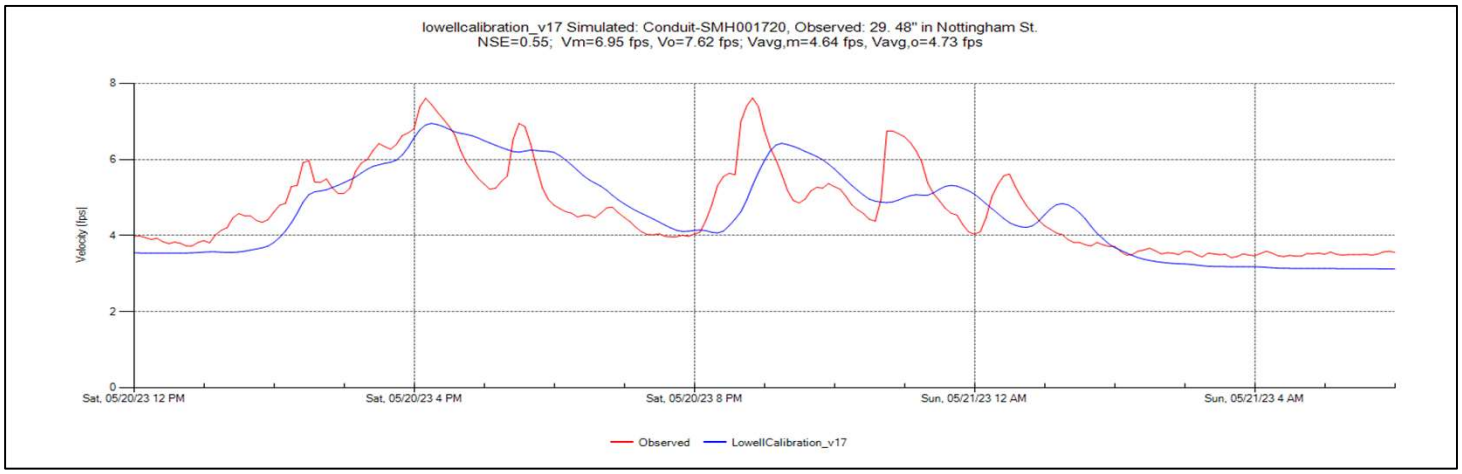


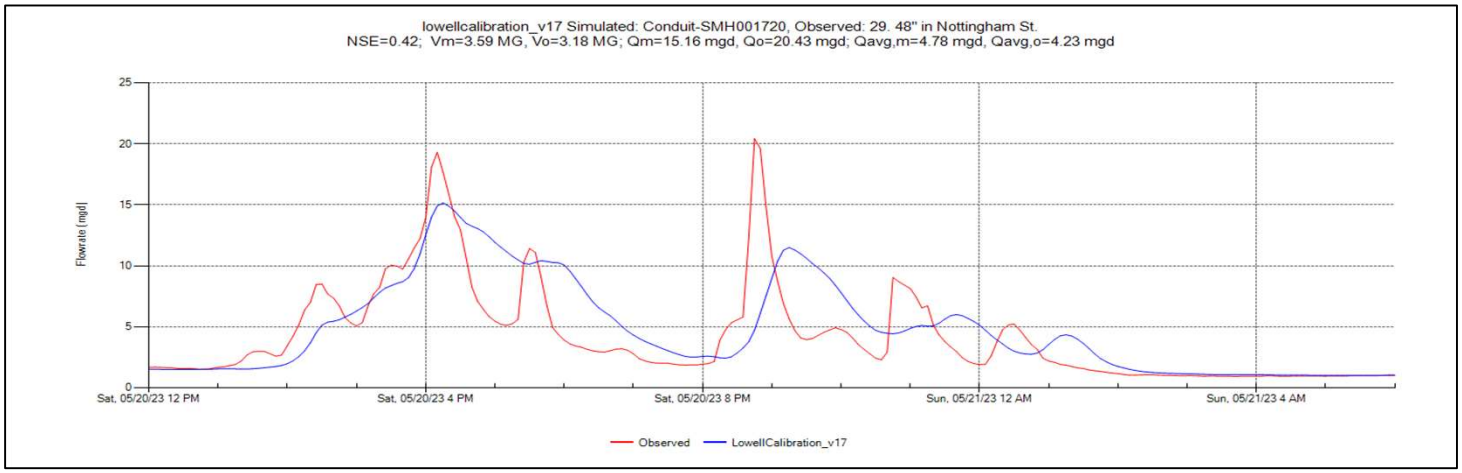


Simulated Versus Observed Flow at Flow Meter Sites

29-May 20

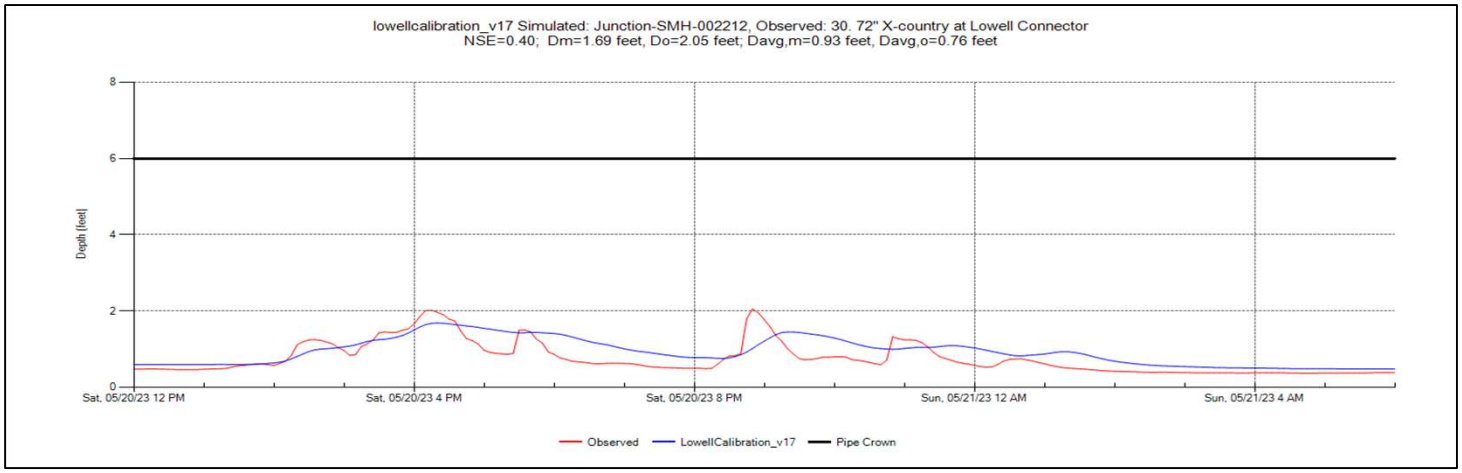


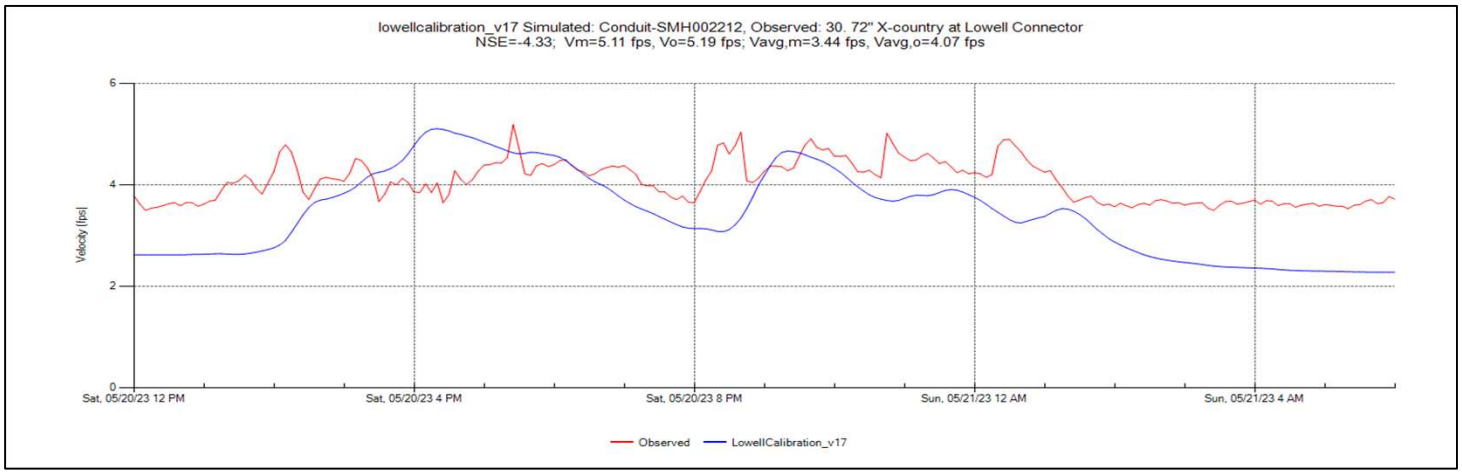


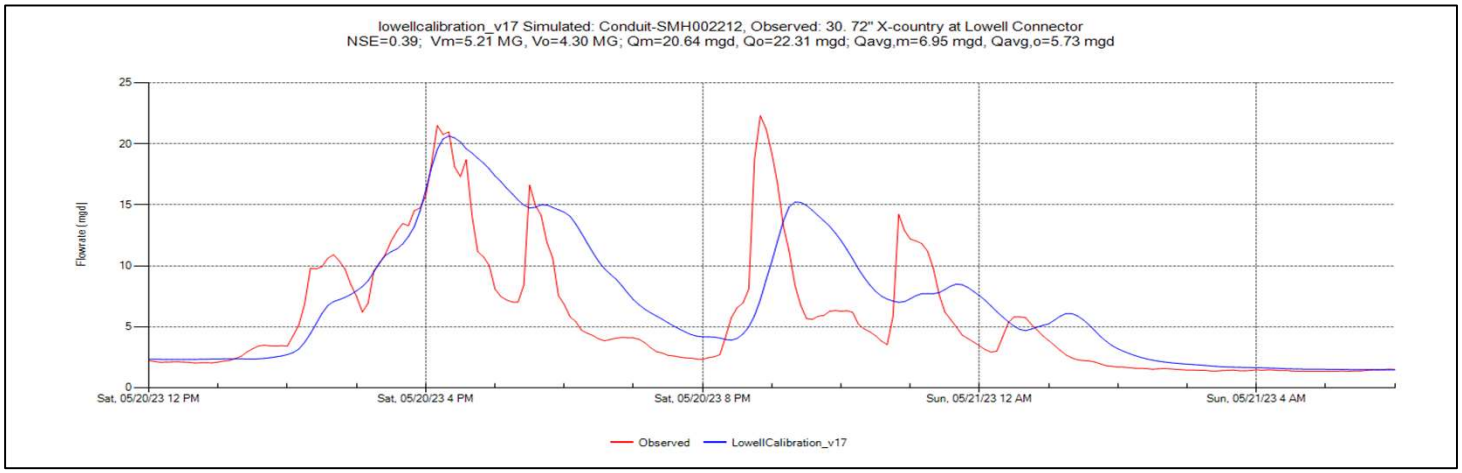


Simulated Versus Observed Flow at Flow Meter Sites

30-May 20

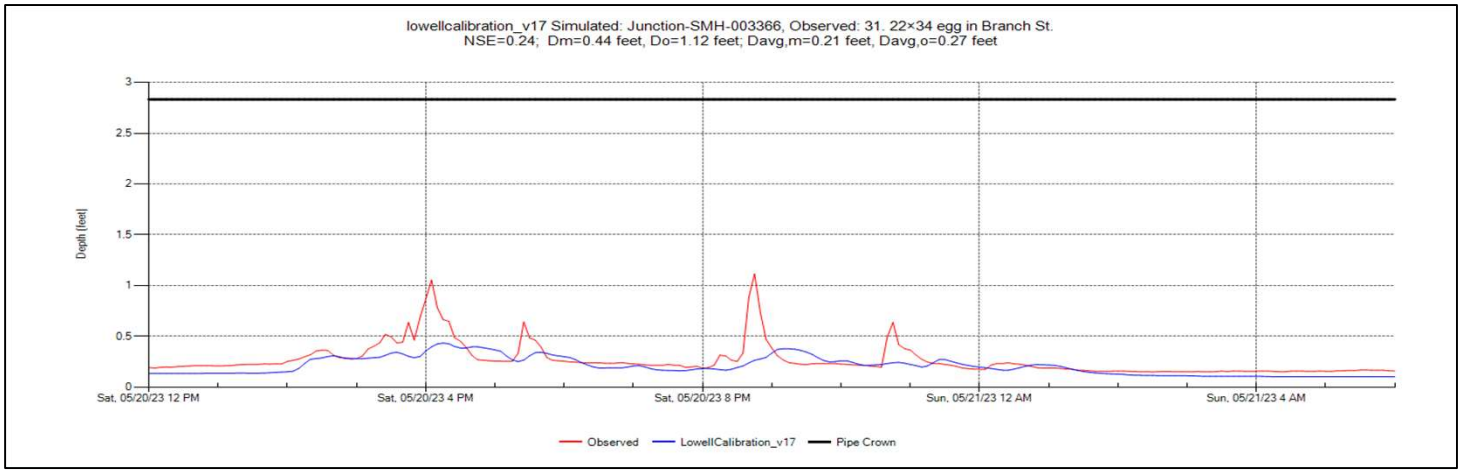


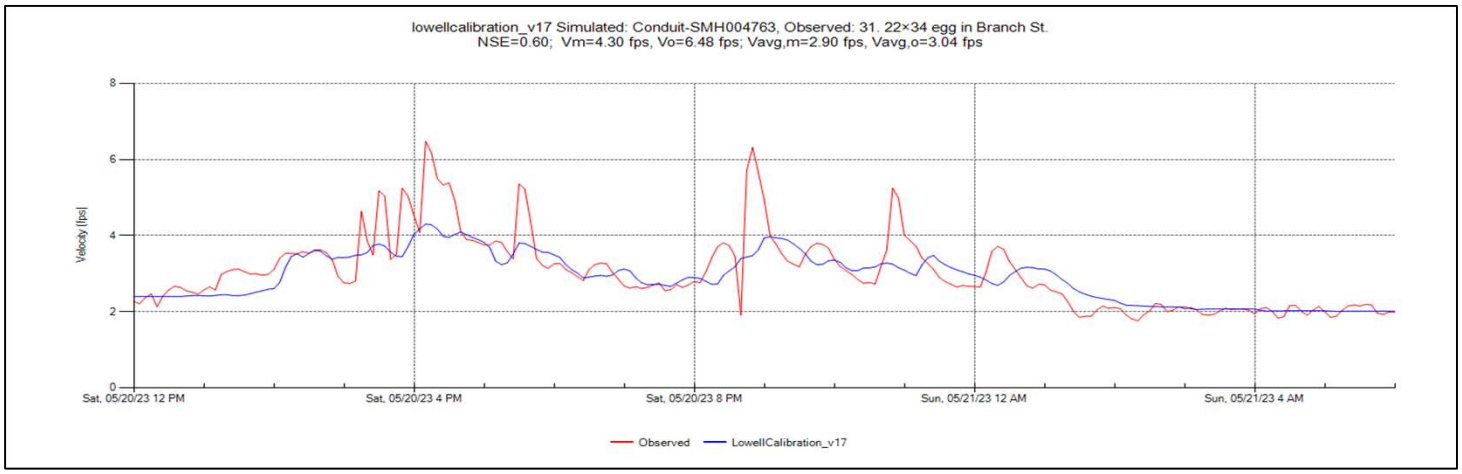


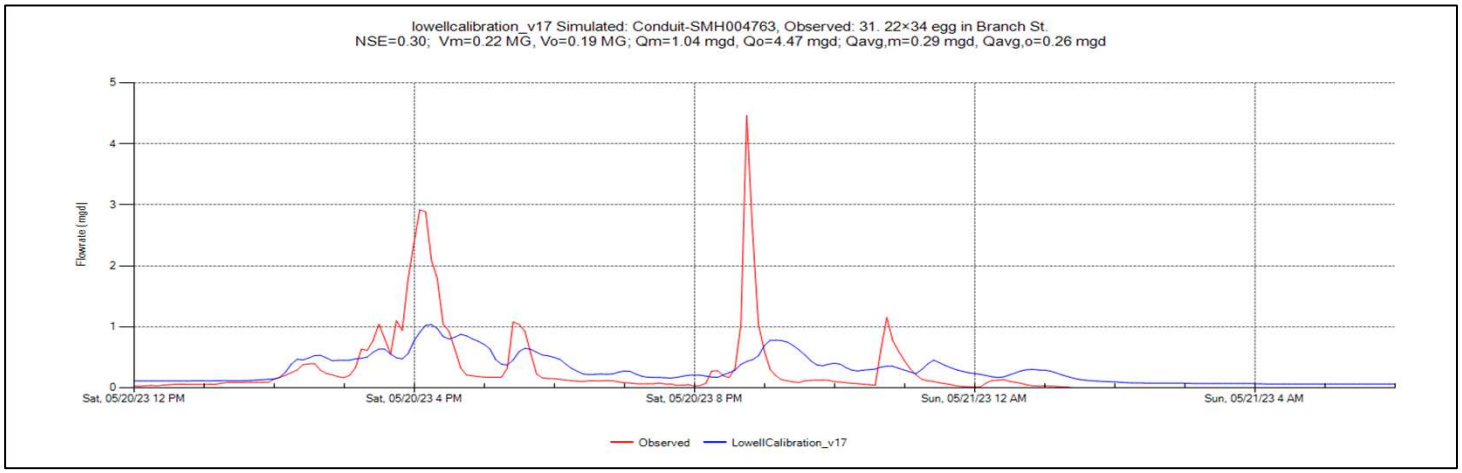


Simulated Versus Observed Flow at Flow Meter Sites

31-May 20

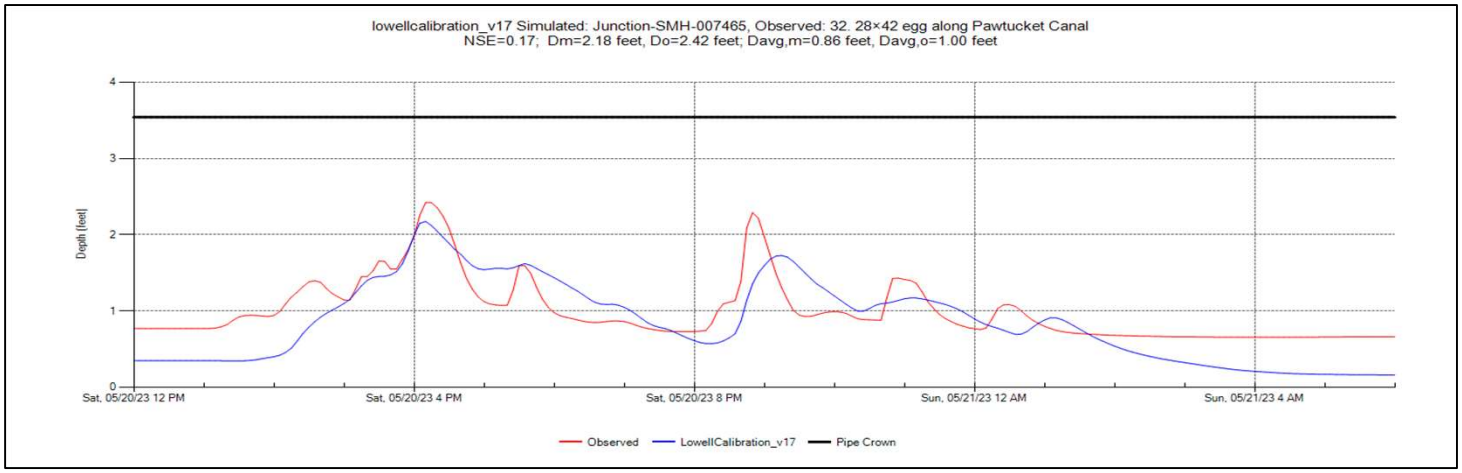


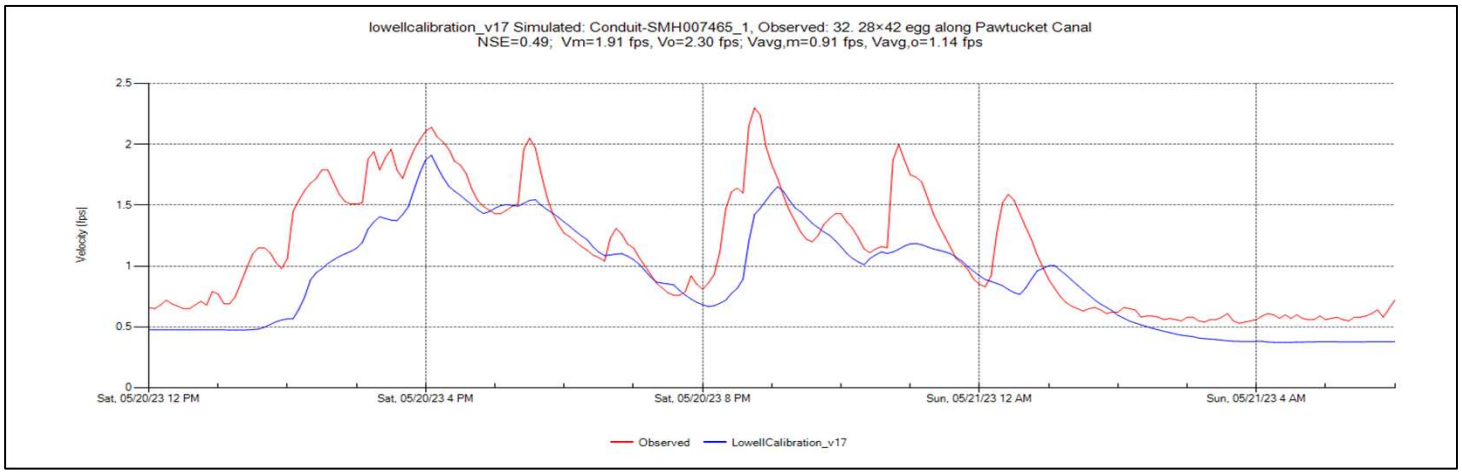


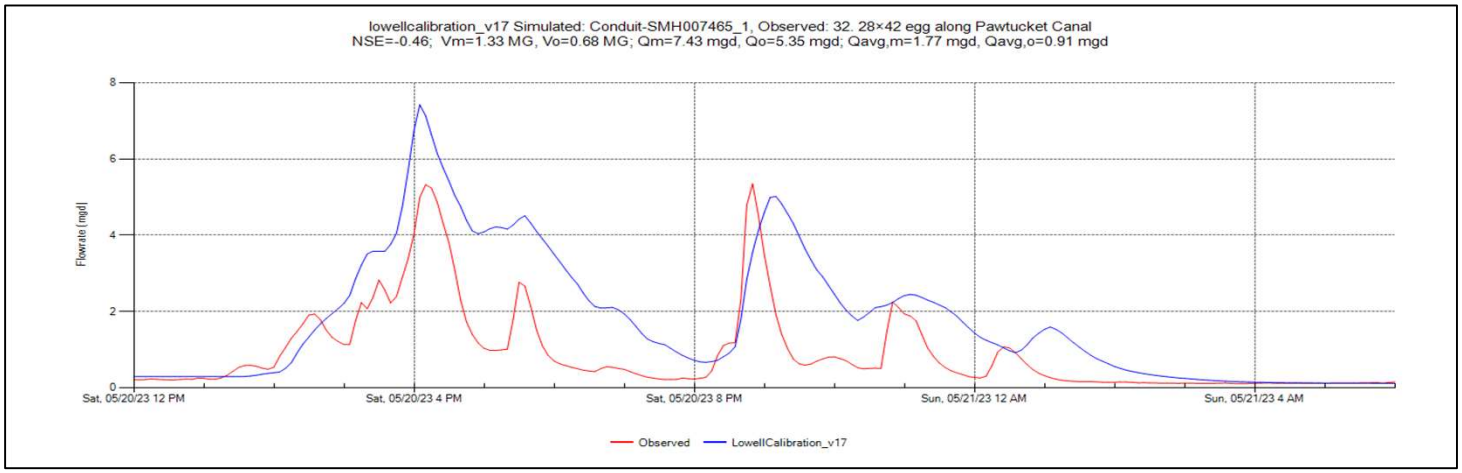


Simulated Versus Observed Flow at Flow Meter Sites

32-May 20

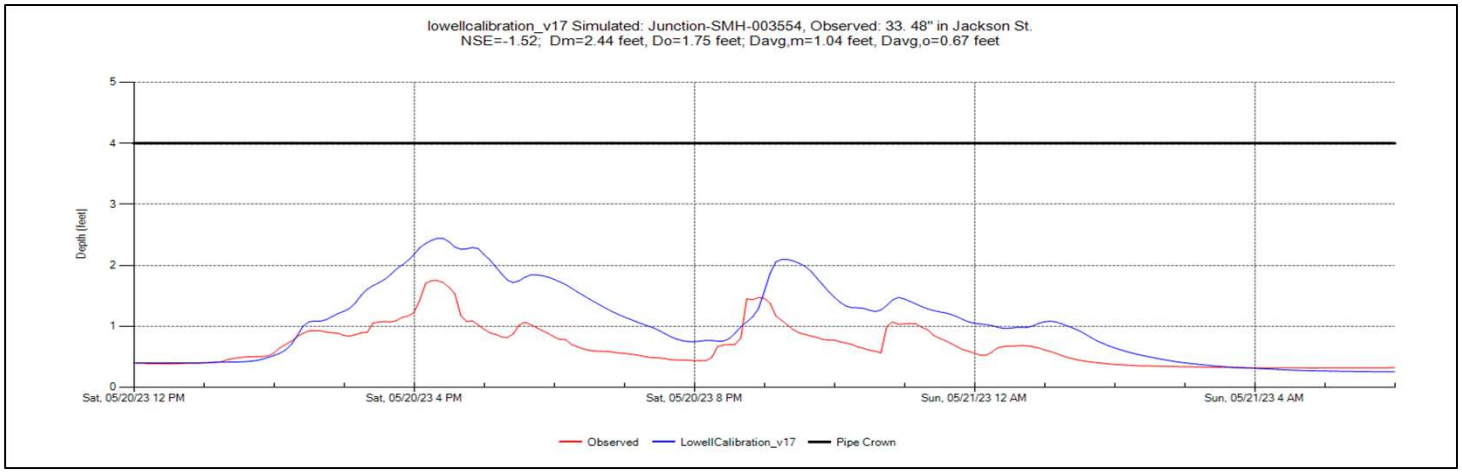


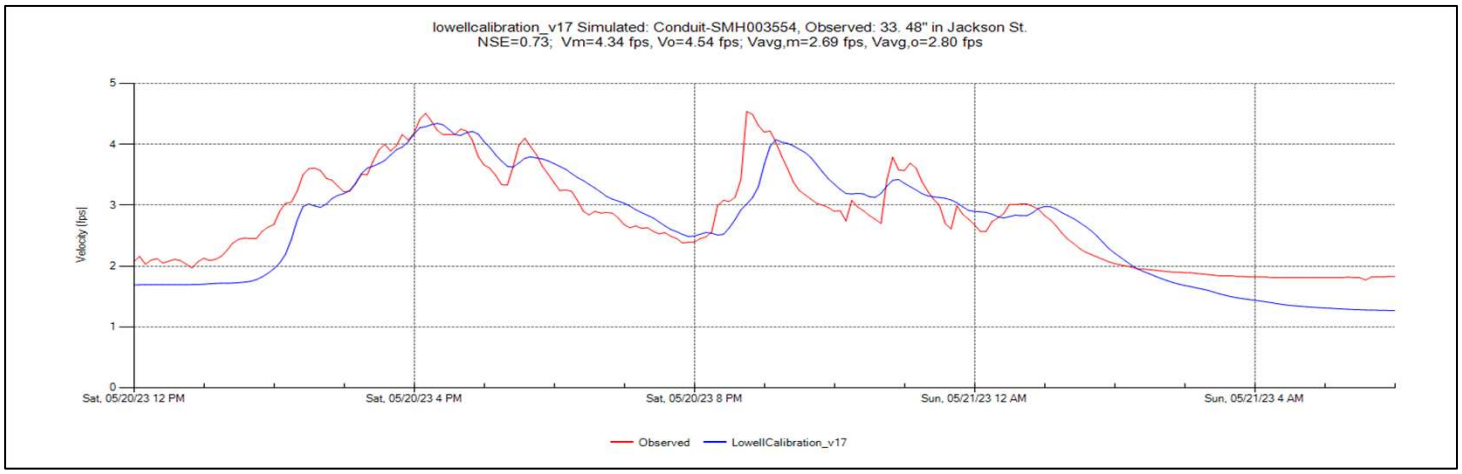


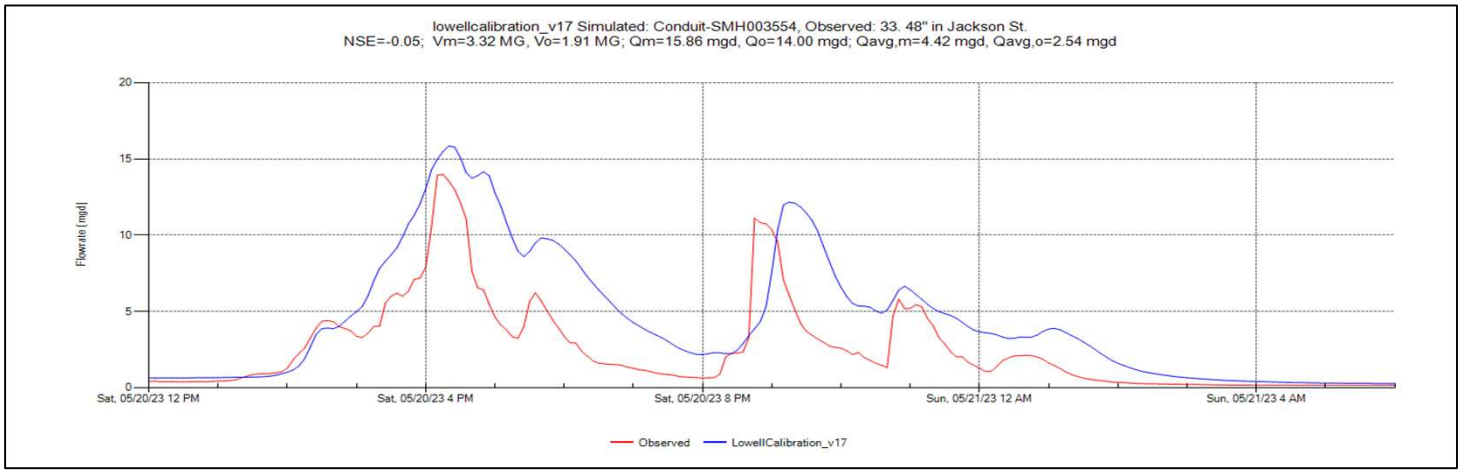


Simulated Versus Observed Flow at Flow Meter Sites

33-May 20

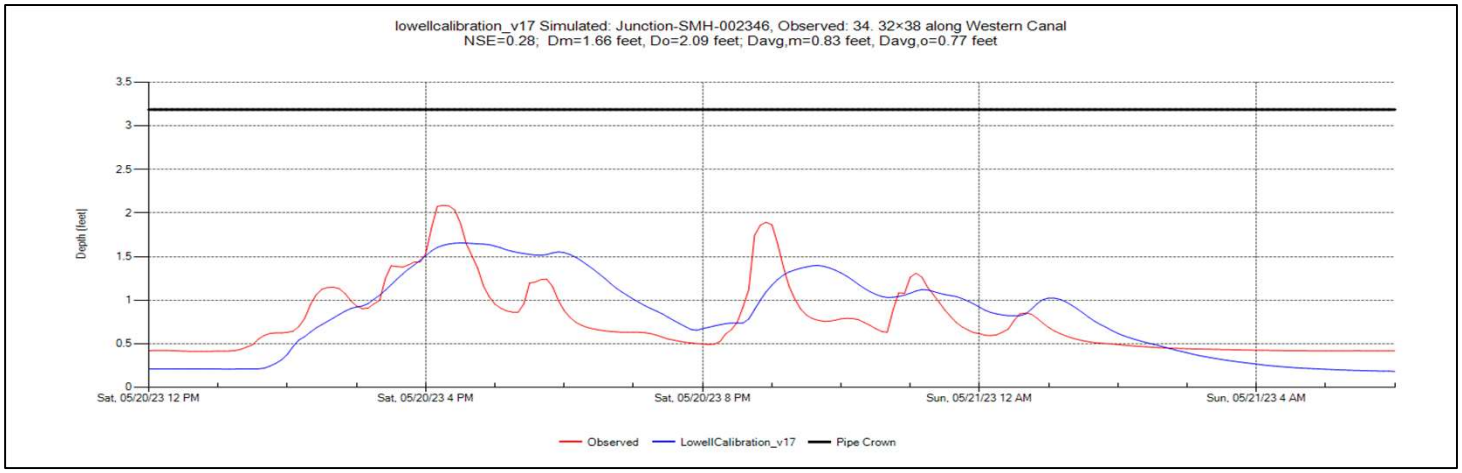


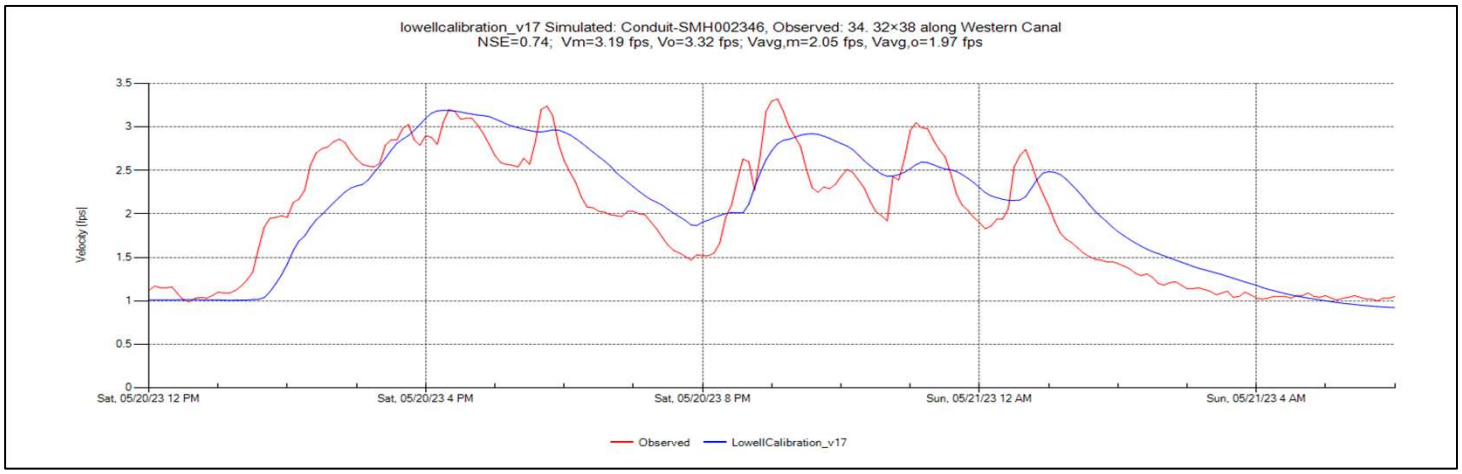


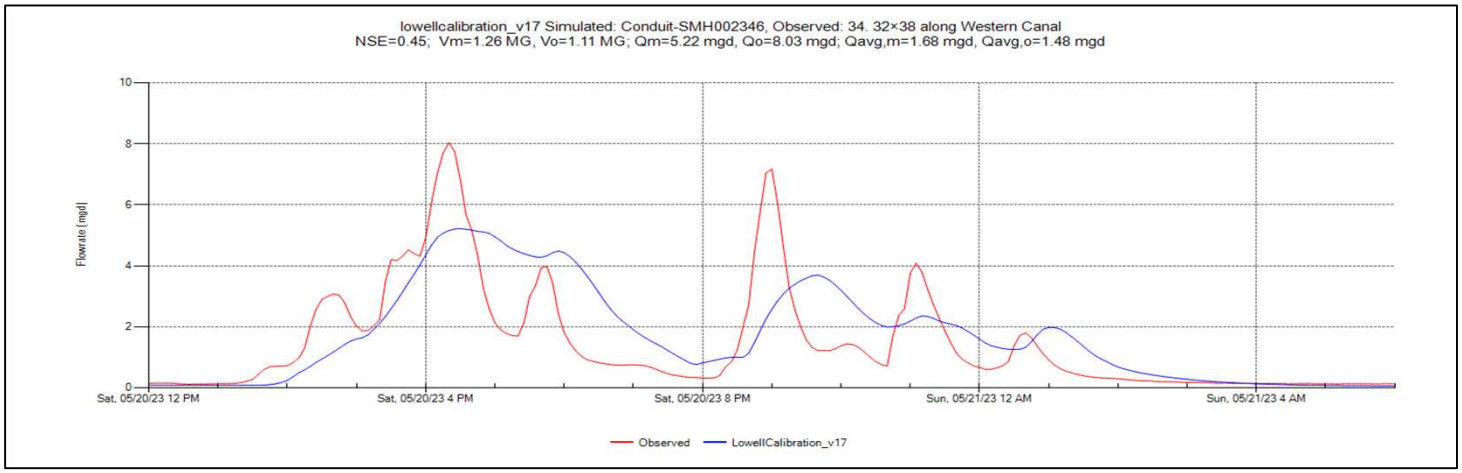


Simulated Versus Observed Flow at Flow Meter Sites

34-May 20

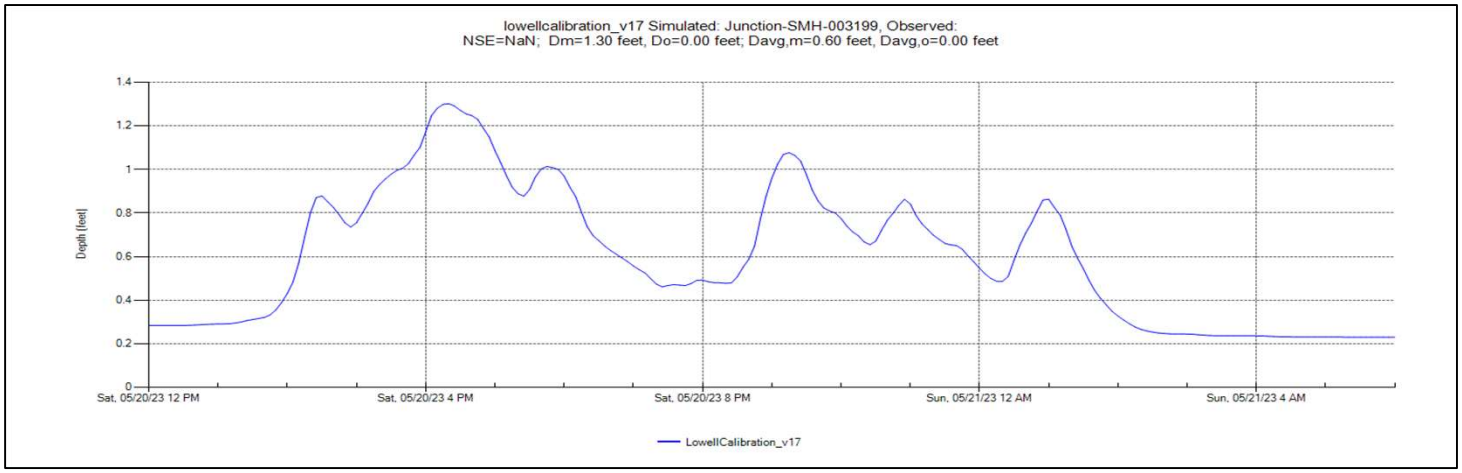


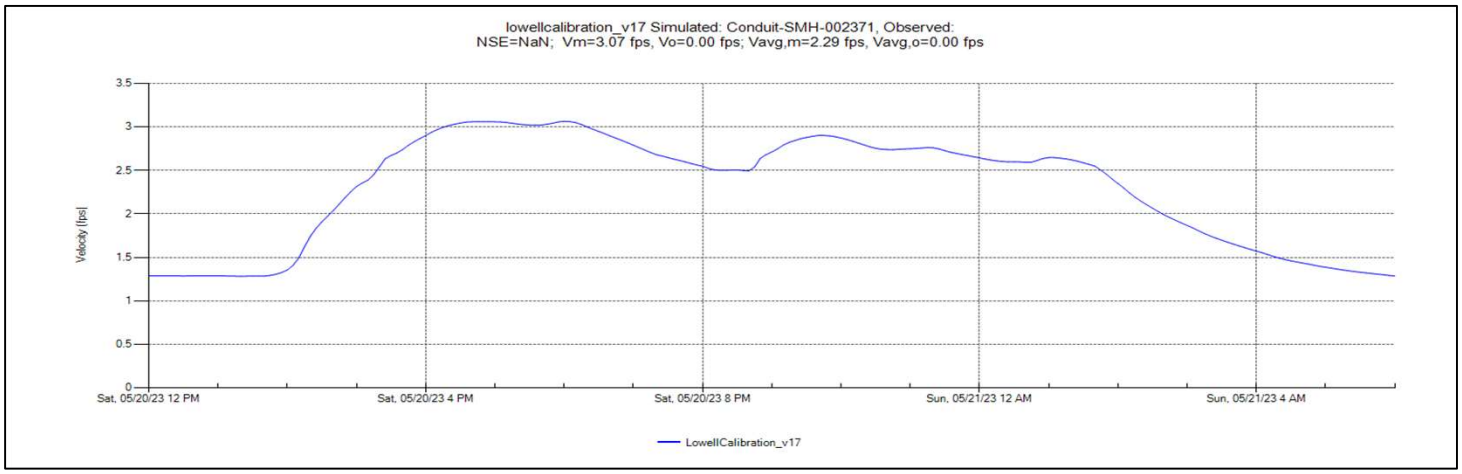


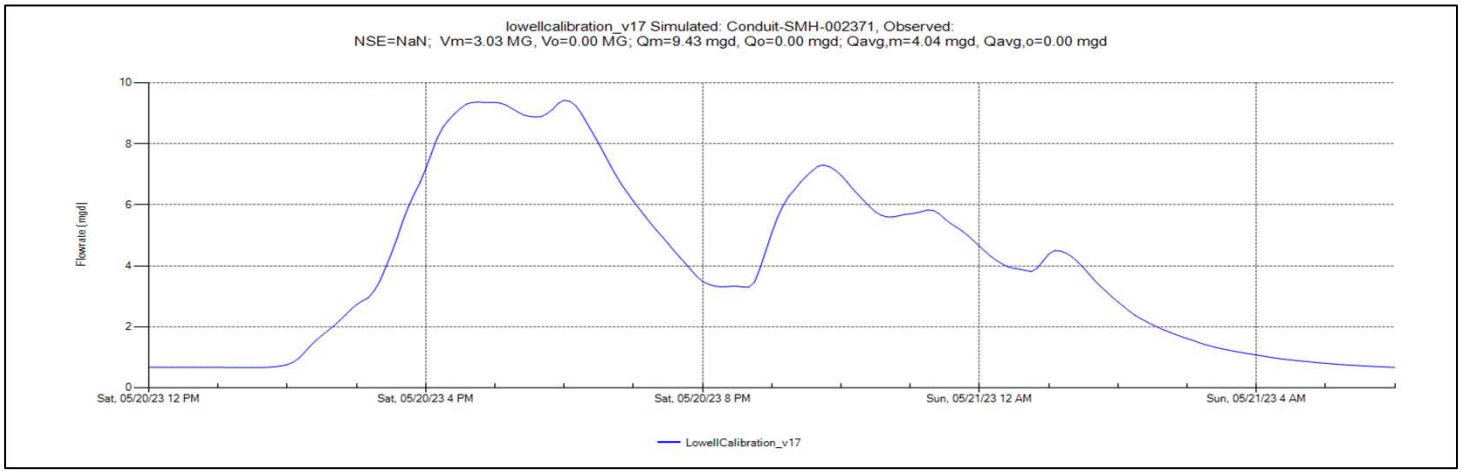


Simulated Versus Observed Flow at Flow Meter Sites

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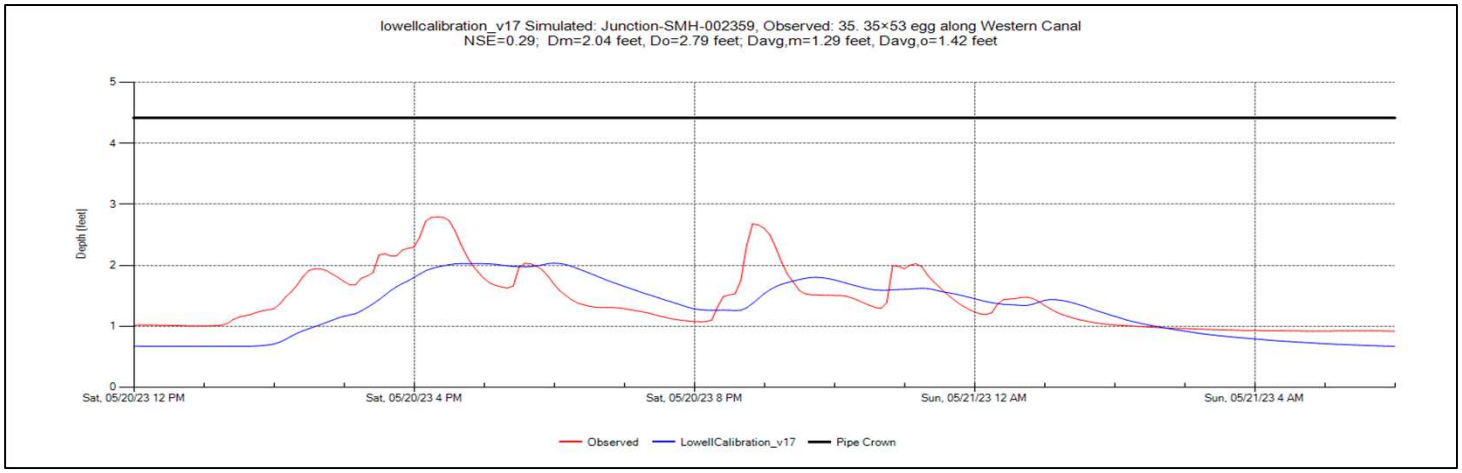


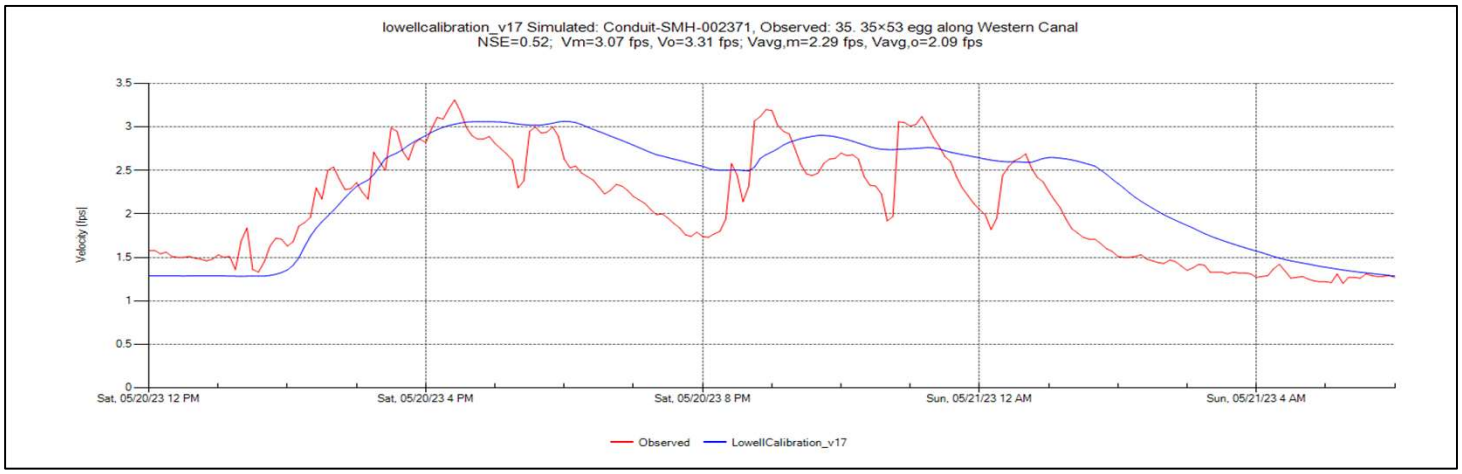


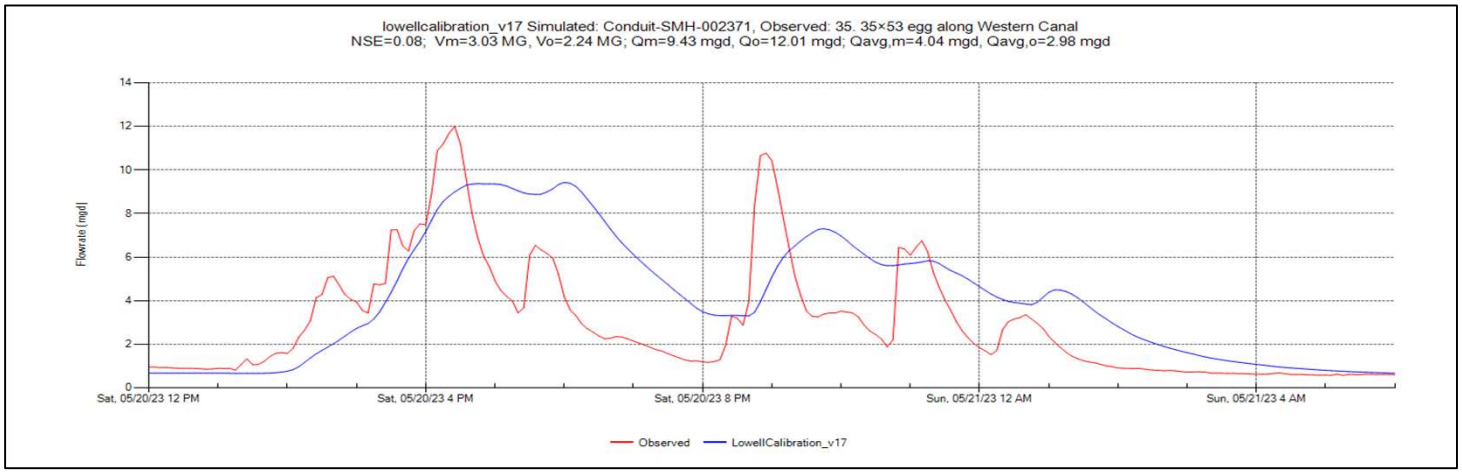


Simulated Versus Observed Flow at Flow Meter Sites

35-May 20

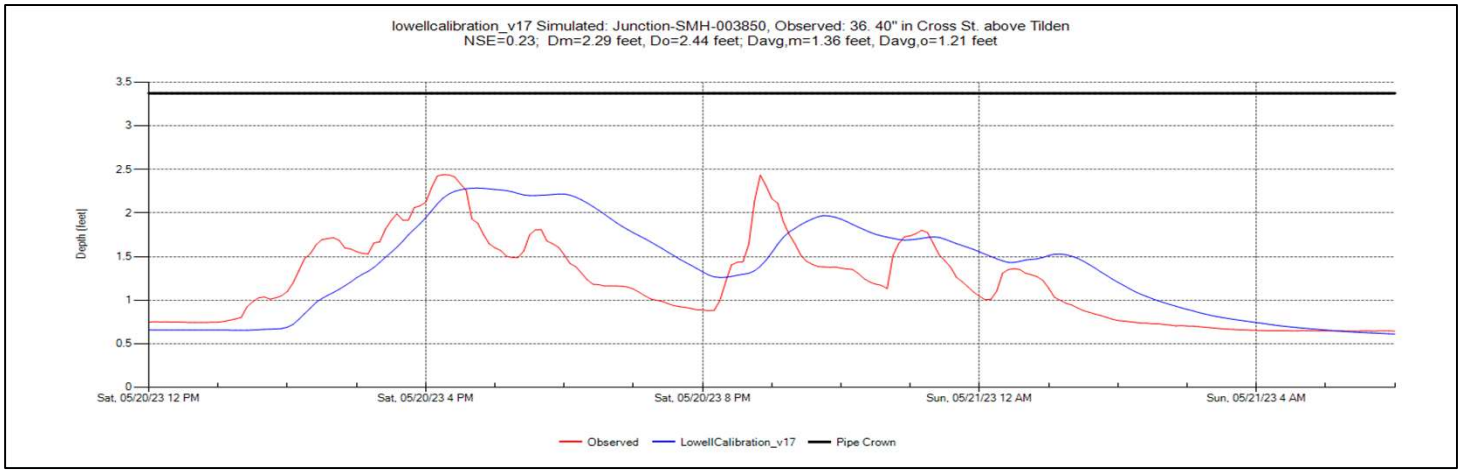


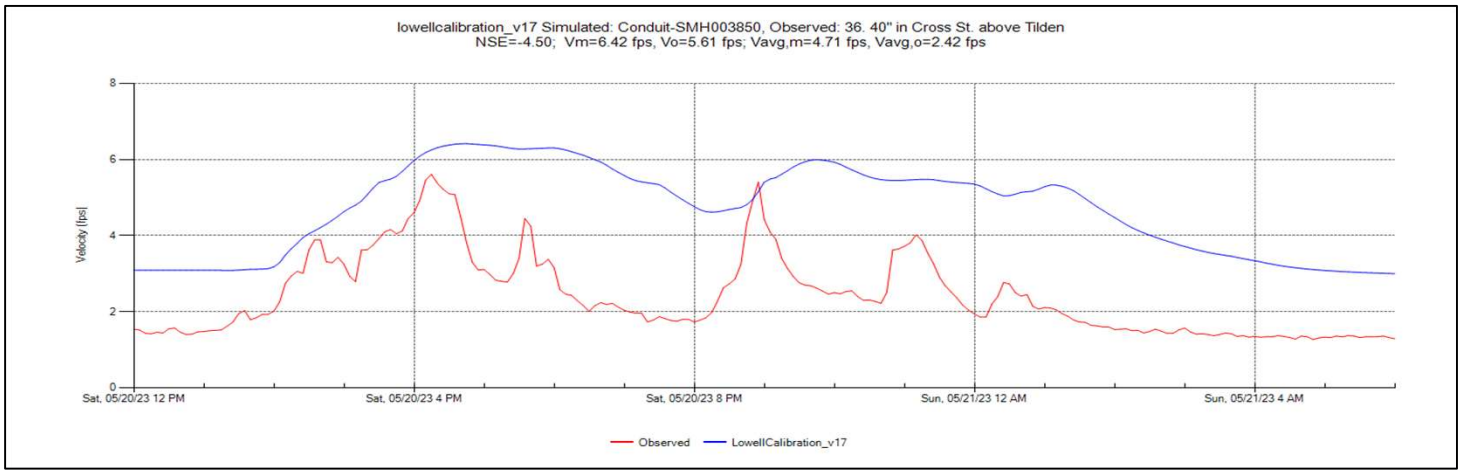


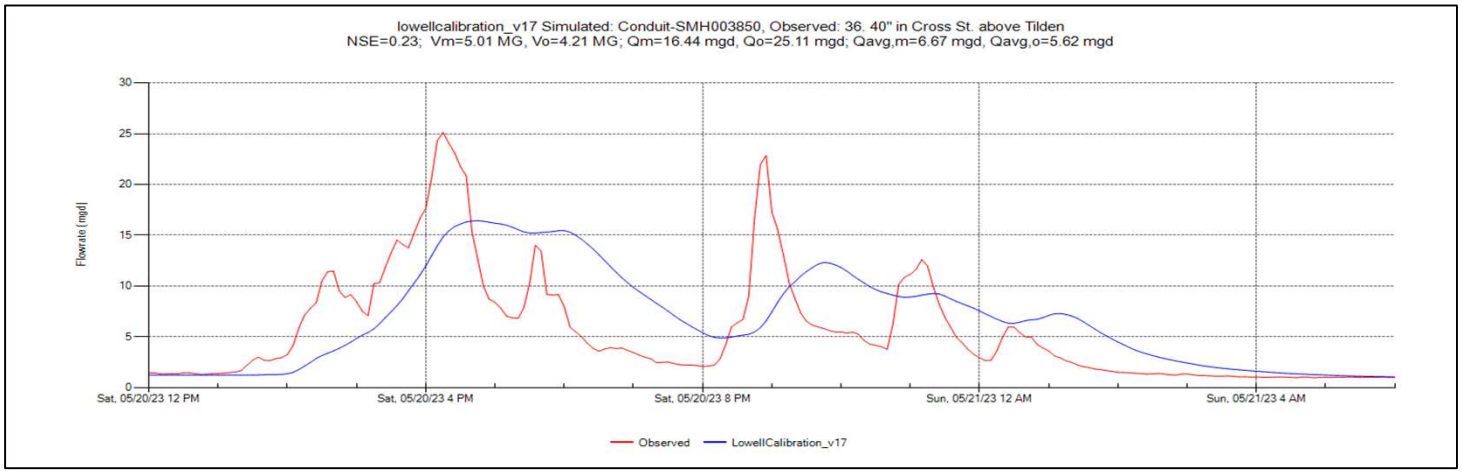


Simulated Versus Observed Flow at Flow Meter Sites

36-May 20

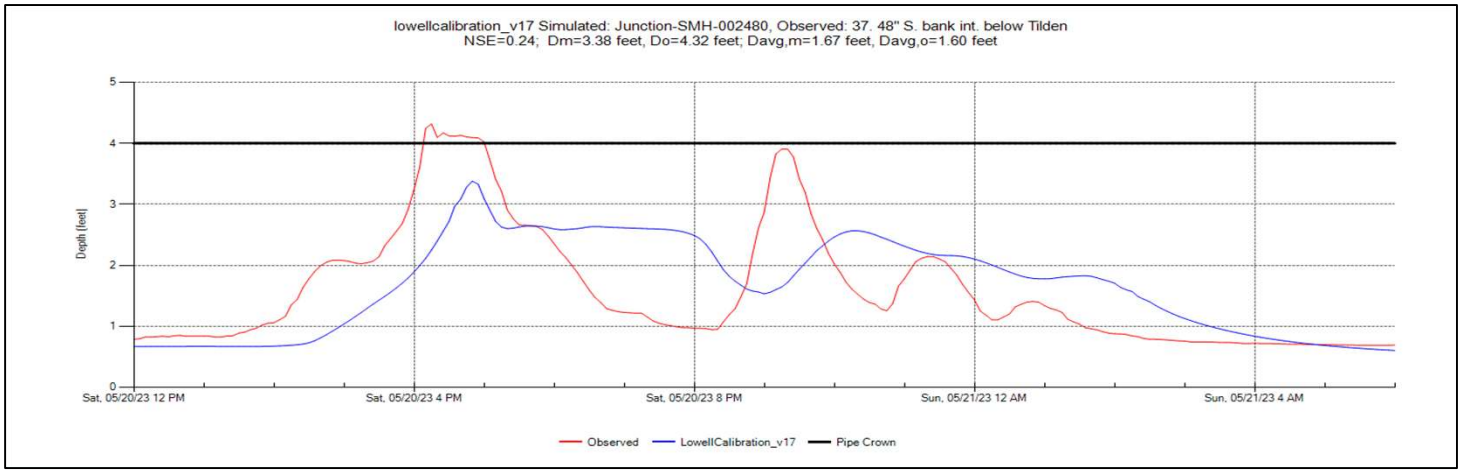


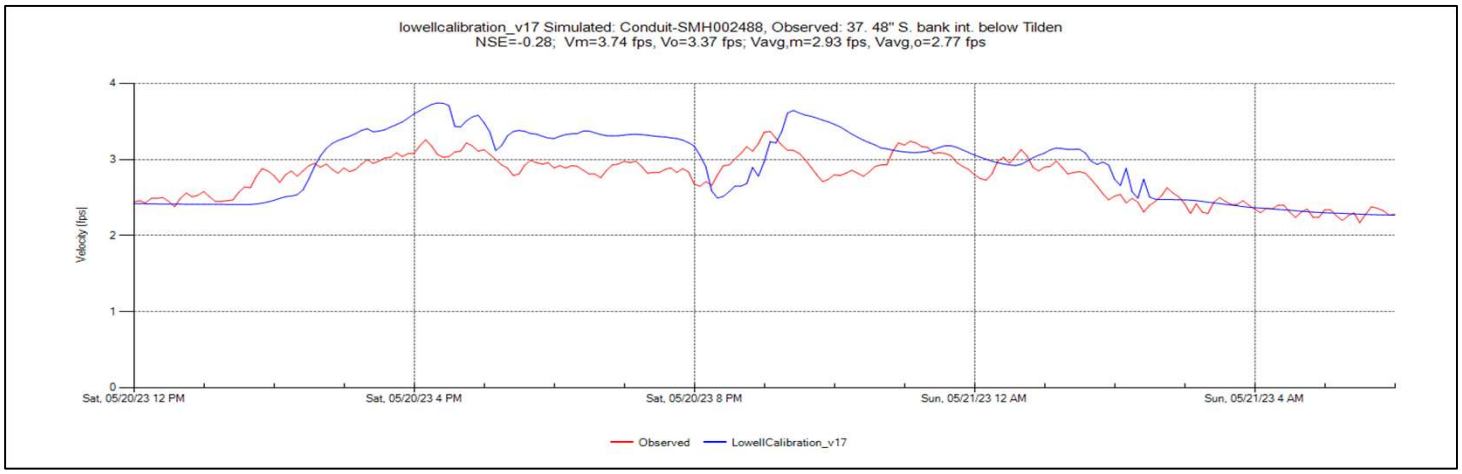


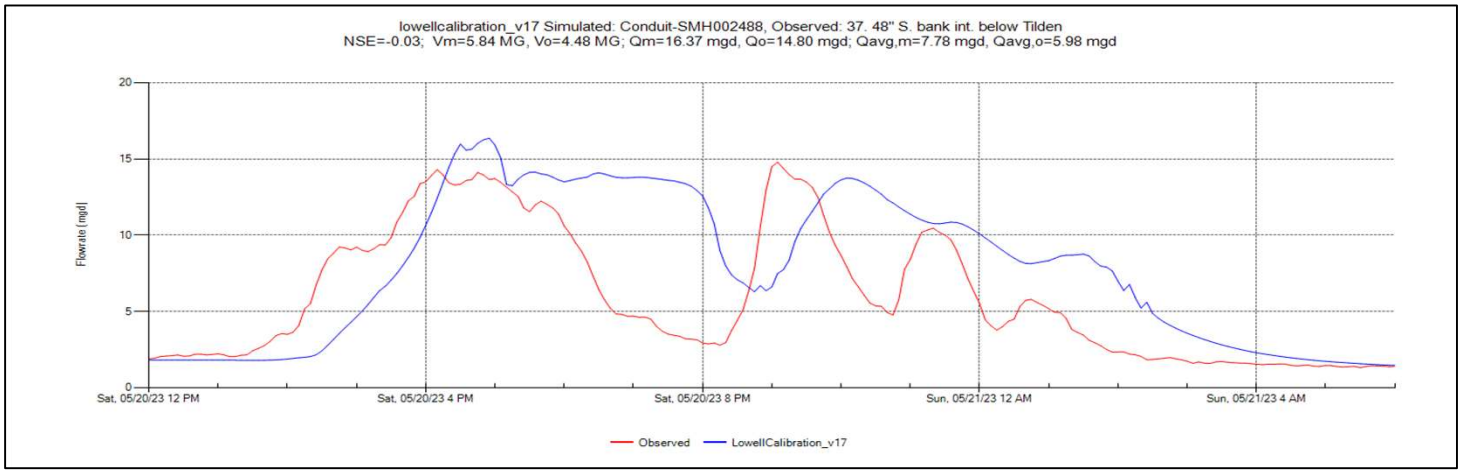


Simulated Versus Observed Flow at Flow Meter Sites

37-May 20

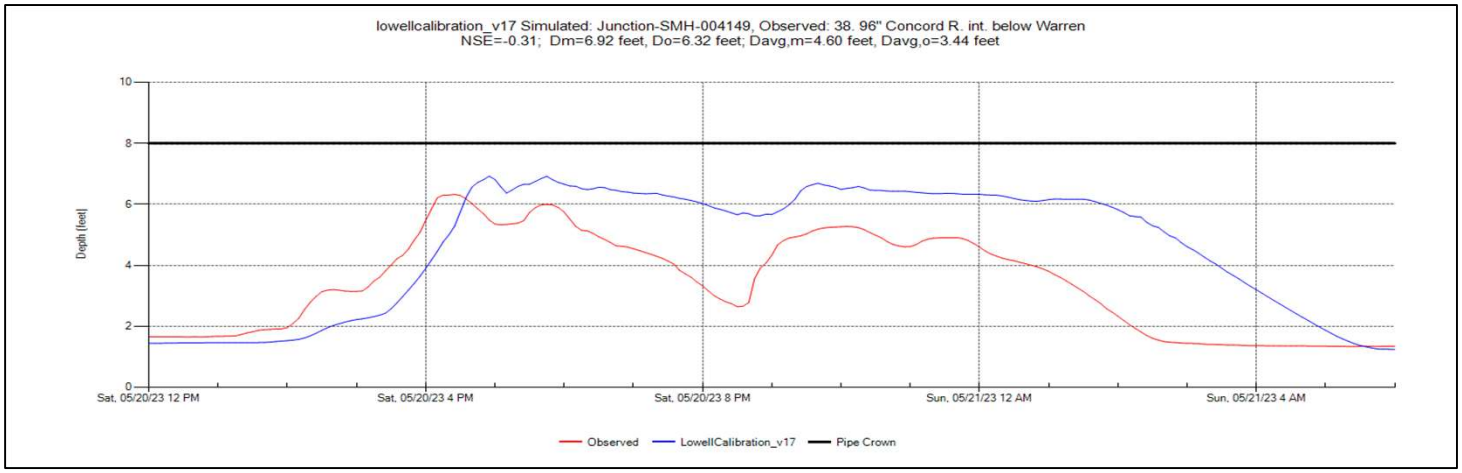


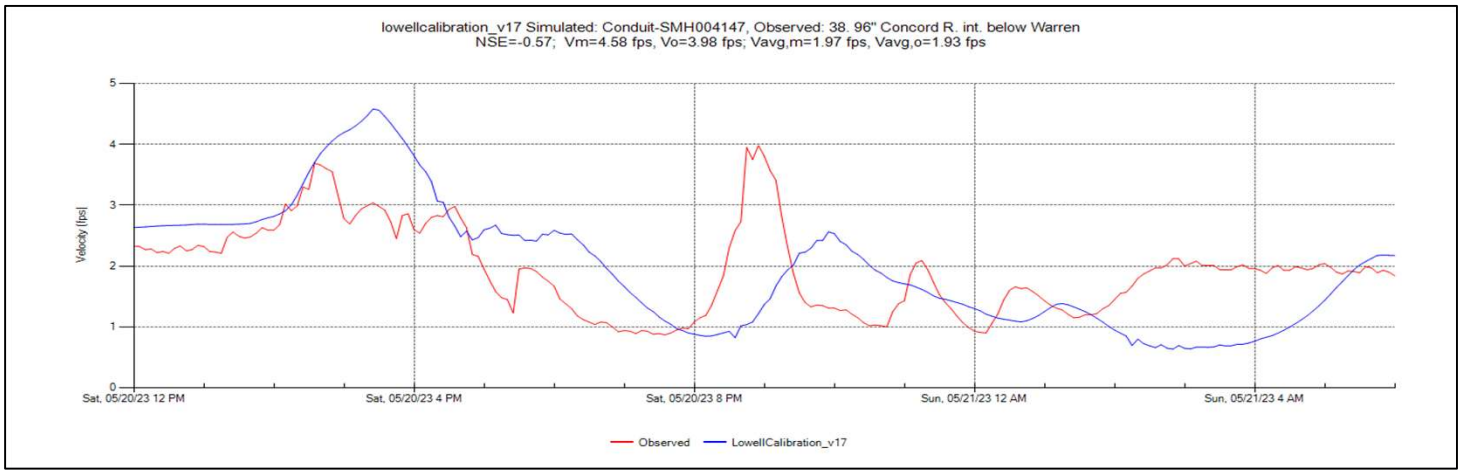


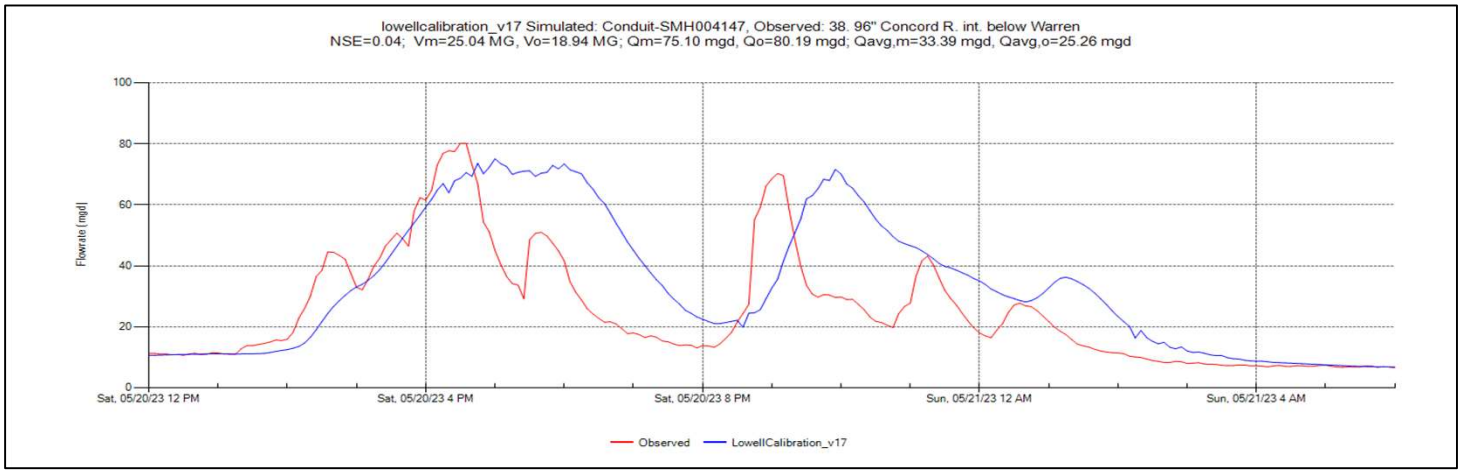


Simulated Versus Observed Flow at Flow Meter Sites

38-May 20

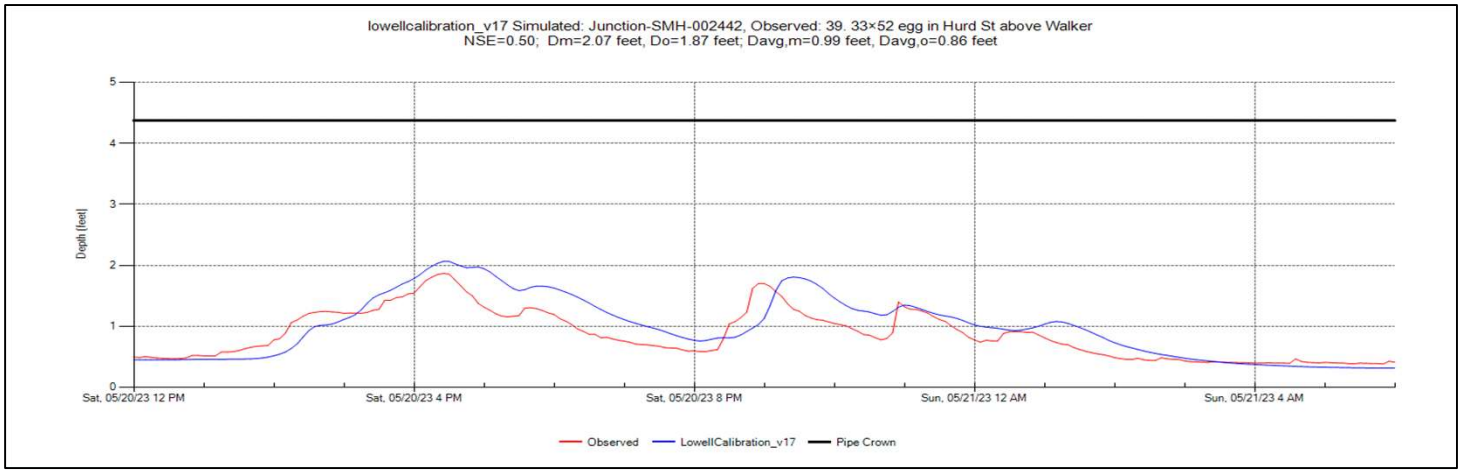


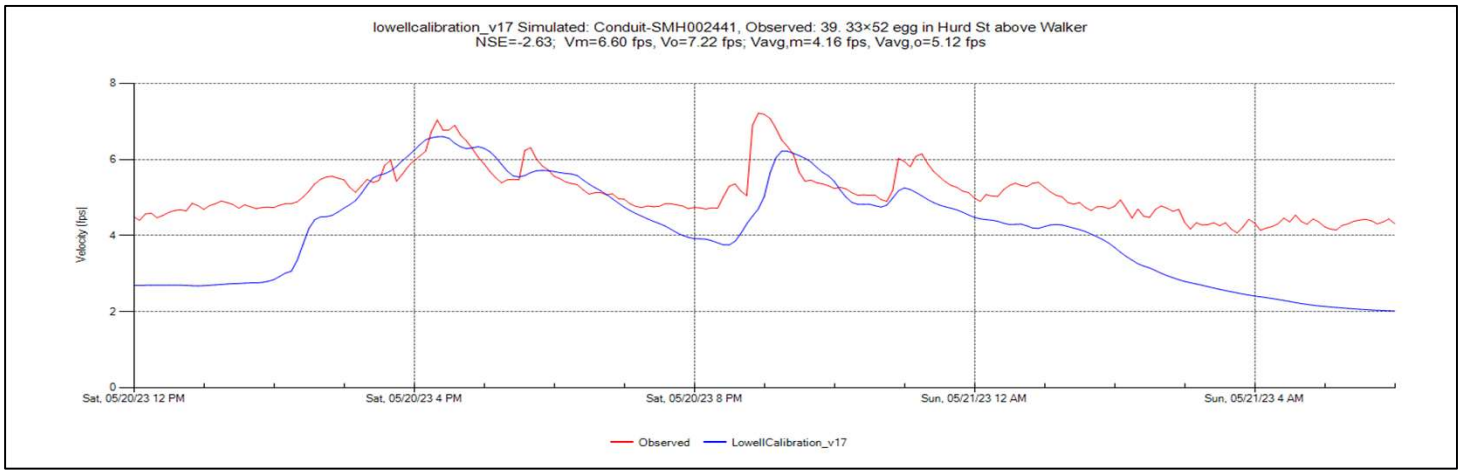


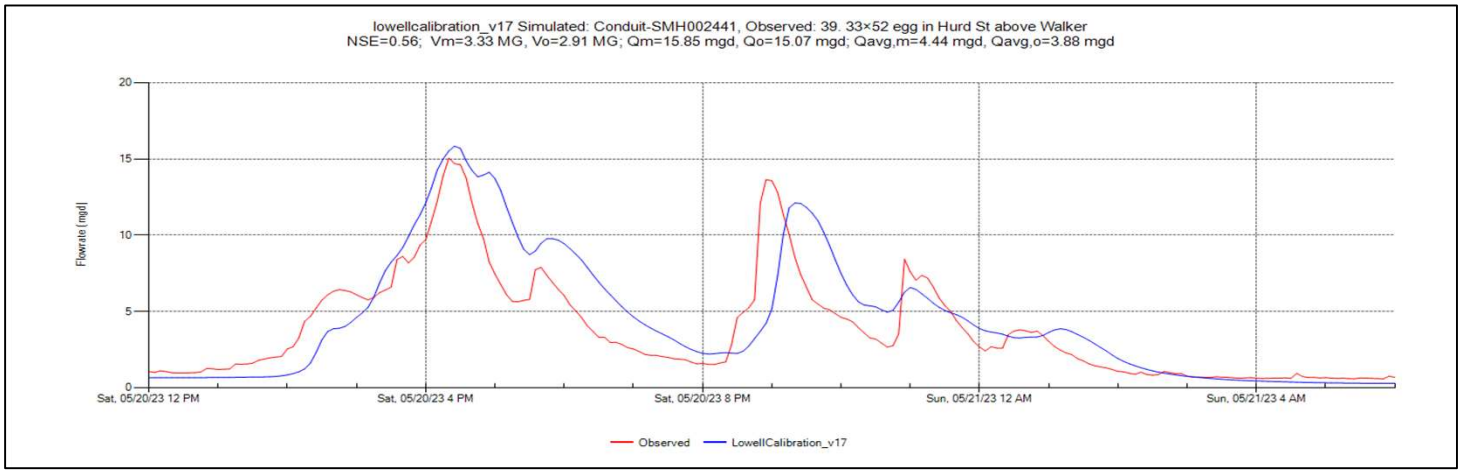


Simulated Versus Observed Flow at Flow Meter Sites

39-May 20

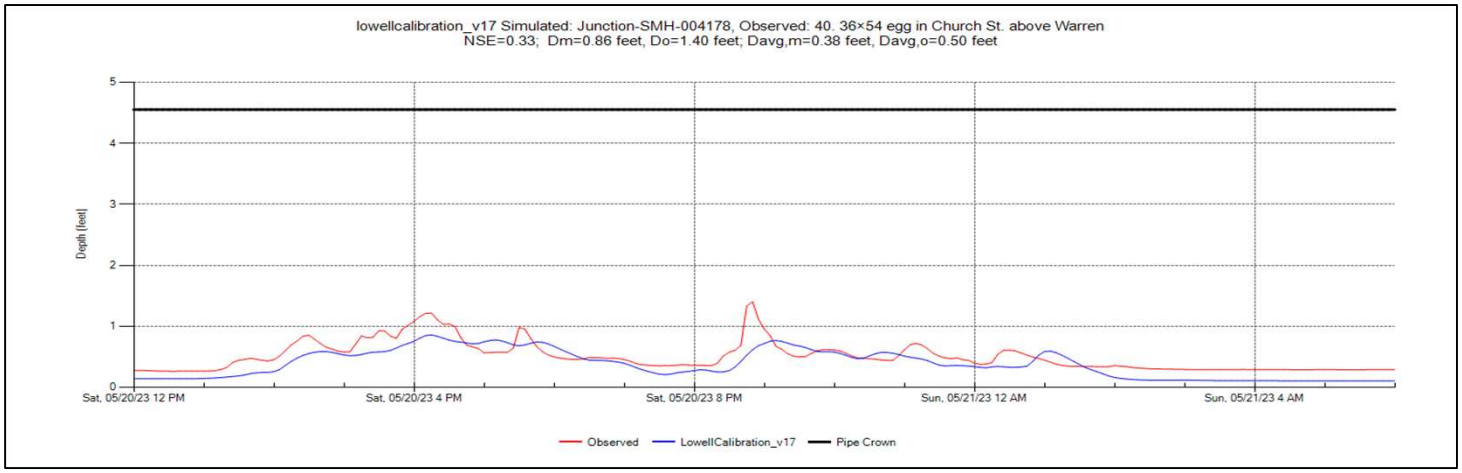


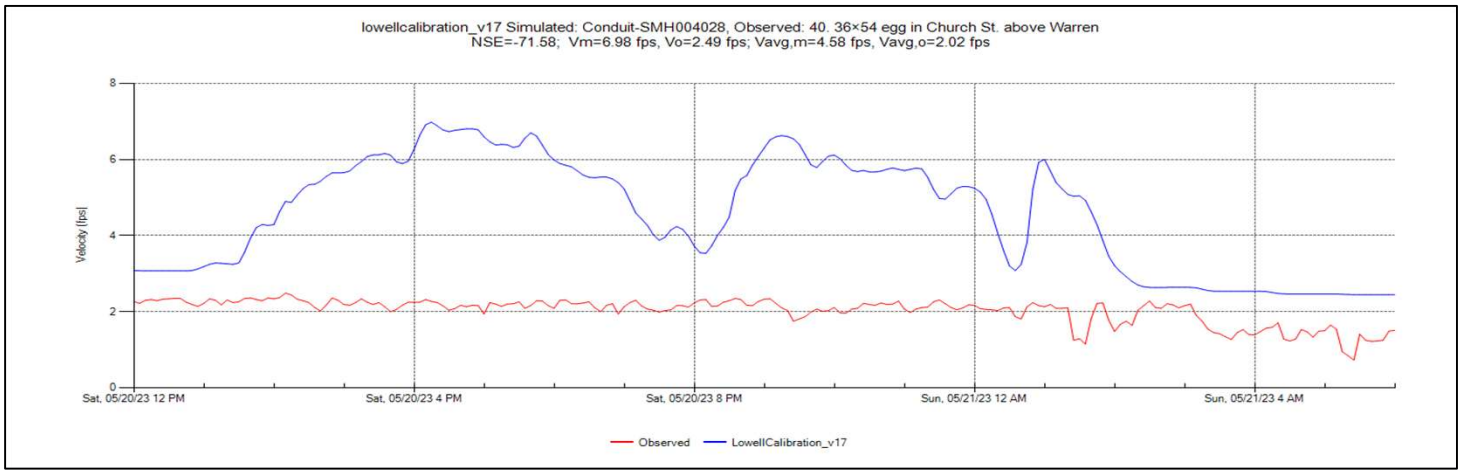


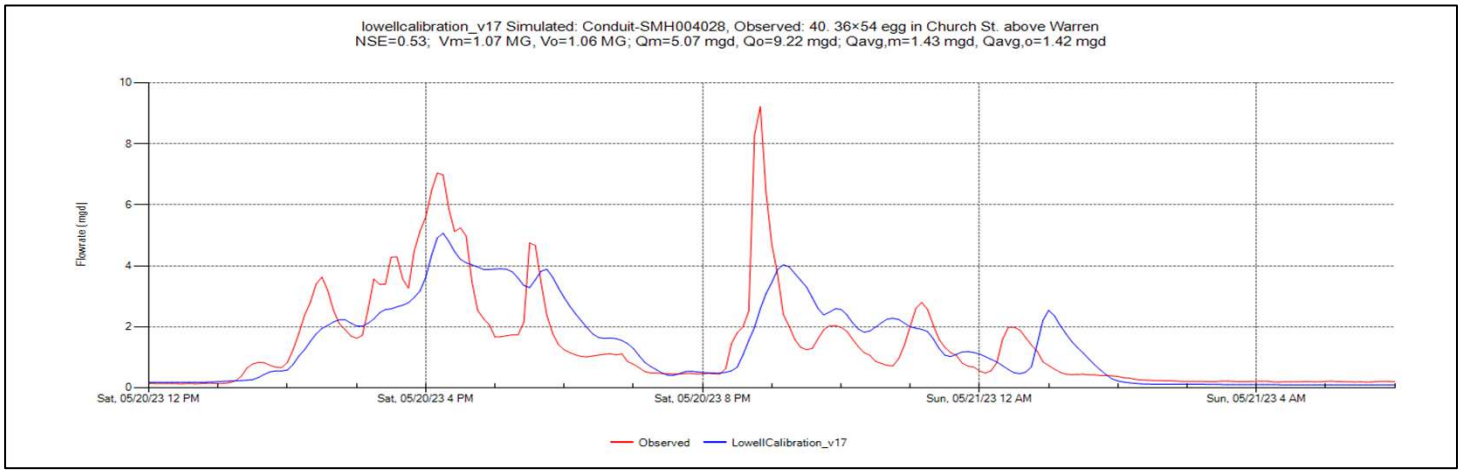


Simulated Versus Observed Flow at Flow Meter Sites

40-May 20

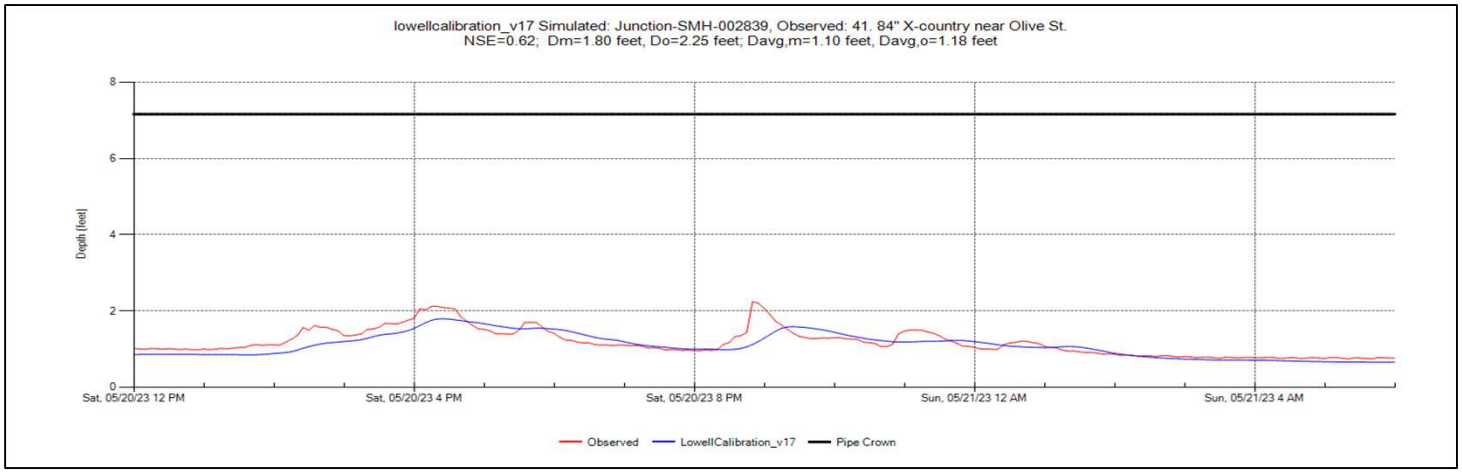


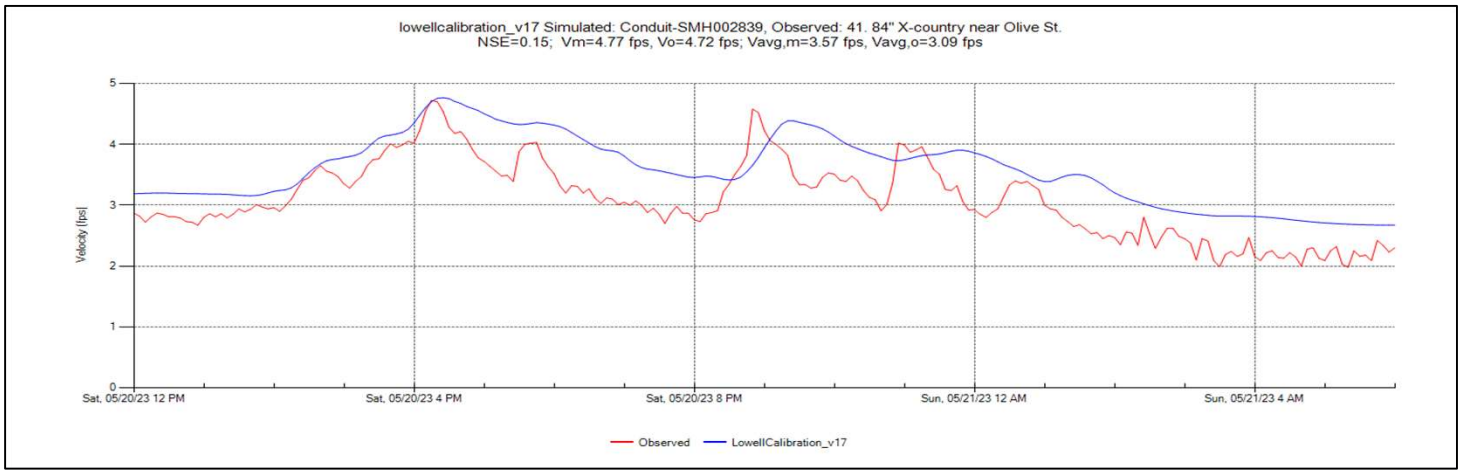


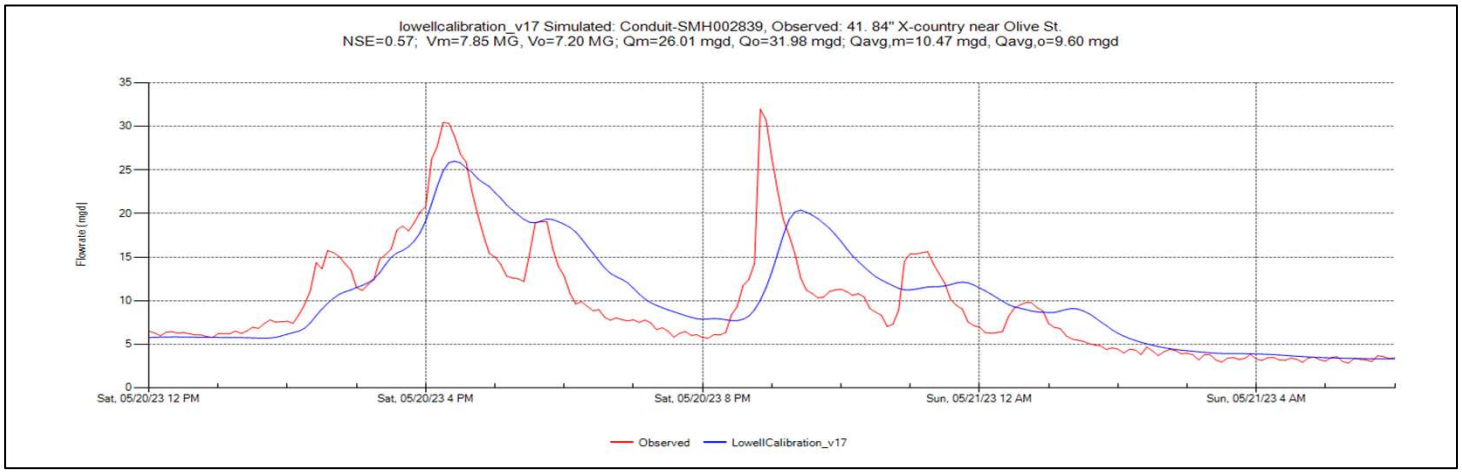


Simulated Versus Observed Flow at Flow Meter Sites

41-May 20

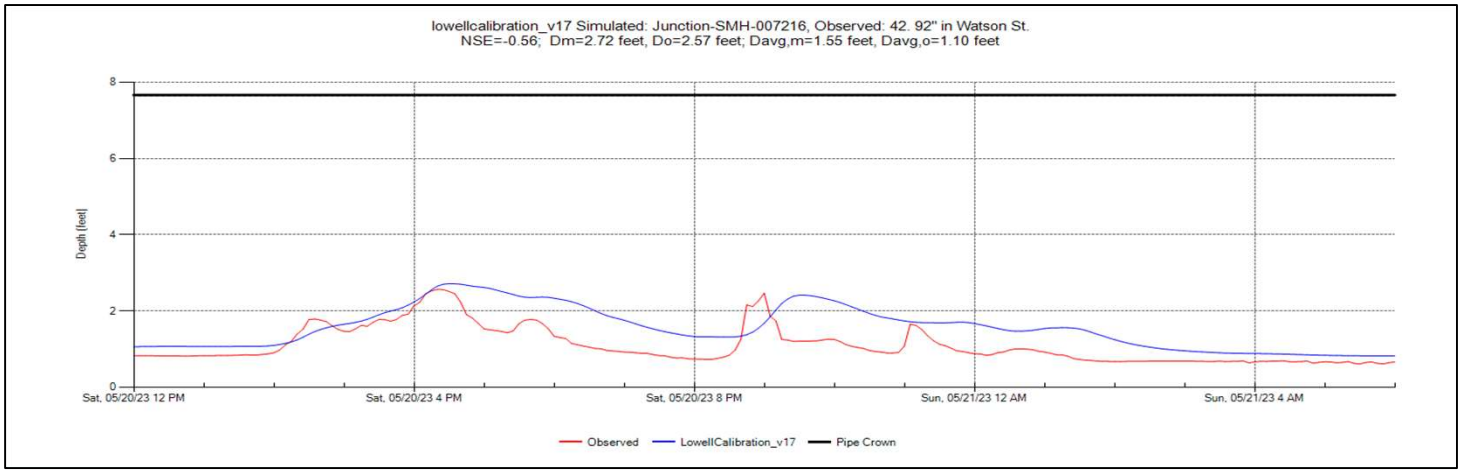


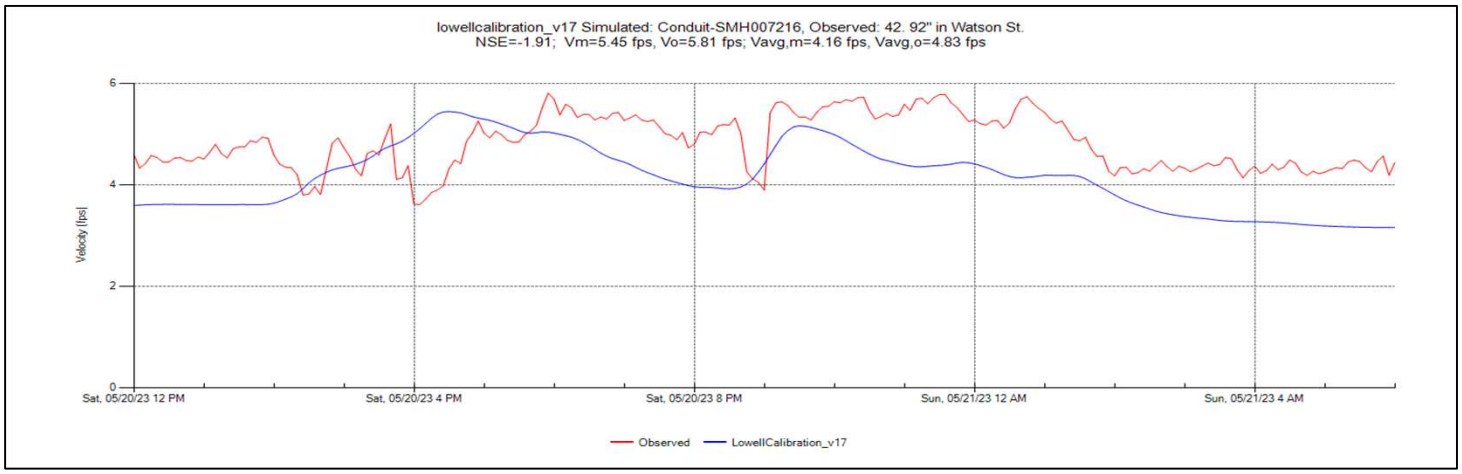


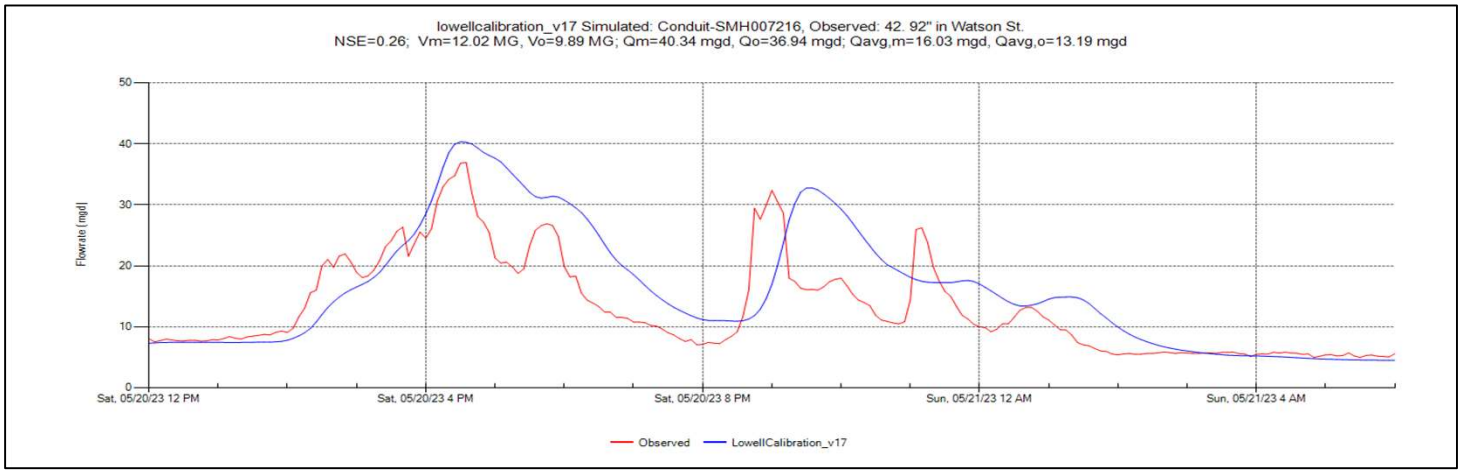


Simulated Versus Observed Flow at Flow Meter Sites

42-May 20

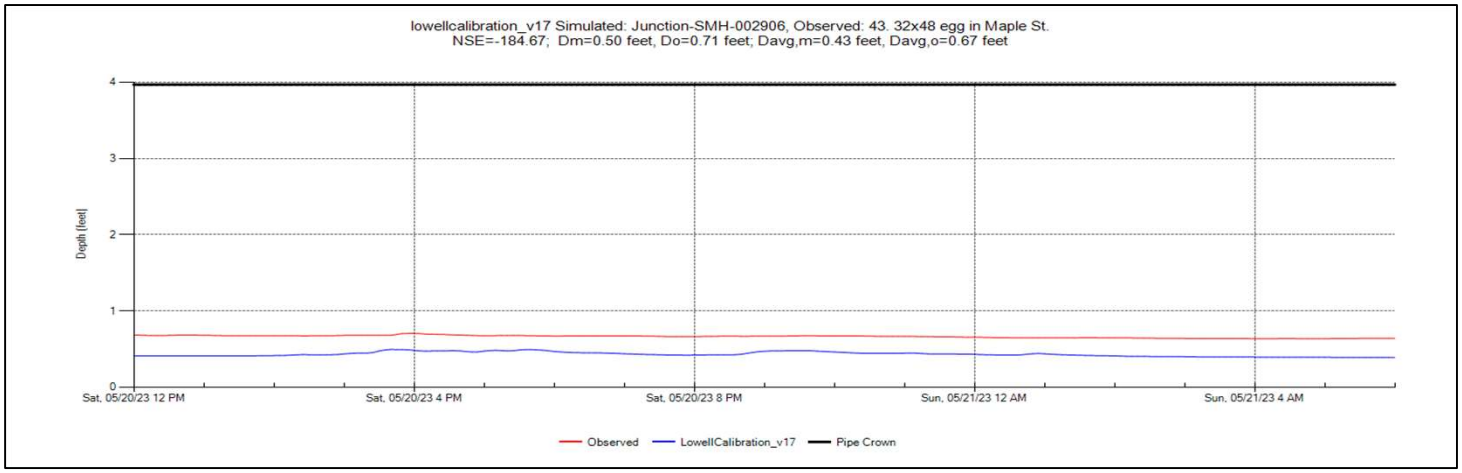


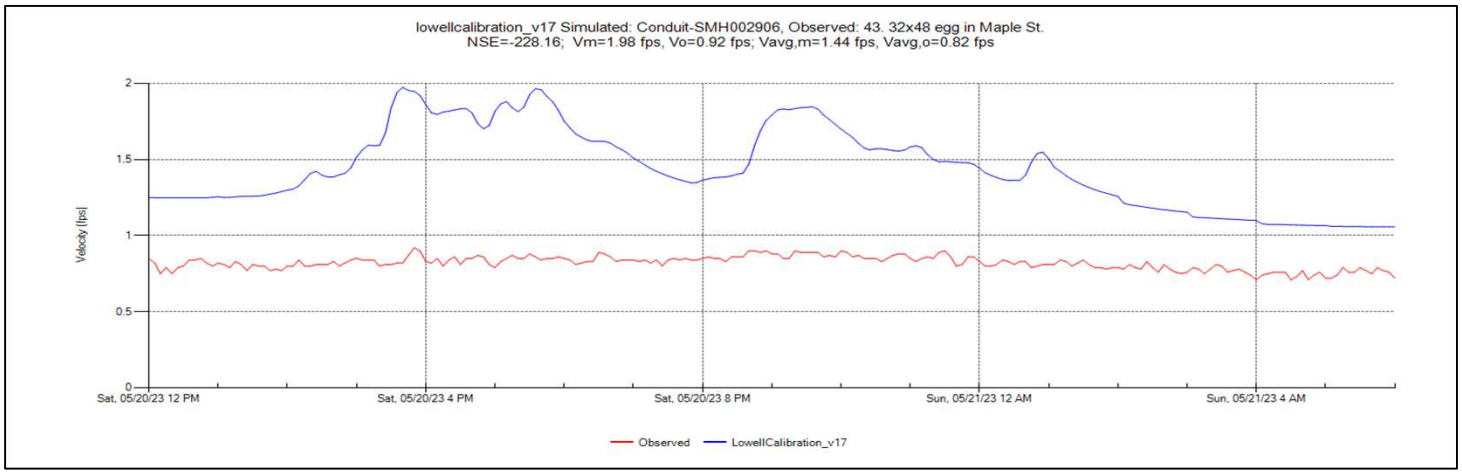


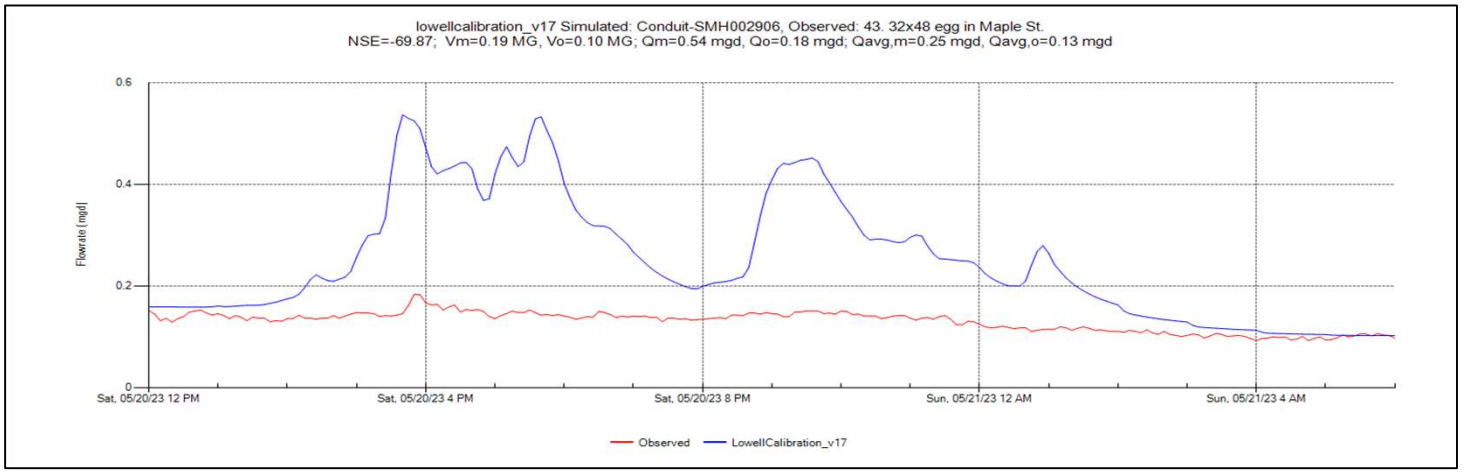


Simulated Versus Observed Flow at Flow Meter Sites

43-May 20

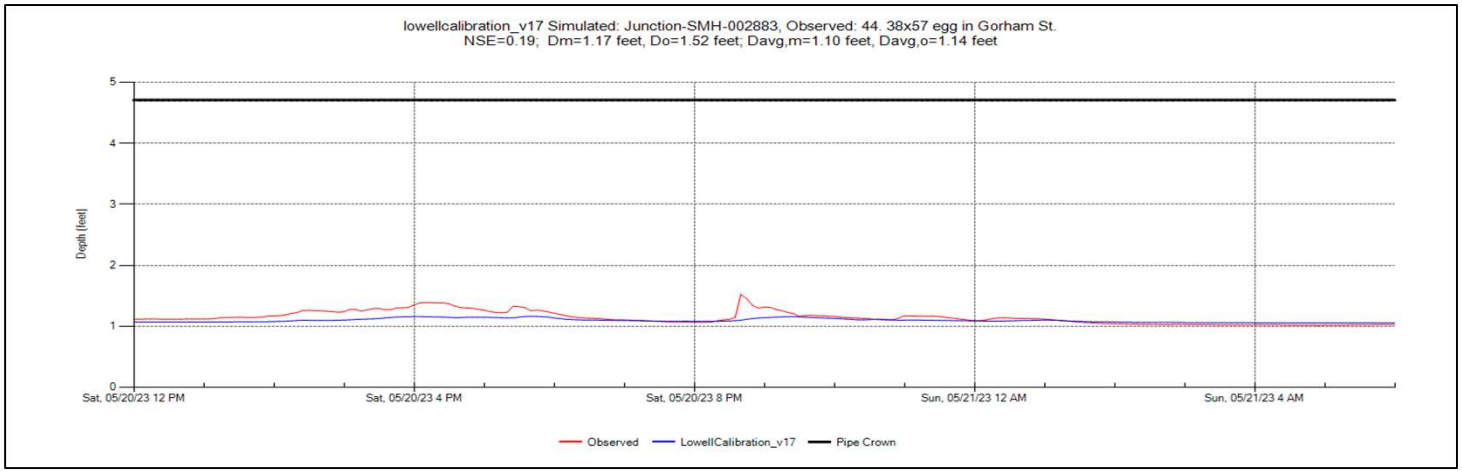


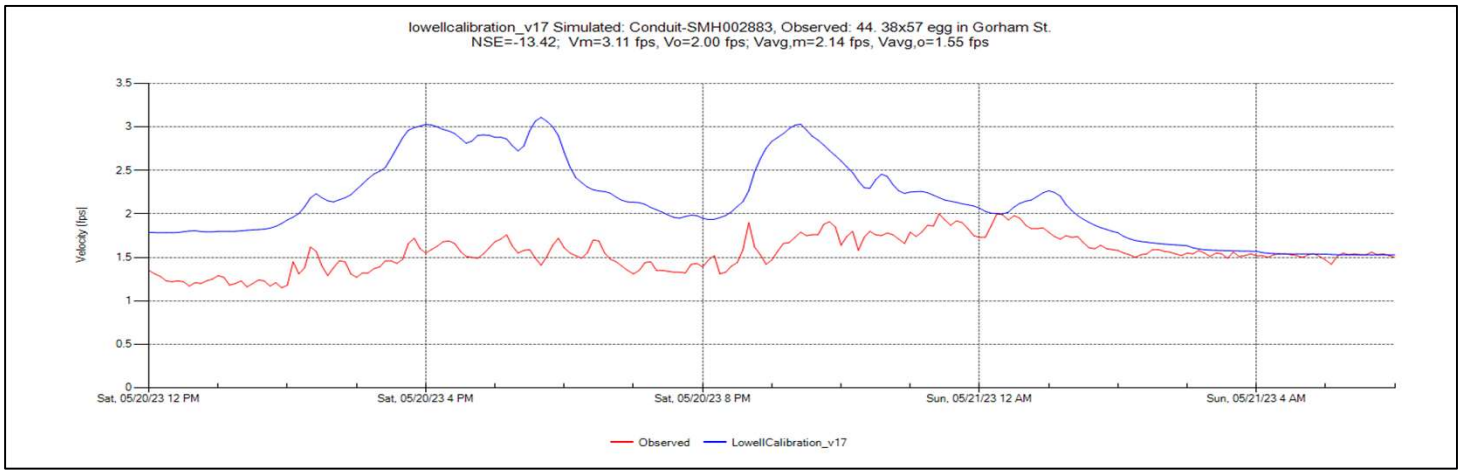


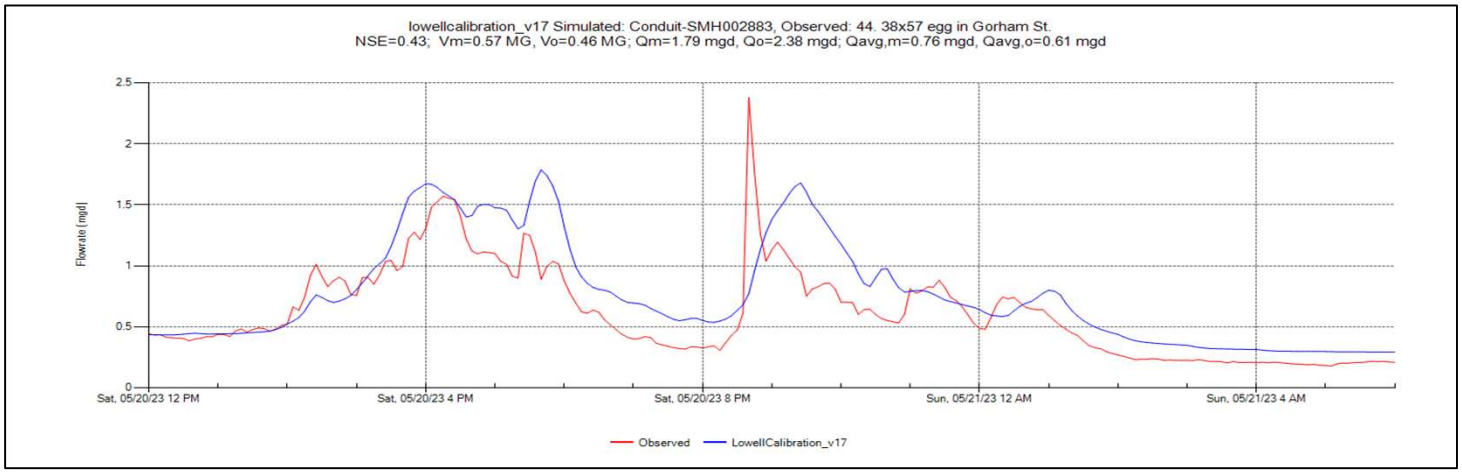


Simulated Versus Observed Flow at Flow Meter Sites

44-May 20

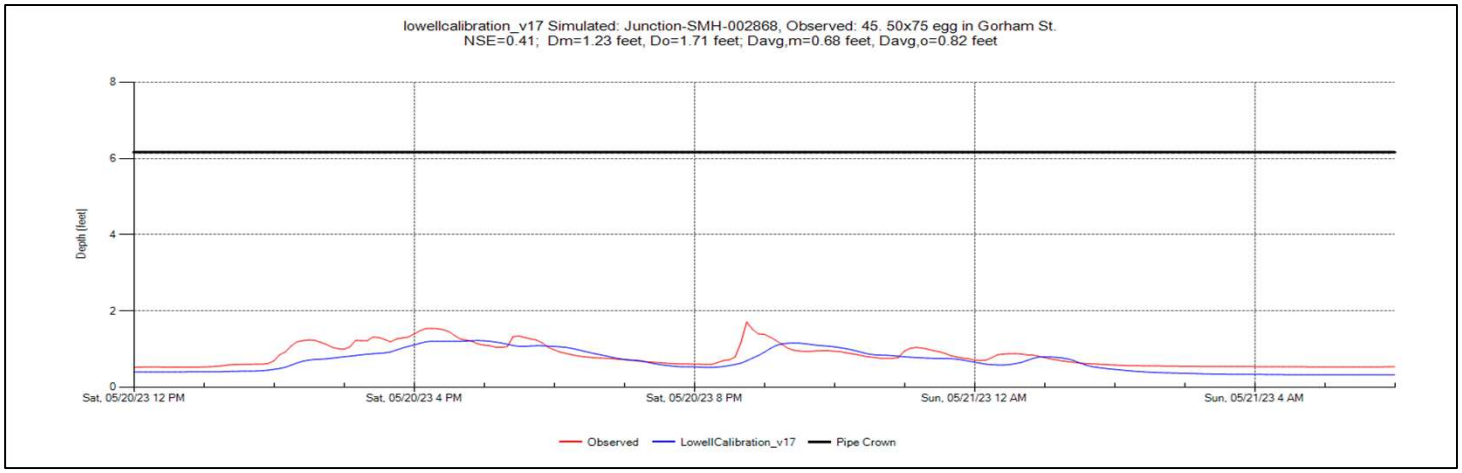


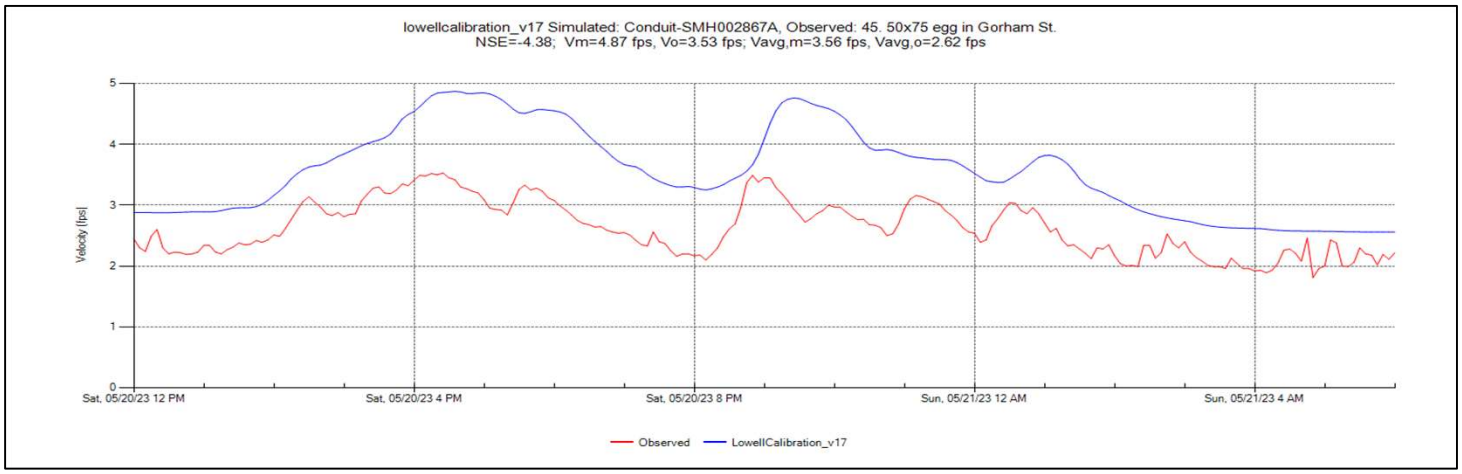


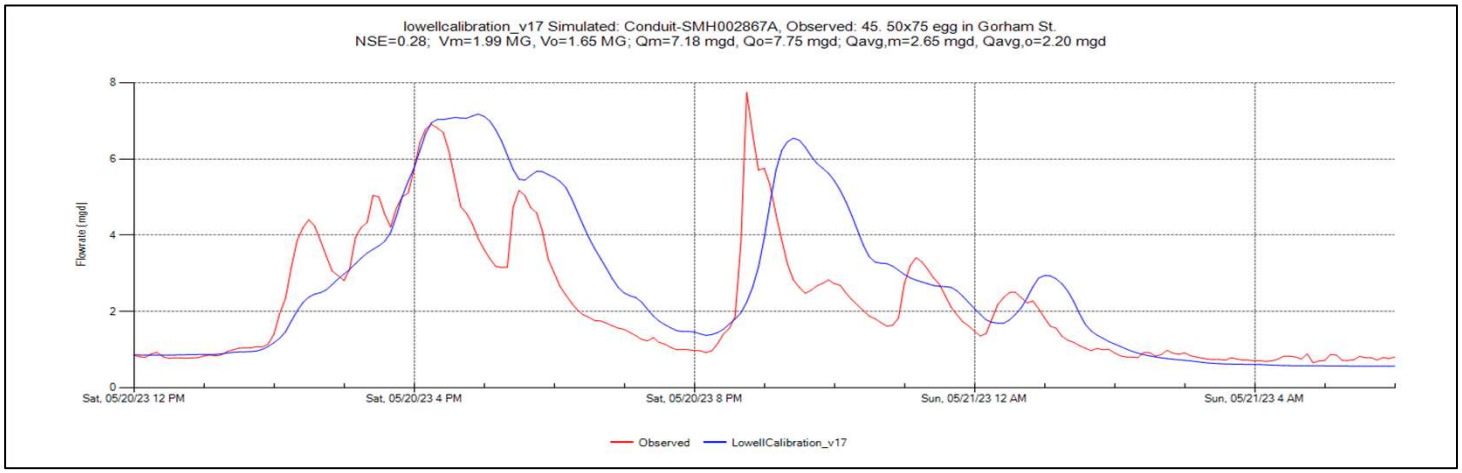


Simulated Versus Observed Flow at Flow Meter Sites

45-May 20

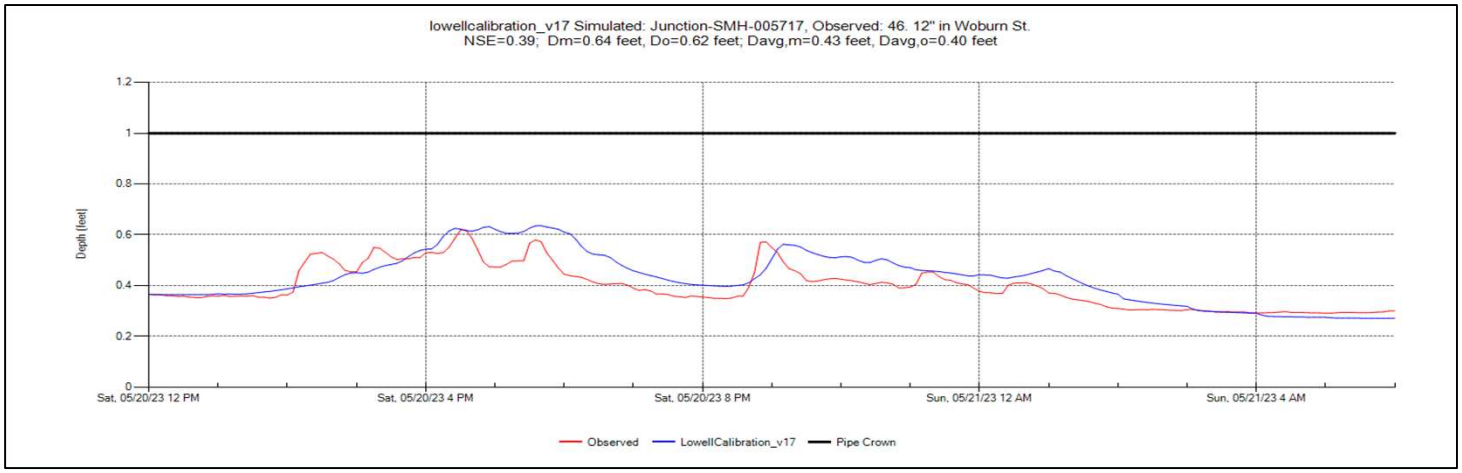


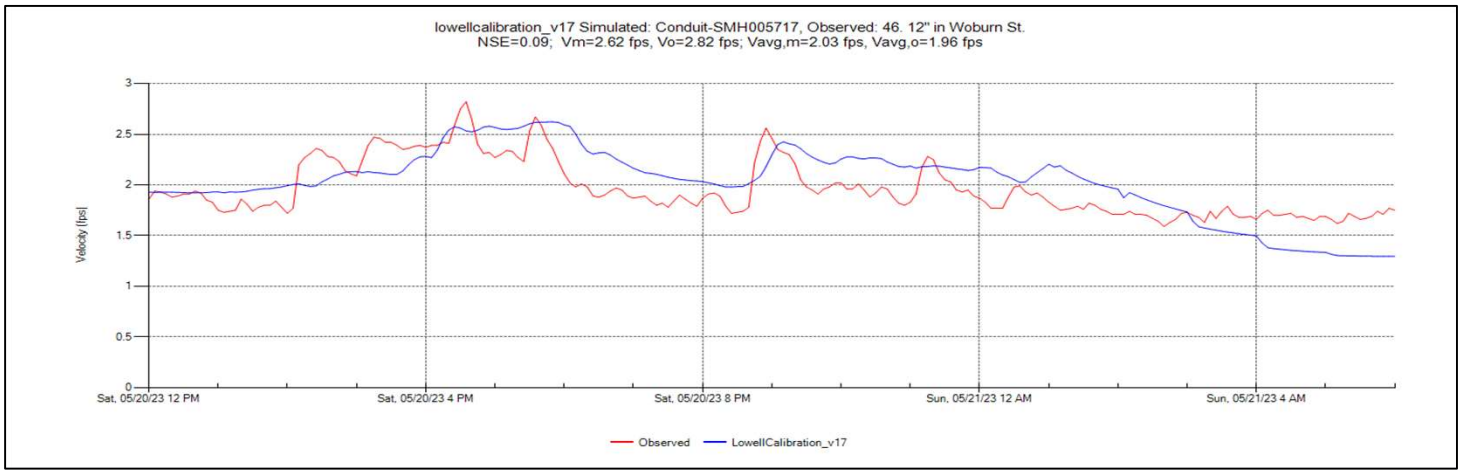


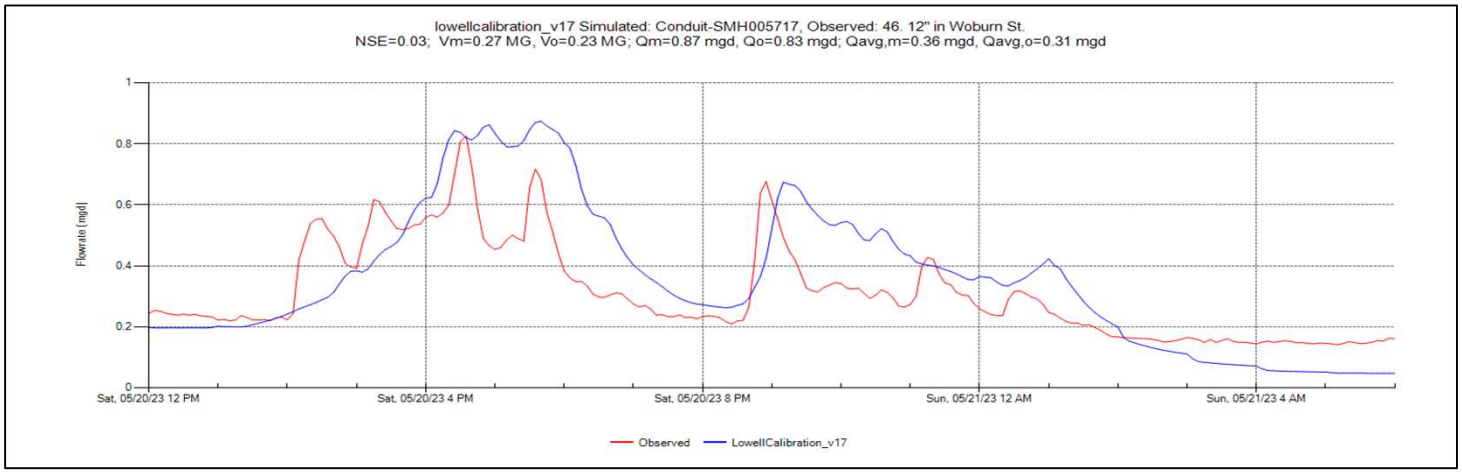


Simulated Versus Observed Flow at Flow Meter Sites

46-May 20

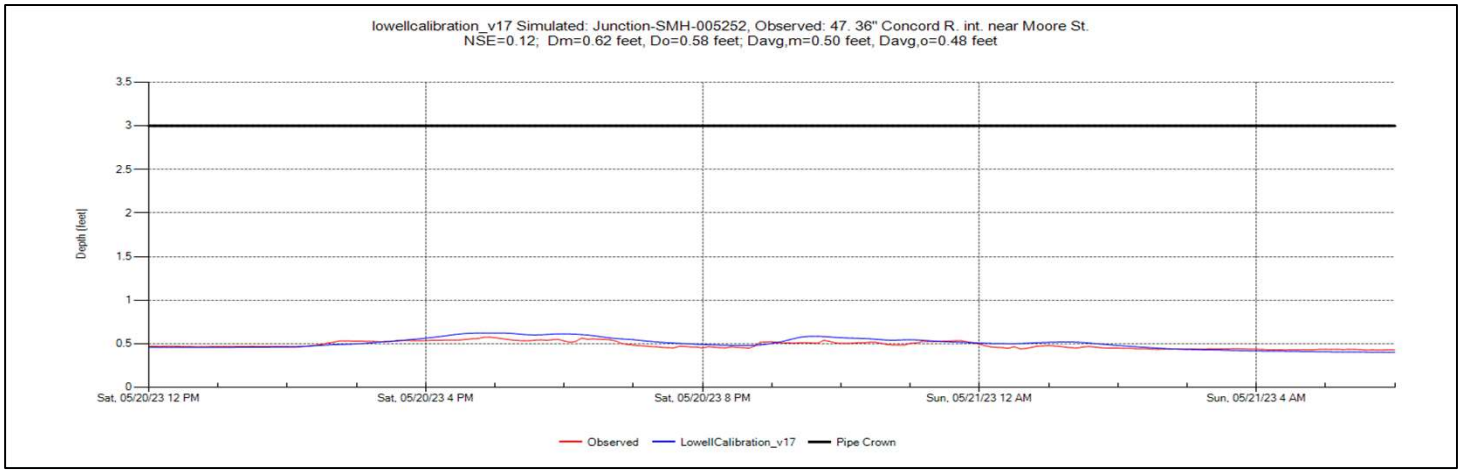


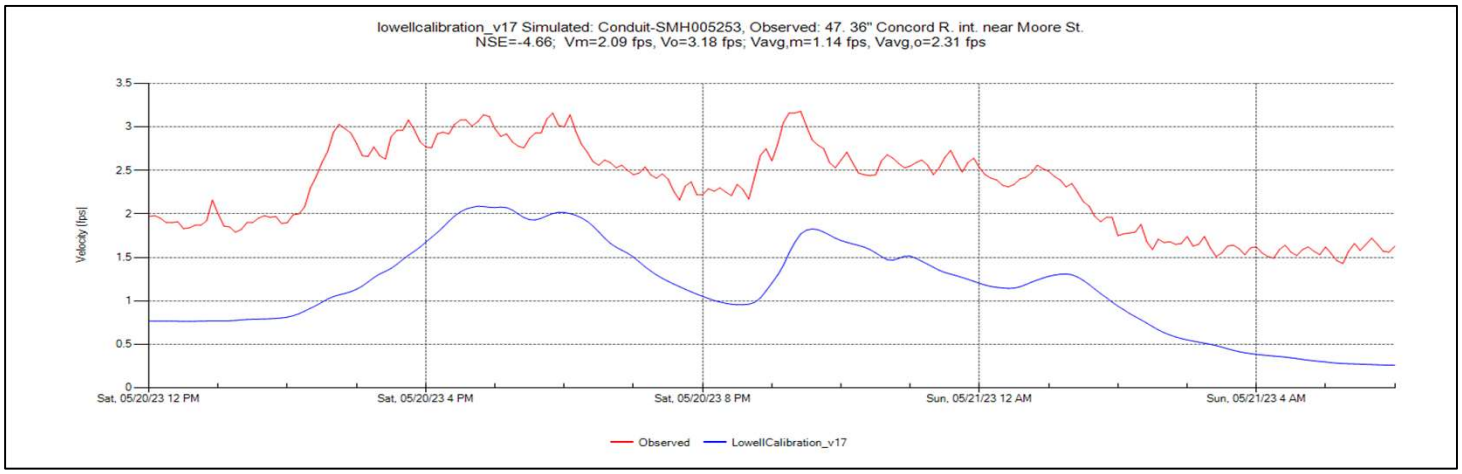


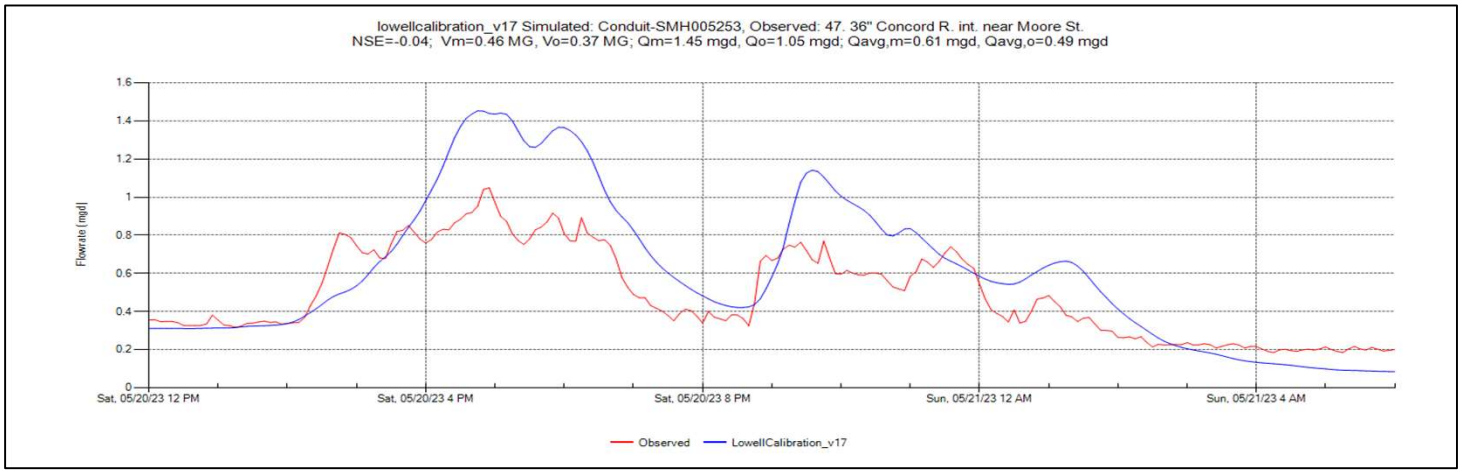


Simulated Versus Observed Flow at Flow Meter Sites

47-May 20

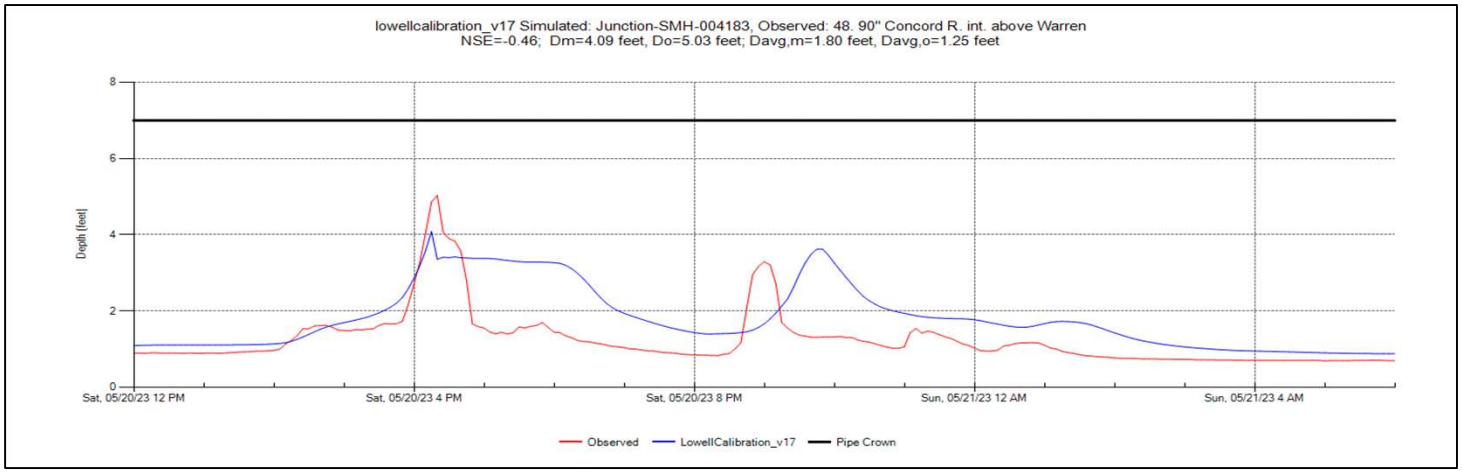


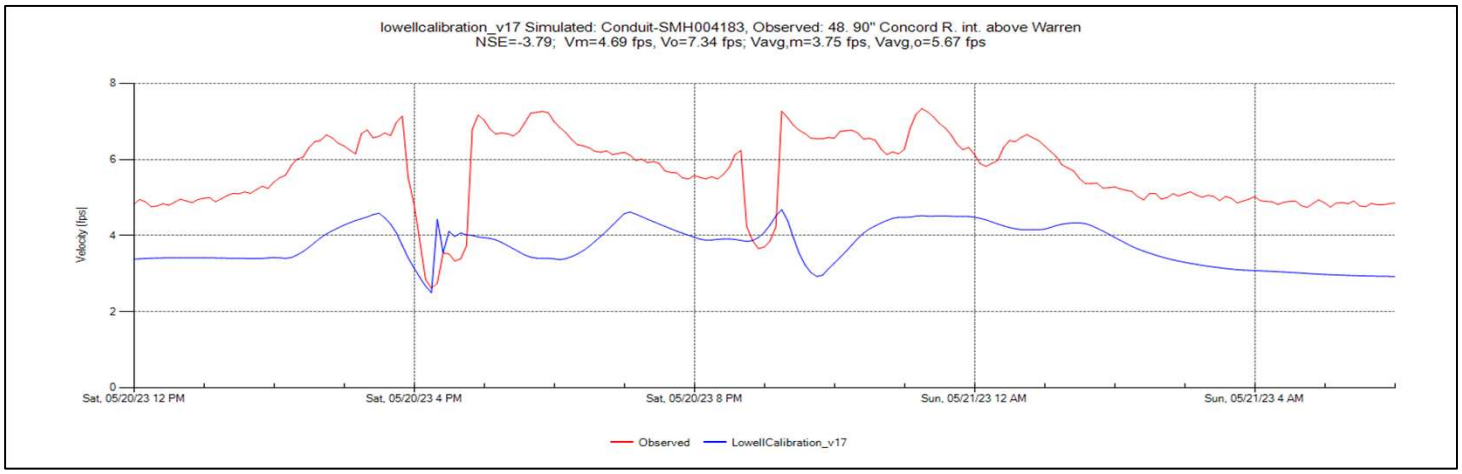


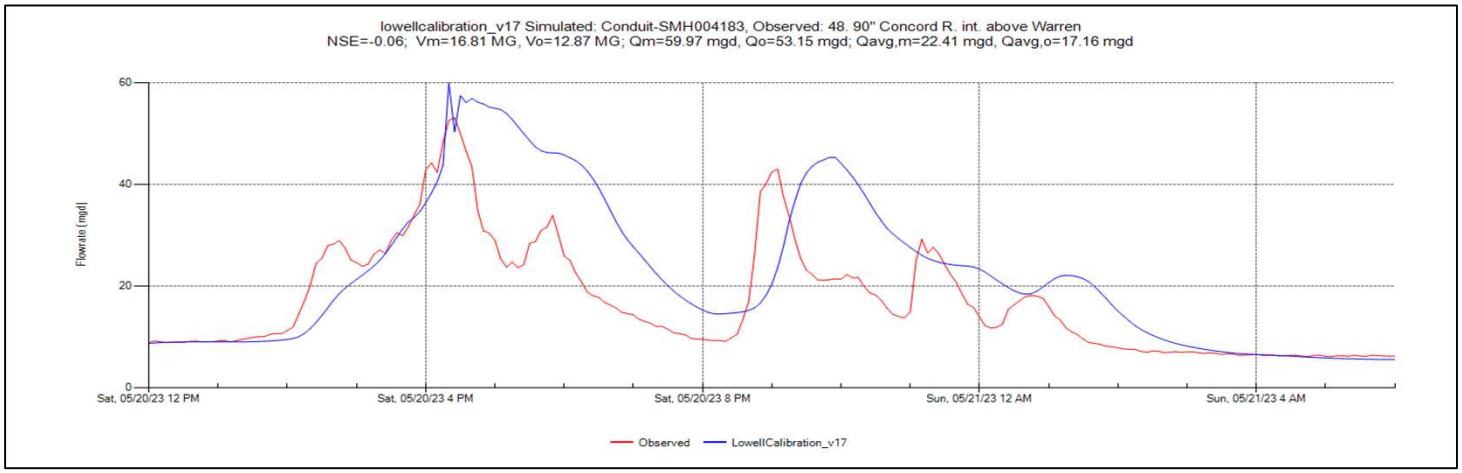


Simulated Versus Observed Flow at Flow Meter Sites

48-May 20

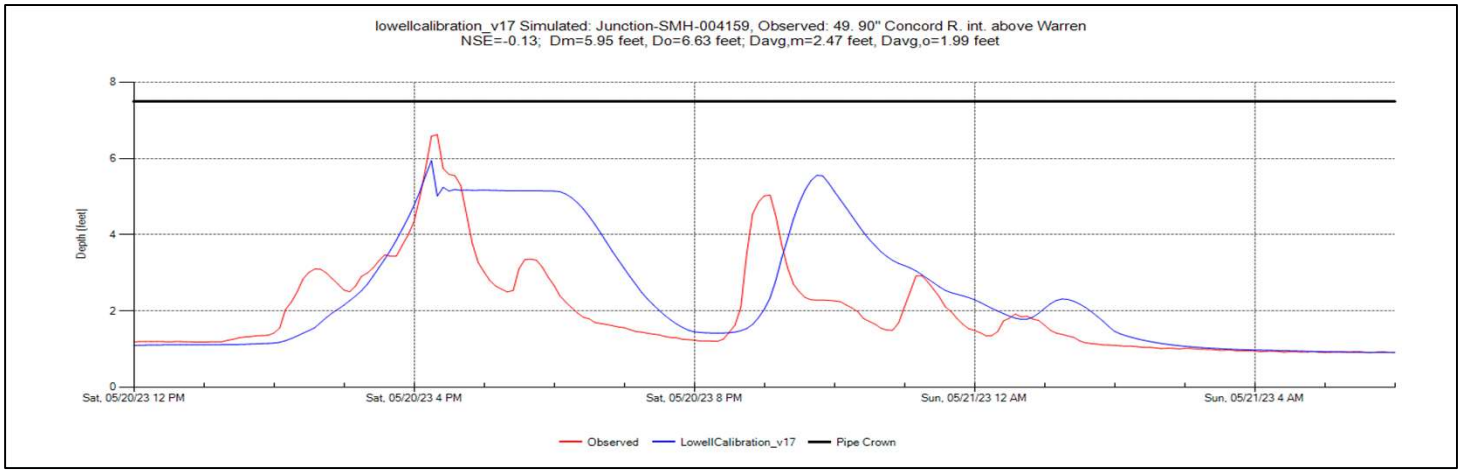


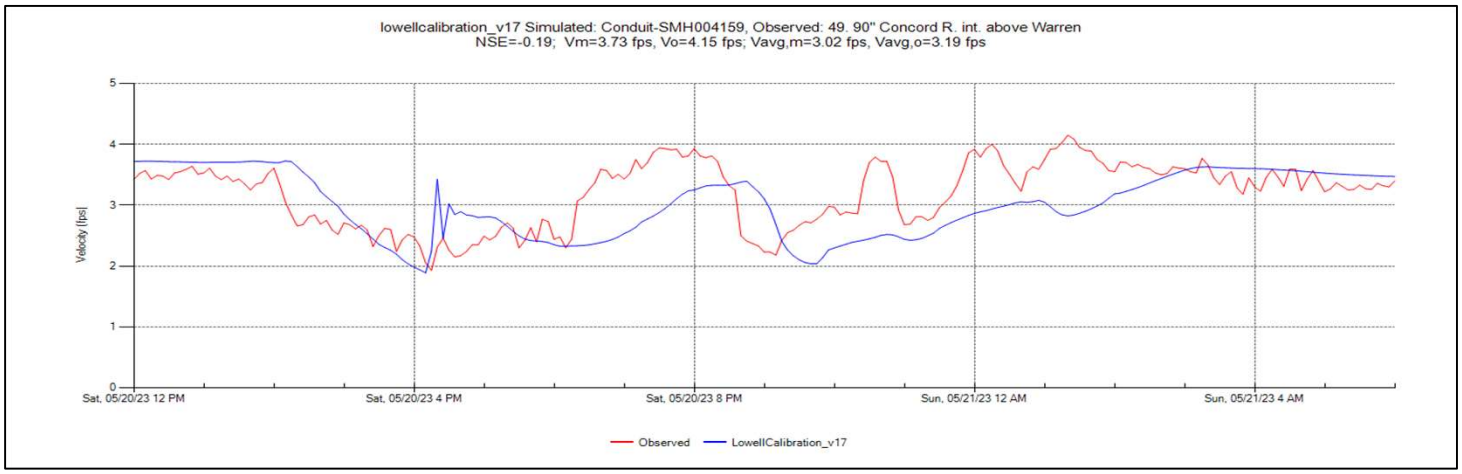


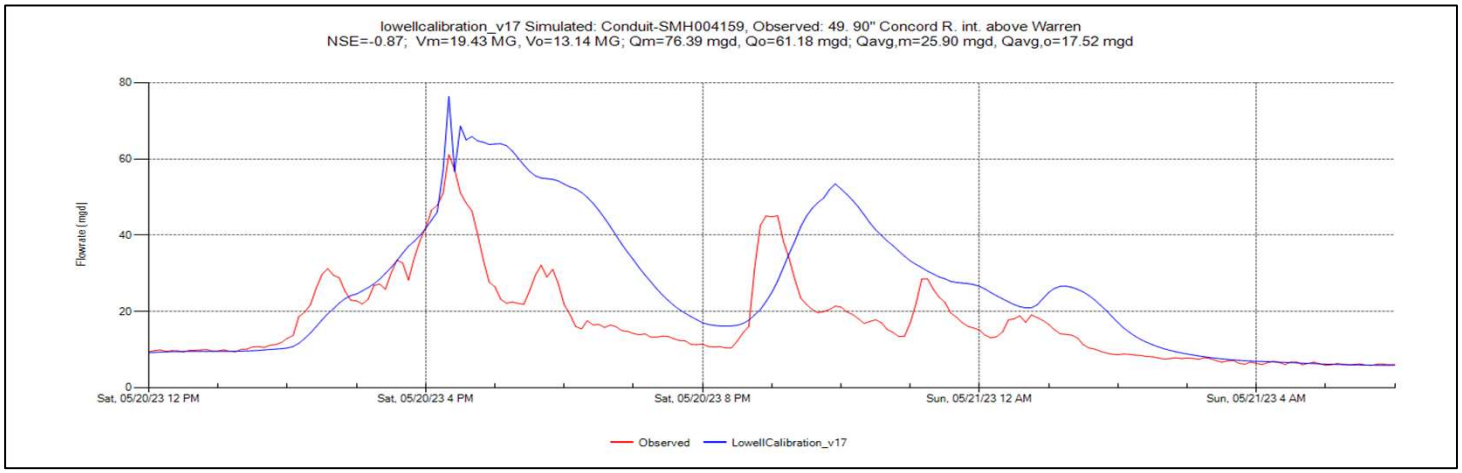


Simulated Versus Observed Flow at Flow Meter Sites

49-May 20

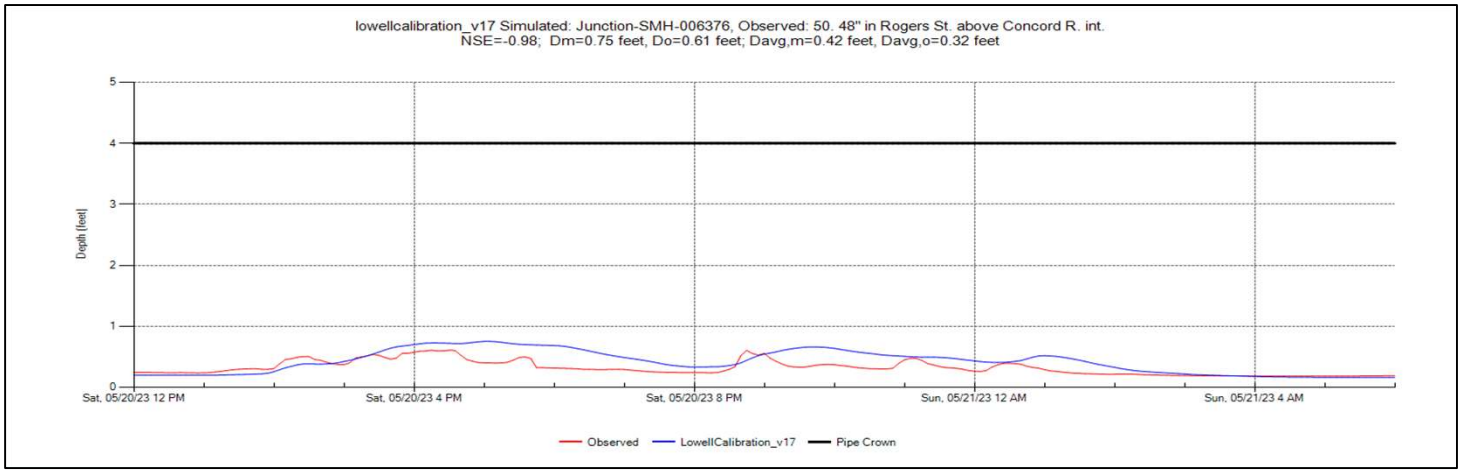


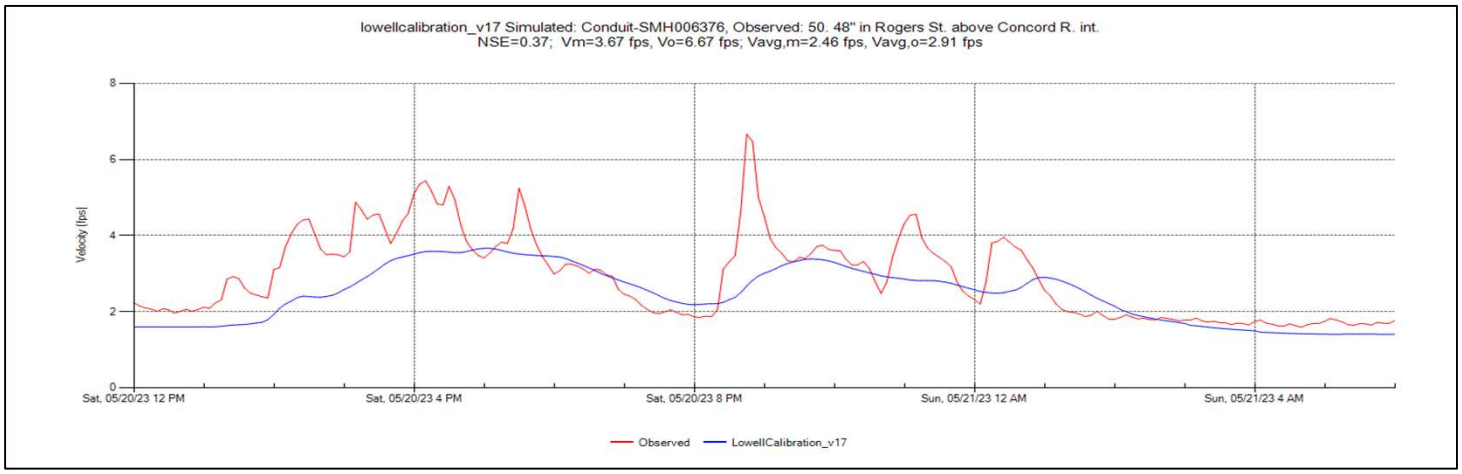


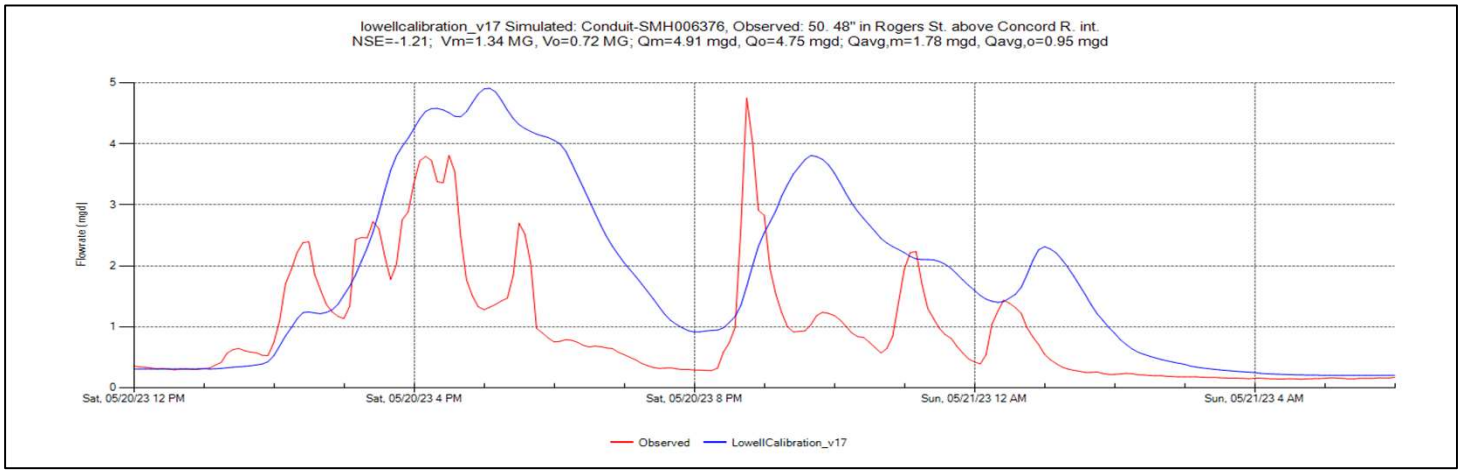


Simulated Versus Observed Flow at Flow Meter Sites

50-May 20

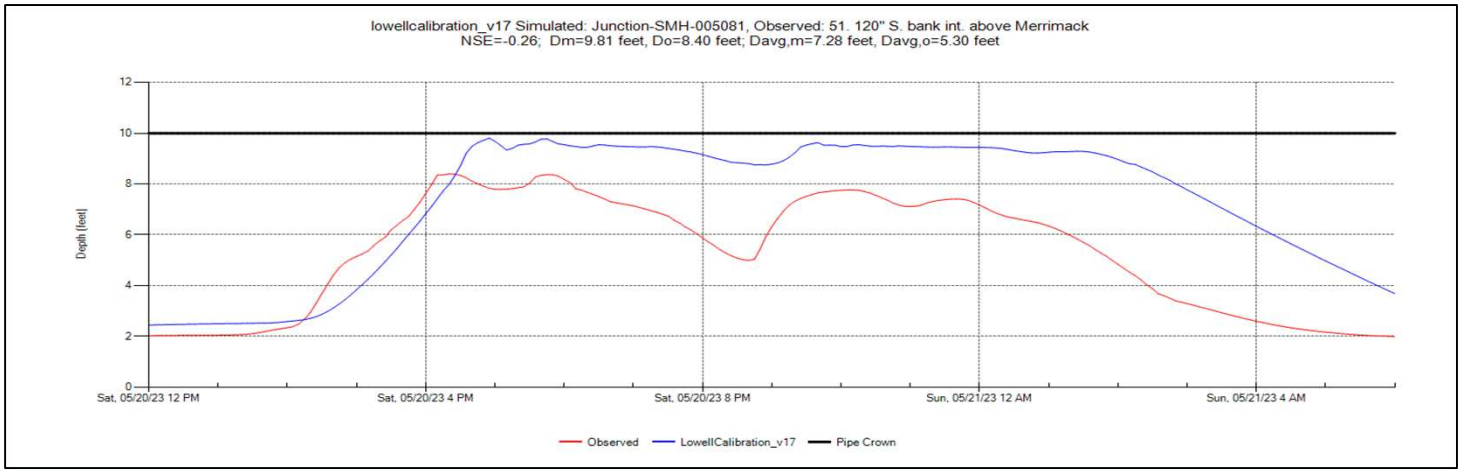


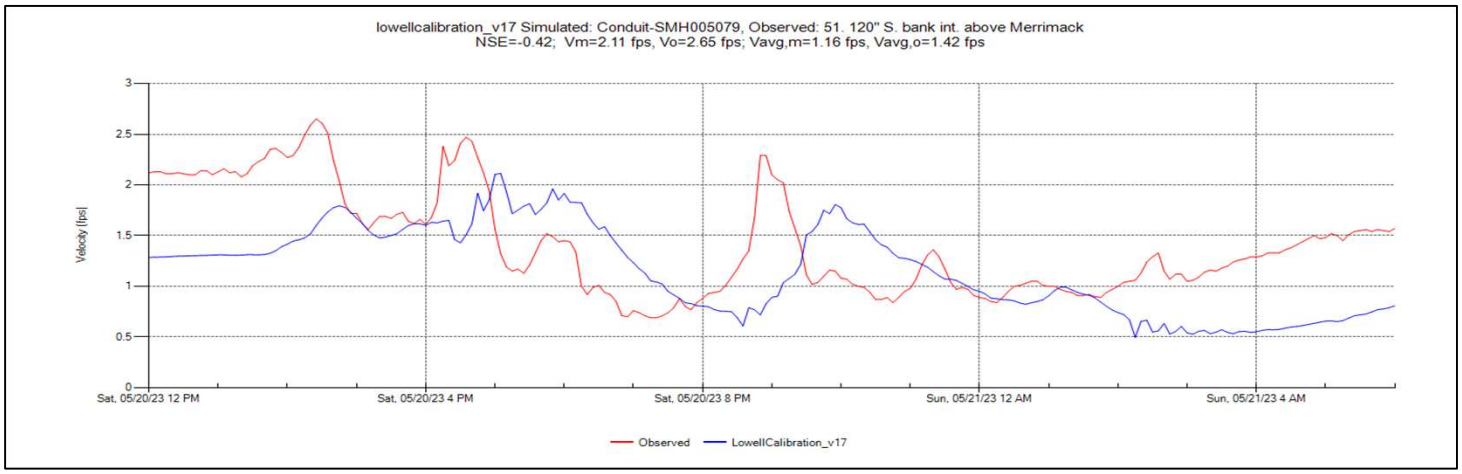


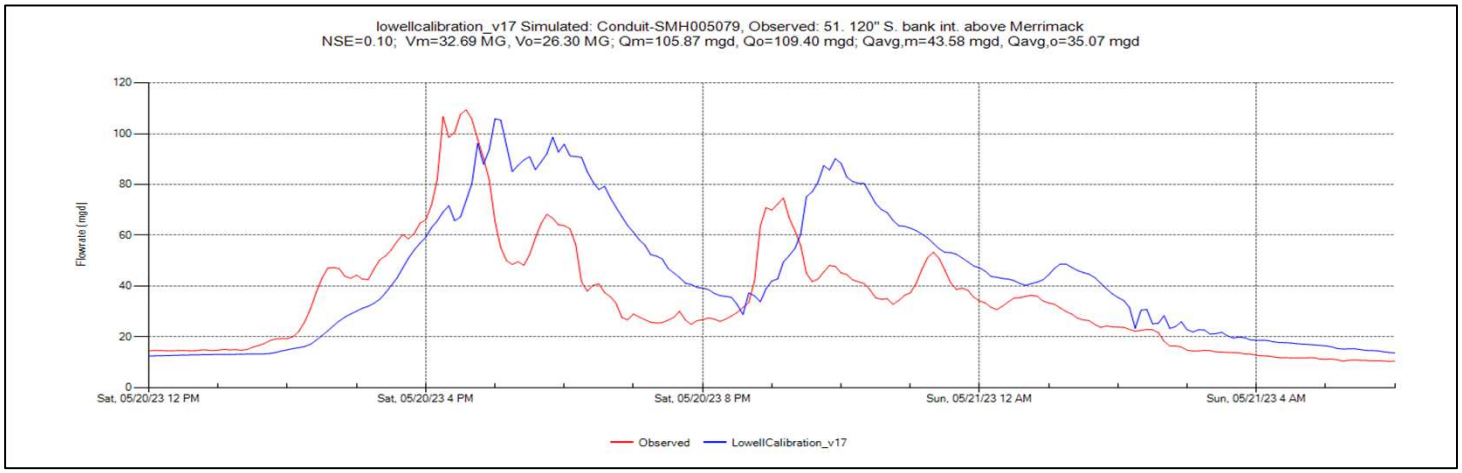


Simulated Versus Observed Flow at Flow Meter Sites

51-May 20

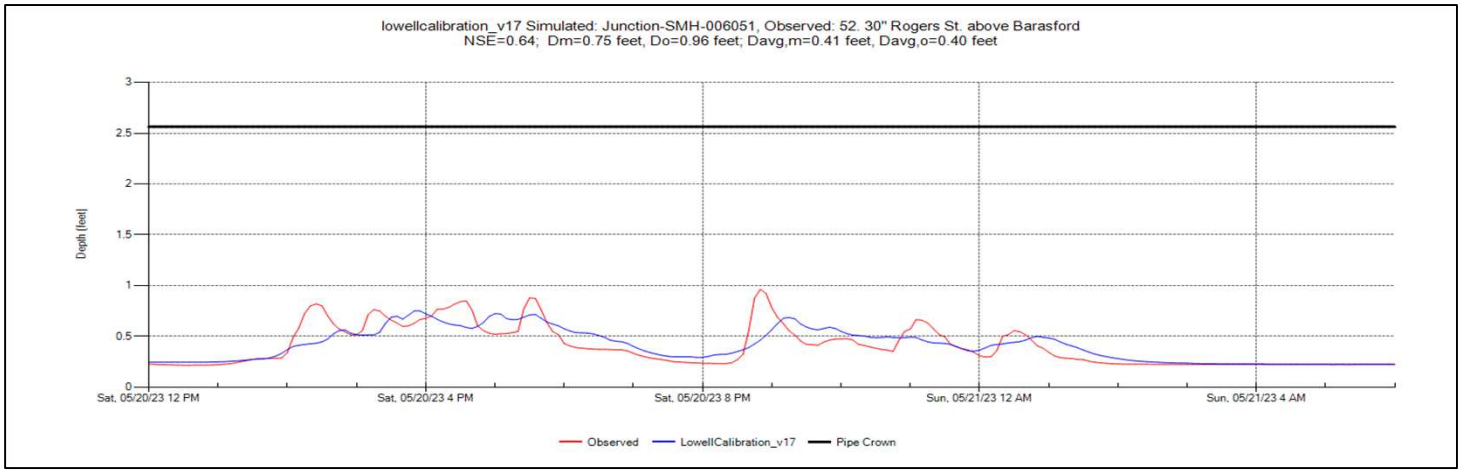


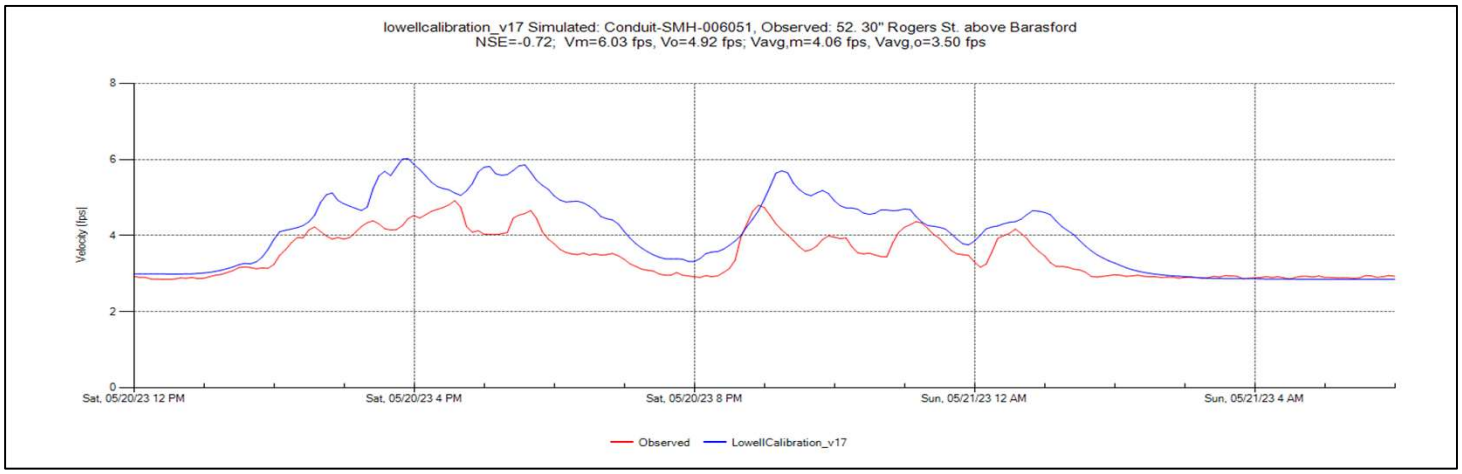


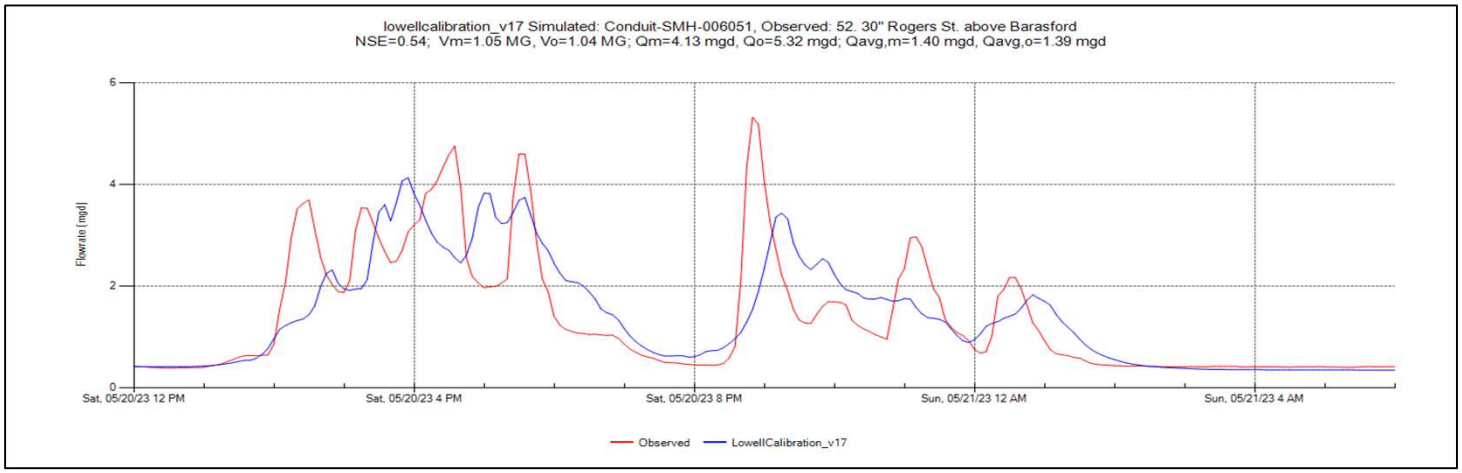


Simulated Versus Observed Flow at Flow Meter Sites

52-May 20

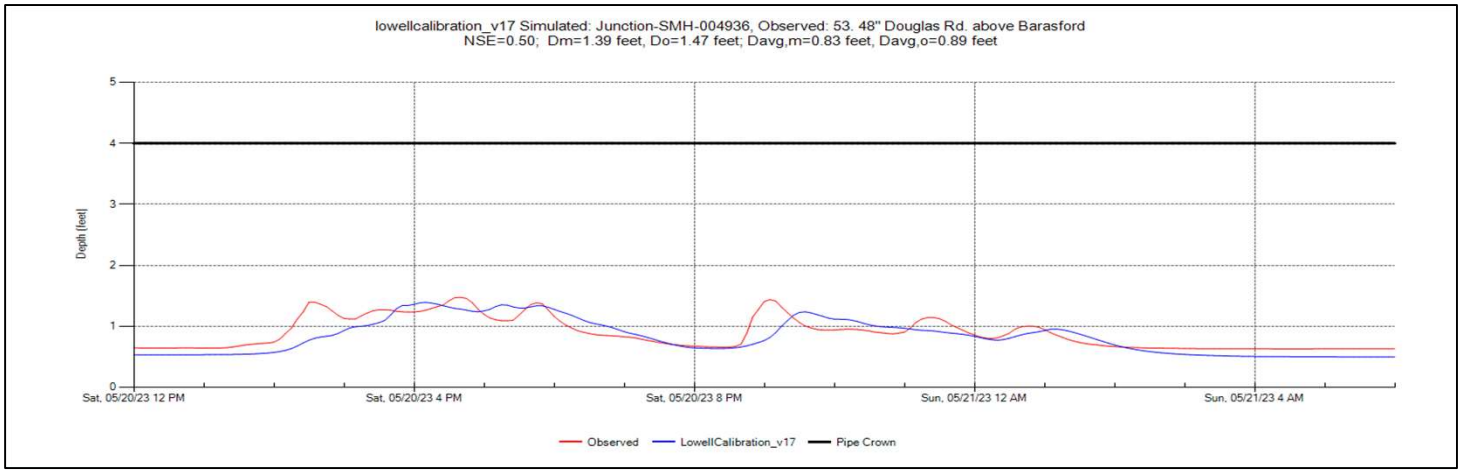


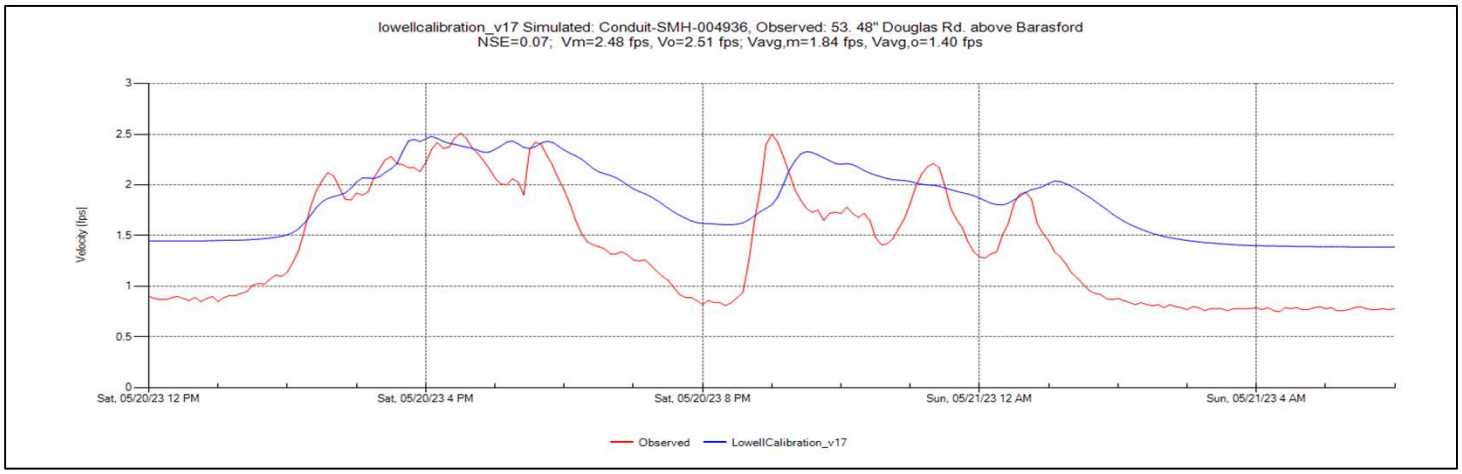


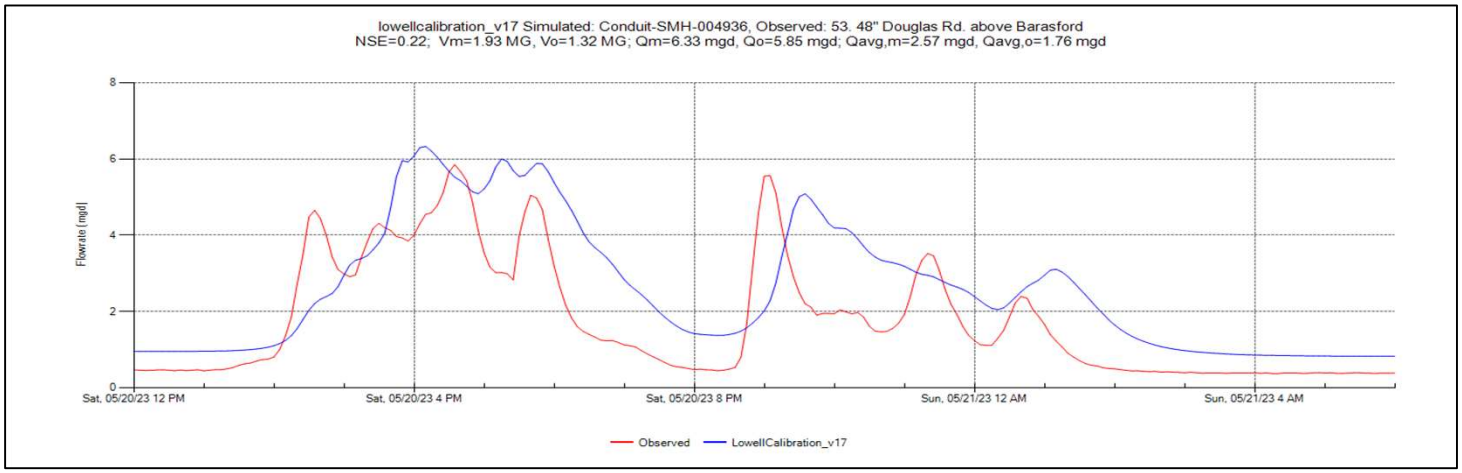


Simulated Versus Observed Flow at Flow Meter Sites

53-May 20

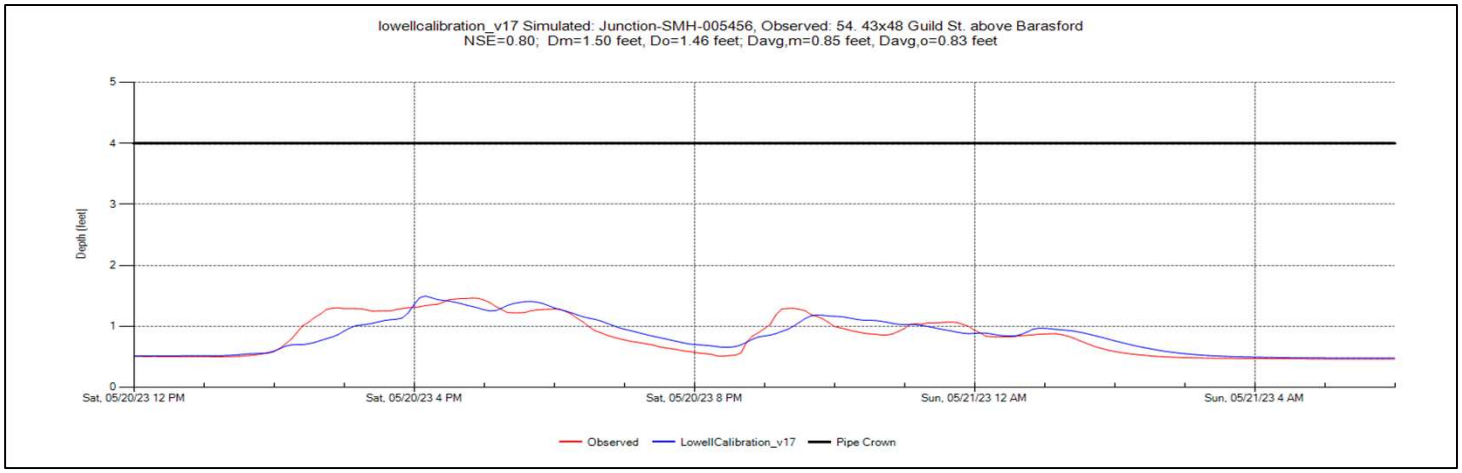


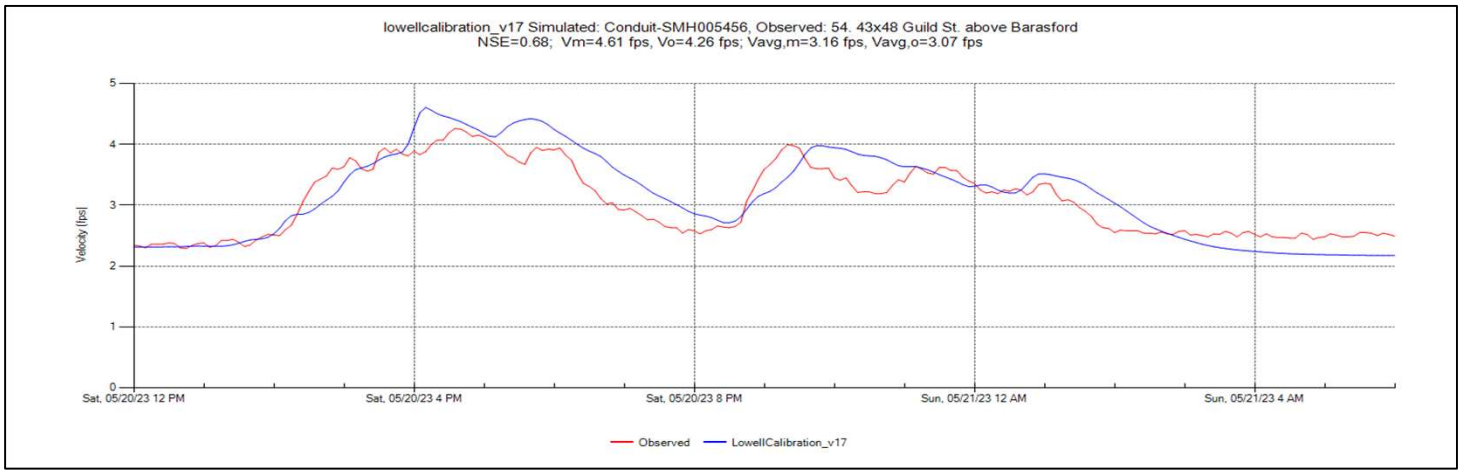


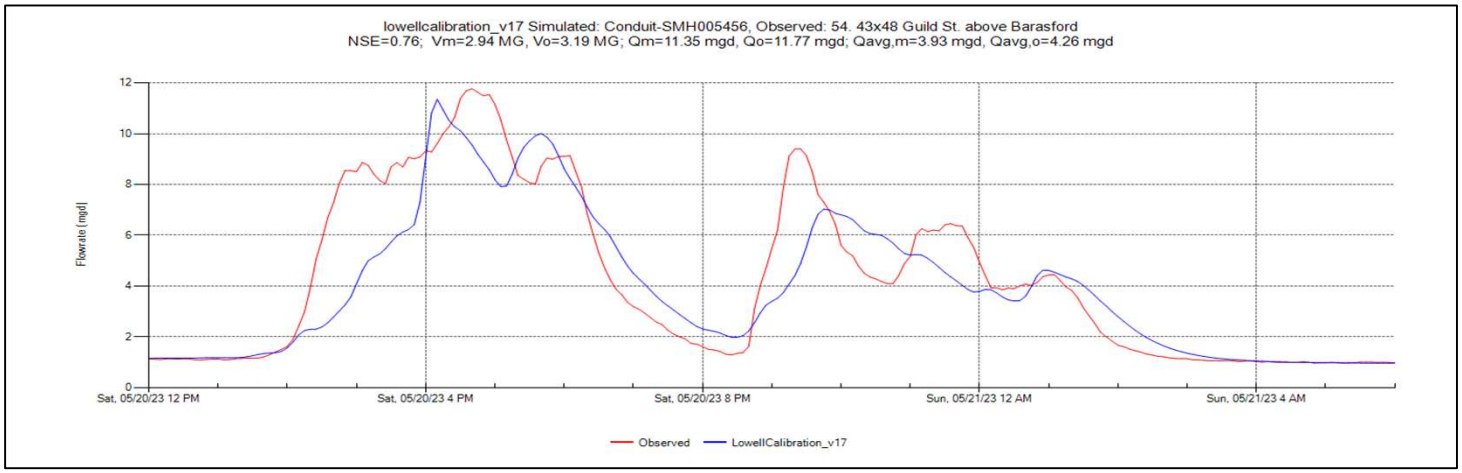


Simulated Versus Observed Flow at Flow Meter Sites

54-May 20

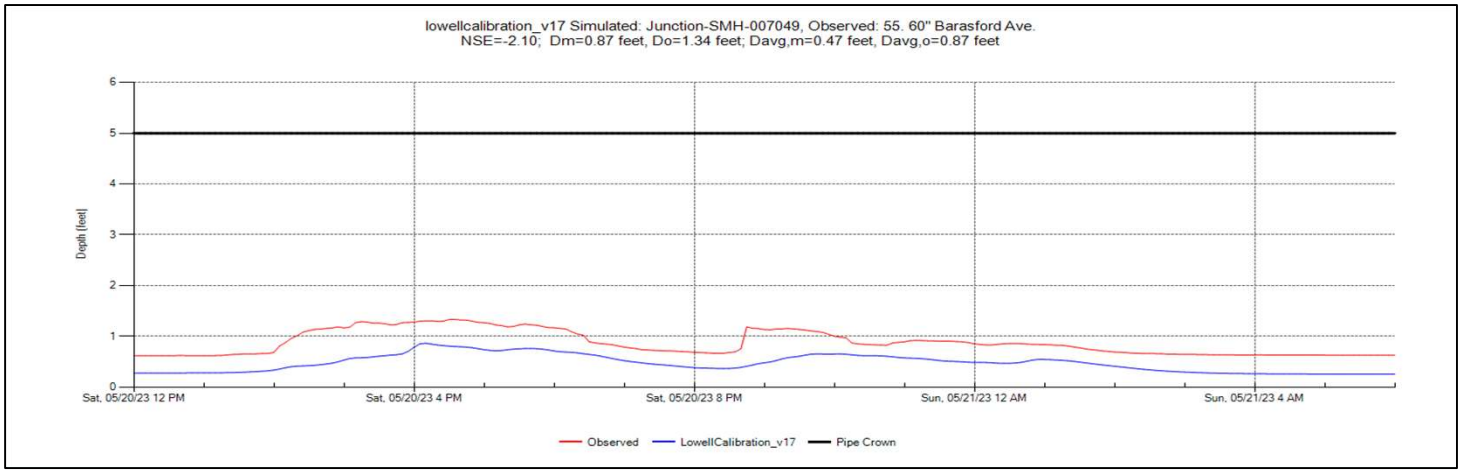


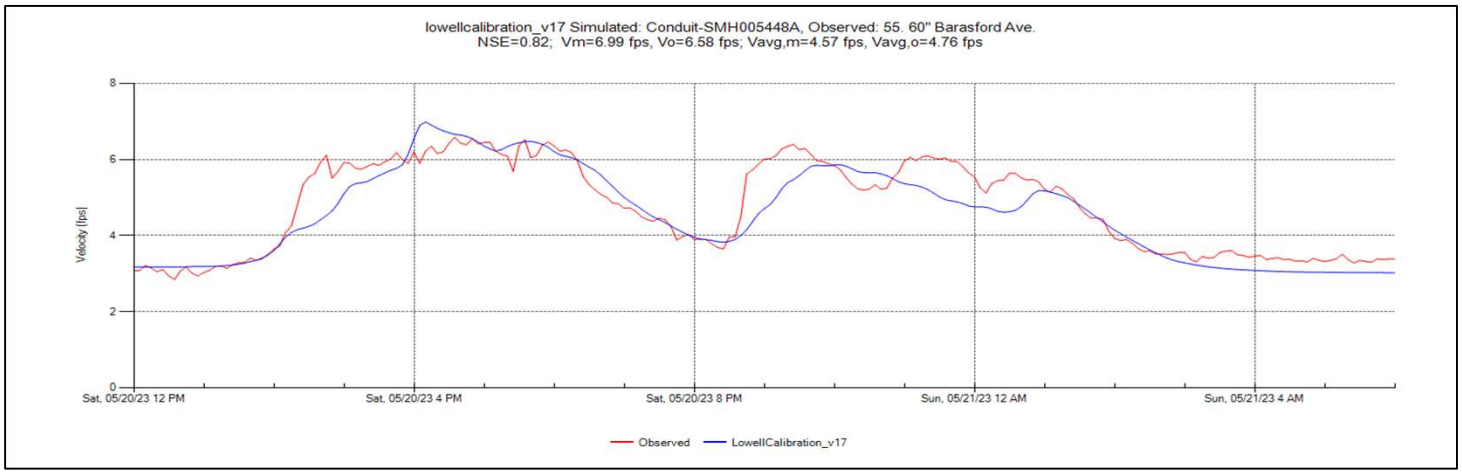


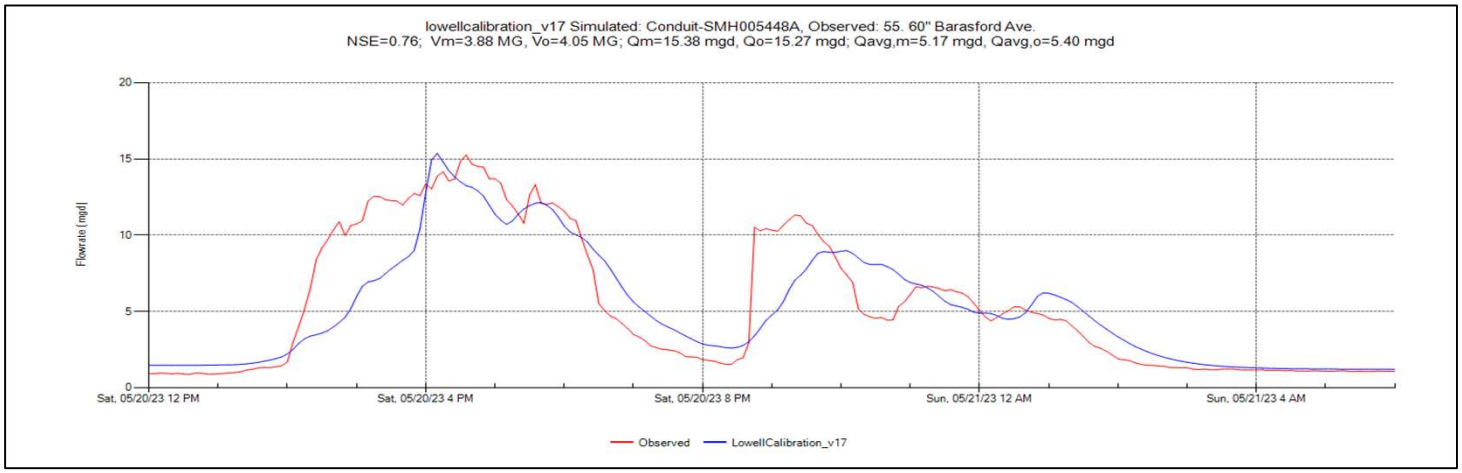


Simulated Versus Observed Flow at Flow Meter Sites

55-May 20

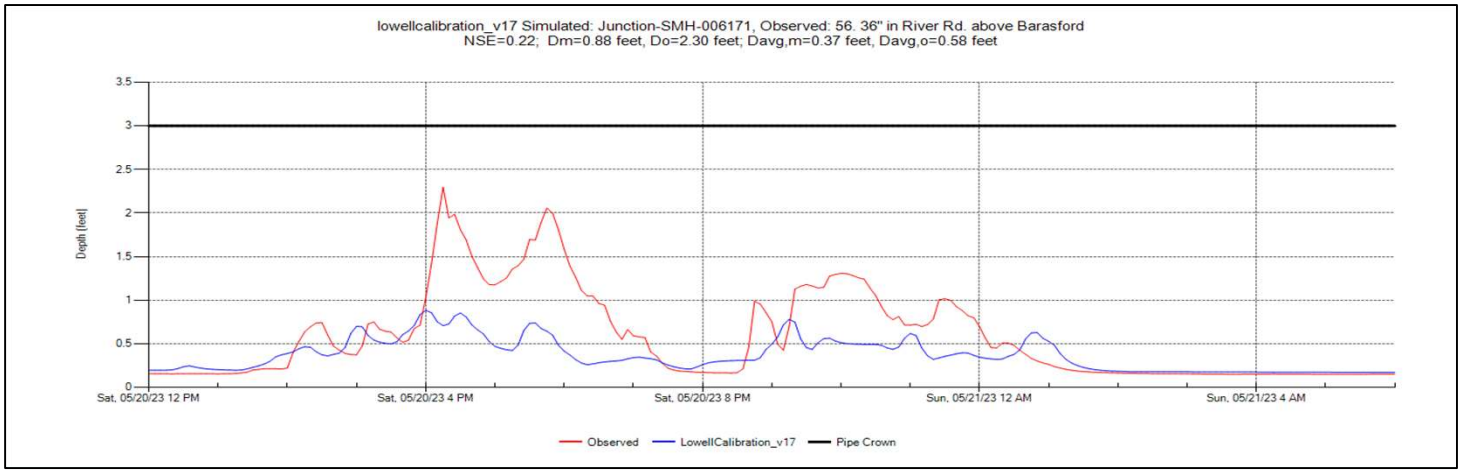


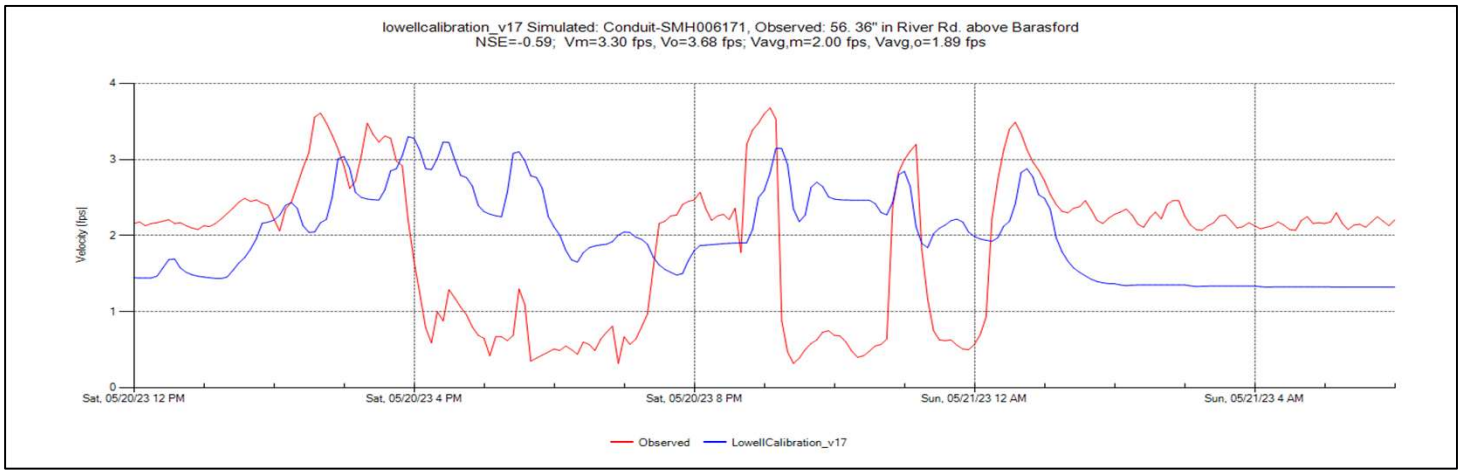


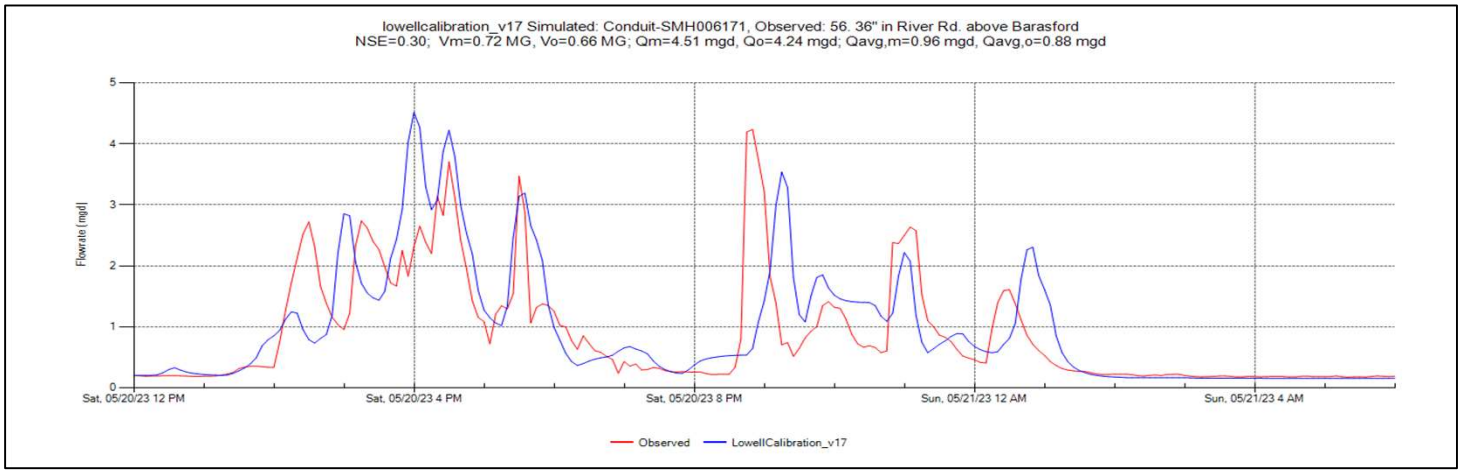


Simulated Versus Observed Flow at Flow Meter Sites

56-May 20

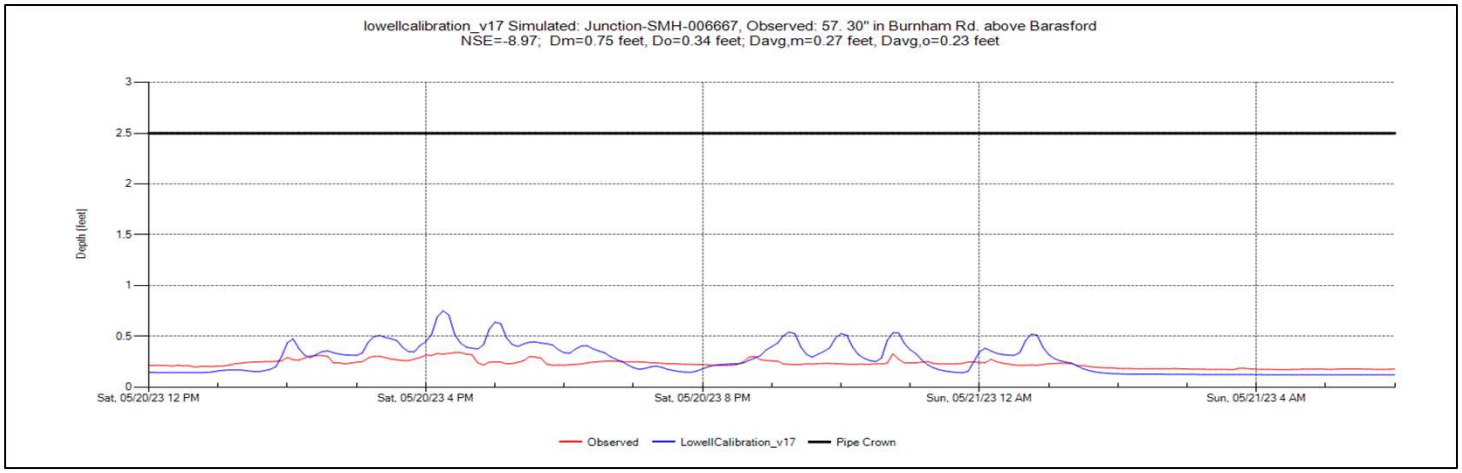


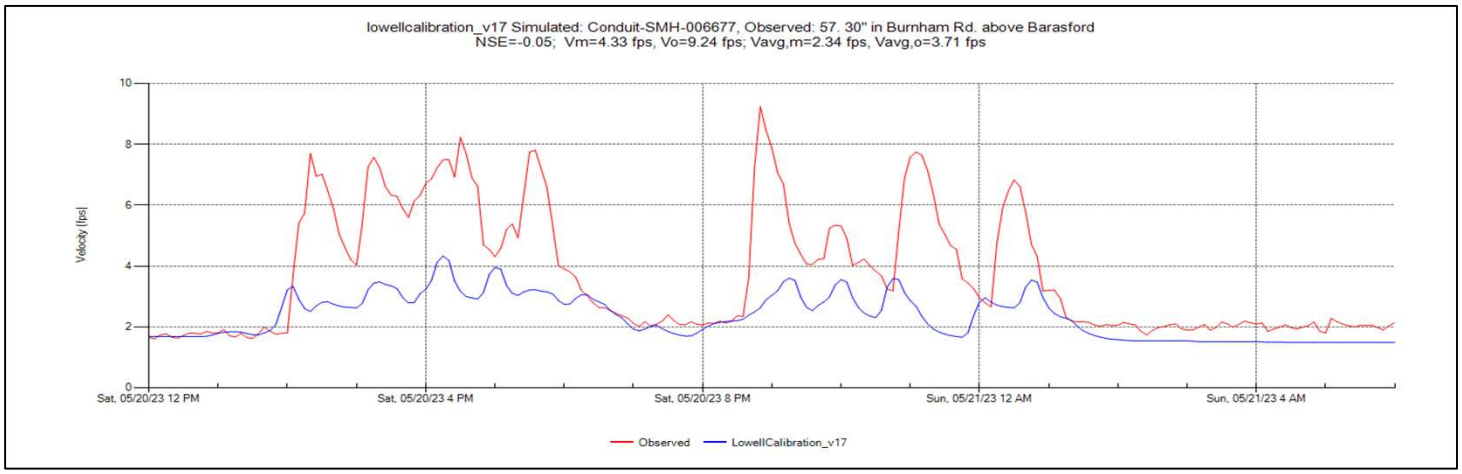


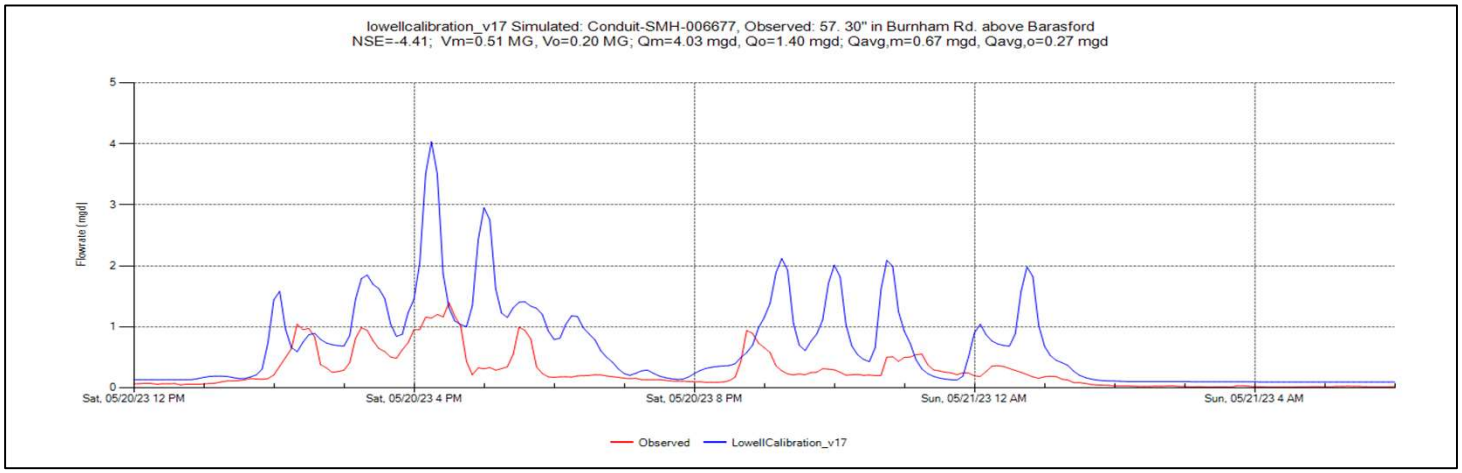


Simulated Versus Observed Flow at Flow Meter Sites

57-May 20

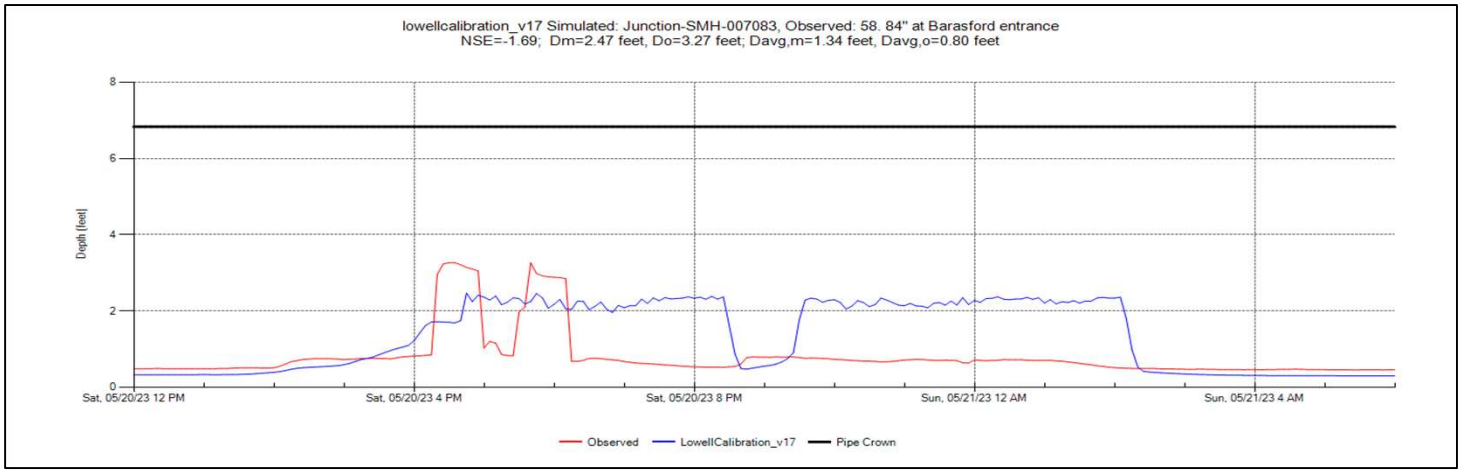


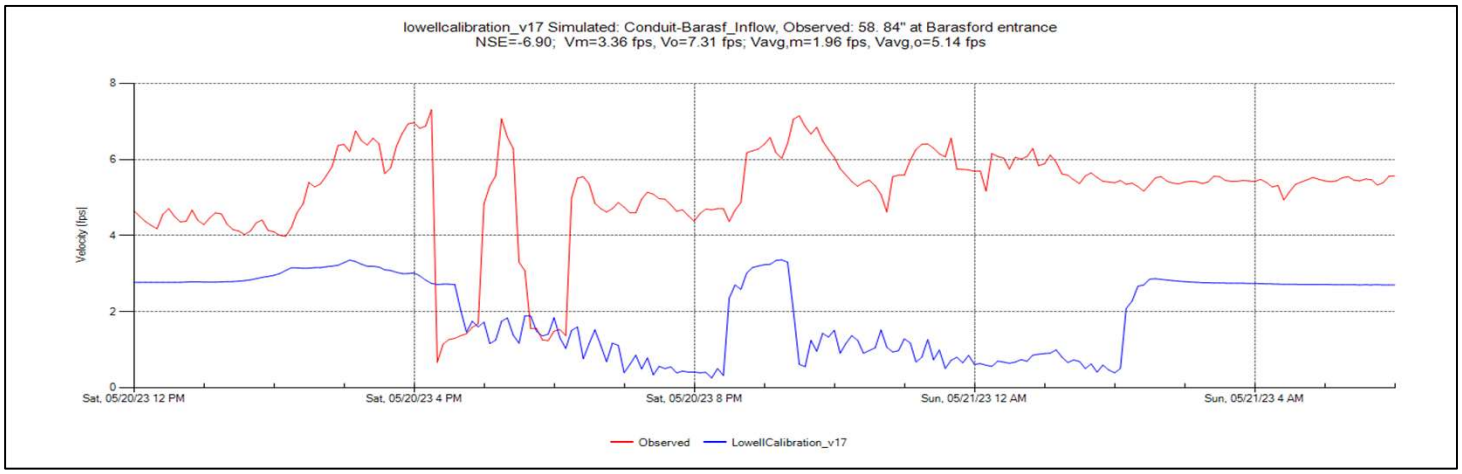


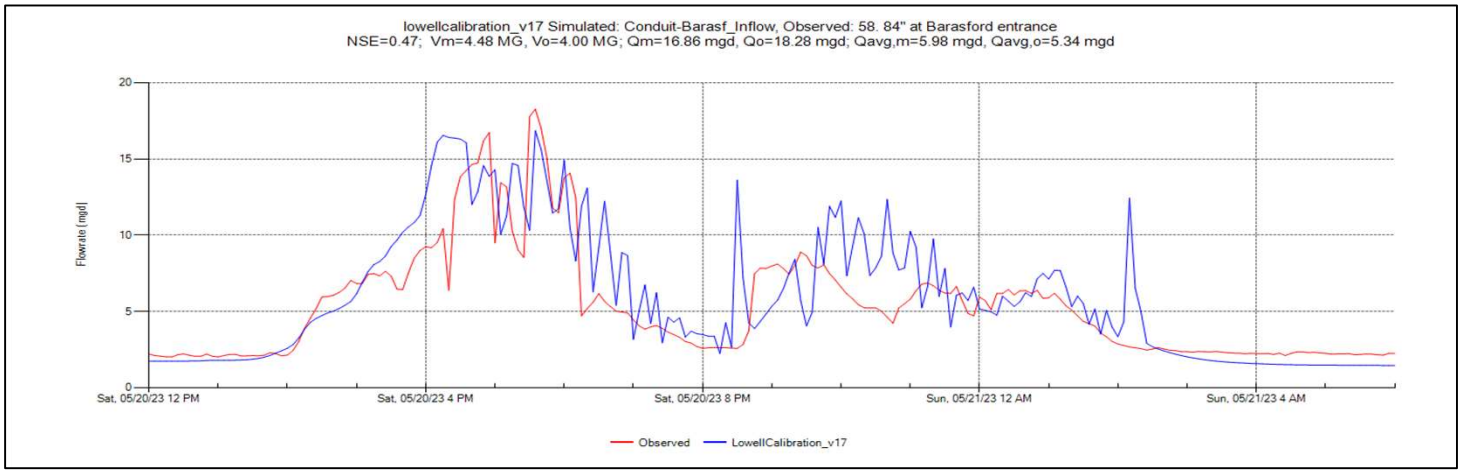


Simulated Versus Observed Flow at Flow Meter Sites

58-May 20

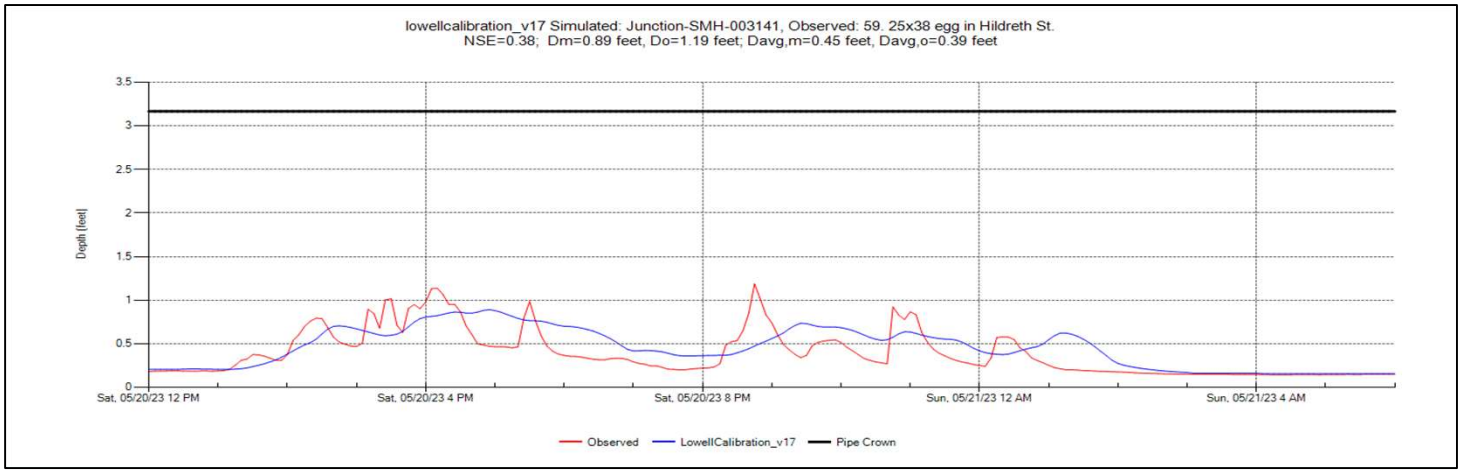


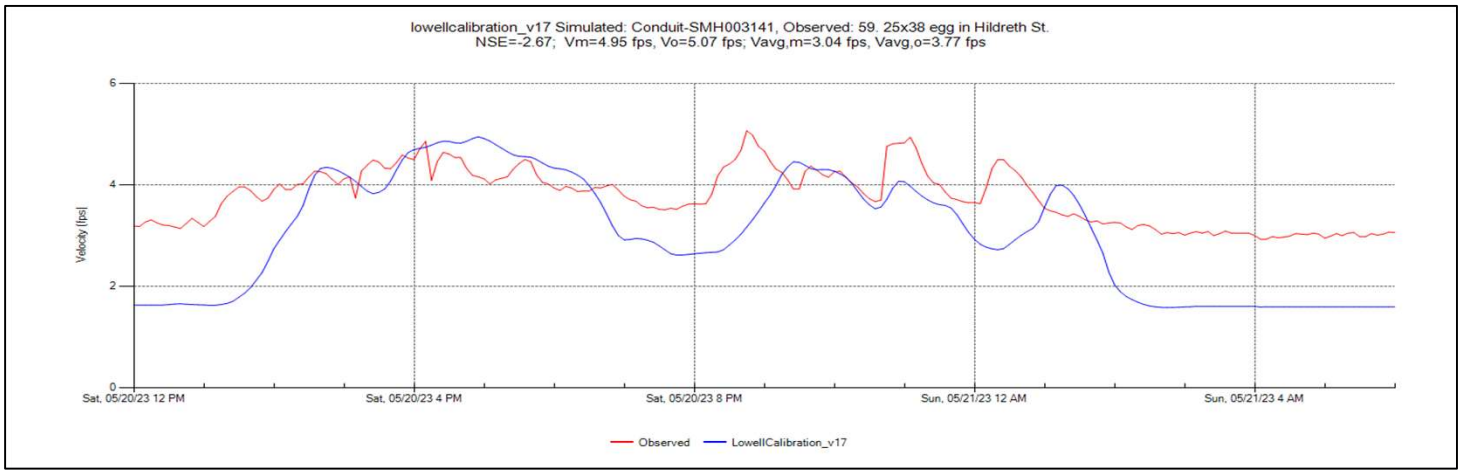


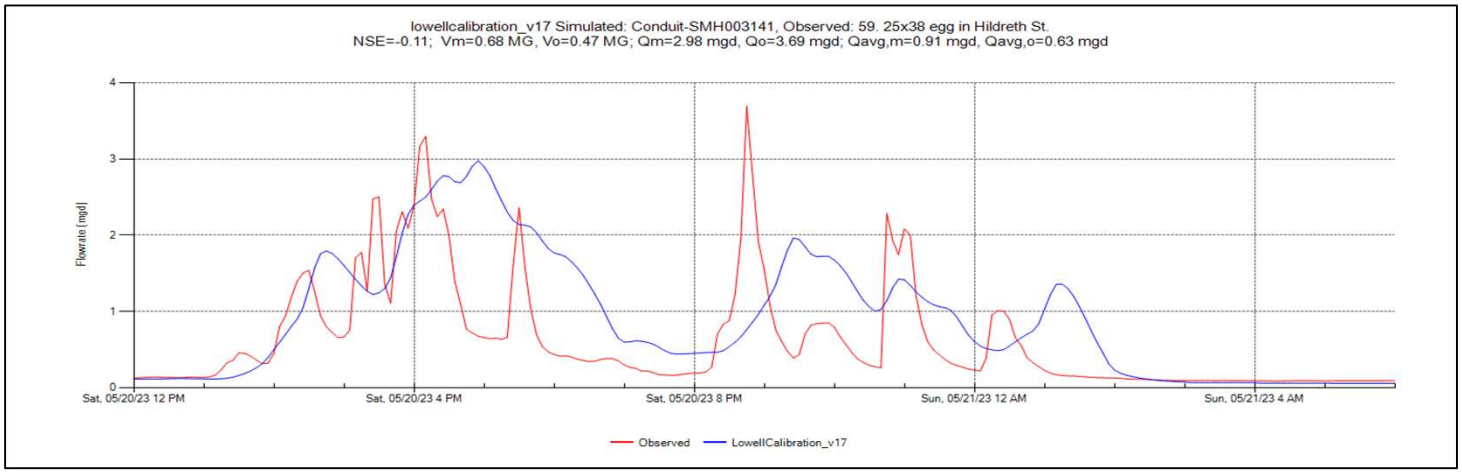


Simulated Versus Observed Flow at Flow Meter Sites

59-May 20

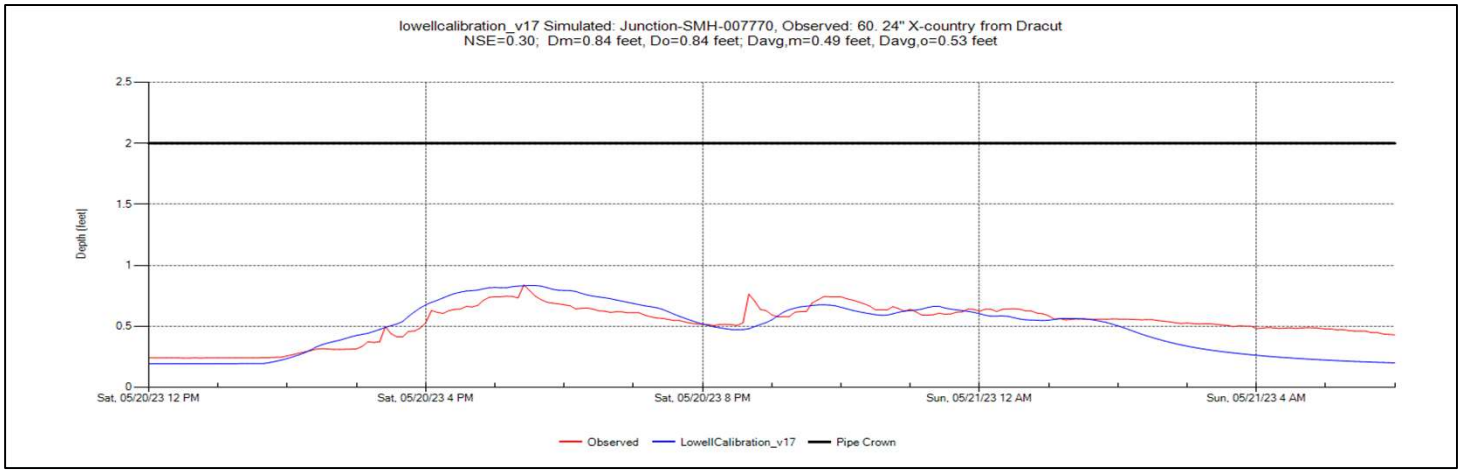


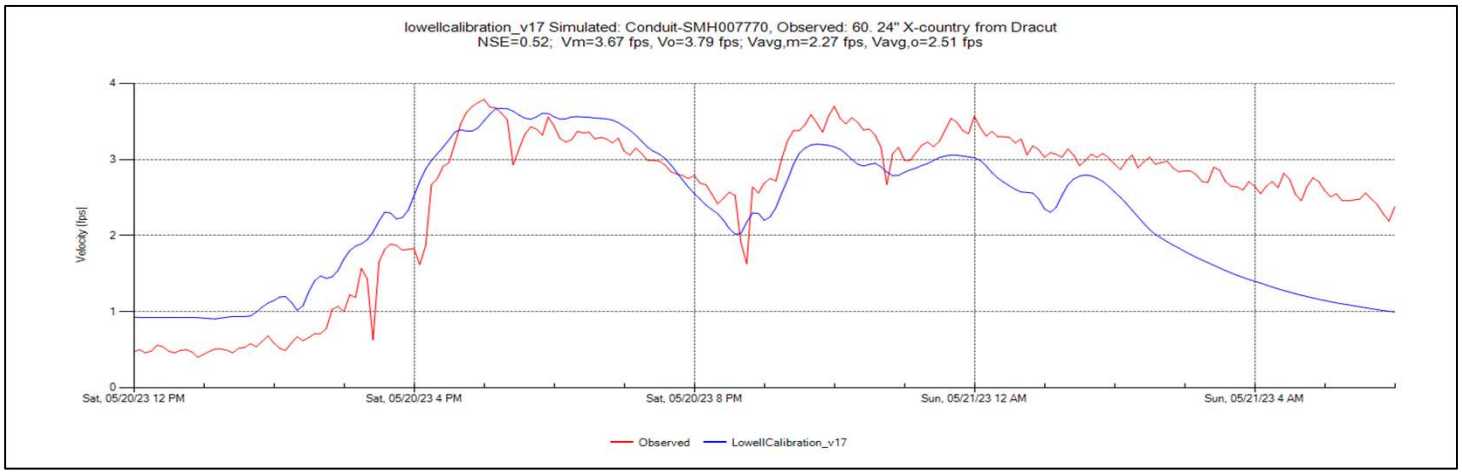


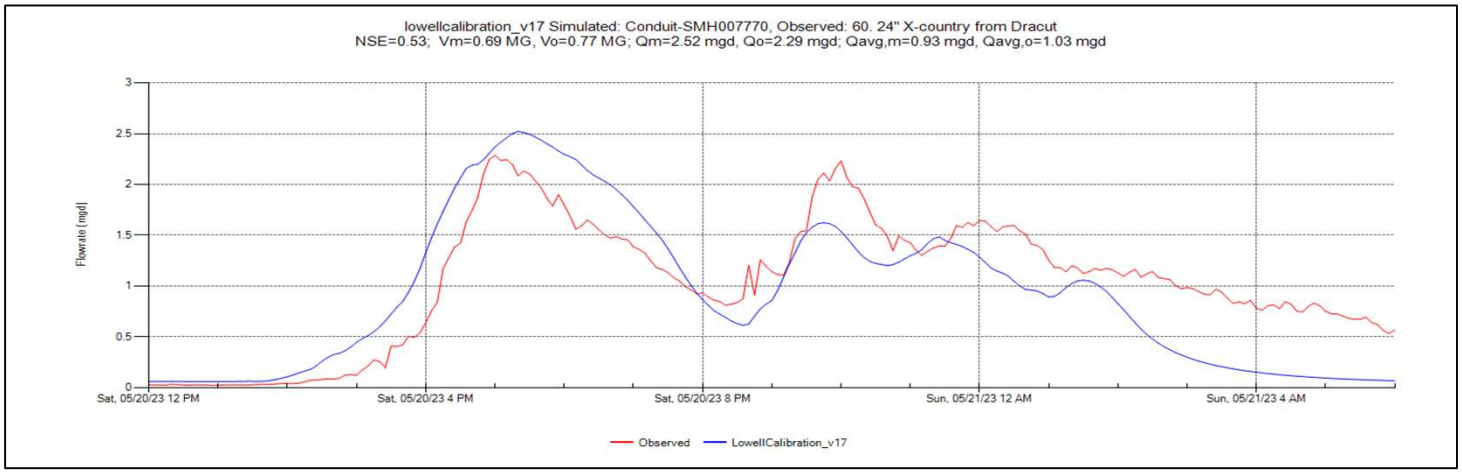


Simulated Versus Observed Flow at Flow Meter Sites

60-May 20

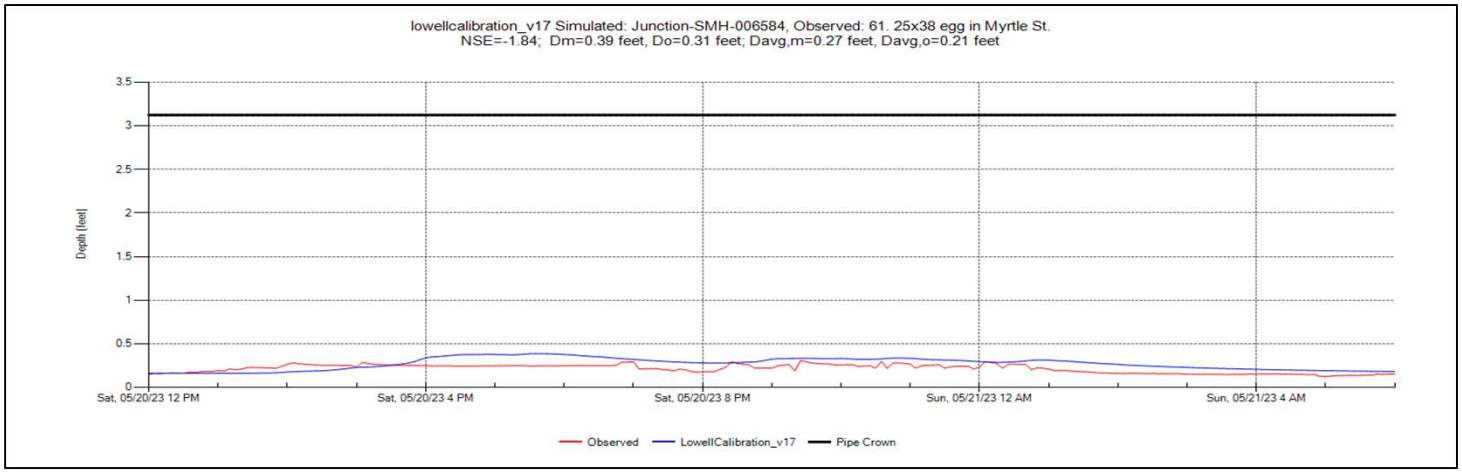


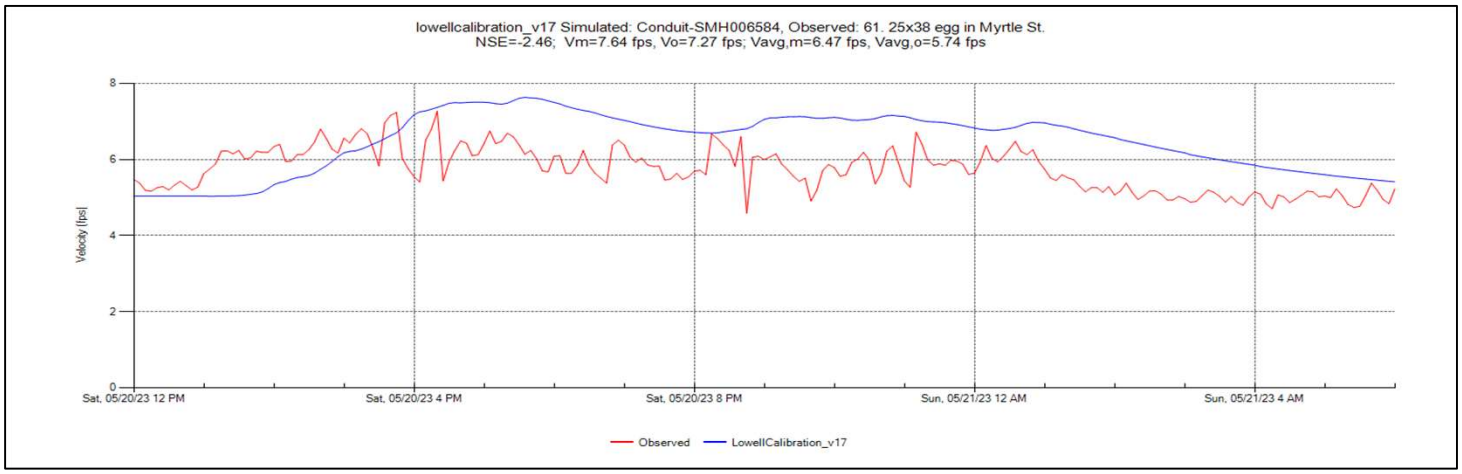


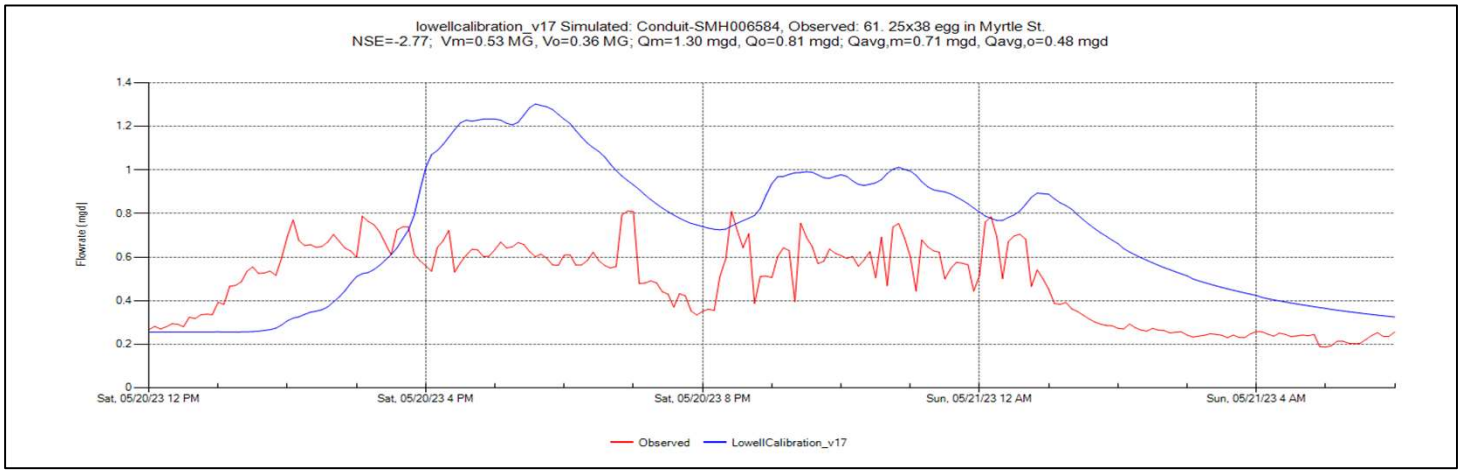


Simulated Versus Observed Flow at Flow Meter Sites

61-May 20

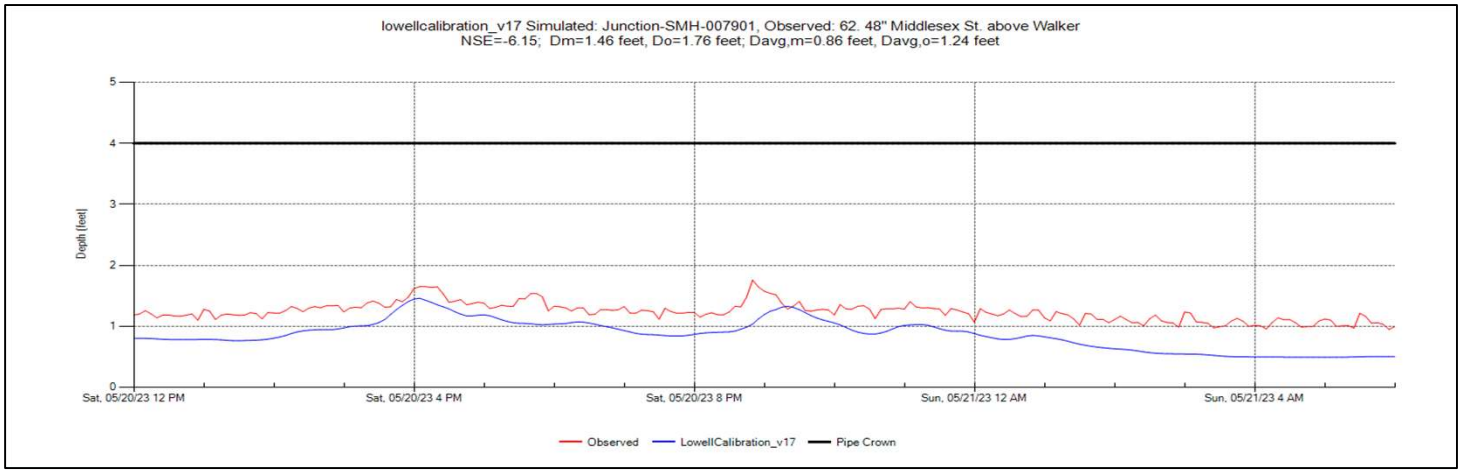


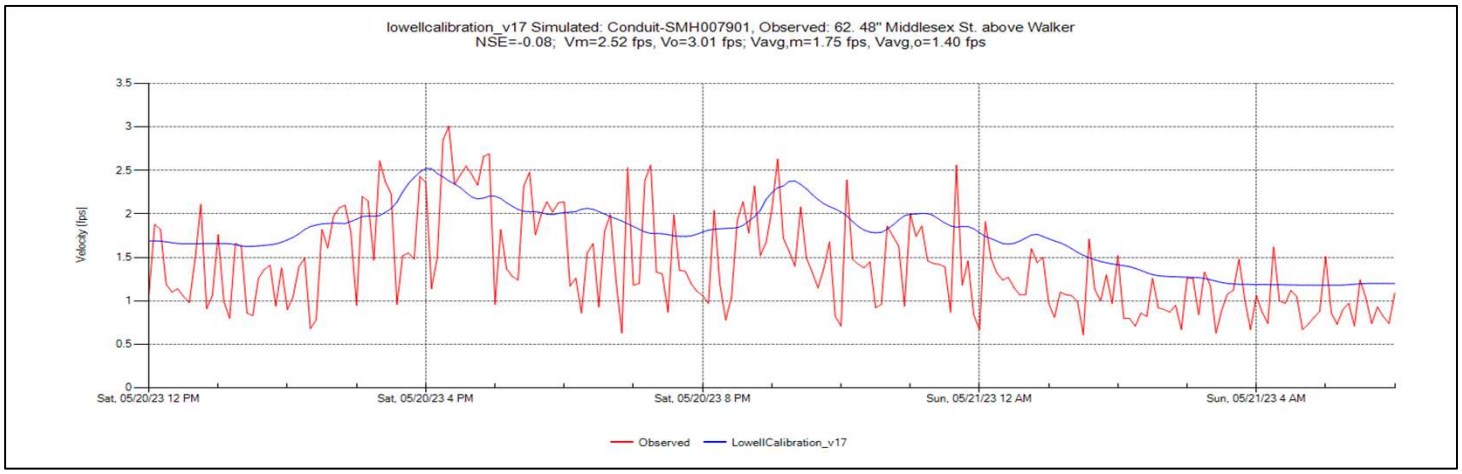


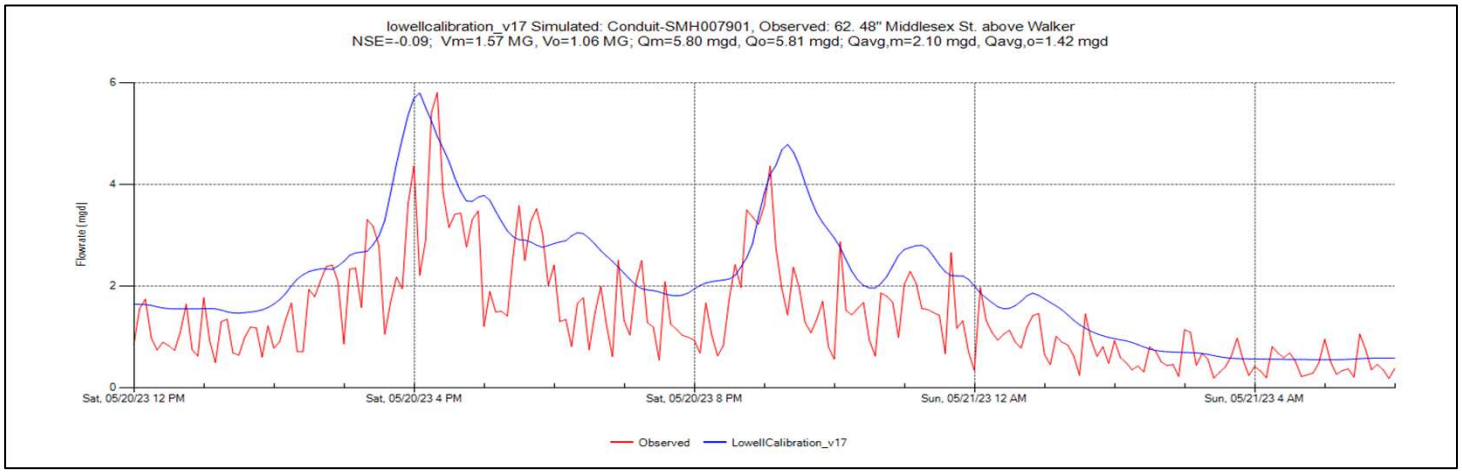


Simulated Versus Observed Flow at Flow Meter Sites

62-May 20

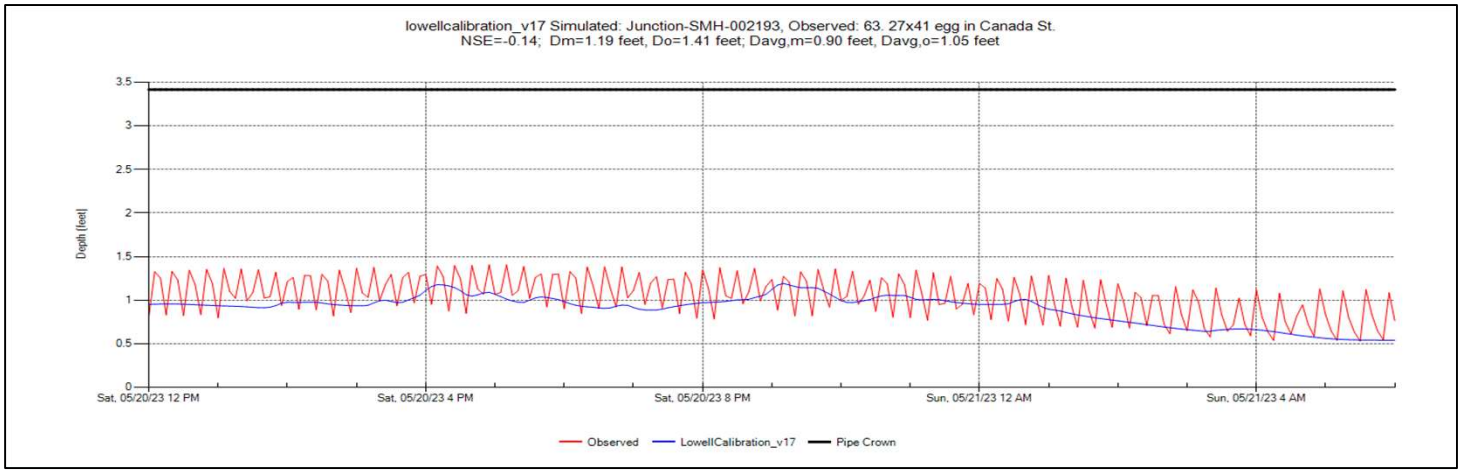


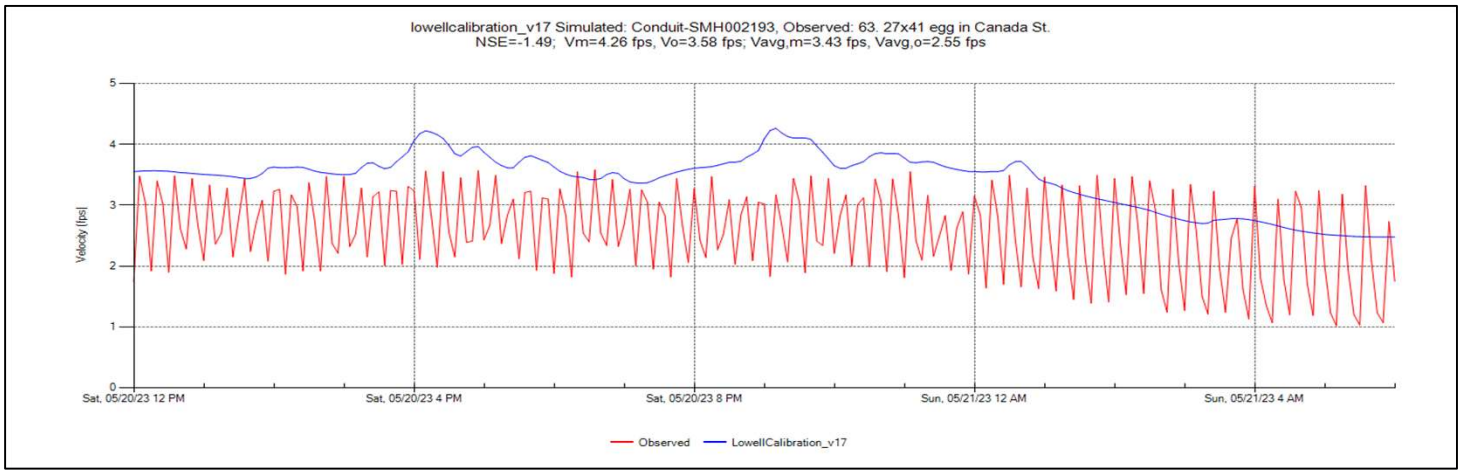


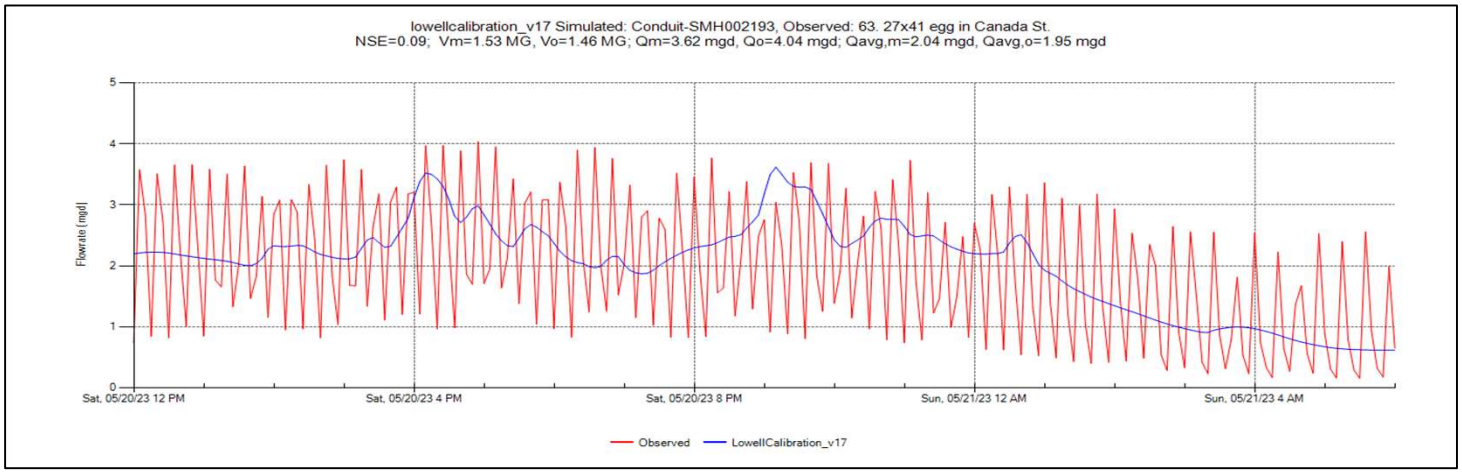


Simulated Versus Observed Flow at Flow Meter Sites

63-May 20





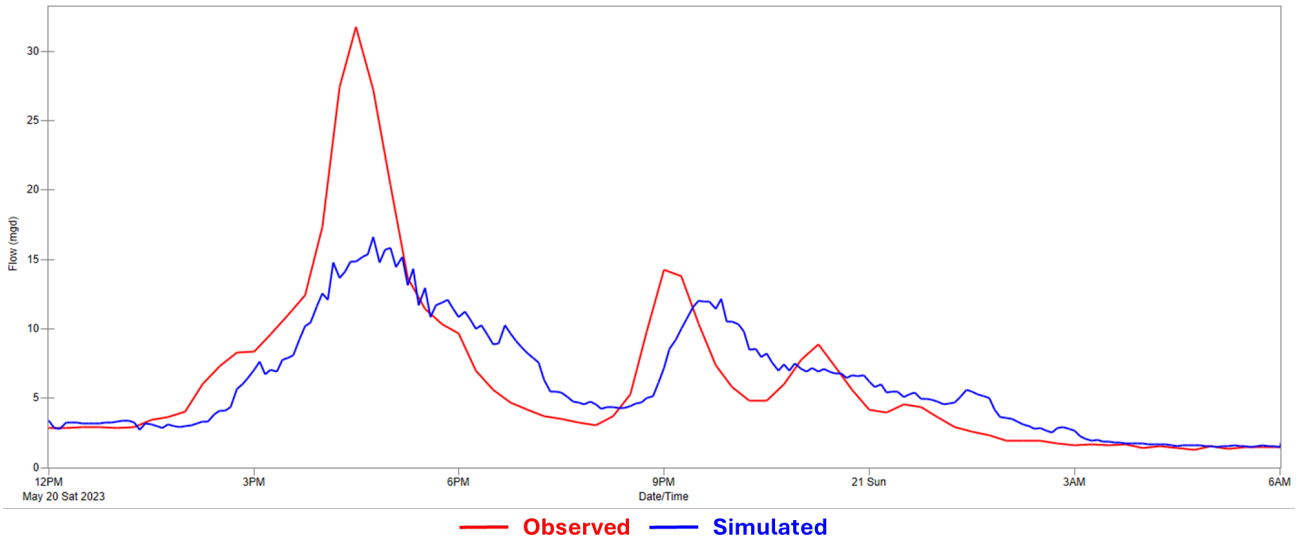


Wet Weather Timeseries CSO Diversion Structures May 20, 2023

CSO Diversion Structures May 20, 2023 Storm

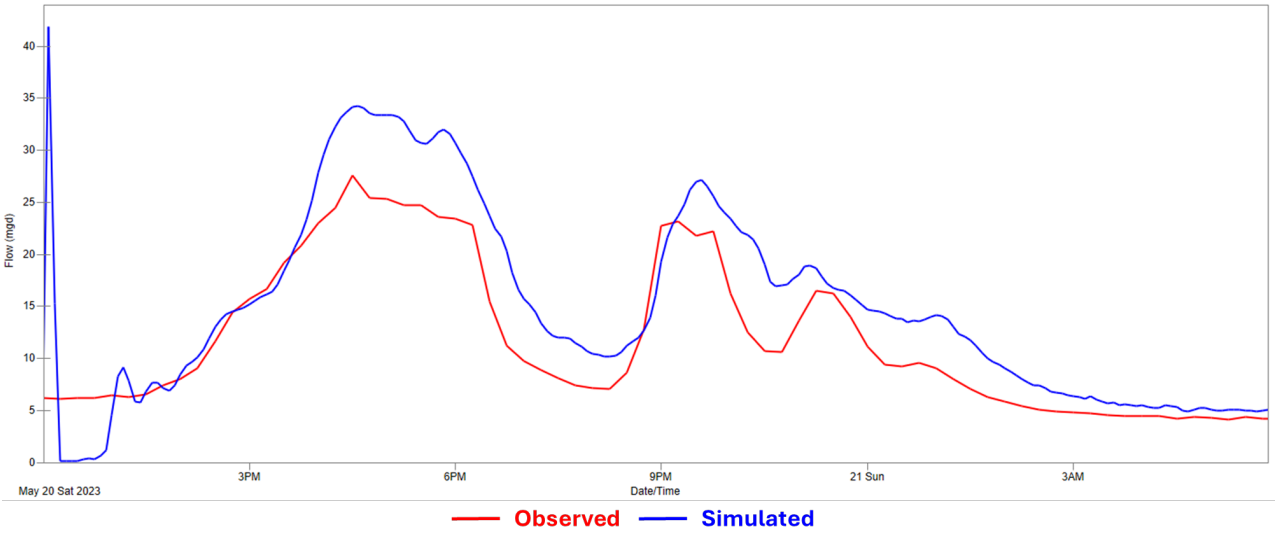
Walker

Station Flow (mgd)



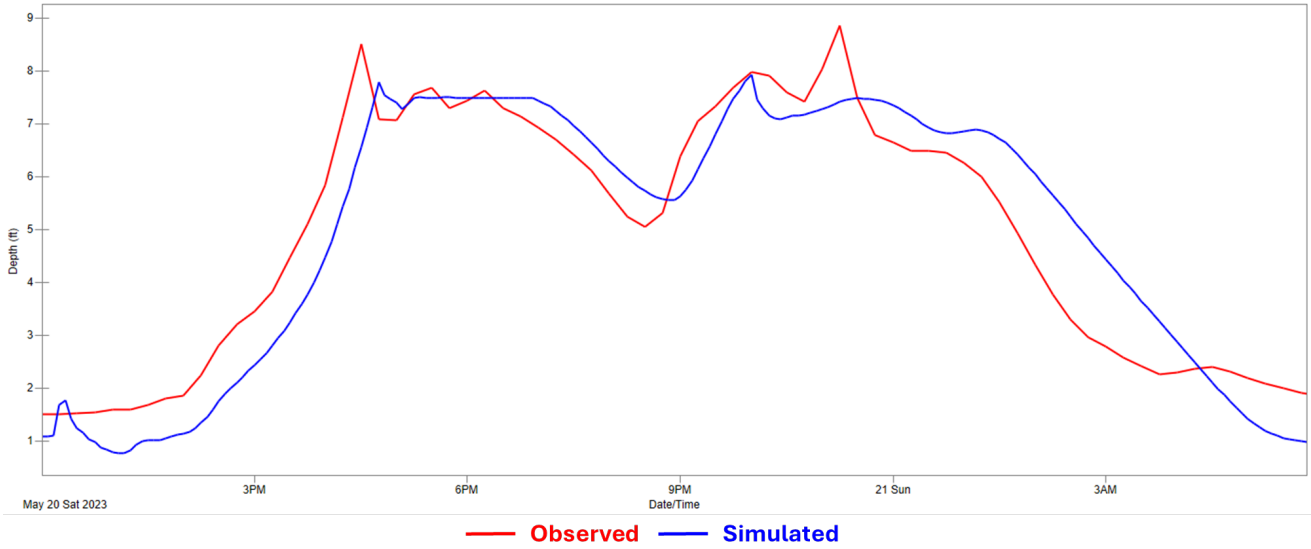
Beaver Brook

Station Flow (mgd)

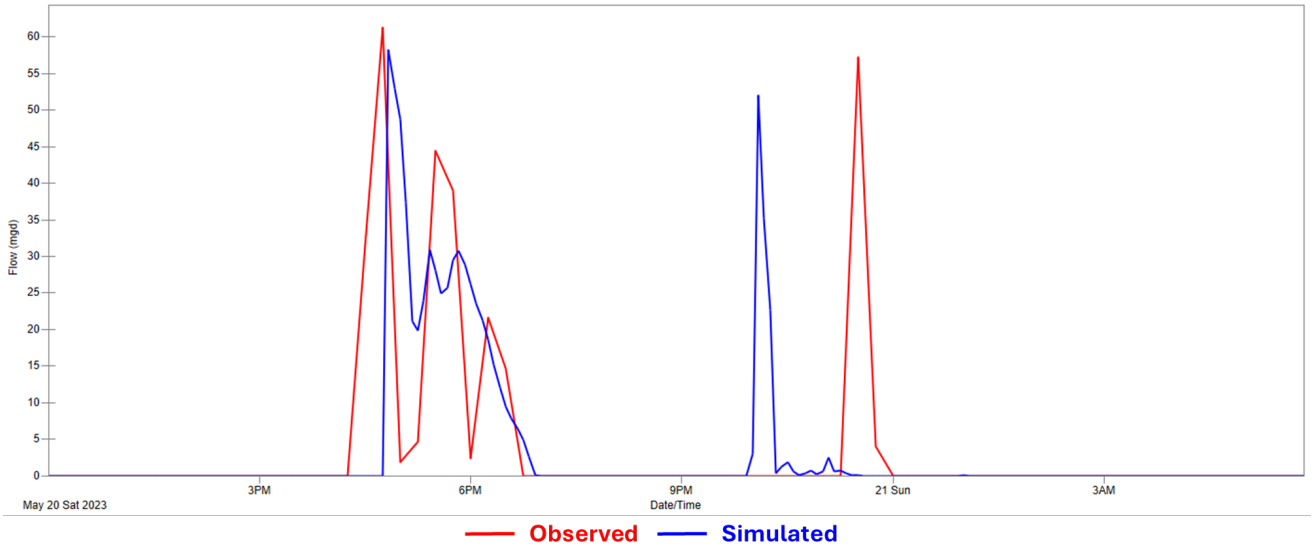


West Street

Interceptor Depth (ft)

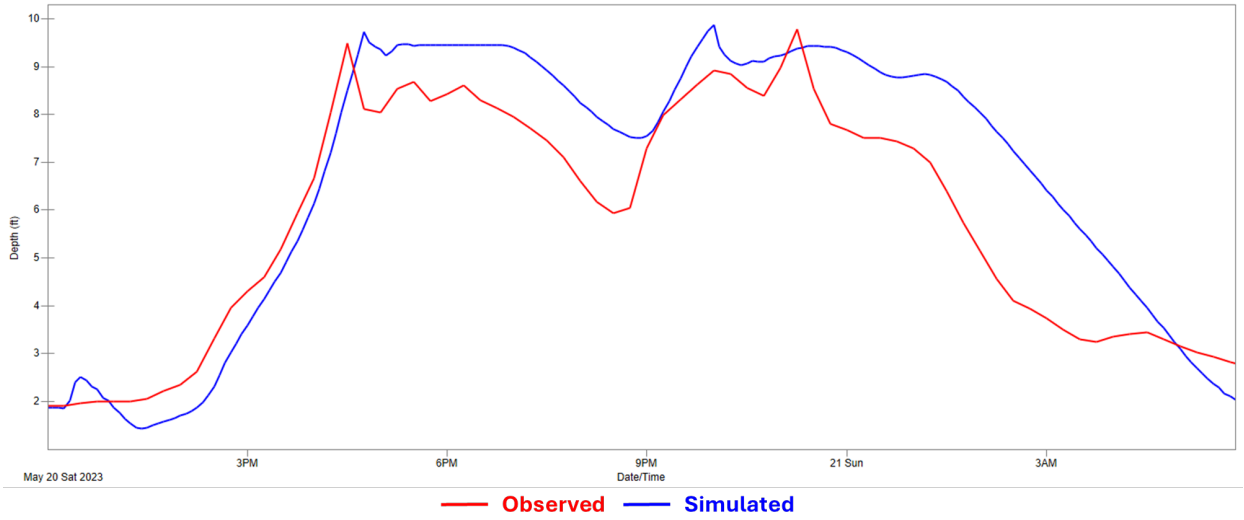


Gravity Diversion Flow (mgd)



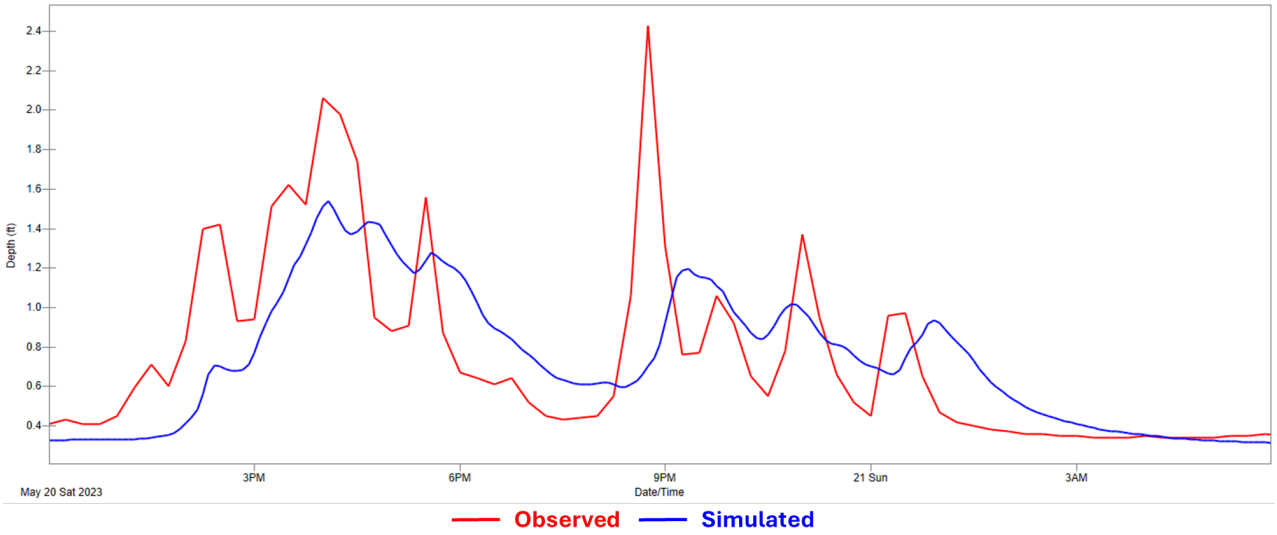
North Bank Control Station

Station Depth (ft)



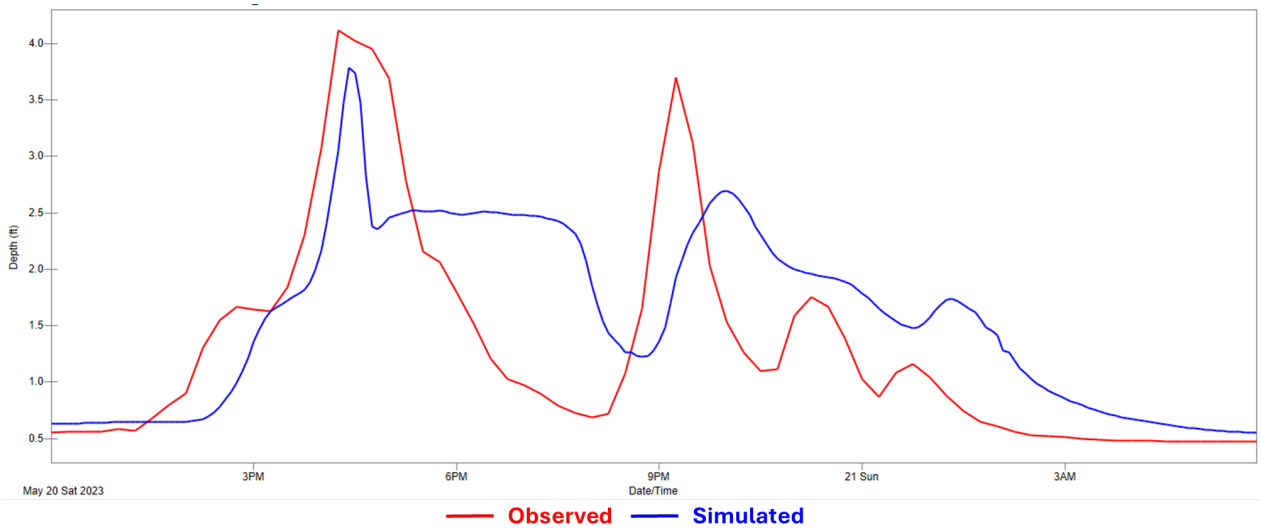
Read Street

Influent Channel Depth (ft)

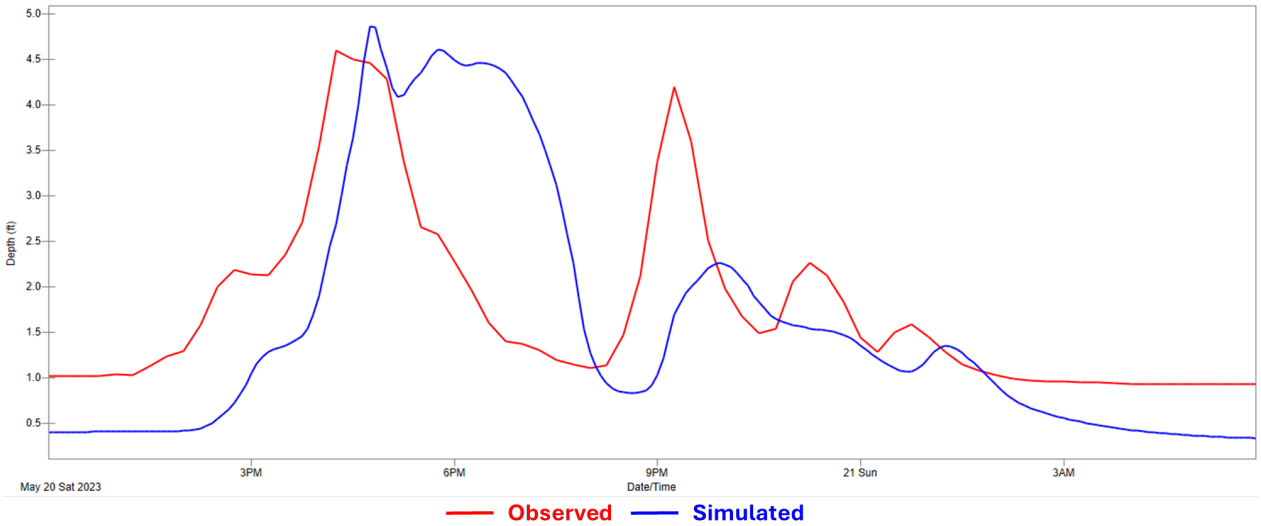


Tilden

Flume Depth (ft)

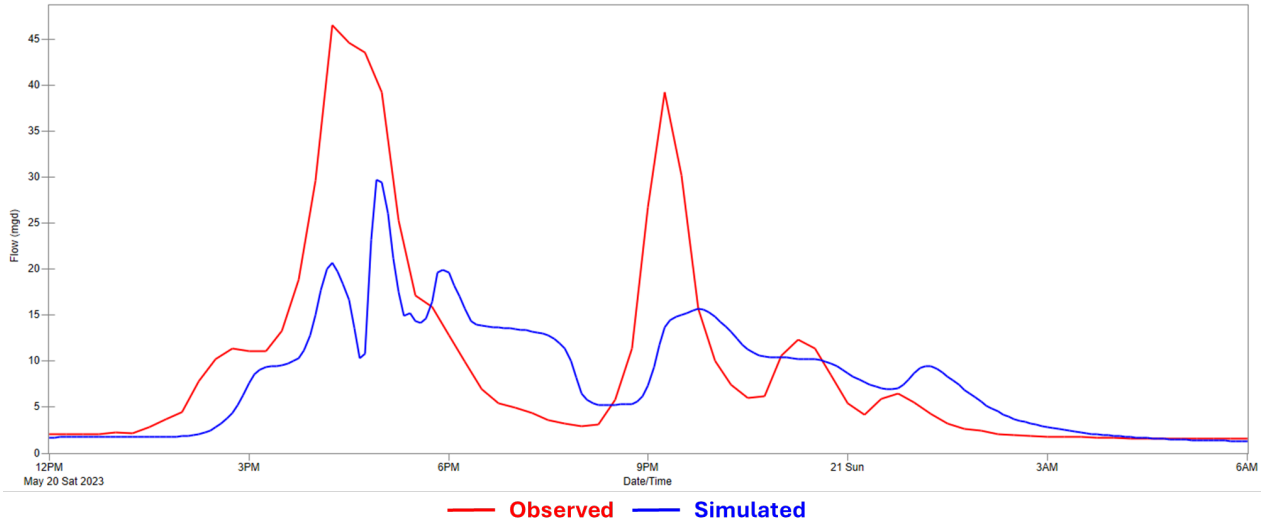


Influent Channel Depth (ft)

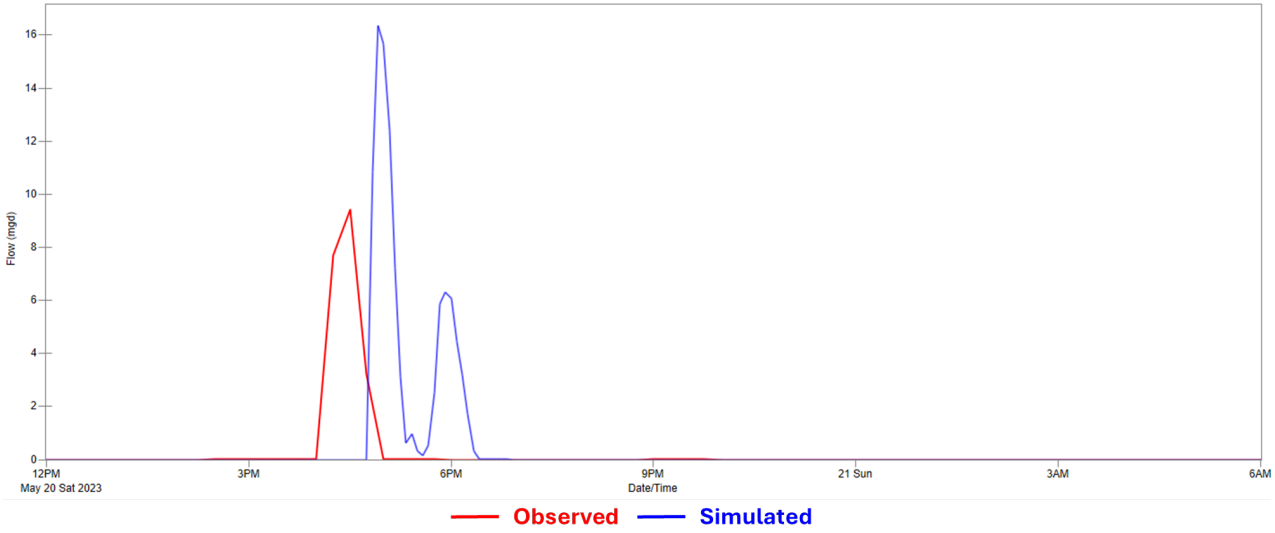


Tilden

Station Flow (mgd)

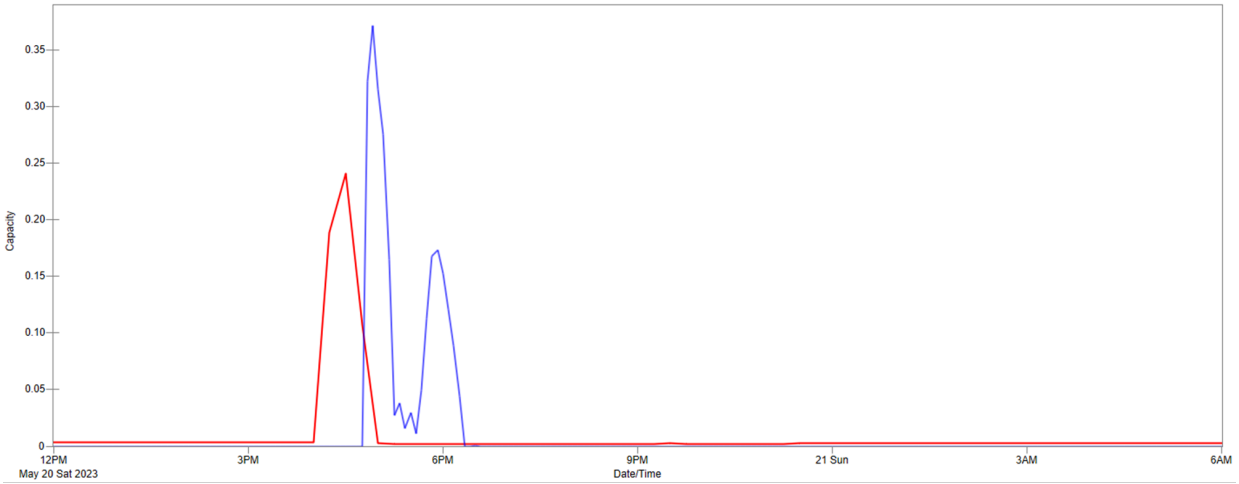


Gravity Diversion Flow (mgd)

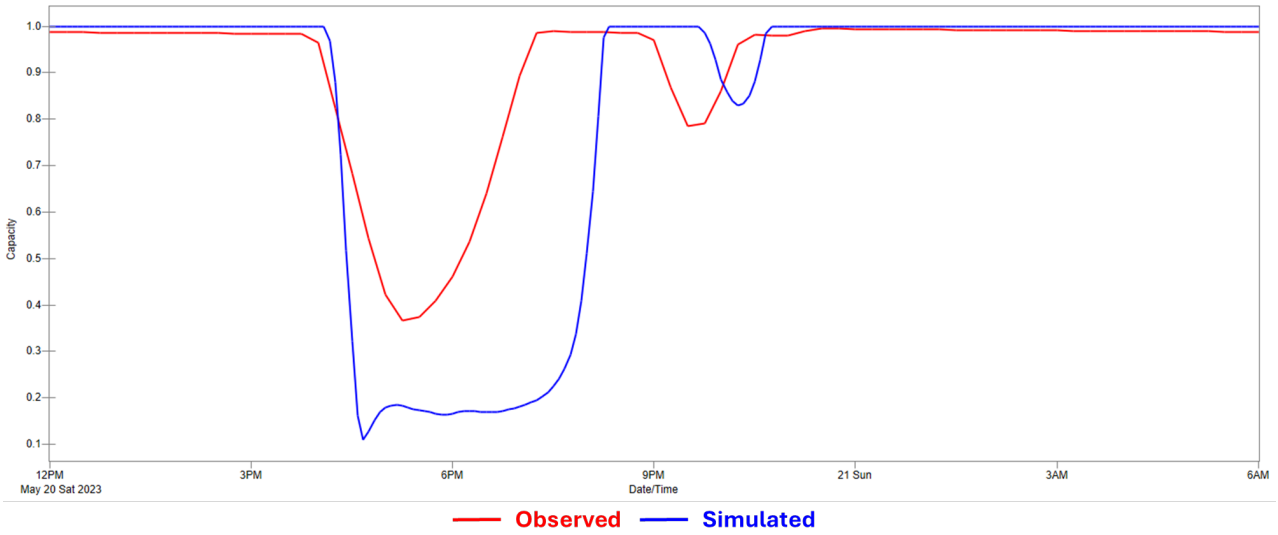


Tilden

Diversion Gate Position

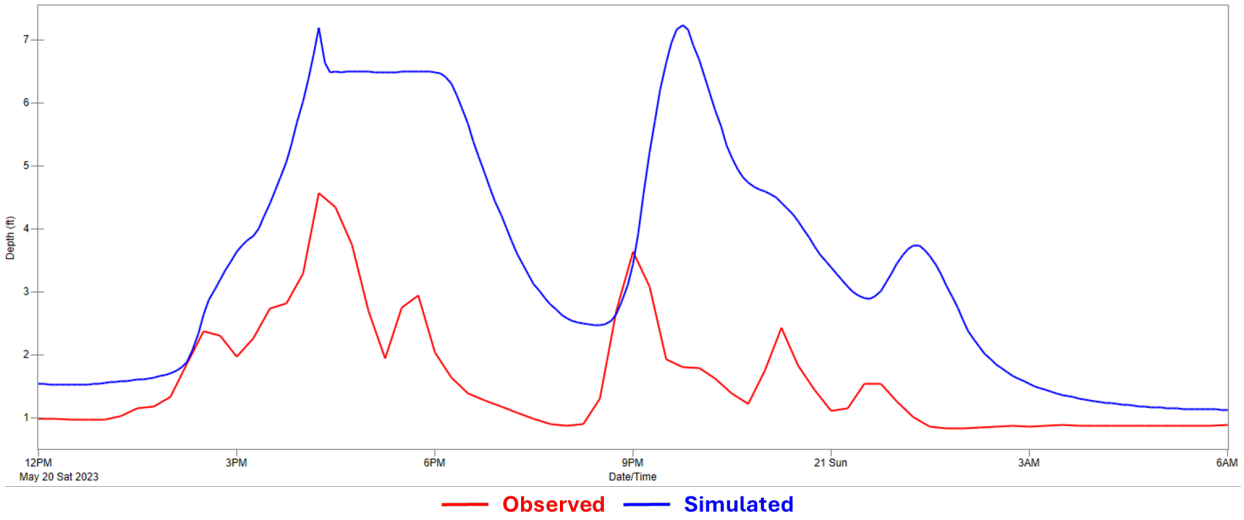


Control Gate Position

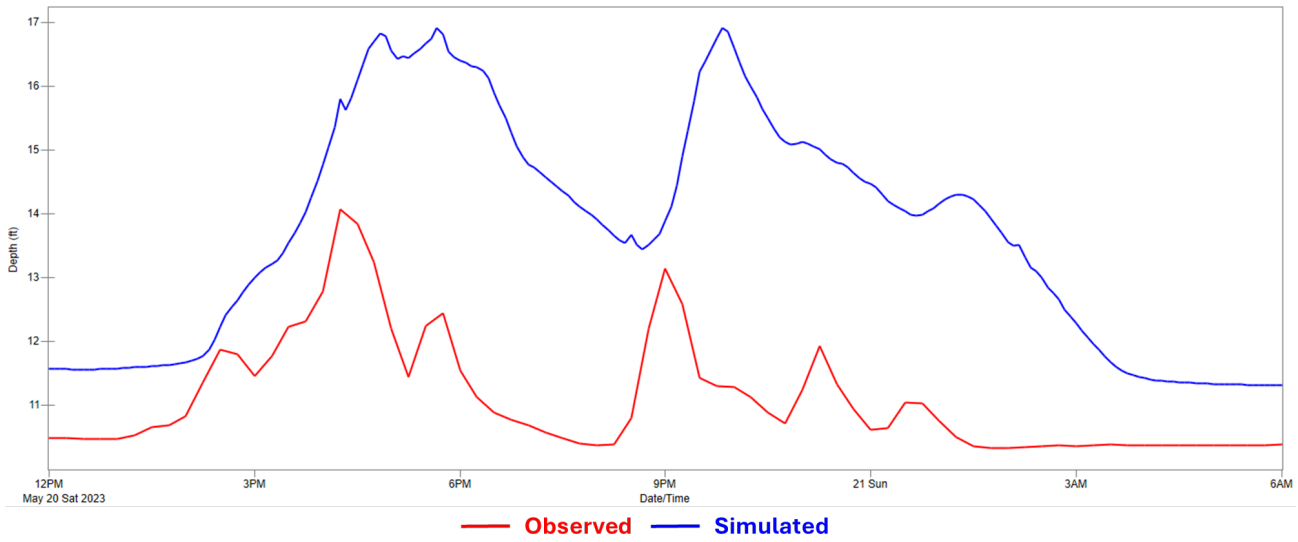


Warren

Influent Depth (ft)

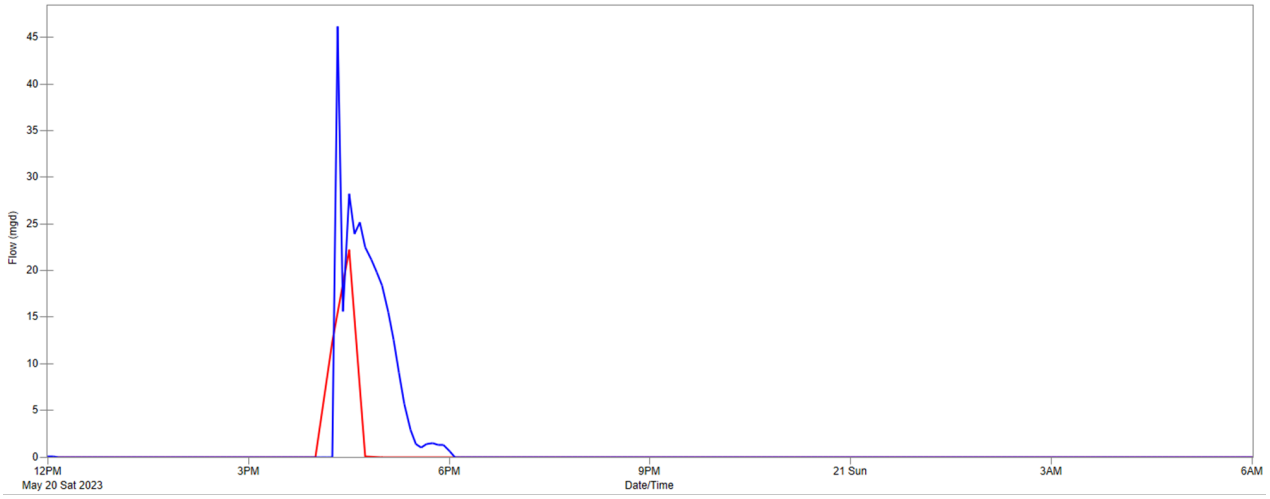


Siphon Depth (ft)

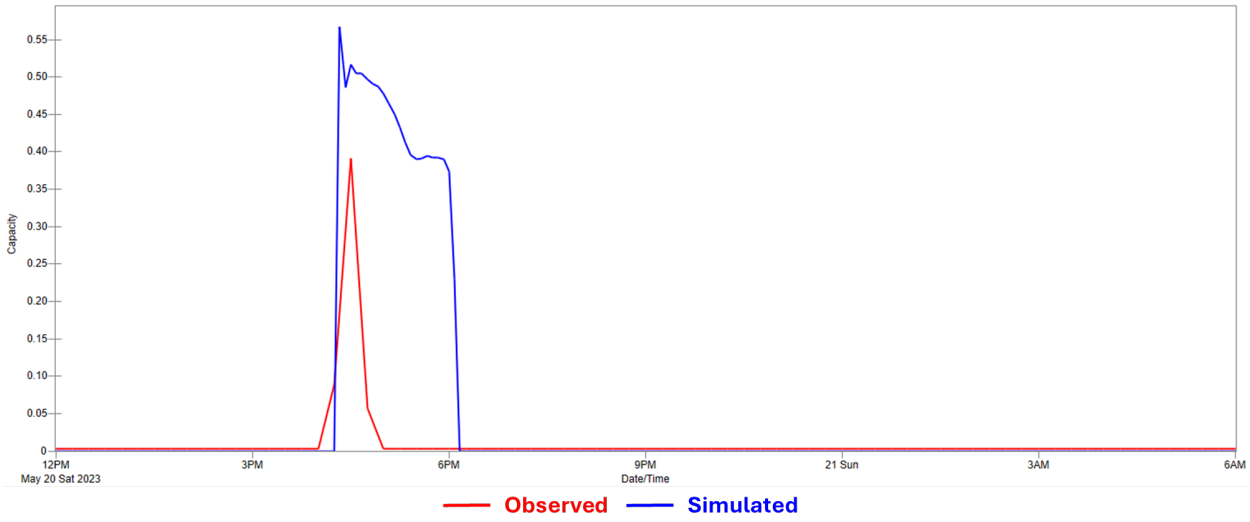


Warren

Gravity Diversion Flow (mgd)

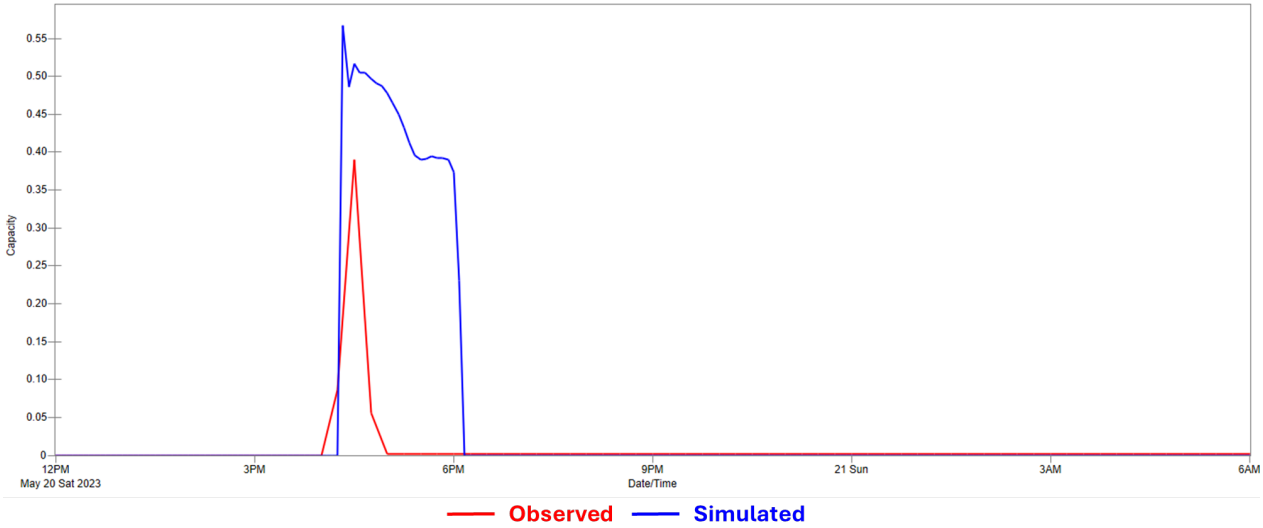


Gate No. 1 Position



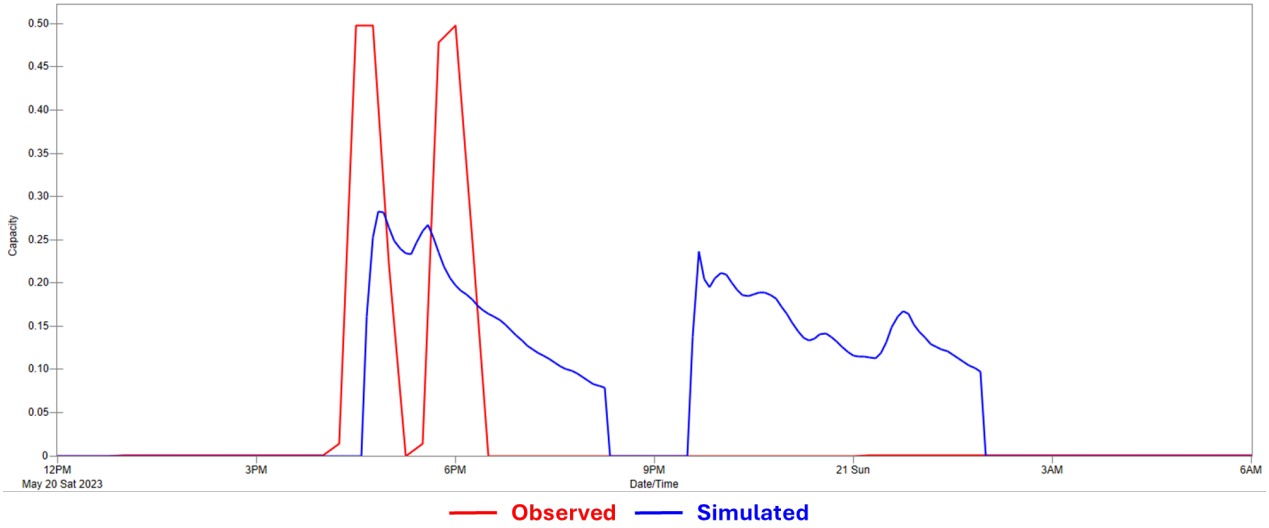
Warren

Gate No. 2 Position



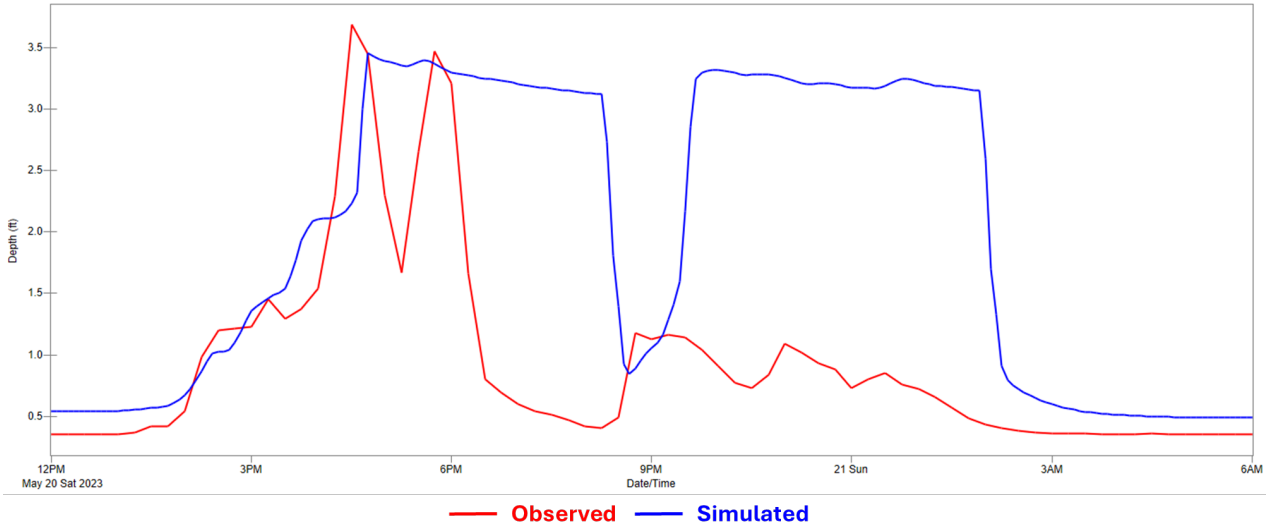
Barasford

Diversion Gate Position

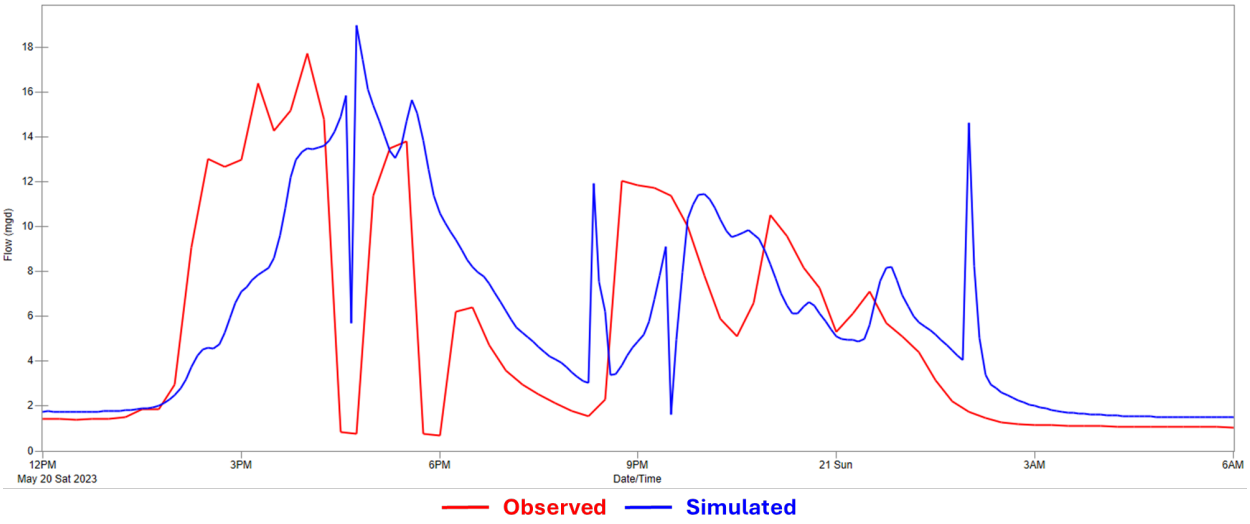


Barasford

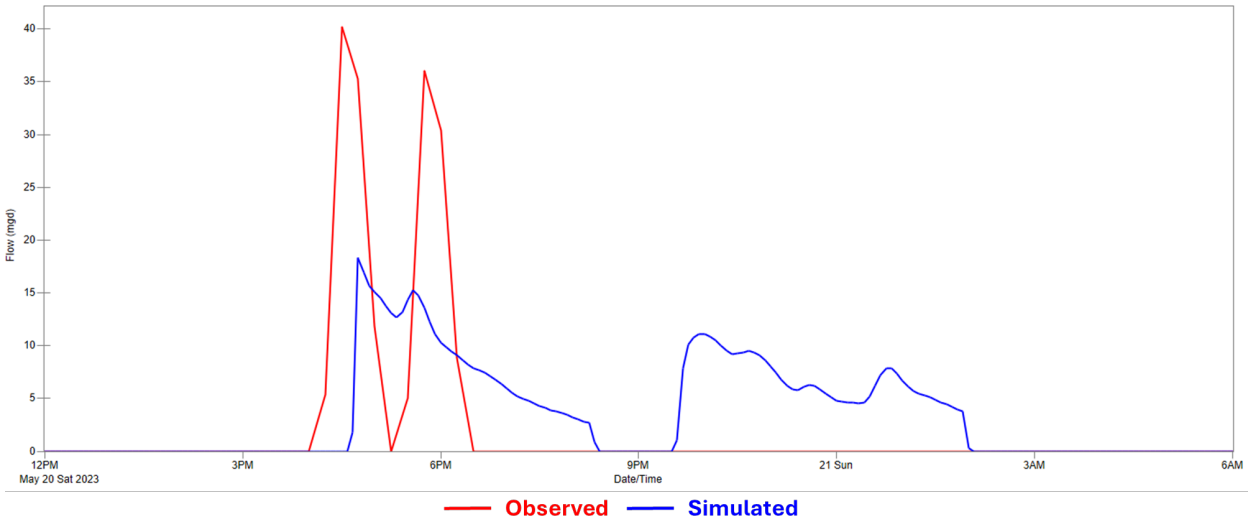
Influent Depth (ft)



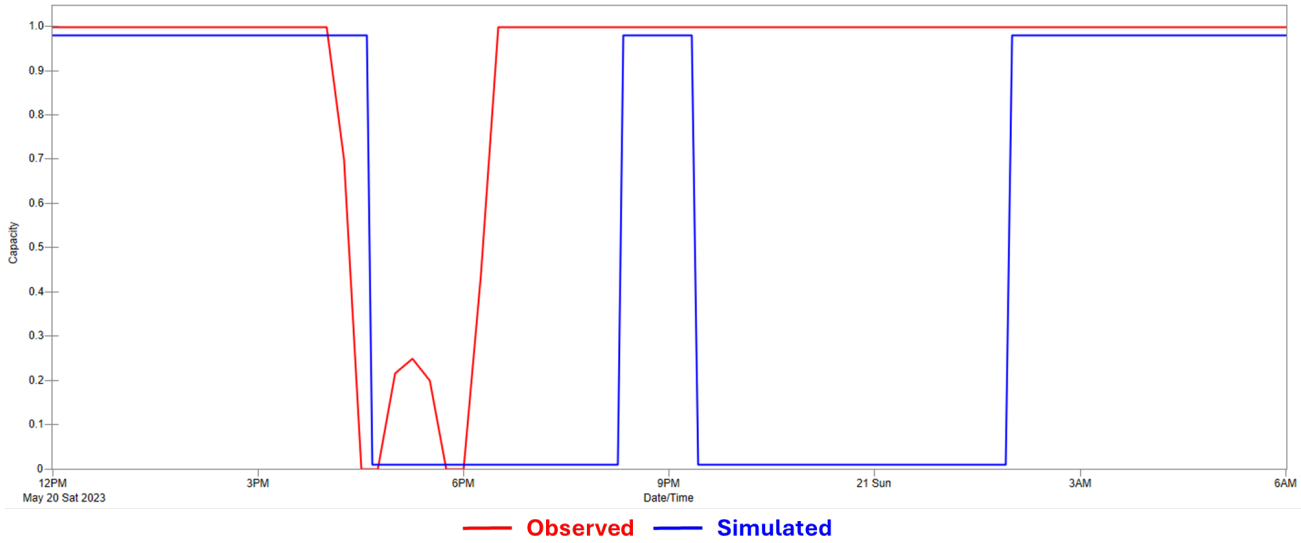
Station Flow (mgd)



Gravity Diversion Flow (mgd)

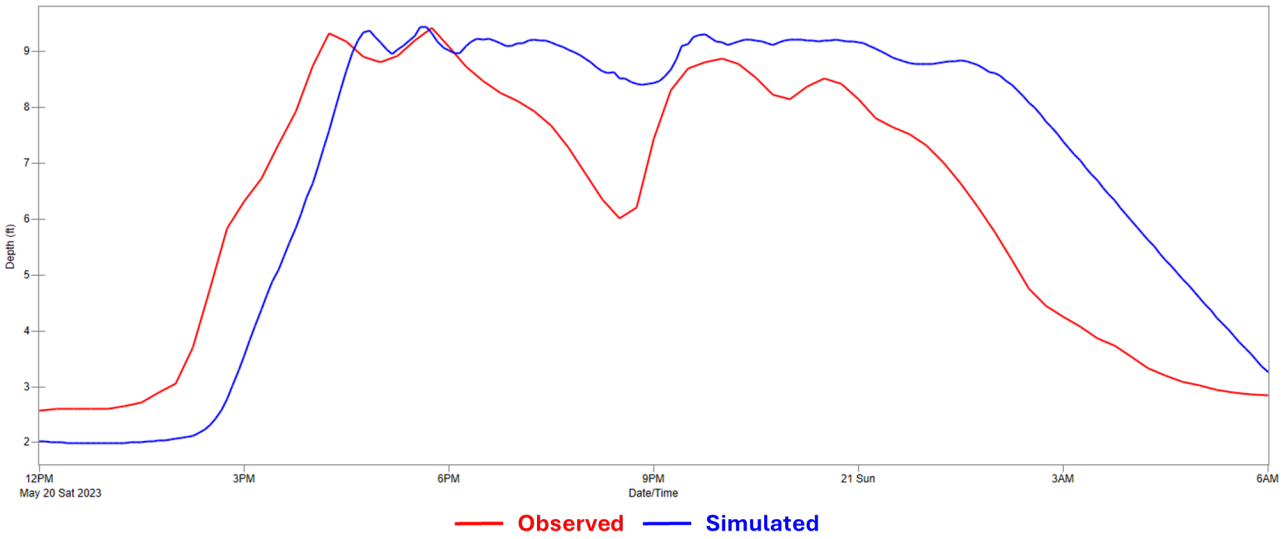


Control Gate Position

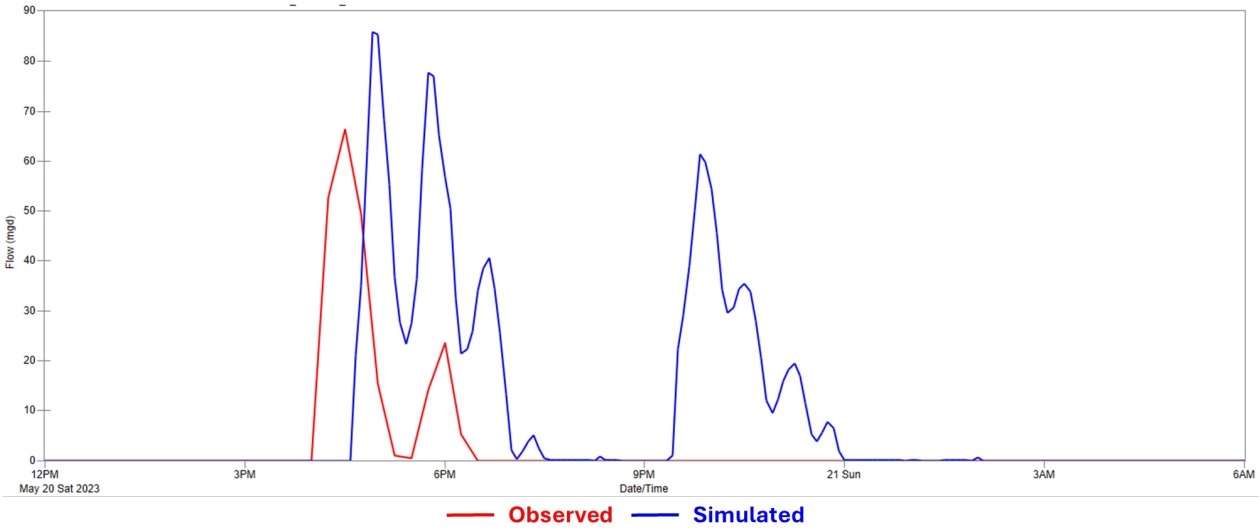


Merrimack

Interceptor Depth (ft)

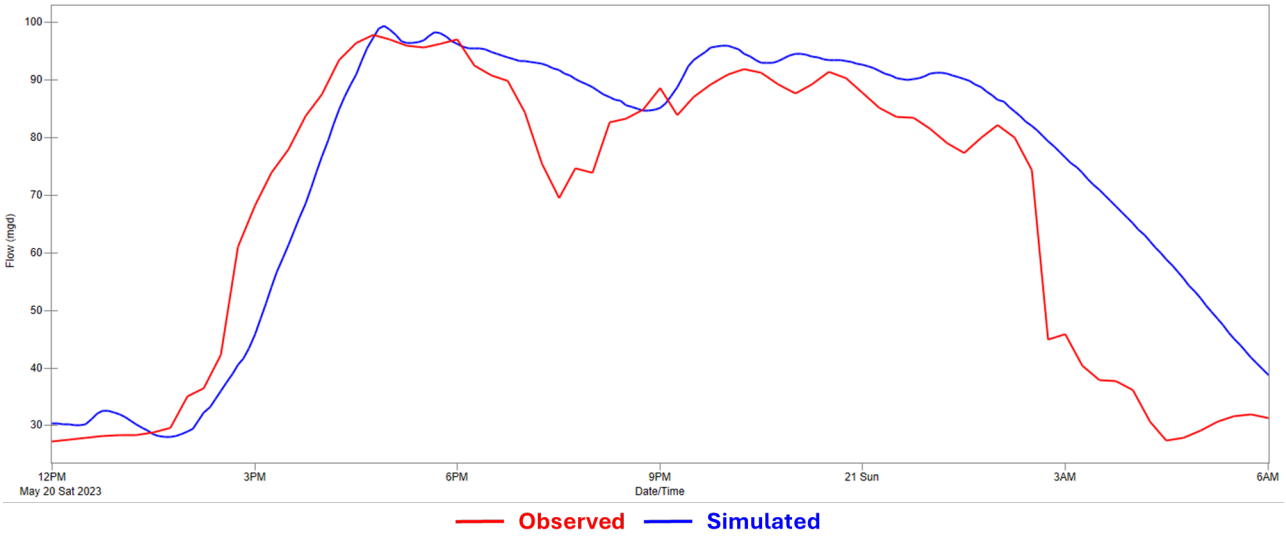


Gravity Diversion Flow (mgd)



Duck Island

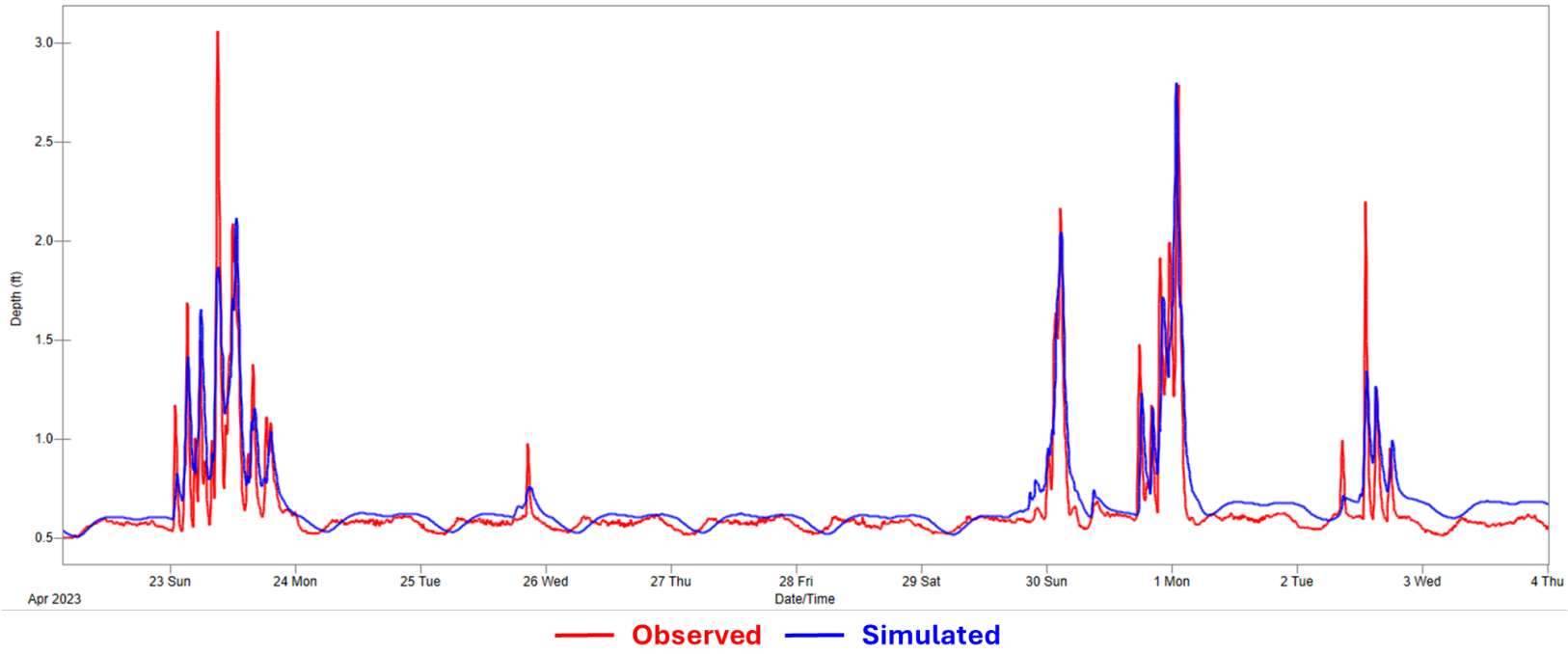
Effluent Flow (mgd)



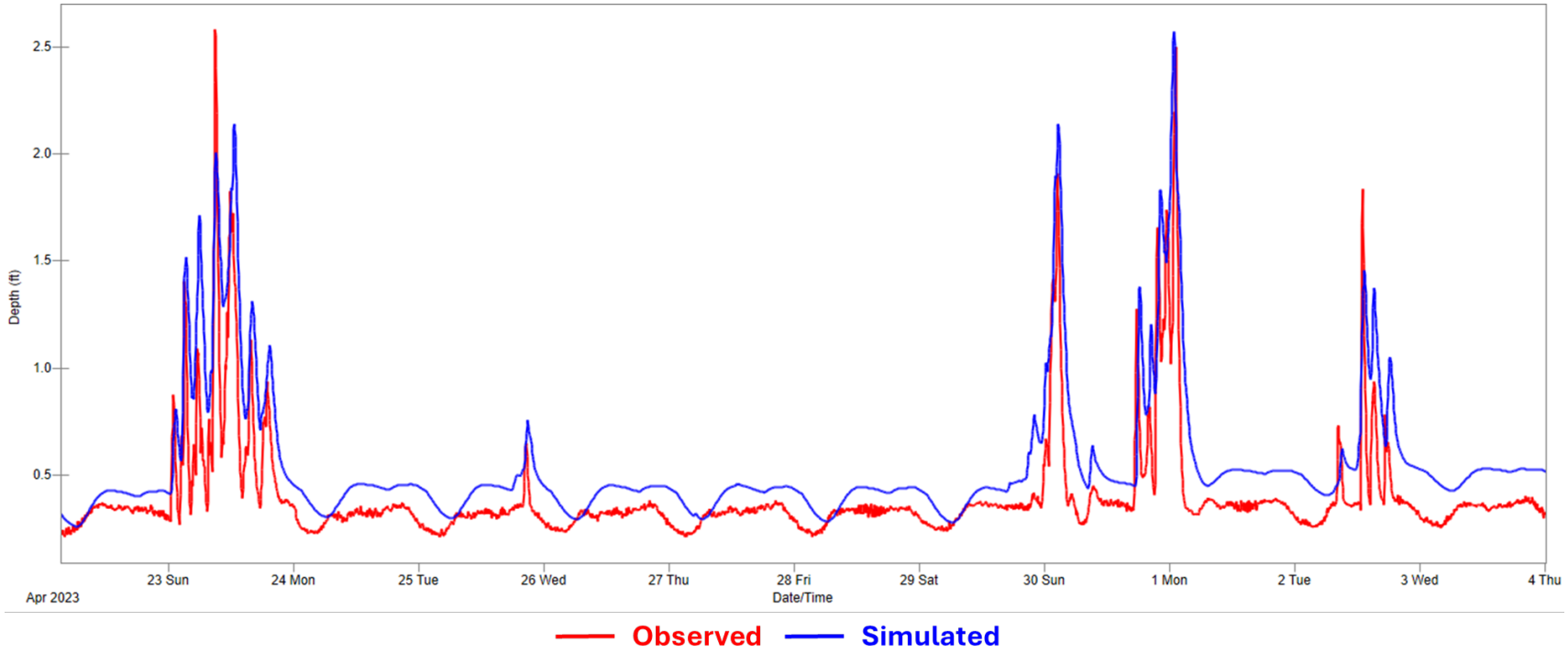
Wet Weather Timeseries Level Meters April- May 2023

SSO Level Meters: April-May Storms

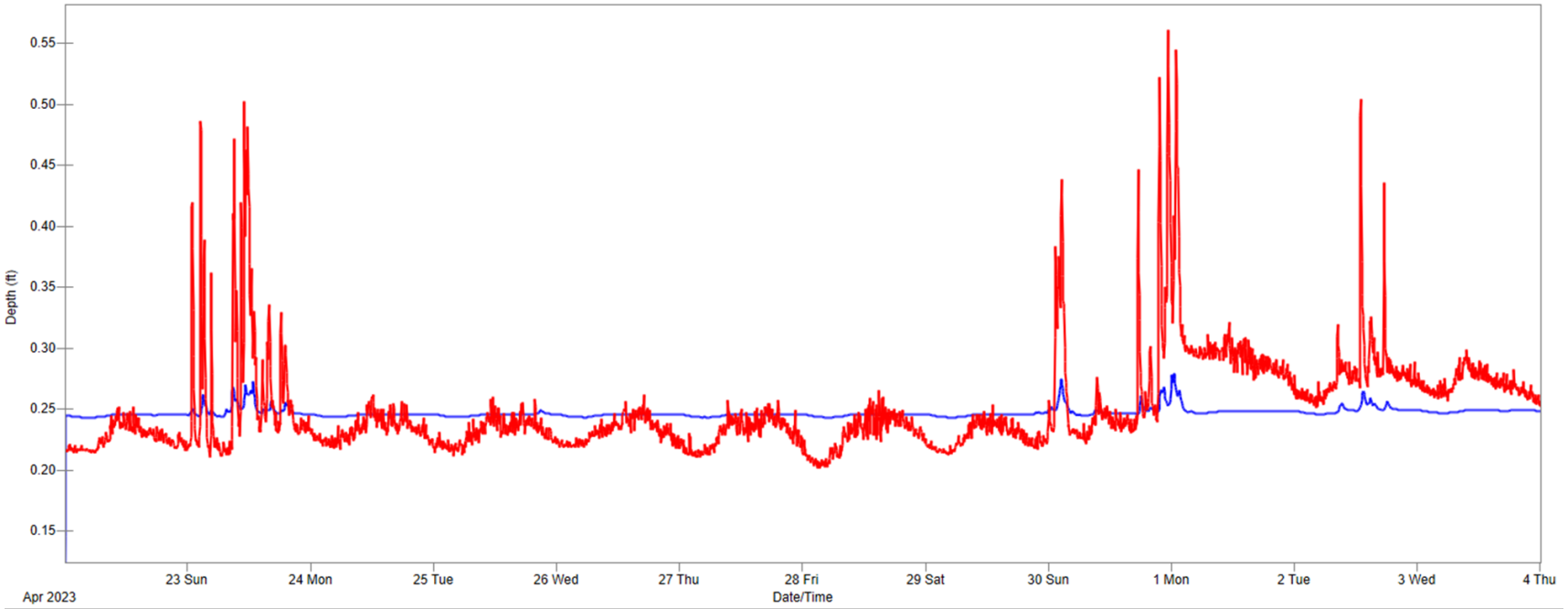
67 Payne St



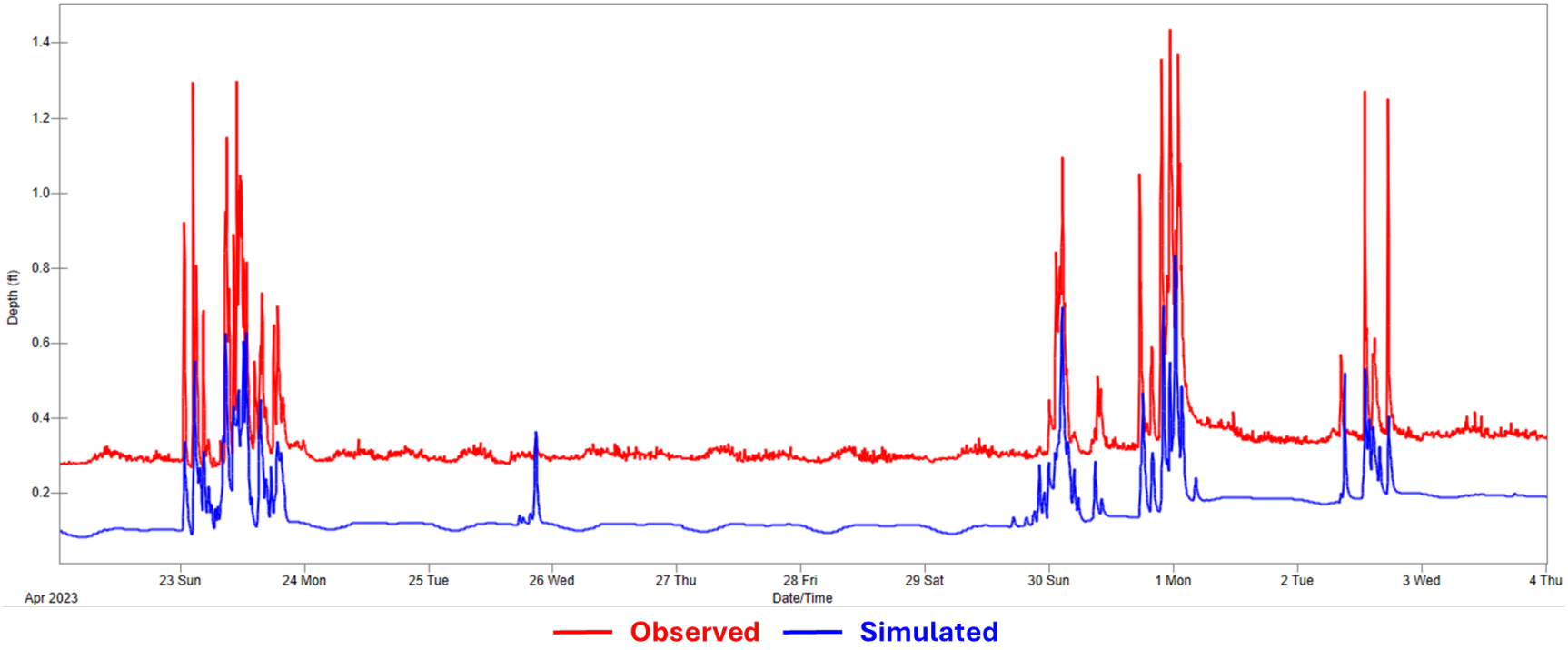
Eagle Court


Depth (ft)
2.5
2.0
1.5
1.0
0.5
Apr 2023
23 Sun
24 Mon
25 Tue
26 Wed
27 Thu
28 Fri
29 Sat
30 Sun
1 Mon
2 Tue
3 Wed
4 Thu
Date/Time
Observed
Simulated

35 Windward Road

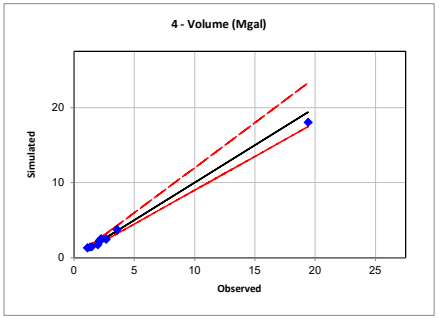


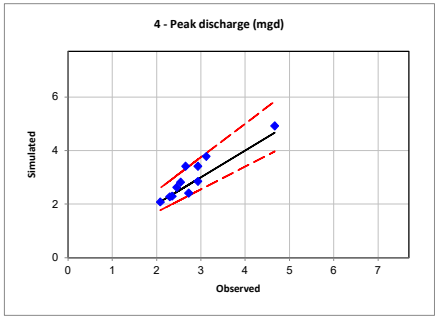
246 Raven St

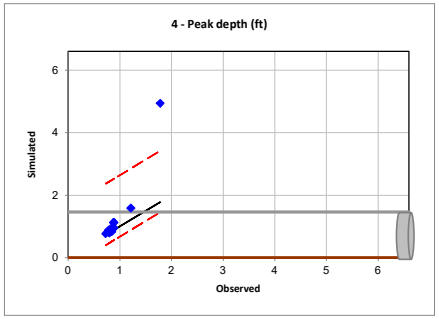

Depth (ft)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Apr 2023
23 Sun
24 Mon
25 Tue
26 Wed
27 Thu
28 Fri
29 Sat
30 Sun
1 Mon
2 Tue
3 Wed
4 Thu
Date/Time
Observed
Simulated

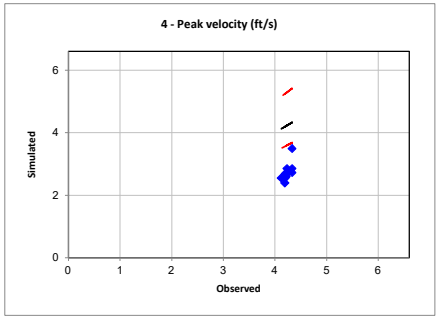
Attachment 3

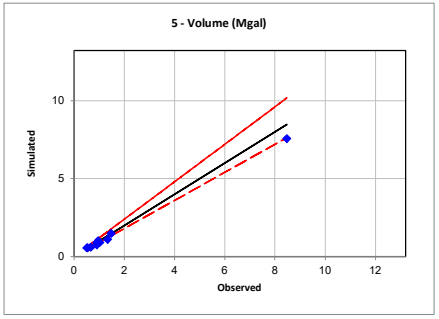
Wet Weather Scatterplots Temporary Meters

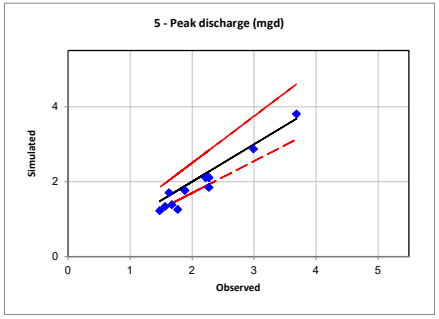

4 - Volume (Mgal)
Simulated
Observed

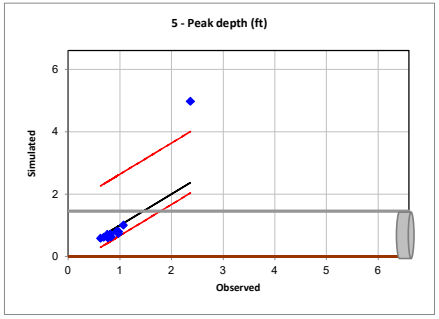

4 - Peak discharge (mgd)
Simulated
Observed

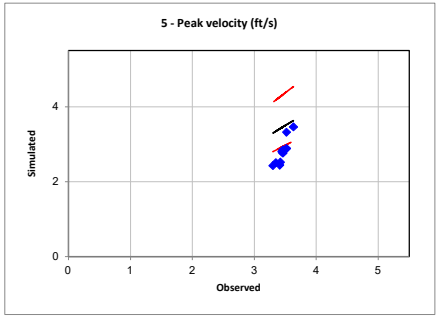

4 - Peak depth (ft)
Simulated
Observed

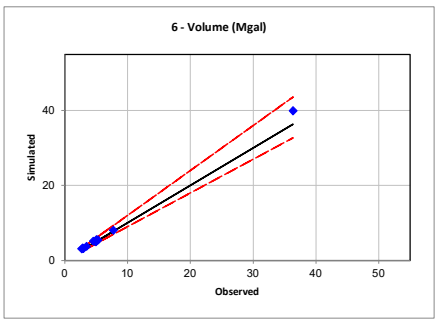

4 - Peak velocity (ft/s)
Simulated
Observed

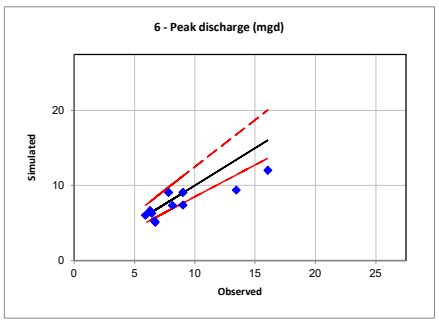

5 - Volume (Mgal)
Simulated
Observed

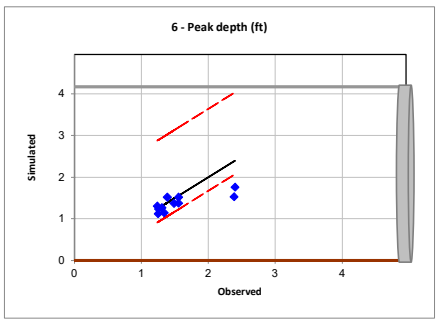

5 - Peak discharge (mgd)
Simulated
Observed

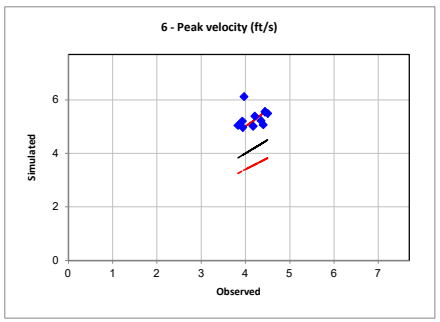

5 - Peak depth (ft)
Simulated
Observed

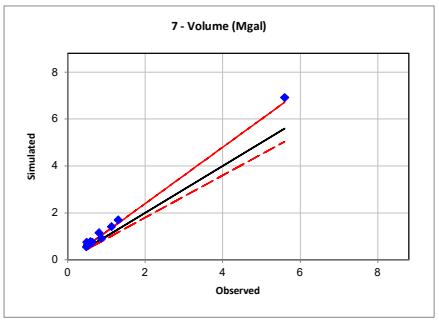

5 - Peak velocity (ft/s)
Simulated
Observed

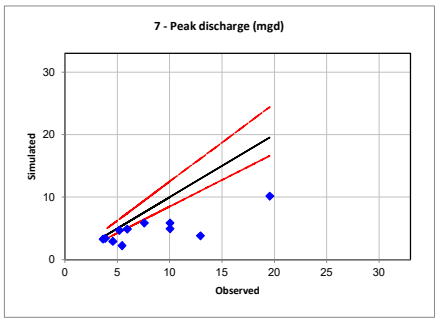

6 - Volume (Mgal)
Simulated
Observed

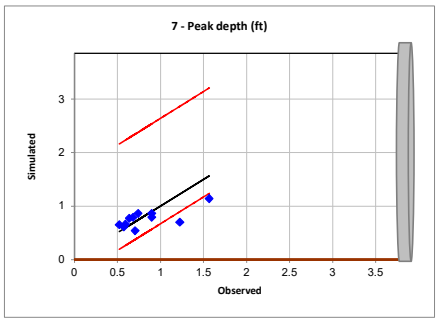

6 - Peak discharge (mgd)
Simulated
Observed

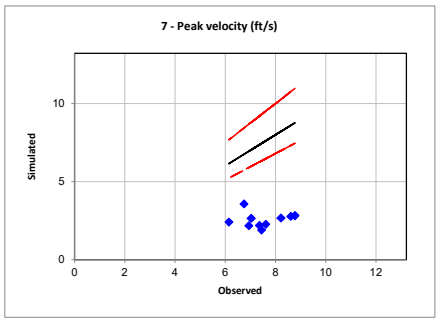

6 - Peak depth (ft)
Simulated
Observed

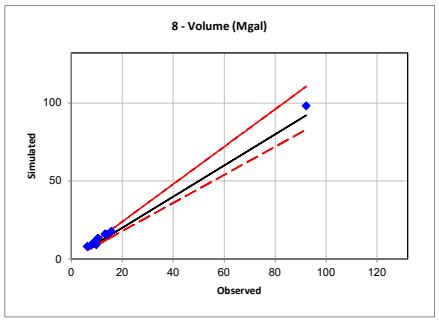

6 - Peak velocity (ft/s)
Simulated
Observed

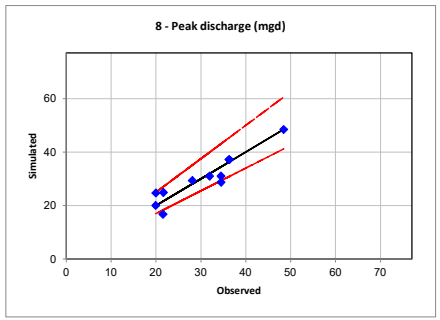

7 - Volume (Mgal)
Simulated
Observed

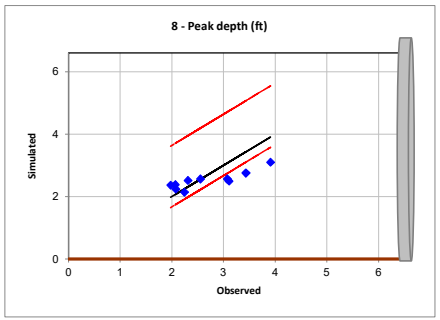

7 - Peak discharge (mgd)
Simulated
Observed

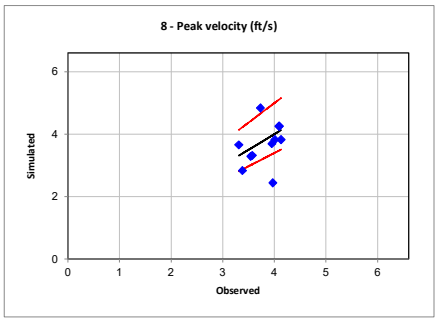

7 - Peak depth (ft)
Simulated
Observed

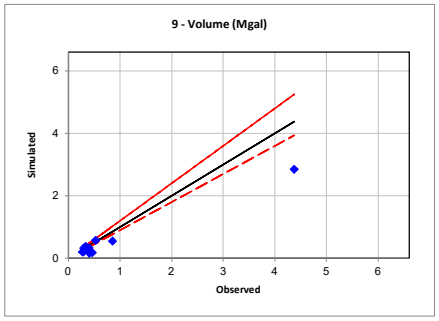

7 - Peak velocity (ft/s)
Simulated
Observed

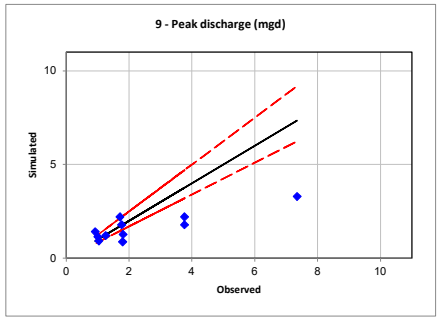

8 - Volume (Mgal)
Simulated
Observed

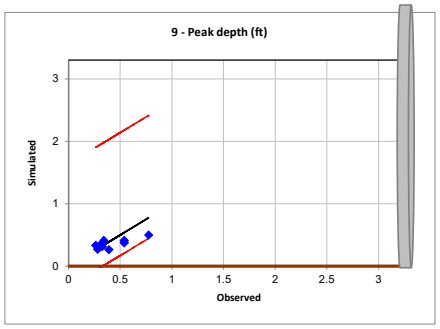

8 - Peak discharge (mgd)
Simulated
Observed

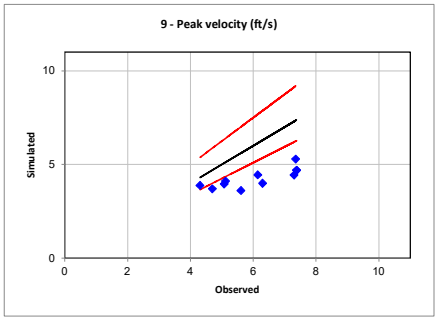

8 - Peak depth (ft)
Simulated
Observed

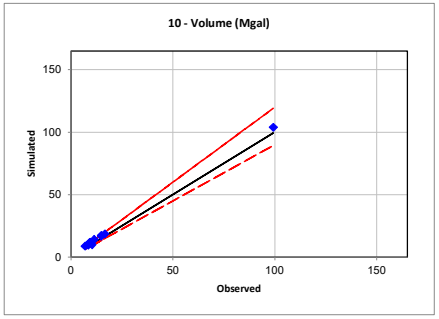

8 - Peak velocity (ft/s)
Simulated
Observed

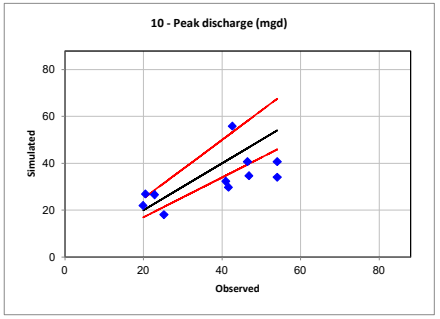

9 - Volume (Mgal)
Simulated
Observed

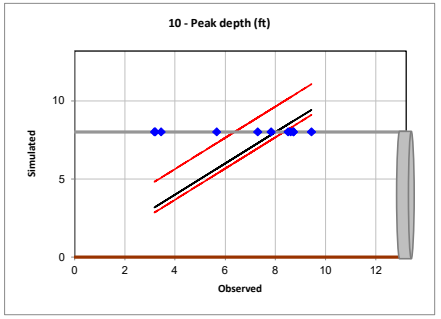

9 - Peak discharge (mgd)
Simulated
Observed

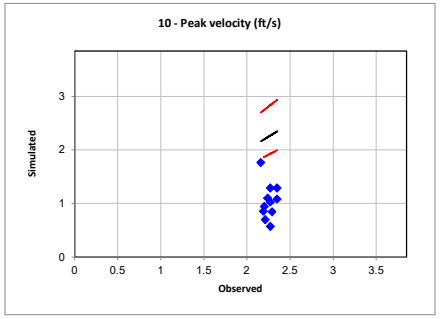

9 - Peak depth (ft)
Simulated
Observed

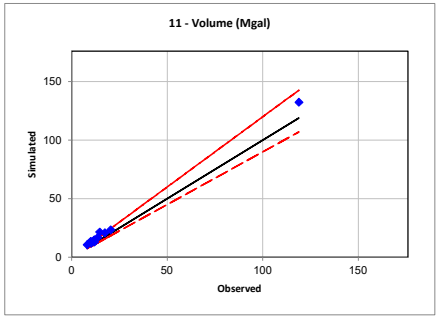

9 - Peak velocity (ft/s)
Simulated
Observed

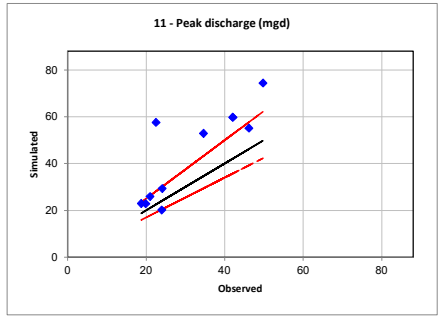

10 - Volume (Mgal)
Simulated
Observed

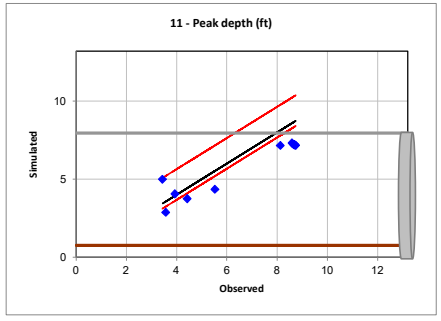

10 - Peak discharge (mgd)
Simulated
Observed

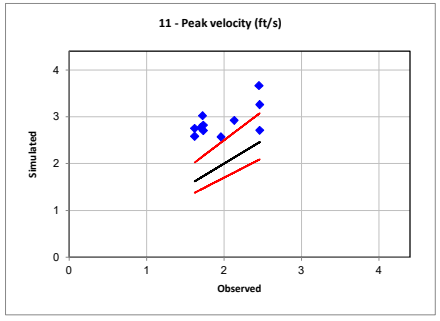

10 - Peak depth (ft)
Simulated
Observed

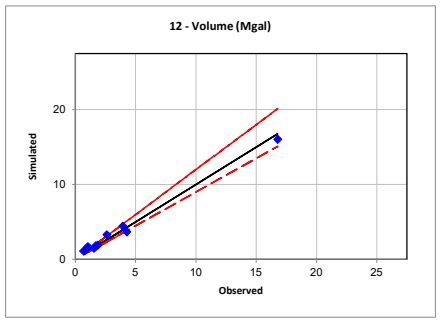

10 - Peak velocity (ft/s)
Simulated
Observed

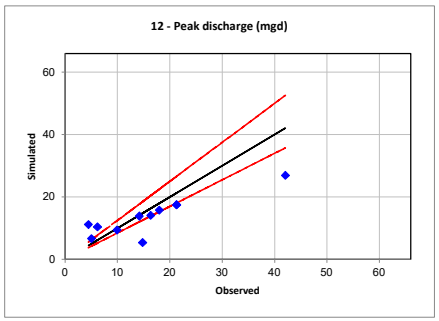

11 - Volume (Mgal)
Simulated
Observed

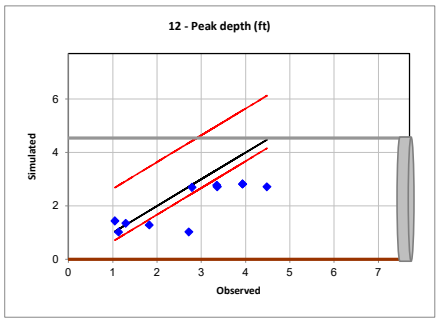

11 - Peak discharge (mgd)
Simulated
Observed

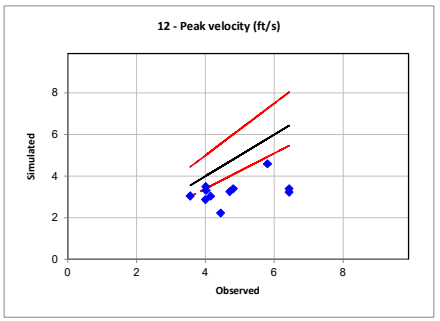

11 - Peak depth (ft)
Simulated
Observed

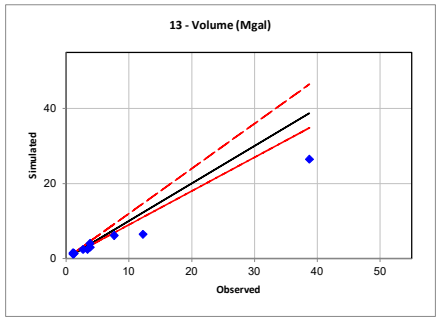

11 - Peak velocity (ft/s)
Simulated
Observed

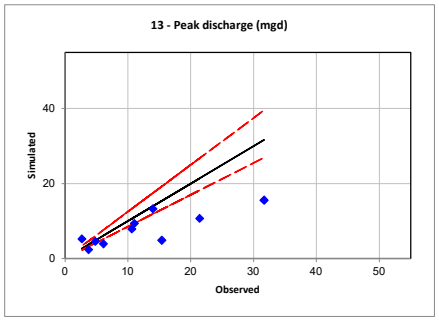

12 - Volume (Mgal)
Simulated
Observed

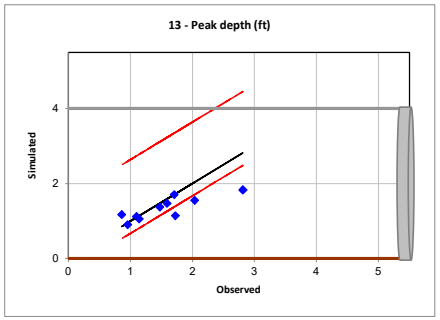

12 - Peak discharge (mgd)
Simulated
Observed

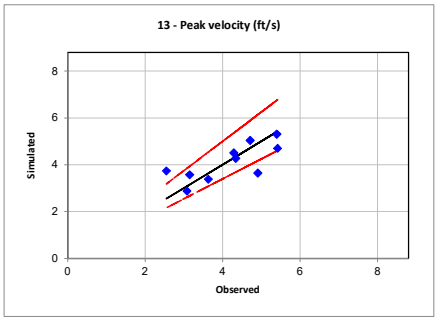

12 - Peak depth (ft)
Simulated
Observed

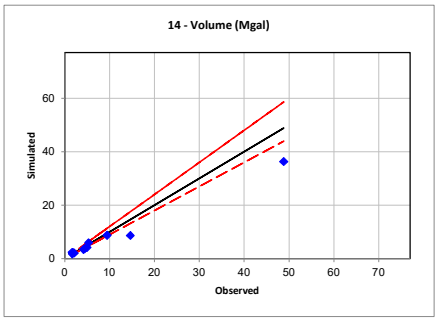

12 - Peak velocity (ft/s)
Simulated
Observed

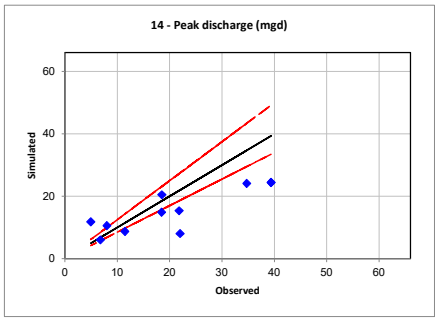

13 - Volume (Mgal)
Simulated
Observed

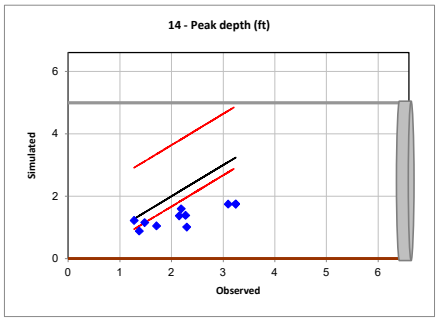

13 - Peak discharge (mgd)
Simulated
Observed

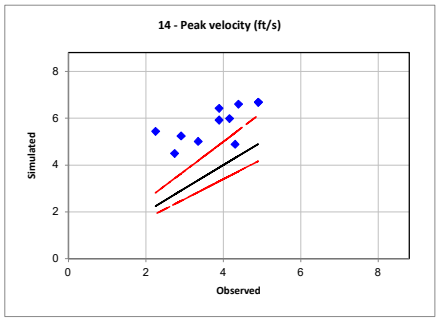

13 - Peak depth (ft)
Simulated
Observed

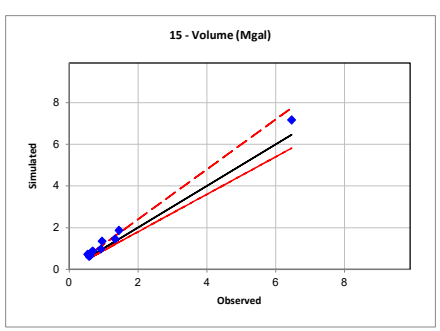

13 - Peak velocity (ft/s)
Simulated
Observed

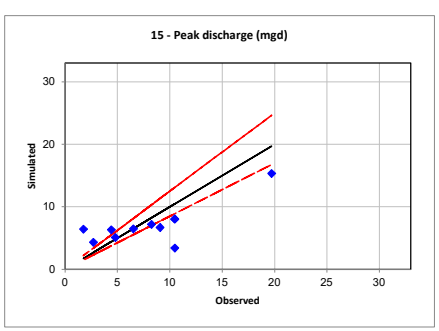

14 - Volume (Mgal)
Simulated
Observed

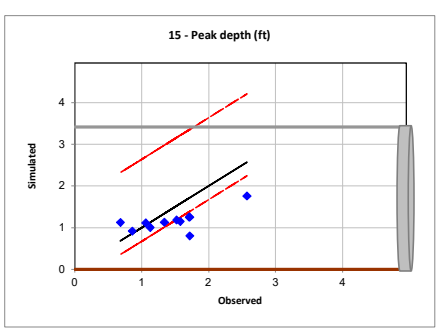

14 - Peak discharge (mgd)
Simulated
Observed

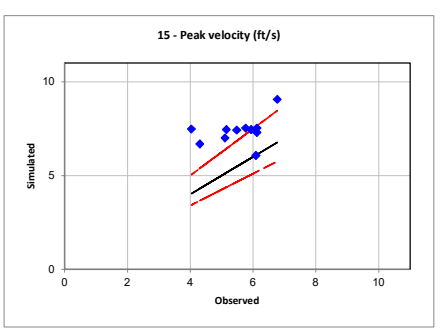

14 - Peak depth (ft)
Simulated
Observed

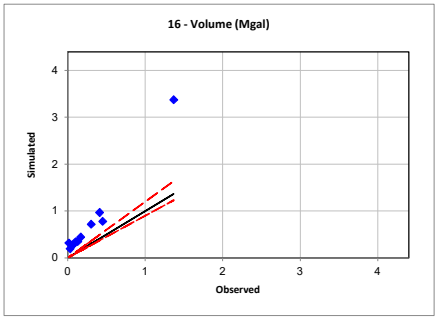

14 - Peak velocity (ft/s)
Simulated
Observed

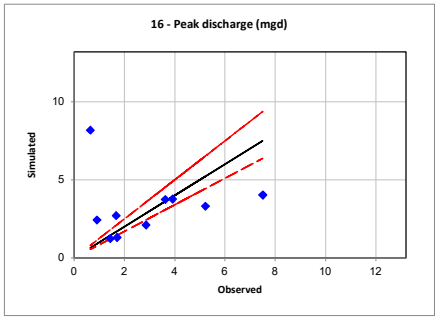

15 - Volume (Mgal)
Simulated
Observed

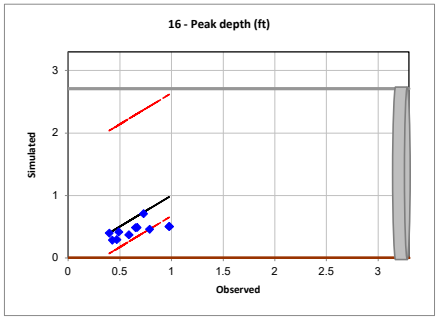

15 - Peak discharge (mgd)
Simulated
Observed

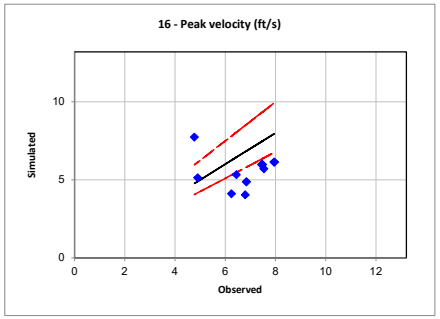

15 - Peak depth (ft)
Simulated
Observed

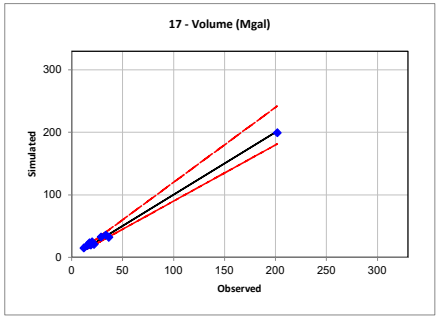

15 - Peak velocity (ft/s)
Simulated
Observed

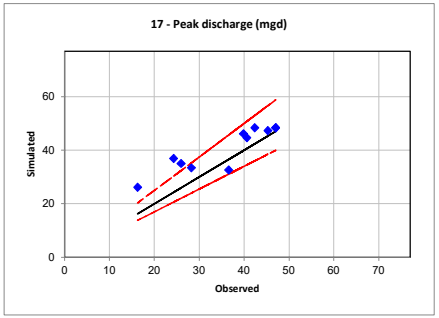

16 - Volume (Mgal)
Simulated
Observed

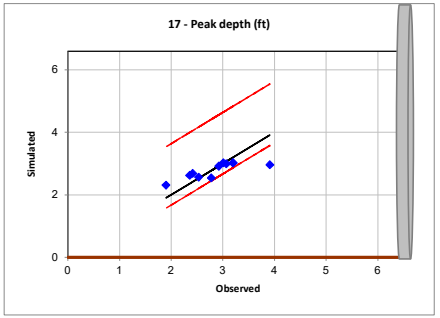

16 - Peak discharge (mgd)
Simulated
Observed

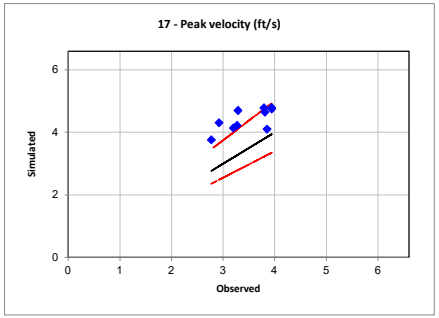

16 - Peak depth (ft)
Simulated
Observed

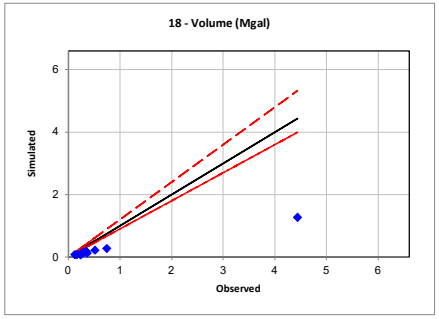

16 - Peak velocity (ft/s)
Simulated
Observed

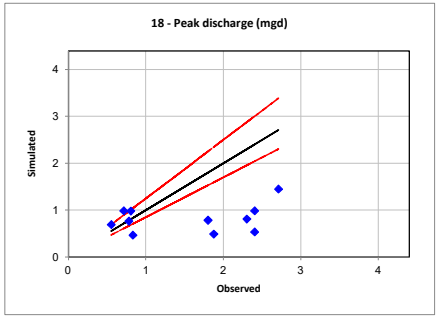

17 - Volume (Mgal)
Simulated
Observed

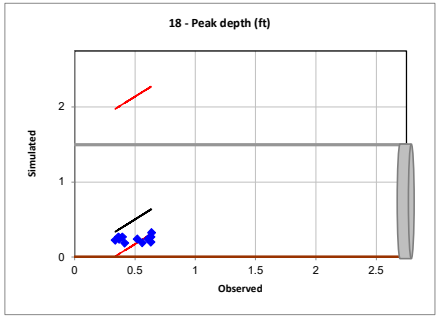

17 - Peak discharge (mgd)
Simulated
Observed

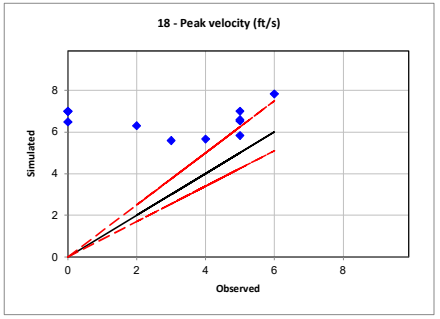

17 - Peak depth (ft)
Simulated
Observed

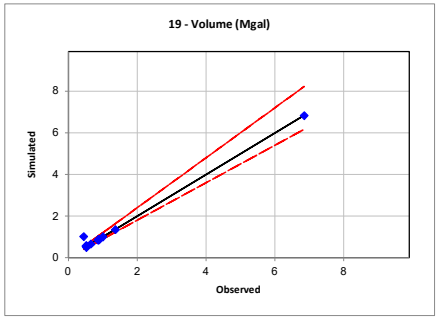

17 - Peak velocity (ft/s)
Simulated
Observed

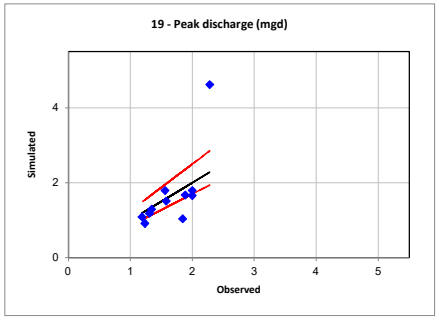

18 - Volume (Mgal)
Simulated
Observed

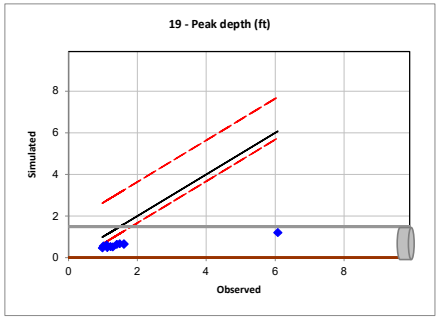

18 - Peak discharge (mgd)
Simulated
Observed

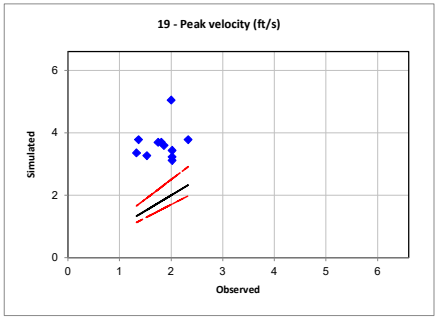

18 - Peak depth (ft)
Simulated
Observed

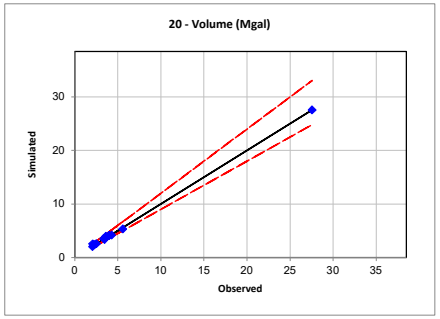

18 - Peak velocity (ft/s)
Simulated
Observed

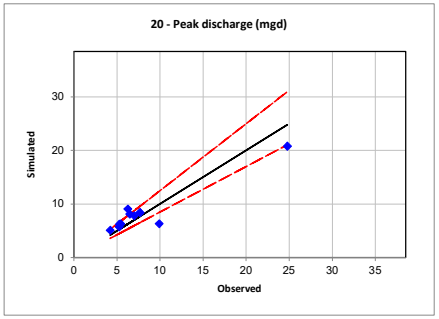

19 - Volume (Mgal)
Simulated
Observed

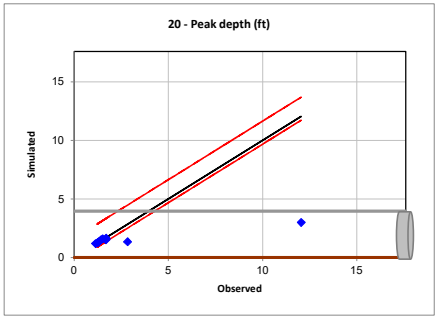

19 - Peak discharge (mgd)
Simulated
Observed

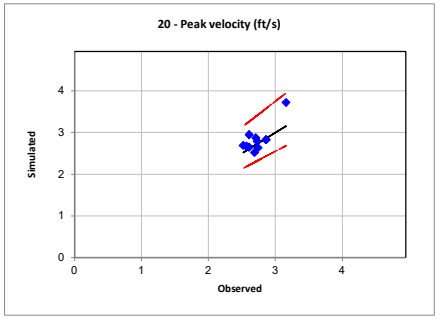

19 - Peak depth (ft)
Simulated
Observed

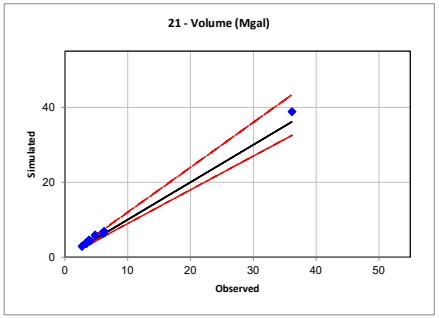

19 - Peak velocity (ft/s)
Simulated
Observed

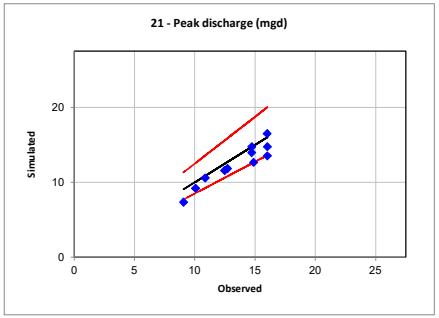

20 - Volume (Mgal)
Simulated
Observed

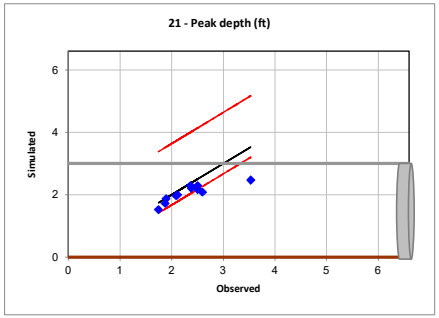

20 - Peak discharge (mgd)
Simulated
Observed

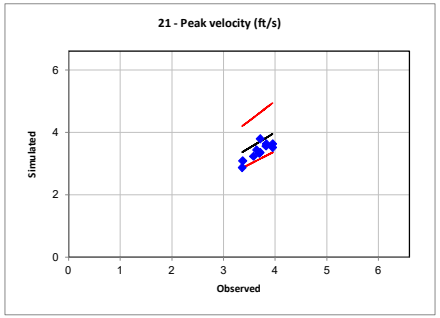

20 - Peak depth (ft)
Simulated
Observed

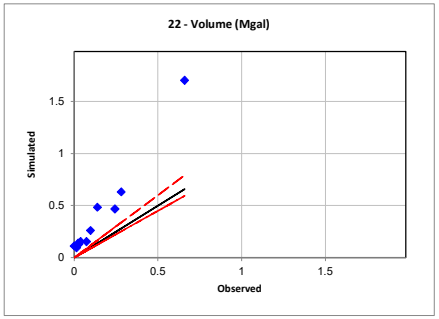

20 - Peak velocity (ft/s)
Simulated
Observed

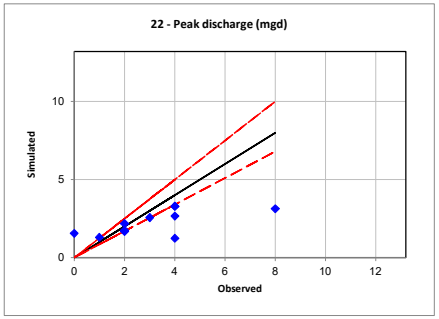

21 - Volume (Mgal)
Simulated
Observed

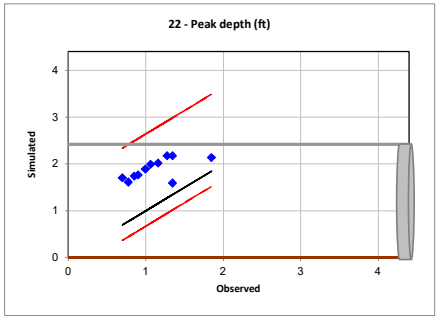

21 - Peak discharge (mgd)
Simulated
Observed

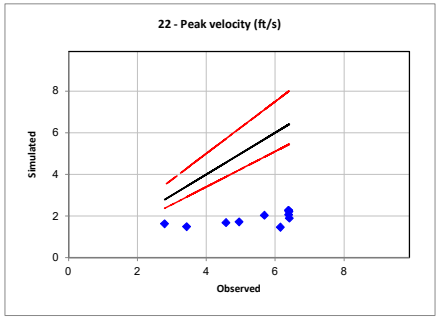

21 - Peak depth (ft)
Simulated
Observed

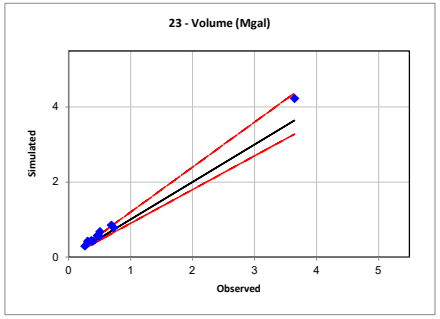

21 - Peak velocity (ft/s)
Simulated
Observed

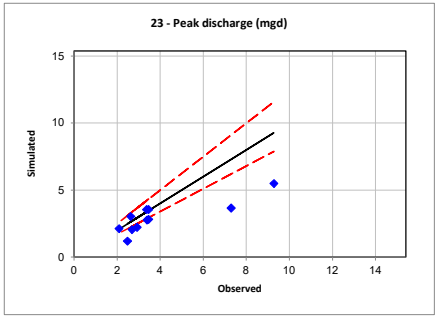

22 - Volume (Mgal)
Simulated
Observed

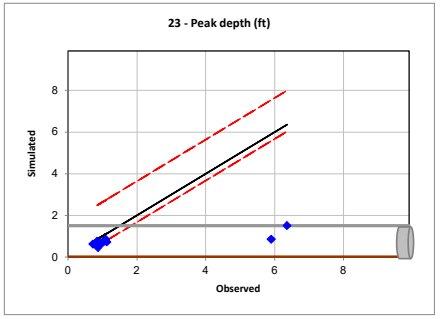

22 - Peak discharge (mgd)
Simulated
Observed

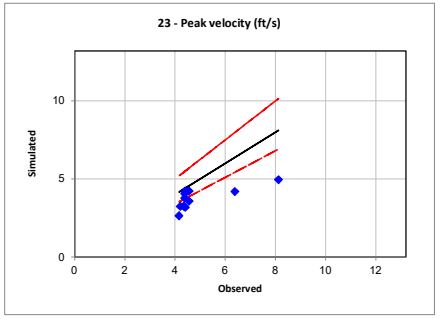

22 - Peak depth (ft)
Simulated
Observed

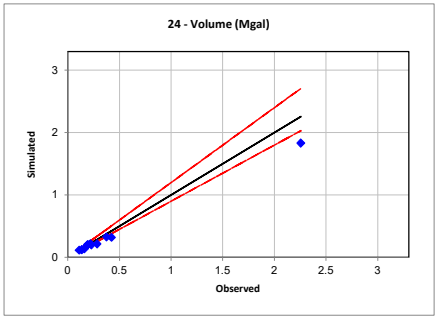

22 - Peak velocity (ft/s)
Simulated
Observed

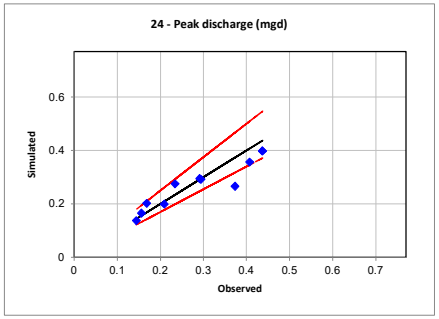

23 - Volume (Mgal)
Simulated
Observed

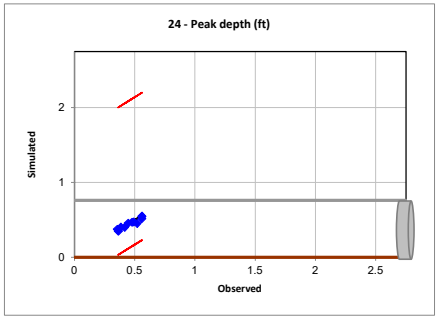

23 - Peak discharge (mgd)
Simulated
Observed

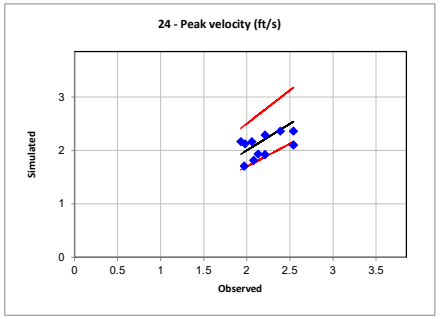

23 - Peak depth (ft)
Simulated
Observed

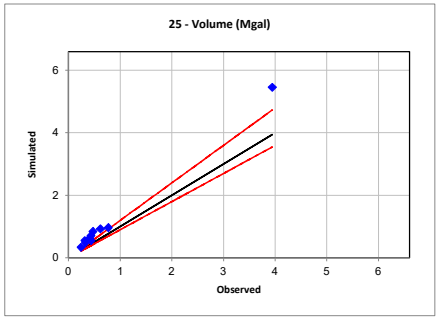

23 - Peak velocity (ft/s)
Simulated
Observed

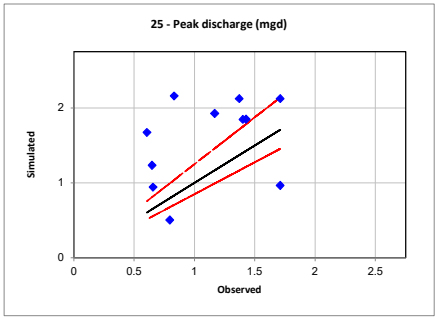

24 - Volume (Mgal)
Simulated
Observed

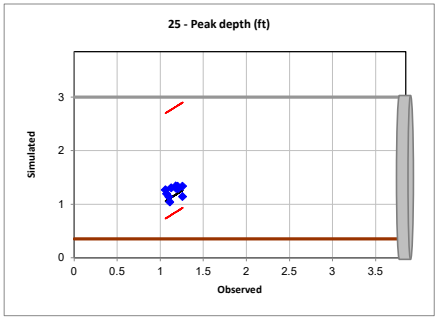

24 - Peak discharge (mgd)
Simulated
Observed

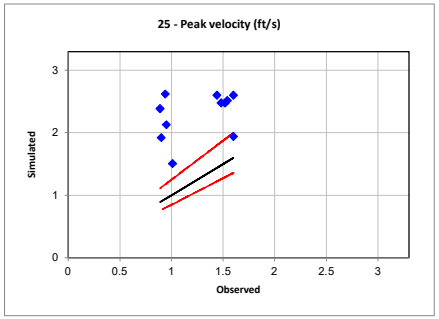

24 - Peak depth (ft)
Simulated
Observed

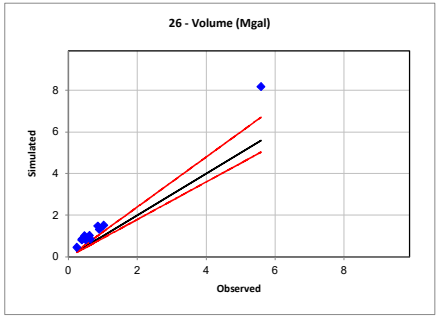

24 - Peak velocity (ft/s)
Simulated
Observed

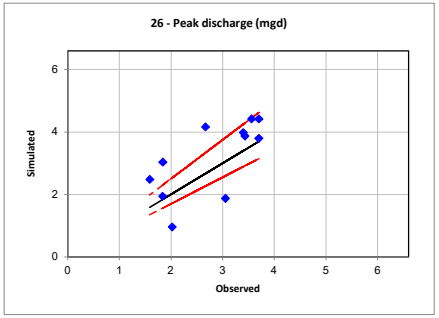

25 - Volume (Mgal)
Simulated
Observed

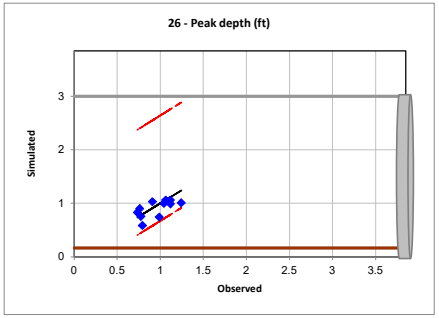

25 - Peak discharge (mgd)
Simulated
Observed

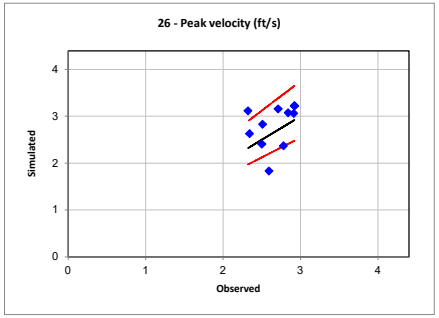

25 - Peak depth (ft)
Simulated
Observed

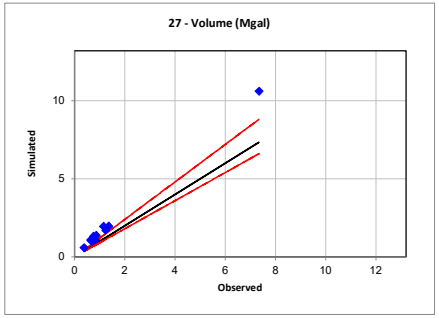

25 - Peak velocity (ft/s)
Simulated
Observed

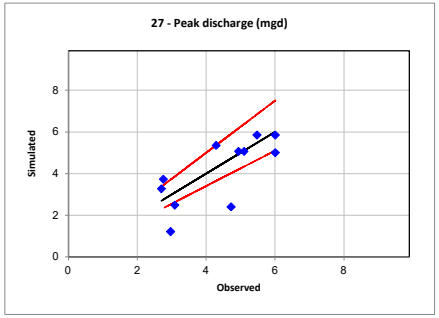

26 - Volume (Mgal)
Simulated
Observed

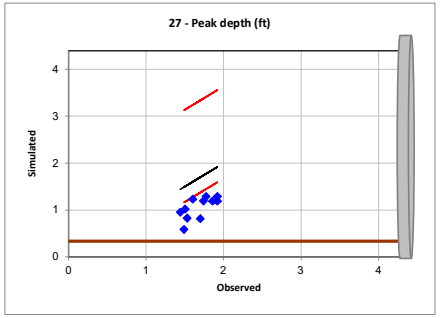

26 - Peak discharge (mgd)
Simulated
Observed

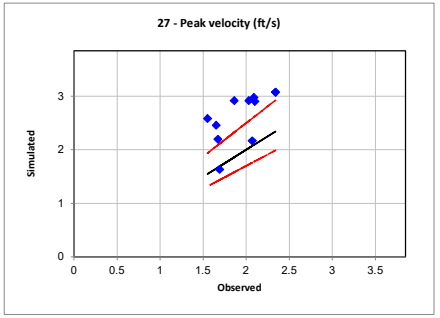

26 - Peak depth (ft)
Simulated
Observed

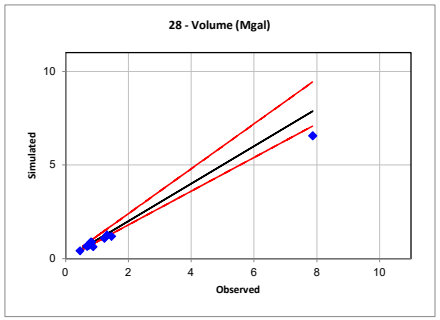

26 - Peak velocity (ft/s)
Simulated
Observed

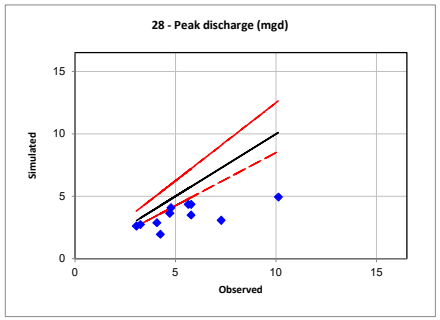

27 - Volume (Mgal)
Simulated
Observed

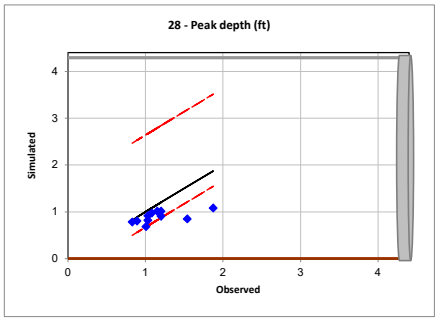

27 - Peak discharge (mgd)
Simulated
Observed

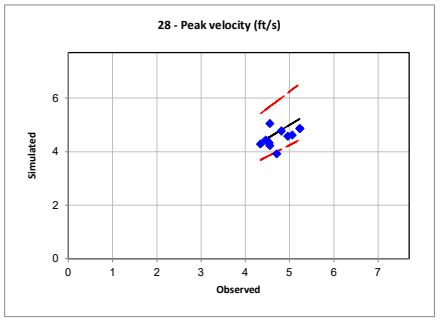

27 - Peak depth (ft)
Simulated
Observed

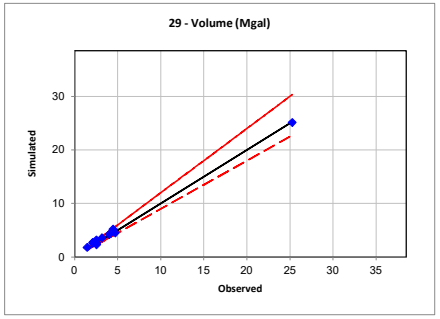

27 - Peak velocity (ft/s)
Simulated
Observed

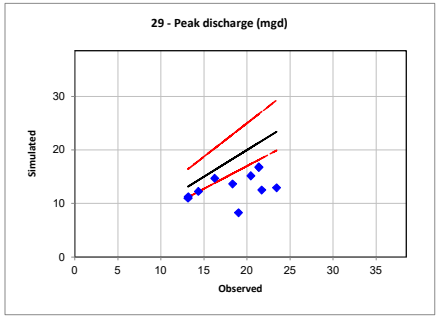

28 - Volume (Mgal)
Simulated
Observed

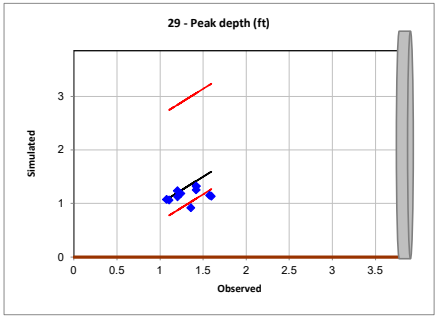

28 - Peak discharge (mgd)
Simulated
Observed

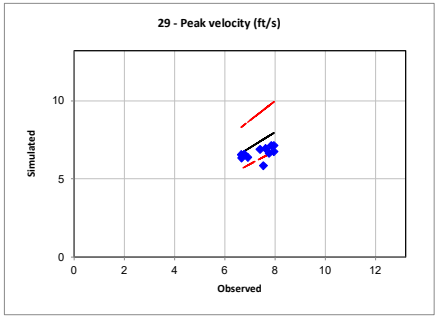

28 - Peak depth (ft)
Simulated
Observed

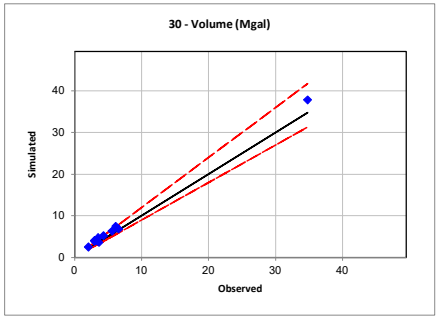

28 - Peak velocity (ft/s)
Simulated
Observed

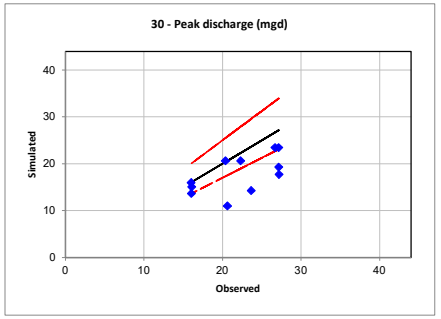

29 - Volume (Mgal)
Simulated
Observed

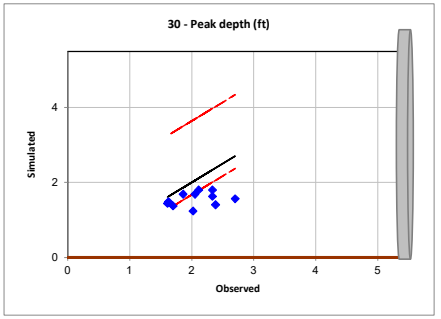

29 - Peak discharge (mgd)
Simulated
Observed

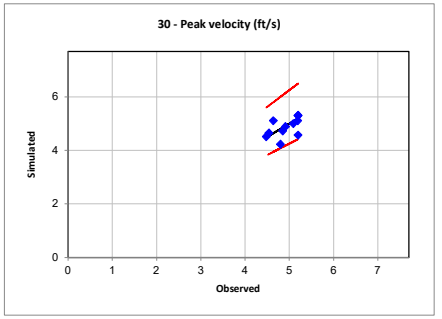

29 - Peak depth (ft)
Simulated
Observed

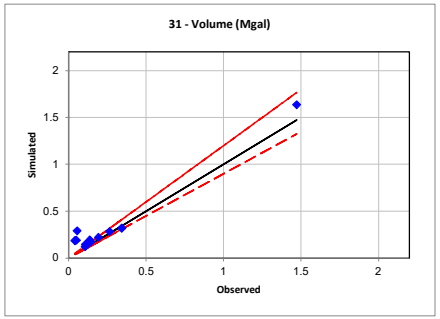

29 - Peak velocity (ft/s)
Simulated
Observed

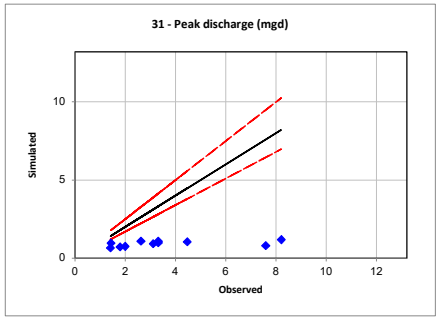

30 - Volume (Mgal)
Simulated
Observed

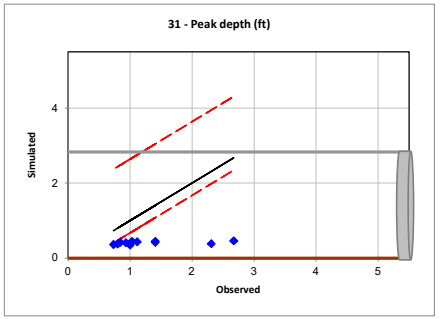

30 - Peak discharge (mgd)
Simulated
Observed

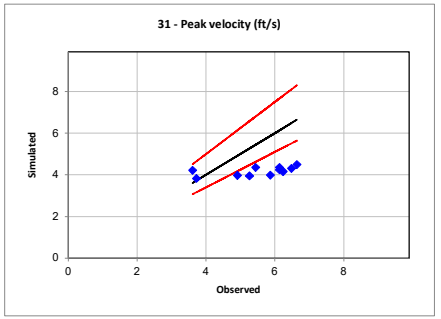

30 - Peak depth (ft)
Simulated
Observed

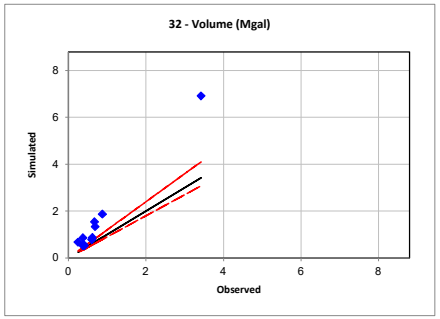

30 - Peak velocity (ft/s)
Simulated
Observed

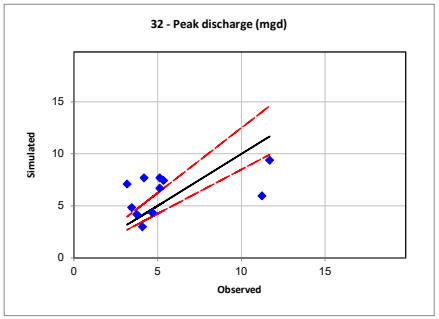

31 - Volume (Mgal)
Simulated
Observed

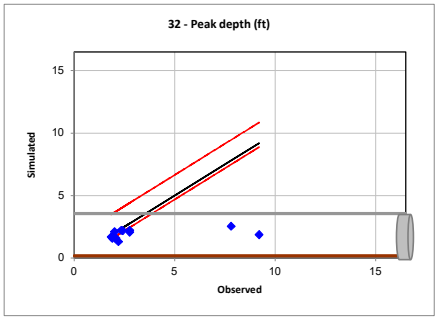

31 - Peak discharge (mgd)
Simulated
Observed

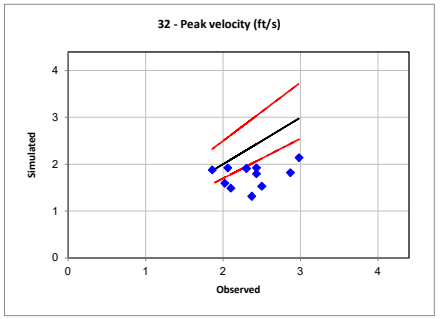

31 - Peak depth (ft)
Simulated
Observed

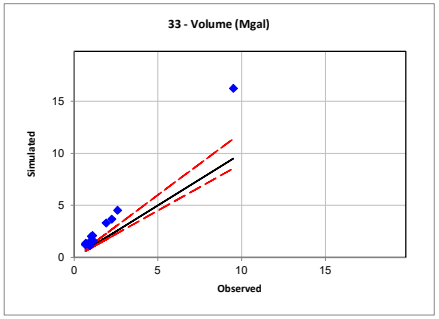

31 - Peak velocity (ft/s)
Simulated
Observed

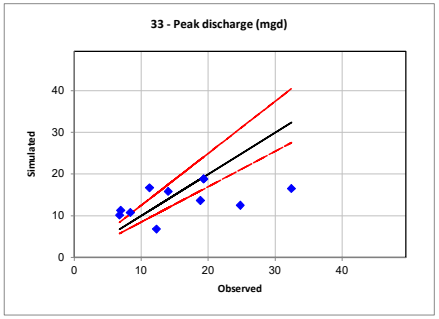

32 - Volume (Mgal)
Simulated
Observed

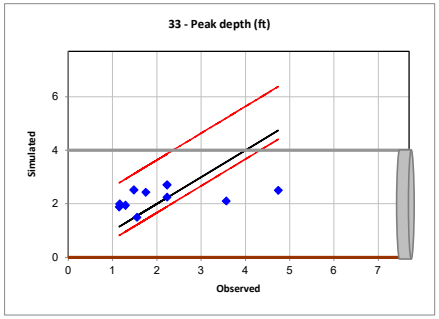

32 - Peak discharge (mgd)
Simulated
Observed

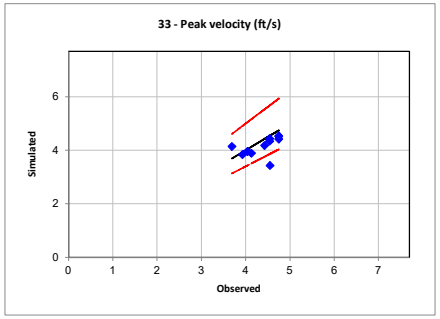

32 - Peak depth (ft)
Simulated
Observed

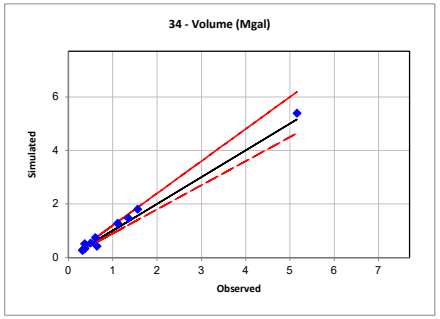

32 - Peak velocity (ft/s)
Simulated
Observed

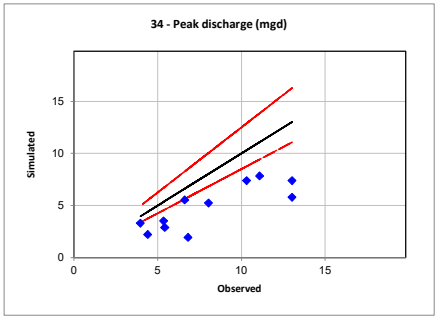

33 - Volume (Mgal)
Simulated
Observed

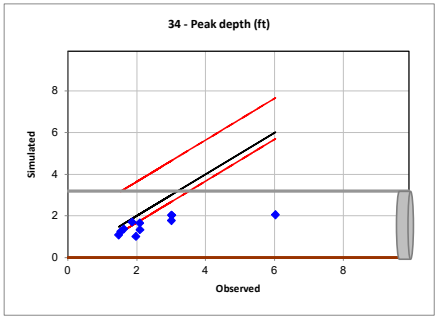

33 - Peak discharge (mgd)
Simulated
Observed

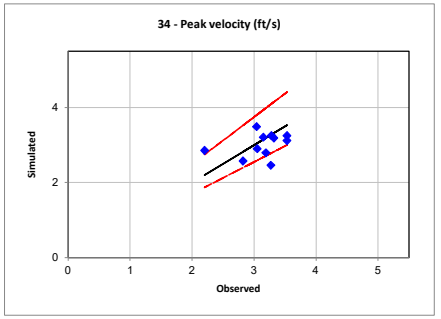

33 - Peak depth (ft)
Simulated
Observed

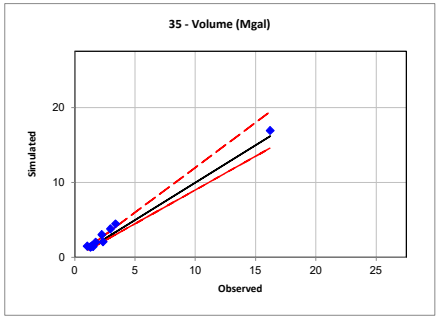

33 - Peak velocity (ft/s)
Simulated
Observed

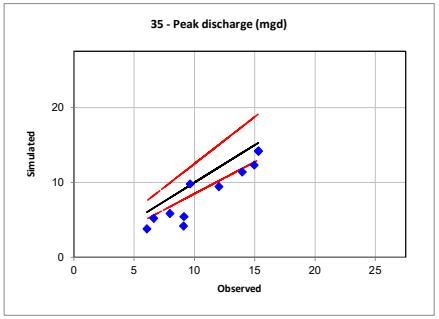

34 - Volume (Mgal)
Simulated
Observed

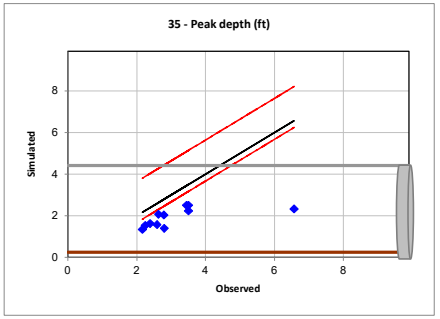

34 - Peak discharge (mgd)
Simulated
Observed

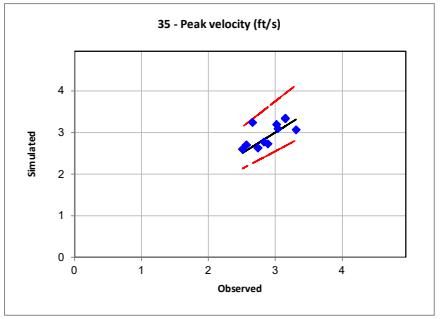

34 - Peak depth (ft)
Simulated
Observed

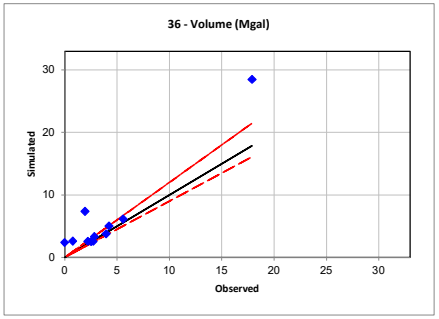

34 - Peak velocity (ft/s)
Simulated
Observed

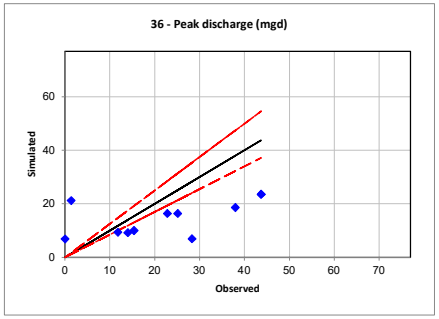

35 - Volume (Mgal)
Simulated
Observed

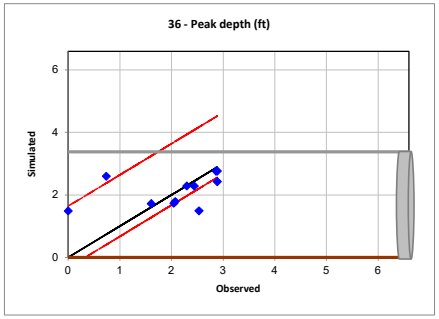

35 - Peak discharge (mgd)
Simulated
Observed

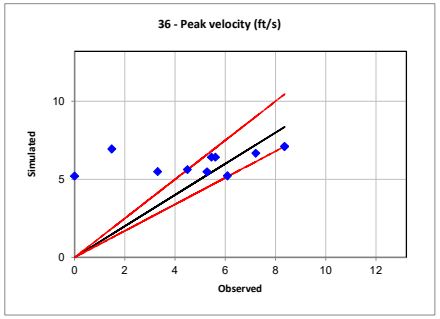

35 - Peak depth (ft)
Simulated
Observed

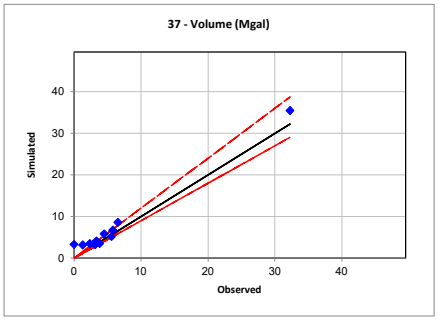

35 - Peak velocity (ft/s)
Simulated
Observed

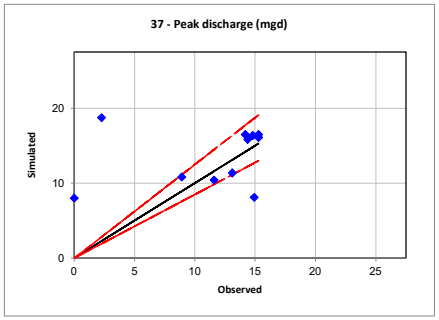

36 - Volume (Mgal)
Simulated
Observed

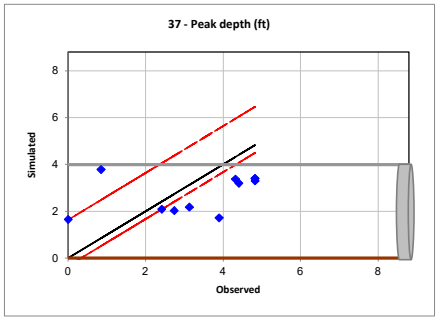

36 - Peak discharge (mgd)
Simulated
Observed

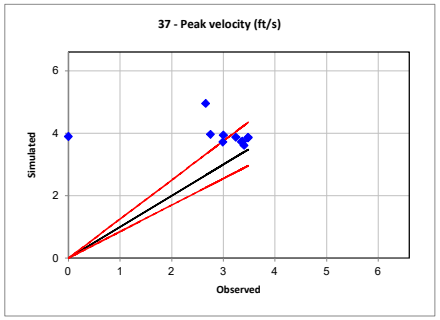

36 - Peak depth (ft)
Simulated
Observed

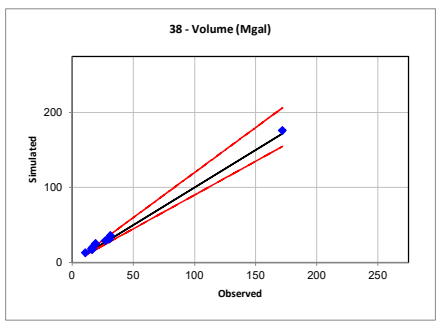

36 - Peak velocity (ft/s)
Simulated
Observed

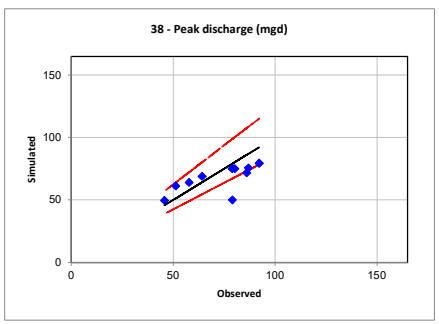

37 - Volume (Mgal)
Simulated
Observed

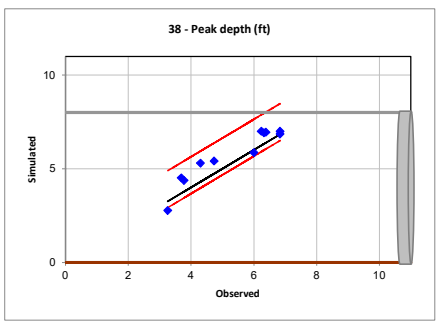

37 - Peak discharge (mgd)
Simulated
Observed

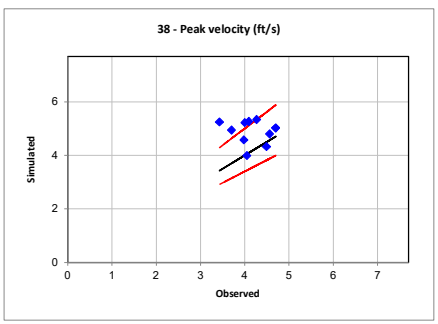

37 - Peak depth (ft)
Simulated
Observed

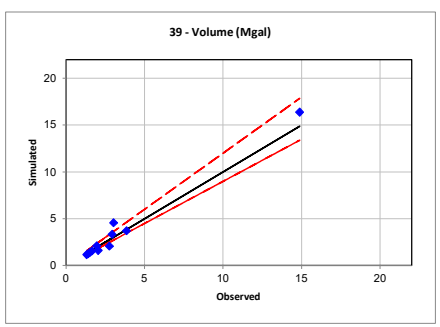

37 - Peak velocity (ft/s)
Simulated
Observed

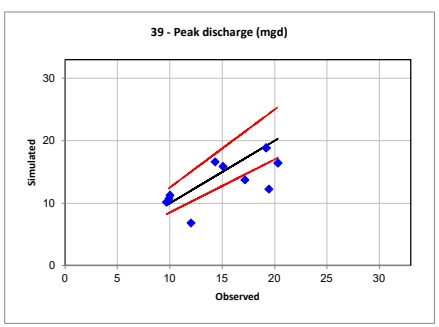

38 - Volume (Mgal)
Simulated
Observed

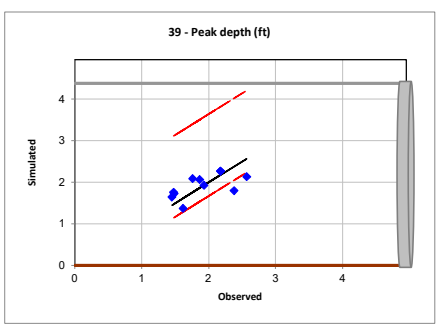

38 - Peak discharge (mgd)
Simulated
Observed

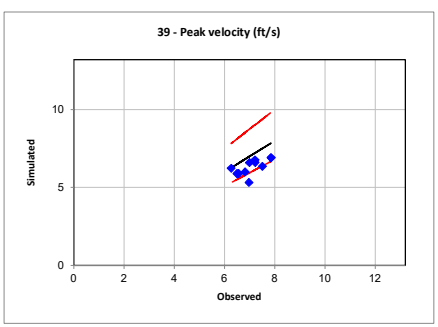

38 - Peak depth (ft)
Simulated
Observed

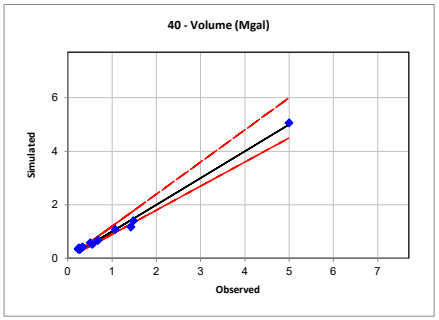

38 - Peak velocity (ft/s)
Simulated
Observed

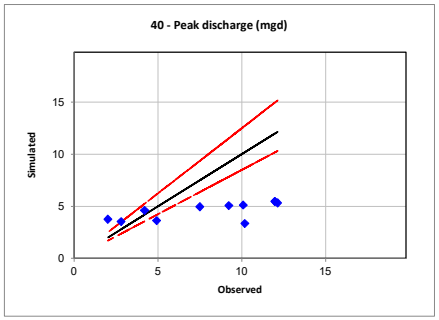

39 - Volume (Mgal)
Simulated
Observed

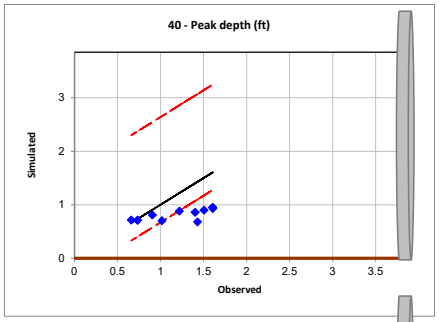

39 - Peak discharge (mgd)
Simulated
Observed

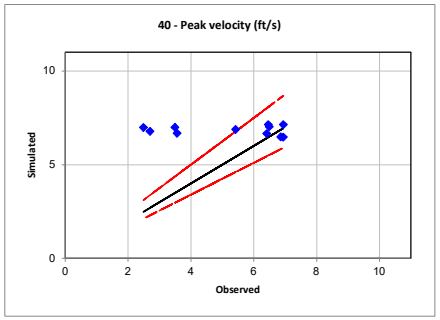

39 - Peak depth (ft)
Simulated
Observed

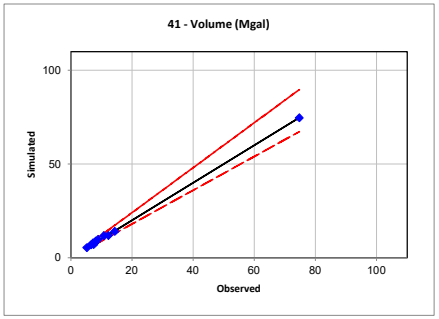

39 - Peak velocity (ft/s)
Simulated
Observed

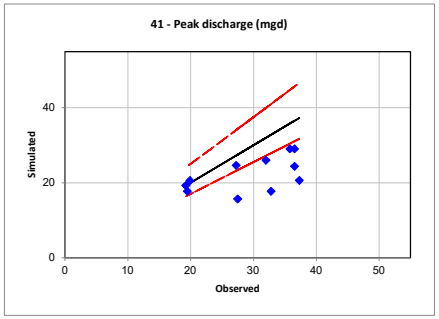

40 - Volume (Mgal)
Simulated
Observed

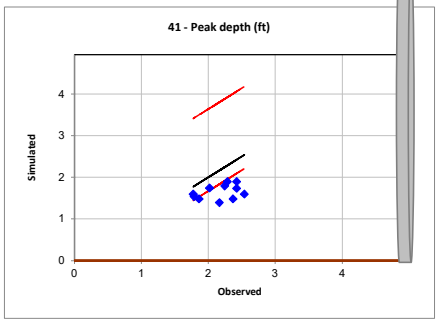

40 - Peak discharge (mgd)
Simulated
Observed

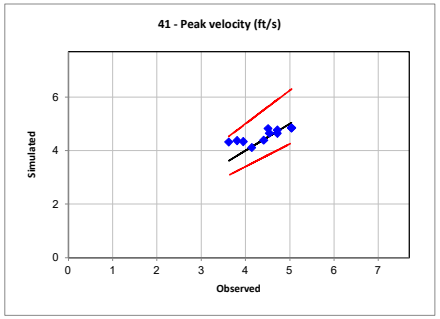

40 - Peak depth (ft)
Simulated
Observed

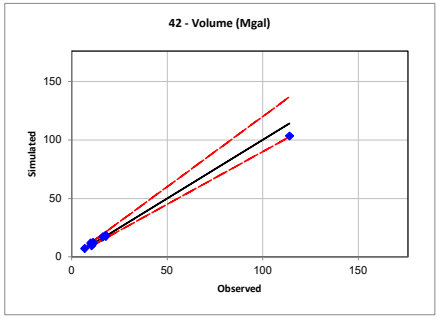

40 - Peak velocity (ft/s)
Simulated
Observed

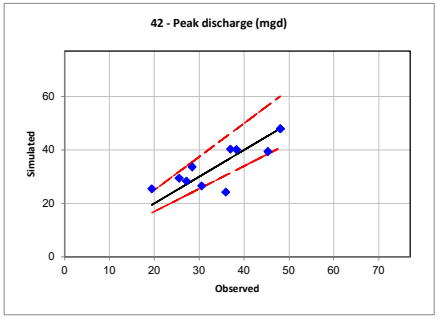

41 - Volume (Mgal)
Simulated
Observed

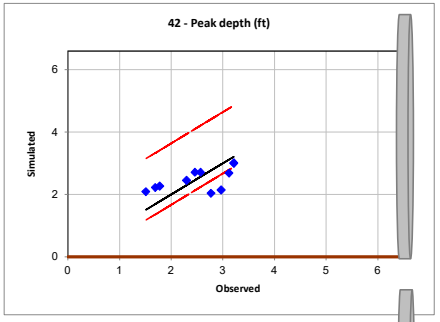

41 - Peak discharge (mgd)
Simulated
Observed

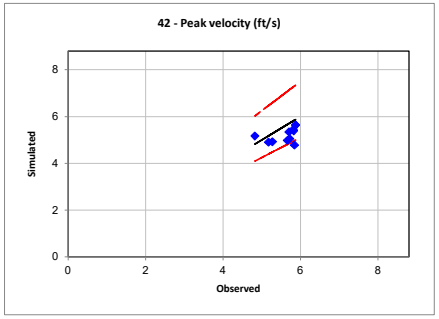

41 - Peak depth (ft)
Simulated
Observed

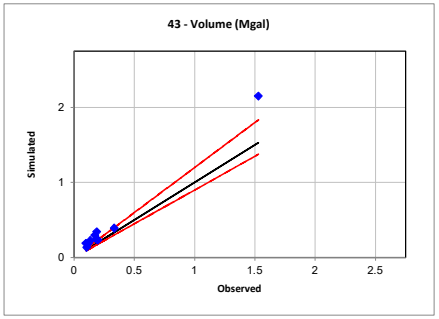

41 - Peak velocity (ft/s)
Simulated
Observed

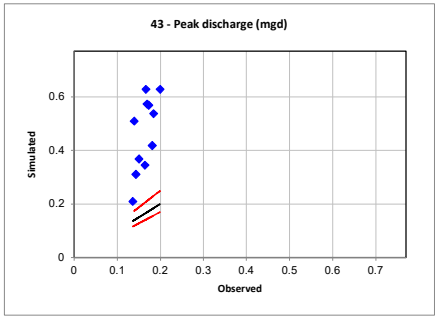

42 - Volume (Mgal)
Simulated
Observed

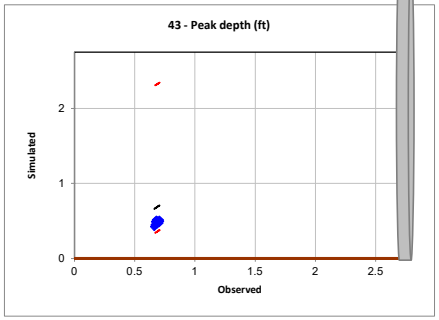

42 - Peak discharge (mgd)
Simulated
Observed

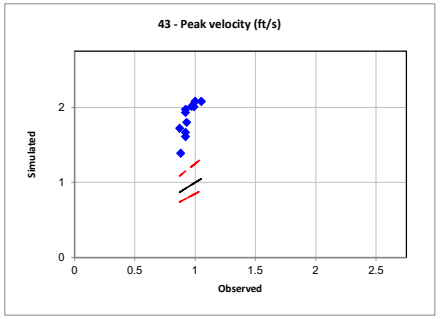

42 - Peak depth (ft)
Simulated
Observed

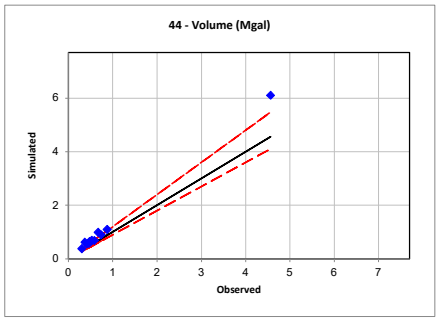

42 - Peak velocity (ft/s)
Simulated
Observed

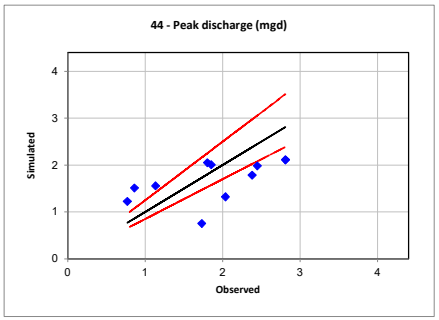

43 - Volume (Mgal)
Simulated
Observed

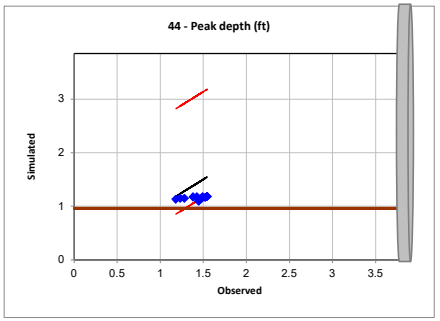

43 - Peak discharge (mgd)
Simulated
Observed

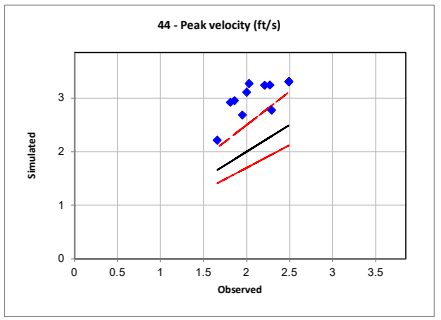

43 - Peak depth (ft)
Simulated
Observed

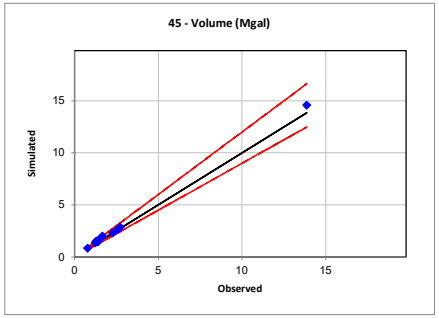

43 - Peak velocity (ft/s)
Simulated
Observed

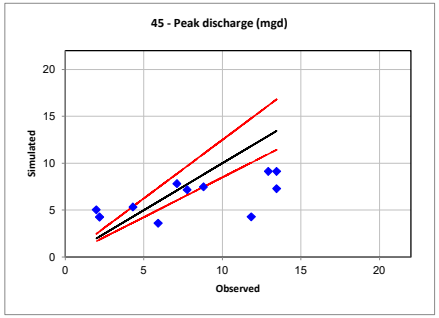

44 - Volume (Mgal)
Simulated
Observed

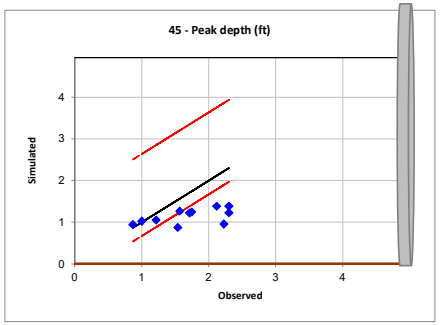

44 - Peak discharge (mgd)
Simulated
Observed

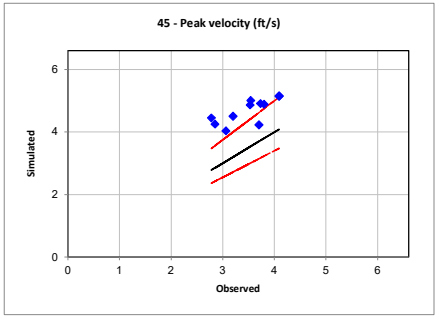

44 - Peak depth (ft)
Simulated
Observed

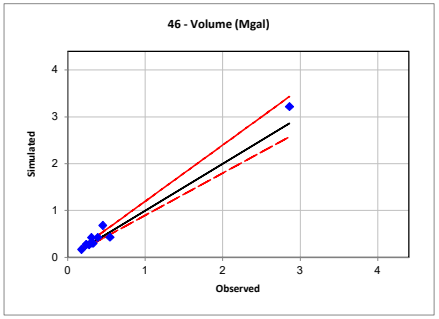

44 - Peak velocity (ft/s)
Simulated
Observed

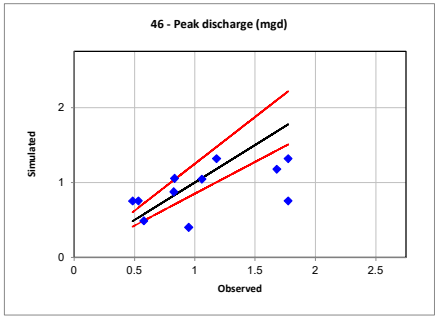

45 - Volume (Mgal)
Simulated
Observed

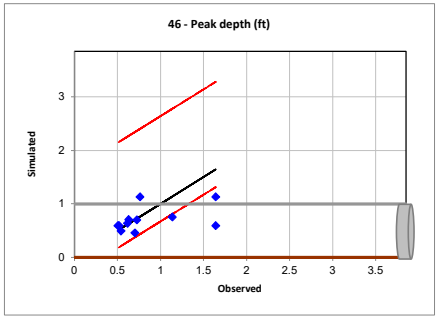

45 - Peak discharge (mgd)
Simulated
Observed

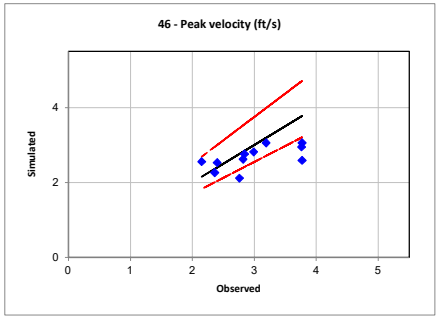

45 - Peak depth (ft)
Simulated
Observed

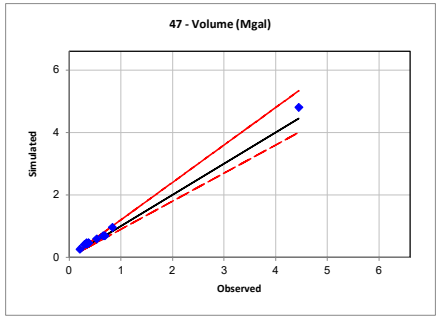

45 - Peak velocity (ft/s)
Simulated
Observed

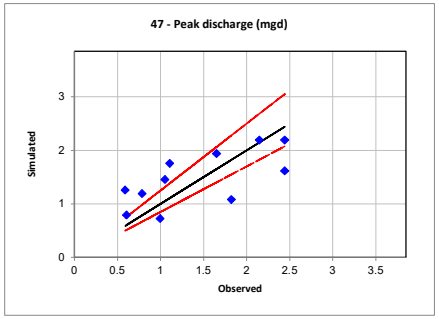

46 - Volume (Mgal)
Simulated
Observed

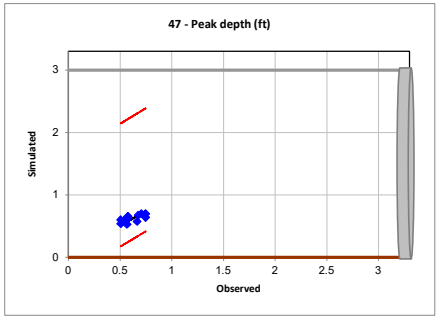

46 - Peak discharge (mgd)
Simulated
Observed

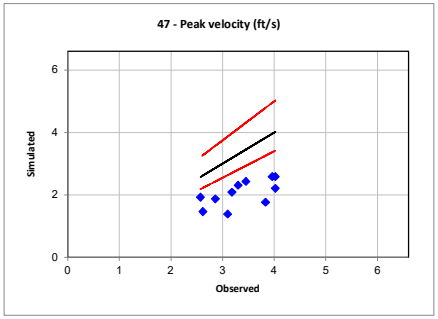

46 - Peak depth (ft)
Simulated
Observed

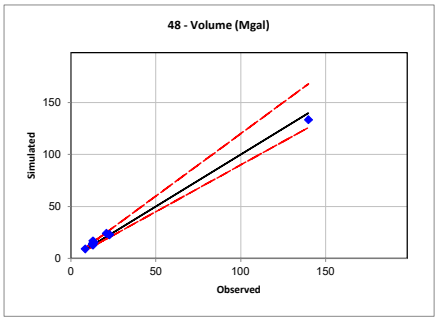

46 - Peak velocity (ft/s)
Simulated
Observed

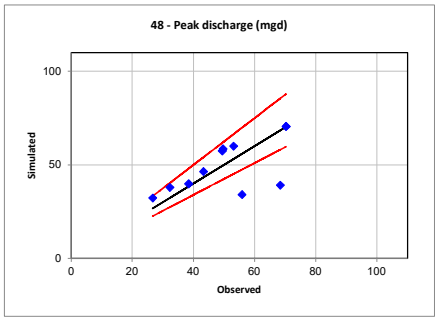

47 - Volume (Mgal)
Simulated
Observed

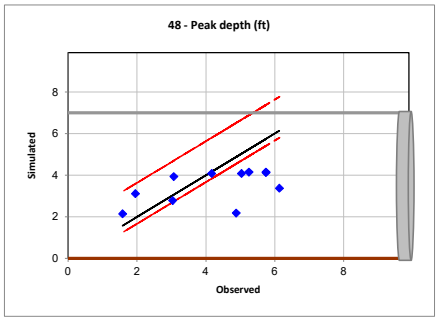

47 - Peak discharge (mgd)
Simulated
Observed

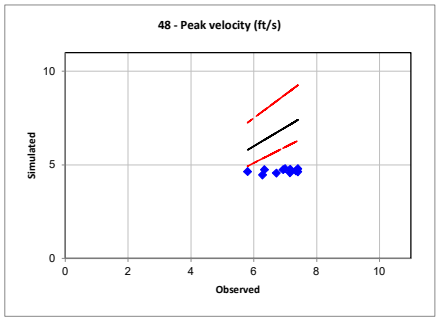

47 - Peak depth (ft)
Simulated
Observed

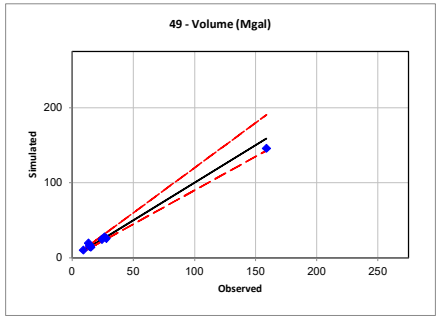

47 - Peak velocity (ft/s)
Simulated
Observed

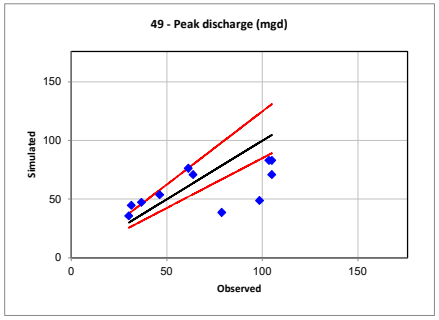

48 - Volume (Mgal)
Simulated
Observed

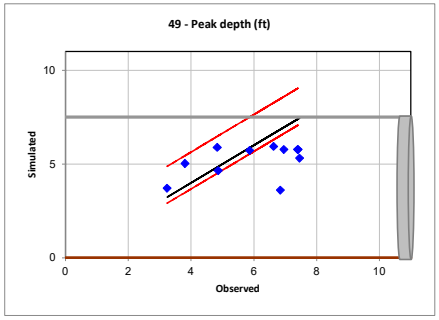

48 - Peak discharge (mgd)
Simulated
Observed

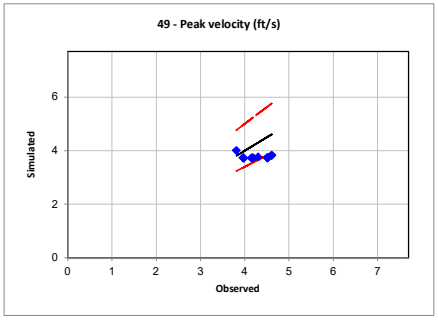

48 - Peak depth (ft)
Simulated
Observed

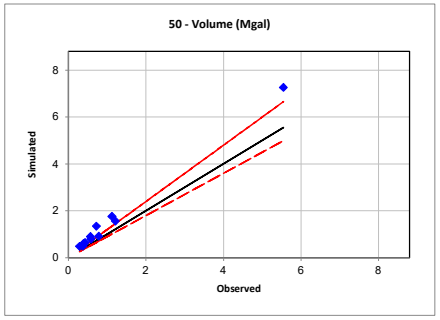

48 - Peak velocity (ft/s)
Simulated
Observed

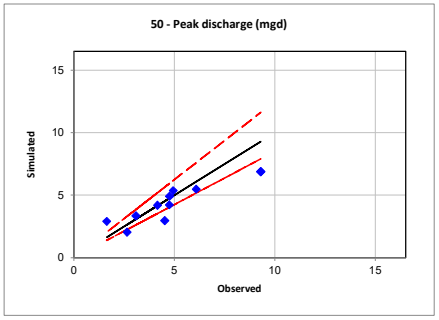

49 - Volume (Mgal)
Simulated
Observed

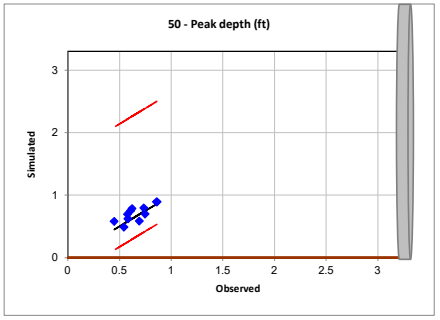

49 - Peak discharge (mgd)
Simulated
Observed

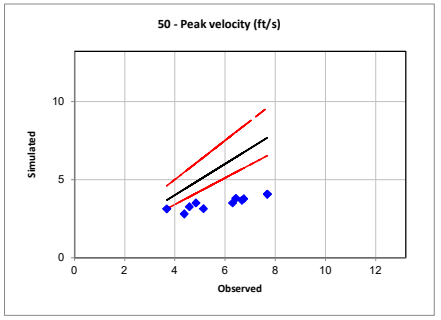

49 - Peak depth (ft)
Simulated
Observed

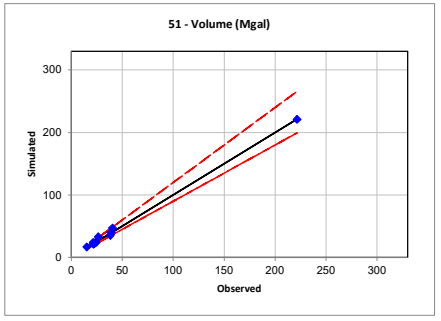

49 - Peak velocity (ft/s)
Simulated
Observed

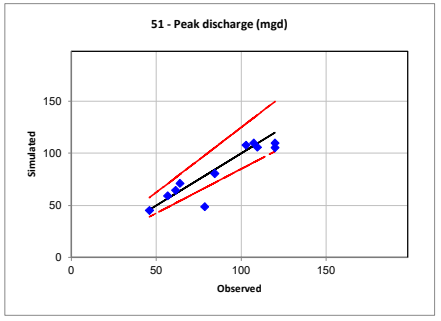

50 - Volume (Mgal)
Simulated
Observed

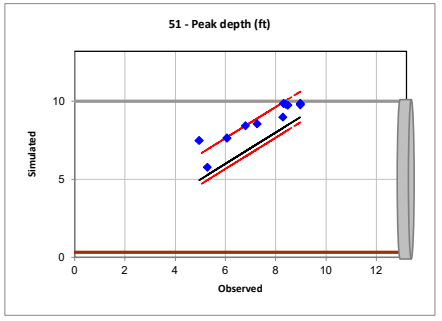

50 - Peak discharge (mgd)
Simulated
Observed

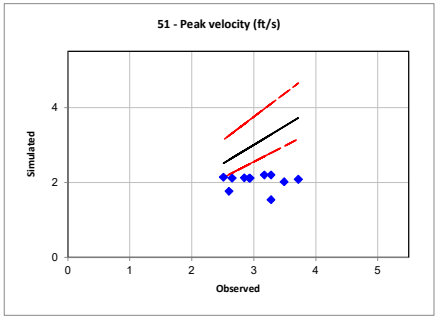

50 - Peak depth (ft)
Simulated
Observed

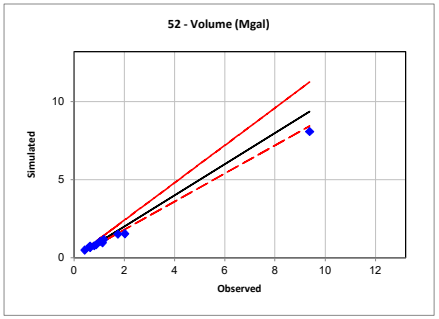

50 - Peak velocity (ft/s)
Simulated
Observed

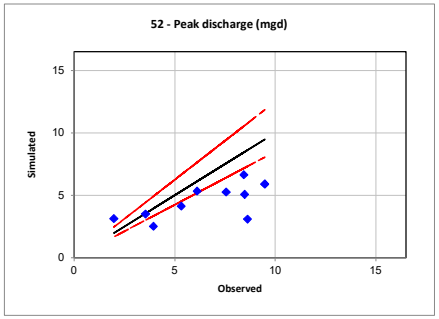

51 - Volume (Mgal)
Simulated
Observed

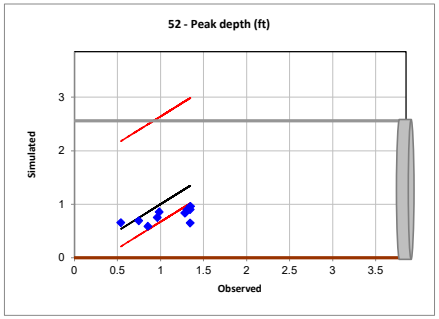

51 - Peak discharge (mgd)
Simulated
Observed

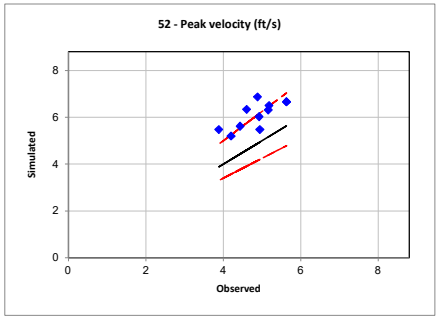

51 - Peak depth (ft)
Simulated
Observed

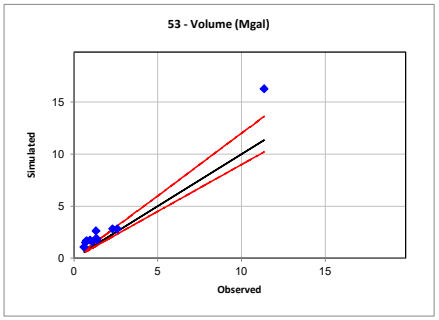

51 - Peak velocity (ft/s)
Simulated
Observed

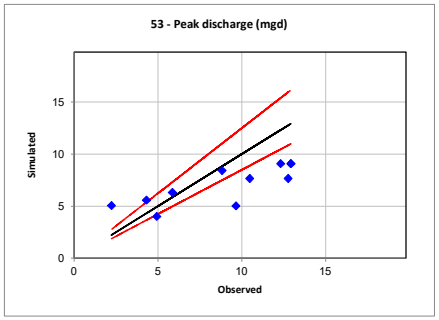

52 - Volume (Mgal)
Simulated
Observed

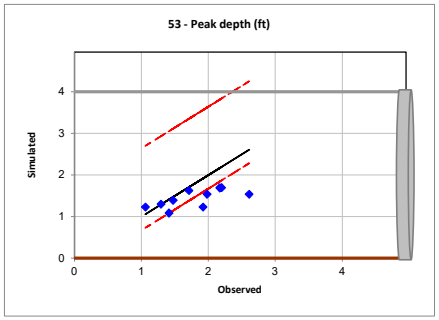

52 - Peak discharge (mgd)
Simulated
Observed

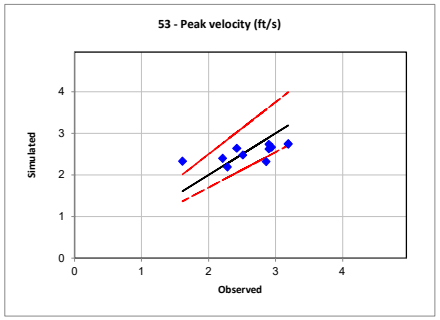

52 - Peak depth (ft)
Simulated
Observed

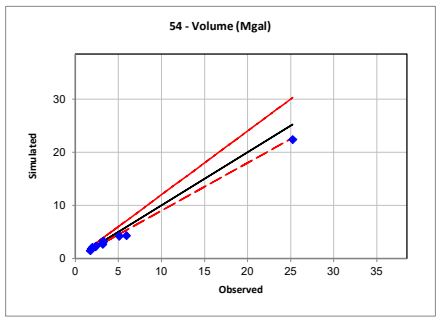

52 - Peak velocity (ft/s)
Simulated
Observed

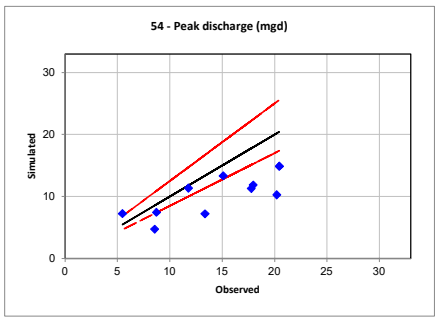

53 - Volume (Mgal)
Simulated
Observed

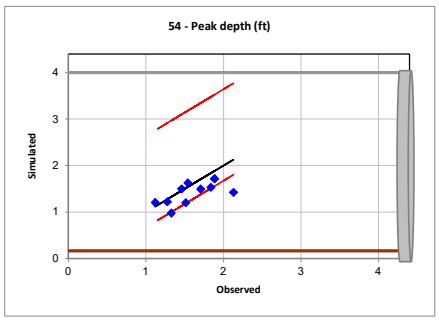

53 - Peak discharge (mgd)
Simulated
Observed

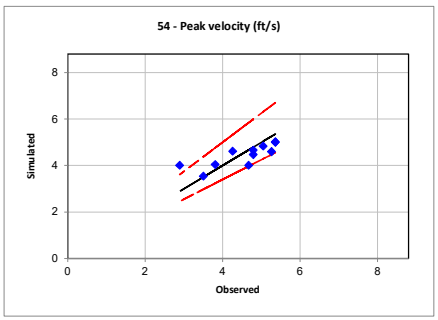

53 - Peak depth (ft)
Simulated
Observed

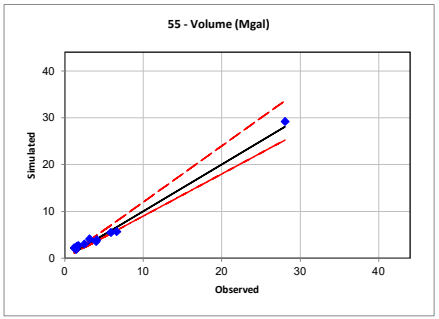

53 - Peak velocity (ft/s)
Simulated
Observed

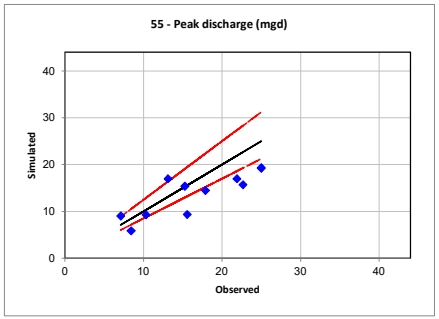

54 - Volume (Mgal)
Simulated
Observed

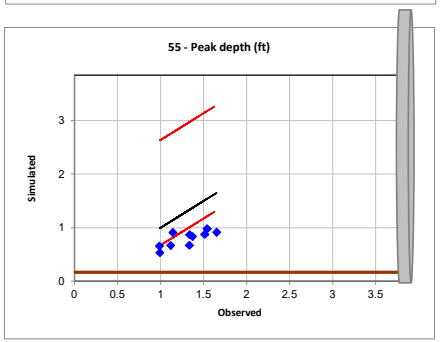

54 - Peak discharge (mgd)
Simulated
Observed

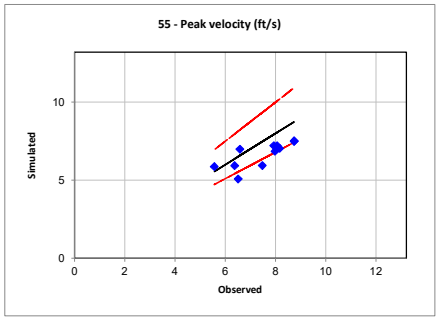

54 - Peak depth (ft)
Simulated
Observed

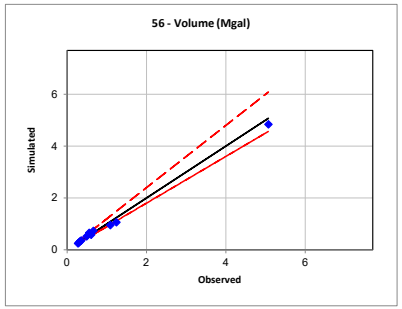

54 - Peak velocity (ft/s)
Simulated
Observed

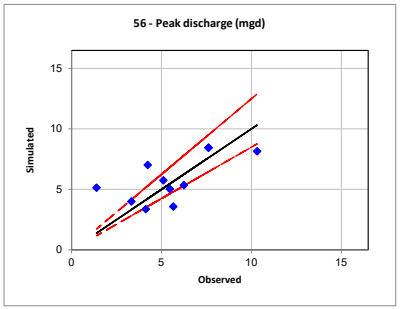

55 - Volume (Mgal)
Simulated
Observed

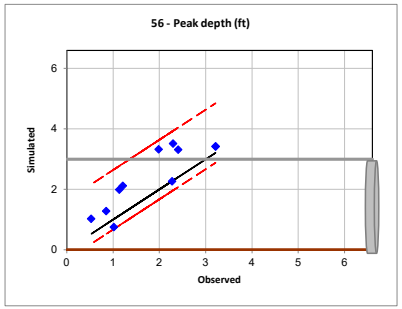

55 - Peak discharge (mgd)
Simulated
Observed

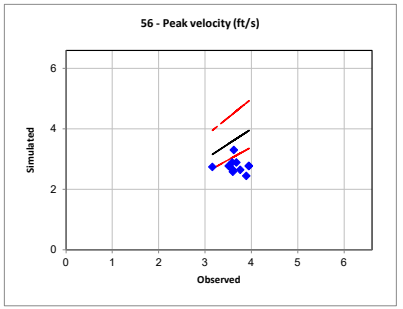

55 - Peak depth (ft)
Simulated
Observed

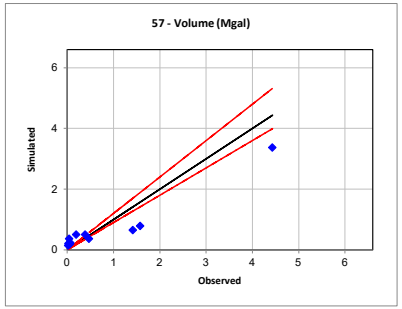

55 - Peak velocity (ft/s)
Simulated
Observed

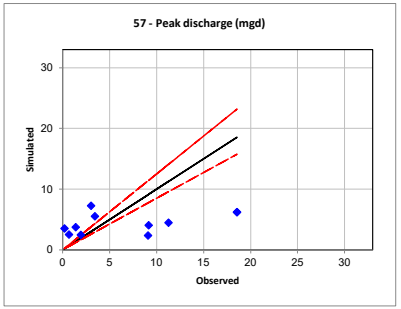

56 - Volume (Mgal)
Simulated
Observed

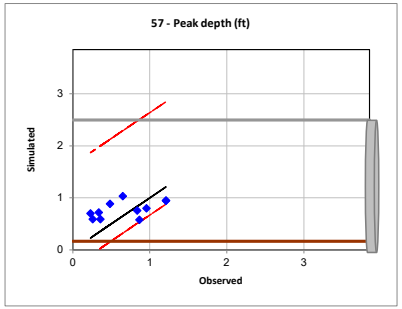

56 - Peak discharge (mgd)
Simulated
Observed

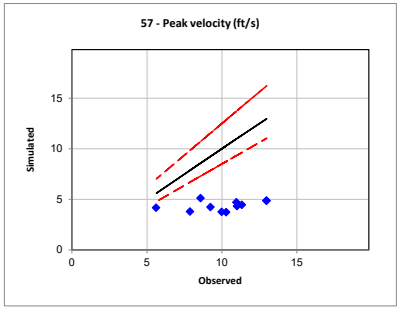

56 - Peak depth (ft)
Simulated
Observed

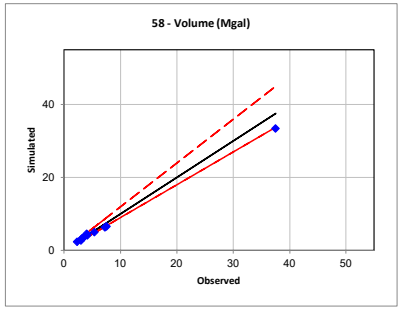

56 - Peak velocity (ft/s)
Simulated
Observed

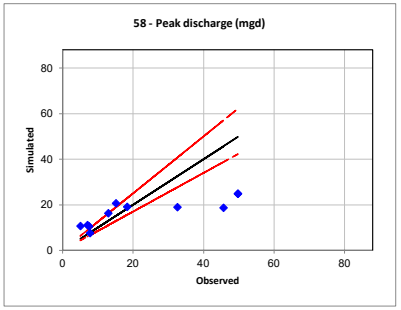

57 - Volume (Mgal)
Simulated
Observed

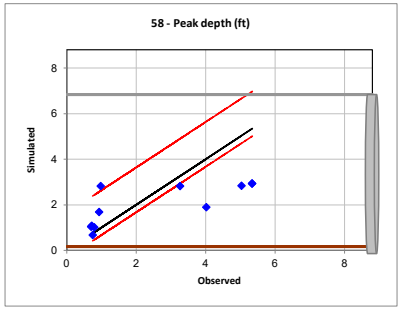

57 - Peak discharge (mgd)
Simulated
Observed

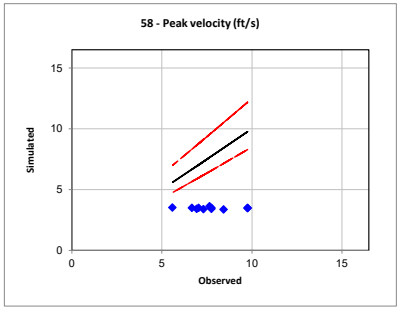

57 - Peak depth (ft)
Simulated
Observed

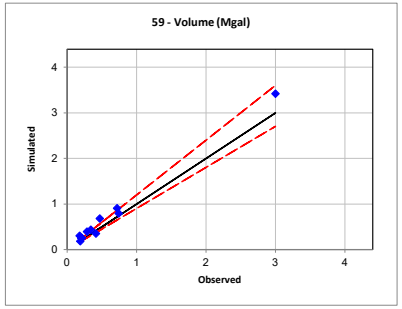

57 - Peak velocity (ft/s)
Simulated
Observed

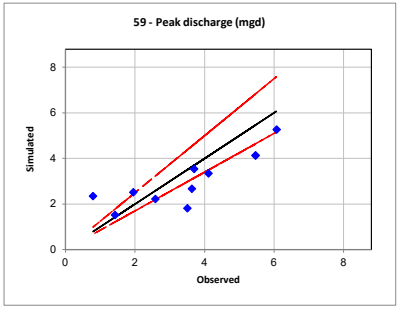

58 - Volume (Mgal)
Simulated
Observed

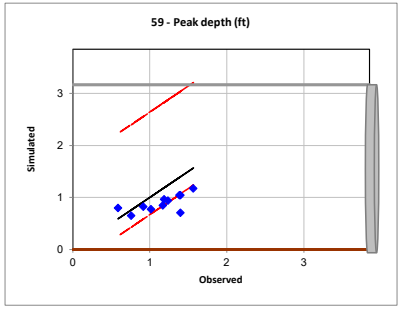

58 - Peak discharge (mgd)
Simulated
Observed

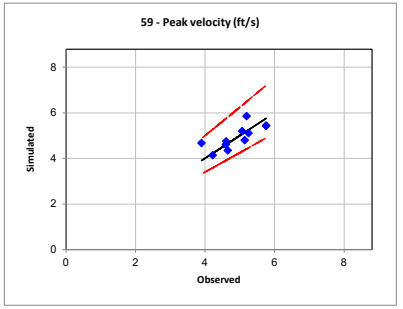

58 - Peak depth (ft)
Simulated
Observed

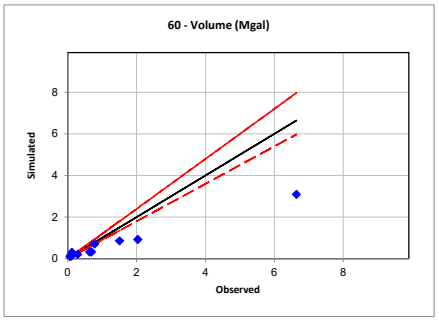

58 - Peak velocity (ft/s)
Simulated
Observed

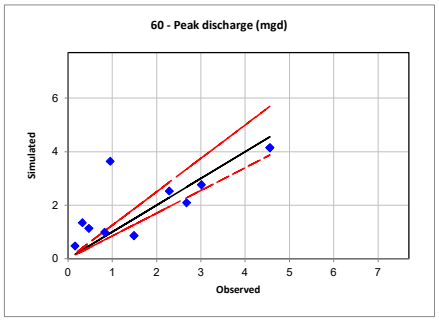

59 - Volume (Mgal)
Simulated
Observed

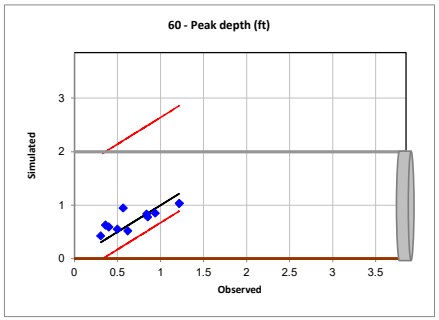

59 - Peak discharge (mgd)
Simulated
Observed

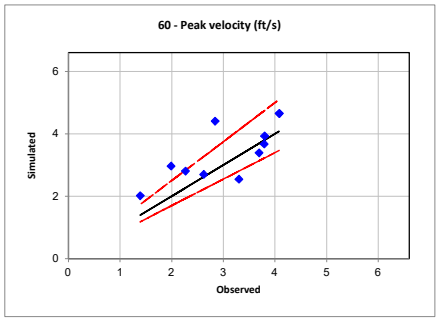

59 - Peak depth (ft)
Simulated
Observed

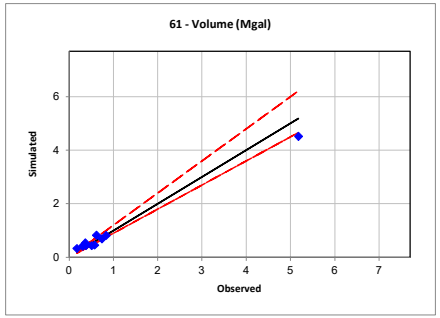

59 - Peak velocity (ft/s)
Simulated
Observed

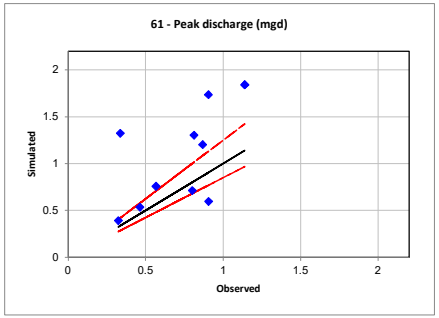

60 - Volume (Mgal)
Simulated
Observed

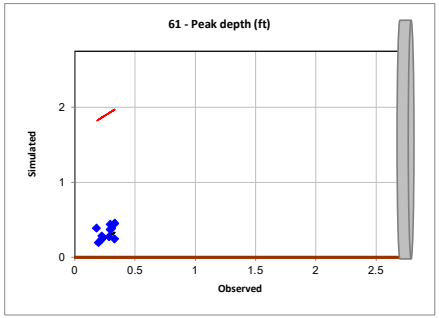

60 - Peak discharge (mgd)
Simulated
Observed

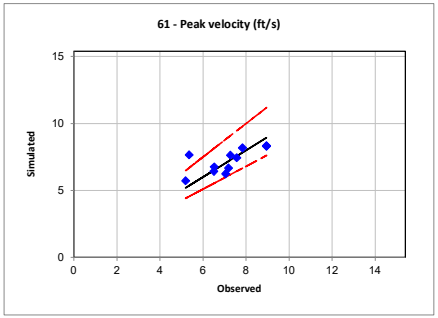

60 - Peak depth (ft)
Simulated
Observed

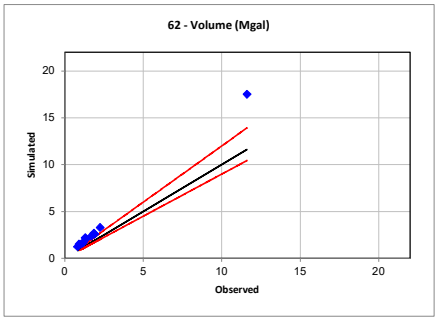

60 - Peak velocity (ft/s)
Simulated
Observed

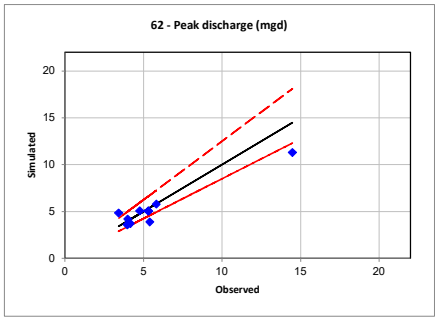

61 - Volume (Mgal)
Simulated
Observed

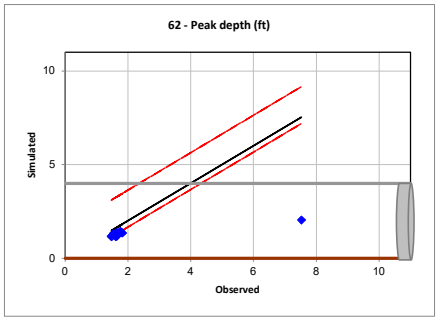

61 - Peak discharge (mgd)
Simulated
Observed

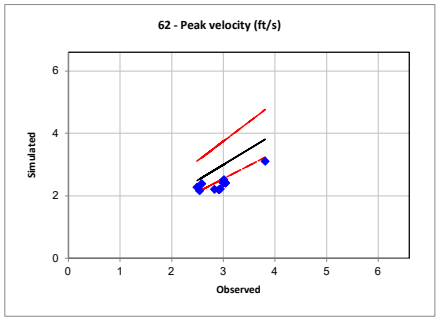

61 - Peak depth (ft)
Simulated
Observed

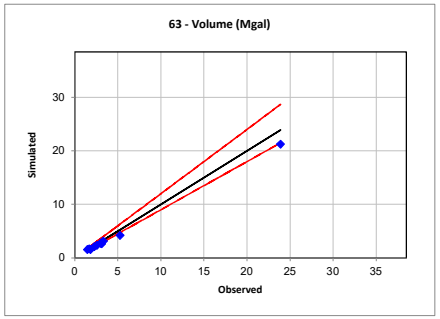

61 - Peak velocity (ft/s)
Simulated
Observed

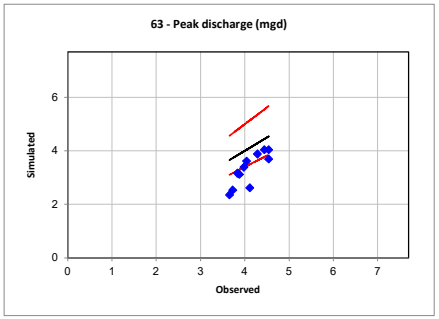

62 - Volume (Mgal)
Simulated
Observed

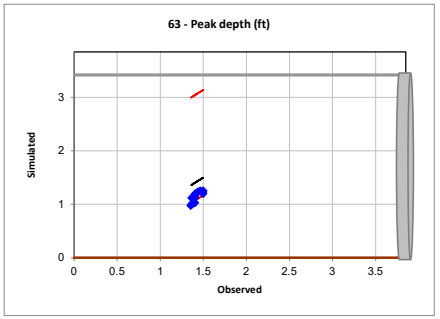

62 - Peak discharge (mgd)
Simulated
Observed

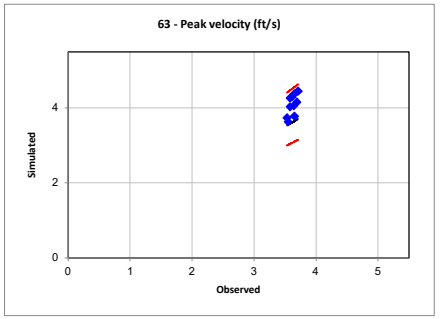

62 - Peak depth (ft)
Simulated
Observed


62 - Peak velocity (ft/s)
Simulated
Observed


63 - Volume (Mgal)
Simulated
Observed


63 - Peak discharge (mgd)
Simulated
Observed


63 - Peak depth (ft)
Simulated
Observed


63 - Peak velocity (ft/s)
Simulated
Observed

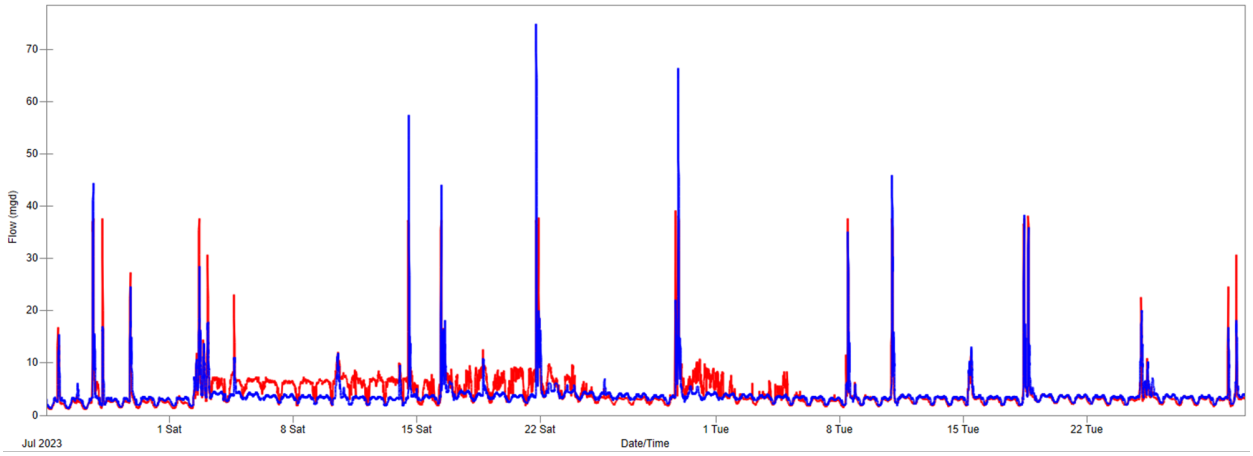
Attachment 4

Summer 2023 CSO Diversion Structures

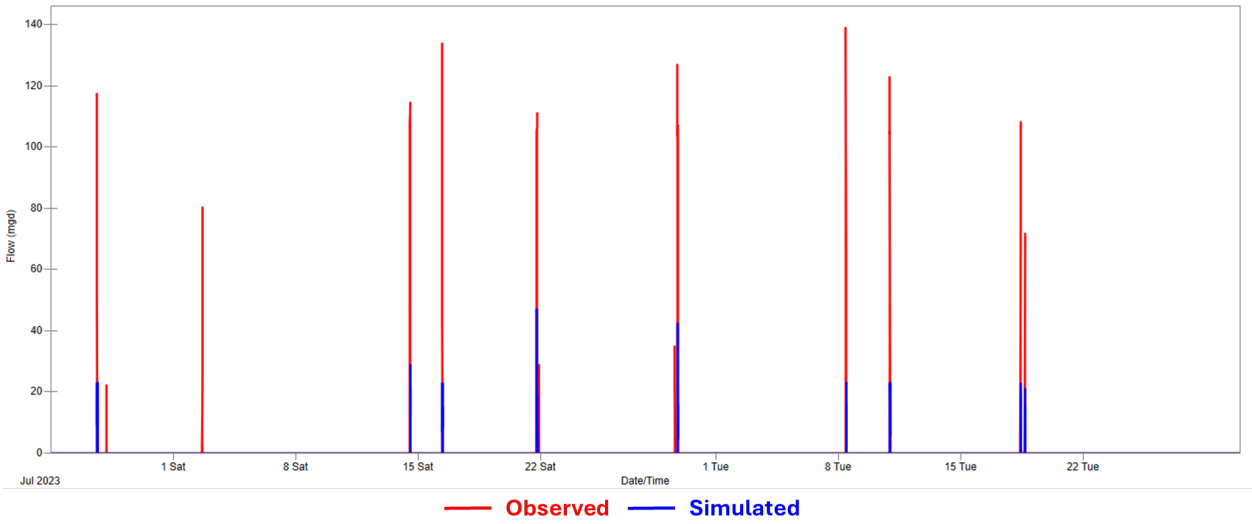
CSO Diversion Structures: Summer 2023

Walker

Station Flow (mgd)

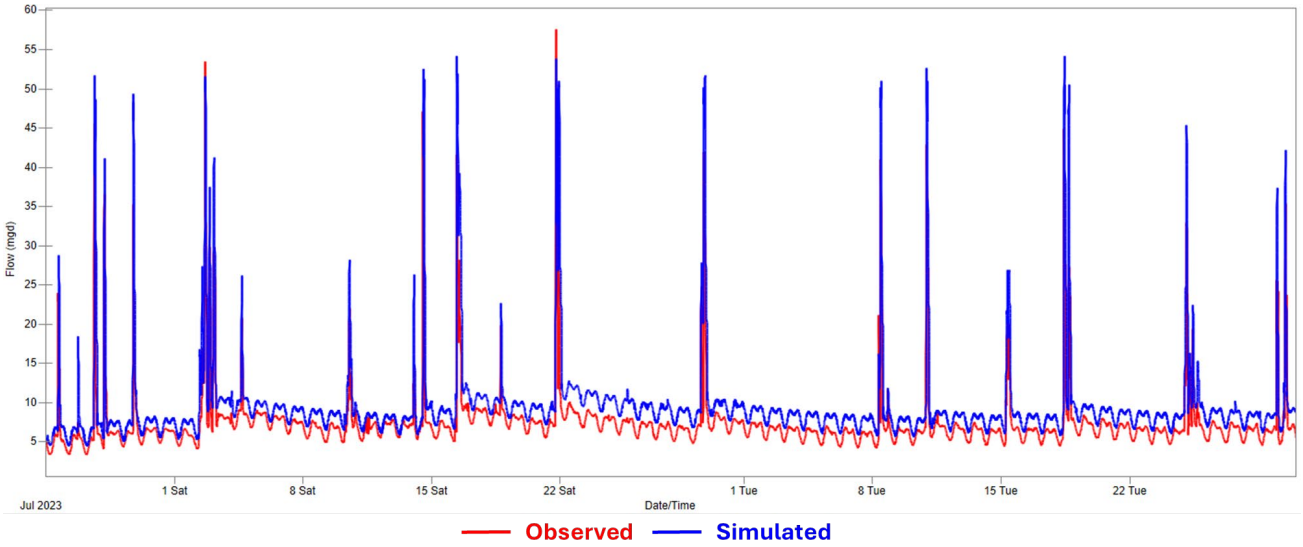


Pumped Diversion Flow (mgd)



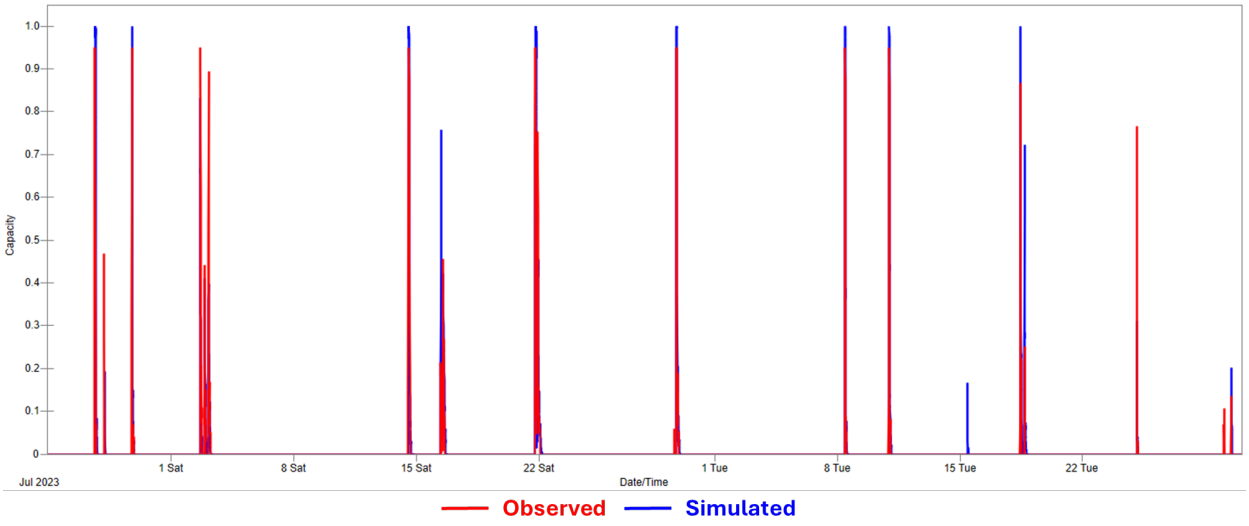
Beaver Brook

Station Flow (mgd)



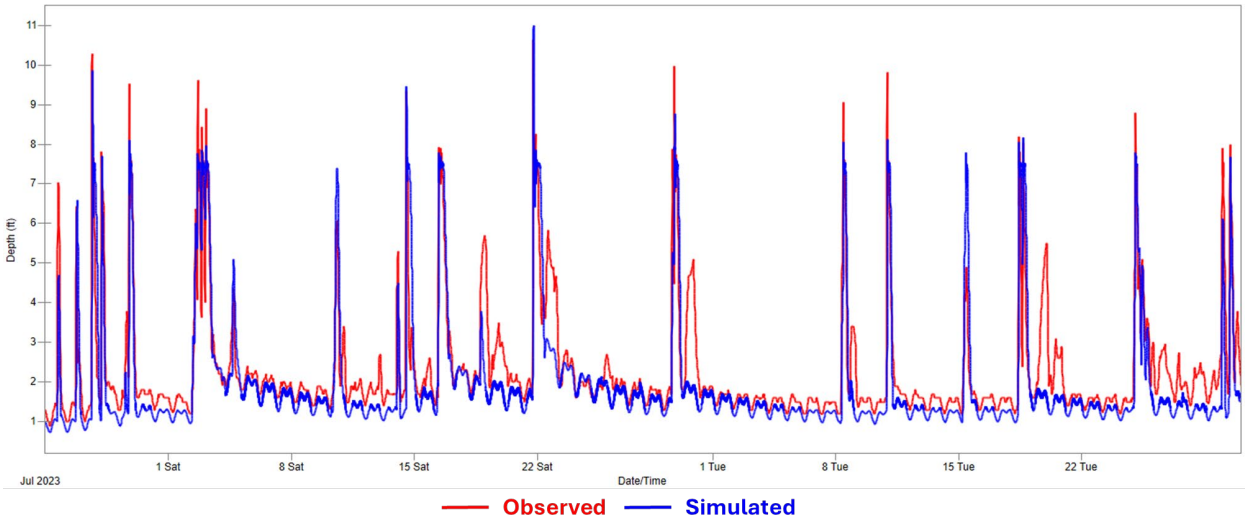
West Street

Diversion Gate Position

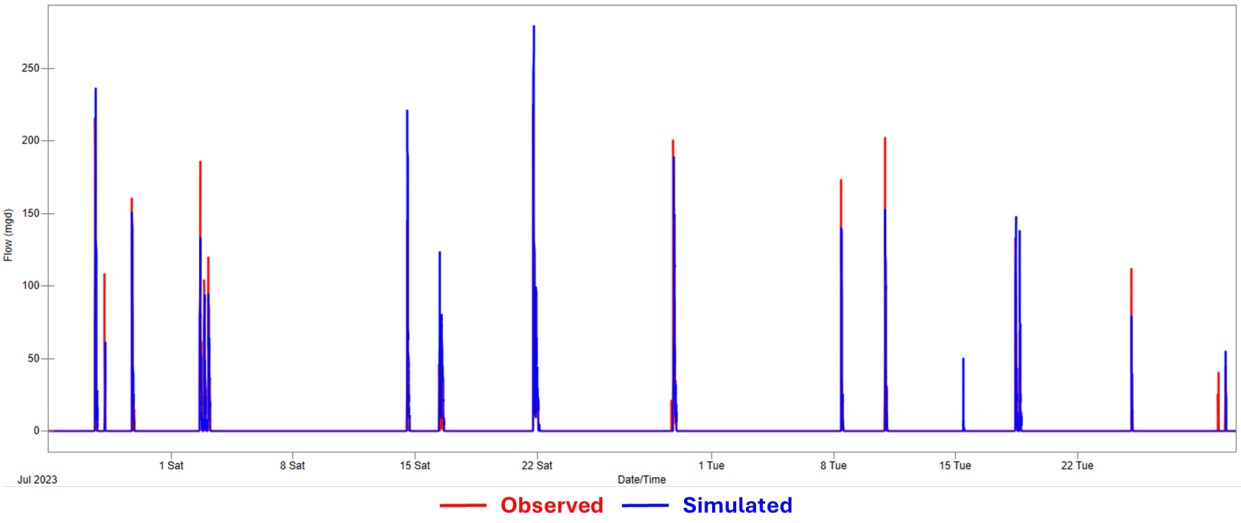


West Street

Interceptor Depth (ft)

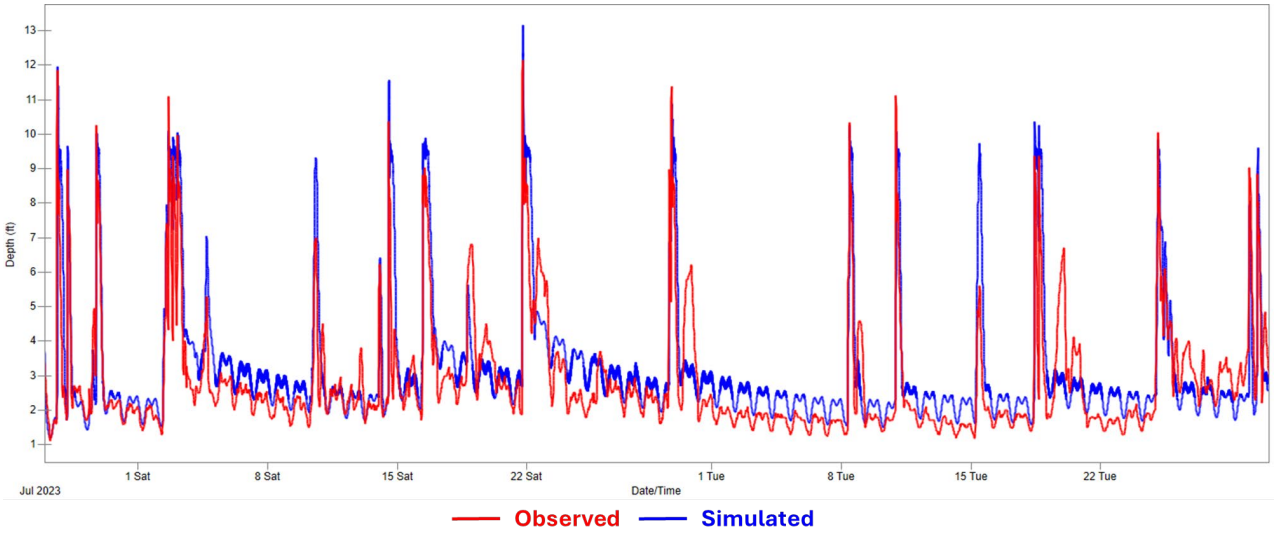


Gravity Diversion Flow (mgd)



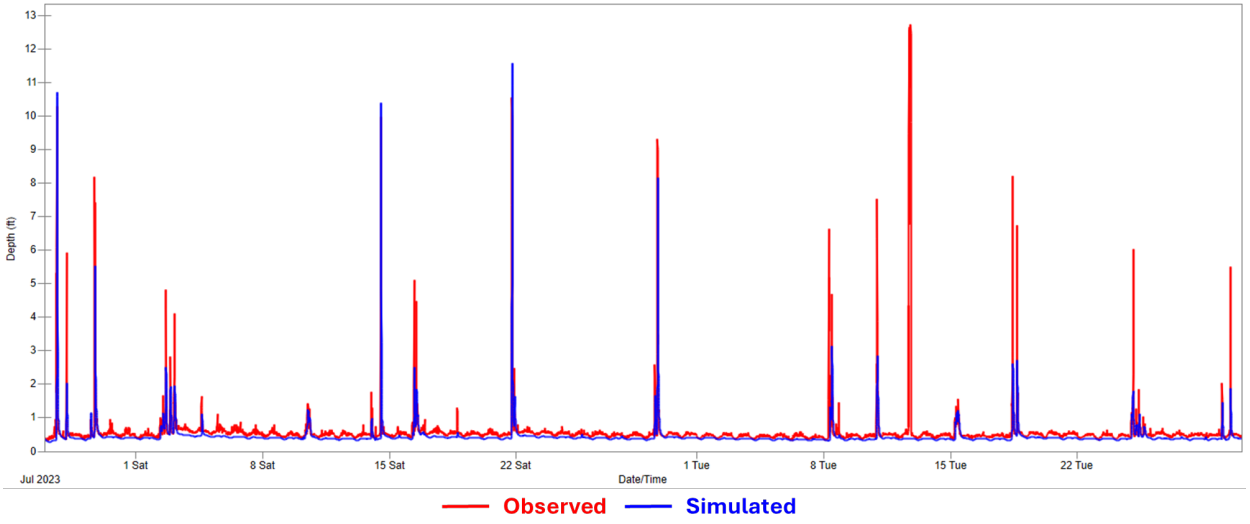
North Bank Control Station

Station Depth (ft)

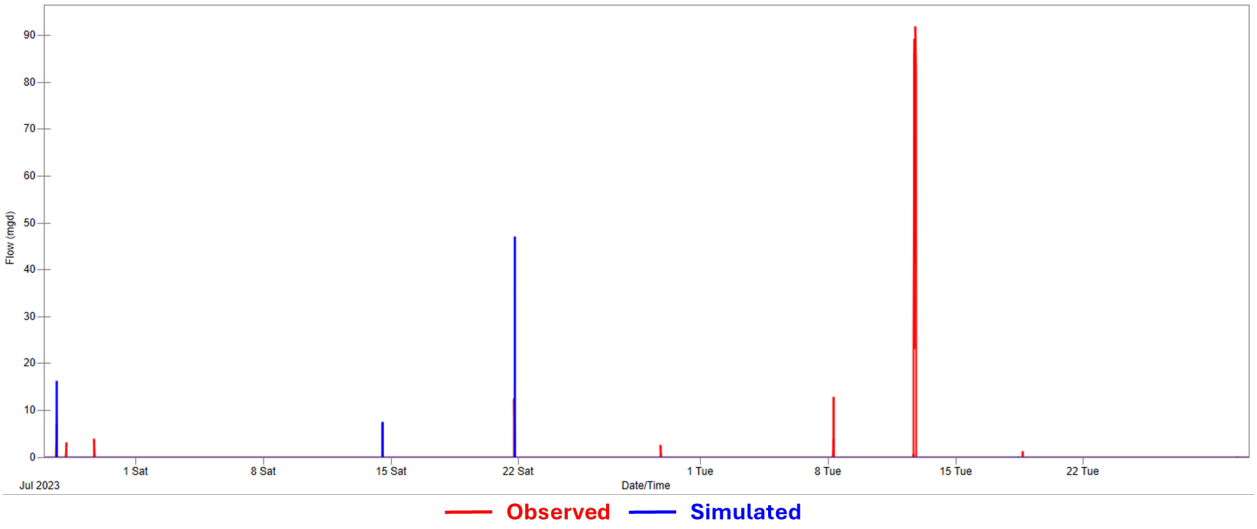


Read Street

Influent Channel Depth (ft)

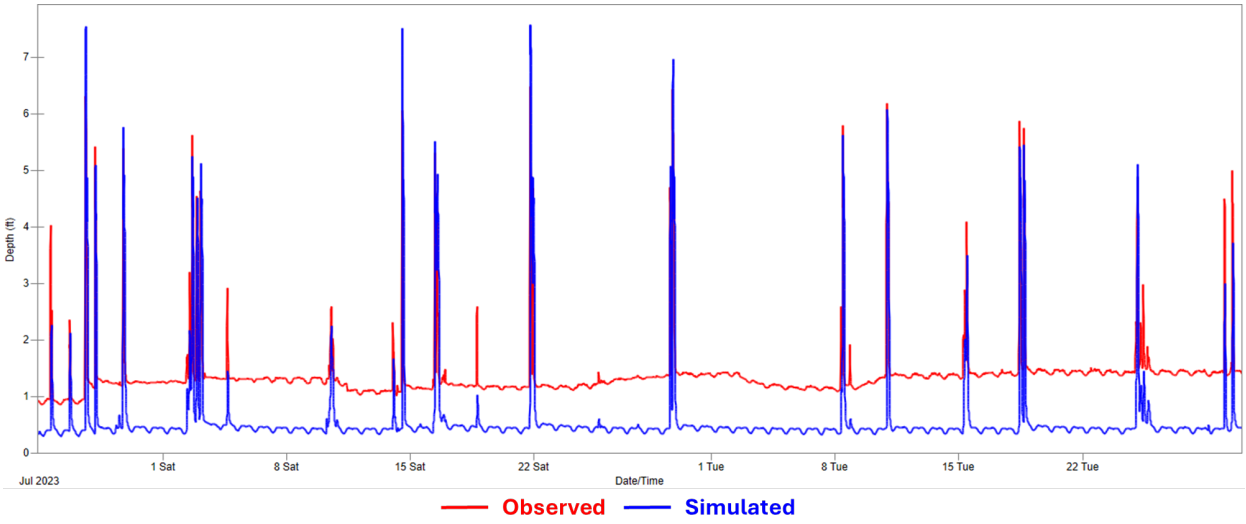


Gravity Diversion Flow (mgd)

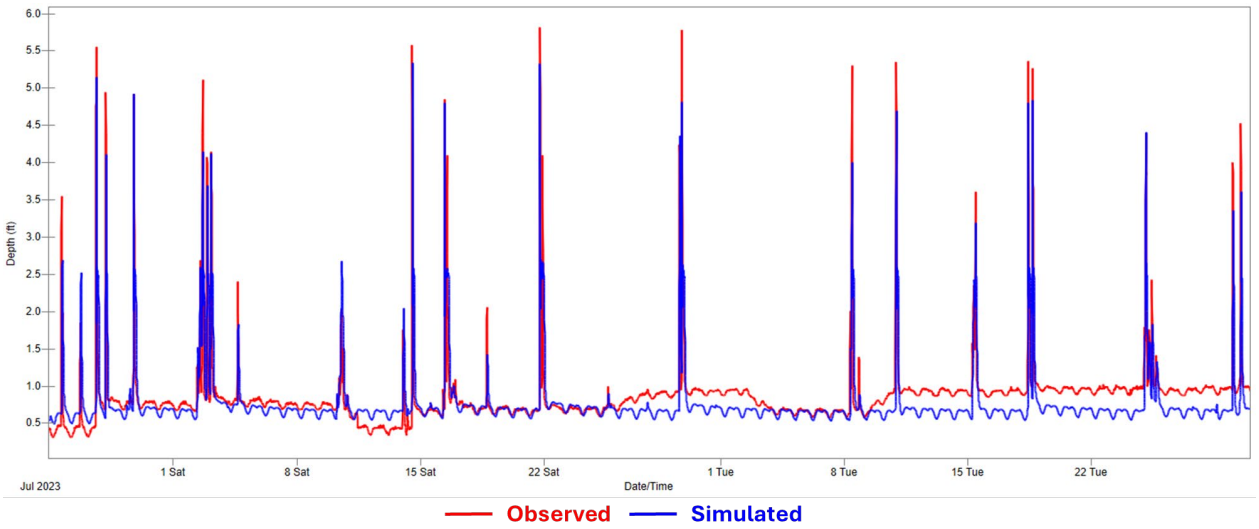


Tilden

Influent Channel Depth (ft)

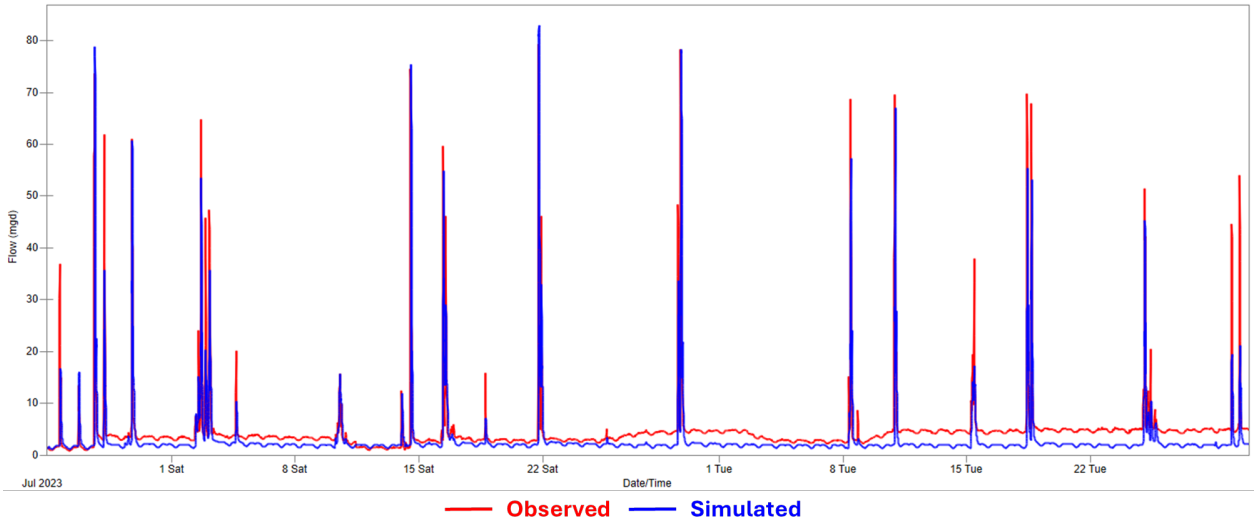


Flume Depth (ft)

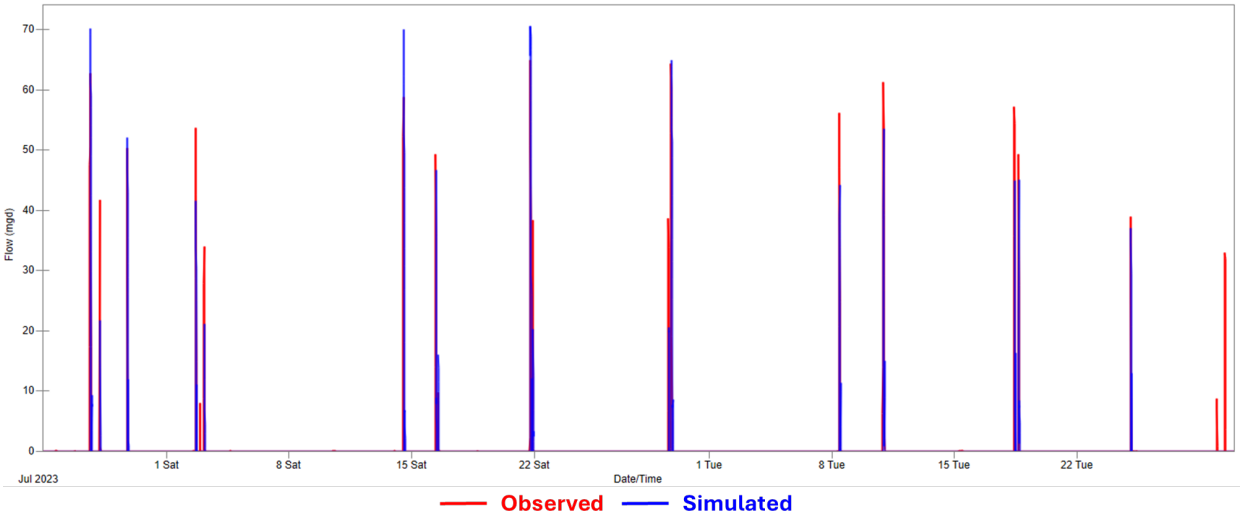


Tilden

Station Flow (mgd)

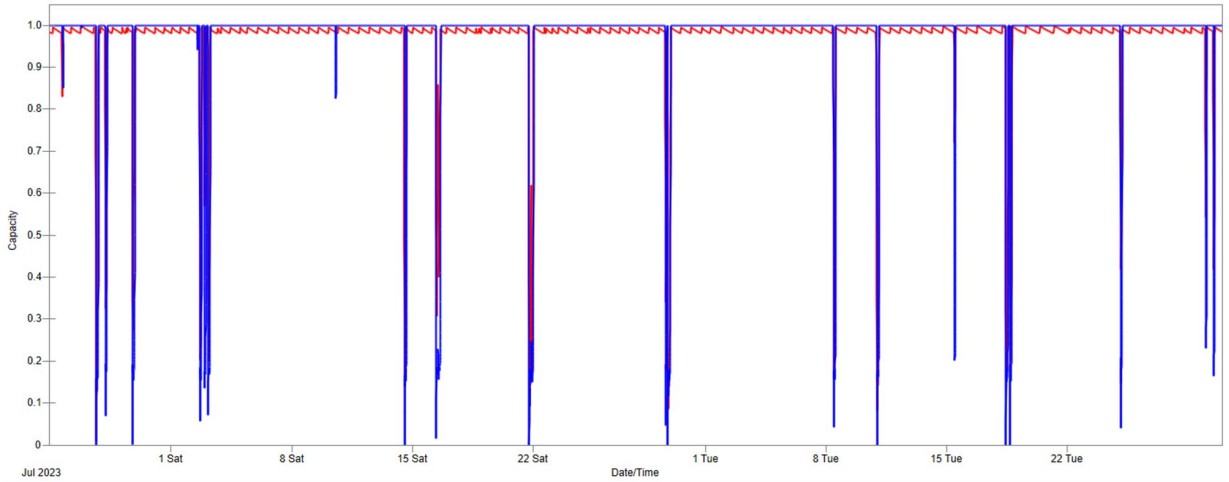


Diversion Flow (mgd)

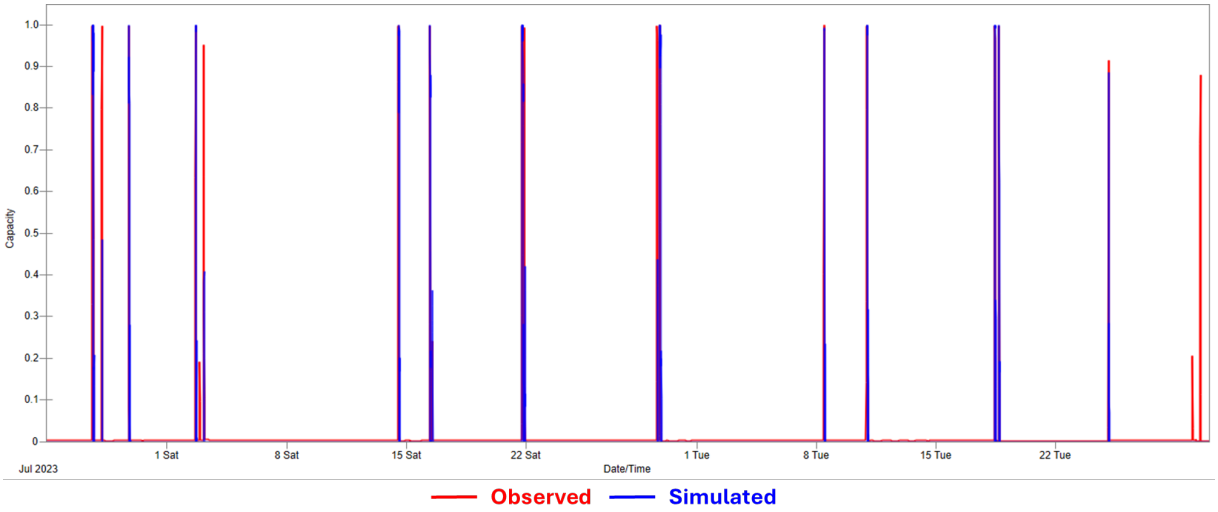


Tilden

Control Gate Position

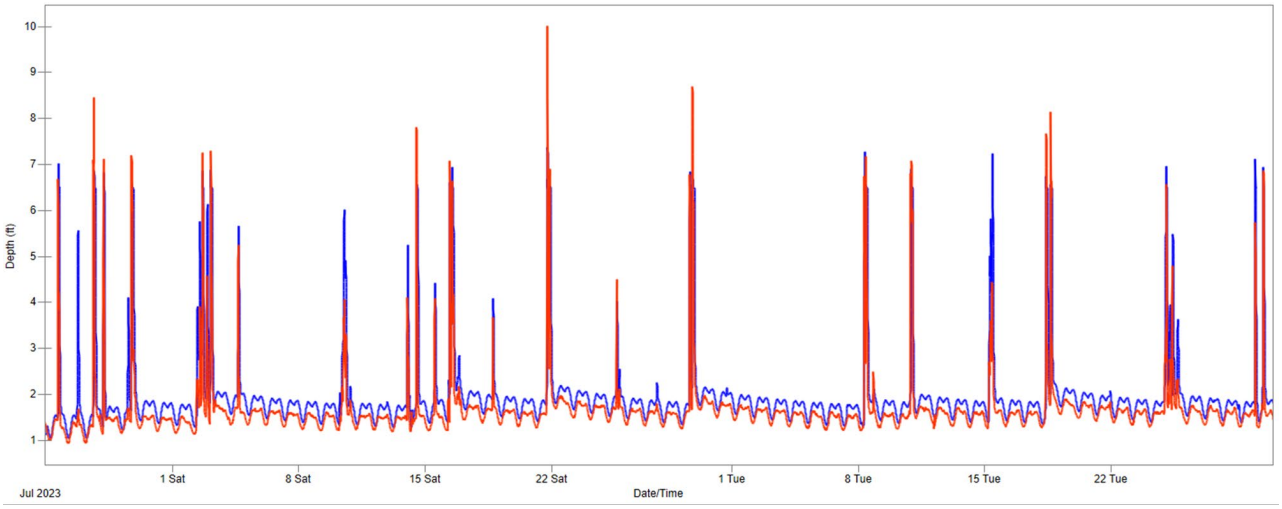


Diversion Gate Position

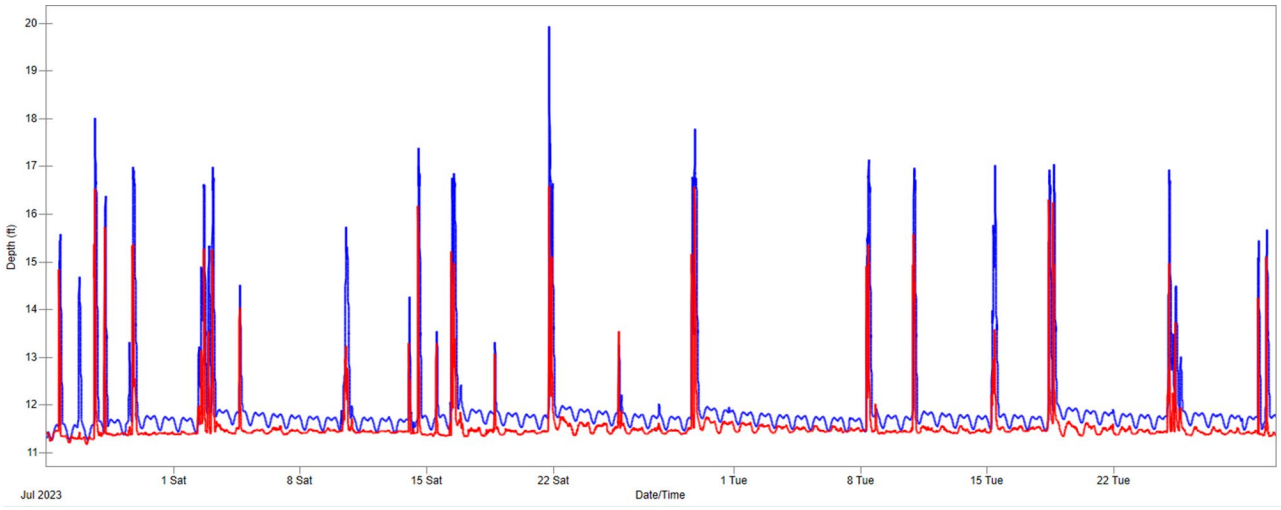


Warren

Influent Channel Depth (ft)

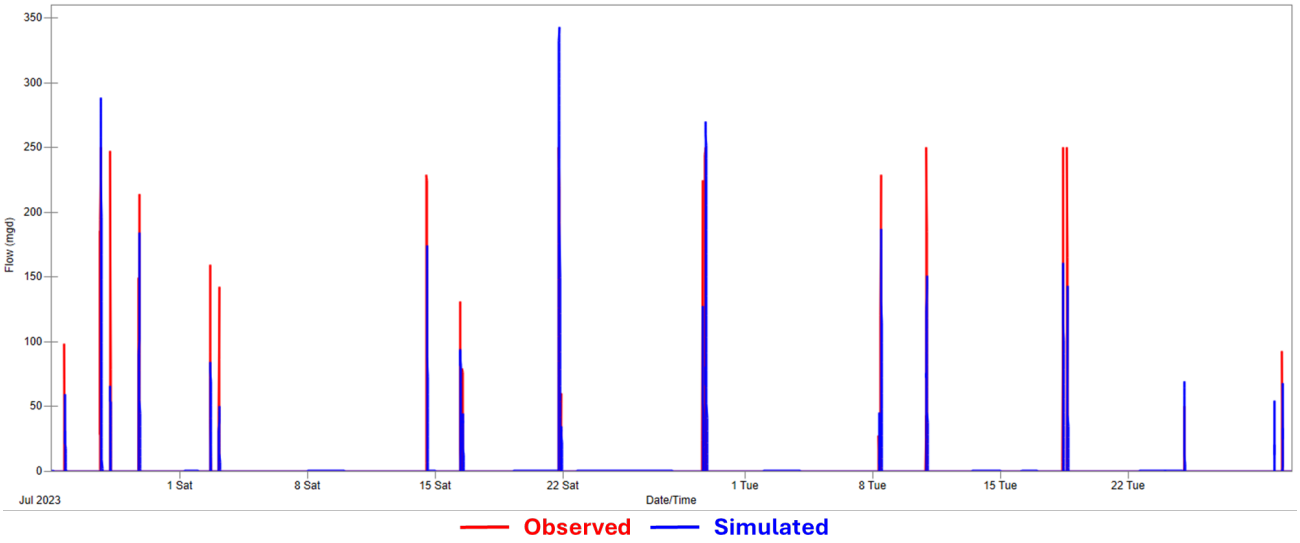


Siphon Depth (ft)

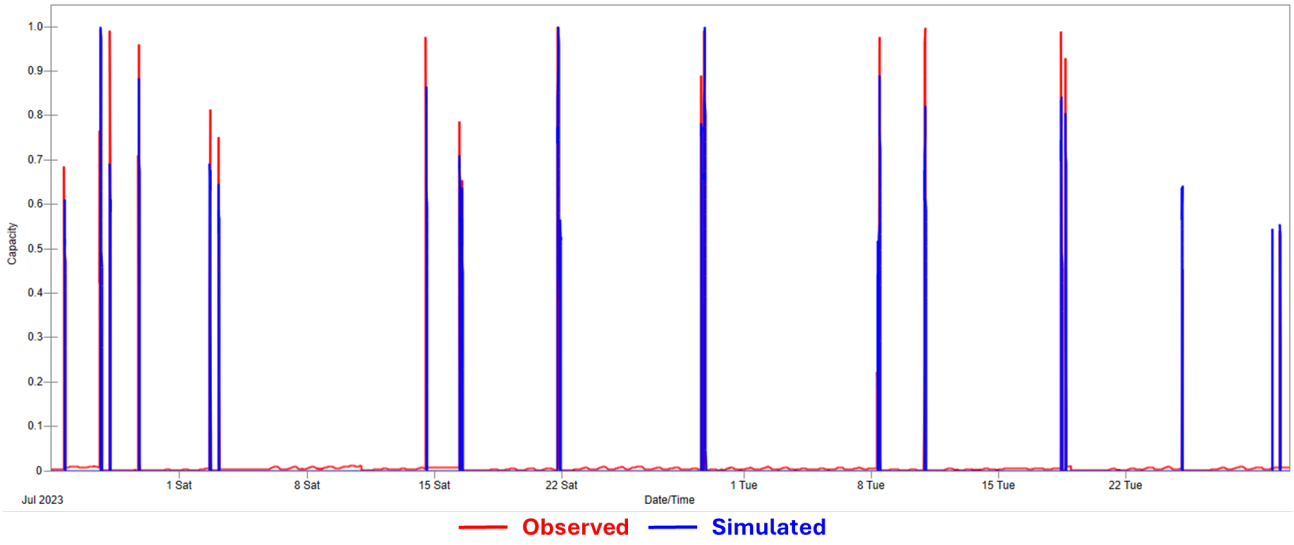


Warren

Gravity Diversion Flow (mgd)

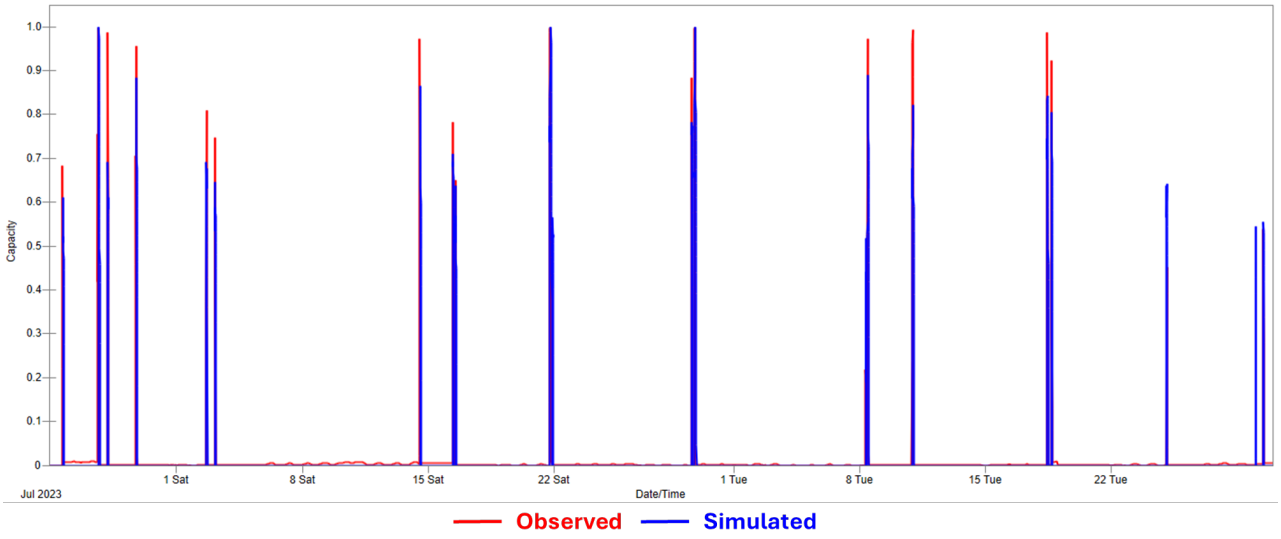


Diversion Gate No. 1 Position



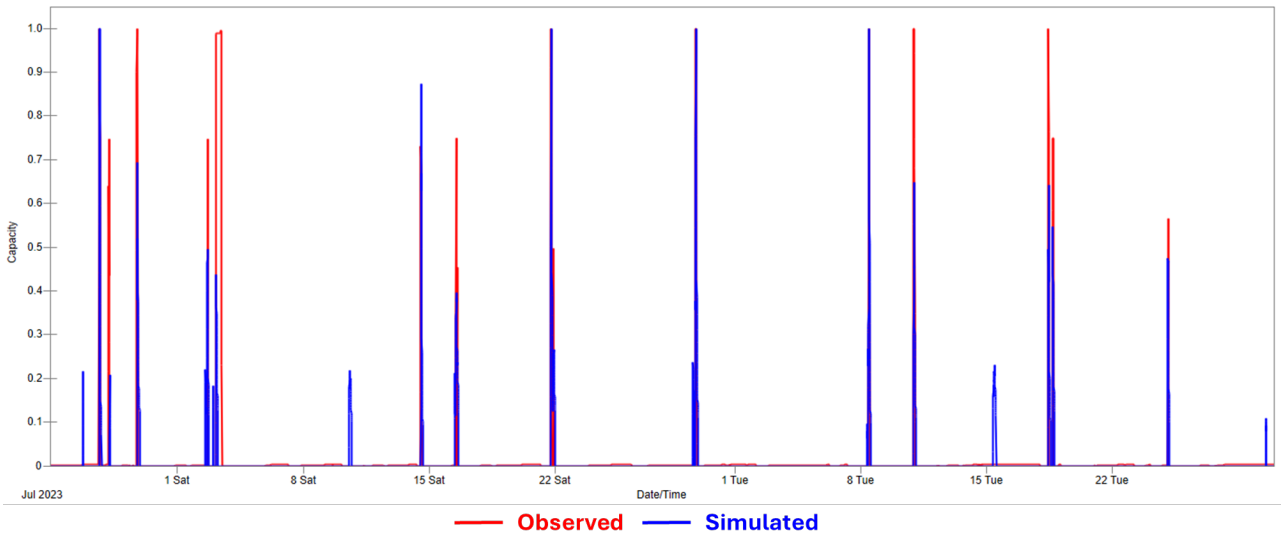
Warren

Diversion Gate No. 2 Position



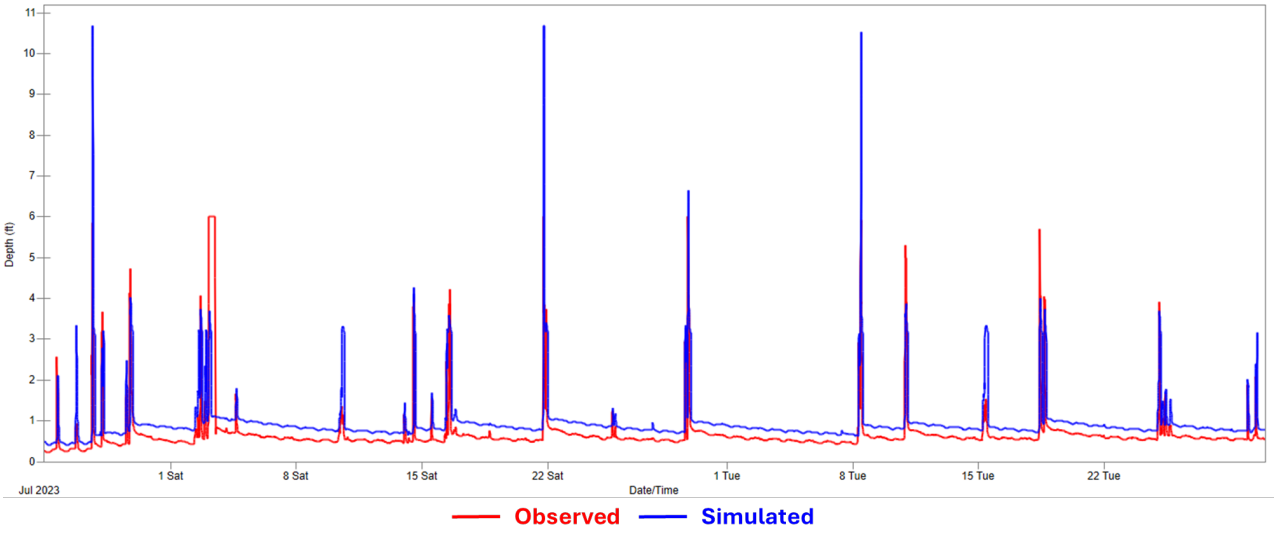
Barasford

Diversion Gate Position

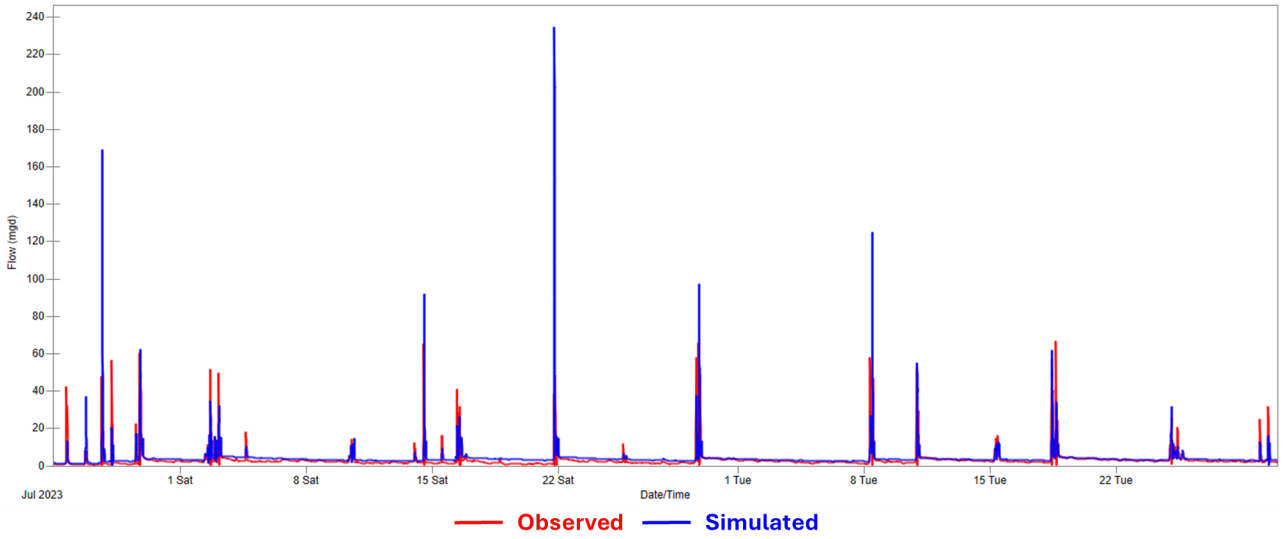


Barasford

Influent Channel Depth (ft)

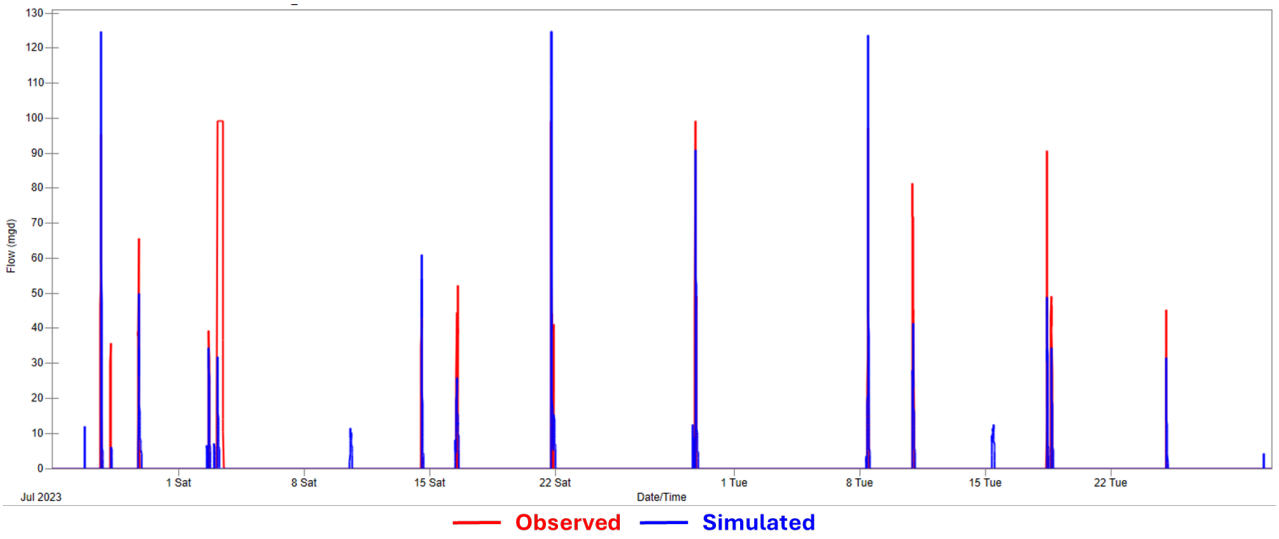


Station Flow (mgd)

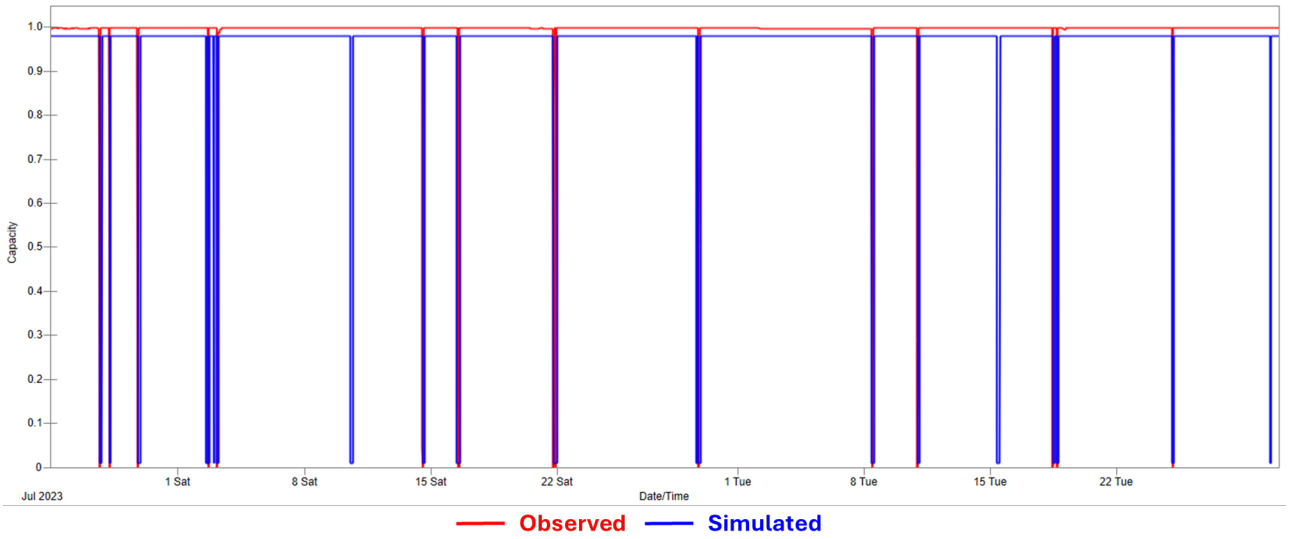


Barasford

Gravity Diversion Flow (mgd)

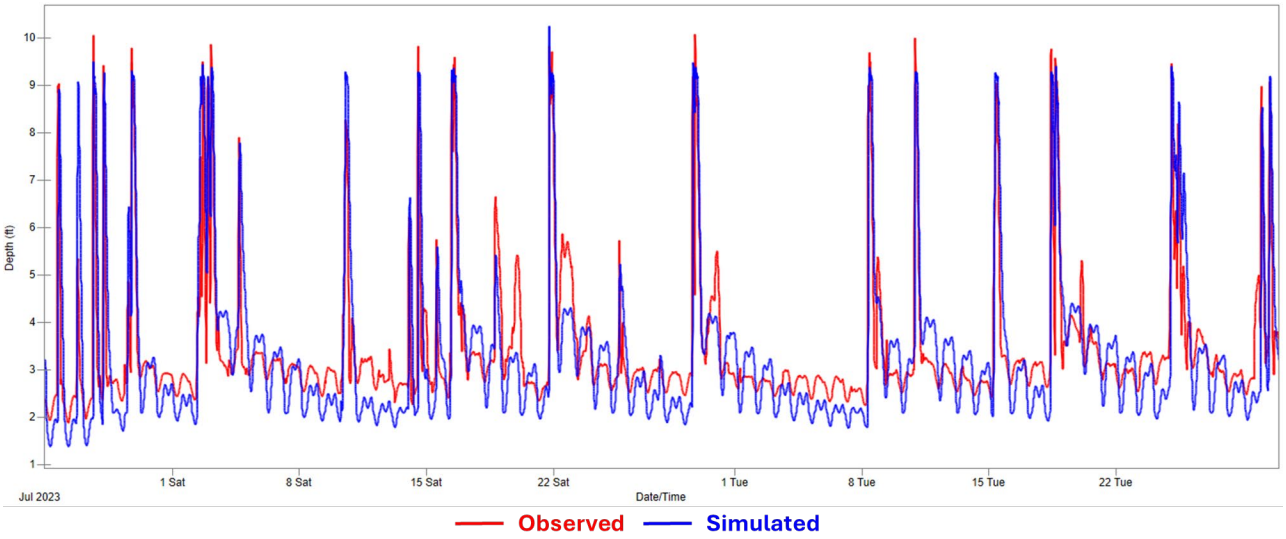


Control Gate Position

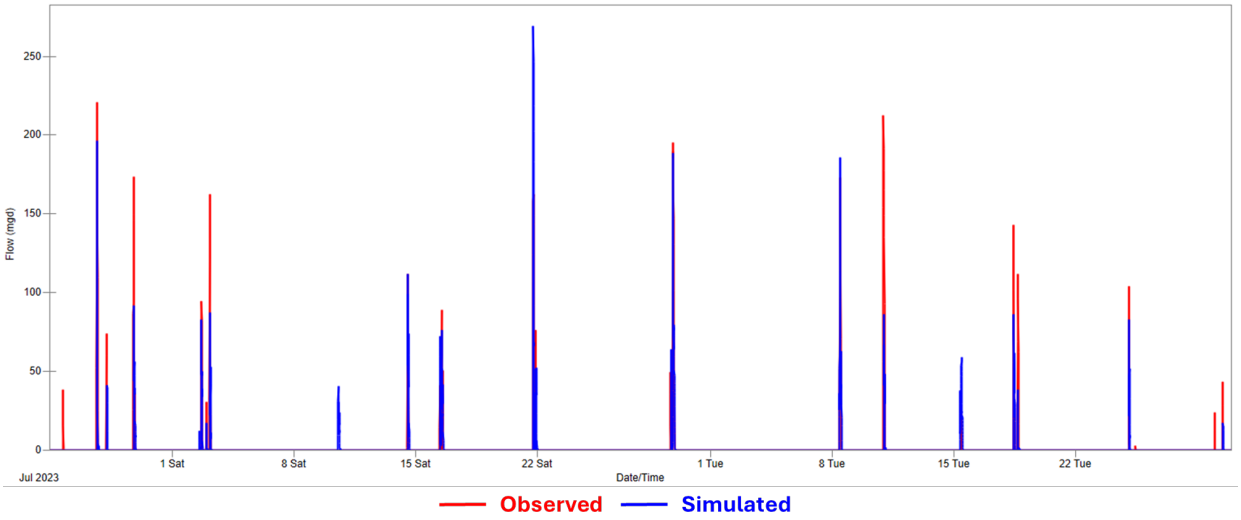


Merrimack

Interceptor Depth (ft)

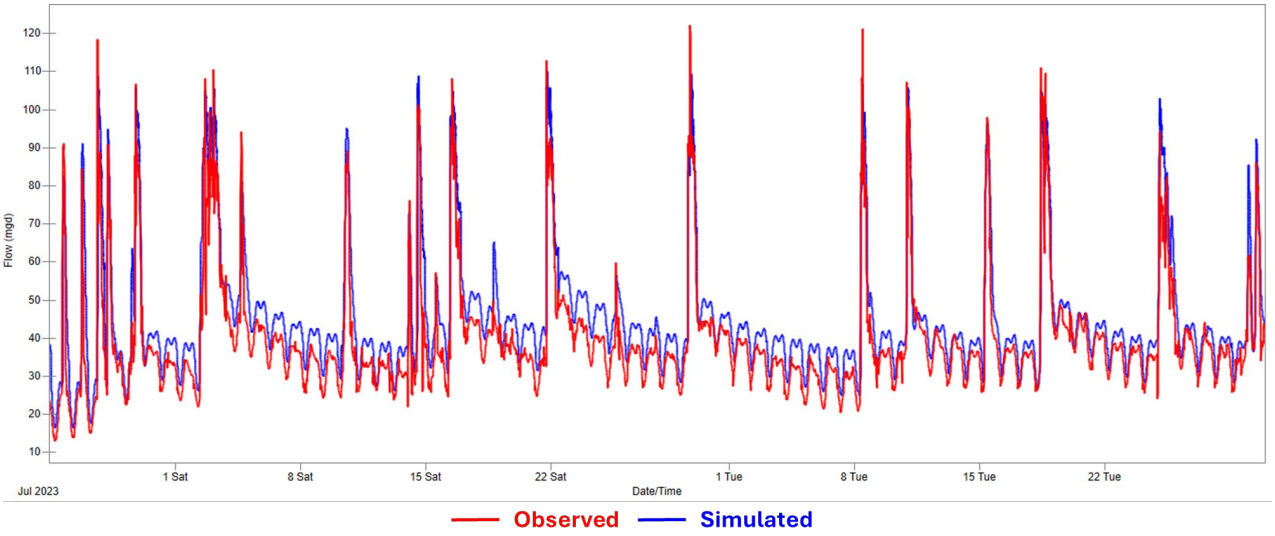


Gravity Diversion Flow (mgd)



Duck Island

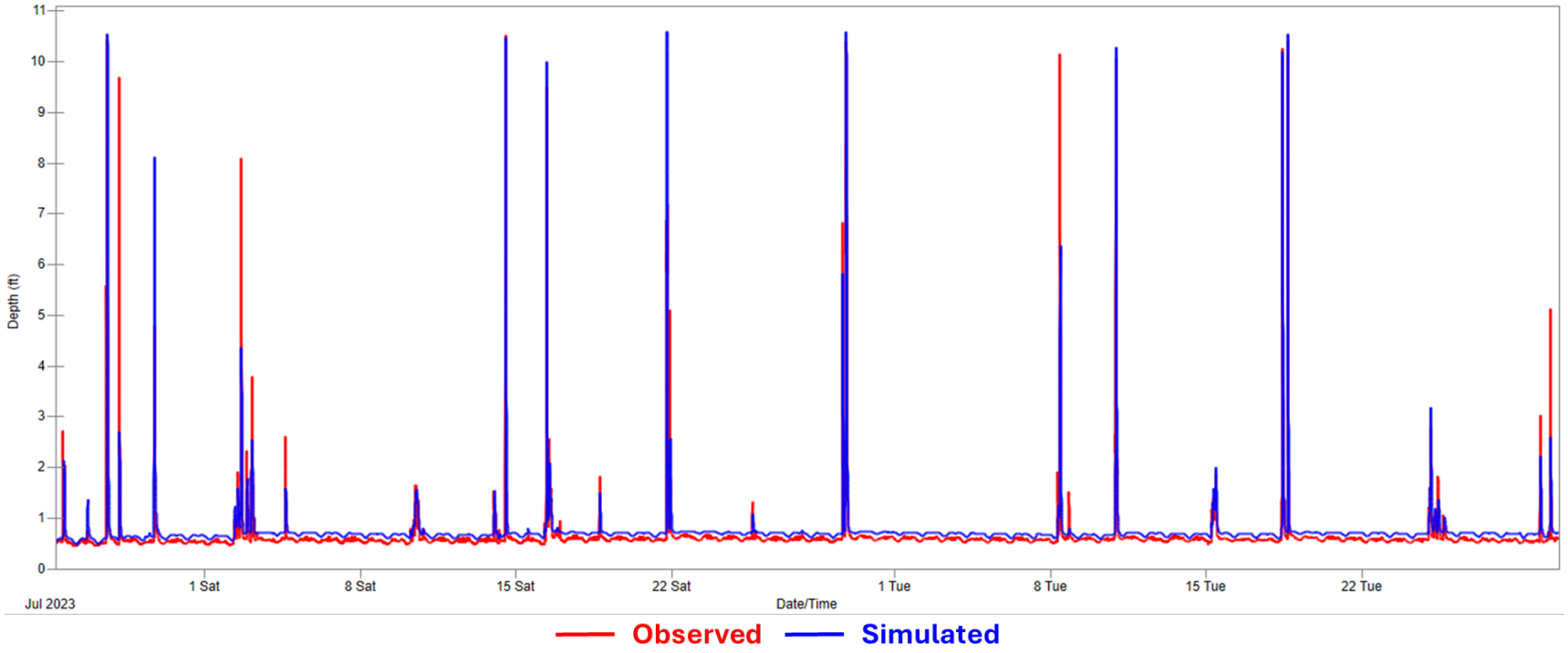
Effluent Flow (mgd)



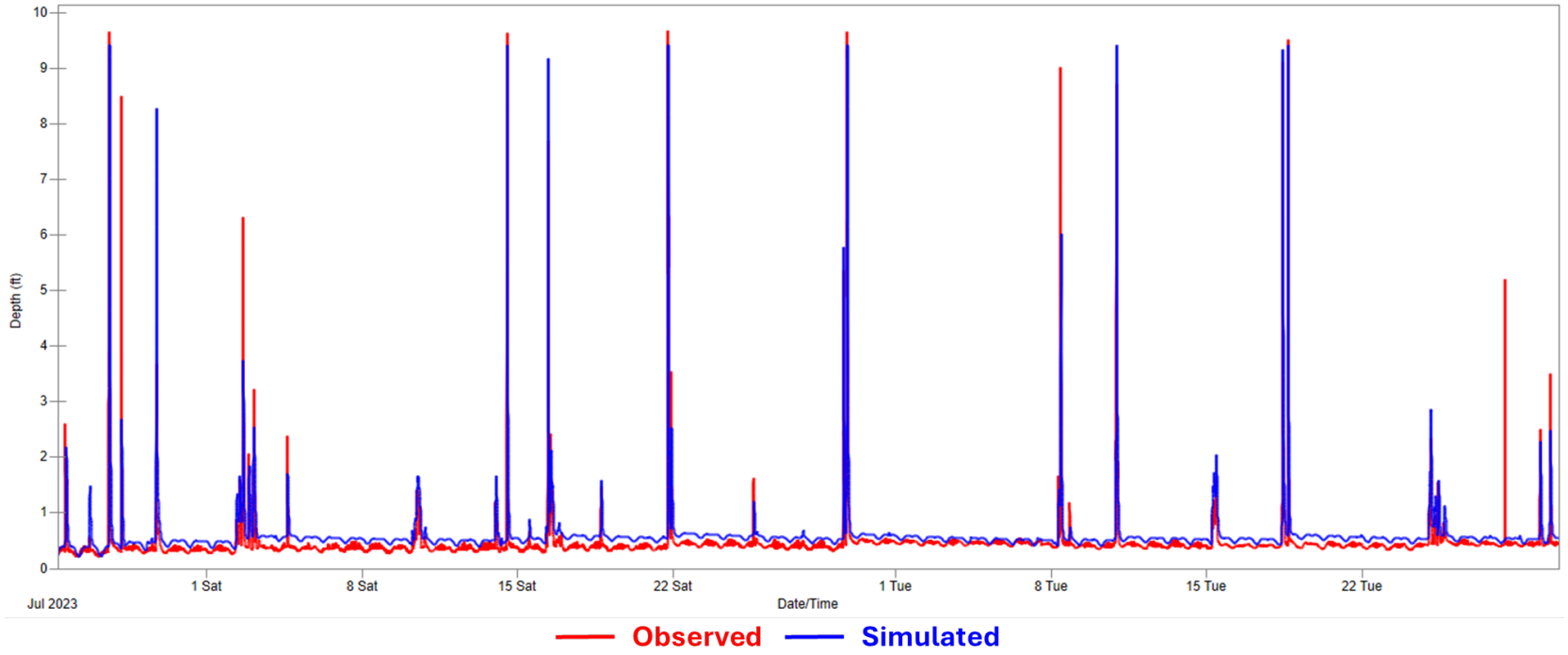
Summer 2023 Level Meters

SSO Level Meters: Summer 2023

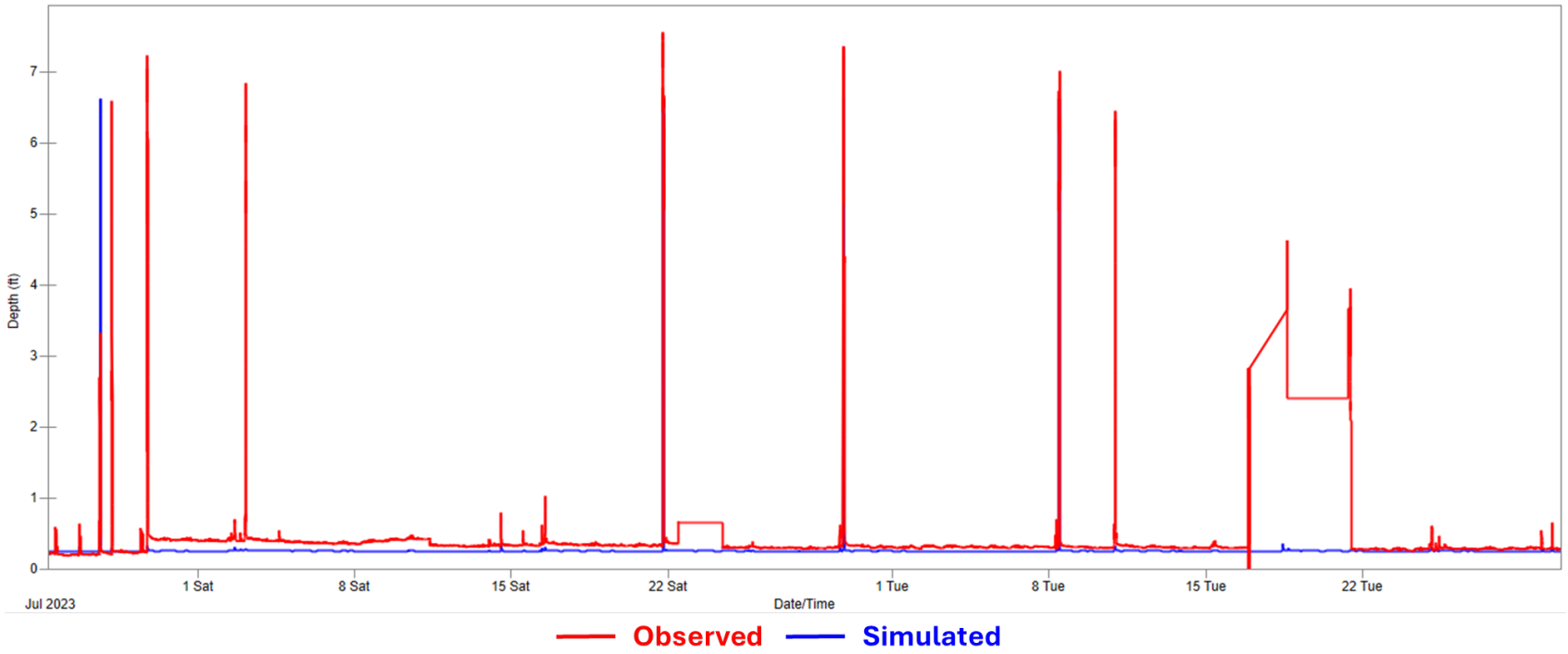
67 Payne Street – SSO Depth = 9.6 ft



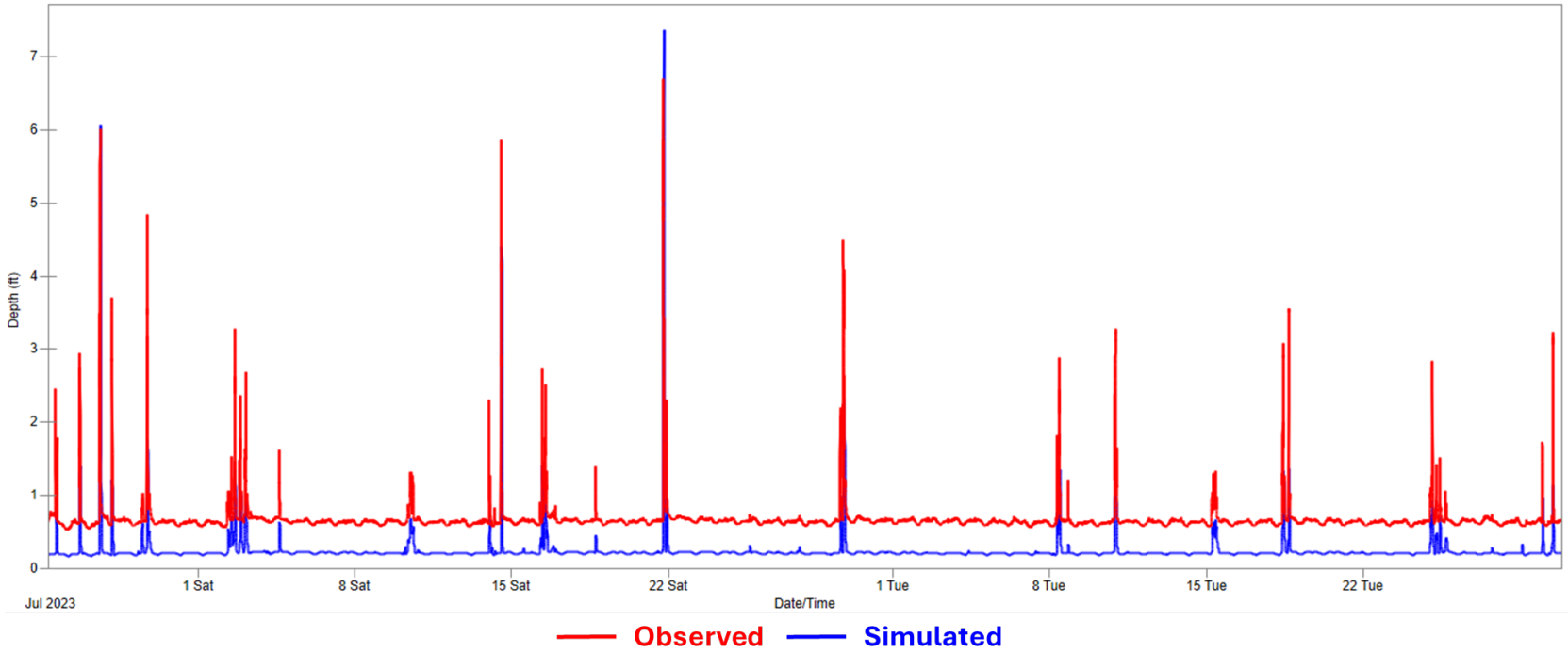
Eagle Court – SSO Depth = 8.4 ft



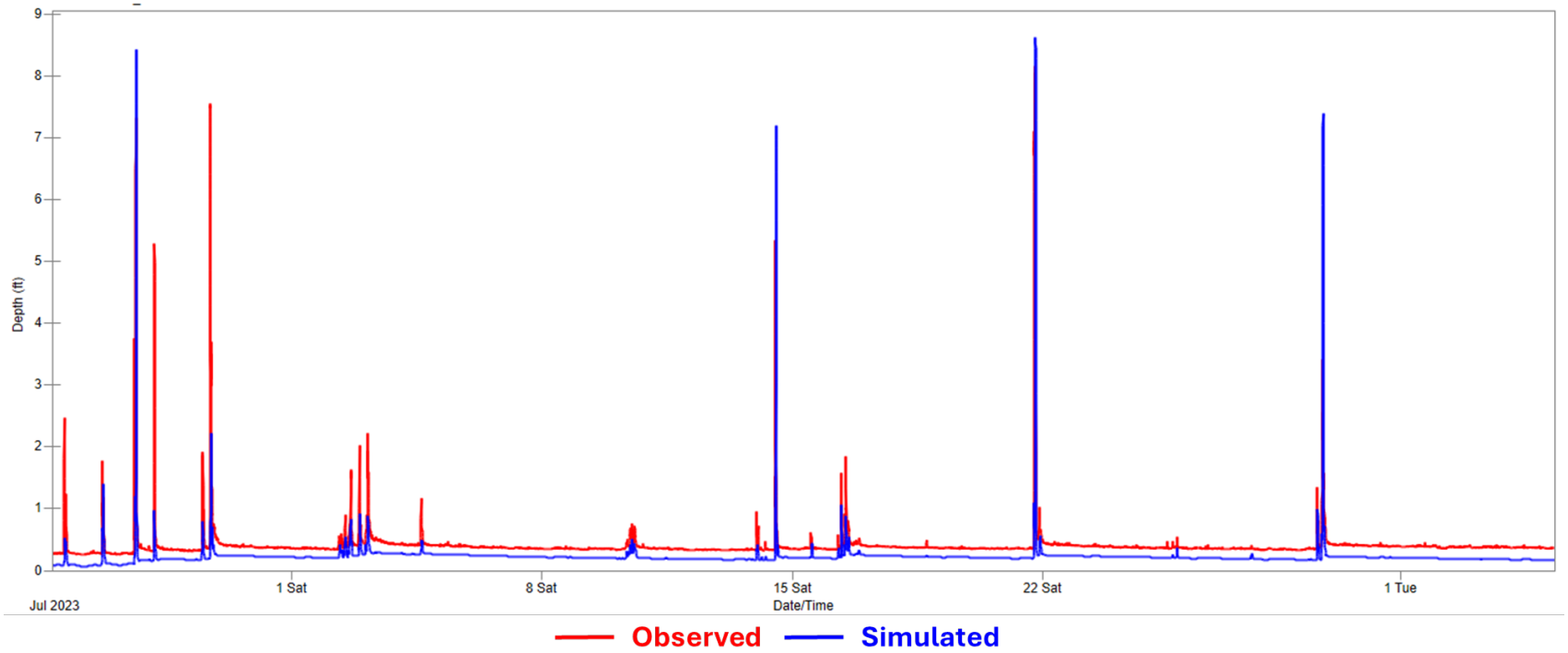
35 Windward Road – SSO Depth = 5.6 ft



34 Coburn St – SSO Depth = 9.2 ft



246 Raven Rd – SSO Depth = 8.06 ft

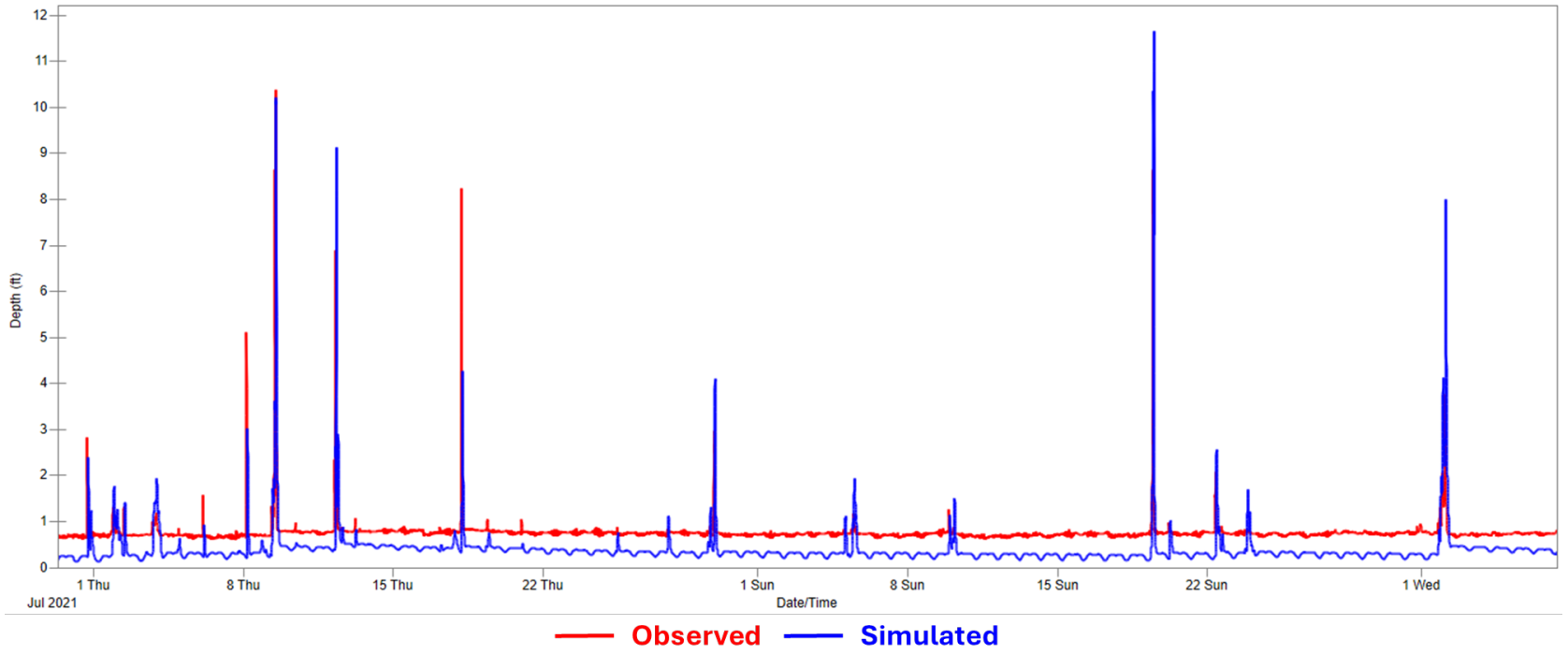


Attachment 5

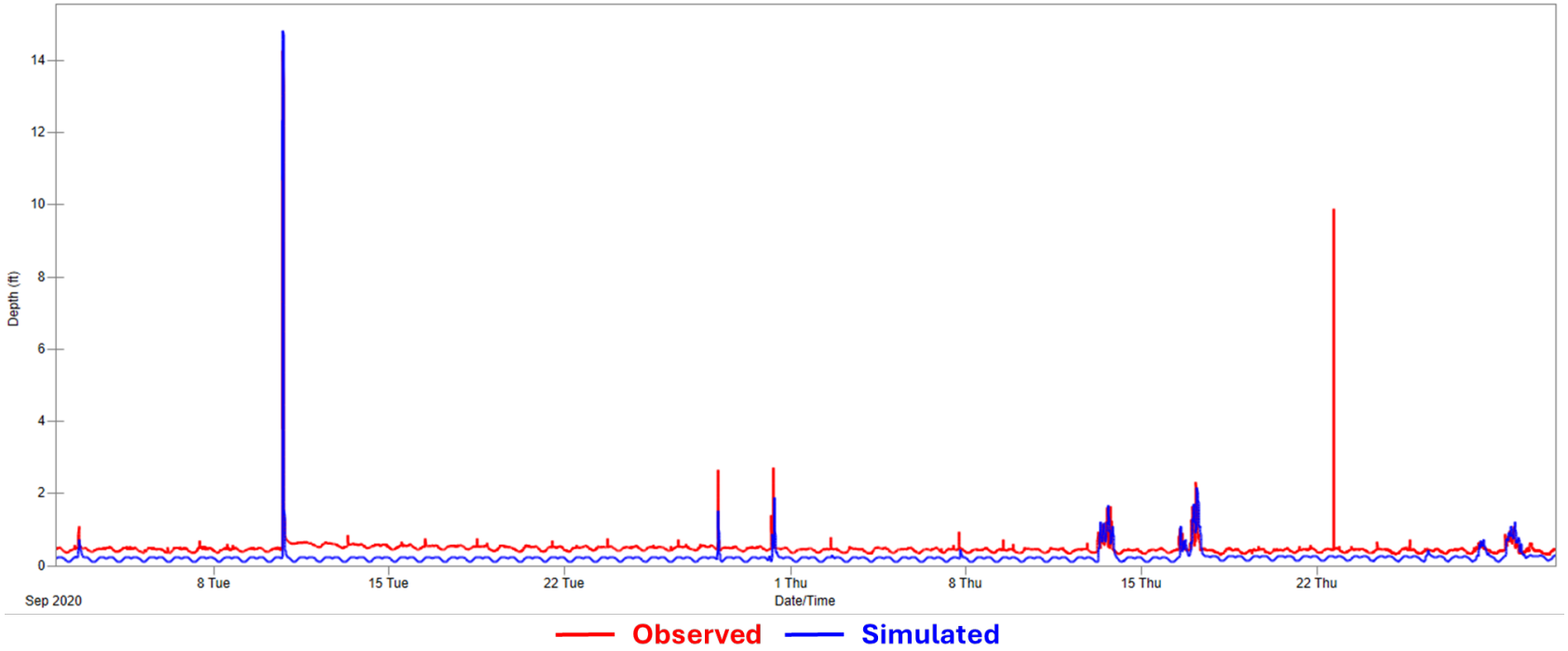
Validation Periods Level Meters

Level Meters for Validation

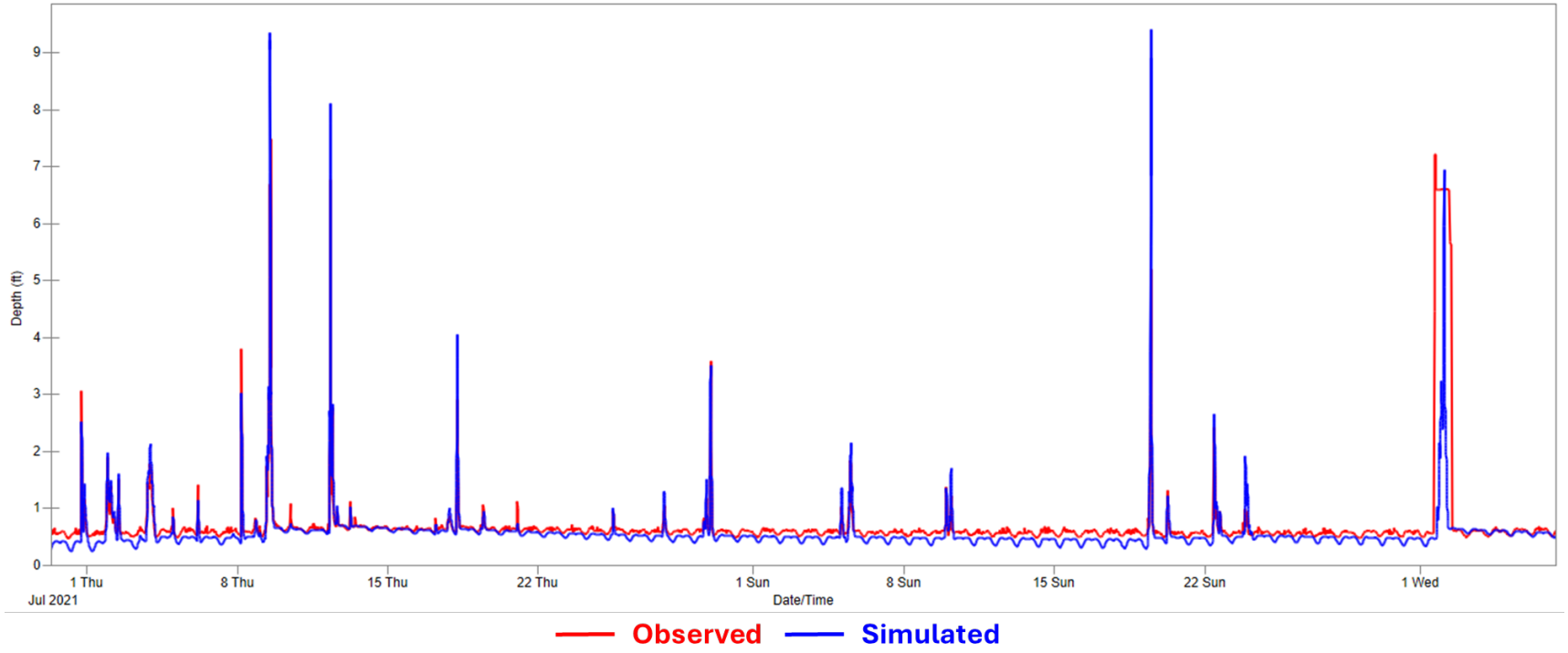
96 Marginal St: July 2021 – August 2021



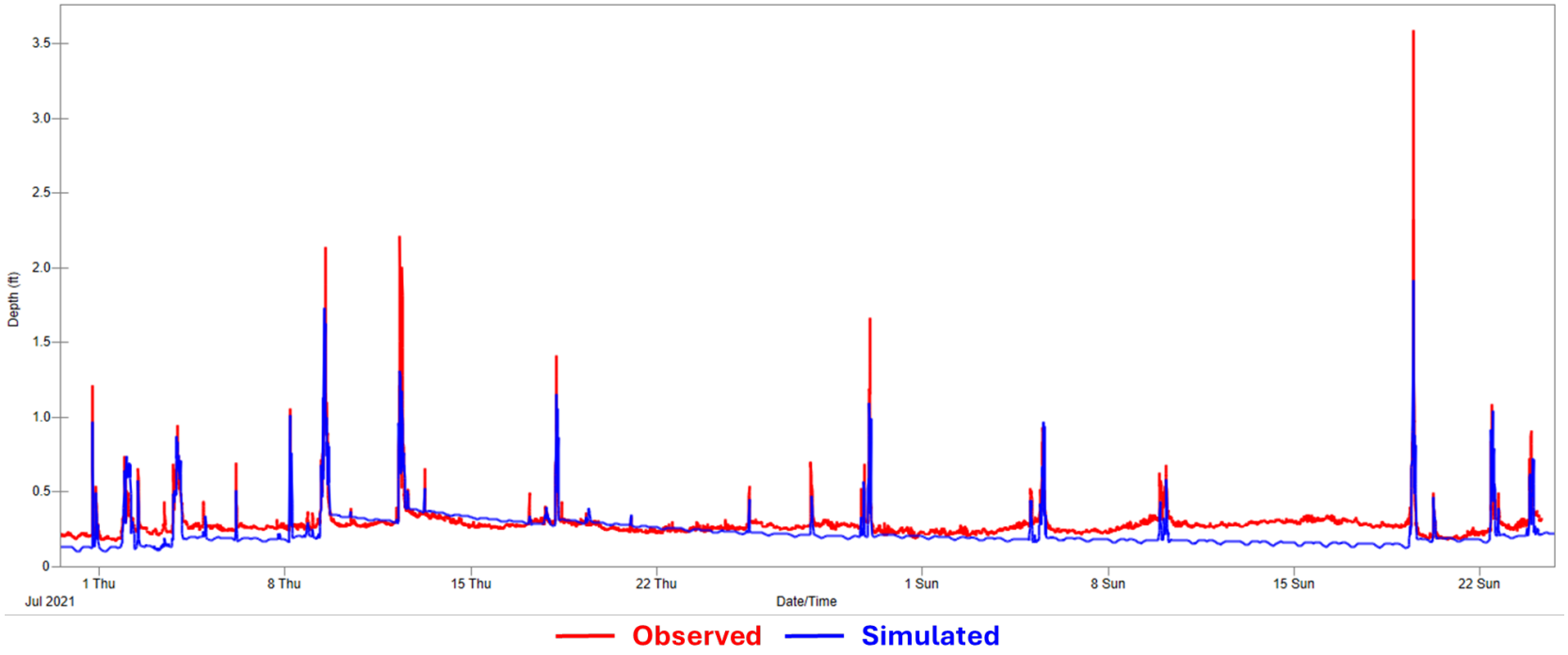
91 Pevey St: September 2020 – October 2020



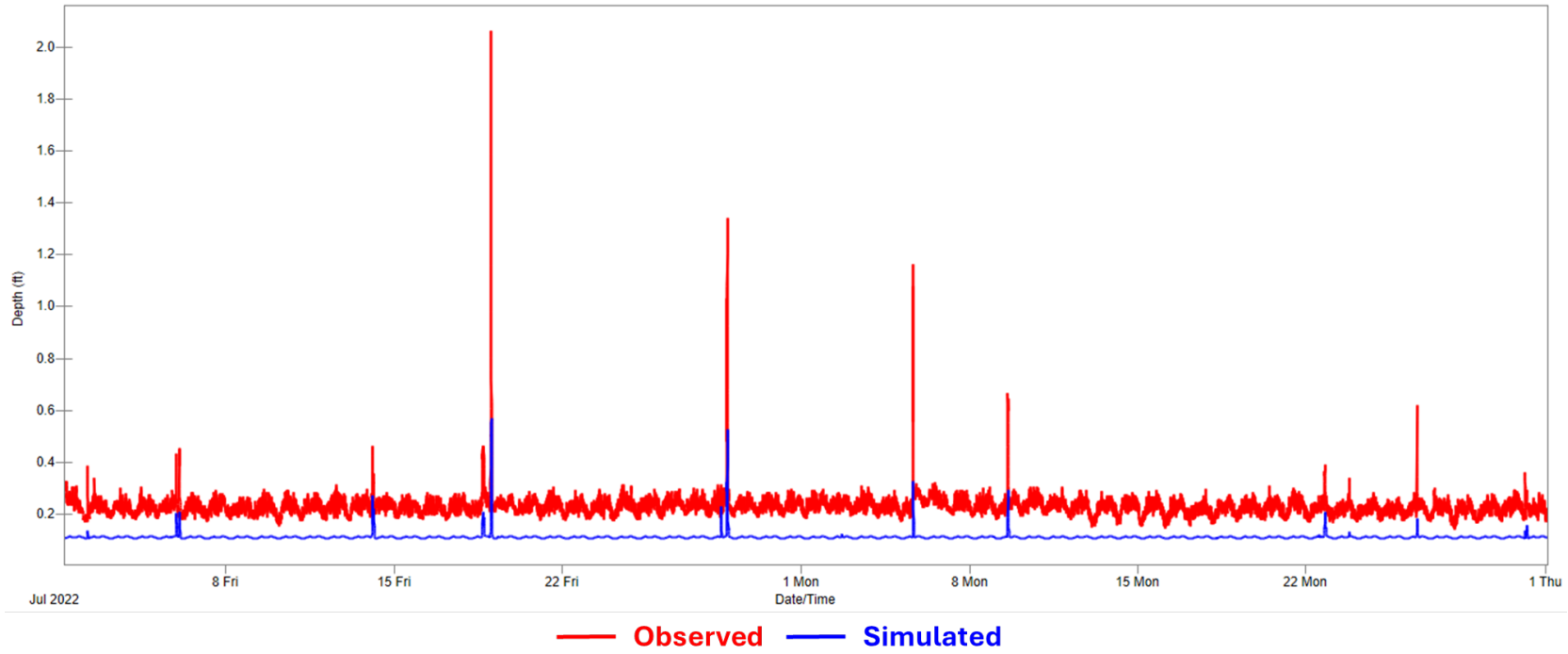
657 Middlesex St: July 2021 – August 2021



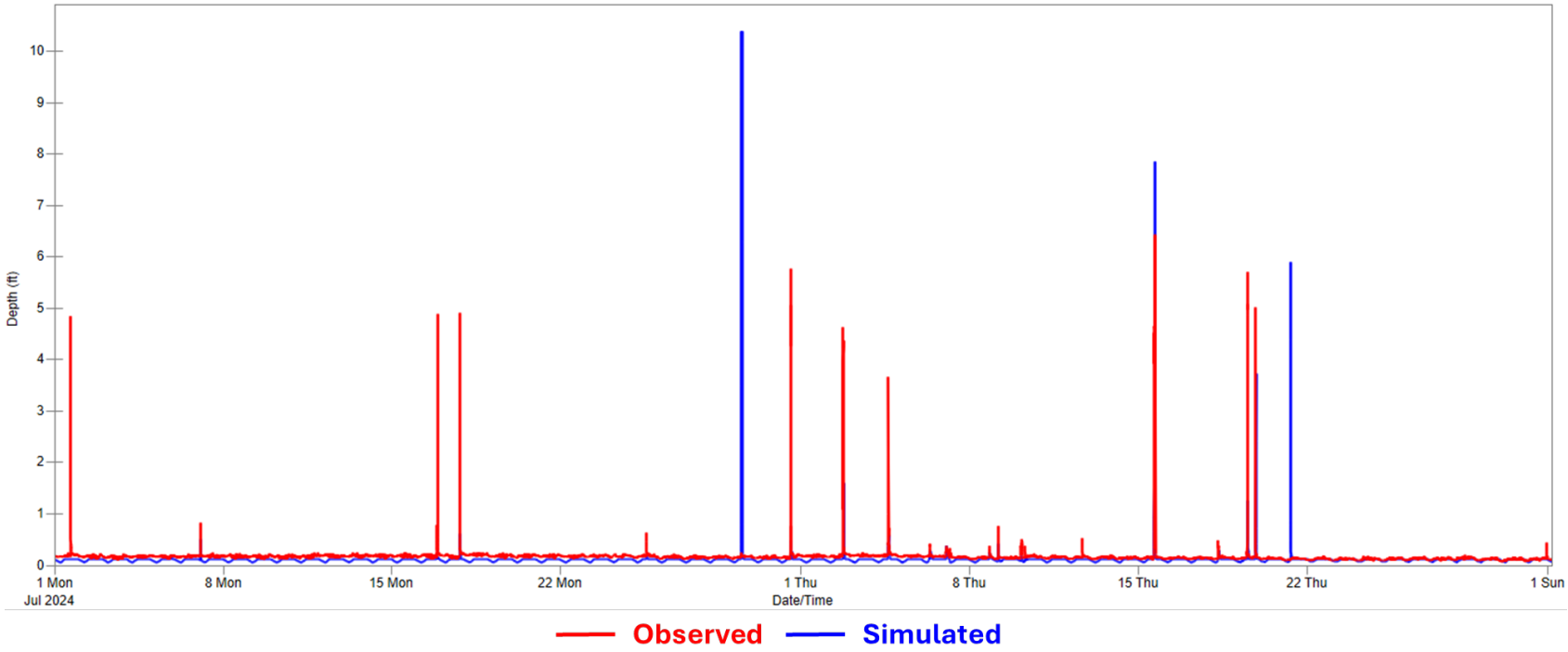
124 Raven Rd


3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
Depth (ft)
1 Thu
8 Thu
15 Thu
22 Thu
1 Sun
8 Sun
15 Sun
22 Sun
Jul 2021
Date/Time
Observed
Simulated

776 Lakeview Avenue: July 2022 – August 2022



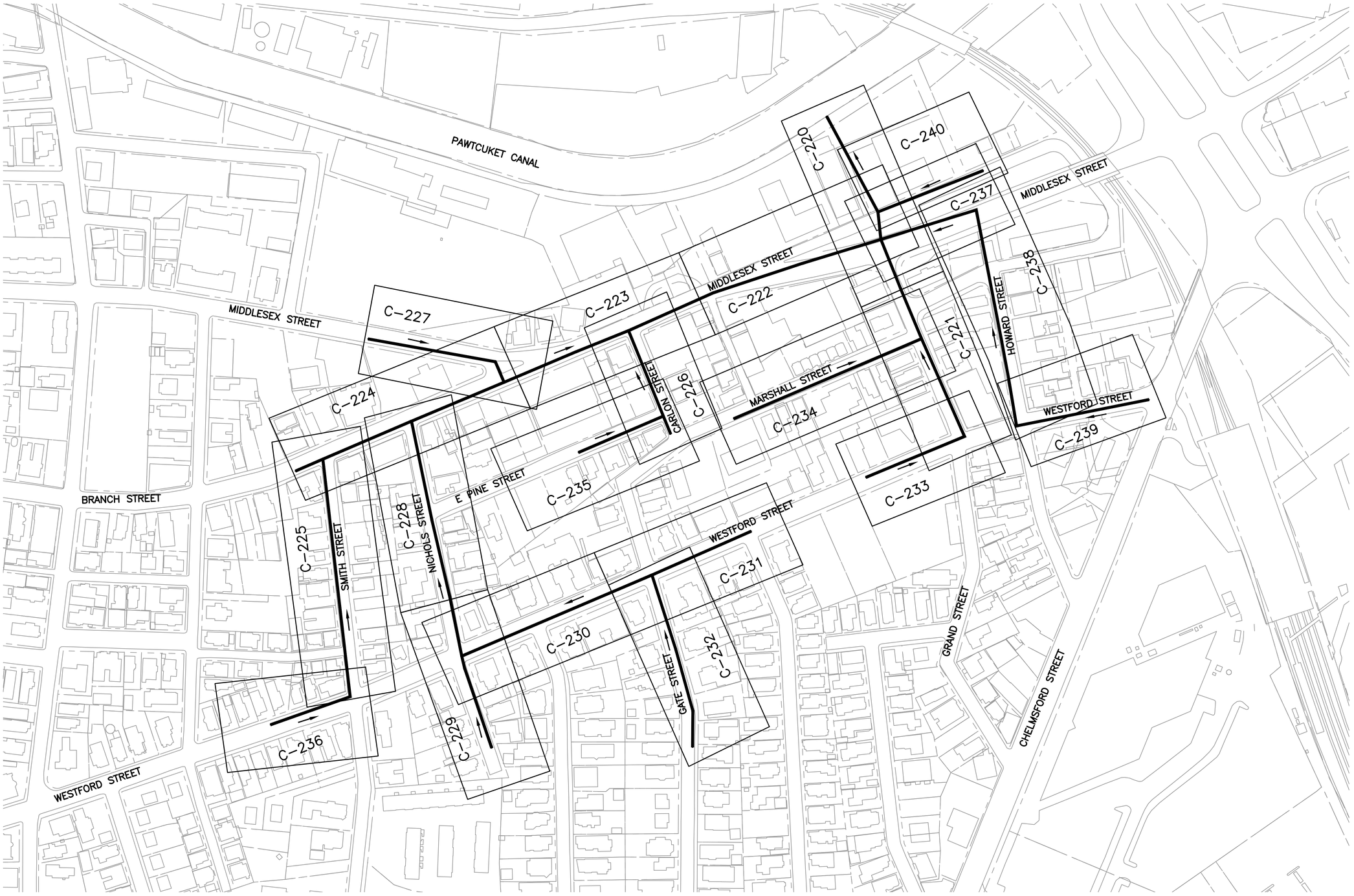
23 St James: July 2024 – August 2024



Appendix E Conceptual Drainpipe Plans and Profiles for Phase 3 Candidate Areas Prioritized Projects

- Grand Area - Conceptual Design - Not for Construction
- Lower Saunders Area - Conceptual Design - Not for Construction
- Pevey Area - Conceptual Design - Not for Construction

Grand Area - Conceptual Design - Not for Construction



PLAN

1" = 100'

50 0 100

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

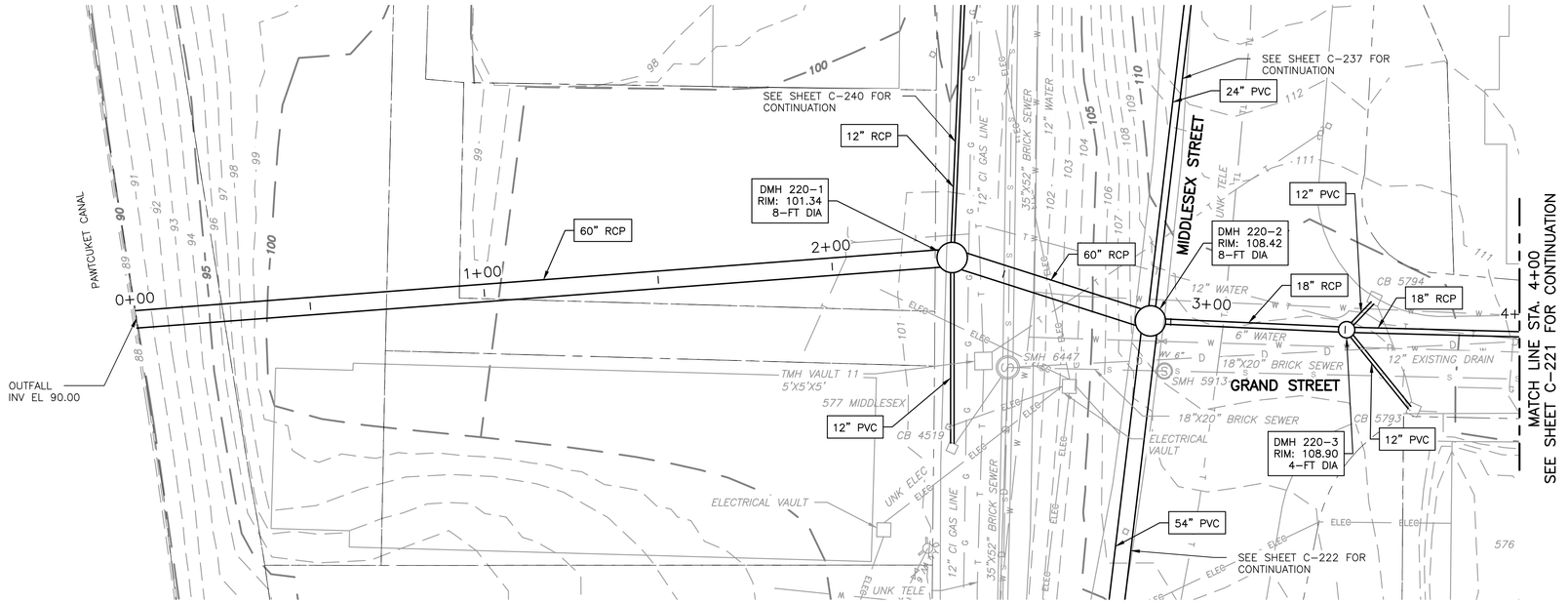
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
KEY PLAN

PROJECT NO. 0552-282899
FILE NAME: G006INDX.DWG
SHEET NO.
G-6

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CDMS_2436, CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP001ST_BASEMAP HUMPHREYS, CEP003ST_EX GAS LINE, BASEMAP, CWZ008PP_CIVIL 3D WORKING MODEL, CWZ009PP_CIVIL 3D WORKING MODEL] Images: []
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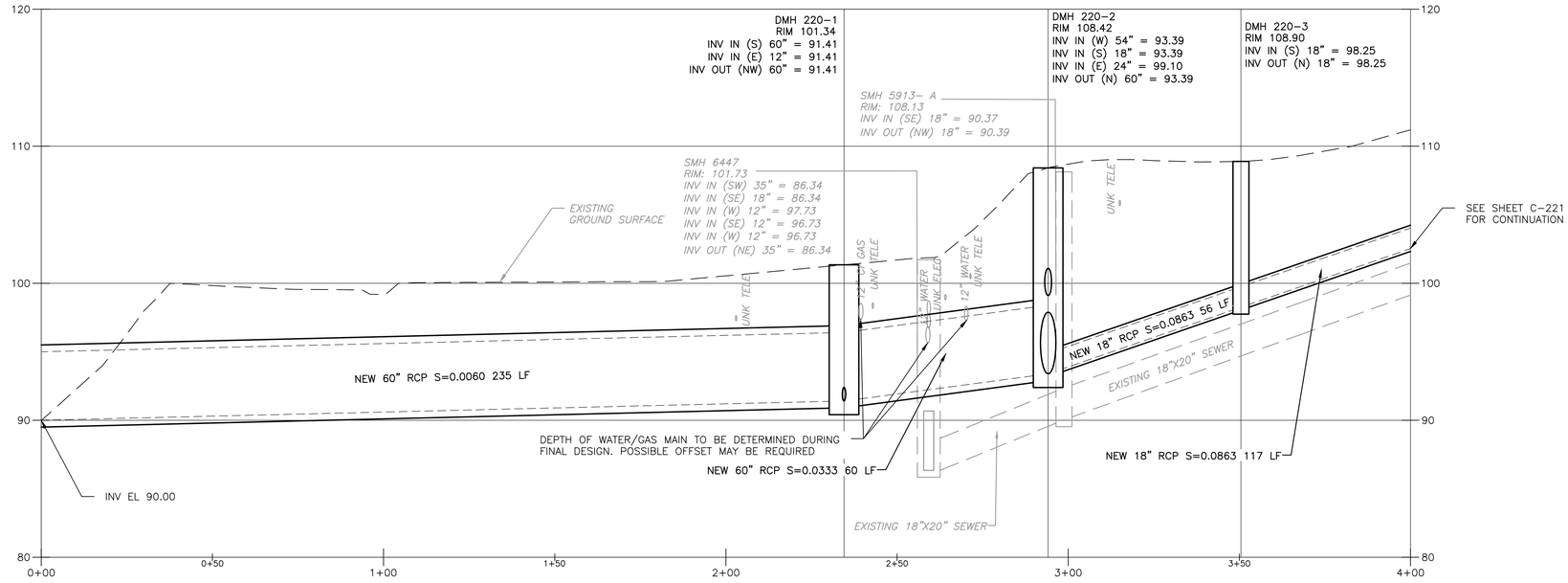


PLAN

1" = 20'

10 0 20

N



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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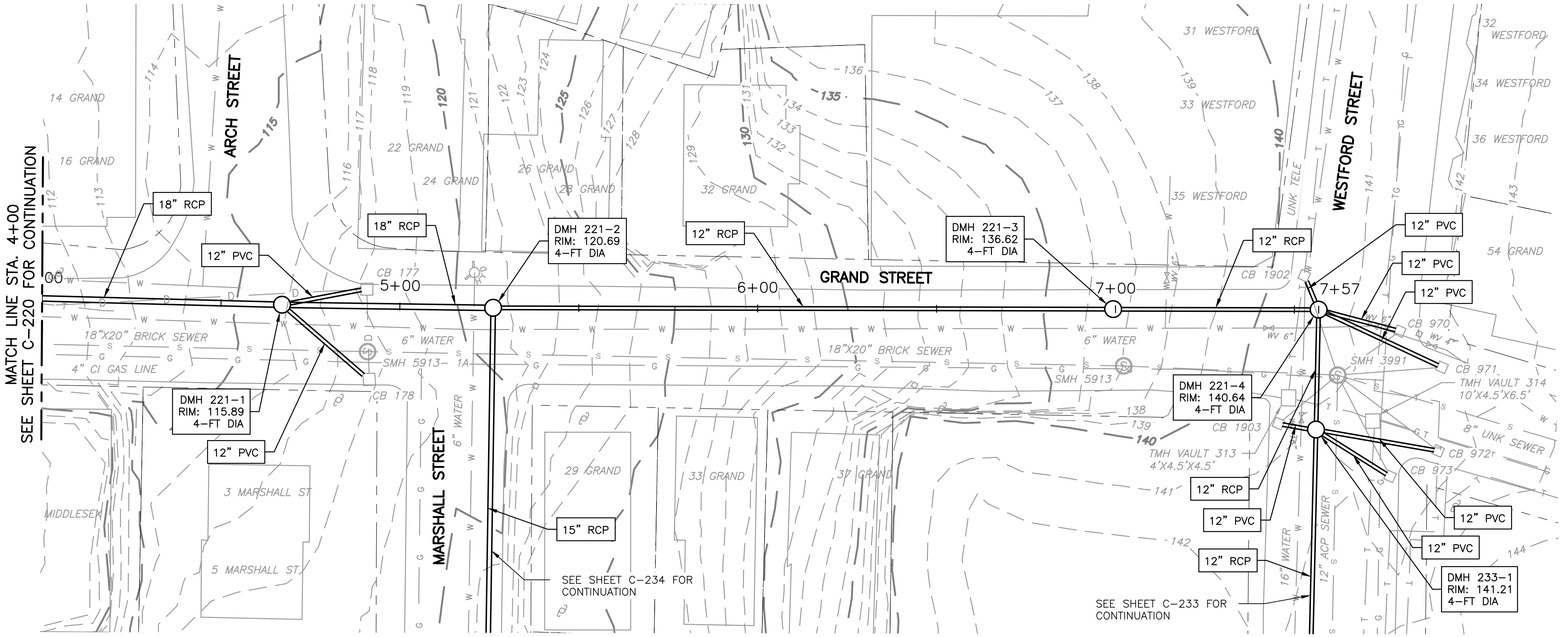
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
GRAND STREET

PROJECT NO. 0552-282899
FILE NAME: C220PLPR.DWG
SHEET NO.
C-220

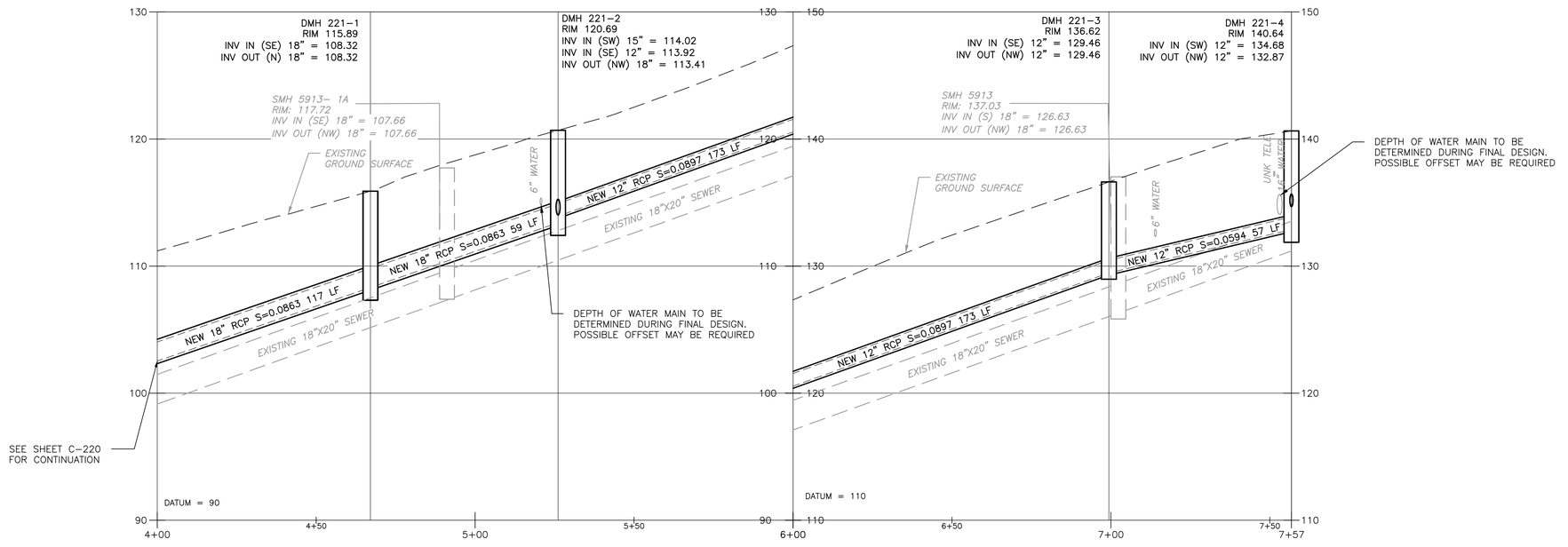
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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

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CROSS CHK'D BY: S. CAREY
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LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

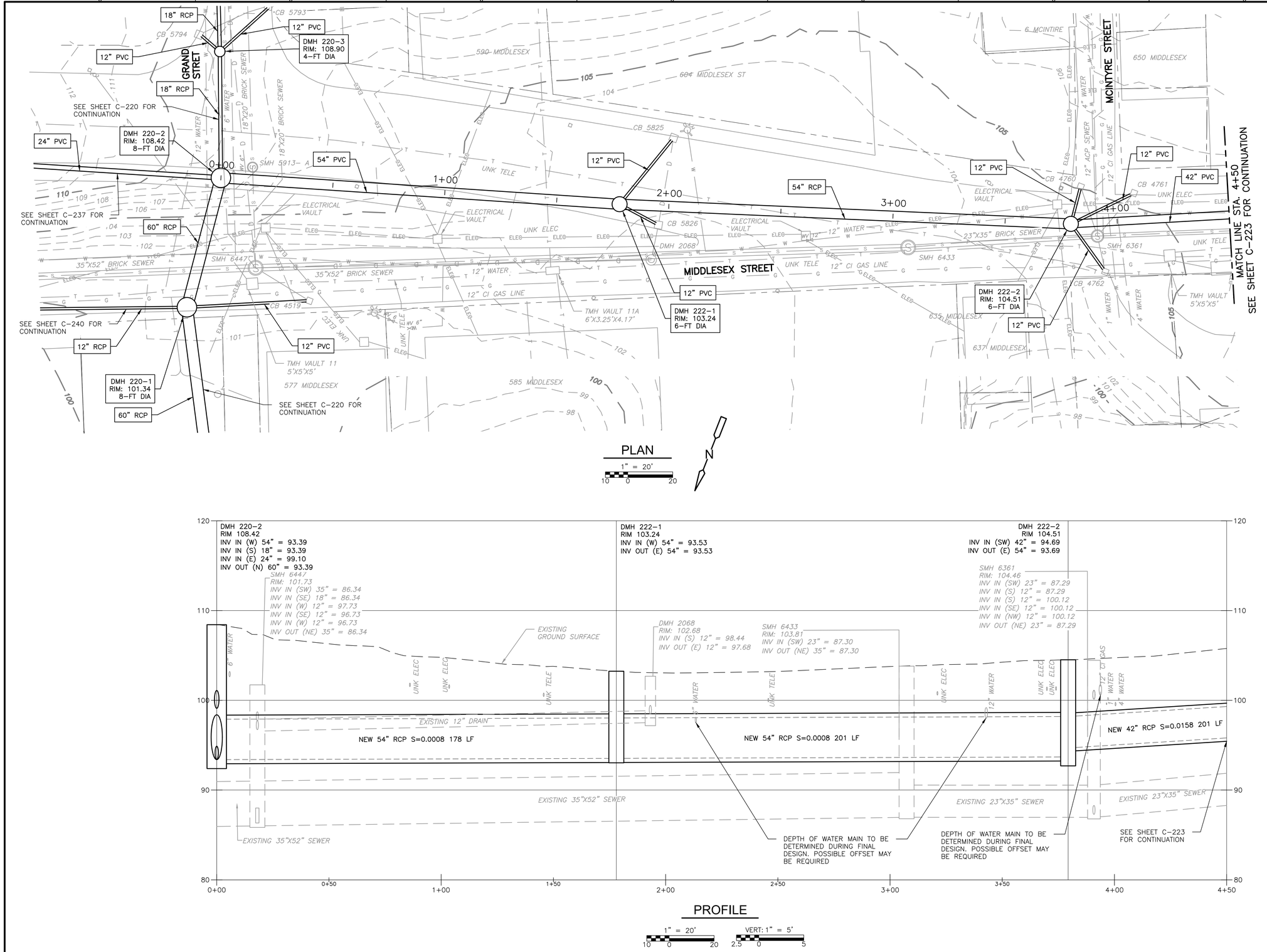
GRAND AREA
GRAND STREET

PROJECT NO. 0552-282899
FILE NAME: C221PLPR.DWG
SHEET NO.
C-221

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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PLAN

1" = 20'

PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

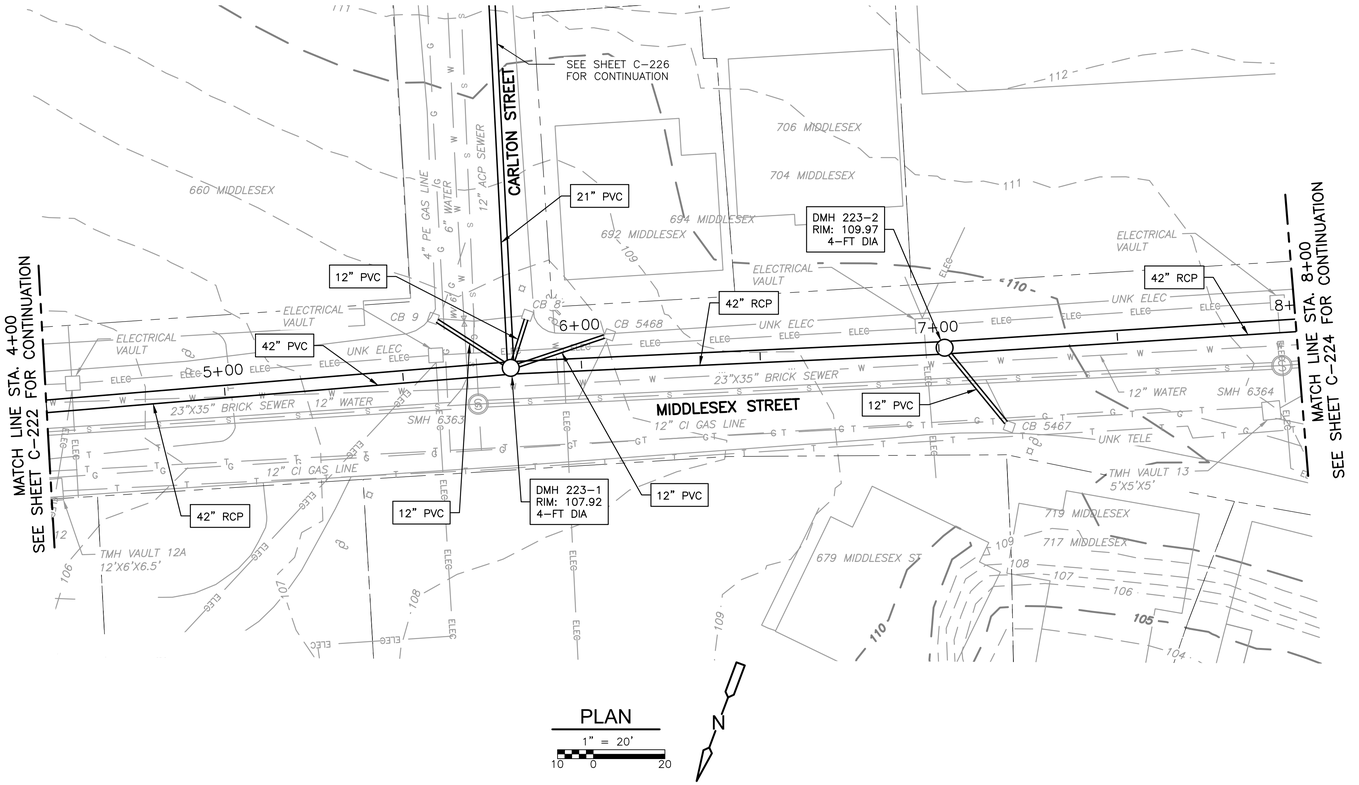
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS

PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
MIDDLESEX STREET

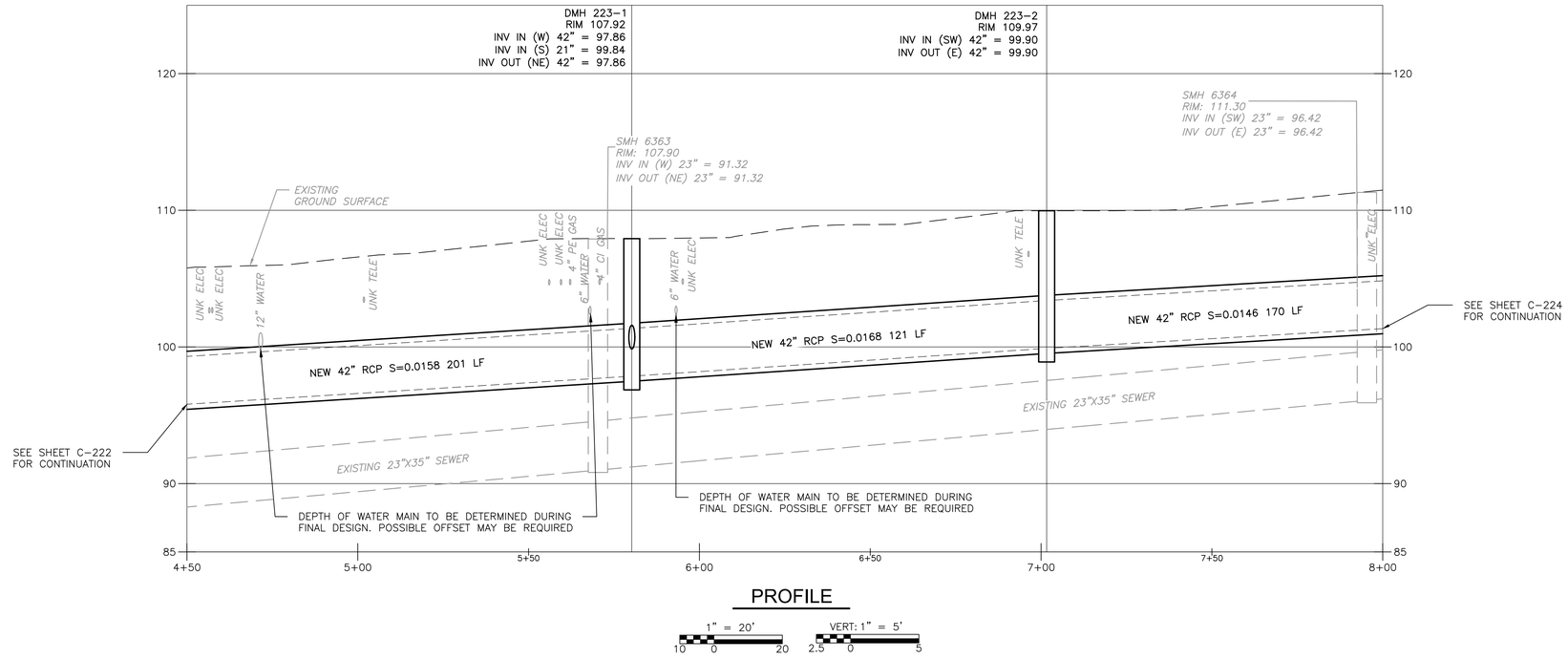
PROJECT NO. 0552-282899
FILE NAME: C222PLPR.DWG
SHEET NO.
C-222

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION



PLAN

1" = 20'



PROFILE

1" = 20' VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

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DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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Manchester, NH 03101
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LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

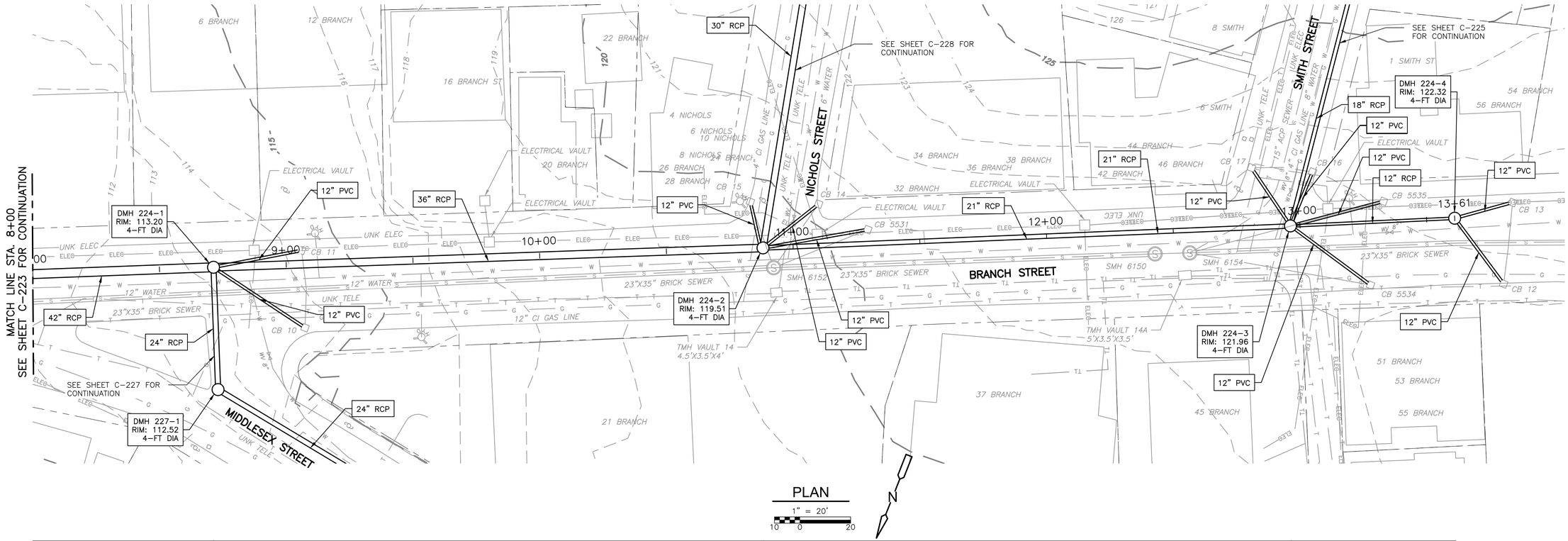
GRAND AREA
MIDDLESEX STREET

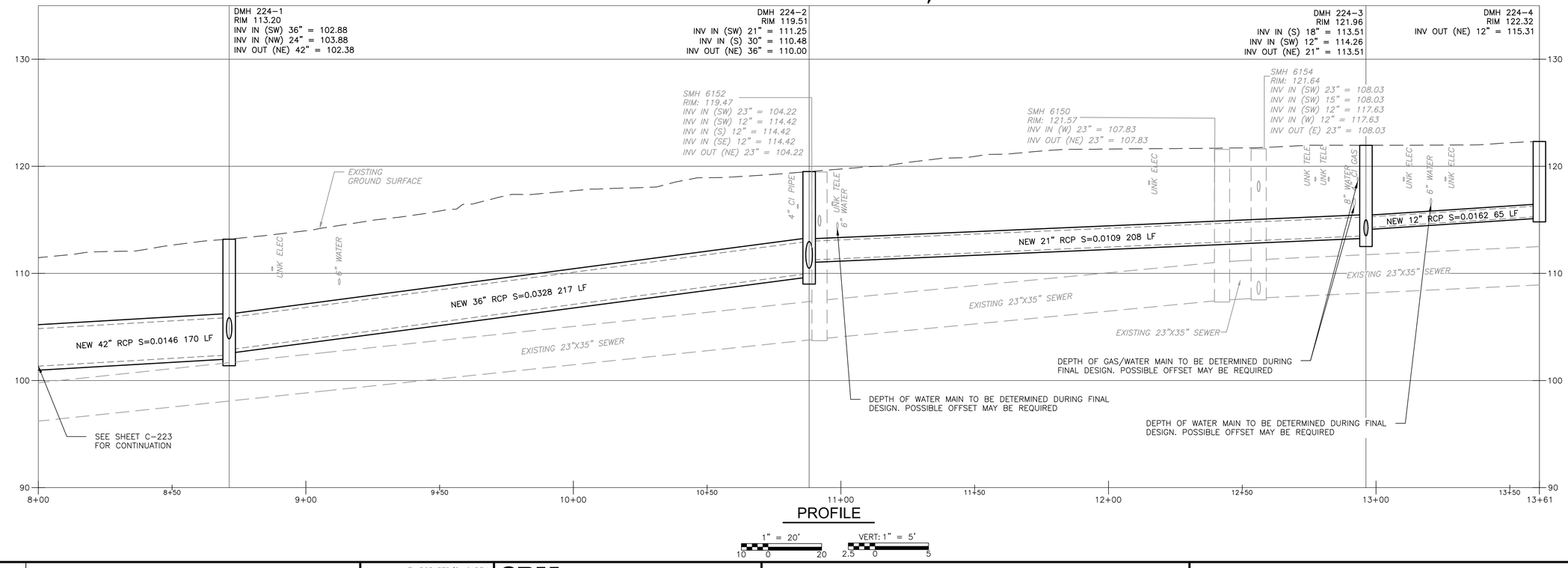
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APPROVED BY:
DATE: DECEMBER 2024

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Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS

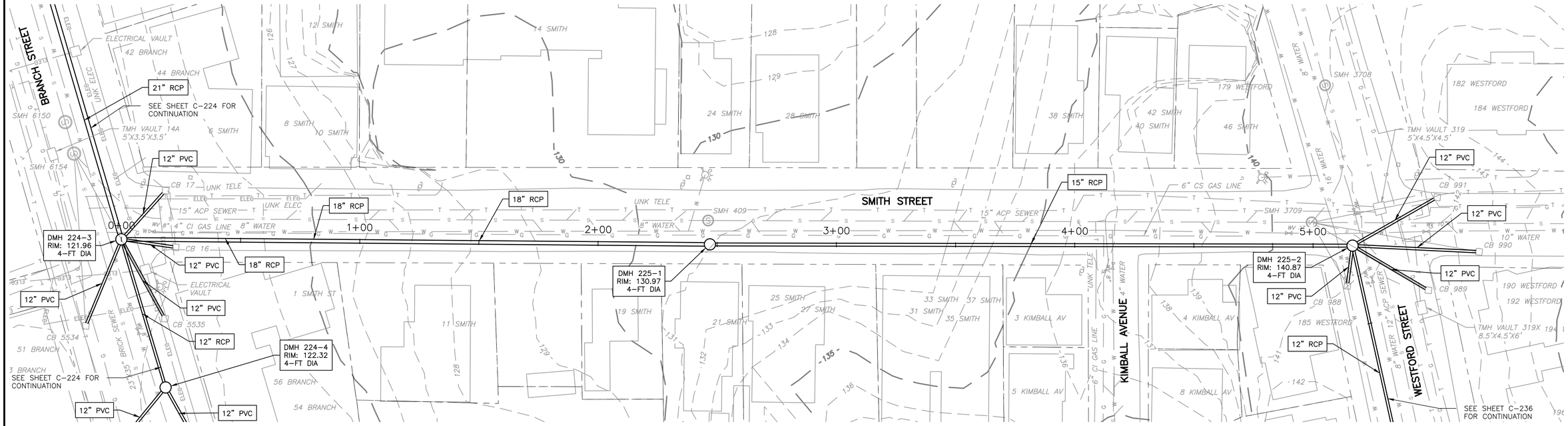
PHASE 3 CANDIDATE AREA SEWER SEPARATION PDR

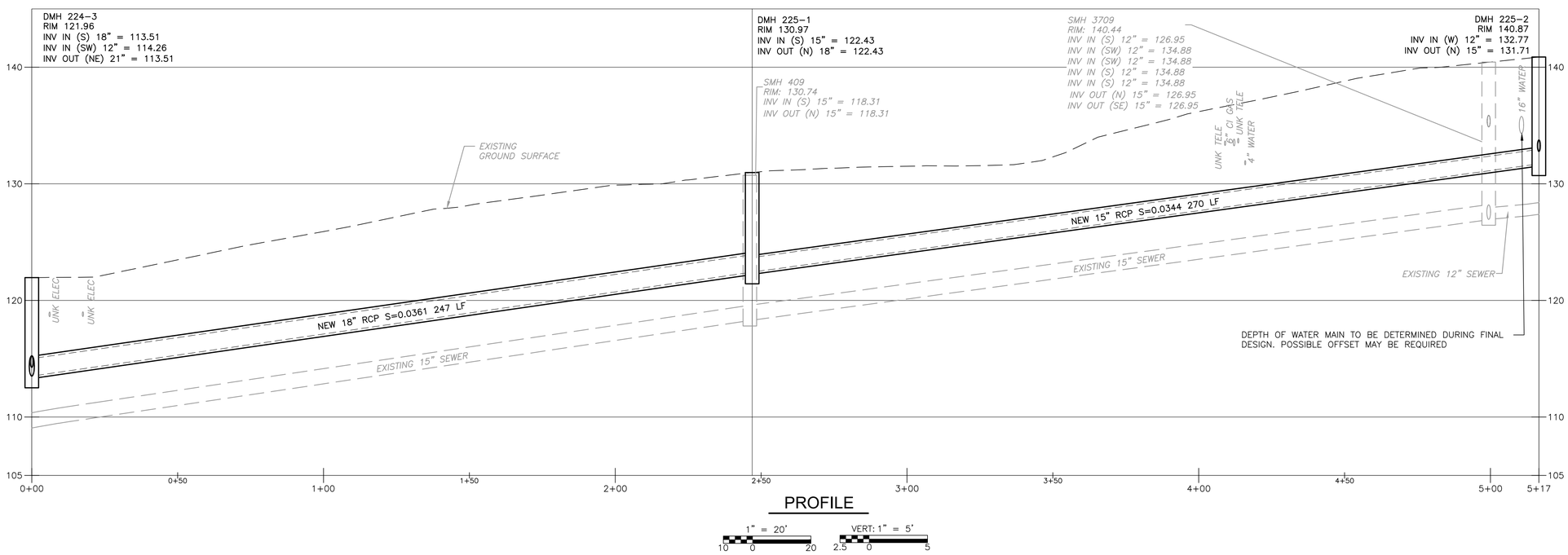
GRAND AREA
BRANCH STREET

PROJECT NO. 0552-282899
FILE NAME: C224PLPR.DWG

SHEET NO.
C-224

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION





REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

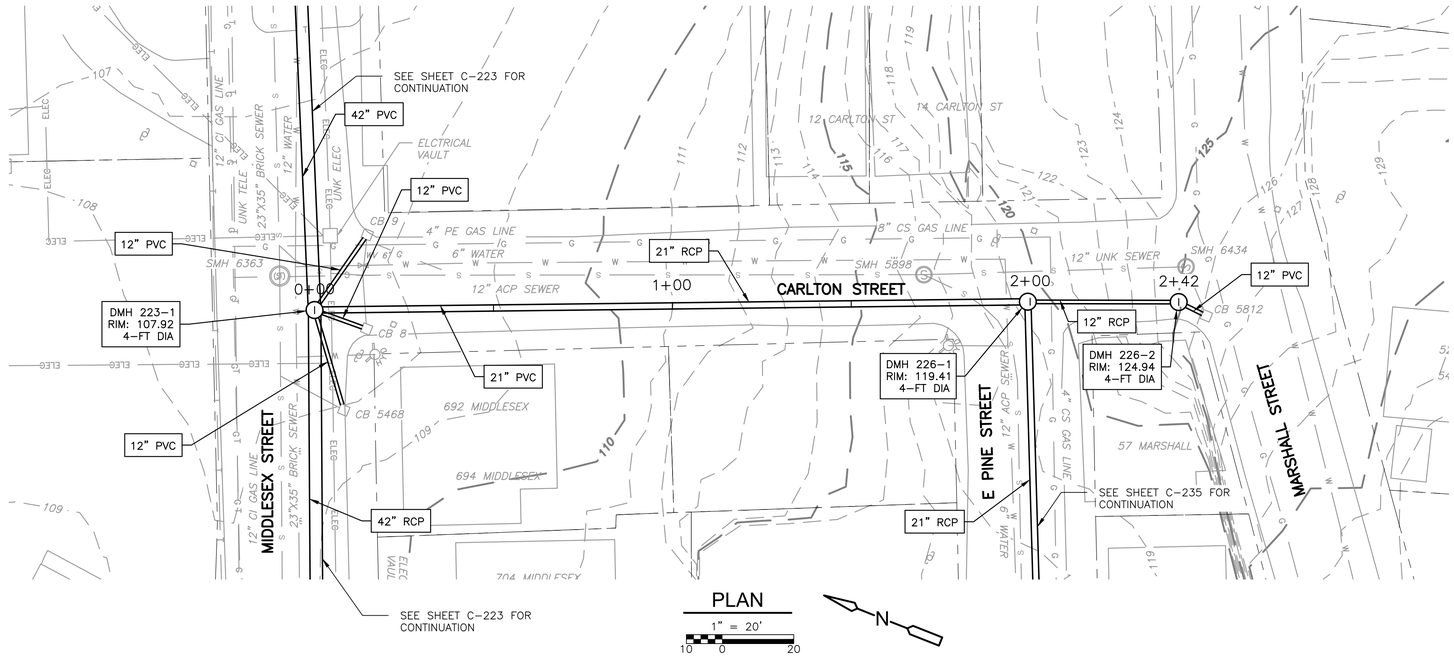
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
SMITH STREET

PROJECT NO. 0552-282899
FILE NAME: C225PLPR.DWG
SHEET NO.
C-225

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, CEP008PP-EXTENET, LowellPhase3_Areas-and-PipeLayouts, BASEMAP, CDMS_2436_Target Separation Areas, CWZ009PP_CIVIL 3D WORKING MODEL] Images: []
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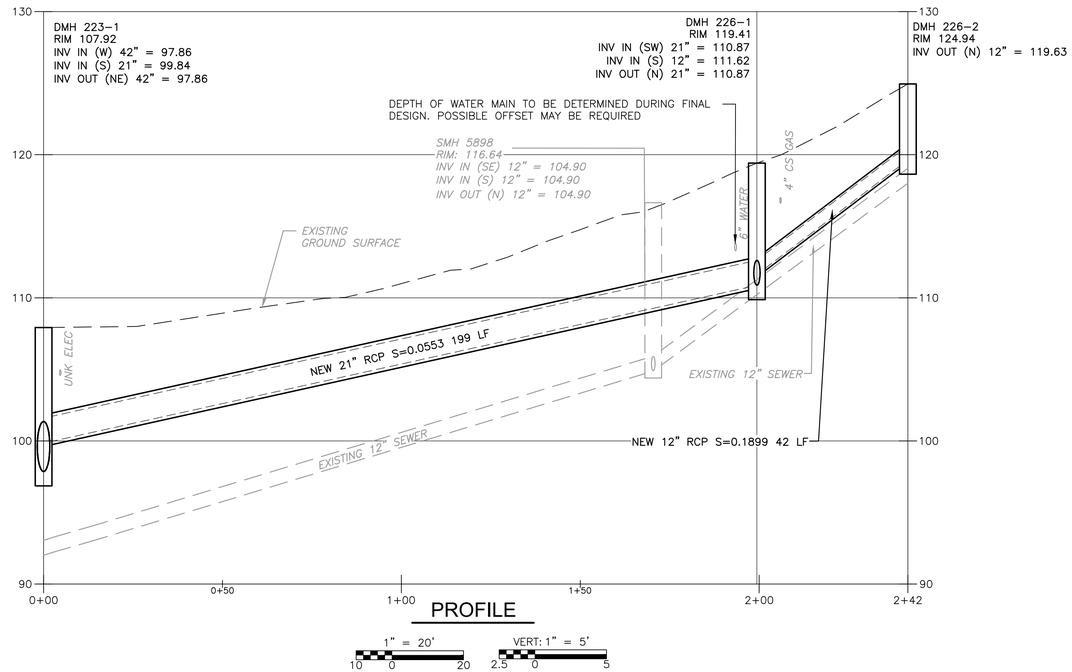


PLAN

1" = 20'

10 0 20

N



PROFILE

1" = 20'

10 0 20

VERT: 1" = 5'

2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

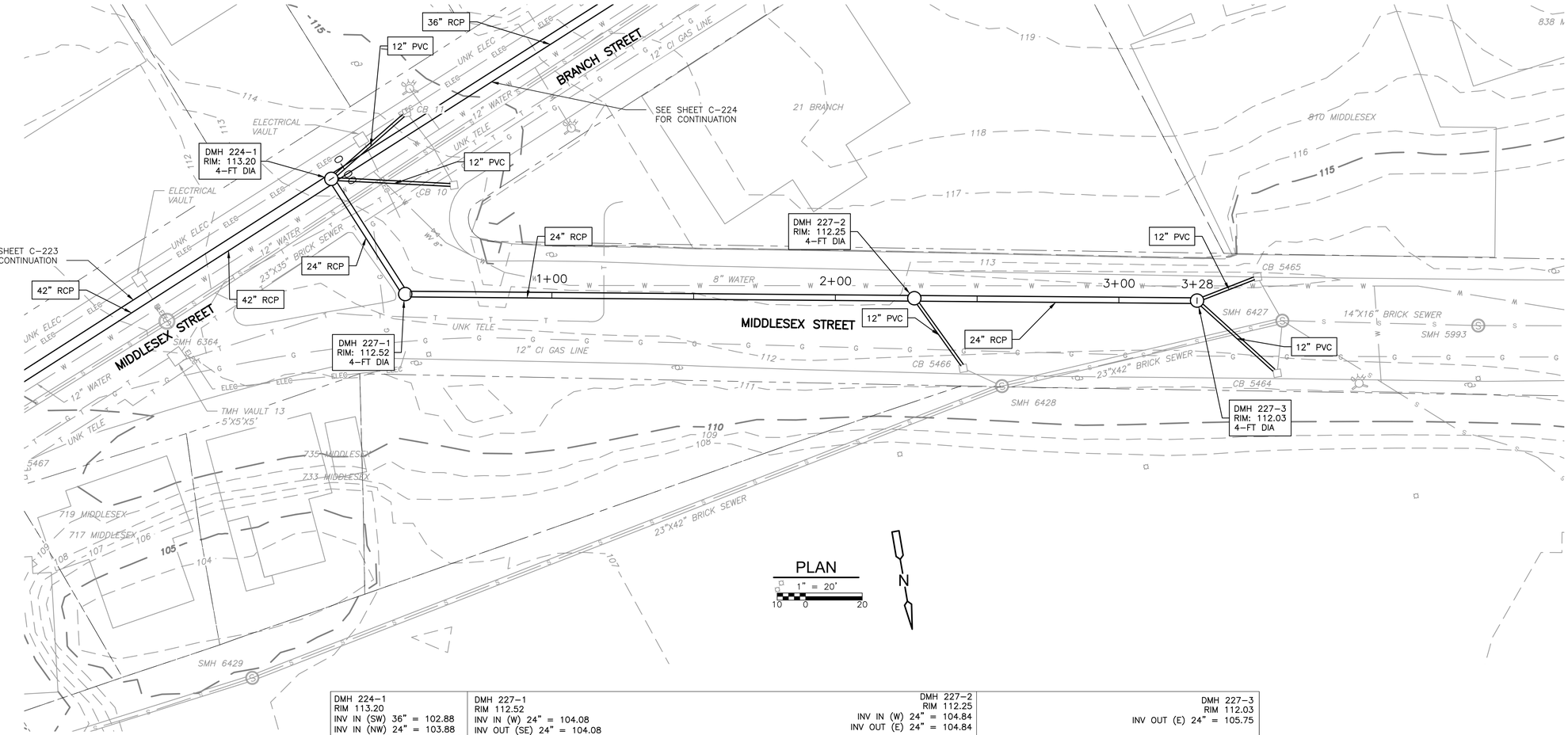
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

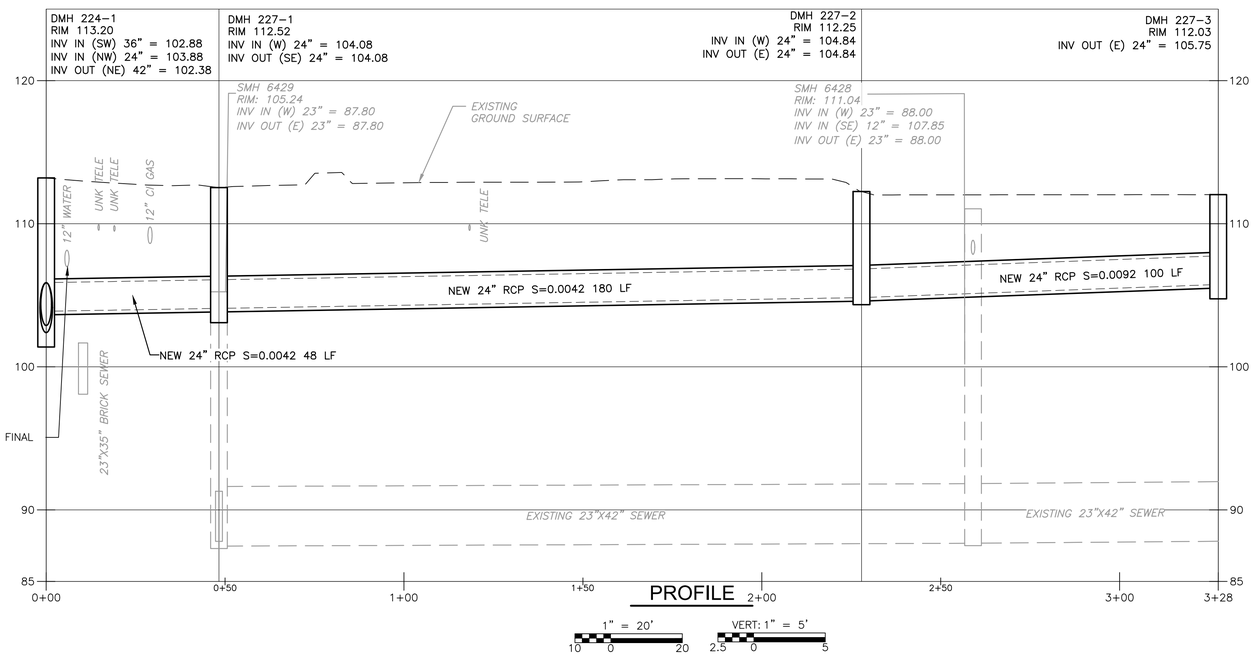
GRAND AREA
CARLTON STREET

PROJECT NO. 0552-282899
FILE NAME: C226PLPR.DWG
SHEET NO.
C-226

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, CEP008PP-EXTENET, LowellPhase3_Areas-and-PipeLayouts, BASEMAP, CDMS_2436_Target Separation Areas, CWZ009PP_CIVIL 3D WORKING MODEL] Images: []
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DEPTH OF WATER MAIN TO BE DETERMINED DURING FINAL DESIGN. POSSIBLE OFFSET MAY BE REQUIRED

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

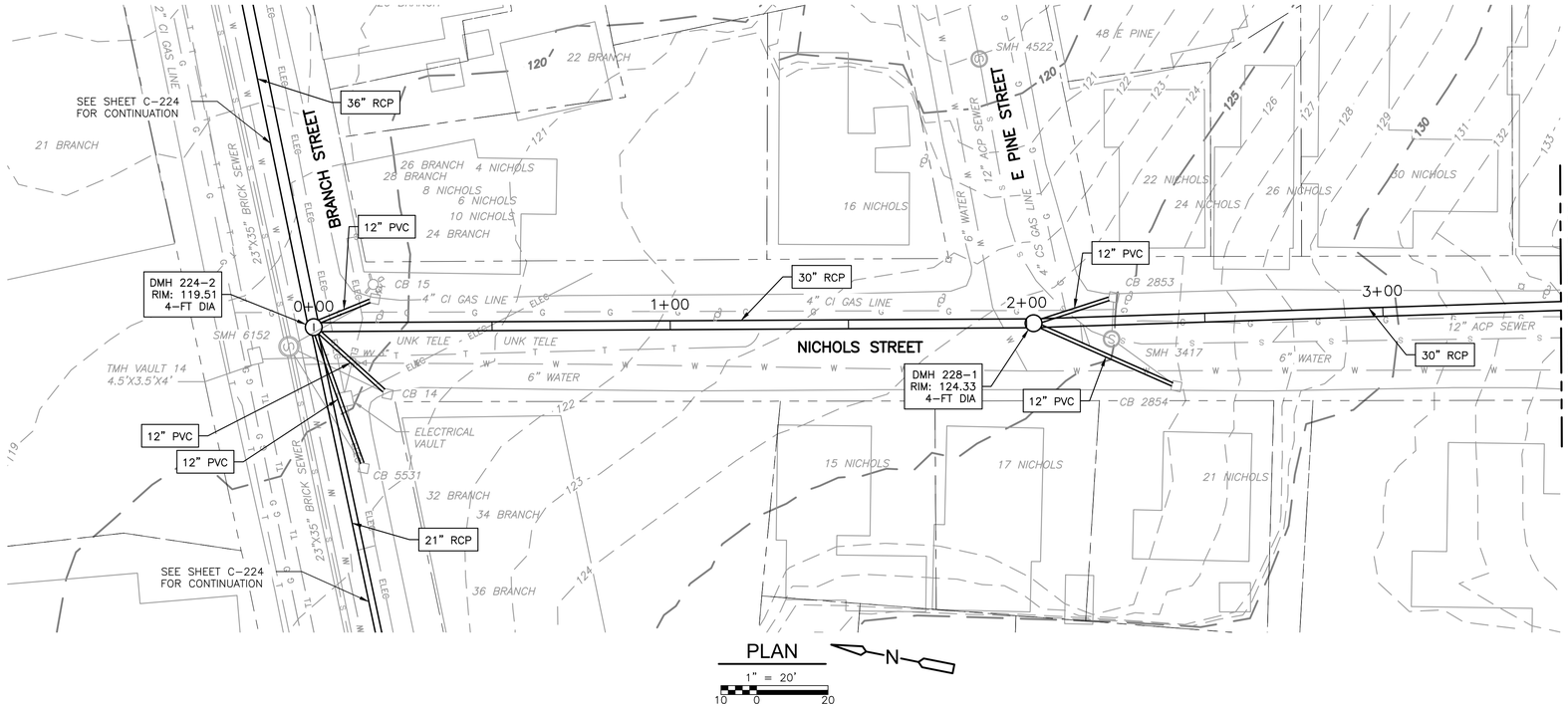
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

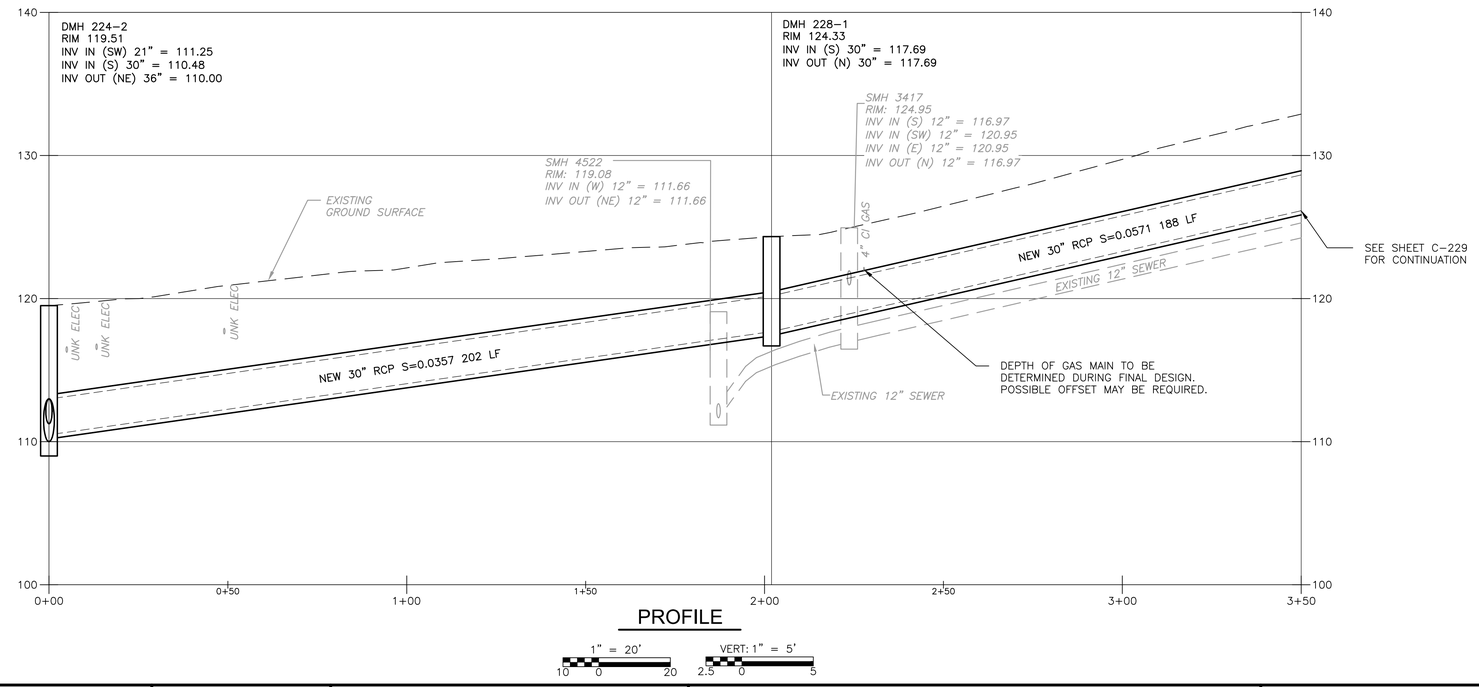
GRAND AREA
MIDDLESEX STREET

PROJECT NO. 0552-282899
FILE NAME: C227PLPR.DWG
SHEET NO.
C-227

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: (CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, CEP008PP-EXTENET, LowellPhase3_Areas-and-PipeLayouts, BASEMAP, CDMS_2436_Target Separation Areas, CWZ009PP_CIVIL 3D WORKING MODEL) Images: []
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REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

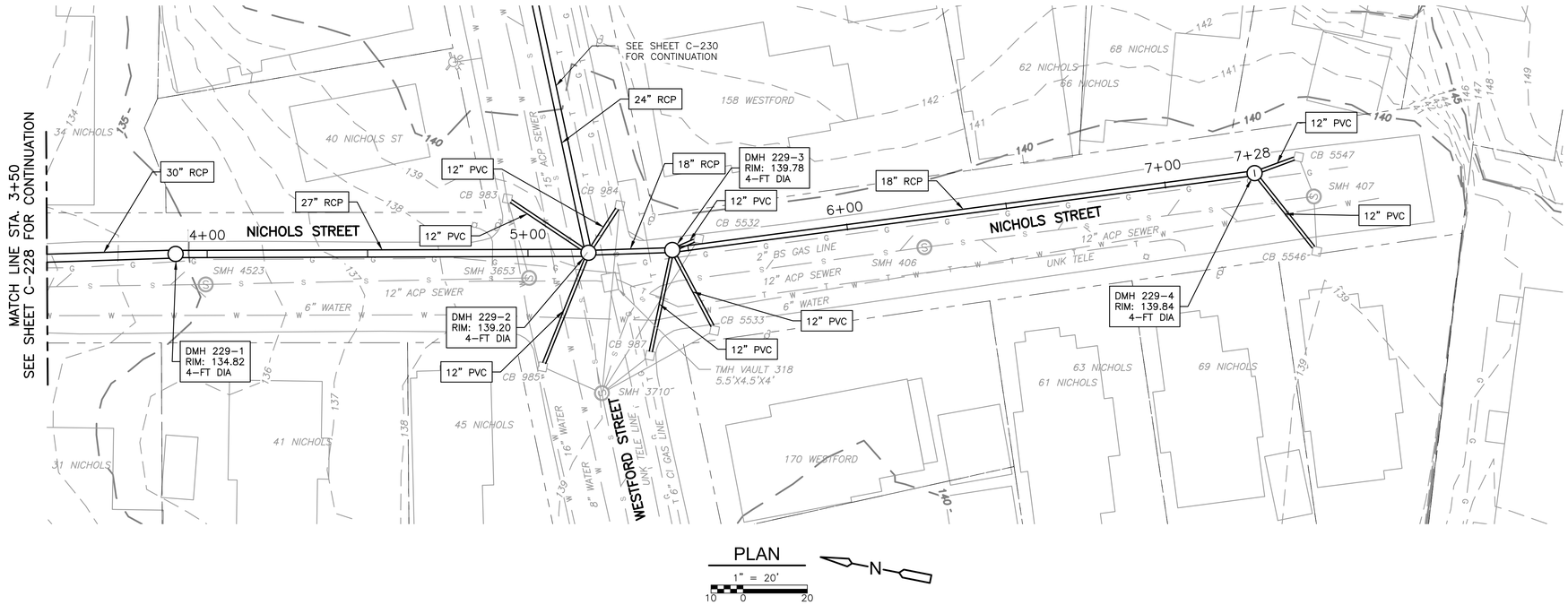
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
NICHOLS STREET

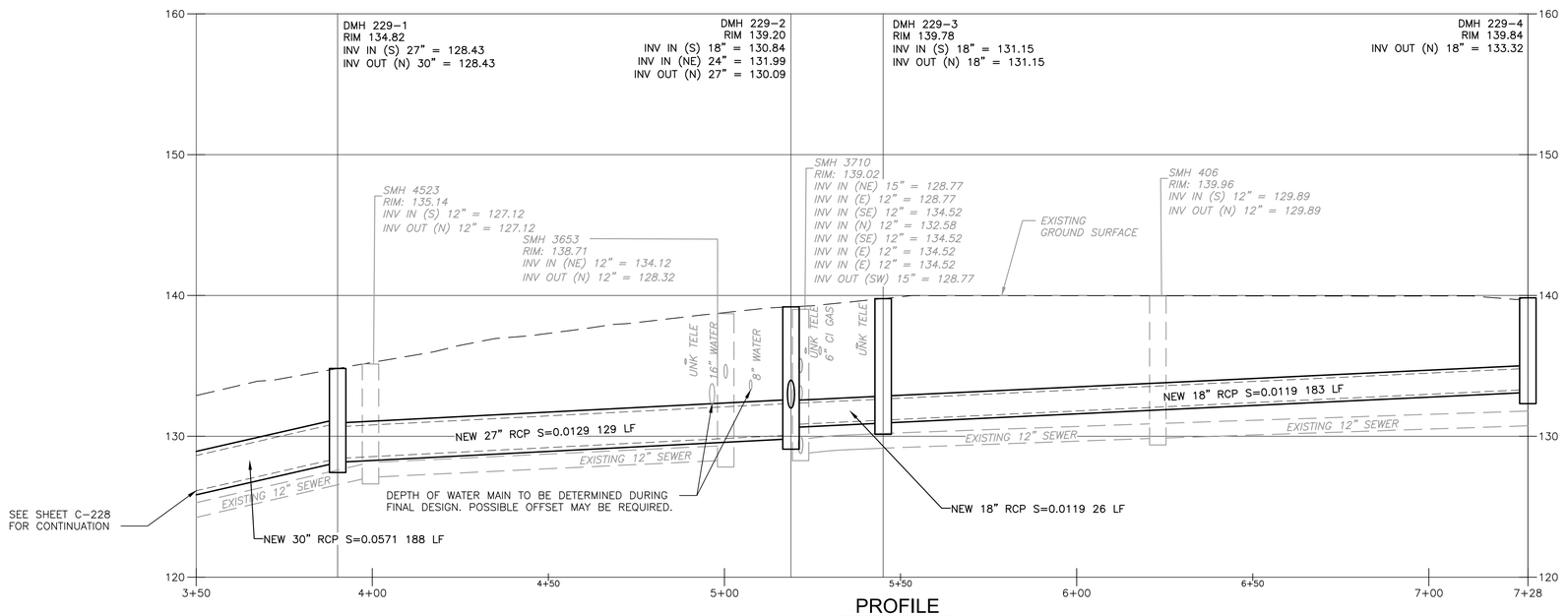
PROJECT NO. 0552-282899
FILE NAME: C228PLPR.DWG
SHEET NO.
C-228

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, CEP008PP-EXTENET, LowellPhase3_Areas-and-PipeLayouts, BASEMAP, CDMS_2436_Target Separation Areas, CWZ009PP_CIVIL 3D WORKING MODEL] Images: []
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PLAN
1" = 20'



PROFILE
1" = 20'
VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

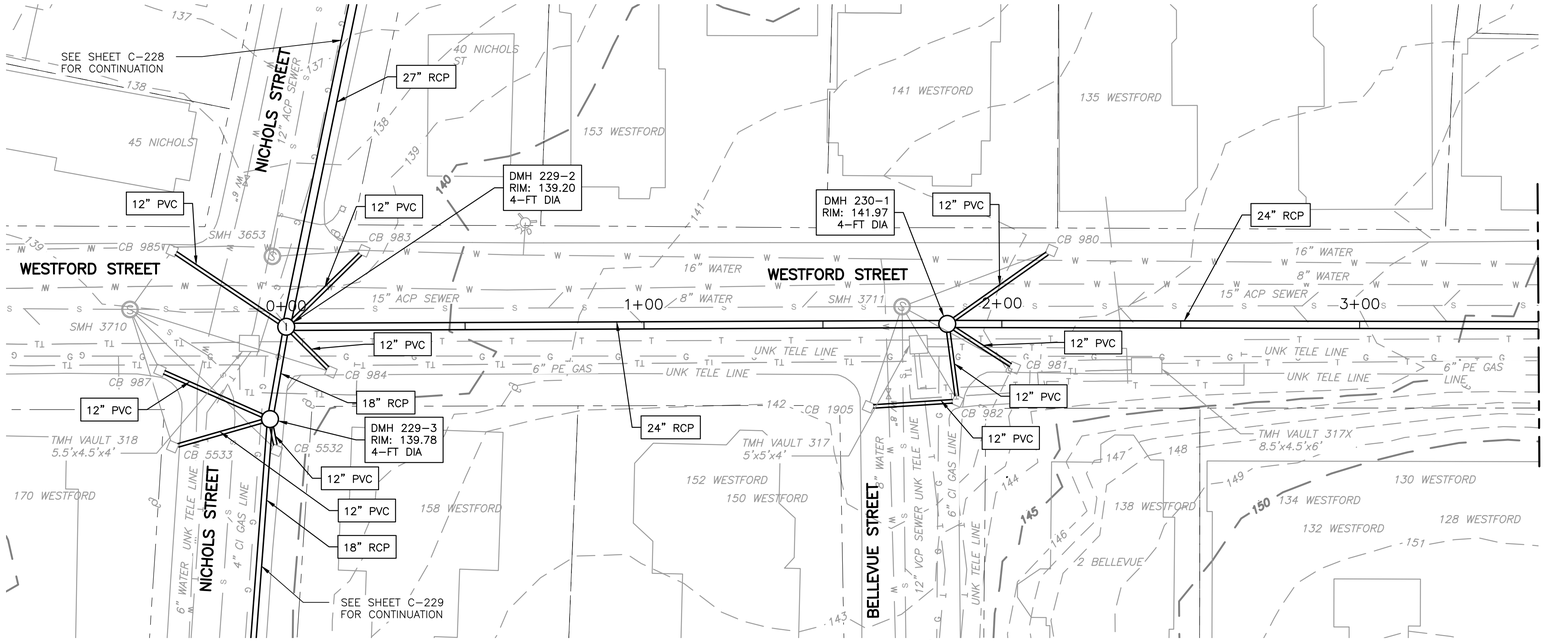
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
NICHOLS STREET

PROJECT NO. 0552-282899
FILE NAME: C229PLPR.DWG
SHEET NO.
C-229

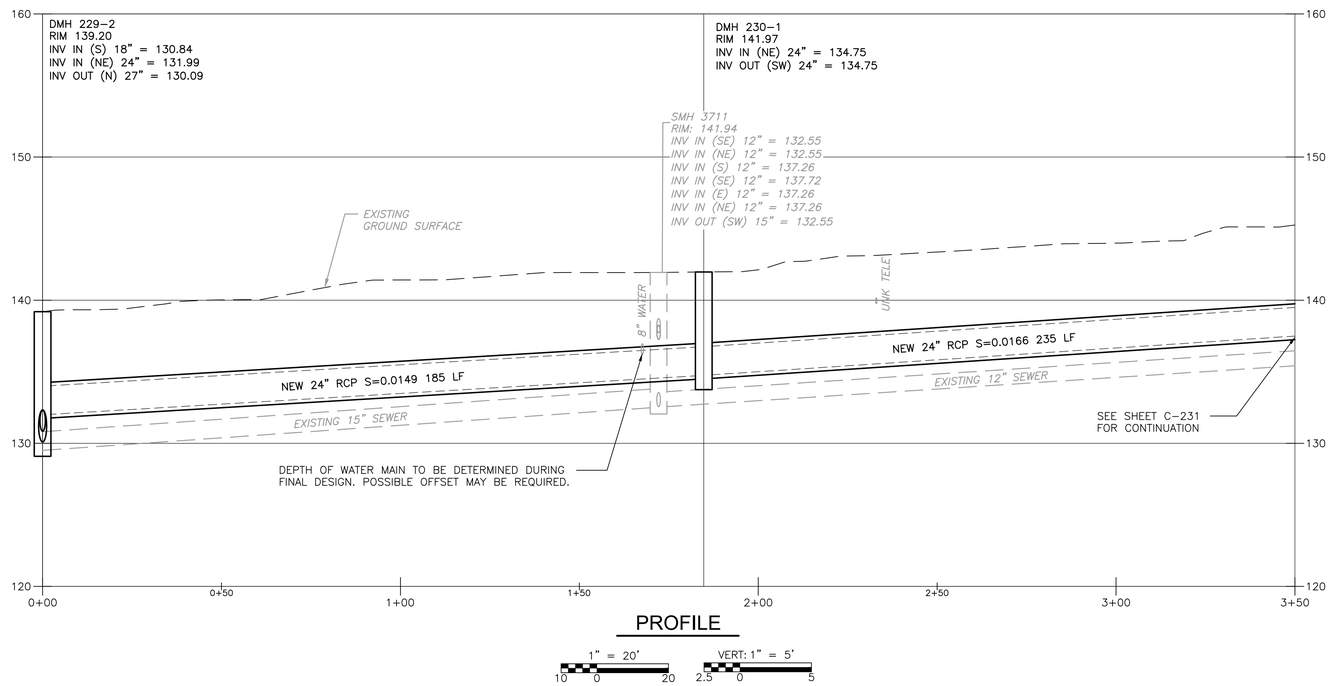
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, CEP008PP-EXTENET, LowellPhase3_Areas-and-PipeLayouts, BASEMAP, CDMS_2436_Target Separation Areas, CWZ009PP_CIVIL 3D WORKING MODEL] Images: []
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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

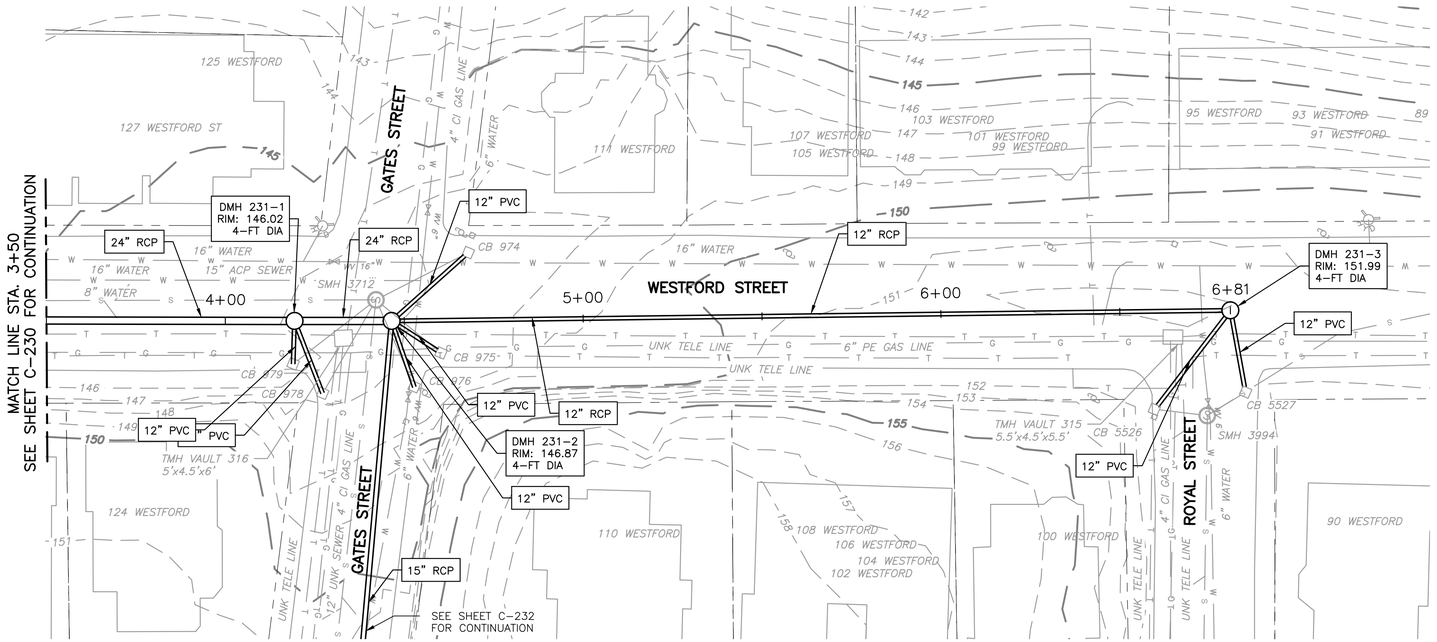
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
WESTFORD STREET

PROJECT NO. 0552-282899
FILE NAME: C230PLPR.DWG
SHEET NO.
C-230

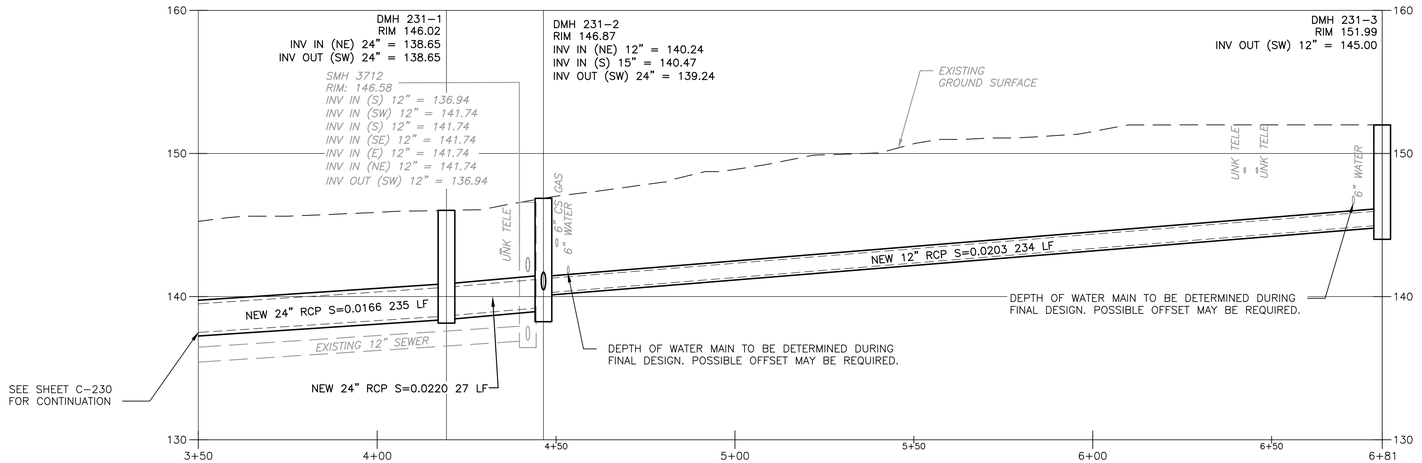
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target Separation Areas, CVIZ109PP_CIVIL 3D WORKING MODEL] Images: []
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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

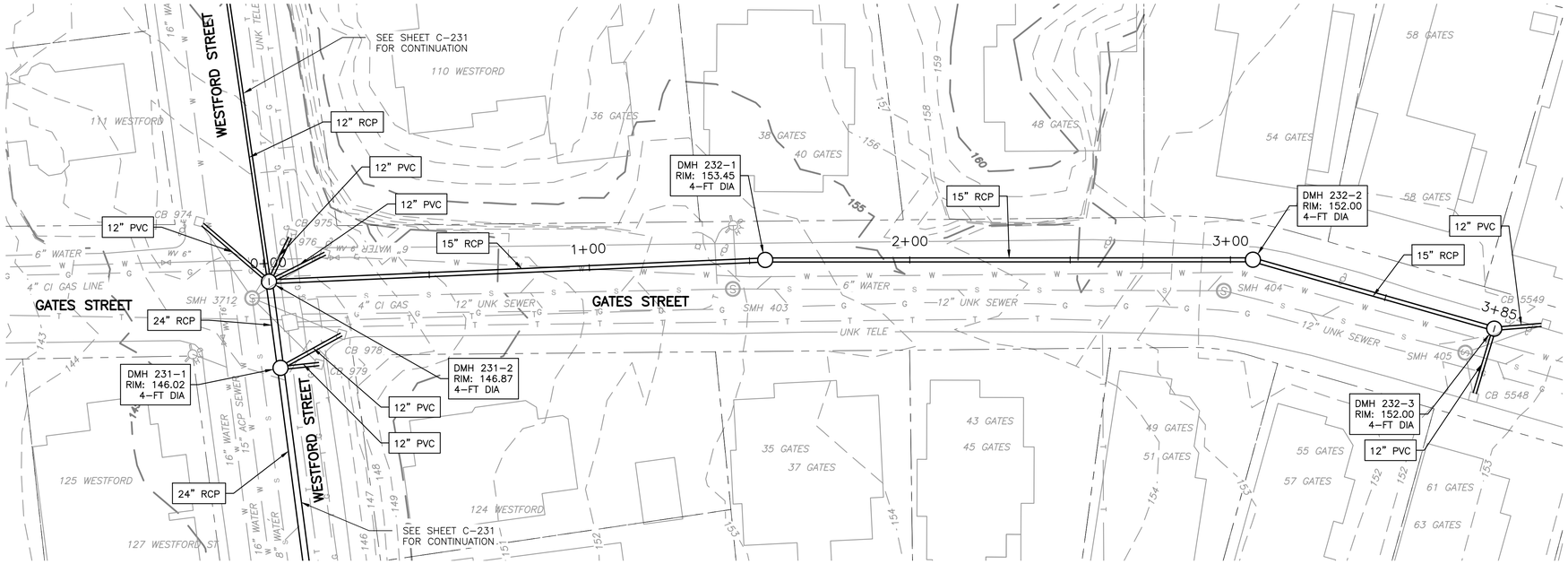
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
WESTFORD STREET

PROJECT NO. 0552-282899
FILE NAME: C231PLPR.DWG
SHEET NO.
C-231

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

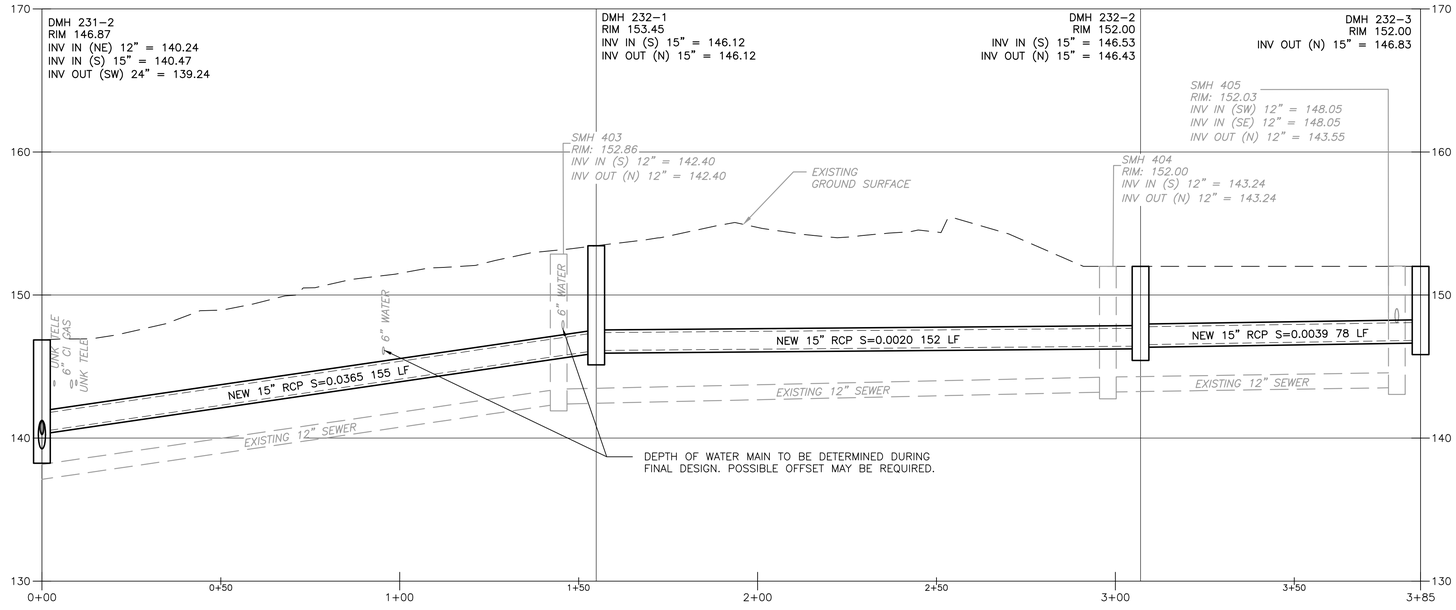
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

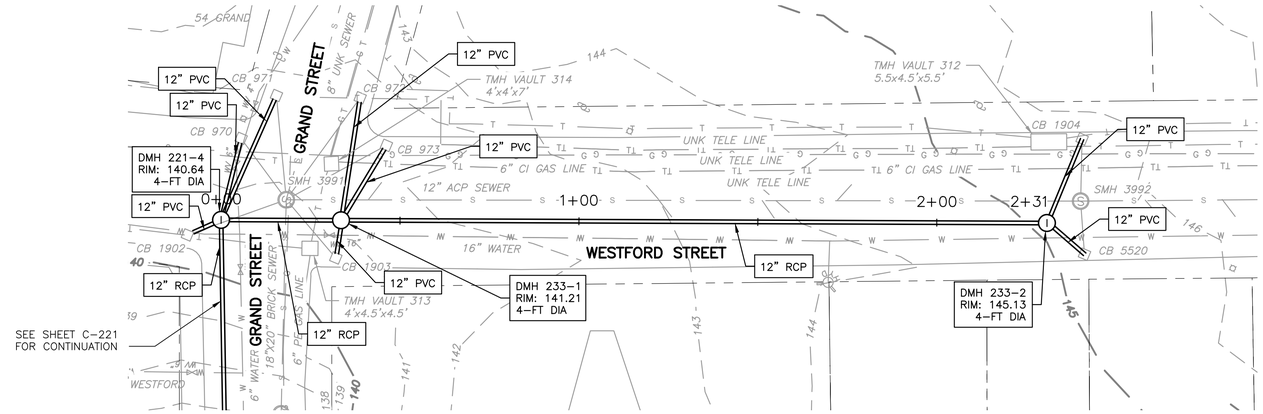
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
GATES STREET

PROJECT NO. 0552-282899
FILE NAME: C232PLPR.DWG
SHEET NO.
C-232

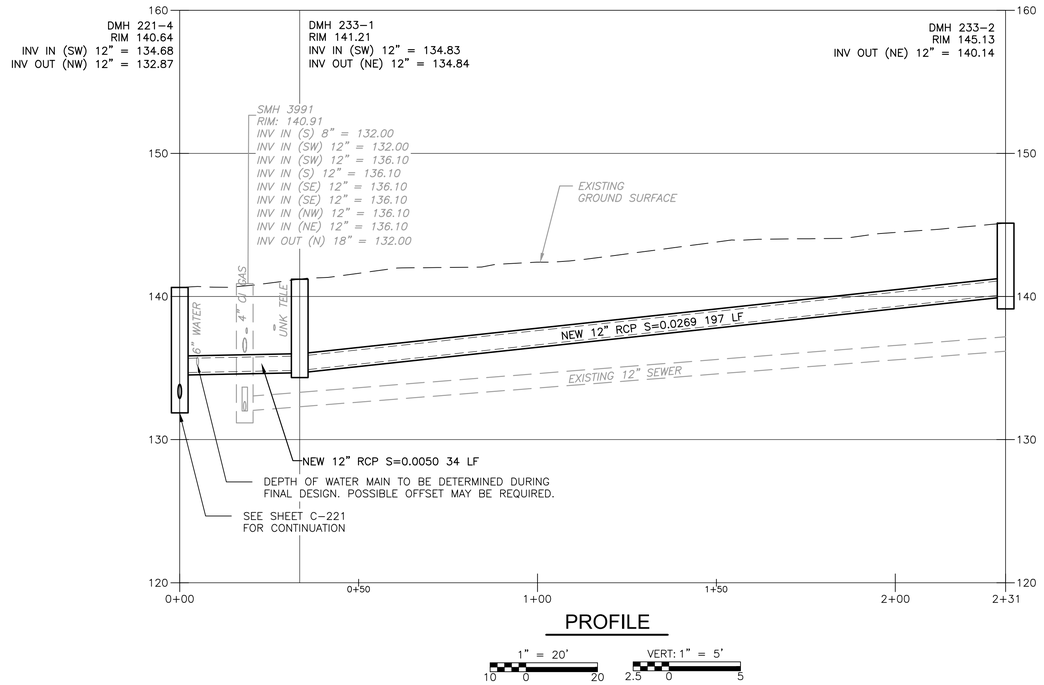
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target-Separation Areas, CWZ009PP_CIVIL 3D WORKING MODEL] Images: []
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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
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Manchester, NH 03101
Tel: (603) 222-8300

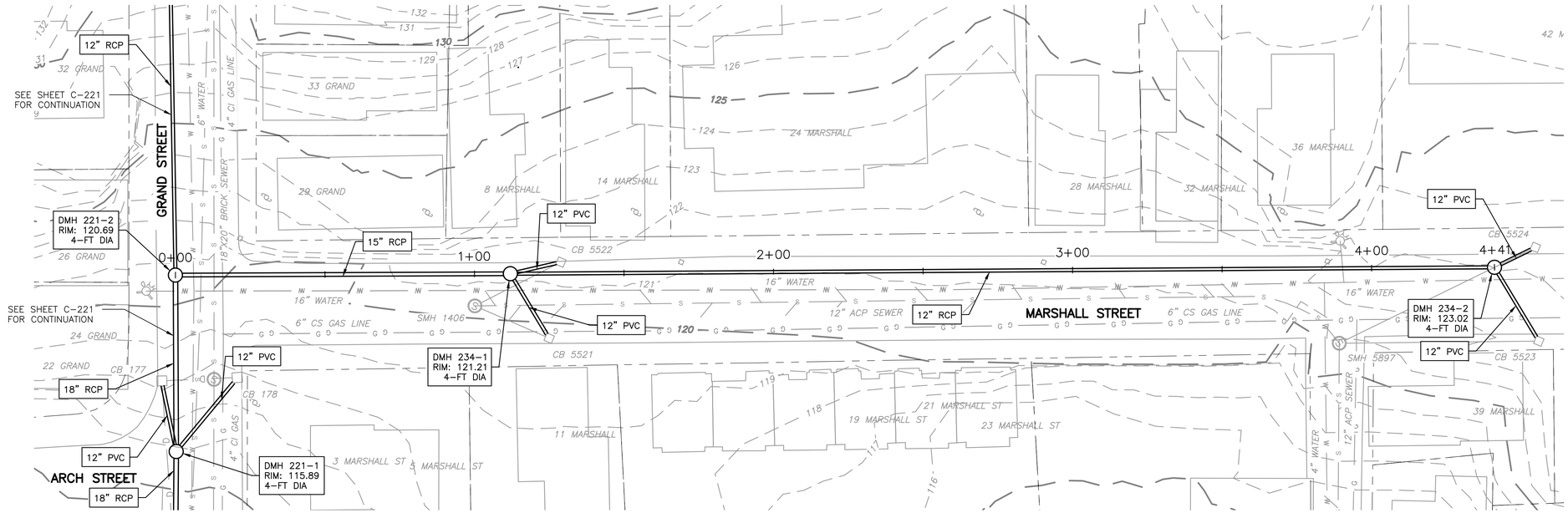
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
WESTFORD STREET

PROJECT NO. 0552-282899
FILE NAME: C233PLPR.DWG
SHEET NO.
C-233

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target Separation Areas, CVZ109PP_CIVIL 3D WORKING MODEL] Images: []
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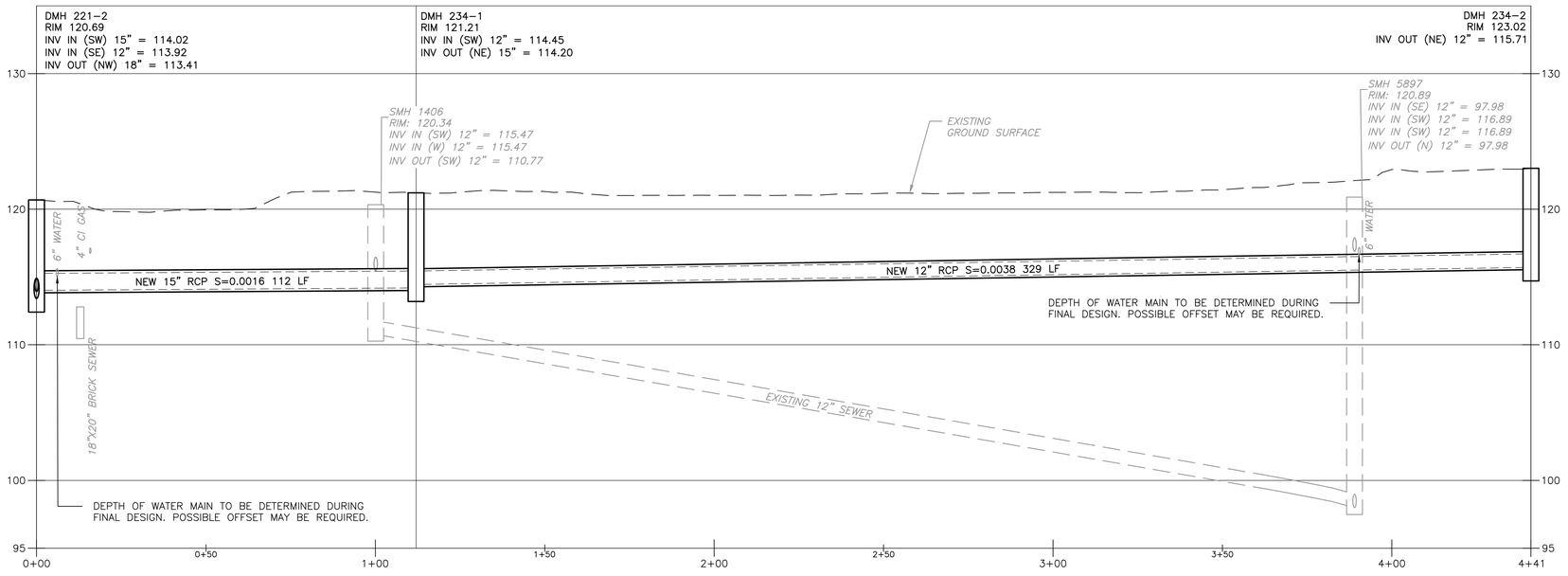


PLAN

1" = 20'

10 0 20

N



PROFILE

1" = 20'

10 0 20

VERT: 1" = 5'

2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
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Manchester, NH 03101
Tel: (603) 222-8300

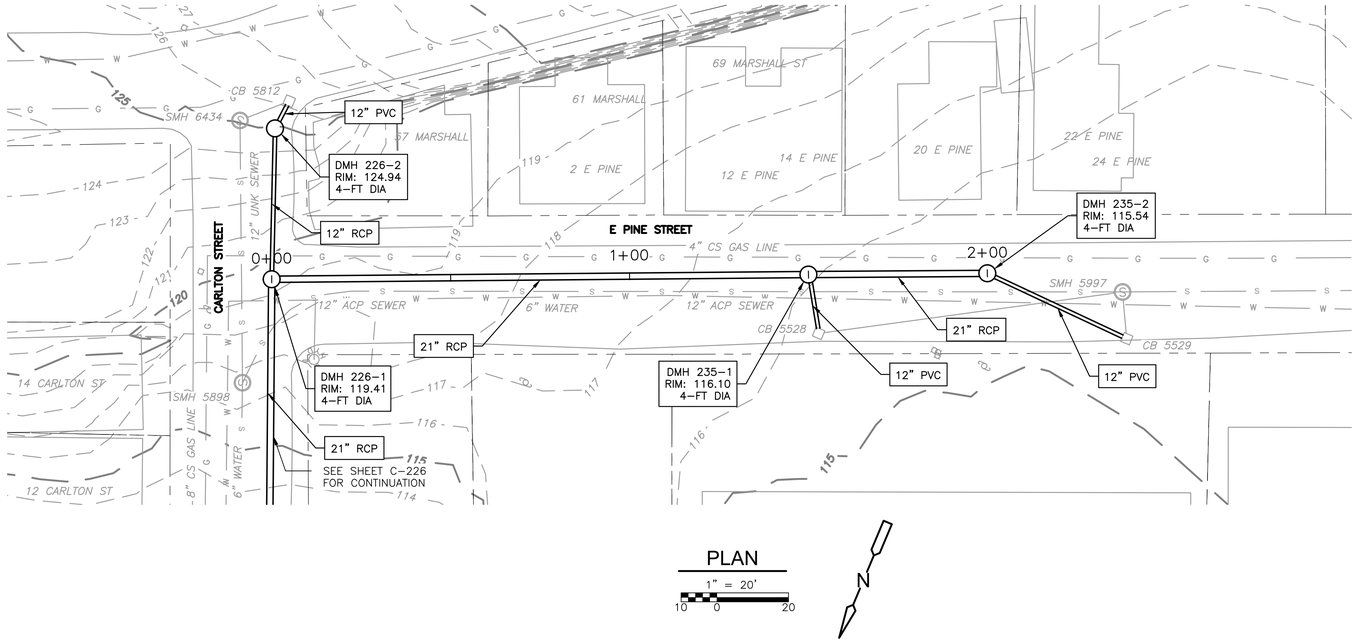
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
MARSHALL STREET

PROJECT NO. 0552-282899
FILE NAME: C234PLPR.DWG
SHEET NO.
C-234

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

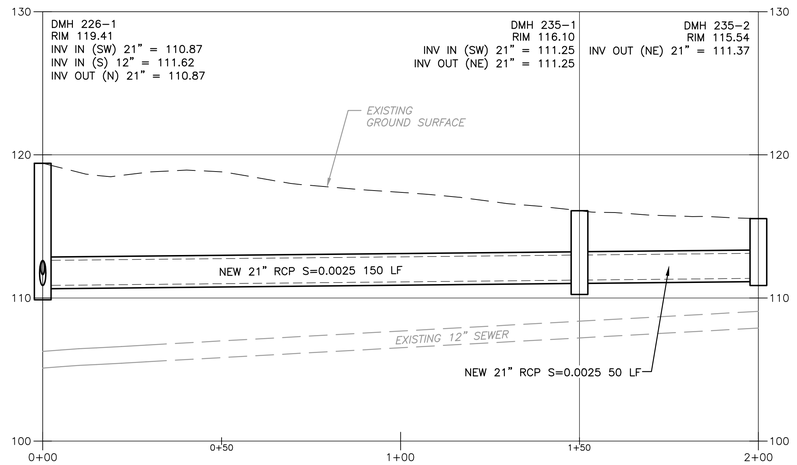
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

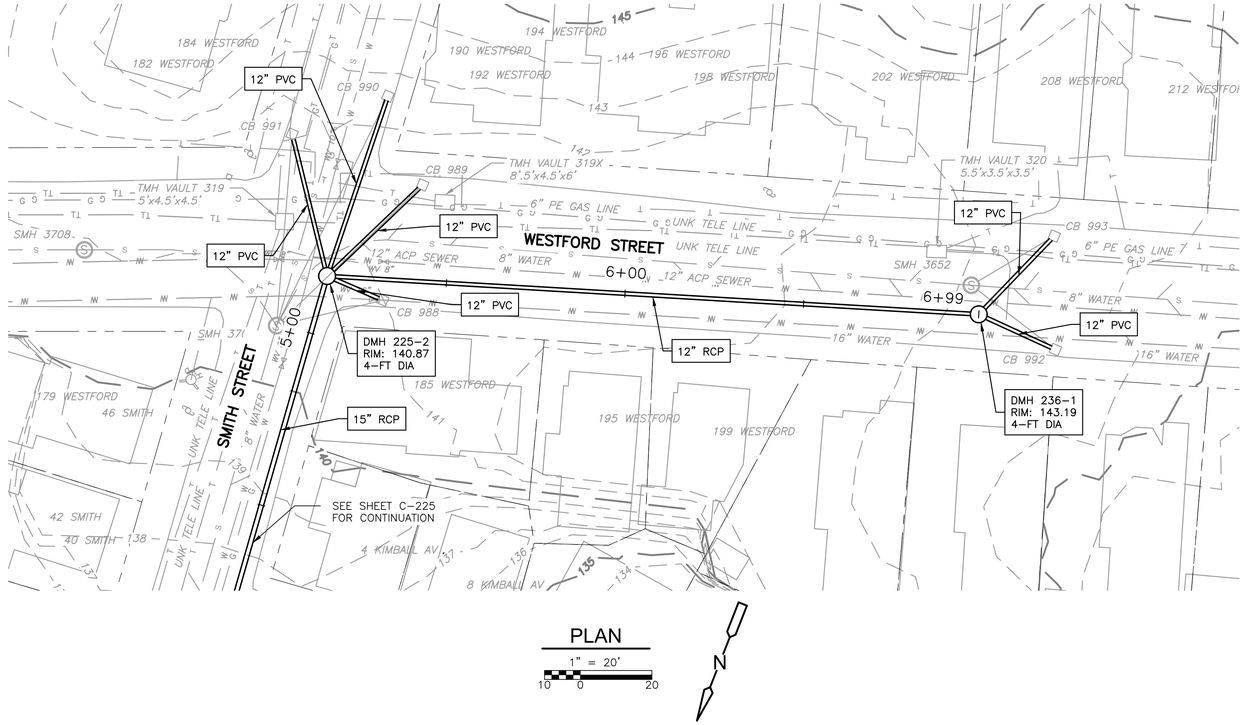
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
E PINE STREET

PROJECT NO. 0552-282899
FILE NAME: C235PLPR.DWG
SHEET NO.
C-235

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

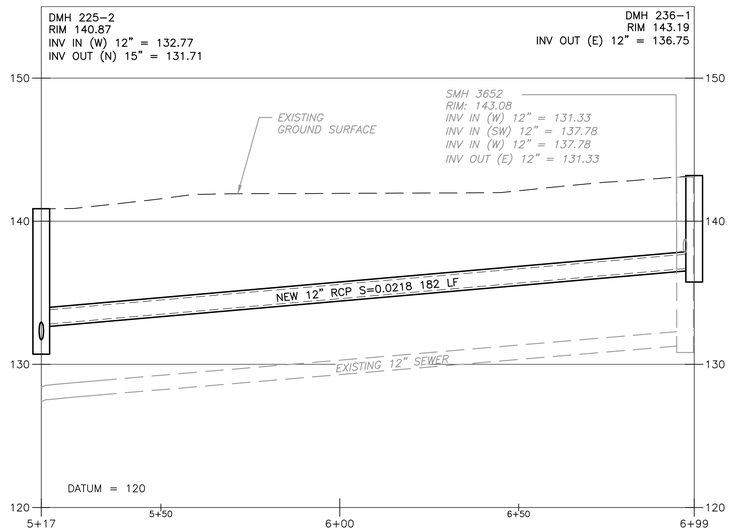
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

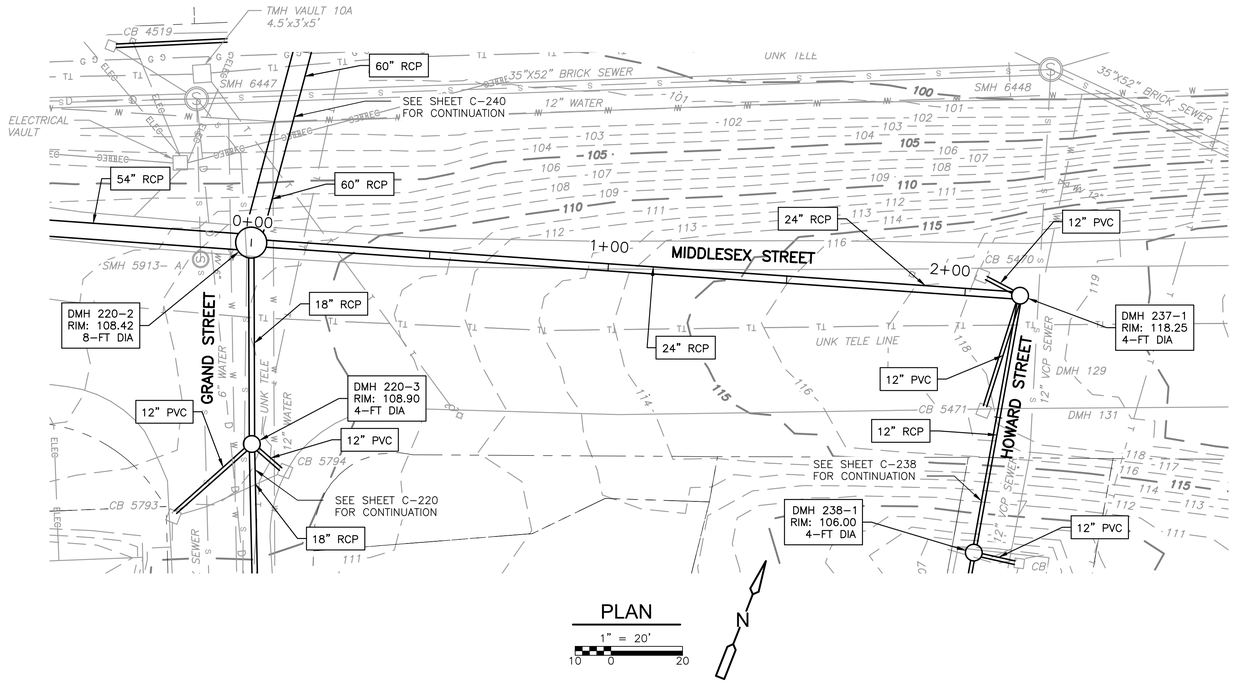
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
WESTFORD STREET

PROJECT NO. 0552-282899
FILE NAME: C236PLPR.DWG
SHEET NO.
C-236

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

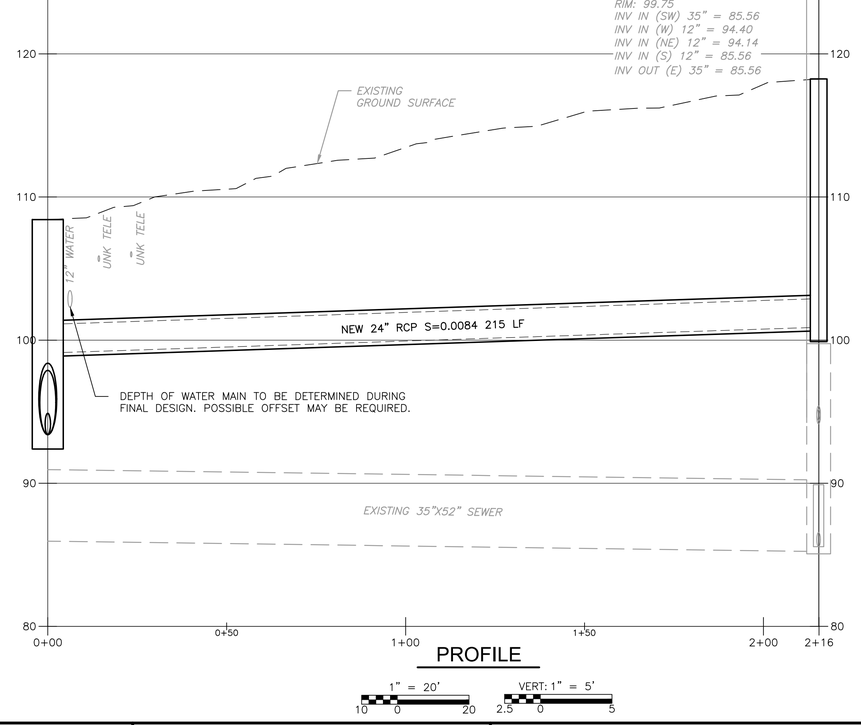
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20'

10 0 20

VERT: 1" = 5'

2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

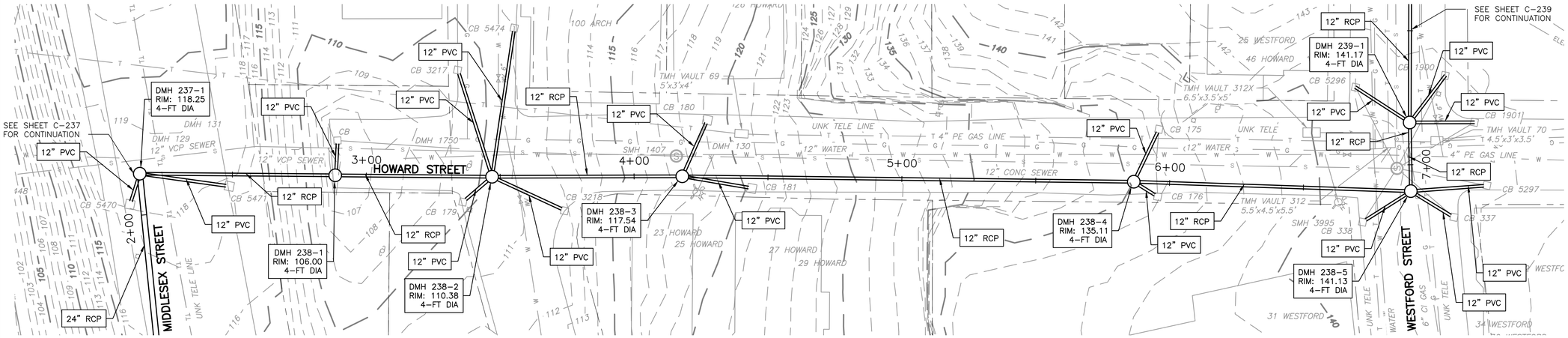
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
MIDDLESEX STREET

PROJECT NO. 0552-282899
FILE NAME: C237PLPR.DWG
SHEET NO.
C-237

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

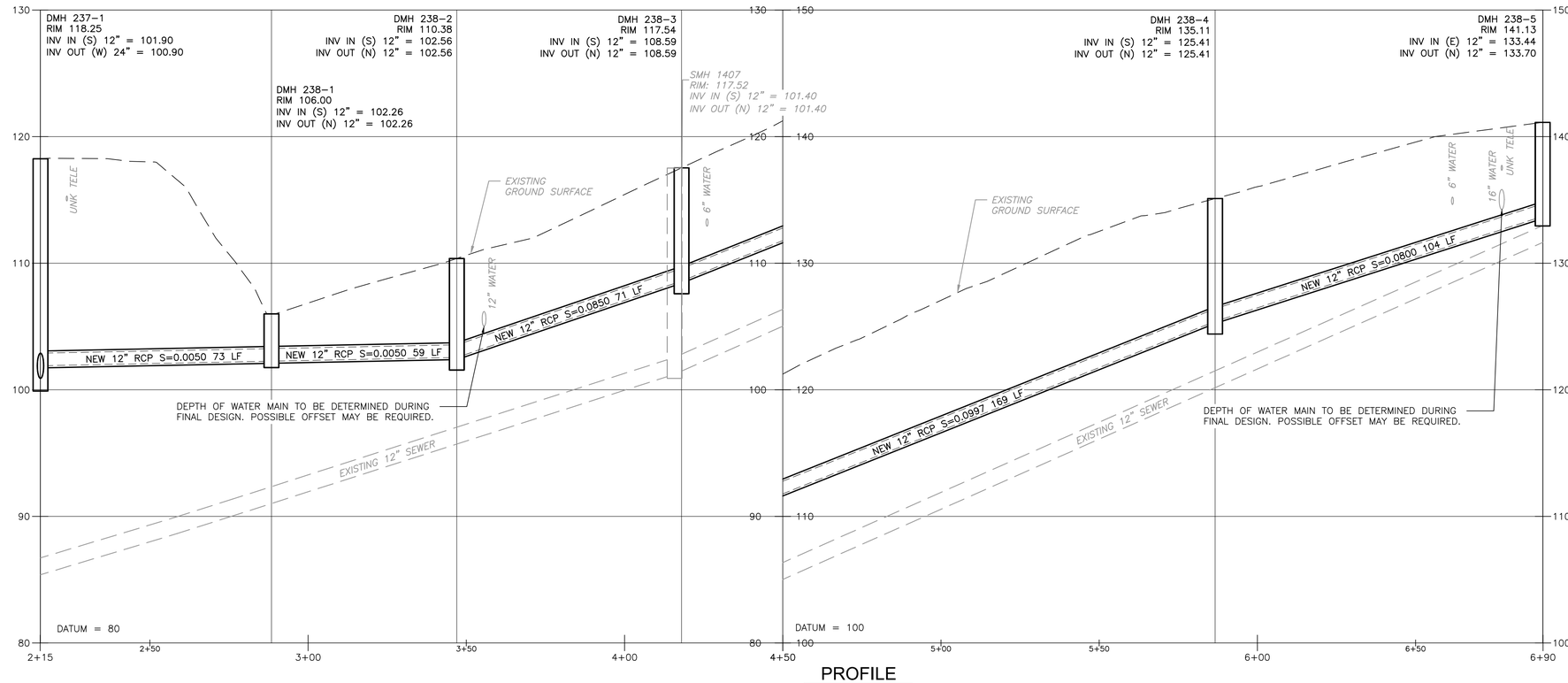
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS

PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

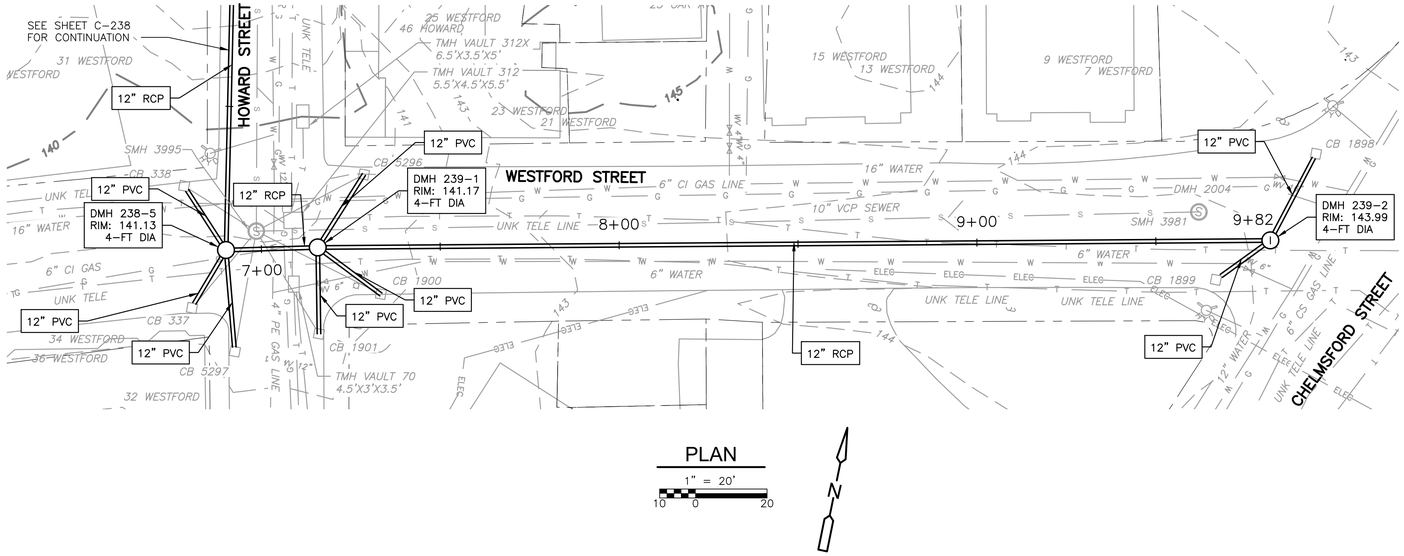
GRAND AREA
HORWARD STREET

PROJECT NO. 0552-282899
FILE NAME: C238PLPR.DWG

SHEET NO.
C-238

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

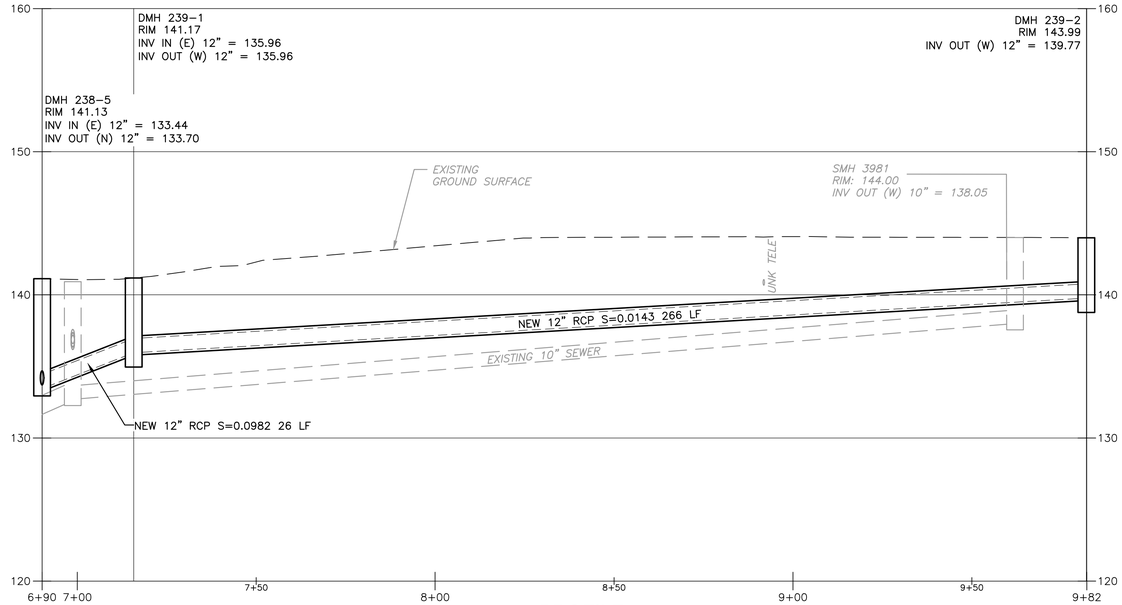
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

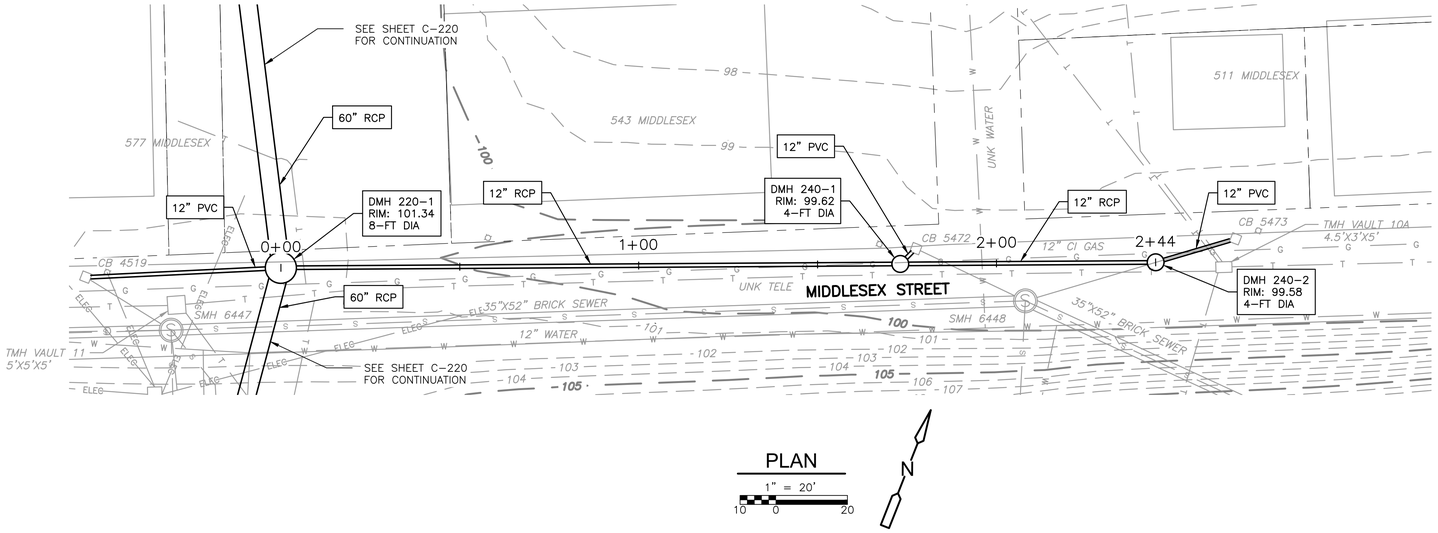
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

GRAND AREA
WESTFORD STREET

PROJECT NO. 0552-282899
FILE NAME: C239PLPR.DWG
SHEET NO.
C-239

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target Separation Areas, CVZ009PP_CIVIL 3D WORKING MODEL] Images: []
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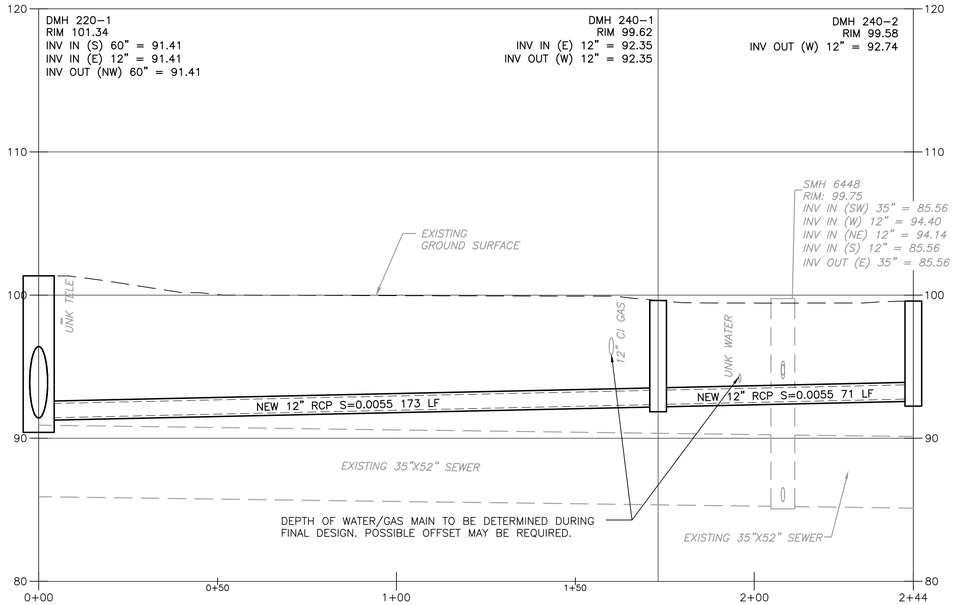


PLAN

1" = 20'

10 0 20

N



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

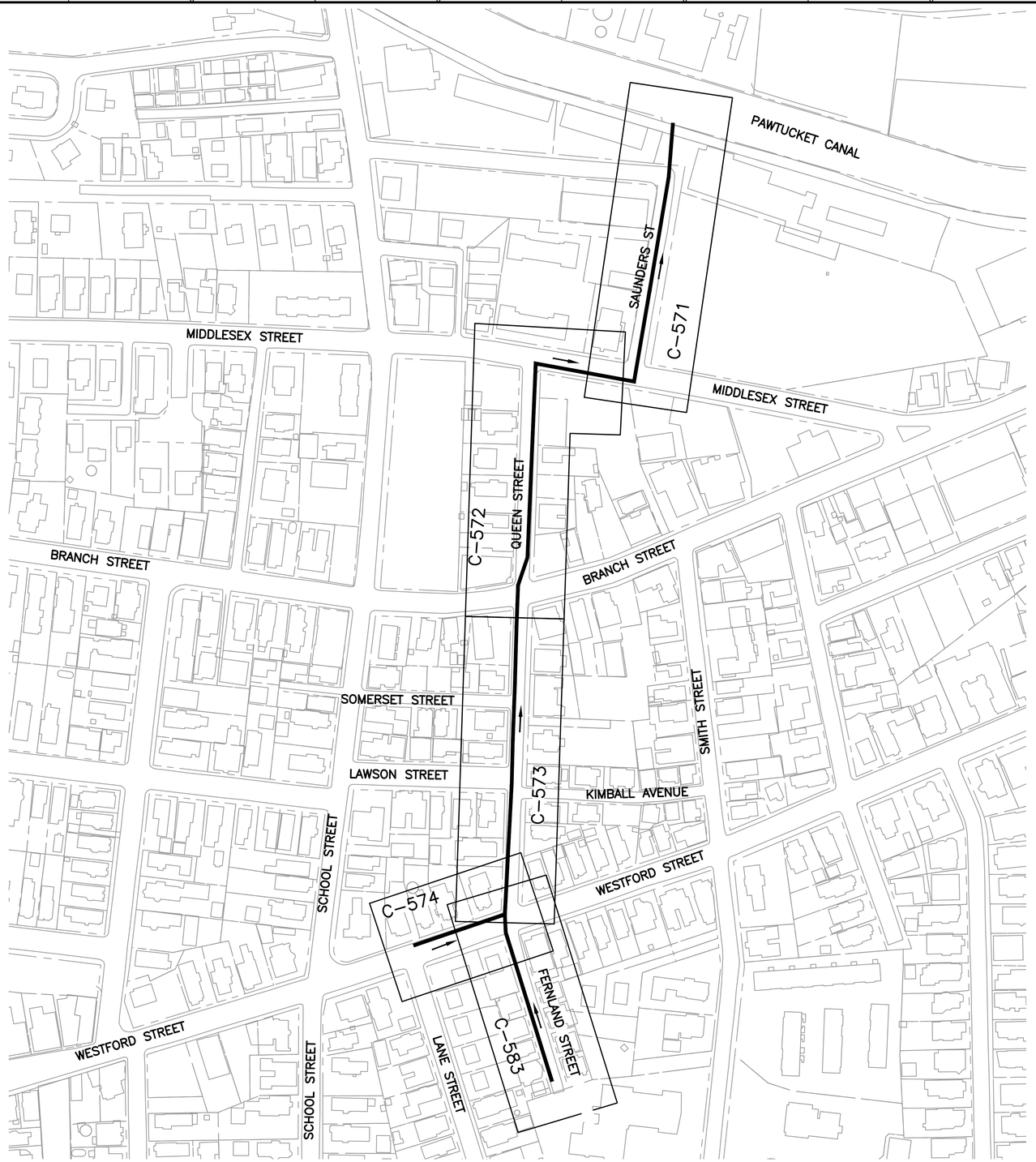
GRAND AREA
MIDDLESEX STREET

PROJECT NO. 0552-282899
FILE NAME: C240PLPR.DWG
SHEET NO.
C-240

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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Lower Saunders Area - Conceptual Design - Not for Construction



PLAN

1" = 100'

50 0 100

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

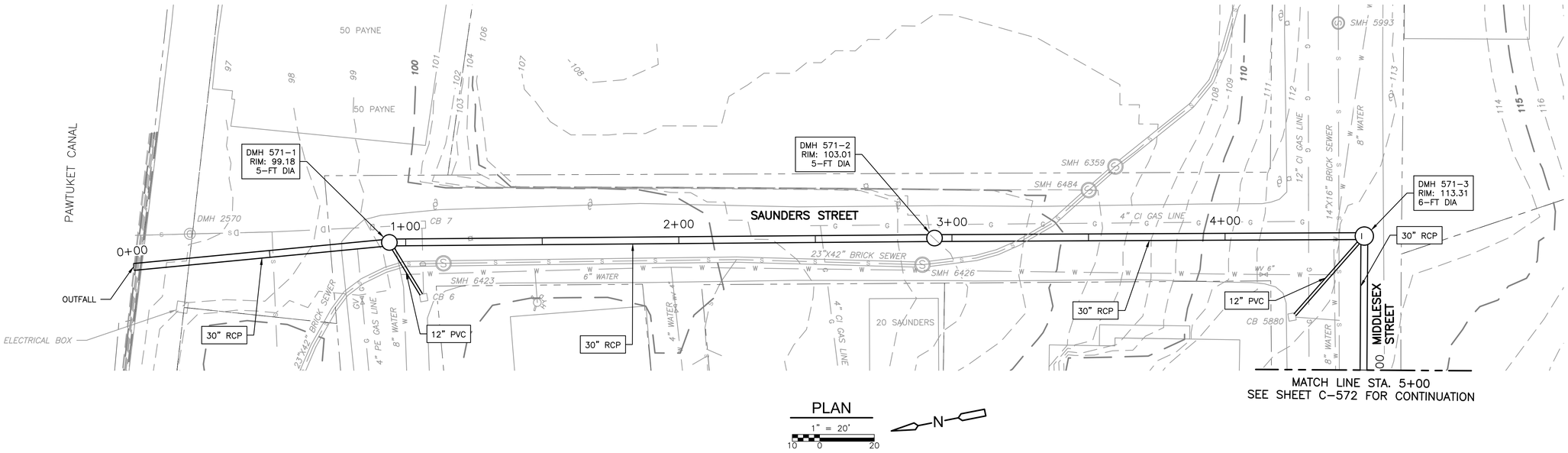
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

LOWER SAUNDERS AREA
KEY PLAN

PROJECT NO. 0552-282899
FILE NAME: G019INDX.DWG
SHEET NO.
G-19

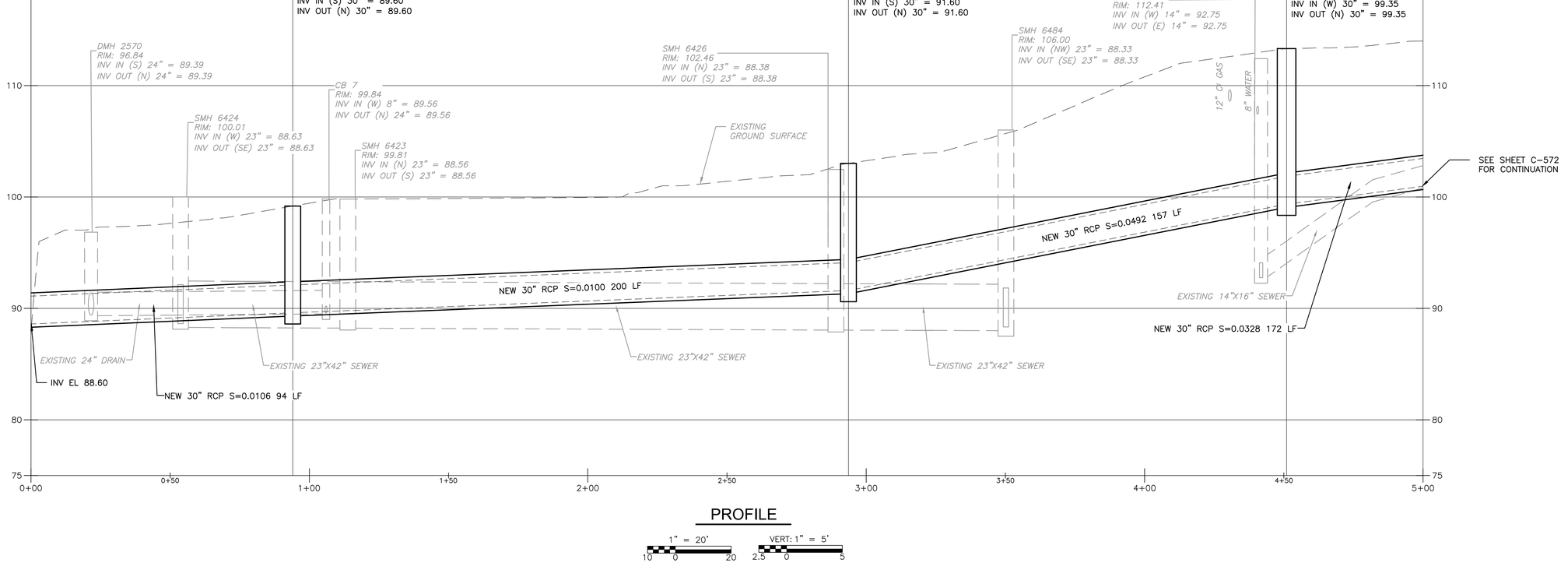
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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

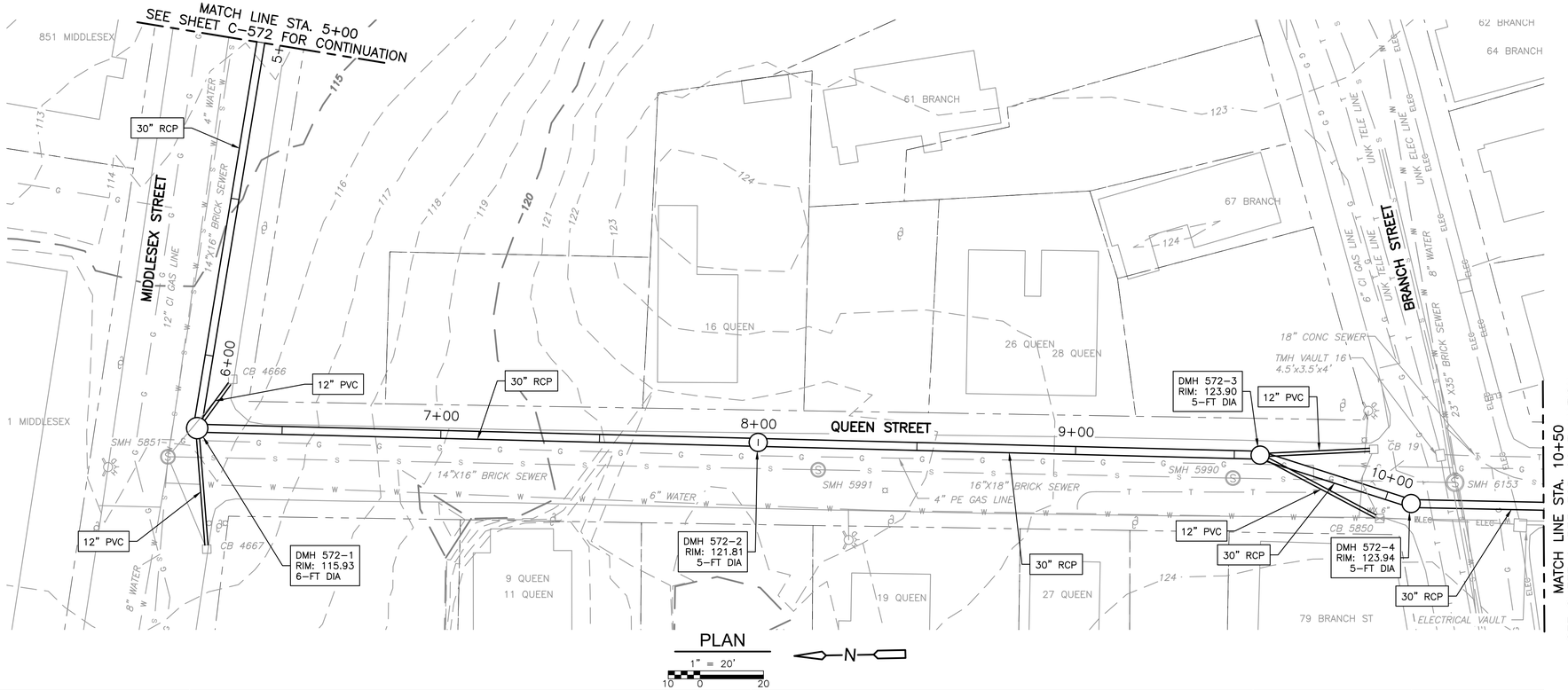
LOWER SAUNDERS AREA
SAUNDERS STREET & MIDDLESEX STREET

PROJECT NO. 0552-282899
FILE NAME: C571PLPR.DWG
SHEET NO.
C-571

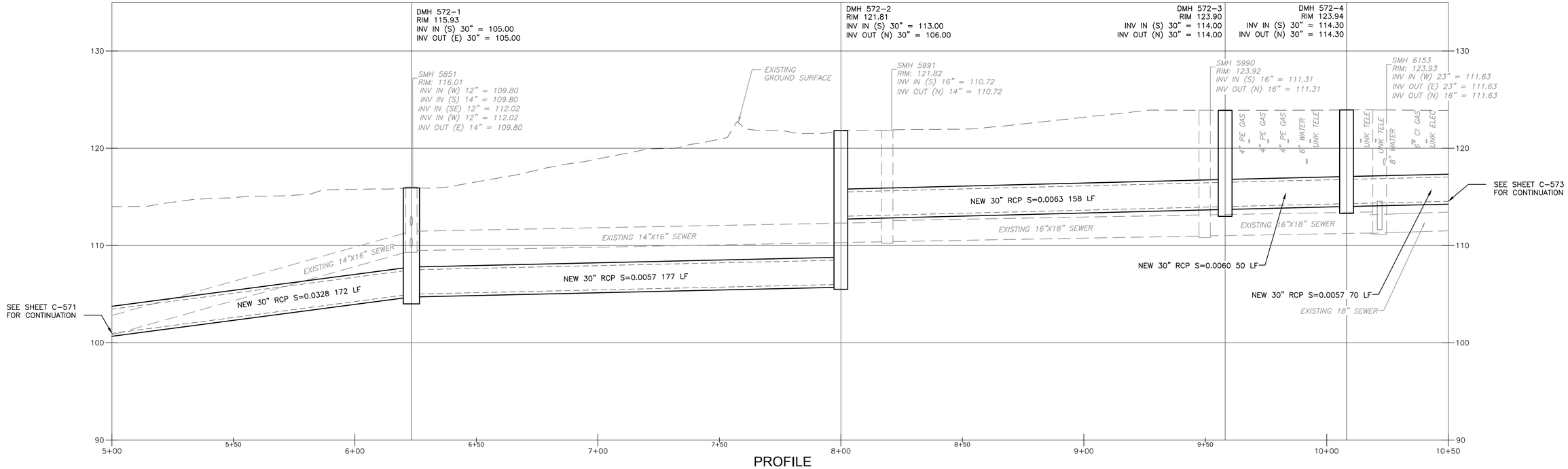
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target Separation Areas, CVIZ016PP_CIVIL 3D WORKING MODEL] Images: []
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PLAN
1" = 20'



PROFILE
1" = 20'
VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

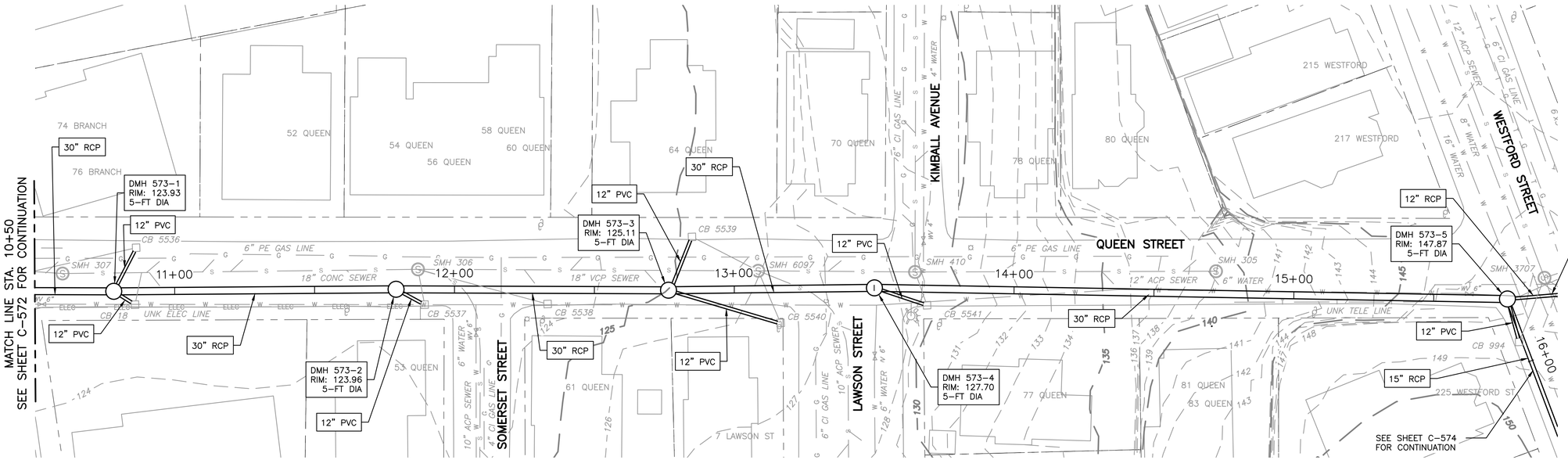
CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

LOWER SAUNDERS AREA
MIDDLESEX STREET & QUEEN STREET

PROJECT NO. 0552-282899
FILE NAME: C572PLPR.DWG
SHEET NO.
C-572

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

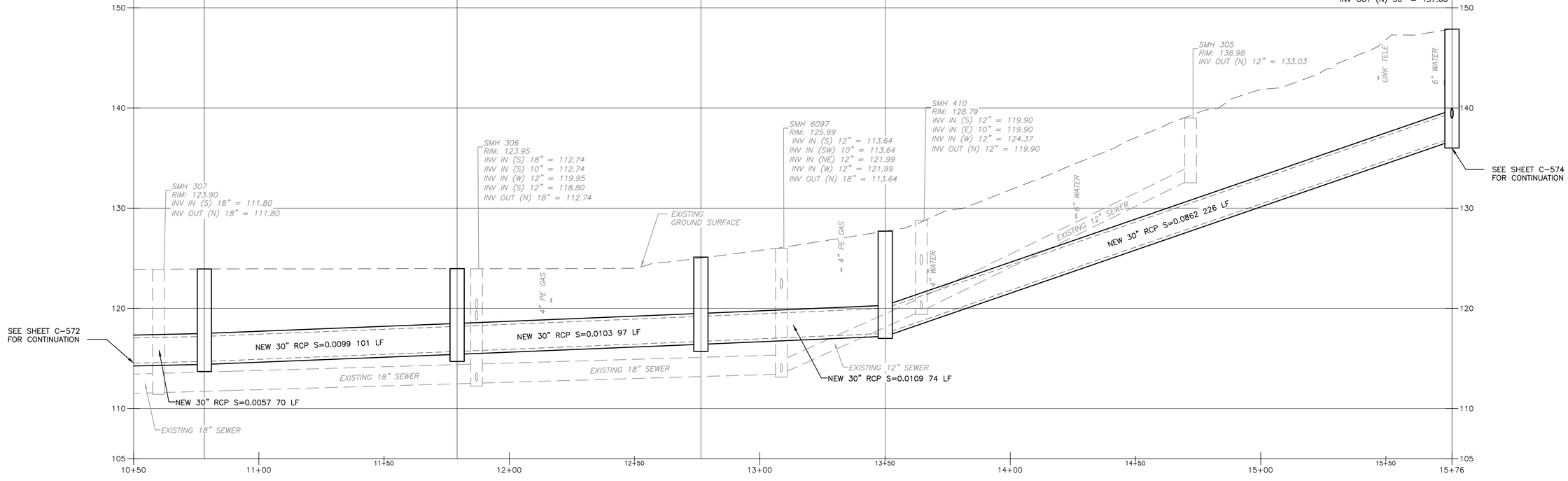


PLAN

1" = 20'

N

DMH 573-1	DMH 573-2	DMH 573-3	DMH 573-4	DMH 573-5
RIM 123.93	RIM 123.96	RIM 125.11	RIM 127.70	RIM 147.87
INV IN (S) 30" = 114.70	INV IN (S) 30" = 115.70	INV IN (S) 30" = 116.70	INV IN (S) 30" = 117.50	INV IN (W) 15" = 141.00
INV OUT (N) 30" = 114.70	INV OUT (N) 30" = 115.70	INV OUT (N) 30" = 116.70	INV OUT (N) 30" = 117.50	INV IN (S) 12" = 138.96
				INV OUT (N) 30" = 137.00



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

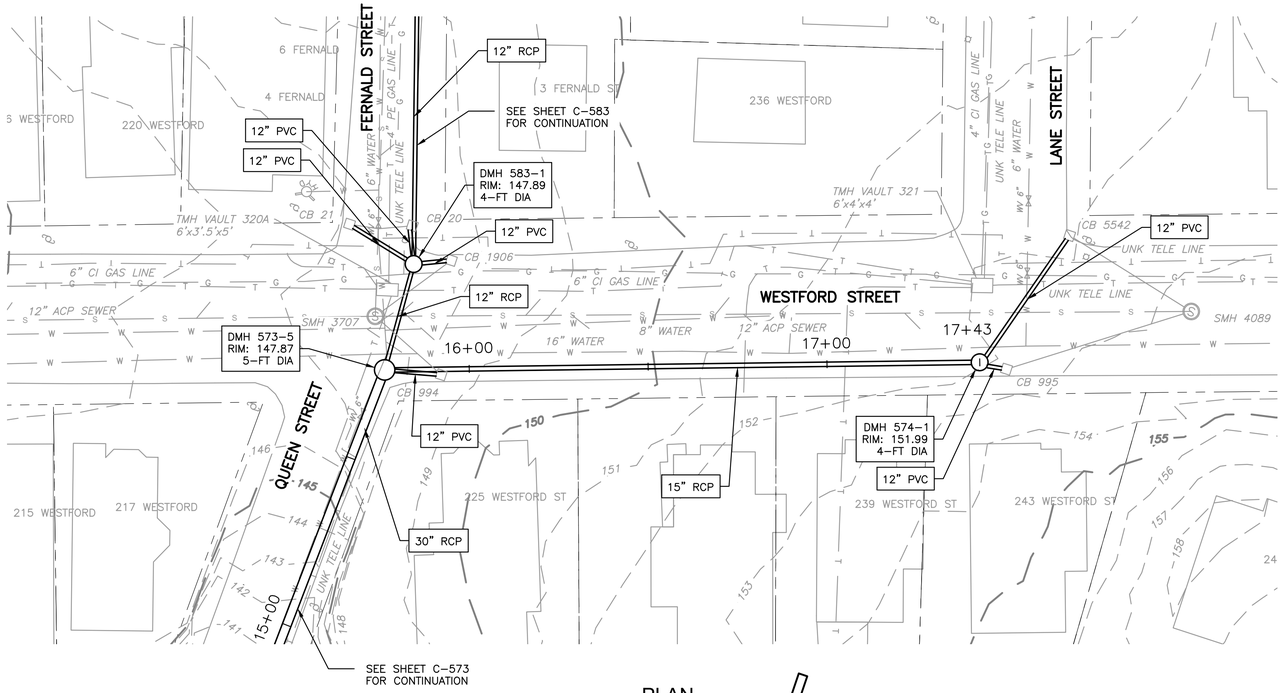
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

LOWER SAUNDERS AREA
QUEEN STREET

PROJECT NO. 0552-282899
FILE NAME: C573PLPR.DWG
SHEET NO.
C-573

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

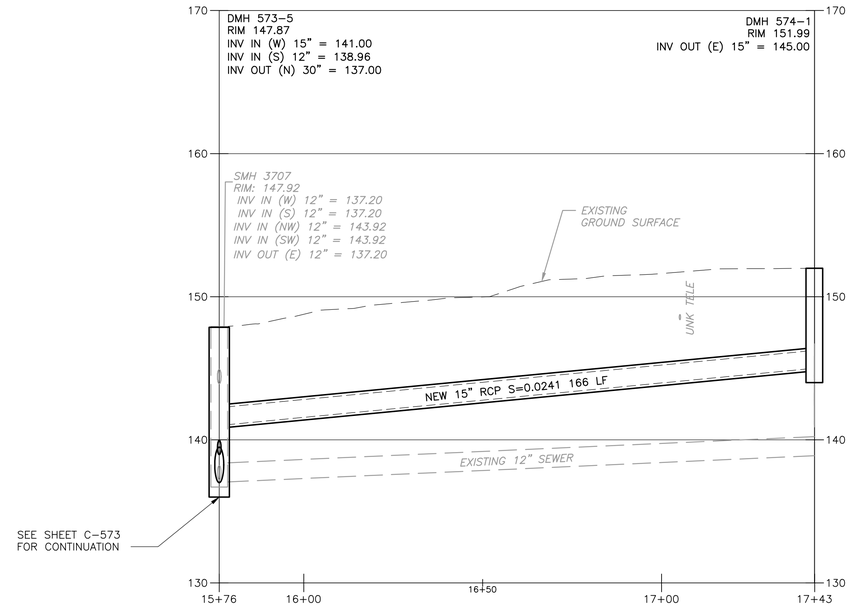
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20' 10 0 20

VERT: 1" = 5' 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

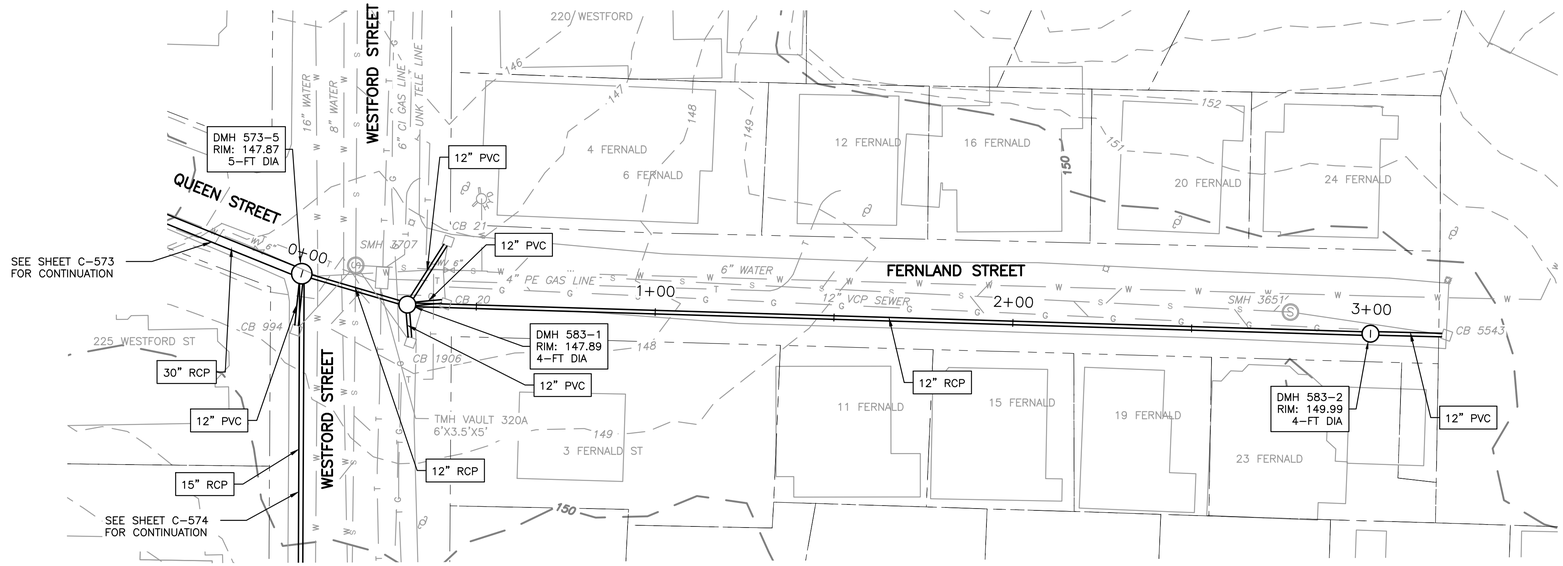
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

LOWER SAUNDERS AREA
WESTFORD STREET

PROJECT NO. 0552-282899
FILE NAME: C574PLPR.DWG
SHEET NO.
C-574

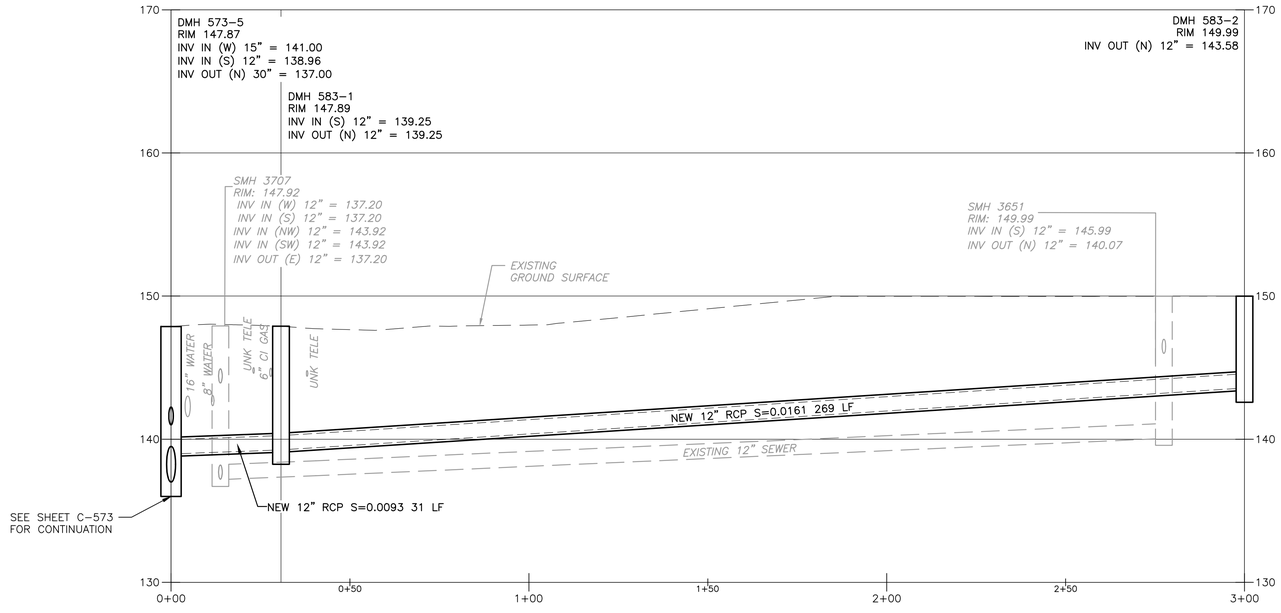
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

LOWER SAUNDERS AREA
FERNLAND STREET

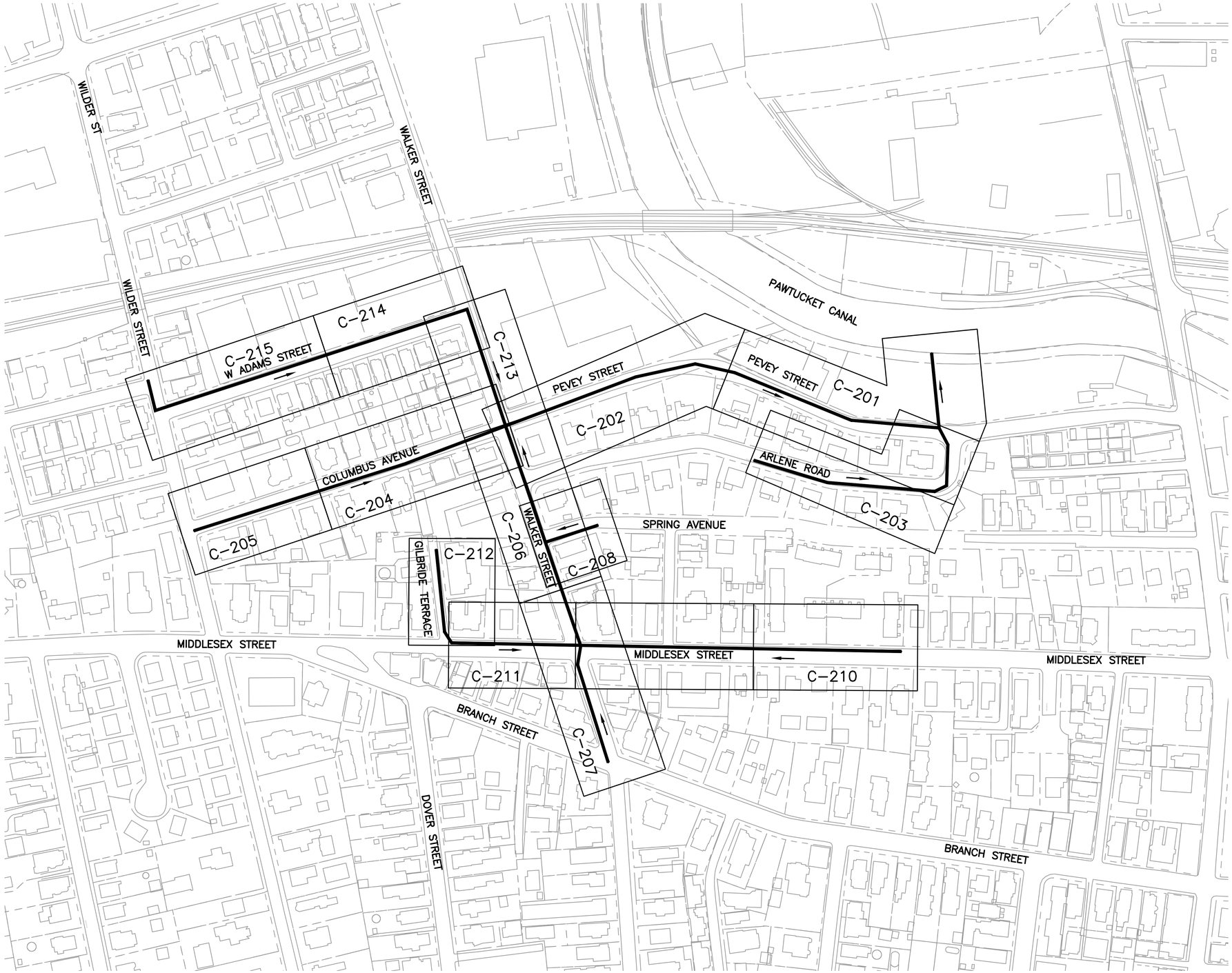
PROJECT NO. 0552-282899
FILE NAME: C583PLPR.DWG

SHEET NO.
C-583

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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Pevey Area - Conceptual Design - Not for Construction



PLAN
SCALE = 1' = 100'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

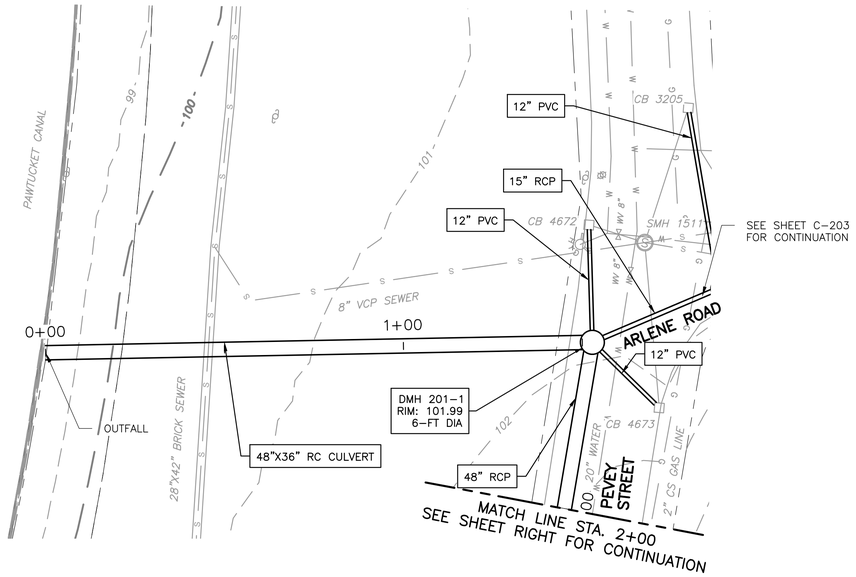
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
KEY PLAN

PROJECT NO. 0552-282899
FILE NAME: G005INDX.DWG
SHEET NO.
G-5

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: (CDMS_2436_BASEMAP_CW2209PP_CIVIL 3D WORKING MODEL) Images: []
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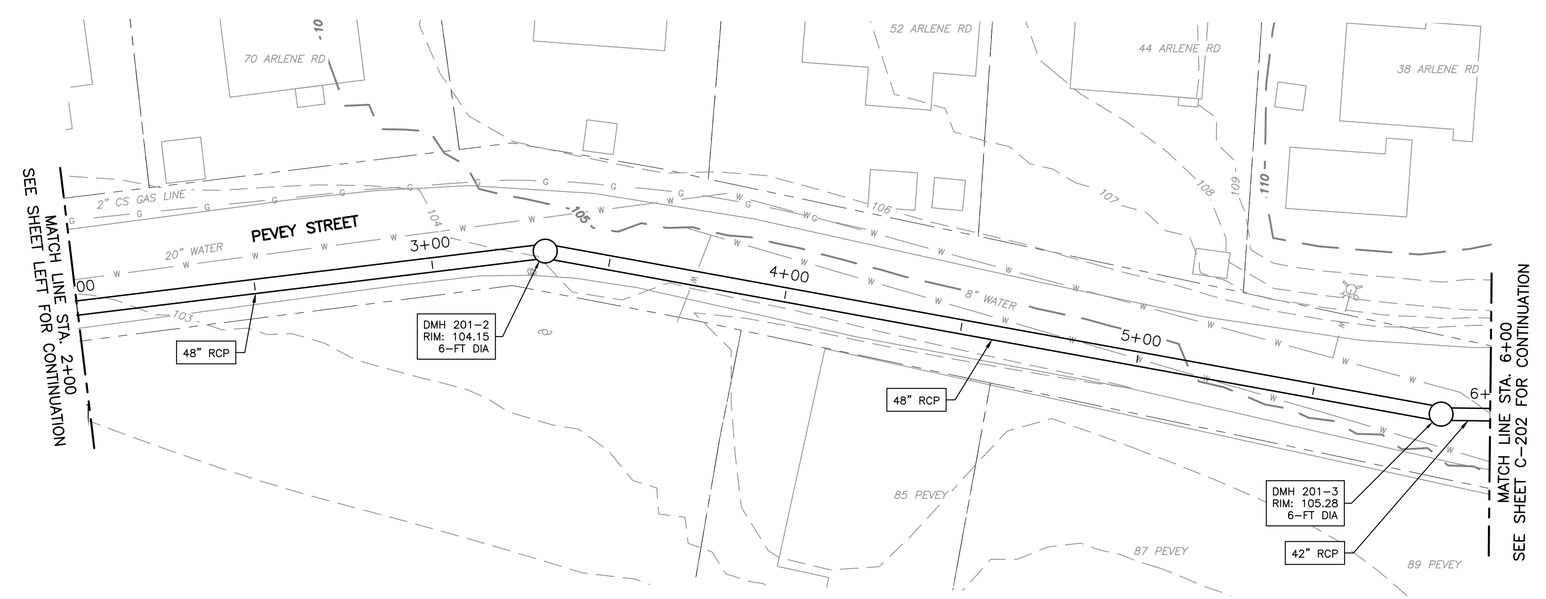


PLAN

1" = 20'

10 0 20

N

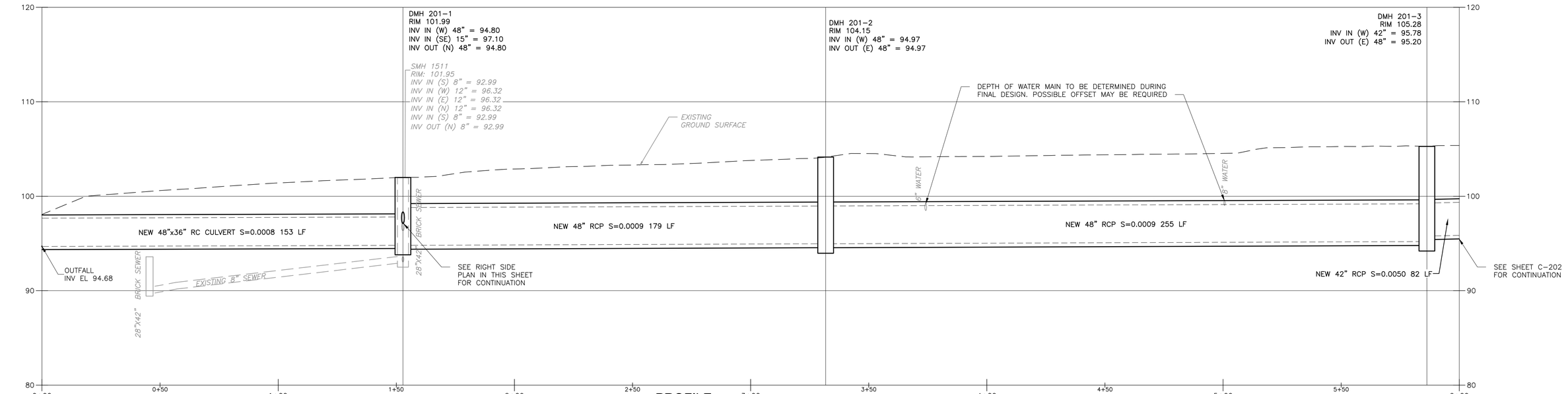


PLAN

1" = 20'

10 0 20

N



PROFILE

1" = 20'

10 0 20

VERT: 1" = 5'

2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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670 North Commercial Street, Suite 208
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Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

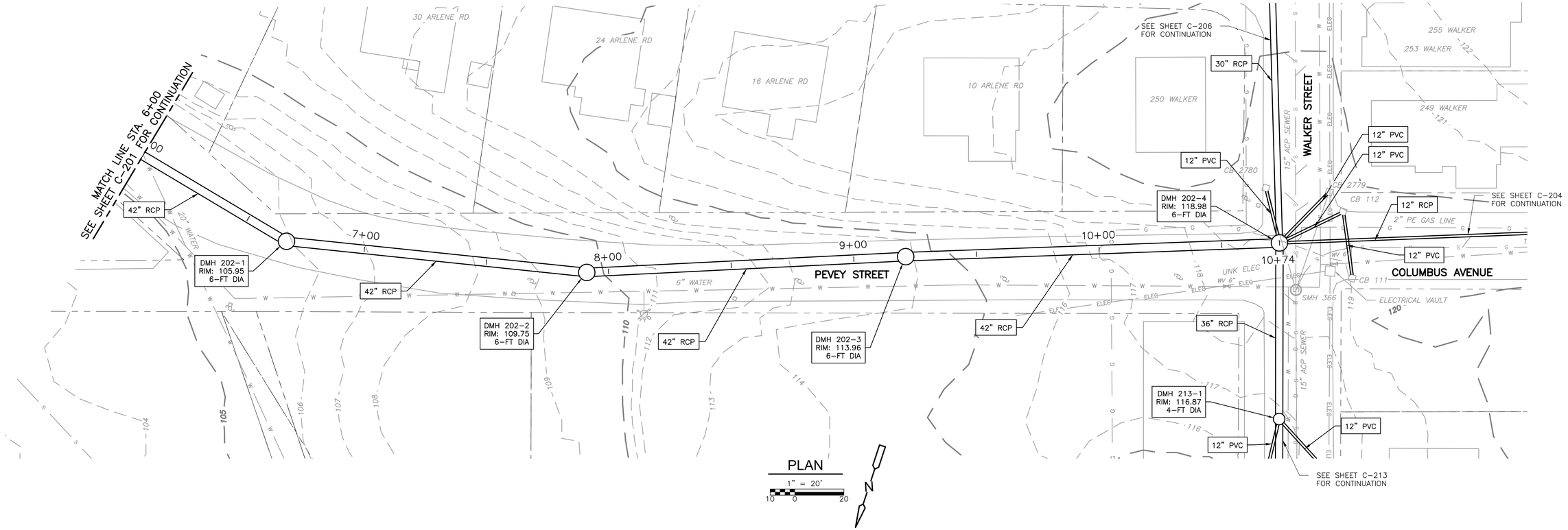
PEVEY AREA
PEVEY STREET

PROJECT NO. 0552-282899
FILE NAME: C201PLPR.DWG
SHEET NO.
C-201

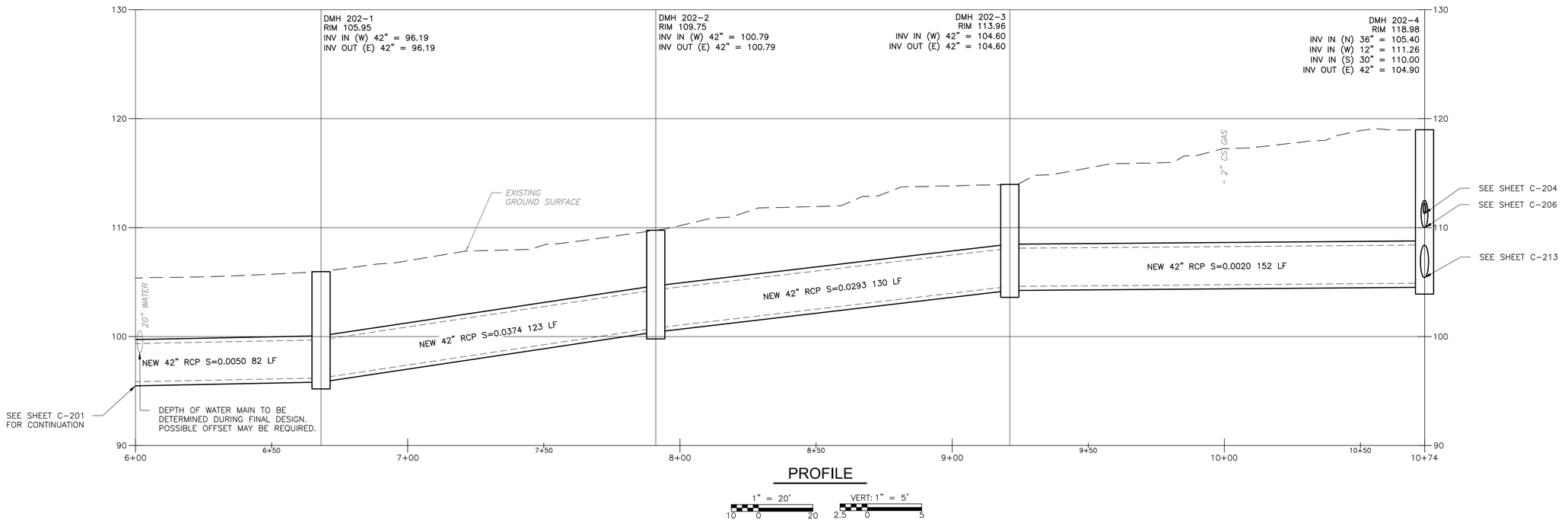
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target Separation Areas, CVIZ109PP_CIVIL 3D WORKING MODEL] Images: []
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PLAN
1" = 20'



PROFILE
1" = 20'
VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

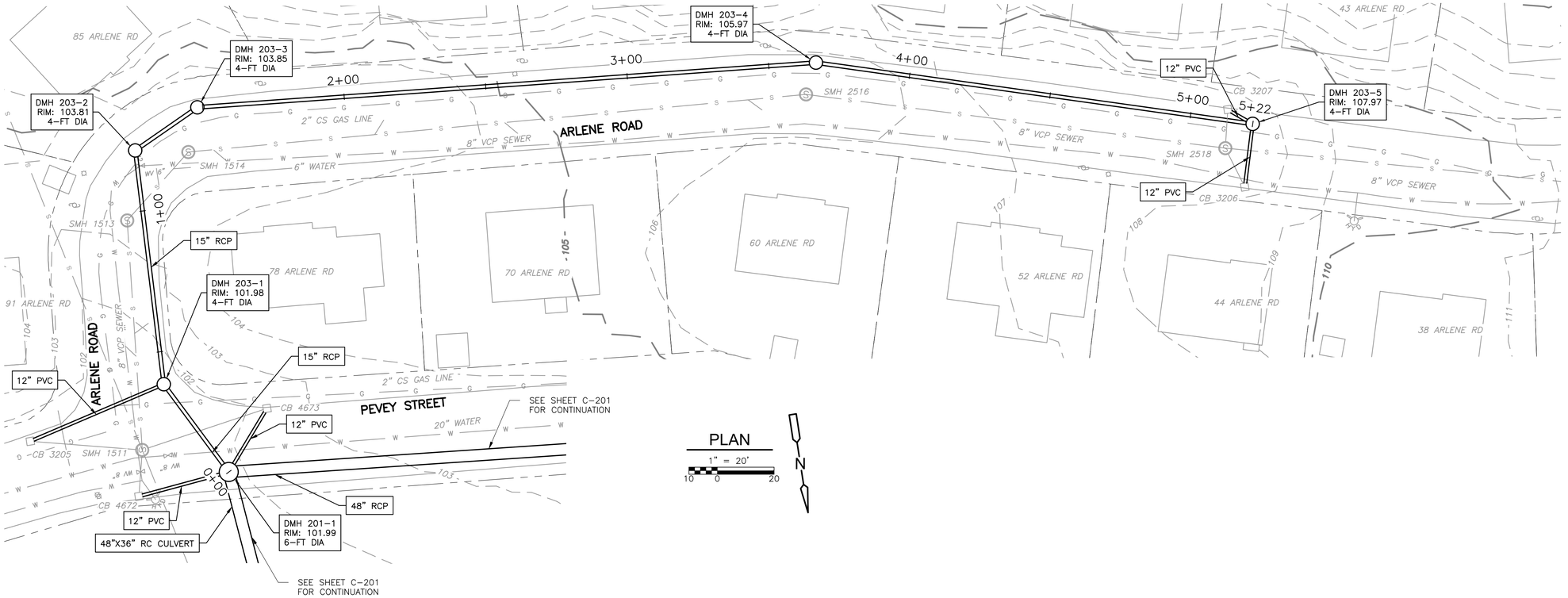
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LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
PEVEY STREET

PROJECT NO. 0552-282899
FILE NAME: C202PLPR.DWG
SHEET NO.
C-202

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

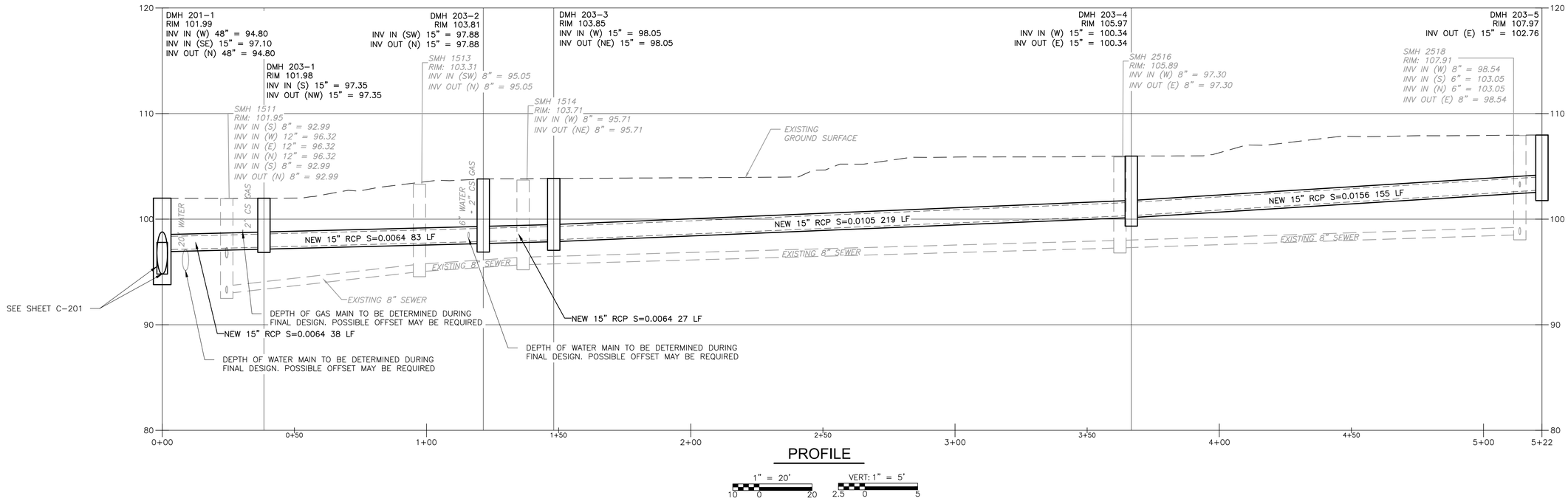


PLAN

1" = 20'

10 0 20

N



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

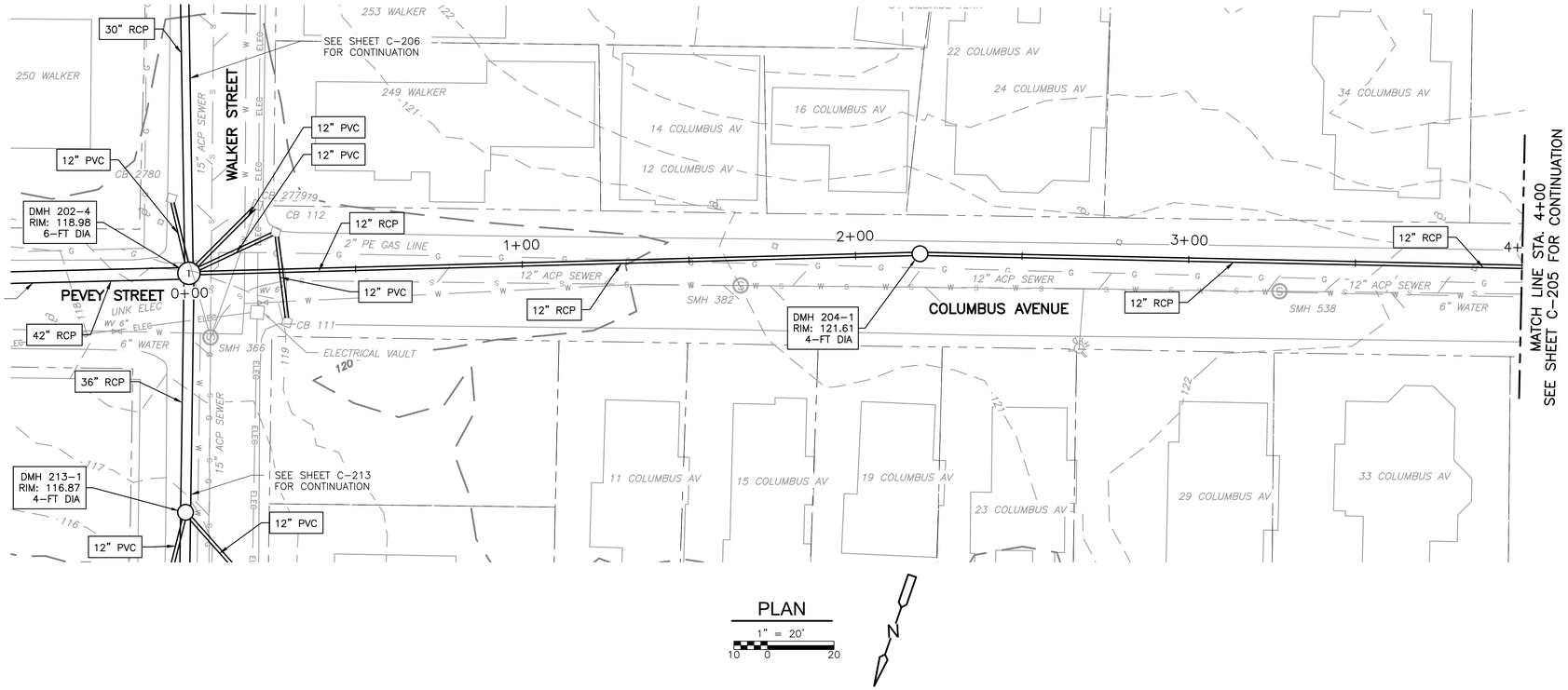
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
ARLENE ROAD

PROJECT NO. 0552-282899
FILE NAME: C203PLPR.DWG
SHEET NO.
C-203

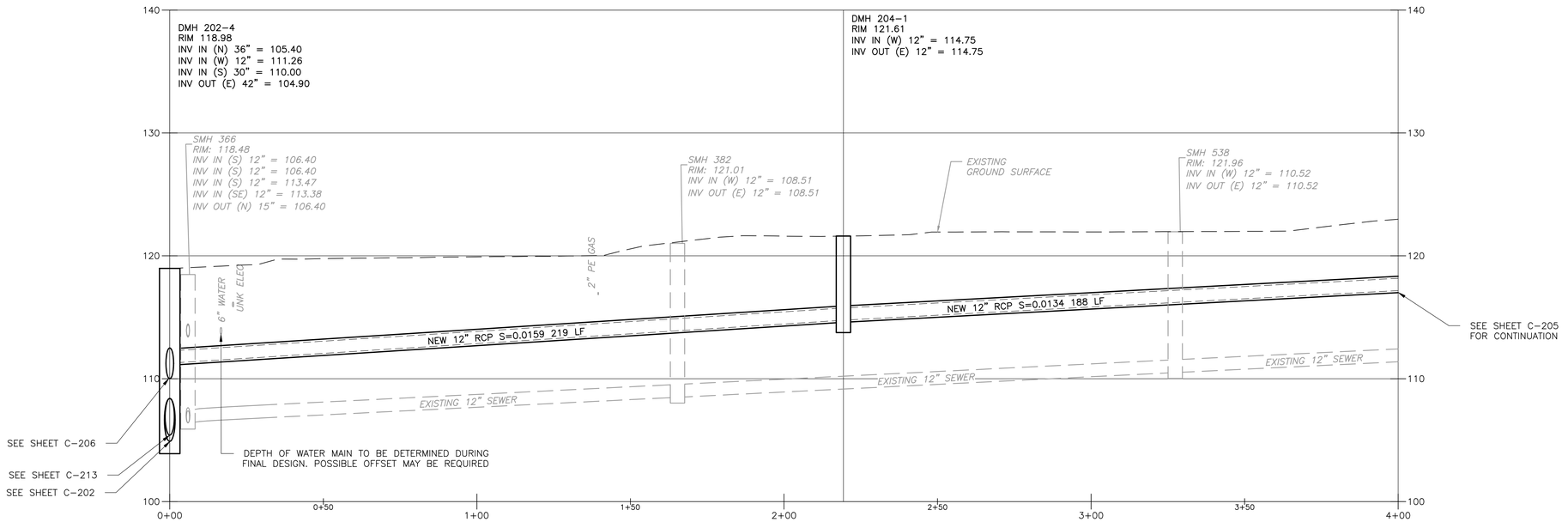
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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Manchester, NH 03101
Tel: (603) 222-8300

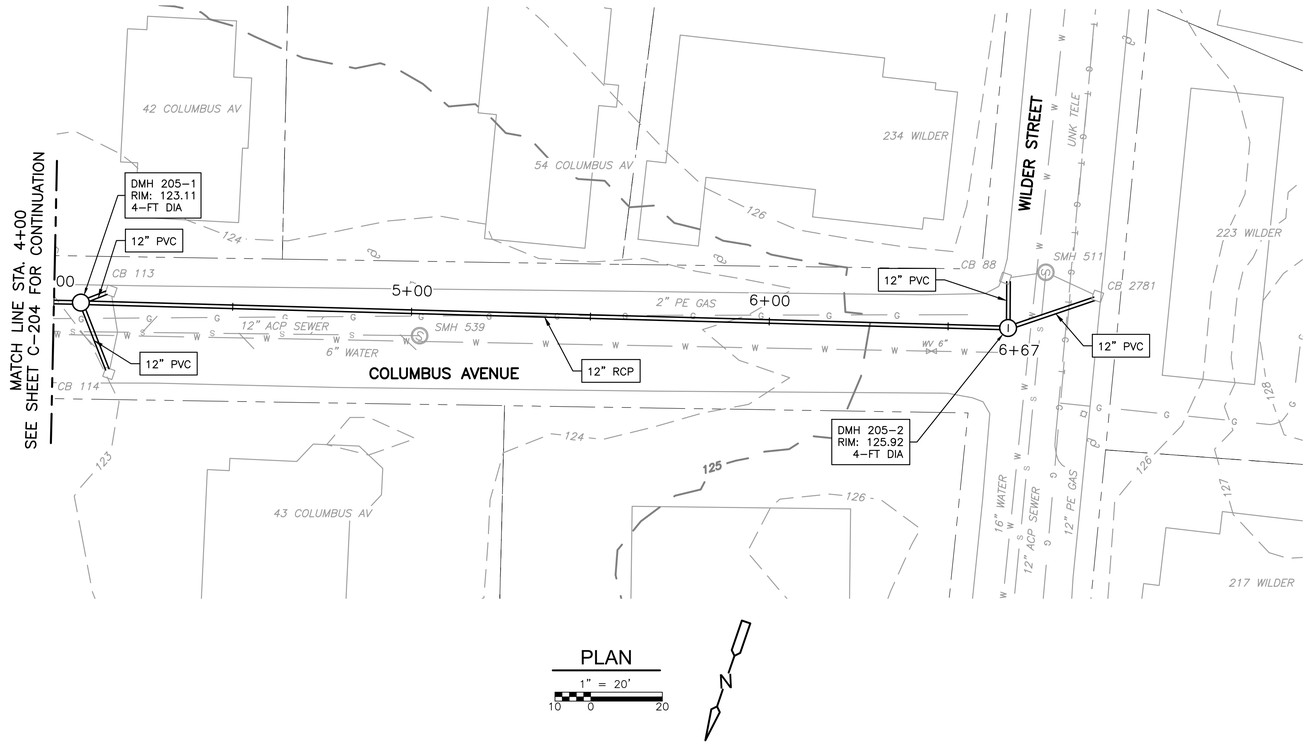
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
COLUMBUS AVENUE

PROJECT NO. 0552-282899
FILE NAME: C204PLPR.DWG
SHEET NO.
C-204

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

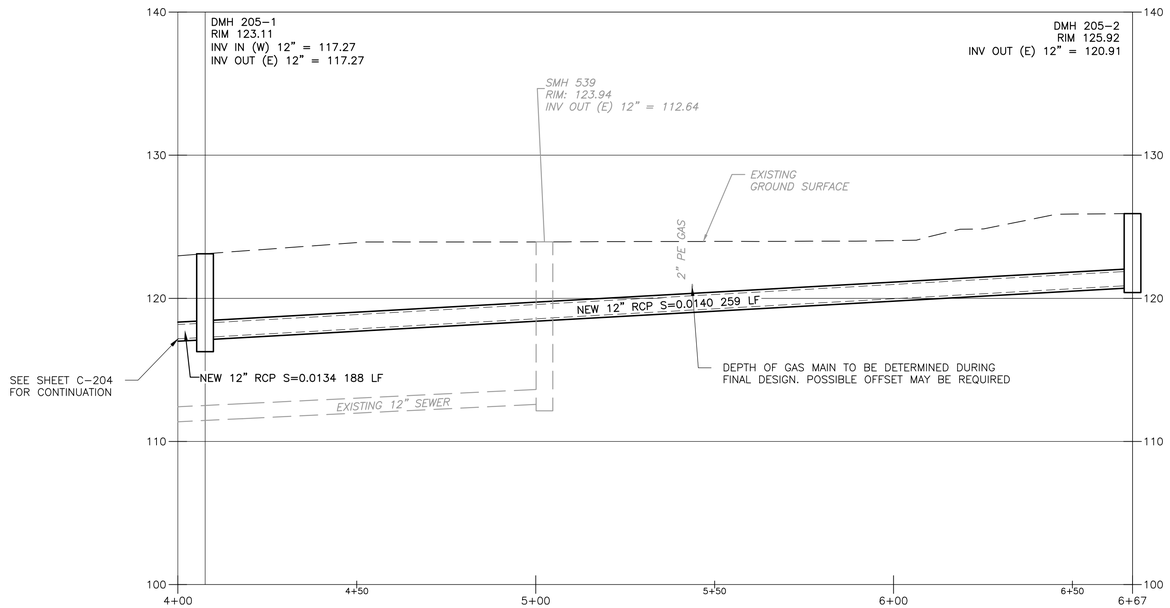
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20' VERT: 1" = 5'

10 0 20 2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
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Manchester, NH 03101
Tel: (603) 222-8300

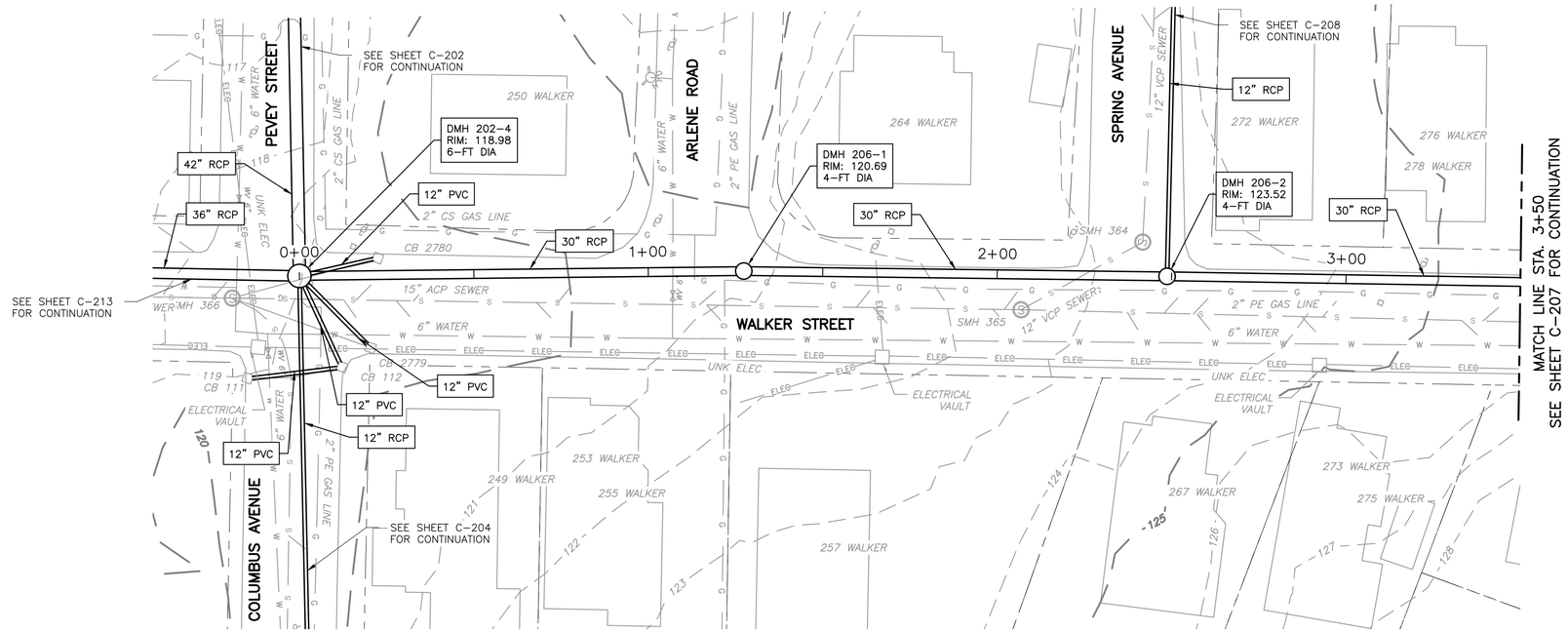
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
COLUMBUS AVENUE

PROJECT NO. 0552-282899
FILE NAME: C205PLPR.DWG
SHEET NO.
C-205

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

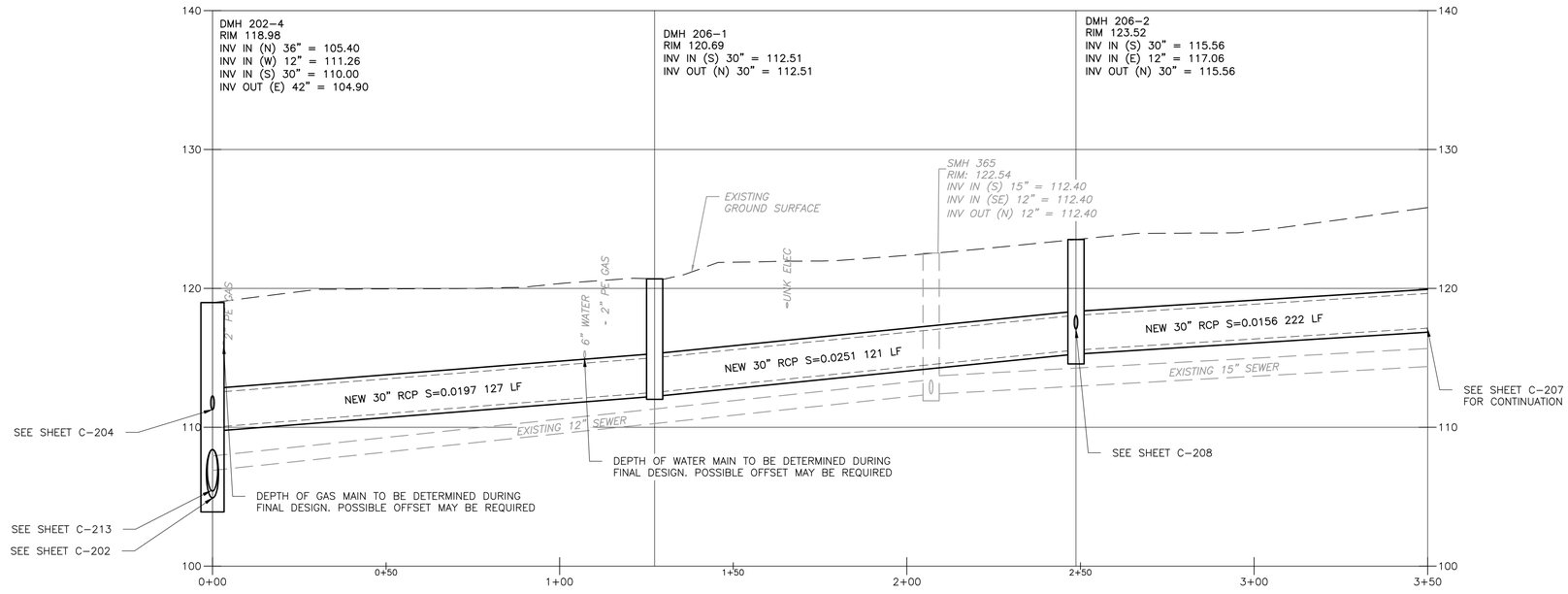
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20'

10 0 20

VERT: 1" = 5'

2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

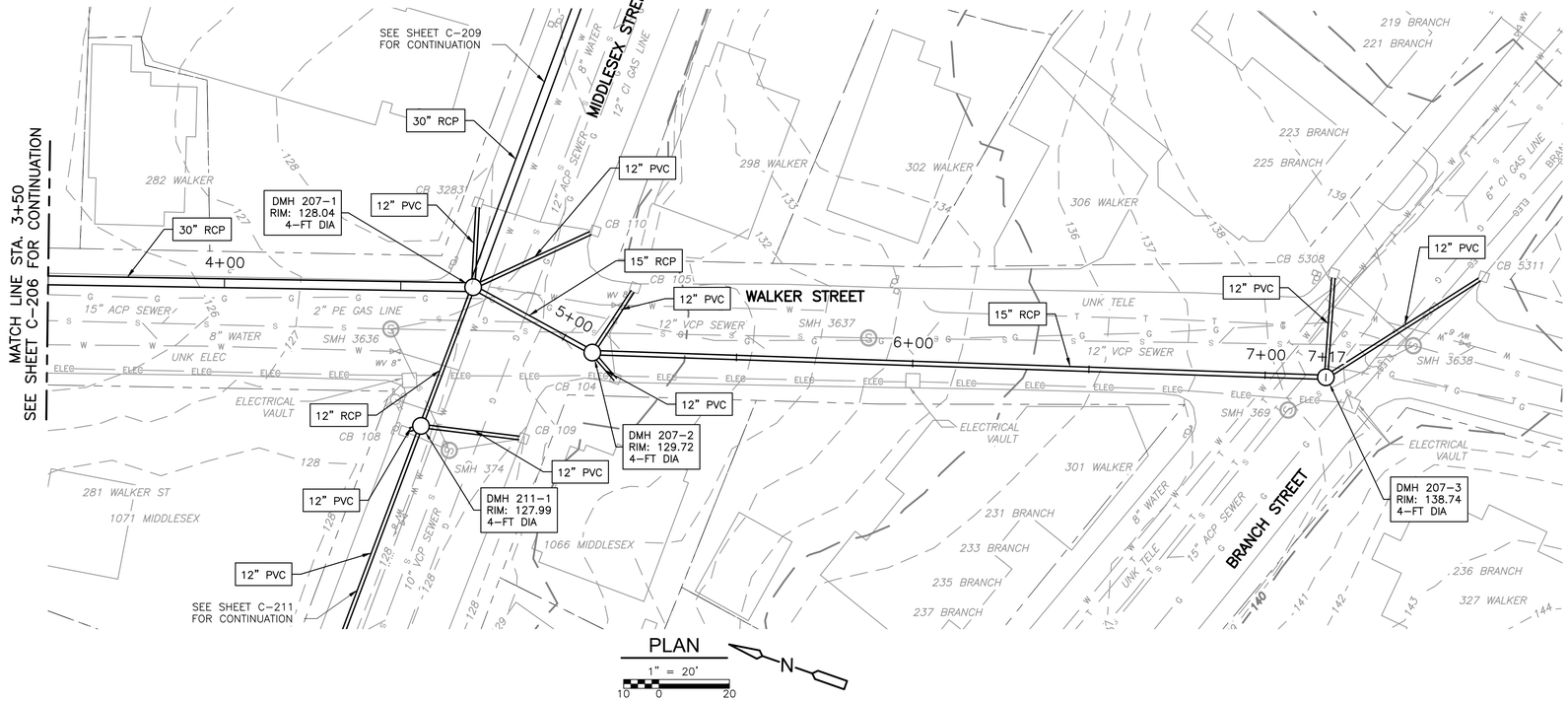
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

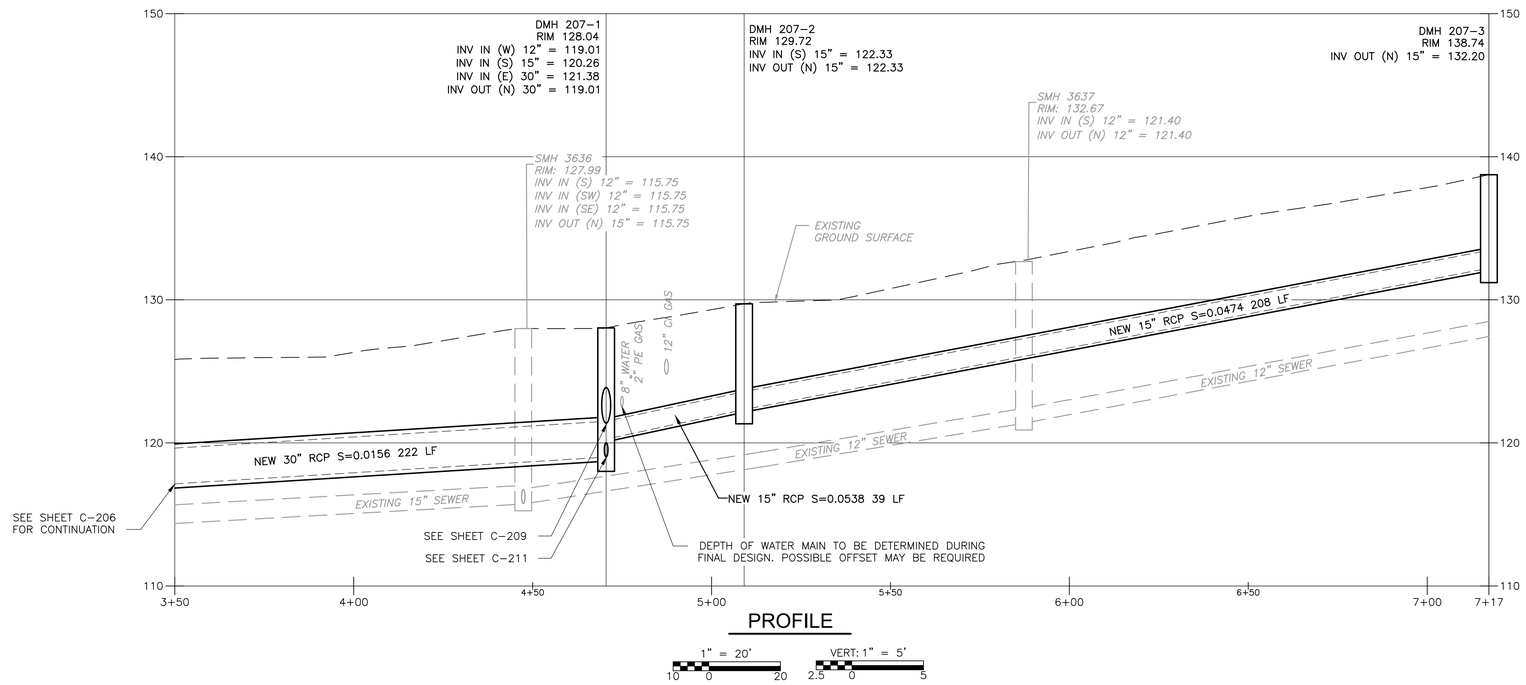
PEVEY AREA
WALKER STREET

PROJECT NO. 0552-282899
FILE NAME: C206PLPR.DWG
SHEET NO.
C-206

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target Separation Areas, CVZ109PP_CIVIL 3D WORKING MODEL] Images: []
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REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

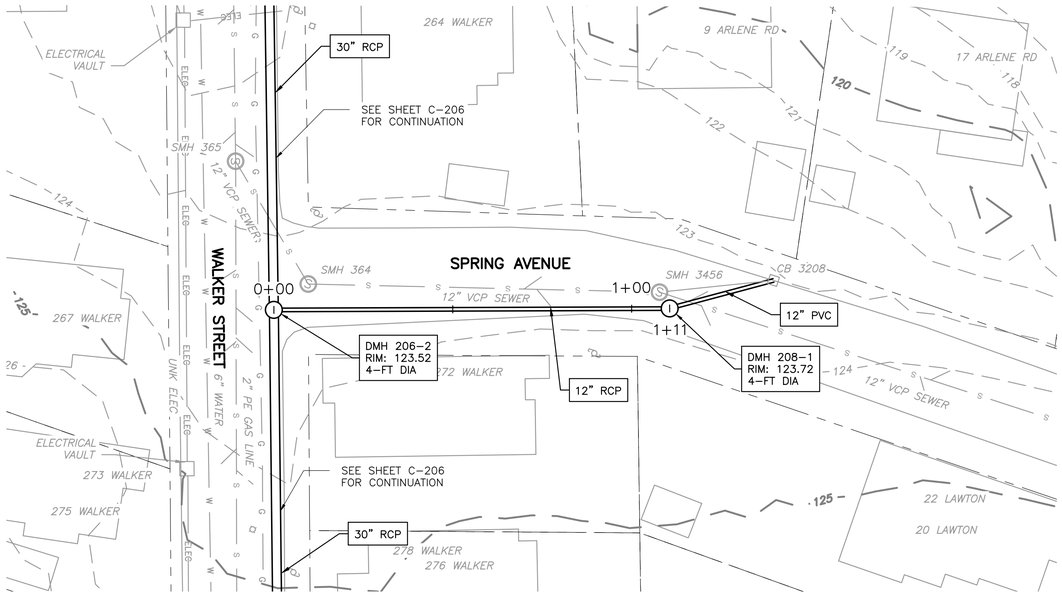
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
WALKER STREET

PROJECT NO. 0552-282899
FILE NAME: C207PLPR.DWG
SHEET NO.
C-207

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

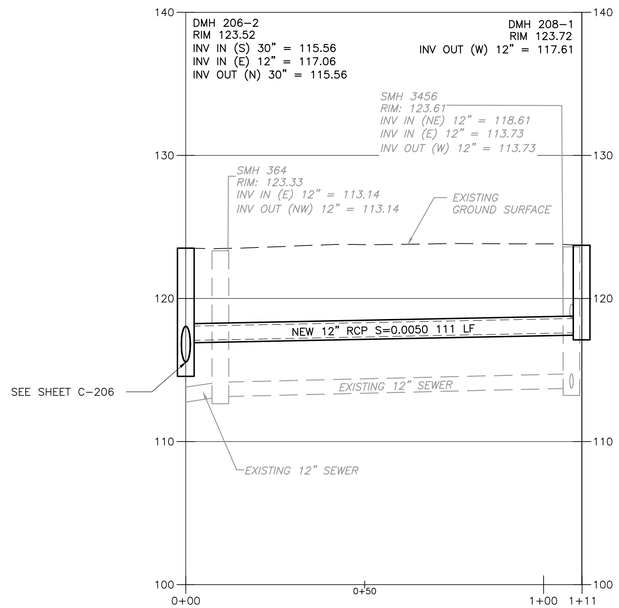
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PLAN

1" = 20'

10 0 20



PROFILE

1" = 20'

10 0 20

VERT: 1" = 5'

2.5 0 5

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

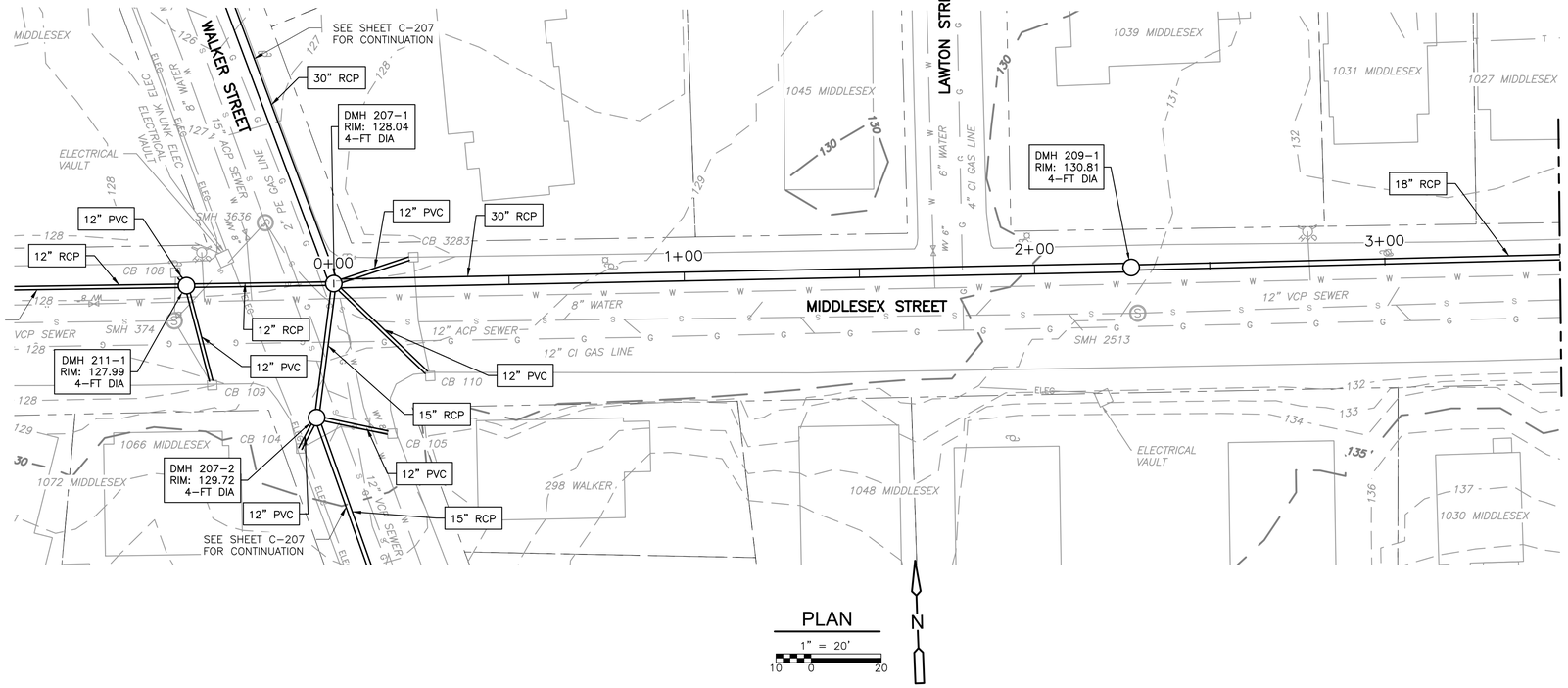
PEVEY AREA
SPRING AVENUE

PROJECT NO. 0552-282899
FILE NAME: C208PLPR.DWG
SHEET NO.
C-208

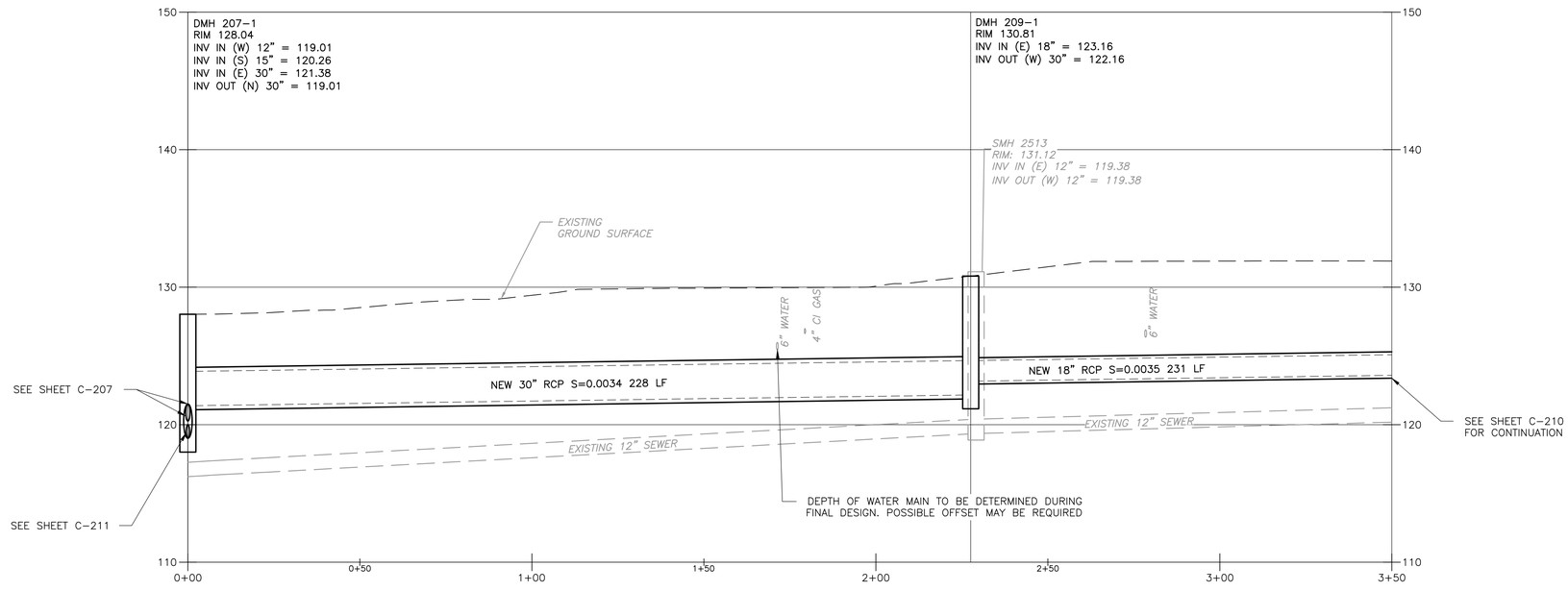
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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PLAN
1" = 20'



PROFILE
1" = 20'
VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

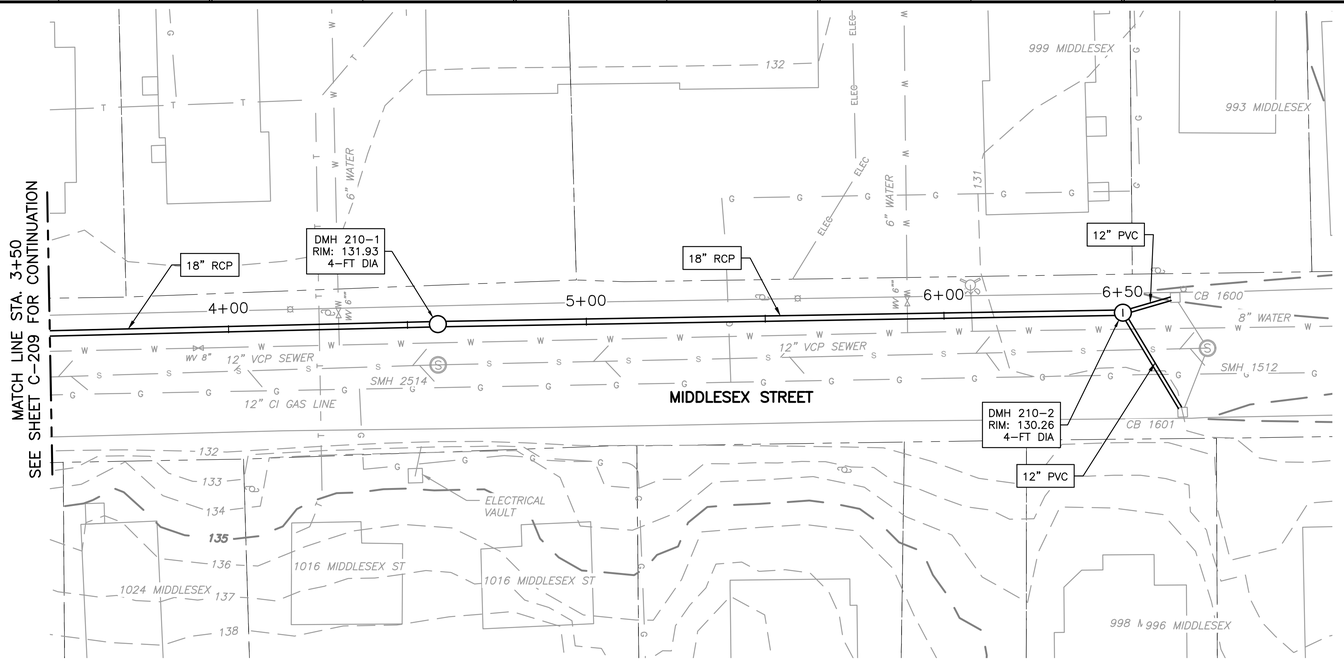
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Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
MIDDLESEX STREET

PROJECT NO. 0552-282899
FILE NAME: C209PLPR.DWG
SHEET NO.
C-209

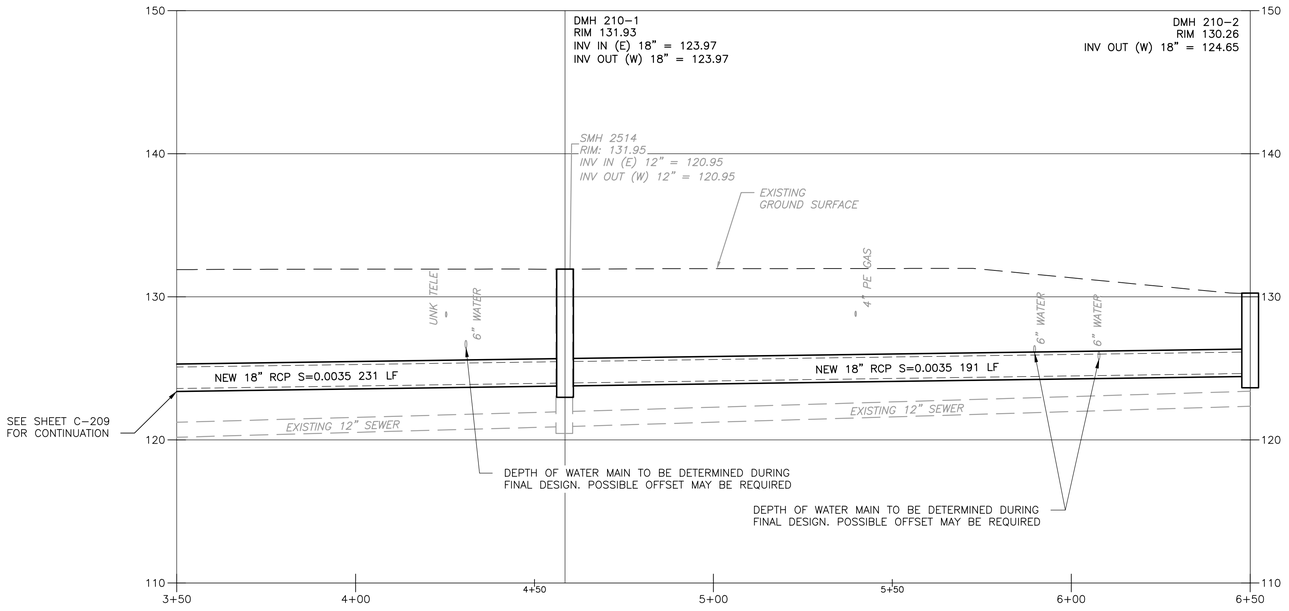
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION



PLAN

1" = 20'

N



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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Tel: (603) 222-8300

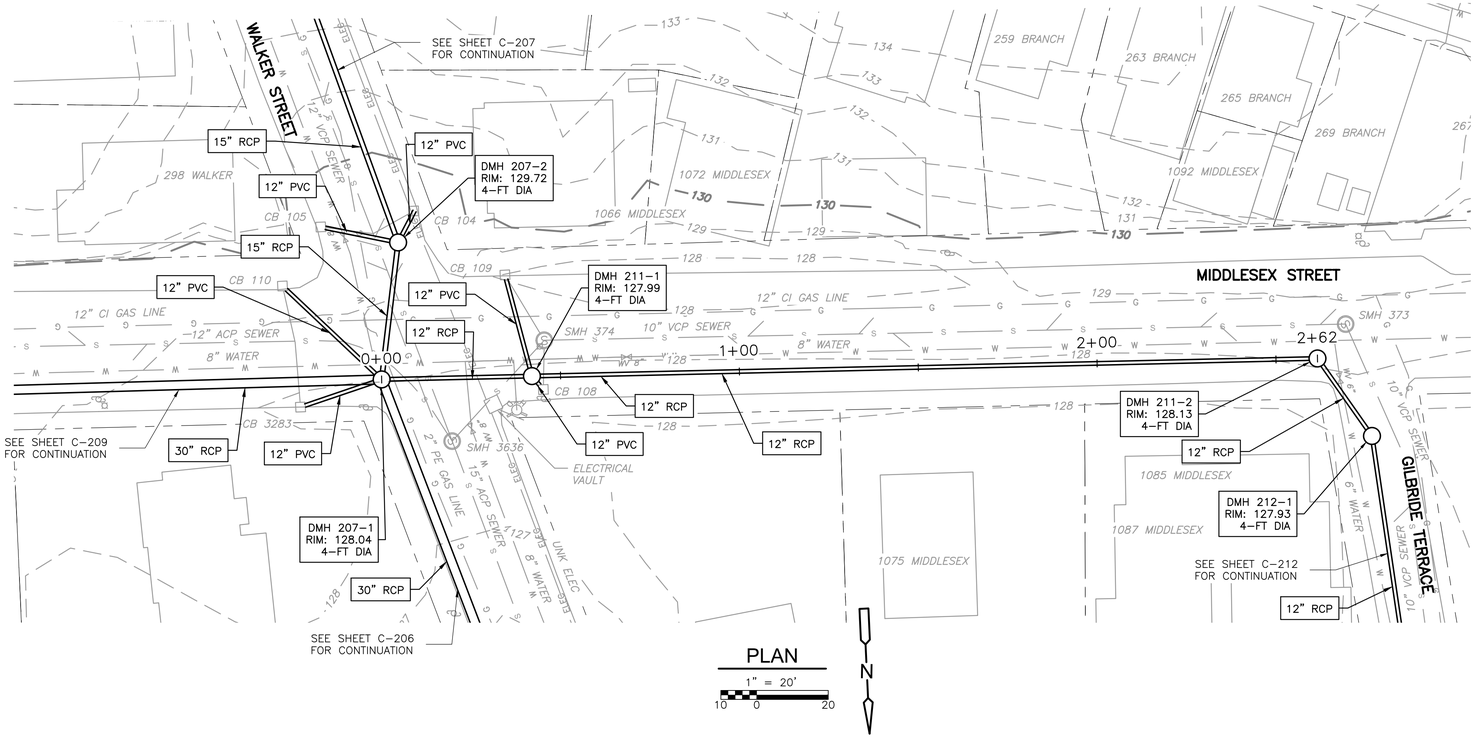
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
MIDDLESEX STREET

PROJECT NO. 0552-282899
FILE NAME: C210PLPR.DWG
SHEET NO.
C-210

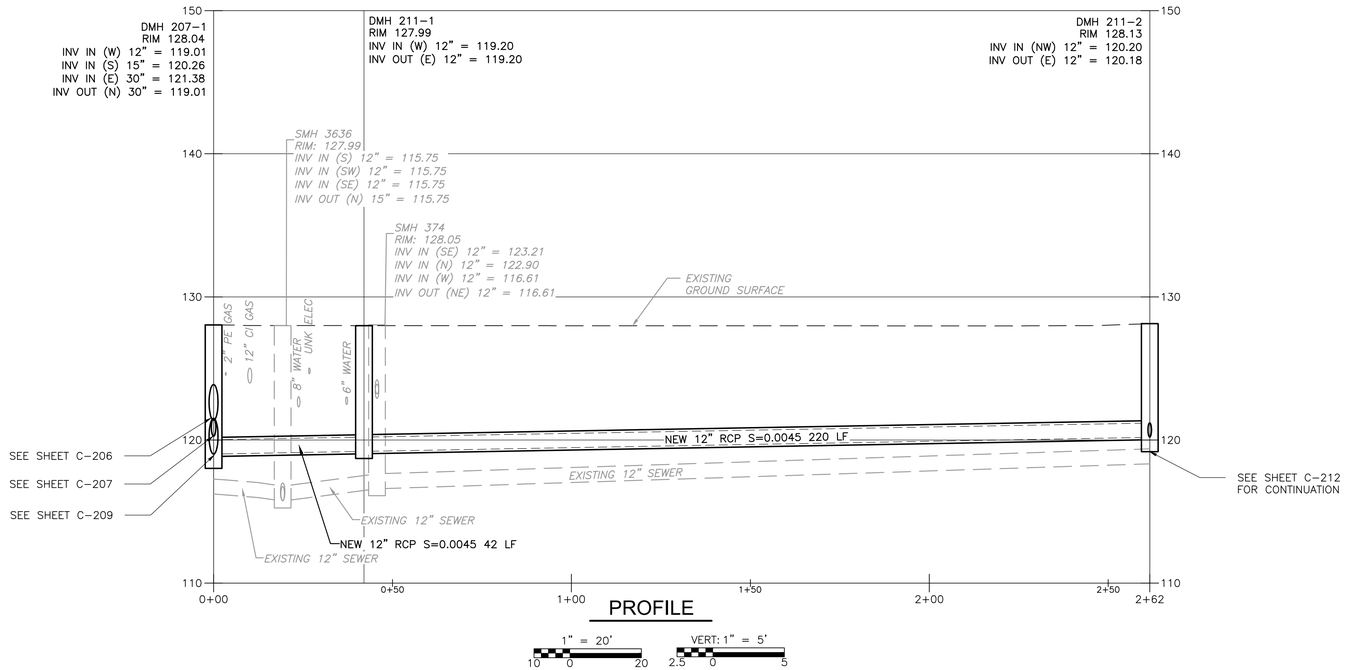
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
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DATE: DECEMBER 2024

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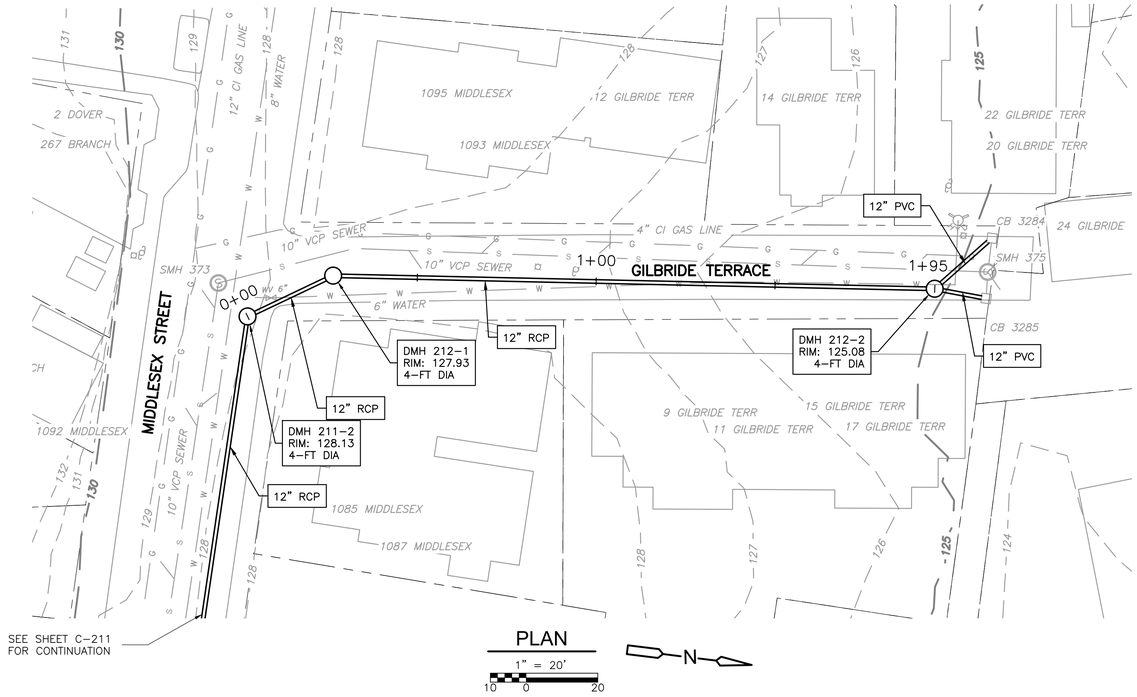
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

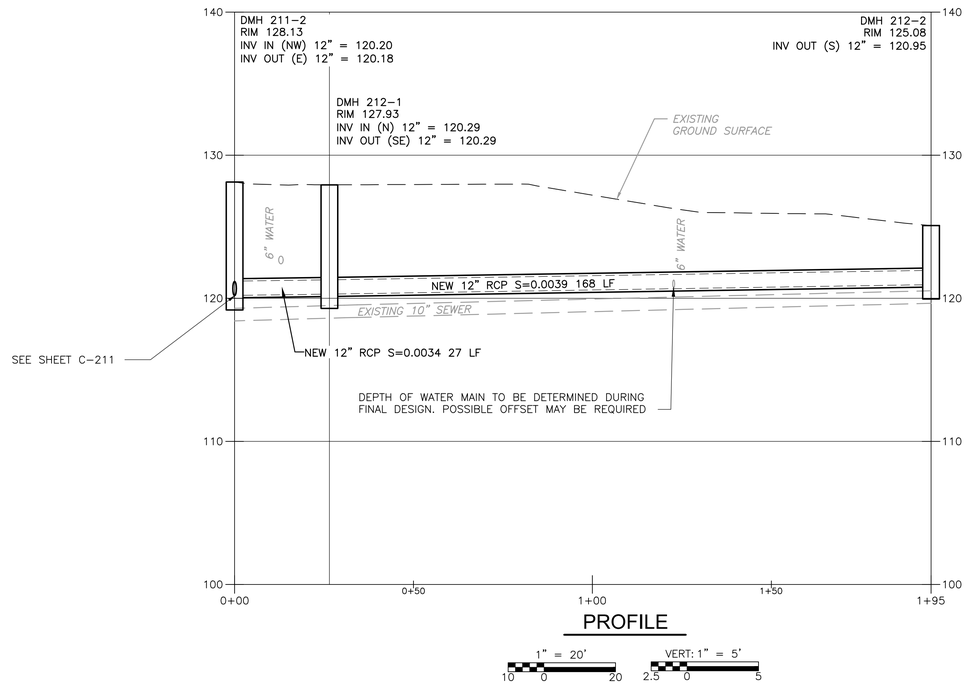
PEVEY AREA
MIDDLESEX STREET

PROJECT NO. 0552-282899
FILE NAME: C211PLPR.DWG
SHEET NO.
C-211

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

XREFs: [CEP005PP_EX SEWER, CEP004PP_EX WATER, CEP002ST_EX DRAIN, CEP007PP_EX CULVERTS, CEP003ST_EX GAS LINE, CEP009PP-STREET LIGHT AND NATIONAL GRID POLE, BASEMAP, CDMS_2436_Target Separation Areas, CVIZ009PP_CIVIL 3D WORKING MODEL] Images: []
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REV. NO.	DATE	DRWN	CHKD	REMARKS

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DRAWN BY: S. SIDANALE
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CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

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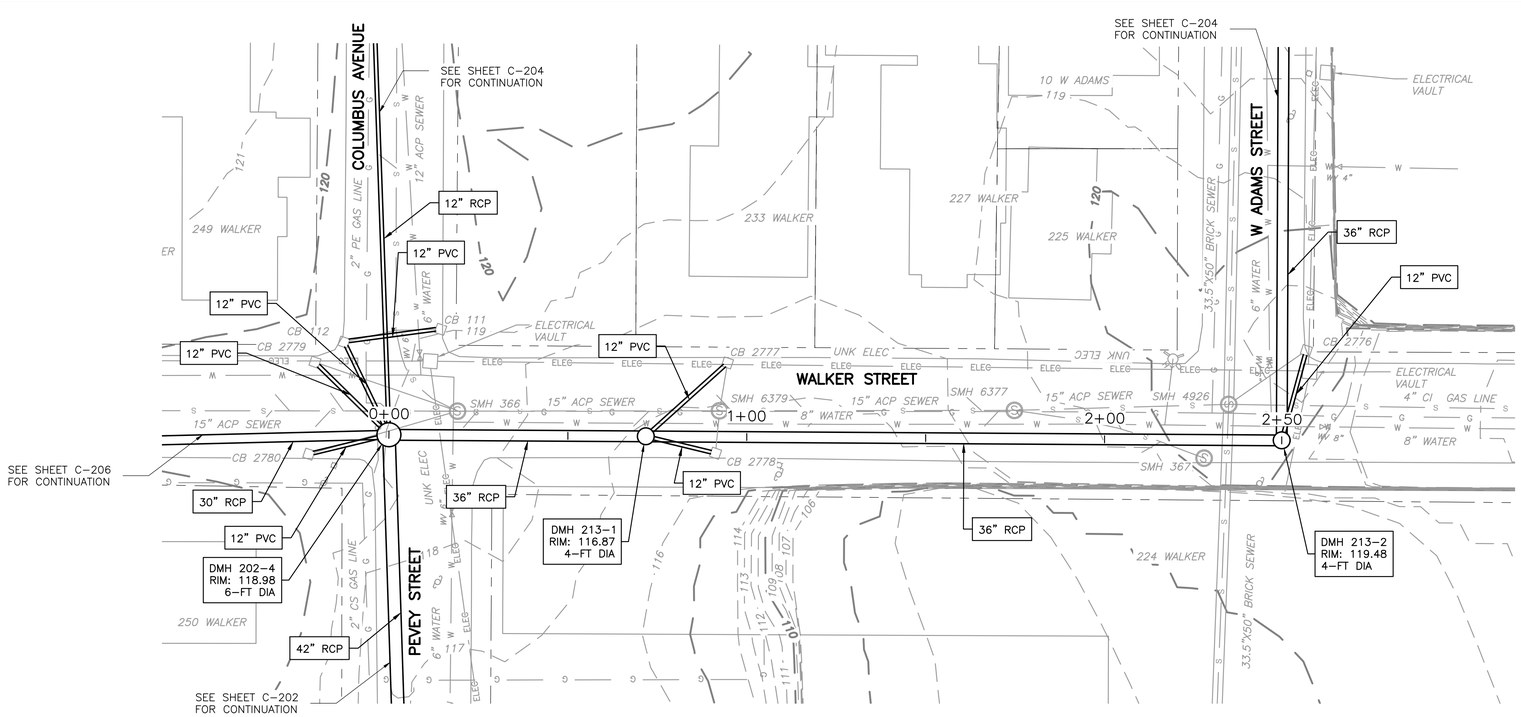
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

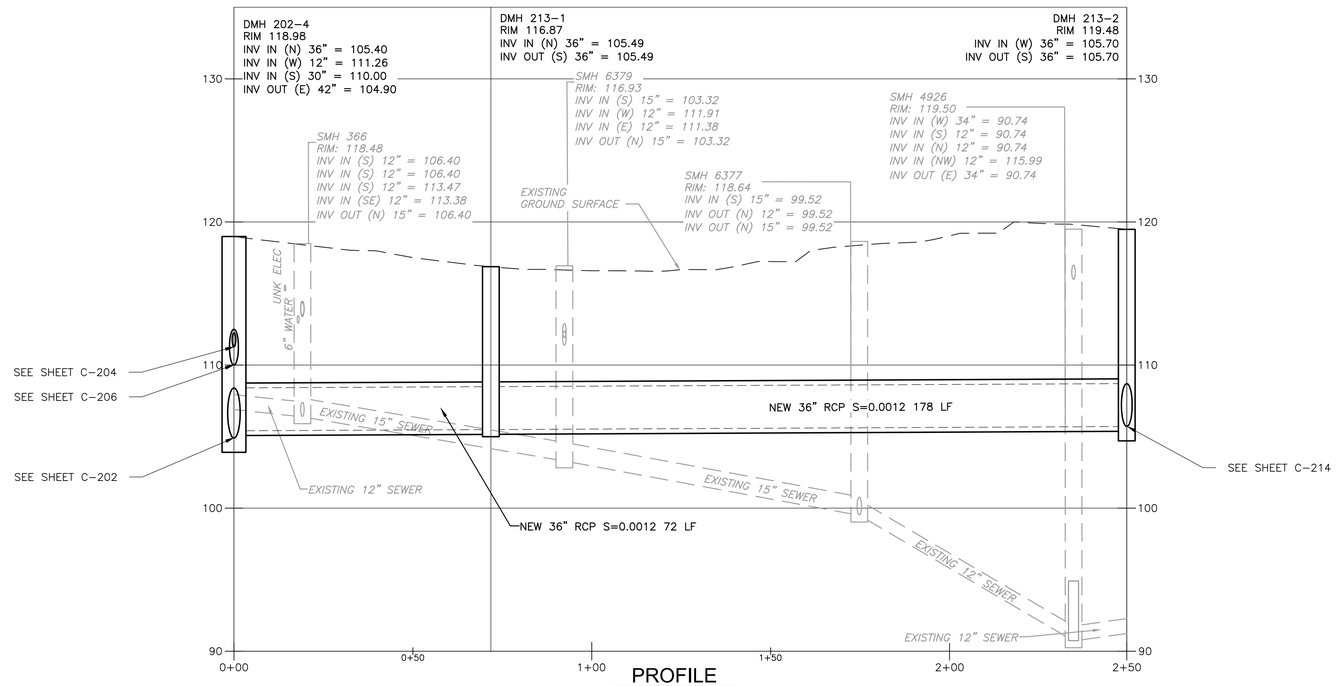
PEVEY AREA
GILBRIDE TERRACE

PROJECT NO. 0552-282899
FILE NAME: C212PLPR.DWG
SHEET NO.
C-212

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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APPROVED BY:
DATE: DECEMBER 2024

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Manchester, NH 03101
Tel: (603) 222-8300

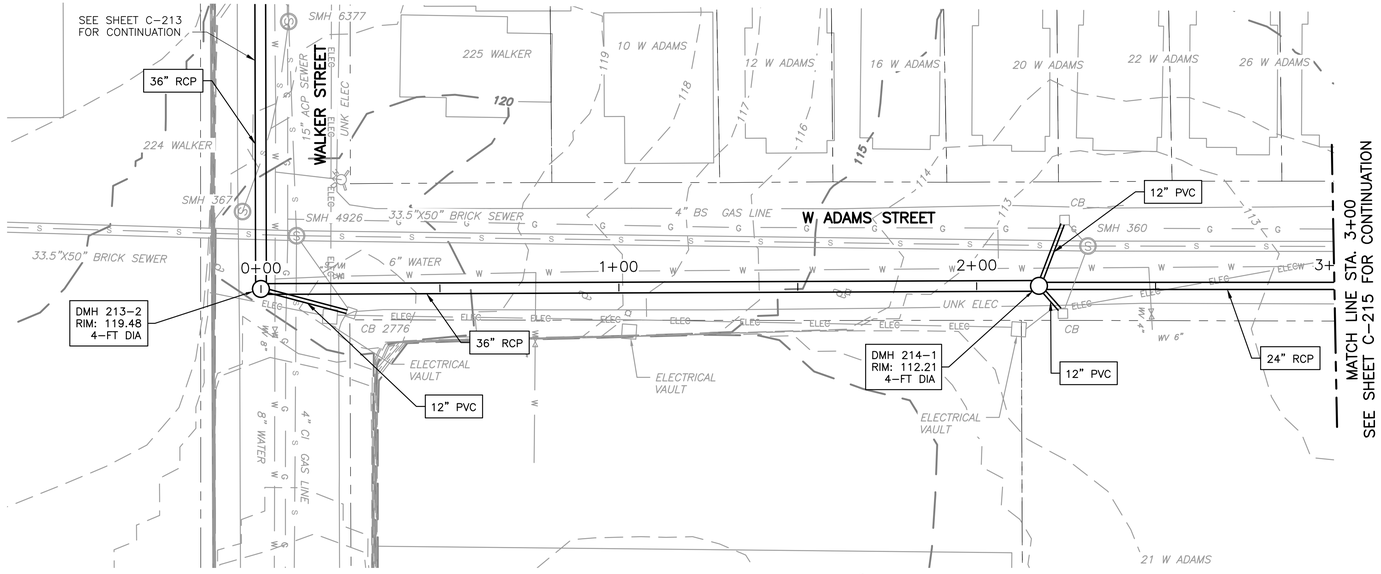
LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
WALKER STREET

PROJECT NO. 0552-282899
FILE NAME: C213PLPR.DWG
SHEET NO.
C-213

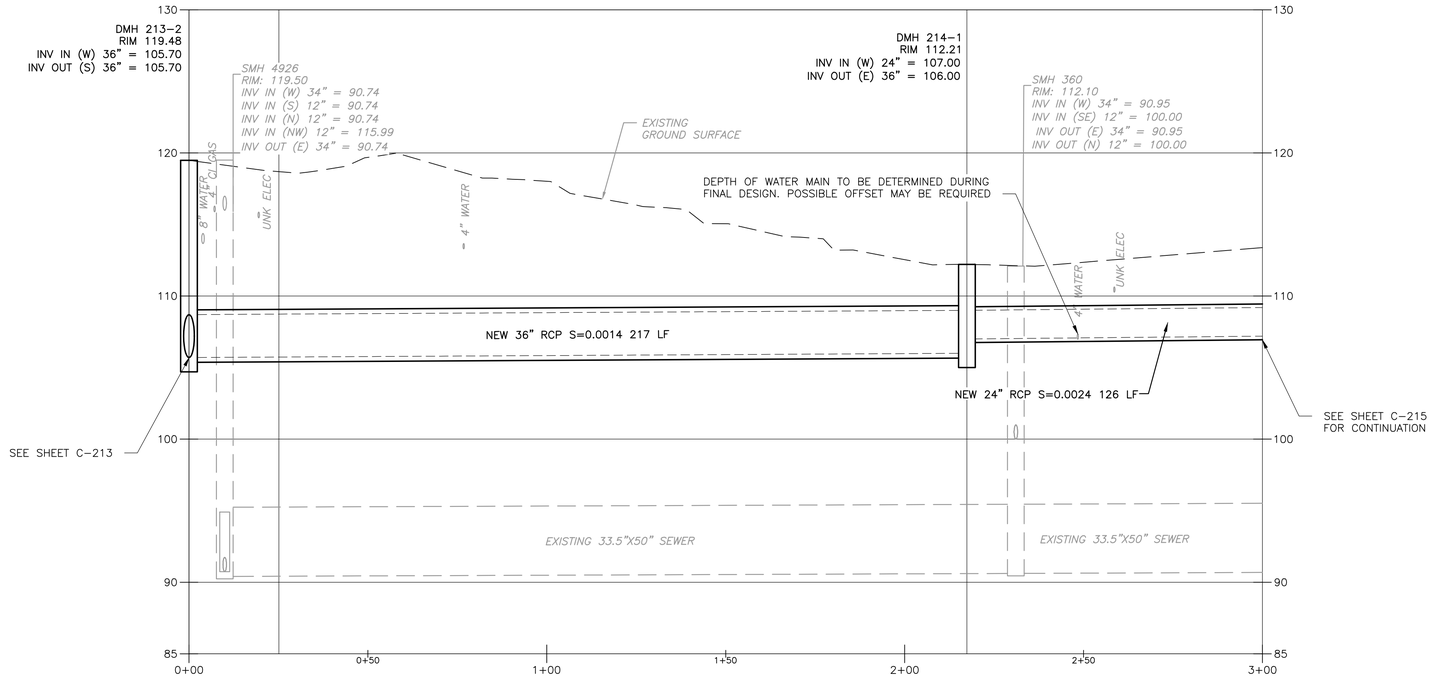
CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS
PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

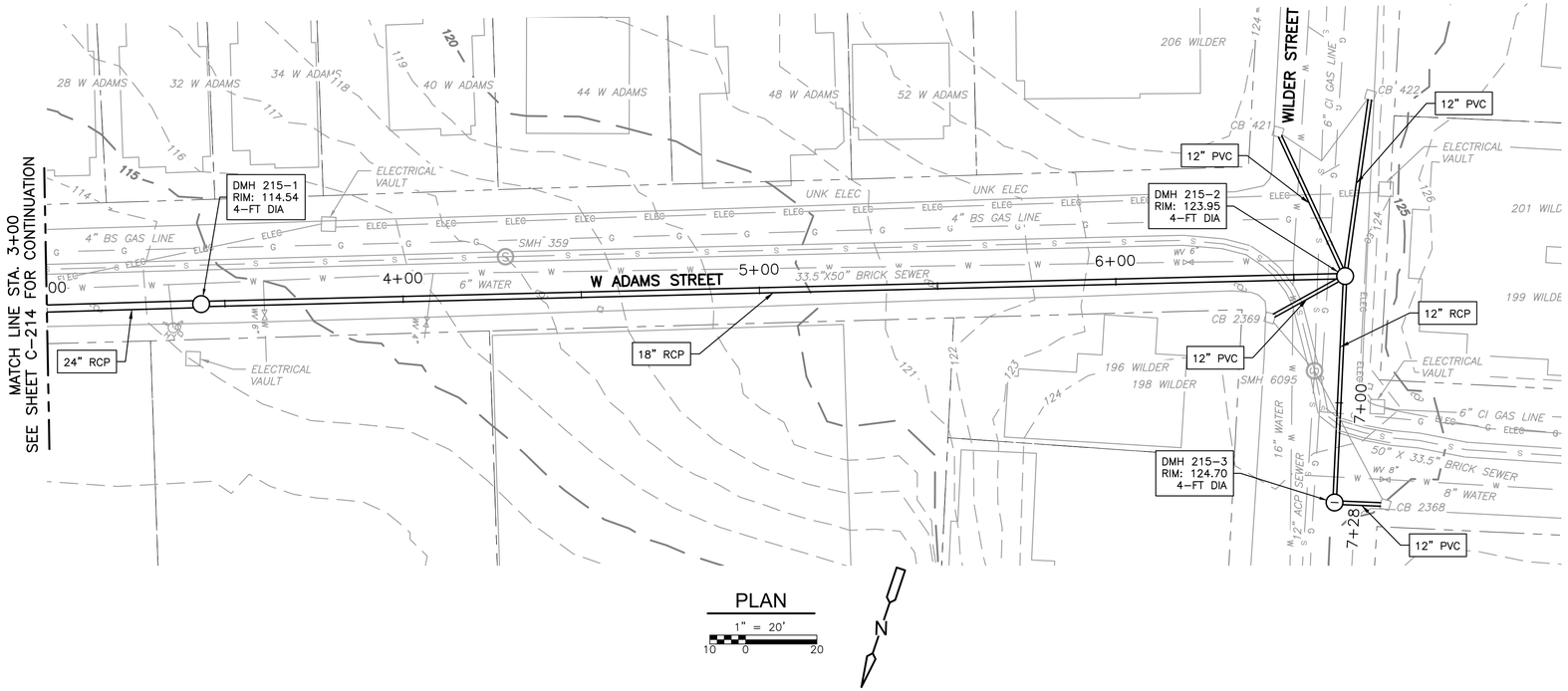
PEVEY AREA
W ADAMS ST

PROJECT NO. 0552-282899
FILE NAME: C214PLPR.DWG
SHEET NO.
C-214

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

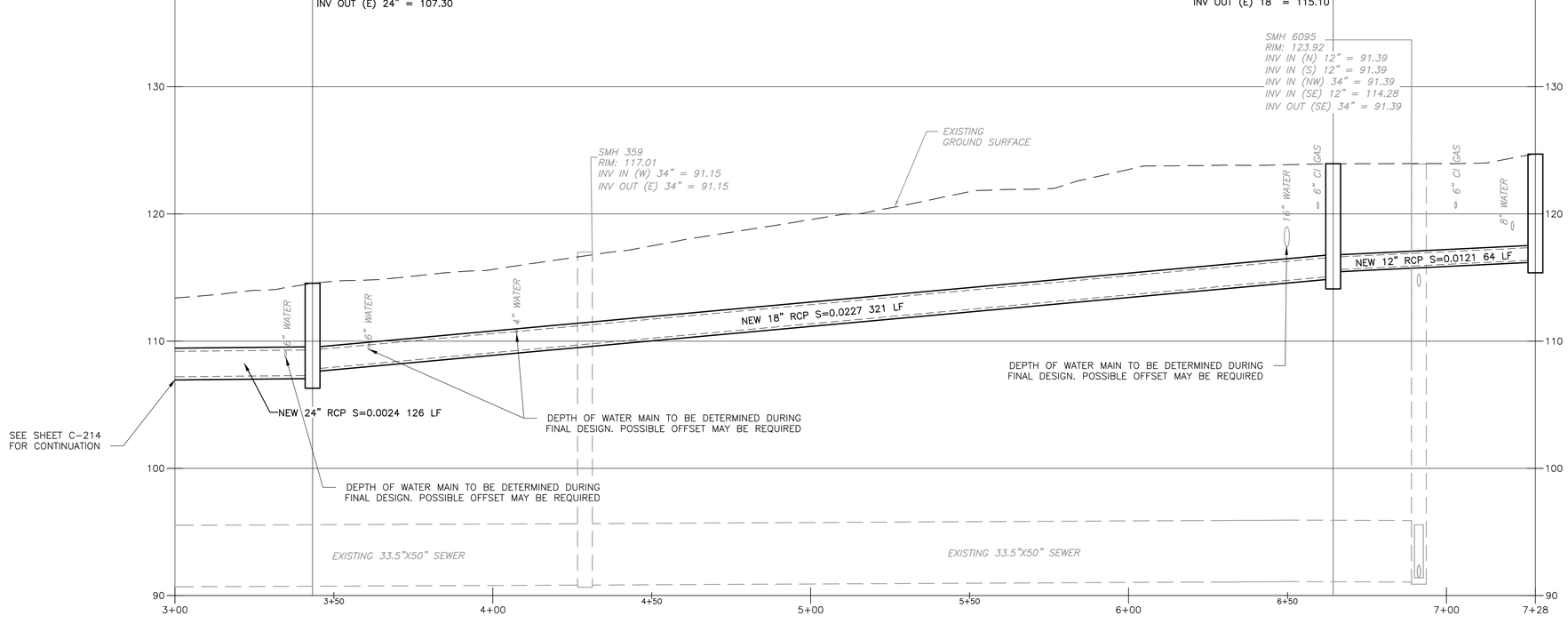
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PLAN

1" = 20'



PROFILE

1" = 20'

VERT: 1" = 5'

REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: Z. ROBARTS/S. CAREY
DRAWN BY: S. SIDANALE
SHEET CHK'D BY: Z. ROBARTS
CROSS CHK'D BY: S. CAREY
APPROVED BY:
DATE: DECEMBER 2024

CDM Smith
670 North Commercial Street, Suite 208
Manchester, NH 03101
Tel: (603) 222-8300

LOWELL REGIONAL WASTEWATER UTILITY
LOWELL, MASSACHUSETTS

PHASE 3 CANDIDATE AREA
SEWER SEPARATION PDR

PEVEY AREA
W ADAMS STREET

PROJECT NO. 0552-282899
FILE NAME: C215PLPR.DWG

SHEET NO.
C-215

CONCEPTUAL DESIGN - NOT FOR CONSTRUCTION

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