June 28, 2019

Mr. Michael Riley, P.E.
CSO Coordinator
Division of Water Quality Management
Bureau of Land and Water Quality
Department of Environmental Protection
State House Station 17
Augusta, ME 04333

Subject: 2019 Twenty Year Clean Water Act Master Plan Update

Dear Mr. Riley:

The City of Lewiston Public Works (LPW), Auburn Sewer District (ASD), and the Lewiston-Auburn Water Pollution Control Authority (LAWPCA) are pleased to submit our Clean Water Act Master Plan (CWAMP) 20- Year Update. This report reviews the progress made in abating overflows to the Androscoggin River over the period in which our three agencies have been formally collaborating on this Master Plan work and details our plans going forward.

Each of the three entities is proud of the work that has been completed and how that work has been reflected in improved water quality of the river that our citizens and visitors enjoy. Without expounding on this point at length, it is notable that a great number of recreational events are now held in and on the River in the area of the Twin Cities in recent years.

We recognize that additional work needs to be done in order to achieve full control of discharges up to and including the one-year recurrence interval storm. As we note our understanding of the goal ahead, and even how close we are to achieving that goal, it is true that the last increments of improvement are the most difficult to achieve. While Auburn has completed essentially full separation of sanitary sewers and storm conveyances in the public right of way, additional work to reduce inflow and infiltration needs to be done. This is time consuming and challenging work. Similarly, in Lewiston, most of the separation work in the public right of way has been completed. What remains is to upgrade choke points in a few isolated sections and/or incorporate additional storage, increase efforts at I/I identification and removal, and continue efforts to maximize the existing infrastructure (such as increased removal of accumulated solids in the collection system. In addition to these efforts, when appropriate, both Cities will consider the use of rain gardens and other means to increase our ability to reduce storm flows by infiltrating precipitation directly into the ground. As the final point in the collection system, LAWPCA needs to continue to maximize the ability of the treatment plant to treat flows – including at times when the facility is able, to treat for brief periods flows in excess of 32 million gallons per day. We believe that nearing the end of the next five years of effort by all parties – including the Department – we will be able to evaluate the potential effectiveness, begin design and siting of a storage facility at or near structure B that will serve to control all flows up to and including the one-year storm.

The City of Lewiston, the Auburn Sewerage District and LAWPCA are proud of the progress we have made in reducing CSO discharges and we believe that the working relationship that has been developed with Maine DEP and our consultant, Tighe and Bond, is an outstanding example of practical work that benefits the Androscoggin River and the people of Maine. We look forward to continuing this work and strengthening the team that has been assembled. We appreciate your careful review of this update and look forward to your input.

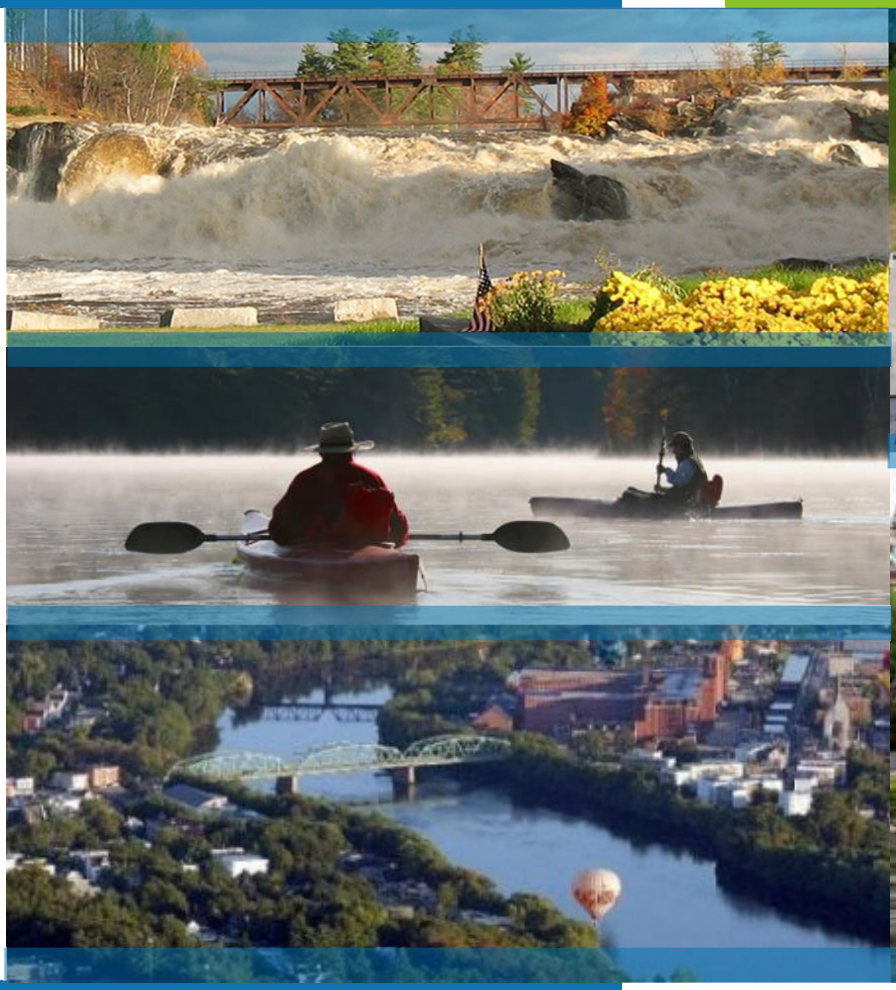
Sincerely;

Dale Doughty, C.G
Director,
Department of Public Works
City of Lewiston

Sid Hazelton, P.E.
Superintendent
Auburn Sewerage District

Clayton (Mac) Richardson, P.E.
Superintendent
Lewiston Auburn Water Pollution Control Authority

Enclosure (1)



Lewiston and Auburn, Maine

CLEAN WATER ACT MASTER PLAN UPDATE

City of Lewiston, Maine

Auburn Sewerage District

Lewiston-Auburn Water Pollution Control Authority (LAWPCA)

June 2019

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June 28, 2019

Mr. Dale Doughty, PE
Director of Public Services
City of Lewiston
103 Adams Avenue
Lewiston, ME 04243-7250

Mr. Sid Hazelton, PE
District Engineer
Auburn Sewerage District
PO Box 414
Auburn, ME 04210

Mr. Clayton Richardson, PE
Superintendent
Lewiston Auburn Water Pollution Control Authority
PO Box 1928
Lewiston, ME 04241-1928

Re: **Clean Water Act Master Plan Update Report**

Dear Sirs:

Please find enclosed the Clean Water Act Master Plan (CWAMP) Update Report for submission to the Maine Department of Environmental Protection (MDEP).

We thank you for your assistance and input in the preparation of this report. We look forward to finalizing this report upon receipt of feedback from MDEP. Please feel free to contact me at (207) 232-6071 with any questions.

Very truly yours,

TIGHE & BOND, INC.

Daniel Bisson, PE, BCEE
Senior Project Manager

Copy: Kevin Gagne, City of Lewiston
Rick Burnham, City of Lewiston
Tiffany Labrie, Tighe & Bond
Travis Peaslee, LAWPCA
Jeff Beaule, City of Lewiston

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Executive Summary

In 1992, the City of Lewiston, Auburn Sewerage District (ASD), and the Lewiston Auburn Water Pollution Control Authority (LAWPCA) initiated efforts to develop a plan to meet the requirements of the Clean Water Act (CWA) as it pertained to managing CSOs. The Clean Water Act Master Plan (CWAMP) was completed in 1998 and submitted to the Maine Department of Environmental Protection (MDEP). The proposed CWAMP included proposals for implementation of Best Management Practices, sewer separation with a one-year level of control using the established six-hour design storm as the basis of this assessment, and compliance monitoring over a 20-year period.

In May 2000, MDEP negotiated an agreement with Lewiston, LAWPCA, and ASD on the content and recommendations made in the Master Plan with a 15-year implementation period to control up to a 1-year design storm (as defined in the CWAMP) and a requirement to provide updates on the progress made every five years during the implementation period.

The first 5-year CWAMP Update for Lewiston, ASD, and LAWPCA was prepared by CDM Smith, and submitted to, and commented on, by the MDEP in 2005. MDEP subsequently provided final approval of the plan and an amendment which included a provision for Lewiston to modify the abatement approach for the CSO 004, 012 and 021 basins to storage. At the direction of the MDEP, Lewiston increased the size of the proposed Androscoggin Storage facility to provide up to a 6-month level of control from the originally proposed 3-month level of control.

In 2008, a Consent Agreement with LAWPCA was amended and subsequently closed. MDEP indicated in its correspondence that "the goal of the amendment was to close out the Consent Agreement and move the focus of controlling storm flows at LAWPCA to the CSO Master Plan." The Consent Agreement committed LAWPCA to include assessment of primary treatment needs at the treatment plant in the second 5-year update to the Master Plan. The second 5-year update is further referred to as the 10-year CWAMP update.

In accordance with requirements stipulated in the Consent Agreement and correspondence from the MDEP, the Clean Water Act Master Plan 10-Year Update prepared by CDM Smith included a temporary flow metering program, a comprehensive update of Lewiston's collection system model, analyses of the effectiveness of sewer separation and storage projects, and an assessment of primary treatment needs at the LAWPCA treatment plant. The final recommendations contained in the 10-Year Update included the following: Lewiston and ASD continue implementing sewer separation projects; ASD and Lewiston consider installing permanent flow meters at critical locations in the collection system; the collection system model be updated and further calibrated with additional metering data; a third (15-year) update report to be completed in 2015; and that Lewiston and ASD should continue with their BMPs, system evaluations, and improvements to reduce I/I in the collection systems.

In January 2015, the scope of work for the 15-year CWAMP update was submitted by Lewiston, ASD and LAWPCA and approved by the MDEP in an April 7, 2015 email. In accordance with requirements stipulated in the correspondence from the MDEP, the Clean Water Act Master Plan 15-Year Update prepared by CDM Smith included a temporary flow metering program, a comprehensive update of Lewiston's collection system model, and analyses of the effectiveness of sewer separation and storage basin projects. In January

2016, Maine DEP provided an official approval of the 2015 Update and implementation schedule.

In November 2015, MDEP issued Maine Pollution Discharge Elimination System (MEPDES) Permit #ME0100994 and Maine Waste Discharge License (WDL) renewal for the City of Lewiston. As stated in the permit, "The permittee shall continue to work with the Auburn Sewerage District and the Lewiston-Auburn Water Pollution Control Authority (LAWPCA) to implement CSO control projects in accordance with the most currently approved CSO Master Plan and implementation schedule in a document entitled City of Lewiston, Maine, Auburn Sewerage District, and Lewiston Auburn Water Pollution Control Authority (LAWPCA), Clean Water Act Master Plan Fifteen Year Update, July 2015. By June 30, 2019, (PCS Code 06699) the permittee shall submit to the Department for review and approval an Updated CSO Master Plan and implementation schedule."

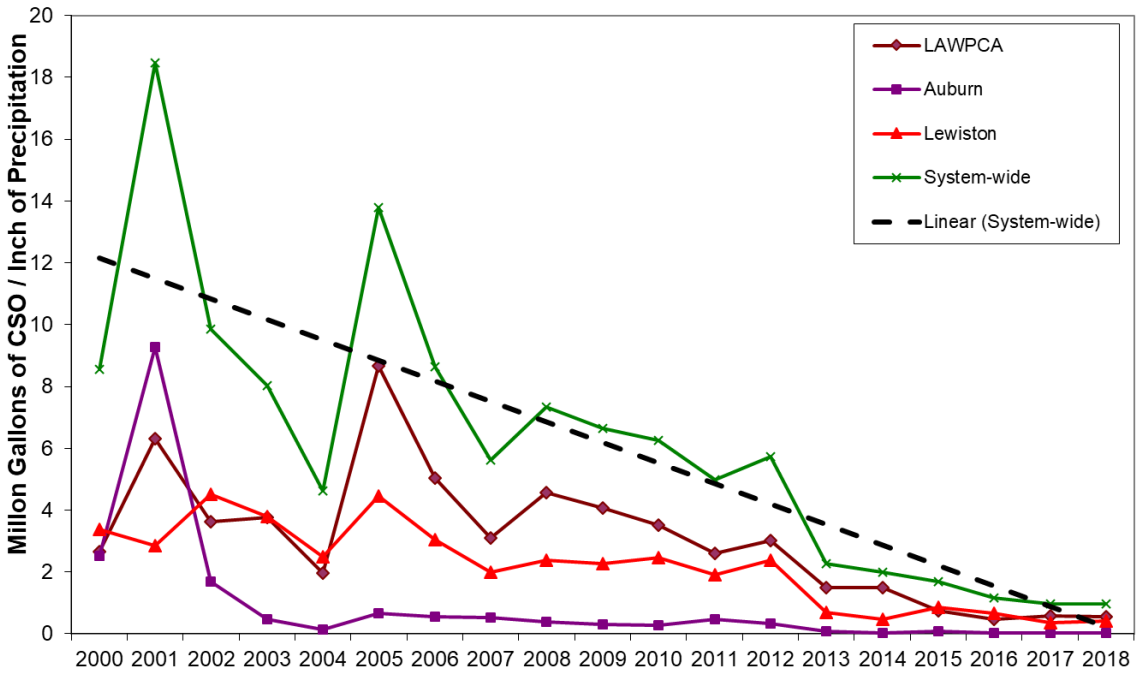
In April 2016, Maine DEP issued Maine Pollution Discharge Elimination System (MEPDES) Permit #ME0101478 and Maine Waste Discharge License (WDL) renewal for LAWPCA requiring that an Updated CSO Master Plan be submitted by December 31, 2019.

In September 2016, Maine DEP issued Maine Pollution Discharge Elimination System (MEPDES) Permit #ME0100005 and Maine Waste Discharge License (WDL) renewal for Auburn Sewerage District requiring that an Updated CSO Master Plan be submitted by December 31, 2019.

This CSO Master Plan/CWAMP Update Report is a comprehensive study integrating several objectives to provide the City of Lewiston, LAWPCA, and ASD with an Updated CSO Master Plan and Implementation Schedule. The plan recommends appropriate, cost-effective solutions that maximize benefits to the receiving waters by reducing CSO volume.

Throughout the last two decades of the implementation period, significant progress has been made and all three entities are meeting the intent and expectations of the CWAMP to abate CSOs. This has been accomplished through collaboration and commitment to capital expenditures despite severe economic conditions from 2008 to 2013. The following Figure (Figure ES-1) demonstrates the trend in combined sewer overflows since 2000. Of particular interest is the overall (system-wide) trend which has dropped to nearly 10 percent of what it was for 2000.

Figure ES-1
Annual CSO Volume Discharged per Inch of Precipitation



Auburn Sewerage District

ASD reduced its total CSO discharges at CSO 001 by more than 40 percent between 2000 and 2014 based on 1-year design storm estimates. ASD also closed six of the original eight CSO regulators. ASD intends to eliminate or close CSO #005 (Miller Street) by the end of 2022. At that time, CSO #001 will be the only remaining CSO in Auburn which will continue to serve the City as a hydraulic relief point during extreme wet weather events.

ASD's planned improvements no longer include public street/right-of-way sewer separation since there are no remaining public streets in Auburn that require separation. However, private inflow and other extraneous flow sources remain in the collection system. ASD efforts are now focused on identifying and removing sources of Inflow and Infiltration (I/I) throughout the City.

ASD is committed to reducing wet weather flows in the collection system by directly targeting I/I sources. ASD will closely monitor any observed CSO discharges over the next 5 years. ASD is currently conducting a detailed drainage area study for drainage area 005 and fully expects to be able to curb its wet weather flows from CSO 005 by 2022 to allow for its elimination. In addition, ASD intends to reduce I/I such that they will achieve the 1-year level of control at CSO 001 in the next five years. If the 1-year level of control is not achieved, ASD has committed to designing and constructing in-line storage within its collection system to achieve the 1-year level of control at CSO 001.

City of Lewiston

Lewiston has reduced its total CSO discharges by more than 80 percent since 2000 based on 1-year design storm estimates. This significant reduction in CSO volume discharged can be largely attributed to Lewiston's sewer separation within the public streets/right-of-way dating back to the 1990s. While this method of separating the drain system from the sewer system is effective at reducing CSO flows, private sources of inflow may remain in the collection system. As of 2019, the City of Lewiston has completed public street sewer separation in 96% of the streets within Lewiston's combined sewer system.

Work has been completed to remove private inflow from the sewer system, especially in the Gully Brook area. In 2001, the City executed a house-to-house inspection program of approximately 300 houses in the Gully Brook area to identify private inflow connections. As of 2010, approximately 123 of the 137 confirmed private inflow sources in the Gully Brook area were removed from the sewer system. The City plans to continue to separate private inflow sources as they are identified during sewer separation designs and site plan reviews.

The City constructed a 0.3-million-gallon storage facility at Goff Brook that captures up to 271,000 gallons of overflow and has reduced discharges from CSO 015. This facility was designed to fill and drain by gravity so that no pumping is required. A constant flow regulator limits the effluent from the storage facility to a preset limit. The City has constructed similar storage facilities at the Water Street CSO (CSO 004; 1.3 MG) and, most recently, Gully Brook CSO (CSO 005D; 0.4 MG).

Lewiston has maximized its sewer system capacity by cleaning over a million linear feet of sewers and removing 1,223 tons of sediment since 2000. The City also continued with its sewer system evaluation program by initiating a TV inspection program, and as of 2019, Lewiston's entire collection system has been video inspected.

To date, Lewiston has closed 29 of the original 37 regulators, leaving 9 active regulators to 8 outfalls. The regulators divert high flows either to another drainage area or to an outfall. The outfalls are the outlets to the surface waters. The City has also been advancing its conditions assessment and asset management programs pertaining to stormwater and sewer collection systems to prioritize and implement system improvements. Through an adaptive management approach, the City is currently systematically evaluating how many additional regulators can be closed without causing undesirable consequences. As the performance of the collection system improves and CSO discharge frequencies decrease, the City will evaluate the feasibility of closing additional regulators while maintaining necessary hydraulic relief points where the integrity of the system would otherwise be compromised during extreme wet weather events.

Lewiston's planned improvements for 2019 through 2024 include completing additional targeted sewer separation projects, mainly aimed at reducing CSOs in Gully Brook and Jepson Brook. This includes disconnecting some catch basins from the sewer system, as well as removing some major private sources of inflow from the collection system. In addition, the City will continue its focus on I/I reduction programs in areas of the City with the highest levels of extraneous flow in the collection system. The City will also perform post-construction monitoring of its recently constructed storage facilities.

LAWPCA

The total CSO discharge resulting from the 1-year design storm at Structure B has been reduced by more than 23 percent over the last five years. LAWPCA has also made improvements to the treatment plant to maximize capacity of the existing infrastructure and improve performance and operations of the plant and Structure B during wet weather events. This is evident by the overall trend exhibiting significant reductions in Structure B overflows since 2000.

LAWPCA continues to be an active partner in the CSO master planning process and will be an integral part of the detailed evaluation of potential storage sites that the entities intend to complete over the next five years. This evaluation will include the identification of viable sites and preliminary design of storage at Structure B. At this time, a storage volume of approximately 2.0 Million Gallons is expected to provide the 1-year level of control after both ASD and Lewiston complete their planned sewer separation and I/I reduction projects. As results from each city's progress is recognized, Lewiston, ASD, and LAWPCA will work together to plan, site and develop costs for improvements that will further control overflows from Structure B and Auburn CSO 001 including centralized or decentralized storage.

Table ES-1 summarizes current estimated costs for completion of the proposed improvements of the CWAMP.

Table ES-1
Estimated CWAMP Capital Improvements

Description	ASD ($ Millions)	Lewiston ($ Millions)	LAWPCA ($ Millions)
Estimated Costs 2000	$18.44	$26.22	$1.45
Amount Spent to Date	$20.02	$30.63	$1.50
Costs 2015 - 2018	$1.73	$4.08	$1.71
Total Costs to Date*	$21.75	$34.71	$3.21

*Costs shown are as reported annually (not adjusted for present worth).

The Major Conclusions of the this CWAMP Update report are:

- To date, Lewiston, ASD, and LAWPCA have been diligently completing recommended plans to control CSO discharges to the Androscoggin River. The significant reduction in CSO volume discharged can be largely attributed to both Lewiston's and ASD's commitment to upgrading the sewer system via separation efforts within the public streets/right-of-way. While this method of separating the stormwater system from the sewer system is effective at reducing CSO flows, it does not address private inflow and other extraneous flow sources that are present in the collection system. ASD has completed its public street separation efforts, and Lewiston will complete some additional targeted sewer separation projects in 2019 - 2021.

- Based on the analyses in this CWAMP update, CSOs caused by wet weather events up to and including the 1-year design storm can be controlled throughout the systems by utilizing a combination of separation within the public streets, I/I removal, and storage.

- The assessment at LAWPCA, as part of this CWAMP Update, has included conceptual level cost estimates for abatement of overflows at Structure B caused by wet weather flows up to and including the 1-year storm event. At this time, the model predicts that a storage volume of approximately 2 million gallons at LAWPCA will achieve the 1-year storm level of control for Structure B. Recent storm events have seen greatly reduced flows from the City of Lewiston and when coupled with flow reductions from Auburn, it is very difficult at this time to estimate what volume will be required to contain the 1-year design storm after both ASD and Lewiston complete sewer separation and I/I reduction projects in the combined areas. Therefore, the cities and LAWPCA intend to perform a detailed evaluation of storage at Structure B in the next five years, concurrent with a detailed site evaluation.

The recommendations of this Clean Water Act Master Plan Update move Lewiston, ASD, and LAWPCA towards complete control of sewer flows up to the 1-year level of control are proposed as follows:

- Based on the original intent of the CWAMP and review of the progress to date as part of the CWAMP updates, Lewiston and ASD will continue to complete their planned sewer separation and I/I reduction efforts.

- Lewiston, ASD, and LAWPCA will work together to plan for improvements that will further control overflows from Structure B and Auburn CSO 001 in a cooperative manner. All three entities will look at the Structure B storage option presented in this report in conjunction with other potentially cost-effective solutions in the two cities that could have the secondary benefit of reducing flows to Structure B.

- Lewiston and ASD should continue with their Best Management Practices (BMPs), system evaluations and improvements to reduce I/I to the system in the separated sewer systems. Additionally, opportunities to incorporate green technologies to reduce storm water entering the combined sewer system should be evaluated and incorporated, where appropriate, into the final sewer separation program to help optimize collection system capacities and downstream facilities.

- Work will continue on projects for the next 5-year period in both Lewiston and Auburn. The attached Clean Water Act Master Plan Update provides more details on rigorous efforts (both past and planned) to achieve further reduction in CSOs and improvement of water quality. These efforts require a significant financial commitment, which both cities and LAWPCA are making.

- Finally, the three entities involved in this CWAMP have committed to arriving at the optimum collaborative solution that is fair and equitable for each entity and its rate-payers. Therefore, while significant progress has been made toward improving the water quality of the Androscoggin River through CSO abatement over the past nineteen years, these final steps toward achievement of the 1-year

level of control system-wide will require careful planning. The three entities have again made the commitment to continue the collaboration which is critical to finalizing the goals of the CWAMP while prudently applying the limited available capital resources.

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SECTION 1

Section 1
Background

1.1 Introduction and Purpose

The City of Lewiston (Lewiston), the Auburn Sewerage District (ASD), and the Lewiston-Auburn Water Pollution Control Authority (LAWPCA) have been implementing improvements to facilities and infrastructure to reduce combined sewage discharges to the Androscoggin River since before the approval of their Clean Water Act Master Plan (CWAMP) in the Spring of 2000. Figure 1-1 shows the location of these cities.

This report summarizes the improvements completed by each of the three entities through 2019 and presents the proposed implementation plan for years 2020 through 2025.

1.2 Clean Water Act Master Plan

Lewiston, ASD, and LAWPCA submitted a draft of the CWAMP to the Maine Department of Environmental Protection (DEP) and the Environmental Protection Agency (EPA) in July 1996. The CWAMP was finalized in the spring of 2000. The recommended implementation period for the plan was 15 years. The CWAMP has been reviewed and updated on a 5-year basis since 2005.

The 1996 CWAMP presented the background of each community, reviewed water quality standards, summarized existing facilities' flows and loads, developed a model of each collection system including the wastewater treatment facility, developed and evaluated alternatives, and presented a recommended plan for Lewiston, ASD, and the LAWPCA.

The CWAMP recommendations were similar for Lewiston and ASD and included Best Management Practices (BMPs), collection system controls, and compliance monitoring. As stated above, the implementation schedule for the plan was 15 years. The agreed level of Combined Sewer Overflow (CSO) control is the 1-year storm event. The 1-year storm describes the rainfall event that, statistically, has a 100 percent likelihood of occurring once per year. In this storm event or smaller events, all the flow is expected to be contained within the collection system with no overflows. The largest component of the recommended plan for Lewiston and ASD was sewer separation.

The largest component for the LAWPCA Wastewater Treatment Plant was to increase wet weather treatment capacity and improve operations. While a number of operational and small capital improvements were made at the treatment plant, the cost and service interruption associated with adding additional screening, raw wastewater pumping and primary treatment was determined to be too costly relative to the benefit. In addition, because the hydraulic capacity of primary clarification was identified as the most significant treatment capacity limitation, it was decided by all parties that the most effective means of reducing CSOs and improving water quality was to reduce extraneous flows in the collection systems.

This 5-year update will evaluate constructing wet weather storage facilities that can be utilized in conjunction with the collection system improvements in Auburn and Lewiston.

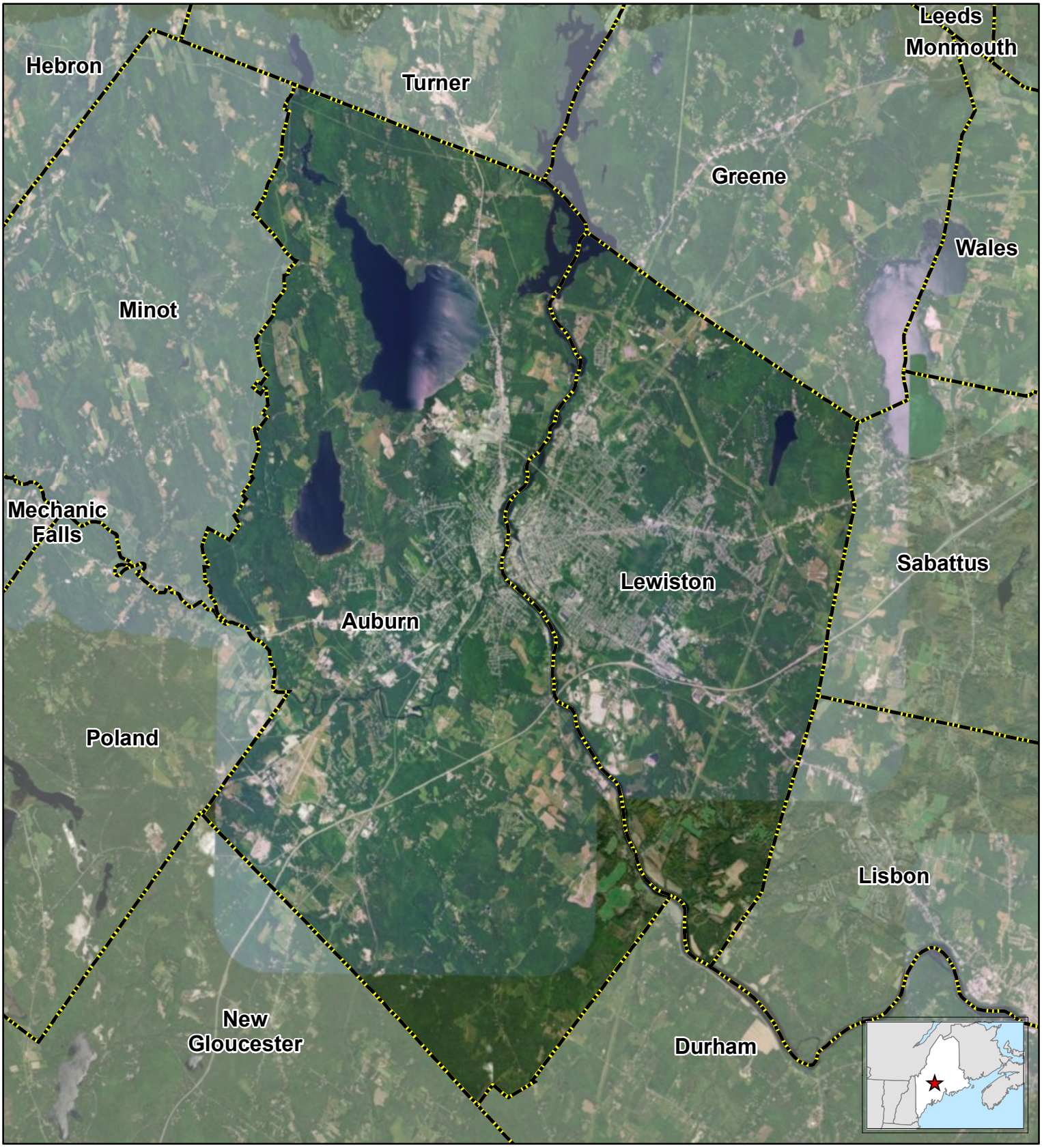

FIGURE 1-1
OVERVIEW MAP

Clean Water Act Master Plan
20 Year Update
Lewiston/Auburn, Maine

June 2019

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Imagery provided by ESRI.

1 inch = 2 miles

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Miles

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1.3 Five Year Updates

The DEP and the EPA agreed that an update to the CWAMP would be necessary every five years following the initial plan formulation. In accordance with the requirements of the MEPDES permit requirements for all three entities, this report presents the next 5-year update to the CWAMP. Consistent with the previous 5-year update reports, this update includes the following:

1. A review of CSO related information including CWAMP project summaries, Annual CSO Reports, the LAWPCA evaluation reports, completed and ongoing CSO projects and associated costs, and CSO volumes and monitoring.
2. Updated CWAMP project lists including:
    a. Projects completed through the five-year period;
    b. Planned and on-going projects and;
    c. Associated costs and schedules.
3. A summary of the above information.
4. A final Five-Year Update Report incorporating comments by DEP.

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SECTION 2

Section 2
Existing Facilities

2.1 Introduction

This section summarizes the existing facilities. Reference for the information in this Section was taken from the "Clean Water Act Master Plan", Volumes I and II, October 2000, by Metcalf & Eddy as well as the "Clean Water Act Master Plan Five Year Update", May 2005, the "Clean Water Act Master Plan Ten Year Update", June 2010, by CDM Smith, and the "Clean Water Act Master Plan Fifteen Year Update", July 2015, also by CDM Smith.

2.2 Existing Facilities

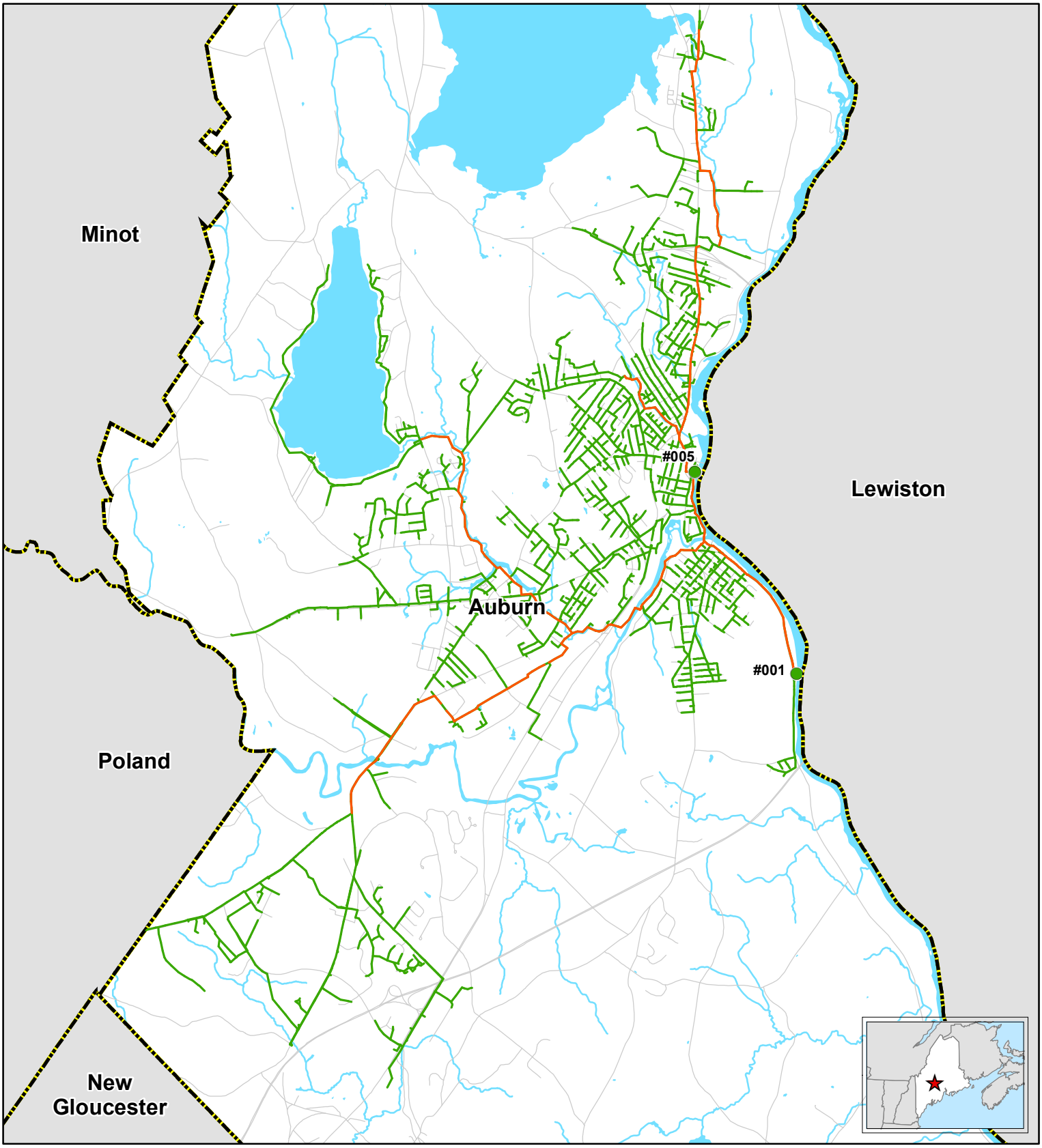
The cities of Lewiston and Auburn, Maine are separated by the Androscoggin River. Auburn is on the west side of the Androscoggin River while Lewiston is on the east side of the river. Both cities have their own independent wastewater collection systems, dating back more than 100 years. Originally constructed as combined sewer systems, each system discharges to the Androscoggin River or its local tributaries in the event that the capacity of each system or subsystem is reached during wet weather events.

In the 1960's and the 1970's, interceptor sewers and a wastewater treatment facility were constructed to reduce direct discharge of sanitary and storm water flows to the rivers and brooks. Dry weather flow is treated prior to discharge to the river. However, during wet weather events, there is not adequate capacity in the sewer system or at the treatment facility to convey and treat all combined flow. To avoid indiscriminate overflows, overflow regulators (CSO regulators) were constructed at key locations to allow the excess flow to be discharged directly to the river and brooks. A detailed discussion of each system and the treatment facility is provided below.

2.2.1 Auburn Collection System

The Auburn Sewerage District (ASD) operates the City's collection system. The Auburn collection system consists of approximately 686,000 feet of sewers, of which approximately 25 percent (171,500 linear feet) was originally part of a combined system. The collection system includes three major interceptors: the Main Interceptor, Little Androscoggin Interceptor, and Canadian National Railroad (CNNR) Interceptor. Details of these major interceptors are included in Table 2-1.

Figure 2-1 illustrates ASD's existing collection system, including locations of the major interceptors as well as other main sewers. ASD's system originally included 11 CSOs. ASD has been able to reduce this to only two CSOs (CSO #001 and CSO #005) through sewer separation efforts. Auburn removed CSO #005 from service in 2015, however, due to flash rainstorms that caused sewer system backups, the plate that sealed the CSO was removed in August of 2016.



Legend

- CSO Regulators
- Sewer Pipes
- Interceptor Sewer

1 inch = 1 miles

0 0.5 1

Miles

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Imagery provided by ESRI.

FIGURE 2-1
AUBURN COLLECTION SYSTEM

Clean Water Act Master Plan
20 Year Update
Lewiston/Auburn, Maine

June 2019

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TABLE 2-1
Auburn Interceptors

Interceptor Name	Approximate Length	Diameter (inches)	CSO Discharge Location
Main Interceptor	12,250	18-54	Androscoggin River
Little Androscoggin Interceptor	4,450	10-30	---
Canadian National Railroad Interceptor	1,250	18-30	---
Total	**17,950**	**---**	**---**

2.2.2 Lewiston Collection System

There are five major sewer interceptors in the Lewiston wastewater collection system. Details of these interceptors are included in Table 2-2.

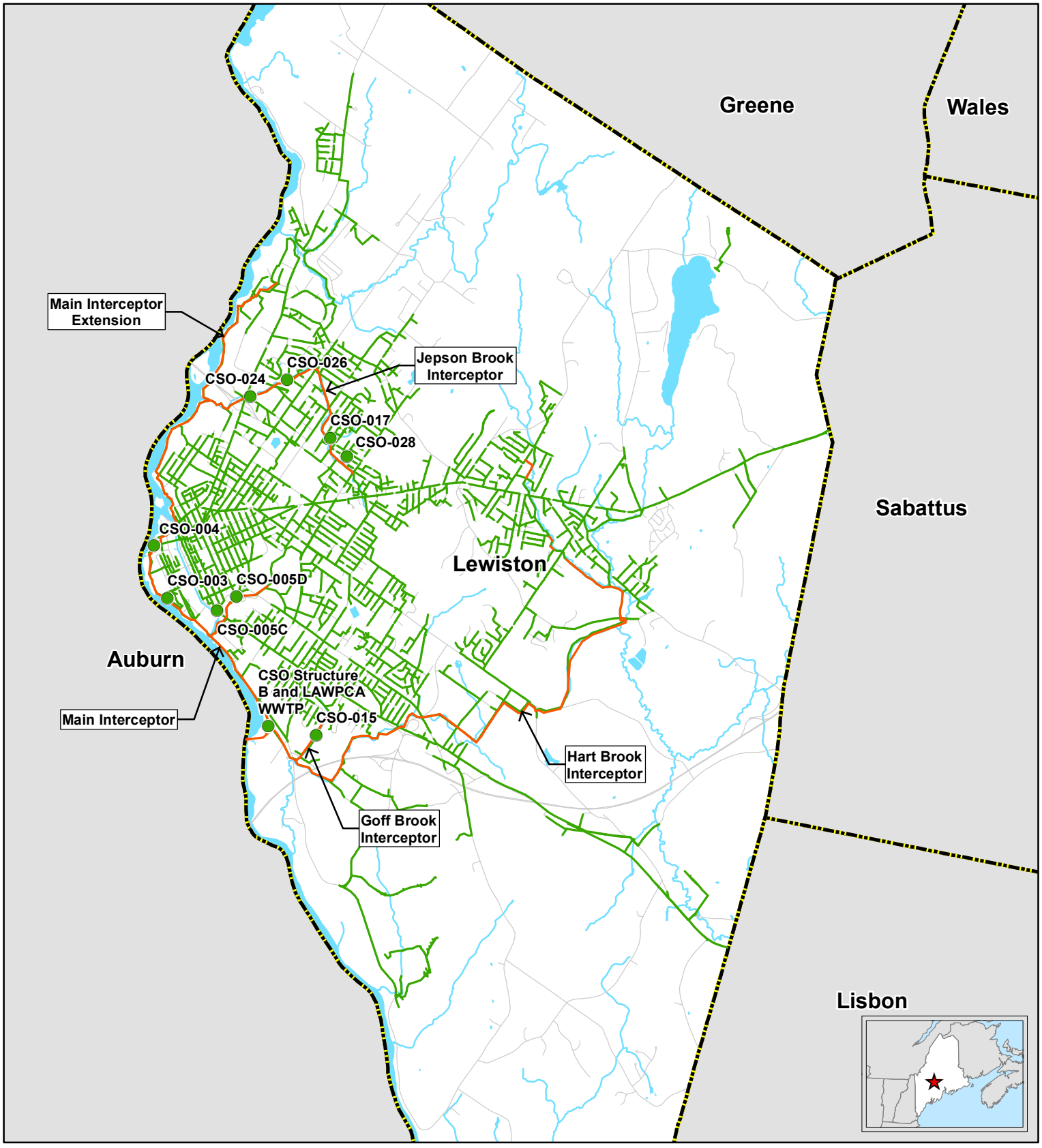
TABLE 2-2
Lewiston Interceptors

Interceptor Name	Approximate Length	Approximate Diameter	CSO Discharge Location
Main Interceptor	18,830	18-48	Androscoggin River
Jepson Brook Interceptor	11,170	24	Jepson Brook
Main Interceptor Extension	9,220	30-36	Androscoggin River
Hart Brook Interceptor	1,540	48	N/A
Goff Brook Interceptor	2,450	18-36	Goff Brook
Total	**43,210**	---	---

The Lewiston collection system has a total of approximately 791,902 linear feet of sewer pipe including interceptors. Approximately 31% (245,500 linear feet) of the total sewer system area was originally a combined system. Figure 2-2 illustrates the Lewiston collection system, including locations of major interceptors as well as other main sewers.

Figure 2-3 shows the City of Lewiston with the original combined areas before any sewer separation efforts took place. By the end of 2014, Lewiston had completed public street sewer separation in 95% of the streets within Lewiston's combined sewer system.

Lewiston has nine flow regulators remaining throughout the collection system. These nine regulators contribute flow to eight CSO outfalls. Four of these regulators contribute flow to the Jepson Brook Interceptor or into Jepson Brook during wet weather events that exceed the capacity of the sewers. Three of these regulators direct flow into the Main Interceptor, or Main Interceptor Extension. One regulator and outfall exist in the Goff Brook Interceptor and one regulator overflows into Gully Brook. During significant wet weather events, these nine regulators direct overflow through outfalls into the Androscoggin River or its Lewiston tributaries, Goff, Jepson and Gully Brooks. There are no remaining discharges of CSO to Hart Brook.



Legend

- CSO Regulators
- Sewer Pipes
- Interceptor Sewer

1 inch = 1.015767 miles

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Miles

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FIGURE 2-2
LEWISTON COLLECTION SYSTEM

Clean Water Act Master Plan
20 Year Update
Lewiston/Auburn, Maine

June 2019

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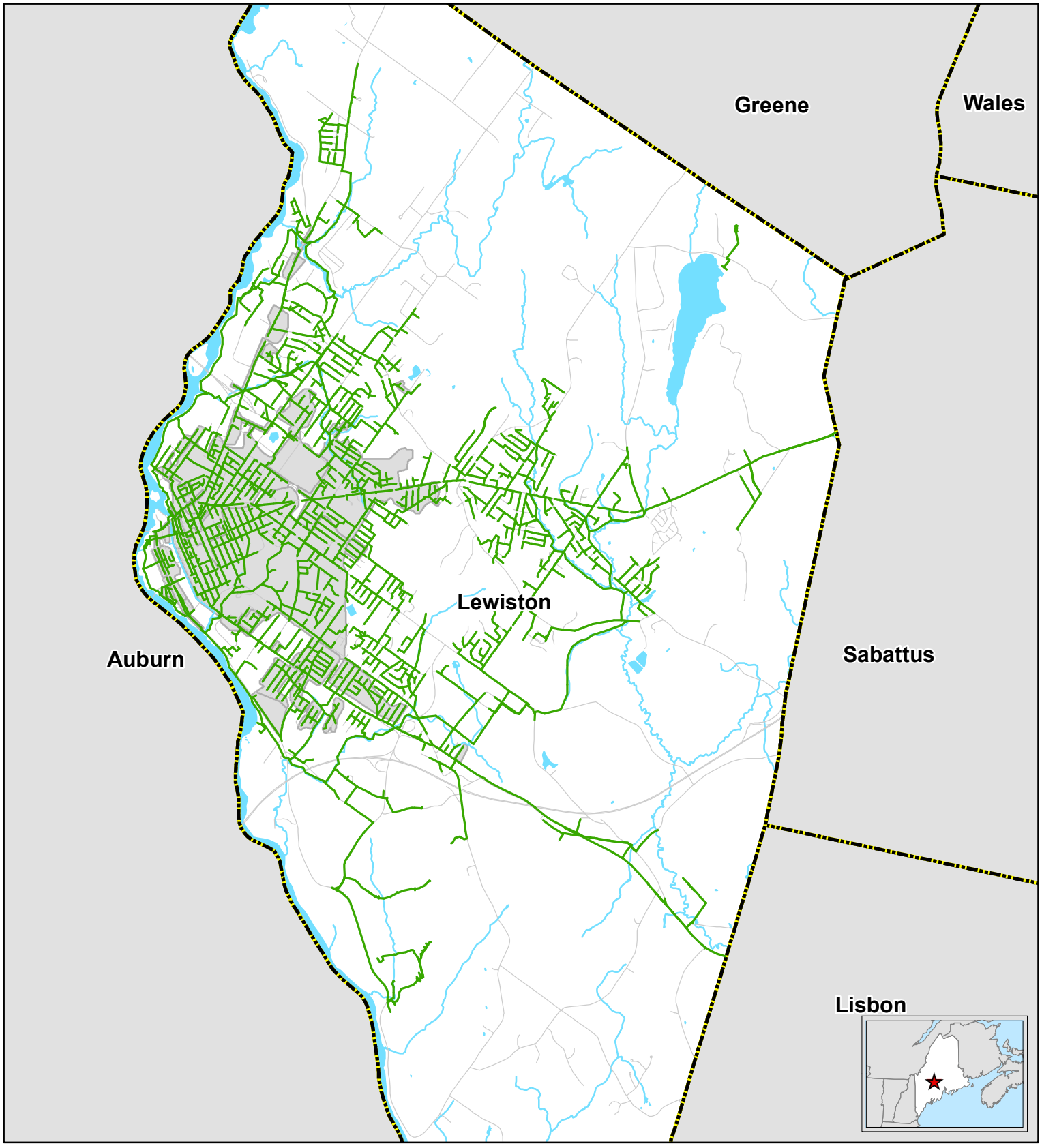

Legend

- Sewer Pipes
- Historically Combined Areas

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Imagery provided by ESRI.

1 inch = 1 miles

0 0.5 1

Miles

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FIGURE 2-3
LEWISTON AREAS HISTORICALLY COMBINED

Clean Water Act Master Plan
20 Year Update
Lewiston/Auburn, Maine

June 2019

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L-5006

The CSO storage facility at Water Street in Lewiston was completed in June 2008. The 1.3-million-gallon storage facility was originally designed to provide a level of control of approximately a 6-month storm at CSO 004. (Preliminary Design Memorandum, CDM Smith, May 15, 2006).

The Goff Brook Storage facility is a 0.3-million-gallon facility that was completed in 2010. This facility has reduced discharges from CSO 015. CSO 015 is the only overflow that discharges into the Goff Brook.

The Gully Brook Storage facility is a 0.4-million-gallon facility that was completed and placed in operation in June 2019. This storage facility is anticipated to reduce discharges from CSO 003.

2.2.3 LAWPCA

The Wastewater Treatment Plant (WWTP), which is operated by the Lewiston Auburn Water Pollution Control Authority (LAWPCA), was constructed in the early 1970's and placed in operation in 1974. The treatment facility is located on the east bank of the Androscoggin River, off Lincoln Street in Lewiston.

Flows from Lewiston and Auburn are conveyed to the WWTP via each City's main interceptor. The Auburn flow is conveyed under the river via an inverted siphon directly into the headworks of the plant. Lewiston flow is conveyed via the 48-inch Main Interceptor. One CSO, Structure B, which is located on the Main Interceptor from Lewiston just upstream of the facility, is operated by LAWPCA. During periods of high flow, to protect the plant, a hydraulic gate in Structure B throttles flow from Lewiston causing a discharge directly to the Androscoggin River through the permitted CSO.

Following flow metering through Parshall flumes and screening at the headworks of the WWTP facility, the combined Lewiston and Auburn flow is pumped by the raw wastewater pumps to primary treatment. Figure 2-2 includes the location of the LAWPCA treatment facility, Structure B, and the LAWPCA outfall to the Androscoggin River.

Tighe&Bond

SECTION 3

Section 3
CSO Improvements - Nineteen Years of Progress (2000-2018)

3.1 Introduction

This section summarizes relevant CSO abatement projects conducted by the Auburn Sewerage District (ASD), the City of Lewiston, and the LAWPCA during the initial twenty-year period (January 2000 through December 2018) of the Clean Water Act Master Plan (CWAMP).

The recommended CWAMP for Lewiston and Auburn includes the following:

1. Best Management Practice (BMP) Program

   The recommended BMP program for both cities consists of improving BMP efforts for the following:

   - Proper collection system operation and maintenance;
   - Maximizing the use of existing systems for storage and transport;
   - Solids and floatable materials control; and
   - A Public Education Program.

2. Collection System Controls

   The collection system controls consist primarily of public street separation and targeted Inflow/Infiltration (I/I) removal. Utilization of an additional storage, both within the collection system pipes and at dedicated storage facilities are discussed in the collection system controls sections.

3. Compliance Monitoring Program

   The compliance monitoring program, a joint effort between Lewiston and ASD, consists of seasonal monitoring of CSO flows. The goal of the compliance monitoring program is to collect data during and after implementation of the recommended plan for the purpose of determining the plan's overall effectiveness in providing control of CSO discharges. Data collected from the LAWPCA wastewater treatment plant is also used in the compliance monitoring program. The data collected from all three entities gives a clear understanding of the entire system.

Throughout the 20-year implementation period of the CWAMP, Lewiston and Auburn have made significant progress in their collection system Capacity, Management, Operation, and Maintenance (CMOM) Programs. These programs incorporate standard procedures and activities in order to better manage collection systems, allow investigation of constrained areas, proactively prevent CSOs, and respond to CSO events.

Lewiston and Auburn have also been following the EPA's Nine Minimum Controls for combined sewer overflows. These controls are implemented by the cities to reduce CSOs and their effects on the Androscoggin River.

3.2 Auburn Accomplishments

Even prior to the establishment of the CWAMP recommended plan, ASD was working towards CSO control through sewer separation. The collection systems tributary to CSOs 007, 010, and 011 were completely separated and the CSO outfalls were closed in 1993, 1989, and 1990 respectively. By 1998 portions of the collection system tributary to CSOs 003 and 005 were separated.

By the end of 2004, ASD was performing collection system operation and maintenance inspections weekly on pump stations and monthly on CSO regulators and CSO outfalls. In addition to sewers being flushed, TV inspections and rodding were also being performed on an annual basis to remove built-up debris and inspect the structural integrity of the sewer piping. ASD completed total separation of areas tributary to CSOs 008 and 009, and the associated outfalls were closed in 2002. By the start of 2005, approximately 112,460 feet of the original 196,940 feet of combined sewer had been separated (approximately 58,080 feet were separated between 2000 and 2005). The total cost of sewer separation projects within the ASD prior to December 31, 2004 was $12.44 million.

After the first 10 years of the CWAMP, Auburn had spent $16.6 million of the expected $19.2 million total CWAMP cost. This represented 86% of the planned expenditures indicating CSO elimination efforts were well ahead of schedule. At the end of 2009, 8 of 11 (73%) CSO outfalls had been closed.

A significant milestone occurred in 2009, as ASD, in partnership with the City of Auburn, received funding of $2,345,000 from the American Recovery and Rehabilitation Act (ARRA) of 2009 through the State of Maine Department of Environmental Protection State Revolving Loan Program. Funding focused on separation of the Perryville Neighborhood Project which included the installation of 18,700 feet, or 3.5 miles of new sewers or drains with pipe sizes from 8-inch through 42-inch. The 103-acre Perryville Neighborhood is a mostly small lot, multi-unit residential development. The development includes 392 homes with an estimated service population of nearly 1,400 people. The project removed 187 catch basins from the combined sewer system and resulted in a reduction of an estimated 7.5 million gallons annually of combined sewer over flow to the Androscoggin River.

Between 2010-2014, ASD separated an additional 11,000 feet of combined sewer at a cost of just over $1 million. At the end of the 2014 reporting period, ASD had theoretically separated 100% of the pipes in the street, with total expenditures at $20.02 million.

Since the start of 2015, ASD has separated an additional 1,000 feet of combined sewer, theoretically reaching 100% separation of the combined sewer piping in the street, with total expenditures at $20.2 million.

Since reaching 100% public sewer separation, the ASD has continued to reduce CSO volumes buy targeting private combined sources, and public/ROW inflow and infiltration.

At this time, ASD has 2 active CSO regulators. ASD closed CSO #005 (Miller Street) during the summer of 2015, however, due to flash rainstorms that caused sewer backups, the plate that sealed the CSO was removed in August of 2016 and the CSO was permitted.

3.2.1 BMP Program

The CWAMP recommended proper collection system operation and maintenance, maximizing the use of existing systems for storage and transport, solids and floatable materials control, and a Public Education Program.

3.2.1.1 Collection System Operations and Management

The ASD improved collection system operation and maintenance through catch basin cleaning, sewer cleaning, and TV inspection. The ASD performs weekly inspections of the pump stations and monthly inspections of CSO regulators and CSO outfalls. Sewer flushing, rodding, and TV inspection are performed on an annual or as-need basis to remove built up debris and inspect the structural integrity of the sewer piping.

Since the 2010-2014 reporting period, all wastewater pump stations have been monitored in real-time via a SCADA system, and are directly inspected on a weekly basis by ASD personnel. Observations are logged with each visit. All SCADA alarms are tested twice each year to ensure proper function and reliability.

Since June of 1994 and prior to full separation, the City of Auburn has followed a CSO Catch Basin Priority Cleaning Program where the city targeted cleaning catch basins and street sweeping based on the combined sewers pollutant discharges to the receiving waters. The Highway Department also provides regular street sweeping and estimates that approximately 7,000 cubic yards of sand and debris are removed from city streets annually from sweeping, which is approximately 70% of sand laid on roadways each winter.

From the period of 2000 through 2009, the Auburn Public Works (APW) cleaned approximately 1,400 catch basins and removed a total of approximately 890 cubic yards of material annually. In the 2010-2014 reporting period, APW cleaned approximately 2,952 catch basins annually and removed a total of approximately 501 cubic yards of material each year. Since 2014, APW has continued this practice and continues to clean approximately 2,000 catch basins annually and remove a total of approximately 400 cubic yards of material each year. Figure 3-1 shows the number of catch basins cleaned each year, and the cubic yards of material removed from 2000-2018.

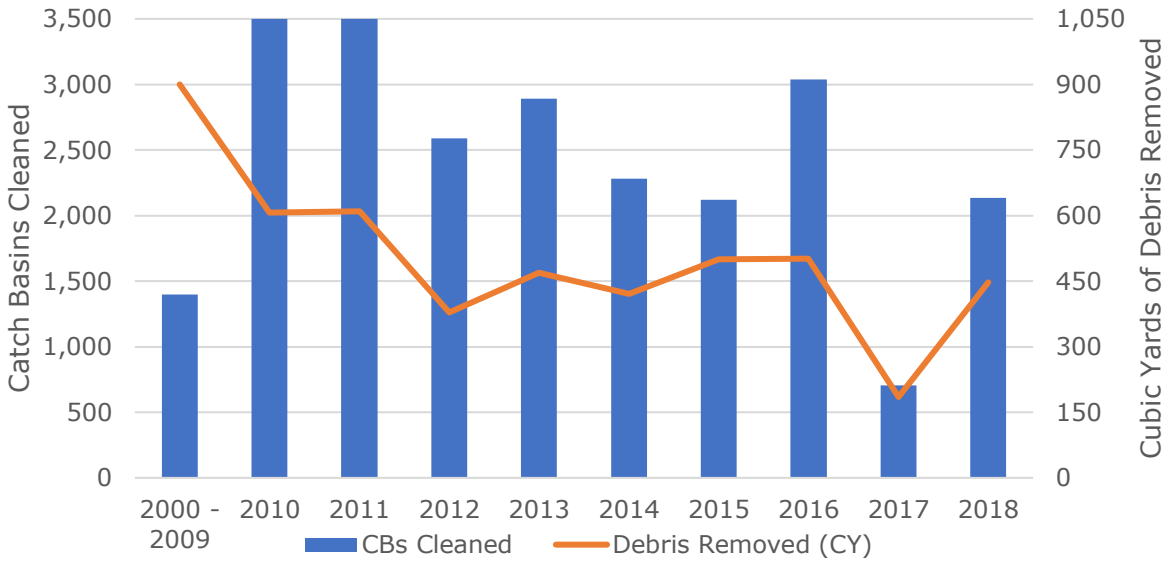


FIGURE 3-1
Auburn Public Works 2000-2018 Catch Basin Cleaning and Debris Removed

ASD continued its BMP efforts through sewer cleaning. Figure 3-2 shows the reported amount of debris removed, and the linear feet of sewer cleaned over the nineteen-year period, 2000-2018. ASD made a significant investment in 2013 in leasing its first ever sewer Vactor truck. The investments helped strengthen ongoing maintenance efforts for the collection system.

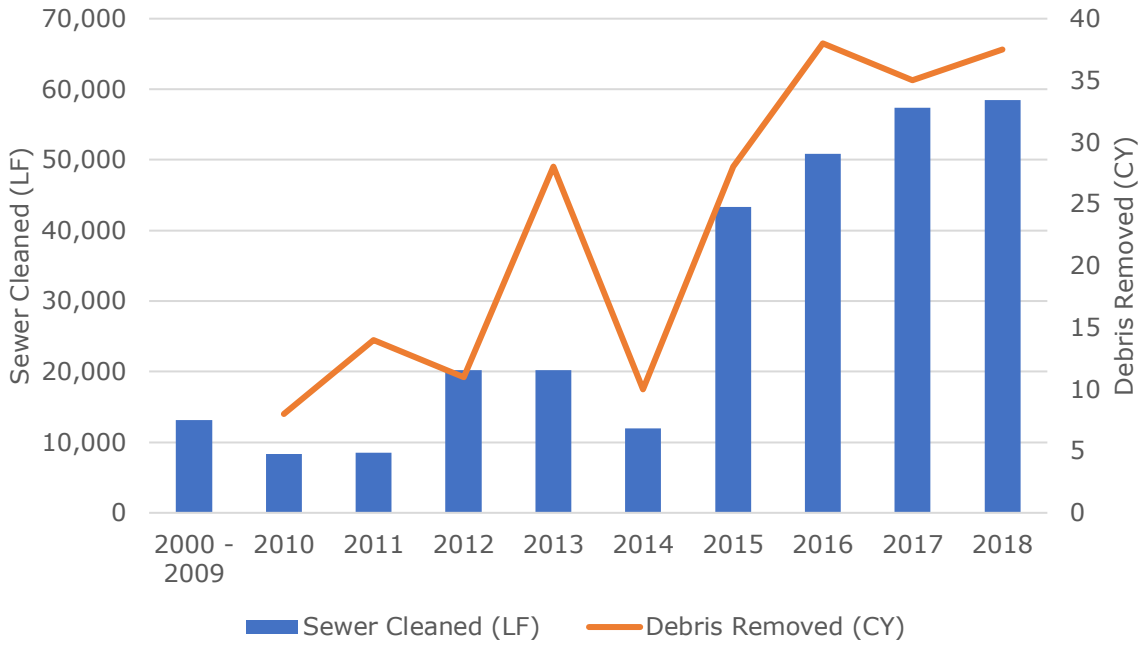


FIGURE 3-2
Auburn Sewer District 2000-2018 Sewer Cleaning and Debris Removed

During the period of 2000-2018, the ASD completed TV inspection of sewer problem areas as needed. In 2013, ASD purchased a video inspection "push-camera" to inspect small sewer mains and residential services. The investments helped strengthen ASD's maintenance efforts in the collection system. Figure 3-3 summarizes the TV work completed from 2000-2018.

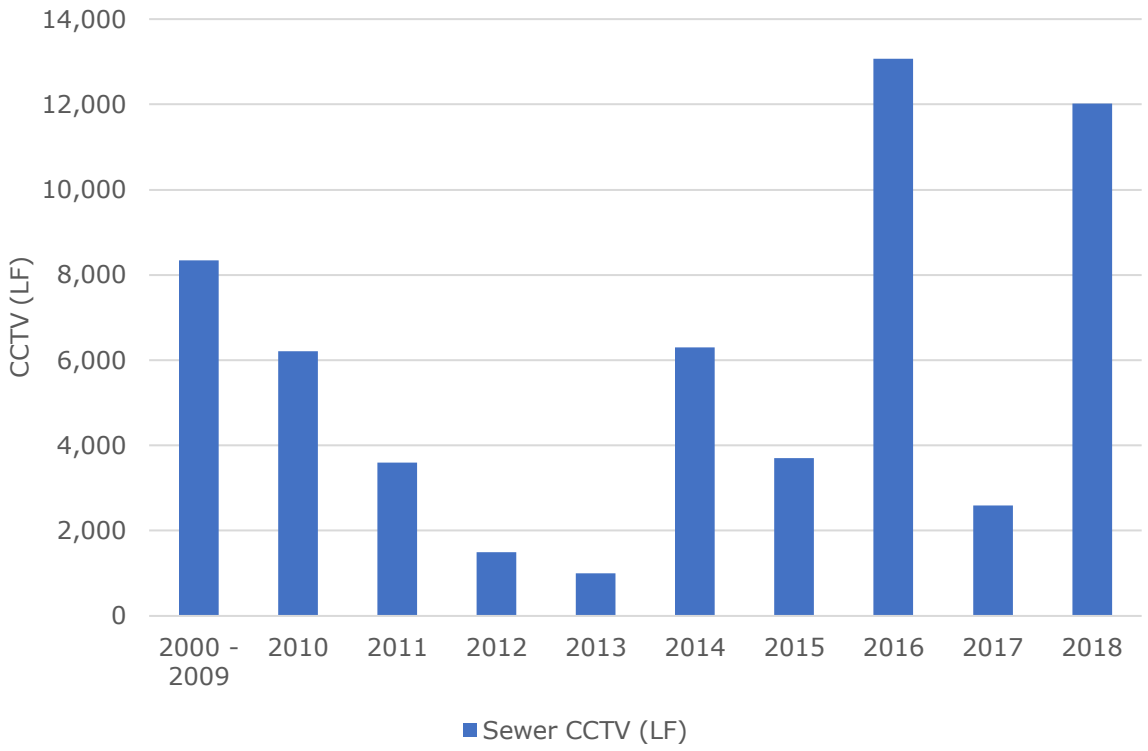


FIGURE 3-3
Auburn Sewer District 2000-2018 Annual Televised Inspection Totals

3.2.1.2 Public Education

The City of Auburn has an annual Household Hazardous Waste Collection Day and a spring curbside cleanup program to encourage people to properly dispose of hazardous and other household wastes that could otherwise be introduced to the sewer or drain collection systems. Signs are installed at each CSO outfall to alert the public that storm runoff and sewage may be discharged to the receiving waters under high flow conditions. The City of Auburn has participated in multiple public education programs including MEPDES' stormwater programs' "Think Blue" campaign and student workshops through the Androscoggin Valley Council of Governments (AVCOG) with the "Drains to River" activities. During May through November, on the first and third Saturdays of the month, residents can bring hazardous waste to the AVCOG, Environmental Depot at the Lewiston Solid Waste Facility on River Road. Additionally, fluorescent lights, waste oil, and antifreeze were accepted at the Auburn Public Works Garage during normal business hours. This service is free of charge to Auburn residents.

In 2012, ASD began experiencing frequent problems with non-dispersible wipes and subsequently developed informational notices for both residential and commercial customers to alert them to the problems of flushing these products into the collection

system. Mailings were sent to all residential customers and ASD hand-delivered flyers to commercial establishments, specifically focusing on restaurants.

Also in 2012, the City of Auburn made efforts in regard to the MS4 Storm Water Compliance Program:

• APW developed and distributed three posters. Two of the posters encouraged homeowners to keep their lawns at a longer length and discouraged the use of phosphorus containing fertilizers. The third poster stressed the need to keep trash and debris out of catch basins.

• Throughout the summer of 2012, Public Works employees applied stencils to the pavement next to all catch basins. The stencils alerted people not to dump illegal substances and reminded them that anything put into the basins drains directly to the river.

Starting in 2015, flyers were created and made available at the ASD office to remind the public to put items in the trash instead of flushing them down the toilet. The City of Auburn continues to make efforts through the MS4 permit to provide public education and outreach, and in 2016 the City began displaying posters promoting proper fertilization of lawns and lawn maintenance to reduce pollutants, as well as an active catch basin stenciling program.

3.2.1.3 Maximizing the Use of Existing Systems for Storage and Transport

During the first ten years of the program (2000-2009), the ASD had been primarily focused on sewer separation. There was a shift towards I/I removal during the last ten-year period.

In 2010, ASD conducted visual inspections of manholes on the Sunset cross-country sewer interceptor which extends up to Colonial Way. A total of 12 manholes were inspected for potential I/I issues. Crews also removed brush and small trees that were starting to grow along this cross-country route. ASD also performed visual inspections and repairs on 32 manholes on the west side of the Taylor Pond sewer system, from Chicoine Avenue to Garfield Road. Repairs ranged from simple mortaring of manhole joints, to complete, full-structure relining of manholes by a lining company.

In 2011, ASD conducted visual inspections of manholes on the Poland Road to Brickyard Circle cross- country sewer interceptor, both of which cross and then run parallel to Taylor Brook. A total of 19 manholes were inspected for I/I issues. Crews also removed brush and small trees that were starting to grow along this cross-country route.

In 2012, an extensive I/I investigative program was implemented by an outside consultant where over 650 sewer manholes and nearly 215,000 feet of sewer main were inspected and smoke-tested. The smoke testing work focused on the core of the older, originally combined sewer system. The consulting firm identified 170 specific "defects" that were either inflow or infiltration sources. These included such inflow sources as private catch basins and roof drains. Infiltration sources consisted of cracked sewer pipes, leaky manholes, or root intrusions on services.

In 2013 and 2014, ASD worked to eliminate the defects identified in the 2012 study.

For the reporting period of 2015-2019, ASD appropriated 2.3 million dollars to fund efforts reducing I/I issues. To date, this funding has been used to locate illicit roof drains, sump pumps, and defects. ASD tv inspected 24 individual sewer services for residents on Davis Avenue and ran a smoke testing program that resulted in the discovery (and later, the removal) of six private catch basins.

3.2.2 Collection System Controls (2005-2019)

The second part of the recommended plan for ASD included primarily sewer separation. The plan concluded that total separation of sewers tributary to CSOs 003, 006, 008, and 009, elimination of the Pettengill Park cross-connection, and partial separation of sewers tributary to CSOs 004 and 005 would be required to obtain full control of CSOs on an annual basis. CSO 002 would be at a 100 percent control level once the upstream sewer systems were at a 100 percent control level.

Even prior to the establishment of the CWAMP recommended plan, ASD was already working towards CSO control through sewer separation. The collection systems tributary to CSOs 007, 010, and 011 were separated and the CSO outfalls were closed in 1993, 1989, and 1990 respectively. By 1998 portions of the collection system tributary to CSOs 003 and 005 were separated, and by 2005 approximately 112,390 feet of the original 198,940 feet of combined sewer had been separated.

Between 2005 and 2009, an additional 66,720 feet of sewer were separated. The ASD closed CSOs 002, 004, and 003 in July 2006, September 2007, and November 2008, respectively. At the beginning of the abatement program, a total of 11 outfalls existed in the system. By the end of 2009, eight outfalls were sealed. At the beginning of the third five-year period of the CWAMP, an initial assessment estimated that only 11,000 feet of new sewer or storm drain was required to achieve 100% public street sewer separation between the sanitary and storm water collection systems. That included approximately 90 catch basins that were believed to still be connected to the sanitary system.

The estimated cost to implement Auburn's recommended plan was $17.77 million. At the end of 2009, $16.67 million (94 percent) had been spent. By the end of 2014, all public street separation work determined to be needed in order to control overflows resulting from the 1-year storm had been completed, with total expenditures of $17.9 million. Auburn's separation efforts included the installation of approximately 33 miles of either new sanitary or storm drain lines.

Figure 3-4 summarizes the annual feet of public sewer separated during 2000-2018. This figure shows no combined areas, indicating that Auburn has reached 100% theoretical separation and must begin the rehabilitation work in the system.

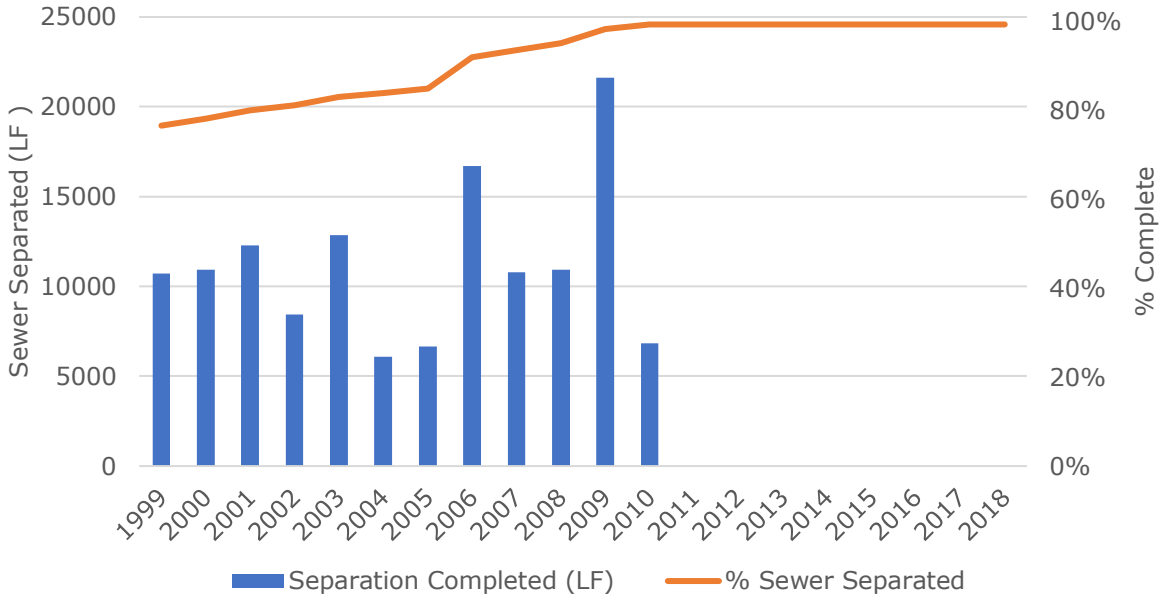


FIGURE 3-4
Auburn Sewer District 2000-2018 Sewer Separation Efforts

After the public street separation projects were complete, Auburn started to shift from public way sewer separation to sewer rehabilitation during the 2010-2018 reporting periods. Attention shifted toward smaller wet-weather contributions that could be attributed to I/I sources. ASD initiated several projects to correct the known defects in the system. Recently, Auburn has begun offering free inspections of private sewer services on a neighborhood-by-neighborhood basis to help identify potential I/I sources. Figure 3-5 summarizes funds spent from 2000-2018 on both sewer separation and sewer rehabilitation projects by the ASD.

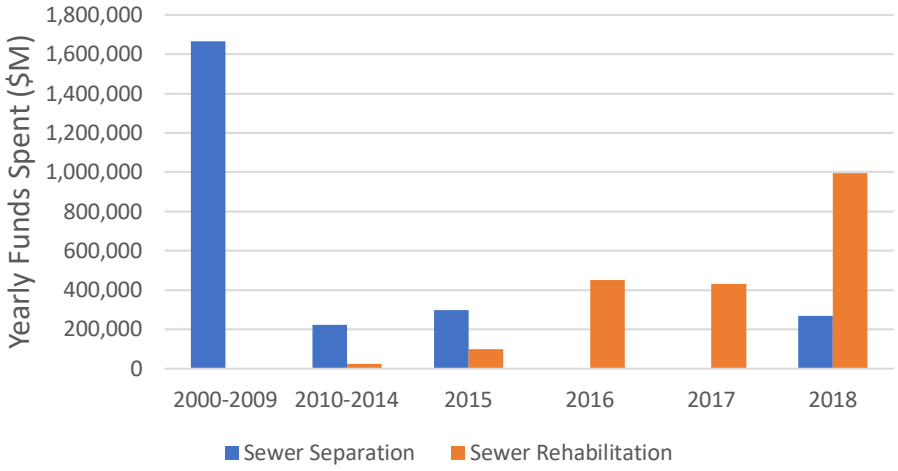


FIGURE 3-5
Auburn Sewer District 2000-2018 Sewer Separation and Rehabilitation Funds Spent

Table 3-1 shows a summary of sewer rehabilitation projects worked on during this

reporting period (2015-2017).

TABLE 3-1
City of Auburn Sewer Rehabilitation Projects 2015-2017

Year	Work Accomplished and Street / Area
2015	Lined over 2,750 LF of sewer on various streets
2016	Replaced 1,206 LF of sewer on various streets Lined 1,374 LF of sewer on various streets
2017	Lake Street – replaced 1,300 LF of sewer Lake Street/New Auburn – lined 4,675 LF Gamage – lined 3,650 LF

3.2.3 Compliance Monitoring (2005-2018)

The recommended plan for Auburn included a compliance monitoring program that involved seasonal monitoring of CSO flows, periodic water quality monitoring, and periodic sampling of CSO discharges. The goal of the program is to collect data both during and after implementation of the recommended plan to determine the overall effectiveness in providing control of CSO discharges. ASD continued monitoring active outfalls and reporting results to DEP in annual CSO reports.

ASD's CSO improvement has been substantial during the past 20 years. ASD experienced five active CSO events in 2014. The total discharge in 2014 was 1.29 million gallons, approximately 1% of the total discharge of over 127 million gallons in the early 2000s.

Since 2014, ASD has experienced one overflow event in 2015 with total discharge slightly less than 2.5 million gallons, four events in 2016 with total discharge slightly more than 0.815 million gallons, two events in 2017 with a total discharge of about 1.12 million gallons, and four events in 2018 with a total discharge of 1.65 million gallons.

Total yearly CSO discharge from 2000 through 2018, for all active outfalls is presented in Figure 3-6. Annual reported precipitation is also included for comparison.

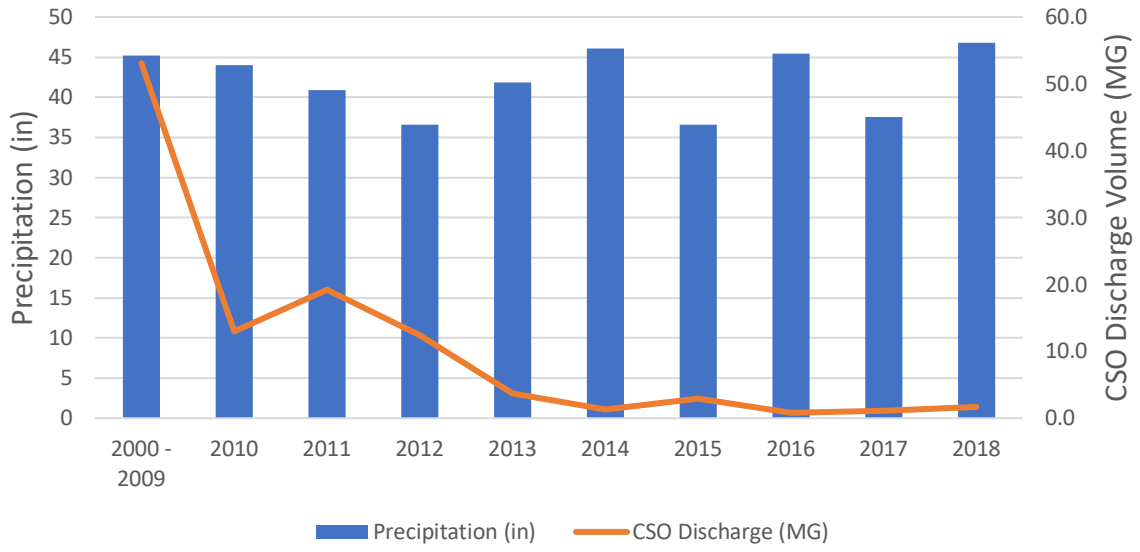


FIGURE 3-6
Auburn Sewer District 2000-2018 Precipitation vs. CSO Discharge

Auburn's CSO improvement has been substantial during the past 20 years. The total discharge in 2018 was 1.65 million gallons, approximately 3% of the total average annual discharge from the years 2000 to 2009 (53.1 million gallons).

3.3 Lewiston Accomplishments

The City of Lewiston's recommended plan also included a BMP program, collection system controls, and a compliance monitoring program. The following sections discuss Lewiston's accomplishments between January 2000 and December 2018 with respect to these three components of the CWAMP.

The City of Lewiston has made significant progress toward reducing CSOs in the system and implementing the recommendations of its CWAMP. The CWAMP included a significant amount of sewer separation in both Lewiston and Auburn. Outside of the congested urban core, the sewer separation completed to date has been an effective means of reducing overall CSO volume. By the end of 2018, Lewiston had completed public street sewer separation in more than 89% of the streets within its combined sewer system. Lewiston has also completed other significant projects including wet weather storage facilities, I/I identification and reduction, and sewer rehabilitation as part of the overall CSO reduction strategy.

Lewiston has reduced its total CSO discharges by more than 80% between 2000 and 2018 based on 1-year design storm estimates. This significant reduction in CSO volume discharged can be largely attributed to Lewiston's commitment to upgrading the sewer system via separation efforts within the public streets/right-of-way dating back to the 1990's. While this method of separating the drain system from the sewer system is effective at reducing CSO flows, it is not considered to be full separation because public street/ROW pipe separation does not account for private inflow and other extraneous flow sources that are present in the collection system. By the end of 2018, the City of Lewiston had expended $34.71 million to complete this public street sewer separation progress.

3.3.1 BMP Program

3.3.1.1 Collection System Operation and Maintenance

The City maintains regular inspection and maintenance of collection system facilities. Lewiston's fifteen pumping stations are cleaned yearly and inspected weekly. The nine CSO regulators are inspected monthly or after each storm event. The six tide gates and eight CSO outfalls are inspected yearly. All active CSO outfalls are equipped with depth sensors and depth data is downloaded monthly to estimate CSO overflow volumes. Currently, all CSO outfalls are equipped with area/velocity meters with real time alarming.

To minimize the effect of river intrusion, the City installed a new tide gate in 2007 at CSO 005C (Lisbon/ Adams) to eliminate backflow from the storm drain in this area and replaced the tide gate with an 18" Tideflex check valve in 2018. Inline Tideflex check valves were installed in 2010 at the Pettingill CSO outfall (#024), and in 2014 at Barrows Ave (#28) and Dingley (#17). In 2014, Bristol Ave (#26) was retrofitted with a Tideflex check valve.

In addition to the annual maintenance of the collection system, Lewiston initiated work to improve floatables and solids controls with a Floatable Controls Demonstration Project at CSO 015 in 2001. Due to the configurations of the regulator structures, there were not significant quantities of floatables discharged and captured during this project. Therefore, Lewiston decided not to install netting at all outfalls.

From the period of 2000-2009, the City cleaned approximately 1,962 catch basins annually and removed a total of approximately 5,688 cubic yards of material. From 2010-2014, the City cleaned approximately 2,284 catch basins annually and removed a total of 1,803 cubic yards of material. During the current reporting period of 2015-2018, the City cleaned approximately 1,800 catch basins annually, as well as performed annual street sweeping, removing a total of 1,238 cubic yards of material. Figure 3-7 shows the annual number of catch basins cleaned and material removed for 2000-2018.

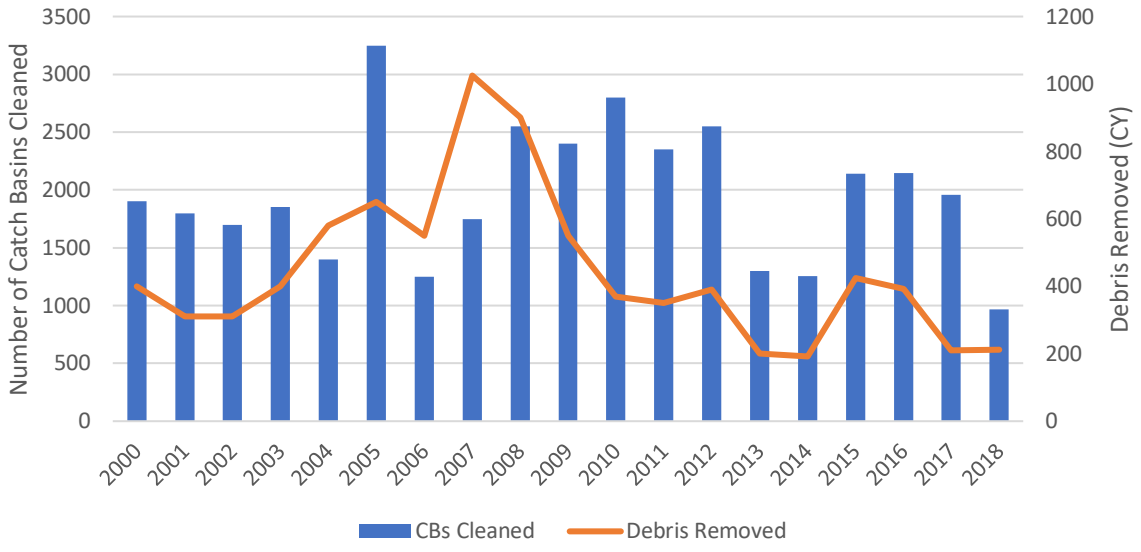


FIGURE 3-7
City of Lewiston 2000-2018 Catch Basin Cleaning and Debris Removed

Lewiston continued its BMP efforts by performing regular sewer cleaning. A total of 460 tons of debris was removed as a result of sewer cleaning/flushing from 2000-2009. This was achieved by cleaning/flushing approximately 322,389 feet of main. From 2010-2014, approximately 466 tons of debris were removed, and 386,040 linear feet of sewer were cleaned. During the current reporting period of 2015-2018, the City cleaned approximately 493,323 linear feet of sewer and removed over 371 tons of debris. Figure 3-8 shows the amount of debris and feet of pipe cleaned annually from 2000-2018.

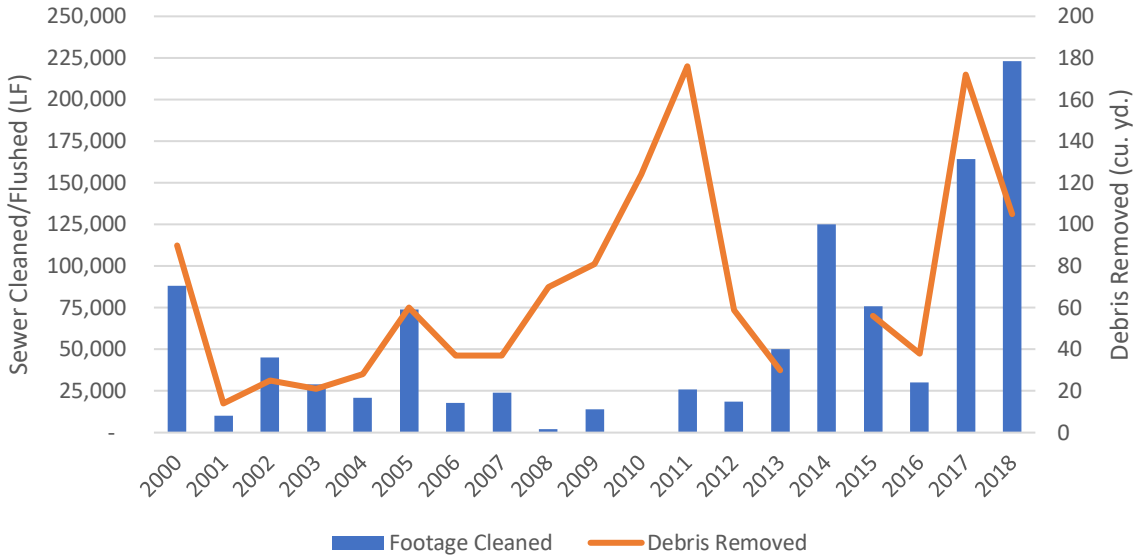


FIGURE 3-8
City of Lewiston 2000-2018 Sewer Cleaning and Debris Removed

In 2000, the City purchased its own TV inspection equipment. This equipment has been used in the City's regular cross-country sewer inspection program. The City completed TV inspection of sewer problem areas as needed and as required for design projects and upcoming construction. Approximately 257,288 feet of sewer mains were televised from 2000-2014. The City continued TV inspections during the 2015-2018 reporting period, performing CCTV on approximately 548,383 linear feet of sewer. All of the condition information on the pipes, including deficiencies, maintenance condition and associated videos, were logged in the City's Asset Management system. As of 2019, all of the City's sewer pipes have now been video inspected and the videos entered into the City's Beehive asset management system. Figure 3-9 summarizes the TV work completed between 2000 and 2018.

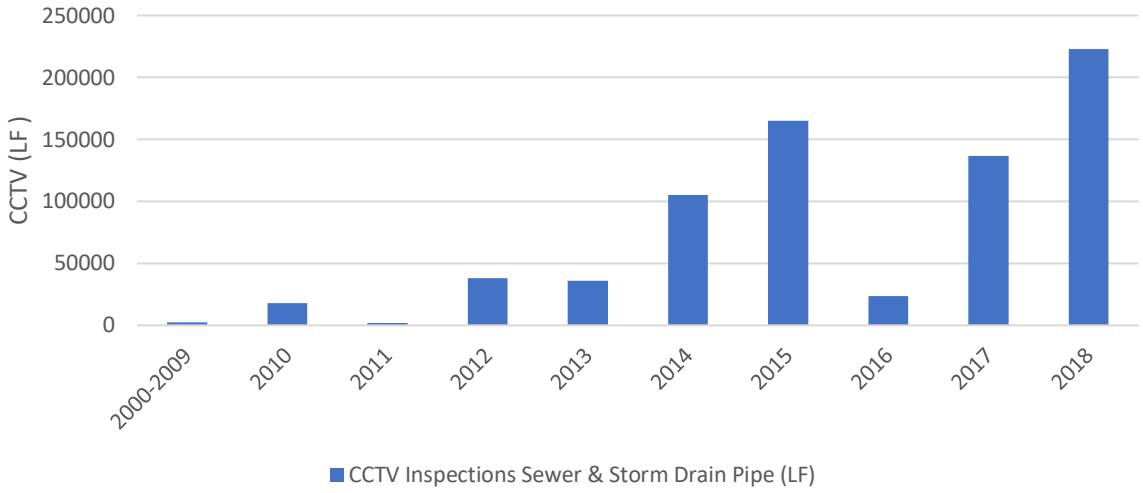


FIGURE 3-9
City of Lewiston 2000-2018 Annual Televised Inspection Totals

3.3.1.2 Public Education

An additional component of Lewiston's recommended BMP improvements included a Public Education Program. All CSO locations are marked with a sign in accordance with requirements to make residents aware of potential overflows. Leaf collection for composting occurs annually throughout the City, coordinated by the Highway Division and the Solid Waste Division of Lewiston. During the 2010-2014 reporting period, the City of Lewiston significantly improved the website. This allows for easier access to valuable information for residents and businesses. Moving forward, Auburn and Lewiston will look into creating a collaborative public education program.

The community continues to host a hazardous waste collection program, open to residents every other Saturday. This program encourages residents to properly dispose of hazardous waste that may otherwise end up in the city sewer system.

3.3.1.3 Existing System Improvements

Work has been completed to remove private inflow from the sewer system, especially in the Gully Brook area. In 2001, the City executed a house-to-house inspection program of approximately 300 houses in the Gully Brook area to identify private inflow connections. As of 2010, approximately 123 of the 137 confirmed private inflow sources in the Gully Brook area were removed from the sewer system. In 2003, Lewiston purchased smoke testing equipment which was used for identifying storm drain connections and other sources of infiltration and inflow (I/I). Smoke testing followed by sewer separation led to the removal of an estimated 450 catch basins from the combined sewer system prior to 2005.

From 2010-2014, the City removed 315 catch basins and 24 roof leaders from the sewer system, and in the reporting period of 2015-2018, an additional 170 catch basins and 27 roof leaders have been removed.

Between 1998 and 2014 the City of Lewiston lined 32,000 linear feet of sewer mains throughout the city in an effort to restore the structural integrity of the pipes and reduce I/I in the system. Since the start of 2015, an additional 45,065 linear feet has been lined.

As part of the pollution prevention program that focuses on contaminant reduction, a sub-surface stormwater management system was installed under Webster Street in 2017. It is a StormTech Chamber to provide storage and treatment for 52 acres of the Hart Brook Watershed. It was funded by $94,000 from a Section 319 MDEP grant and $66,647 from the City.

3.3.1.4 Asset Management

Beginning in 2010, the City of Lewiston established an interactive GIS link with the ITPipes database. This database highlights all of the pipe segments that have been video inspected in the City since 2010. The database is capable of classifying pipes by condition and is helpful in highlighting the pipes with the poorest condition ratings. The ITPipes database is fully integrated with the GIS mapping and video pipe inspections which allows users to view the videos by simply clicking on a pipe.

Over the past five years, the City has completed significant work toward establishing a comprehensive asset management system for its collection system. The City began this effort to not only address its capacity, management, operations and maintenance (CMOM) requirements but also to streamline its maintenance activities and more effectively prioritize necessary capital work. Lewiston adopted Beehive as its computerized maintenance management system (CMMS) in 2018 and has leveraged the system to better facilitate and track O&M activities, including work orders, the deployment of staff, and to realize improved efficiencies in operations. The City has since advanced toward implementing an Asset Management-based approach and has upgraded the Beehive enterprise to include its use of ITPipes to catalog the National Association of Sewer System Companies (NASSCO) ratings of its sewers, sewer laterals, and structures.

In 2016, the City progressed its asset management system by implementing a risk assessment program operated by Ted Berry. The risk assessment program utilizes risk-based ratings, such as likelihood of failure and consequence of failure, to prioritize and plan capital improvements. The risk assessment program is updated each year with all pipes that have been inspected since the prior update.

3.3.2 Collection System Controls

The second part of the recommended plan for Lewiston included collection system controls, which consists primarily of sewer separation in public streets and right of way. Along with sewer separation, Infiltration and inflow investigations and removal has been ongoing in the city for several years, with more work planned for the next several years as the city's focus moves away from public street separation and toward I/I removal.

The City of Lewiston lined sewer mains throughout the city in an effort to restore the structural integrity of the pipes and reduce I/I in the system.

The recommended plan included fourteen separation construction contracts over fifteen years. The Gully Brook drainage basin, CSO 005, was identified as a priority because separation would remove approximately 80 percent of CSO discharged annually from this basin.

The city completed two CSO regulator modifications in 2005 to maximize the use of existing systems for storage and transport. One of these modifications was in the Gully Brook area. The inlet to the sewer at the Gully Brook outfall, CSO 005, was plugged to allow stormwater to discharge to the river instead of entering the sewer system. The CSO regulator was moved 1500 feet upstream. This reduced daily flows to LAWPCA by approximately 0.5 MGD and significantly reduced discharges from CSO 005.

The second modification was lowering the weir at CSO 024 (Pettingill) by 12.5 inches to relieve surcharging and backup into houses along the Jepson Brook Interceptor during rain events. The City completed another two CSO regulator modifications in 2007 on regulators 029 and 031A to eliminate inflow from a wetland, sport field, and a large parking lot.

In 2008, Lewiston completed the Water Street CSO Storage Facility and 2,700 feet of separation, along with smaller CSO related projects for a total expenditure of over $6.2 million. The storage facility came online in June and captured over 21 million gallons of combined sewer volume in the first six months of operation. Over 40 inches of rain fell in that same six-month period and the facility performed well.

Though minor separation occurred in 2009, the focus for the year was the Goff Brook CSO Storage Project. Construction of this storage facility began in January 2010.

A total of 60,000 linear feet of the original 469,920 feet of combined sewer was separated from 1997 through 2009, with expenditures totaling at approximately $19.5 million. From 2010-2014, approximately $11.15 million was expended on the separation of 52,830 linear feet of sewer. During the current reporting period of 2015-2018, an additional 12,000 linear feet of sewer was separated, bringing the total expenditures for the CWAMP separation efforts through the end of 2018 to $34.71 million. It is important to note that the linear footage of work reported is the linear footage of the pipes that were actually installed in the ground, rather than the length of sewer pipe separated which is often much greater. For instance, 500 feet of new drains may be all that is required to separate 1,500 feet of sewers.

Recently completed projects are described in more detail below.

Table 3-2 shows a summary of sewer separation projects worked on during this reporting period (2015-2018).

TABLE 3-2
City of Lewiston Sewer Separation Projects 2015 -2018

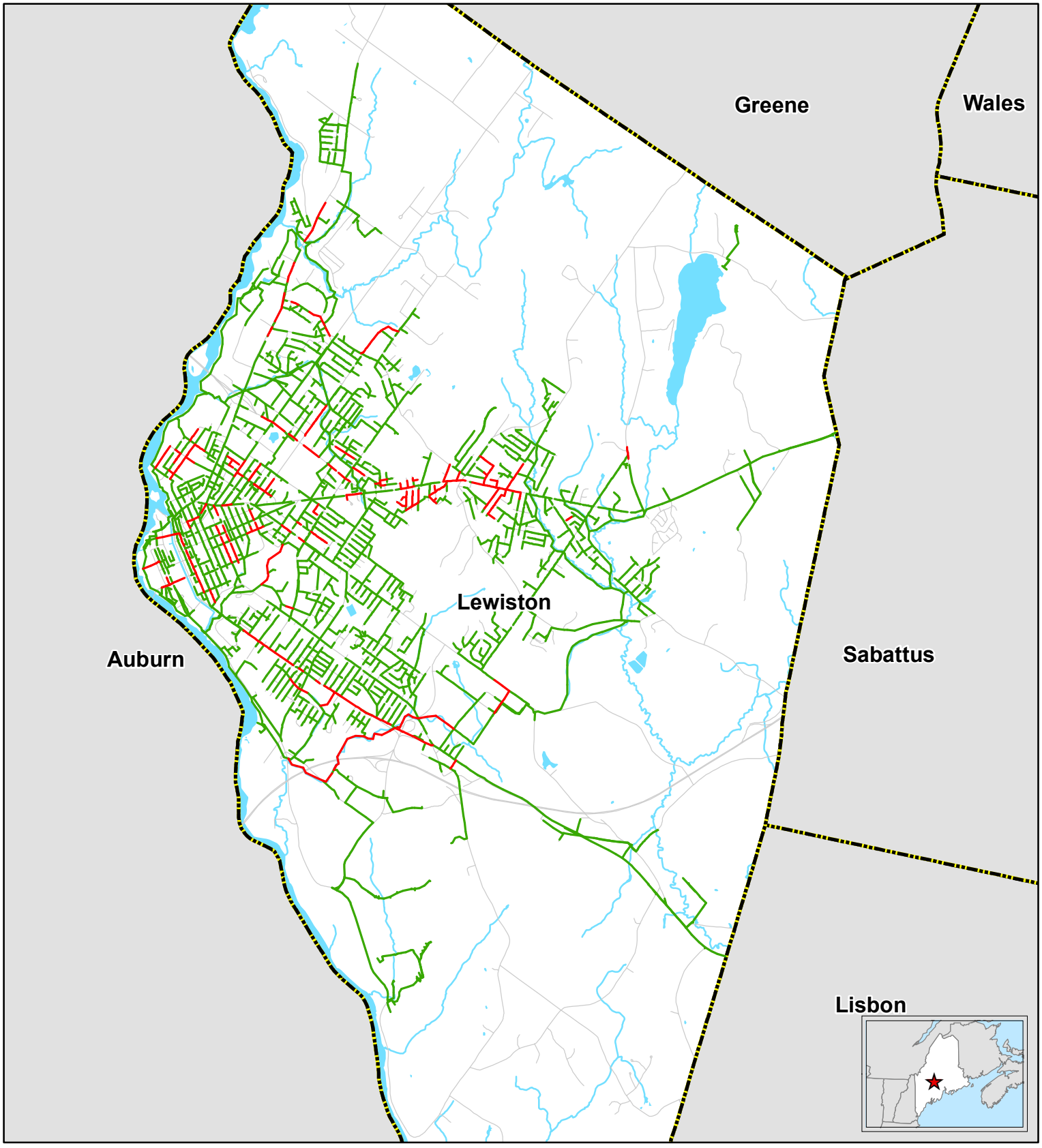
Year	Street / Area of Sewer Separation
2015	Main Street – 750 LF and 10 catch basins
2016	Sunnyside Area – 4,800 LF and 54 catch basins Dumont Avenue – 300 LF and 3 catch basins Main Street – 360 LF and 5 catch basins Lisbon Street – 570 LF and 21 catch basins Chestnut Street – 320 LF and 4 catch basins
2017	Simard Street – 850 LF and 7 catch basins Albert Street – 200 LF and 2 catch basins Vale Street – 500 LF and 9 catch basins Central Street – 850 LF and 8 catch basins Campus Street – 300 LF Mountain Avenue – 250 LF and 4 catch basins
2018	College and Frye Street – 2,000 LF and 20 catch basins

Approximately 12,000 feet of public street sewer separation was completed by the end of 2018 through the installation of new drains and sewers. Now that separation work in the public streets is substantially complete, Lewiston has begun working to reduce I/I in this area and further reduce CSO discharges during wet weather events.

Between 2009 and 2014, the city lined more than 6,000 linear feet of the Hart Brook interceptor as a structural rehabilitation and I/I reduction project. From 2015-2018, Lewiston increased sewer lining efforts, including 10,626 linear feet in 2015, 21,716 linear feet in 2017 and 12,723 linear feet in 2018, totaling at 45,065 linear feet lined during this reporting period.

Between 1998 and 2018, Lewiston lined over 77,000 linear feet of sewer mains throughout the city in an effort to restore the structural integrity of the pipes and reduce I/I in the system. Figure 3-10 shows the lined pipes in red.

Table 3-3 shows a summary of the CSOs removed during this reporting period (2015-2018).



Legend

- Sewer Mains
- Lined Sewer Mains

1 inch = 1 miles

0 0.5 1

Miles

N

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Imagery provided by ESRI.

FIGURE 3-10
SEWER PIPES LINED

Clean Water Act Master Plan
20 Year Update
Lewiston/Auburn, Maine

June 2019

V:\Projects\L\L5006\Figure3-11_Lewiston_LinedPipes.mxd

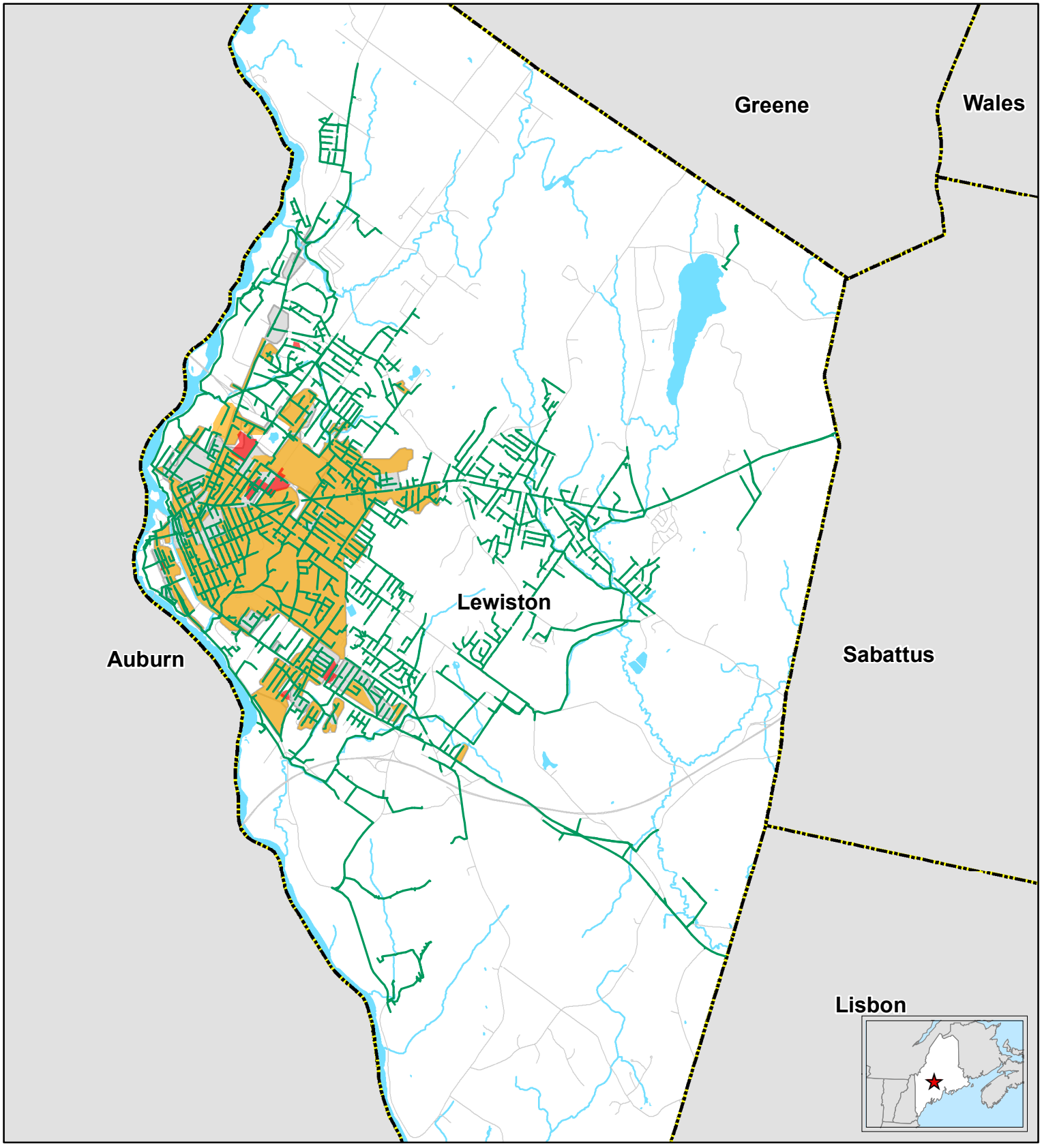
L-5006

TABLE 3-3
City of Lewiston CSOs Removed 2015-2018

Year	CSOs Closed
2015	#013 Northwood Road
2016	#011 Beech Street
	#021 Lowell/Middle Street

The only additional collection system control implemented during this reporting period was the replacement of Tide Gate 005C (Lisbon at Adams) with an 18-inch Tideflex check valve during February 2018.

A total of 107,929 linear feet of sewer has been separated from 1997 through 2018. A breakdown of the separation lengths by year in Lewiston is shown in Figure 3-11. The remaining combined and separated areas through 2018 are shown in Figure 3-12.



Legend

- Sewer Pipes
- Historically Combined Areas
- 2015-2018 Separation
- Prior to 2014 Separation

1 inch = 1 miles

0 0.5 1

Miles

N

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Imagery provided by ESRI.

FIGURE 3-12
COMBINED AND SEPARATED AREAS

Clean Water Act Master Plan
20 Year Update
Lewiston/Auburn, Maine

June 2019

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L-5006

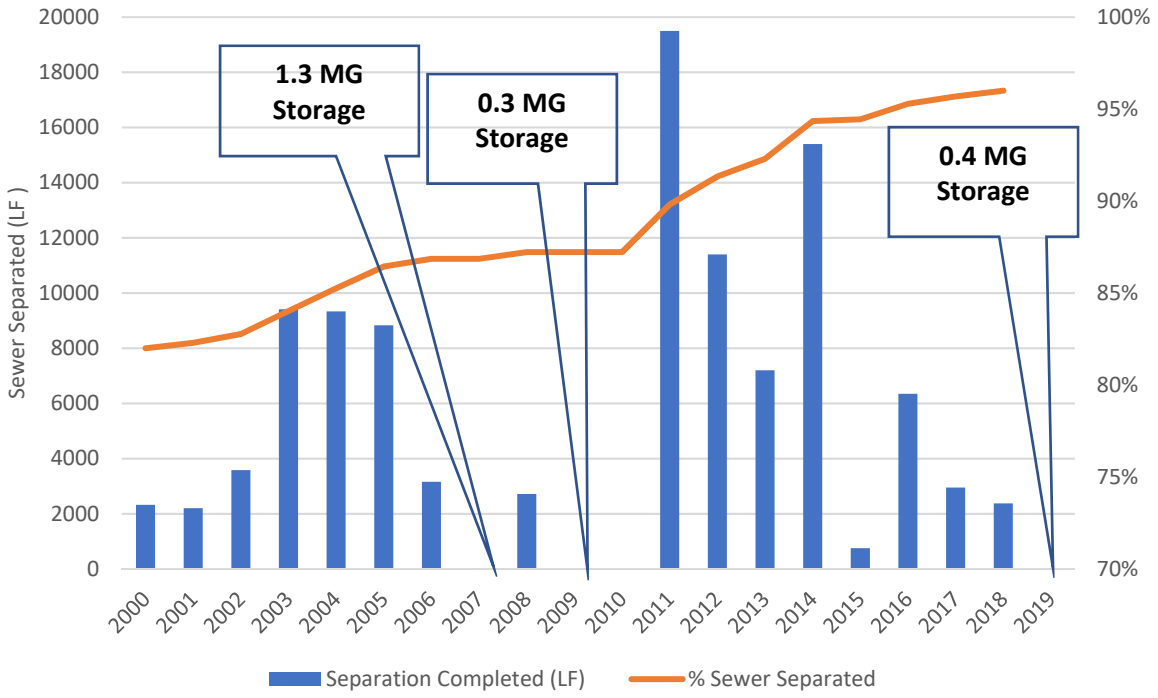

FIGURE 3-11
City of Lewiston 2000-2018 Sewer Separation Efforts

3.3.3 Compliance Monitoring

The recommended plan for Lewiston included a compliance monitoring program that involved seasonal monitoring of all CSO flows.

Following the recommended CWAMP, the City purchased meters for CSO monitoring. The City previously did not have an adequate number of meters or staff to install and maintain meters in all CSO regulators and cross connections. Instead, Lewiston used blocks to determine the number of overflow events at some CSO regulators and cross connections and seasonally monitored others via meters at locations where full monitoring could not be provided. In 2017, the City contracted with Flow Assessment Services to replace all of their meters and monitor all outfalls.

The City performed multiple CSO related projects each year to reduce flow in the sewer. The projects and estimated reductions are included in Table 3-4.

TABLE 3-4
City of Lewiston 2015-2018 Projects and Estimated Flow Reduction and Catch Basins Disconnected*

Year	Project	Estimated Flow Reduction or Catch Basins Disconnected
2015	Main Street Sewer Separation	0.75 MG/year
2016	Sunnyside Area Separation	54 Catch Basins
2016	Lisbon St Separation	21 Catch Basins
2016	Main Street Separation	5 Catch Basins
2017	Vale Street Area Separation	18 Catch Basins: Armory & Middle School Roof Drain
2017	Simard Ave Separation	9 Catch Basins
2017	Mountain Ave Separation	10 Catch Basins; Dorm Roofs & Underdrains
2018	College and Frye Separation	20 Catch Basins

*Source: Lewiston Annual CSO Progress Reports

The City of Lewiston has continued monitoring active outfalls and reporting results to DEP in annual CSO reports. Total yearly CSO discharge from 2000-2018, for all active outfalls is presented in Figure 3-13. Annual reported precipitation is also included.

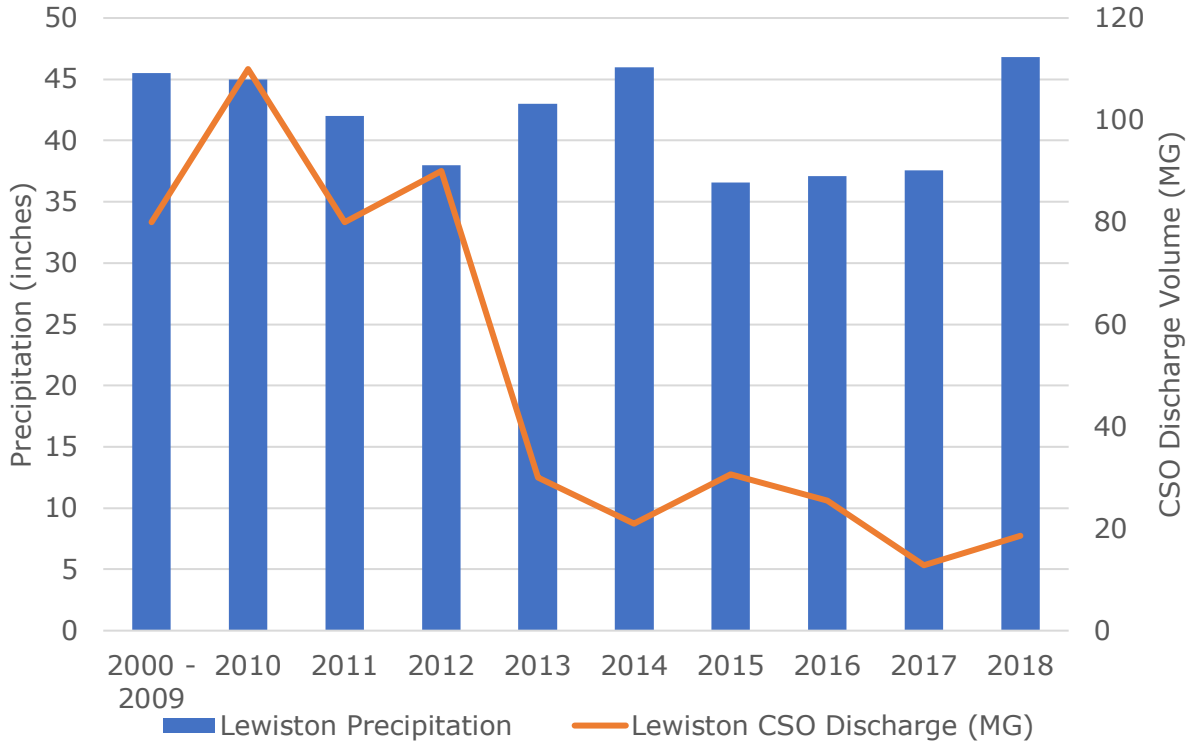

FIGURE 3-13
City of Lewiston 2000-2018 Precipitation vs. CSO Discharge

Lewiston's CSO improvement has been substantial during the past 20 years. The total discharge in 2018 was 19 million gallons, a reduction of 80% from the total average annual discharge from 2000.

3.4 LAWPCA Accomplishments

The LAWPCA's recommended plan included a BMP program and a compliance monitoring program. As for the collection system controls, there is one CSO located on the LAWPCA site, Structure B, which is on the Lewiston Main Interceptor. This CSO provides relief when the treatment facility is at full capacity including operation of the secondary bypass. Even though Structure B is part of the LAWPCA system, the recommended plan for LAWPCA did not include a component for collection system controls. Instead, the approved plan required a reevaluation of the flows at Structure B at each five-year update and at the end of the program.

The evaluation at each five-year update was intended to determine if the improvements in both collection systems were providing adequate reduction in total flow to reduce CSO discharges from structure B to the 1-year design storm. This five-year update includes the fourth evaluation of sewer separation efforts and the effects on the wastewater treatment facility. A more detailed discussion of the evaluation conducted at LAWPCA is included in Section 7 of this report.

Prior to the period encompassing the years from 2015 through 2018, the LAWPCA staff worked with the Lewiston Water and Sewer Division of Public Works to replace the flow

meter located in the outfall pipe of the LAPWCA's only CSO at Structure B. Additionally, LAWPCA significantly improved control of Structure B CSO by installing a new REXA actuated gate to provide real time control of flows during storm events to maximize containment and treatment. Over that period, the volume of combined sewage discharged and the number of overflow events has shown a sustained and continual downward trend. Depending on the variation in storm intensity and duration and the efforts being made to eliminate CSO points in the Lewiston collection system and the ASD collection system, the record shows some years where CSO flows at Structure B have actually increased slightly from one year to the next and as expected towards the end of CSO Abatement Programs provide diminishing returns. This is expected as the treatment facility influent elevation is at the lowest point in both collection systems. Table 3-5 provides an annual summary of CSO activity at Structure B and at the WWTP from 2000 through 2018.

TABLE 3-5
Annual Structure B CSO Activity and WWTP Flows

Year	Precipitation (in)	# of Structure B Activations	Total Annual Volume from Structure B (MG)	Flows Treated at LAWPCA (MG)
2000	45.58	41	108.0	4,319.2
2001	32.46	28	135.8	3,763.1
2002	44.62	34	141.5	4,391.3
2003	46.14	48	157.5	4,583.5
2004(1)	41.79	35	83.1	4,041.9
2005	65.75	49	480.0	5,077.8
2006	62.46	44	265.5	4,818.5
2007(2)	45.98	32	142.3	3,980.8
2008	64.04	38	292.2	4,431.6
2009	59.98	44	212.5	4,636.1
2010	55.6	44	157.1	4,066.3
2011	50.51	37	108.3	4,407.2
2012	36.59	22	113.4	3,920.5
2013	41.84	32	63.6	3,931.8
2014	54.03	26	68.6	3,853.9
2015	43.70	17	27.8	3,267.9
2016	37.10	13	18.7	3,027.3
2017	37.57	10	21.9	3,314.2
2018	46.79	20	25.7	3,329.3

(1) The total CSO flow volume for 2004 is an estimated figure due to a sensor failure during five bypass events, total flow excluding estimated volume was 65 MG.

(2) Of the 142 MG discharged through Structure B, 98.3 MG were discharged during a 7-day period in April when a jammed check valve allowed river water into the collection system.

Table 3-5 above shows that the total amount of CSO volume has significantly decreased since 2000. Although it does not account for storm intensity, Figure 3-14 below shows the total CSO discharge volume and the total precipitation during that year and Figure 3-15 below shows the volume of CSO discharge per inch of precipitation. Both graphs show that CSO discharge has been steadily declining over the past several years.

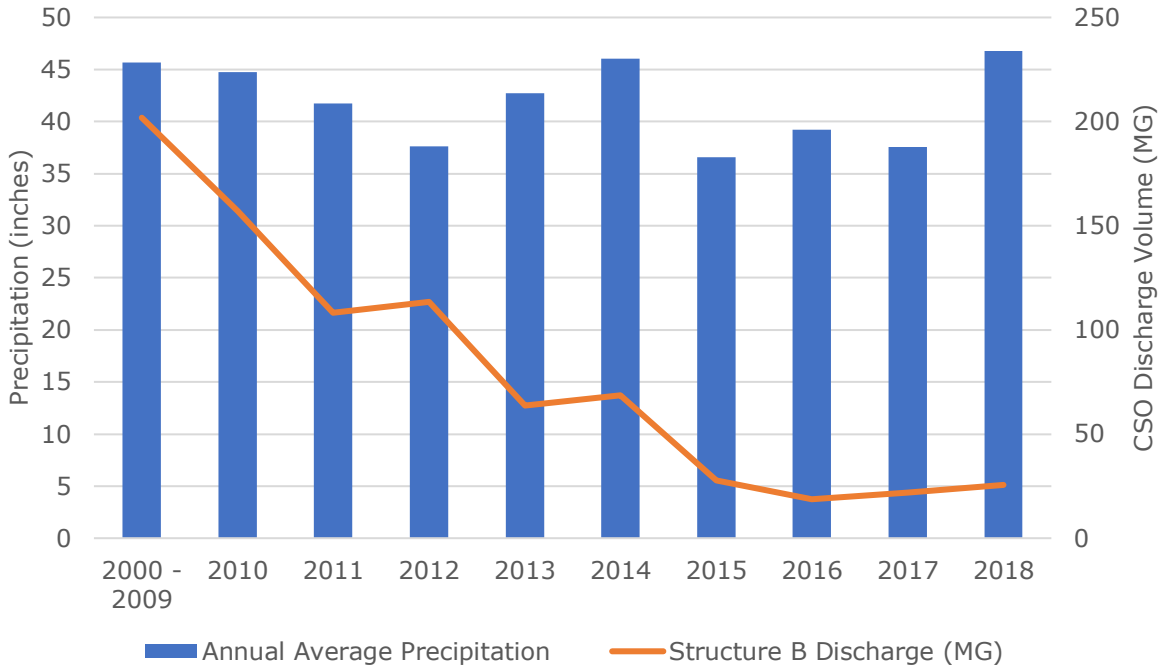

FIGURE 3-14
Structure B Million Gallons of CSO per Inch of Precipitation

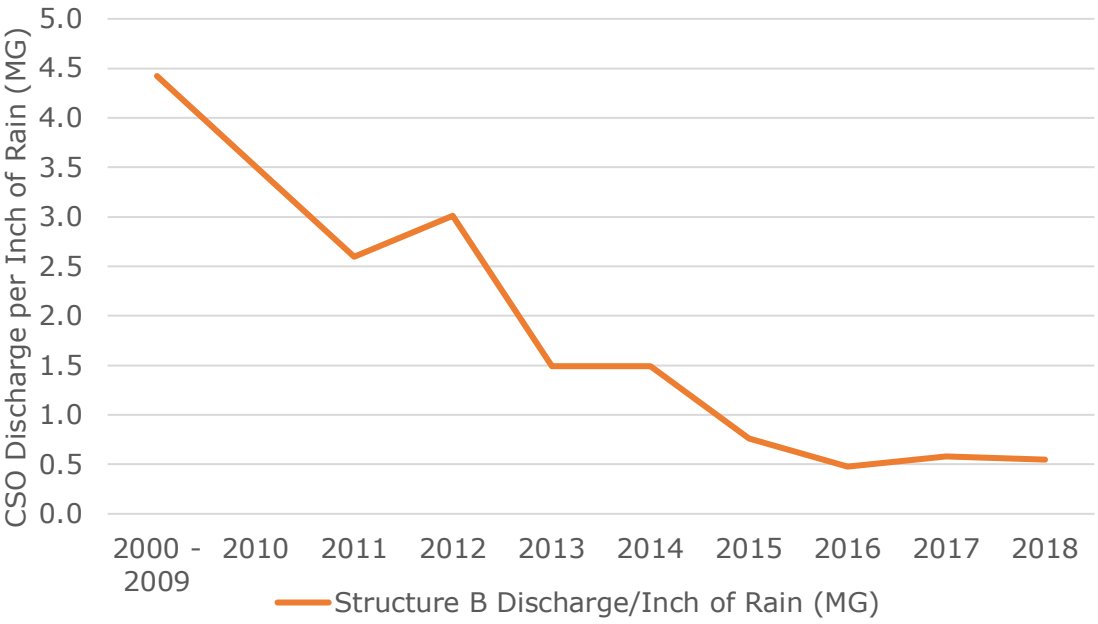

FIGURE 3-15
Million Gallons of CSO per Inch of Precipitation

In 2009, LAWPCA reported a total of 37 CSO events at Structure B resulting in an annual volume of 212.5 million gallons being bypassed. In 2014, 26 events resulted in a CSO flow of 113.4 million gallons, and in 2018, 45 events resulted in a CSO flow of 25.7 million gallons. While the bulk of this reduction is clearly due to the efforts made in the collection

system by both the Lewiston Department of Public Works and the Auburn Sewerage District, capital projects completed by LAWPCA have been helpful in this effort. Of these, the reconditioning of the bar screens at a cost of $588,000 and the addition of the "Vactor pad" at a cost of $122,000 were the most significant. The bar screen project included new rake arms, retrofit of the motors with a "can" that allows the drive motors to be submerged during high flows, instrumentation to start the screens automatically as flow to the plant exceeds a dry weather set point, and better handling of the screenings removed from the channel. The Vactor pad has proven to be very useful in facilitating maintenance in the collection system as previously semi solid materials including saturated sand, silt and muck could not be disposed of at most landfills or incinerators due to the water content in the material. The pad allows both cites to discharge the contents of Vactor trucks into a roll off can having a special screen and liner which allows water to slowly drain out of the material removed from the sewers and into the wastewater system and leaving a solid waste without "free liquid". The result is a solid material that can be taken to landfills for disposal.

Moving forward, the LAWCPA is now considering the possibility of constructing a wet weather storage facility at the treatment plant site. If constructed, this facility would likely be sized to contain the volume of combined sewage that exceeds the capacity of the treatment plant which is currently discharged from structure B. The sizing of this proposed wet weather storage facility is critical as it will serve to equalize flow spikes allowing for optimizing real time control by the Rexa throttling gate allowing for treatment of CSO through the plant.

3.5 Summary of Collective Accomplishments

City of Lewiston, the Auburn Sewerage District, and the LAWPCA have been making significant progress by implementing improvements to the collection systems and the treatment facility to comply with requirements of the CWAMP recommendations and specifically the approved five-year plan (years 2015 through 2019).

Work identified by the recommended plan completed through 2019 included improvements and implementation of BMP's, collection system controls to abate CSO, and compliance monitoring to determine the results of system improvements and monitor CSO discharge volumes. Lewiston and ASD's BMP programs were very similar and both have been committed to implementing and successfully improving their BMP programs to meet the requirements of the recommended plan. Each City and the LAWPCA monitor CSO discharge volumes and Lewiston utilizes its SWMM model to supplement the data as required.

Auburn has completed public street sewer separation projects as established in the recommended plan and has now moved to I/I removal projects as the next step in controlling extraneous flow in the collection system.

Lewiston has completed several public street separation projects, supplemented the collection system with two storage facilities completed and another storage facility recently started up and completed several inflow and infiltration projects. The storage facilities provide CSO control more cost-effectively than completing separation in these urbanized areas. Table 3-6 includes summary statistics of the programs in Auburn and Lewiston during the past 20 years.

TABLE 3-6
Summary of Cities' CSO Abatement Programs

Description	Auburn	Lewiston
Percent Separated (based on public street sewer separation)	100%	95%
Volume of Storage Facilities (MG)	0	2.0
Total Cost of CSO Abatement Projects to 2018 ($ millions)	$20.20 M	$34.71 M

3.5.1 Public Education

LAWPCA hosts tours of many school and community groups including Bates College Students studying hydrology. Tours explain what CSOs are and why they remain after years of effort and significant investments by the ASD and Lewiston.

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SECTION 4

Section 4
Flow Monitoring Program

4.1 Introduction

This section describes the City of Lewiston's and LAWPCA's flow monitoring program, including the permanent flow monitoring program as well as the comprehensive system-wide temporary flow monitoring program that was completed in 2018. The objective of monitoring rainfall and flow (as well as depth and velocity) is to obtain data that describes the dry weather flow contributions as well as wet weather infiltration and inflow (I/I) response of the system to varying rainfall events. Monitoring data is used to calibrate the Lewiston's collection system model, which was developed to evaluate the performance of collection system improvements (calibration will be discussed in the next section). The temporary and permanent meter locations are shown in Figure 4-1.

4.2 Permanent Monitoring

4.2.1 LAWPCA

The LAWPCA continually monitors influent flows to the plant as well as CSO flows discharged from Structure B during wet weather events. Raw wastewater is routed to the headworks of the plant by a 60-inch and 42-inch diameter gravity sewer from Lewiston and Auburn, respectively. Flow metering is performed by two Parshall flumes, which separately measure the influent wastewater flow from Lewiston and Auburn. Flow data for 2018, recorded at 5-minute intervals by the two influent flumes and Structure B, was provided by the LAWPCA. The data from that 2018 rainfall event is included in Table 4-2 below.

4.2.2 Regulatory Monitoring

The City of Lewiston continuously meters all nine active CSOs throughout the collection system. These nine CSO meters measure depth and velocity to provide flow data. Flow data within regulators was provided by the City of Lewiston from January 2018 to December 2018.

4.3 Temporary Flow Metering

A temporary metering program was conducted by Flow Assessment Services Inc. from September 17, 2018 through December 6, 2018 in Lewiston's collection system. A total of eleven flow meters, which measure depth and velocity and calculate flow, were installed. These meters recorded data at five-minute intervals through the metering period. The locations of the four meters are shown on Figure 4-1.

The eleven temporary flow meters were installed in the vicinity of regulators to measure both dry and wet weather flows. Meter location information is provided in Table 4-1 below for the eleven temporary meters. Additional details on the temporary monitoring program can be found in the Flow Assessment report (provided under separate cover) and includes other details such as site reports, commentary and data summaries.

TABLE 4-2

Summary of Precipitation Events (From 09/17/2018-12/6/2018)[1]

Precip. Event	Date (2018)	Duration (hours)		Total Precipitation (inches)		Peak Intensity (in/hr)		Average Intensity (in/hr)[2]		Recurrence Interval[3]
		Temporary Rain Gauge	Permanent Rain Gauge	Temporary Rain Gauge	Permanent Rain Gauge	Temporary Rain Gauge	Permanent Rain Gauge	Temporary Rain Gauge	Permanent Rain Gauge	
1	09/25	9.1	8.9	1.25	1.25	0.44	0.48	0.13	0.13	3-Month
2	09/26	1.6	1.8	0.51	0.58	0.36	0.41	0.20	0.19	1-Month
3	10/01	3.7	3.7	0.28	0.26	0.11	0.12	0.06	0.06	< 1-Month
4	10/02	19.8	19.2	0.69	0.61	0.13	0.12	0.03	0.03	< 1-Month
5	10/11	11.6	10.7	0.77	0.80	0.16	0.16	0.06	0.06	< 1-Month
6	10/15	12.0	11.3	0.25	0.21	0.06	0.05	0.02	0.02	1-Week
7	10/23-10/24	13.7	14.7	0.65	0.68	0.11	0.11	0.04	0.02	< 1-Month
8	10/27	10.8	7.4	0.60	0.63	0.10	0.11	0.05	0.08	< 1-Month
9	10/29	3.5	3.4	0.43	0.41	0.19	0.17	0.10	0.10	< 1-Month
10	11/02-11/03	32.4	32.6	2.12	2.20	0.31	0.34	0.06	0.06	3-Month
11	11/06	20.3	20.3	0.71	0.78	0.26	0.28	0.03	0.04	1-Month
12	11/09-11/10	17.8	17.3	1.07	1.07	0.23	0.22	0.06	0.06	1-Month
13	11/13	12.2	12.4	1.15	1.24	0.16	0.19	0.09	0.10	< 3-Month
14	11/17	1.8	2.0	0.32	0.31	0.21	0.23	0.14	0.13	3-Month
15	11/25	4.3	4.0	0.24	0.26	0.07	0.10	0.05	0.06	< 1-Month
16	11/27-11/28	24.2	25.4	1.30	1.18	0.33	0.18	0.05	0.05	< 3-Month
17	12/02	7.6	7.7	0.45	0.67	0.13	0.13	0.06	0.08	< 1-Month

[1] Events with less than 0.2 inches of accumulated precipitation were not included.

[2] Data recorded in 5 minute increments. Average hourly intensities are presented and are calculated on a rolling average basis.

[3] Recurrence intervals based on IDF curves developed by the *2002 Metcalf & Eddy Clean Water Act Master Plan* (Figure 5-13).

Figure 4-1
Temporary and Permanent Flow Meter Locations

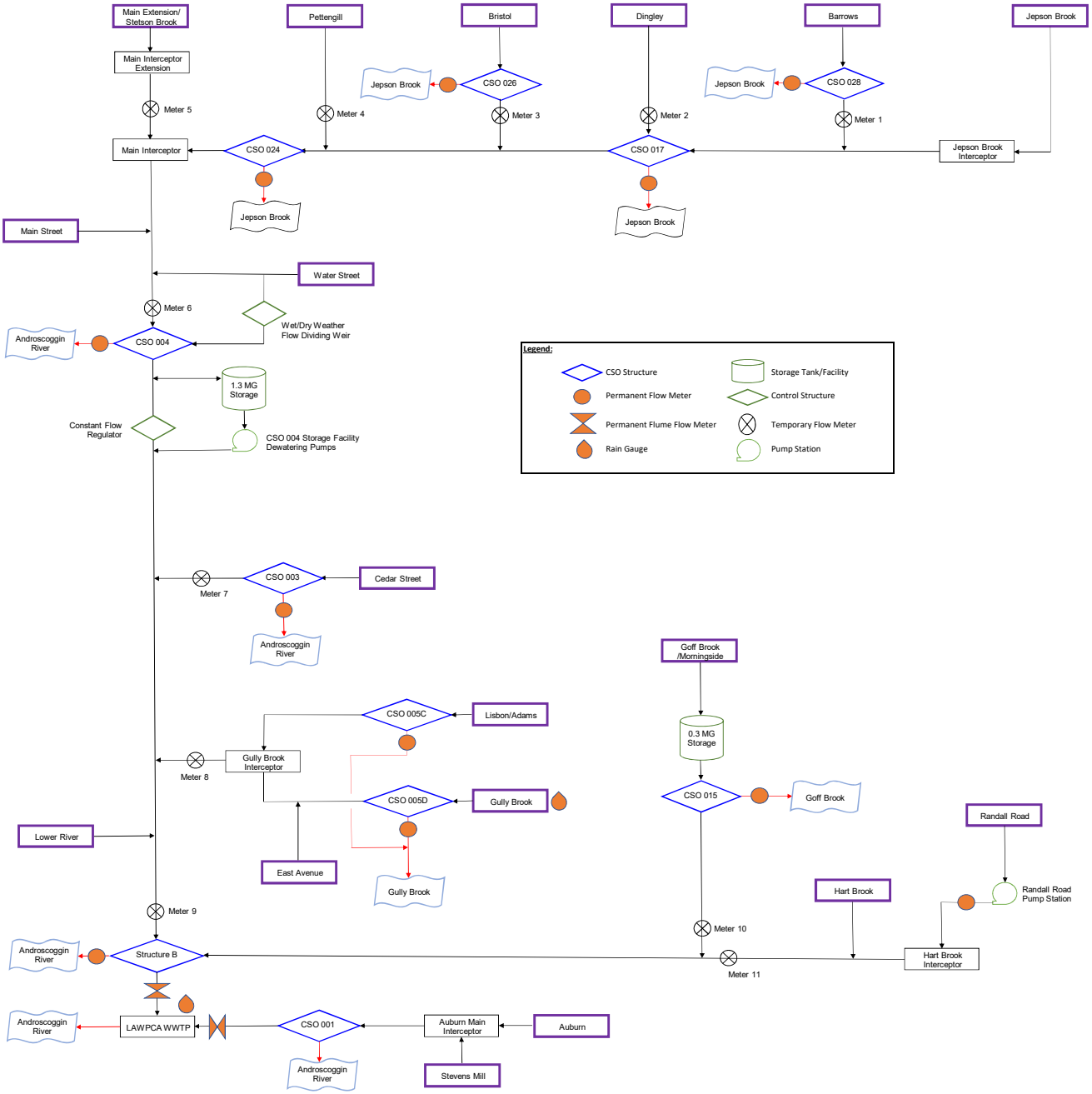

TABLE 4-1
Temporary Meter and Rain Gauge Locations

Site	Location	Pipe Diameter Size (Inches)
1	Lemont Ave at Barrows St	10
2	Dingley St at Roland Ave	24
3	Buttonwood Ln at Bristol Rd	8
4	49 Brooks Ave	8
5	Androscoggin Riverside Trail	36
6	Water Street (Rear of Hampton Inn)	48
7	Cedar Street R.O.W.	24
8	Lincoln Street R.O.W.	24
9	Lincoln Street R.O.W.	48
10	River Road R.O.W.	18
11	River Road R.O.W.	29
RG-1	LAWPCA WWTP	
RG-2	Central Avenue Pumping Station	

4.4 Rain Data Collection

Rainfall data was collected by Flow Assessment Inc. with the use a tipping bucket type rain gauge from September 17, 2018 through December 6, 2018. The rain gauge was installed at the LAWPCA facility. The rainfall data was recorded in 5-minute intervals and provided an adequate dataset for model calibration. Rainfall data was also collected from the permanent rain gauge monitored and maintained by Flow Assessment Services. The permanent flow meter is a tipping bucket type rain gauge installed at the Central Avenue Pump Station near Central Avenue and Sabattus Street in Lewiston. This data was also collected in 5-minute intervals. See Figure 4-1 for the location of the rain gauge.

Seventeen storm events occurred during the metering period. Each rainfall event was classified by recurrence interval for various durations. All events were 3- month recurrence interval or less for various durations based on the IDF curves developed by the 2002 *Metcalf & Eddy Clean Water Act Master Plan* (Figure 5-13). Table 4-2 summarizes the rainfall events. In this table the duration refers to the duration of the entire rainfall event and the total precipitation represents the total amount of precipitation that occurs over the entire storm.

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SECTION 5

Section 5
Collection System Modeling

5.1 Introduction

Prior to this study, the Lewiston sewer system model was last updated in 2017. This section describes improvements and calibration procedures that were applied to the 2017 model to create the updated 2019 model. The new hydrologic and hydraulic model of the Lewiston and Auburn sewer systems was developed using EPA Stormwater Management Model (SWMM) Version 5.1.012 and calibrated to data collected in the Fall of 2018. The model results were used to assess the performance of the collection system in its current state, to project expected CSO reduction following the completion of scheduled projects, and to evaluate the benefits of CSO reduction alternatives.

5.1.1 Auburn Sewerage District

The Auburn Sewerage District catchment area is represented in the model by two subcatchments: one for the Steven's Mill area and one for the remainder of Auburn. The Auburn collection system is represented hydraulically from just upstream of CSO 001, through the inverted siphons under the Androscoggin River, and into the headworks of the LAWPCA wastewater treatment plant. Dry weather flows and wet weather flows from the entirety of Auburn's collection system enter the system upstream of CSO 001 in the model.

5.1.2 Lewiston

The Lewiston catchment area was originally represented by 513 subcatchments in the 2017 model. The subcatchments were consolidated in the new model and revised to a total of 18 subcatchments. The new subcatchments were delineated based on wastewater service areas, CSO locations, geographic features, and meter locations. The Lewiston collection system is represented hydraulically from the furthest reaches of the City wastewater service areas including Jepson Brook and Randall Road all the way down to the LAWPCA WWTP.

The pipe network in the model primarily consists of the interceptors and short lengths of smaller diameter sewers which contribute to the CSO structures. There are 9 remaining active CSOs and one bypass structure in the Lewiston Sewerage District including CSOs 003, 004, 005C, 005D, 015, 017, 024, 026, 028, and bypass Structure B. The model was updated and re-calibrated to account for changes in the Lewiston sewer system since 2017.

5.2 Modeling Construction

Updates to the Auburn/Lewiston sewer system model include:

- Simplified subcatchments for Lewiston
- Hydraulic updates based on improved City of Lewiston GIS Data,
- Calibration of Auburn and Lewiston subcatchments to Fall 2018 flow data, and
- Calibration of CSO structures to Fall 2018 flow data.

5.2.1 Hydrology

A rain gauge was added to the model to represent the permanent rain gauge installed on the roof of the Central Avenue Pump Station. A second rain gauge was also added to the model to represent the temporary rain gauge installed at the LAWPCA WWTP. The temporary rain gauge was active for the duration of the Fall 2018 flow monitoring period. The rain gauges in the model reference the 15-minute rain data collected at each location.

All subcatchments from the 2017 model were updated in the 2019 model besides the Auburn and Steven's Mill subcatchments. The area for each of the 18 subcatchments in Lewiston were estimated based on the remaining combined sewer information in the City of Lewiston GIS system and were adjusted during calibration. The area of the Auburn subcatchments were adjusted during calibration based on the Auburn LAWPCA influent flow data from the Fall of 2018. The Lewiston subcatchments range in area from 2.0 acres to 63 acres and the Auburn and Steven's Mill subcatchments are 300 and 400 acres, respectively. Table 5-1 summarizes the area of each subcatchment in the updated model.

TABLE 5-1
Model Subcatchment Areas

Subcatchment Name	Area (Acres)
Jepson Brook	31.0
Barrows	3.5
Dingley	2.5
Pettengill	5.0
Bristol	4.0
Main Extension/Stetson Brook	15.0
Main Street	10.0
Water Street	63.0
Cedar Street	7.0
Lisbon/Adams	10.0
Gully Brook	32.0
East Avenue	2.0
Lower River	10.0
Goff Brook/Morningside	20.0
Randall Road	13.0
Hart Brook	15.0
Auburn	300.0
Steven's Mill	400.0

Other properties of the Lewiston subcatchments (percent impervious, slope, manning's coefficients, etc.) were adjusted during the calibration process for each subcatchment. All aquifers from the 2017 model besides the Auburn and Steven's Mill aquifers were removed from the updated model during the subcatchment consolidation process.

Temperature data consisting of daily minimum and maximum temperatures were input in the model and used by the model to simulate potential evaporation. Daily minimum and maximum temperatures were obtained from the National Oceanic and Atmospheric Administration National Climatic Data Center from Station US23003 in Lewiston, Maine. Snow melt and wind speed were not considered in the updated model and the snow packs from the 2017 model were no longer applied to the subcatchments since ground freezing and snow melt have not historically been well represented in collection system models.

5.2.2 Hydraulics

The model includes all pipes downstream of CSO structures and at least one pipe length upstream of each CSO structure. The updated model is represented by 326 pipes and 336 manholes. The pipe and manhole information in the updated model was adapted from the 2017 model and updated based on the 2018 GIS data provided by the City Lewiston. Pipe and manhole labels in the model match the labels in the City of Lewiston GIS database. Pipes and manholes that were no longer required from the 2017 model were deleted in the updated model.

Manhole rim elevations and invert elevations that were not provided in the GIS database were interpolated based on 2-foot contours. In the case where pipe diameter, invert elevations, and pipe lengths were not provided, they were interpolated based on upstream and downstream pipe properties and manhole information or record drawings. If no label was provided in the GIS database for a pipe or manhole, then one was assigned to it based on its position along the sewer line and the upstream and downstream pipes or manholes.

In addition to the GIS database system, the City of Lewiston provided as-built drawings of each CSO structure including recent modifications (i.e. raising weir heights, etc.). Each of the CSO structures was checked and modified in the model to represent the current conditions and new improvements since the 2017 model. Other drawings provided by the City of Lewiston and used for updating the hydraulic network included the Jepson Brook Interceptor, the Randall Road force main, and CSO Storage Facility record drawings.

The variable head, constant flow regulator at the Water Street Storage Facility is represented in the model by a pipe with a maximum allowed flow of 20 MGD. Conversations with officials at the City of Lewiston have indicated that the actual allowed flow rate through the Water Street Storage Facility regulator may be less than 20 MGD. However, the flow limitation was kept at 20 MGD in the new model. Future optimization of the flow regulator may be considered for maximizing the capacity of the Water Street Storage Facility. An orifice was added to the model to represent the 24” x 24” opening between the two chambers of the Water Street wet weather control structure (old regulator 004) which now more accurately represents the relationship between dry weather and wet weather flow at the Water Street Storage Facility compared to the 2017 model.

In the 2017 model, bypass Structure B was represented as a simple elevated overflow pipe and did not include the Structure B control gate. Structure B was improved in the new model by adding an orifice to represent the electrically actuated control gate. A control statement was added to the model to activate the control gate based on the total combined influent flow at the LAWPCA. The control rule tells the Structure B control gate to remain in the 53% open position until the total influent flow to the LAWPCA (Auburn plus Lewiston) increases to 32 MGD, at which point the control gate closes to the 35%

open position and thus causes a bypass through Structure B. The control gate returns to the 53% open position when the total plant influent flow returns to below 32 MGD.

Conduits and manholes were added to the model for the new CSO 005D Storage Facility (Gully Brook Storage Facility) that is currently under construction and nearly complete. The conduits and manholes were added to the model based on available GIS data and construction drawings. The Gully Brook Storage Facility was added to the model for the Base Prime conditions only (see discussion below in Section 5.3).

The storage node from the 2017 model used to represent the LAWPCA WWTP remained in the new model. However, the maximum depth of the storage node was decreased to an appropriate height to eliminate an issue that was discovered with the previous model. The pumps at the LAWPCA, at the Water Street Storage Facility, and at the Randall Road Pump Station remained un-modified from the 2017 model.

5.3 Model Calibration

The updated model was calibrated to flow metering data collected from several sources in the Fall of 2018 between the dates of September 17th and December 7th. The data used for calibration of the model included:

- Eleven temporary flow meters installed throughout the City of Lewiston collection system (see Figure 5-1 for flow meter locations).
- Permanent overflow metering data for each of the 9 CSOs plus Structure B.
- Depth measurements at the Water Street Storage Facility.

Precipitation data used for model calibrations was recorded at two locations; the permanent rain gauge at the Central Avenue Pump Station, and a temporary rain gauge installed by the Flow Assessment, Inc. at the LAWPCA WWTP. There was a negligible difference between the two rain gauges for all storms during the Fall 2018 flow assessment period. Therefore, all subcatchments and CSOs utilized the permanent rain gauge data for calibration.

5.3.1 Dry Weather Calibration

In general, sanitary time patterns and average dry weather flows were updated in the 2019 model for locations where the temporary flow meters provided enough data to justify update the time patterns from the previous model. For locations not well represented by the temporary flow meters, the existing average dry weather flow values and time patters from the 2017 model were maintained.

Each loading point in the model, generally located at subcatchment inlets and at select locations along each interceptor between CSOs, were assigned an average sanitary flow value with hourly weekday, hourly weekend, and monthly time patterns. The average sanitary flow values and time patterns represent diurnally-varied flow variations due to sanitary wastewater flow and infiltration baseflow.

The average sanitary flow value for each loading point was calculated based on five selected dry weather days during the Fall 2018 flow assessment. The five selected dates included October 9th, 10th, 18th, 19th, and 22nd. These days were selected because no precipitation occurred, and they were preceded by at least 48 hours of dry weather. The same dates were used to develop the hourly weekday time patterns for each loading point.

The hourly weekend dry weather flow patterns for each loading point were developed by analyzing the hourly flow data for six weekend dates (3 Saturdays and 3 Sundays). The selected weekend dates were September 22nd, 23rd, 30th, and October 6th, 20th, and 21st.

Previous models did not include monthly time patterns. However, to improve the model performance monthly time patterns were developed during this study and added to the updated model for each loading point. The monthly time patterns account for variation in seasonal sanitary and infiltration baseflow which is not necessarily represented by the weekday hourly and weekend hourly time patterns.

Two separate monthly time patterns were developed, one for Auburn and one for Lewiston. The monthly time patterns were calculated by analyzing the LAWPCA influent flow from Auburn and Lewiston and subtracting out wet weather days or any times that were preceded by rain 48 hours prior. This was completed for the entire year of 2018. Following the removal of the wet weather days, the average monthly flow for each month was the calculated and compared to the average for the entire year to develop a monthly time pattern.

The base sanitary patterns were checked against observed flows during dry weather dates in September, October, and November 2018 and appeared to be adequate relative to observed data during the dry weather periods. The dry weather time patterns and dry weather calibration plots for each meter location are included in Appendix A.

5.3.2 Wet Weather Calibration

Wet weather calibration was performed based on Fall 2018 flow data and was accomplished by iteratively adjusting each of the 18 subcatchments. The subcatchments were calibrated to four calibration storms including the storms on September 25th and 26th, October 23rd, and November 2nd and 13th. Although a 1-year recurrence interval storm did not occur during the 2018 flow assessment, the calibration storms were selected because they most closely matched the parameters of the 1-year design storm and had a relatively uniform rainfall intensity throughout the City of Lewiston and City of Auburn. Each of the calibration storms are summarized in Table 5-2.

TABLE 5-2
Calibration Storm Summary

Calibration Storm No.	Date	Duration (hrs)	Total Precip. (in)	Peak Intensity (in/hr)	Recurrence Interval
1	09/25/18	9	1.25	0.46	3-month
2	09/26/18	2	0.55	0.39	1-month
3*	11/02/18	32	2.16	0.33	3-month
4	11/13/18	12	1.20	0.18	< 3-month
5	10/23/18	14	067	0.11	< 1-month

*Temporary Meter No. 1 was down for this storm event. Therefore, the storm on 10/11 was used for calibrating the Barrows Subcatchment for Calibration Storm No. 3.

Calibration was generally accomplished by starting at the furthest upstream subcatchment and working downstream towards the LAWPCA. The principal calibration parameters for each subcatchment were the contributing area, the equivalent width, the percent slope, and the manning's roughness coefficient for impervious surfaces. The parameters of the subcatchments were adjusted until the simulated hydrographs closely matched the observed hydrographs, within reason.

In locations where the temporary flow meter was installed downstream of the CSO (for example temporary flow meter 1 at CSO 028) the subcatchments were calibrated to the temporary flow meter data plus the overflow data at the CSO. The Auburn and Steven's Mill subcatchments were calibrated concurrently based on the influent flow at the LAWPCA. The CSOs were calibrated concurrently with the subcatchments and are discussed in Section 5.3.3 below.

Model performance was primarily evaluated by relative agreement between the model output and observed data through visual comparison of the two hydrographs for each calibration storm. In addition to each calibration storm, the model output was also compared to the observed output for the entire 3-month duration of the 2018 flow assessment. Wet weather calibration plots for each calibration storm and for the entire duration of the 2018 flow assessment are included in Appendix B.

5.3.3 CSO Calibration

As mentioned in Section 5.3.2, the CSOs were calibrated in a similar fashion to the subcatchments, starting from the furthest upstream CSO and working downstream. However, the CSOs were calibrated to two separate calibration storms. The two calibration storms for the CSOs include the storms on April 16th and July 26th, 2018. These two calibration storms are summarized in Table 5-3 and were selected because they most closely match the duration and intensity of the 1-year design storm and had sufficient overflow data for comparison.

TABLE 5-3
CSO Calibration Storm Summary

Calibration Storm No.	Date	Duration (hrs)	Total Precip. (in)	Peak Intensity (in/hr)	Recurrence Interval
1	04/16/18	15	2.34	0.48	1-year
2	07/26/18	2	2.71	2.35	5-year

The simulated CSO overflow hydrographs were visually compared to the observed CSO overflow hydrographs to asses model performance of the CSOs. Adjustment of the CSO structures was kept to a minimum where possible and was primarily accomplished by adjusting the calibration of the upstream subcatchments while simultaneously comparing the effects on the simulated CSO overflow. In some cases, the CSO structure parameters had to be modified to accurately model the CSOs. Modifications to the CSO structures in the model included adjustment of orifice gate discharge coefficients, adjustment of overflow weir discharge coefficients and/or crest heights, and adjustment of overflow pipe invert elevations for CSO structures with elevated overflow pipes.

In addition to each calibration storm, the CSO model output was also compared to the observed output for the entire 3-month duration of the 2018 flow assessment. Calibration plots for each CSO are included in Appendix C.

Dry weather and wet weather scenarios including wet weather volume and peak flows are well represented by the calibrated model at all eleven flow meters and at the Lewiston and Auburn flow to the LAWPCA WWTP. In addition, CSO structure calibration and subsequent model simulations have closely portrayed the observed overflows at each of the remaining CSO locations, thus resulting in a calibrated model that can be confidently utilized to predict future conditions and guide the recommendations for future CSO improvements.

5.4 1-Year Design Storm Projections

Lewiston and Auburn's CSO performance has historically been assessed relative to synthetic design stroms originally developed by Metcalf and Eddy in the 2000 CWAMP. The design storm used in this assessment is the 1-year, 6-hour duration event. The design storm hyteograph is shown in Figure 5-2.

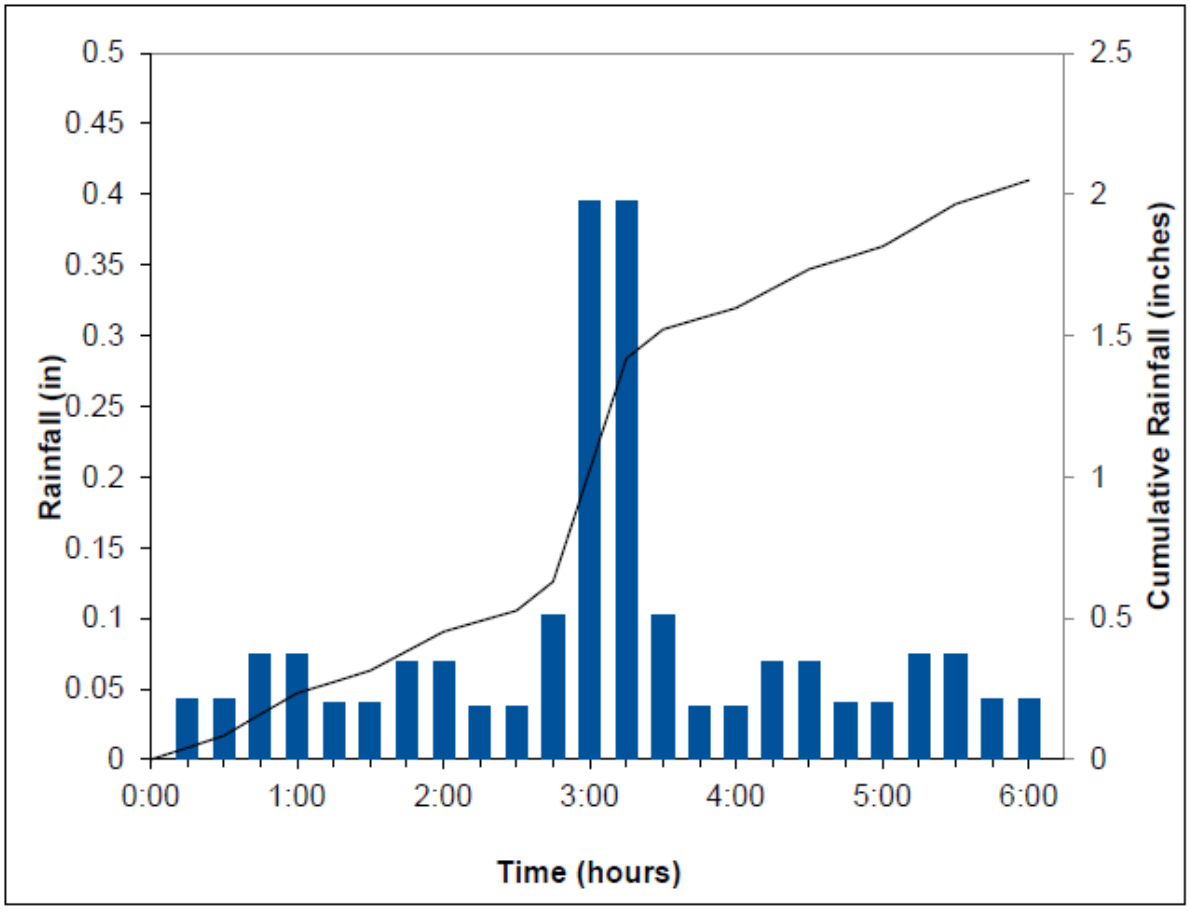

FIGURE 5-2
1-year, 6-hour Design Storm Hyetograph

The updated and calibrated model represents the 2019 base conditions. Another model was created for the 2019 base prime (2019') conditions which includes the Gully Brook Storage Facility at CSO 005D. The Gully Brook Storage Facility is predicted to be completed by the end of 2019. The 2019 base prime model includes the new Gully Brook Storage Facility which has been designed and sized to capture the 1-year design storm.

Table 5-4 compares the 1-year, 6-hour design storm overflows for the 2000, 2009, 2014, 2019 base, and 2019 base prime conditions.

Lewiston CSO estimates for the 2019 base prime conditions show a 64% reduction compared to the 2015 predictions and Structure B discharges are predicted to be 49% lower than the 2015 conditions. The predicted reduction in overflow volume for most of the CSOs are reflective of the improvements and CSO reduction efforts implemented between 2015 and 2019.

TABLE 5-4
Comparison of Modeled CSO Volume at Auburn and Lewiston CSO Regulators for the 1-year, 6-Hour Design Storm

CSO	Overflow (MG)				
	2000	**2009**	**2015**	**2019**	**2019'**
001	0.10	0.00	CLOSED	CLOSED	CLOSED
002a	0.15	CLOSED	CLOSED	CLOSED	CLOSED
002 (002b)	0.08	0.39	CLOSED	CLOSED	CLOSED
003	0.17	0.75	0.61	0.07	0.03
004	4.80	2.31	0.50	0.00	0.00
005	6.74	0.78	0.00	0.52	0.10
006	0.02	CLOSED	CLOSED	CLOSED	CLOSED
007	0.12	CLOSED	CLOSED	CLOSED	CLOSED
008	0.03	0.00	CLOSED	CLOSED	CLOSED
009	0.02	CLOSED	CLOSED	CLOSED	CLOSED
010	0.04	0.05	CLOSED	CLOSED	CLOSED
011	0.21	0.00	0.00	CLOSED	CLOSED
012	1.60	0.00	CLOSED	CLOSED	CLOSED
013 (013a)	0.25	0.02	0.09	CLOSED	CLOSED
013b	0.34	CLOSED	CLOSED	CLOSED	CLOSED
014	0.07	CLOSED	CLOSED	CLOSED	CLOSED
015	0.62	0.42	0.18	0.00	0.00
017	0.41	0.90	0.37	0.44	0.44
018	0.25	0.61	CLOSED	CLOSED	CLOSED
020 (X-18)	0.04	0.02	CLOSED	CLOSED	CLOSED
021 (X-17)	0.29	0.14	0.23	CLOSED	CLOSED
024 (X-12)	0.13	0.19	0.44	0.17	0.17
025 (X-2)	0.09	0.48	CLOSED	CLOSED	CLOSED
026 (X-1)	0.05	0.11	0.34	0.21	0.21
027 (X-3)	0.09	0.00	CLOSED	CLOSED	CLOSED
028 (X-8)	0.03	0.38	0.14	0.07	0.07
030 (X-4)	0.03	0.15	CLOSED	CLOSED	CLOSED
031B (X-5)	0.13	0.32	CLOSED	CLOSED	CLOSED
Lewiston Total	16.88	8.01	2.90	1.48	1.03
Structure A	0.94	CLOSED	CLOSED	CLOSED	CLOSED
LAWPCA Structure B	8.71	5.75	4.70	2.47	2.38
Lewiston + LAWPCA Total	26.53	13.76	7.60	3.96	3.40
Auburn 001	1.58	0.99	0.96	0.81	0.81

'The 2019 base prime model includes the Gully Brook Storage Facility

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SECTION 6

Section 6
Collection System Improvements

6.1 Introduction

This section discusses collection system improvements to reduce and abate CSOs in Auburn Sewerage District (ASD) and City of Lewiston (Lewiston) collection systems. The improvements discussed are planned for completion over the next 5-year period.

6.2 Lewiston Projects

Lewiston has completed extensive sewer separation as described earlier in this report. Lewiston has also completed the Water Street Storage facility (1.3 MG) which has significantly reduced discharges from CSOs 004, 012 and 021. Lewiston also applied the approach of employing targeted sewer separation and storage in the Goff Brook and College Street areas. Most recently, Lewiston completed the construction of an in-line storage facility in the Gully Brook area to manage the overflows from CSO 005D. Lewiston designed and managed construction of the storage facility.

As part of this update, the Gully Brook storage facility was modeled within SWMM to analyze the effectiveness for CSO reduction. The 1-year design storm was then run through the model, and the results indicated that CSO 005D will not overflow at or below the 1-year design event. Therefore, with the recent start-up of this storage facility in June 2019, overflows to Gully Brook from CSO 005D will be abated up to the 1-year design storm.

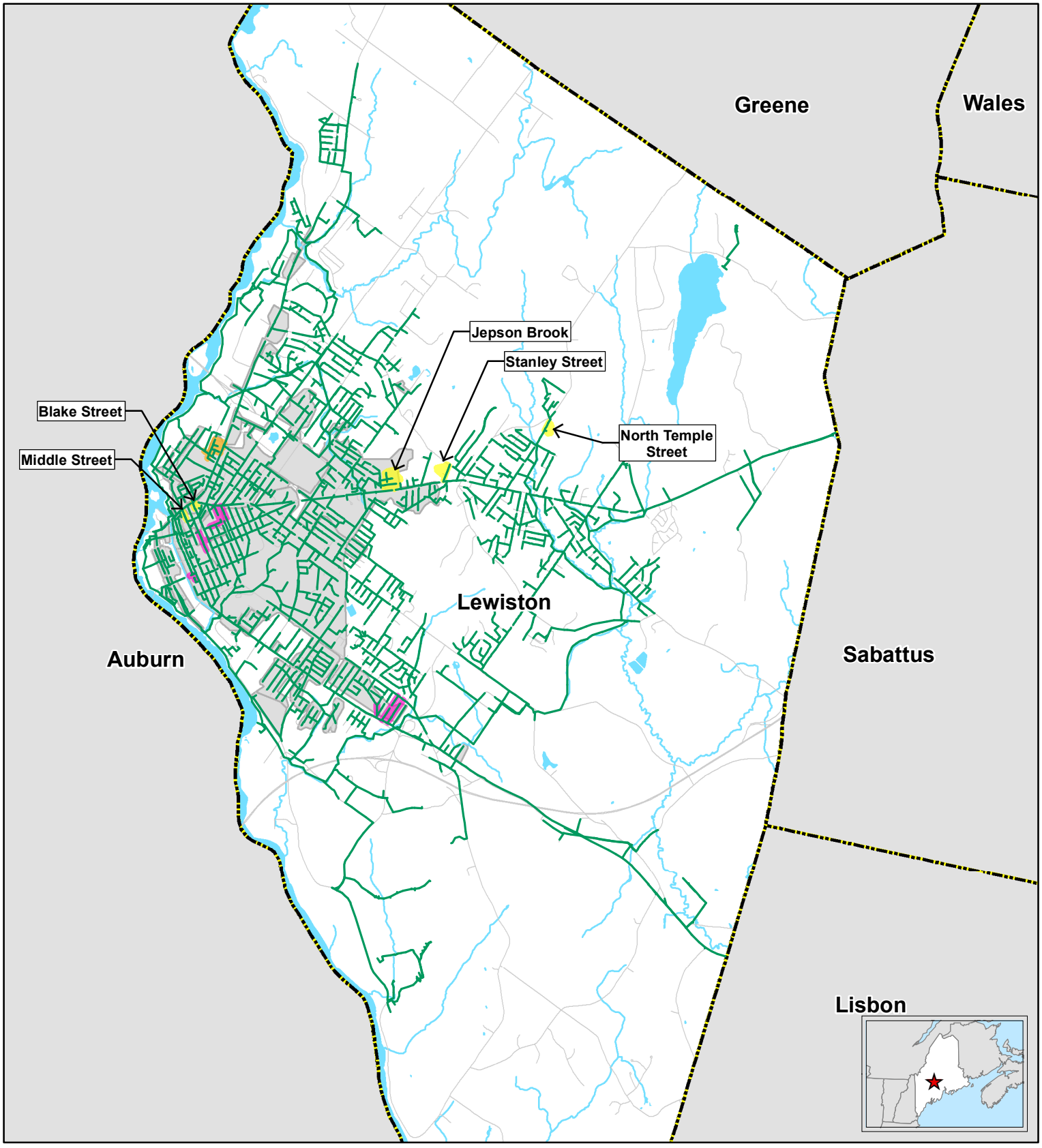
These projects also have a secondary benefit of further reducing downstream CSOs, especially at Structure B.

6.2.1 Sewer Separation Projects

Lewiston has included sewer separation in its downtown area in its capital improvements planning for 2019 – 2020 to reduce flows at the Water Street (CSO 004) Storage Tank, Gully Brook outfall 005C, and Structure B. It is predicted that completing this sewer separation will reduce overflows at Gully Brook during storms up to and including the 1-year design storm. The areas planned for sewer separation are shown in Figure 6-1.

6.2.2 Targeted I/I Reduction and Sewer Rehabilitation Program

In addition, Lewiston is planning approximately $1.1 million of sanitary sewer rehabilitation work to be completed in 2020 in an effort to continue I/I reduction and promote collection system operations and maintenance. Of the City's approximately 153 miles of sewer, approximately 36 miles of pipe have been identified as needing rehabilitation by Lewiston's Risk Assessment Management Program. The scope of the planned work includes cured-in-place pipe lining and pipeline and manhole replacement. The work will be prioritized consistent with the city's planned paving and road reconstruction projects and the results of ongoing pipeline inspection and rating efforts. Many clay, brick, and asbestos cement sewers in the city have reached the end of their design lives and are beginning to show signs of failure causing sewer backups into homes, and cave-ins under streets, buildings, and homes. In addition to the collection system maintenance concerns, these projects have been prioritized consistent with the City's



Legend

- Sewer Pipes
- Historically Combined Areas
- 2020 Separation
- 2021 Separation
- 2022 Separation

1 inch = 1 miles

0 0.5 1

Miles

N

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Engineers | Environmental Specialists

Imagery provided by ESRI.

FIGURE 6-1
FUTURE COMBINED SEWER SEPARATION

Clean Water Act Master Plan
20 Year Update
Lewiston/Auburn, Maine

June 2019

V:\Projects\L\L5006\Figure6-1_Lewiston_FutureCombinedSewerSeparation.mxd

L-5006

continued focus on I/I reduction and its positive effect on CSO abatement. The specific FY2020 projects will be identified after the City completes their review of the inspection videos and maintenance records collected to date.

6.2.3 Equipment Replacement Program

Lewiston continues to fund the replacement of equipment used to maintain the collection system. The equipment is used for both routine maintenance and repair and to meet regulatory requirements to reduce the frequency of repairs, reduce operating expenses, and to promote worker health and safety. For FY2020 – 2024, the City of Lewiston plans to fund the replacement of a standby pickup truck, a trailer generator, a sewer vactor/jet truck, a 6-inch trailer pump, and a dump truck.

6.2.4 Collection System Inspection

Lewiston's Capital Improvements Plan includes approximately $2.6 million over the next five years for the condition assessment of its sewer collection system by cleaning and video inspecting sewer mains and manholes in accordance with National Association of Sewer Service Companies (NASSCO) standards. The city's budget reflects the inspection of approximately 79,200 linear feet and 360 manholes each year. As of 2019, the City of Lewiston has completed video inspection of all pipe and manholes in its sewer collection system, but the city plans to continue this effort to provide continued planning for operation, maintenance, and capital improvements.

6.2.5 Pump Station Replacement

Lewiston's Capital Improvements Plan includes approximately $200,000 for the replacement of the Chadbourne Road Pump Station. The pump station has reached the end of its design life, and the pumps and pump chamber are showing signs of corrosion and aging. The proposed project will replace the pump station with a new submersible pump station and will also include cleaning of the force main and electrical upgrades including a new control panel. The project will increase the reliability of the pump station and will increase the capacity of the force main, making a positive contribution toward CSO abatement. During the period of FY2020 – 2024, the city also intends to replace the Foss Road 2, Michaud Heights, Sherbrooke Avenue, and Sabattus Road Pump Stations. All of these pump station replacements are expected to positively affect collection system reliability and CSO abatement.

6.3 Auburn Sewerage District Projects

ASD has been committed to full separation of its collection system since 2000. ASD is also committed to further reduce wet weather flow through Infiltration/Inflow (I/I) reduction plans. As of 2011, ASD's originally identified combined system was separated. ASD continues to pursue additional targeted I/I reduction to reduce CSO 001 and to work toward closure of its CSO 005.

6.3.1 ASD Projects (2020 – 2024)

In accordance with a letter from Maine DEP dated March 20, 2018, the Auburn Sewerage District must eliminate the discharge of untreated storm water and sanitary wastewater through CSO 005 by December 31, 2022. To begin working toward this deadline, ASD conducted flow metering at several locations within the system in 2017 and 2018 through deployment of ADS Echo monitors and ADS Triton Flow Sharks. Data from the monitoring program was plotted against LAWPCA flows for comparison. It appeared that overflow

events at CSO 005 may be caused by a combination of localized system hydraulics, capacity issues, and extraneous I/I flows influenced by precipitation events.

In February 2019, ASD initiated a study to deploy multiple assessment techniques to identify the most appropriate course of action to improve these hydraulic, capacity, and I/I issues. The scope of work of this ongoing engineering study, which is expected to be complete in September 2019, includes:

- Reviewing existing mapping, flow monitoring, and CSO activation data
- Development of updated system mapping including flow metering locations
- Additional flow metering in spring and summer 2019
- Smoke testing of approximately 65,000 linear feet of sewers, and subsequent property investigations and dye water tests of properties identified through smoke testing to have possible inflow sources
- Sewer cleaning and CCTV inspection of approximately 1,000 – 2,000 linear feet of sewers in the CSO 005 drainage area to evaluate for capacity issues
- Development and calibration of a partial sewer system hydraulic model to evaluate the capacity of the sewer interceptor downstream of CSO 005
- Development of a report summarizing the study and the recommended improvements, which are expected to include a combination of I/I reduction work and interceptor modifications.

The Auburn Sewerage District anticipates utilizing the results and recommendations of the investigation to address identified I/I sources, in order to eliminate CSO 005 by December 31, 2022. The Auburn Sewerage District is committed to the capital expenditure that may be required to accomplish this goal.

In addition, with the City of Auburn as a partner, ASD will continue to seek out, identify, and eliminate sources of I/I into the sanitary sewer system. ASD will continue to utilize our Vactor truck with the goal of cleaning approximately 15 miles per year of sanitary sewer. ASD will continue to eliminate I/I throughout our sanitary sewer collection system and fund an aggressive sewer main replacement/lining program every year.

ASD believes its efforts will result in meeting the goal of containing the one-year storm within its sanitary sewer collection system by 2024. If the ASD finds through continued CSO and collection system monitoring that it is not able to attain this goal, the ASD plans to consider in-line storage facilities within its collection system in addition to working with the City of Lewiston and LAWPCA to design and construct a storage facility at Structure B.

6.4 Other Improvements

In addition to continued efforts to maintain collection system reliability and capacity, both Lewiston and Auburn have committed to performing post-construction monitoring after all collection system improvements are completed so that the benefits of each improvement can be quantified. For example, Lewiston intends to begin post-construction monitoring of the new Gully Brook Storage Facility shortly, as the facility went online earlier this month. Lewiston also intends to monitor flows downstream of its Water Street Storage Facility at CSO 004 to evaluate whether the storage is being optimized with the current control protocol. Since the storage facility currently employs a simple passive mechanical regulator to control flows to the interceptor, the City would like to evaluate whether a

more dynamic regulator like what was installed at Structure B, controlled based on downstream flows or water levels, might better optimize the storage volume at this facility.

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SECTION 7

Section 7
Alternatives Analysis

7.1 Introduction

This section provides CSO reduction alternatives for City of Lewiston, Auburn Sewerage District, and LAWPCA. The alternatives analysis had three focuses: Jepson Brook area in Lewiston, Auburn CSO 005, and LAWPCA Structure B. The following alternatives and variations were considered:

Alternative 1: Sewer Separation in Jepson Brook and Lisbon/Adams Subcatchments (public sources only)

Alternative 2: Sewer Separation plus upsizing sections of Jepson Brook interceptor with capacity < 3 MGD

Alternative 3: Sewer Separation plus upsizing section of Jepson Brook Interceptor with capacity < 4 MGD

Alternative 4: Sewer Separation and Storage at Structure B

Alternative 5: Sewer Separation and Storage at Structure B and Jepson Brook

Alternative 6: Sewer Separation and Storage at Structure B and Randall Road

Alternative 7: Sewer Separation and Storage at Structure B, Jepson Brook, and Randall Road

7.2 Background

The LAWPCA facility is an activated sludge plant with influent screening and pumping, primary sedimentation, selector contact stabilization activated sludge, secondary clarification, chlorination and dechlorination. The plant is designed for an average daily flow of 14.2 million gallons per day (MGD) and a maximum daily flow of 32 MGD. Flow can be diverted around the secondary treatment process via a 48-inch diameter pipe, though typically the plant is capable of passing 32 MGD through the secondary treatment process. The secondary bypass pipe is located at the influent end of the aeration tanks and allows treated primary flow to be blended with treated secondary flow prior to the chlorine contact tanks and discharge to the river. LAWPCA currently handles all flow through secondary treatment and does not use the bypass except during rare high flow when either an unusual upset condition is being experienced in the activated sludge system or tankage is off line for maintenance.

Once the treatment facility reaches its maximum hydraulic capacity (or influent flow), a gate in Structure B restricts flow to the headworks from the Lewiston system and causes excess flow to discharge to the river. Following metering and screening at the headworks, the combined Lewiston and ASD flow is pumped by the raw wastewater pumps to downstream treatment processes. Currently during a 1-year storm event, the total flow rate exceeds the plant's hydraulic capacity, and as a result, Lewiston's flows are restricted at Structure B when the combined flows from both cities exceeds 32 MGD.

ASD's flows are conveyed under the river via an inverted siphon then through a 42-inch diameter pipe into the headworks of the facility. ASD has a hydraulic relief outfall CSO001 located at the siphon structure on the Auburn side of the river. Flow from the City of

Auburn has hydraulic dominance into the LAWPCA facility during wet weather events. This hydraulic dominance allows more of Auburn's flow to enter the treatment facility while the flow from Lewiston is restricted and ultimately results in an overflow from structure B.

Lewiston's flows are conveyed via a 48-inch diameter main interceptor. Structure B, a combined sewer overflow located on the LAWPCA plant site, is on the main interceptor from Lewiston just upstream of the facility headworks.

7.3 CSO Control Options for Lewiston

The alternatives considered for CSO reduction included three categories: sewer separation, interceptor upsizing, and storage. Each alternative considered used a combination of these three components to determine the most cost effective CSO reduction approach to meet the level of control. Each reduction method considered is described below.

7.3.1 Sewer Separation

Lewiston has identified a total of 281 catch basins or roof drain systems within the City that are connected to the sewer system. 41 catch basins and roof drain systems have been identified for the sewer separation alternative. There are 6 known catch basins and one large roof drainage system in the area of CSO 005C and 35 known catch basins in the Jepson Brook Area. The sewer separation would focus on removing all public catch basins and known roof drains that have drainage systems within the area.

Table 7-1 provides a summary of the conceptual level costs for separation of the 41 catch basins. Catch basins that can be connected to a drainage system were estimated based on a linear foot cost of pipe. There are eight catch basins that will not be able to be connected to the city drainage system as there are no drainage structures in the near vicinity. It has been assumed that these catch basins will be separated through green infrastructure. For the purposes of carrying a conceptual level cost, we have assumed the construction of bioretention systems at each of these catch basins. On average, a conceptual level cost for a bioretention system is between $5,000 to $10,000 per acre drained. As all of the catch basins within the separation list are at or around one acre drained, it has been assumed that the cost for all catch basin bioretention basins will be $10,000. As all green infrastructure solutions, including bioretention systems, require specific site conditions to be viable, site specific investigations must be conducted at each catch basin location to evaluate the viability of green infrastructure. For example, green infrastructure solutions generally require appreciable depths to groundwater and well-draining soils. If green infrastructure solutions are deemed not suitable for any of these locations, then the City may have less success with CSO reductions that predicted by the model for this Alternative (Alternative 2).

TABLE 7-1
Catch Basin Separation Summary

Catch Basin(s)	Length of Pipe	Cost of Piping ($350/LF)
Catch basin stMH-1147[1]		$10,000
Catch basin stMH-1214[1]		$10,000
Catch basin stMH-13435 & 1405	60	$21,000
Catch basin stMH-1409, 1410	200	$70,000
~~Catch basin stMH-14716~~	~~140~~	~~$49,000~~
~~Catch basin stMH-1474, 1475, 1477, 1478~~	~~375~~	~~$131,250~~
~~Catch basin stMH-1476, 1577, 9781~~	~~220~~	~~$77,000~~
Catch basin stMH-1654, 1655, 9761, ~~21656, and 21657~~	709	~~$248,150~~ $150,000
Catch basin stMH-1969[1]		$10,000
Catch basin stMH-20904, 33696	315	$126,000
Catch basin stMH-29795	275	$96,250
~~Catch basin stMH-34499, 34500, 34501, 34502, 34504, 34505~~	~~240~~	~~$84,000~~
Catch basin stMH-5970[1]		$10,000
Catch basin stMH-5971[1]		$10,000
Catch basin stMH-746[1]		$10,000
Catch basin stMH-895 & 896	77	$26,950
Catch basin stMH-9915[1]		$10,000
Corner of Canal Street & Cedat Street (stMH-14445, 152, 151)	463	$162,050
Corner of Lisbon Street & Canal St. Alley (stMH-216)	150	$52,500
Roof drains from Country Kitchen Building	300	$105,000
Canal Street Alley[1]		$10,000
	Total	~~**$1,329,150**~~ $889,750

[1.] Catch basin requires green infrastructure to remove the sewer connection. Cost represents a conceptual level cost for a bioretention system at this catch basin.

7.3.2 Interceptor Upsizing

The model indicated that there were capacity restricting pipe lengths within the Jepson Brook Interceptor which limit flow conveyance and may reduce CSOs if upgraded. To evaluate the benefits of capacity upgrades, the interceptor upsizing was classified into two categories: pipes that have a capacity less than 3 MGD, and pipes that have a capacity less than 4 MGD. These pipes are listed in the Table 7-2. The proposed sewer sizes for all pipes to be upsized is 36 inches.

TABLE 7-2
Lewiston Sewer Interceptor Pipe Segment Upsizing

Pipes with Capacity < 3 MGD	Pipes with Capacity < 4 MGD
7512 (70 LF)	5671 (170 LF)
5678 (120 LF)	5679 (400 LF)
12482 (130 LF)	5680 (70 LF)
5684 (235 LF)	5681 (190 LF)
5685 (360 LF)	5682 (290 LF)
5667 (155 LF)	

7.3.3 Storage

Structure B is the largest source of discharge on the east side of the Androscoggin River in Lewiston-Auburn. Therefore, at a planning level, alternatives for additional storage within Lewiston were considered, including:

- Additional storage at Structure B
- 0.4 MG Storage at Jepson Brook
- 0.4 MG Storage at Randal Road

The location and design of each storage structure would be required if a storage alternative is selected.

Additional storage at Structure B would be constructed along Lincoln Street between the LAWPCA Treatment Facility drive and Lincoln Street. Four levels of storage at Structure B were considered based on the volume required to capture the 1-year design storm, 2.3 MG, 2.1 MG, 2.0 MG, and 1.8 MG.

The model indicated that an additional storage facility of approximately 2.3 MG would be required to capture the 1-year design storm from Lewiston if all storage was located at Structure B.

The model indicated that approximately 0.4 MG of storage at Jepson Brook could reduce the storage required at Structure B from 2.3 MG to 2.1 MG. A potential location for the Jepson brook storage tank is along the Androscoggin Riverside Trail between the Riverside Cemetery and Russell St.

The model indicated that approximately 0.4 MG of storage at Randall Road could reduce the storage required at Structure B from 2.3 MG to 2.0 MG. A potential location for the Randall Road storage tank is along Old Webster Rd at the intersection of Webster St.

If storage is constructed at all three locations, around 1.8 MG of storage would be required at Structure B.

7.4 Estimated CSO Reduction

The model was utilized to simulate design storm conditions and the corresponding benefits from each alternative in terms of CSO reduction. Each alternative was modeled to determine the amount of CSO overflow observed during a 1-year design storm.

Table 7-3 presents the results of this analysis.

TABLE 7-3
Estimated CSO Reduction

CSO	Overflow (MG)								
	Base	Base Prime[1]	Alt. 1 Base Prime + Separation	Alt. 2 Base Prime + Separation + JB Capacity Imp. < 3 MGD[2]	Alt. 3 Base Prime + Separation + JB Capacity Imp. < 4 MGD[3]	Alt. 4 Base Prime + Separation + 2.2 MG Structure B Storage	Alt. 5 Base Prime + Separation + 2.1 MG Structure B Storage + 0.4 MG Jepson Brook Storage	Alt. 6 Base Prime + Separation + 2.0 MG Structure B Storage + 0.4 MG Randall Road Storage	Alt. 7 Base Prime + Separation + 1.8 MG Structure B Storage + 0.4 MG Jepson Brook Storage + 0.4 MG Randall Road Storage
003	0.071	0.034	0.029	0.030	0.030	0.029	0.029	0.025	0.025
004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
005c	0.098	0.098	0.017	0.017	0.017	0.017	0.017	0.017	0.017
005d	0.421	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
017	0.444	0.444	0.099	0.134	0.095	0.099	0.099	0.099	0.099
024	0.170	0.170	0.084	0.092	0.068	0.084	0.084	0.084	0.084
026	0.213	0.213	0.081	0.028	0.007	0.081	0.081	0.081	0.081
028	0.067	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lewiston Subtotal	**1.484**	**1.026**	**0.310**	**0.301**	**0.217**	**0.310**	**0.310**	**0.306**	**0.306**
Structure B	2.472	2.377	2.234	2.333	2.367	0.000	0.000	0.000	0.000
Auburn CSO 001	0.808	0.808	0.808	0.808	0.808	0.808	0.808	0.808	0.808
TOTAL	**4.764**	**4.211**	**3.352**	**3.442**	**3.392**	**1.118**	**1.118**	**1.114**	**1.114**

[1] Includes the Gully Brook CSO Storage Facility

[2] Increased the size of pipes along the Jepson Brook Interceptor from 24" to 36" for pipes that have a capacity of less than 4 MGD (1,000 feet)

[3] Increased the size of pipes along the Jepson Brook Interceptor from 24" to 36" for pipes that have a capacity between 4 and 5 MGD (1,100 feet)

7.5 Planning Level Cost Estimates

The planning opinion of probable cost (OPCC) for the CSO reduction alternatives is based on Class 5 level construction cost estimates, as defined by the Association for the Advancement of Cost Engineering (AACE) International Recommended Practices and Standards. The end usage for a Class 5 estimate is screening and feasibility. The expected accuracy range of a Class 5 estimate is between +50% to -30%.

The planning level OPCC is based on recent project costs and the cost equations provided in the September 1993 EPA Combined Sewer Overflow Control Manual: Cost ($M)=3.637 x (volume)0.826, adjusted based on the ratio of the current and 1992 ENRs (ENR Index for equation=4800 (1992) vs. May 2019 Index = 11230). To address the accuracy of the planning level cost estimate, and the current volatile market prices for materials, and current bidding market, a 30% construction and bidding contingency was added to the total project cost excluding engineering. It is recommended that site specific preliminary design evaluations be conducted to provide a greater certainty on cost estimation in relation to the corresponding direct water quality benefits of future CSO abatement improvements.

Table 7-4 provides a summary of the planning level construction cost for each alternative and the associated cost per million gallons abated.

TABLE 7-4
Alternatives Analysis Cost Evaluation

CSO	Overflow (MG)								
	Base	**Base Prime[1]**	**Base Prime + Separation**	**Base Prime + Separation + JB Capacity Imp. < 4 MGD[2]**	**Base Prime + Separation + JB Capacity Imp. < 5 MGD[3]**	**Base Prime + Separation + 2.3 MG Structure B Storage**	**Base Prime + Separation + 2.1 MG Structure B Storage + 0.4 MG Jepson Brook Storage**	**Base Prime + Separation + 2.0 MG Structure B Storage + 0.4 MG Randall Road Storage**	**Base Prime + Separation + 1.8 MG Structure B Storage + 0.4 MG Jepson Brook Storage + 0.4 MG Randall Road Storage**
Lewiston	1.484	1.026	0.399	0.301	0.217	0.399	0.398	0.394	0.394
Structure B	2.472	2.377	2.293	2.333	2.367	0.000	0.000	0.000	0.000
Auburn CSO 001	0.808	0.808	0.808	0.808	0.808	0.808	0.808	0.808	0.808
TOTAL	**4.764**	**4.211**	**3.500**	**3.442**	**3.392**	**1.207**	**1.206**	**1.202**	**1.202**
INCREMENTAL REDUCTION			**0.711**	**0.058**	**0.050**	**2.293**	**2.294**	**2.298**	**2.298**
COST ($M)			**$ 1.33**	**$ 1.78**	**$ 2.31**	**$ 23.20**	**$ 26.80**	**$ 26.00**	**$ 29.80**
INCREMENTAL COST/MG			**$ 1.87**	**$ 30.69**	**$ 46.22**	**$ 10.12**	**$ 11.68**	**$ 11.31**	**$ 12.97**

[1] Includes the Gully Brook CSO Storage Facility

[2] Increased the size of pipes along the Jepson Brook Interceptor from 24" to 36" for pipes that have a capacity of less than 4 MGD (1,000 feet)

[3] Increased the size of pipes along the Jepson Brook Interceptor from 24" to 36" for pipes that have a capacity between 4 and 5 MGD (1,100 feet)

7.6 Alternatives Analysis Discussion

Table 7-3 shows that targeted sewer separation in Lewiston, as represented by the Base Prime plus Separation alternative (Alternative 1), has a relatively low incremental cost-to-benefit ratio at approximately $1.87 million per million gallons of CSO. Conversely, the alternatives which include replacement of sections of the Jepson Brook Interceptor to 4 and 5 MGD (Alternatives 2 and 3) appear to offer very limited benefit in terms of CSO abatement, with reductions of 0.058 and 0.050 million gallons, respectively. As such, these interceptor replacement options have very high cost-to-benefit ratios at $30.69 and $46.22 per million gallons of CSO.

Alternatives 4 through 7 included the same targeted sewer separation as was included in Alternative 1, plus an array of storage facilities of varying volumes and at various locations in Lewiston's collection system. The volumes of the storage facilities were as predicted by the volume to provide the 1-year level of control at the Structure B CSO. Alternative 4 included a single storage facility near Structure B; whereas Alternatives 5-7 included additional storage facilities in Lewiston in concert with a storage facility at Structure B. By comparing the cost-to-benefit ratios of each of these alternatives, it is clear that constructing additional storage facilities in addition to the Structure B storage facility increases the cost-to-benefit ratio. Therefore, it appears to be more cost-effective to provide the storage volume required with a single storage facility at Structure B rather than both at Structure B and additional locations within Lewiston. This is not particularly surprising since Alternatives 5 through 7 involve construction at multiple sites and the construction of multiple facilities rather than construction of a single facility.

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SECTION 8

Section 8
Next 5-Year Plan (2020 - 2024)

8.1 Introduction

The proposed implementation plan includes work by each of the three entities, as well as continued active monitoring and collaboration as a team. Continued collaboration is critical to developing the optimum and most cost-effective solution for achievement of the 1-year level of control of CSO discharges to the Androscoggin River.

8.2 Auburn Sewerage District Plan

ASD plans to continue its rigorous system maintenance, cleaning, and inspection program to maintain the capacity of its collection system and continue to identify and remove sources of I/I. In addition, ASD intends to complete and implement the recommendations of its ongoing CSO 005 drainage area study toward the ultimate closure of CSO 005 by the end of 2022. If construction of a storage facility at Structure B is determined to be the optimal solution to achieving the 1-year level of control, then Auburn will work cooperatively with Lewiston and LAWPCA to begin preliminary design and detailed site evaluations toward the ultimate design and construction of this storage facility.

8.3 Lewiston Plan

Lewiston plans to undertake a multi-pronged approach to the next five years of CSO abatement, including targeted sewer separation, system maintenance, cleaning and inspection. Lewiston will also perform some system monitoring to realize some optimization of its existing storage facilities. Finally, Lewiston will work cooperatively with Auburn and LAWPCA to confirm the need for a storage facility at Structure B and, if confirmed, perform a detailed site evaluation and preliminary design for the Structure B storage facility.

8.4 LAWPCA Plan

In addition to the activities that ASD and Lewiston will undertake individually, all parties will continue to collaborate with LAWPCA on the evaluation of the need for CSO storage to address Structure B overflows. Upon confirmation of the need for this storage facility, the entities will work together to determine the optimum volume of this facility to provide the 1-year level of control and perform a site evaluation. This site evaluation will culminate in a preliminary design of a storage facility to provide a 1-year level of control at Structure B. The intent of the detailed site evaluation will be to identify, and screen viable sites based on location within the collection system and system hydraulics, and site features that impact project cost, including layout, geotechnical and environmental consideration, and preliminary design criteria.

8.5 Recommendations

This 5-year CWAMP update therefore recommends that ASD, Lewiston, and LAWPCA continue with investments in performing BMPs, I/I investigations and remedial work, renewal and replacement of existing infrastructure, and further monitoring, studies and

analyses to confirm the need for and identify the optimum storage volume for Structure B. It is the intent of the entities that the final design and construction of the proposed Structure B storage facility would occur at the conclusion of the preliminary design efforts. This will allow for the final design of the storage facility to account for any system optimization improvements and subsequent reduction in overflows achieved over the course of the next five years.

In summary, the proposed Implementation Plan for the next five years is shown in Figure 8-1 and is as follows:

- Lewiston – Targeted sewer separation projects, I/I inspection, targeted sewer rehabilitation, and maintenance of its CMOM program.
- ASD – Continued I/I investigations, targeted sewer rehabilitation, closure of CSO005, and evaluation of the need for CSO storage within Auburn.
- LAWPCA – Siting analyses, site investigations, and preliminary design evaluations for storage at Structure B.

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Figure 8-1
Clean Water Act Master Plan Twenty-Year Update

Implementation Schedule Year 2020 through 2024

LEWISTON PROJECTS	2020				2021				2022				2023				2024			
	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec
Targeted Sewer Separation (Jepson, Lisbon/Adams, Water Street, Hart)																				
I/I Inspections, CMOM Program																				
Targeted Sewer Rehabilitation																				
Work with All Entities to Control CSOs (Storage Study and Report)																				
25- Year CWAMP Update																				

ASD PROJECTS	2020				2021				2022				2023				2024			
	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec
Drainage Area 005 Investigations, Close of CSO 005																				
I/I Inspections, CMOM Program																				
Targeted Sewer Rehabilitation																				
Work with All Entities to Control CSOs (Storage Study and Report)																				
25- Year CWAMP Update																				

LAWPCA PROJECTS	2020				2021				2022				2023				2024			
	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec	Jan	Mar	Jun	Dec
Work with All Entities to Control CSOs (Storage Study and Report)																				
25- Year CWAMP Update																				

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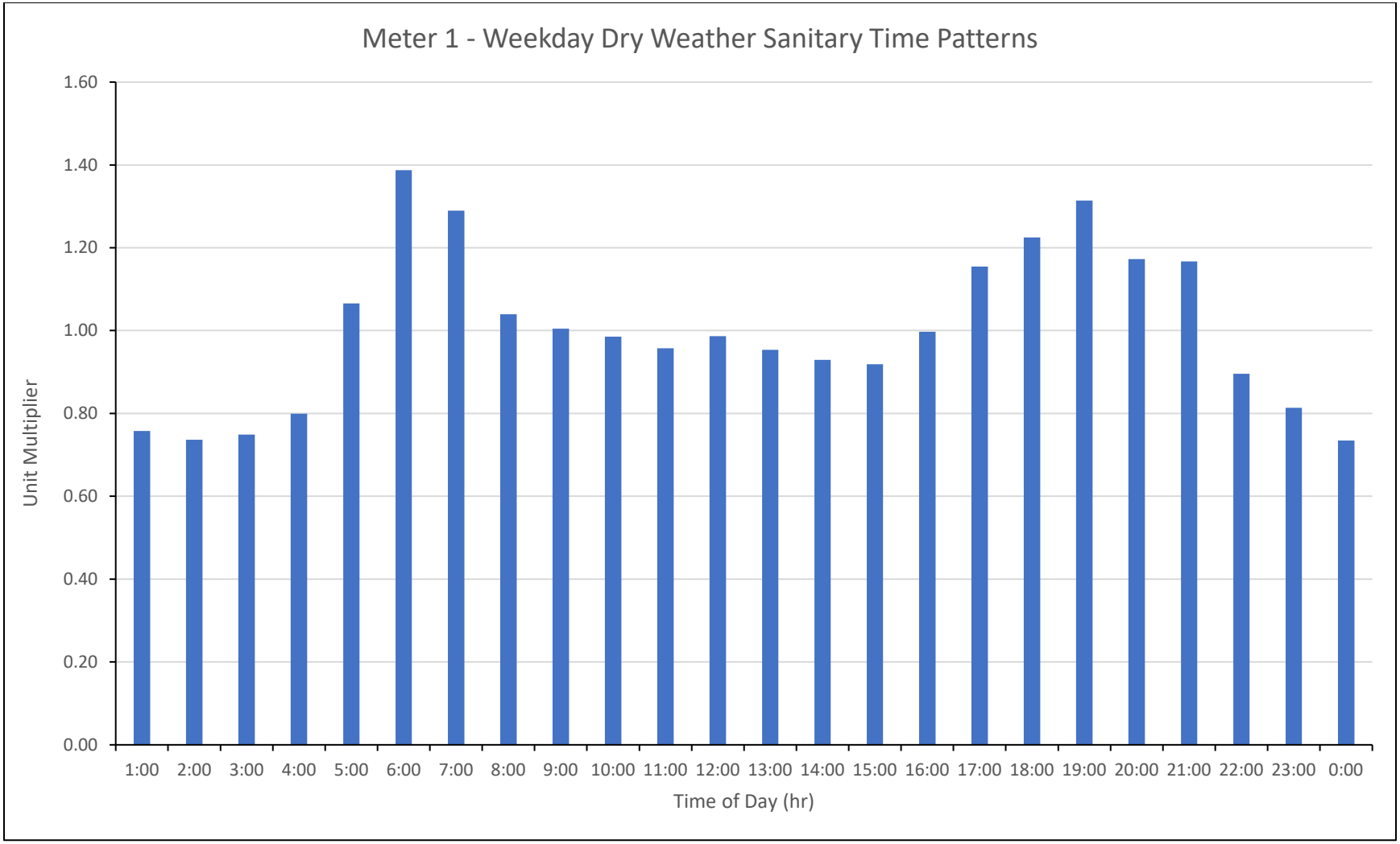
APPENDIX A

Dry Weather Time Patterns and Calibration Plots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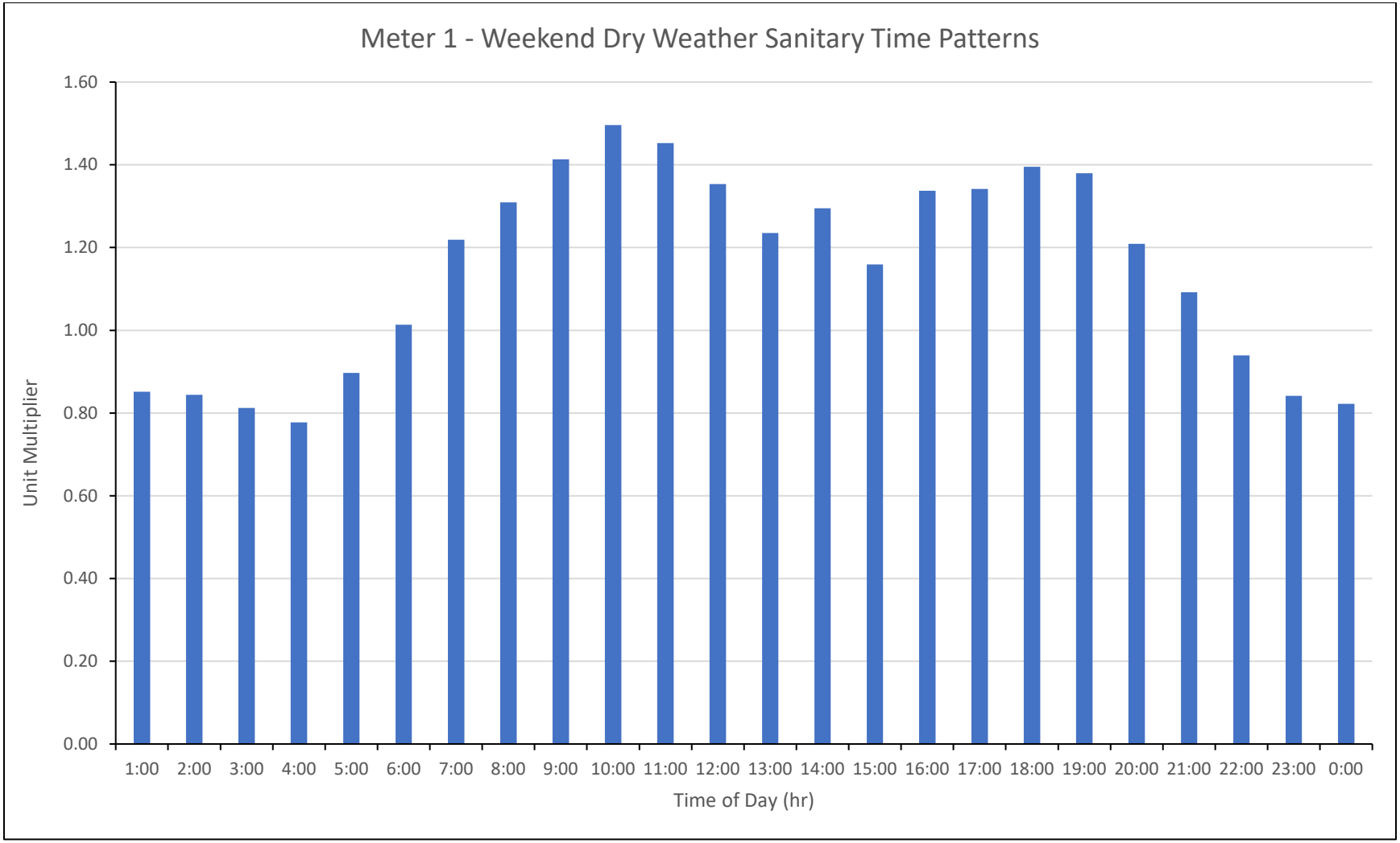
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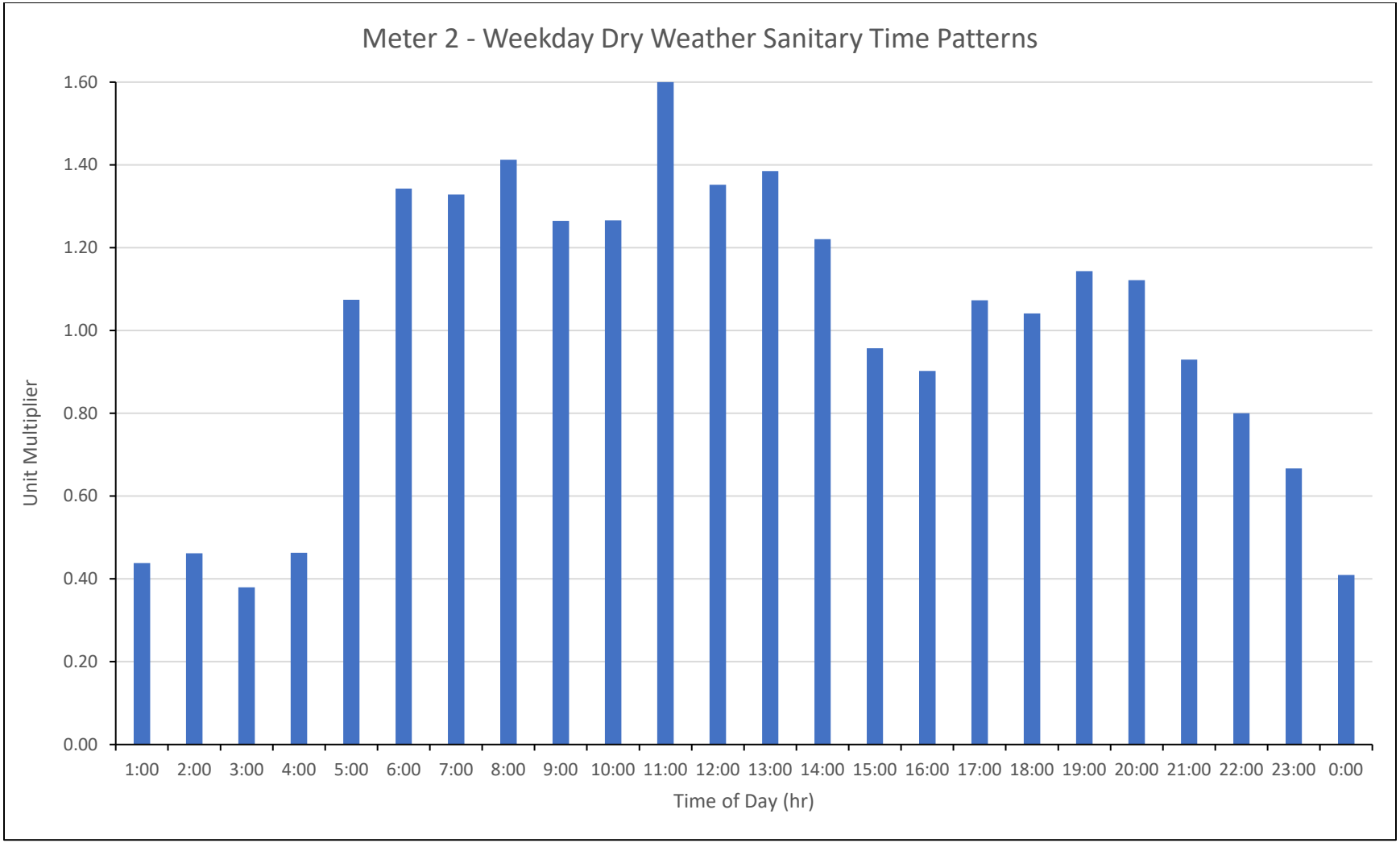
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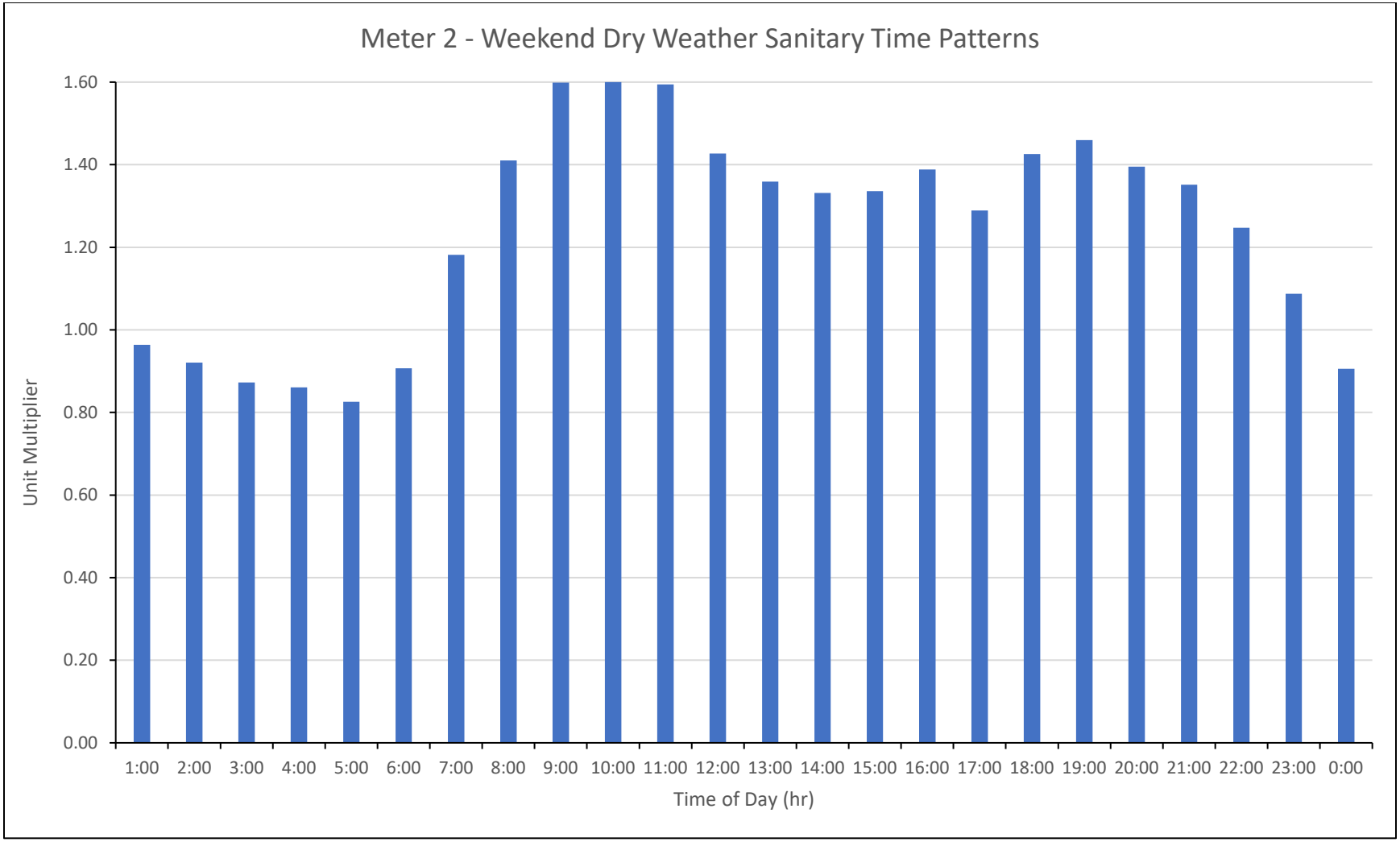
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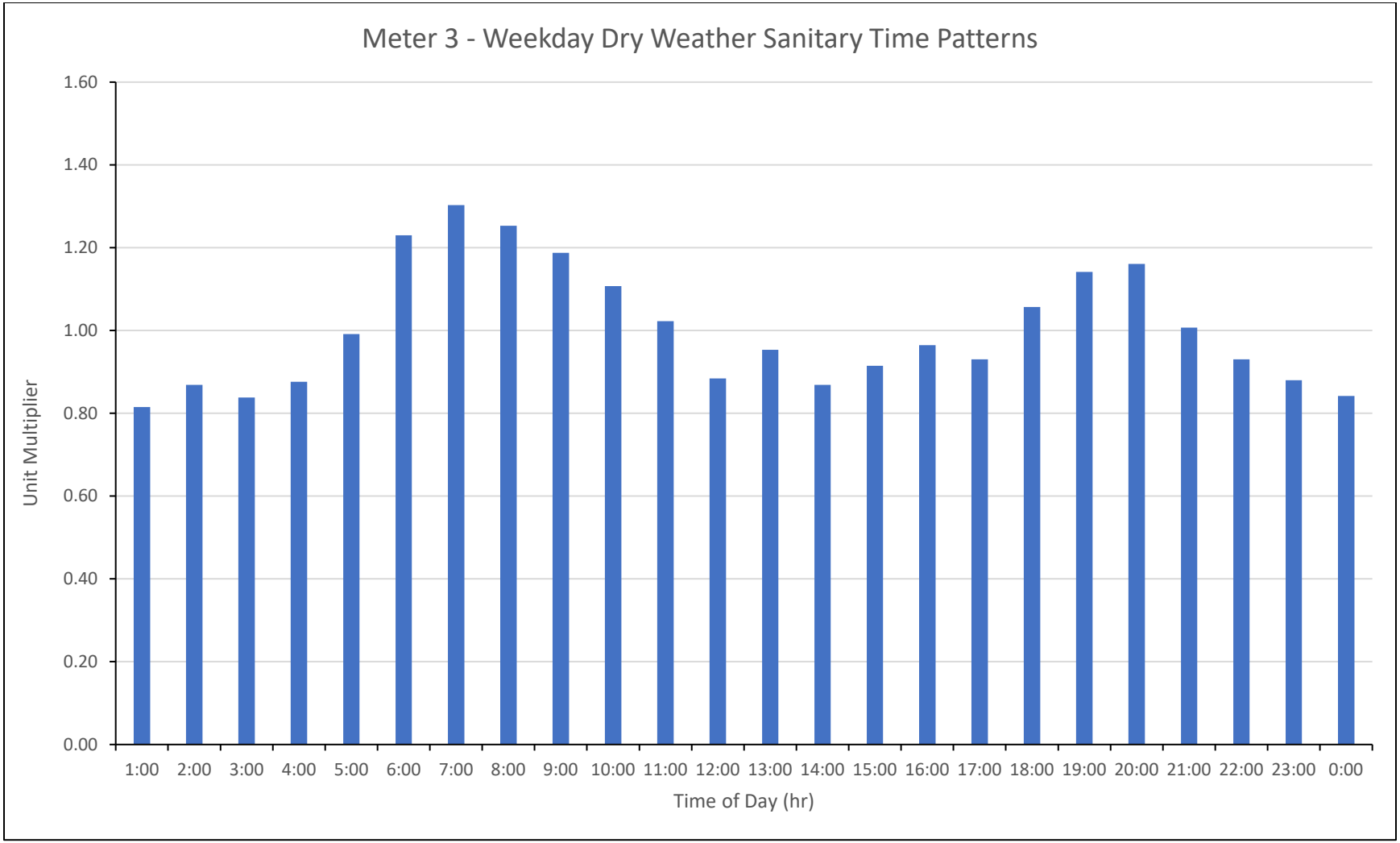
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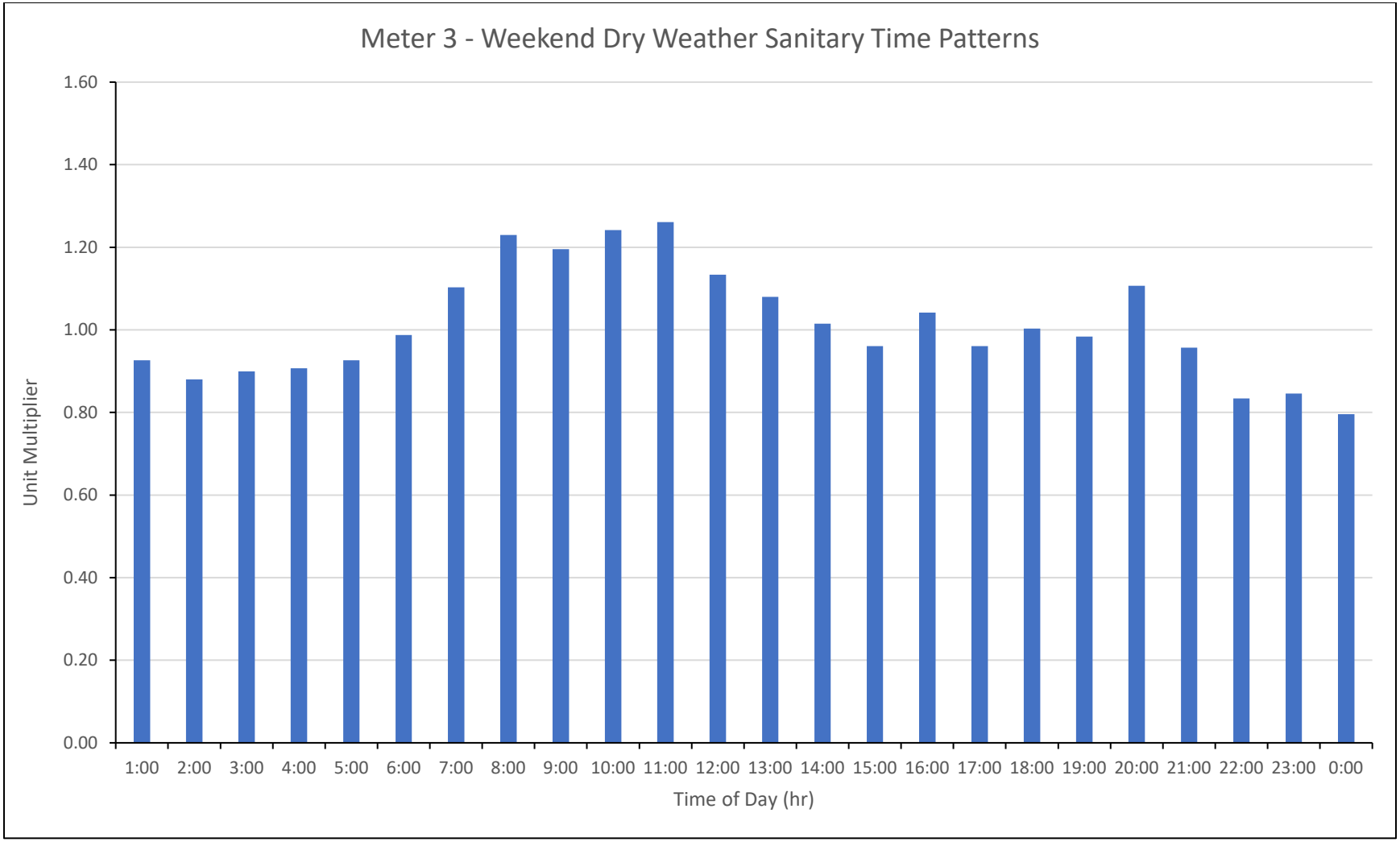
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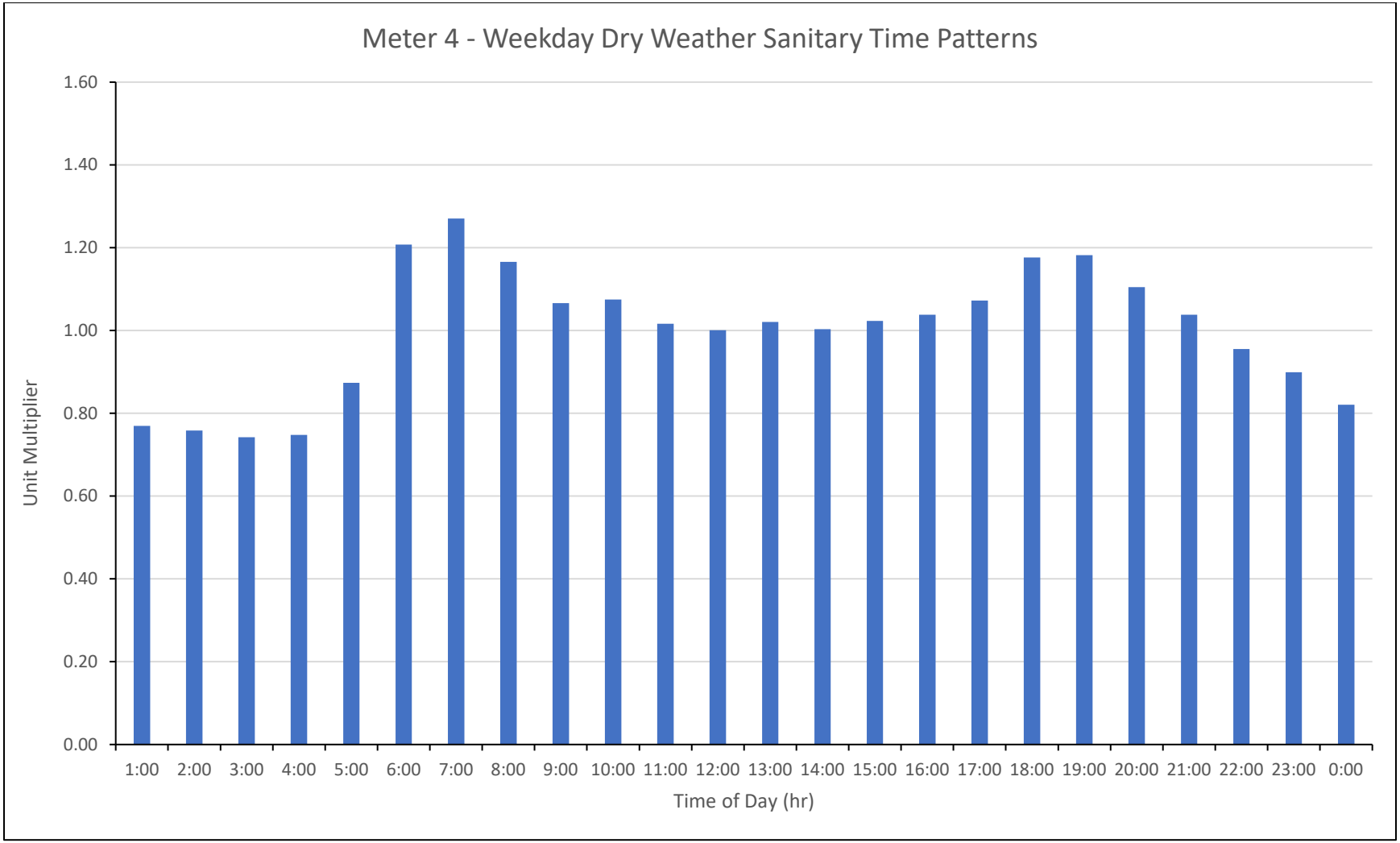
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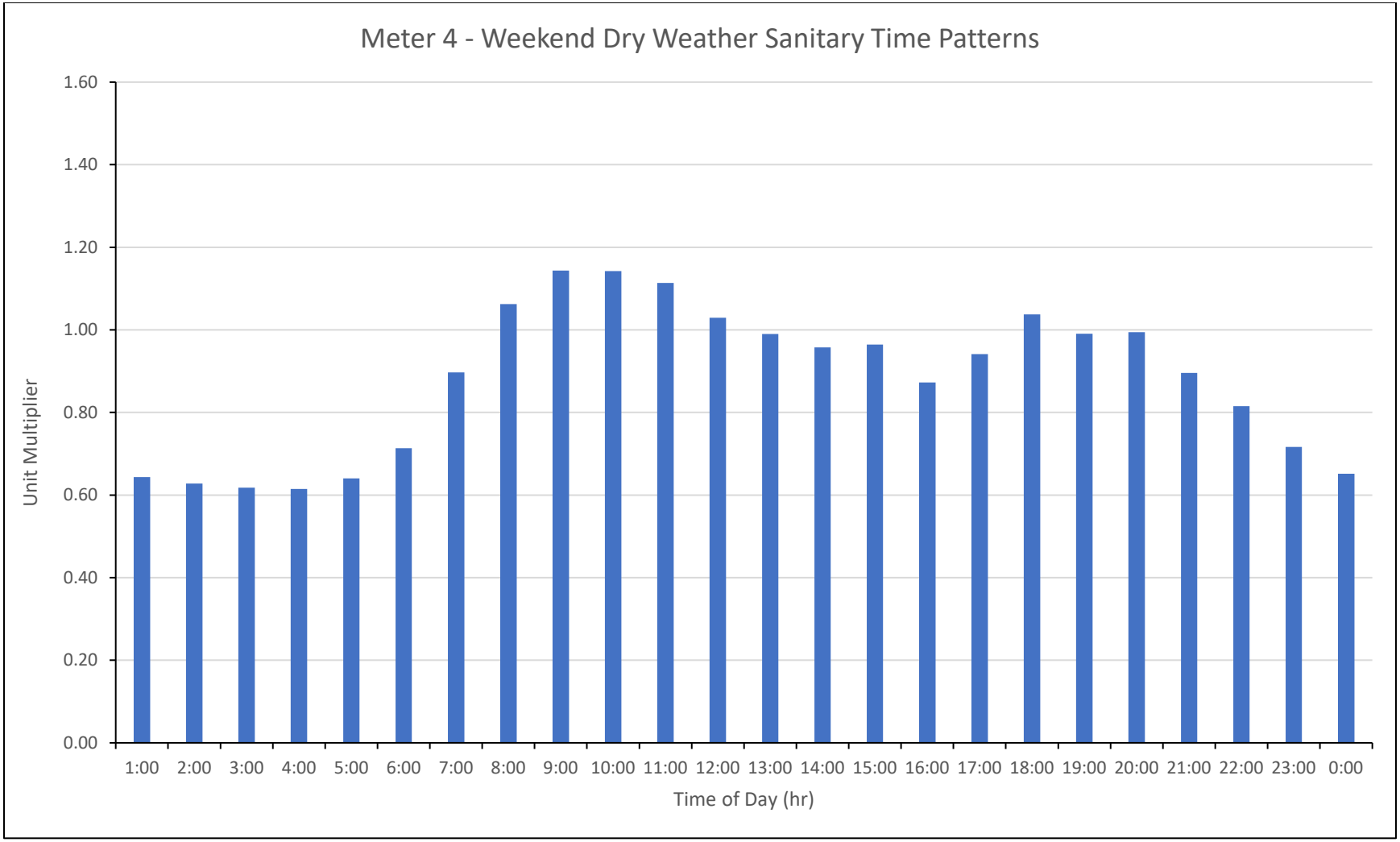
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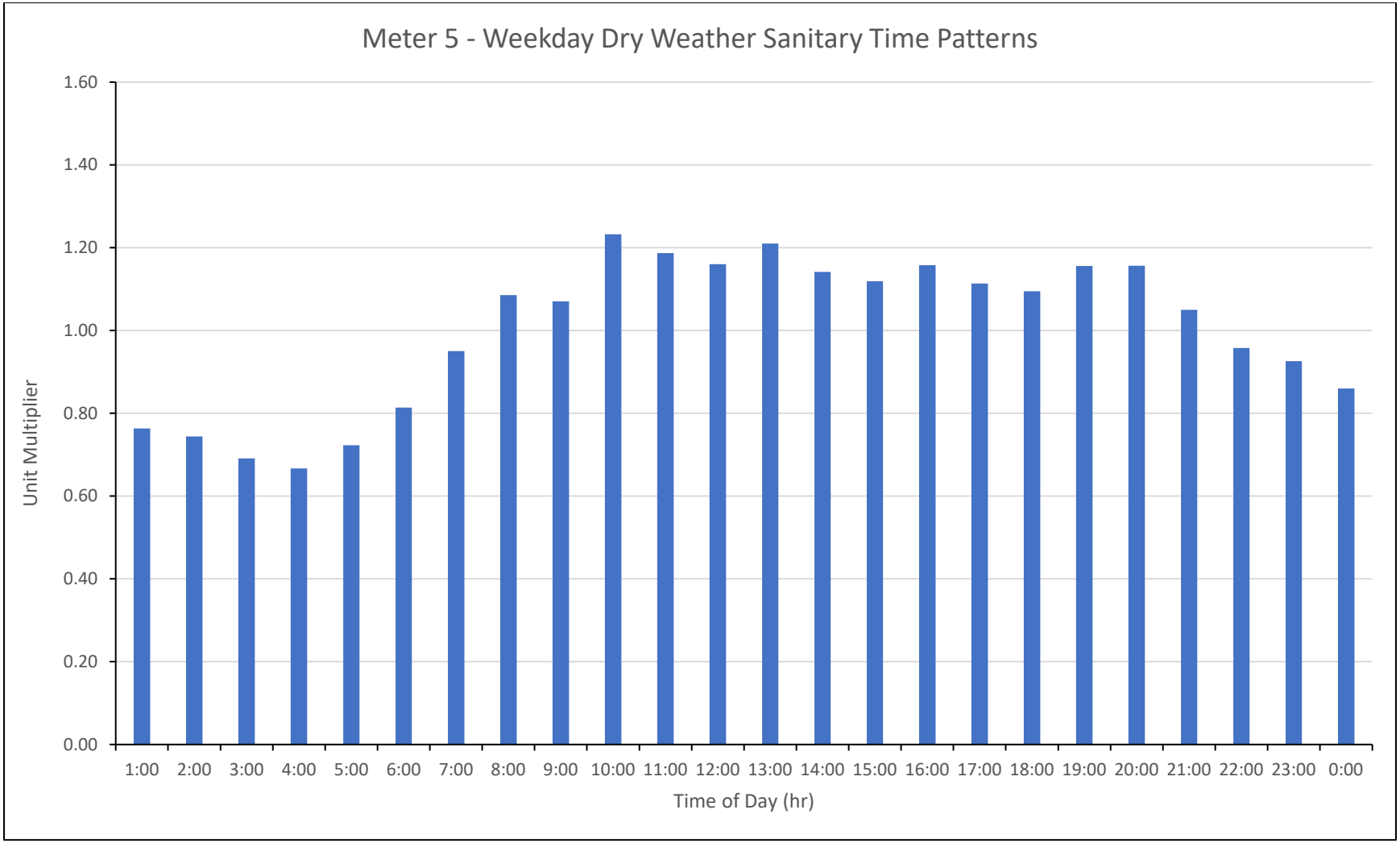
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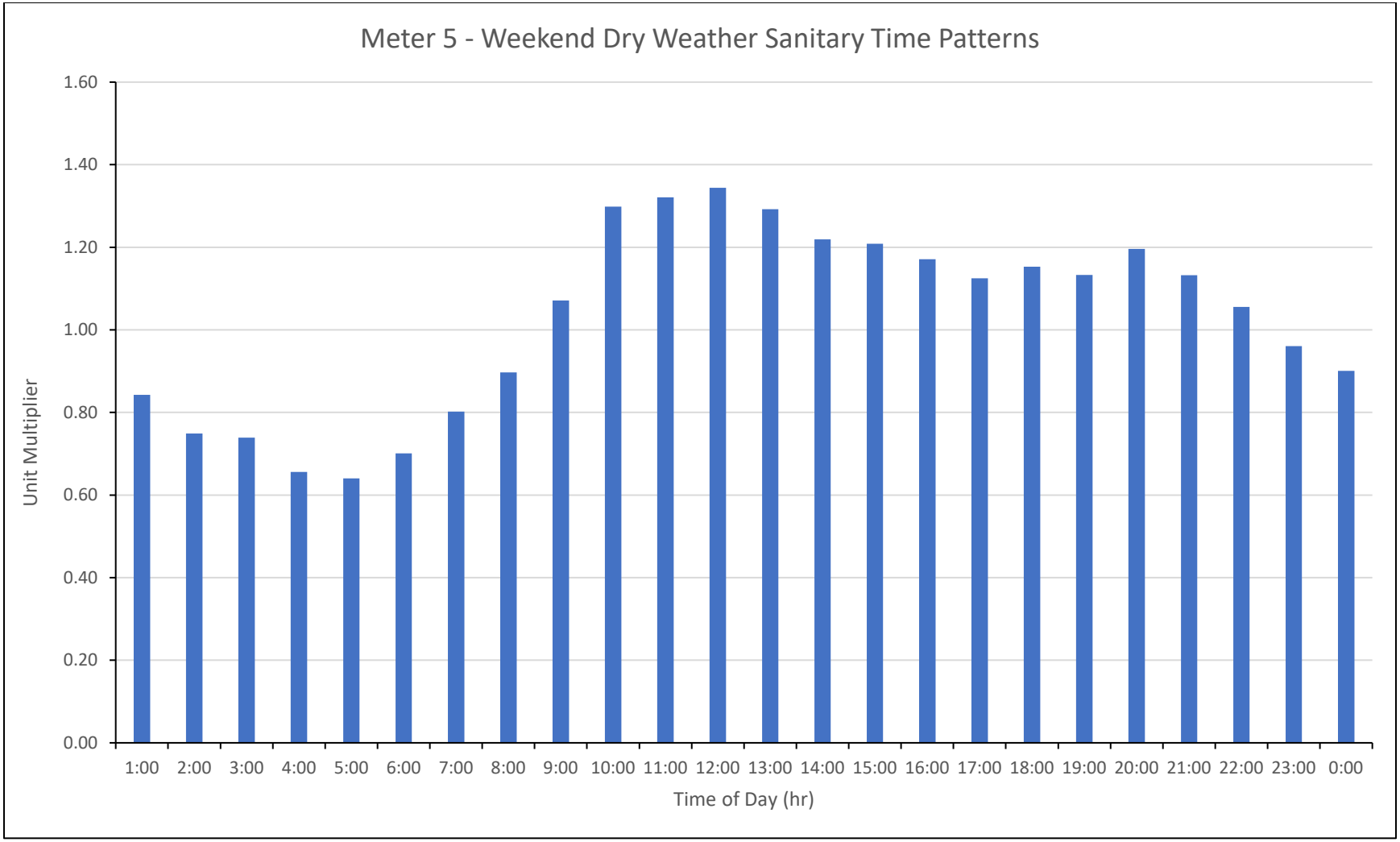
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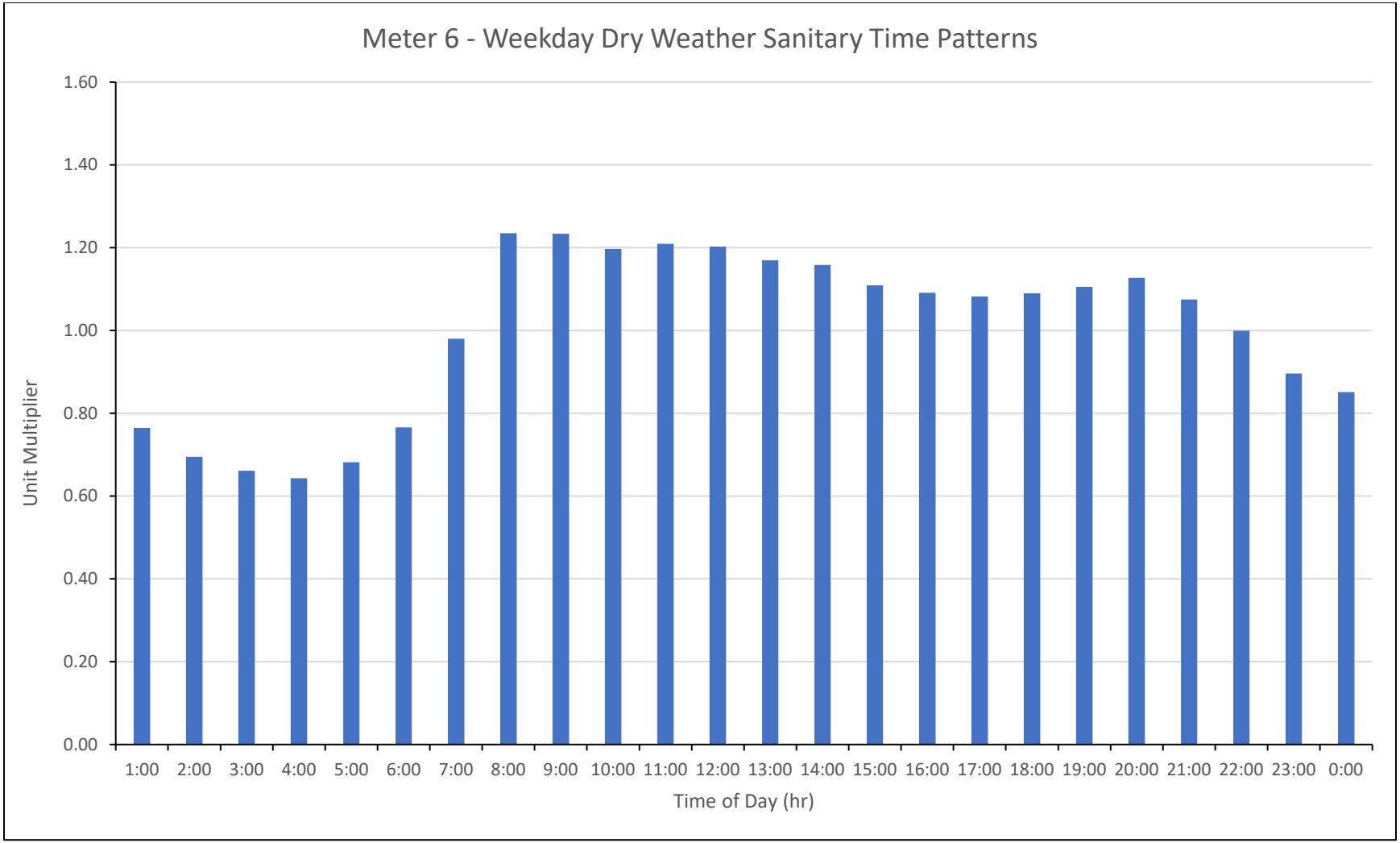
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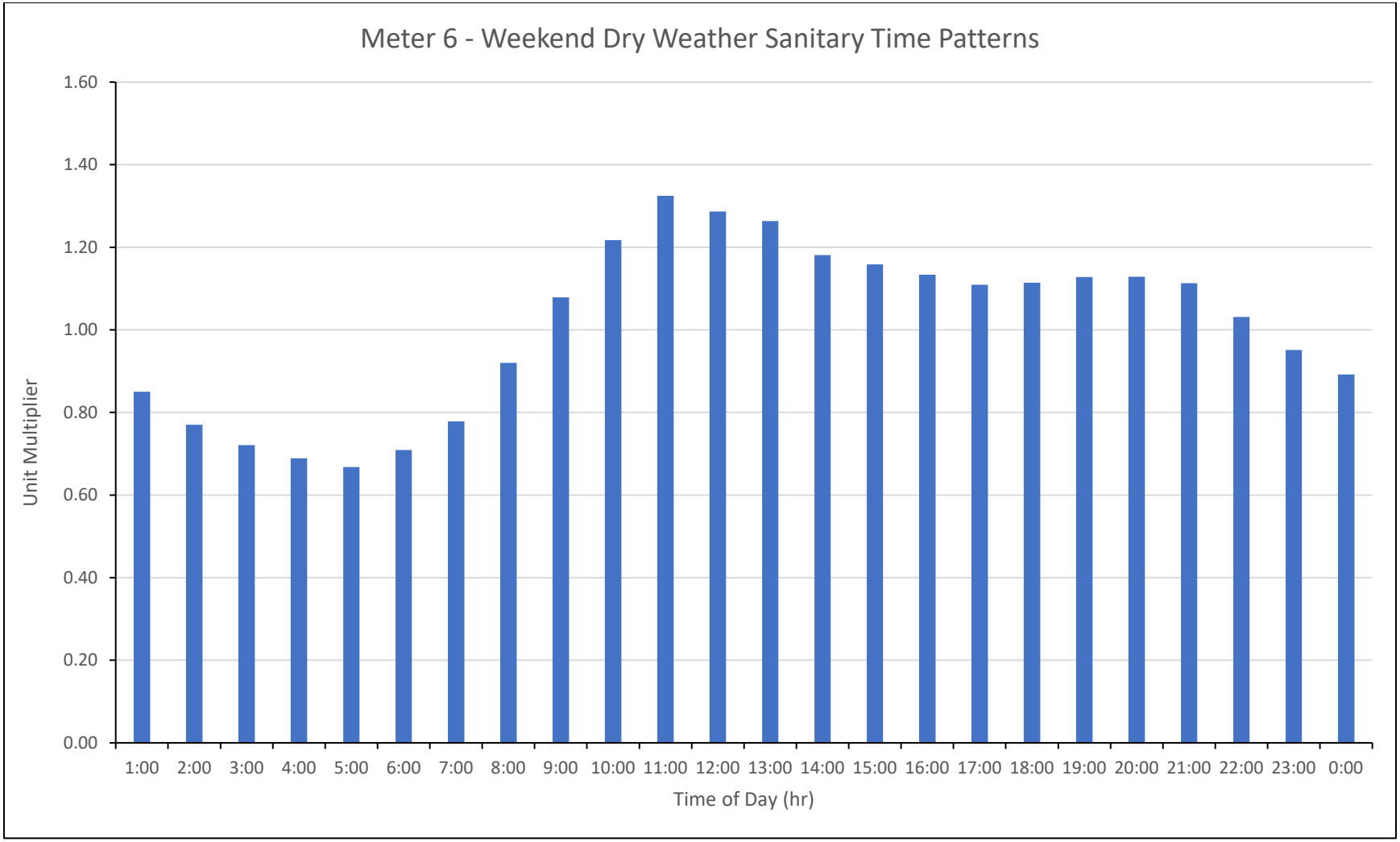
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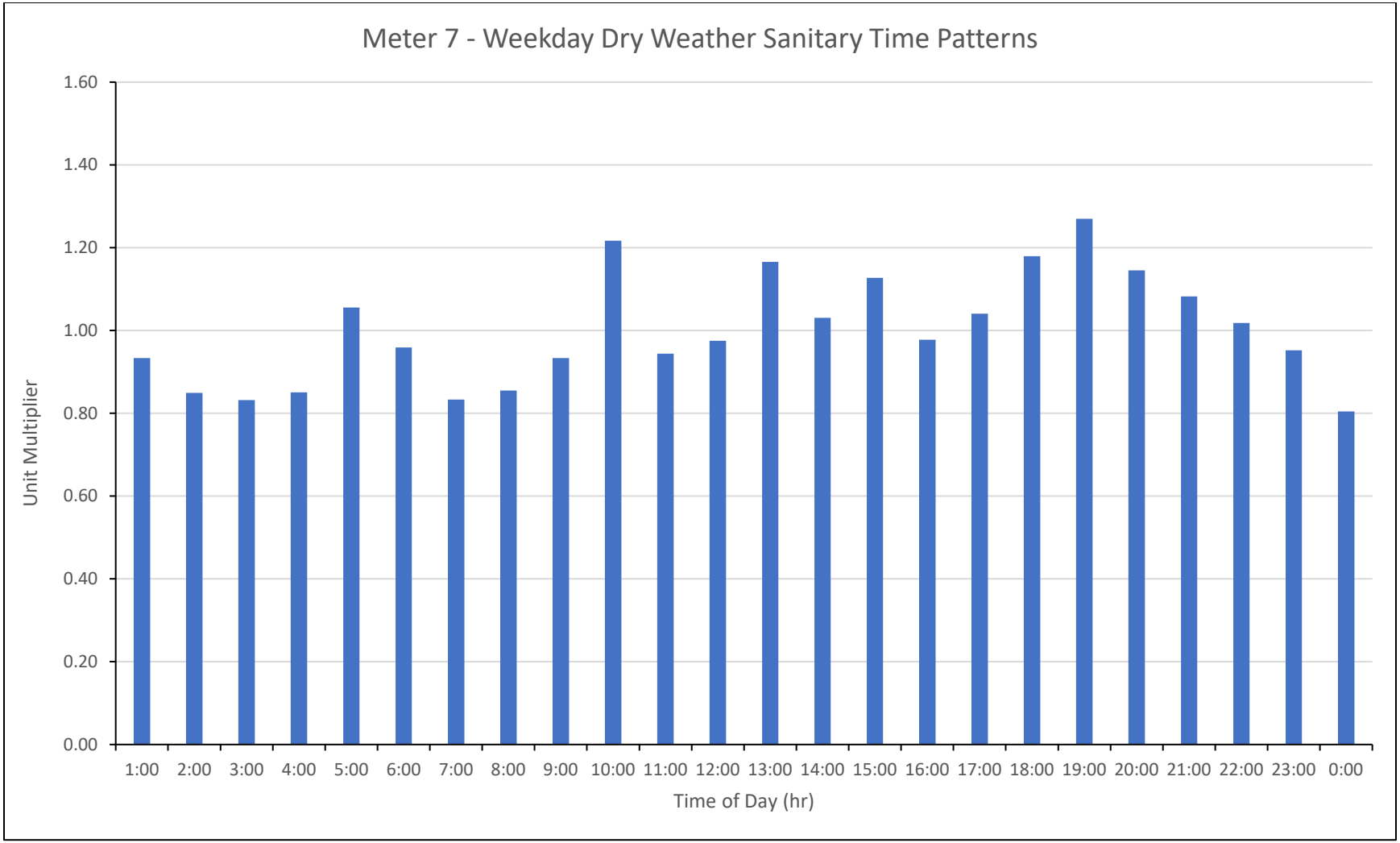
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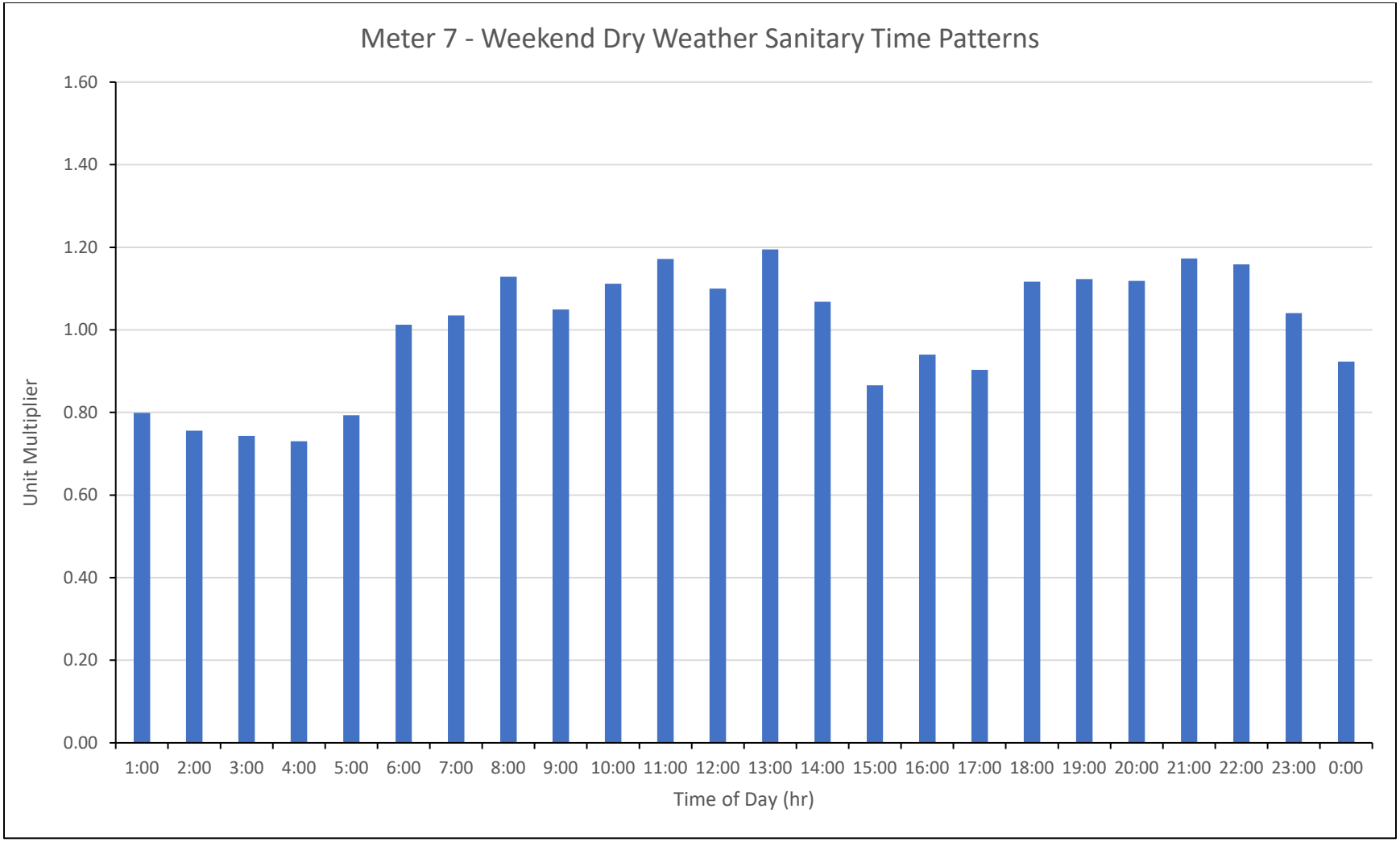
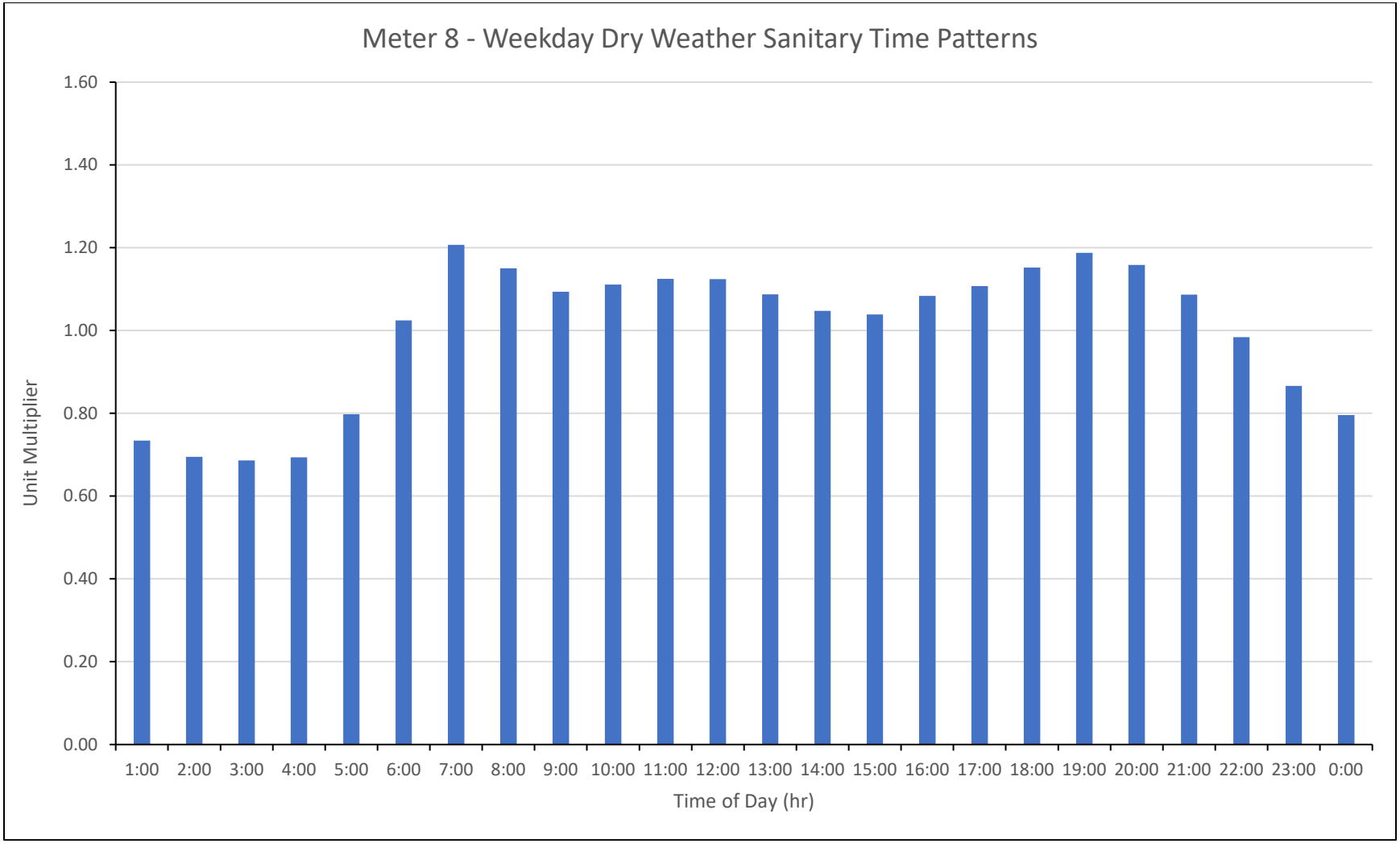
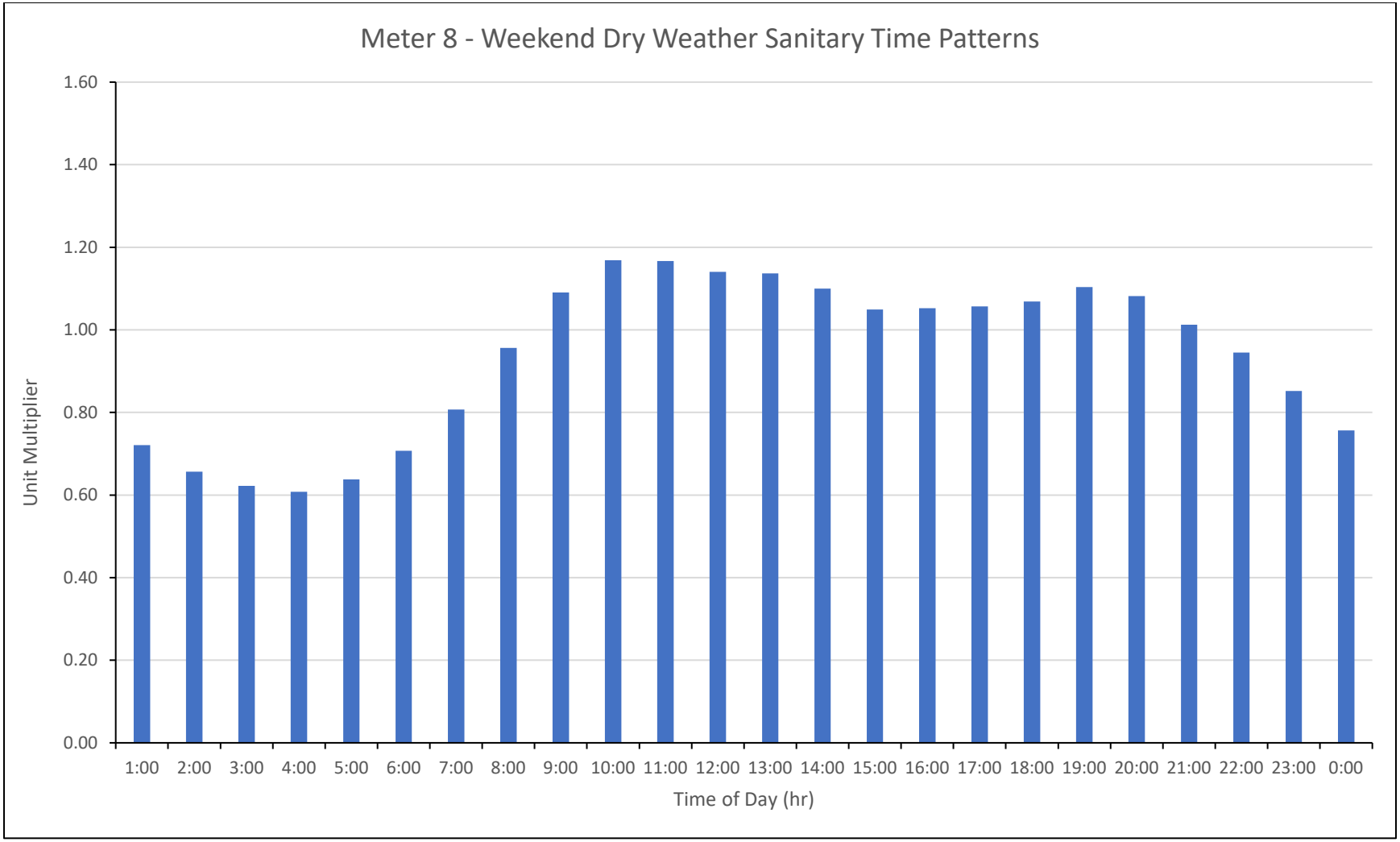
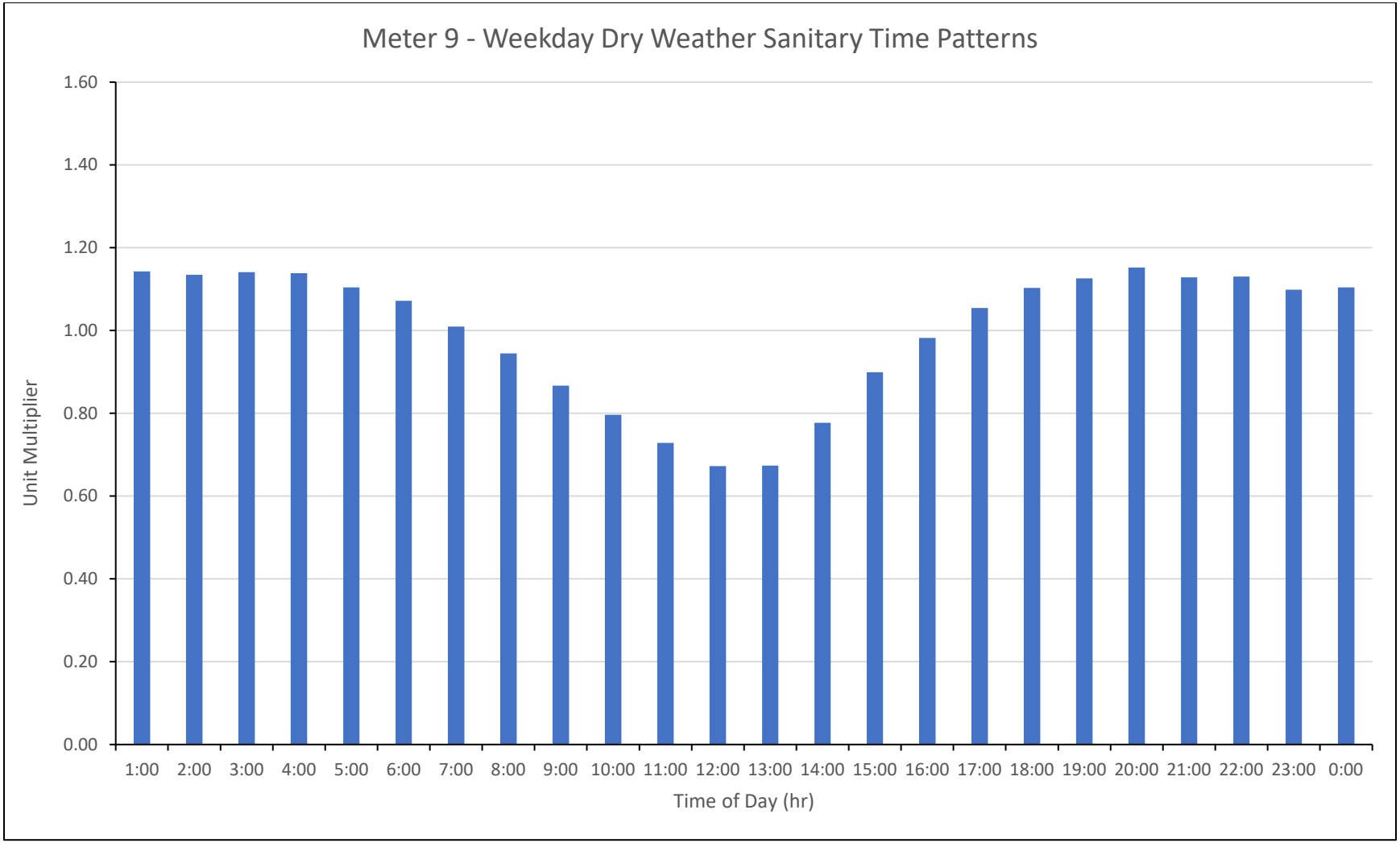
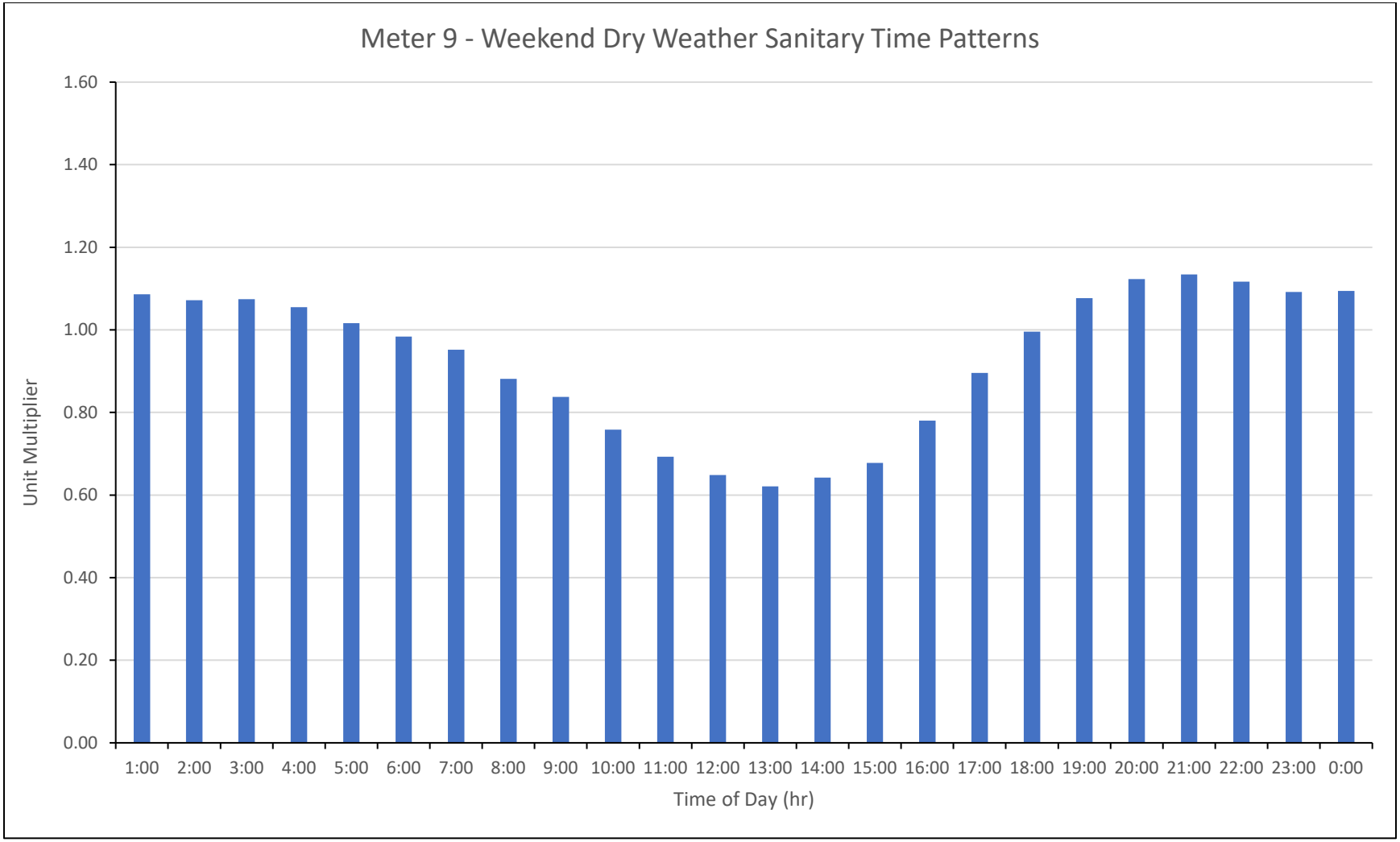
Time of Day (hr)

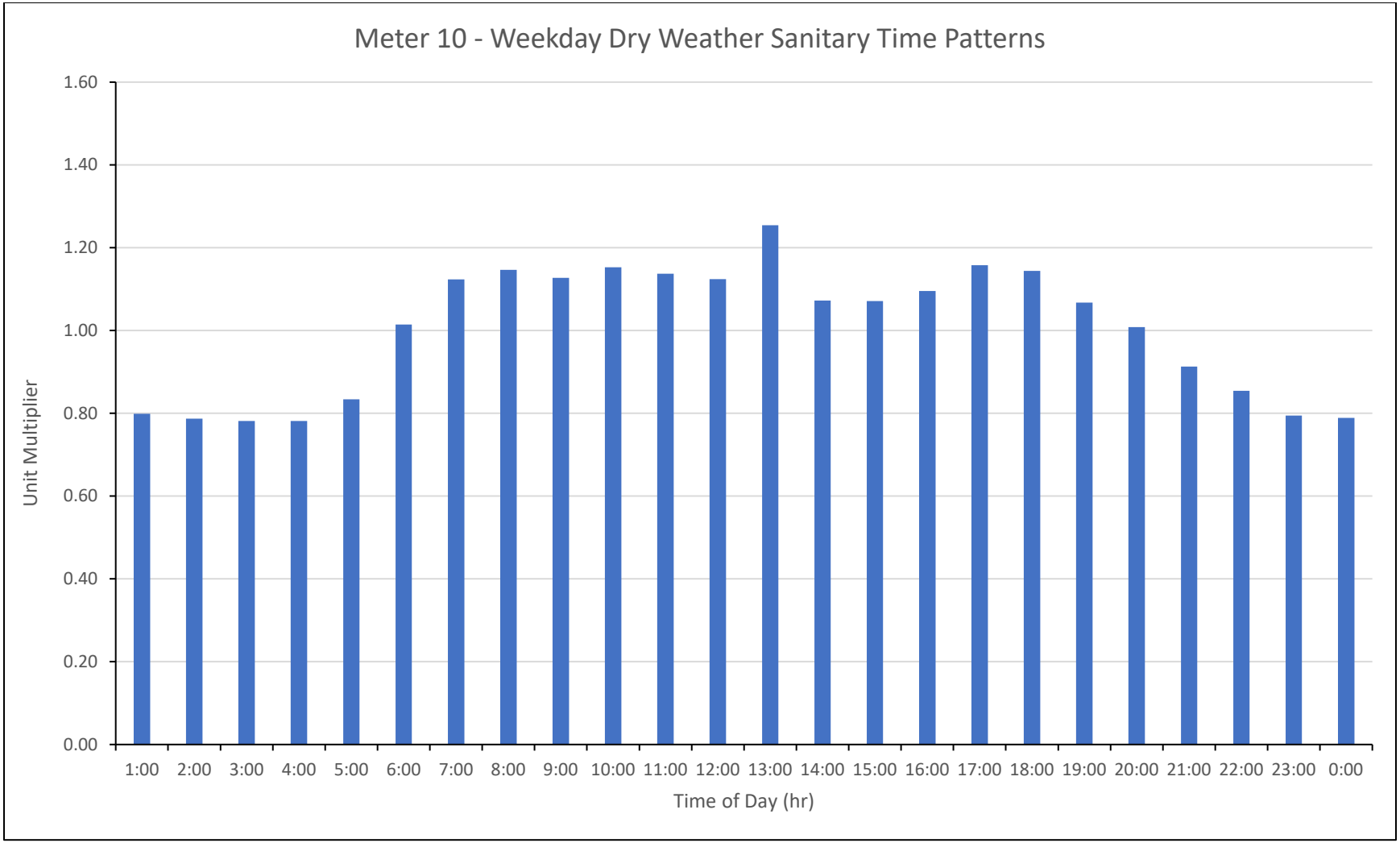

Meter 7 - Weekend Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

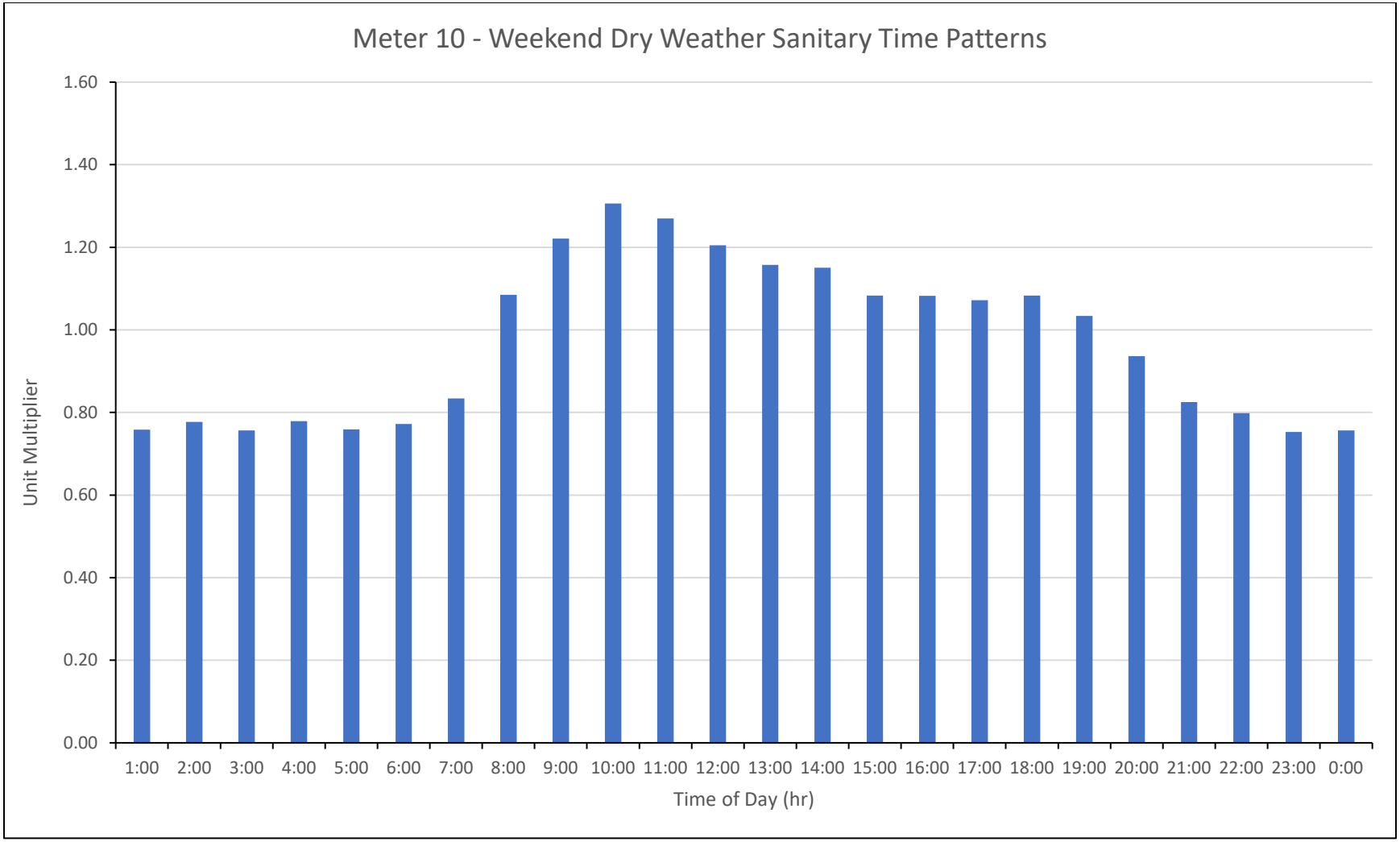

Meter 8 - Weekday Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

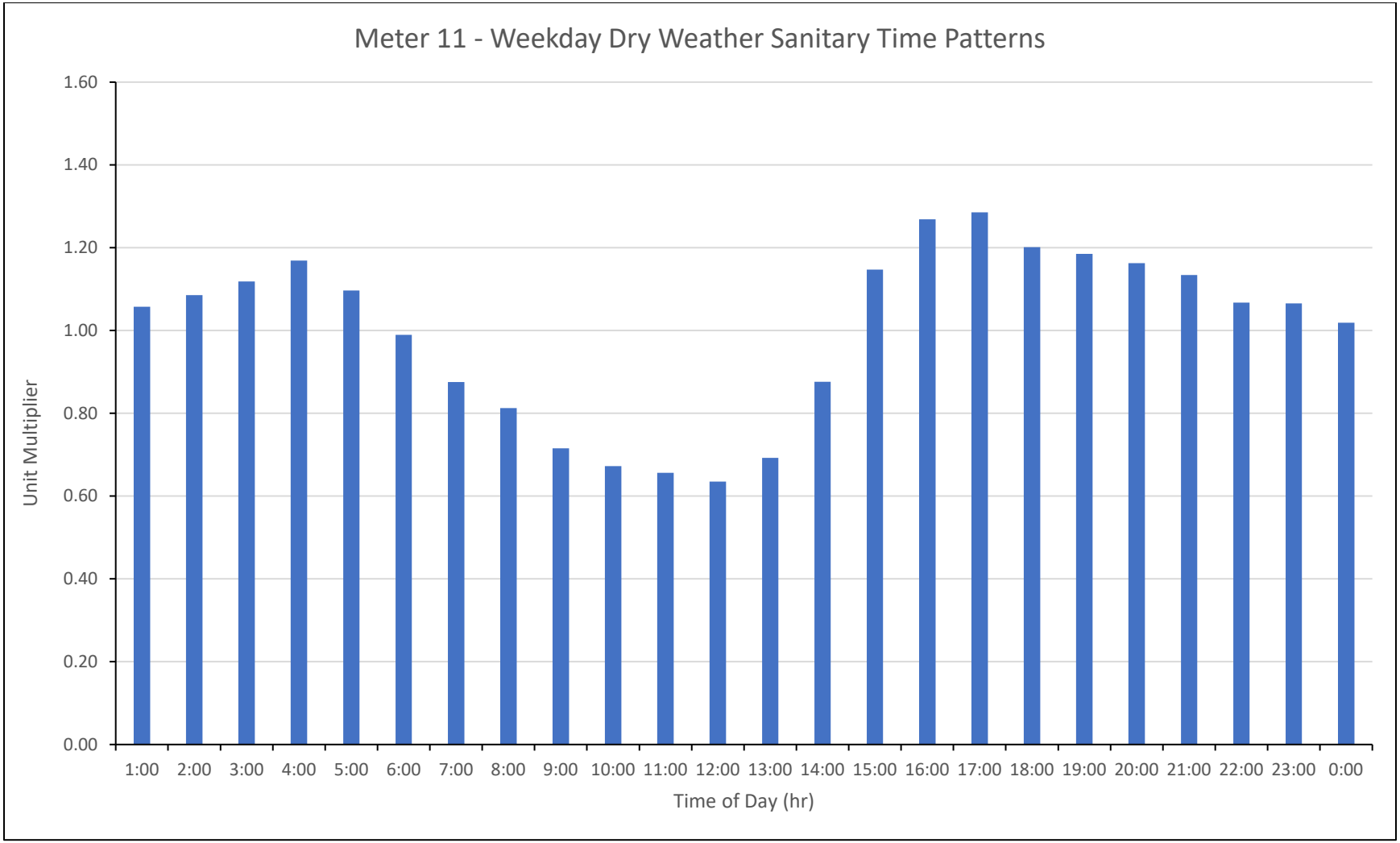

Meter 8 - Weekend Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

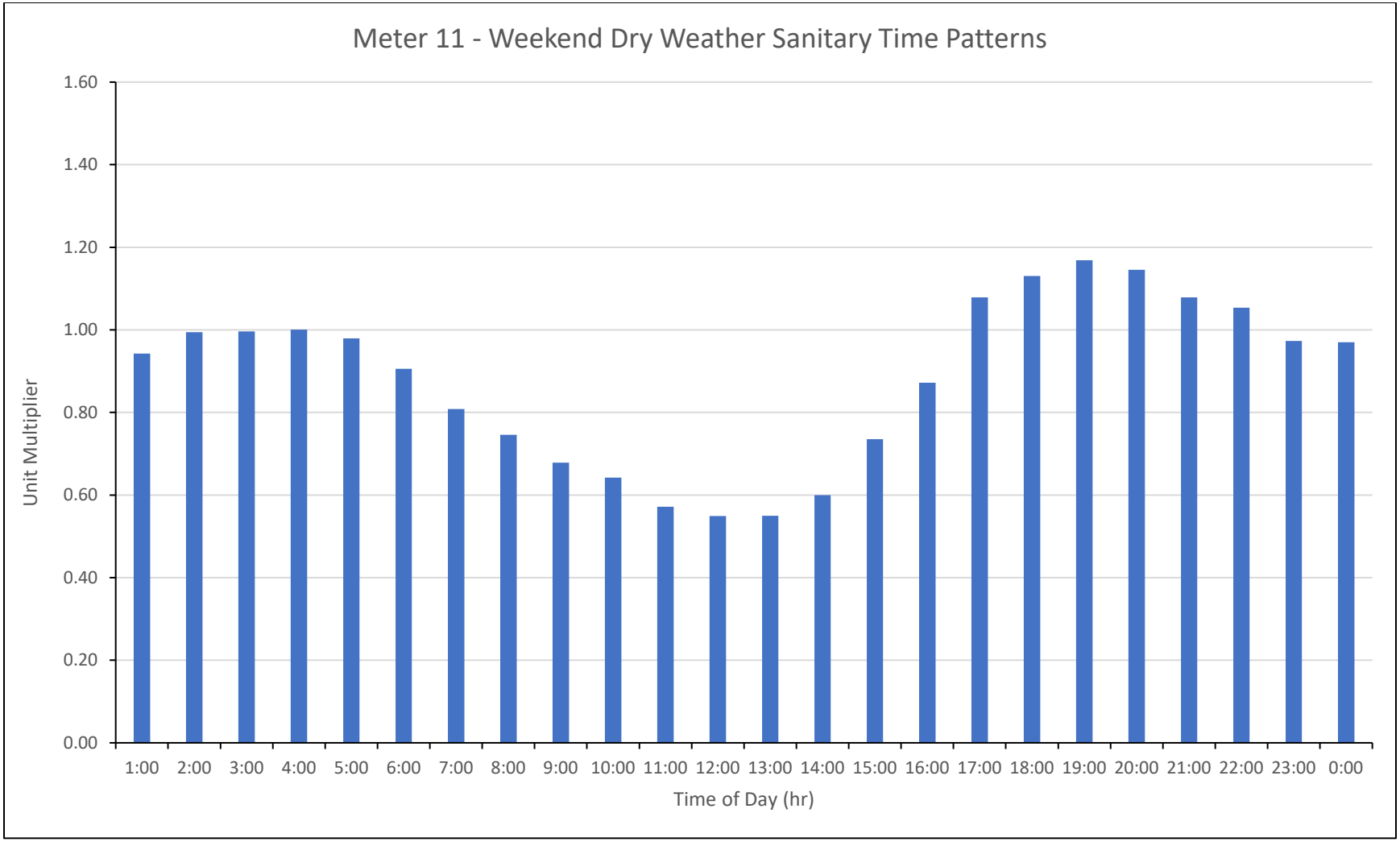

Meter 9 - Weekday Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

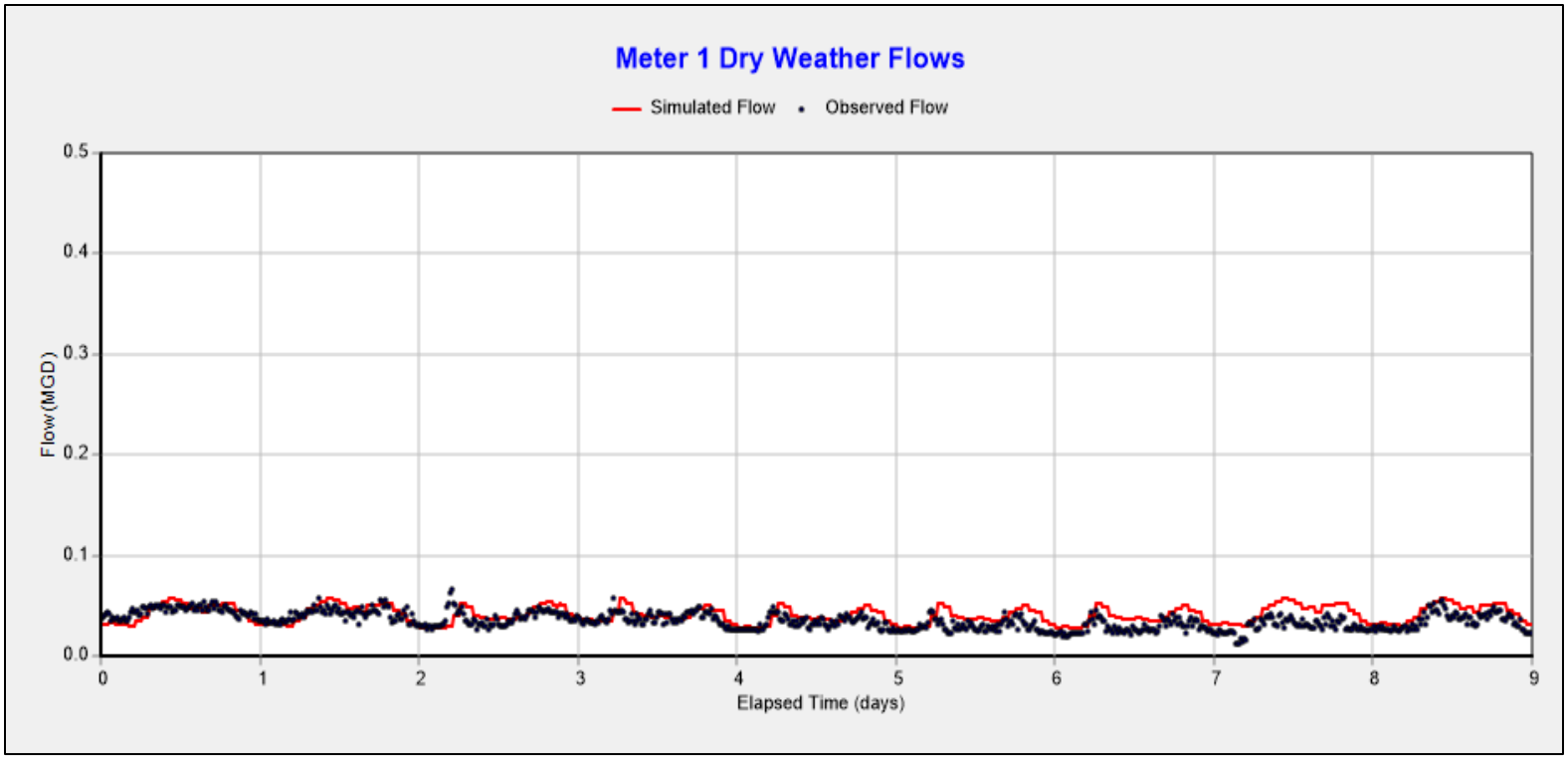

Meter 9 - Weekend Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

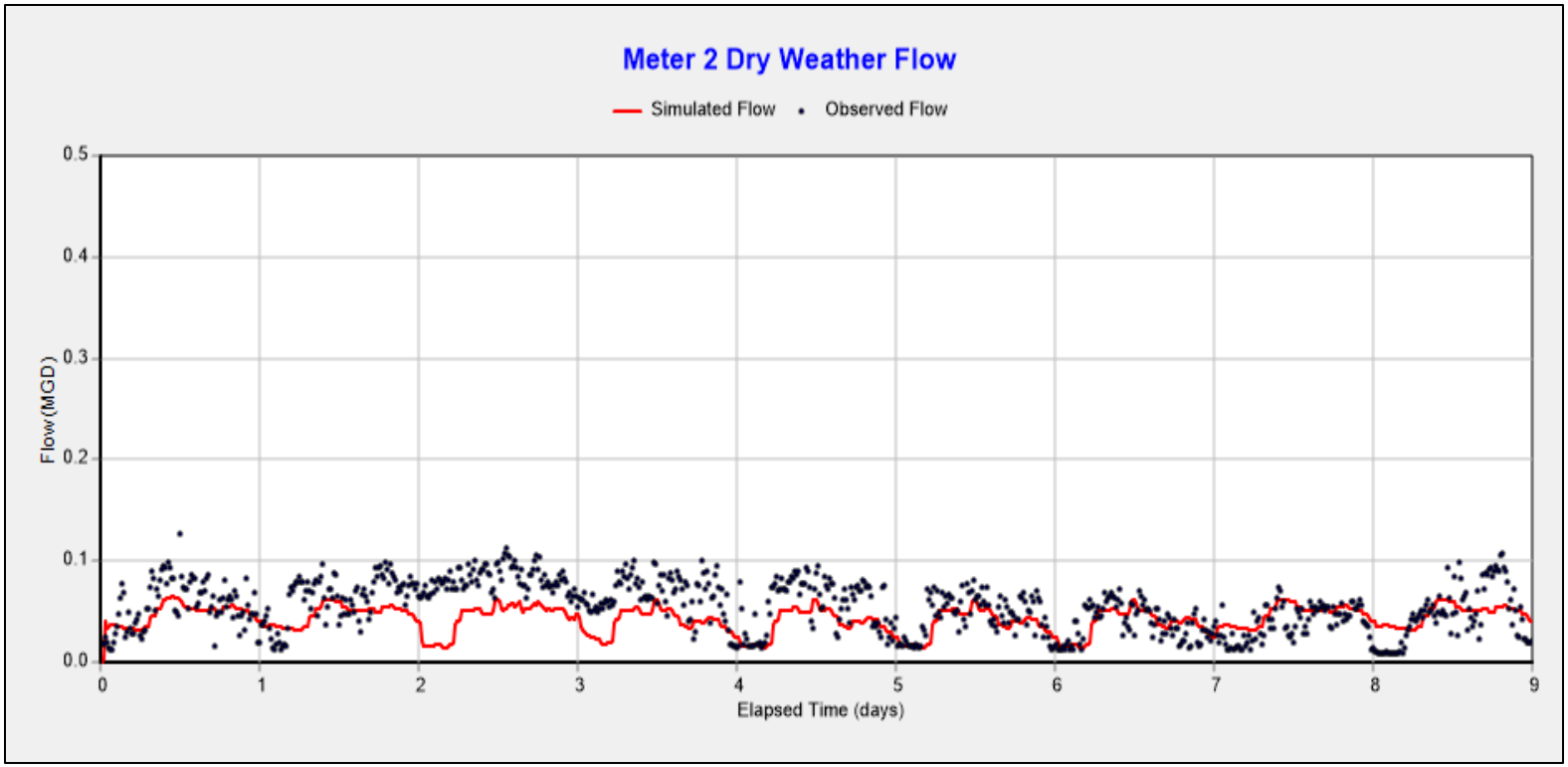

Meter 10 - Weekday Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

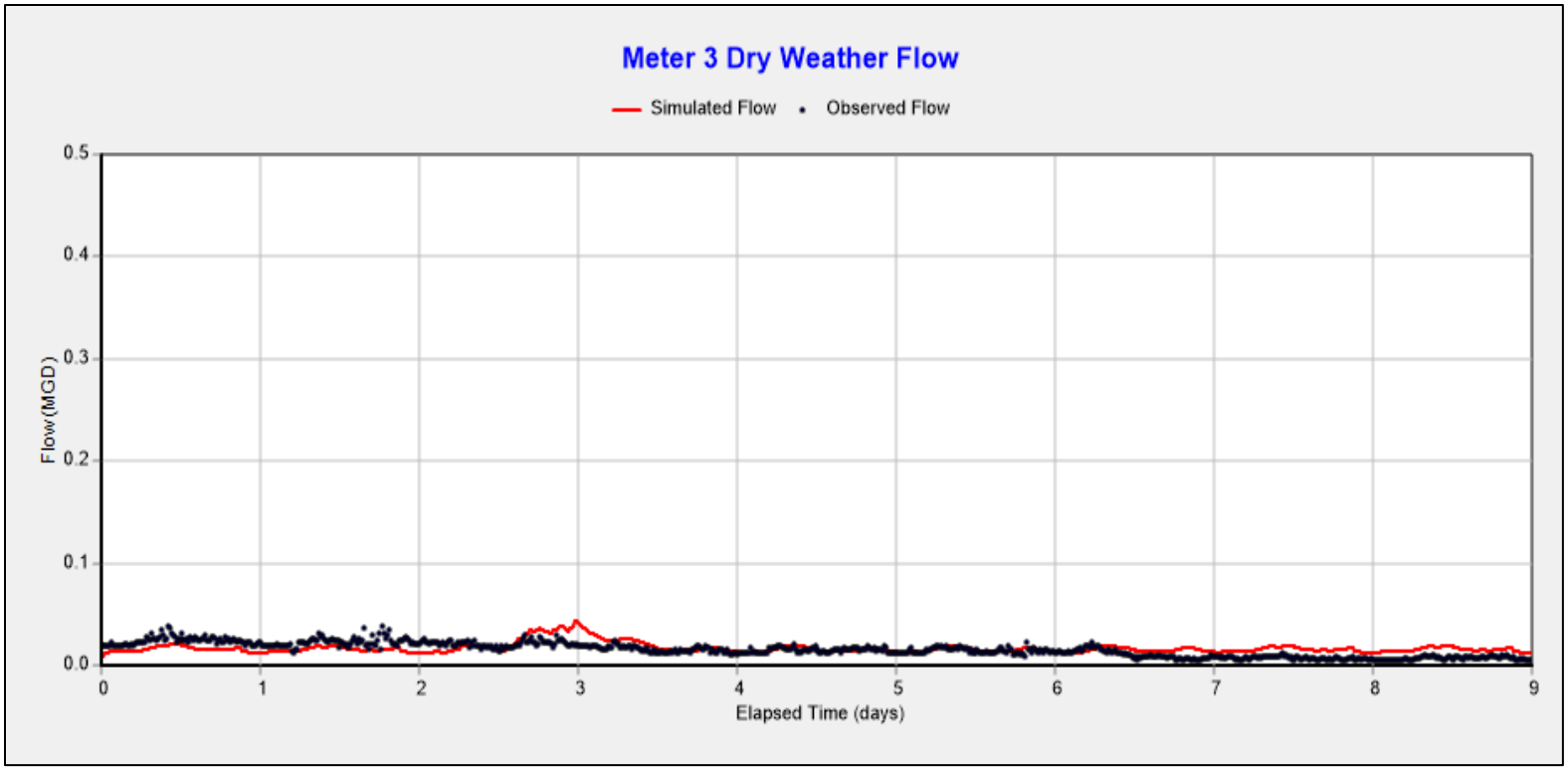

Meter 10 - Weekend Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

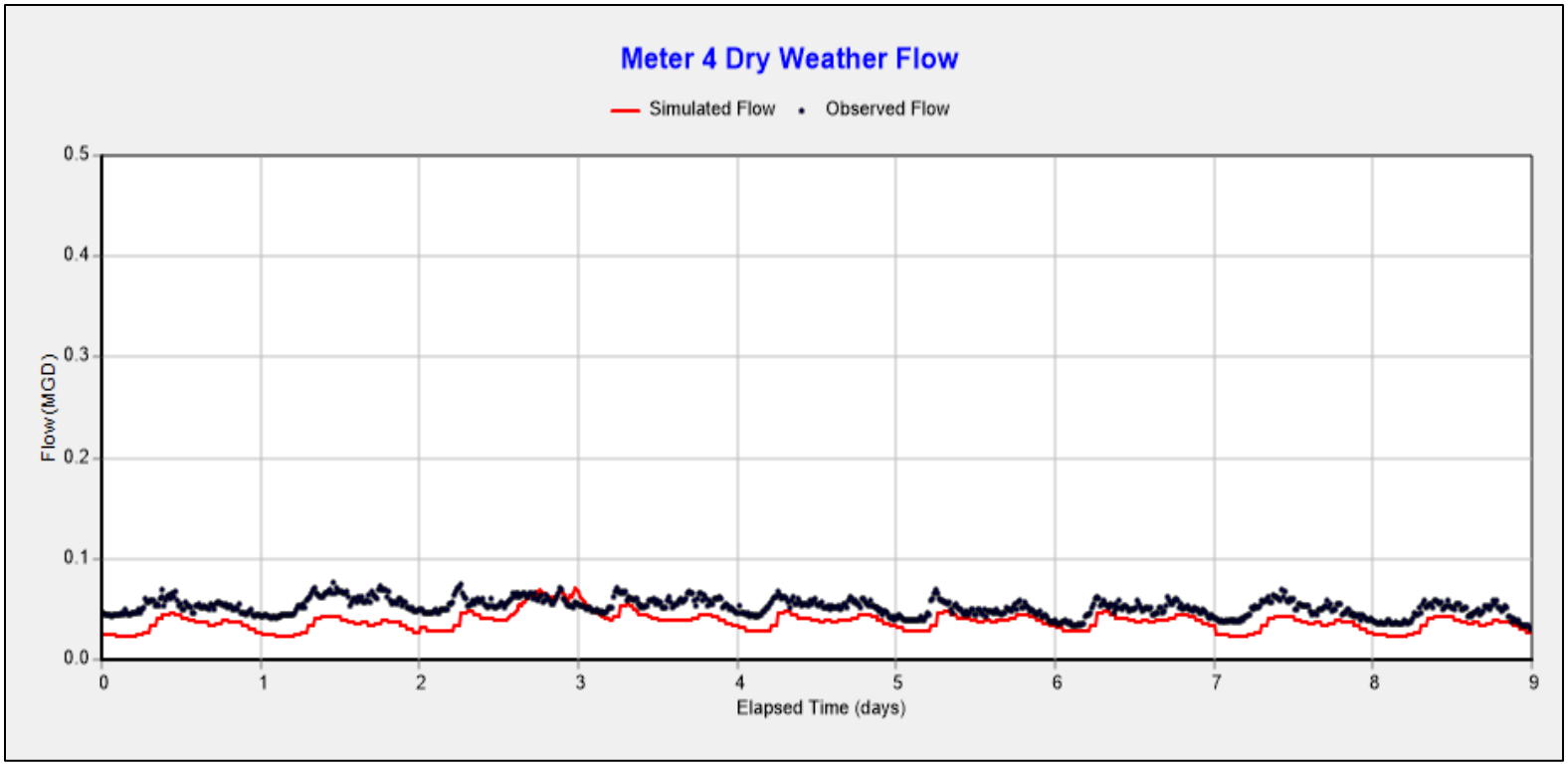

Meter 11 - Weekday Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

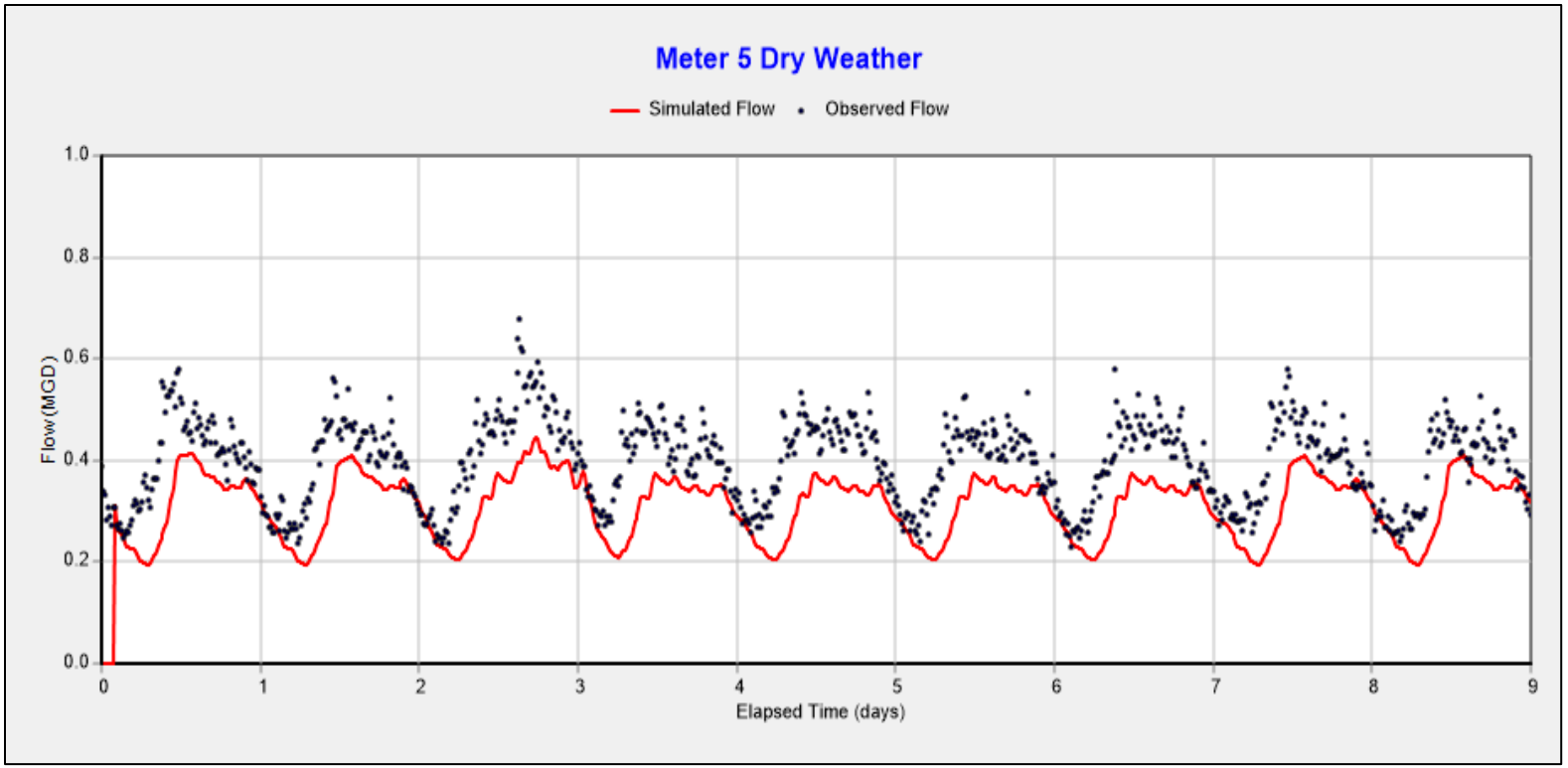

Meter 11 - Weekend Dry Weather Sanitary Time Patterns
Unit Multiplier
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (hr)

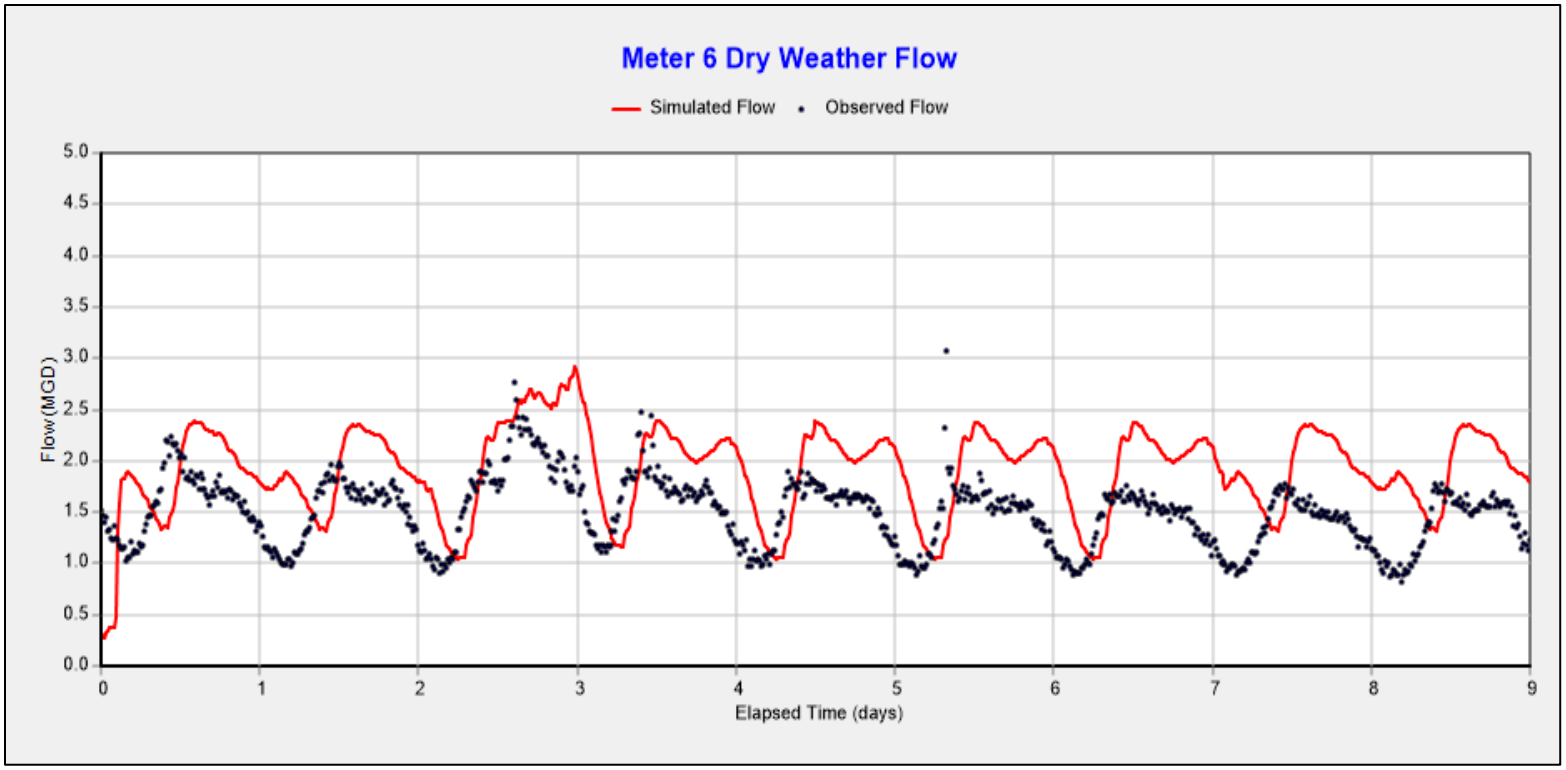

Meter 1 Dry Weather Flows
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)

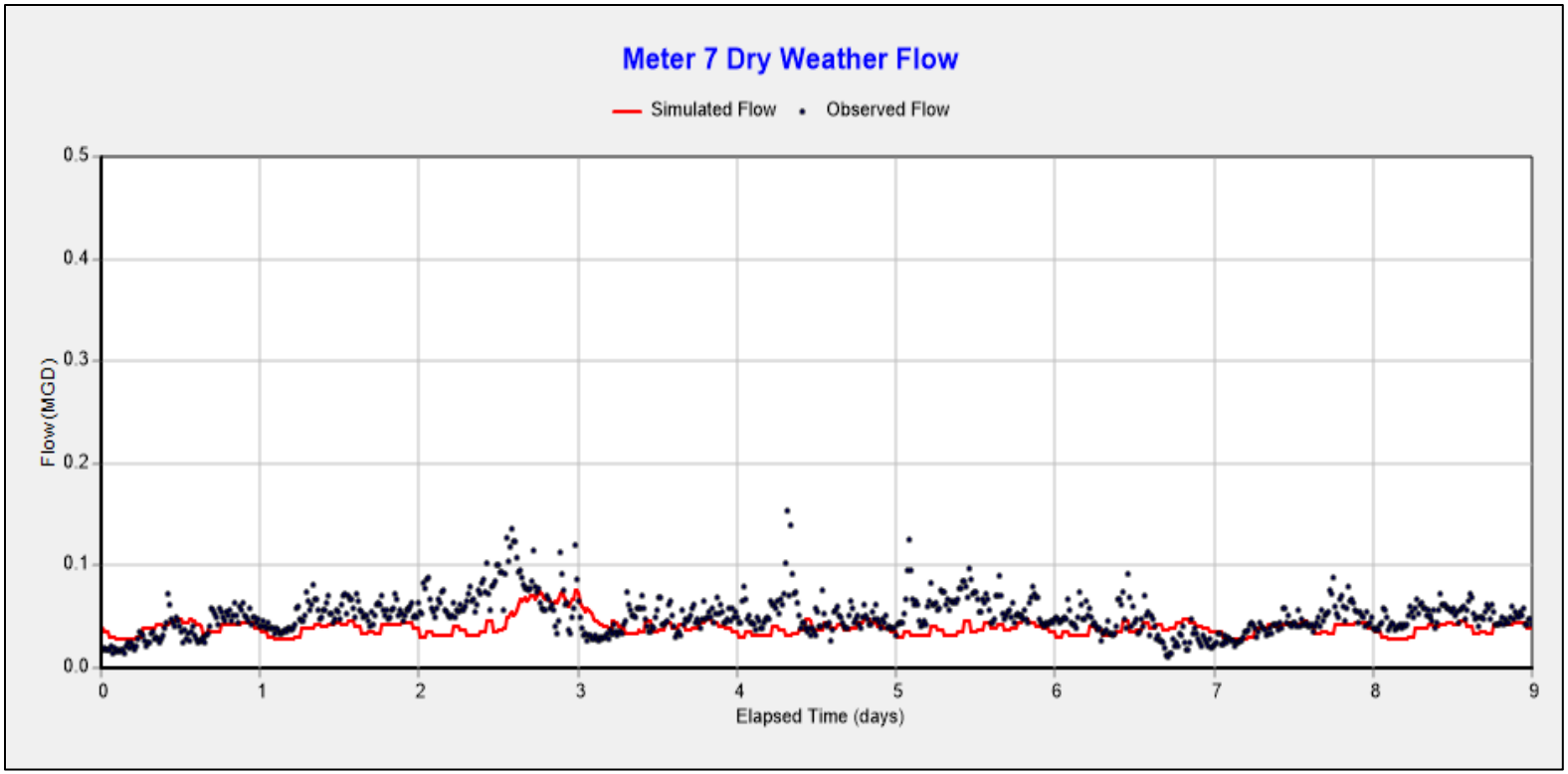

Meter 2 Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)

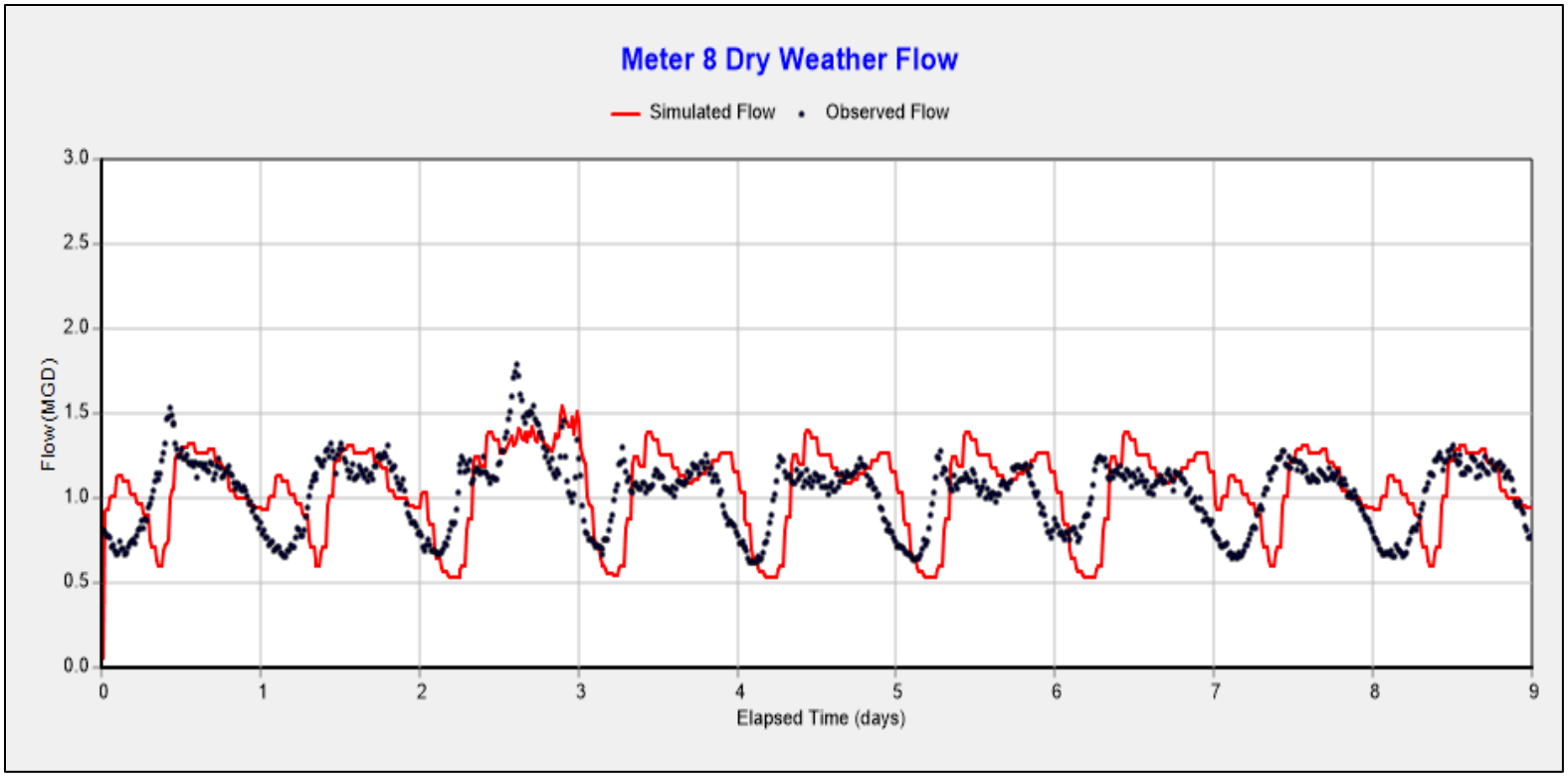

Meter 3 Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)

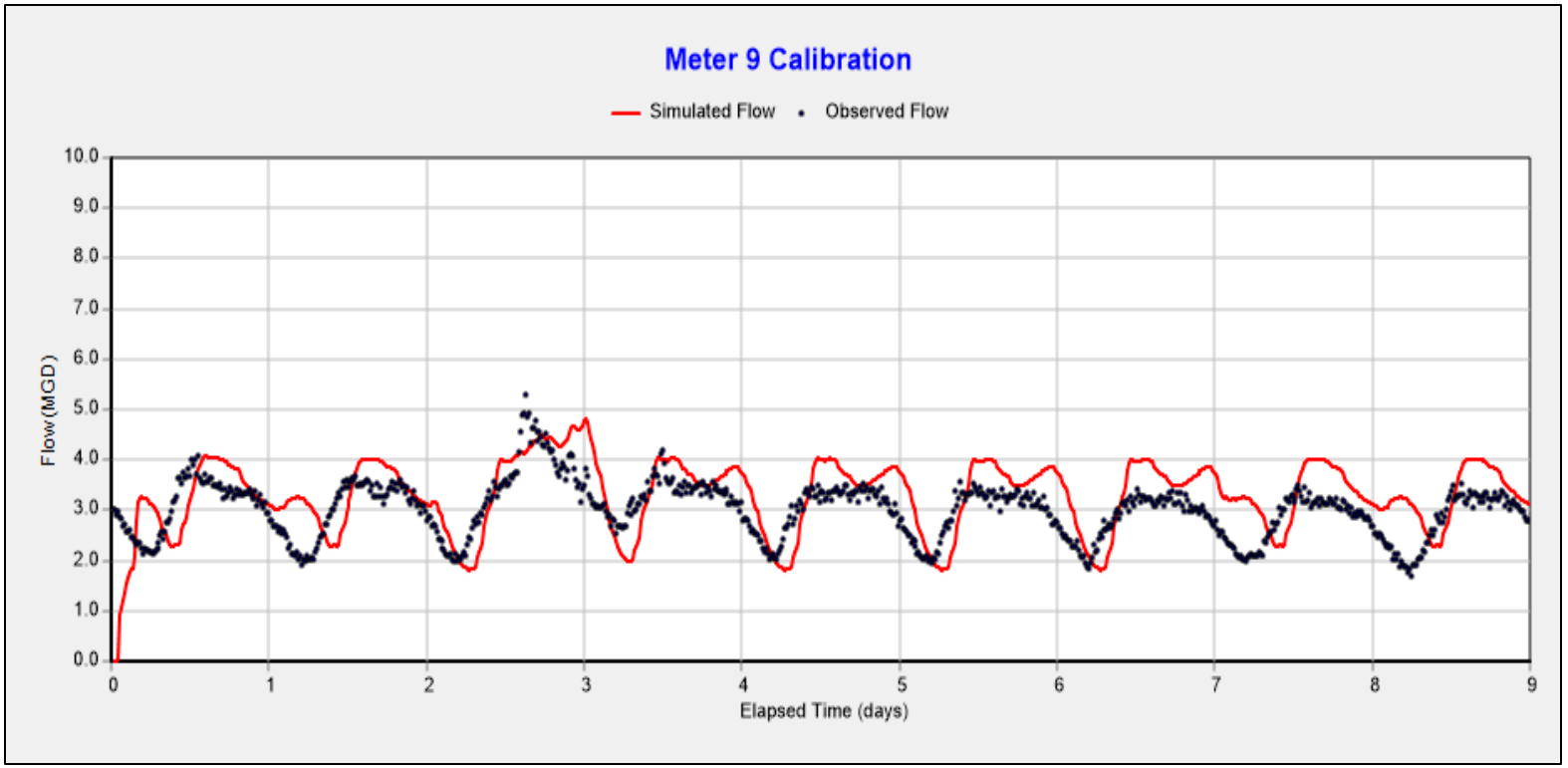

Meter 4 Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)

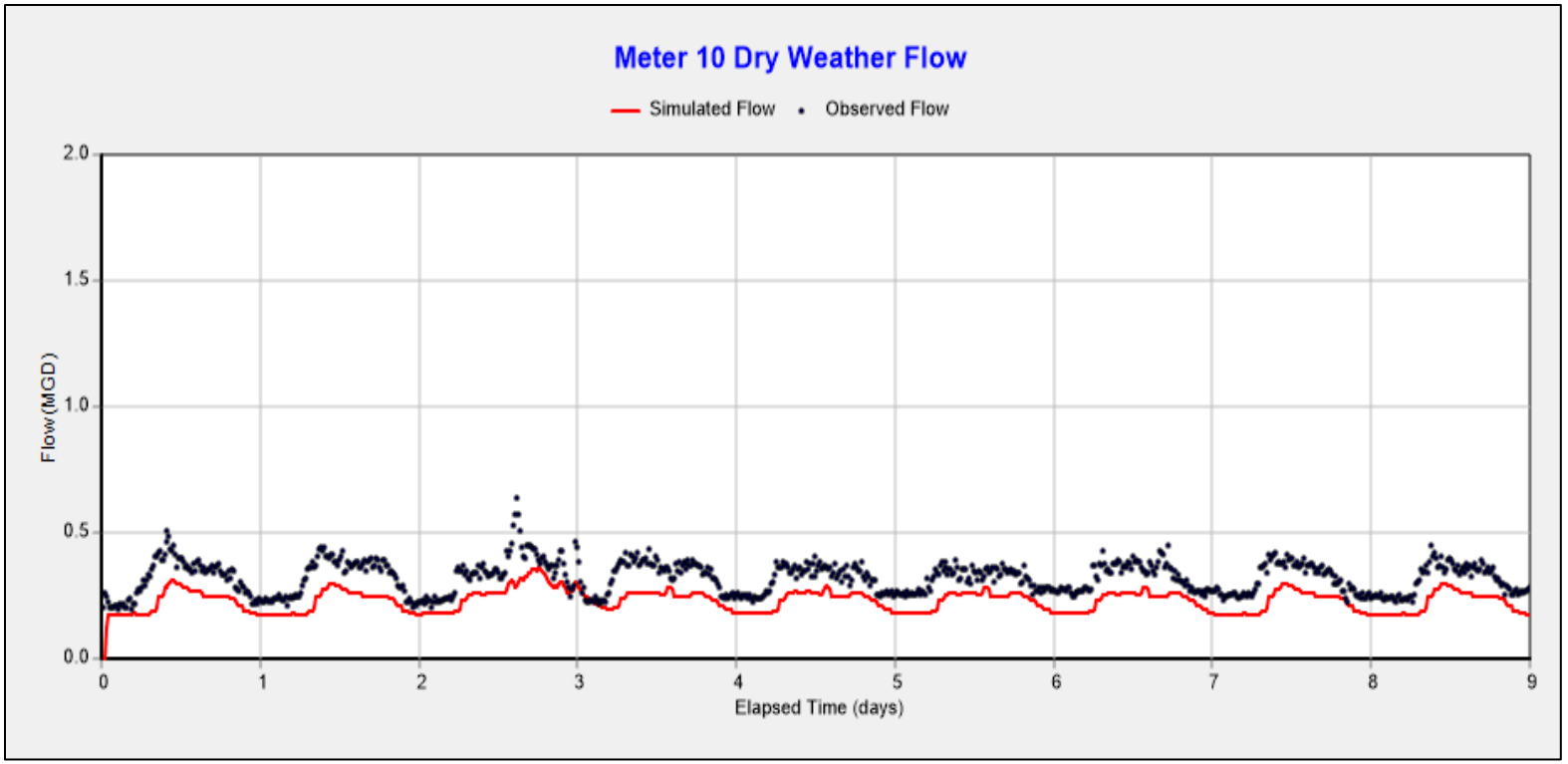

Meter 5 Dry Weather
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)

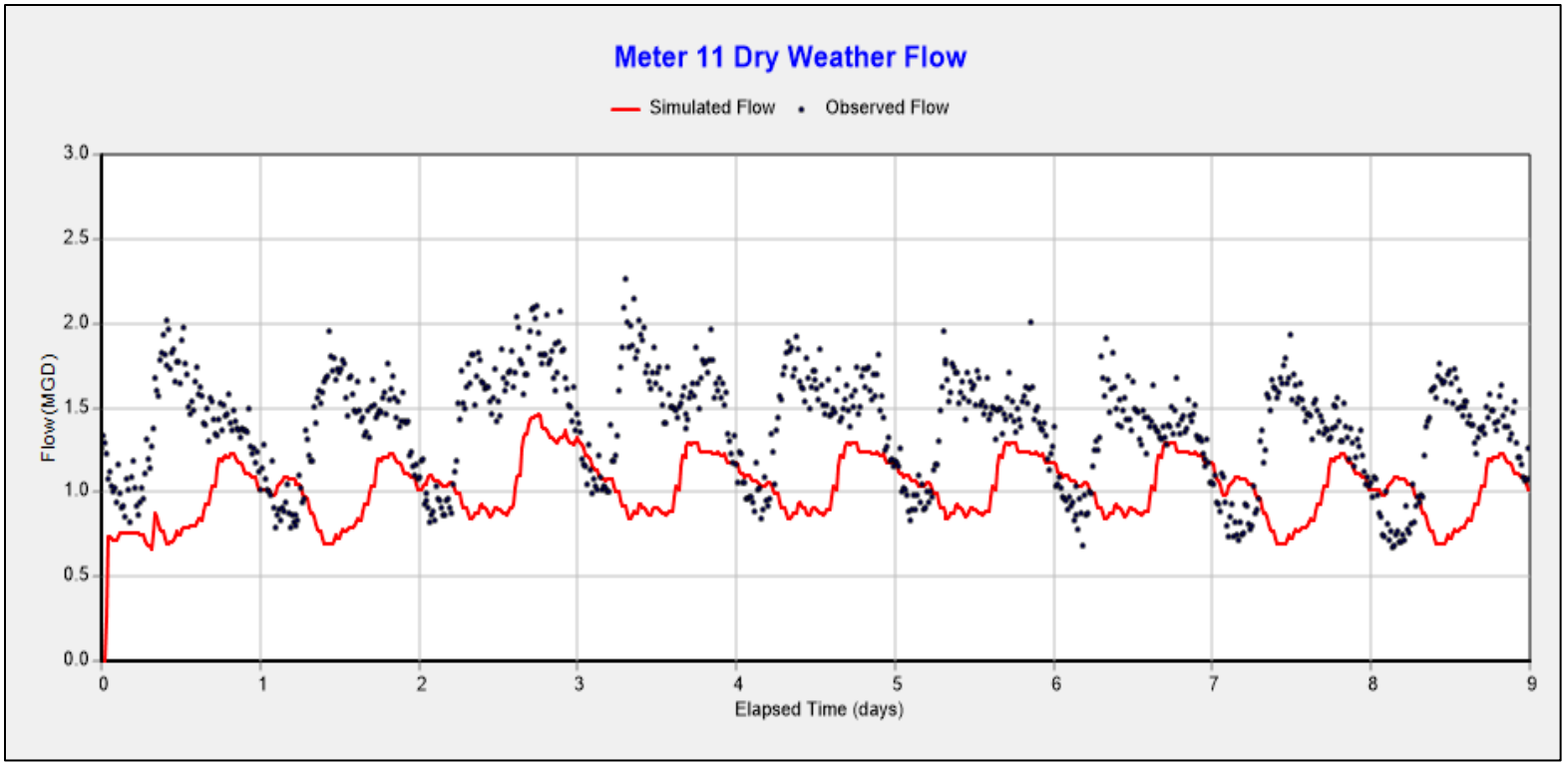

Meter 6 Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)

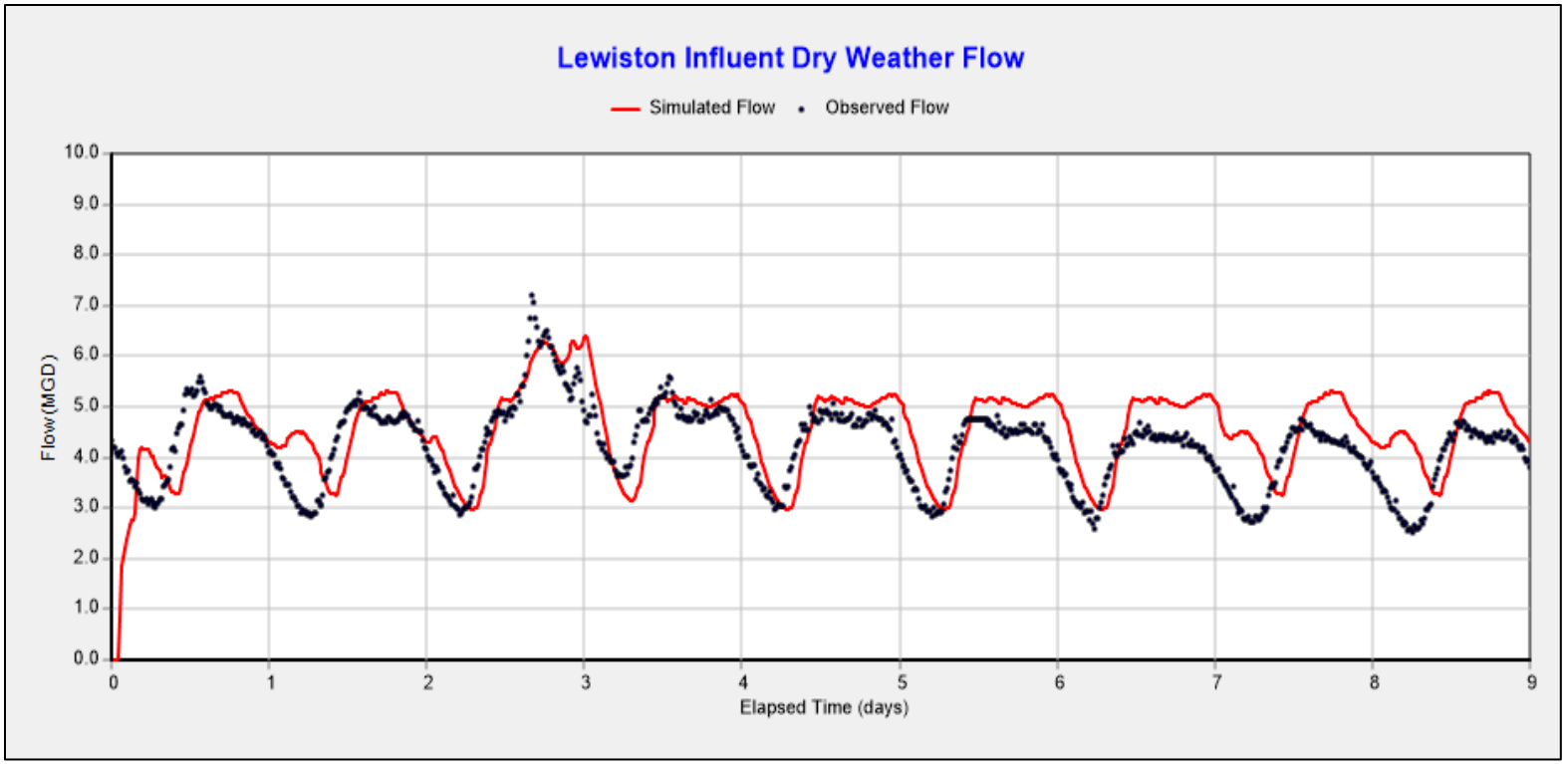

Meter 7 Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)

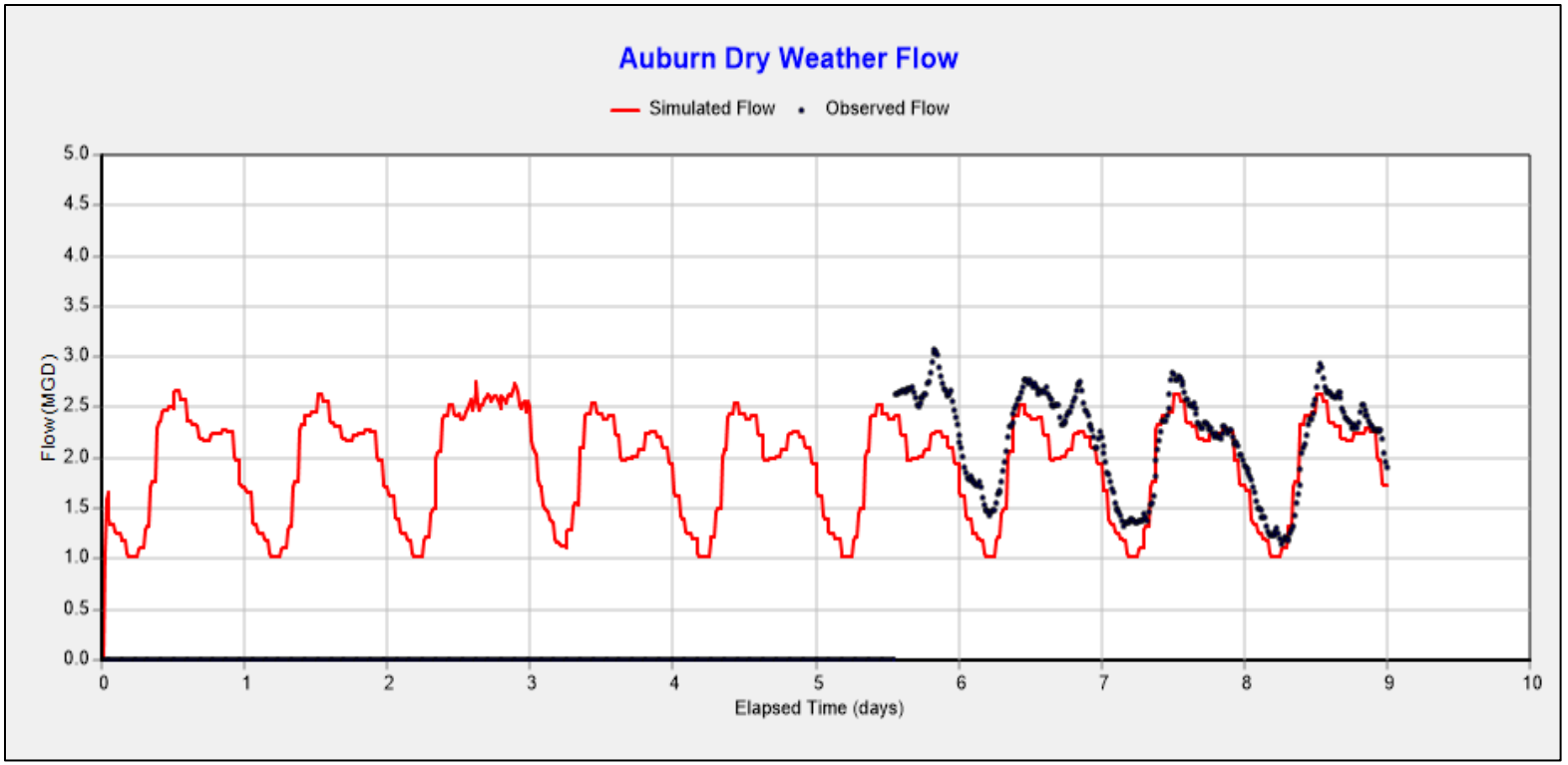

Meter 8 Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)


Meter 9 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)


Meter 10 Dry Weather Flow
Simulated Flow
Observed Flow
2.0
1.5
1.0
0.5
0.0
Flow (MGD)
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)


Meter 11 Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)


Lewiston Influent Dry Weather Flow
Simulated Flow
Observed Flow
Flow (MGD)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
1
2
3
4
5
6
7
8
9
Elapsed Time (days)



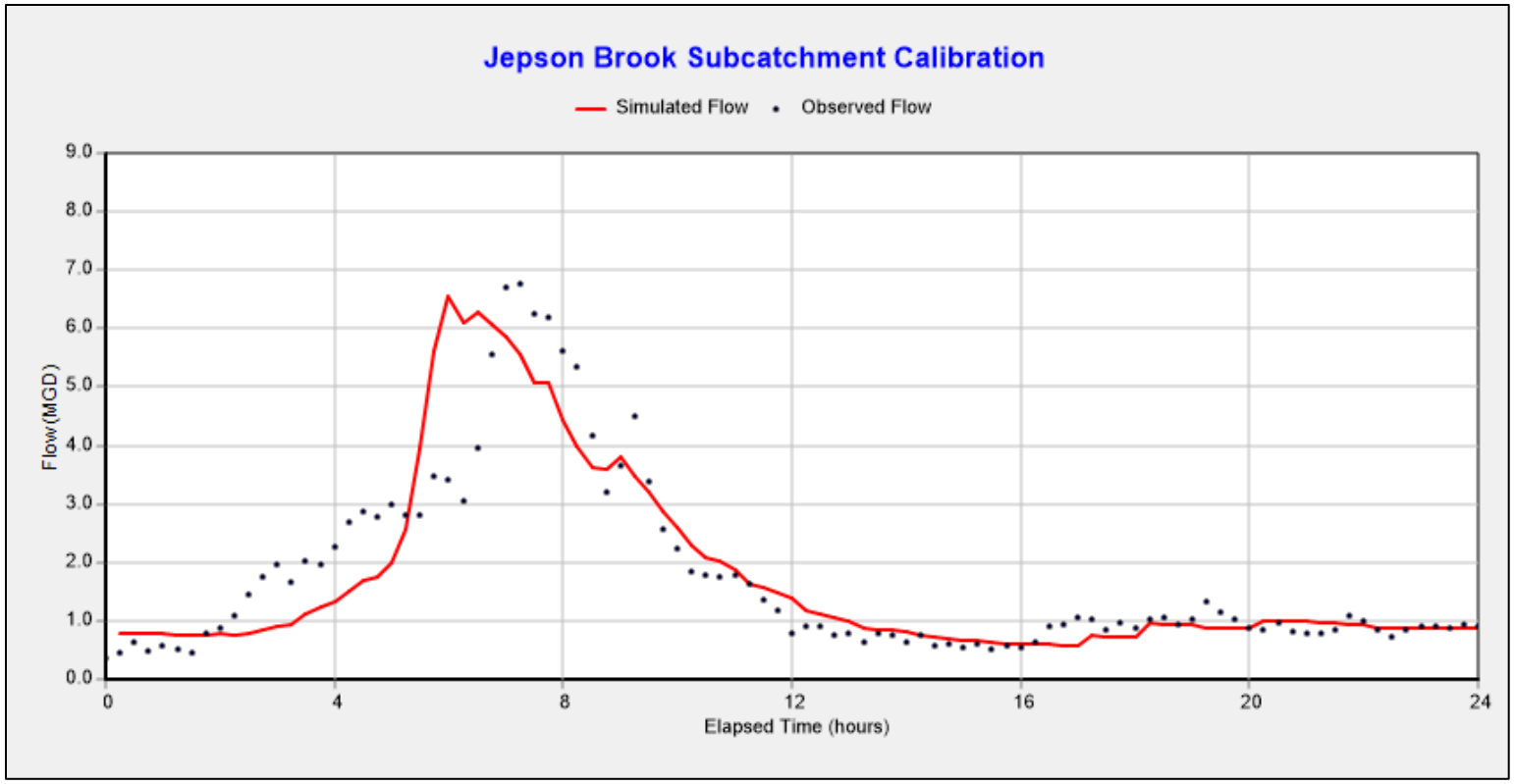
*Auburn influent flow meter not in service for days 0 – 5.5

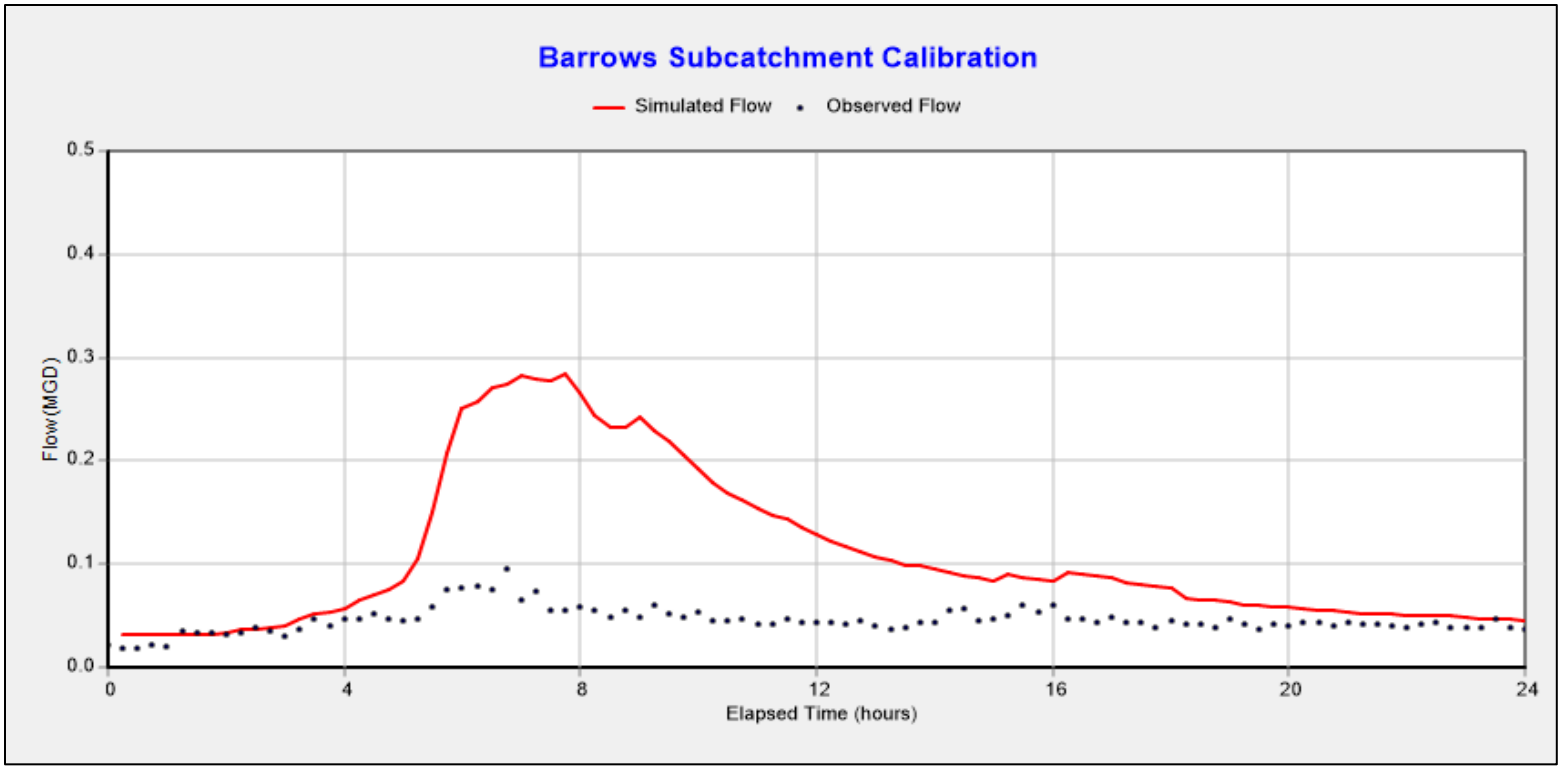
APPENDIX B

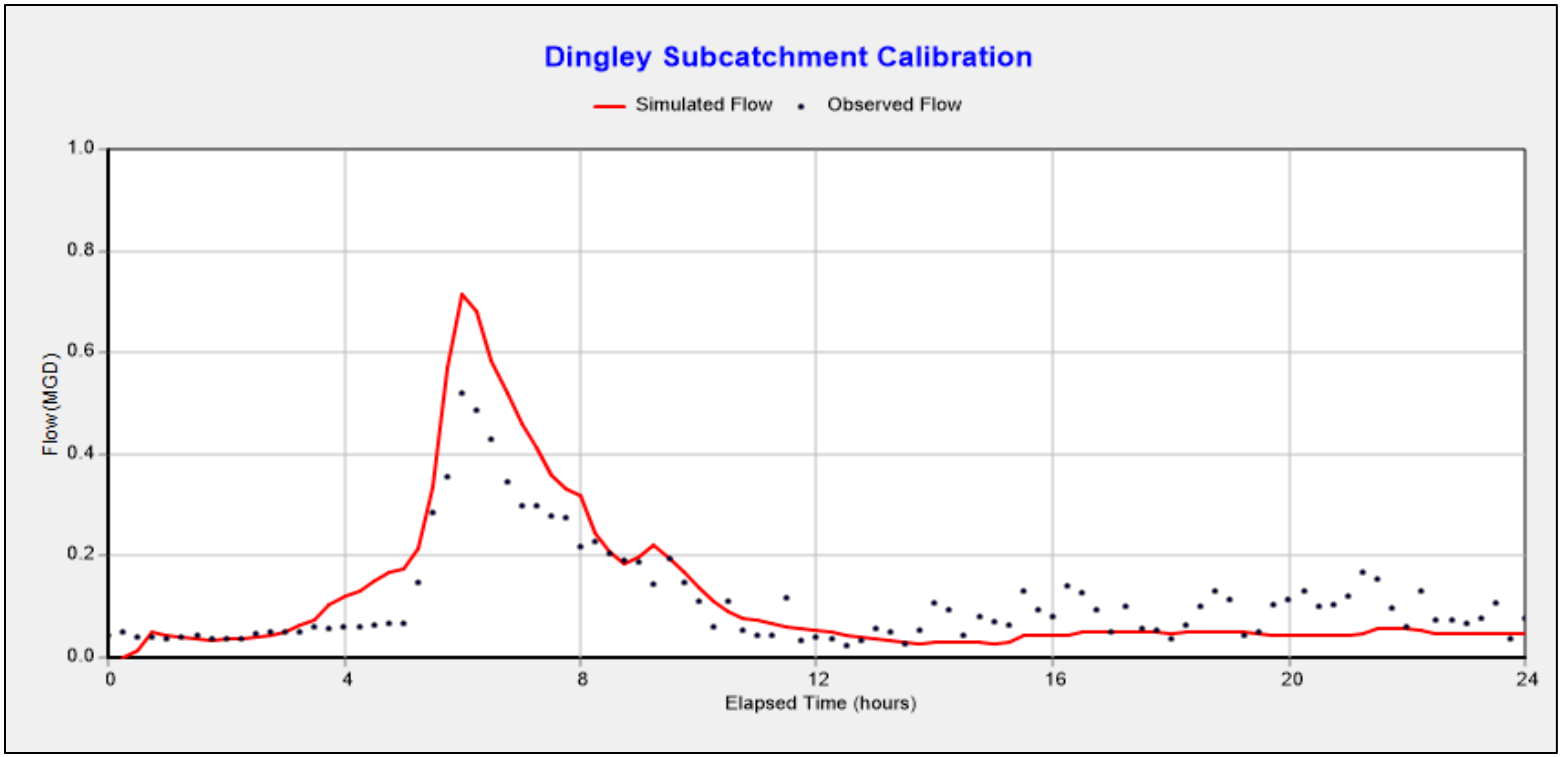
Wet Weather Calibration Plots

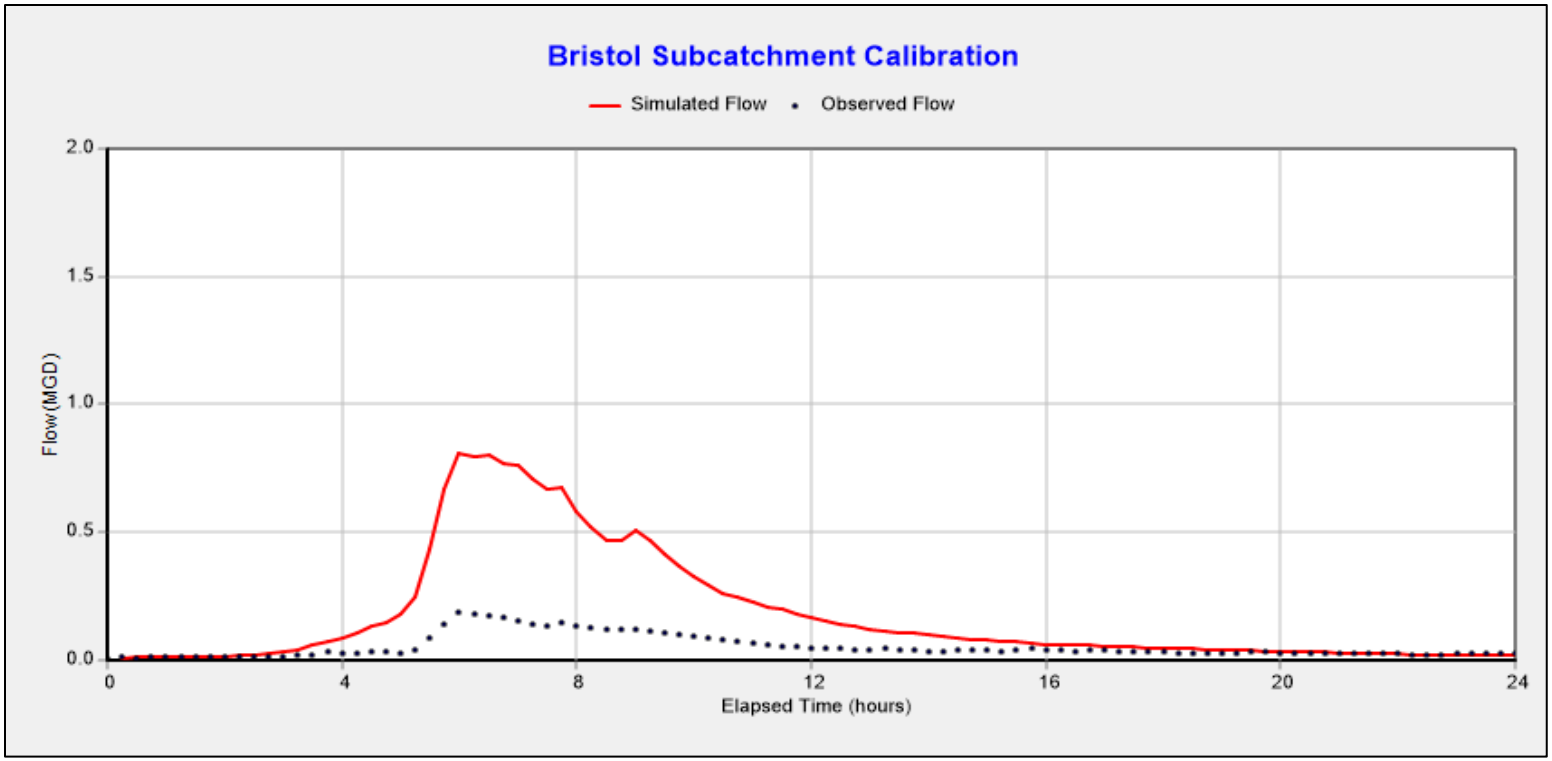
Calibration Storm No. 1

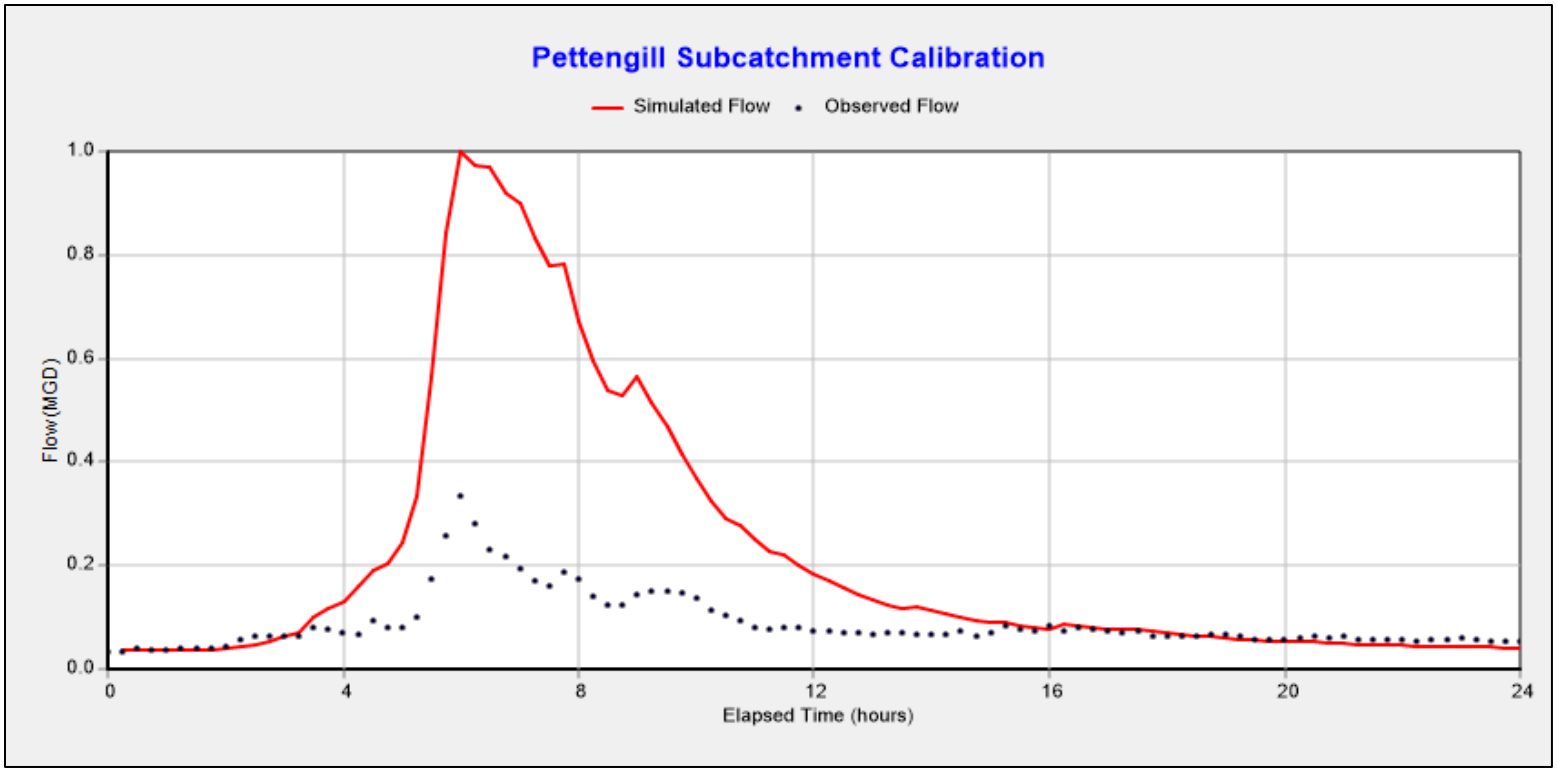
Date:	September 25, 2018
Duration:	9 hours
Total Precipitation:	1.25 inches
Peak Intensity:	0.46 inches/hour
Recurrence Interval:	3-month

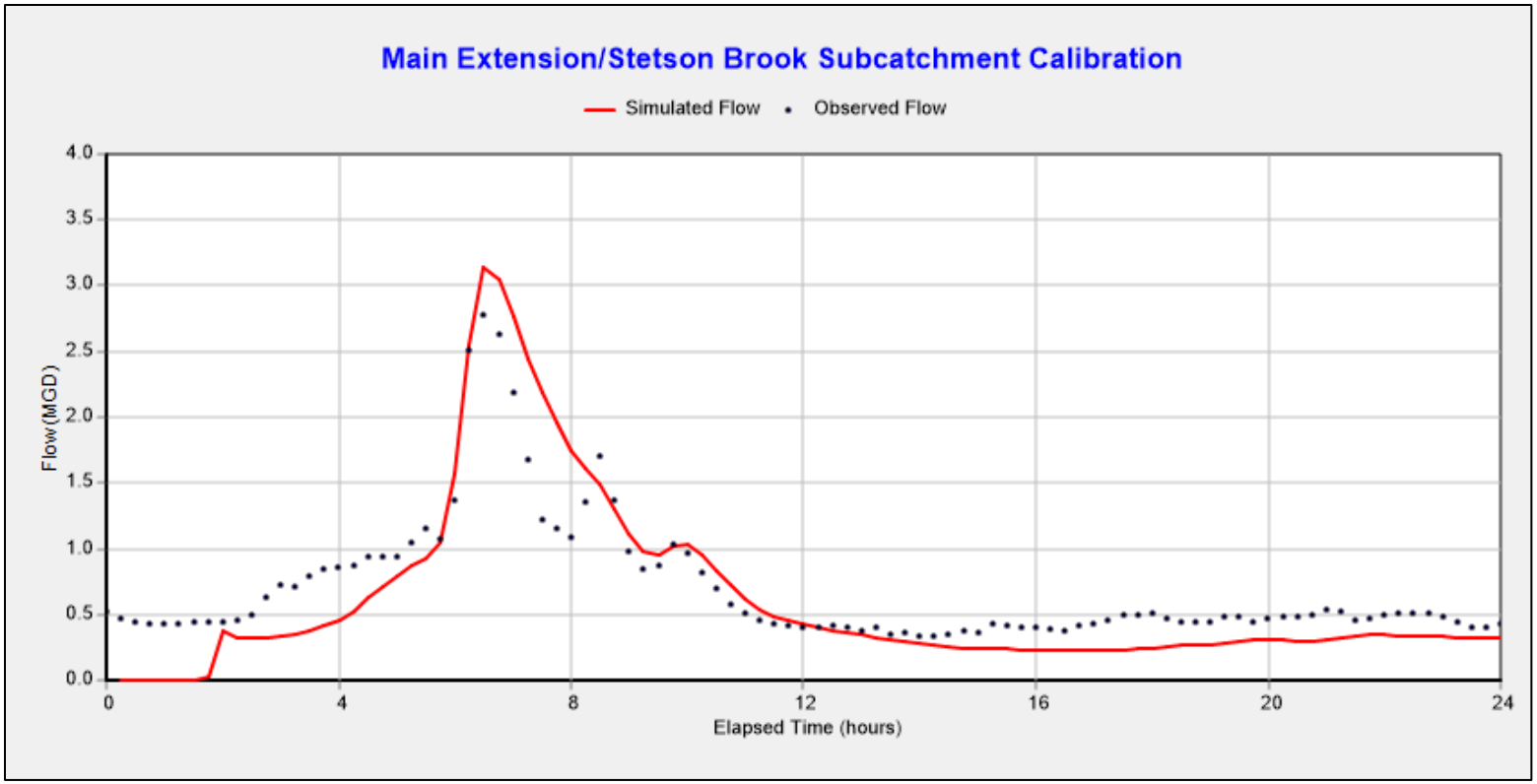

Jepson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

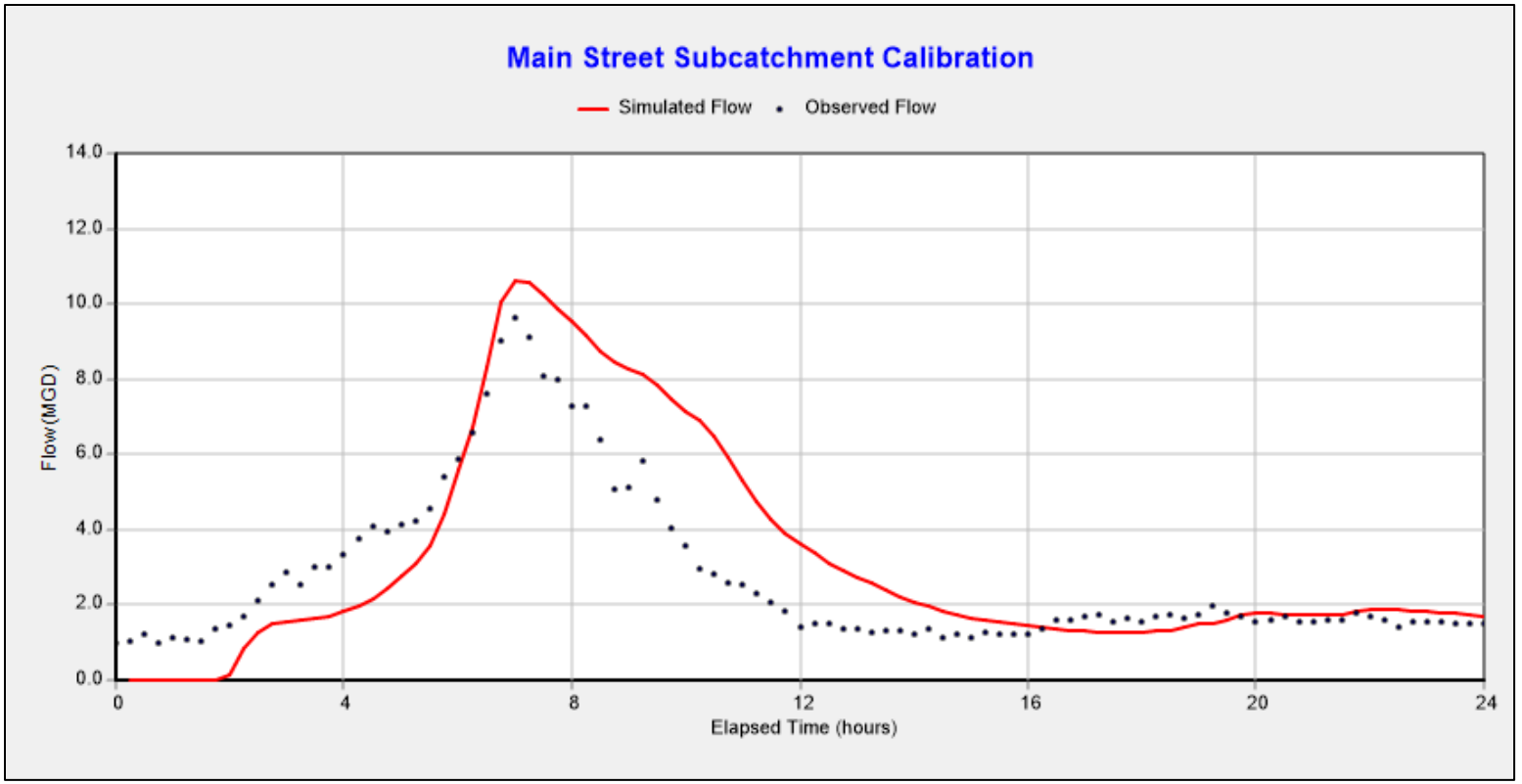

Barrows Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

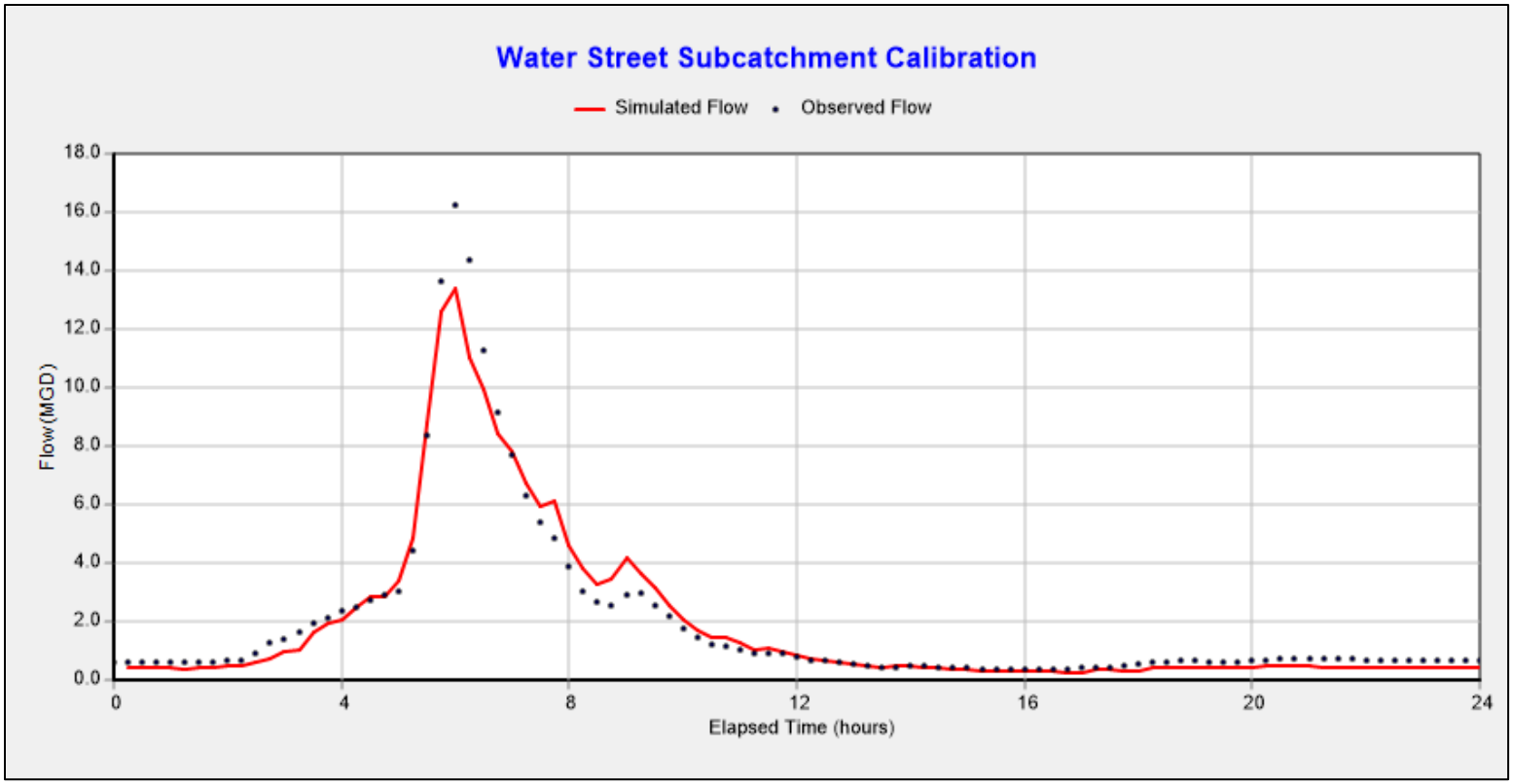

Dingley Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

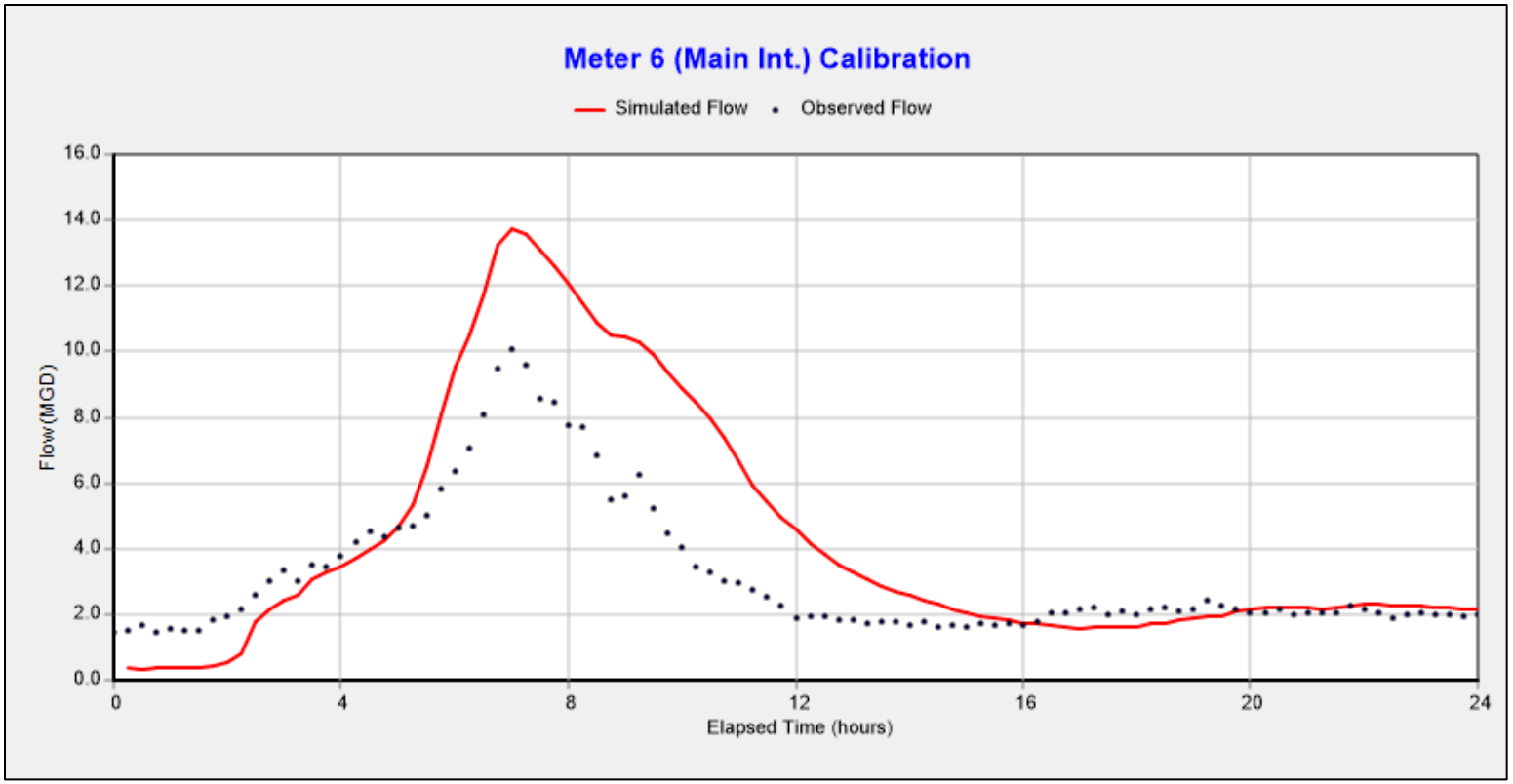

Bristol Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

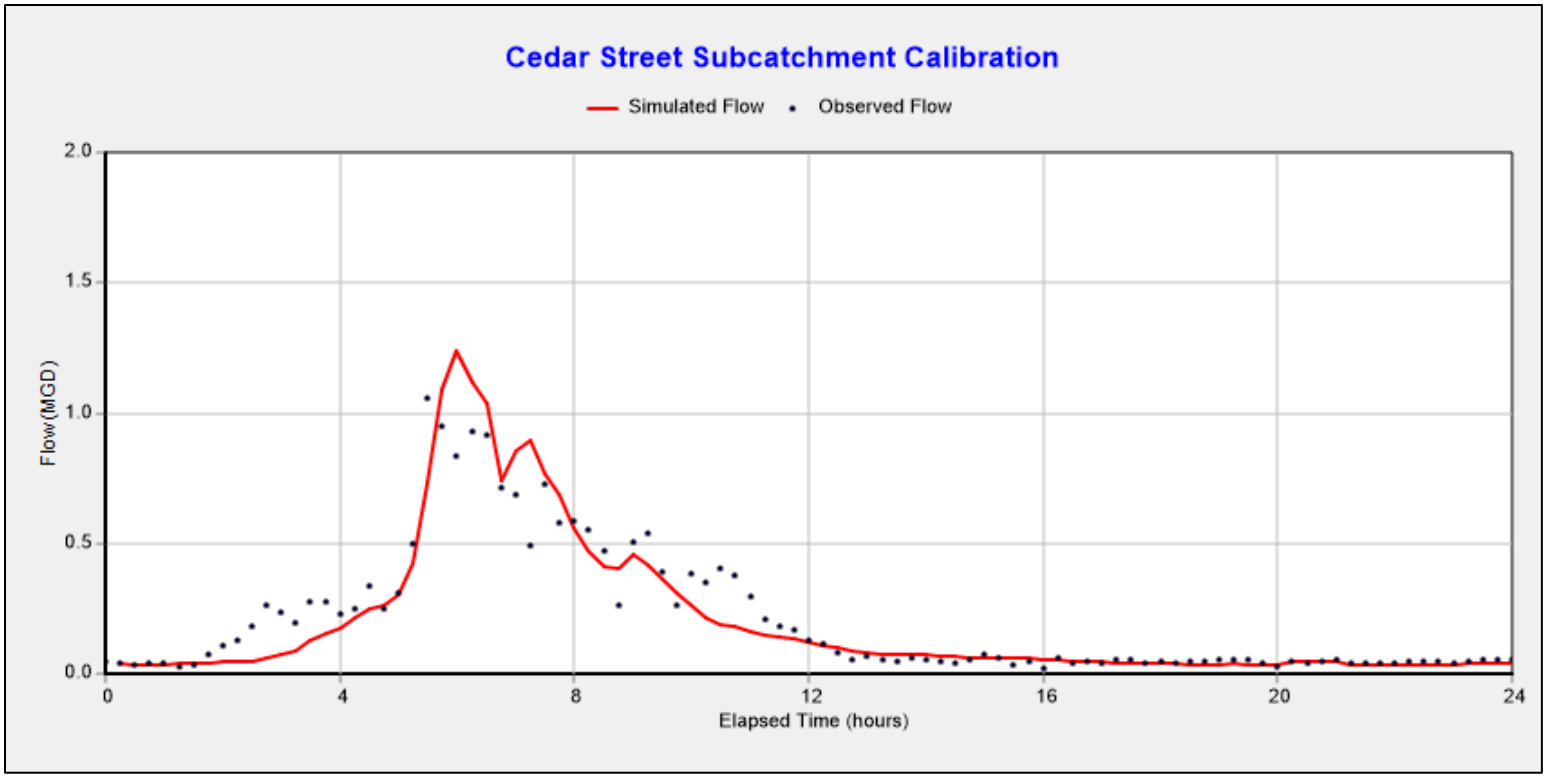

Pettengill Subcatchment Calibration
Simulated Flow
Observed Flow
Flow(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

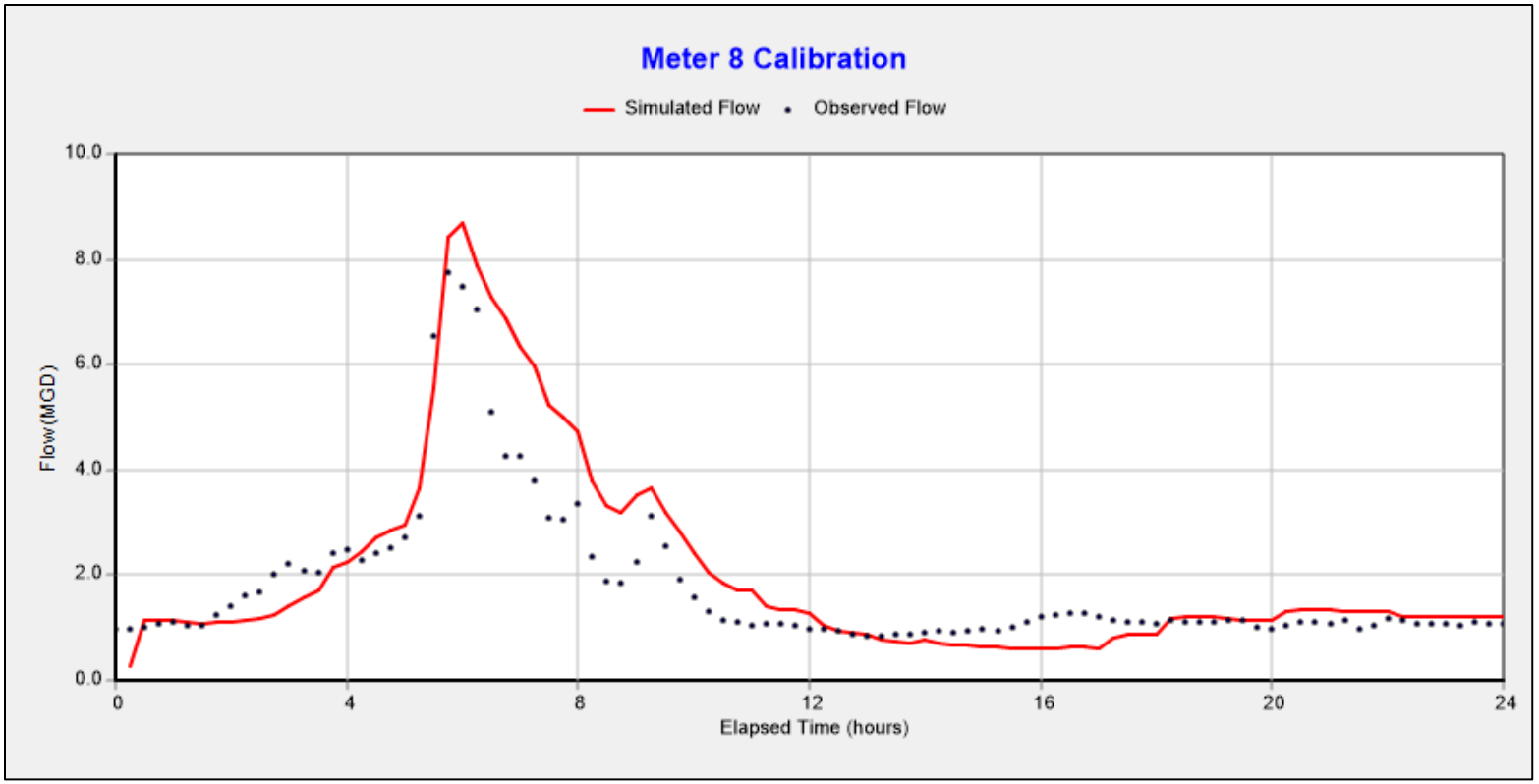

Main Extension/Stetson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

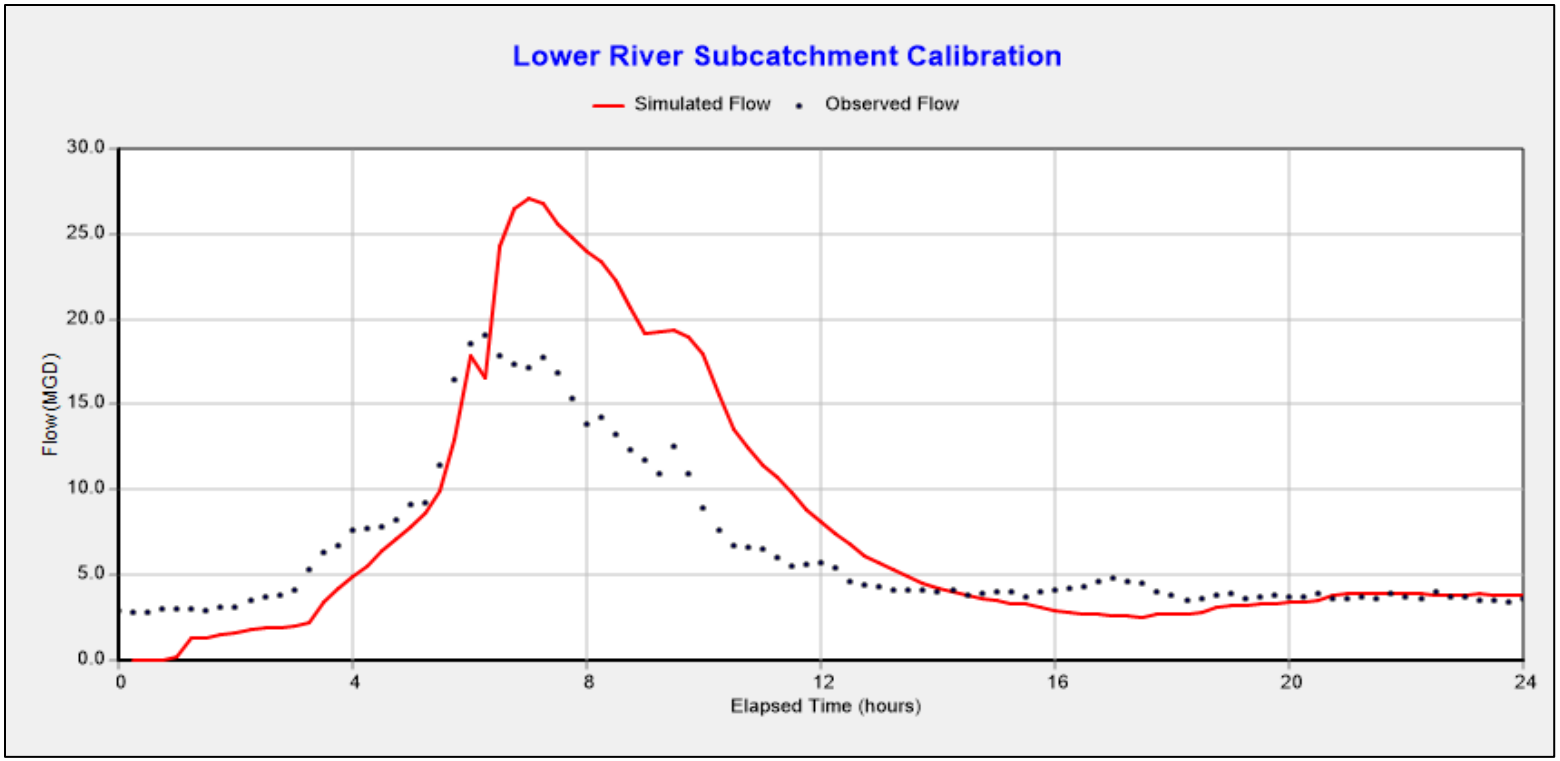

Main Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

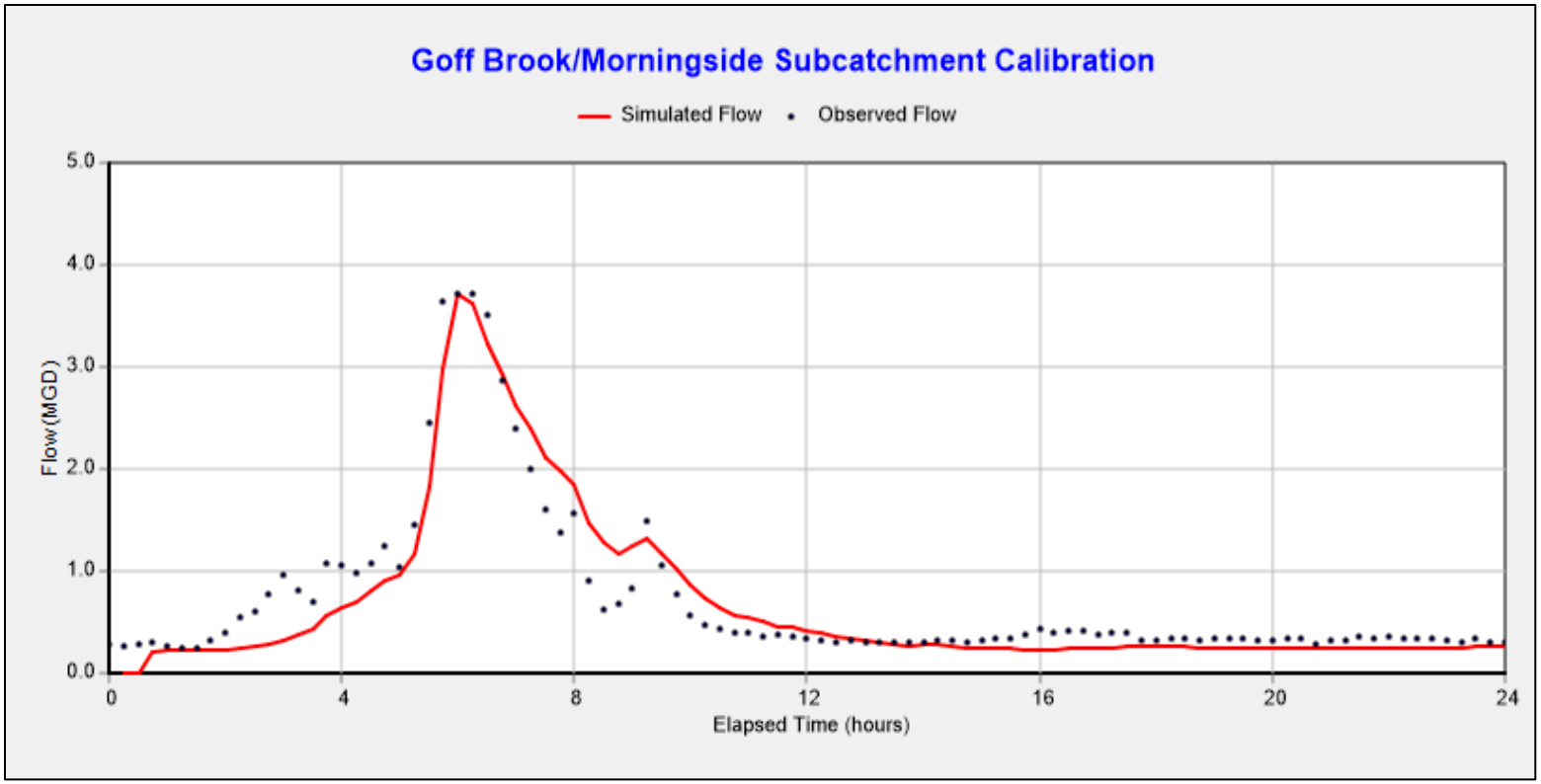

Water Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

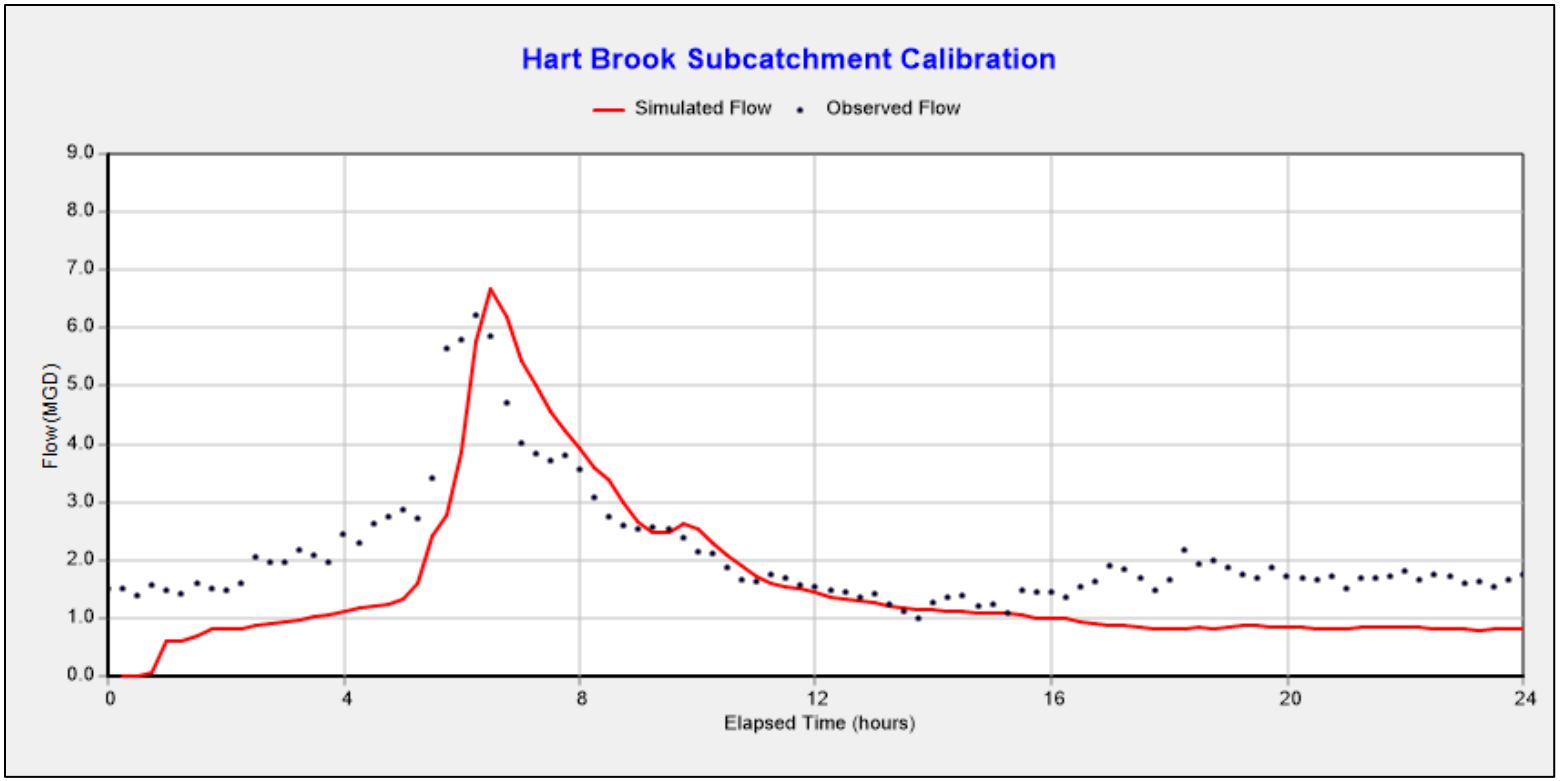

Meter 6 (Main Int.) Calibration
Simulated Flow
Observed Flow
Flow (MGD)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

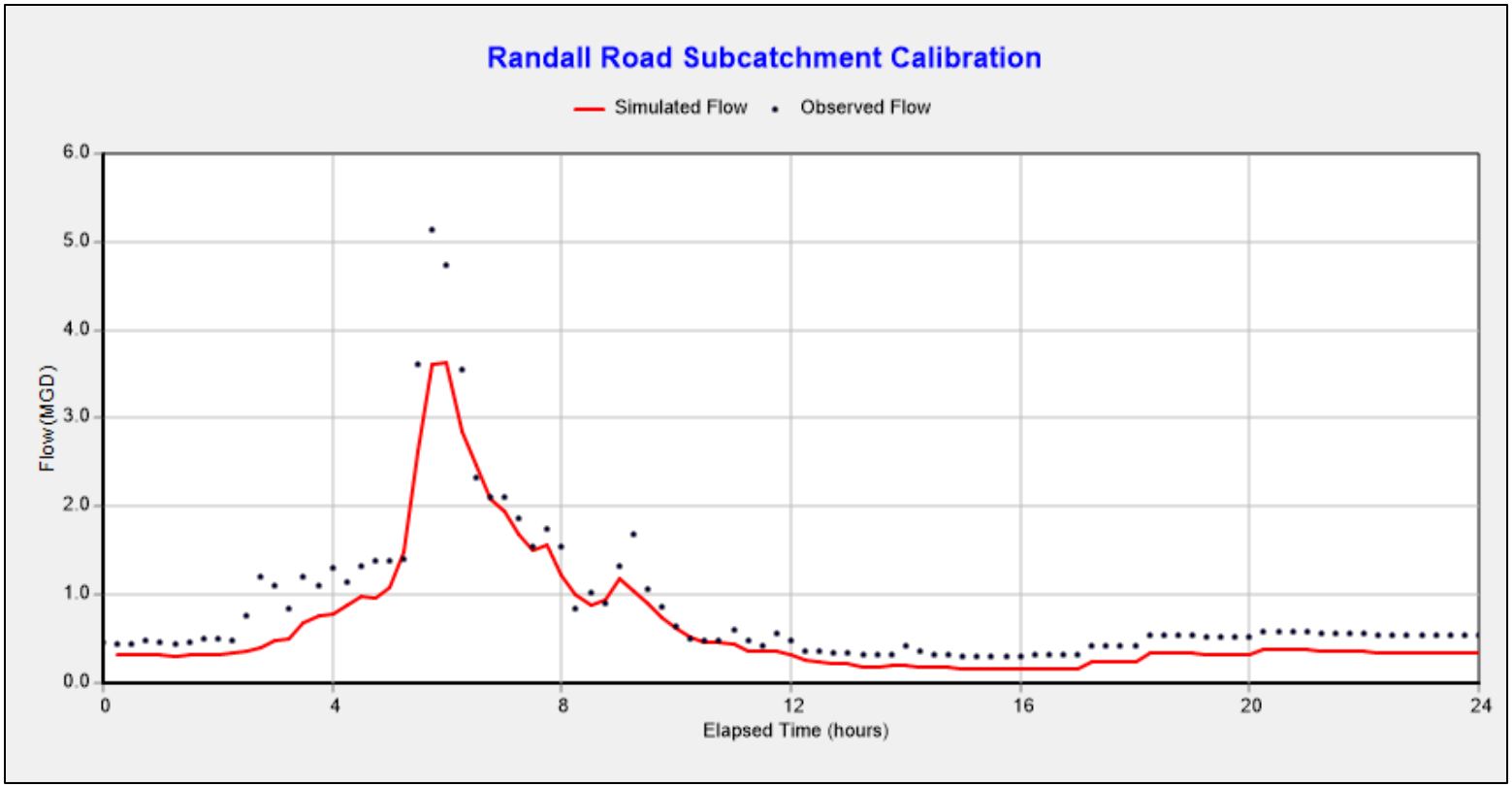

Cedar Street Subcatchment Calibration
Simulated Flow
Observed Flow
2.0
1.5
1.0
0.5
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

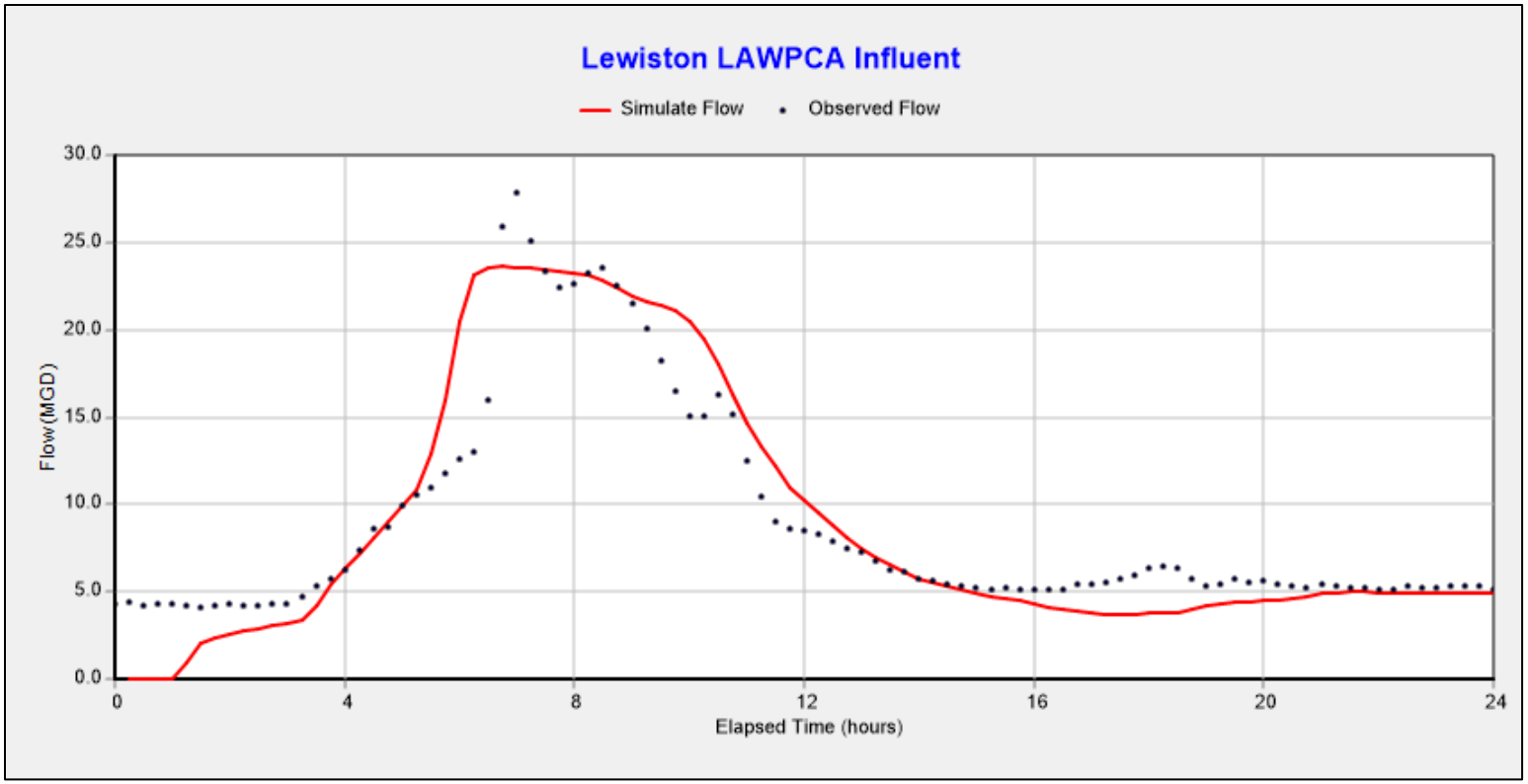

Meter 8 Calibration
Simulated Flow
Observed Flow
10.0
8.0
6.0
4.0
2.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

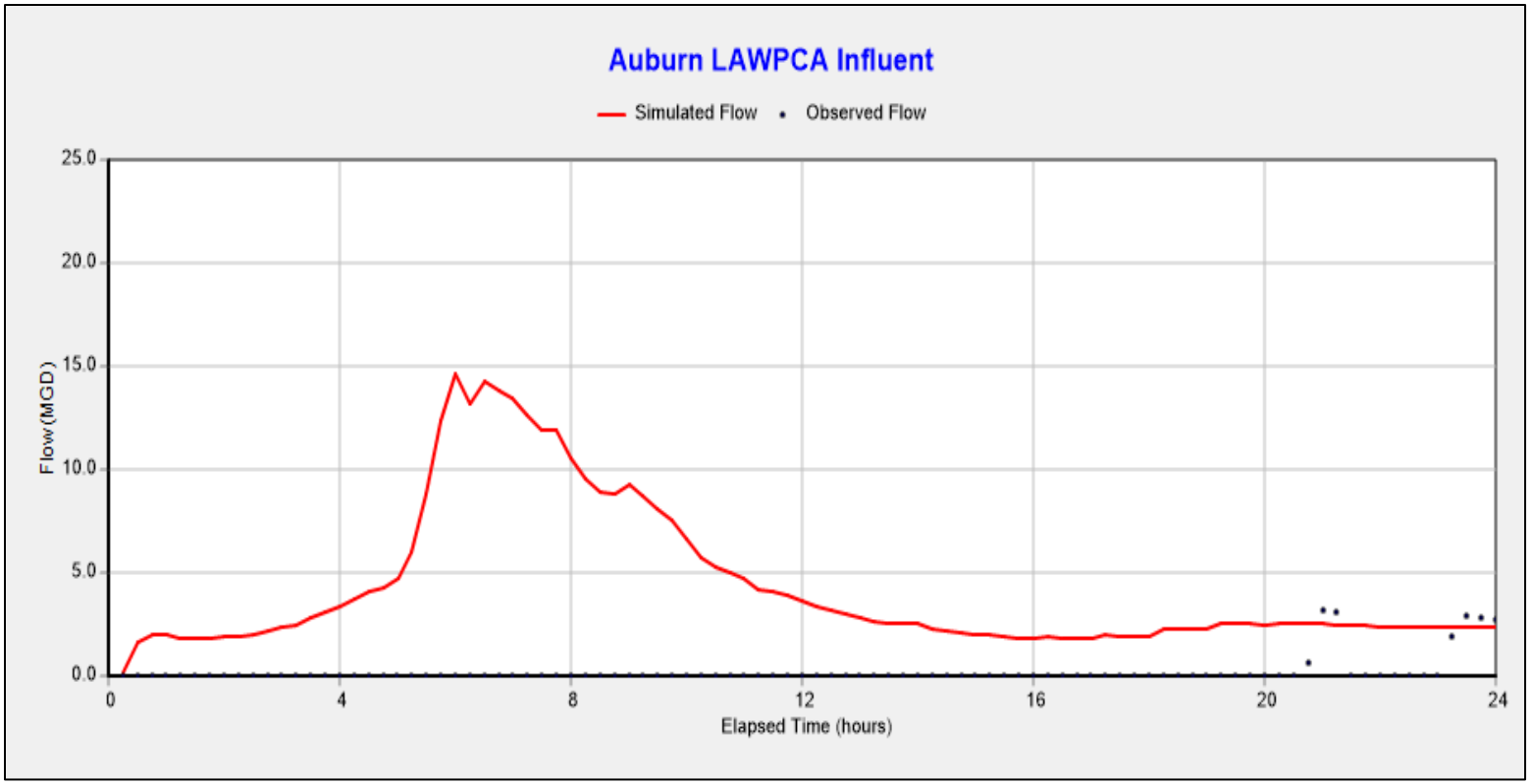

Lower River Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)


Goff Brook/Morningside Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)


Hart Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

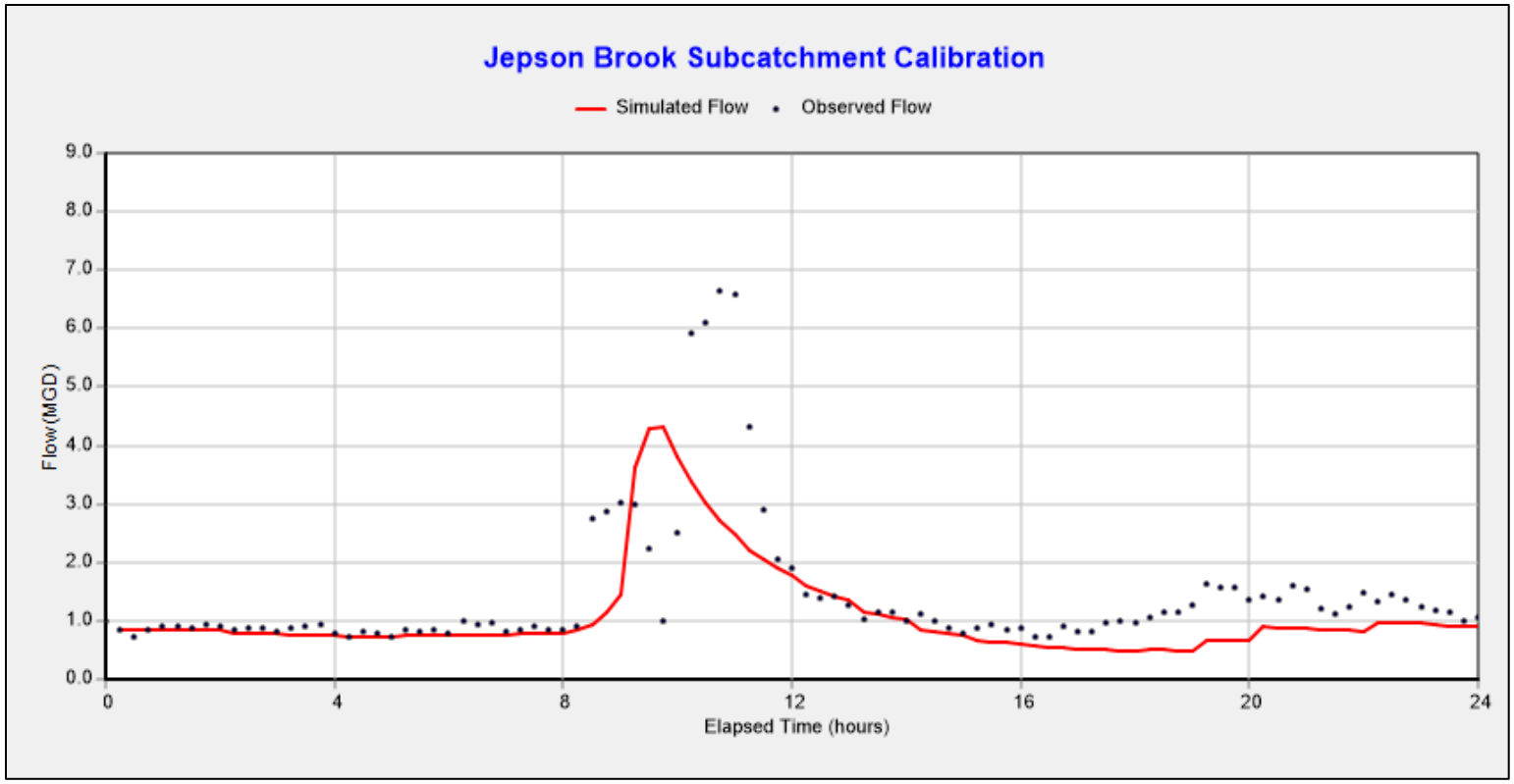

Randall Road Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

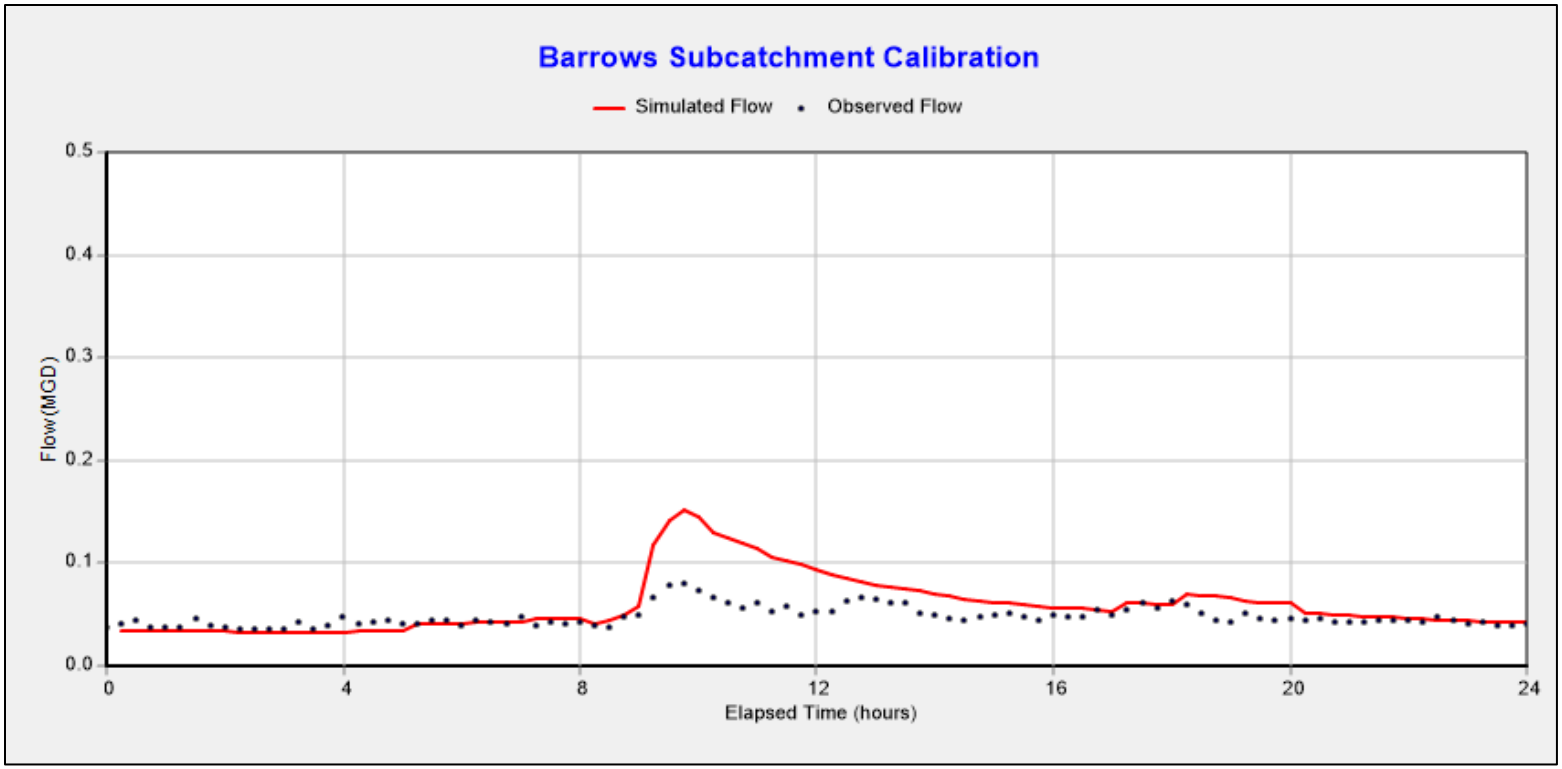

Lewiston LAWPCA Influent
Simulate Flow
Observed Flow
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

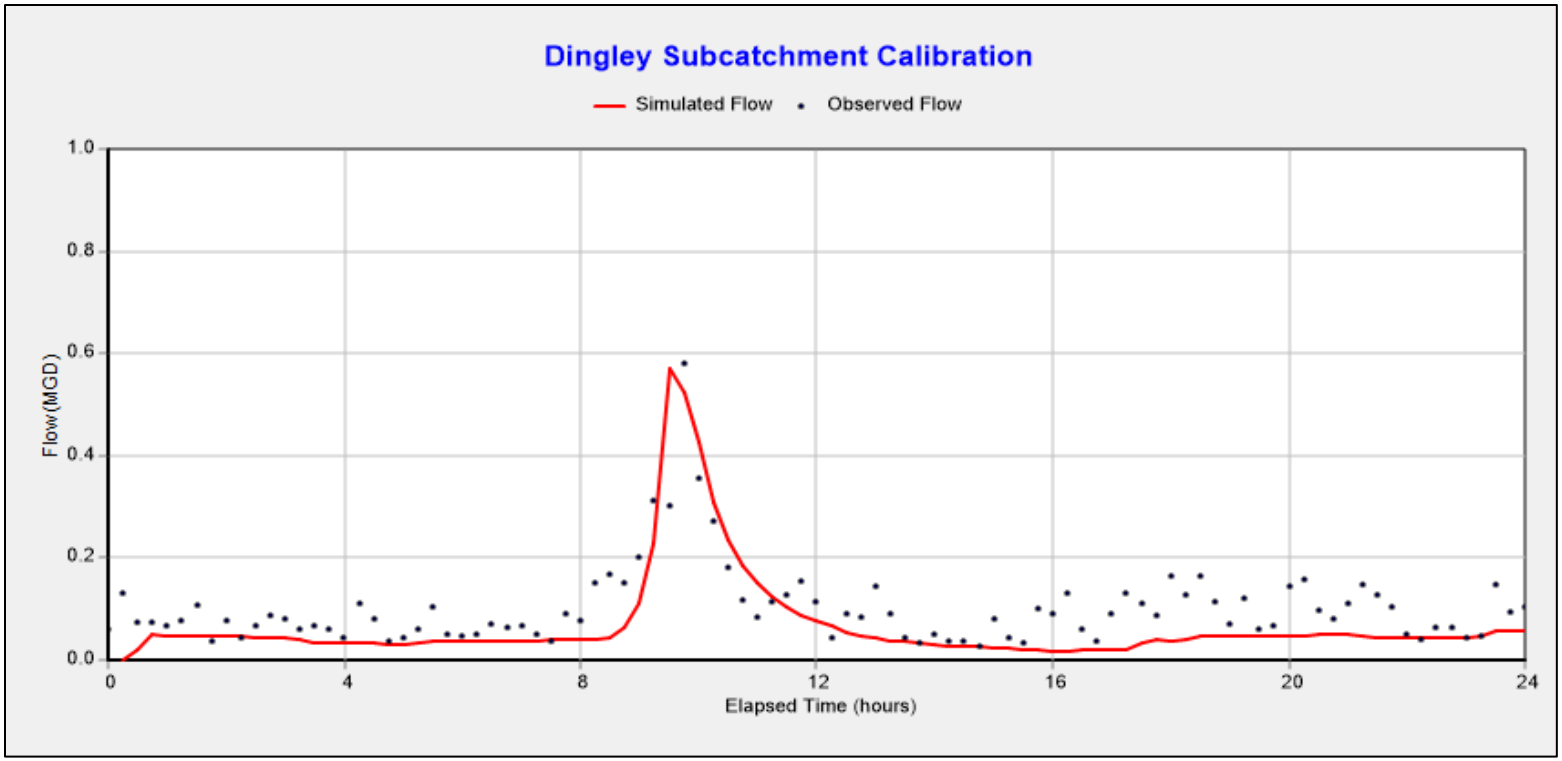

Auburn LAWPCA Influent
Simulated Flow
Observed Flow
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

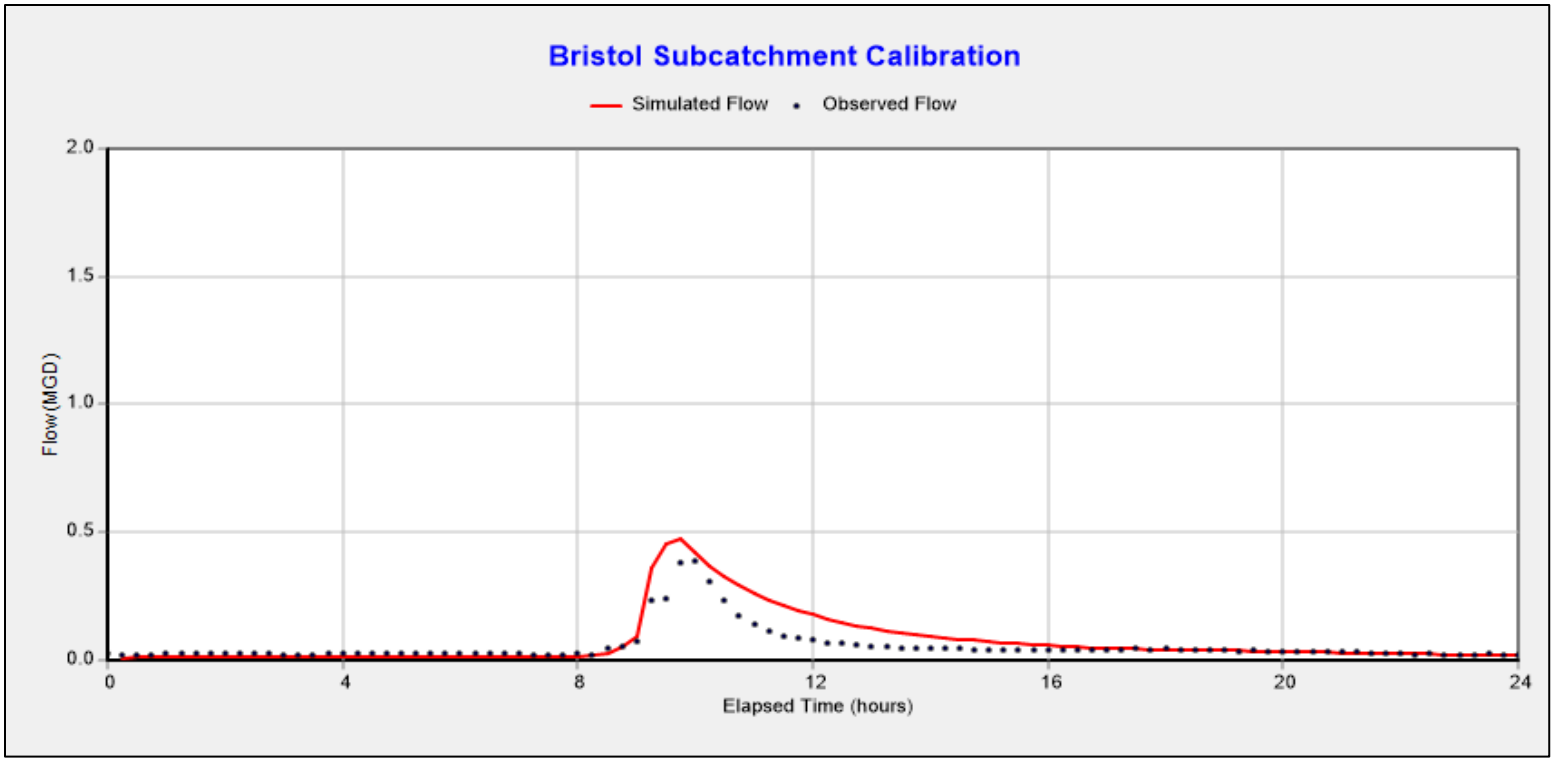
Calibration Storm No. 2

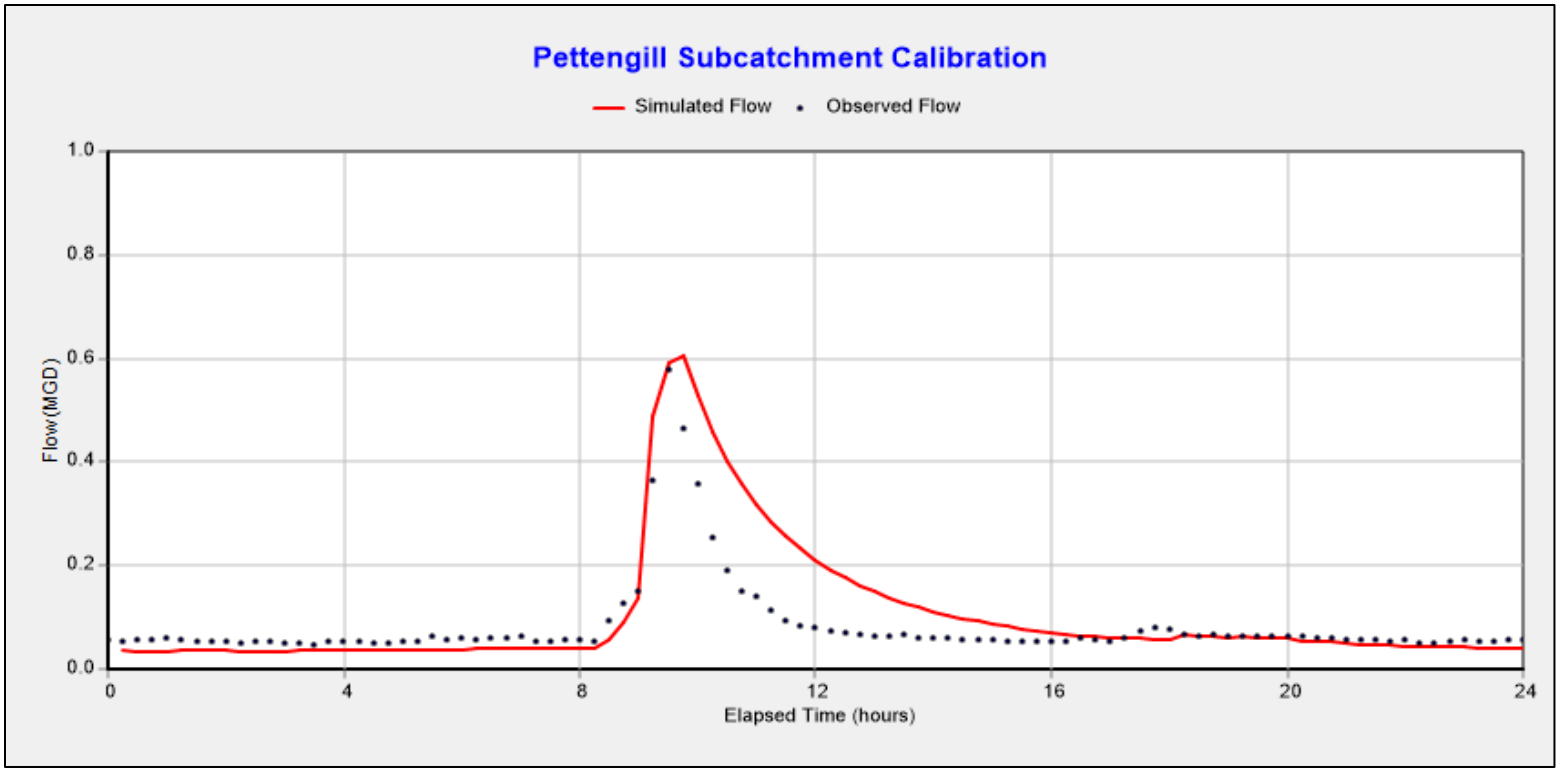
Date:	September 26, 2018
Duration:	2 hours
Total Precipitation:	0.55 inches
Peak Intensity:	0.39 inches/hour
Recurrence Interval:	1-month

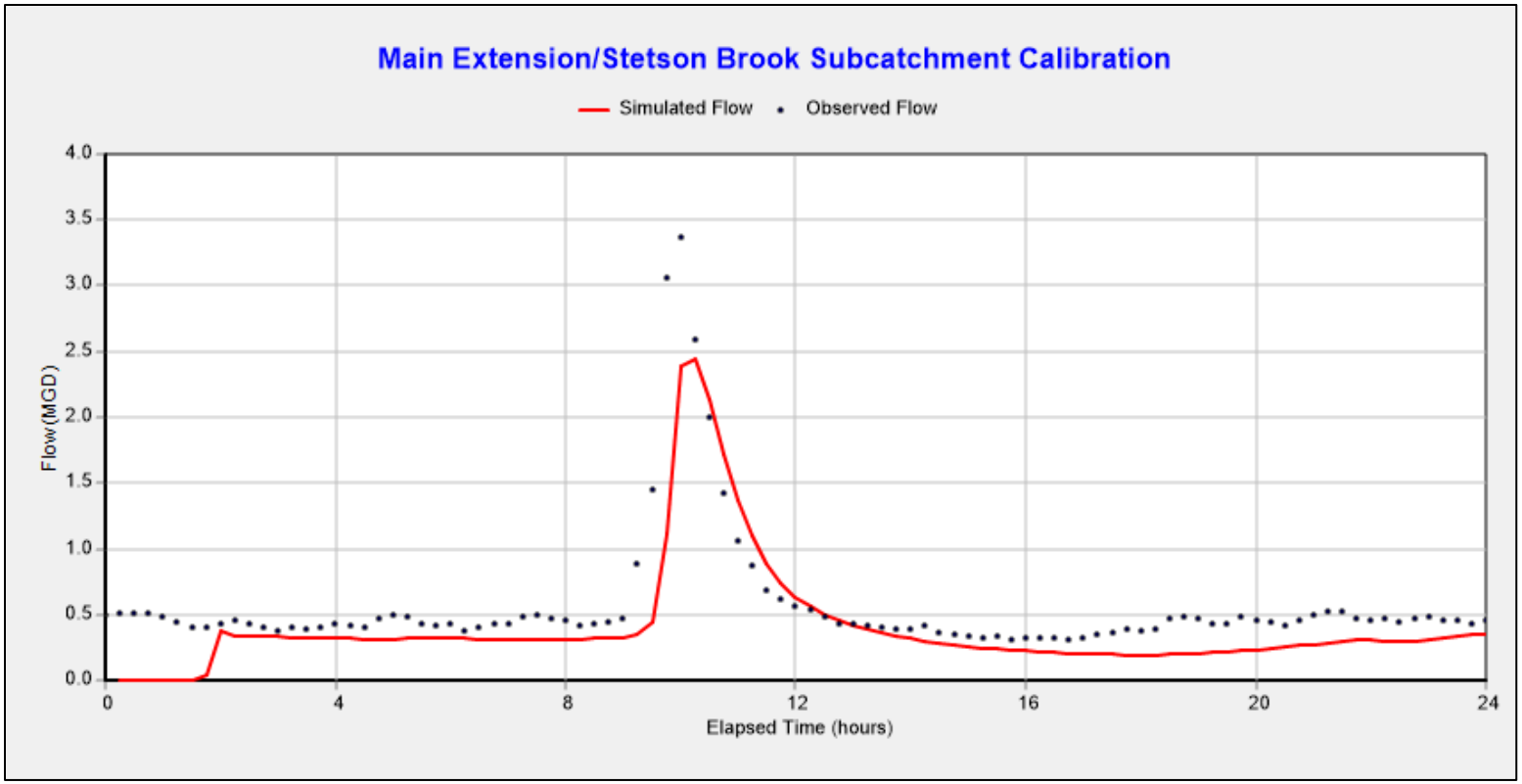

Jepson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

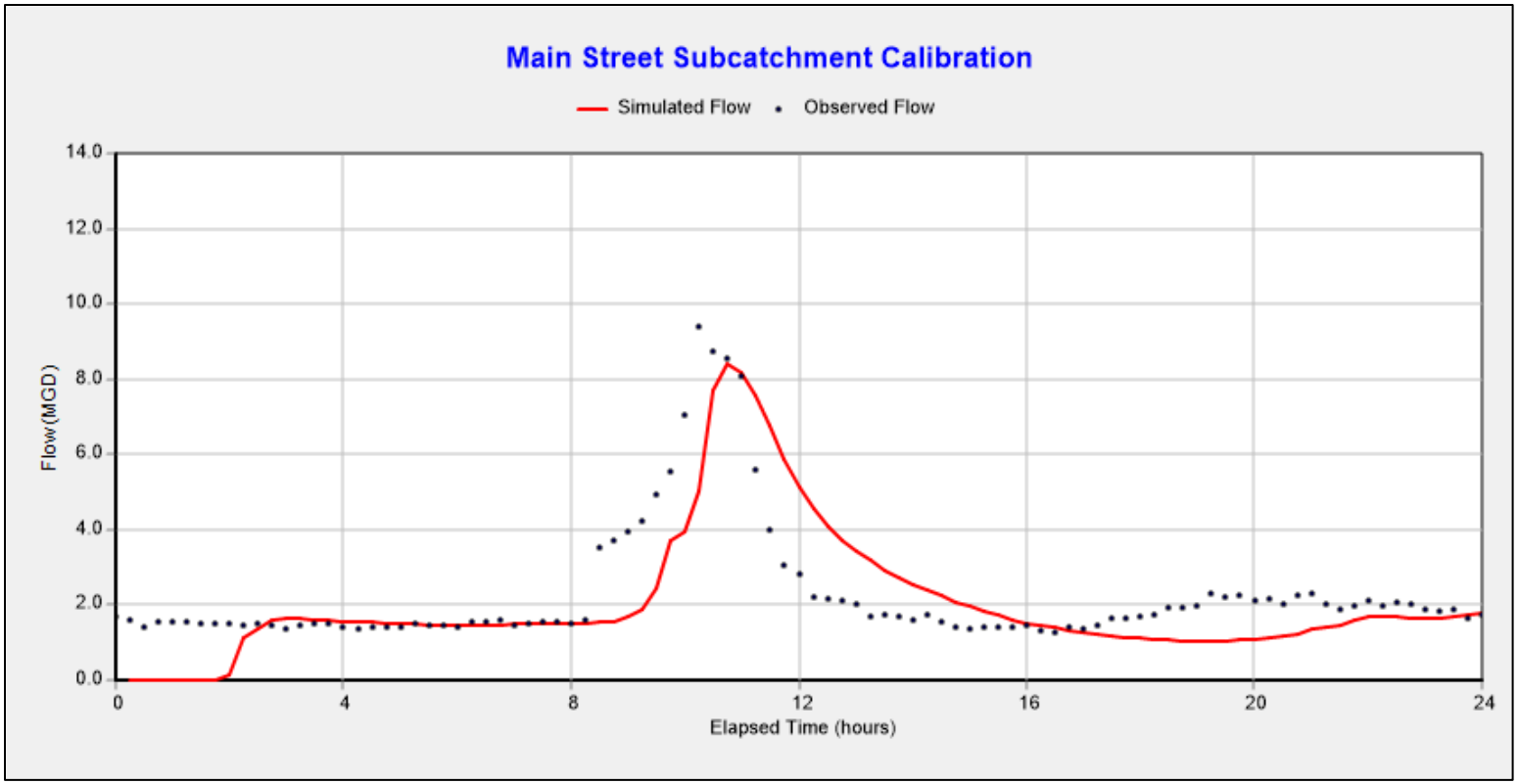

Barrows Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

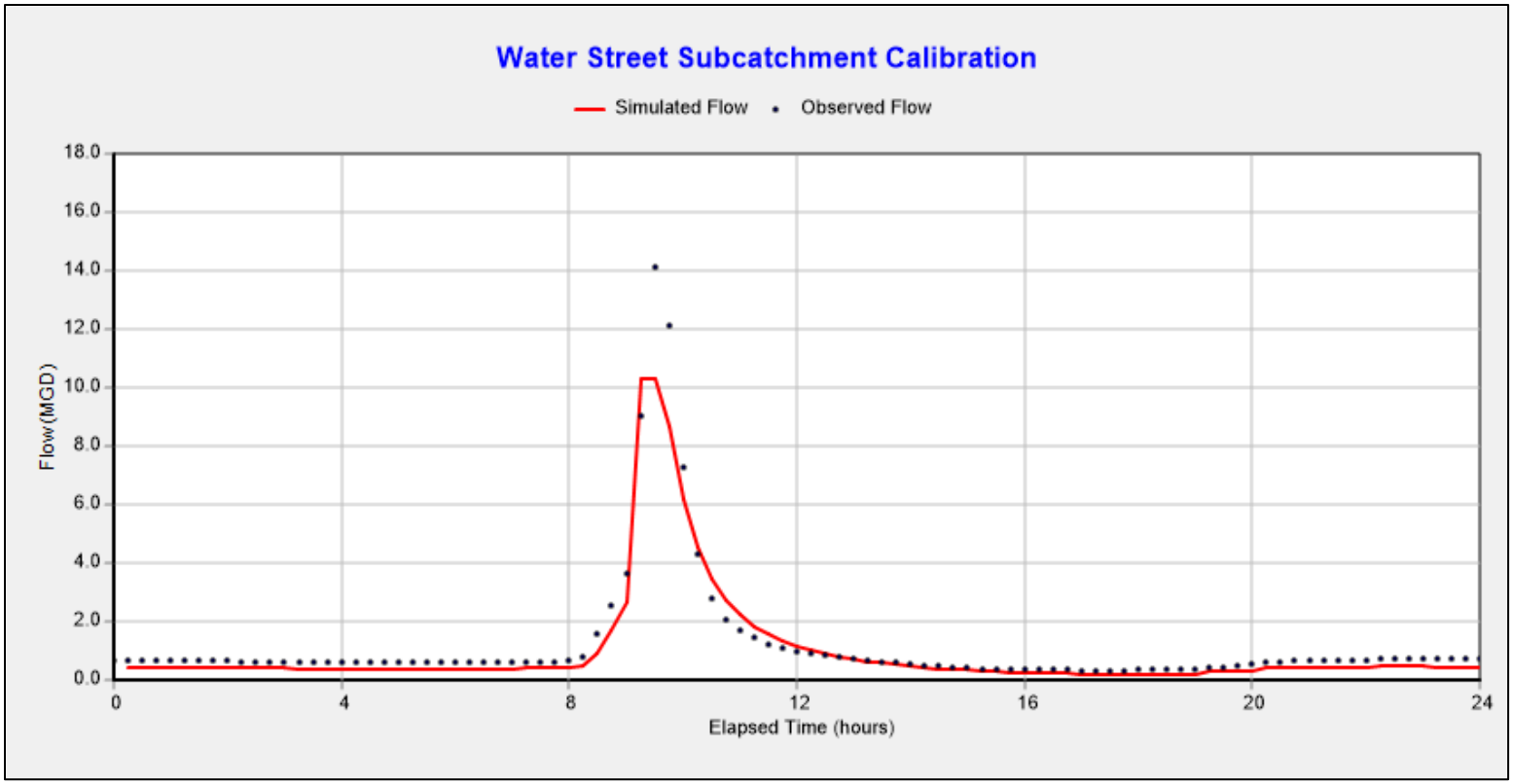

Dingley Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

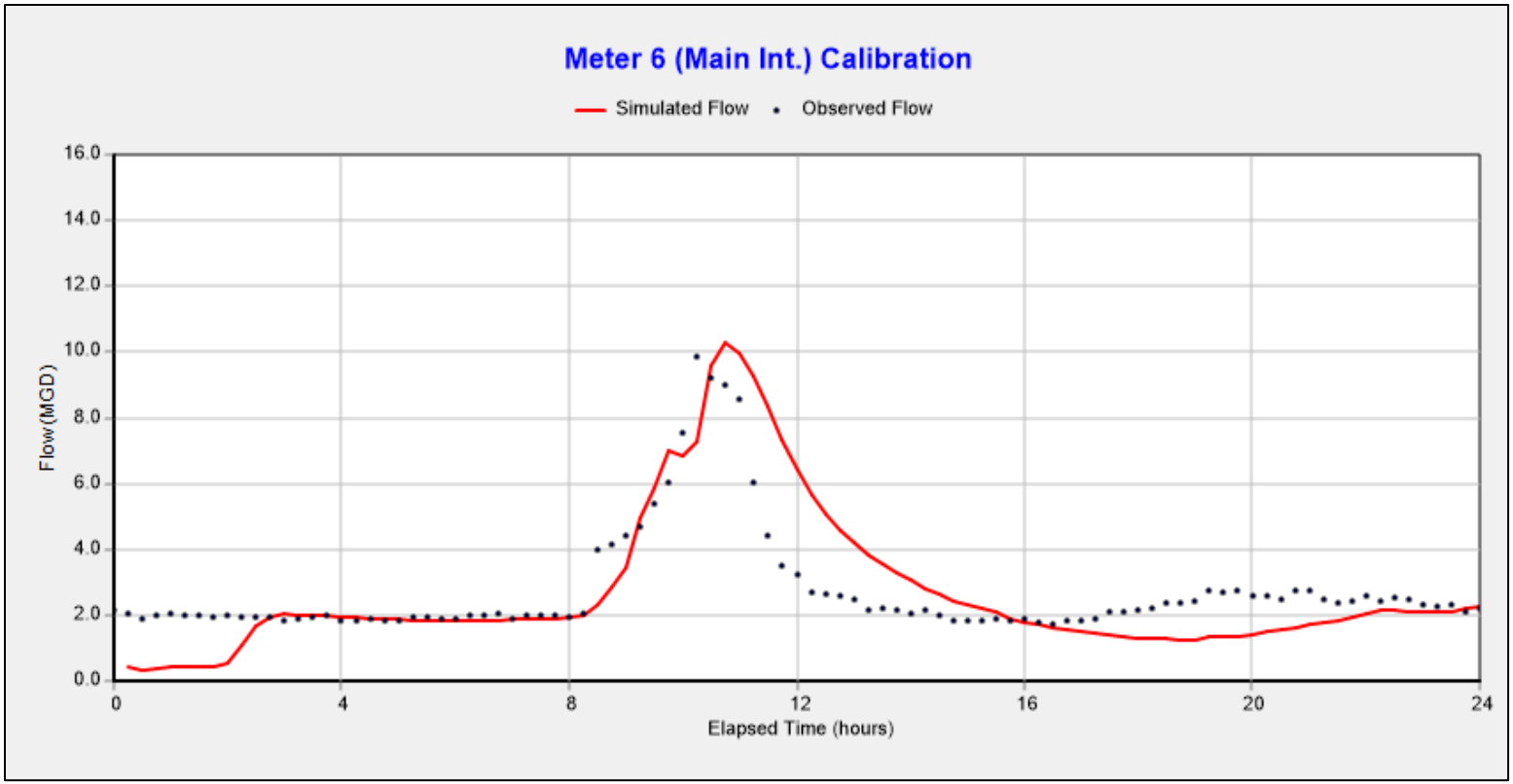

Bristol Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

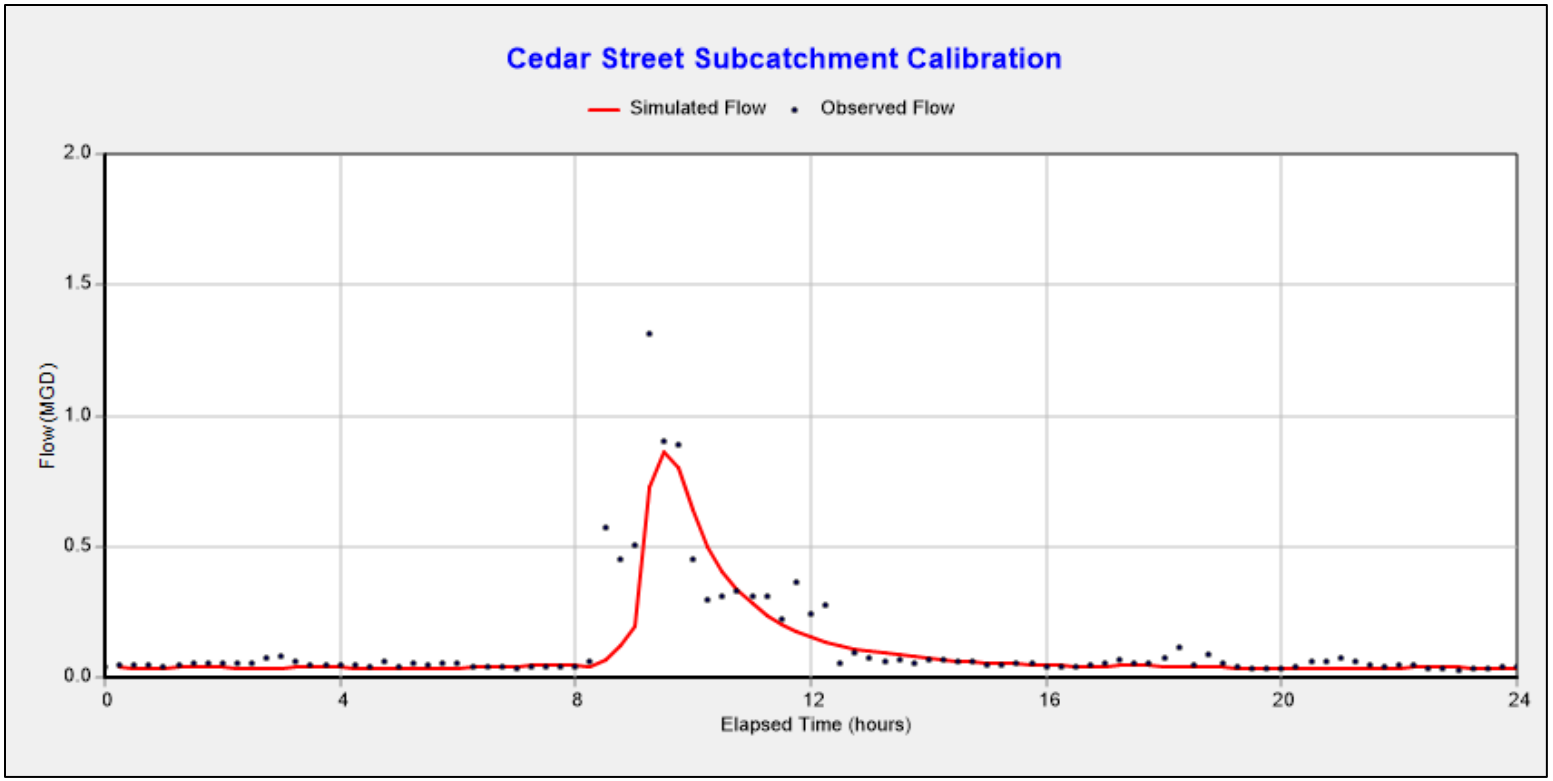

Pettengill Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

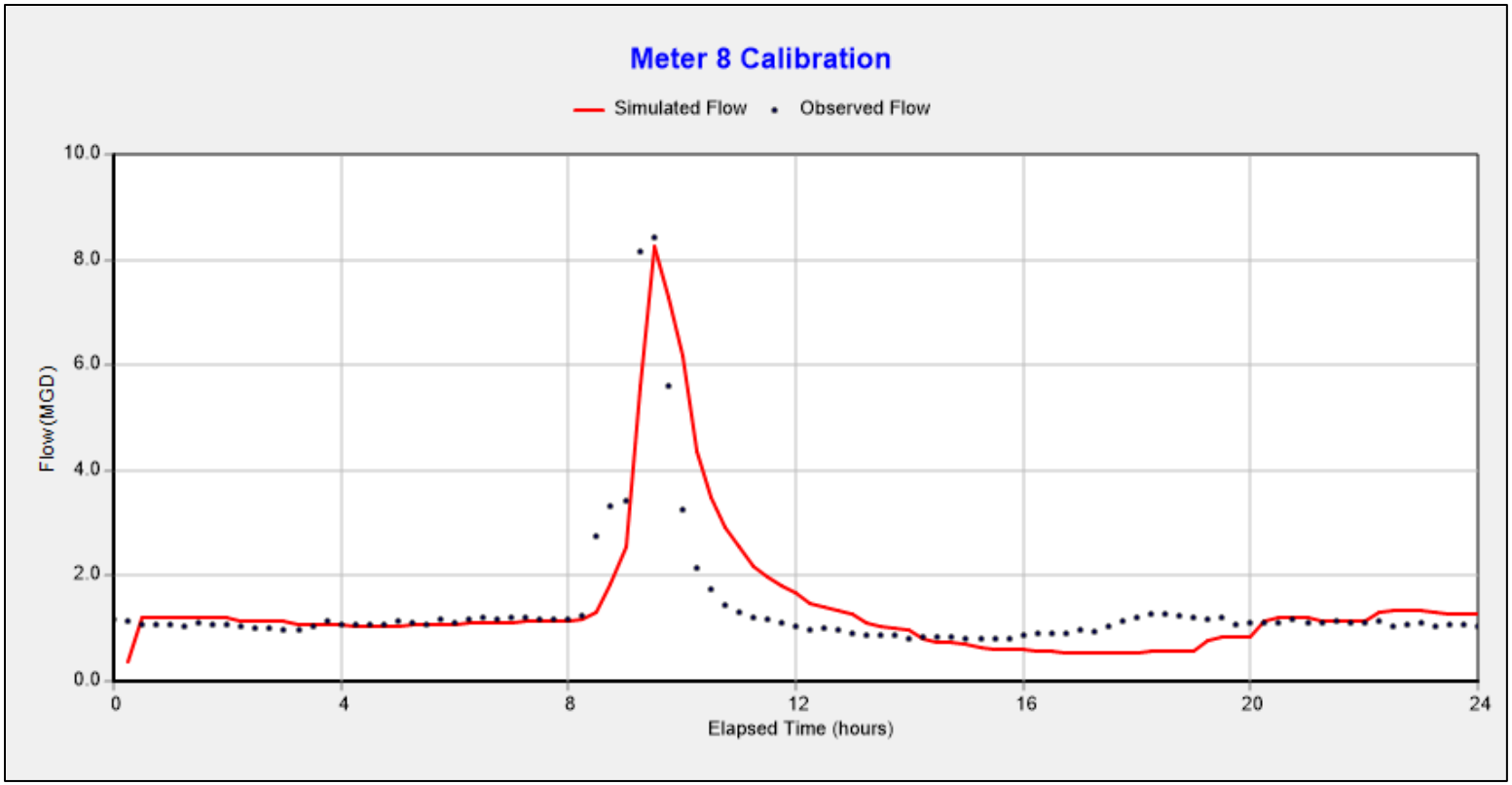

Main Extension/Stetson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

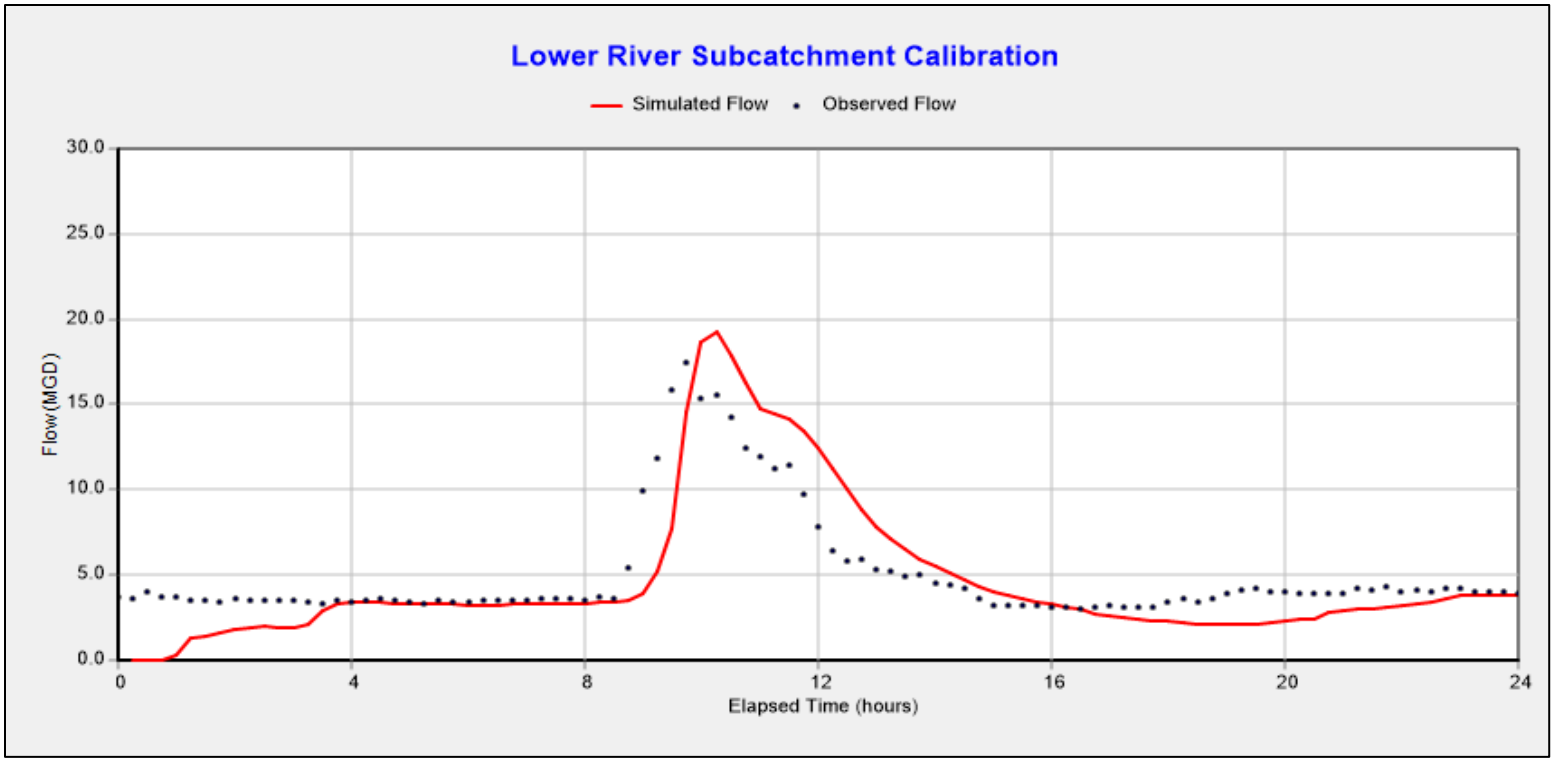

Main Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

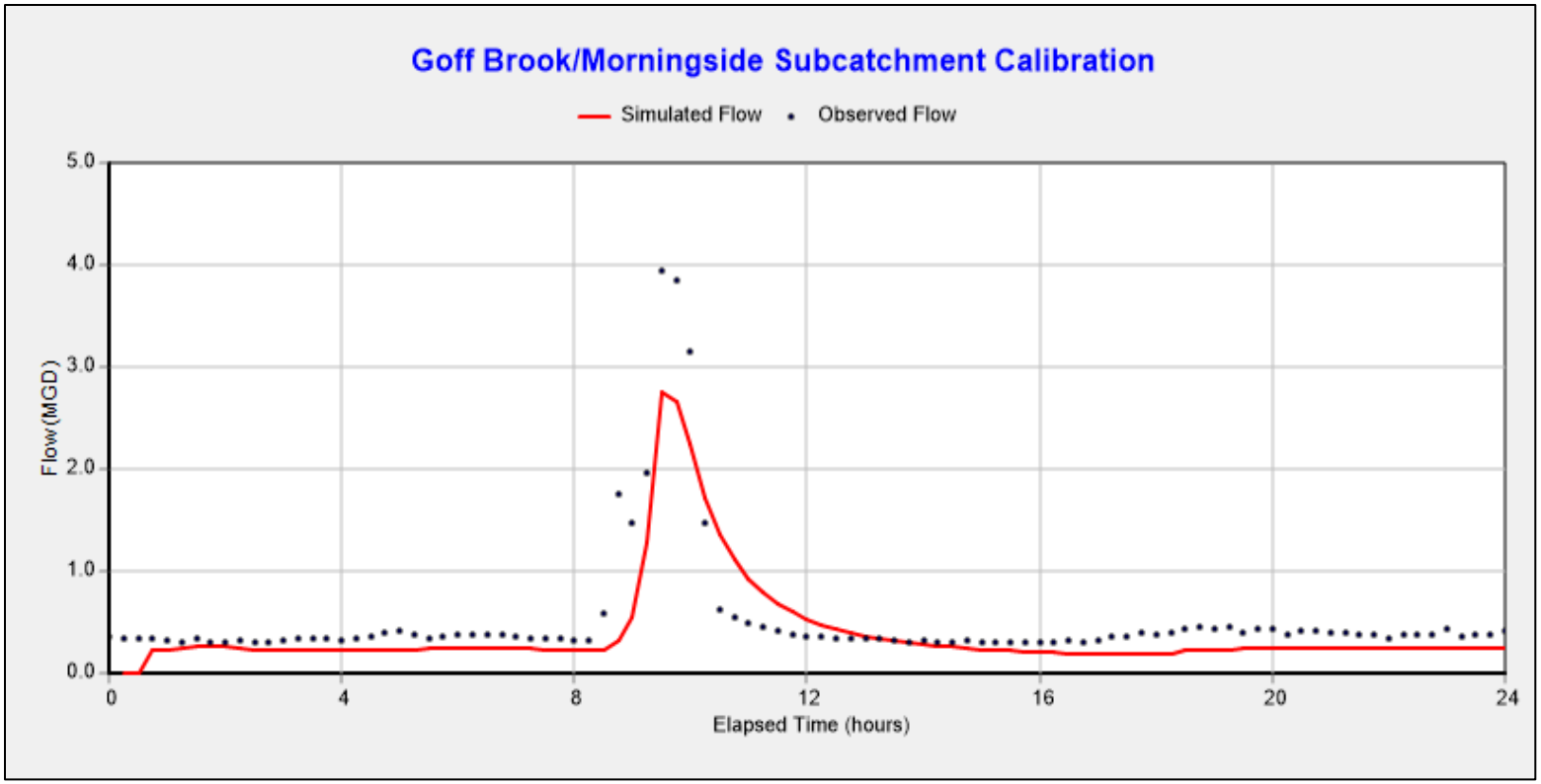

Water Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

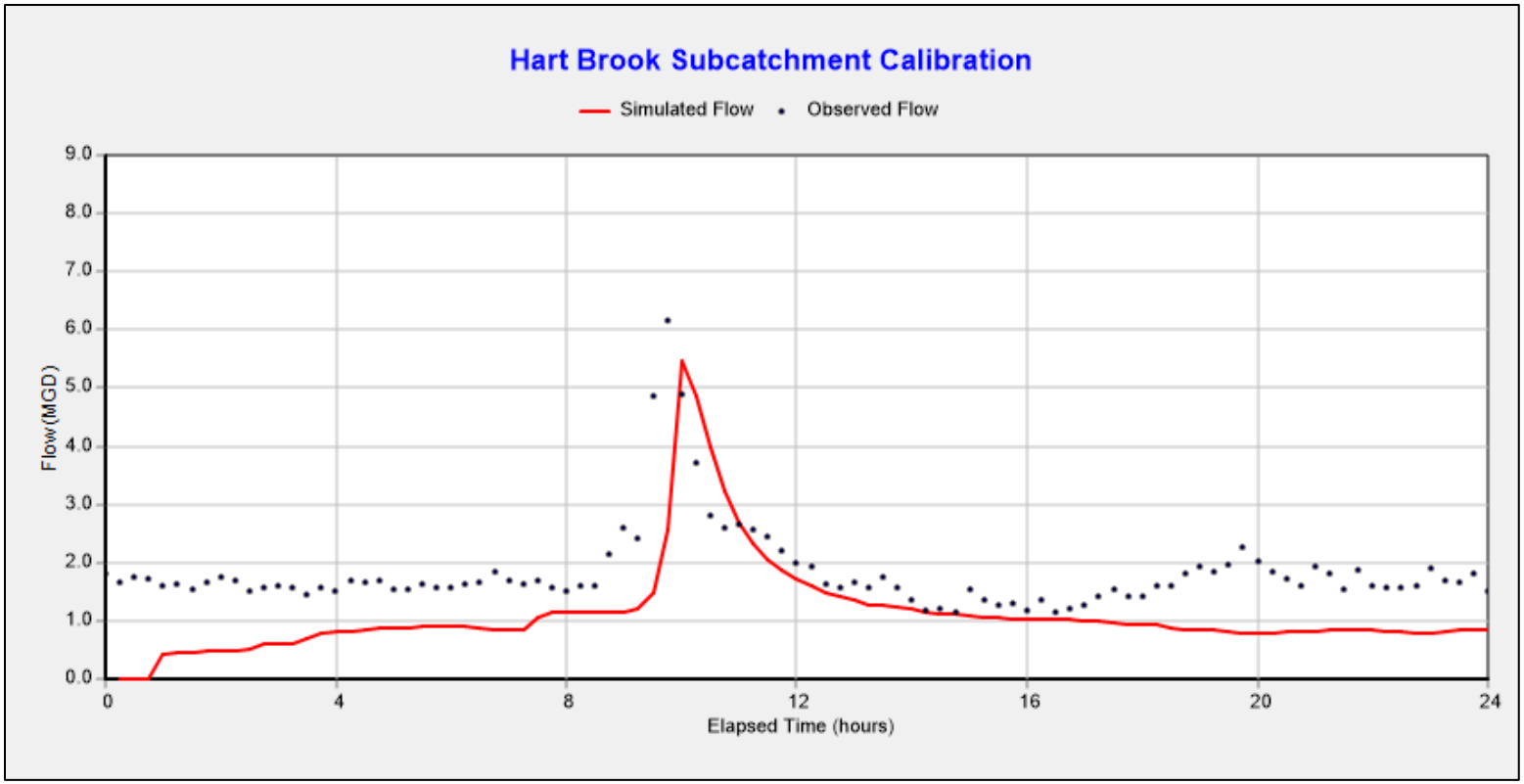

Meter 6 (Main Int.) Calibration
Simulated Flow
Observed Flow
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

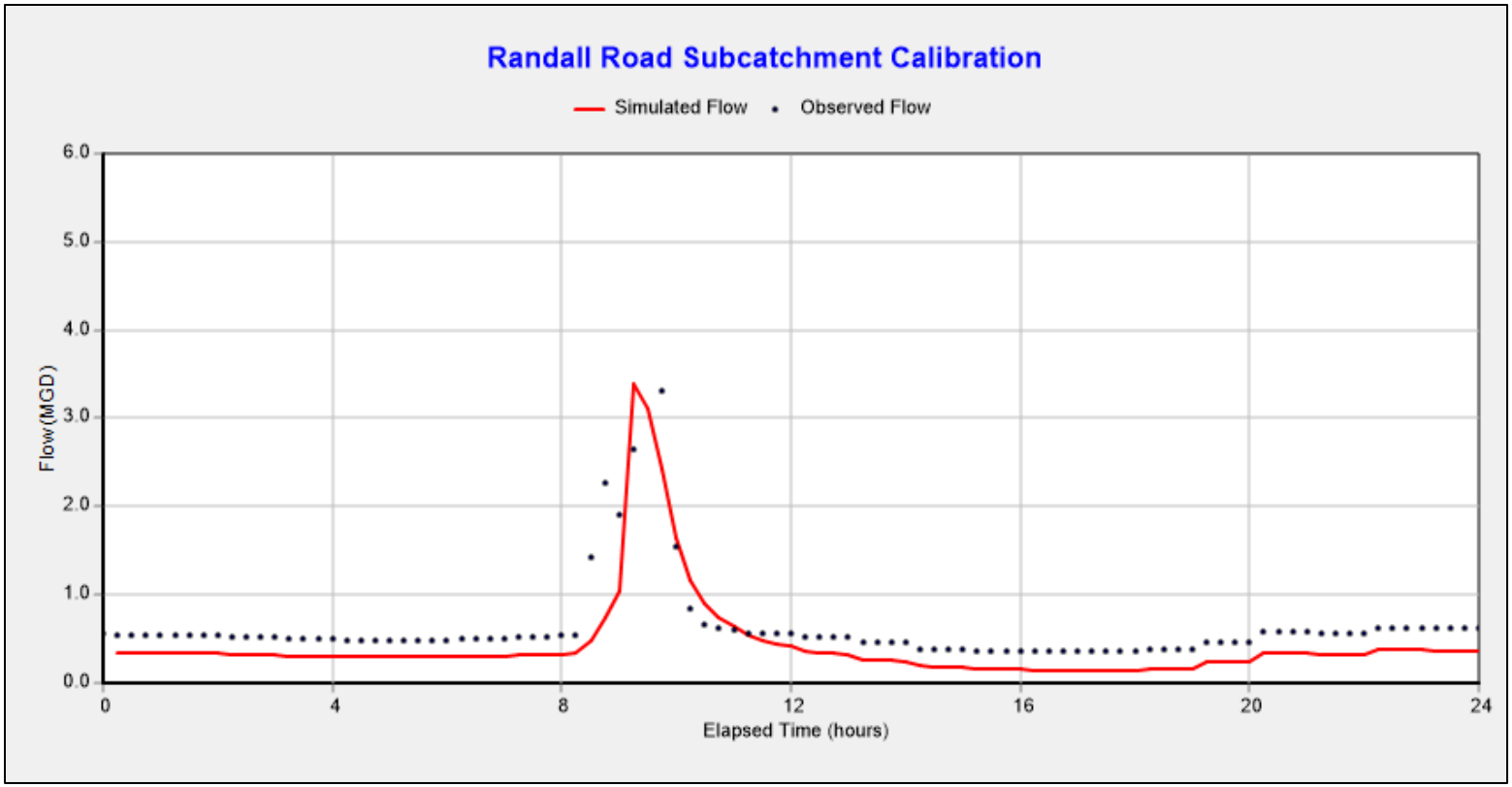

Cedar Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

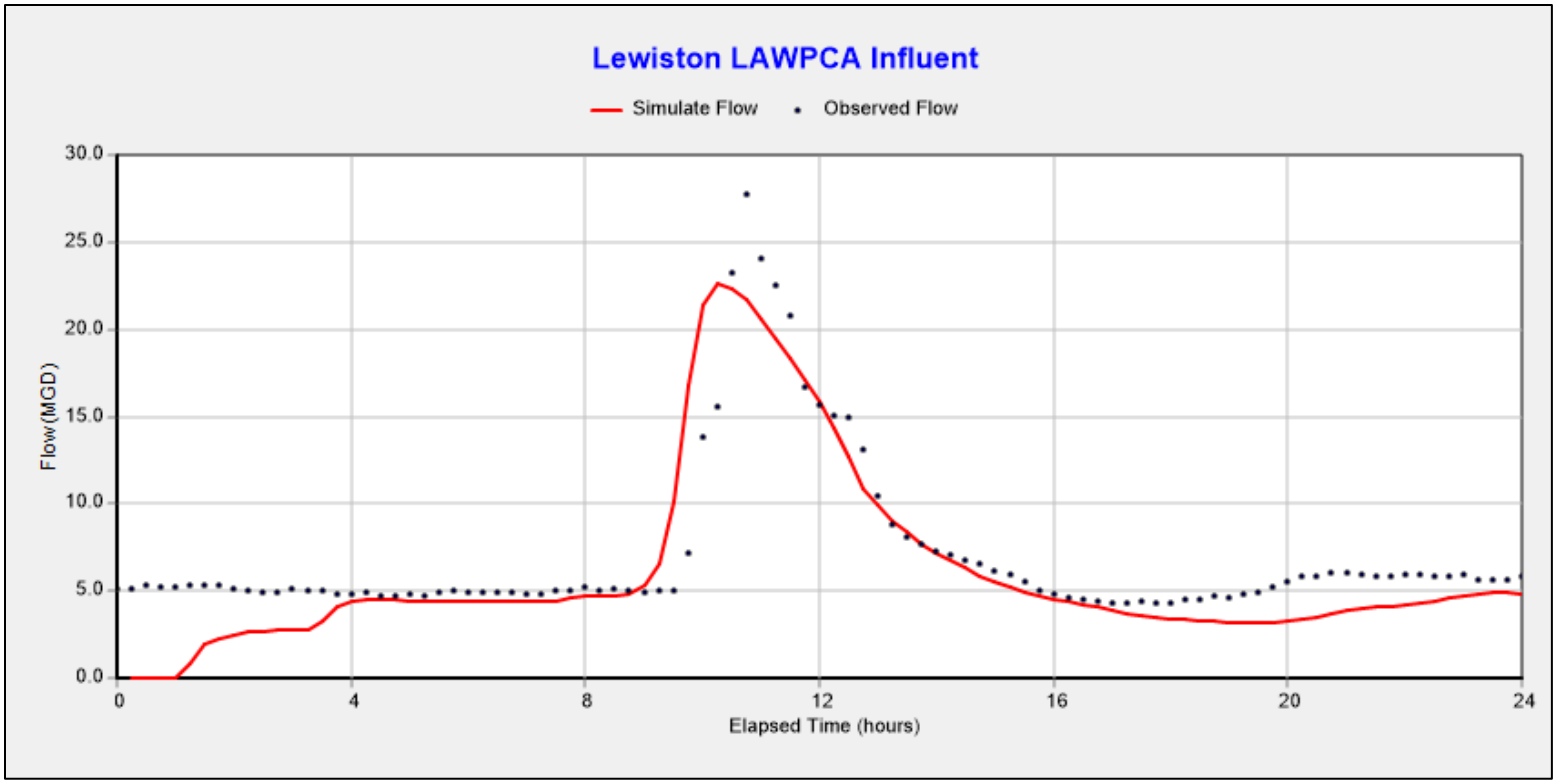

Meter 8 Calibration
Simulated Flow
Observed Flow
10.0
8.0
6.0
4.0
2.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

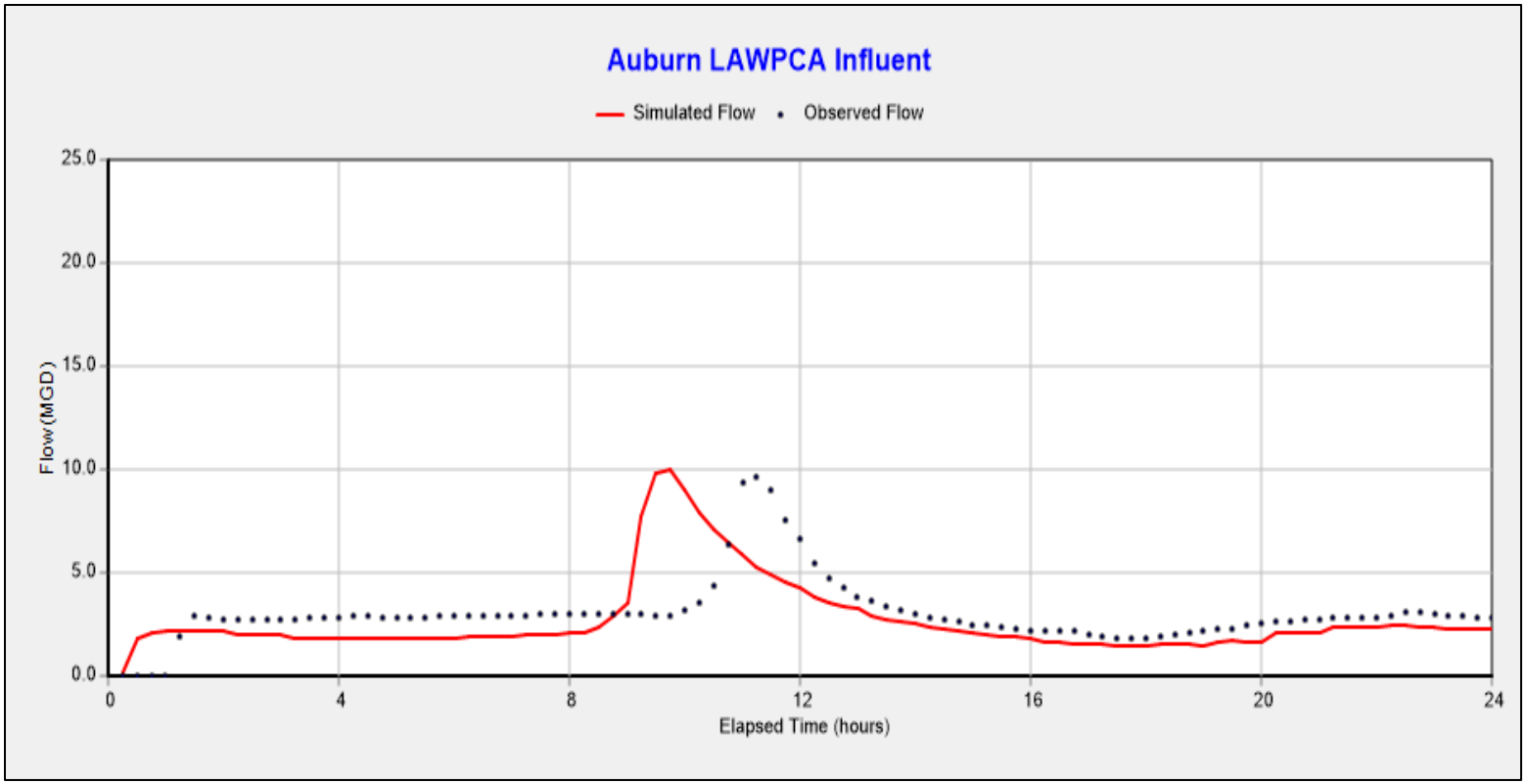

Lower River Subcatchment Calibration
Simulated Flow
Observed Flow
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)


Goff Brook/Morningside Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)


Hart Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

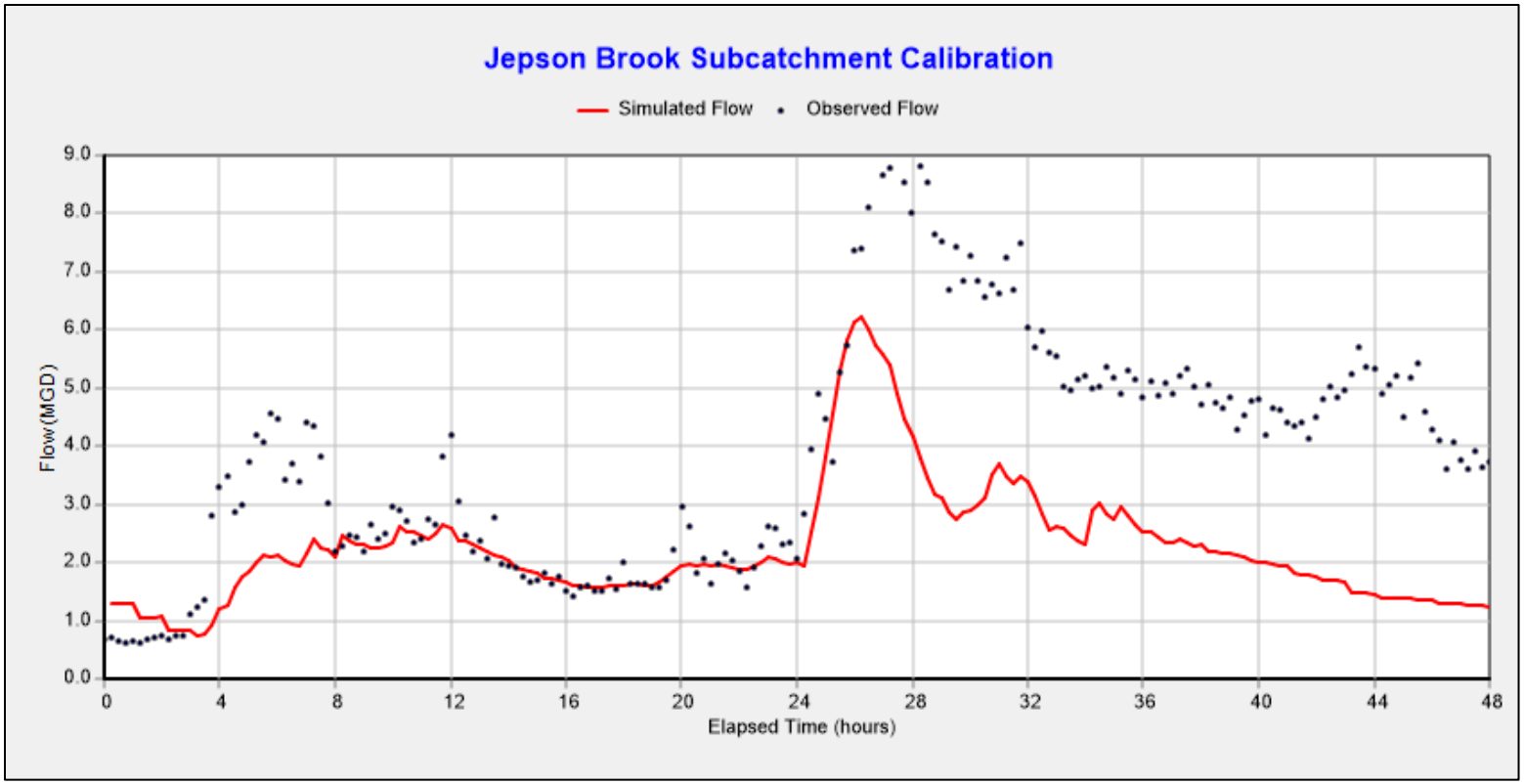

Randall Road Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
Elapsed Time (hours)

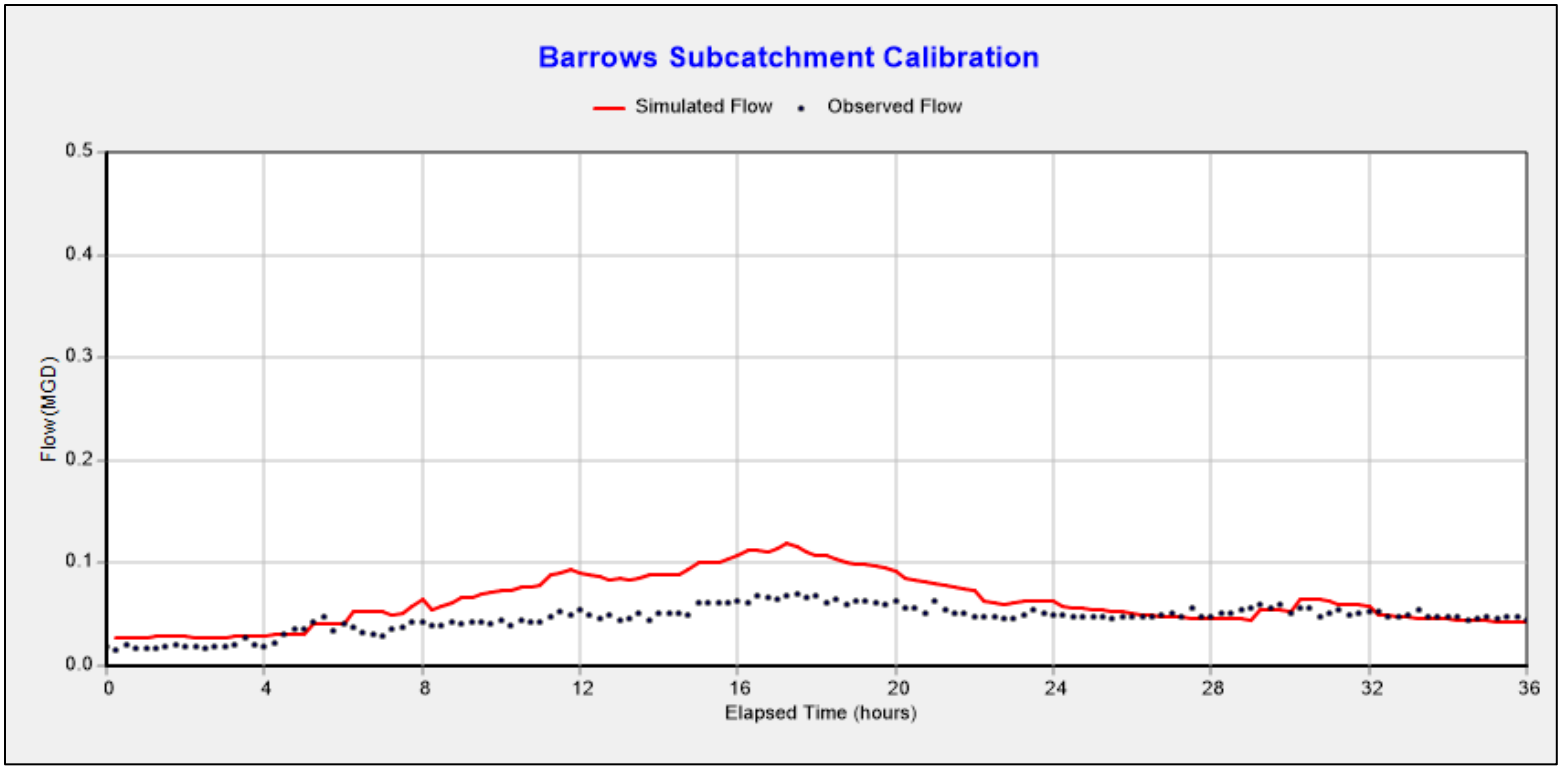

Lewiston LAWPCA Influent
Simulate Flow
Observed Flow
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

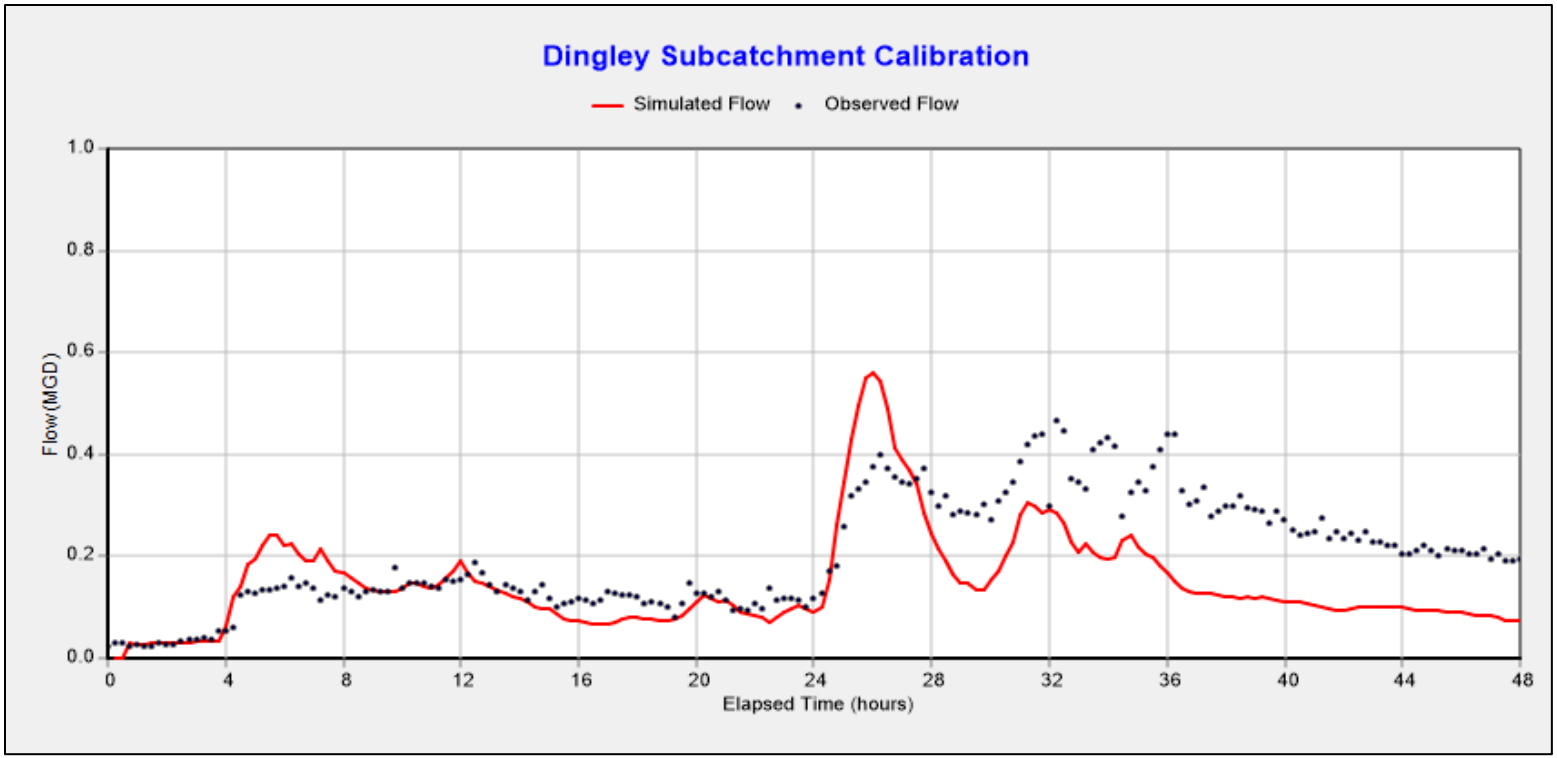

Auburn LAWPCA Influent
Simulated Flow
Observed Flow
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
Elapsed Time (hours)

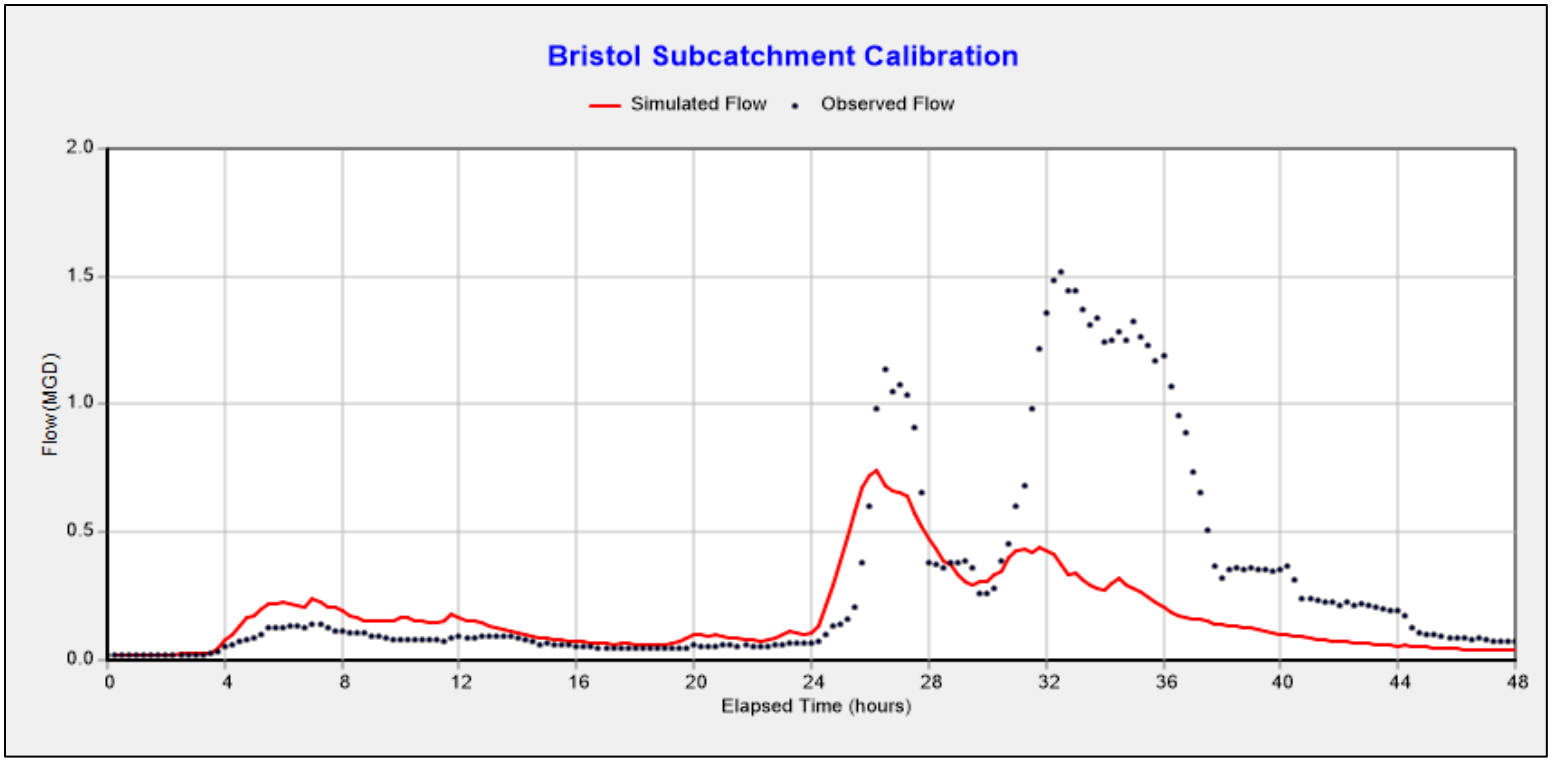
Calibration Storm No. 3

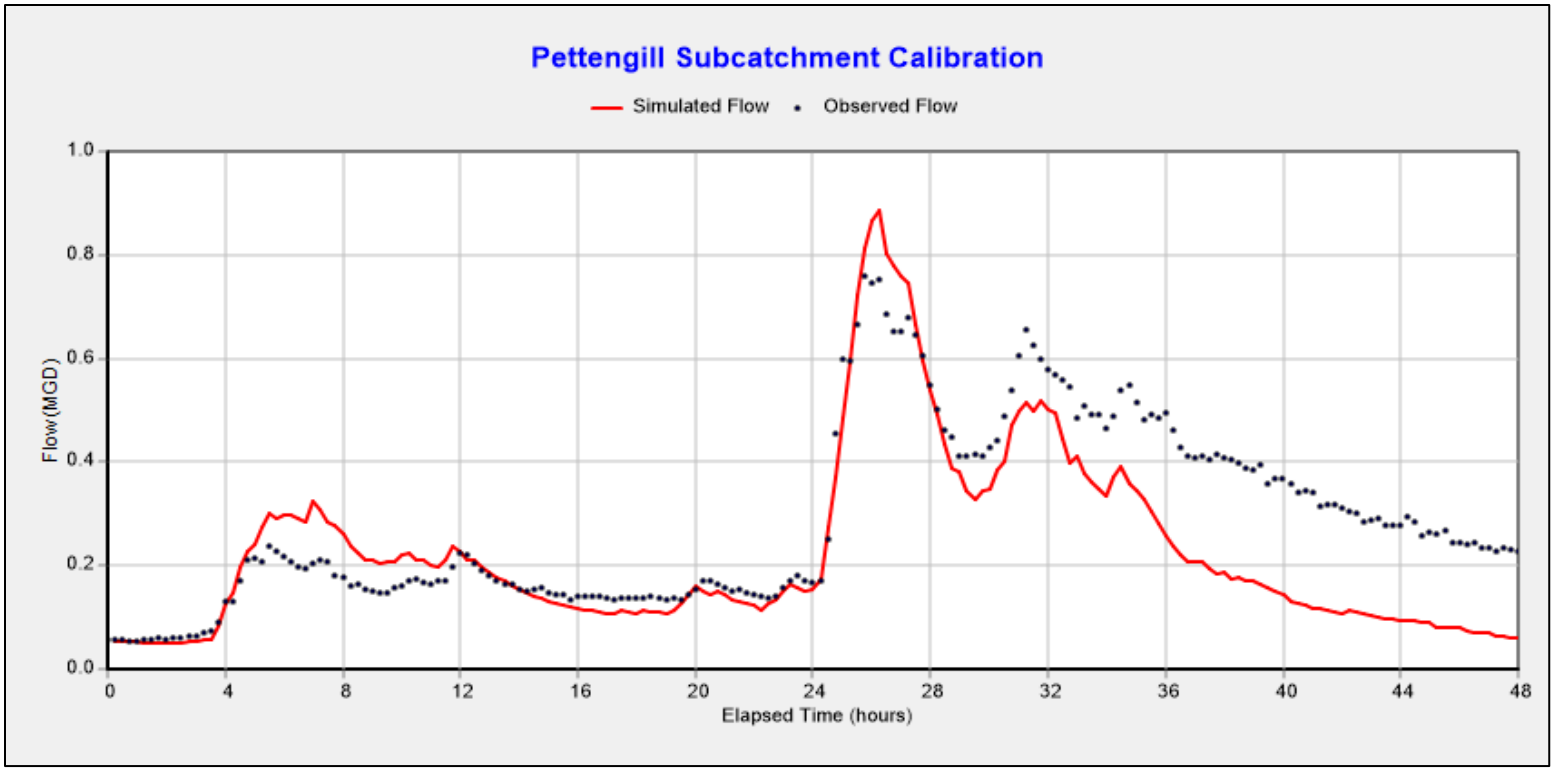
Date:	November 02, 2018
Duration:	32 hours
Total Precipitation:	2.16 inches
Peak Intensity:	0.33 inches/hour
Recurrence Interval:	3-month

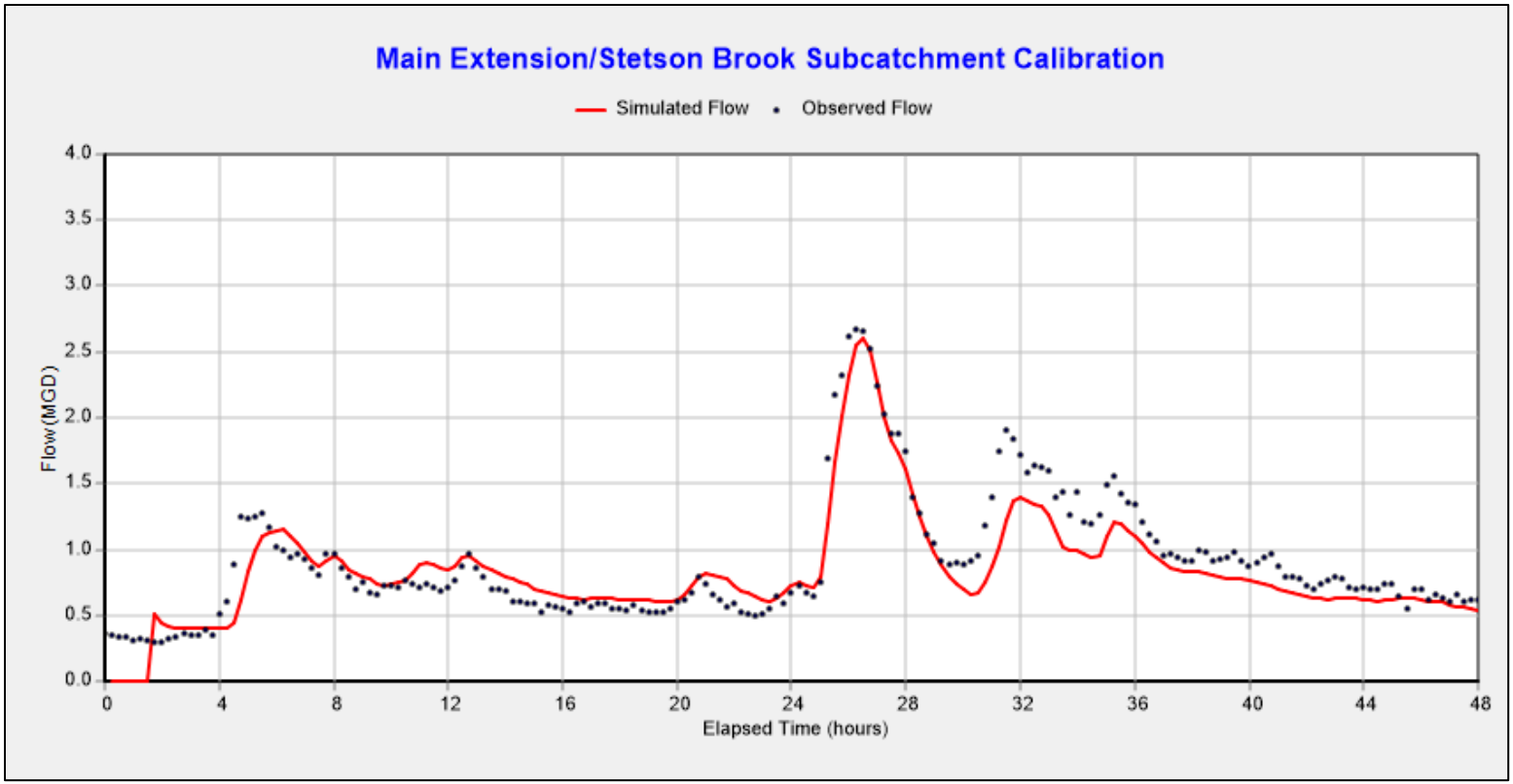

Jepson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

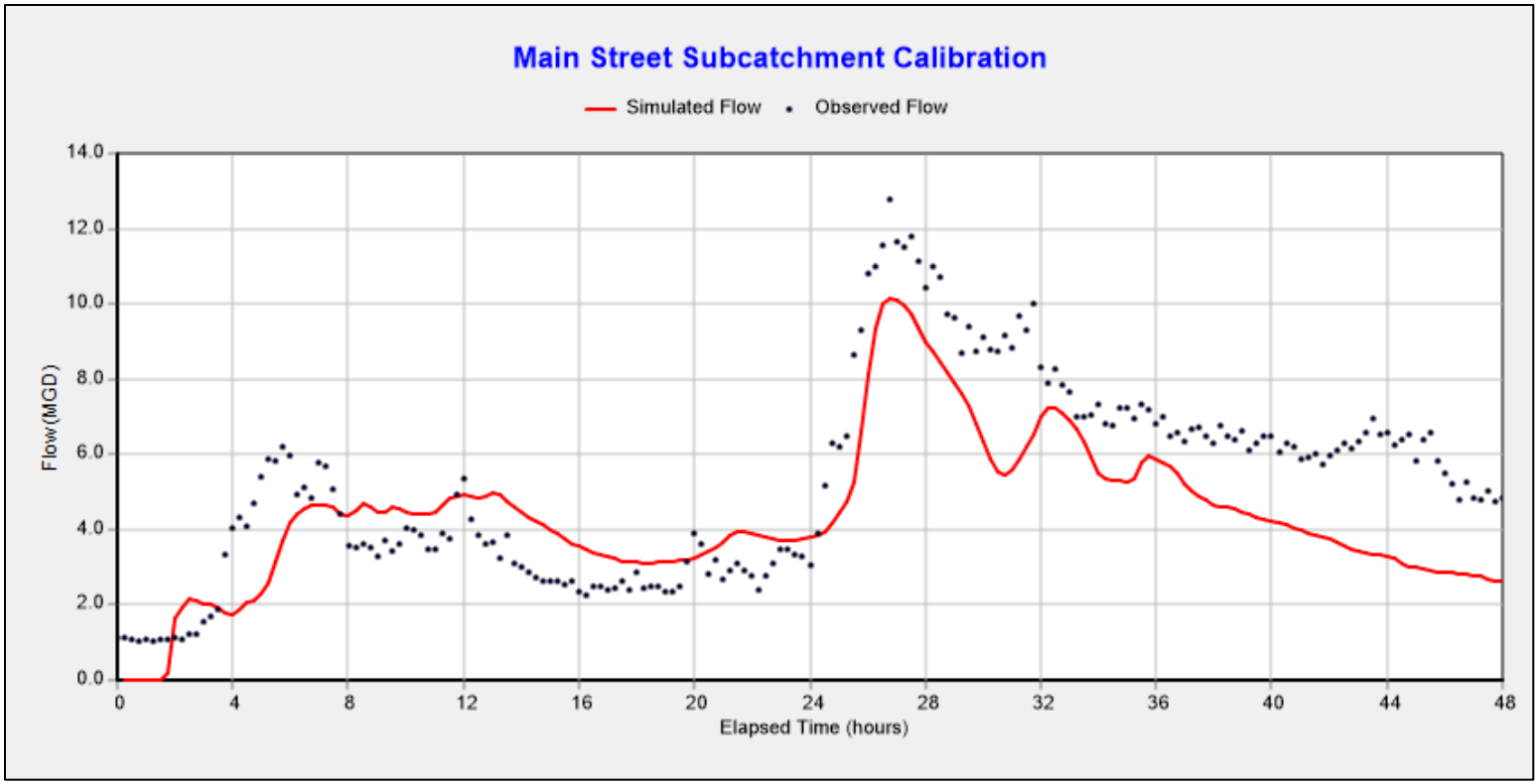

Barrows Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

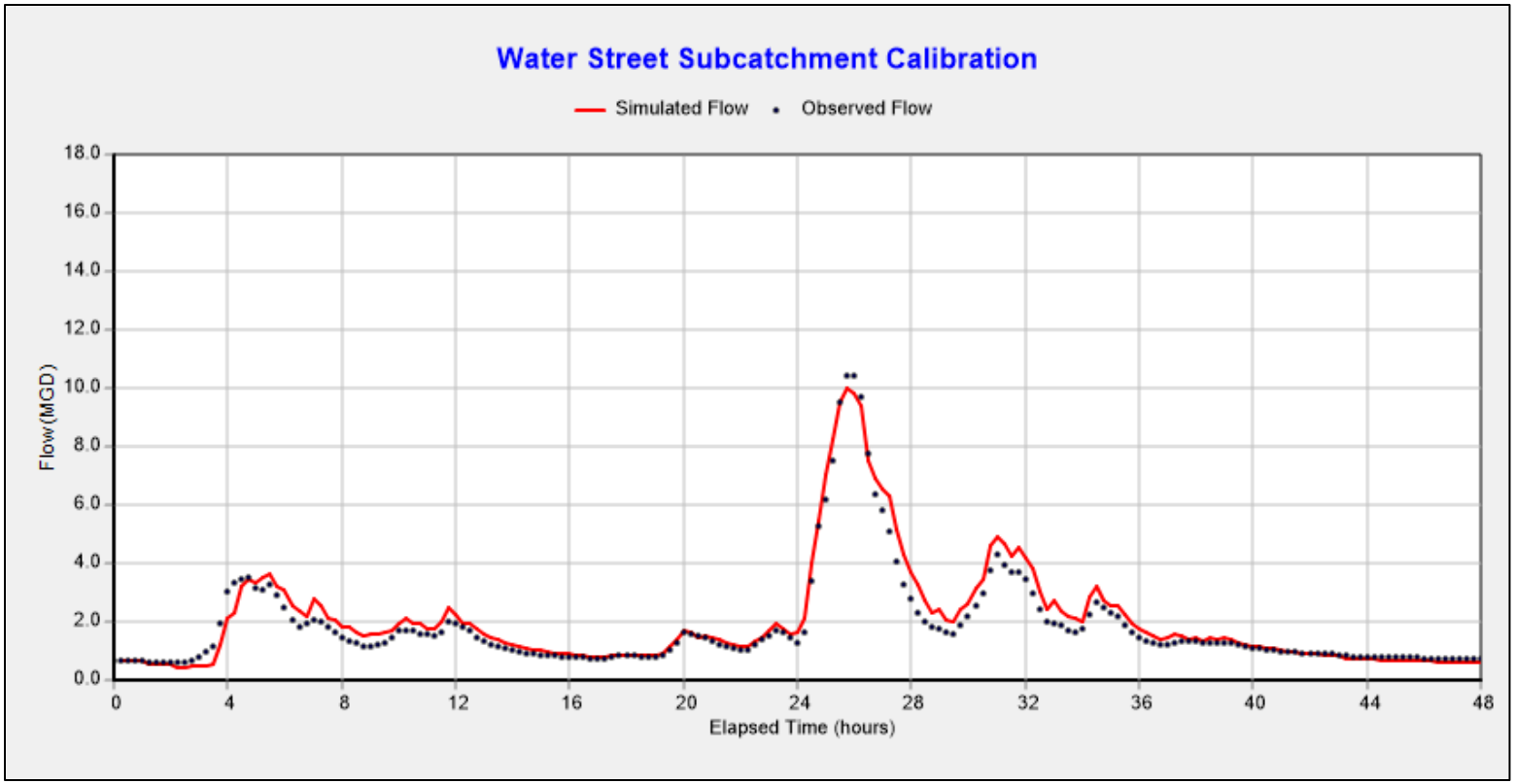

Dingley Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

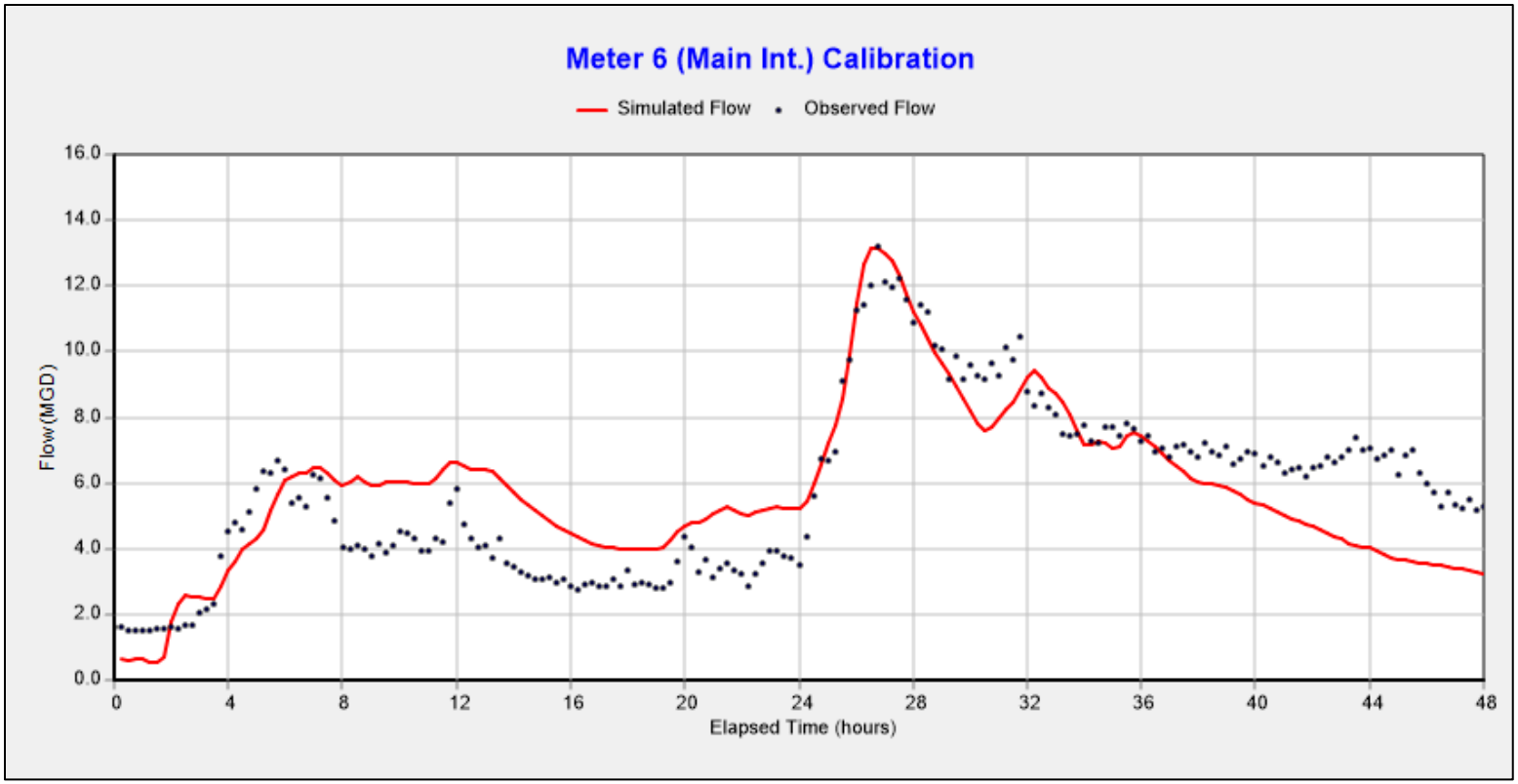

Bristol Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

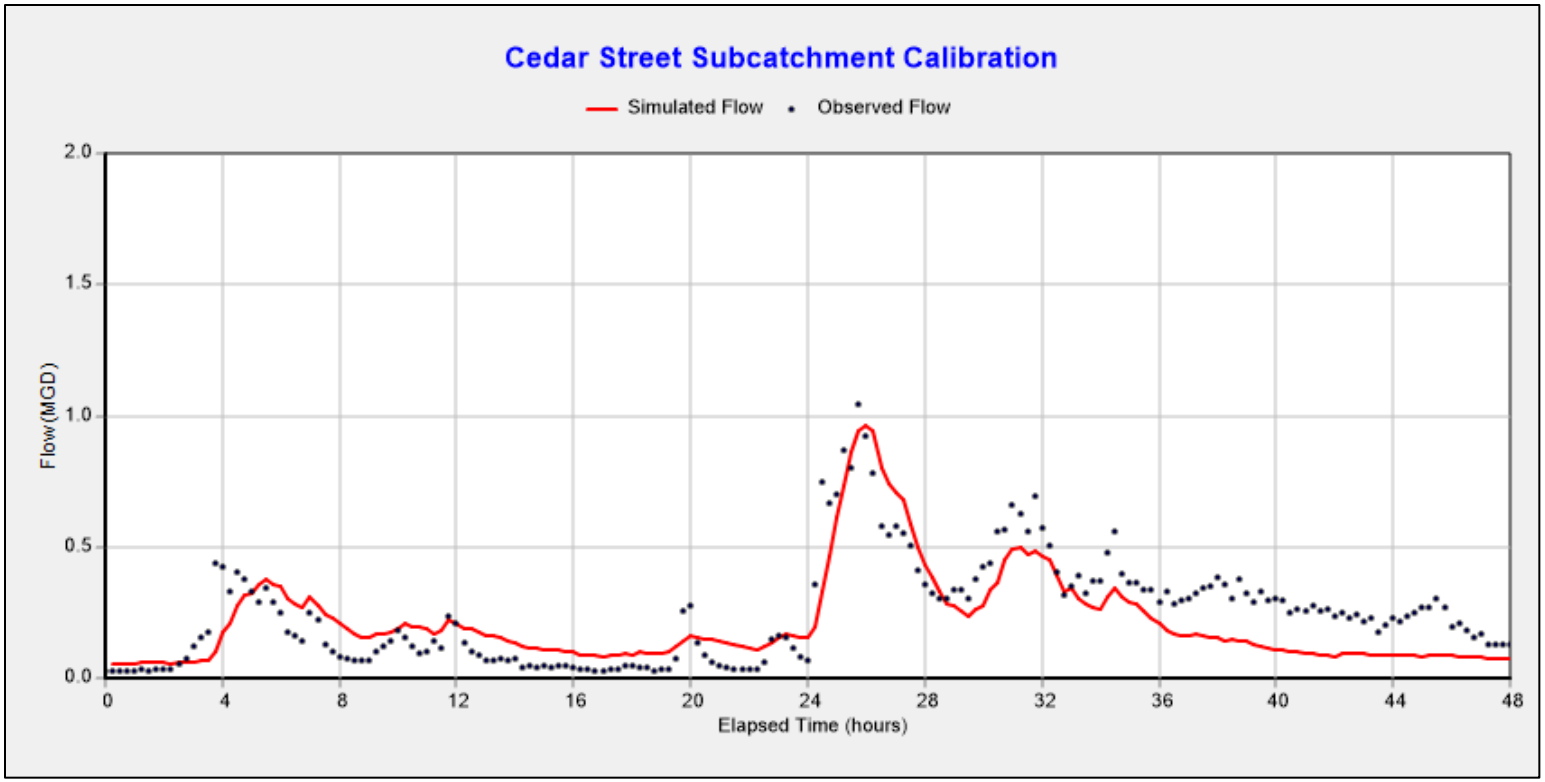

Pettengill Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

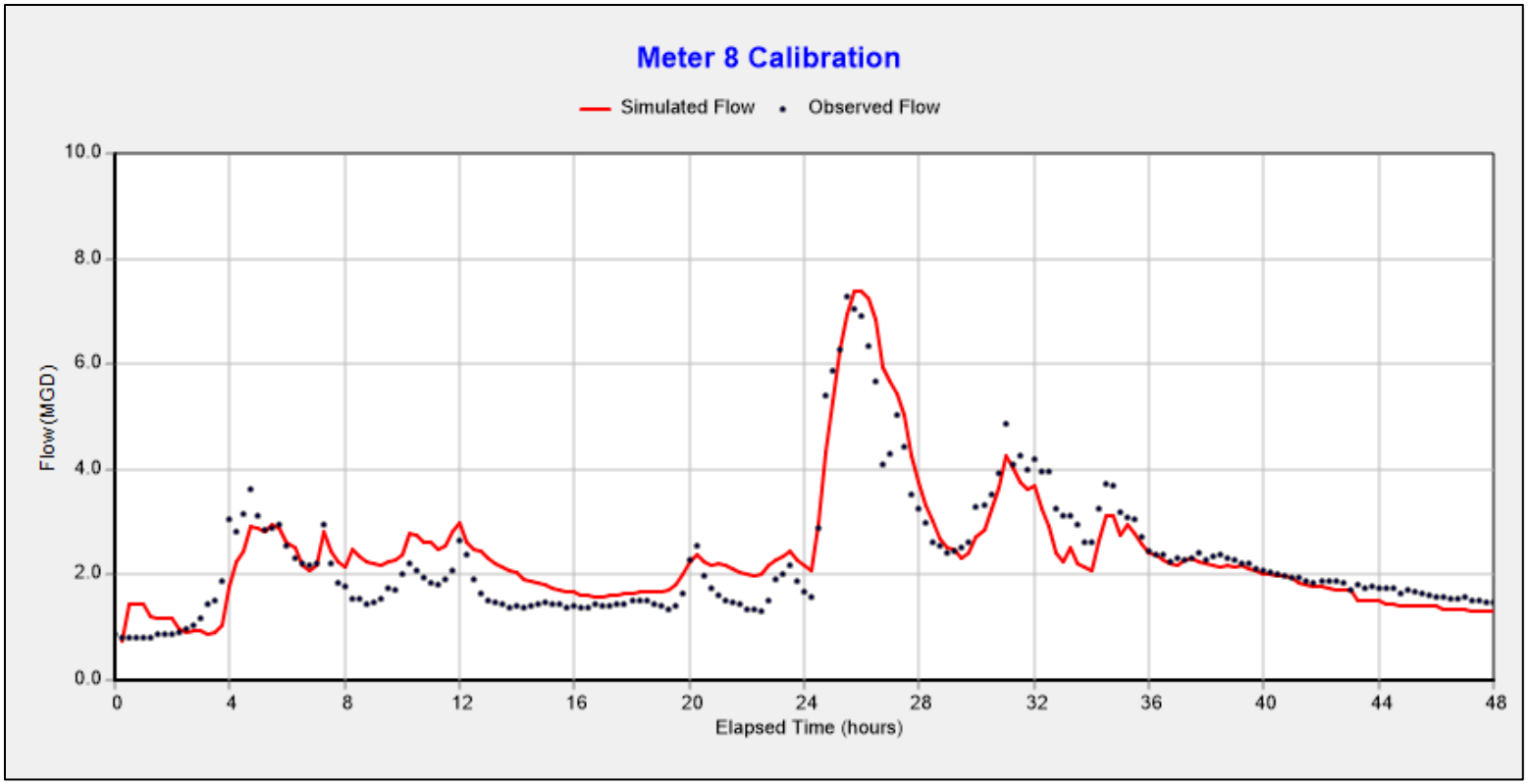

Main Extension/Stetson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

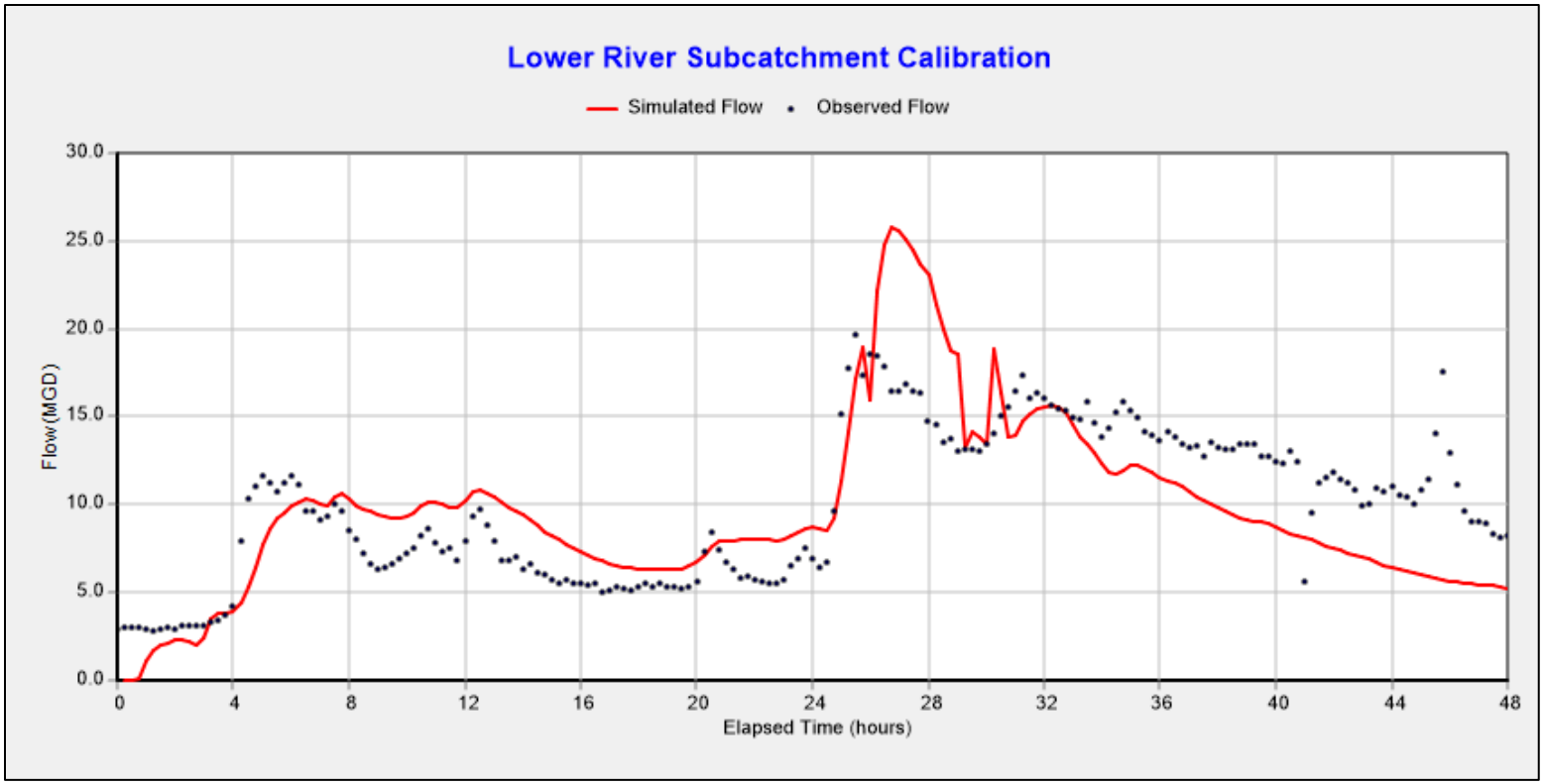

Main Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

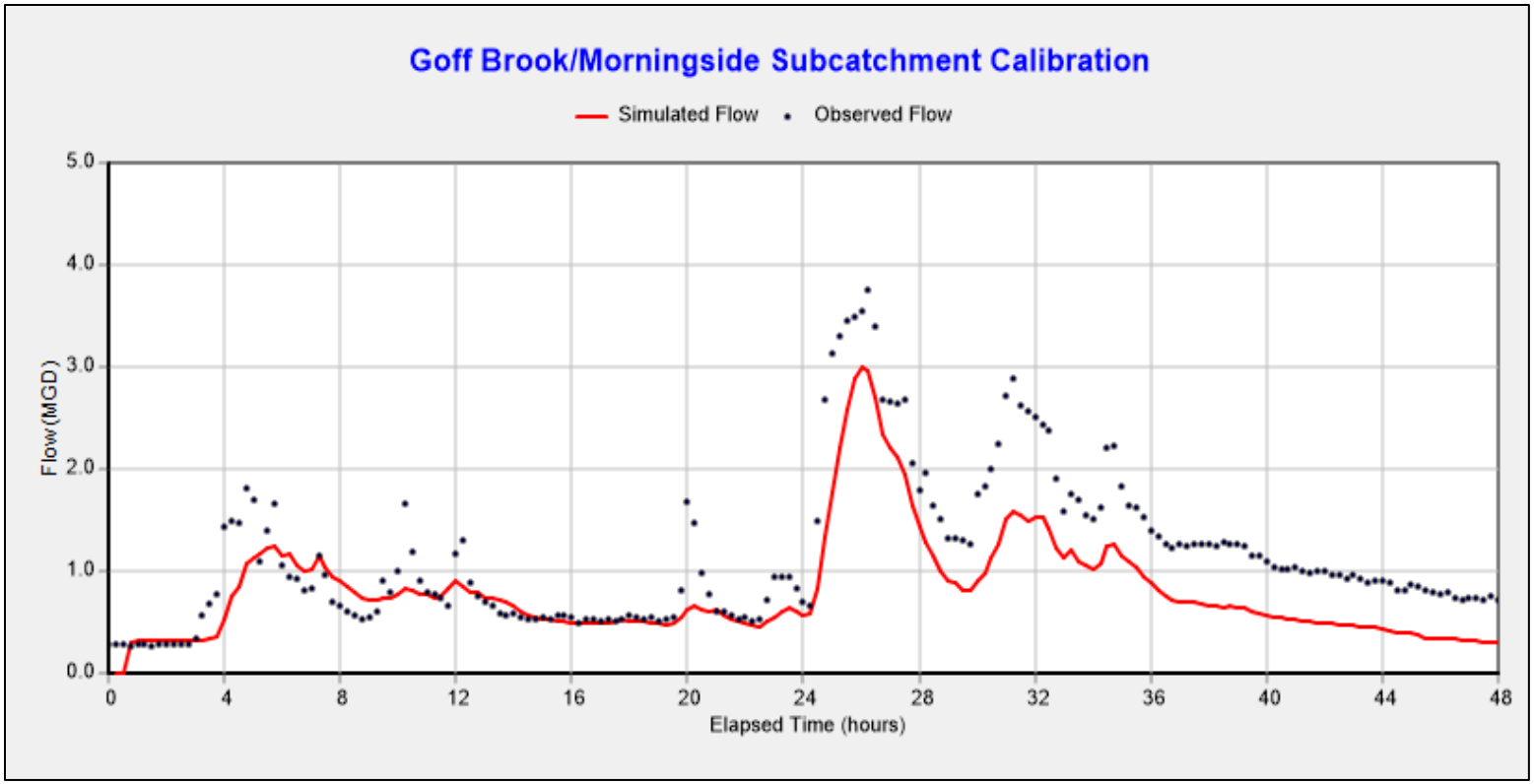

Water Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

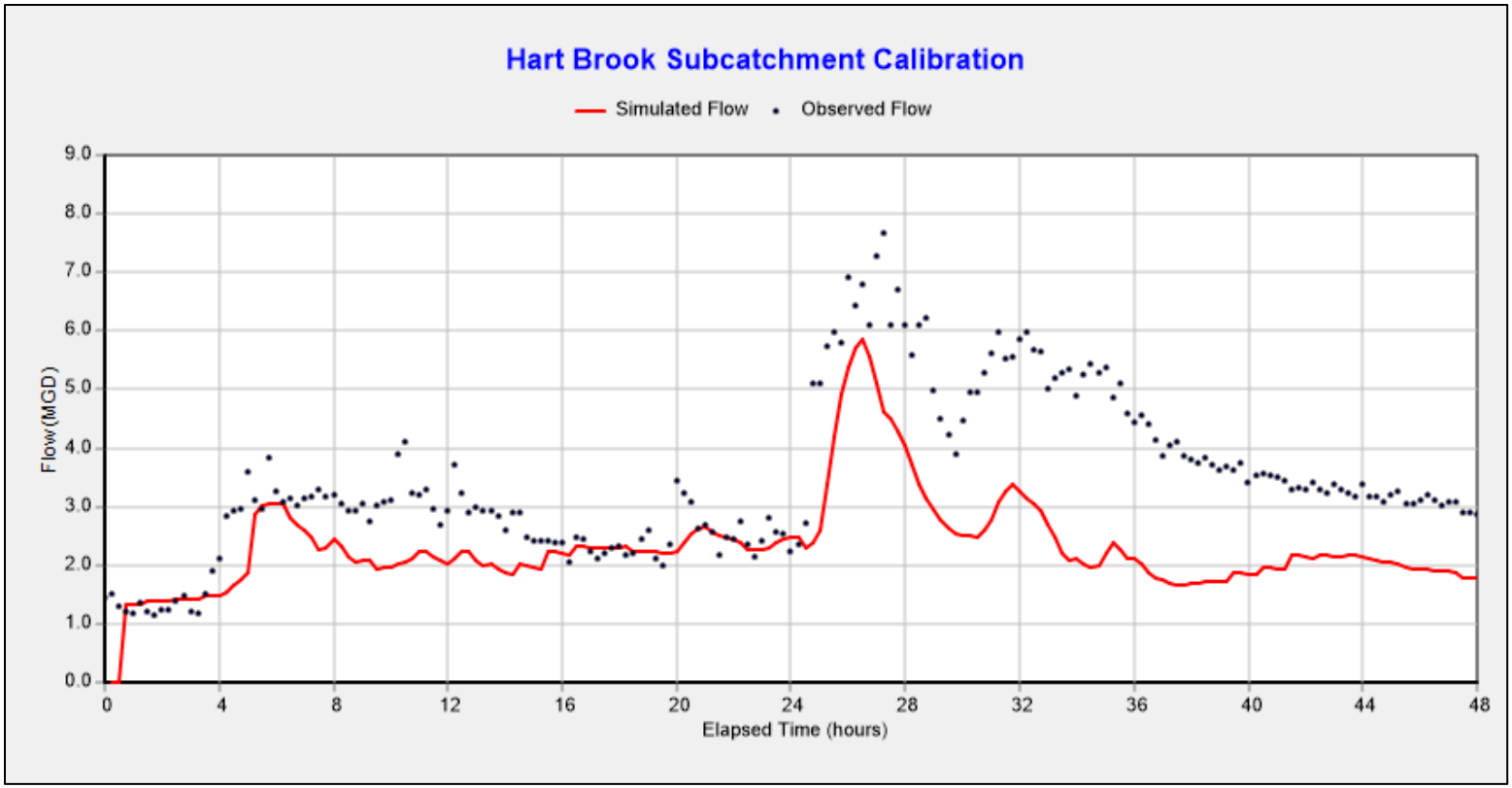

Meter 6 (Main Int.) Calibration
Simulated Flow
Observed Flow
Flow (MGD)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

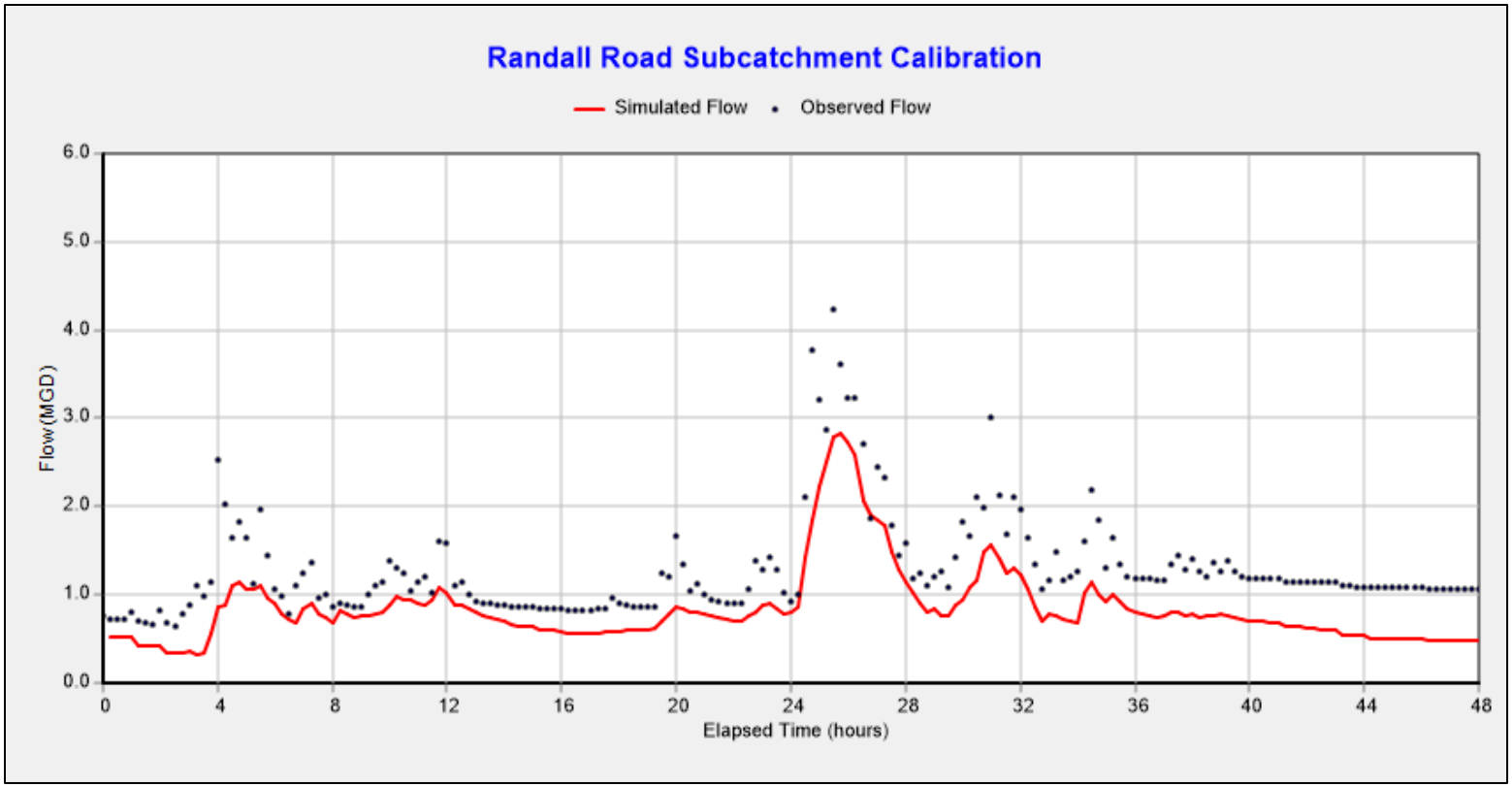

Cedar Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

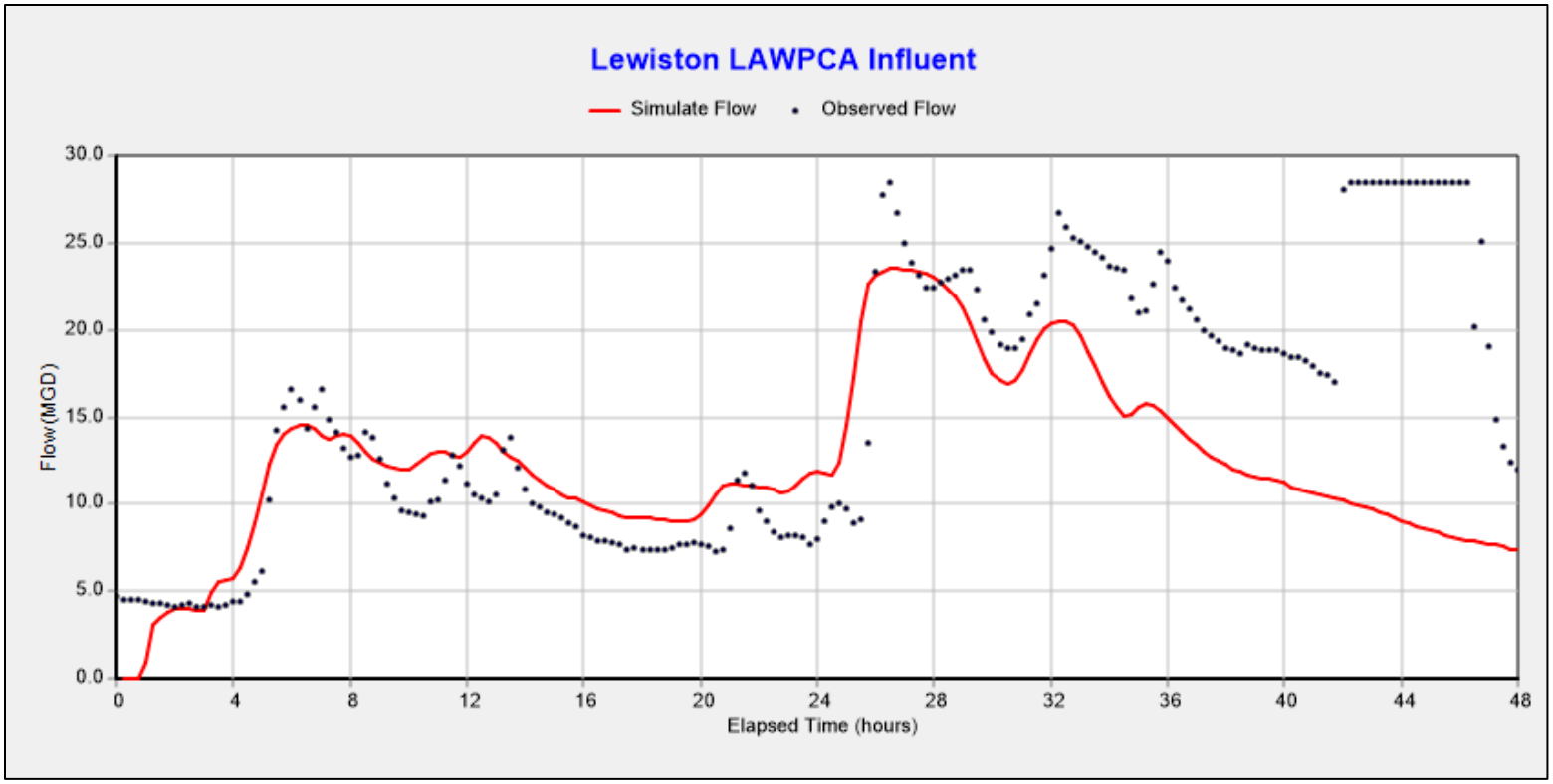

Meter 8 Calibration
Simulated Flow
Observed Flow
10.0
8.0
6.0
4.0
2.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

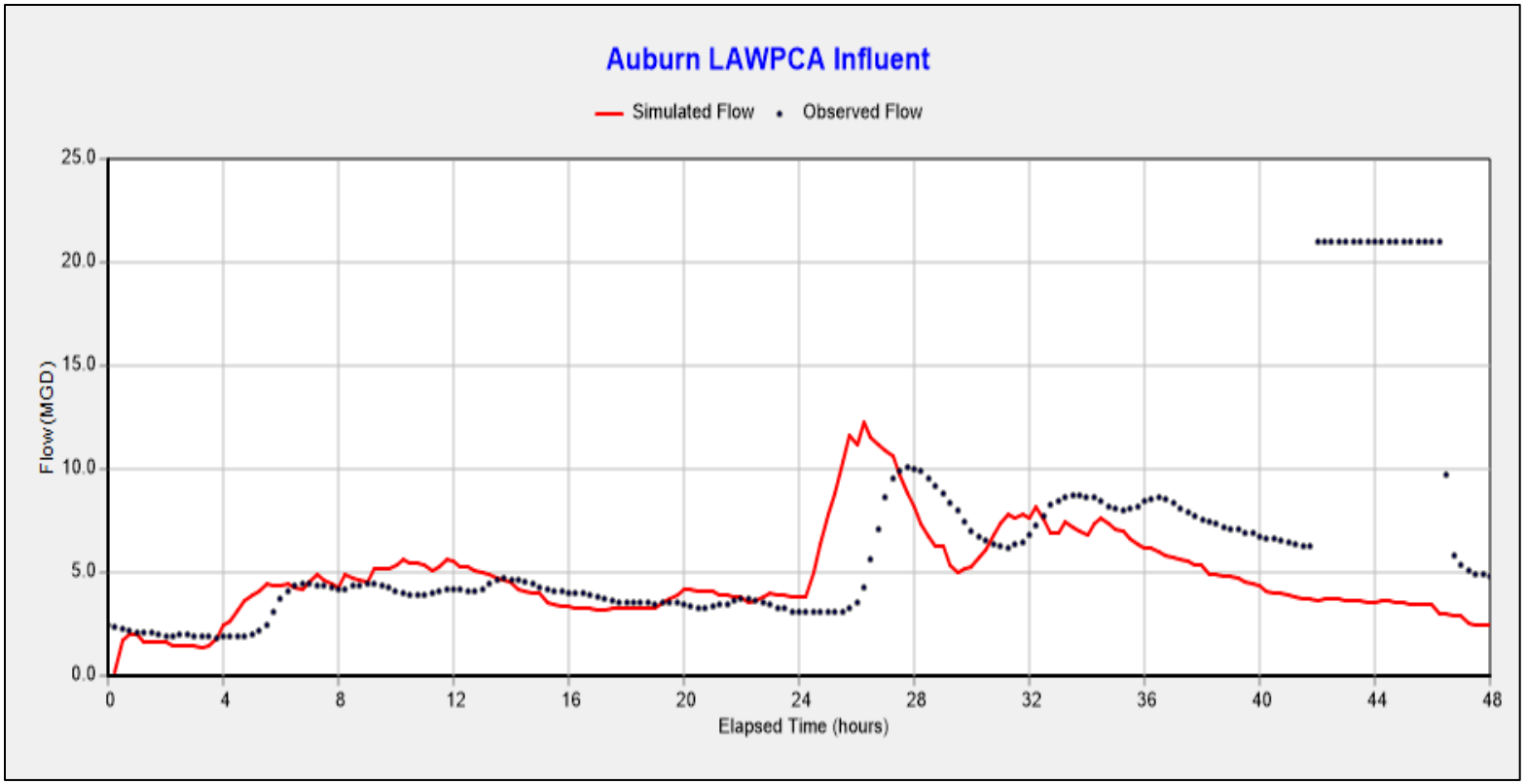

Lower River Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)


Goff Brook/Morningside Subcatchment Calibration
Simulated Flow
Observed Flow
Flow(MGD)
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)


Hart Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

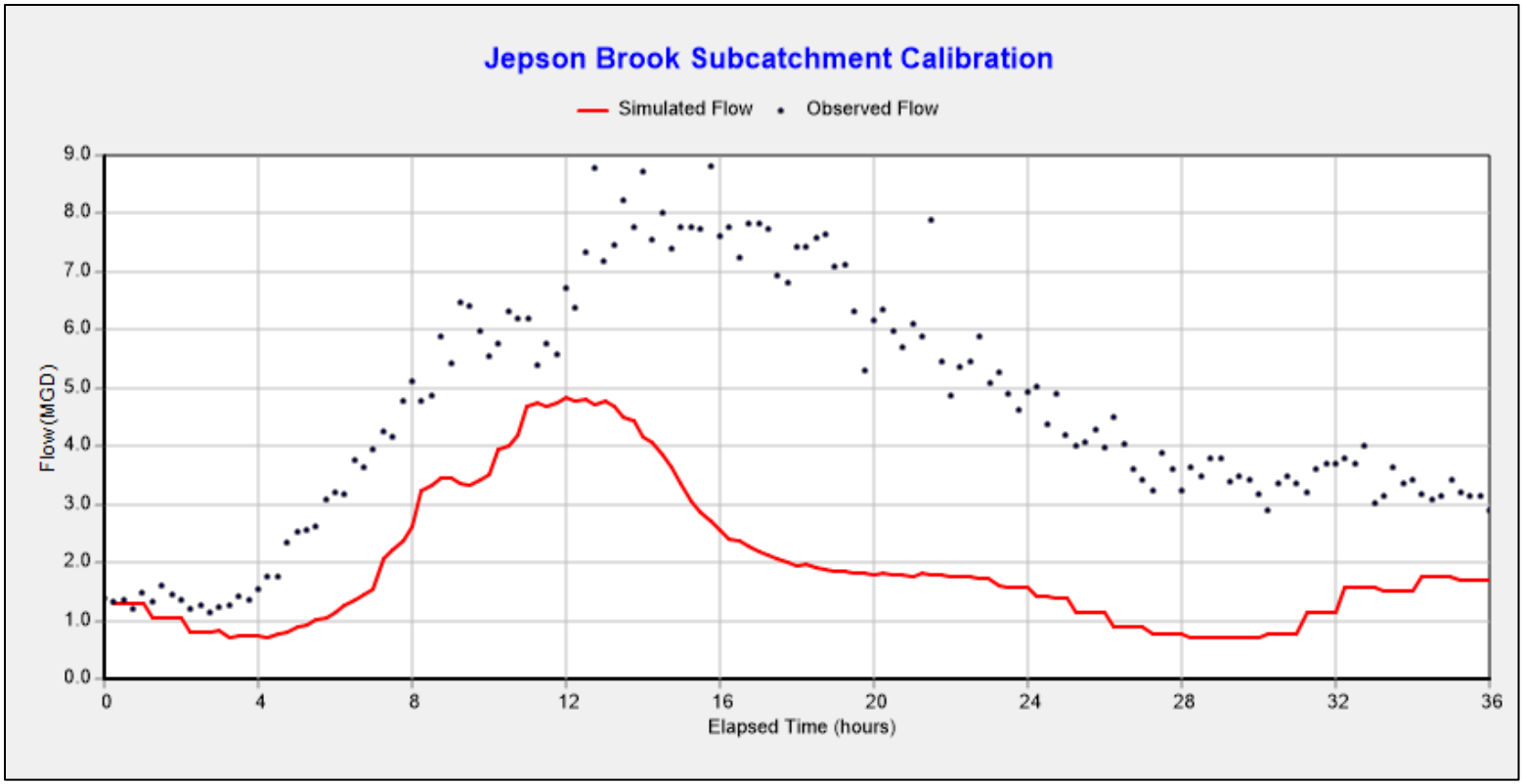

Randall Road Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

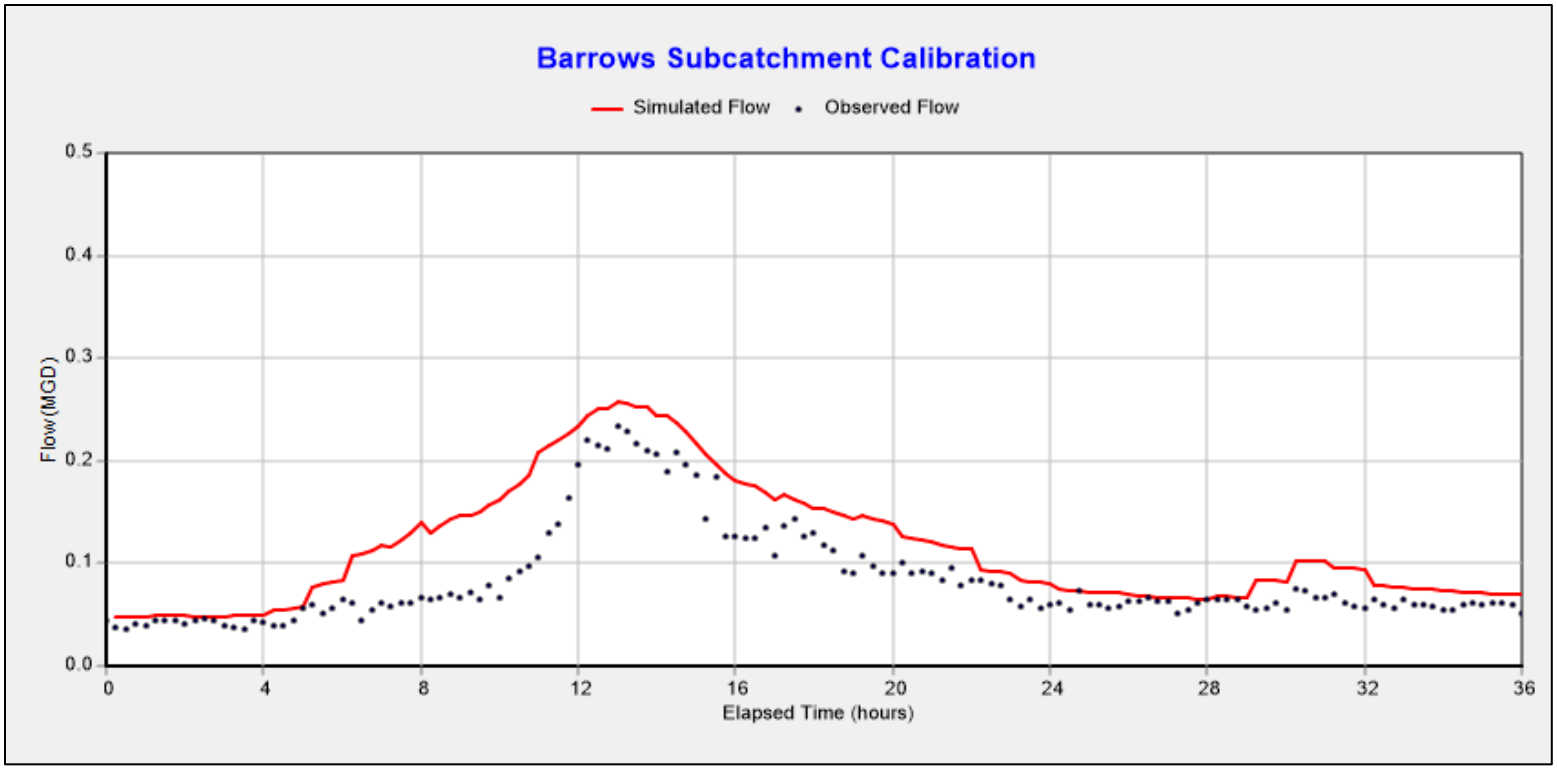

Lewiston LAWPCA Influent
Simulate Flow
Observed Flow
Flow (MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

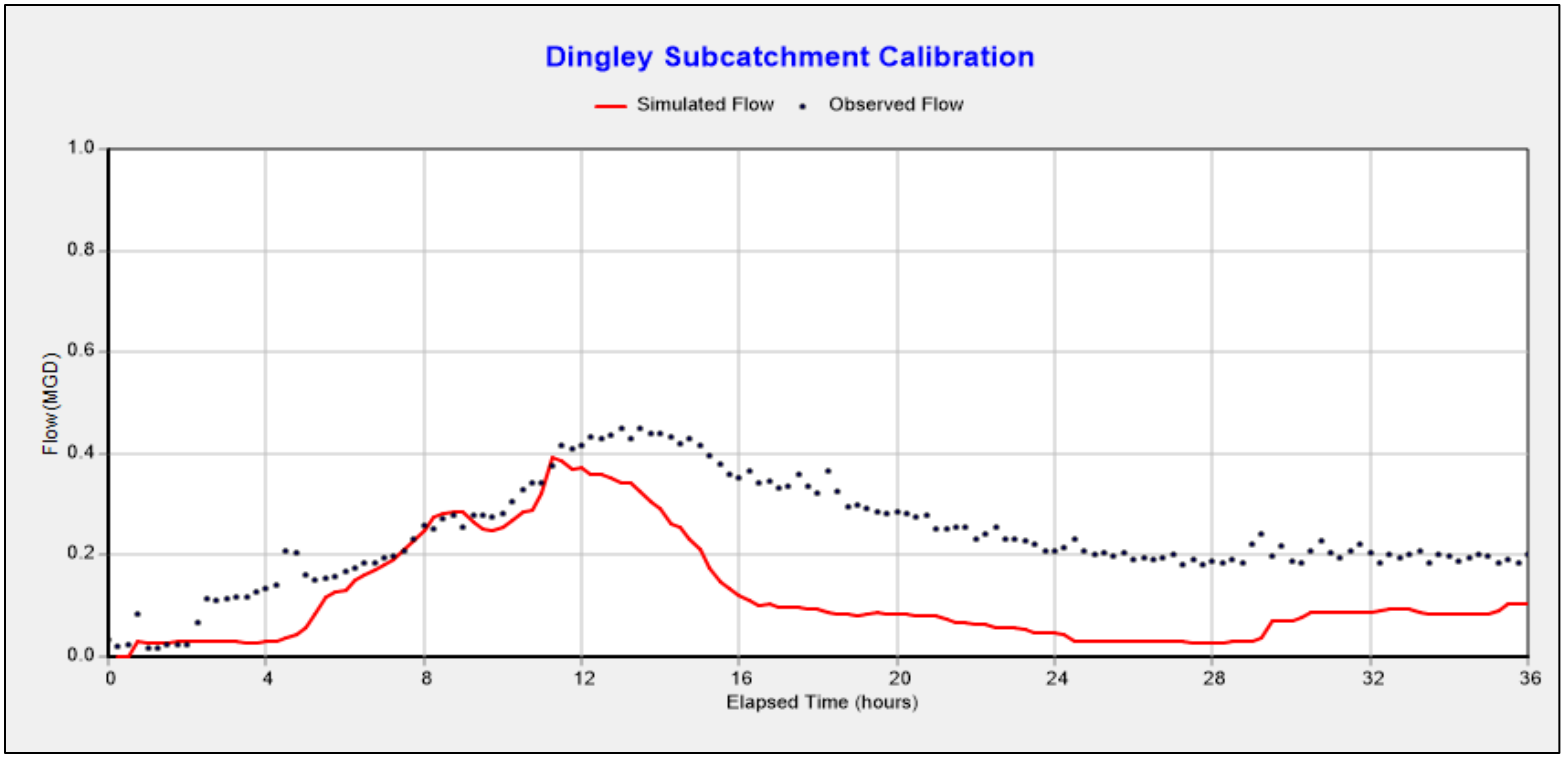

Auburn LAWPCA Influent
Simulated Flow
Observed Flow
Flow (MGD)
25.0
20.0
15.0
10.0
5.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

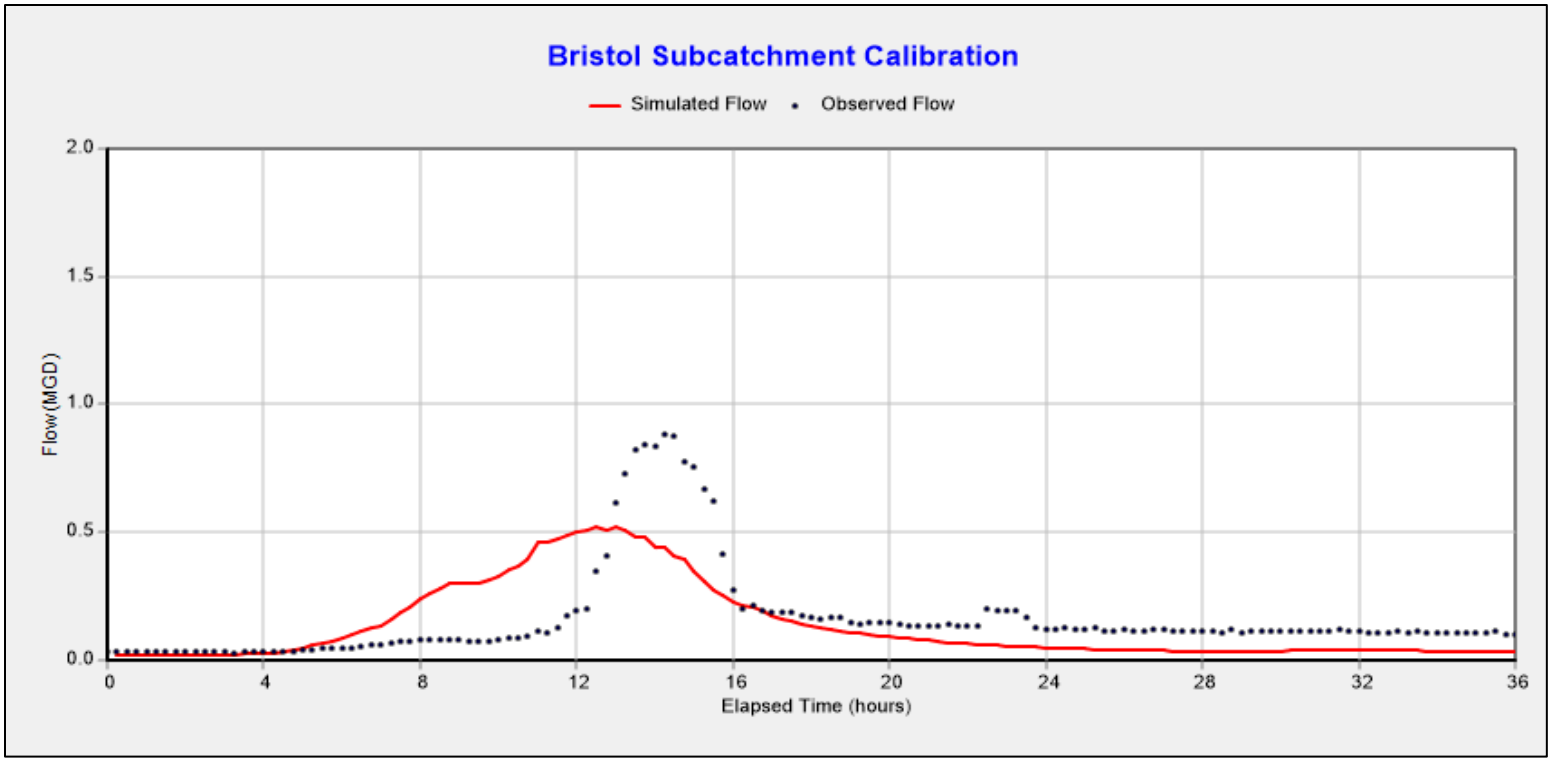
Calibration Storm No. 4

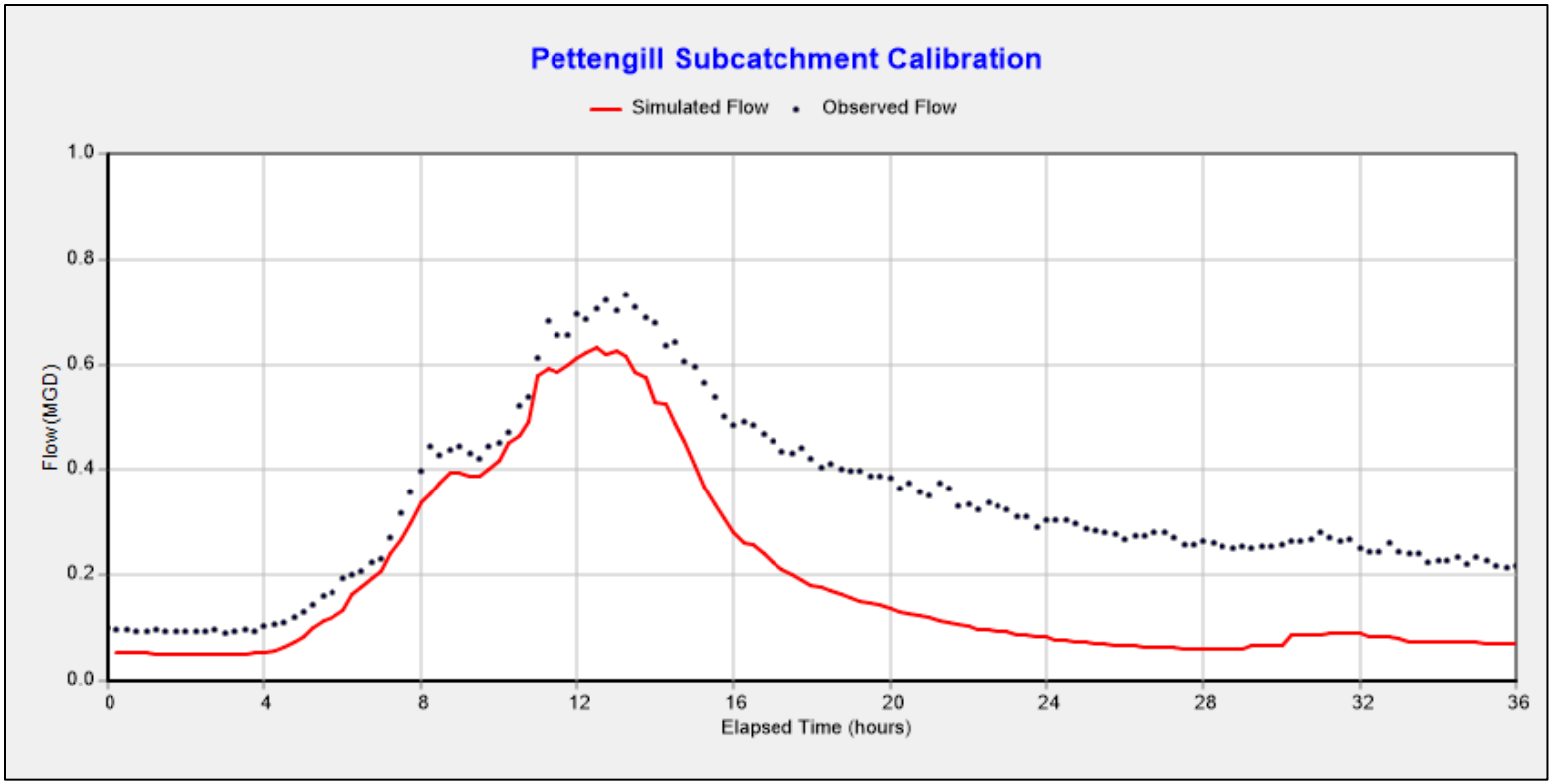
Date:	November 13, 2018
Duration:	12 hours
Total Precipitation:	1.20 inches
Peak Intensity:	0.18 inches/hour
Recurrence Interval:	< 3-month

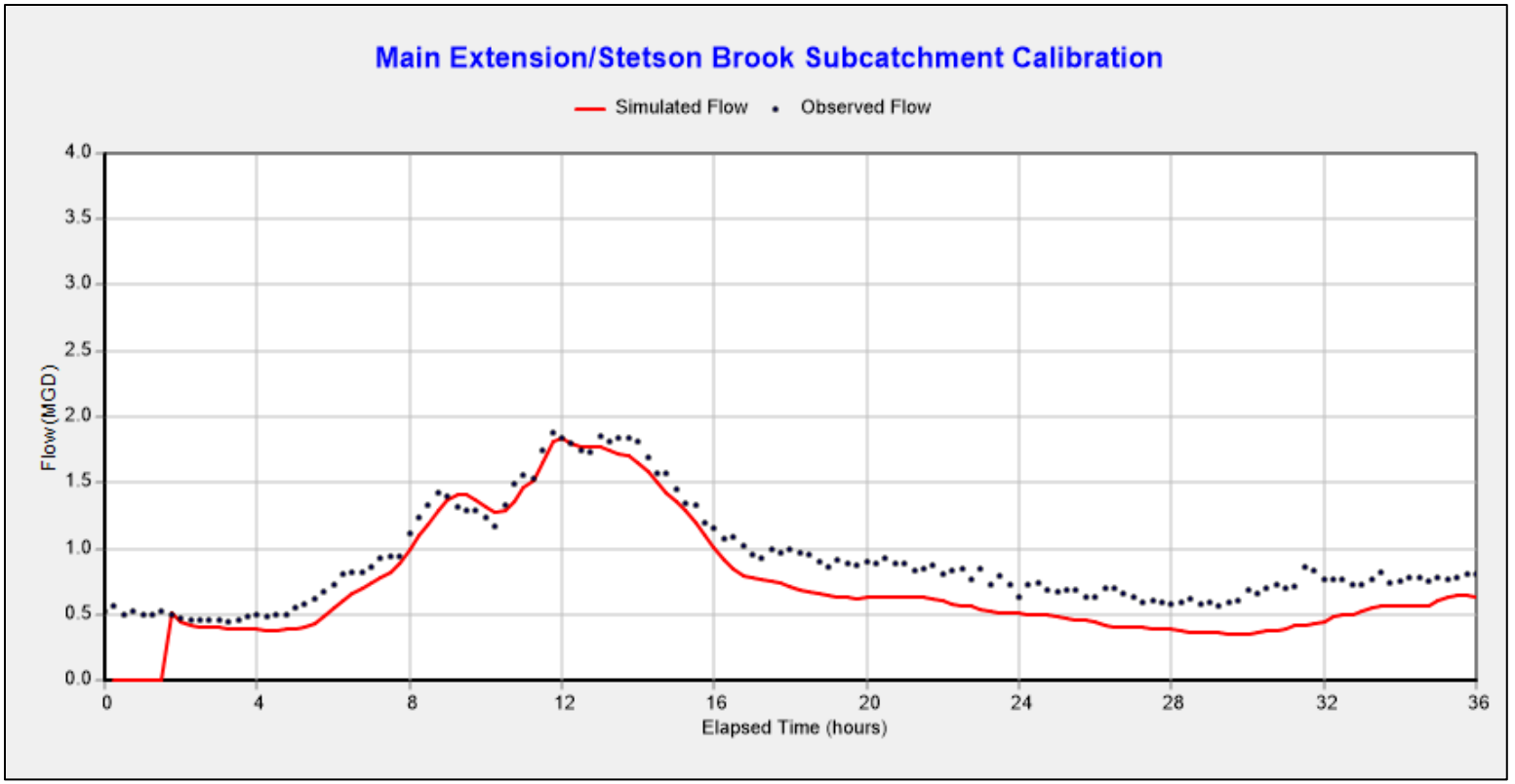

Jepson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

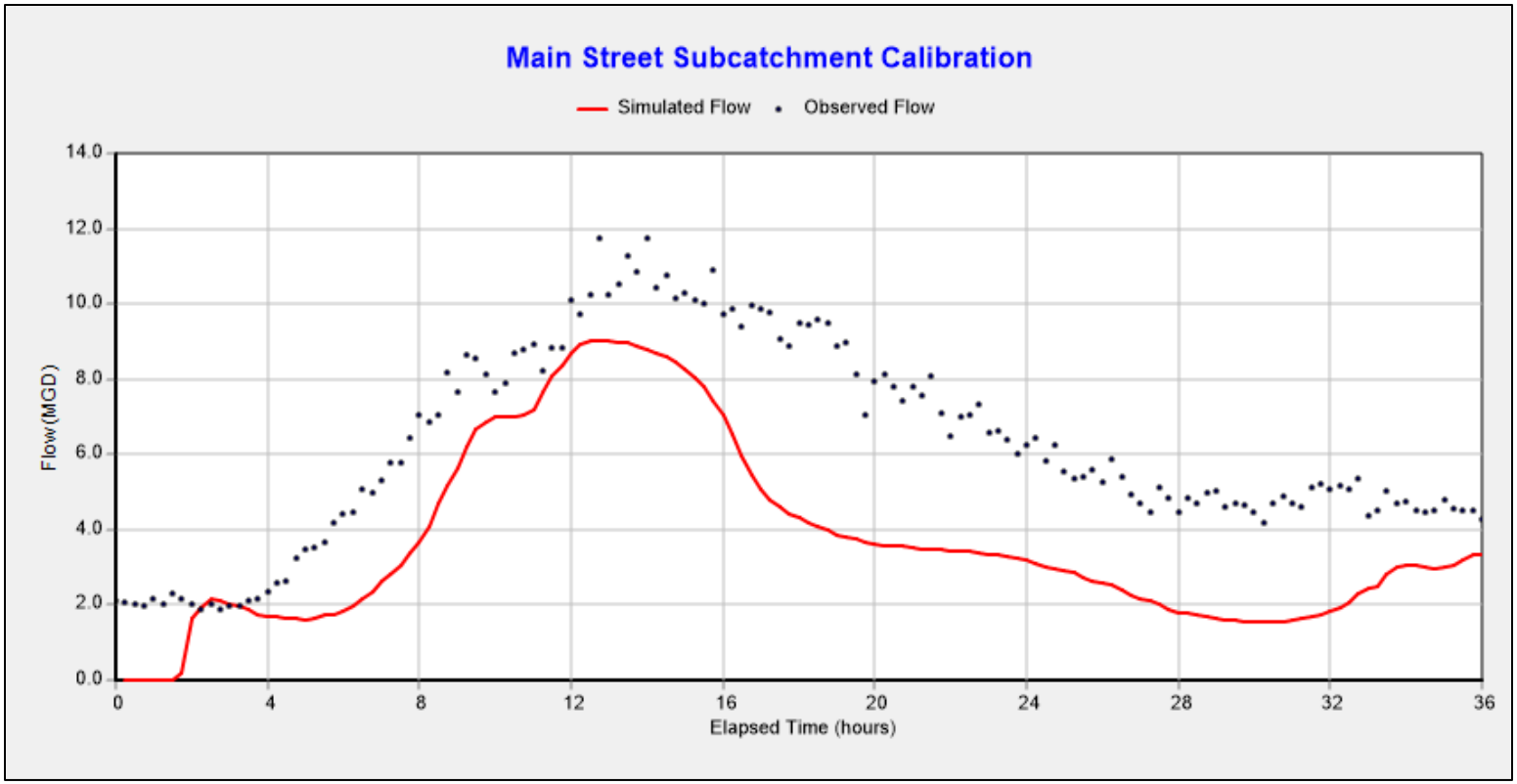

Barrows Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

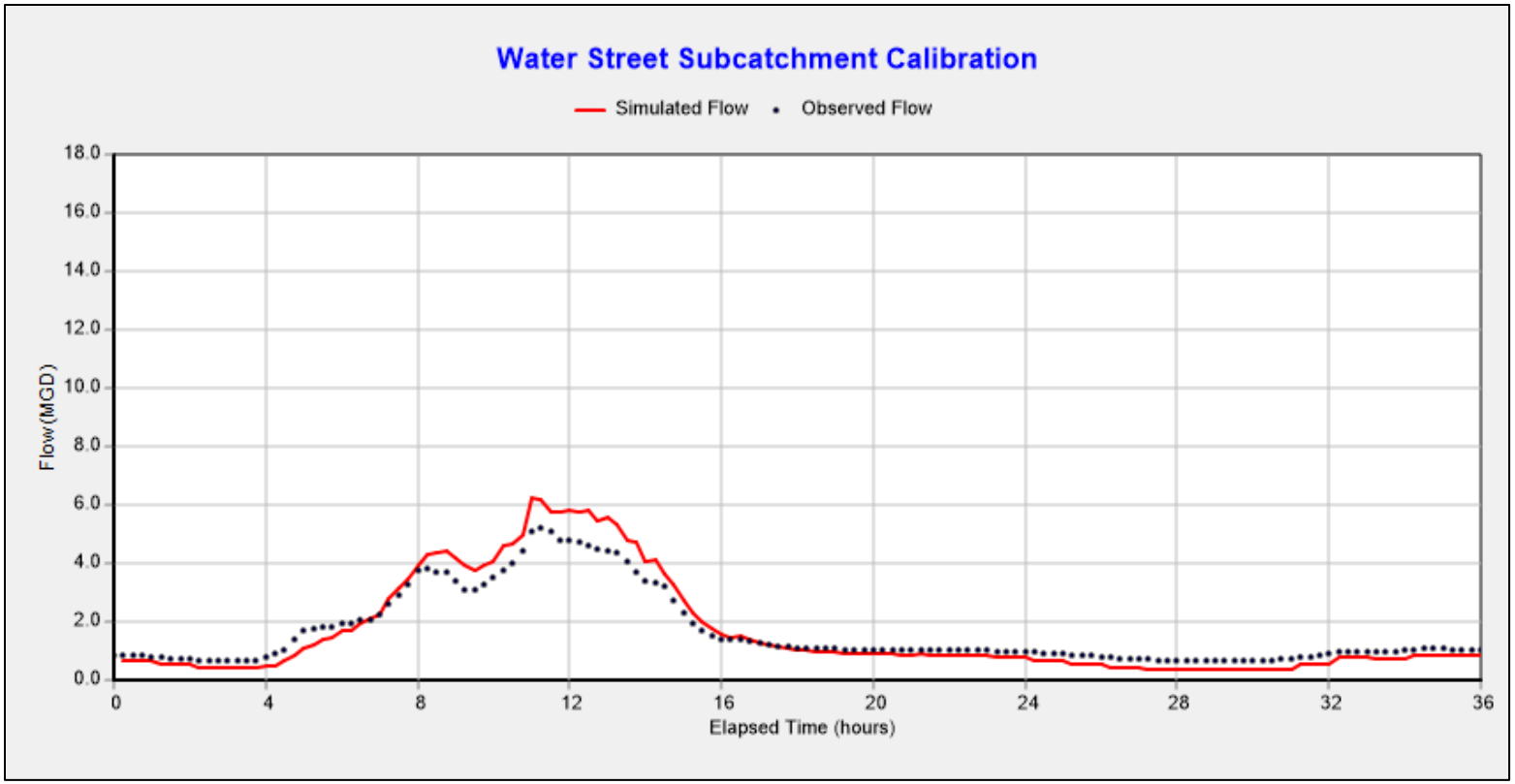

Dingley Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

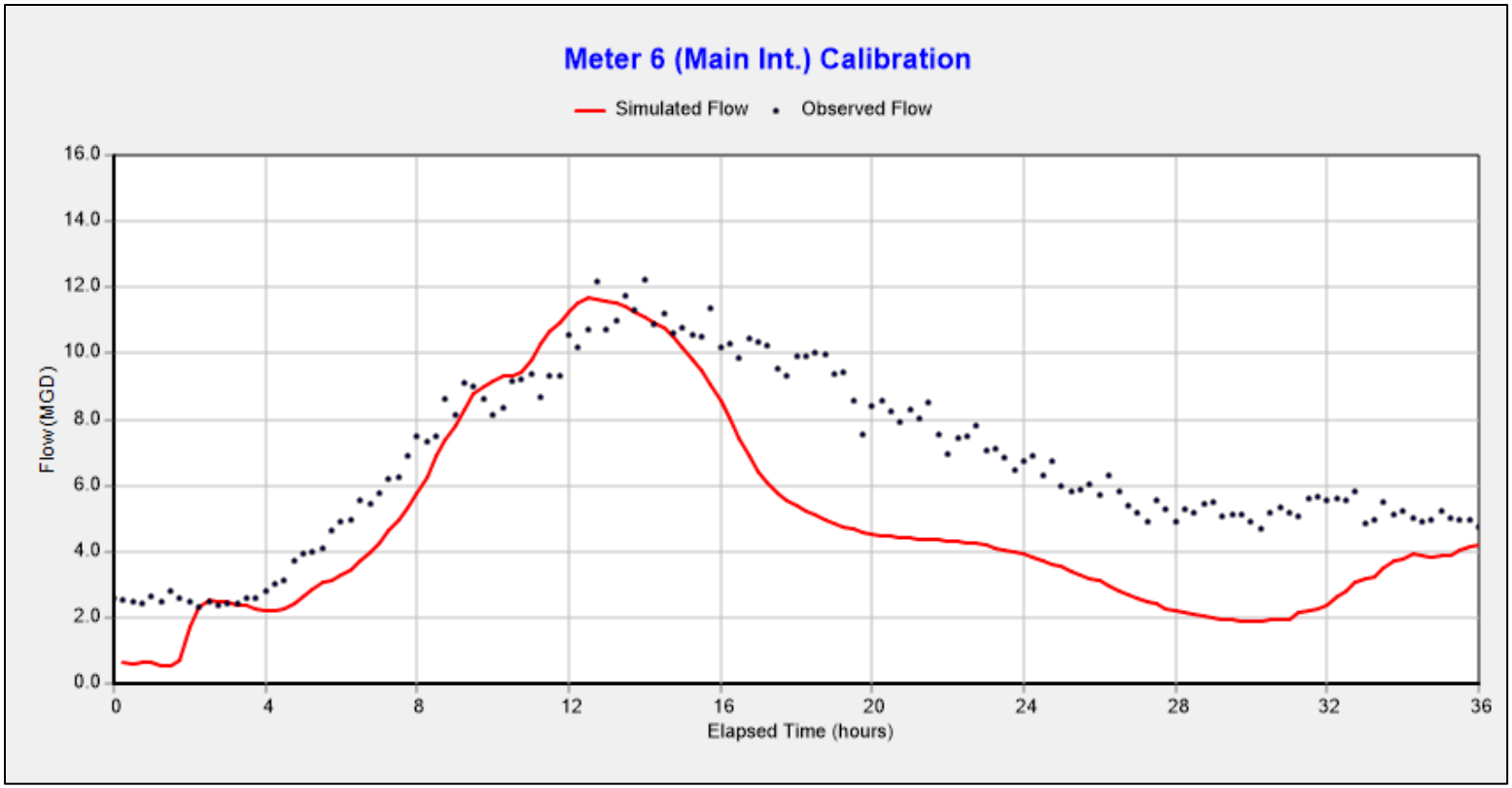

Bristol Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

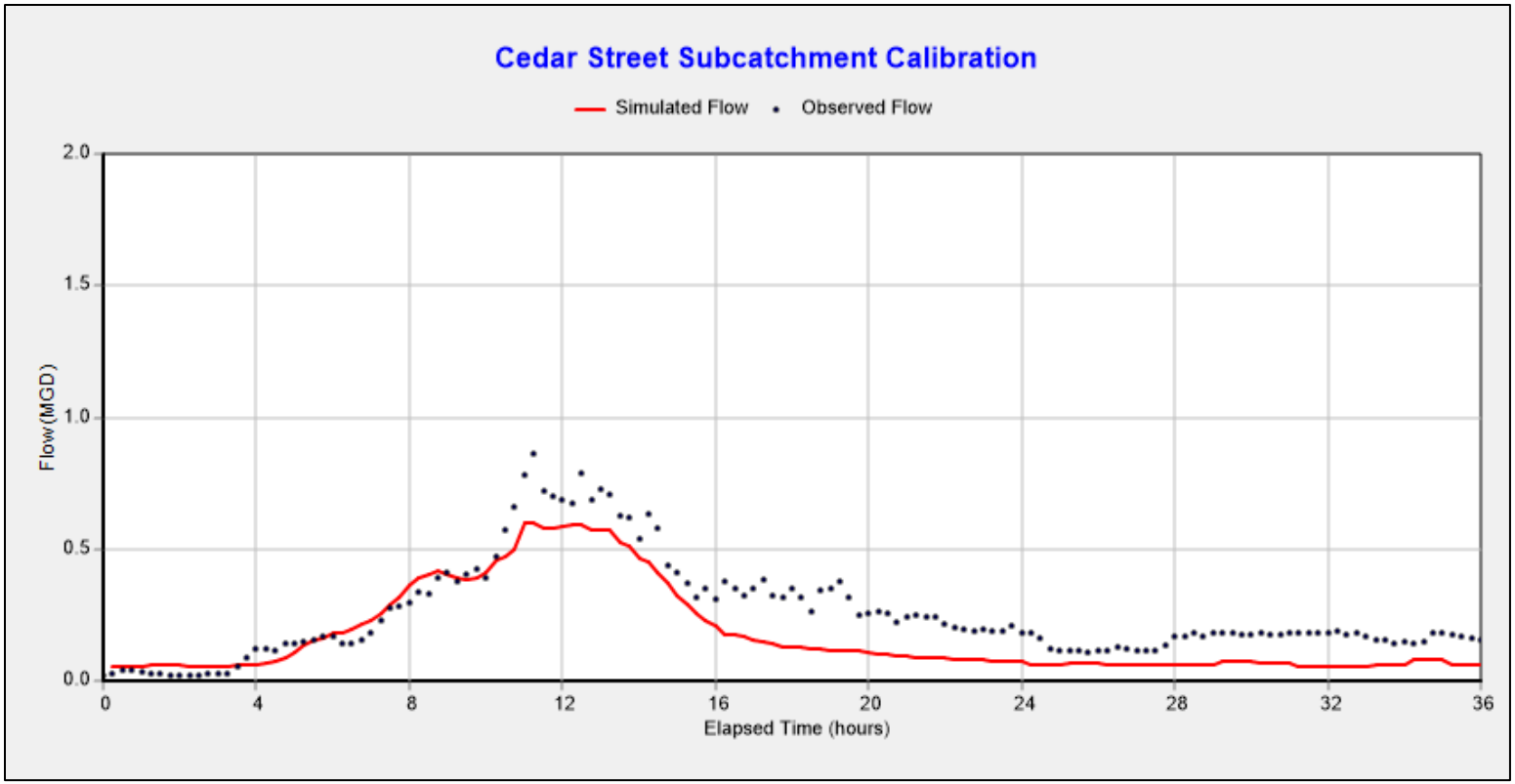

Pettengill Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

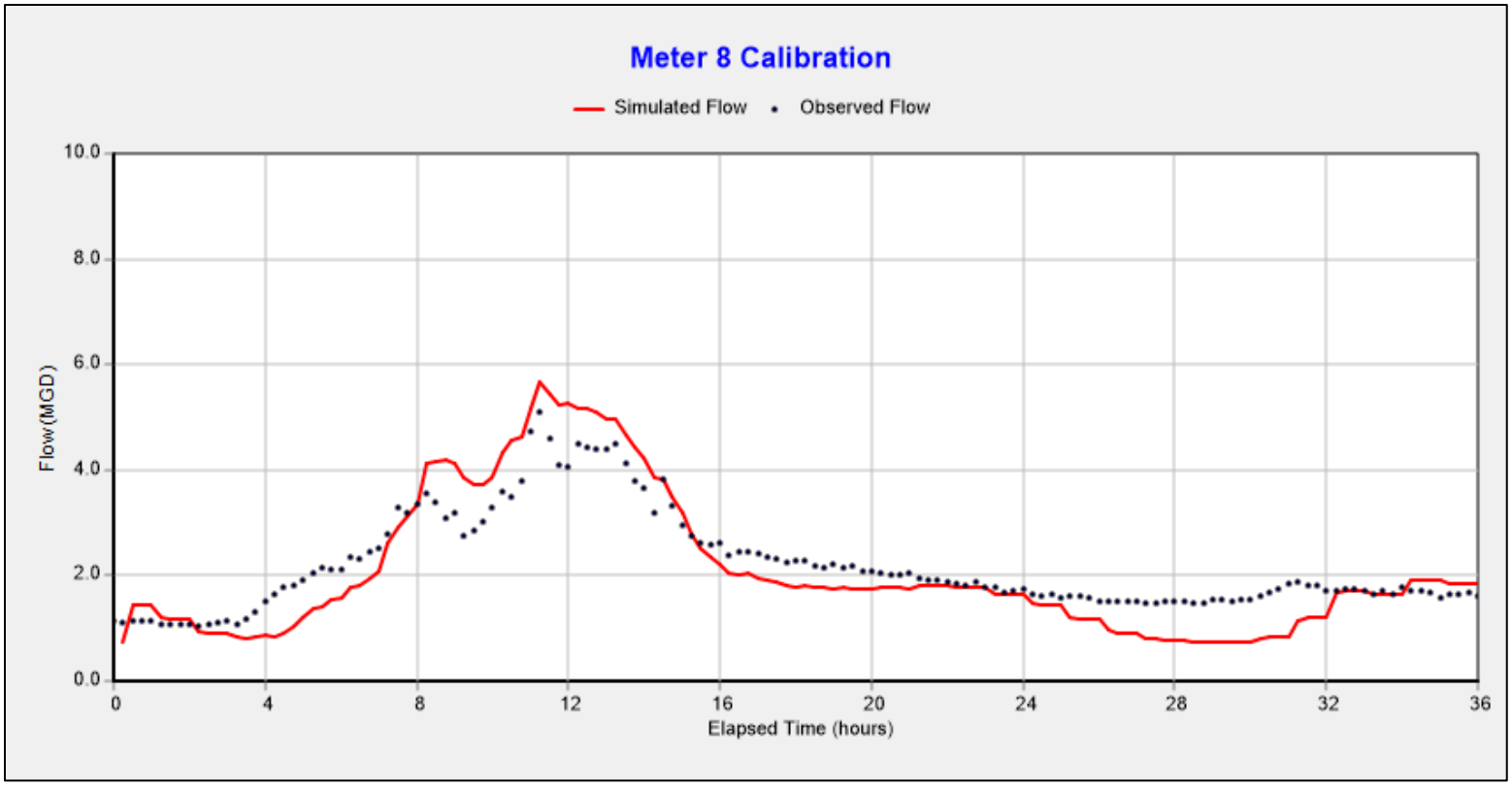

Main Extension/Stetson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

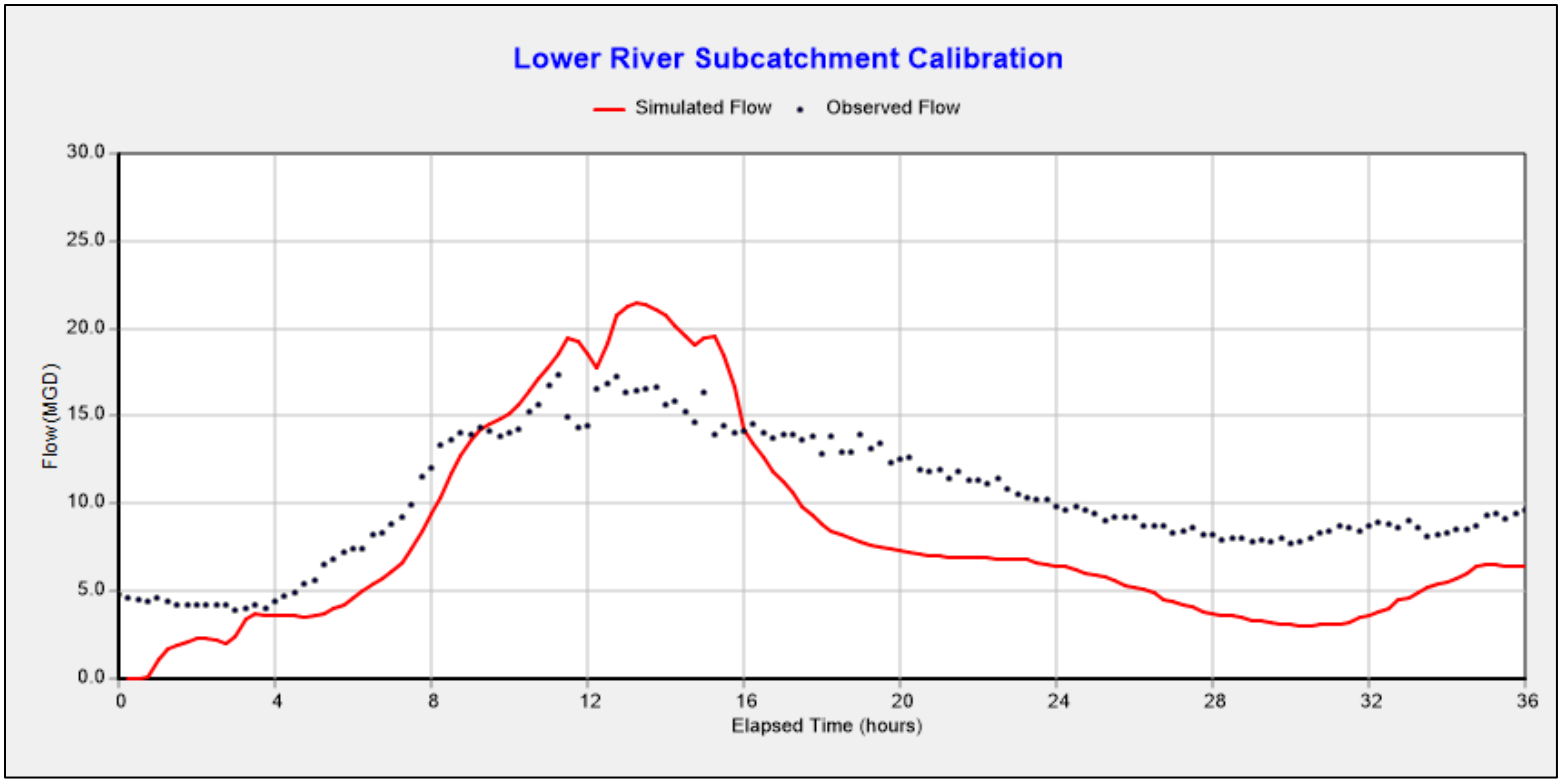

Main Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

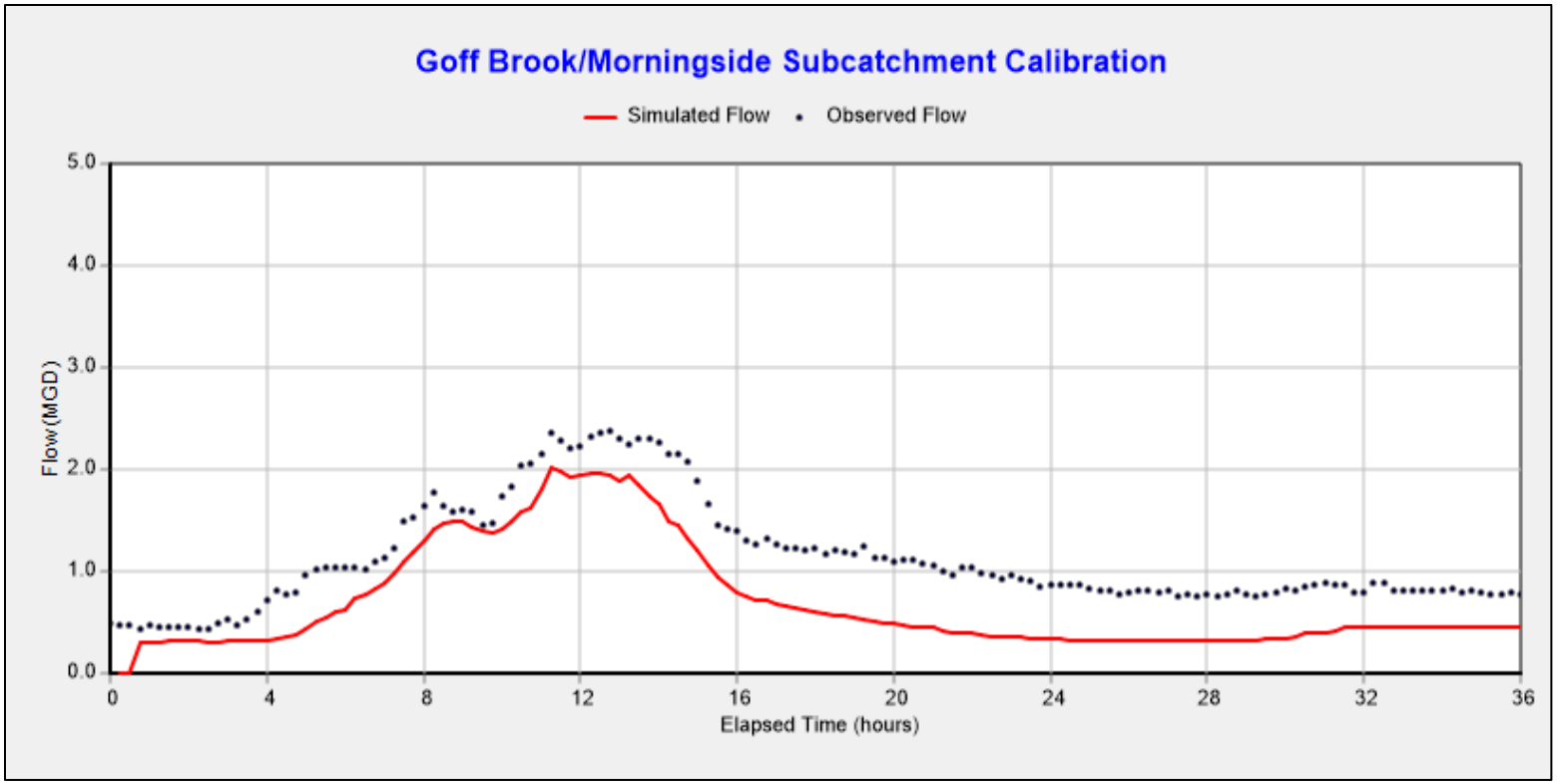

Water Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

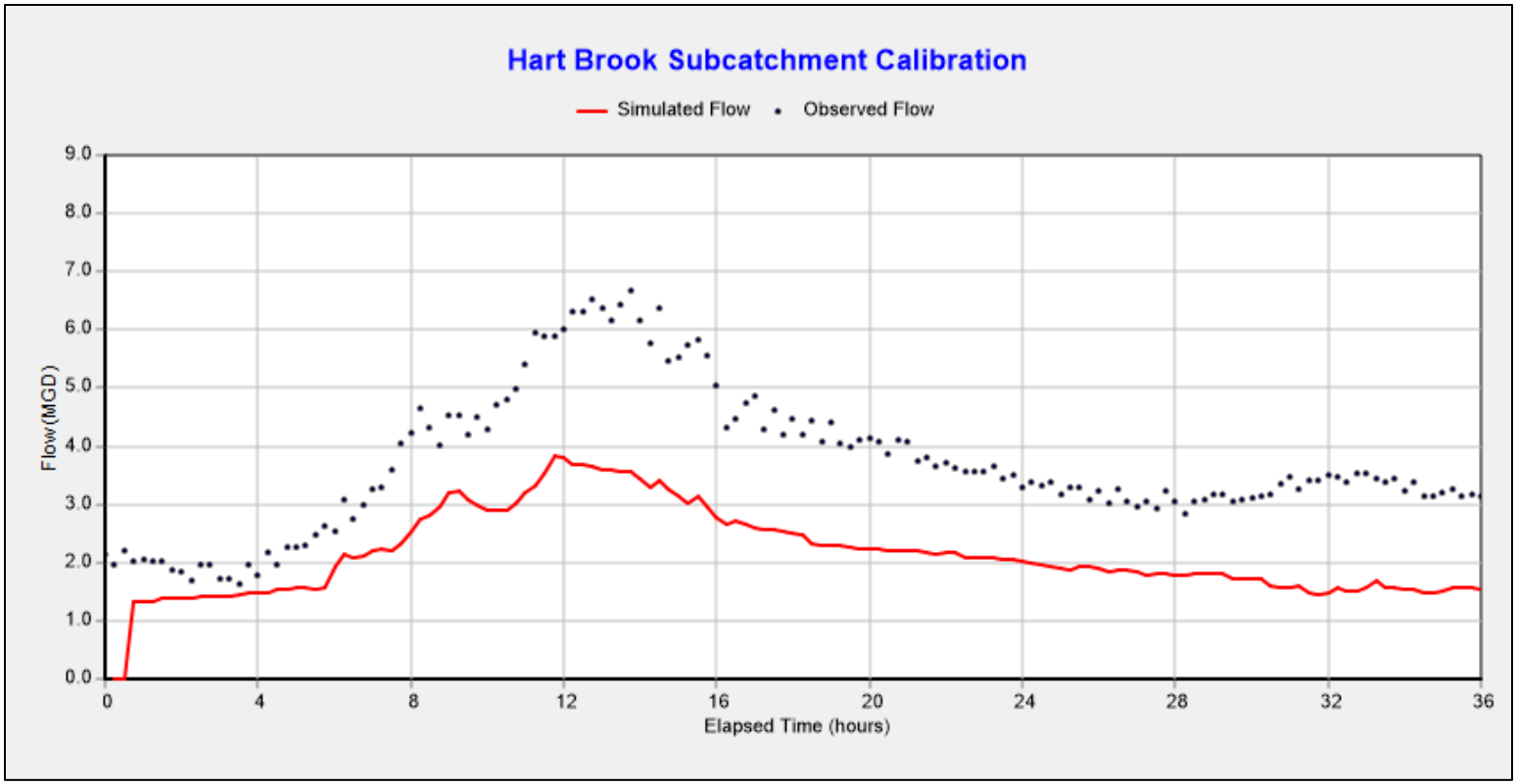

Meter 6 (Main Int.) Calibration
Simulated Flow
Observed Flow
Flow (MGD)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

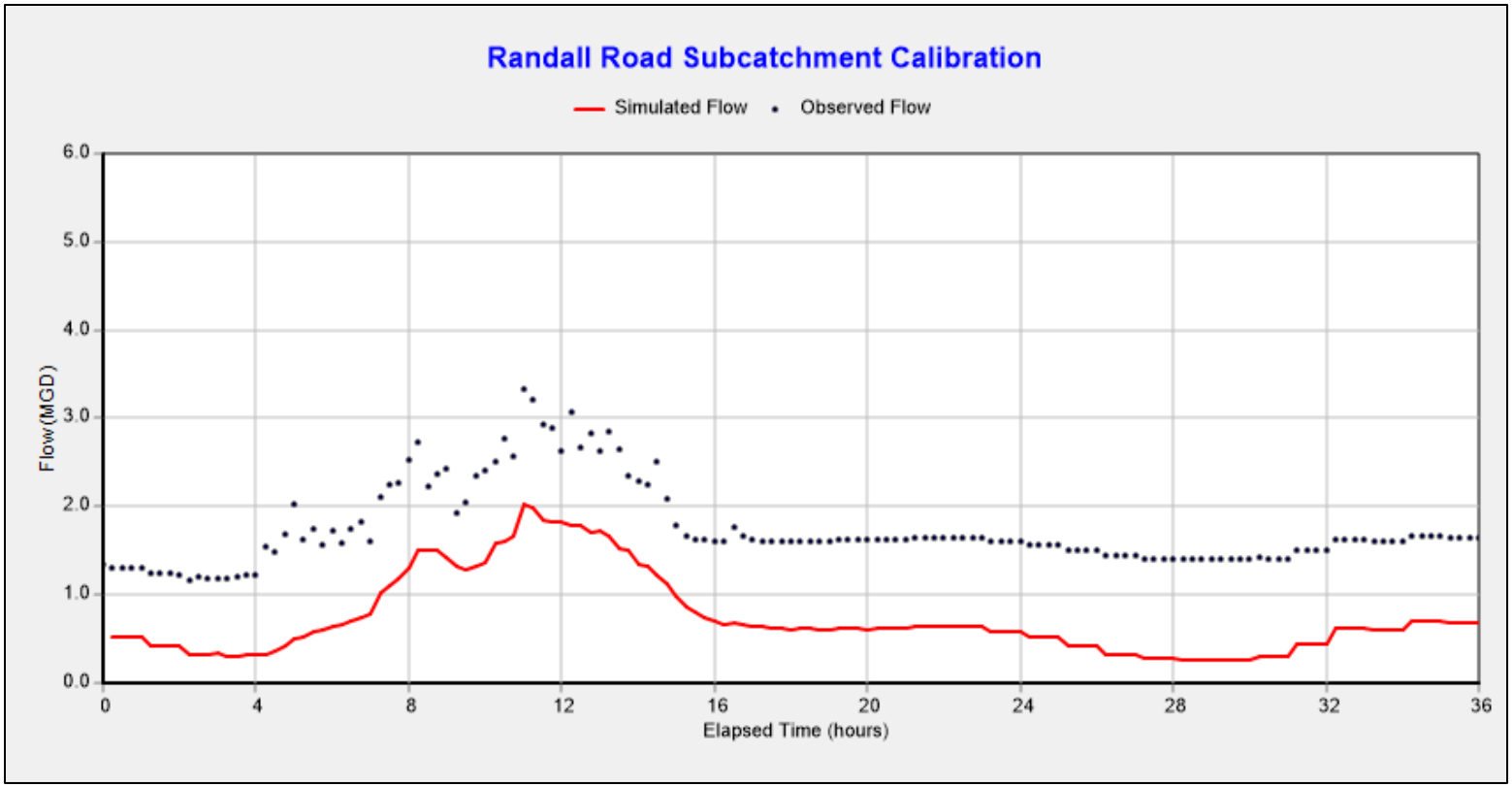

Cedar Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

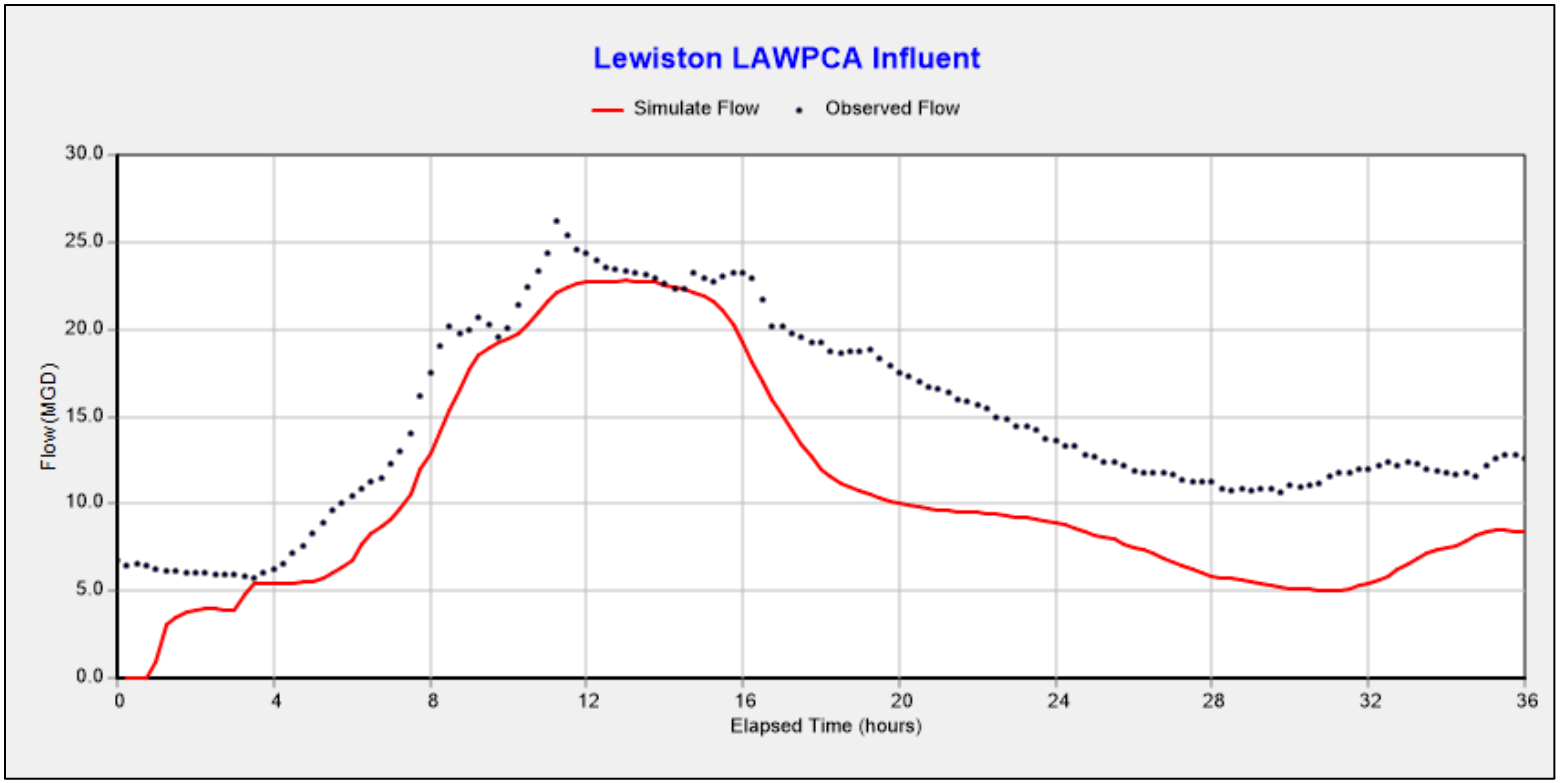

Meter 8 Calibration
Simulated Flow
Observed Flow
10.0
8.0
6.0
4.0
2.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

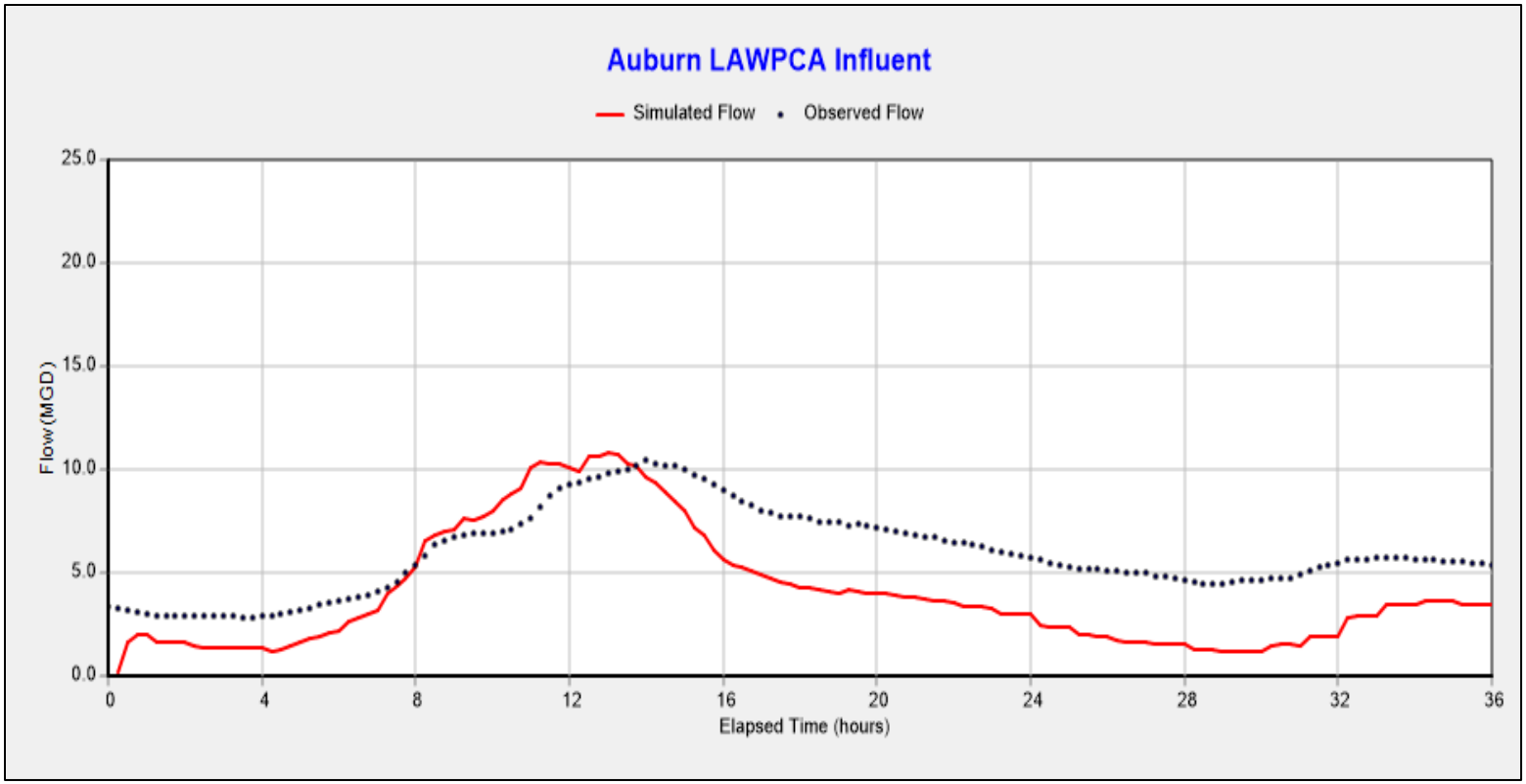

Lower River Subcatchment Calibration
Simulated Flow
Observed Flow
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)


Goff Brook/Morningside Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)


Hart Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

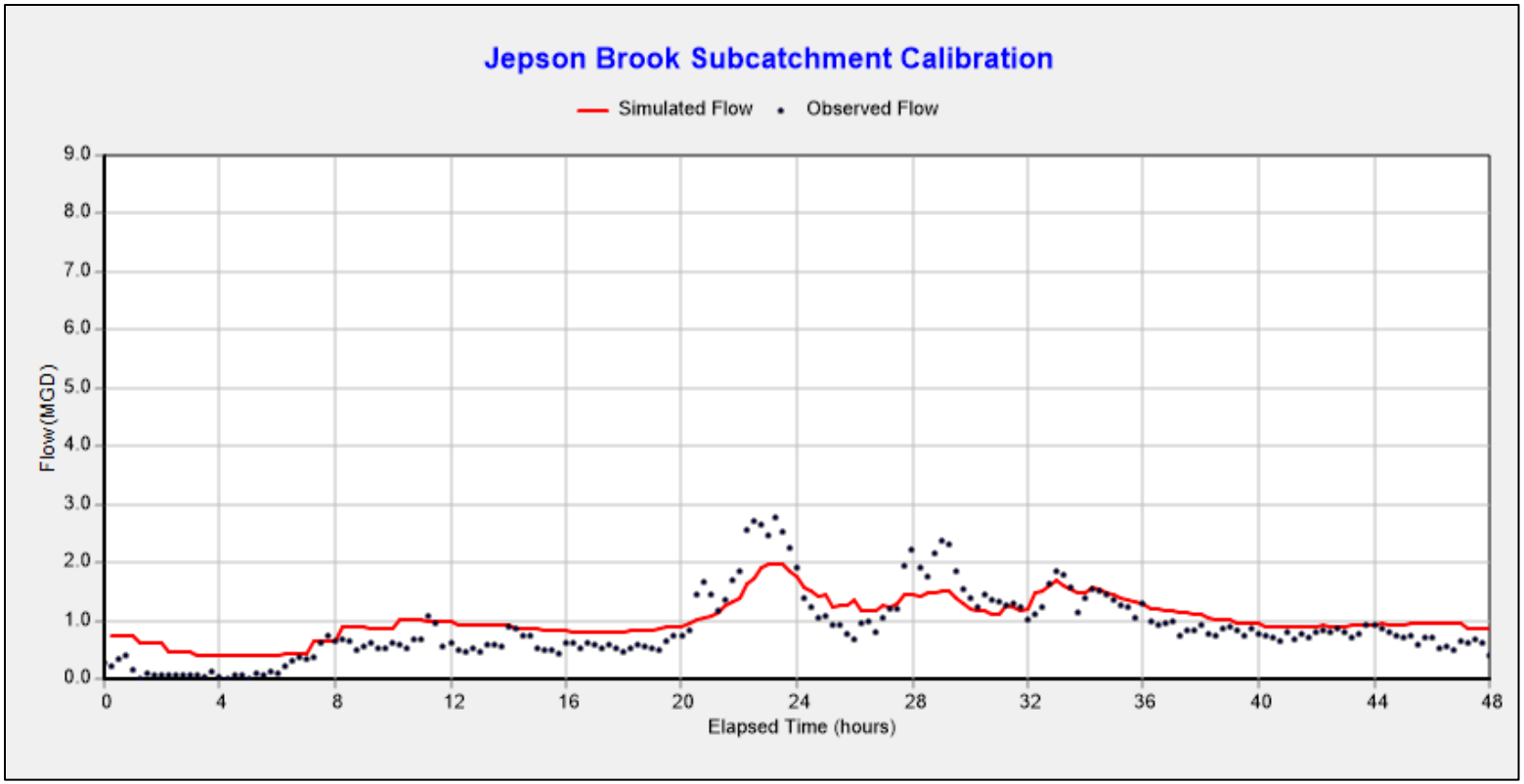

Randall Road Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

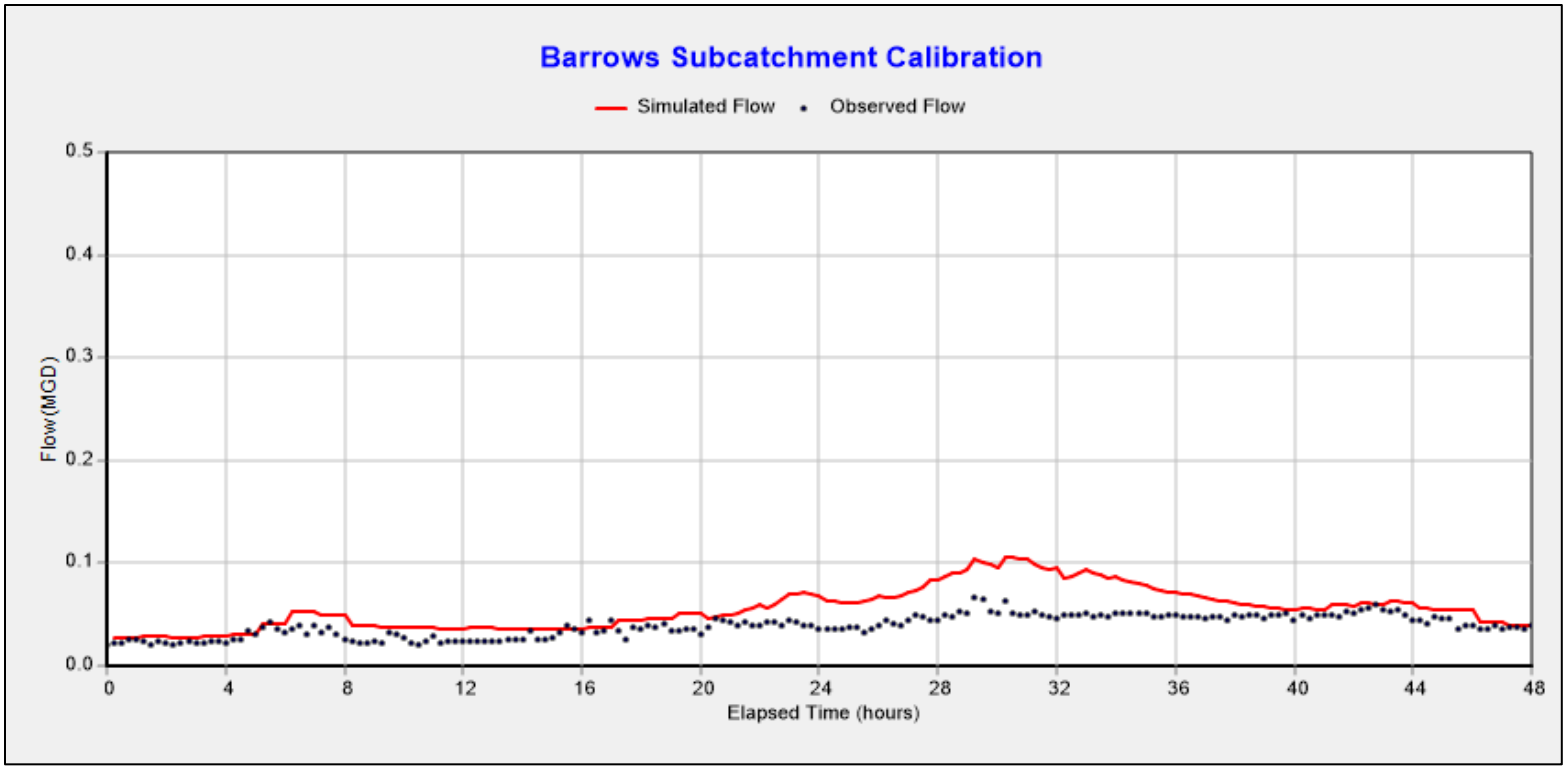

Lewiston LAWPCA Influent
Simulate Flow
Observed Flow
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

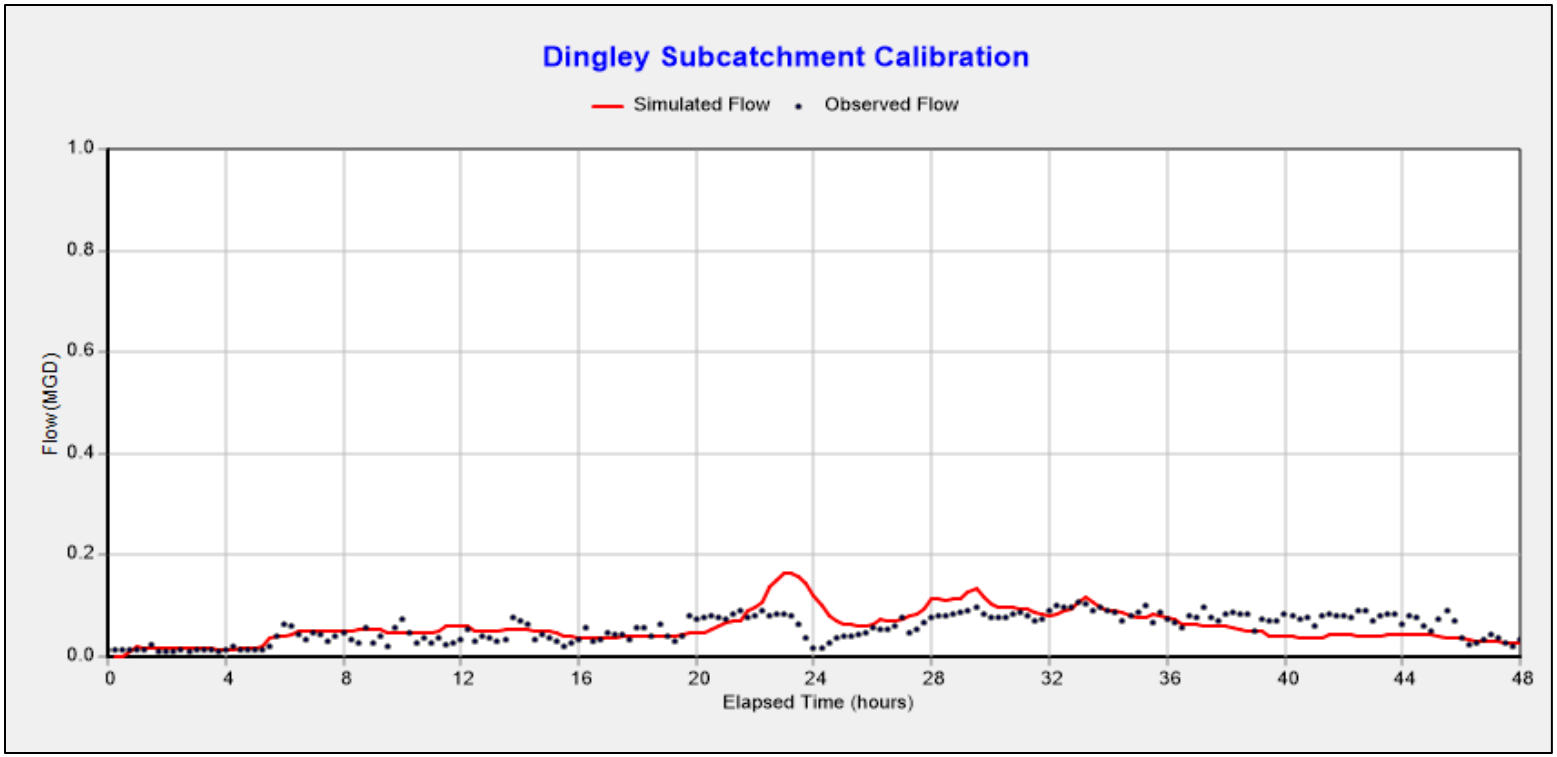

Auburn LAWPCA Influent
Simulated Flow
Observed Flow
Flow (MGD)
25.0
20.0
15.0
10.0
5.0
0.0
0
4
8
12
16
20
24
28
32
36
Elapsed Time (hours)

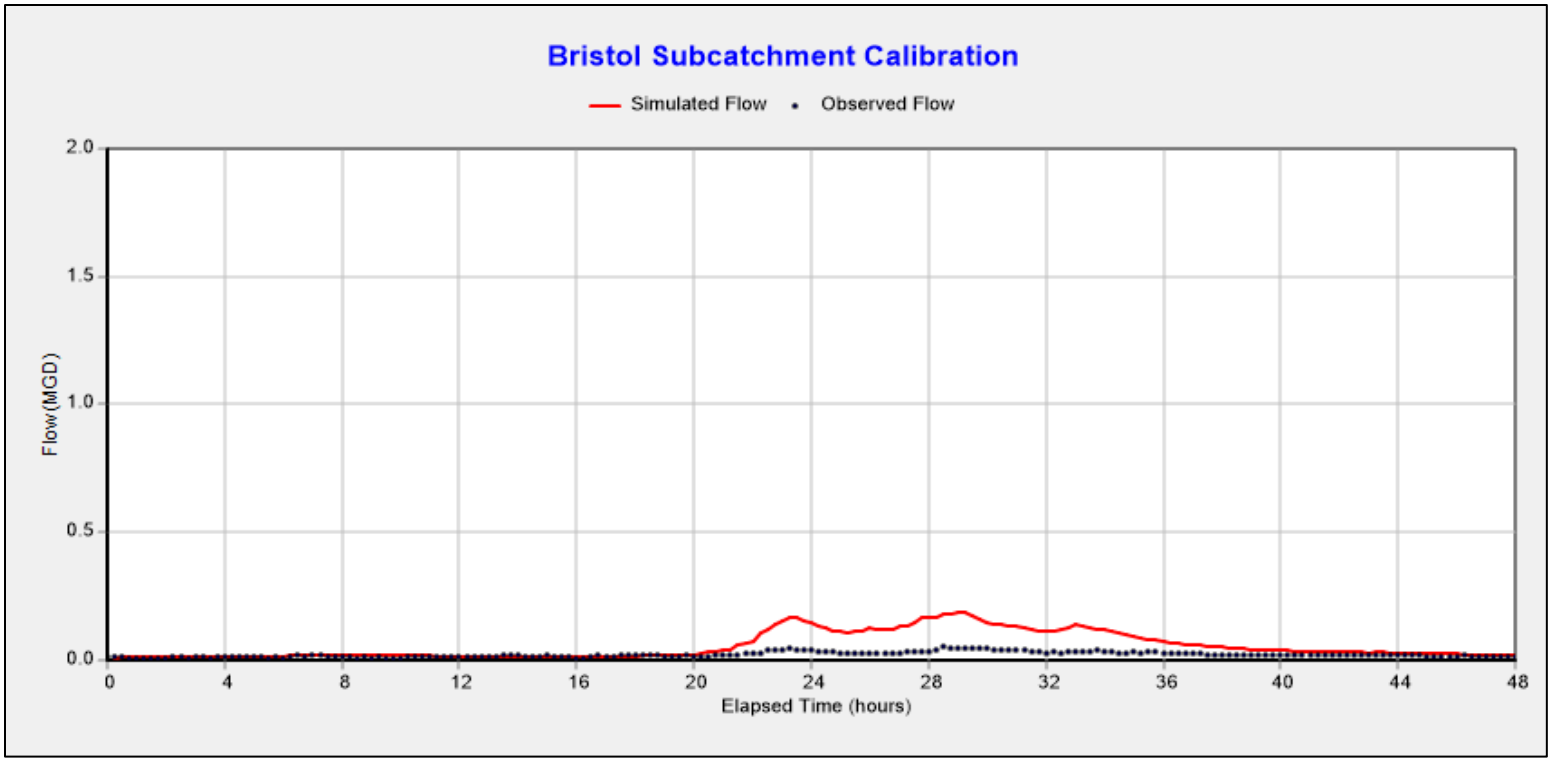
Calibration Storm No. 5

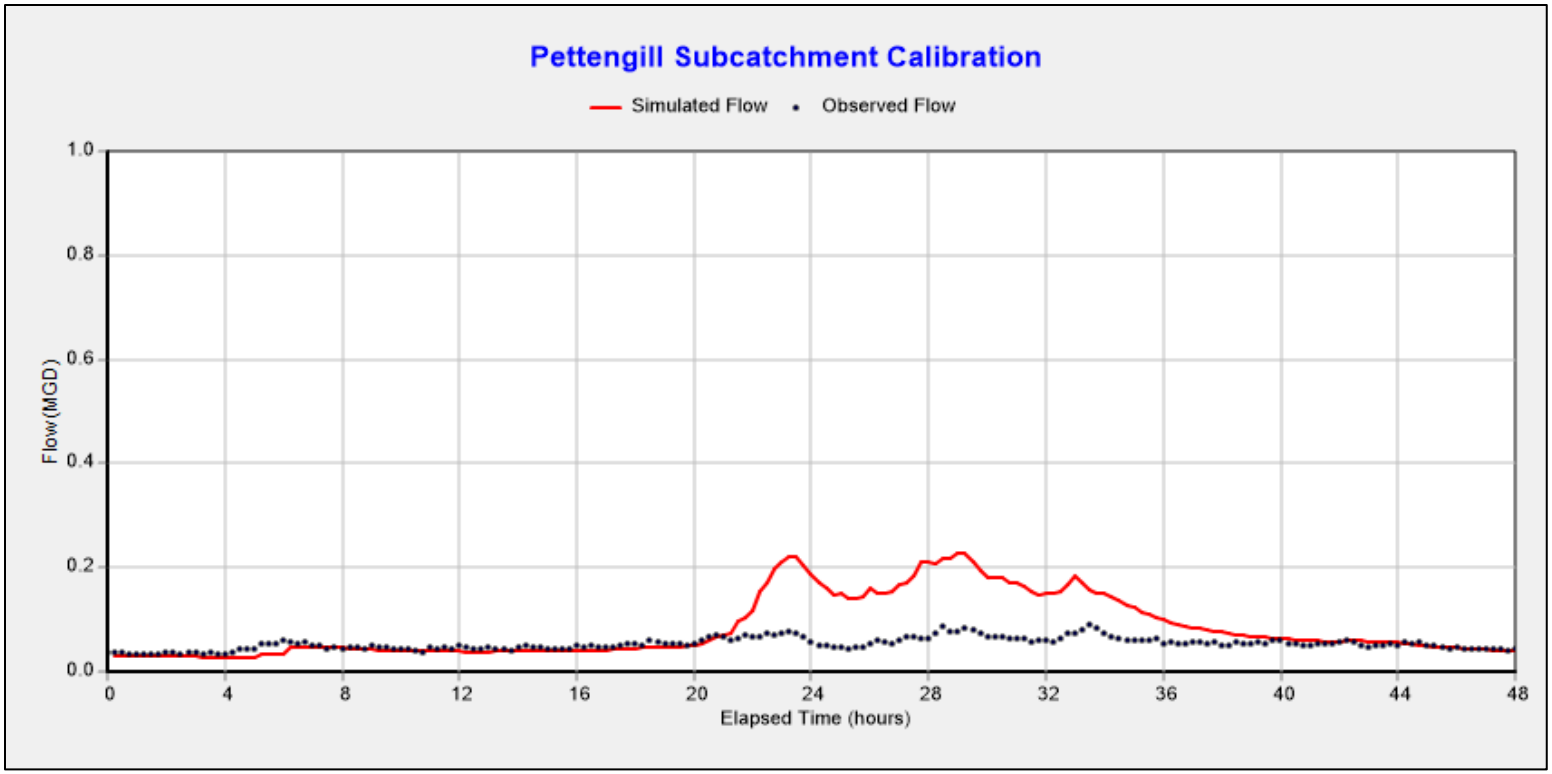
Date:	October 23, 2018
Duration:	14 hours
Total Precipitation:	0.67 inches
Peak Intensity:	0.11 inches/hour
Recurrence Interval:	< 1-month

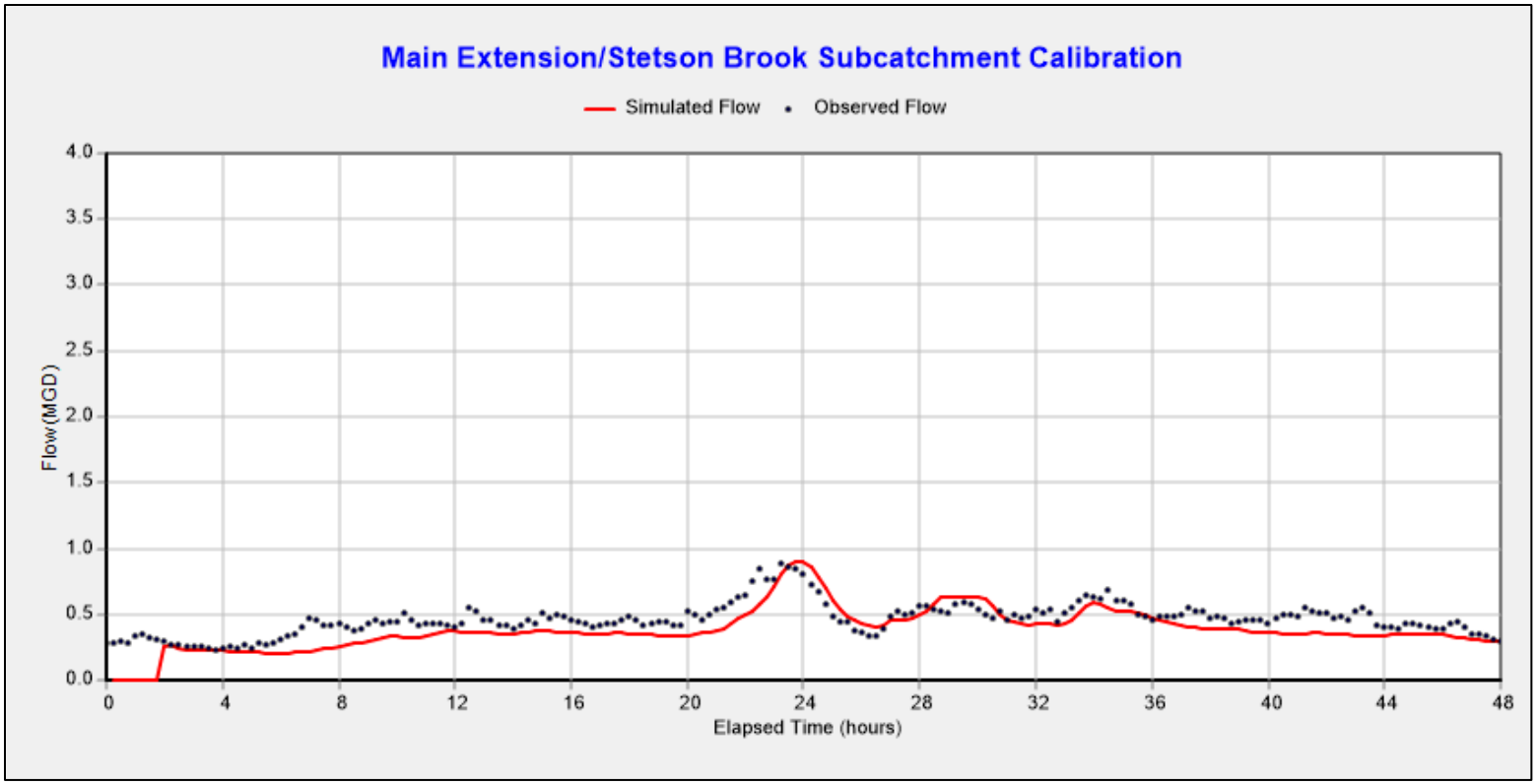

Jepson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

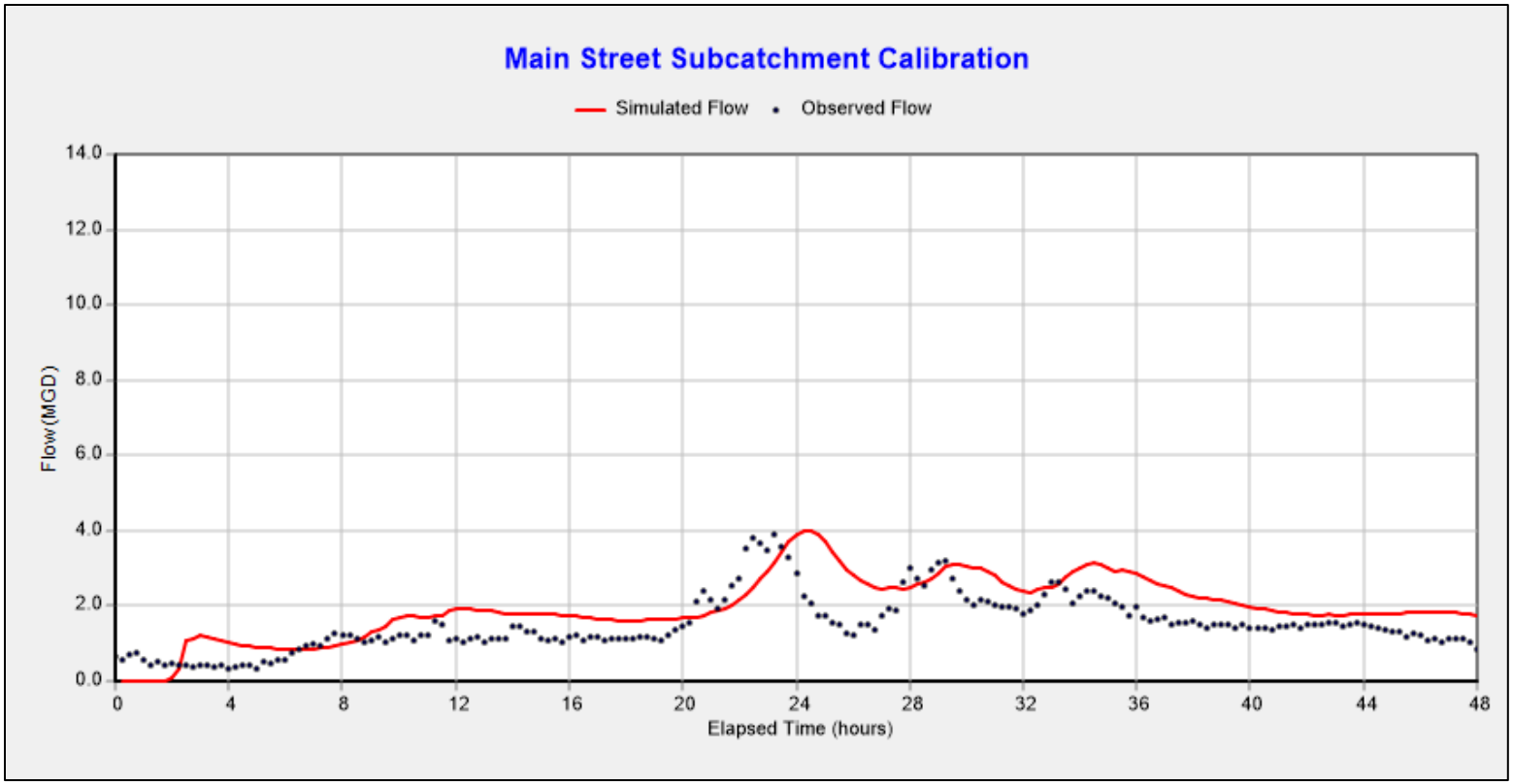

Barrows Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

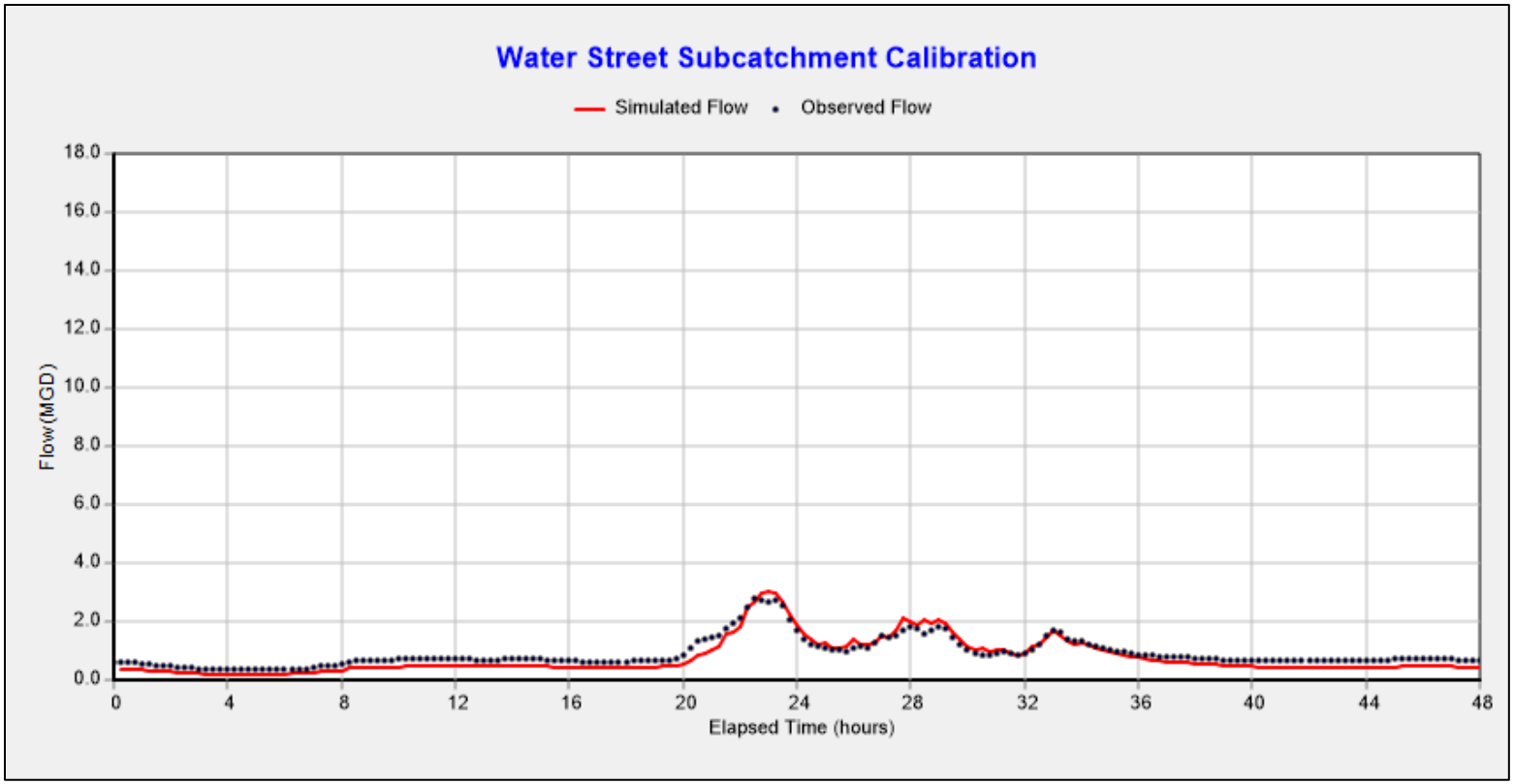

Dingley Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

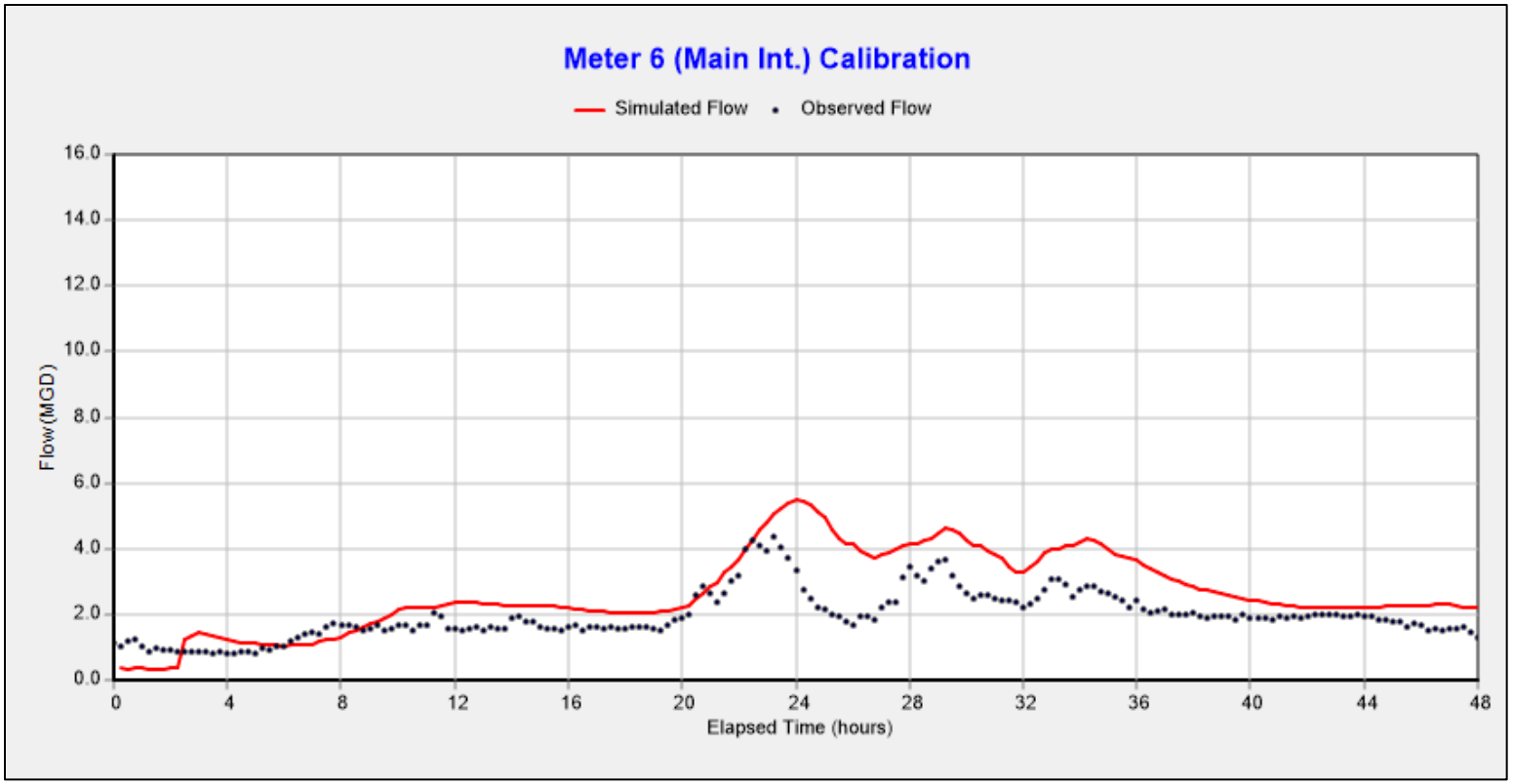

Bristol Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

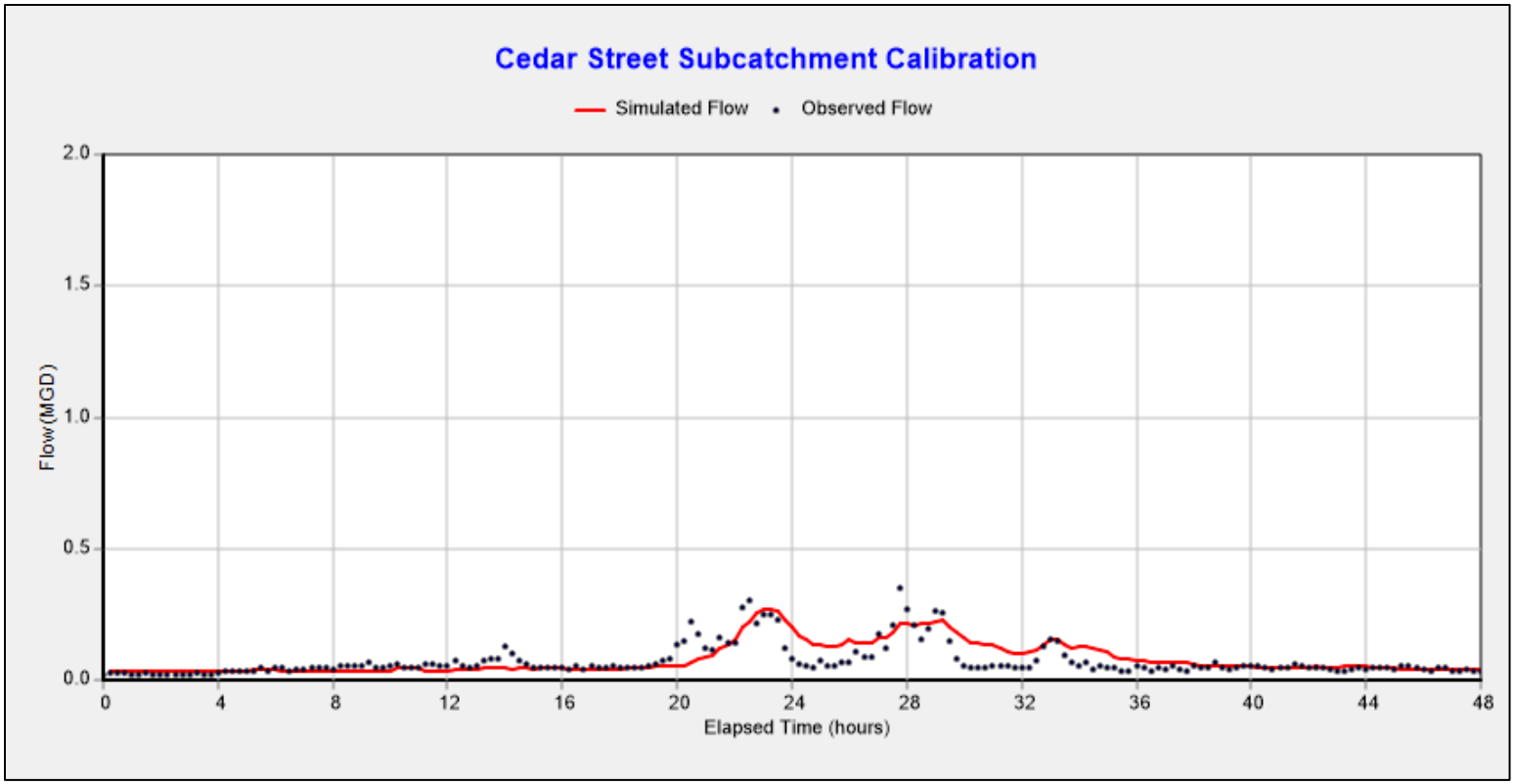

Pettengill Subcatchment Calibration
Simulated Flow
Observed Flow
Flow(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

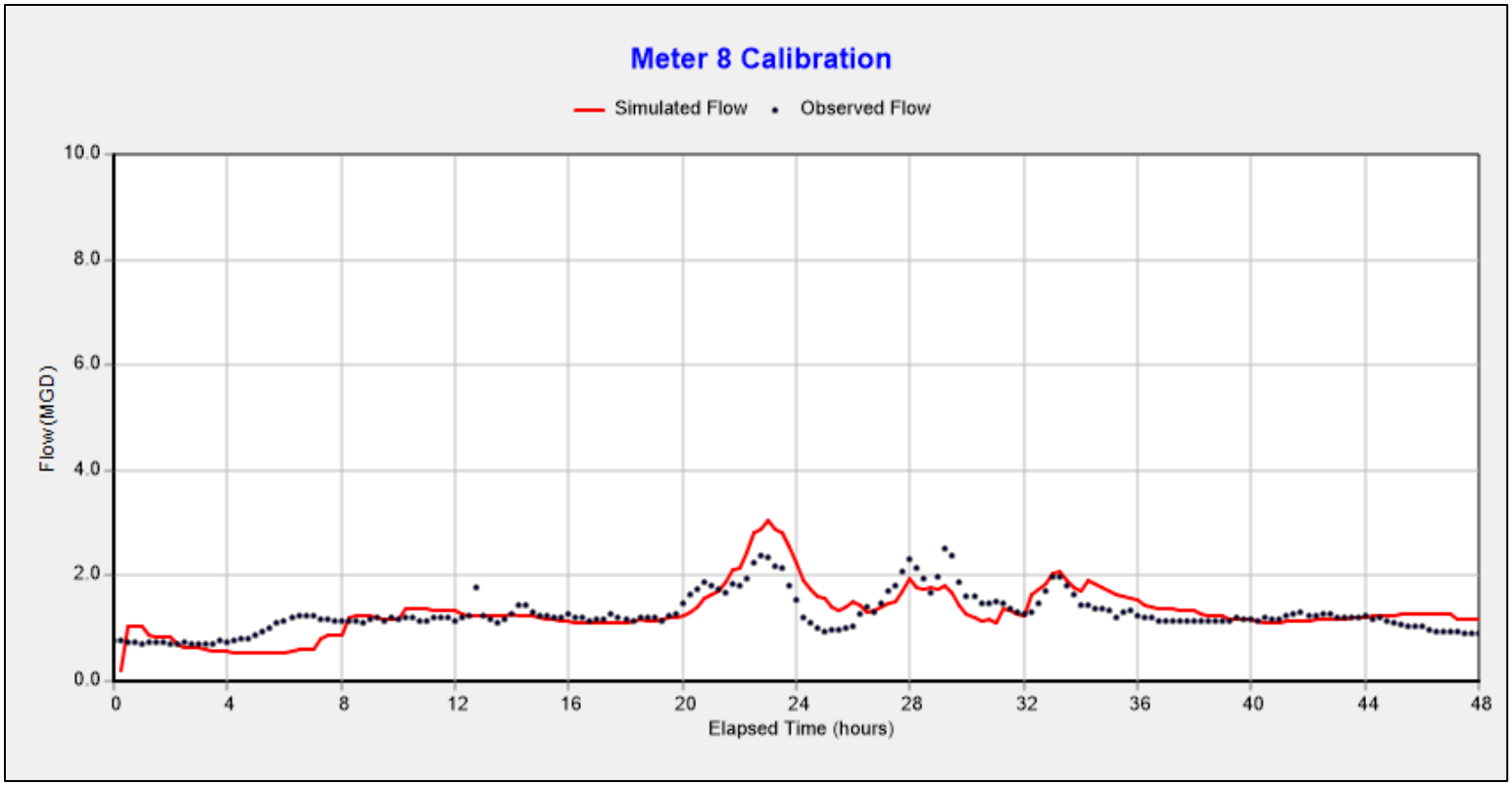

Main Extension/Stetson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow(MGD)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

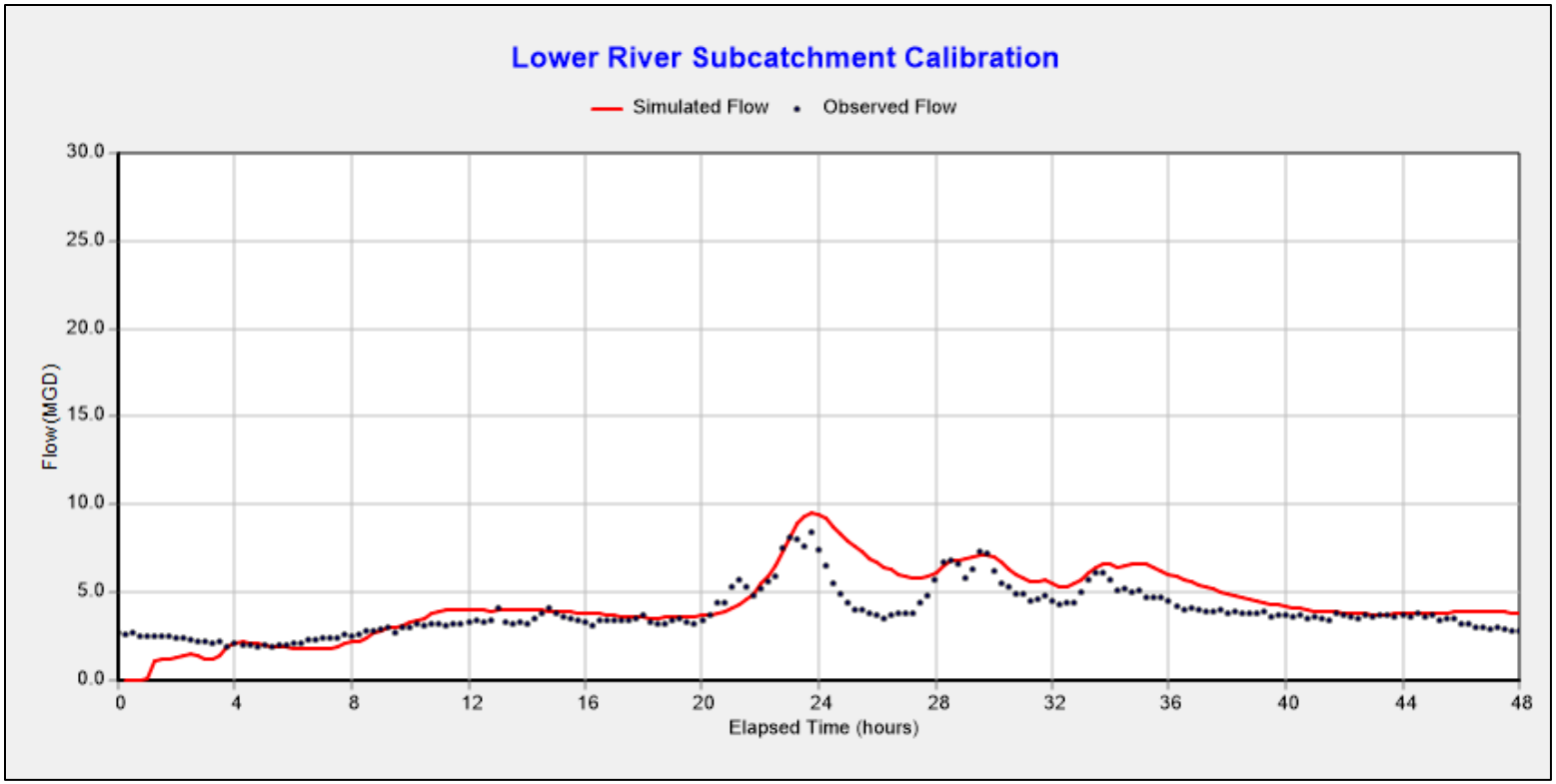

Main Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

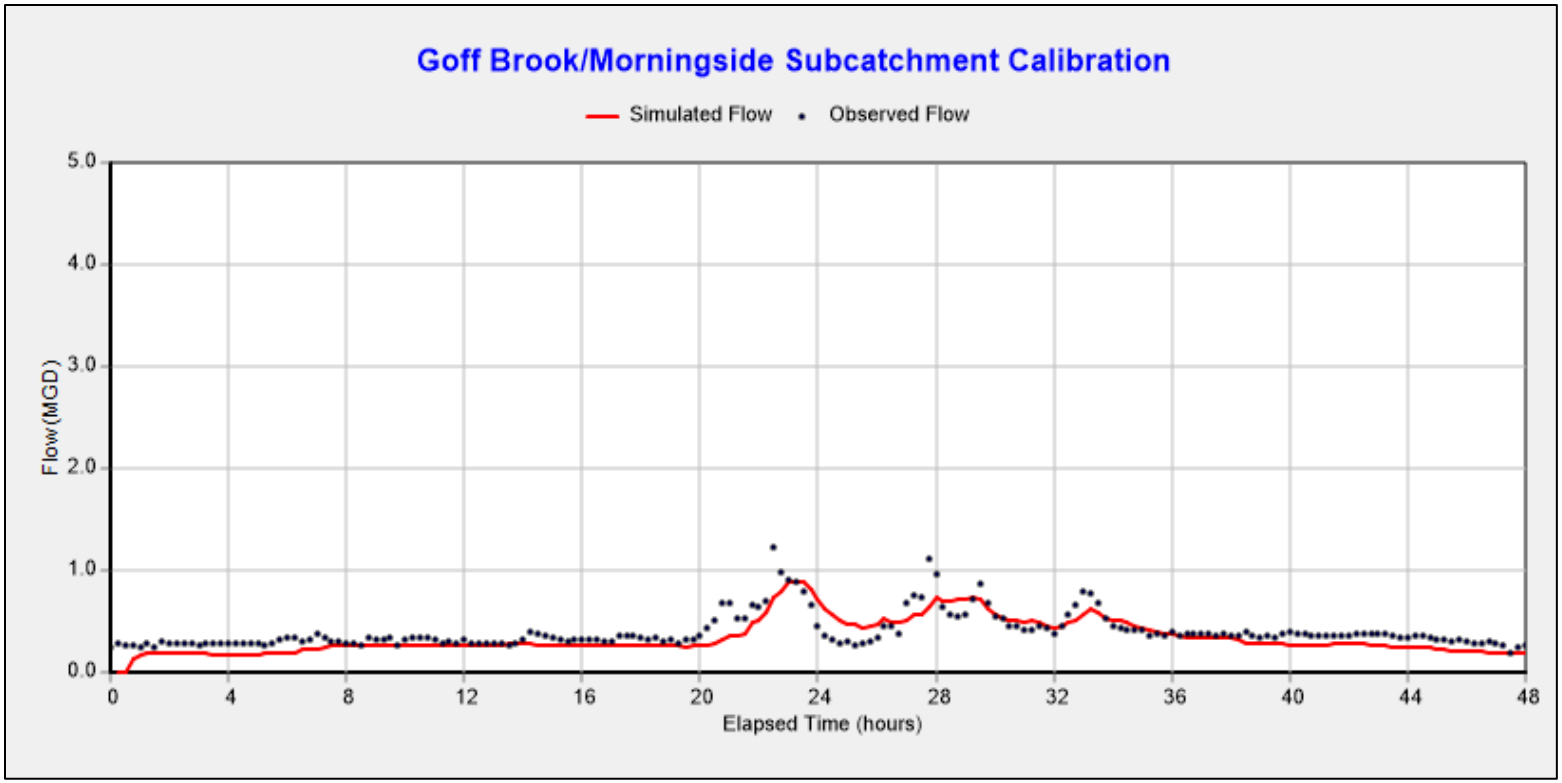

Water Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

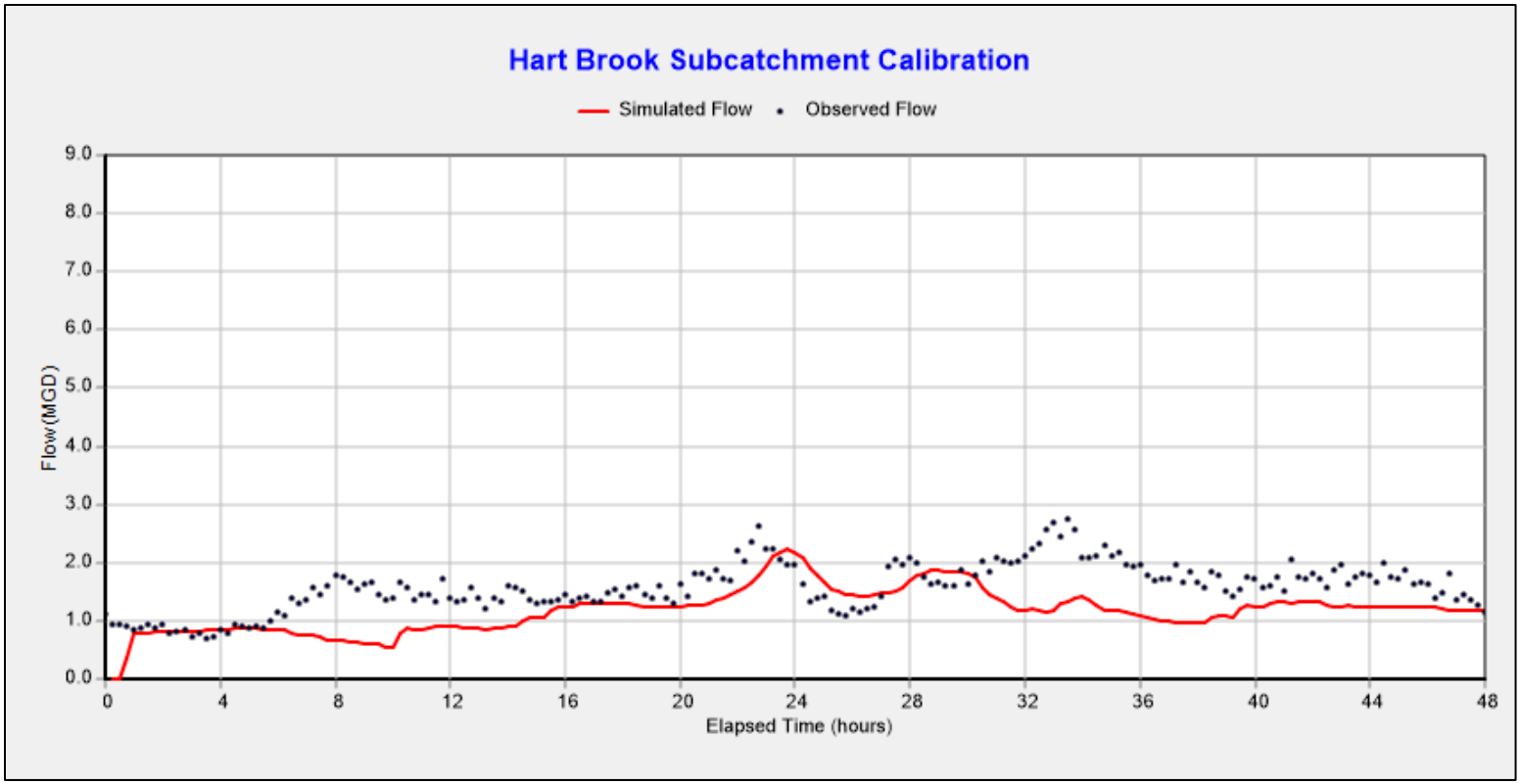

Meter 6 (Main Int.) Calibration
Simulated Flow
Observed Flow
Flow (MGD)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

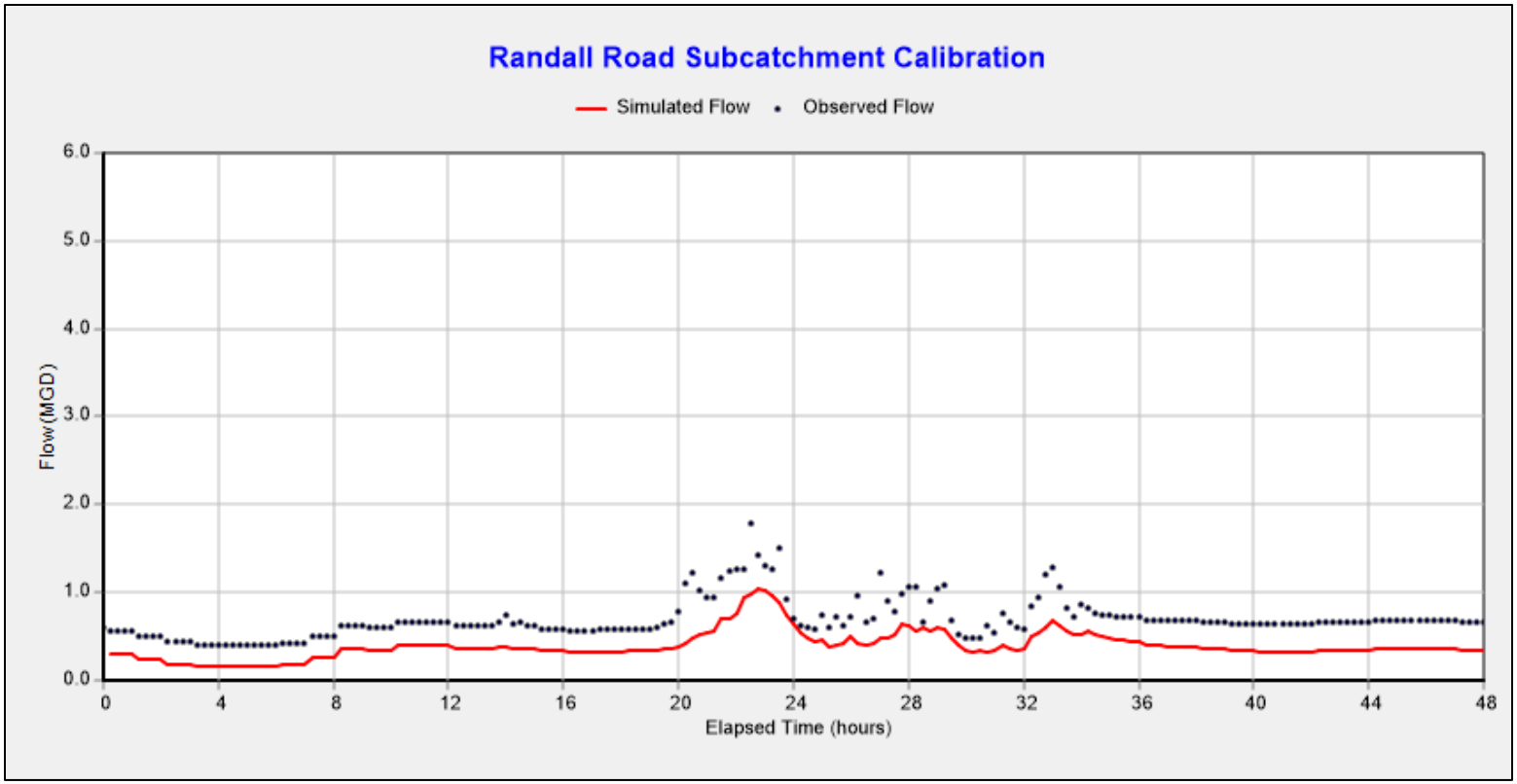

Cedar Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

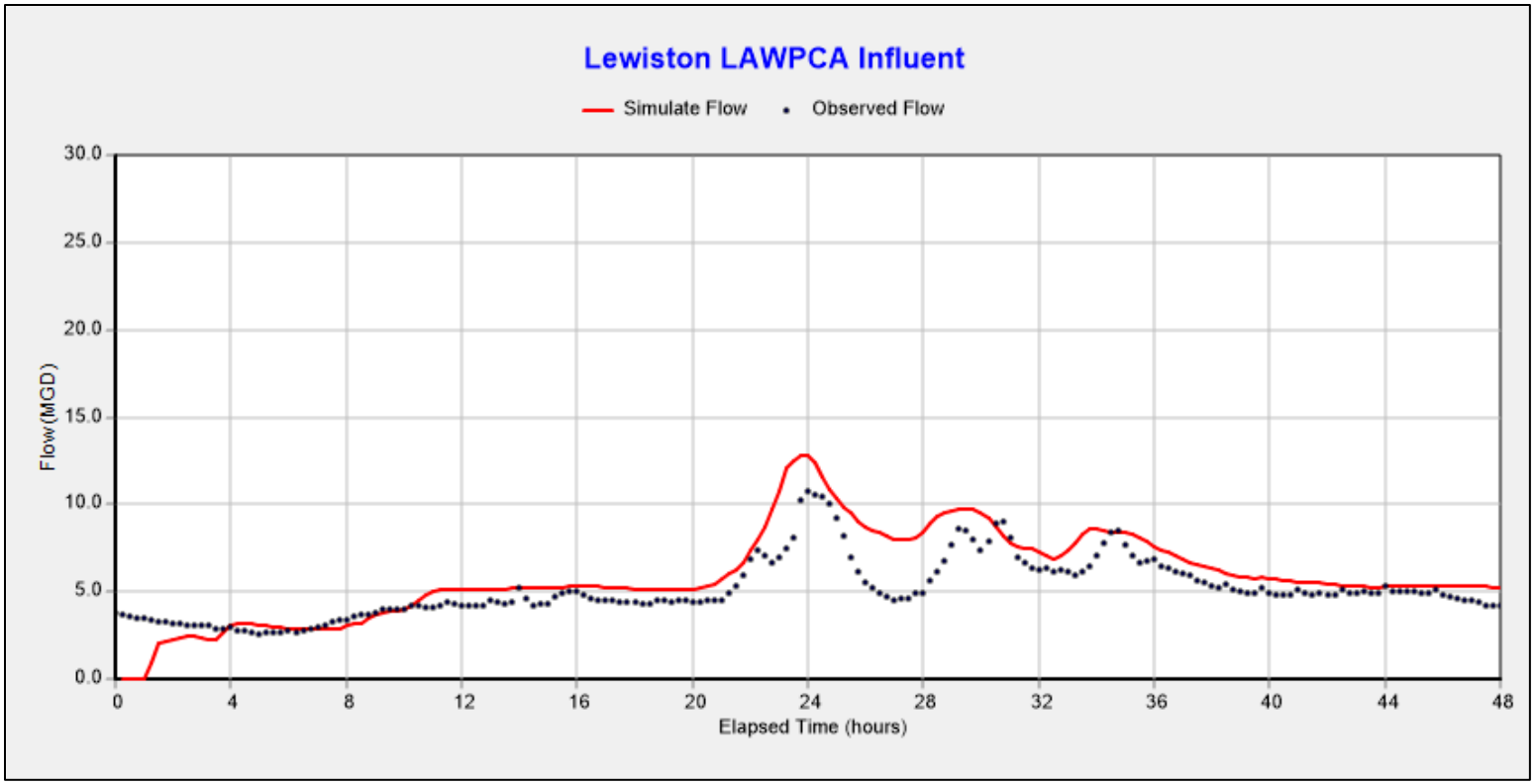

Meter 8 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
10.0
8.0
6.0
4.0
2.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

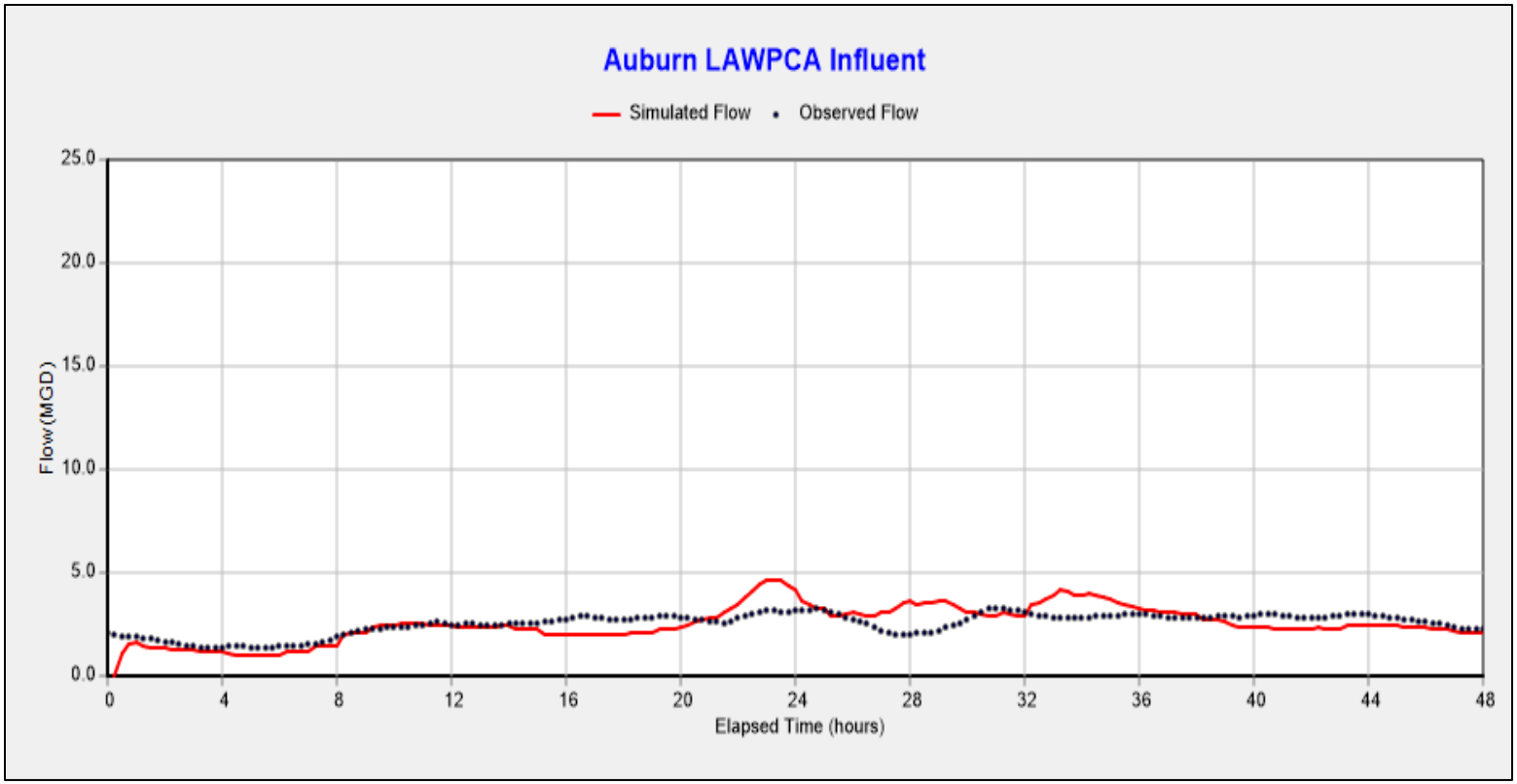

Lower River Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)


Goff Brook/Morningside Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)


Hart Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

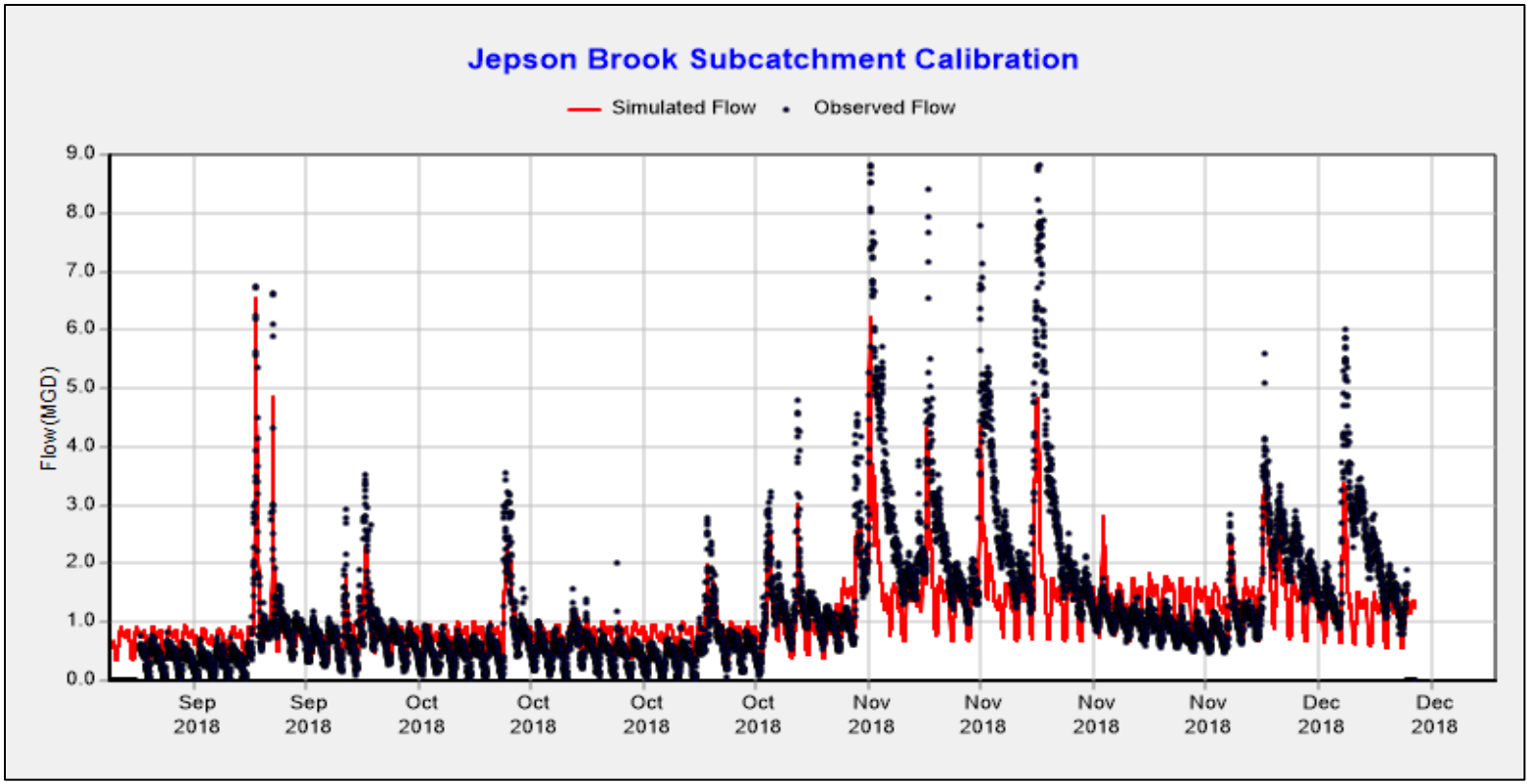

Randall Road Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

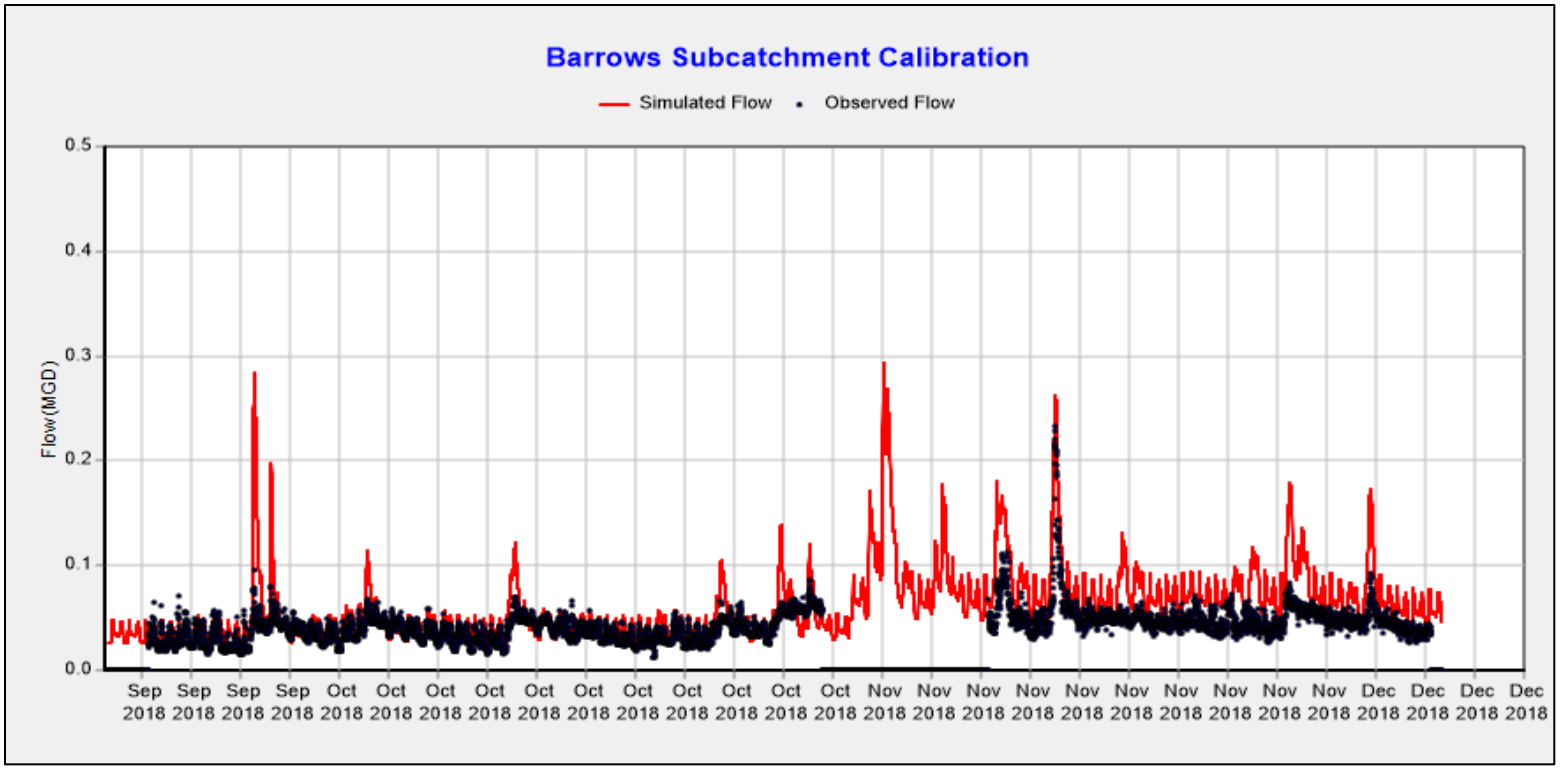

Lewiston LAWPCA Influent
Simulate Flow
Observed Flow
Flow (MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

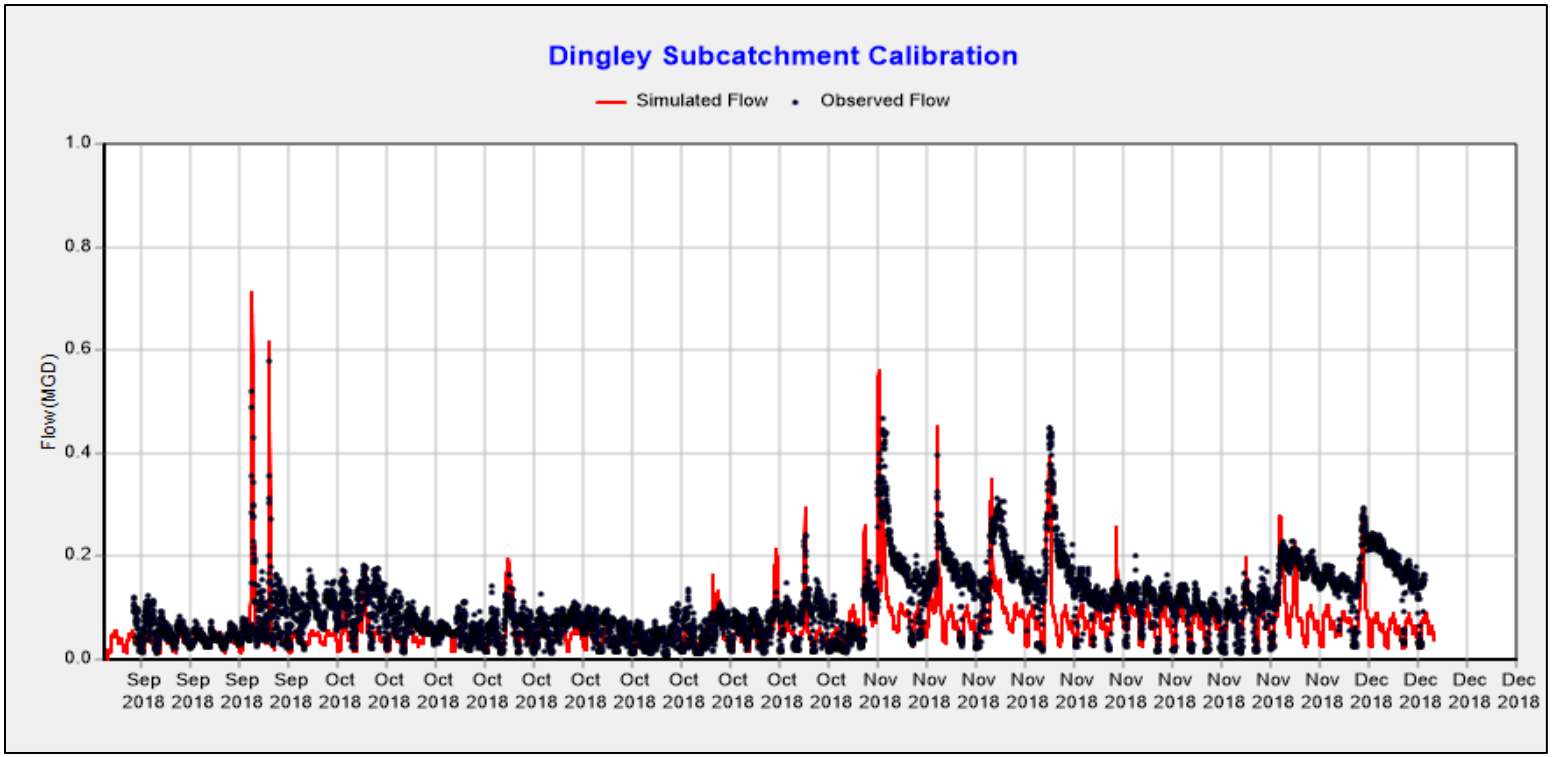

Auburn LAWPCA Influent
Simulated Flow
Observed Flow
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
4
8
12
16
20
24
28
32
36
40
44
48
Elapsed Time (hours)

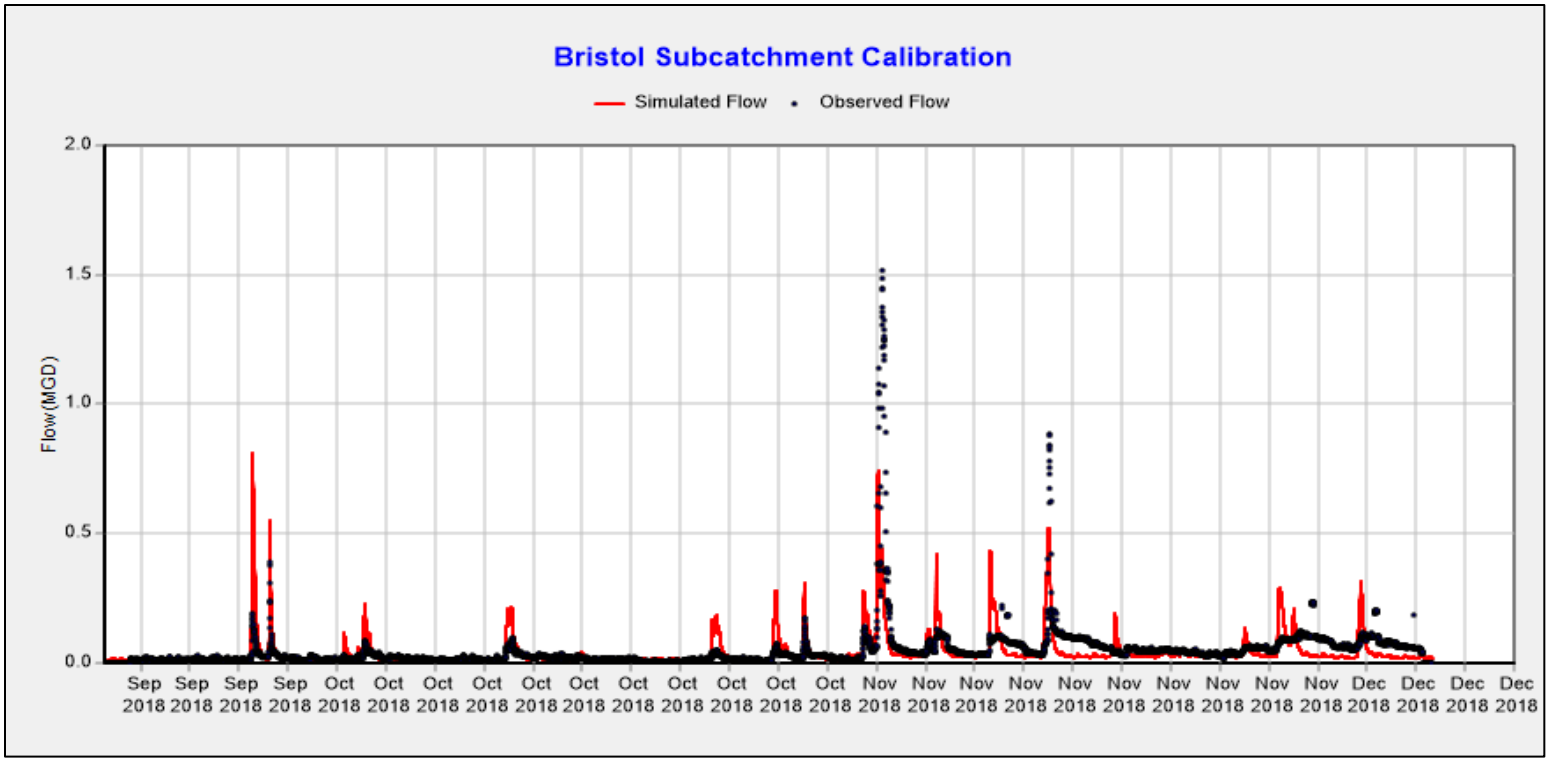
2018 Flow Assessment Period

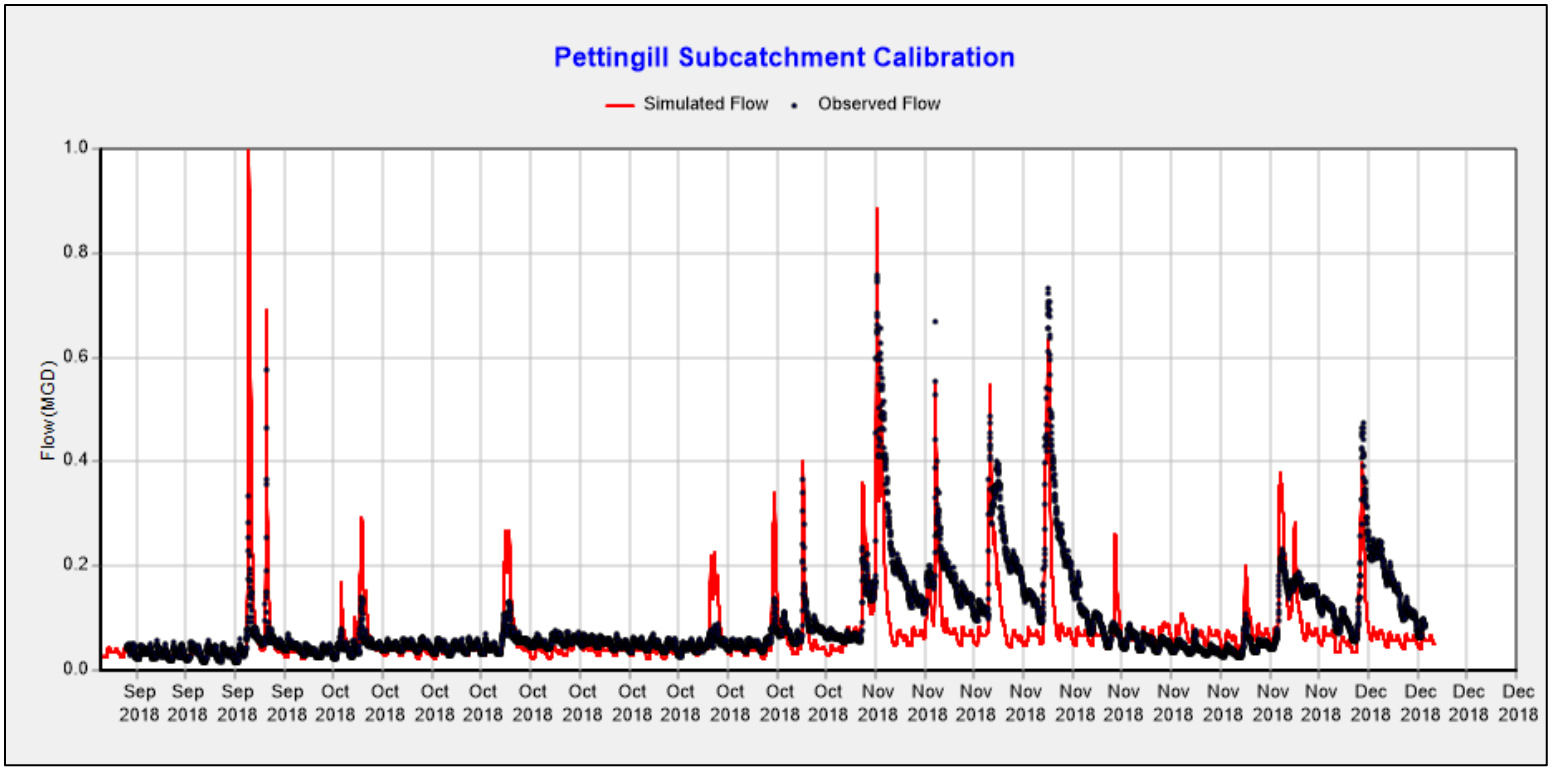
Start Date:	September 17th, 2018
End Date:	December 7th, 2018


Jepson Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Dec 2018
Dec 2018


Barrows Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
0.5
0.4
0.3
0.2
0.1
0.0
Sep 2018
Sep 2018
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Dec 2018
Dec 2018
Dec 2018
Dec 2018


Dingley Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
Sep 2018
Sep 2018
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Dec 2018
Dec 2018
Dec 2018
Dec 2018


Bristol Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
Sep 2018
Sep 2018
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Dec 2018
Dec 2018
Dec 2018
Dec 2018


Pettingill Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
1.0
0.8
0.6
0.4
0.2
0.0
Sep 2018
Sep 2018
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
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Nov 2018
Nov 2018
Nov 2018
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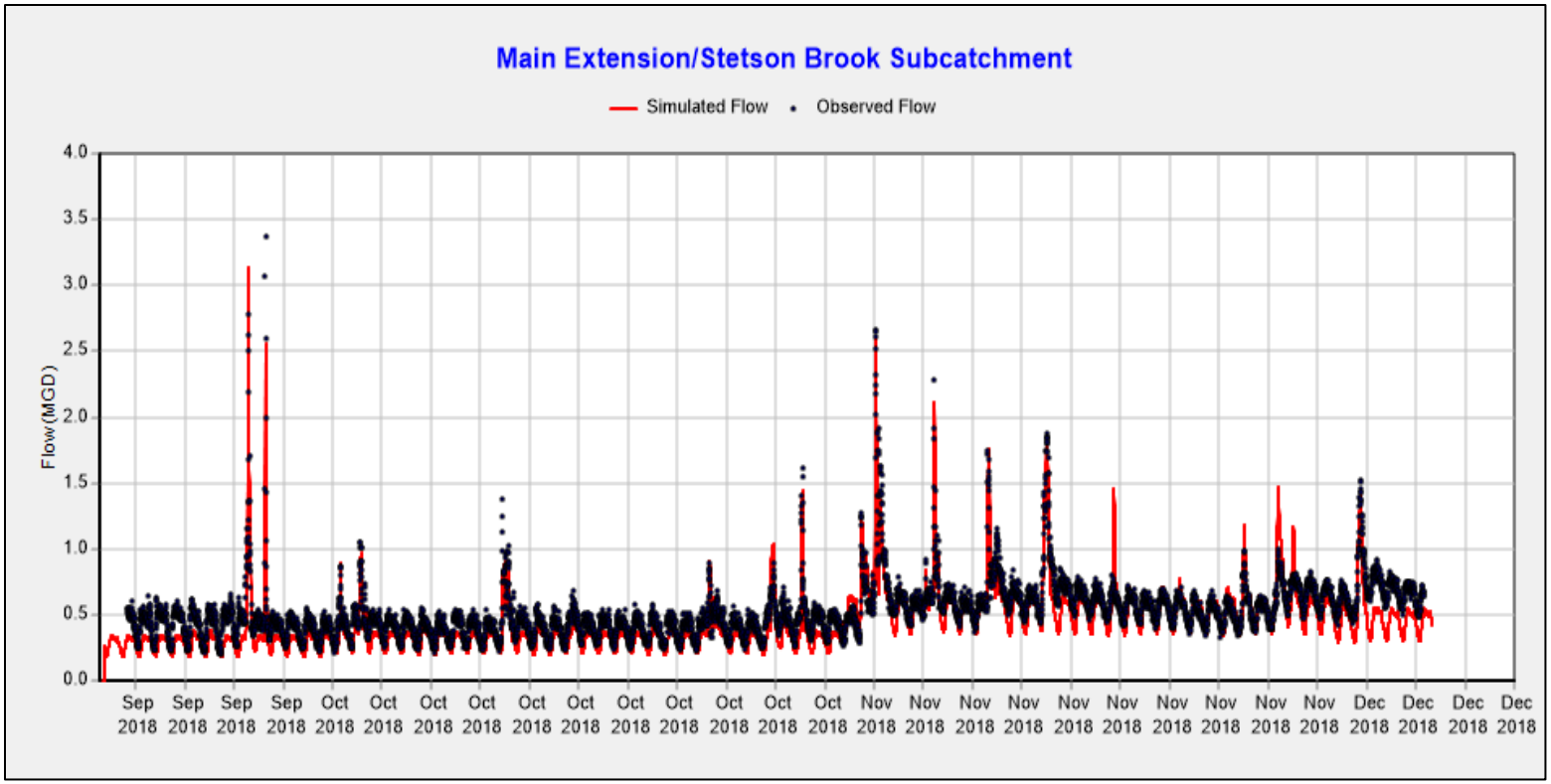
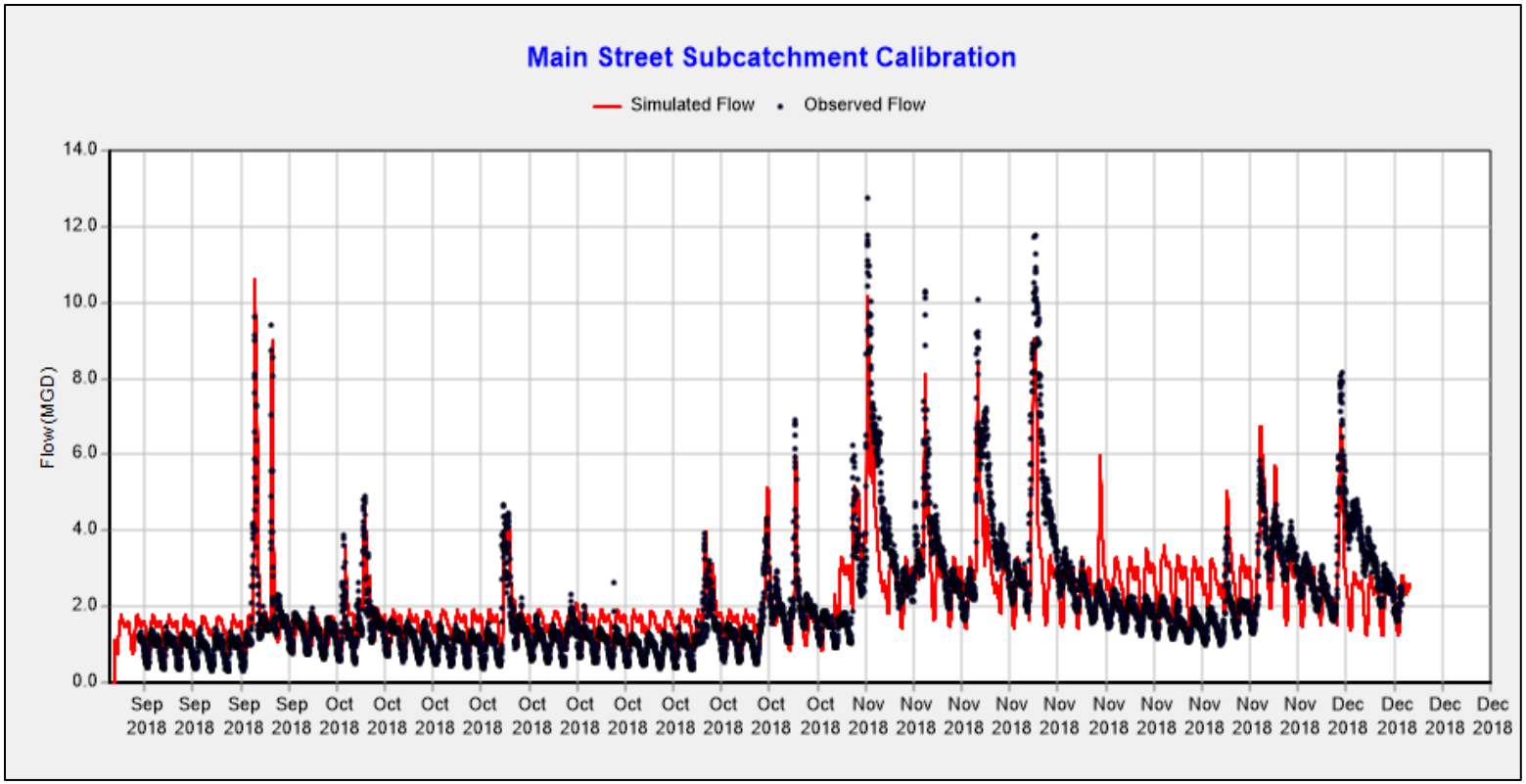
Nov 2018
Nov 2018
Nov 2018
Dec 2018
Dec 2018
Dec 2018
Dec 2018


Main Extension/Stetson Brook Subcatchment
Simulated Flow
Observed Flow
Flow (MGD)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Sep 2018
Oct 2018
Nov 2018
Dec 2018


Main Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Sep 2018
Sep 2018
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
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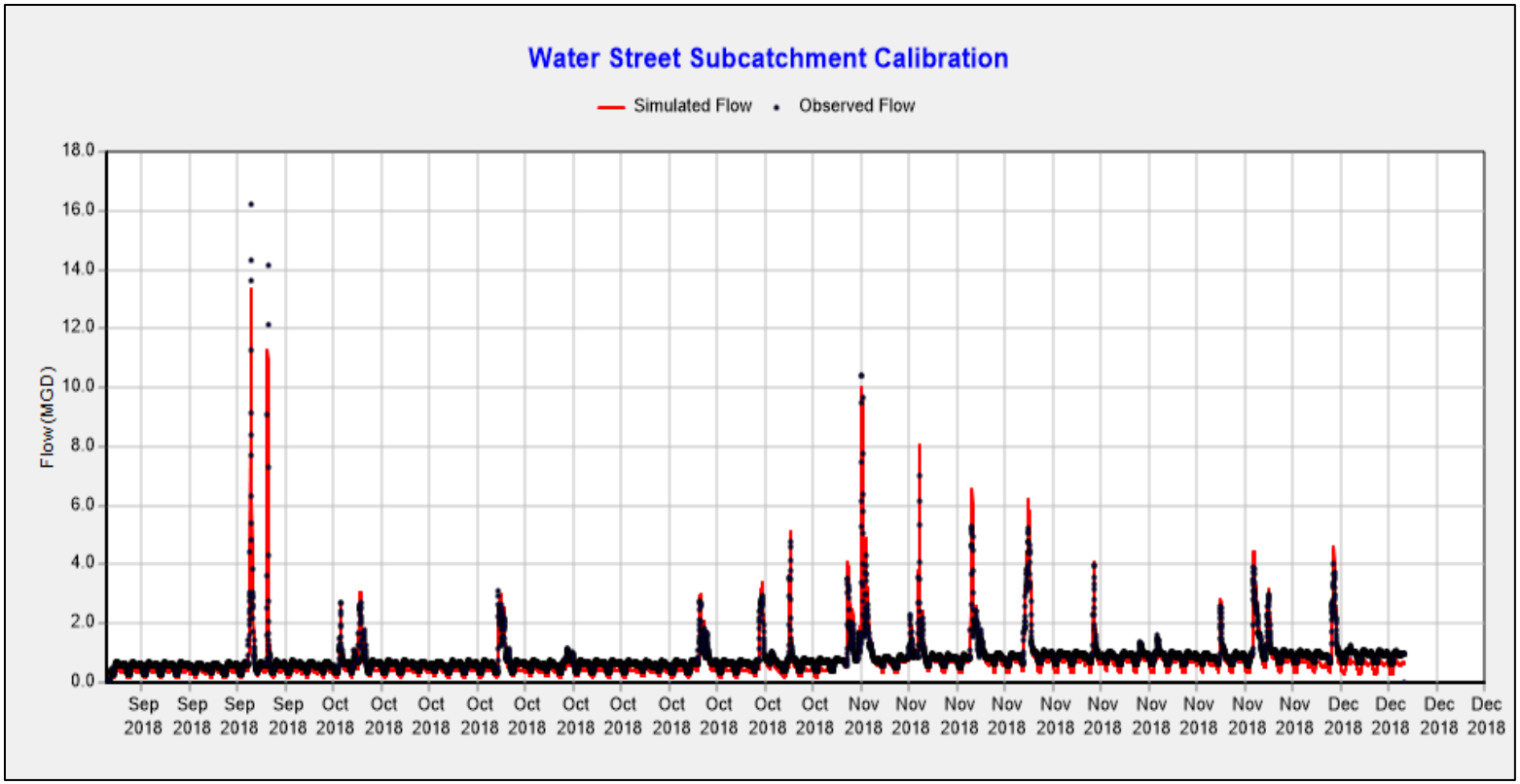
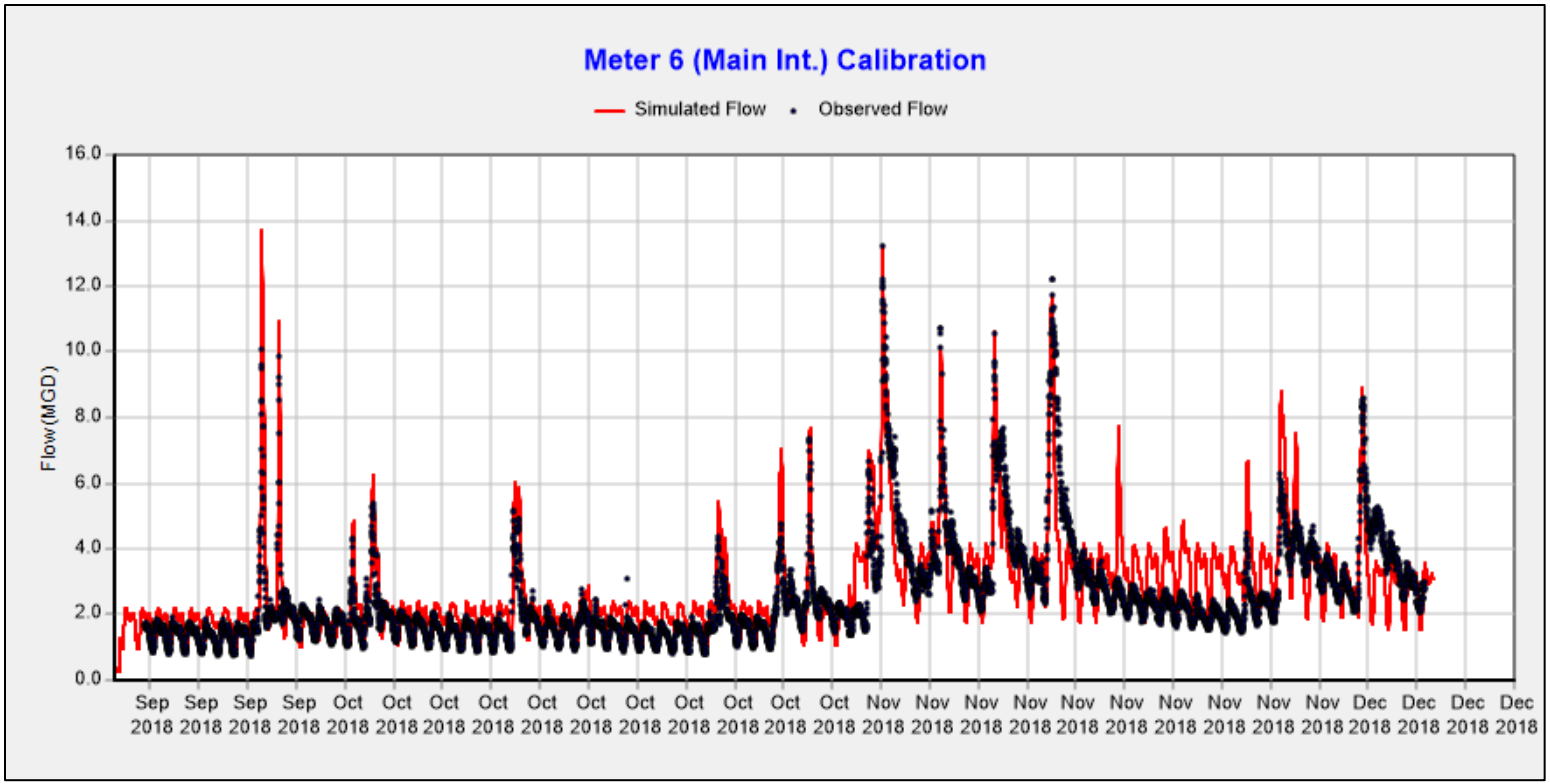
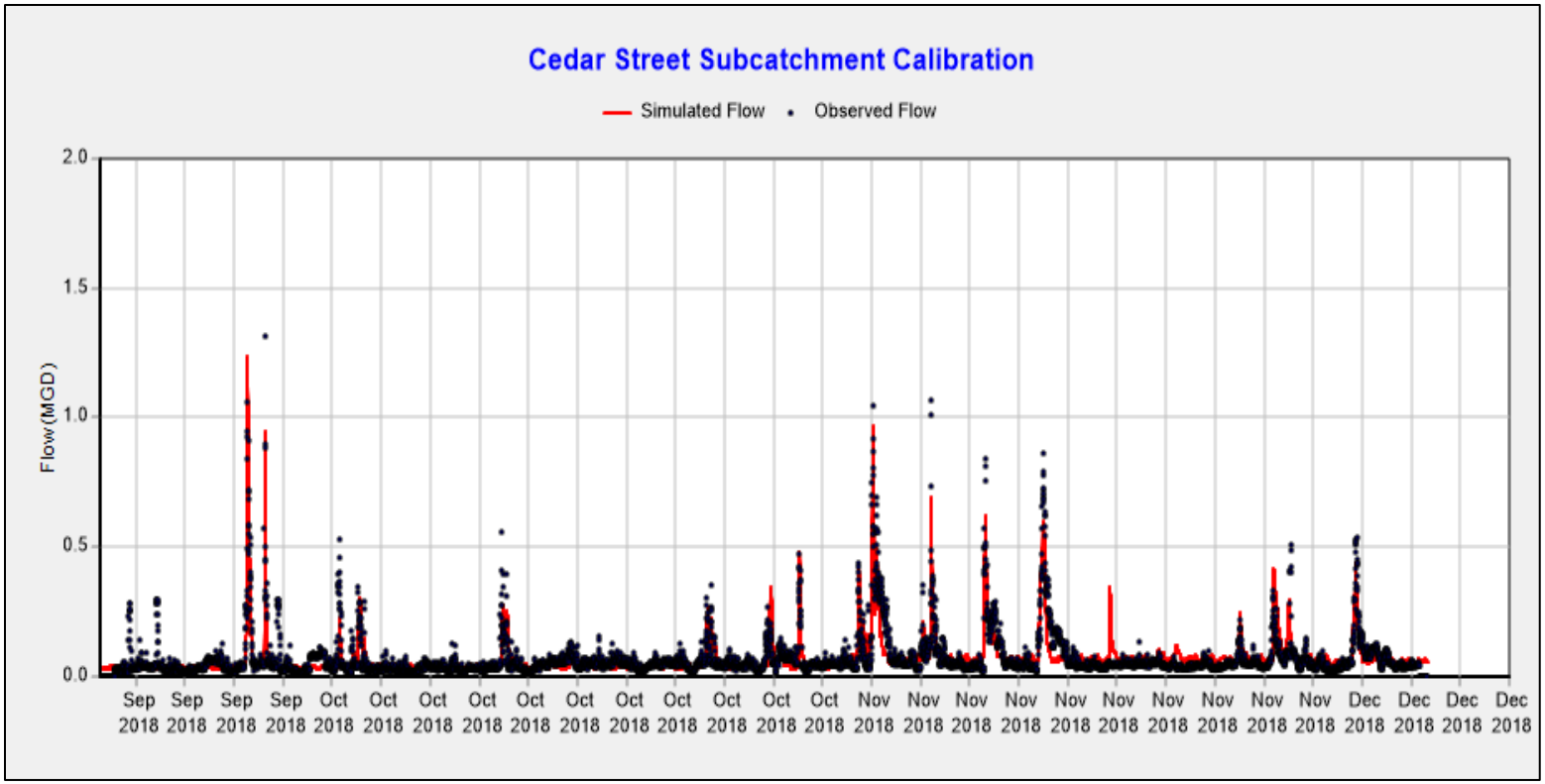
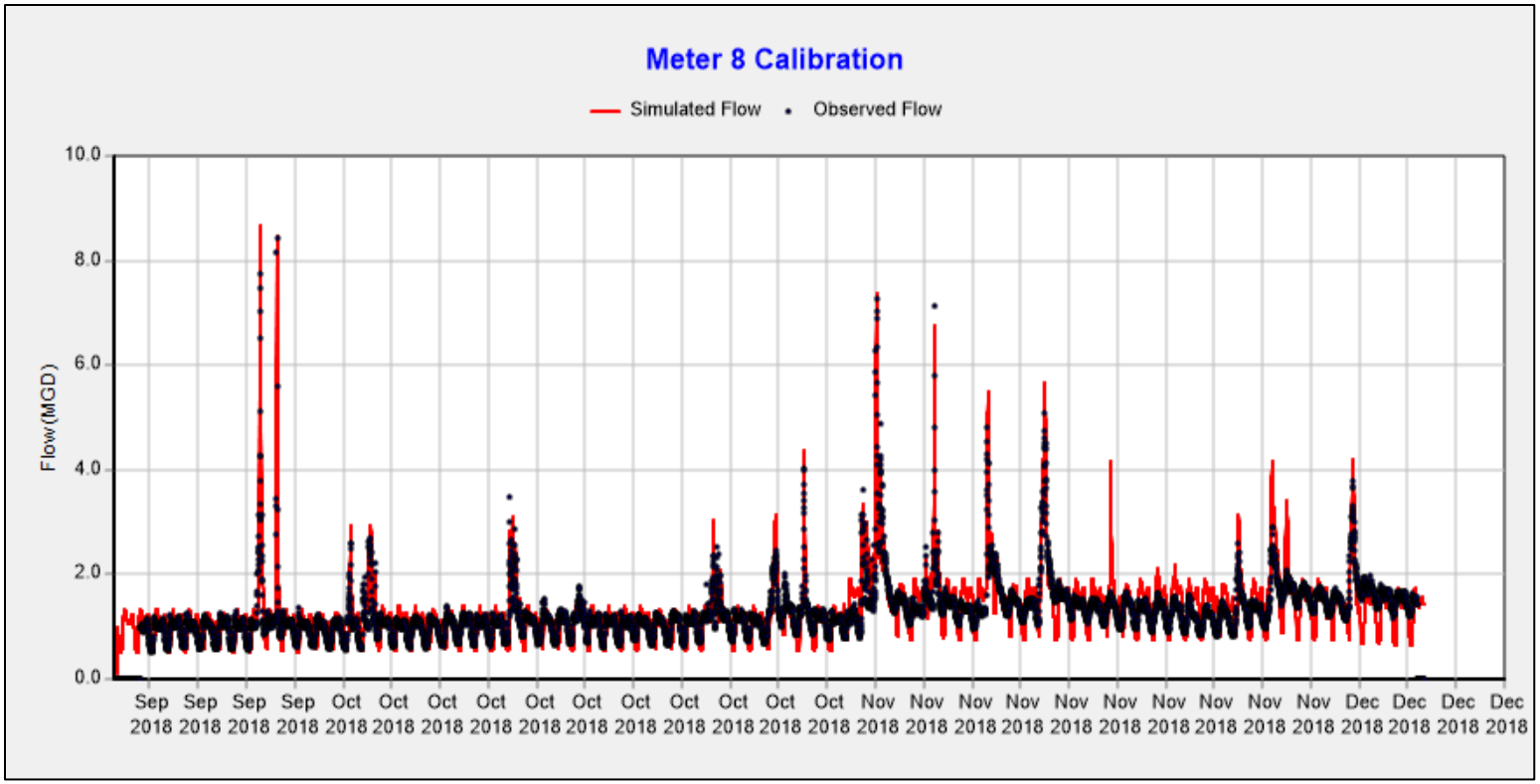
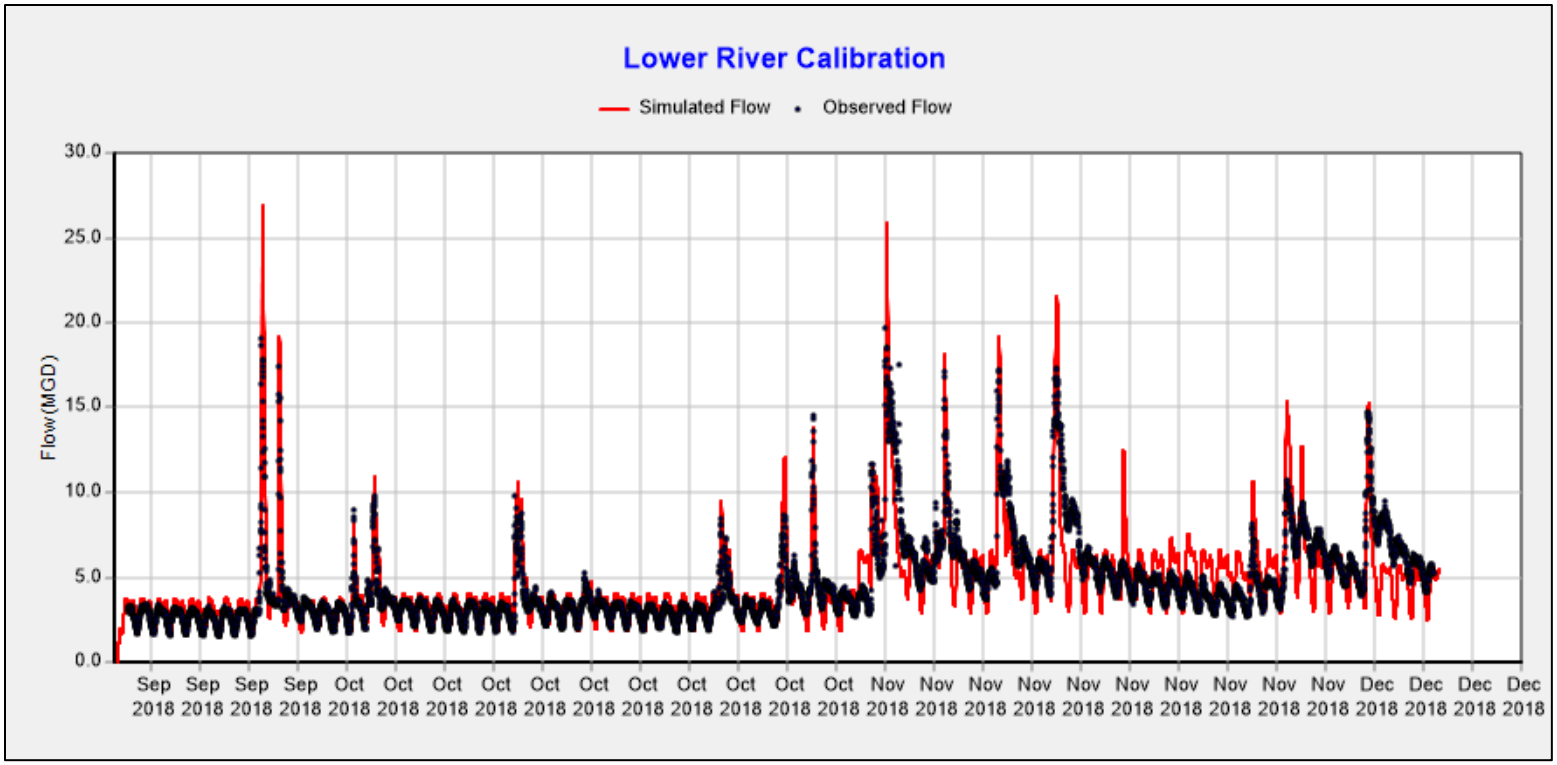
Nov 2018
Nov 2018
Dec 2018
Dec 2018
Dec 2018
Dec 2018


Water Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Sep 2018
Oct 2018
Nov 2018
Dec 2018


Meter 6 (Main Int.) Calibration
Simulated Flow
Observed Flow
Flow (MGD)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Sep 2018
Oct 2018
Nov 2018
Dec 2018


Cedar Street Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
2.0
1.5
1.0
0.5
0.0
Sep 2018
Oct 2018
Nov 2018
Dec 2018


Meter 8 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
10.0
8.0
6.0
4.0
2.0
0.0
Sep 2018
Oct 2018
Nov 2018
Dec 2018


Lower River Calibration
Simulated Flow
Observed Flow
Flow (MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Sep 2018
Sep 2018
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
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Nov 2018
Nov 2018
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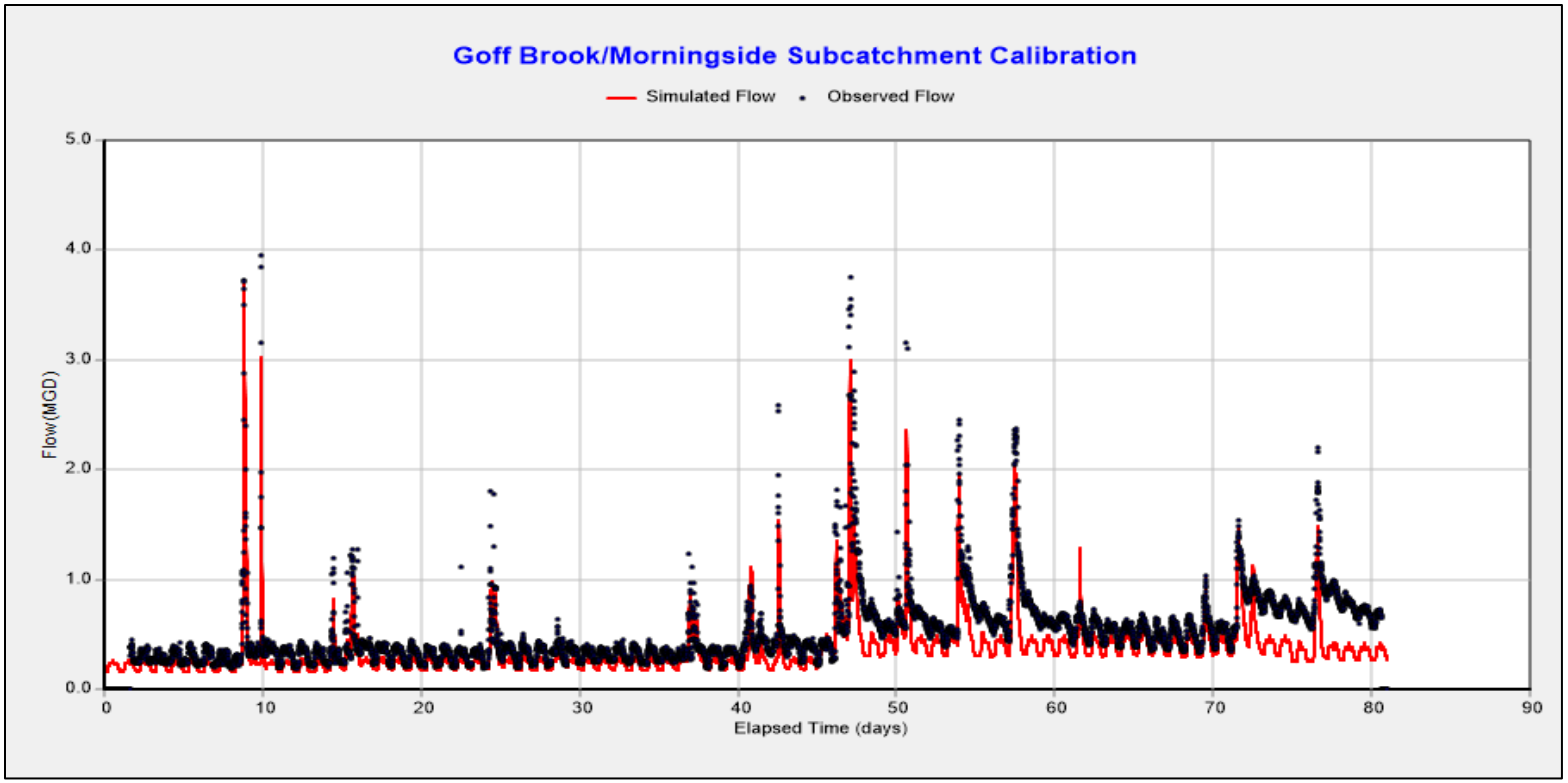
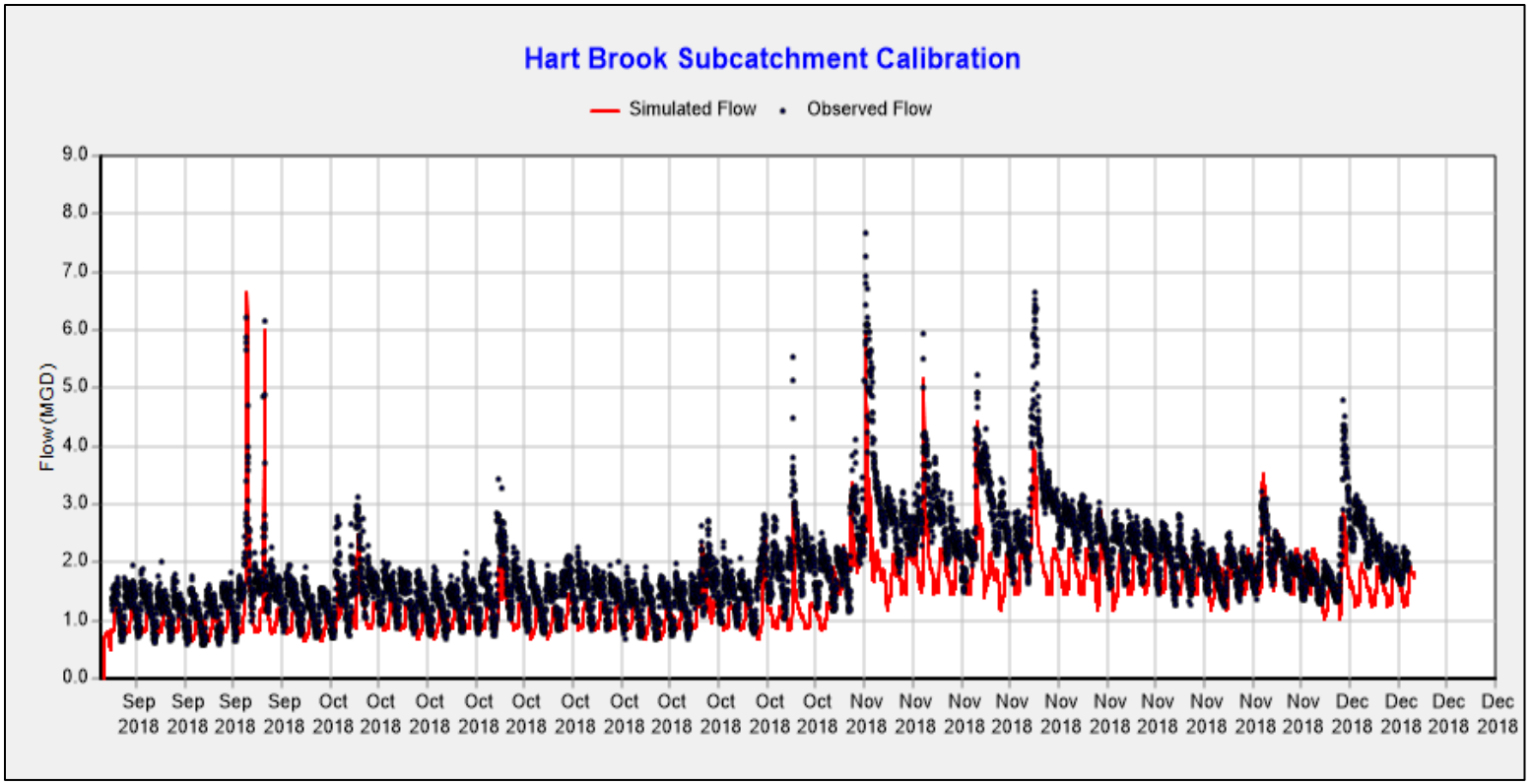
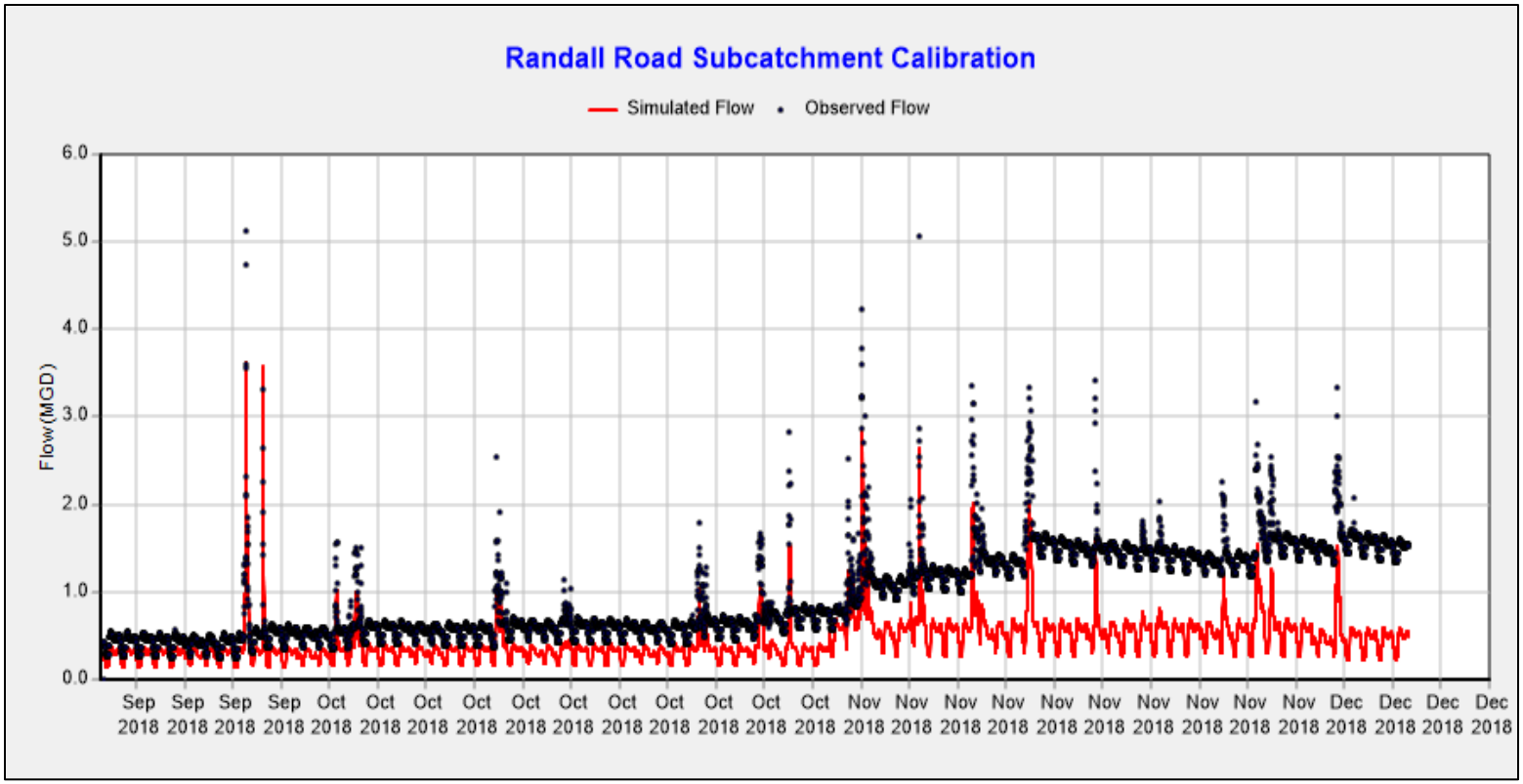
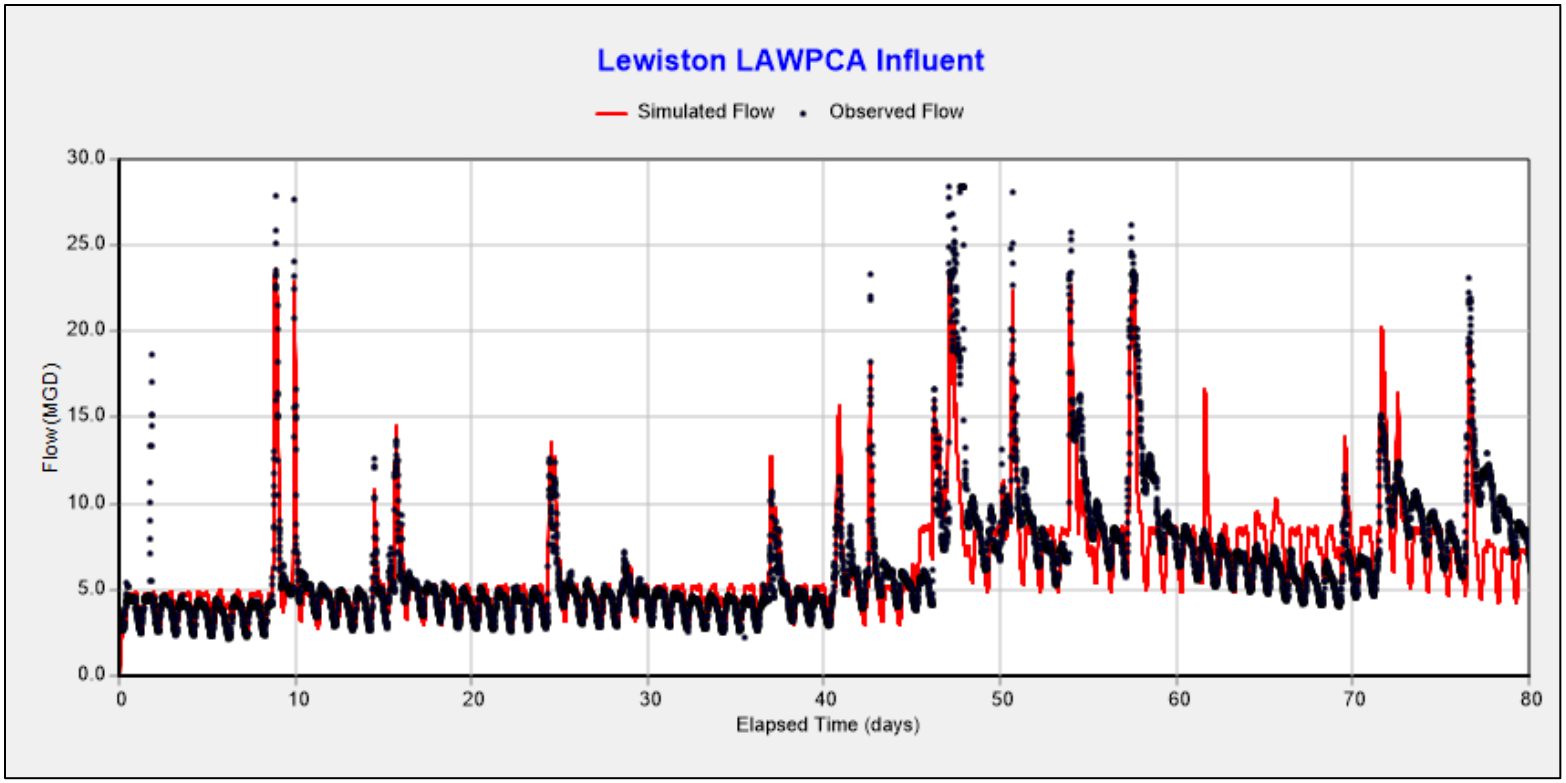
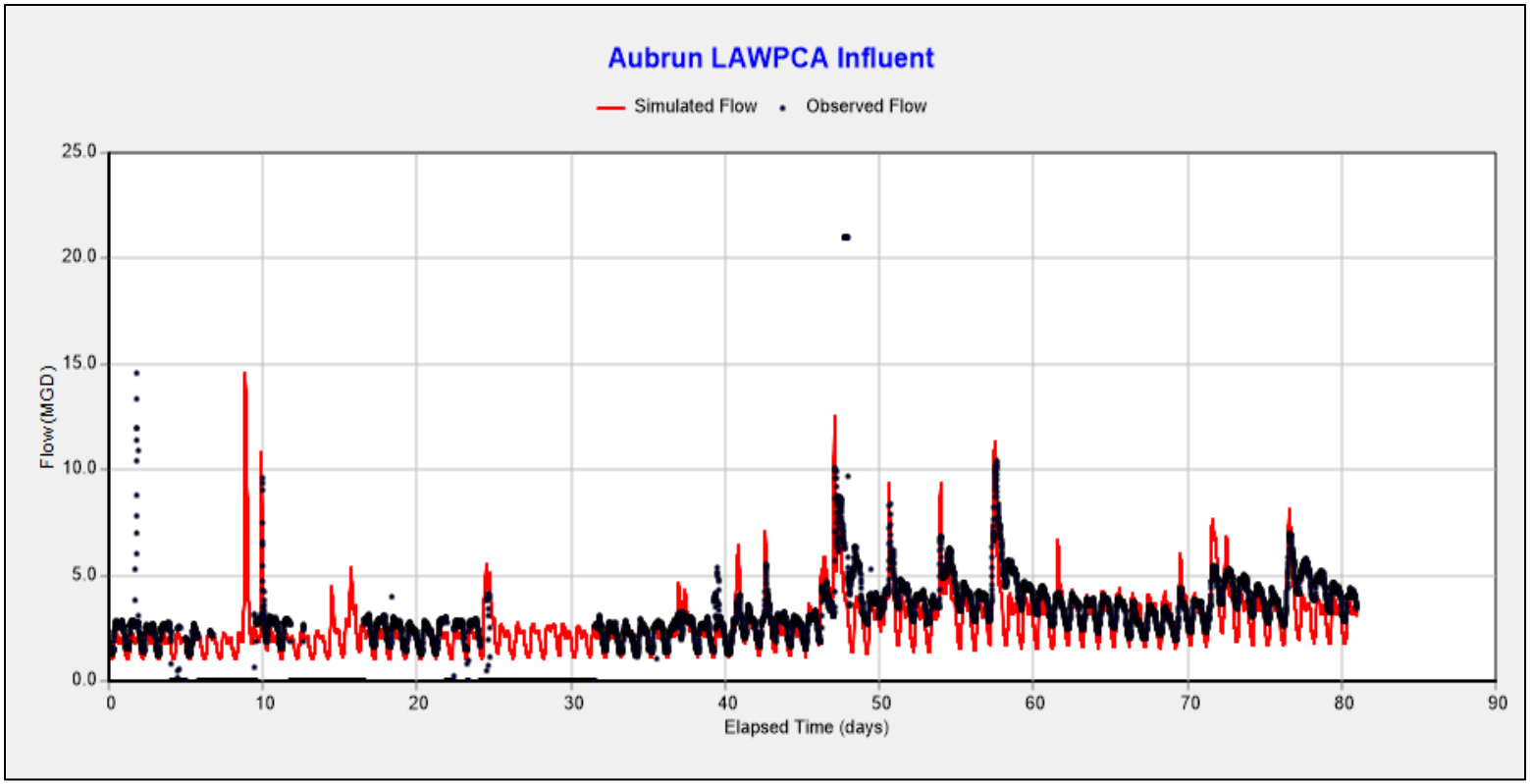
Nov 2018
Nov 2018
Dec 2018
Dec 2018
Dec 2018
Dec 2018


Goff Brook/Morningside Subcatchment Calibration
Simulated Flow
Observed Flow
Flow(MGD)
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)


Hart Brook Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Sep 2018
Oct 2018
Nov 2018
Dec 2018


Randall Road Subcatchment Calibration
Simulated Flow
Observed Flow
Flow (MGD)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Sep 2018
Sep 2018
Sep 2018
Sep 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Oct 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Nov 2018
Dec 2018
Dec 2018
Dec 2018
Dec 2018


Lewiston LAWPCA Influent
Simulated Flow
Observed Flow
Flow (MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
10
20
30
40
50
60
70
80
Elapsed Time (days)

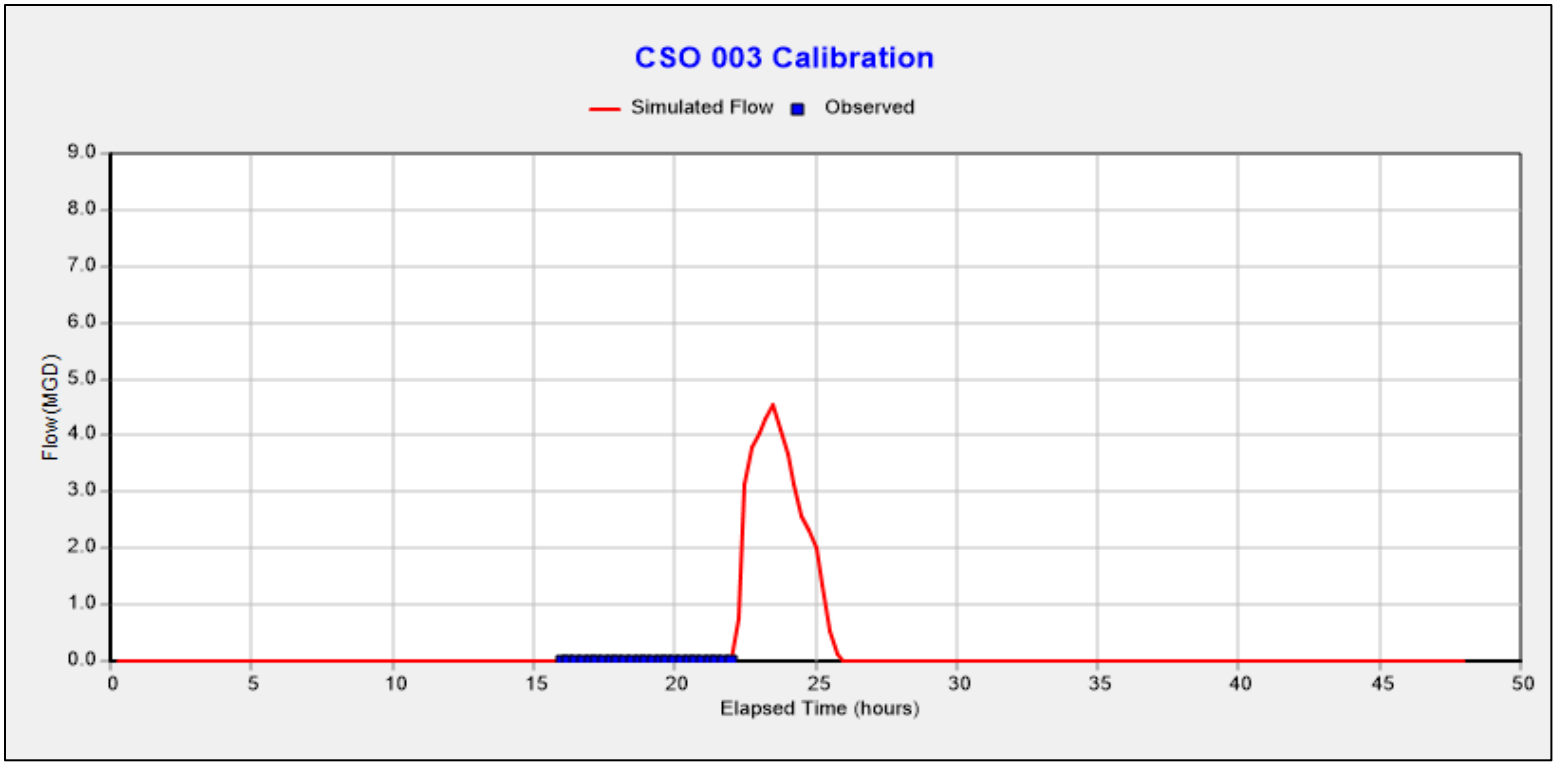

Aubrun LAWPCA Influent
Simulated Flow
Observed Flow
Flow (MGD)
25.0
20.0
15.0
10.0
5.0
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)

APPENDIX C

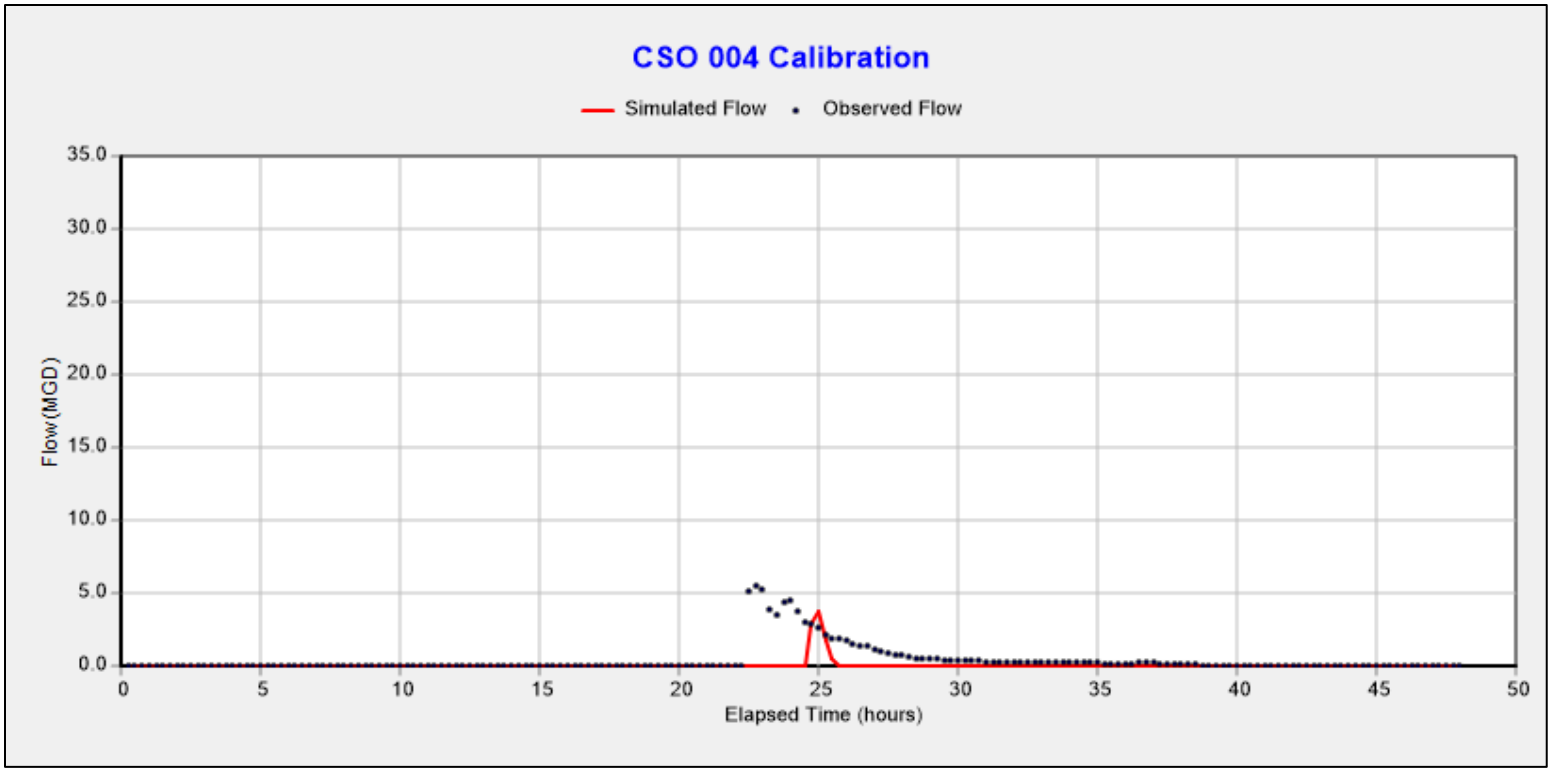
CSO Calibration Plots

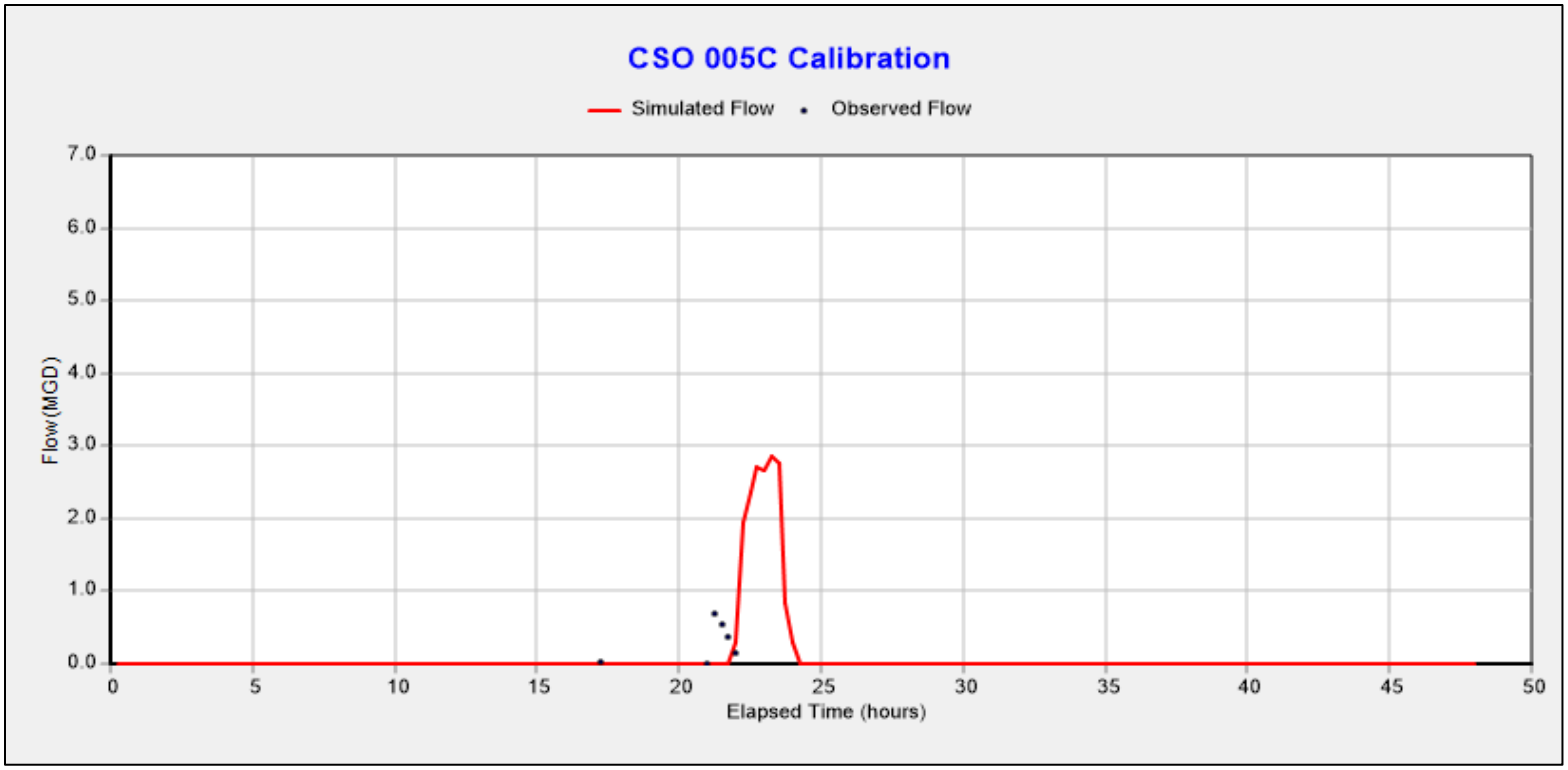
Calibration Storm No. 1

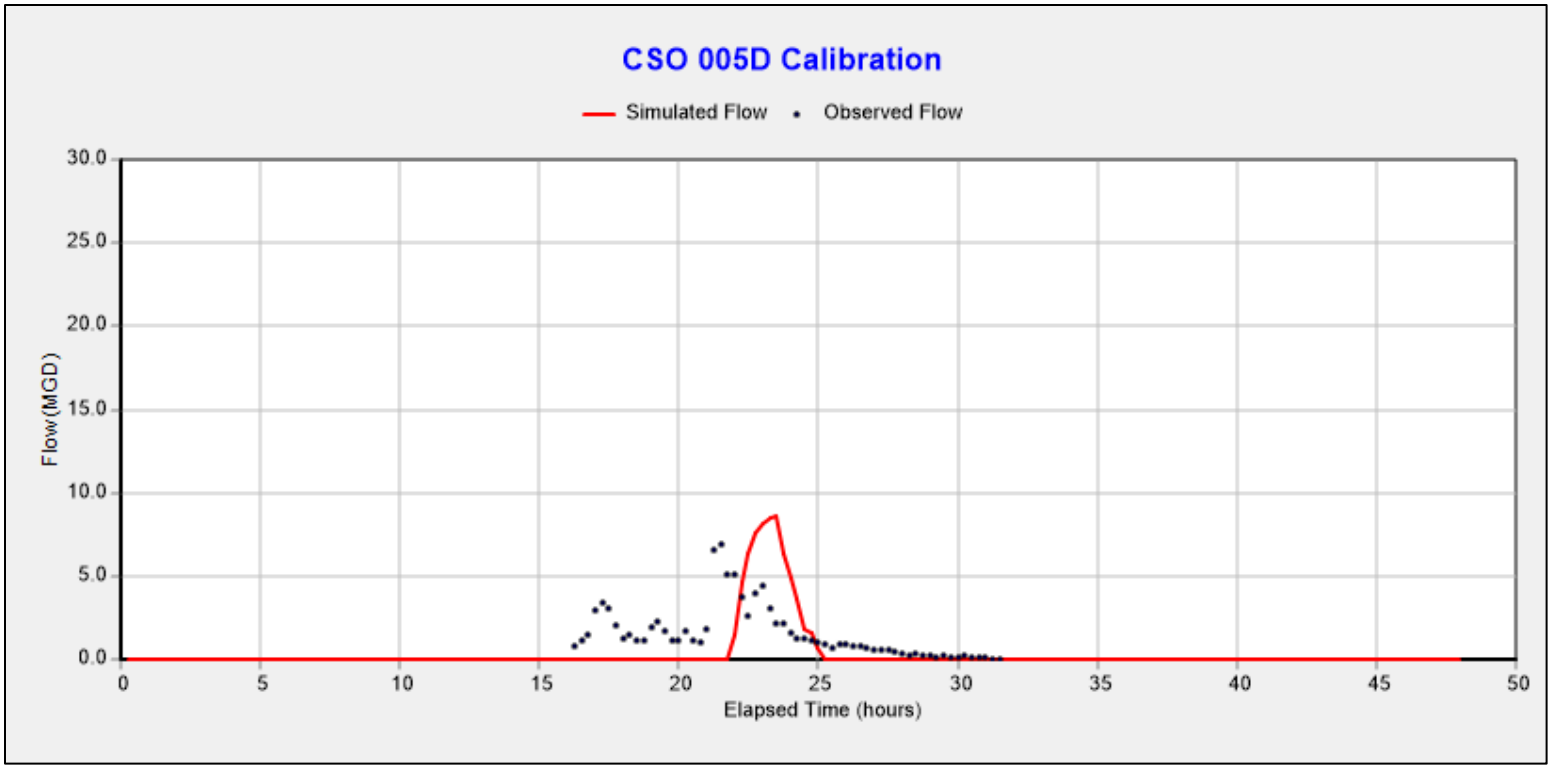
Date:	April 16th, 2018
Duration:	15 hours
Total Precipitation:	2.34 inches
Peak Intensity:	0.48 inches/hour
Recurrence Interval:	1-year

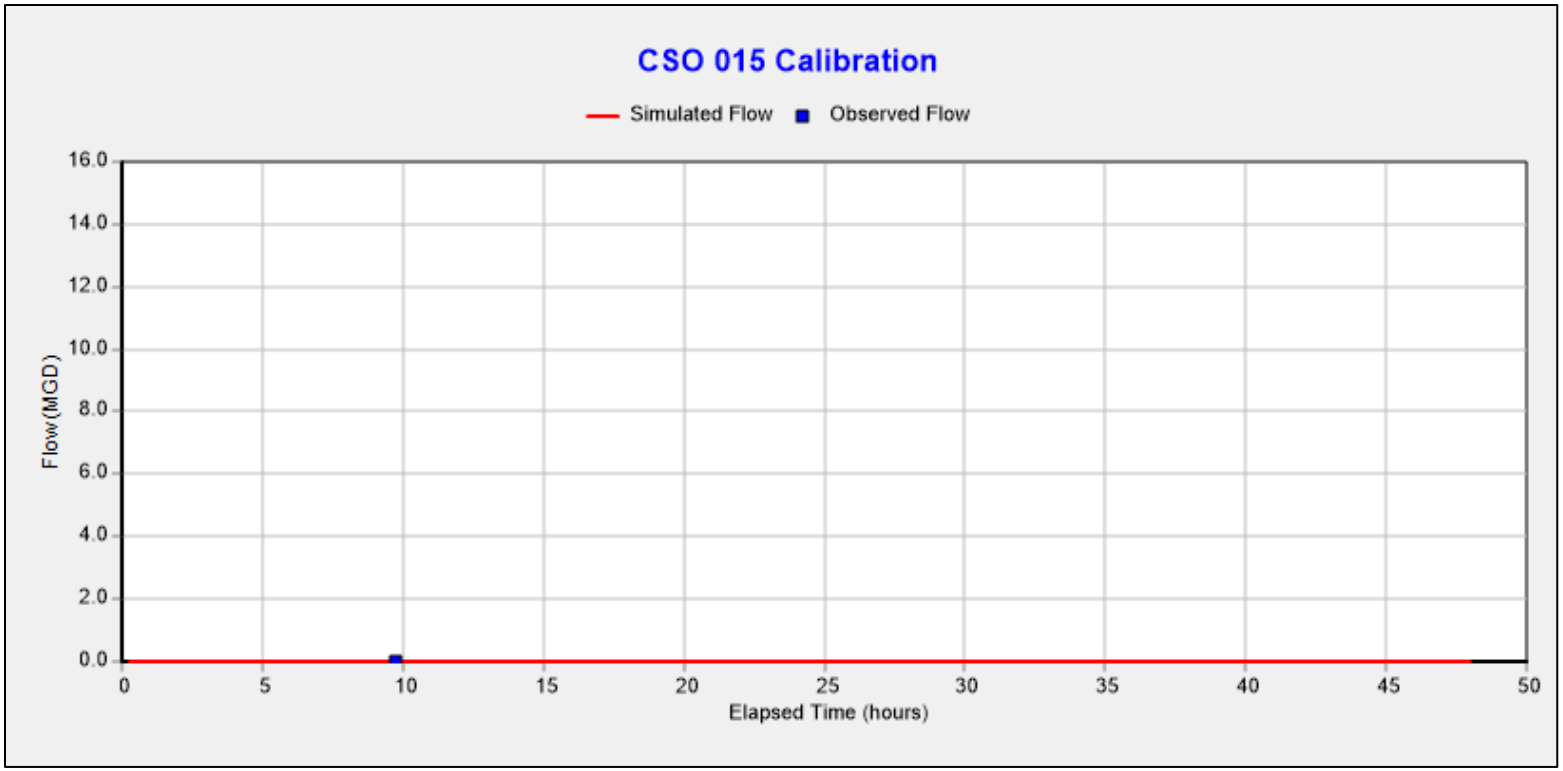


*CSO 003 flow meter was not functioning during this storm event.

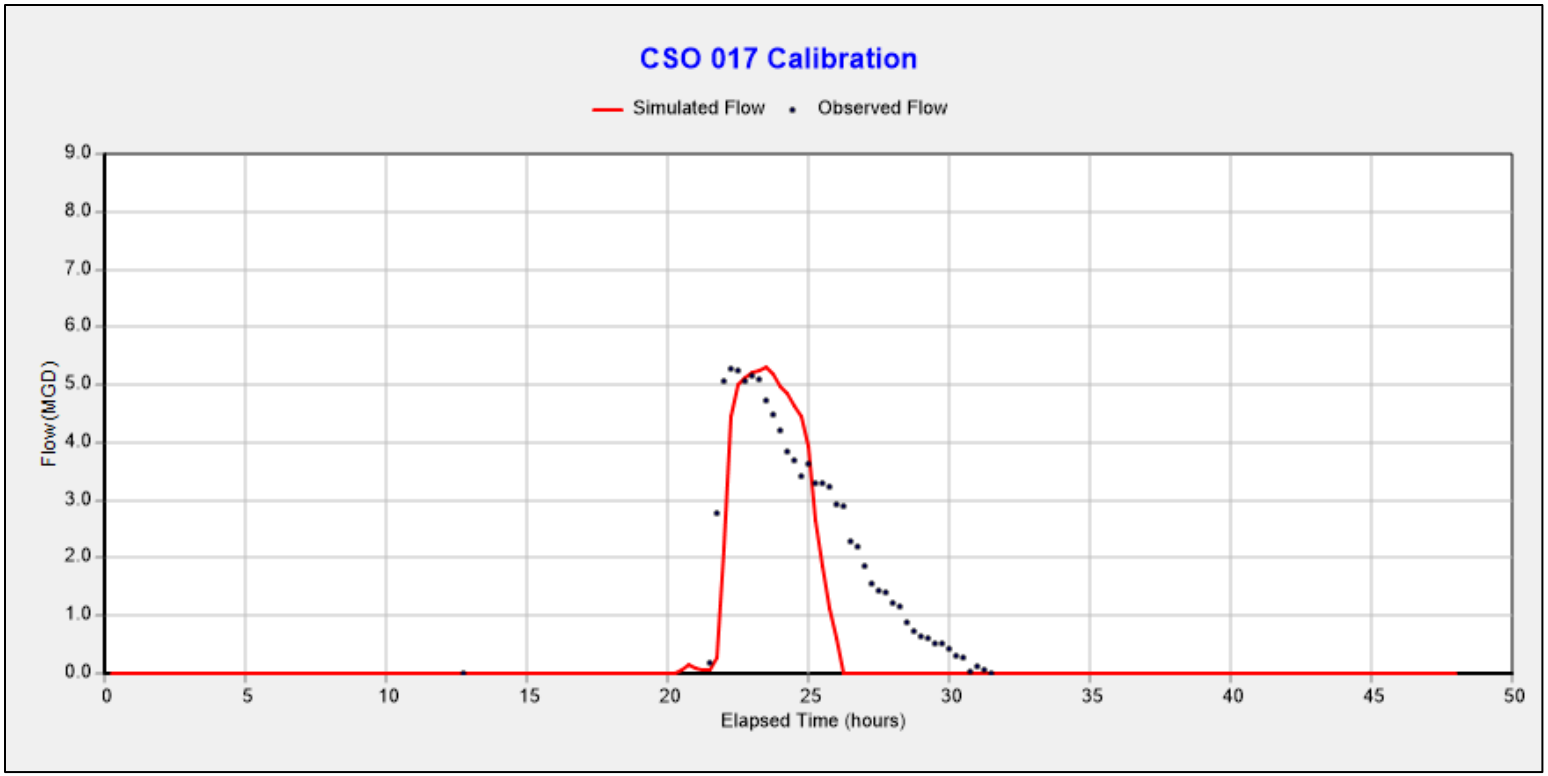

CSO 004 Calibration
Simulated Flow
Observed Flow
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow(MGD)
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)

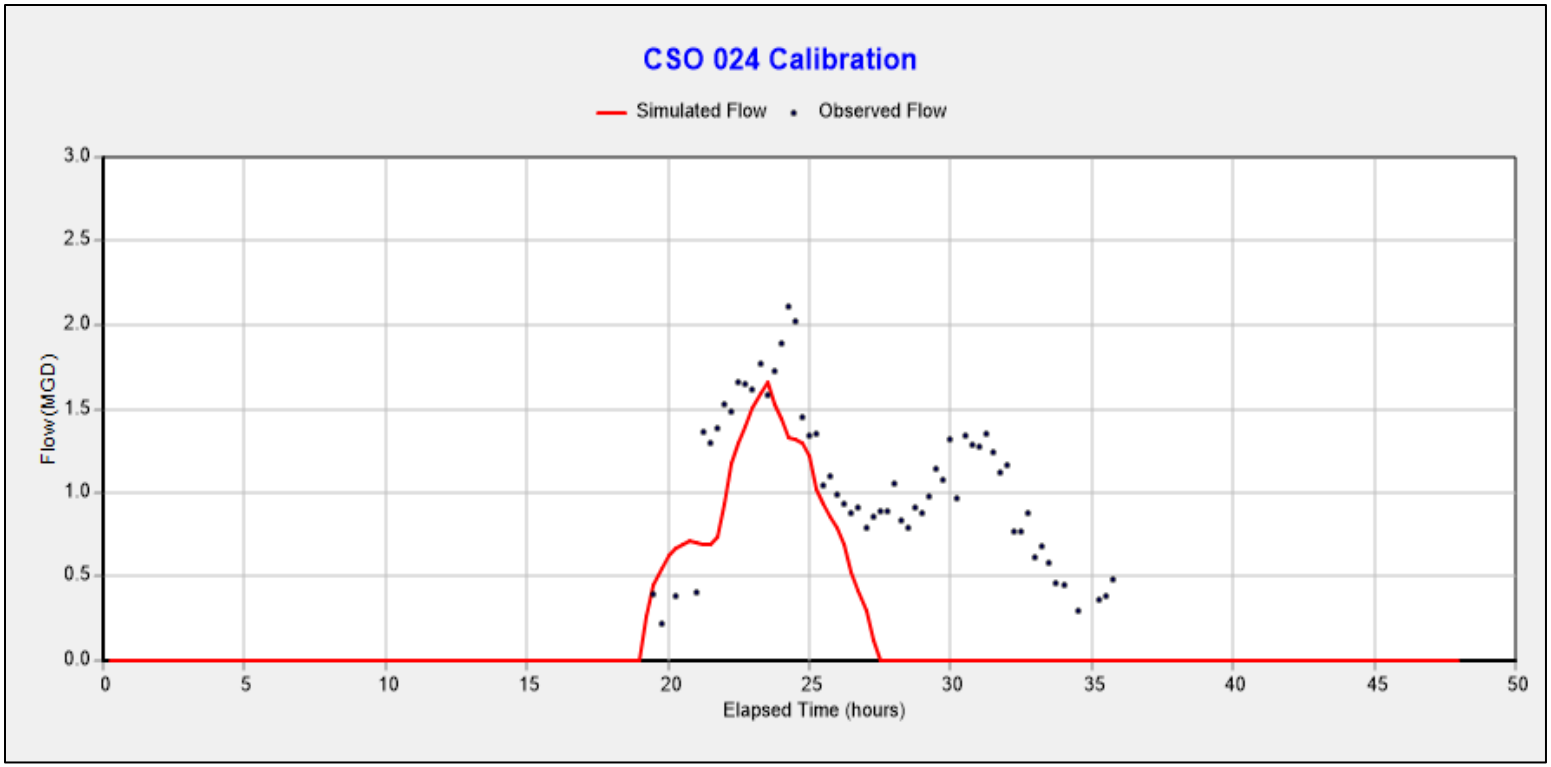

CSO 005C Calibration
Simulated Flow
Observed Flow
Flow (MGD)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)

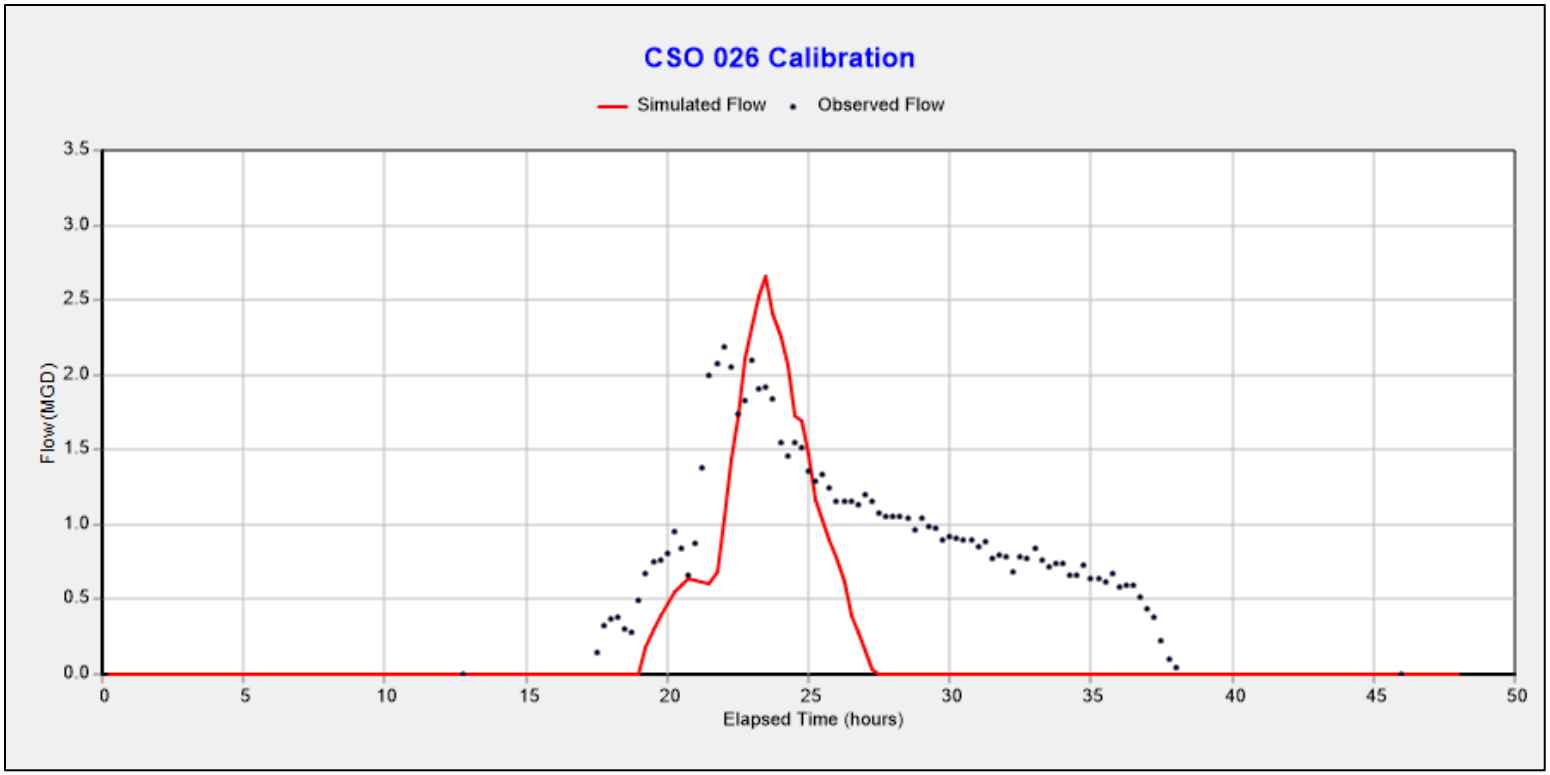

CSO 005D Calibration
Simulated Flow
Observed Flow
Flow(MGD)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)

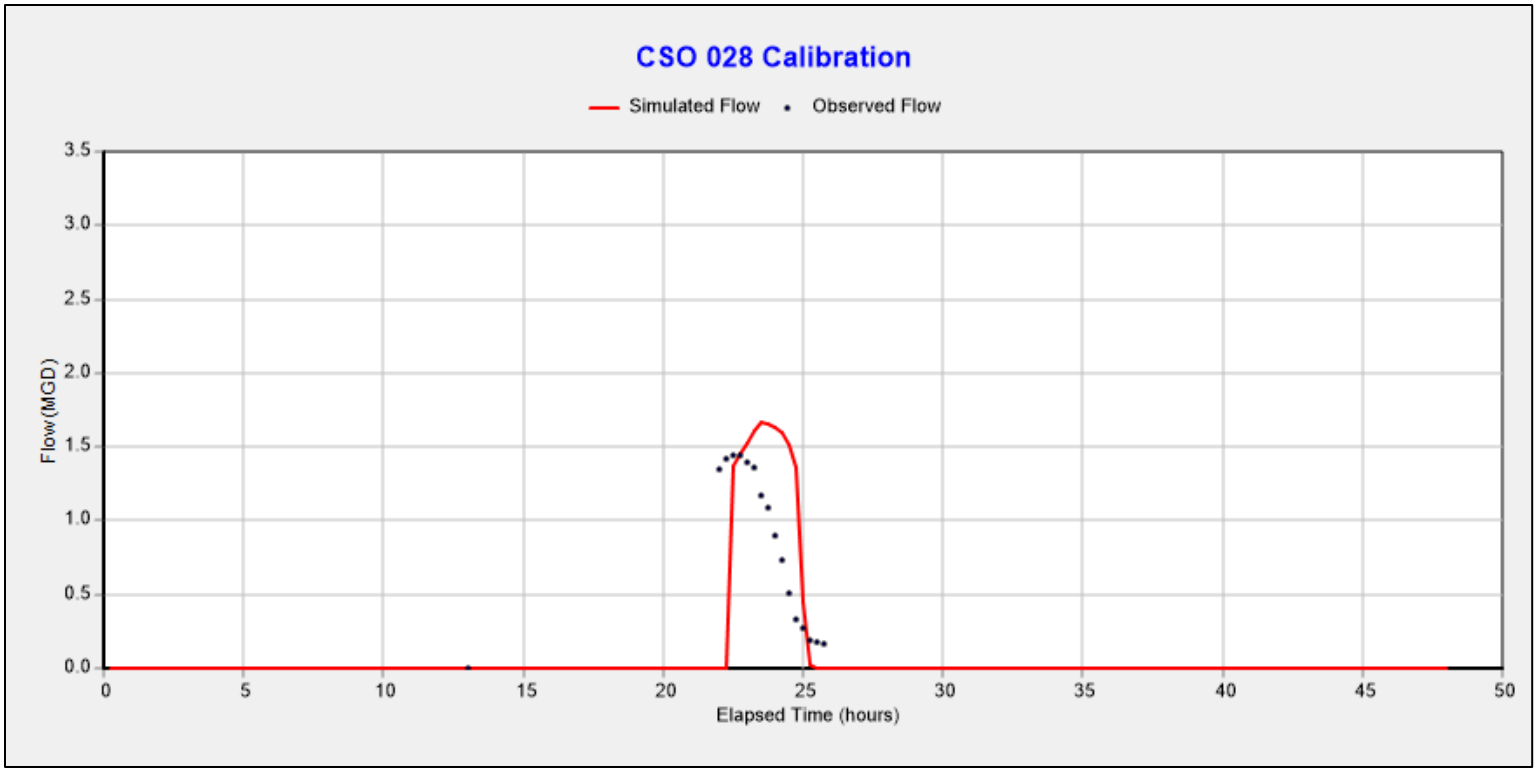


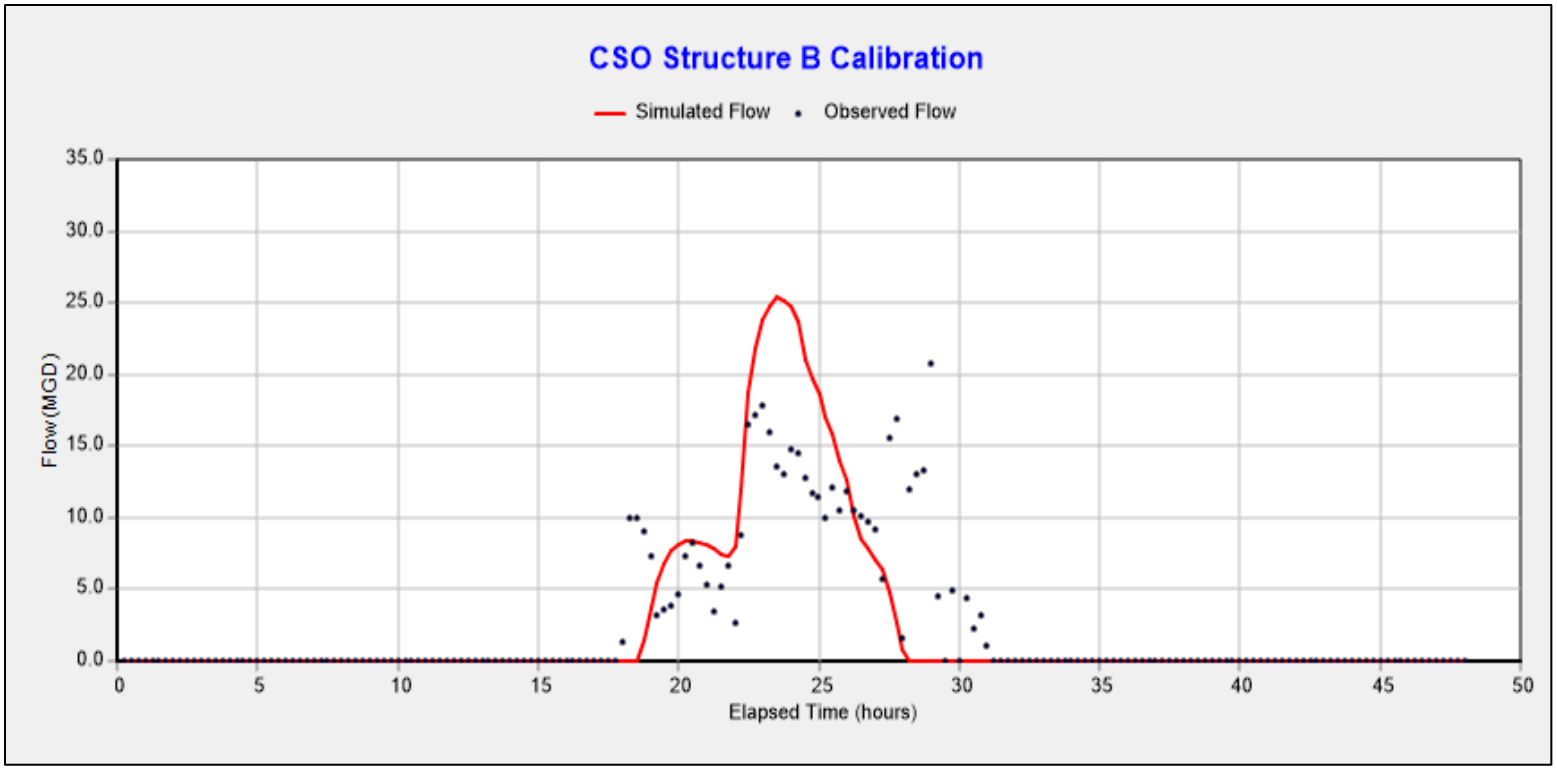
*CSO 015 did not overflow during this storm event.

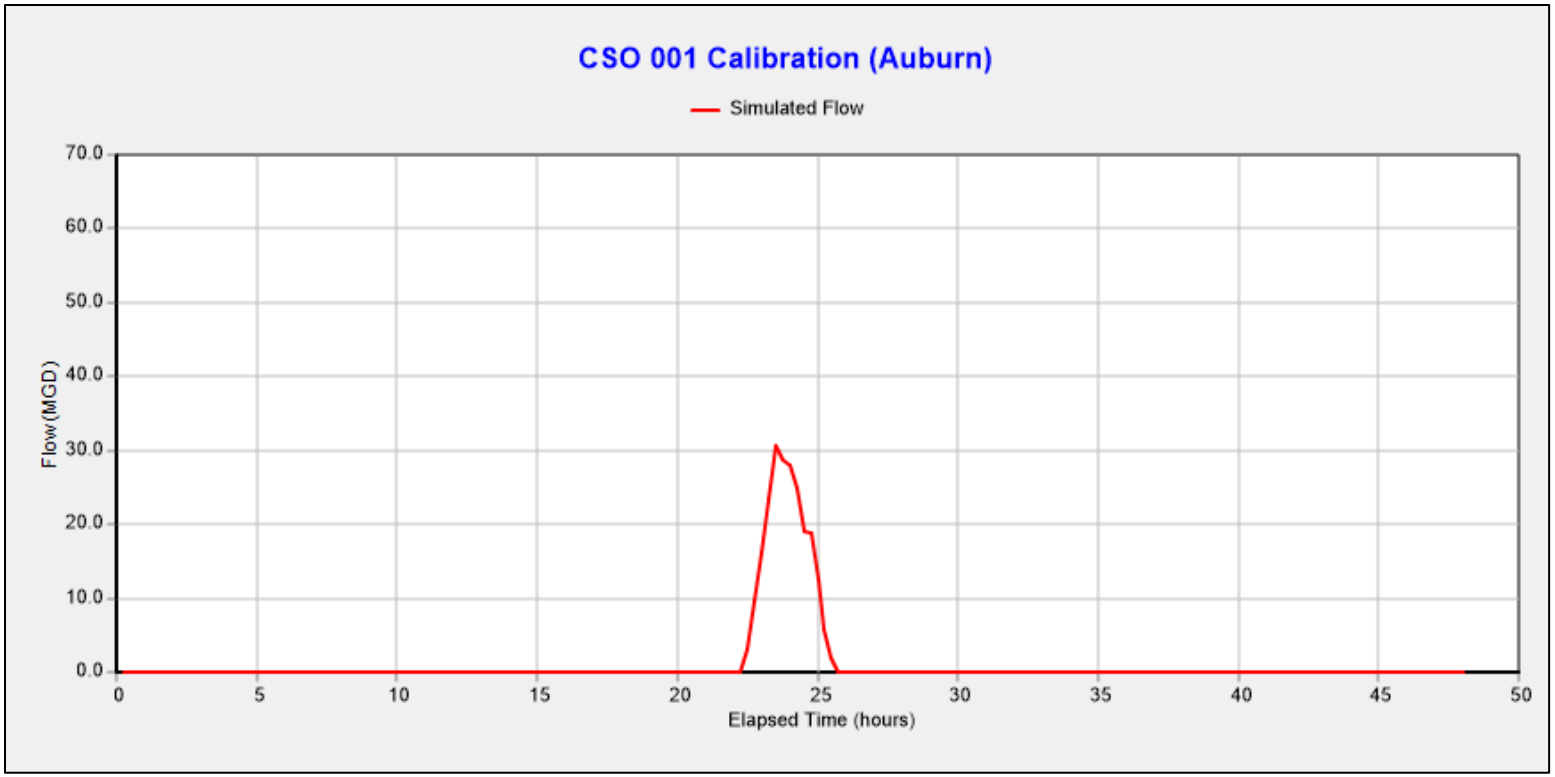

CSO 017 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)


CSO 024 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)


CSO 026 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)


CSO 028 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)

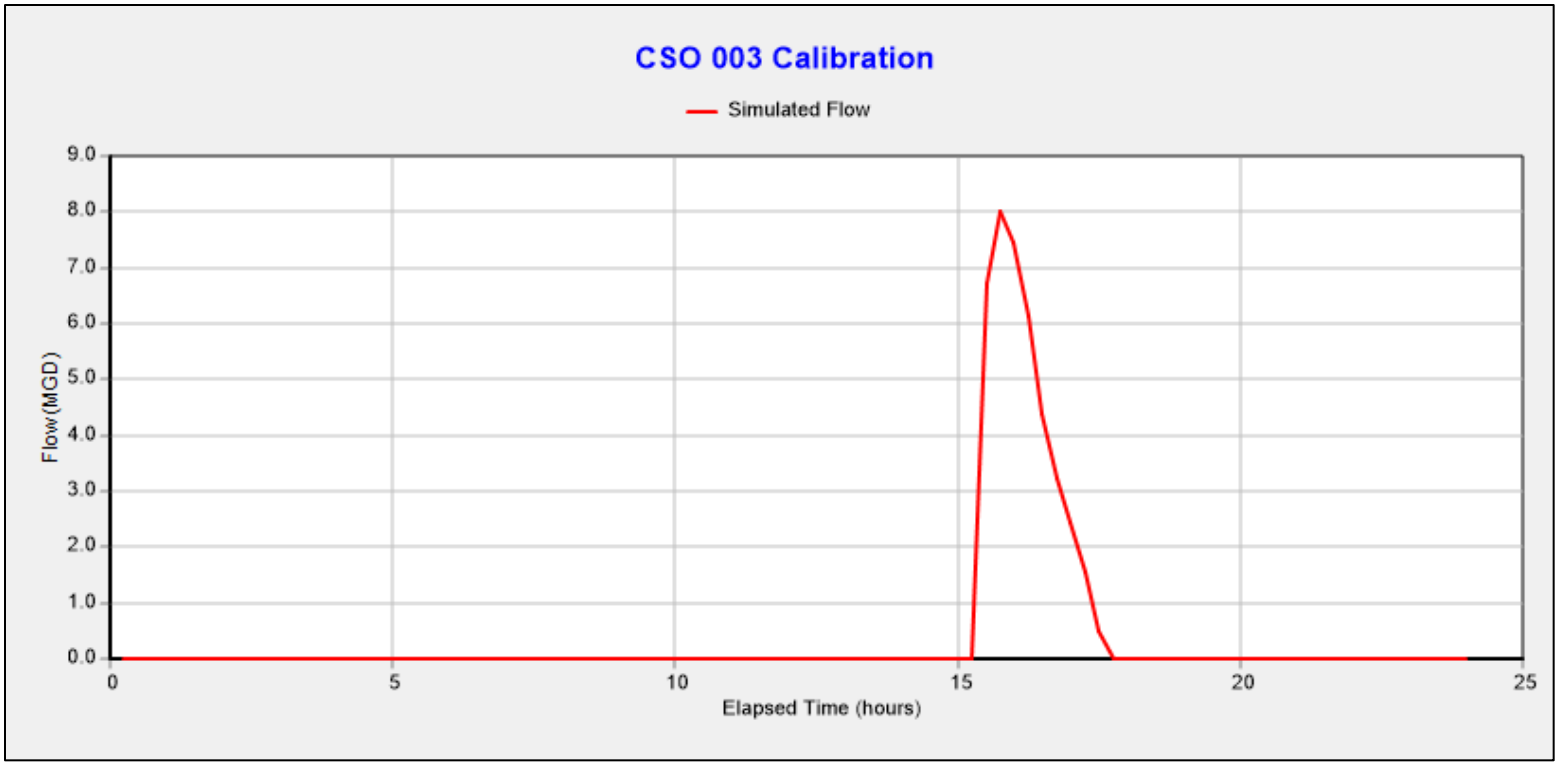

CSO Structure B Calibration
Simulated Flow
Observed Flow
Flow (MGD)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
5
10
15
20
25
30
35
40
45
50
Elapsed Time (hours)



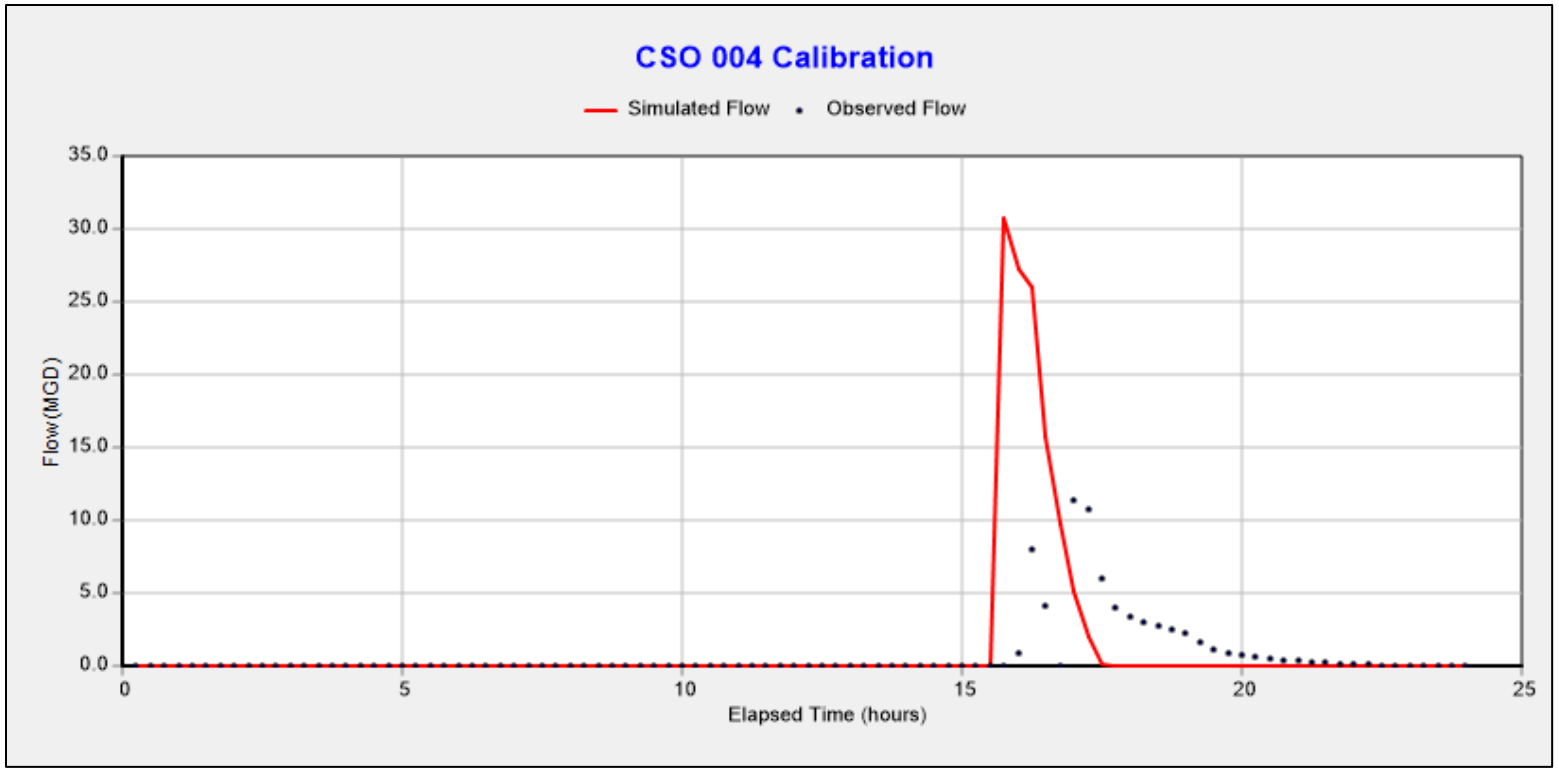
*Overflow data was not available for Auburn CSO 001.

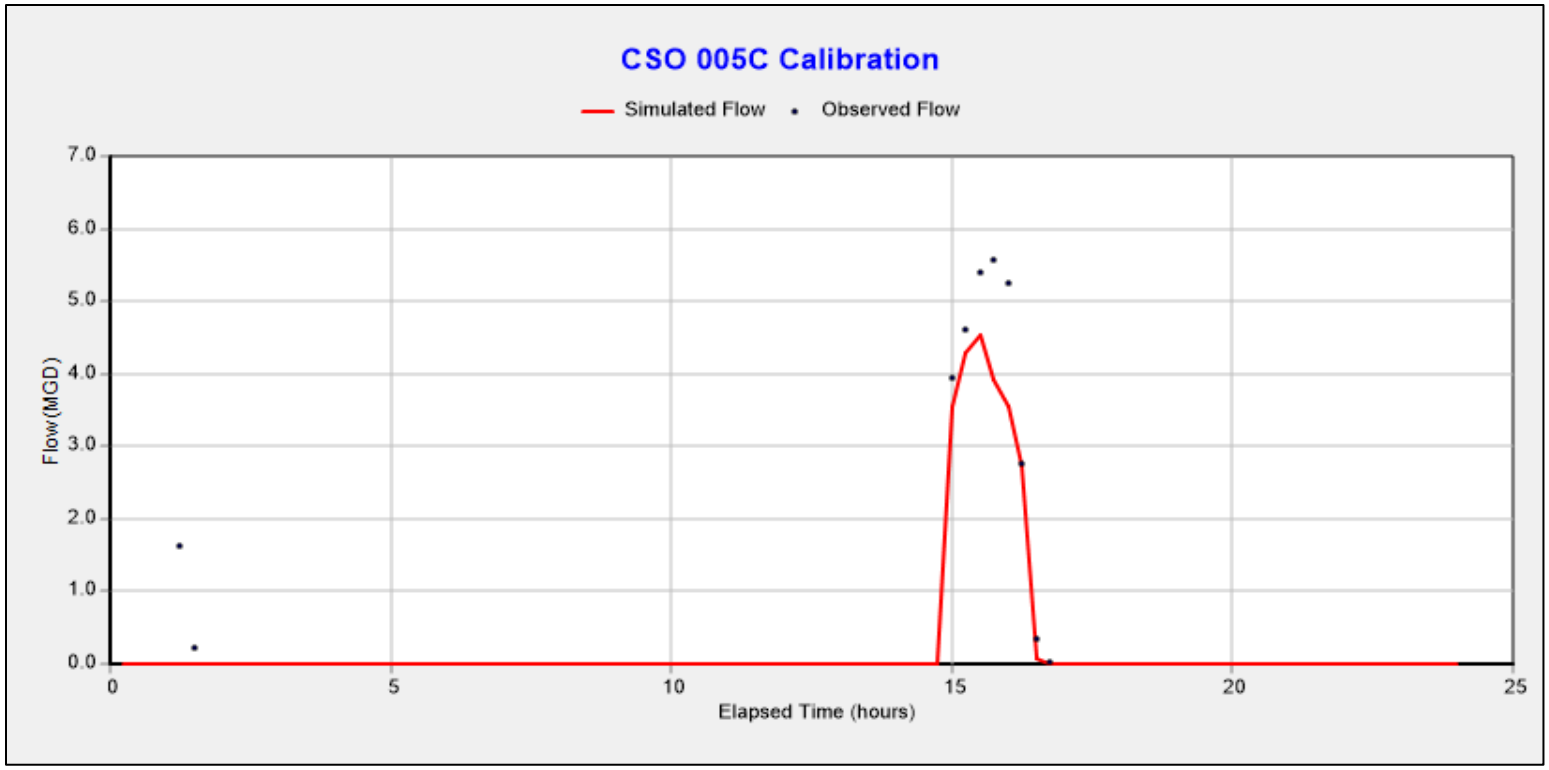
Calibration Storm No. 2

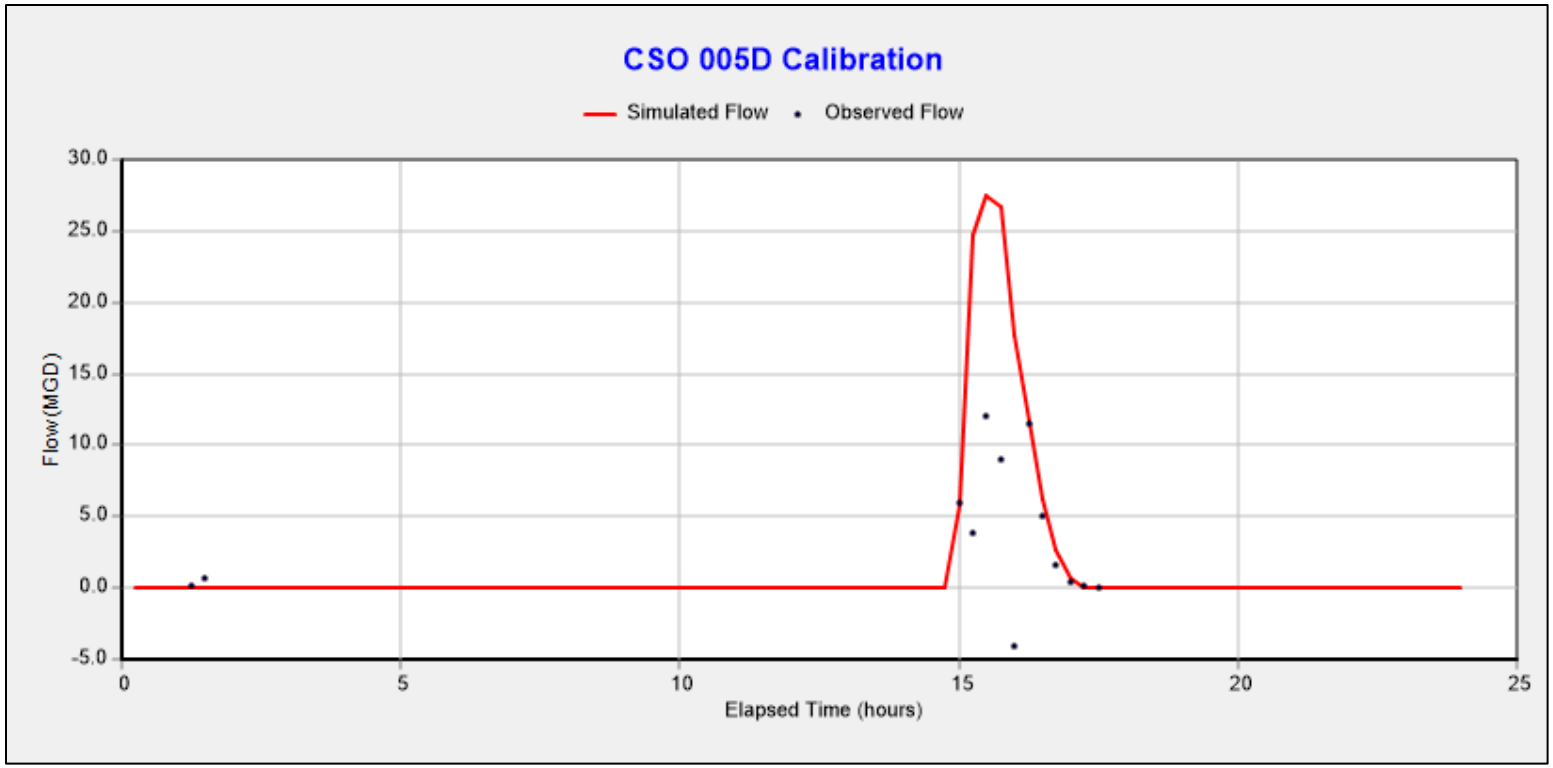
Date:	July 26th, 2018
Duration:	2 hours
Total Precipitation:	2.71 inches
Peak Intensity:	2.35 inches/hour
Recurrence Interval:	5-year



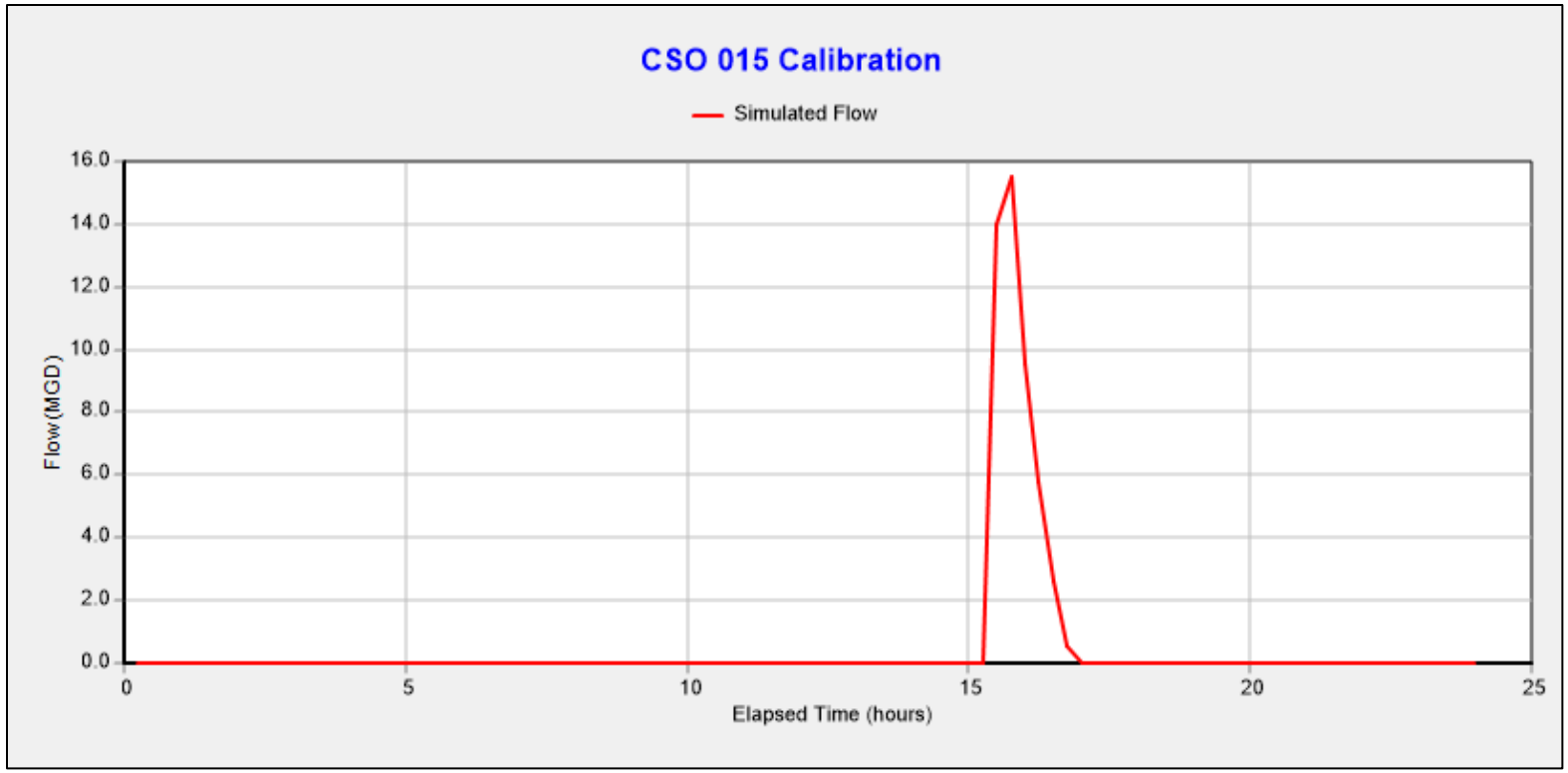
*CSO 003 flow meter was not functioning during this storm event.

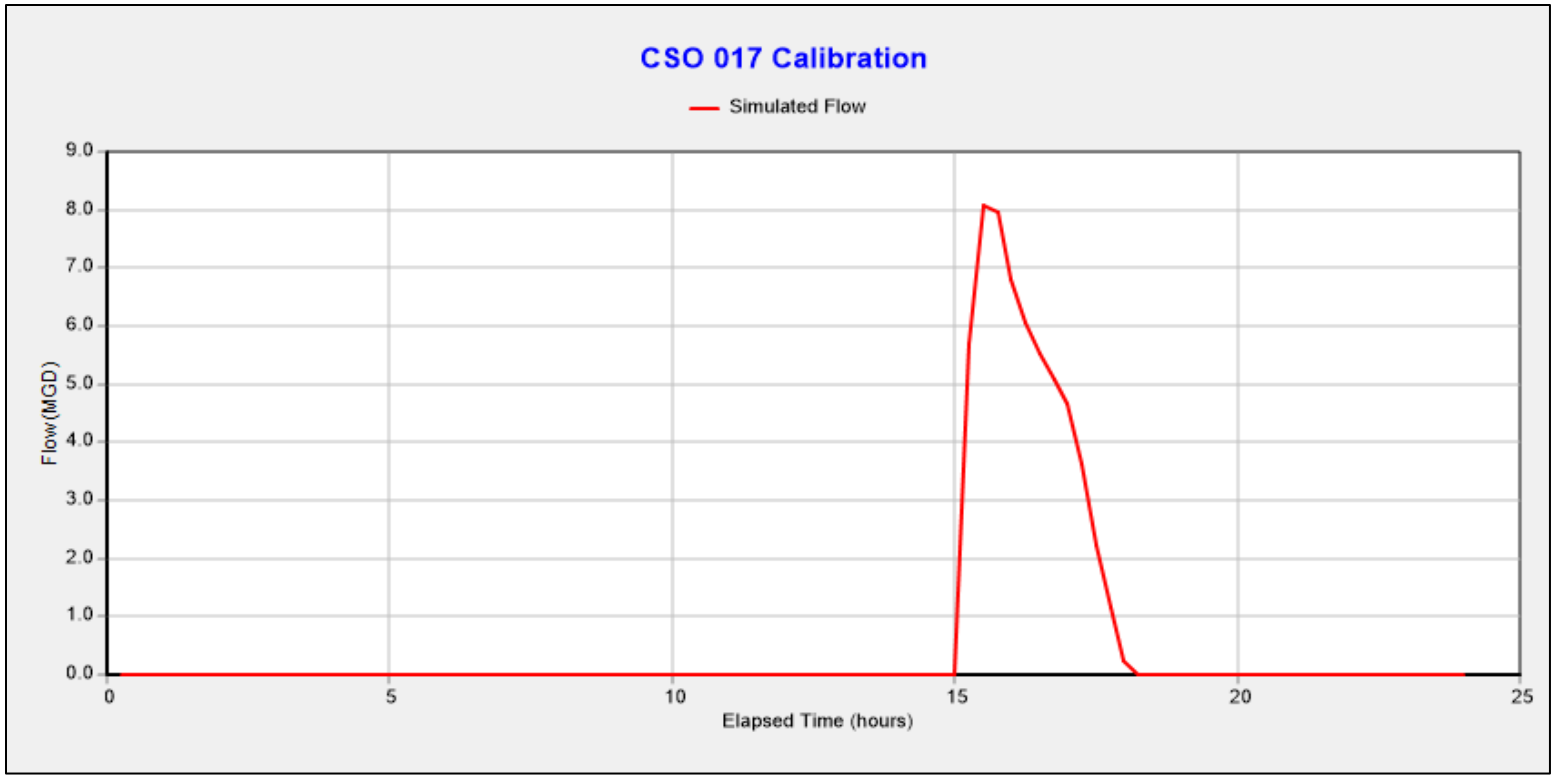

CSO 004 Calibration
Simulated Flow
Observed Flow
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow(MGD)
0
5
10
15
20
25
Elapsed Time (hours)


CSO 005C Calibration
Simulated Flow
Observed Flow
Flow (MGD)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
5
10
15
20
25
Elapsed Time (hours)

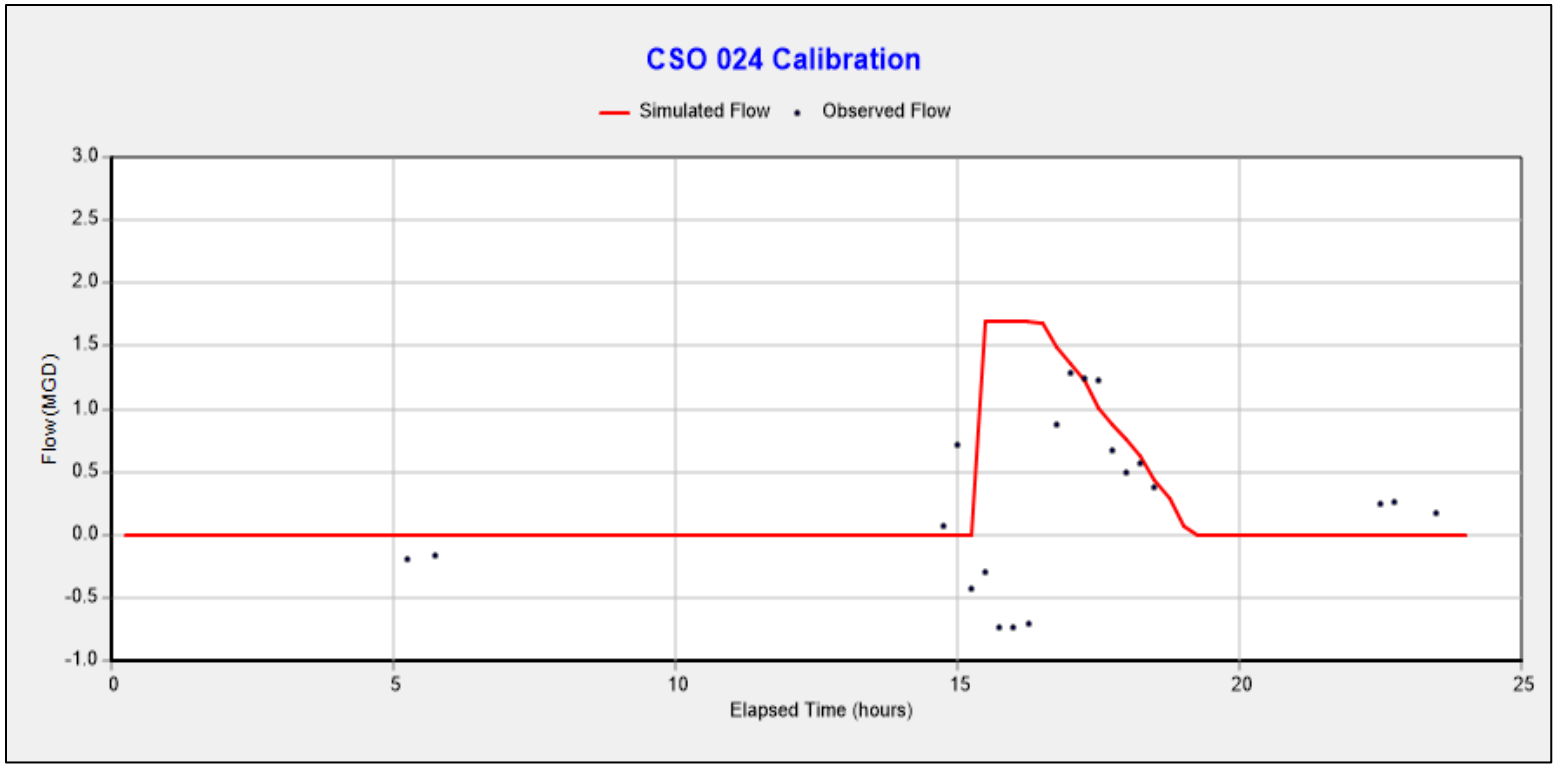


*Meter showed some instability as indicated by negative flow values.

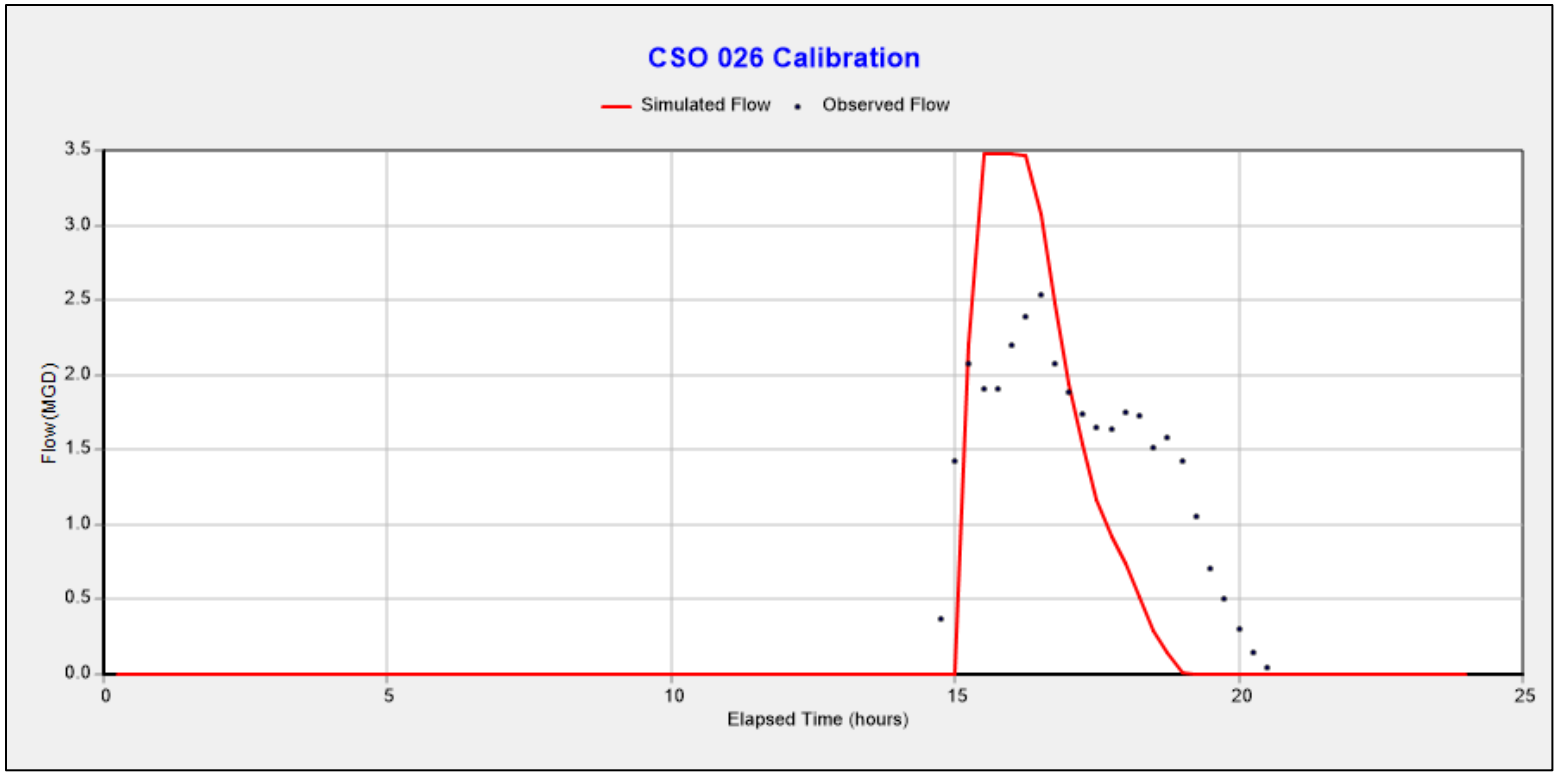

CSO 015 Calibration
Simulated Flow
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Flow (MGD)
0
5
10
15
20
25
Elapsed Time (hours)

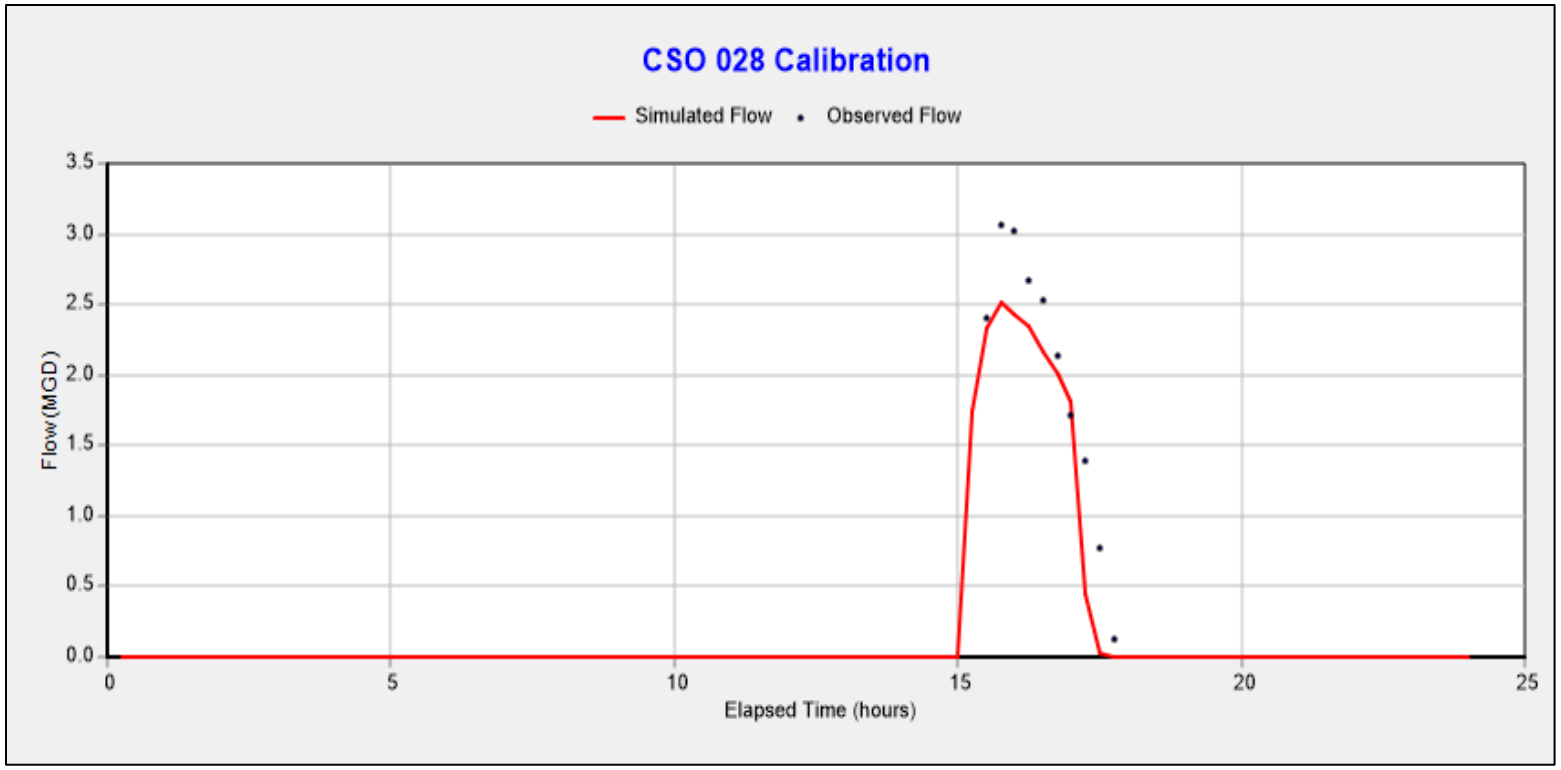


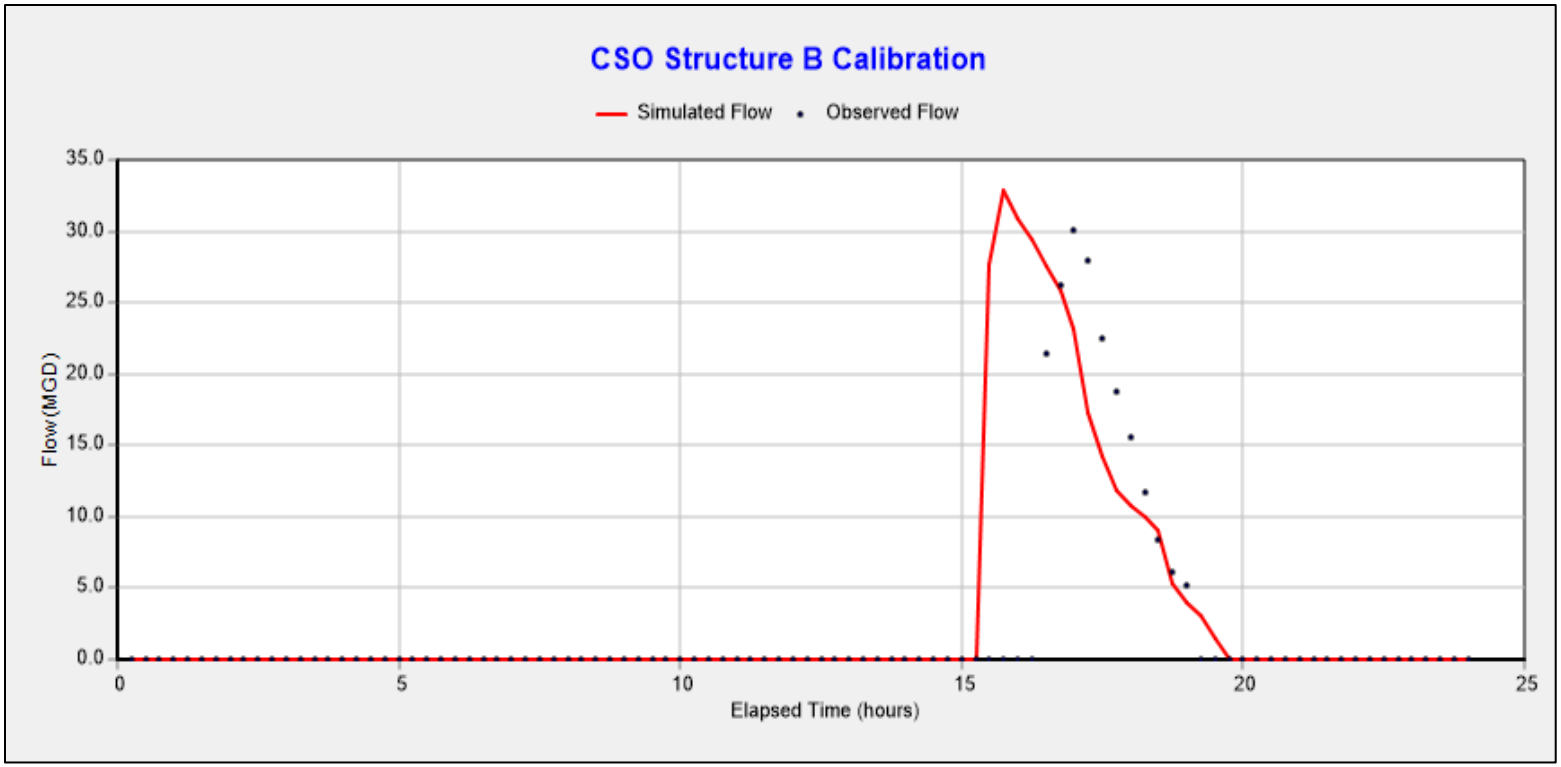
*CSO 017 flow meter was not operational during this storm.

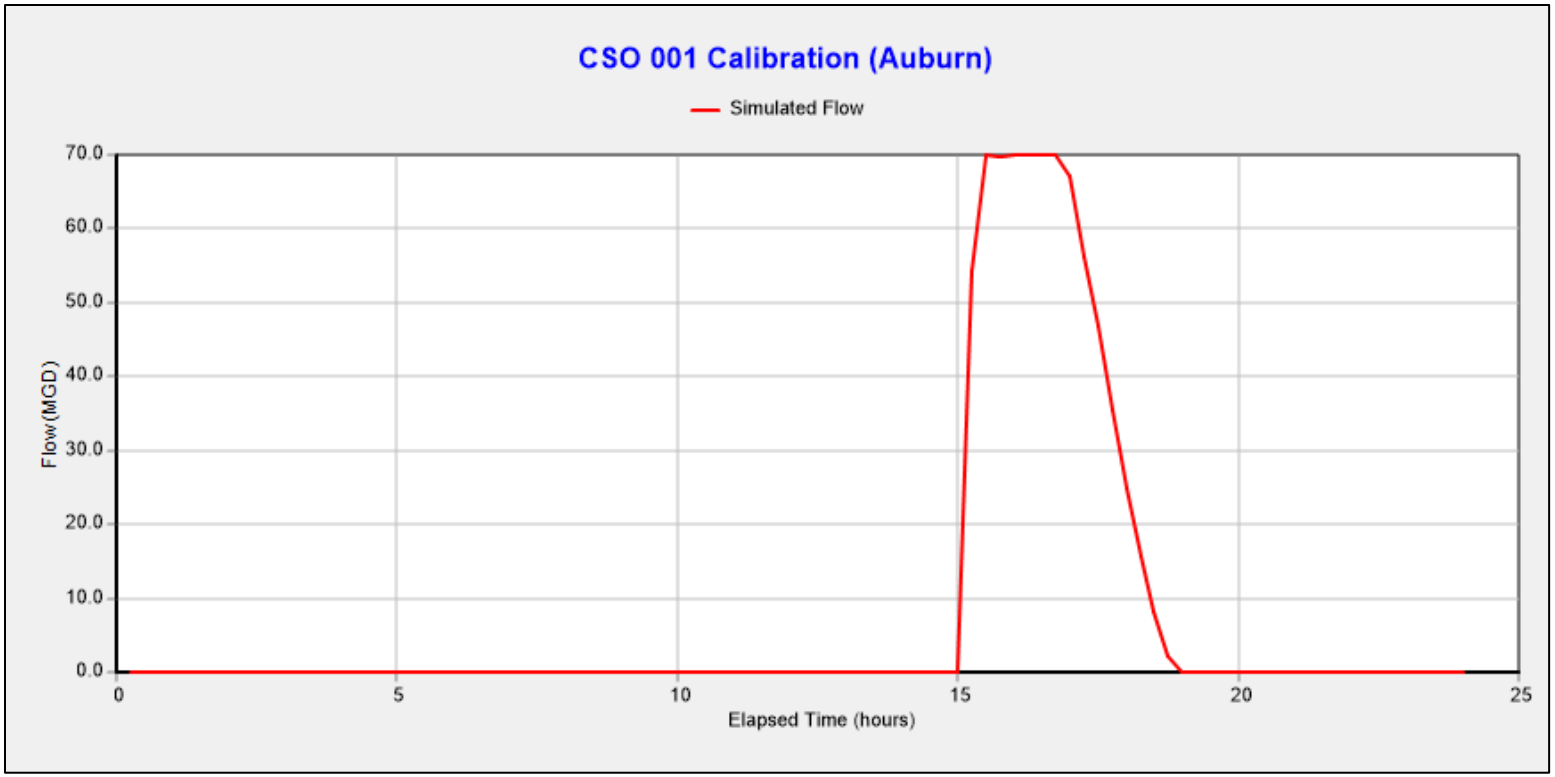


*Meter showed some instability as indicated by negative flow values.


CSO 026 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
Elapsed Time (hours)


CSO 028 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
Elapsed Time (hours)

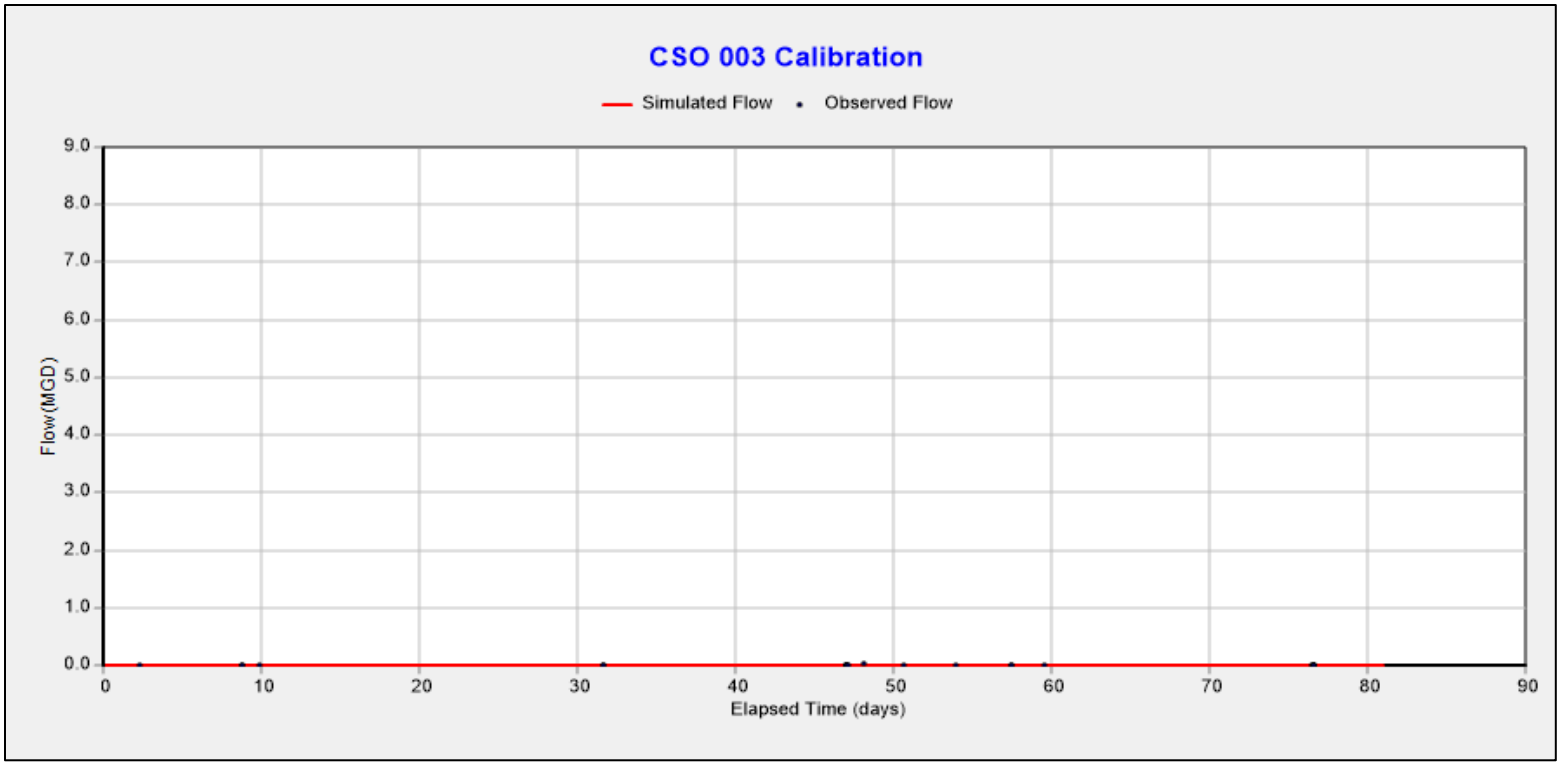

CSO Structure B Calibration
Simulated Flow
Observed Flow
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
5
10
15
20
25
Elapsed Time (hours)

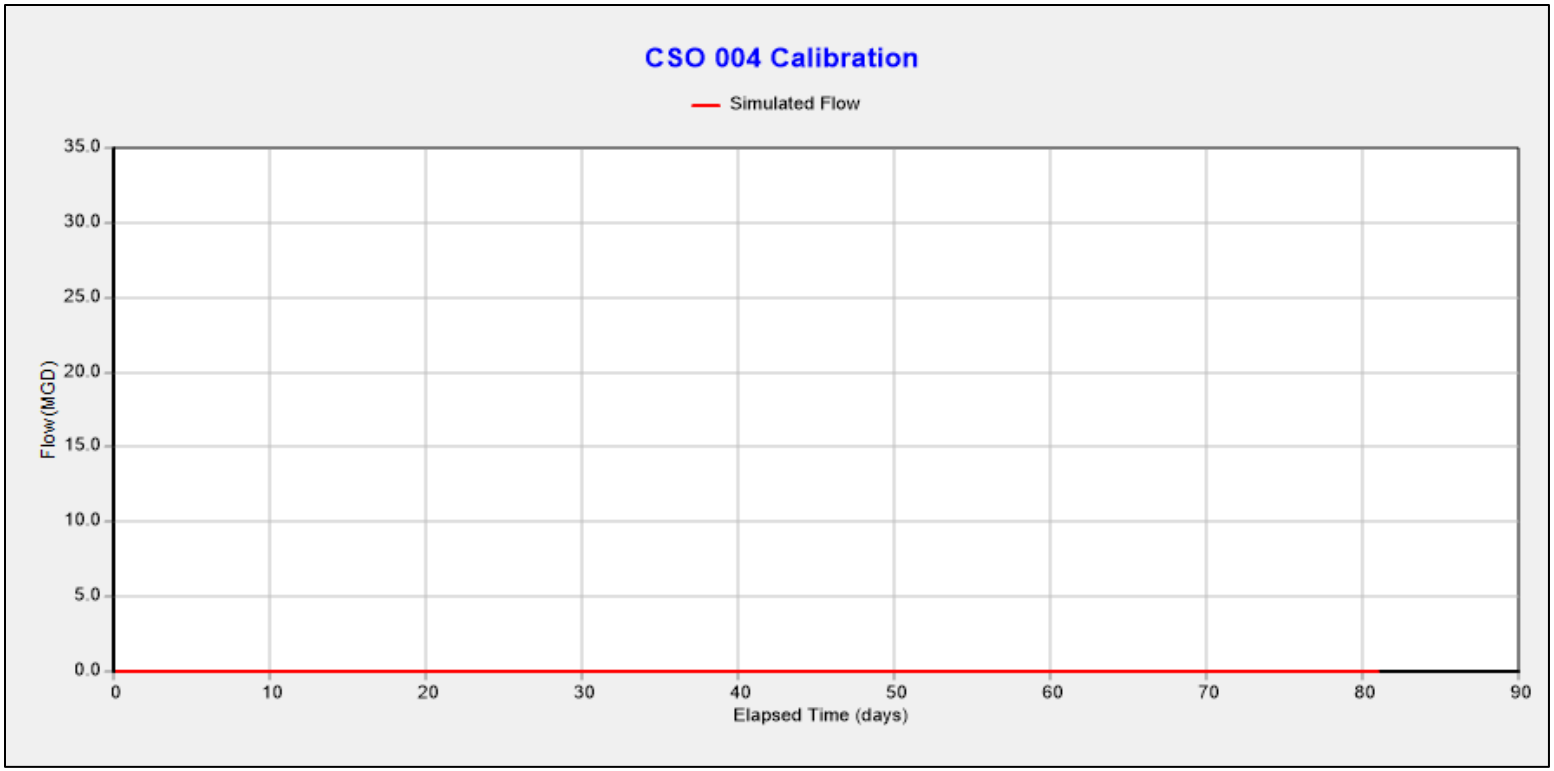


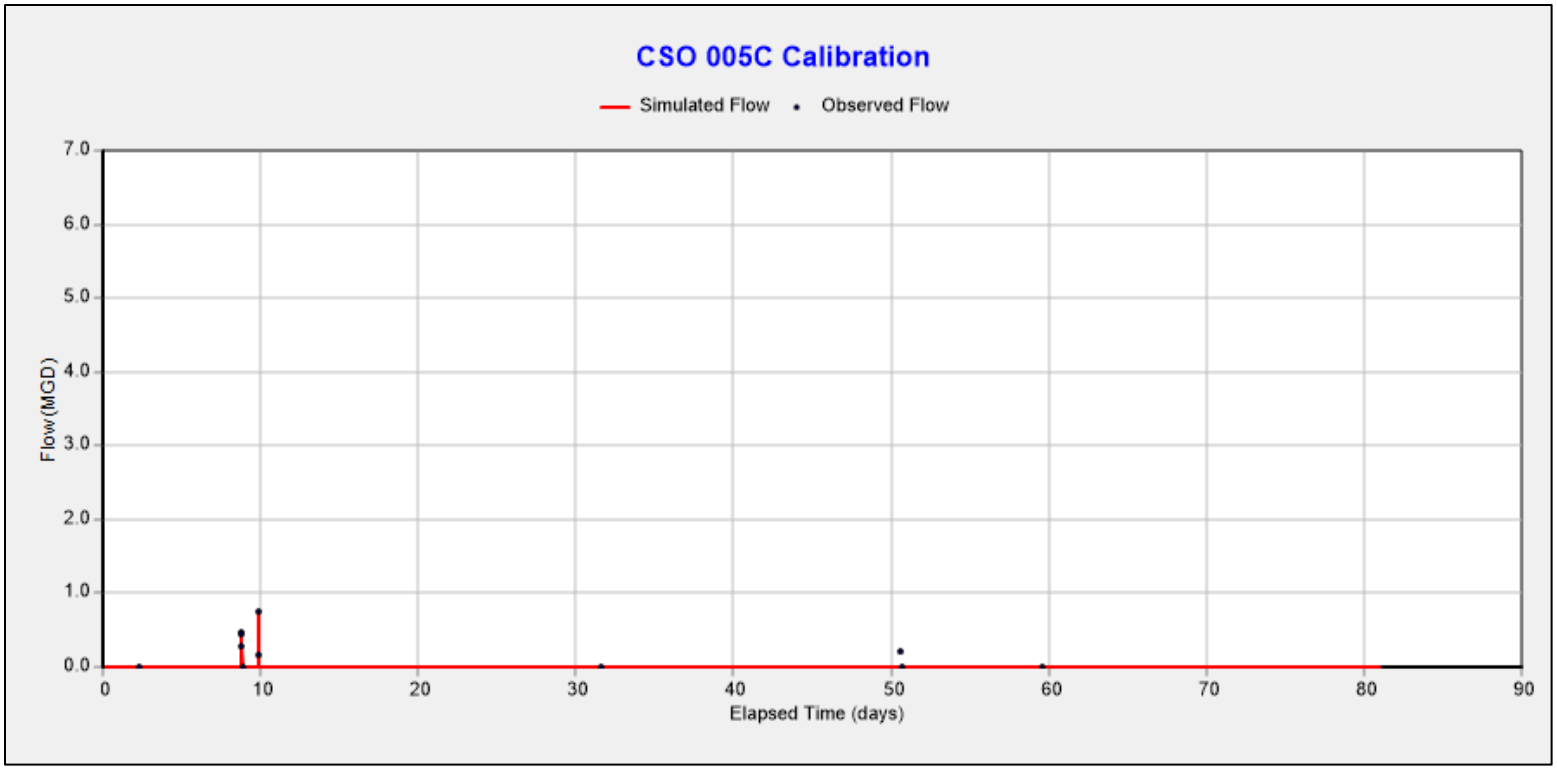
*Overflow data was not available for Auburn CSO 001.

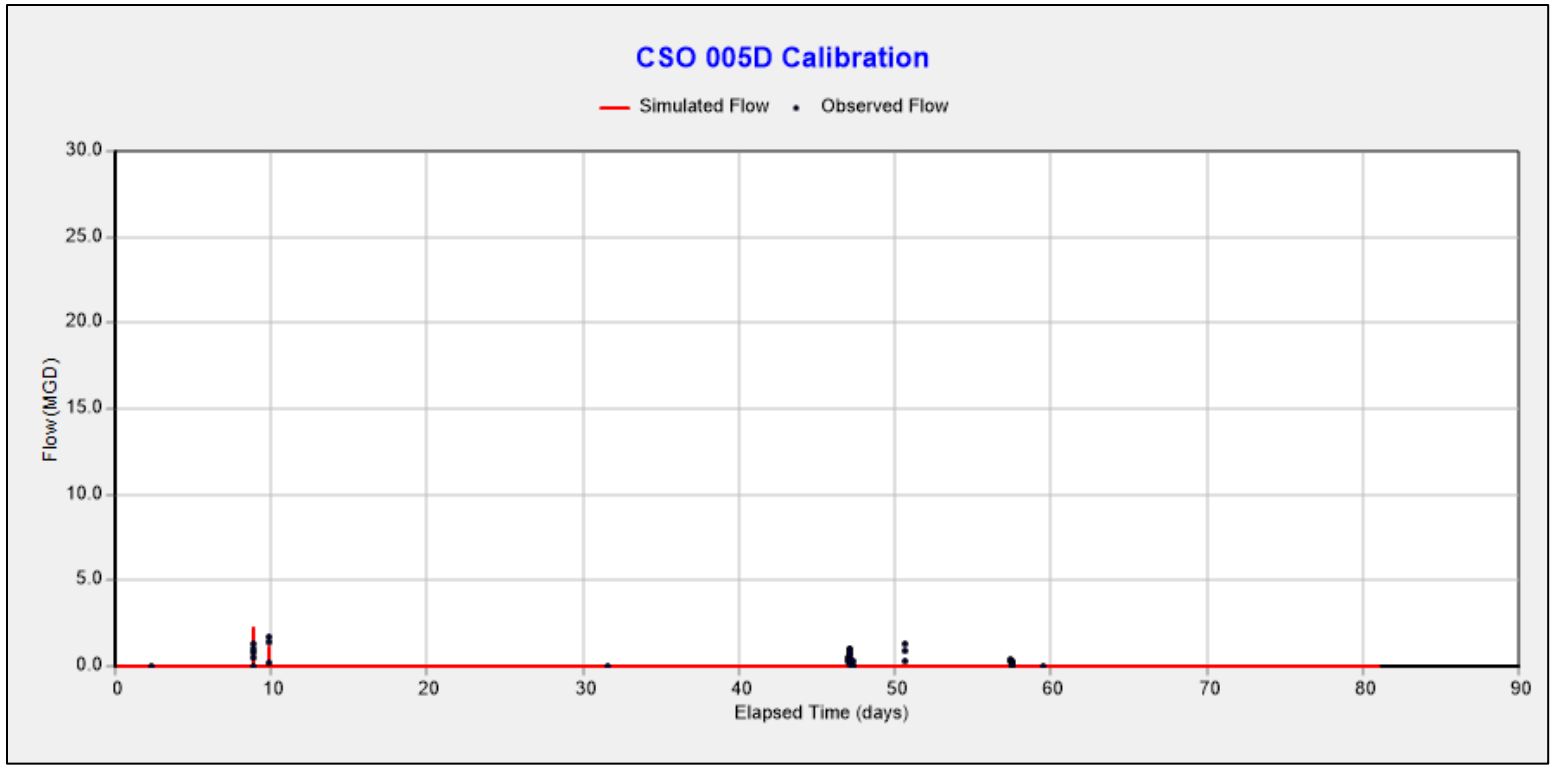
2018 Flow Assessment Period

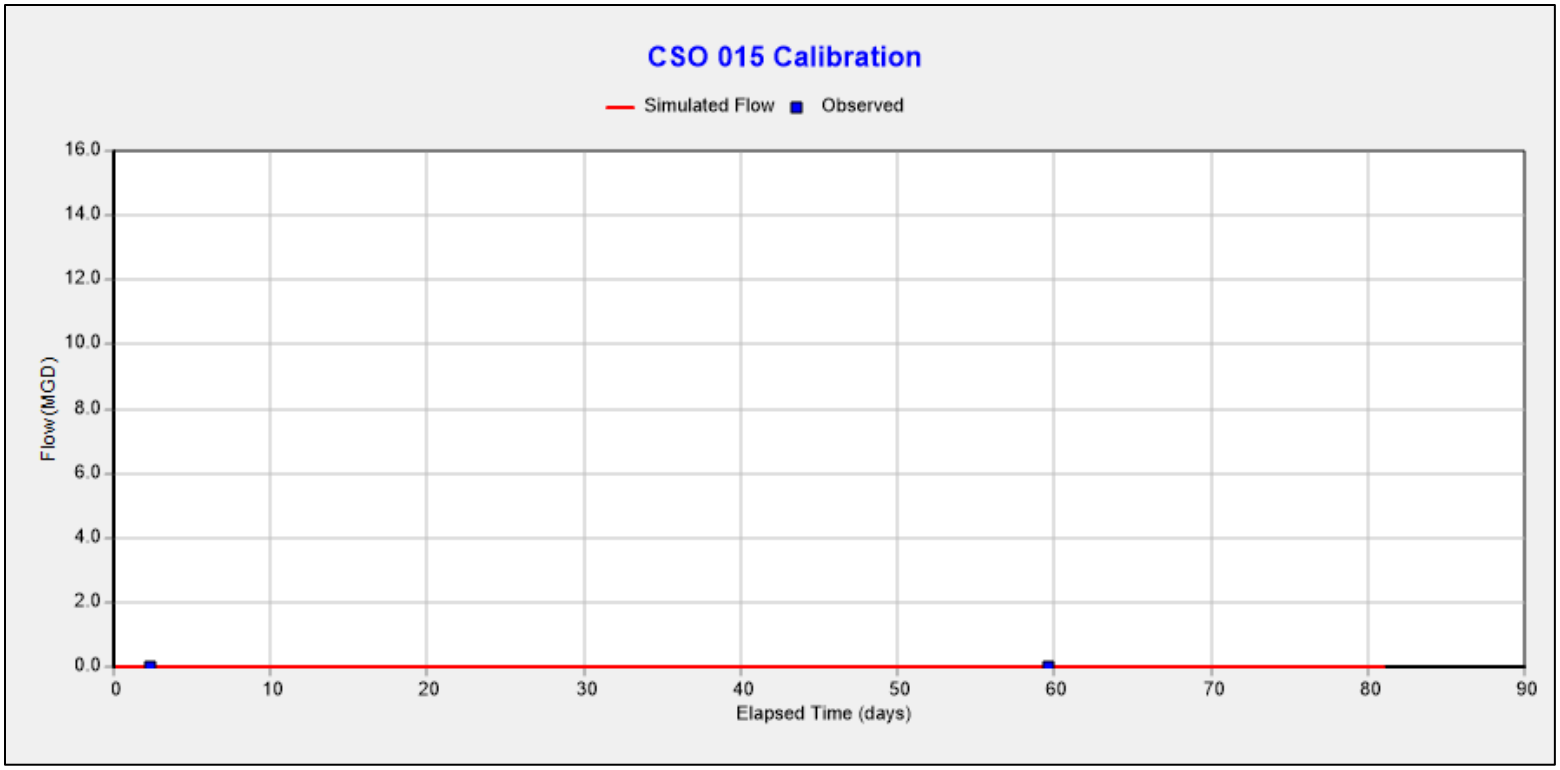
Start Date:	September 16th, 2018
End Date:	December 7th, 2018

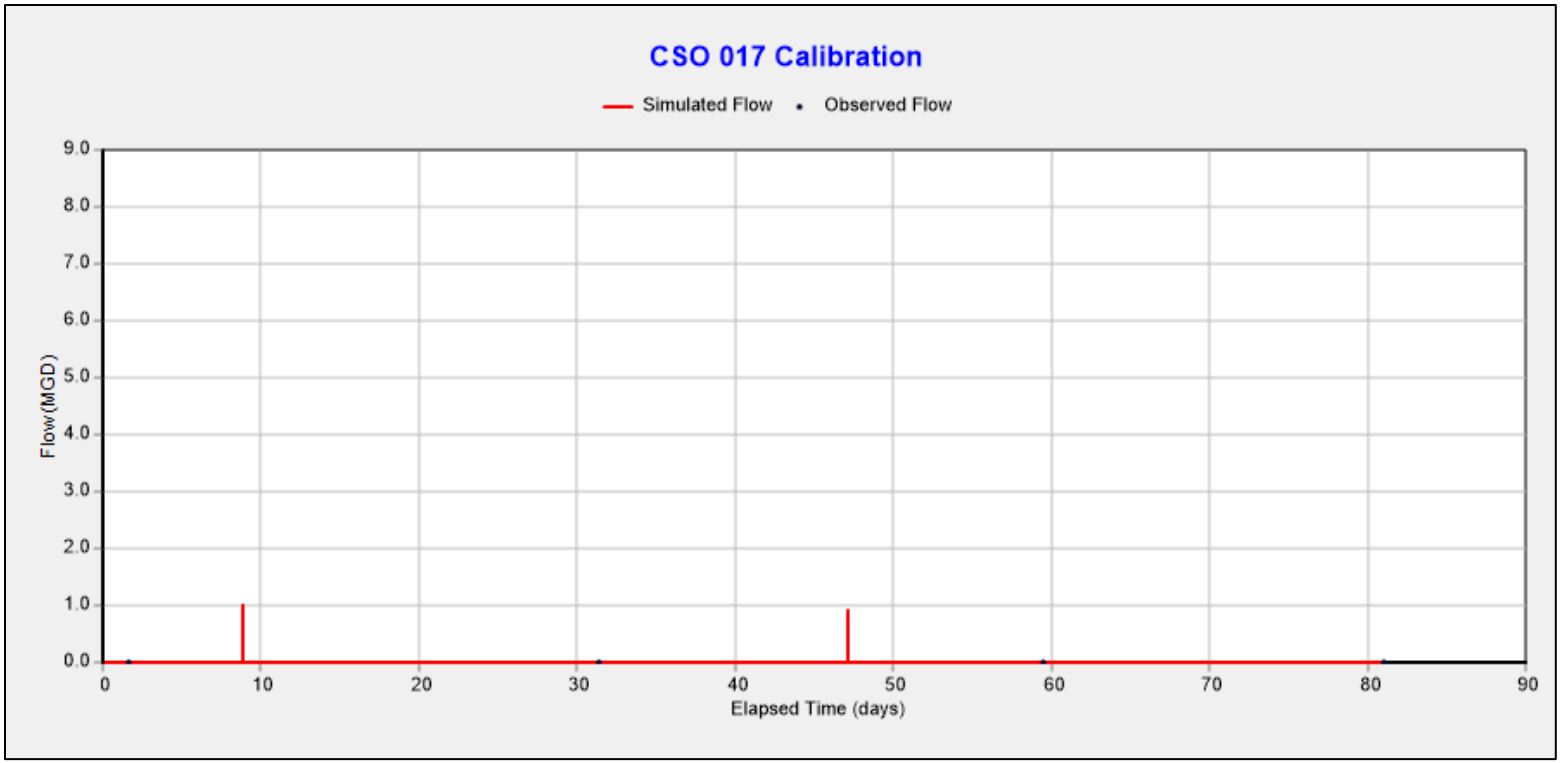

CSO 003 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)

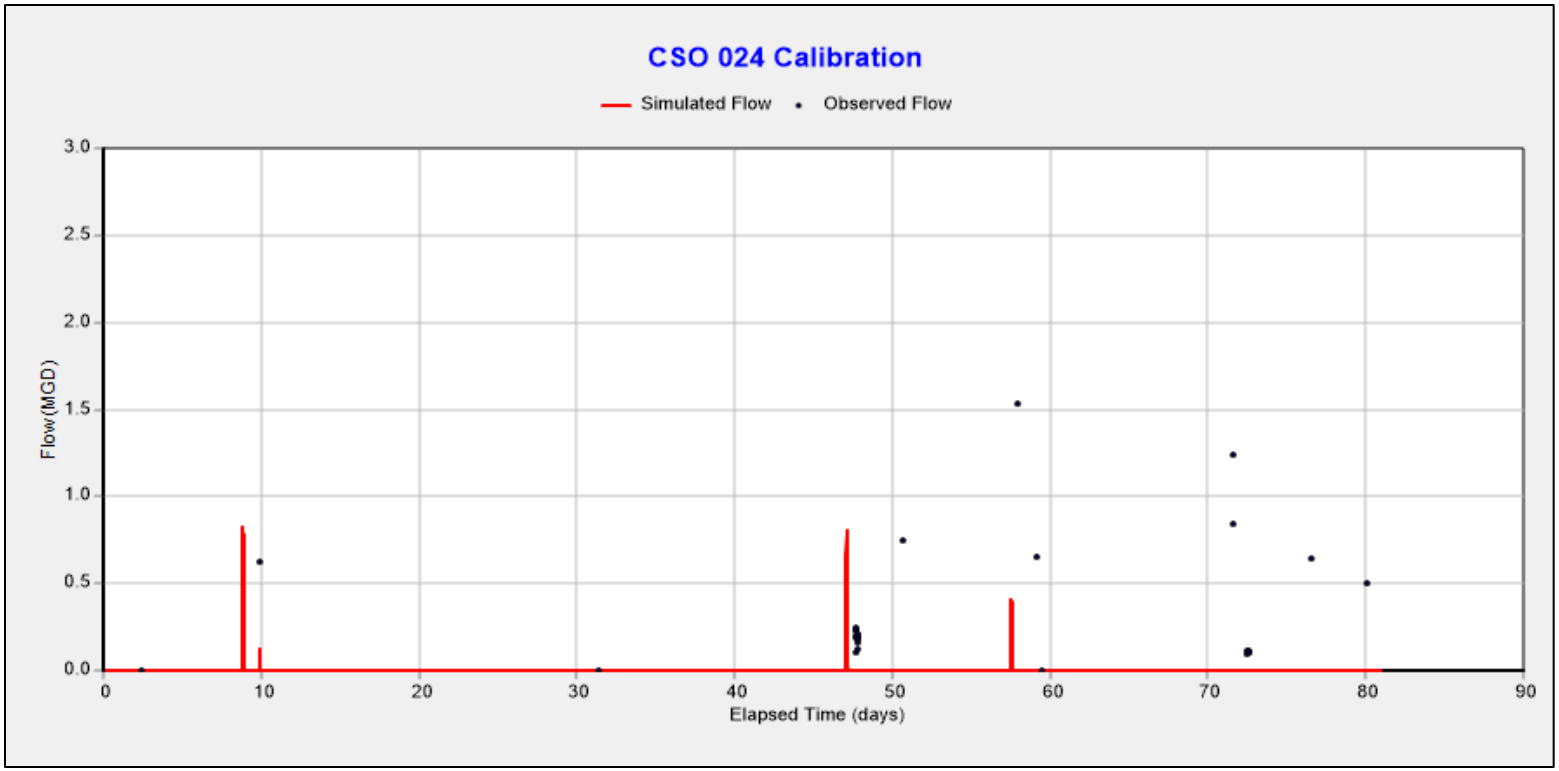

CSO 004 Calibration
Simulated Flow
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow (MGD)
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)

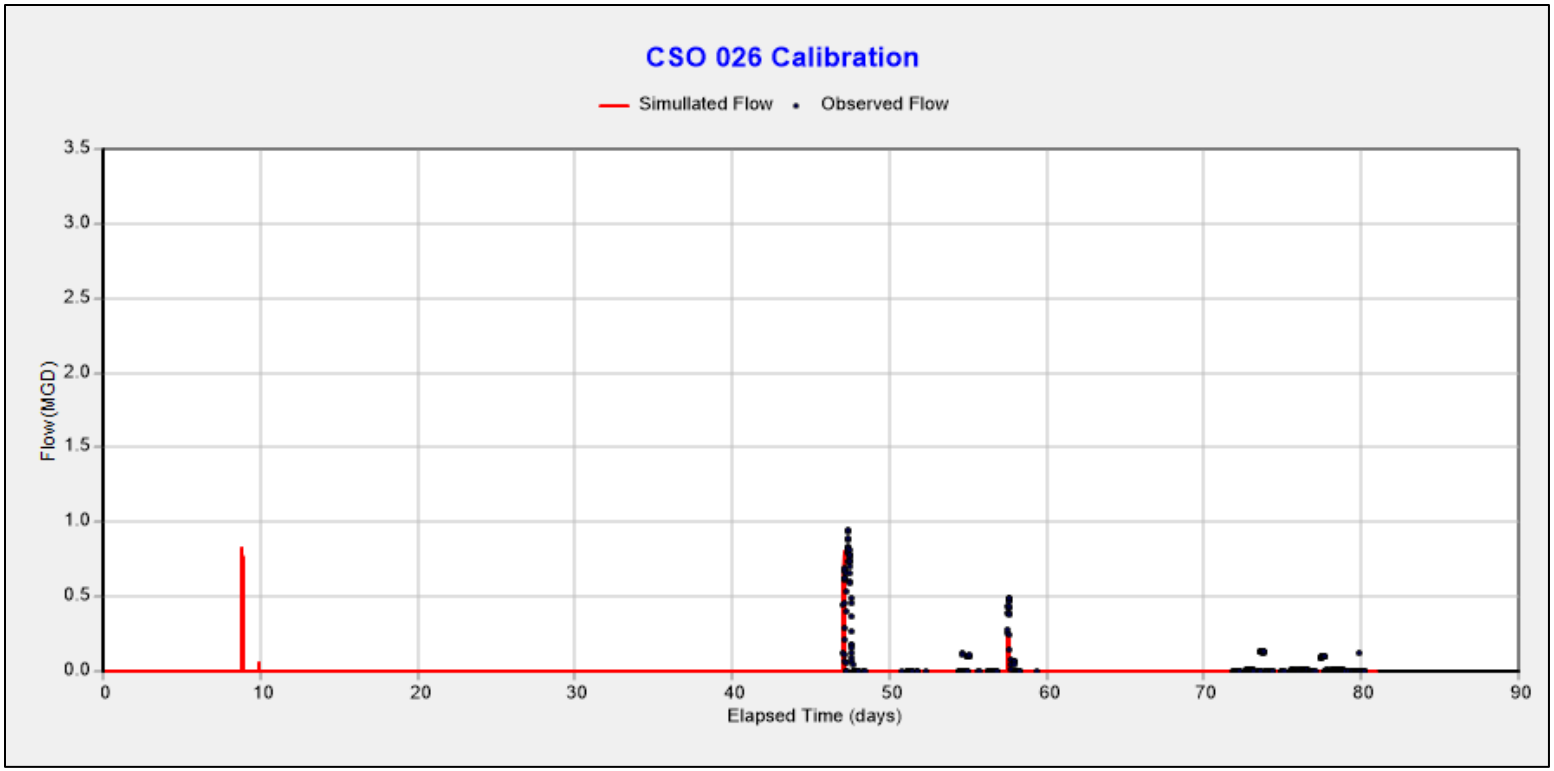

CSO 005C Calibration
Simulated Flow
Observed Flow
Flow (MGD)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)

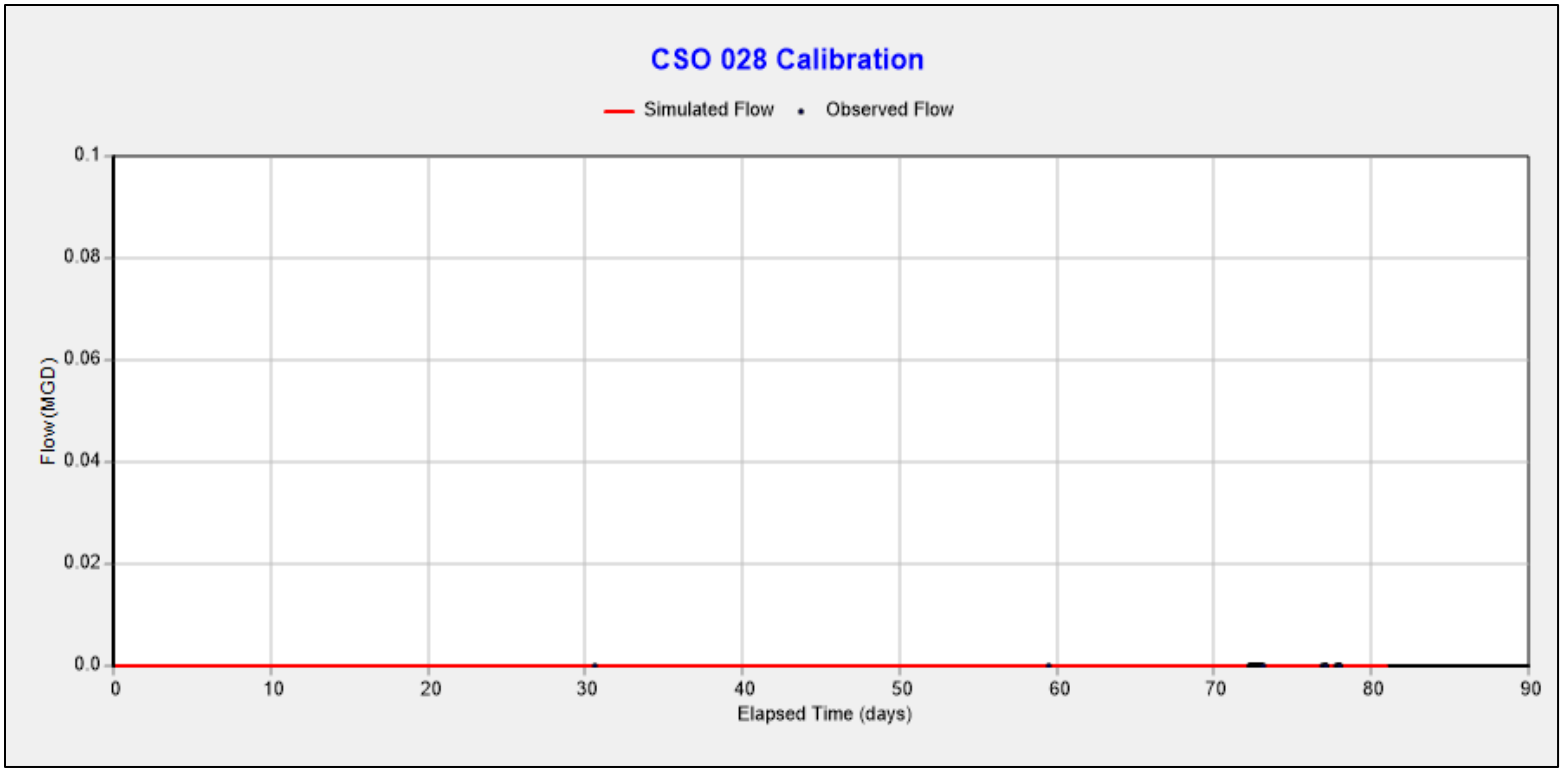

CSO 005D Calibration
Simulated Flow
Observed Flow
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Flow(MGD)
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)

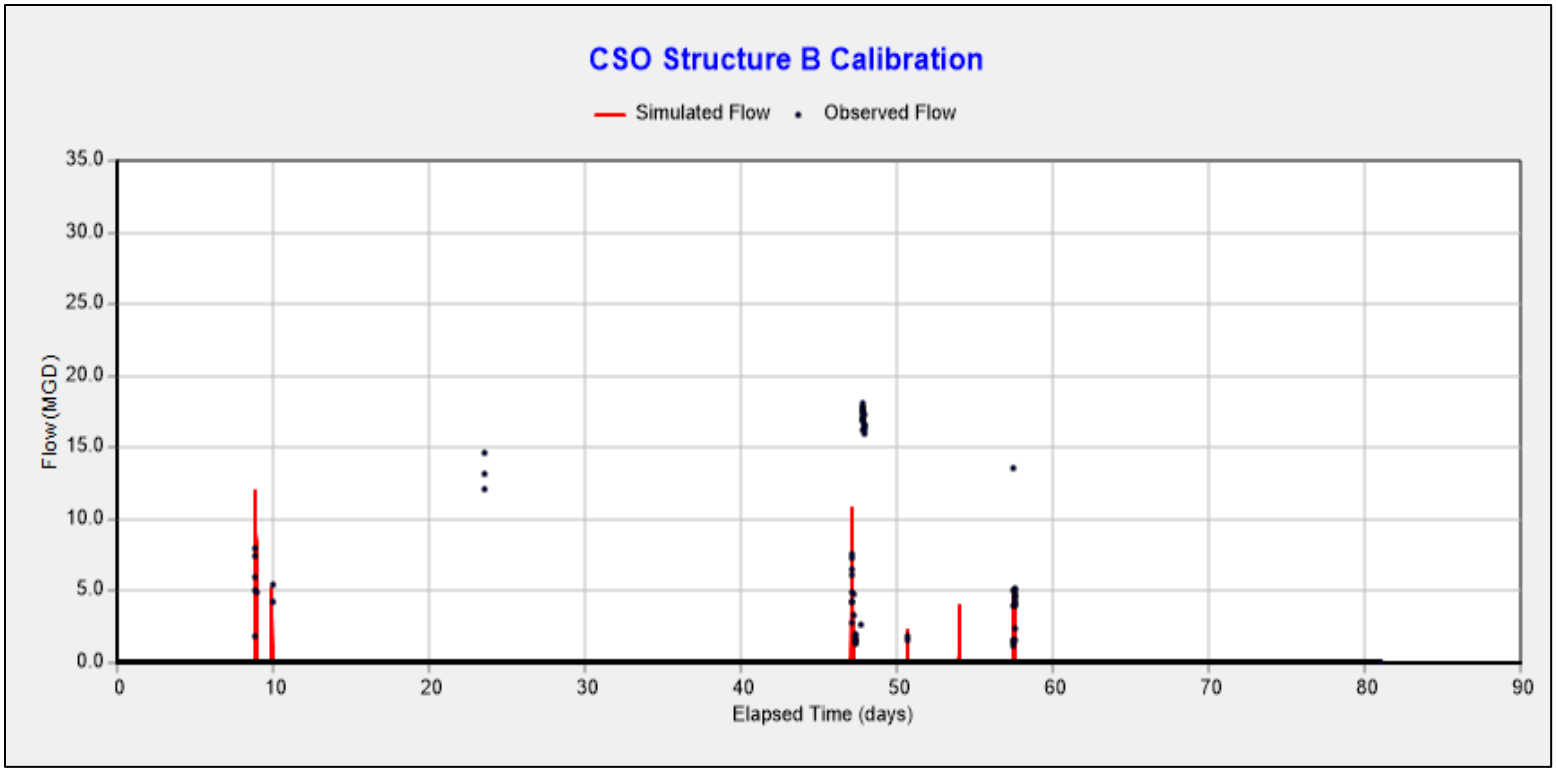

CSO 015 Calibration
Simulated Flow
Observed
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Flow (MGD)
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)

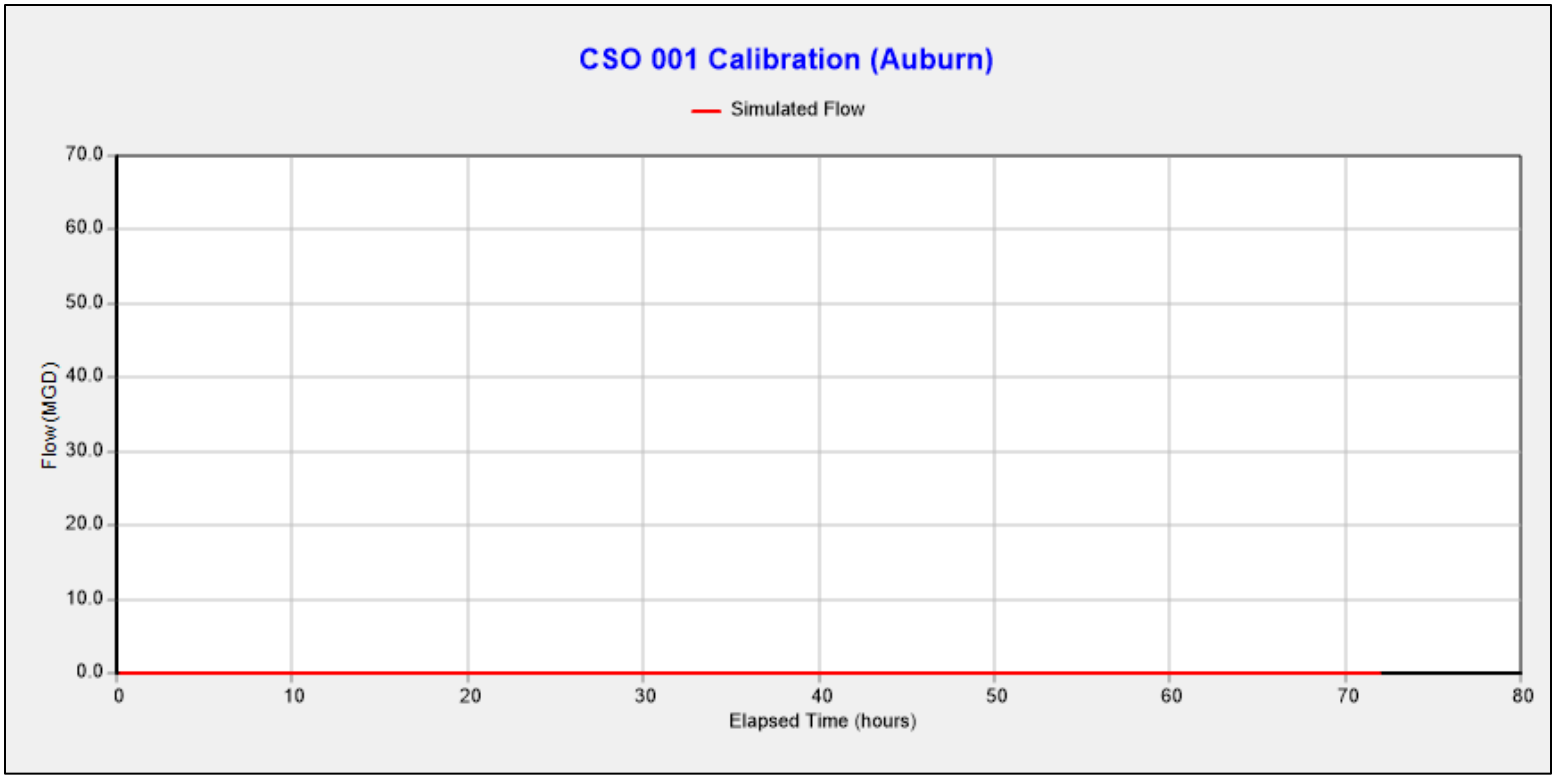

CSO 017 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)


CSO 024 Calibration
Simulated Flow
Observed Flow
Flow(MGD)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)


CSO 026 Calibration
Simullated Flow
Observed Flow
Flow(MGD)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)


CSO 028 Calibration
Simulated Flow
Observed Flow
Flow (MGD)
0.1
0.08
0.06
0.04
0.02
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)


CSO Structure B Calibration
Simulated Flow
Observed Flow
Flow(MGD)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0
10
20
30
40
50
60
70
80
90
Elapsed Time (days)



*No overflow data was available for Auburn CSO 001

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